TRIBOLIUM INFORMATION BULLETIN

VOLUME 39

1999

EDITOR: ALEXANDER SOKOLOFF

PROFESSOR EMERITUS

BIOLOGY DEPARTMENT

CALIFORNIA STATE UNIVERSITY

SAN BERNARDINO, CA 92407

TELEPHONE: (909) 880-5305, EXT. 5407

e-mail address: ASOKOLOF@WILEY.CSUSB.EDU

FAX: (909) 880-7005

Tribolium Information Bulletin, Volume 39

Table of Contents

NOTE

THE TRIBOLIUM INFORMATION BULLETIN (TIB) IS NOT AN OFFICIAL PUBLICATION. INFORMATION APPEARING IN THE BULLETIN IS REFEREED, BUT IT SHOULD NOT BE USED FOR PUBLICATION WITHOUT THE CONSENT OF THE AUTHOR. UNLESS THE ARTICLE IS PRECEDED BY AN ASTERISK OR BY THE NOTE "REFERENCE AUTHORIZED", PERMISSION TO QUOTE FROM THE BULLETIN MUST BE OBTAINED FROM THE AUTHOR(S), WHO ARE SOLELY RESPONSIBLE FOR THE CONTENTS OF THE ARTICLE.

ACKNOWLEDGMENTS

THE EDITOR IS INDEBTED TO BARBARA SOKOLOFF AND ELAINE SOKOLOFF FOR ASSISTANCE IN THE PREPARATION AND DISTRIBUTION OF TIB 39. I ALSO THANK FREDERIC ARMAND AND ILIA ADAME FOR TYPING PART OF THE REVIEW OF TRIBOLIUM BREVICORNIS.

ANNOUNCEMENT I

FOR SALE

A SMALL NUMBER OF SETS OF SOKOLOFF'S THREE VOLUME THE BIOLOGY OF TRIBOLIUM WITH SPECIAL EMPHASIS ON GENETIC ASPECTS IS AVAILABLE FROM THE EDITOR ON A FIRST COME-FIRST SERVED BASIS AND ONLY AS A FULL THREE VOLUME SET.
PRICE: $180/SET (INCLUDING POSTAGE, HANDLING & INSURANCE)

OFFICIAL LANGUAGE

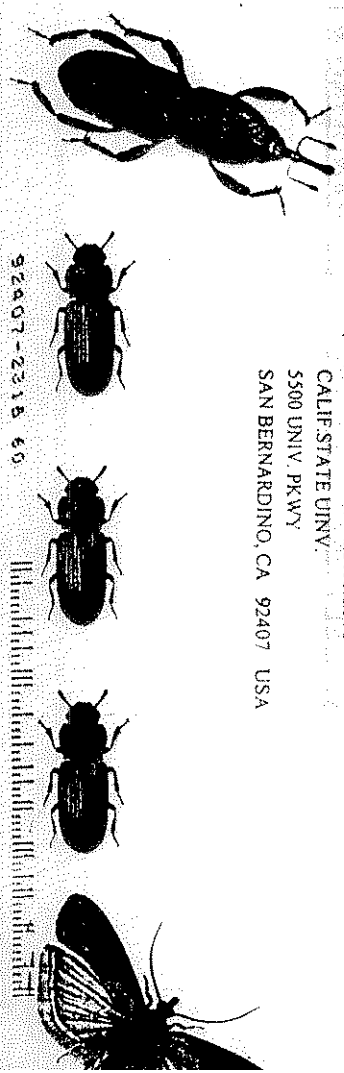
The official language of the conference will be English.

FRESNO

The city of Fresno is located in the central San Joaquin Valley of California midway between San Francisco and Los Angeles. It is the heart of agricultural production for the state and represents a significant amount of the production in the United States. Major agricultural products include fresh fruit such as citrus, peaches, plums, pears, apples, apricots, grapes and durable products such as cereals, cotton, walnuts, almonds, pistachios, raisins, prunes and other dried fruit.

October is the end of the busy harvesting season in the Valley with only some walnuts and persimmons remaining to be processed. The weather is changing from the heat of summer to the mild climate of fall. Leaves are beginning to change to golden yellows and brilliant reds. Near Fresno are such popular sights as Yosemite National Park, Sequoia National Forest (home of the Giant Redwoods) and Kings Canyon National Park. A post conference tour to the Yosemite National Park can be arranged, if enough people are interested.

Fresno is easily accessible from either San Francisco, Los Angeles, Phoenix and Salt Lake City by air with several flights each day to connecting flights in those cities.



J.G. Leesch
CAF ORGANIZING COMMITTEE
USDA-ARS-HCRL
2021 S. Peach Avenue
Fresno, CA 93727-5951
U.S.A.

DR. ALEXANDER SOKOLOFF
CALIF.STATE UINV.
5500 UNIV. PKWY
SAN BERNARDINO, CA 92407 USA

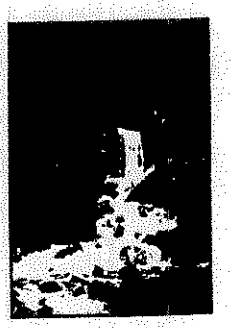
International Conference on Controlled Atmosphere and Fumigation in Stored Products

Oct. 29 - Nov. 3, 2000
Radisson Hotel and
Convention Center,
Fresno, California

Second
Announcement

REGISTRATION AND
CALL FOR ABSTRACTS

PERMANENT COMMITTEE



J. Banks, Australia
Chairman
S. Navarro, Israel
Secretary
H. Bartali, Morocco
C. H. Bell, United Kingdom
E. J. Bond, Canada
P. Ducom, France
E. Jay, U.S.A.
D. Jayas, Canada
J. G. Leesch, U.S.A.
R. Noyes, U.S.A.
Ch. Reichmuth, Germany
B. E. Ripp, Australia
M. Sidik, Indonesia

ABOUT THE CONFERENCE

The International Conference on Controlled Atmosphere and Fumigation in Stored Products (formerly the International Conference on Controlled Atmosphere and Fumigation in Grain Storage) is the leading international meeting reporting on advances in research and development on gaseous treatments applied to protect commodities in storage. These commodities include cereal grains, legumes, root crops, dried fruits and vegetables, and other agricultural products including bulbs and flowers, excluded are CA treatments for quality preservation of fresh agricultural products. The permanent Committee of the International CAF Conference (in a meeting held during the Conference in Cyprus, 1996) selected the Horticultural Crops Research Laboratory (HCRL), USDA, ARS, in Fresno, to host the next Conference, because the HCRL has been instrumental in implementing advanced dried fruit and nut processing and storage technologies under hot and dry climate conditions of California.

This conference will be held under the cloud of current worldwide pressure to reduce or phase out use of fumigants in general, and methyl bromide in particular. These constraints pose new challenges to technologically advanced countries and in particular to countries heavily relying on the use of conventional fumigants.

CONFERENCE OBJECTIVES

- *To report on advances in research and development and the current status of controlled atmosphere and fumigation for insect pests, microflora and quality control in stored products.*
- *To evaluate and discuss the potential alternative control methods in view of the threat to reduce or phase out use of chemical fumigants in general and methyl bromide in particular.*
- *To evaluate the technical, environmental and economical advantages of, and examine the potential for, emerging controlled atmosphere technologies.*
- *To provide a forum for interchange of ideas between government authorities, research agencies and industry.*
- *To enable the industry to display the latest commodity treatment, monitoring, handling and storage equipment, facilities and services.*
- *To discuss, disseminate information, and allow transfer of technologies applying controlled atmosphere and fumigation.*

CONFERENCE FORMAT

Speakers may present papers covering different aspects of research and application of controlled atmosphere and fumigation techniques on stored products. The tentative titles of the sessions are:

1. Biological responses of arthropods to treatment with CA and/or fumigation.
2. Biological responses of microflora to treatment with CA and/or fumigation.
3. Influence of CA and/or fumigation on quality preservation of stored products.
4. Physical and chemical properties of the application of CA and/or fumigation.
5. Application methodology of CA and/or fumigation, including use of carbon dioxide under increased pressure.
6. Sealing techniques and methods of determining gastightness.
7. Integrated commodity management methods with CA and/or fumigation.
8. Potential threats to conventional CA and/or fumigation (regulatory, insect resistance).
9. Quarantine and regulatory issues pertaining to use of CA and/or fumigation.
10. Sampling and trapping to monitor insect populations in relation to CA and/or fumigation.

A Poster Session will constitute an integral part of the program and will allow presentation of a wide variety of specific research projects related to the above sessions.

PROCEEDINGS

Oral and poster presentations will be considered for publication in the Proceedings. The Proceedings will be fully edited. Full manuscripts of each presentation/poster will be submitted by authors at the conference.

LOCAL ORGANIZING COMMITTEE

Jim G. Leesch, *Chairman*
Libby Fouse, John Hendon, Gary Obenauf, Jane Tebbets, Pat Vail, Larry Zettler

PARTICIPANTS

The Conference will be of benefit to a wide range of interests associated with the preservation of grain, oilseeds, dried fruit and similar commodities in storage including:

Dried Fruit and Nut Industries, Grain Handlers, Food Processing Companies, Equipment, Materials and Chemical Suppliers, Engineers and Storage Designers, Pest Control Officers, Food Technologists, Entomologists, Mycologists, Food Company Directors and Managers, Researchers, Government Regulatory Agencies.

FOR ADDITIONAL INFORMATION
J. G. Leesch
CAF ORGANIZING COMMITTEE
USDA - ARS- HCRL
2021 S. Peach Avenue, Fresno, CA 93727-5951, U.S.A.
E-Mail: caf@qnis.net Web Page: www.qnis.net/caf
Phone: +1-559-453-3090 Fax: +1-559-453-3088

ACCOMMODATION INFORMATION (Requires Action):

The hotel of the CAF Conference is the Radisson Hotel & Conference Center at 2233 Ventura Street, Fresno, CA 93721.

The room rate is $87.00 per night for all rooms (up to 4 persons occupancy) plus hotel tax which is currently 12%.

Reservations are to be made by each participant directly with the hotel. For those not guaranteeing a room with a credit card, the first nights room charge must be paid in advance to the hotel payable by either check (North America only) or money order (all in US$). There is a 72 hour cancellation policy. The rate for the Conference will apply 3 nights before and after the conference for participants who wish to stay in Fresno either before or after the conference. **The hotel will not guarantee the room rate after October 18, 2000.** You can make reservations by calling (800) 333-3333 or (559) 268-1000 and mentioning the CAF Conference and its dates. You can also register by internet at ***www.radisson.com*** or by ***mailing or faxing this form***, along with your credit card number, check or money order to:

Radisson Hotel & Convention Center • 2233 Ventura Street • Fresno, CA 93721 • USA • Fax: (559) 268-72

Name: _____ Phone: _____

Address: _____

City: _____ State: _____ Country: _____ Zip: _____

Check-in date: _____ Check-out date: _____

Number of rooms requested: _____ Number of people: _____

Room type (single or double) requested: _____ ( ) Smoking ( ) Non-Smoking

Amount enclosed US$ (Minimum $100.00): _____

Credit Card #: _____ Expiration date: _____

Name of Card: (Visa, MasterCard, American Express etc.): _____

Authorized Signature: _____ Date: _____

PL
ST
H

J.G. Leesch
CAF ORGANIZING COMMITTEE
USDA-ARS-HCRL
2021 S. Peach Avenue
Fresno, CA 93727-5951
U.S.A.

INTERNATIONAL CONFERENCE ON CONTROLLED ATMOSPHERE AND FUMIGATION IN STORED PRODUCTS

APPLICATION FOR PRESENTATION

POSTER PRESENTATIONS: Posters should be prepared to fit in a space measuring 122 cm by 122 cm (4ft by 4ft). Format for the posters is the same as th for oral presentations (i.e. Title, Abstract, Introduction, Materials and Methods, Results, Discussion and Conclusions). They will be published in th Proceedings.

ORAL PRESENTATIONS: Oral presentations will be limited to 15 or 20 minutes depending on the number of presentations to be made. Presentations can b made with either overhead transparencies or 35mm slides. An overhead projector and a slide carousel projector with slide trays will be provided.

DEADLINE TO RECEIVE ABSTRACTS FOR PRESENTATIONS AND POSTER : JANUARY 31, 2000. Abstracts can be transmitted by e-mail to : Dr. J. Leesch JLeesch@qnis.net

INSTRUCTIONS FOR ABSTRACT PREPARATION: Abstracts of presentations and posters will be presented in the Program that will be distributed t participants upon registration at the beginning of the Conference. Therefore a standard size and uniformity will be required of each abstract. Abstracts shou be typed (preferably using a word processor such as Word or WordPerfect for Windows). The size of the abstract should be no longer than 1 page and the to height and width of the text on the page should be within a measurement of 15 cm wide by 22 cm high. The top line should be the title of the presentation poster in block (all capital) letters. The second line should list the author(s) with the last name in block letters. The third and fourth line should be the full addres of the institution or affiliation of the author(s). The text should follow using font size of 10 or 12 point and a plain style such as Times Roman or Courier. Th abstract text is limited to 250 words and should not contain tables and figures.

INDUSTRIAL DISPLAYS: Space for an exhibition of scientific, technical and commercial equipment will be provided by the Conference.

If you are interested in exhibiting during the conference, please contact the Organizing Committee to receive information as to available space, fees and time exhibition.

OFFICIAL LETTER OF INVITATION: To facilitate efforts to obtain financial support for attending the Conference, an official letter of invitation will be sent participants upon written request of the Secretariat. The letter does not obligate the Organizing Committee to pay for either travel or other expenses incurred the participants. However, participants who cannot get financial aid to attend the Conference may write the Organizing Committee to obtain information as the availability of funds to assist in travel and other expenses.

CAF REGISTRATION FORM

Last Name _____ First Name _____ Middle Initials _____

Name for Badge _____ Title: Prof. ( ) Dr. ( ) Mr. ( ) Ms ( )

Company/Organization _____

Address _____

City _____ State _____ Country _____ Postal Code _____

Phone: _____ Fax : _____ E-mail : _____

Accompanied by: _____
(Last Name) (First Name)

REGISTRATION FEE (in U.S. Dollars) $

Registration **until** April 30, 2000	(US$ 350)		= _____
Registration **after** April 30, 2000	(US$ 425)		= _____
Accompanying Person**	(US$ 60)		= _____
Additional Conference Tour Tickets	(US$ 55)	(2 tours available during conference)	= _____
Additional Banquet Tickets	(US$ 35)		= _____
Post Conference Tour to Yosemite	(US$ 60)	X No. Attending _____	= _____
			TOTAL = _____

IF PAYING BY CREDIT CARD, PLEASE COMPLETE THIS PART.

I agree to pay the sum of total fees above for US$ _____.

This is for registration and optional tour deposits (if applicable) for the CAF Conference.

My credit card is: ( ) Visa ( ) MasterCard ( ) American Express

Card Number _____

Cardholder's Name: _____ Expiration Date: _____

Signature _____ Date: _____

(Please be sure that all information supplied is legible. We cannot be responsible for errors due to inability to read information provided.)

[redacted]

* Registration Fees cover: Admission to the Conference, 1 Program with abstracts, welcoming reception at the Radisson Hotel, 1 ticket to the banquet at the Radisson Hotel, beverages and snacks during breaks, 1 ticket to each of the 2 Conference tours, Proceedings of the Conference (book format).

**Accompanying Person Fees cover: Admission to the Conference, ticket to the welcoming reception at the Radisson Hotel, and Spouses Program.

OVER for accommodation information that requires action.

XXI International Congress of Entomology
Iguassu Falls - Brazil
August 20-26, 2000

Dear entomologist

As you are probably aware, Brazil will host the next International Congress of Entomology, from August 20 to 26, 2000, at one of the most beautiful world sites, Iguassu Falls. The Organizing Committee, composed of entomologists from several countries, is doing its best to make the XXI ICE one of the most important entomological events ever held.

Besides the formal congress program, scientists will have the chance to participate of satellite entomological events. Up to the end of June, we are receiving suggestions for symposia, and if you want to contribute, send your suggestion to the president of the Scientific Committee Programme, Dr F. Moscardi, at moscardi@cnpso.embrapa.br. We will also provide social and touristic activities for both participants and accompanying persons. For more information, please visit our homepage at http://www.embrapa.br/ice.

During the last two years we have organized a database of more than 12.000 addresses of entomologists, from all over the world, including yourself. If you want to continue receiving information on the XXI ICE, please confirm your interest through our homepage, looking for the icon "Subscribe to the congress mailing list now" on the bottom of the front page. Or directly, on the address http://centeio.sede.embrapa.br/ice/ICE.nsf/MailingList?OpenForm.

In case you do not have access to the Internet, please fill the form below and send it to us, to continue receiving XXI ICE information. If we do not receive your confirmation, we will assume that you are not interested in participating of the XXI ICE and your name will be dropped from our mailing list.

Thank you for your help, and we hope to seeing you during the Congress

Family Name _____

First Name _____

Institution _____

Address _____

City, ZIP _____

State _____

Country _____

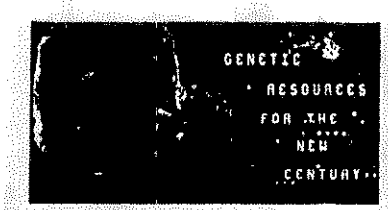
Our address
XXI International Congress of Entomology
Caixa Postal 231 - 86001-970 Londrina PR - BRAZIL

ANNOUNCEMENT IV

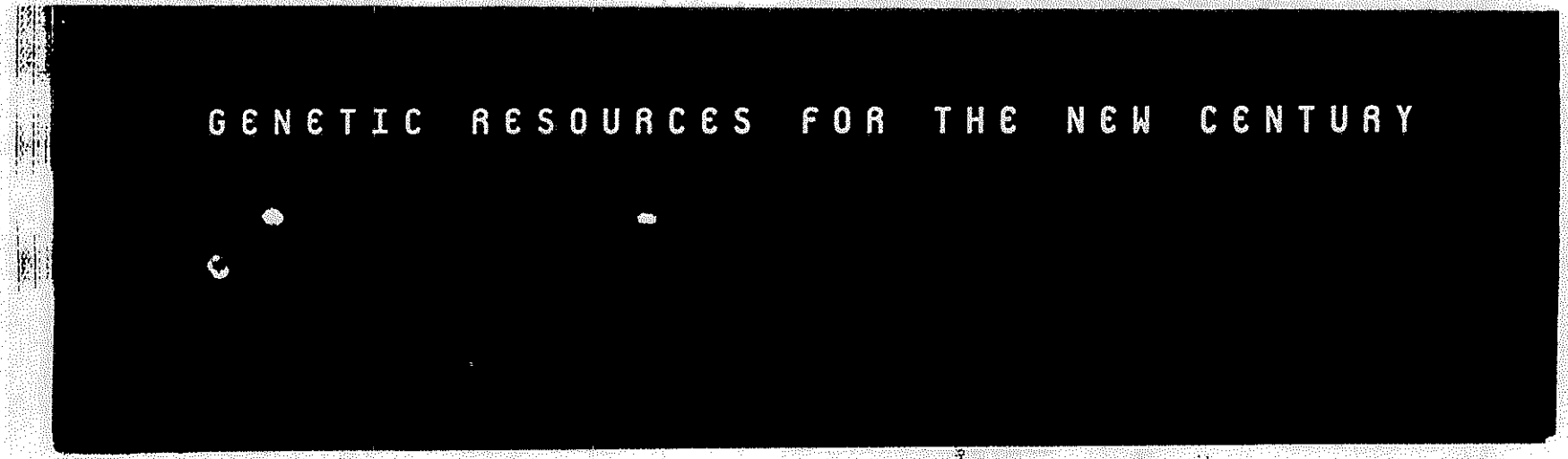
PRELIMINARY ANNOUNCEMENT
GENETICS CONFERENCE • MAY 7-11, 2000

PRESERVING THE GENETIC HERITAGE OF LIFE ON EARTH.

The Zoological Society of San Diego and its research division, the Center for Reproduction of Endangered Species, will be hosting an international conference to consider the values, benefits, means, and options for conserving the genetic heritage of life on Earth. In January, you will be sent a registration brochure with more details of this upcoming conference. Conference dates are May 7-11, 2000. For more information visit us at: www.sandiegozoo.org/cres/genetic_conference.html



ZOOLOGICAL SOCIETY OF SAN DIEGO®



-X-

3rd Announcement

GSC 2000

The 2000 Annual Meeting of the

Genetics Society of Canada

will be in

Vancouver

with the Genetics Society of America

on the Campus of the University of British Columbia

June 14 - 17, 2000

The 2000 Annual Meeting of the Genetics Society of Canada will be held Vancouve B.C.. For GSC members, there will also be the usual student poster and travel bursa competitions, the award lectures and a banquet. Accommodation for the meeting will b available at downtown hotels or on the campus at the University of British Columbia.

For further information **please see the inside of this Bulletin issue**, visit the new meetin WWW site at,

http://www.zoology.ubc.ca/genetics/2000

and keep and eye on your mailbox. Further inquiries about the meeting can be directed to:

Tony Griffiths
agriff@unixg.ubc.ca

Genetics 2000: Visions of the future

A joint meeting of the

Genetics Society of Canada and the

Genetics Society of America.

On the campus of the

University of BC, Vancouver, Canada,

June 14 - 17, 2000

As society enters the new millenium, genetics is on the brink of an era that will see large changes in the ways that genetic research is carried out, and the ways in which society perceives this research. The focus of this extraordinary meeting is best summed up by the word "vision". In plenary session, senior geneticists will present their vision of the themes that will occupy geneticists into the new millenium. These discussions will be relevant to all geneticists, including students.

There will also be regular poster sessions for presenting current research. Some presenters may be invited to participate in the plenary sessions.

Plenary sessions will include the following areas:

Changing concepts in genetics.
Genetics and the human organism.
Genetics in human affairs.
The future of model genetic organisms.
Industry versus academy in the future of genetic research.
The future of genetics education.

So far, the following **individuals have accepted** invitations to speak:

Patricia Baird (University of British Columbia)
David Botstein (Stanford University)
James Crow (University of Wisconsin)
Julian Davies (University of British Columbia)
John Doebly (University of Wisconsin)
Clare Fraser (The Institute for Genome Research)
Bill Gelbart (Harvard University)
Anthony Griffiths (University of British Columbia)
Dan Hartl (Harvard University)
Mary Claire King (University of Washington)
Chuck Langley (University of California, Davis)
Maurice Moloney (University of Calgary)
Arno Motulski (University of Washington)
Stephen O'Brien (National Cancer Institute)
Charles Scriver (McGill University)

Accomodation and registration costs are very affordable. GSC members pay a reduced rate. (Now would be a good time to join!) The abstract and late registration deadline is March 31, 2000.

Registration, accomodation and abstracts are processed through the Genetics 2000 website:

http://www.zoology.ubc.ca/genetics/2000

For more information, please contact the head of the Local Organizing Committee:

Anthony J. F. Griffiths
Botany Department
University of British Columbia
6270 University Boulevard
Vancouver, BC
Canada V6T 1Z4
Phone: (604) 822-5629
Fax: (604) 822-9179
E-mail: agriff@unixg.ubc.ca

The participation in discussion of the first topic of discussion entitled "Interactions in Tribolium: Competition or predator-prey?" was very disappointing. Instead of a forum there was one response, enough only for a dialogue. Because the Editor considers the subject worth discussing, the subject suggested for the open forum remains open for discussion, and it will be for the next two years.

As usual, the Editor reminds subscribers that the very existence of the TIB is dependent not only on subscription, but also on contributions to the Newsletter. Please be as generous of your time as possible by responding when calls for contribution arrive in your hands. This includes not only research notes but also revision of personnel in your lab, stock lists, and lists of current bibliography.

TRIBOLIUM NEWS EXCHANGE MEMBER LIST

A small group of Tribolium investigators have initiated a Tribolium News Exchange. Its purpose is to provide an informal forum to exchange ideas, techniques and suggestions about Tribolium.

If you wish to join the Tribolium News Exchange Group, contact Margaret Bloch Qazi at her email address: tribolium@emerald.tufts.edu

Announcement VII

At long last we have received permit for importation of 3 species of Tribolium: T. anaphe, T. audax and T. destructor. If you are interested in obtaining samples of these beetles in the near future contact me by fax or e-mail.

June 1999

Tribolium News Exchange - ELECTRONIC MAIL ADDRESSES.

The following includes an updated list of people subscribed to the Tribolium News Exchange. The purpose of this group is to provide an informal forum to exchange ideas, techniques and suggestions about Tribolium. To send electronic mail to the group, address it to: tribolium@emerald.tufts.edu

If you have suggestions of other people not included on this list who you think would be interested in participating, please send their addresses to me.

Happy beetling,

Margaret Bloch Qazi

People on the Tribolium News Exchange E-mail List:

Austad, Steve
Dept. of Biological Sciences
University of Idaho
Moscow, Idaho 83843
austad@uidaho.edu

Bancroft, Jay
EEB U-42
University of Connecticut
Storrs, CT
06269 USA
jsb95003@uconnvm,uconn.edu

Barnes, Jim
8771 So 83 St.
Franklin, WI
53132 USA
jbarnes@omnifest.uwm.edu

Beeman, R.W.
USDA Grain Research Lab
1515 College Avenue
Manhattan, KS
66502 USA
beeman@crunch.usgmrl.ksu.edu

Bernasconi, Giorgina
Universitaet, Bern
Ethologische Station
Wohlenstr. 50a
CH 3032 HINTERKAPPELEN SWITZERLAND
bernasconi@ubeclu.unibe.ch

Bloch Qazi, Margaret
Biology Department
Tufts University
Medford, MA 02155 USA
mbloch@emerald.tufts.edu

Brown, Sue
Division of Biology
Ackert Hall
Kansas State University
Manhattan, KS 66506 USA
sjbrown@ksu.ksu.edu

Emery, Rob
Agriculture Western Australia
3 Baron-Hay Court
SOUTH PERTH 6151
Western Australia
robe@apb.agric.wa.gov.au

Goodnight, Charles
Dept. of Zoology
115 Marsh Life Science
University of Vermont
Burlington, VT 05405-0086 USA
charles.goodnight@uvm.edu

Haas, Sue
U.S. Grain Marketing Research Lab
1515 College Ave.
Manhattan, KS 66502 USA
haas@crunch.usgmrl.ksu.edu

Hesler, Louis CPT
Entomological Science Division
US Army Ctr. for Health Promotion
and Preventive Med-Europe
CPT_Louis_Hesler@chppm-eur-ccmail.army.mil

Heilmann, Larry J.
heilmanl@ars.usda.gov

Horace Greeley High School
70 Roaring Brook Rd
Chappaqua, NY 10514
Unc11@aol.com

Janovy, John
University of Nebraska Lincoln
jjanovy@unLinfo.unL.edu

Keller, Laurent
Universite de Lausanne
Faculte de Sciences
Institut de Zoologie et d'ecologie animale
Batiment de Biology
CH-1015 Lausanne SWITZERLAND
Laurent.Keller@izea.unil.ch

Knecht, Kirk
kfknecht@aol.com

Lewis, Sara M
Biology Department
Tufts University
Medford, MA 02155 USA
slewis1@emerald.tufts.edu

Lomniki, Adam
The Institute of Environmental Biology
Jagiellonian University
Cracow, POLAND
lomniki@eko.uj.edu.pl

Mason, Linda
Department of Entomology
1158 Entomology Hall
West Lafayette, IN 47907 USA
Linda_Mason@mailhost.entm.purdue.edu

Muir, Bill
1151 Lilly Hall
Department of Animal Sciences
Purdue University
W. Lafayette, IN 47907-1151
bmuir@www.ansc.purdue.edu

Phillips, Thomas
USDA ARS Tropical Fruit & Vegetable Res. Lab
P.O. Box 4459
Hilo, HI 96720 USA
phillip@aloha.net

Sokoloff, Alexander
Biology Department
California State University
5500 N. University Pkwy
San Bernardino, CA 92407-2397
A.SOKOLOF@WILEY.CSUSB.EDU

Stevens, Lori
Department of Zoology
Marsh Life Science Building
University of Vermont
Burlington, VT 05405-0086 USA
Lori.Stevens@uvm.edu

Stuart, Jeff
Department of Entomology
Purdue University
West Lafayette, IN 47907 USA
Jeff_Stuart@mailhost.entm.purdue.edu

Thomson, Scott
Department of Biological Sciences
University of Wisconsin - Parkside
Kenosha, WI 53141 USA
thomson@cs.uwp.edu

Wade, Michael J.
Dept. of Biology
Indiana University
Jordan Hall
Bloomington, IN 47405
wade@midway.uchicago.edu

STOCK LISTS

RIVER FOREST, ILLINOIS
ROSARY COLLEGE
DEPARTMENT OF NATURAL SCIENCES

I. Wild type strains
 A. Tribolium castaneum
  1. "Chicago" (originally from Thomas Park)
  2. "Brazil" (originally from Rio de Janeiro; also known as cI)
  3. "Arkansas" (originally from Michael Wade)
 B. Tribolium confusum
  1. "Chicago" (originally from Thomas Park)
  2. "Circle" (collected in Chicago)
  3. bI (derived from "Chicago")
  4. bII (derived from "Chicago")
  5. bIII (derived from "Chicago")
  6. bIV (derived from "Chicago")

II. Mutant strains
 A. Tribolium castaneum
  1. "Chicago" black (derived from "Chicago")
 B. Tribolium confusum
  1. "Chicago" black (derived from "Chicago")

David M. Craig

GAINESVILLE, FLORIDA
ARS, USDA
P.O. BOX 14565
INSECT ATTRACTANTS, BEHAVIOR AND BASIC BIOLOGY LABORATORY.

Attagenus megatoma	black carpet beetle
Cadra cautella	almond moth
Cylas formicarius elegantulus	sweet potato weevil
Lasioderma serricorne	cigarette beetle
Oryzaephilus surinamensis	sawtoothed grain beetle
Paramyelois transitella	navel orangeworm
Plodia interpunctella	Indian meal moth
Sitotroga cerealella	Angoumois grain moth
Sitophilus oryzae	rice weevil
Tribolium castaneum	red flour beetle
Trogoderma granarium	khapra beetle
Trogoderma inclusum	

(Ed.).

KINGSTON, RHODE ISLAND 02881
UNIVERSITY OF RHODE ISLAND
DEPARTMENT OF ZOOLOGY

Tribolium castaneum

Purdue Foundation	via Purdue
Black Foundation	via Purdue
Corn oil unsaturated fatty acid sensitive (cos)	

Tribolium confusum

Chicago	Park 1955
black	via San Bernardino
pearl	via San Bernardino

Tribolium madens	via San Bernardino
Tribolium brevicornis	via San Bernardino

(Ed.).

LAFAYETTE, INDIANA 47907
PURDUE UNIVERSITY
ANIMAL SCIENCES DEPARTMENT

Tribolium castaneum

I. Wild type strains

A. Foundation "+" - originated in 1954 at Purdue University from a broad genetic base and maintained with no artificial selection and minimal breeding.

B. Foundation s - Same genetic base as Foundation "+", but genetically marked with the sooty mutant (s).

C. Foundation b - Originated in 1959 at Purdue University with a broad genetic base unrelated to Foundation "+", no artificial selection, minimal inbreeding, and genetically marked with the black mutant (b).

D. Foundation p - Originated in 1959 at Purdue University with a broad genetic base unrelated to Foundation "+" and b, no selection, minimal inbreeding, and genetically marked with the pearl mutant (p).

W.M. MUIR

LEXINGTON, KENTUCKY
UNIVERSITY OF KENTUCKY
AGRICULTURAL EXPERIMENT STATION

I. Base populations

1. Purdue + foundation	Purdue
2. Purdue s foundation (sooty)	Purdue
3. Purdue b foundation (black)	Purdue
4. Purdue p foundation (pearl)	Purdue

II. Synthetic strains -- with a history of long-term selection for increased pupa weight but maintained in population cages without selection pressure but discrete generations.

1. MRS-1	Minnesota, 1970
2. MRS-2	Minnesota, 1970
3. P	Purdue, 1976

4. C Davis, 1976

III. Synthetic strain IS from a cross of CSI-10 X E1 inbred lines, maintained in population cages with extremely large
1. IS - From a cross of CSI-10 X e1 inbred lines, maintained in population cages with extremely large population size and random mating for 28 generations.

(Ed.).

MANHATTAN, KANSAS
KANSAS STATE UNIVERSITY
DEPARTMENT OF ENTOMOLOGY

LEPIDOPTERA

Phycitidae: Cadra cautella and Plodia interpunctella

Gelechiidae: wild and red eyed strains.

Pyralidae: Corcyra cephalonica

COLEOPTERA

Anobiidae: Lasioderma serricorne and Stegobium paniceum

Bostrichidae: Rhyzopertha dominica

Bruchidae: Callosobruchus maculatus

Cucujidae; Cryptolestes ferrugineus, C. pusillus,

Curculionidae: Sitophilus granarius, S. oryzae, and two strains of S. zeamais.

Dermestidae: Trogoderma inclusum, Attagenus megatoma

Ostomatidae: Tenebroides mauritanicus

Ptinidae: Gibbium psylloides

Silvanidae; Ahasverus advena, Oryzaephilus surinamensis, O. mercator

Tenebrionidae:

Palorus ratzeburgi,Kansas 1965
Tenebrio molitor, Kansas
Tenebrio obscurus Manhattan, Kansas, 1971
Tribolium castaneum, Kansas
Tribolium confusum, Kansas

Valerie Wright

MANHATTAN, KANSAS 66502
U.S. GRAIN MARKETING RESEARCH LABORATORY

Tribolium castaneum

I. Insecticide-resitant strains

1. GA-1, malathion-specific, collected in Georgia, 1980
2. NC-1, malathion-specific, collected in North Carolina. From W.C. CAMPBELL.
3. Kano, malathion-specific, collected in northern Nigeria, 1961. From W.R. Wilkin.
4. CTC 12, nonspecific, oxidase type, collected in Kingaroy, Australia, 1968. From W.R. Wilkin.
5. TC 95, nonspecific. From B.R. Champ.
6. DDT C, DDT-resistant, collected in South Africa, 1959. From D.G. Blackman.
7. Rmal-2 allelic to Rmal-1
8. Rdiel--Resistant to lindane, dieldrin and other cyclodienes, linkage group not determined.

II. Mutant strains

(see next pages)

Stock Lists

R. W. Beeman Laboratory 1999 Manhattan, Kansas

Tribolium castaneum:

Mutant / Strain	Mutant Origin	Full Name or description	Linkage Group	Stocks	Stock Origin
35.17	Manhattan	dominant lethal	2	35.17/Ag4,Stm	Manhattan
3P1	Purdue	crossover suppressor	3	3P1/au14	Purdue
3P2	Purdue	crossover suppressor	3	3P2/au14	Purdue
A(Ag1),Stm	Manhattan	abdominal (from Ag), cis Stm	2	A(Ag1),Stm /ptlD60	Manhattan
A(Ag2)	Manhattan	abdominal (from Ag)	2	A(Ag2)/ Ag4,Stm	Manhattan
A(mc)	Manhattan	abdominal (from mc)	2	A(mc),p/Stm,Cx5	Manhattan
A10	Manhattan	Abdominal 10	2	A10 / Ey	Manhattan
A10,mxpA10	Manhattan	Abdominal 10, mxp fr. A10	2	A10,mxpA10/Ag5,Stm	Manhattan
A12	Manhattan	Abdominal 12	2	A12/Ey	Manhattan
A14,Ey	Manhattan	Abdominal 14, Stm cis	2	A14,Ey / Ag4,Stm	Manhattan
A15, Stm	Manhattan	Abdominal 15, Stm cis	2	A15,Stm/Ey	Manhattan
A20 Rdiel	Unknown	Dieldrin resistant	2	A20 Rdiel	Unknown
A4	Manhattan	Abdominal 4	2	A4/Stm,Ag5	Manhattan
A8	Manhattan	Abdominal 8	2	A8/Stm,Cx5	Manhattan
A83	Manhattan	Abdominal 83	2	A83/Stm	Manhattan
ab	Bogota	antenna bifurcada	9	ab,pas30,p	Manhattan
ab	Bogota	antenna bifurcada	9	ab/ab	Bogota, Colombia
ab (IN20)	Parkside	inbred line, 20 generations, from ab	?	ab(IN20)/ab(IN20)	U.Wisc.,Parkside
Abidjan	Ivory Coast	wild-type strain	-	Abidjan	Ivory Coast, 19??
AD100,Stm,Cx5	Manhattan	Notched gena,Stm,Cx5 (cis)	2	AD100,Stm,Cx5/Es1	Manhattan
Ag	Manhattan	Antennagalea	2	Ag/Es1	Manhattan
Ag	Manhattan	Antennagalea	2	Ag/Stb	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/35.17	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/A^{Ag2}	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/Skl4	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/Es1	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/sp	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/vwe	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/X(ab-1s)	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/X-31	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/X-47	Manhattan
Ag4, Stm	Manhattan	Antennagalea 4, Stm (cis)	2	Ag4,Stm/X-83	Manhattan
Ag4, Stm^R	Manhattan	Antennagalea 4, Stm (revertant)	2	Ag4,Stm^R/Es1	Manhattan
Ag5, Stm	Manhattan	Antennagalea 5, Stm (cis)	2	Ag5,Stm/A4	Manhattan
Ag5, Stm	Manhattan	Antennagalea 5, Stm (cis)	2	A10,mxpA10/Ag5,Stm	Manhattan
Ag5, Stm	Manhattan	Antennagalea 5, Stm (cis)	2	Ag5,Stm/A14,Ey	Manhattan
Ag5, Stm	Manhattan	Antennagalea 5, Stm (cis)	2	Ag5,Stm/Es1	Manhattan
Ag5, Stm	Manhattan	Antennagalea 5, Stm (cis)	2	Ag5,Stm/Es2	Manhattan
Ag5, Stm	Manhattan	Antennagalea 5, Stm (cis)	2	Ag5,Stm/GoPL4	Manhattan
AgPin	Manhattan	Antennagalea (Pinhead)	2	AgPin/Stm,Cx5	Manhattan
Ahd	Purdue	Arrowhead	8	Ahd/Ahd	Purdue
ap	Englert	antennapedia	8	ap, b	Manhattan
ap	Englert	antennapedia	8	ap, sq2	Manhattan
ap	Englert	antennapedia	8	ap,sq/ap,sq,Bald	Manhattan
ap	Englert	antennapedia	8	MMS (s,rb,ap,au,mas)	Manhattan
Apl	Manhattan	Antennapalpus	2	Apl,apt,mas,pas	Manhattan
Apl	Manhattan	Antennapalpus	2	Apl/Apl	Manhattan
apt	Sokoloff & Hoy	alate prothorax	2	apt, pas	San Bernadino
apt	Sokoloff & Hoy	alate prothorax	2	b, apt, sa, c	Manhattan
apt	Sokoloff & Hoy	alate prothorax	2	Quint(mxp,apt,mas,pas,ub)	Manhattan
au	Hoy	aureate	3	b(t),p,lod,au,msg	Manhattan
au	Hoy	aureate	3	au,lod isoline (JS)	Purdue
au	Hoy	aureate	3	au, lod, p	San Bernadino
au	Hoy	aureate	3	mas, p,au	Manhattan
au	Hoy	aureate	3	MMS (s,rb,ap,au,mas)	Manhattan
au^{14}	Purdue	aureate 14, lethal	3	3P1/au^{14}	Purdue
au^{14}	Purdue	aureate 14, lethal	3	3P2/au^{14}	Purdue
au^{14}	Purdue	aureate 14, lethal	3	3.2 Bamp/au^{14}	Purdue
au^{2}	Manhattan	aureate	3	au^{2}	Manhattan
b	Sokoloff	black body color	3	b	San Bernadino
b	Sokoloff	black body color	3	b, ap	Manhattan
b	Sokoloff	black body color	3	b, apt, sa, c	Manhattan
b(i-2)	Purdue	black body color	3	b(i-2)	Purdue
b(M)	Purdue	black body color	3	b(M)	Purdue
b(New)	Manhattan	black, dominant	3	b(New)/b(ST)	Manhattan
b(ST)	Manhattan	black, dominant	3	b(ST)/Chr	Manhattan
b(ST)	Manhattan	black, dominant	3	b(ST)/b(New)	Manhattan
b(t)	Dyte & Blackman	tawny body color	3	b(t)	San Bernadino
b(t)	Dyte & Blackman	tawny body color	3	b(t),p,lod,au,msg	Manhattan
ba	Manhattan	broken antennae	2	ba, mxp, apt, pas30	Manhattan
Bald	Manhattan	Bald (reduced setiferous pits)	8	Bald	Manhattan
Bald	Manhattan	Bald (reduced setiferous pits)	8	Bald,ap,sq/ap,sq	Manhattan
Bamp27	Manhattan	Blunt anterior metasternal, projection 27	3	Bamp27/+,au/au	Manhattan
Bamp27	Manhattan	Blunt anterior metasternal, projection 27	3	M1/M1,Bamp27/+	Manhattan
Bamp27,au	Manhattan	Blunt anterior metasternal, projection 27,au (cis	3	Bamp27/+,au/au	Manhattan
Bamp29	Manhattan	Blunt anterior metasternal, projection 29	3	Bamp29/+	Manhattan
Bamp31	Manhattan	Blunt anterior metasternal, projection 31	3	Bamp31/+	Manhattan
Bamp58	Manhattan	Blunt anterior metasternal, projection 58	3	Bamp58/+	Manhattan

Stock Lists

R. W. Beeman Laboratory | 1999 | Manhattan, Kansas

$Bamp^{J-1}$	Purdue	Blunt anterior metasternal. projection J-1	3	$Bamp^{J-1}$/+	Purdue
BampSp	Manhattan	Blunt anterior metasternal. projection Sp	3	BampSp/+	Manhattan
Bang-1	Bangladesh	wild-type strain	-	Bang-1	Bangladesh, 1989
Bang-2	Bangladesh	wild-type strain	-	Bang-2	Bangladesh, 1979
Banos	Ecuador	wild-type strain	-	Banos	Ecuador, 19??
Be	Lasley & Sokoloff	Bar eye	4	Be/+	San Bernadino
Be	Lasley & Sokoloff	Bar eye	4	Be/+, s/s	San Bernadino
Berlin	Germany	wild-type strain	-	Berlin	Germany, 19??
bge	Manhattan	bug-eyed	?	bge	Manhattan
Bha-4 (slight sq)	India	wild-type strain	-	Bha-H	India, 1988
Bha-B (squinty)	India	wild-type strain	-	Bha-B	India, 1988
Blakely	Georgia	wild-type strain	-	Blakely	Georgia, 1993
BMT Lab	Beaumont	wild-type strain	-	BMT Lab	Beaumont, 1974?
Bordeaux	France	wild-type strain	-	Bordeaux	France, 19??
box	Manhattan	box (abdominal)	2	box / Es	Manhattan
BRM	Texas	wild-type strain	-	BRM	Texas, 1988
BRZ-4	Brazil	wild-type strain	-	BRZ-4	Brazil, 1987
BRZ-5	Brazil	wild-type strain	-	BRZ-5	Brazil, 1988
BRZ-6	England	wild-type strain	-	BRZ-6	England, 1943
BT-15	Bangladesh	wild-type strain	-	BT-15	Bangladesh, 1981
c	Eddleman	chestnut eye	7	b, apt, sa, c	Manhattan
c	Eddleman	chestnut eye	7	Nppc	San Bernadino
c	Eddleman	chestnut eye	7	sa,c	San Bernadino
Causey-S	S. Carolina	wild-type strain	-	Causey-S	S. Carolina, 1991
cfl	Manhattan	confusum-like	?	cfl	Manhattan
Cg	Manhattan	Cleft gular (sutures)	?	Cg/+	Manhattan
Chr	Ackermann	Charcoal body color	3	Chr/b(ST)	Manhattan
ChrE	Manhattan	Charcoal (Elytra indented)	3	ChrE/+	Manhattan
co	Manhattan	cola body color	9	co,p	Manhattan
co	Manhattan	cola body color	9	co,Pyr-R	Manhattan
co	Manhattan	cola body color	9	Se,co,p/+,co,p	Manhattan
COL-1	Colombia	wild-type strain	-	COL-1	Colombia, 1987
COL-2	Colombia	wild-type strain	-	COL-2	Colombia,1989
CR-1	Costa Rica	wild-type strain	-	CR-1	Costa Rica, 19??
Crab	Manhattan	Crab (warped legs)	7	Crab/PL4	Manhattan
CRRI-1	India	wild-type strain	-	CRRI-1	India,1989
CRRI-2	India	wild-type strain	-	CRRI-2	India,1983
CTC-4	Australia	wild-type strain	-	CTC-4	Australia, 1965
CTC-485	Australia	wild-type strain	-	CTC-485	Australia, 1988
Cx20	Manhattan	Cephalothorax 20	2	Cx20/Es1	Manhatta..
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/A8	Manhattan
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/A(mc),p	Manhattan
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/AgPin	Manhattan
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/Es1	Manhattan
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/Lu	Manhattan
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/Mcs1R5	Manhattan
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/Skl4R3	Manhattan
Cx5,Stm	Manhattan	Cephalothorax 5, Stm (cis)	2	Cx5,Stm/Skl6R1	Manhattan
Cx5,Stm,AD100	Manhattan	Cephalothorax 5, Stm, notched gena	2	Cx5,Stm,AD100/Es1	Manhattan
Cx6	Manhattan	Cephalothorax 6	2	Cx6/Es1	Manhattan
Dch1	Sokoloff	Dachshund 1	2;9	Dch1/Es1	Manhattan
Dch1	Sokoloff	Dachshund 1	2;9	Dch1/Lu	Manhattan
Dch1	Sokoloff	Dachshund 1	2;9	Dch1/Skl6	Manhattan
Dch3	Manhattan	Dachshund 3	2;9	Dch3/ Ey	Manhattan
Dch4	Manhattan	Dachshund 4	2	Dch4 / Es	Manhattan
Det43	Manhattan	Divergent elytral tips	4;5	Det43/+	Manhattan
Df(Dch1)	Manhattan	Deficiency (from Dch1)	2	Df(Dch1)/Ey	Manhattan
Df1-3/Ey	Manhattan	Deficiency	2	Df1-3/Dp/Es1	Manhattan
Df1-3/Ey	Manhattan	Deficiency	2	Df1-3/Ey	Manhattan
Df1-5/Ey	Manhattan	Deficiency	2	Df1-5/Ey	Manhattan
dms	Manhattan	distorted metasternal suture	?	dms	Manhattan
Dp	Manhattan	Duplication (from Dch1)	2	Dp/Es1/Df(Dch)	Manhattan
Dp	Manhattan	Duplication (from Dch1)	2	Dp/Es1/Df1-3	Manhattan
Dp	Manhattan	Duplication (from Dch1)	2	Dp/Es1/pas30	Manhattan
Dp	Manhattan	Duplication (from Dch1)	2	Dp/Ey/Ey	Manhattan
DpLu	Manhattan	Duplication (from Lu)	2	DpLu/Ey	Manhattan
DpSpa	Manhattan	Duplication (from Spa)	2	DpSpa/Es1/pas30	Manhattan
Ds	Oregon State U.	Displaced sternellum	4	Ds/+	Manhattan
ds(euD)	Manhattan	displaced sternellum (from euD)	?	ds(euD)	Manhattan
Ds(New)	Manhattan	Displaced sternellum	?	Ds(New)/+	Manhattan
ds-X	Manhattan	displaced sternellum, x-linked	4?;X	ds-X	Manhattan
Dwi-1	India	wild-type strain	-	Dwi-1	India, 1989
Dwi-1 , #189	India	wild-type strain	-	Dwi-1 , #189	India
Dwi-3 (dark body color)	India	wild-type strain	-	Dwi-3 (dark body color)	India, 1989
Dwi-3 , #191	India	wild-type strain	-	Dwi-3	India
Dwi-3 isoline (ST)	India	inbred isoline	-	Dwi-3 isoline (ST)	India/Manhattn
Em,A16s	Manhattan	Enlarged mentum, abdominal (cis)	2	Em,A16s/Stb	Manhattan
Er	Manhattan	Eye reduced	2	Er/mxpD1,Skl6	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	AD100,Stm,Cx5/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Ag+RptlD1/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Ag/Es1	Manhattan

Es	Manhattan	Extra sclerite (abdominal)	2;4	Ag4,Stm/Es	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Ag5,Stm/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR102-1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR2	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR2a-2	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR3a-1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR4a(Dp)/Ey	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR5a	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR6a-1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR6a-2	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/AR8a	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/ARA3	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/ARA4	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	box / Es	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Es1/Cx5,Stm	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Cx6/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Cx20/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Dch1/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Dch3/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Det43/Es	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Dp/Es1/Df(Dch)	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Dp/Es1/Df1-3	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Dp/Es1/pas30	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	DpSpa/Es1/pas30	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	DpLu (Es1,Skl6)/Ey	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Ey/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	g/Es	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	GoPL6/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	GoPL10/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	GoPL11/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	GoPL14/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Hw/mxpX9,Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	lp69/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	LuR1a/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Mc-2,Utx1/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	mxp8/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	mxp19/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	mxp170/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	mxpX9,Es1/Ey	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Ns, Stm/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	ptlD16, Stm/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	ptlD57, Stm/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Spa/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Stb/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Stbd/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Stm+RSptlD/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Stm-Es1/+NDJ	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	StmR1/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	StmR2/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	StmR5/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	StmR6/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	StmR,Ag4/Es1	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	tr/Es	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Utx1/Es	Manhattan
Es	Manhattan	Extra sclerite (abdominal)	2;4	Utx2,Stm/Es	Manhattan
Es(Skl6)	Manhattan	Extra sclerite (from Skl6)	2	Es(Skl6)/+	Manhattan
Es(Skl6)	Manhattan	Extra sclerite (from Skl6)	2	Es(Skl6)GoPL4	Manhattan
Es1+R1	Manhattan	Extra sclerite revertant 1	2	Es1+R1/Ey	Manhattan
Es1+R9	Manhattan	Extra sclerite revertant 9	2	Es1+R9/Ey	Manhattan
Es2	Manhattan	Extra sclerite 2	2	Es2/Ag5	Manhattan
Estill	S. Carolina	wild-type strain	-	Estill	S. Carolina, 19??
eu	Lasley & Sokoloff	extra urogomphi	2	eu	San Bernadino
eu	Lasley & Sokoloff	extra urogomphi	2	eu, apt, mas	Manhattan
eu	Lasley & Sokoloff	extra urogomphi	2	eu, mas	Manhattan
euD	Manhattan	Extra urogomphi (male sterile)	2	euD/+	Manhattan
Ey	Manhattan	eyeless	2;5	A10 / Ey	Manhattan
Ey	Manhattan	eyeless	2;5	A12/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	A15,Stm/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Dch3 / Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Df(Dch1)/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Df1-3/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Df1-5/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	DpLu/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Ey/Es1	Manhattan
Ey	Manhattan	eyeless	2;5	LuR1a/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	LuRptl/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Mcs1R1/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Mcs1R2/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	mxpD1,Skl6/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	mxpX9,Es1/Ey	Manhattan

Stock Lists

R. W. Beeman Laboratory 1999 Manhattan, Kansas

Ey	Manhattan	eyeless	2;5	ptID60/Ey	Manhattan
Ey	Manhattan	eyeless	2;5	Skl4R2/Ey	Manhattan
Ey,A14	Manhattan	Eyeless, Abdominal 14 (cis)	2	Ag5,Stm/Ey,A14	Manhattan
Ey-Lethal-Free	Manhattan	lethal free from Eyeless	NA	Ey-Lethal-Free	Manhattan
fa	Manhattan	fused antennae	5?	fa	Manhattan
fe	Manhattan	folded elytra	?	fe	Manhattan
Ff	Purdue	fused funnicle	6	Ff/+	Purdue
FFM-C	Georgia	wild-type strain	-	FFM-C	Georgia, 1993
fs(sa)	Manhattan	short antennae, female sterile	?	fs(sa)	Manhattan
FSS2	England	wild-type strain	-	FSS2	England, 1943
Fta	Sokoloff & St. Hilaire	Fused tarsi and antennae	?	Fta/+	San Bernadino
g	Manhattan	glossy	2	g/Es	Manhattan
g	Manhattan	glossy	2	g,pas30	Manhattan
Ga-1	Georgia	Georgia 1, wild type	NA	Ga-1	Georgia
Ga-2	Georgia	Georgia 2, Ga-1 inbred 20 generations	NA	Ga-2	U.Wisc.-Parkside
Ga-2 iso-M1	Georgia	Georgia 2, isoline to M1/M1	NA	Ga-2 iso-M1	U.Wisc.-Parkside
Ga-9s	Georgia	Georgia back-X to s 9X, sel. For Rmai gene	4	Ga-9s	Manhattan
Ger-1	Germany	wild-type strain	-	Ger-1	Germany, <1989
Gi	Sokoloff & Brownlee	Giant (body size)	NA	Gi/Gi	San Bernadino
Go	Manhattan	Goliath (body size)	7	Go/+	Manhattan
Go	Manhattan	Goliath (body size)	7	Go/+ c/c	Manhattan
Go	Manhattan	Goliath (body size)	7	Go/+ b,sa,c/b,sa,c	Manhattan
GoPL10	Manhattan	Goliath-derived crossover suppressor	7;2	GoPL10/Es1	Manhattan
GoPL11	Manhattan	Goliath-derived crossover suppressor	7;2	GoPL11/Es1	Manhattan
GoPL14	Manhattan	Goliath-derived crossover suppressor	7;2	GoPL14/Es1	Manhattan
GoPL4	Manhattan	Goliath-derived crossover suppressor	7;2	GoPL4/Ag5,Stm	Manhattan
GoPL4	Manhattan	Goliath-derived crossover suppressor	7;2	GoPL4/Crab	Manhattan
GoPL4	Manhattan	Goliath-derived crossover suppressor	7;2	GoPL4/Es(Skl6)	Manhattan
GoPL6	Manhattan	Goliath-derived crossover suppressor	7;2	GoPL6/Es1	Manhattan
GW-13	Australia	wild-type strain	-	GW-13	Australia,19??
GW-3	Australia	wild-type strain	-	GW-3	Australia, 1988
GW-4	Australia	wild-type strain	-	GW-4	Australia,1965
h	Dawson	hazel eye	4	h, s	San Bernadino
H-1 (ST)	Parkside	H-factor	?	H-1	U.Wisc.-Parkside
H-2 (ST)	Parkside	H-factor	?	H-2	U.Wisc.-Parkside
Heng-5	Thailand	wild-type strain	-	Heng-5	Thailand, 1989
HO-TCS	Singapore	wild-type strain	-	HO-TCS	Singapore,1989
HO-TJC, #121	Singapore	wild-type	-	HO-TJC	Singapore
Hw	Manhattan	Hairy wing	2	Hw/Es,mxpX9	Manhattan
i	Bartlett	ivory (*eye* color)	?	i,lod	San Bernadino
Ibad-2cf	Nigeria	wild-type strain	-	Ibad-2cf	Nigeria, 1987
Is	Manhattan	Incomplete sternelium	?	Is/+	Manhattan
ISR-1	Israel	wild-type strain	-	ISR-1	Israel, 1988
ISR-2	Israel	wild-type strain	-	ISR-2	Israel, 1988
j	Park	jet, body color	5	j,mc	San Bernadino
j	Park	jet, body color	5	mc,rb,j	Manhattan
j	Park	jet, body color	5	rb,j	San Bernadino
j2 (Z-4)	Manhattan	jet, body color	5	j2	Manhattan
Japan #1	Japan	wild-type strain	-	Japan #1	Japan, <1978
Japan #2	Japan	wild-type strain	-	Japan #2	Japan, 1988
Japan #4	Japan	wild-type strain	-	Japan #4	Japan, 1988
ju	Sokoloff	juvenile urogomphi	4?	ju,eu,b	Manhattan
Kent (small eyes)	England	wild-type strain	-	Kent (small eyes)	England, 19??
Lab-S Rusty	Manhattan	Lab strain, rusty, wild-type	NA	Lab-S Rusty	Manhattan
LF-3 (JS)	Purdue	Lethal free strain	3	LF-3 (JS)	Purdue
Little Rock	Arkansas	wild-type strain	-	Little Rock	Arkansas, 1988
lod	Sokoloff	light optical diaphragm	3	au,lod isoline (JS)	Purdue
lod	Sokoloff	light optical diaphragm	3	au,lod,p	San Bernadino
lod	Sokoloff	light optical diaphragm	3	b(t),p,lod,au,msg	Manhattan
lod	Sokoloff	light optical diaphragm	3	i,lod	San Bernadino
lod	Sokoloff	light optical diaphragm	3	lod,p	San Bernadino
lod	Sokoloff	light optical diaphragm	3	M1,au,lod,p	Manhattan
lod	Sokoloff	light optical diaphragm	3	mc(eg),lod,p	Manhattan
lod	Sokoloff	light optical diaphragm	3	Rd(HD),lod,p	Manhattan
lod	Sokoloff	light optical diaphragm	3	Rd,mc,lod,p	Manhattan
lp69	Manhattan	labiopedia 69	2	lp69/Es1	Manhattan
Lu	Manhattan	Lucifer (dorsal head horns)	2	Lu / Stm,Cx5	Manhattan
Lu	Manhattan	Lucifer (dorsal head horns)	2	Lu,Skl6/Stb	Manhattan
Lu	Manhattan	Lucifer (dorsal head horns)	2	Lu, au/Dch1	Manhattan
LuR1a	Manhattan	Lucifer revertant	2	LuR1a/Es1	Manhattan
LuR1a	Manhattan	Lucifer revertant	2	LuR1a/Ey	Manhattan
m.l. 9.14	Manhattan	(Male linked)	2	9.14 (male linked)	Manhattan
M1	Manhattan	Medea 1	3	M1Big III, p	Manhattan
M1	Manhattan	Medea 1	3	M1 - iso 3B1 (G)	Manhattan
M1	Manhattan	Medea 1	3	M1 isoline (JS)	Manhattan
M1	Manhattan	Medea 1	3	M1,au,M3	Manhattan
M1	Manhattan	Medea 1	3	M1,au,p,lod	Manhattan
M1	Manhattan	Medea 1	3	M1,b	Manhattan
M1	Manhattan	Medea 1	3	M1/M1, Bamp27/+	Manhattan
M3	Manhattan	Medea 3	3	M3,au	Manhattan

Stock Lists

R. W. Beeman Laboratory 1999 Manhattan, Kansas

M3	Manhattan	Medea 3	3	M1,au,M3	Manhattan
mas	Hoy & Sokoloff	missing abdominal sternite	2	mas	San Bernadino
mas	Hoy & Sokoloff	missing abdominal sternite	2	mas, p,au	Manhattan
mas	Hoy & Sokoloff	missing abdominal sternite	2	ptl, mas, pas	Manhattan
mas	Hoy & Sokoloff	missing abdominal sternite	2	Quint(mxp,apt,mas,pas,ub)	Manhattan
mas	Hoy & Sokoloff	missing abdominal sternite	2	MMS (s,rb,mas,ap,au)	Manhattan
mas2	Manhattan	missing abdominal sternite 2	2 ?	mas2	Manhattan
mc	Sokoloff & Lasley	microcephalic	5	j,mc	San Bernadino
mc	Sokoloff & Lasley	microcephalic	5	mc,rb,j	Manhattan
mc(eg)	Sokoloff & Lasley	microcephalic (eye growth variant)	5	mc(eg),p,lod	Manhattan
mc(eg)	Sokoloff & Lasley	microcephalic (eye growth variant)	5	Rd,mc(eg),lod,p	Manhattan
Mc-2,Ubx1	Manhattan	Microcephalic-2,Ultrathorax(cis)	2	Mc-2,Ubx1/Es1	Manhattan
Mcs1	Manhattan	Miscadestral sclerite	2	Mcs1/Stm	Manhattan
Mcs1R1	Manhattan	Miscadestral sclerite, revertant 1	2	Mcs1R1/Ey	Manhattan
Mcs1R2	Manhattan	Miscadestral sclerite, revertant 2	2	Mcs1R2/Ey	Manhattan
Mcs1R4	Manhattan	Miscadestral sclerite, revertant 4	2	Mcs1R4/mxpNG	Manhattan
Mcs1R5	Manhattan	Miscadestral sclerite, revertant 5	2	Mcs1R5/Stm,Cx5	Manhattan
Mek-1	China	wild-type strain	-	Mek-1	China, 1987
Mo	Sokoloff	Micropthalmic	6	Mo/+	San Bernadino
Montreal	Montreal	wild-type strain	-	Montreal	Montreal, 1973
msg	Sokoloff & Hoy	melanotic stink gland	?	b(t),p,lod,au,msg	Manhattan
mxp	Sokoloff	maxillopedia	2	ba,mxp,apt,pas30	Manhattan
mxp	Sokoloff	maxillopedia	2	mxp, apt, pas30	Manhattan
mxp	Sokoloff	maxillopedia	2	Ubx1,mxp,apt/A10,mxpA10	Manhattan
mxp	Sokoloff	maxillopedia	2	Quint(mxp,apt,mas,pas,ub)	Manhattan
mxp170	Manhattan	maxillopedia 170, lethal	2	mxp170/Es1	Manhattan
mxp19	Manhattan	maxillopedia 19, lethal	2	mxp19/Es1	Manhattan
mxp8	Manhattan	maxillopedia 8, lethal	2	mxp8/Es1	Manhattan
mxpD1,Ski6/Ey	Manhattan	Maxillopedia, dom. 1, Ski6 (cis)	2	mxpD1,Ski6/Ey	Manhattan
mxpNG	Manhattan	maxillopedia, Notched Gena, lethal	2	mxpNG/Es1	Manhattan
mxpNG	Manhattan	maxillopedia, Notched gena	2	Mcs1R4/mxpNG	Manhattan
mxpX9, Es	Manhattan	lethal maxillopedia, Es (cis)	2;4	mxpX9,Es1/Ey	Manhattan
NDG-2 (#59)	Manitoba	Wild-type	NA	NDG-2 (#59)	Manitoba
NDJ-11	Hawaii	wild-type strain	-	NDG-11	Hawaii, 1976
NDJ-13	Vancouver	wild-type strain	-	NDG-13	Vancouver, 1976
NDJ-3	Manitoba	wild-type strain	-	NDG-3	Manitoba, 1987
NDJ-6 (some white eye)	Minnesota	wild-type strain	-	NDJ-6 (some white eye)	Minnesota, 1982
NIG-1 (red eye)	Nigeria	wild-type strain	-	NIG-1 (red eye)	Nigeria, 1988
Npp	Hoy	Non-punctate prothorax	?	Nppc (Sokl 428)	San Bernadino
p	Park	pearl eye	9	p	San Bernadino
p	Park	pearl eye	9	ab,pas30,p	San Bernadino
p	Park	pearl eye	9	au, lod, p	San Bernadino
p	Park	pearl eye	9	b(t),au,lod, p,msg	Manhattan
p	Park	pearl eye	9	co,p	Manhattan
p	Park	pearl eye	9	lod, p	San Bernadino
p	Park	pearl eye	9	M1Big III, p	Manhattan
p	Park	pearl eye	9	mas, p,au	Manhattan
p	Park	pearl eye	9	mc(eg),lod, p	Manhattan
p	Park	pearl eye	9	pas30, p	Manhattan
p	Park	pearl eye	9	Rd,mc(eg),p	Manhattan
p	Park	pearl eye	9	Rd,mc(eg),lod, p	Manhattan
p	Park	pearl eye	9	Rd(HD),lod, p	Manhattan
p	Park	pearl eye	9	Se,co,p/+,co,p	Manhattan
p	Park	pearl eye	9	Se,p/+,p	Manhattan
PAK-1	Pakistan	wild-type strain	-	PAK-1	Pakistan, 1979
PAK-2 (dark body color)	Pakistan	wild-type strain	-	PAK-2 (dark body color)	Pakistan, 1979
PAK-3	Pakistan	wild-type strain	-	PAK-3	Pakistan, 1988
pas	Sokoloff	pointed abdominal sternite	2	apt, pas	San Bernadino
pas	Sokoloff	pointed abdominal sternite	2	ptl, mas, pas	Manhattan
pas	Sokoloff	pointed abdominal sternite	2	Quint(mxp,apt,mas,pas,ub)	Manhattan
pas30	Manhattan	pointed abdominal sternite 30	2	ab,pas30,p	Manhattan
pas30	Manhattan	pointed abdominal sternite 30	2	ba,mxp,apt,pas30	Manhattan
pas30	Manhattan	pointed abdominal sternite 30	2	mxp,apt,pas30	Manhattan
pas30	Manhattan	pointed abdominal sternite 30	2	ub,pas30	Manhattan
pd	Park & Frank	paddle antenna	X	py, pd, plt	San Bernadino
pep	Manhattan	peppered cuticle	X	pep	Manhattan
pnk (NDG-2)	Manhattan	pink eye, from NDG-2	?	pnk (NDG-2)	Manhattan
pnk (Tiw-1 iso-43)	Manhattan	pink eye, from Tiw-1 iso-43	?	pnk (Tiw-1 iso-43)	Manhattan
PRC-Nan	China	wild-type strain	-	PRC-Nanj	China,1989
PRC-Ning	China	wild-type strain	-	PRC-Ning	China,1989
Pruz +	Poland	wild-type strain	-	Pruz +	Poland, 1988
Pruz-1	Poland	wild-type strain	-	Pruz-1	Poland, 1963
Ps	Manhattan	Pinched sternellum	2	Ps/Rd(CS)	Manhattan
PS-129	India	wild-type strain	-	PS-129	India, 1984
pte	Sokoloff	platinum eye	X	py, pd, plt	San Bernadino
ptl	Lasley & Sokoloff	prothoraxless	2	ptl	San Bernadino
ptl	Lasley & Sokoloff	prothoraxless	2	ptl, mas, pas	Manhattan
ptl(Rd)	Manhattan	prothoraxless from Rd stock	2	ptl(Rd)	Manhattan
ptlD16,Stm	Manhattan	Dom. prothoraxless 16, Stm (cis)	2	ptlD16,Stm/Es1	Manhattan
ptlD2	Manhattan	Dom. prothoraxless 2	2	ptlD2/Stb	Manhattan
ptlD26Y,Stm	Manhattan	Dom. prothoraxless 26, Y-linked	2;Y	ptlD26Y,Stm/+	Manhattan

Stock Lists

R. W. Beeman Laboratory 1999 Manhattan, Kansas

ptlD57,Stm	Manhattan	Dom. prothoraxless 57, Stm (cis)	2	ptlD57,Stm/Es1	Manhattan
ptlD60	Manhattan	dominant prothoraxless 60	2	A(Ag1), Stm /ptlD60	Manhattan
ptlD60	Manhattan	dominant prothoraxless 60	2	ptlD60/Ey	Manhattan
py	Lasley	pygmy	X	py, pd, plt	San Bernadino
py2	Manhattan	pygmy 2	X	py2	Manhattan
Pyr-R	Peter Collins	Pyrethroid resistant	9	co,Pyr-R	Peter Collins
QTC 279 (Pyr-R)	Peter Collins	Pyrethroid resistant	9?	QTC 279 (Pyr-R)	Peter Collins
Raj-1	India	wild-type strain	-	Raj-1	India, 1<1979
Ram-B	India	wild-type strain	-	Ram-B	India, 19??
Ramsey (MT '88)	Minnesota	wild-type strain	-	Ramsey (MT '88)	Minnesota,1988
Rap	Manhattan	Recurved anterior pronotum	2	Rap	Manhattan
rb	Dewees	ruby eye	5	mc,rb,j	Manhattan
rb	Dewees	ruby eye	5	MMS (s,rb,ap,au,mas)	Manhattan
rb	Dewees	ruby eye	5	rb,j	San Bernadino
Rd	Dawson	Reindeer, homozygous viable	2	Rd	San Bernadino
Rd	Dawson	Reindeer, homozygous viable	2	Rd, mas, p	Manhattan
Rd	Dawson	Reindeer, homozygous viable	2	Rd,mc,p	Manhattan
Rd	Dawson	Reindeer, homozygous viable	2	Rd,pas30	Manhattan
Rd(CS)	Manhattan	Reindeer, crossover suppressor	2	Ps/Rd(CS)	Manhattan
Rd(HD)	Manhattan	Reindeer (honey-dipper style)	2	Rd(HD)	Manhattan
Rd(HD)	Manhattan	Reindeer (honey-dipper style)	2	Rd(HD),lod, p	Manhattan
Rdiel BC9 Lab-S	Unknown	Dieldrin resistant from Lab-S	NA	Rdiel BC9 Lab-S	Unknown
REJ-1	Philippines	wild-type strain	-	REJ-1	Philippines,19??
RINI-3	India	wild-type strain	-	RINI-3	India,1989
RINI-4	India	wild-type strain	-	RINI-4	India, 19??
s	Bartlett, Bell & Shideler	sooty	4	s	San Bernadino
s	Bartlett, Bell & Shideler	sooty	4	h, s	San Bernadino
s	Bartlett, Bell & Shideler	sooty	4	Be, s	San Bernadino
s	Bartlett, Bell & Shideler	sooty	4	Ga-9s	Georgia,1993
s	Bartlett, Bell & Shideler	sooty	4	MMS (s,rb,ap,au,mas)	Manhattan
sa	Sokoloff	short antenna	?	b, apt, sa, c	Manhattan
sa	Sokoloff	short antenna	?	Go,b, sa, c	Manhattan
sa	Sokoloff	short antenna	?	sa,c	San Bernadino
Sa-8	Manhattan	Short antenna-8	?	Sa-8	Manhattan
sa-X	Manhattan	short antenna, X-linked	X	sa-X	Manhattan
Se	Manhattan	Short elytra	9	Se	Manhattan
Se	Manhattan	Short elytra	9	Se,co,p	Manhattan
Se	Manhattan	Short elytra	9	Se,p	Manhattan
se 46	Purdue	short elytra 46	?	se 46	Purdue
Se12	Purdue	Short elytra 12	?	Se12	Purdue
Se-2	Manhattan	Short elytra 2	8	Se-2	Manhattan
Shellman	Georgia	wild-type strain	-	Shellman	Georgia,1993
Skl2s	Manhattan	Socketless spontaneous 2	2	Skl2s/Stb	Manhattan
Skl4	Manhattan	Socketless 4	2	Skl4/Ag4,Stm	Manhattan
Skl4R2	Manhattan	Socketless 4, revertant 2	2	Skl4R2/Ey	Manhattan
Skl4R3	Manhattan	Socketless 4, revertant 3	2	Skl4R3/Stm,Cx5	Manhattan
Skl6	Manhattan	Socketless 6	2	Skl6/Stm,Cx5	Manhattan
Skl6R1	Manhattan	Socketless 6, revertant 1	2	Skl6R1/Stm,Cx5	Manhattan
small	Purdue	small body size	?	small	Purdue
Sok 16	California	wild-type strain	-	Sok 16, (TC16, Veracruz)	California, 19??
Sok 19	California	wild-type strain	-	Sok 19, (TC19,Berkeley)	California, 19??
Sok 22	California	wild-type strain	-	Sok 22, (TC22)	California, 19??
Sok 25	California	wild-type strain	-	Sok 25, (TC25, ex NY)	California, 19??
Sok 4	California	wild-type strain	-	Sok 4, (TC4,Davis)	California, 19??
Sok 8	California	wild-type strain	-	Sok 8, (TC8, McGill)	California, 19??
Solet	Israel	wild-type strain	-	Solet	Israel, 1979
sp	Manhattan	shoulder pads	2	sp/Stm,Ag4	Manhattan
Spa	Sokoloff & Hoy	Spatulate antennae	2,4	Spa/Es1	Manhattan
sq (Tiw-1)	India	squint (from Tiw-1)	?	sq (Tiw-1)	India
sq(euD)	Manhattan	squint (from euD)	?	sq(euD)	Manhattan
sq	Bywaters	squint eye	8	Bald,ap,sq/ap,sq	Manhattan
sq	Bywaters	squint eye	8	sq	San Bernadino
sq2	Manhattan	squint eye 2	8	ap,sq2	Manhattan
sq-B	Burma	squint (from Burma)	?	sq-B	Burma
Stb	Manhattan	Stubby antennae	2,X	Ag/Stb	Manhattan
Stb	Manhattan	Stubby antennae	2,X	Em,A16s/Stb	Manhattan
Stb	Manhattan	Stubby antennae	2,X	Ey,pasN/Stb	Manhattan
Stb	Manhattan	Stubby antennae	2,X	Es/Stb	Manhattan
Stb	Manhattan	Stubby antennae	2,X	Lu,Skl6/Stb	Manhattan
Stb	Manhattan	Stubby antennae	2,X	ptlD2/Stb	Manhattan
Stb	Manhattan	Stubby antennae	2,X	Skl2s/Stb	Manhattan
Stbd	Manhattan	Stubboid (short antennae)	2	Lu/Stbd	Manhattan
Stbd	Manhattan	Stubboid (short antennae)	2	Stbd/Es	Manhattan
Stm	Manhattan	Stumpy	2	Stm/Stm	Manhattan
Stm,Ag4	Manhattan	Stm, Antennagalea 4	2	X-83/Stm,Ag4	Manhattan
Stm,Ag4	Manhattan	Stm, Antennagalea 4	2	X-47/Stm,Ag4	Manhattan
Stm,Ag4	Manhattan	Stm, Antennagalea 4	2	vwe/Stm,Ag4	Manhattan
Stm,Ag4	Manhattan	Stm, Antennagalea 4	2	sp/Stm,Ag4	Manhattan
Stm,Ag4	Manhattan	Stm, Antennagalea 4	2	g/Stm,Ag4	Manhattan
Stm,Ag4	Manhattan	Stm, Antennagalea 4	2	X-31/Stm,Ag4	Manhattan

Stock Lists

R. W. Beeman Laboratory | 1999 | Manhattan, Kansas

Stm,Ag5	Manhattan	Stm, Antennagalea 5	2	A4/Stm,Ag5	Manhattan
Stm,Ag5	Manhattan	Stm, Antennagalea 5	2	A10,mxpA10/Stm,Ag5	Manhattan
Stm,Ag5	Manhattan	Stm, Antennagalea 5	2	A14,Ey/Stm,Ag5	Manhattan
Stm,Ag5	Manhattan	Stm, Antennagalea 5	2	Es2/Stm,Ag5	Manhattan
Stm,Ag5	Manhattan	Stm, Antennagalea 5	2	GoPL4/Stm,Ag5	Manhattan
Stm,Cx5	Manhattan	Stm, Cephalothorax 5, cis	2	A8/Stm,Cx5	Manhattan
Stm,Cx5	Manhattan	Stm, Cephalothorax 5, cis	2	AgPin/Stm,Cx5	Manhattan
Stm,Cx5	Manhattan	Stm, Cephalothorax 5, cis	2	Lu / Stm,Cx5	Manhattan
Stm,Cx5	Manhattan	Stm, Cephalothorax 5, cis	2	AD100,Stm,Cx5/Es1	Manhattan
Stm,Cx5	Manhattan	Stm, Cephalothorax 5, cis	2	Skl4R3/Stm,Cx5	Manhattan
Stm,Cx5	Manhattan	Stm, Cephalothorax 5, cis	2	Skl6R1/Stm,Cx5	Manhattan
Stm,Cx5	Manhattan	Stm, Cephalothorax 5, cis	2	Stm,Cx5/Es1	Manhattan
Stm,Ns	Manhattan	Stm, Narrow sternellum (cis)	2	Stm,Ns/Es1	Manhattan
Stm+RSptlD	Manhattan	Stm spontaneous revertant, ptl (dominant)	2	Stm+RSptlD/Es1	Manhattan
Stm-Es1/+NDJ	Manhattan	Non-disjunction	?	Stm-Es1/+NDJ	Manhattan
StmR1	Manhattan	Stm revertant 1	2	StmR1/Es1	Manhattan
StmR2	Manhattan	Stm revertant 2	2	StmR2/Es1	Manhattan
StmR5	Manhattan	Stm revertant 5	2	StmR5/Es1	Manhattan
StmR6	Manhattan	Stm revertant 6	2	StmR6/Es1	Manhattan
Stm-Skl6/+NDJ	Manhattan	Non-disjunction	?	Stm-Skl6/+NDJ	Manhattan
Sylvania	Sylvania, GA	wild-type strain	-	Sylvania	Sylvania, GA
T(Y;3)	Manhattan	Translocation Y-3	Y;3	T(Y;3)	Manhattan
T(Y;4)	Manhattan	Translocation Y-4	Y;4	T(Y;4)	Manhattan
tar	Manhattan	anterior melanotic stink glands	2	tar	Manhattan
tib	Manhattan	tibialess (from ab)	9?	tib	Manhattan
Tiw-1	India	?	NA	Tiw-1	India
Tiw-1 (iso 43)	India	Tiw-1 isoline	NA	Tiw-1 (iso 43)	India
Tiw-1(iso 43) pink	India	pink eye from Tiw-1	NA	Tiw-1(iso 43) pink	India
Tiw-5	India	wild-type strain	-	Tiw-5	India,1989
Tiw-6	India	wild-type strain	-	Tiw-6	India,1989
tr	Manhattan	trembler, recessive lethal	2;4	Es/tr	Manhattan
tr	Manhattan	trembler, homozygous viable	2;4	tr	Manhattan
ub	Manhattan	unbuckled	2	ub	Manhattan
ub	Manhattan	unbuckled	2	ub,pas30	Manhattan
ub	Manhattan	unbuckled	2	Quint(ub,mxp,apt,mas,pas)	Manhattan
ue	Manhattan	unsclerotized elytra	?	ue	Manhattan
Ug-1	Uganda	wild-type strain	-	Ug-1	Uganda, 1989
UG-3	Tanzania	wild-type strain	-	UG-3	Tanzania,1986
Ubx(New)	Manhattan	Ultrathorax (New)	2	Ubx(New)/+	Manhattan
Ubx1	Manhattan	Ultrathorax	2	Ubx1/Es	Manhattan
Ubx1	Manhattan	Ultrathorax	2	Ubx1/Ubx1	Manhattan
Ubx2,Stm	Manhattan	Ultrathorax 2, Stm (cis)	2	Ubx2,Stm/Es1	Manhattan
Vienna (GA '93)	Georgia	wild-type strain	-	Vienna (GA '93)	Georgia,1993
vwe	Manhattan	vestigial wings and elytra	2	vwe/Stm,Ag4	Manhattan
w	Eddleman & Bell	white eye	4	w	San Bernadino
Waunakee (WI '92)	Wisconsin	wild-type strain	-	Waunakee (WI '92)	Wisconsin, 1992
WI-1	Wisconsin	wild-type strain	-	WI-1	Wisconsin?
X(ab-1s)	Manhattan	Lethal revertant from ab	9	X(ab-1s)/Ag4,Stm	Manhattan
X-31	Manhattan	lethal 31	2	X-31/Ag4,Stm	Manhattan
X-47	Manhattan	lethal 47	2	X-47/Stm,Ag4	Manhattan
X-83	Manhattan	Lethal 83	2	X-83/Stm,Ag4	Manhattan
Z-1	Alabama	wild-type strain	-	Z-1	Alabama, 1988
Z-2 (occ.dk.red eye)	Oklahoma	wild-type strain	-	Z-2 (occ.dk.red eye)	Oklahoma, 1988
Z-3 (#30)	Kankakee	wild-type strain	-	Z-3 (#30)	Kankakee, IL
Z-4 (occ. dark body)	Iowa	wild-type strain	-	Z-4 (occ. dark body)	Iowa, 1988
Z-5	Minnesota	wild-type strain	-	Z-5	Minnesota, 1988
Z-7	S. Carolina	wild-type strain	-	Z-7	S. Carolina, 1988

Tribolium confusum:

BA50 - cf	Kansas	Tribolium confusum	-	BA50 - cf	Kansas, ~1986-87
HP70 - cf	Kansas	Tribolium confusum	-	HP70 - cf	Kansas, ~1986-87
MN61 - cf	Kansas	Tribolium confusum	-	MN61 - cf	Kansas, ~1986-87
PAK-3-cf	Pakistan	Tribolium confusum	-	PAK-3-cf	Pakistan, 1988
P-Ning -cf	China	Tribolium confusum	-	P-Ning -cf	China,1989
T. confusum (apt,mas,sti)	San Bernadino	T.cf.(alate prothorax, missing abd. stem., sti	?	T. confusum (apt,mas,sti)	San Bernadino
T. confusum (b,au,lod,p)	San Bernadino	T.cf. (black, aureate, light optical diaph., pearl	?	T. confusum (b,au,lod,p)	San Bernadino
T. confusum (lod,p)	San Bernadino	light optical diaphragm, pearl	?	T. confusum (lod,p)	San Bernadino
T. confusum (PRC)	P.R. China	Tribolium confusum	-	T. confusum (PRC)	P.R. China
ThaiB-cf (tan eye)	Thailand	Tribolium confusum	-	ThaiB-cf (tan eye)	Thailand, 19??
UG-2 cf	Uganda	Tribolium confusum	-	UG-2 cf	Uganda, 1989

Other Species:

Gnathocerus comutus	?	wild-type strain	-	Gnathocerus comutus	?
Longheaded flour beetle	?	wild-type strain	-	Longheaded flour beetle	?
T. brevicornis	Manhattan	Tribolium brevicornis	-	T. brevicornis	Manhattan
T. freemani	Japan	Tribolium freemani	-	T. freemani	Japan
T. madens	Manhattan	Tribolium madens	-	T. madens	Manhattan

Sue Haas

SAVANNAH, GEORGIA
STORED-PRODUCT INSECTS RESEARCH AND DEVELOPMENT LABORATORY

I. Wild type strains

A. Lepidoptera

1. Cadra cautella (Walker)	N.C. Tifton, Ga.
2. Plodia interpunctella (Hubner)	Modesto, Ca.
3. Sitotroga cerealella (Olivier)	Manhattan, Ka Can., and Durham, N.H.

b. Coleoptera

1. Attagenus megatoma (Fab.)	CSMA strains
2. Callosobruchus maculatus (Fab.)	Fresno, ca.
3. Cryptolestes ferrugineus (Stephens)	S. Carolina
4. Lasioderma serricorne (Fab.)	Unknown
5. Oryzaephilus mercator (Fauvel)	Unknown
6. Oryzaephilus surinamensis (L.)	Manhattan, Kan.
7. Rhyzopertha dominica Fab.)	Unknown
8. Sitophilus granarius (L.)	Manhattan, Kan.
9. S. oryzae (L.)	Ark., Calif., Kan., La.
10. S. zeamais Motchulsky	Estill, S.C.
11. Stegobium paniceum (L.)	Madison, Wis.
12. Tribolium castaneum (Herbst)	Unknown
13. Tribolium confusum duVal	Manhattan, Kan.
14. Trogoderma glabrum (Herbst)	Madison, wis., Riverside, Ca.

II. Mutant strains. None

Richard T. Arbogast, Laboratory Director.

South Orange, New Jersey
Seton Hall University
Department of Biology

T. castaneum

Wild Type Strains

Seton Hall-1

McGill, via California State

Synthetic Strains

Pearl Foundation, via Purdue University

Black Foundation, via Purdue University

Mutant Strains

Paddle (pd) via Cal State U., S.B.

Ho Ho
Red (R) Via Cal State U., S.B.

White (w) Via Cal State U., S.B.

short antenna (ca) Via Oregon State

Short antenna (Sa) Via Purdue University

Tribolium confusum Via Carolina Biological Supply

Eliot Krause

Storrs, CT 06269
University of Biology

Tribolium castaneum
Ga-1
sooty
Charcoal
RR strain from Costantino
Oryzaephilus surnamensis

J.S. Bancroft

ST. PAUL, MINNESOTA
UNIVERSITY OF MINNESOTA
DEPARTMENT OF ENTOMOLOGY, FISHERIES AND WILDLIFE

I. Wild type strains

A. Coleoptera strains

Dermestidae

Attagenus megatoma (F.)	Madison, Wis., 1975, Savannah, Ga. 1974
Trogoderma variabile Ballion	field collected, Mn. 1972

Cucujidae

Oryzaephilus surinamensis (L)	
Oryzaephilus mercator (Fauvel)	
Cryptolestes pusillus (Schoenherr)	Manhattan Ka. 1967
Cryptolestes ferrugineus (Stephens)	Unknown

Silvanidae

Ahasverus advena Waltl.	Minnesota

Tenebrionidae	
Cyaneus angustus (LeConte)	Winnipeg; Minnesota
Tribolium castaneum (Herbst)	Corvallis, Ore
Tribolium confusum duVal	Unknown
Tenebrio molitor	Carolina Biological, 1984
Anobiidae	
Lasioderma serricorne (Fab.)	Savannah, Ga.
Bostrichidae	
Rhizopertha dominica (F.)	Manhattan, Ka.
Prostephanus truncatus (Horn)	Unknown
Curculionidae	
Sitophilus granarius (L.)	Unknown
S. oryzae (L.)	"
B. Lepidoptera	
Pyralidae	
Anagasta kuehniella (Zeller)	Savannah, Ga.
Gelechiidae	
Sitotroga cerealella (Oliver)	Savannah, Ga.

(Ed.)

St. Paul, Minnesota 55108
University of Minnesota
Department of Entomology
Stored-Grain Pest Management Program

Eight species of stored-product beetles and two species of moths are maintained in the laboratory. These species include: Angoumois grain moth, flat grain beetle, Indian meal moth, larger grain borer, lesser grain borer, merchant grain beetle, red flour beetle, red flour beetle, rusty grain beetle, rice weevil, and sawtoothed grain beetle.

The Angoumois grain moth was obtained in June 1993 from Community Research Service, Kentucky State University, Kentucky. All other species were obtained in January 1992 from the Department of Entomology, Kansas State University, Manhattan, Kansas. Except for the merchant grain beetle, all species originated from farm-stored grain. The origin of merchant grain beetles is unknown.

Areas of research:

Developing and validating sampling schemes for insects associated with farm-stored grain.

Evaluating nonchemical alternatives for suppressing stored-grain traits.

Modeling population trends of insects from life-history traits.

Bhadriraju Subramanyam, Ph. D.

San Bernardino, CA 92407
California State University
Biology Department

Tribolium btrevicornis

Wild Type Strains

1. Original Waterman Population #2
2. Original Waterman Population #1
3, Waterman
4. Waterman
5. Waterman
6. Riverside
7. Riverside
8. Waterman
9. Waterman
10. Waterman
11. Waterman Canyon +/+
12.Waterman Canyhon II
12'. Riverside
13. Riverside
13' Riverside

Mutant Strains.

15. Red eyed mutation and fas-1
16. Strong Rg (reduced gena) fas-1
17. msg-like melanotic stink glands?
18. Short elytra (sshe)
19. she (te-like)
20. short elytra (se)
21. light ocular diaphragm? (lod)
22. incomplete mesosternum (ims)
23 creased abdominal sternites (cas)

Tribolium castaneum

Wild type strains

1. Chicago
4. Davis
8. McGill
12. Sacramento
16. Yucaipa
19. Synthetic, marked with sooty
22. Wildtype
23. New York

Mutant strains

31. pg , (p)	pegleg, pearl
33 ros apt	roseate, alate prothorax
38 r	red
51 dve, pd	divergent elytra, paddle
53 pd, py	paddle, pygmy
55 py, r	pygmy, red
56 msg, py, r	pygmy, red, melanotic stink glands
59 .r sp	red. Spotted
68. Malta p	Malta pearl
70 pg	peg leg
74 mas, p (pg)	missing abdominal segments, pearl, pegleg
82. b Chicago	black, Chicago
83. b McGill	black, McGill. UPF background
91. lod, p	light ocular diaphragm, pearl
93. Gi	Giant
94 Gi , ptl	Giant, prothoraxless
96. mt t	mottled
99 . b d	tawny
100. b	dusky
101. ap, rb, au, mc, s	antennapedia, ruby, aureate, microcephalic, sooty
105. fas-2	fused antennal segments-2
120. spiral	spiral arrangement of all three parts of the body
124. Be, s	Bar eye, sooty
139. mc	microcephalic
143. fas-3a	fused antennal segments-3a
150. rb	ruby
161. Sa, c, mxp	Short andtenna, chestnut, maxillopedia
196. mas	missing abdominal segments
220. Rd, p, knp	Reindeer, pearl, knobby prothorax
256. weird	weird eggs
272 supergiant	
276. Davis low body weight	
295 p, pd	pearl, paddle.
338 pd, py, p	paddle, pygmy,. Pearl
381. b, ptl	black, prothorax-less
392. j-2	jet-2 from Beeman
421. Rd, ptl, p	Reindeer, prothorax-less, pearl
436 au, mc	aureate, microcephalic
444. i, locd, Mo	ivory, light ocular diaphragm, Microphthalmic

63. ble (rby)
65. ble, e (cas, sti)
71. btf
73. btt , es (elb)
79. cas, sti
85. Chi +/+ ex N.Y.
87. Chi +/+
89. cru
90. cru, Hg
93. dim'd eye
95. dpe
97. dj (strong)
101. dj , r2
103 dt (see umb)
105. dt, es
109. dt, p
111. e
114. e Winnipeg
115. e, fas-3
117. e McGill
119. e L & H
121 e2 (fas, p, sti)
123. e (fas-1)
124. e-2, p
125. ele
128. e2, p fas-2
129. es
130 e2-lod
131 es, fas
133. es (car)
142. fas-1
145. fas-2
147. fas-2, dj, msg
149. fas-2, lod, p
150 fas-2
151 fas-2, msg
152 fas-4
153. fas-3 Yugo
154. fro
157 lod, p.
159. lod, rs
161 mag
163 +/+ McDonald
165 +/+ McGill.
167 msg (sp)
170. msg inbred
171. msg inbred 113 generations
172. Hg (msg, e-2, p)
176. Hg, es (apt, msg)
177. Hg, es
180. fas-2, lod, p, msg)
181. N.Y. +/+ (msg.sti
182. Npp-like (weak) r/r
183. ov-like
185 ov-like, Sp
187 p (sti, cas)

448 ap., Chr — antennapedia, Charcoal
464. i, lod — ivory, light ocular diaphragm
471 R-mal — malathion resistant
478 Spa, p — Spatulate, pearl
484. mxp (ap) — maxillopedia, antennapedia
485. fas-like — fused antennal segments-like
487 by syn — black synthetic
488 .(au), lod, p — aureate,, light ocular diaphragm, pearl
491. fas — fused antennal segments
494 Ag/Es' — Argentum/ Es'
S 6
495. Dch /ey — Dachshund, eyeless
496. Stbd/Es'
497. pt/ey
490. Stm/ey

T. confusum

1. apt, msg
2. apt, msg, r
4. au, p
6. au, msg, rus (p)
7. b, (sh., cas, sp)
8. bl
10. b, fas-2
11. b, fas-3 , r
14. b, lod, au, p (sp)
15. b, p
17. b, rus
19. bl
23. sh,, spl
25. b, sp
29. b, twa
33. b-2
35. b (cas, sti, r)
36. b (fas-3)
37. b, r (cas)
39. b Chicago/ b McGill
41. b Donner
43. b Georgia
47. b McGill
49. b McGill ex N.Y.
51 b McGill (syn)
53. b McGill fas
57 b SSM, sp
58. b, spl
59. b, syn
60 b, circle +/+

188. p (dre)
189. p Slough
192. py-like
193. ptl (msg)
194. +/+ Redlands
195. r (msg, sp)
196. riboflavinless, p
199. ru (sti, cas)
200. r Zagreb (msg, cas, Fas)
203. rby (cas, msg)
205 rus (cas, sti, msg)
206. rus –like (inbred)
210. black found in 206
211. Sacramento +/+
213. San Bernardino +/+
215. sh (Berkeley)
219. sp (spl)
221 spl-1 Sok (ble, sti)
223 sti (msg, cas)
225. stl
227. soy adapted
229. synthetic +/+
230. pearl robpf:avonless (msg)
231. thu (msg)
233. twa
234. umb
236. Xl (sh, sp)
238. +/+ Yugo
239 msg.
250. +/+ Japan
251. autosomal lethal nr b.

Tribolium freemani

1. +/+	Wild type	Slough
1a. +/+	Wild type	Slough
1b. +/+	Wild type	Slough
2. +/+	Wild type	Japan
2a. +/+	Wild type	Japan
2b. +/+	Wild type	Japan
3. b/b	black	San Bernardino
3a. b/b	black	San Bernardino
4. cas	creased abdominal segments	San Bernardino
4a. cas	" " "	" "
4b. cas dve	cr. abd. seg., divergent elytra	" "
5. cor	corrugated elytra	" "
6. ju	juvenile urogomphi	" "
7 fas-1	fused antennal segs.-1.	" "
8. mdls	median line on abd. sternites	" "
8a "	" " " "	" "
9. ov-like	overshot-like	" "
9a "	"	" "
10. sc	scar	" "
10a. sc	"	" "
10b. sc	"	" "
11. vt	vaulted elytra	" "
12. ims	incomplete mesosternum	" "

A. Sokoloff

WASHINGTON, D.C. 20204
DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
DIVISION OF MICROBIOLOGY

Coleoptera

Anobiidae
Stegobium paniceum (L.)

Anthribidae
Araecerus fasciculatus (Deg.) (poor condition; may be dead).

Bostrichidae
Rhyzopertha dominica (F.)

Bruchidae
Acanthoscelides obtectus (Say)

Cleridae
Necrobia rufipes (Deg.)

Cucujidae
Ahasverus advena (Waltl)
Cryptolestes ferrugineus (Steph.). Poor condition, may be dead.
C. pusillus (Schon.)
C. turcicus (Grouv.)
Oryzaephilus surinamensis (Linnaeus)

Curculionidae
Sitophilus granarius (L.)
S. zeamais Motschulsky

Dermestidae
Anthrenus flavipes LeC. Weak culture
Anthrenus verbasci (Linnaeus)
Dermestes maculatus De Geer
Trogoderma variabile Ballion

Ostomidae
Gibbium psylloides (Czemp.)

Silvanidae
Ahasverus advena (Waltl.)
Oryzaephilus surinamensis

Tenebrionidae
Alphitobius diaperinus (Panz.)
Gnathocerus maxillosus (F.)
Palorus ratzeburgi (Wissm.)
Tribolium brevicornis (LeConte)
T. castaneum (Herbst)
T. confusum Duv.
T. destructor Uytt.--weak culture, may be diseased.

I. madens (Charpentier)

M. Nakashima

AUSTRALIA

Burnley, Victoria
Victoria Plant Research Institute
Department of Agriculture

COLEOPTERA

Tribolium castaneum

Wild type strains
Malathion specific resistant strain
Malathion non-specific strain

Tribolium confusum

Wild type strains
Malathion specific strain

Oryzaephilus surinamensis

Wild type strain
Malathion resistant strain

Oryzaephilus mercator

Alphitobius diaperinus

Cryptolestes ferrugineus

Gnathocerus cornutus

Gnathocerus maxillosus

Latheticus oryzae

Rhyzopertha dominica

Sitophilus granarius

Sitophilus oryzae

Sitophilus zeamais

Tenebroides mauritanicus

LEPIDOPTERA

BURLINGTON, NORTH CAROLINA
CAROLINA BIOLOGICAL SUPPLY COMPANY

Tribolium castaneum

1. black
2. jet
3. pearl
4. Wild
5. High body weight
6. Low body weight

Tribolium confusum

1. Wild

(Ed.).

BURLINGTON, VERMONT 05401
UNIVERSITY OF VERMONT
DEPARTMENT OF ZOOLOGY
STEVENS/GOODNIGHT LAB

T. confusum	T.castaneum	Oryzaephilus surinamensis
bI	cI	
bII	cSM-+/+	
bIII	cCM-b/b	
bIV	cIV-a	
b-Chicago b/b	c-Brazil	
b-Chicago	c-Costa Rica	
b-Circle	c-Thailand	
b-yugo-Illinois b/b	c-Spain	
b-yugo-Illinois +/+	c-Israel	
bSM		
b-yugo-Kentucky		
b-McGill		
b-Thailand		
b- Nigeria		
b-Pakistan		

L. Stevens

CARBONDALE, ILLINOIS 62901
SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE
DEPARTMENT OF ZOOLOGY

Tribolium castaneum

I. Wild type strains

1. Purdue + Foundation

II. Mutant strains

1. antennapedia (ap)

D.C. Englert

Chicago, Illinois 60637-1573
The University of Chicago
Department of Ecology and Evolution

Stock lists

I. Wild type strains

A. Tribolium castaneum

1. c+, "Chicago" (from Thomas Park)
2. c-ARK, Arkansas
3. c-YUGO, Yugoslavia, now Croatia
4. c-Texas
5. c-BS, collected in Naperville, IL, on birdseed
6. c-Infantes, Spain
7. c-Jerez, Spain
8. c-Campanaro, Spain
9. c-Osaka, Japan
10. c-Nigeria

B. Tribolium confusum (*= infected with Wolbachia pipientis)

*1. b+, "Chicago" from Thomas park)
2. b-I, inbred strain derived from (1),
*3. b-II, inbred strain
*4. b-III, " "
*5. b-IV " "
*6. b-YUGO, Yugoslavia, now Croatia
7. b-YUGO, "
8. b-Illinois
9. b-Mississippi
10. b-Nigeria

Michael J. Wade Norman T. Johnson

Ephestia cautella

Ephestia figulella

Galleria mellonella

Plodia interpunctella

P. Williams

Indooroopilly, Queensland 4068, Australia
Queensland Department of Primary Industries
Plant Protection Unit

Coleoptera

Oryzaephilus surinamensis

Wild type strains		
VOS 48	insecticide susceptible	Victoria
QOS 42	fenitrothion susceptible	Queensland
QOS 115	chlorpyrifos-methyl-R a	Queensland

Rhyzopertha dominica

Wild type strains		
QRD 369	phosphine-resistance	Queensland
QRD 14	insecticide susceptible	Queensland
QRD 2	multiresistant	Queensland
QRD 63	multiresistant	Queensland
QRD 318	pyrethroid-resistant	Queensland

Sitophilus oryzae

Wild type strains		
LS 2	insecticide susceptible	Queensland
QSO 56	multi-resistant	Queensland
CSO 231	multi-resistant	W. Australia
QSO 388	phosphine-resistant	Queensland

Tribolium castaneum

Wild type strains		
QTC 4	insecticide susceptible	Queensland
QTC 279	pyrethroid insecticide resistant	Queensland
QTC 285	multi-resistant, composite strain	Queensland
CTC 12	non-specific malathion resistant	Queensland
QTC 34	malathion specific-resistant	Queensland
QTC 320	phosphine-resistant	Queensland

Lepidoptera Queensland

Ephestia cautella Wild

Patrick J. Collins, Senior Entomologist

ECOLOGY OF FIELD AND STORED PRODUCT PESTS SECTION
AGRICULTURE AND AGRI-FOOD CANADA
WINNIPEG RESEARCH CENTRE
195 DAFOE ROAD
WINNIPEG, MANITOBA, R3T 2M9

STOCKLIST

	SPECIES	ORIGIN	
	COLEOPTERA		
1.	*Acanthoscelides obtectus*	Phillips, Wis	1993
2.	*Ahasverus advena*	Argyle, MB	1991
3.	*Callosobruchus maculatus*	Phillips, Wis	1993
4.	*Cryptolestes ferrugineus*	Manitoba, MB	1991
5.	*Cryptolestes pusillus*	Lac du Bonnet, MB	1988
6.	*Cryptolestes turcicus*		1971
7.	*Cynaeus angustus*	Minnesota, MN	1982
8.	*Lasioderma serricorne*	Winnipeg, MB	1984
9.	*Liposcelis bostrychophilus*	Winnipeg, MB	1994
10.	*Oryzaephilus mercator*	Winnipeg, MB	1994
11.	*Oryzaephilus surinamensis*	Landmark, MB	1991
12.	*Prostephanus truncatus*	Mexico City, Mexico	1977
13.	*Rhyzopertha dominica*	Manitoba	1993
14.	*Sitophilus granarius*		
15.	*Sitophilus oryzae*	Coal Lake, AB	1992
16.	*Sitophilus zeamais*		
17.	*Stegobium paniceum*	Winnipeg, MB	1993
18.	*Tenebrio molitor*	Winnipeg, MB	1980
19.	*Tribolium audax*		
20.	*Tribolium castaneum*	Manitoba	1991

SPECIES	ORIGIN		
The following *Tribolium castaneum* mutant strains were received in November, 1985 from Dr. Sokoloff's laboratory at California State University.			
21. Culture S38	red eye		
22. Culture S351	red eye, pygmy, fused antennal segments		
23. Culture S156	microphthalmic		
24. Culture S136	jet (dark body)		
25. Culture S113	sooty (dark body)		
26. Culture S63	pearl eye		
27. Culture S165	chestnut eye		
28. Culture S148	maroon eye		
29. Culture S38	paddle (antennae fused, flattened)		
30. *T. castaneum*	abbreviated appendages (aa), missing abdominal *sternites* (mas)		
31. *T. castaneum*	Rio Desago Malathion resistance		
The following mutant strains of *Tribolium castaneum* have had no linkage analysis:			
32. malathion-specific resistance			
33. black body and pearl eyes			
The following mutant strains of *Tribolium confusum* have had no linkage analysis.			
34. red eyes			
35. black body			
36. *Tribolium confusum*	Winnipeg, MB	1994	
37. *Tribolium madens*			
38. *Trogoderma variabile*			
39. *Typhaea stercorea*	Manitoba	1991	
LEPIDOPTERA			
1. *Plodia interpunctella*	Winnipeg, MB	1990	
2. *Sitotroga cerealella*	Kansas	1982	

Dr. Noel D.G. White
Section Head

Stock Lists

Gembloux agricultural University - Unit of general and applied Zoology
2, Passage des déportés - B-5030 Gembloux, Belgium
zoologie@fsagx.ac.be

Dr Eric Haubruge & Ludovic Arnaud

Insect	Strain	Origin	Year	From
Bostrychidae				
Prostephanus truncatus	Togo	Togo	1993	-
	Dalaba	Guinea-Konakry	1996	-
Rhizopertha dominica				
Insecticide susceptible	Canada	Canada	1991	P. Fields
Insecticide resistant	Methyl bromide, phosphine	Kenya		P. Golob
Bruchidae				
Callosobruchus maculatus	Senegal	Senegal	1989	D. Seck
	Campinas (black strain)	Brazil	1975	O. Legros
Curculionidae				
Sitophilus granarius	Belgium	Belgium	1991	-
Sitophilus zeamais	Senegal	Senegal	1995	G.Pierrard
	Dimbokro	Ivory Coast	1998	-
Gryllidae				
Gryllus bimaculatus		Spain		E.H. Morrow
Tenebrionidae				
Tribolium anaphe		Nigeria	1956	Slough, UK
Tribolium audax		Canada	1969	Slough, UK
Tribolium brevicornis				A. Sokoloff
Tribolium confusum	Dalaba	Guinea-Conakry	1996	-
	Hoielaert	Belgium	1999	-
Tribolium castaneum				
Insecticide susceptible	Abidjan	Ivory Coast	1989	F.Fleurat-Leussard
	Lab-S	USA		R. Beeman
	Japan	Japan		H. Nakakita
	Mozambique	Mozambique		N. White
	Ex-maff	UK	1991	P. Golob
Insecticide resistant				
	A20 Rdiel (dieldrin, lindane)	USA		R. Beeman
	Argyle, malathion-specific	Canada	1992	N. White
	CTC-12 (malathion, cross resistant)	Australia	1968	D. Wool
	Dalaba, malathion-specific	Guinea-Conakry	1996	-
	Dimbokro (malathion-specific, lindane)	Ivory-Coast	1997	-
	Ga-1, malathion-specific	Geaogia, USA	1980	R. Beeman
	Kano, malathion-specific	Nigeria	1961	D. Wool
	Landmark, malathion-specific	Canada	1991	N. White
	Pakistan, malathion-specific & lindane	Pakistan		P. Golob
	Paulo d'Amico (malathion-specific)	Canada	1976	N. White
	PRm, malathion-specific	Philippines	1989	P. Golob
	Rio desago, malathion-specific	Canada	1976	N. White
	Steinback (malathion-specific)	Canada	1989	N. White
	Sun Chong (malathion, cross resistant)	Canada	1976	N. White
	Thailand (malathion-specific & phosphine)	Thailand	1989	P. Golob
	Waseco, malathion-specific	Canada	1982	N. White
Mutant strain	Black Jack	-	1993	-
Tribolium destructor		Ethiopia	1968	Slough, UK
Tribolium freemani		Japan	1980	H. Nakakita
Tribolium madens				A. Sokoloff

SANTA FE DE BOGOTA, D.C.,
UNIVERSIDAD NACIONAL DE COLOMBIA
FACULTAD DE CIENCIAS
DEPARTAMENTO DE BIOLOGIA
APDO. AEREO #14470

Tribolium castaneum

I. Wild type strains

NAME	ORIGIN	DATE
1. ABBC	Synthetic, Bogota	1982
2. Apulo	Apulo (Cund.) Col.	1982
3. Bogota	Inst. Publ. Health, Bogota, Col.	1978 1981
4. Bucaramanga	Bucaramanga, (Sant.)	1981
5. Cartagena	Cartagena, Bol., Col	1980
6. Fusa	Fusagasuga, Cund. Col	1986
7. Honda	Honda, tol. Col.	1986

II. Domestic mutants

Mutant strains discovered in Colombia

NAME	SYMBOL	LINKAGE GROUP	ORIGIN	DATE OF ENTRY
8. Antennapedia	ap N	VIII	Bog.	1981
9. Argentum eyes	ae	I	Bog	1993
10. Bifurcated antenna	ab N	I	Bog.	1980
11. Black	b	III	Bog.	1983
12. colossal pupae	cp b	?	Bog.	1993
13. Charcoal	Chr	III	Bog.	1979
14. Disjuncted elytra	ed	?	Bog.	1990
15. Fused antennameres	af	?	Bog.	1980
16. Glass legs	py	?	Bog.	1980
17. Globose antenna	Ag	VII	Bog.	1989
18. Light eyes-1	oc	?	Bog.	1990
19. Light eyes-2	?	?	Bog.	1990
20. Light eyes-3	?	?	Bog.	1991
21. Light eyes-4	?	?	Bog.	1993
22. Metathoracic scar	sc V	III	Bog.	1983
23. Miniature appendaged	ma	I	Bog.	1981
24. Narrow eyes	oje	?	Bog.	1980
25. Red eyes	or	?	Bog.	1986
26. White eye	obl	IV	Bog.	1982

III. Imported mutants from Tribolium Stock Center, 1985

27. Antennapedia	ap D	VIII
28. Black	b	III
29. Charcoal	Chr	III
30. Miniature appendaged	ma	I
31. Microcephalic	mc	V
32. Microphthalmic	Mo	VI
33. Pearl eye	p	II
34. Platinum eye	pte	I
35. Pygmy	py	I
36. Short antenna	Sa	VII
37. Sooty	s	IV

Fernando Nunez del Castillo

DENMARK

LYNGBY
STATENS SKADEDYRLABORATORIUM
(DANISH PEST INFESTATION LABORATORY)

Anthrenus museorum
A. vorax
Attagenus smirnovi
A. unicolor (piceus)
A. woodroffei
Dermestes hemorrhoidalis
Lasioderma serricorne
Oryzaephilus surinamensis
Prostephanus truncatus
Ptinus tectus
Sitophilus granarius
S. oryzae
Stegobium (Sitodrepa) paniceum
Tenebrio molitor
Thylodrias contractus
Tribolium confusum
T. destructor
Trogoderma angustum
T. granarium

K. Arevad and H. Mourier

FRANCE

VILLEURBANE (LYON) RHONE
INSTITUT NATIONAL DES SCIENCES APPLIQUEES
LABORATOIRE DE BIOLOGIE

A. Wild type strains

1. Sitophilus granarius L.

2. S. oryzae L.
   a. FB strain (La Reunion)
   b. SFr strain (lyon) (56,500+3,000 ovarian symbiotes)
   c. W strain (Villeurbane) (22,700+1500 ovarian symbiotes)

3. S. zea-mais Mots--from PIL, Slough

B. Selected lines of Sitophilus oryzae

   1. SS/Sfr strain:aposymbiotic strain (0 ovarian symbiotes) obtained from Sfr
   2. LL strain (slow development)(42,000+3000 ovarian symbiotes)
   3. RR strain (fast development) 8^{R},000+5000 ovarian symbiotes)

P. Nardon
(No updated list available, Ed.).

ZOOLOGISCHES INSTITUT I
(ZOOLOGIE) DER ALBERT LUDWIGS UNIVERSITAT
D 78 FREIBURG IM BREISGAU
KATHARINENSTRASSE 20

Wild type strains
1. Oryzaephilus surinamensis Freiburg
2. Tribolium castaneum San Bernardino
3. T. confusum San Bernardino

Mutant strains (All from San Bernardino)
A. Tribolium castaneum
4. alate prothorax (apt)
5. Bar eye (Be)
6. black (Brazil background)
7. black (Chicago background)
8. Dachs (Dch)
9. Fused tarsi and antennae (Fta)
10. Microphthalmic (Mo)
11. nude (nd)
12. pygmy (py)

13. short antenna (sa)
14. Short antenna (Sa-2)
15. sooty (s)
16. Spatulate antenna (Spa)
weird eggs (wd)

B. Tribolium confusum
18. black-3 (b-3)
19. ebony (e)
20. ebony-2 (e-2)
21. McGill black (McBb)

K. Sander

MUNICH,
BAYER. LANDESANSTALT FUR BODENKULTUR
UND PFLANZENBAU, ABT. PFLANZENSCHUTZ

Coleoptera

Bruchidae--Acanthoscelides obtectus (Say)

Cucujidae--Cryptolestes turcicus Grouv. Munich, 1966

Ptinidae
Gibbium psylloides (Czemp) Regensburg, 1960
Ptinus tectus (Boi.) Munich, 1972

Silvanidae

Oryzaephilus mercator (Fauv.)	Munich,	1966
O. surinamensis (L)	?	1971

Munich (cont'd)

Tenebrionidae

Gnathocerus cornutus (F.)	MUNICH,	1966
Tribolium castaneum	?	1971
T. confusum Duv.	Munich,	1960
T. destructor Uyttenb.	"	1957

Lepidoptera

Phycitidae--Ephestia kuehniella (Zell.)	"	1966

E. Naton.

GERMANY

D-80333 München
Institut fur Zoologie
Luisenstrasse 14

WILD TYPE

Tribolium castaneum

MUTANTS provided by A. Sokoloff

Tribolium castaneum
- Bar eye, sooty (Be, s)
- Black, microcephalic pearl (b,mc,p)
- Microcephalic (mc)
- Microcephalic aureate (mc, au)
- Microphthalmic (Mo)
- Squint (sq)

Tribolium confusum
- Diminished eye (dim)

INDIA

NEW DELHI
INDIAN AGRIC. RESEARCH INSTITUTE
DIVISION OF ENTOMOLOGY
INSECT GENETICS LAB.

STOCK LIST

STRAIN	RESIST LEVEL	REARING MEDIA
1. Malathion-resist.	>x200	common wheat flour charged with tech malathion.
2. lindane-resist.	>X100	c. w. f. charged with tech. lindane
3. DDT-RESISTANT	>x100	c.w.f. charged with tech ddt.
4. pirimiphosmethyl resistant	>X100	C.W.F. CHARGED WITH tech. pirimiphosmethyl
5. phosphine-resistant	> 6.3	c.w.f.
6. delta-methrin resist	>2819.3	cwf chargedwwith tech deltamethrin
7. fenitrothion-resist.	>25.96	c.w.f.
8. susceptible	-	c.w.f.
9. black mutant	-	"

Tribolium confusum

10. susceptible	-	c.w.f.
11. nigrat- melanic mutant	-	"

J.D. Saxena.

Tel Aviv University, Israel

Tribolium castaneum -wild type :

1) Ishaaya	Israel
2) **CTC-12**	Slough, England
3) **Kano-C**	Slough, England

-mutants

1) csbb	black	Tribolium stock center
2) cs pearl	pearl	Tribolium stock center
3) cs mc	microcephalic*	recovered from cs pearl stock
4) cs eu	extra urogomphi*	recovered from csbb stock
5) cs pygmy	pygmy	Tribolium stock center

* it is uncertain if the mutations are still maintained in the stocks.

Tribolium confusum - wild type

1) CF Chicago	Tribolium stock center

-mutants

1) CF bb	black	Tribolium stock center
2) CF xl	extra large	Tribolium stock center

Tribolium brevicornis

1) Riverside ++	Tribolium stock center

Tribolium freemani

1) Tsukuba strain	Gembloux, Belgium

Prof. David Wool,

JAPAN

NATIONAL FOOD RESEARCH INSTITUTE
MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES
2-1-2 KANNONDAI, YATABE-MACHI
TSUKUBA-GUN, IBARAKI-KEN 305

Psocoptera	
Liposcelidae	
Liposcelis bostrychophilus Badonel	Wild
Liposcelis entomophilus (Enderlein)	Wild
Trogiidae	
Lepinotus reticulatus Endelein	Wild
Coleoptera	
Anobiidae	
Lasioderma serricorne (Fabricius)	Wild
Stegobium paniceum (L.)	Wild
Ptinidae	
Gibbium equinoctiale Boieldieu	Wild
Bostrichidae	
Rhyzopertha dominica (Fabricius)	Wild
Dinoderus minutus (Fabricius)	Wild
Cucujidae	
Cryptolestes turcicus	Wild
Cryptolestes pusilloides (Steel & Howe	Wild
Silvanidae	
Oryzaephilus surinamensis (L.)	Wild
Tenebrionidae	
Alphitobius diaperinus (Panzer)	wild
Gnathocerus cornutus (Fabricius)	Wild (Okayama str.)
Palorus ratzeburgi (Wissmann)	Wild
Tribolium castaneum (Herbst)	Wild
T. confusum Jacquelin du Val	Wild
T. freemani Hinton	Wild
Tenebrio molitor L.	
Bruchidae	
Callosobruchus chinensis (L.)	Wild
Anthribidae	
Araecerus fasciculatus Degeer	Wild
Rhynchophoridae	
Sitophilus zeamais Motschulsky	Wild
Sitophilus oryzae (L.)	Wild
Lepidoptera	
Pyralidae	
Ephestia cautella (Walker)	Wild
E. kuhniella (Zeller)	Wild
Plodia interpunctella	Wild
Corcyra cephalonica	Wild
Gelechiidae	
Sitotroga cerealella (Olivier)	Wild

H. Nakakita H. Ikenaga

OKAYAMA
LABORATORY OF APPLIED ENTOMOLOGY
COLLEGE OF AGRICULTURE
OKAYAMA UNIVERSITY

1. Wild type strains

COLEOPTERA

1.	Alphitobius diaperinus	Miyazaki
2.	Callosobruchus chinensis	Okayama
3.	C. maculatus	
4.	Gnathocerus cornutus	Miyazaki
5.	Lasioderma serricorne	Okayama
6.	Latheticus oryzae	Miyazaki
7.	Oryzaephilus surinamensis	Miyazaki
8.	Palorus ratzeburgii	Miyazaki
9.	P. subdepressus	Miyazaki
10.	Rhyzopertha dominica	Miyazaki
11.	Sitophilus oryzae	Okayama
12.	S. zeamais	Okayama
13.	Tenebrio molitor	Okayama
14.	Tenebroides mauritanicus	Okayama
15.	Tribolium castaneum	Miyazaki
16.	T. confusum	Miyazaki
17.	T. freemani	

HYMENOPTERA

1.	Anisopteromalus calandrae	Okayama
2.	Choetospila elegans	Okayama
3.	Lariophagus distinguendus	Okayama

Toshiharu Yoshida

INSTITUTE OF BIOLOGICAL SCIENCES
UNIVERSITY OF TSUKUBA
SAKURA-MURA, IBARAKI
300-31 JAPAN

Bruchidae

Callosobruchus chinensis

13 wild type strains from different localities in Japan and abroad

Black colored mutant derived from Shusenji strain.

cC Mainland China
fC Fukushima, Japan
hC Hirosaki, Japan
h1C Hirosaki, Japan

jC Kyoto, Japan, 1936
mC Morioka, Japan
nC Niigata, Japan, 1964
pC Punjab, India
sCb1 Shusenji black mutant
tC Tokyo (Nishigahara, Nat. Inst. Agr.(, Japan
taC Tsukuba, Japan
taC2 Tsukuba, Japan
tsC Tsukuba, Japan
yC Taisha, Japan

C. maculatus

12 wild type strains from different localities in the world.

aQ U.S.A. (probably Louisiana).
bQ Burma
cQ Fresno Lab., USDA, Calif., U.S.A.
eQ Thailand
fQ Thailand
oQ Ohio, U.S.A.
rQ
tQ Tel Aviv, Israel (Dept. Plant Prot., Stored Prod. Res. Res. Lab.
kQ Kyoto, Japan
mQ Kansas State Univ., Manhattan, KS, U.S.A.
sQ Savannah Lab, USDA, georgia, U.S.A.

C. analis From United Kingdom
C. phaseoli From United Kingdom
Zabrotes subfaciatus From Africa
Acanthoscelides obtectus From California, U.S.A.

Hymenoptera

Braconidae

Heterospilus prosopidis from Hawaii, U.S.A.

Pteromalidae

Anisopteromalus calandrae, Japan
Chaetospila elegans from United Kingdom
Dinarmus basalis from India

K. Fujii

PAKISTAN

LAHORE
University of the Punjab (New Campus)
Department of Zoology

Tribolium castaneum
a) Pak Wild type strain
b) CTC 12 Malathion resistant
c) FSS II Multi organophosphorus susceptible

PEOPLE'S REPUBLIC OF CHINA

Beijing
Beijing Agricultural University
Dept of Animal Science

Tribolium castaneum
Wild type strains
1. Base population for quantitative genetics, Guelph, 1987.
2. Inbreeding line--Beijing, 1987
Mutant strains: pygmy
1. Base population maintained with no artificial selection and minimum of inbreeding--Guelph, 1987
2. Inbreeding line--Beijing, 1987.

Lao Zhang

POLAND.

International Centre of Ecology.
Polish Academy of Sciences
05-092 Łomianki, Dziekanów Leśny near Warsaw
Poland

Stock list:

T. confusum Duval, strain: HV
T. castaneum Herbst, strain: cl

SPAIN

MADRID
INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS
DEPARTAMENTO DE GENETICA CUANTITATIVA Y MEJORA ANIMAL

Tribolium castaneum

A. wild type strains

1.	Consejo	C.S.I.C. Madrid, Spain	1964
2.	Purdue	Purdue, USA.	1964
3.	Edinburgh 1	Edinburgh, Scotland	1970
4.	Edinburgh 2	Edinburgh, Scotland	1970
5.	Campanario	Campanario, Spain	1973
6.	Coronada	La Coronada, Spain	1976
7.	Andujar	Andujar, Spain	1975
8.	Jerez	Jerez, Spain	1975
9.	Osuna	Osuna, Spain	1975
10.	Carpio	Carpio, Spain	1975
11.	Jafo	Jafo, Israel	1975
12.	Beer-Sheba	Beer-Sheba, Israel	1975

B. Mutant type strains

13.	Black Purdue	Purdue, USA,	1964

C. Experimental lines
Originated from the "Consejo" strain and selected for egg laying performance through 42 generations

		selected for	Temperature (oC)
14.	AN-I	high performance at	33
15.	AN-II	" "	33
16.	AF-I	" "	28
17.	AF-II	" "	28
18.	AT-I	" "	38
19.	AT-II	" "	38
20.	BN-I	low performance at	33
21.	BF-I	" "	28
22.	BF-II	" "	28
23.	BT-I	" "	38
24.	BT-II	" "	38

Stock Lists

25. RN-I*	high cross performance at	33
26. SN-I*	" " " "	33
27. RN-II	" " " "	33
28. SN-II	" " " "	33
29. RF-I	" " " "	28
30. SF-I	" " " "	28
31. RF-II	" " " "	28
32. SF-II	" " " "	28
33. RT-I	" " " "	38
34. ST-I	" " " "	38
35. RT-II	high cross performance at	38
36. ST-II	" " " "	
37. CTD-I	high performance at diff. levels of selection	
38. CTD-II	" " " " " "	
39. DTD-I	" " " " " " "	
40. DTD-II	" " " " " " "	
41. ETD-I	" " " " " " "	
42. ETD-II	" " " " " " "	
43. FTD-I	" " " " " " "	
44. FTD-II	" " " " " " "	

D. mutants

45. antennapedia ap, VIII	Purdue, 1964
46. diferencial Df, IV	Purdue, 1964
47. fused antennal segments-2 fas-2 IV	Sokoloff, 1968
48. ivory i ?	Purdue, 1964
49. paddle, pd i	Purdue, 1964
50. pearl p II	Sokoloff, 1968
51. pegleg pg II	Purdue, 1968
52. pygmy py I	Purdue, 1968
53. rose rs I	Purdue, 1964
54. ruby rb ?	Purdue, 1964
55. short elytra sh VIII	
56. squint sq VIII	Purdue, 1964
57. white w ?	Purdue, 1964
58. wine r I	Purdue, 1968
59. eye mutant ?	Madrid, 1967
60. maroon m V	Purdue, 1977
61. melanotic stink glands--like	Madrid, 1968
62. sooty s Iv	Sokoloff, 1977
63. chestnut c VII	Sokoloff. 1977
64. microcephalic mc V	Sokoloff, 1977
65. Microphthalmic Mo VI Pk	Sokoloff, 1977
66. pink p II	Sokoloff, 1977
67. Bar eye Be IV	Sokoloff, 1977
68. prothoraxless ptl IX	Sokoloff, 1977
69. light ocular diaphragm lod III	Purdue, 1968
70. black B III	Sokoloff, 1977

Tribolium confusum

A. Wild type strains

71. Coronada La Coronada, Spain

B. Mutants

72. creased abdominal sternites cas II Sokoloff, 1968
73. ebony-2 e-2 II Sokoloff, 1968

Ma. C. Fuentes

REPUBLIQUE DU SENEGAL Bambey,

MINISTERE DE L'AGRICULTURE

Institut Sénégalais

De Recherches Agricoles

Centre National de la Recherche Agronomique

1. Stock list
Tribolium Castaneum (Wild type strains)
genetic origin Bambey (Senegal)

: Dr. Dogo SECK
Chef ISRA/CNBA

UNITED KINGDOM

University of Newcastle upon Tyne
United Kingdom,
Faculty of Agriculture and Biological Sciences,
Department of Agricultural and Environmental Science, University of Newcastle upon Tyne, NE1 7RU, UK.

Species/Strains	Status	Derived from
I Wild type strains		
A. *Tribolium castaneum*		
1. Ph-1	malathion specific resistant	Dr. Freeman, NRI, UK
2. FSS-II	malathion susceptible	Central Science Laboratory, Sand Hutton, York, UK.
B. *Tribolium confusum*		
1. *Tribolium confusum*	malathion susceptible	Central Science Laboratory, Sand Hutton, York, UK.
C. *Sitophilus granarius*		
1. 1022 A	lindane resistant	Central Science Laboratory, Sand Hutton, York, UK.
2. *Sitophilus granarius*	lindane susceptible	Central Science Laboratory, Sand Hutton, York, UK.
D. *Sitophilus oryzae* (L.)		
1. *Sitophilus oryzae* (L.)	Susceptible	Central Science Laboratory, Sand Hutton, York, UK.

TIB-39

Stock lists

Number of insects per culture, charged at £50 + VAT

Cockroaches	100 sexed insects
Pharaoh's ants	Colony of 6-10 queens plus several hundred workers
Beetle, moth, silverfish and psocids. (Some species may be charged at a higher rate because they require special handling or are in limited supply).	50 insects (minimum) of mixed sexes except for parthenogenic psocids

Prices for aphid cultures are available on request.

Please add £2.50 to your order for postage and packaging.
Payments must be made in Sterling.
Cheques must be made payable to Central Science Laboratory.

Regular orders can be supplied under commercial contract.

Customs and Quarantine regulations

Overseas customers are requested to include any necessary licences or documents with their request.

Other services

- **Identification** - CSL runs courses on identification and on storage and public health pests. We run an identification service and a wide range of insect identification cards is available. Apply to the Librarian at CSL Harpenden (address below) for identification cards.
- **Advice** - on the care and maintenance of cultures can be provided.
- **Mites** - CSL can supply cultures of mites, for which a separate leaflet is available.

Contacts

Mrs C Trowe or Mrs S Henderson
Central Science Laboratory,
MAFF, London Road, Slough
Berks, SL3 7HJ UK

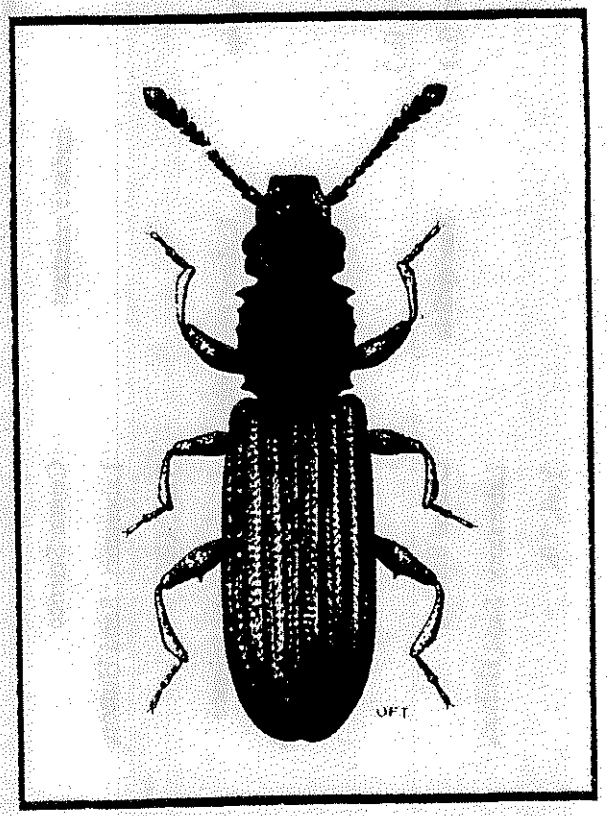
Telephone: 0753 534626
International code: +44 -753 534626
Fax: 0753 824058
International Fax: +44 -753 824058

The Librarian,
Central Science Laboratory,
MAFF, Hatching Green
Harpenden, Herts, AL5 2BD UK

Telephone: 0582 715241
International code: +44 -528 715241
Fax: 0582 762178
International Fax: +44 -582 762178

CENTRAL SCIENCE LABORATORY

Insect Cultures



Over 100 species of stored product and public health insects available

MAFF

Species currently available

Coleoptera

Ahasverus advena
Alphitobius diaperinus
Anthrenocerus australis
Anthrenus flavipes
Anthrenus flavipes semimveus
Anthrenus picturatus hintoni
Anthrenus sarnicus
Anthrenus verbasci
Attagenus brunneus
Attagenus cyphonoides
Attagenus fasciatus cinnamomeus
Attagenus insidiosus
Attagenus pellio
Attagenus rufiventris
Attagenus smirnovi
Attagenus unicolor canadensis
Attagenus unicolor japonicus
Attagenus unicolor simulans
Attagenus unicolor unicolor
Attagenus woodroffei
Attagenus fasciatus fasciatus
Callosobruchus maculatus
Carpophilus dimidiatus
Carpophilus dimidiatus pearl-eye mutant
Carpophilus hemipterus
Coelopalorus foveicollis
Cryptolestes capensis
Cryptolestes ferrugineus
Cryptolestes pusilloides
Cryptolestes pusillus
Cryptolestes pusillus fuscus
Cryptolestes turcicus
Cryptolestes turcicus red-eye mutant
Cryptolestes ugandae
Dermestes ater
Dermestes frischi
Dermestes haemorrhoidalis
Dermestes lardarius
Dermestes maculatus
Dermestes maculatus pearl-eye mutant
Dermestes maculatus black-brown mutant
Dermestes peruvianus
Gibbium aequinoctiale
Gnatocerus cornutus
Gnatocerus maxillosus
Lasioderma serricorne
Lasioderma serricorne black mutant
Latheticus oryzae
Mezium affine
Mezium americanum
Niptus hololeucus
Oryzaephilus acuminatus
Oryzaephilus mercator
Oryzaephilus surinamensis
Oryzaephilus surinamensis small mutant
Palorus cerylonoides
Palorus ficicola
Palorus genalis
Palorus ratzeburgii
Palorus subdepressus
Prostephanus truncatus
Pseudeurostus hilleri
Ptinus clavipes
Ptinus exulans
Ptinus pusillus
Ptinus sexpunctatus
Ptinus tectus
Rhyzopertha dominica
Sitophagus hololeptoides
Sitophilus granarius
Sitophilus oryzae
Sitophilus zeamais
Sphaericus gibboides
Stegobium paniceum
Stethomezium squamosum
Tenebrio molitor
Tenebrio obscurus
Tipnus unicolor
Tribolium confusum
Tribolium anaphe
Tribolium audax
Tribolium brevicornis
Tribolium castaneum
Tribolium castaneum black mutant
Tribolium destructor
Tribolium freemani
Tribolium madens
Trigonogenius globulus
Trigonogenius particularis
Trogoderma angustum
Trogoderma anthrenoides
Trogoderma glabrum
Trogoderma granarium
Trogoderma grassmani
Trogoderma inclusum
Trogoderma irroratum
Trogoderma ornatum
Trogoderma sternale plagifer
Trogoderma variable
Trogoderma varium
Typhaea stercorea

Dictyoptera

Blatta orientalis
Blattella germanica
Diploptera punctata
Periplaneta americana

Lepidoptera

Ephestia cautella
Ephestia kuehniella
Galleria mellonella
Plodia interpunctella
Sitotroga cerealella
Tinea pellionella
Tineola bisselliella

Thysanura

Lepisma saccharina

Hymenoptera

Monomorium pharaonis

Psocoptera

Liposcelis bostrychophila
Liposcelis subfuscus
Liposcelis paetus
Lepinotus patruelis
Trogium pulsatorium

Hemiptera

Aphis fabae
Aphis gossypii
Brevicoryne brassicae
Macrosiphum euphorbiae
Myzus persicae
Nasonovia ribisnigri
Phorodon humuli
Rhopalosiphum padi
Sitobion avenae

Availability

Please give two weeks notice.
Although most species can be supplied within two weeks, those th breed slowly may take longer to supply.
We will advise you if there is likely t be a delay.

CENTRAL SCIENCE LABORATORY

LONDON ROAD
SLOUGH
BERKS U K
SL3 7HJ

TEL. 44 1753 534626
FAX 44 1753 82405

Insects mentioned below are bred in controlled environmental conditions and , as far as possible, free from disease. All new stocks pass through a quarantine procedure before acceptance into the main insectary. This list was last updated January 1995. The country of origin and year of receipt at this laboratory are shown against the strains where this information is known. For some of the older strains such information is not known. Please note that some strains do not have a name, especially if only one strain of a species is held. Where more than five strains of a species are held, full details are not given. (However, full details of all mutant strains held are given). Please write to me or Carol TROWE for further details on any aspect of this list and with any requests for specimens. The latter will be met where sufficient are available, but a charge will have to be made.

CHRISTINE B MUGGLETON (Mrs)

INSECT DATABASE FOR TRIBOLIUM INFORMATION BULLETIN

Genus , species, sub-species.	Strain	Place of origin	Year received
COLEOPTERA			
Ahasverus advena	6 strains from 2 countries, many differing in their susceptibility to pesticides		
Alphitobius diaperinus	6 strains all from Britain, many differing in their susceptibility to pesticides		
Anthrenocerus australis		Britain	1933
Anthrenus flavipes			
Anthrenus flavipes seminiveus			
Anthrenus picturatus hintoni		Russia	1977
Anthrenus sarnicus	Wiltshire	Britain	1966
Anthrenus verbasci		Britain	1951
Attagenus brunneus	Canada		
Attagenus brunneus	Spain	Spain	
Attagenus cyphonoides		Tashkent	1976
Attagenus fasciatus fasciatus		New S. Wales	1972
Attagenus fasciatus cinnamomeus		Botswana	1965
Attagenus insidiosus		Kenya	
Attagenus pellio		Britain	1950
Attagenus rufiventris		Botswana	1970
Attagenus smirnovi		Kenya	1962
Attagenus unicolor canadensis		N. America	1980
Attagenus unicolor japonicus		Japan	1956
Attagenus unicolor simulans		U.S.S.R.	1976
Attagenus unicolor unicolor			pre 1958
Attagenus woodroffei	Sweden	Sweden	1978
Attagenus woodroffei	Finland	Finland	1965
Callosobruchus maculatus			
Carpophilus dimidiatus		USA	pre 1958
Carpophilus hemipterus			1962
Coelopalorus foveicollis		Trinidad	1972
Cryptolestes capensis			1961
Cryptolestes ferrugineus	24 strains all from Britain, many differing in their susceptibility to pesticides		
Cryptolestes pusilloides		Canada	1944
Cryptolestes pusillus			
Cryptolestes pusillus fuscus		Trinidad	1960
Cryptolestes turcicus			pre 1958
Cryptolestes ugandae		E. Africa	1954
Dermestes ater		Britain	1953
Dermestes frischii		Nigeria	pre 1958

Dermestes haemorrhoidalis		Britain	1962
Dermestes lardarius		Britain	pre 1958
Dermestes maculatus	Chittagong	Chittagong	1975
Dermestes peruvianus		Britain	1961
Gibbium aequinoctiale		Britain	1937
Gnatocerus cornutus			pre 1958
Gnatocerus cornutus			
Gnatocerus maxillosus			pre 1958
Lasioderma sericorne			pre 1958
Latheticus oryzae			pre 1958
Mezium affine		Britain	pre 1958
Mezium americanum			1960
Niptus hololeucus		Britain	pre 1958
Oryzaephilus acuminatus		Sri Lanka	
Oryzaephilus mercator			pre 1958
Oryzaephilus mercator	9127 Pickering	Britain	1994
Oryzaephilus surinamensis	54 strains from 4 countries, many differing in their susceptibility to pesticides		
Palorus cerylonoides		Indonesia	
Palorus ficicola	1168	Nigeria	
Palorus ficicola	1176	Nigeria	
Palorus genalis		Guyana	
Palorus ratzeburgii		Britain	1960
Palorus subdepressus		Turkey	1956
Prostephanus truncatus		Tanzania	1981
Pseudeurostus hilleri		Britain	1940
Ptinus clavipes		Britain	1954
Ptinus exulans		Britain	1971
Ptinus pusillus			pre 1958
Ptinus sexpunctatus			pre 1958
Ptinus tectus	Wild	Britain	1975
Ptinus tectus	PICL		1960
Ptinus tectus	Birkenhead	Britain	1975
Rhyzopertha dominica	7 strains from 3 countries, many differing in their susceptibility to pesticides		
Sitophagus hololeptoides		Trinidad	1972
Sitophilus granarius	11 strains from 3 countries, many differing in their susceptibility to pesticides		
Sitophilus oryzae	5 strains from 4 countries, many differing in their susceptibility to pesticides		
Sitophilus zeamais			pre 1958
Sitophilus zeamais	U.S.A.	U.S.A.	1982
Sphaericus gibboides		Britain	1976
Stegobium paniceum			1959
Stethomezium squamosum		Britain	1976
Tenebrio molitor			pre 1958

CENTRAL SCIENCE LABORATORY

Insect Cultures Order Form

Name: .....

Address: .....

.....

.....

Tel No: ..... Fax No: .....

Species	Quantity	Live/ Dead	Adult/ Larvae	Price
			Subtotal	
(Note: VAT is not payable for orders paid from outside UK)			VAT	
			Post & Packing	2.50
			TOTAL	

Latest date required: (see note about availability): .....

Signature: ..... Date: .....

Please send or fax this order to:

Mrs C Trowe
Central Science Laboratory
London Road
SLOUGH, Berkshire, SL3 7HJ UK
Fax: 0753 824058
International code +44 -753 824058

(Cheques payable to Central Science Laboratory)

Tenebrio obscurus			pre 1958
Tipnus unicolor		Kenya	pre 1958
Tribolium anaphe		Nigeria	1956
Tribolium audax		Canada	1969
Tribolium brevicornis		U.S.A.	
Tribolium castaneum	9 strains from 3countries, many differing in their susceptibility to pesticides		
Tribolium confusum	W-44		
Tribolium confusum	Lab. susc.		
Tribolium confusum			1962
Tribolium destructor	African	Ethiopia	1968
Tribolium freemani		Japan	1980
Tribolium madens		Yugoslavia	1959
Trigonogenius globulus		Ireland	1961
Trigonogenius particularis		Kenya	1962
Trogoderma angustum		Germany	1975
Trogoderma anthrenoides		U.S.A	1957
Trogoderma glabrum		U.S.A.	1959
Trogoderma granarium		Britain	
Trogoderma granarium		Britain	pre 1958
Trogoderma grassmani		U.S.A.	1976
Trogoderma inclusum			pre 1958
Trogoderma irroratum		Egypt	1959
Trogoderma ornatum		U.S.A.	1974
Trogoderma sternale plagifer		New Mexico	1966
Trogoderma variabile		U.S.A.	1965
Trogoderma varium		Korea	1970
Typhaea stercorea	Datchet	Britain	1980
THYSANURA			
Lepisma saccharina		Britain	1978
LEPIDOPTERA			
Ephestia cautella		Cyprus	1969
Ephestia cautella	Brown/Yellow	Florida	
Ephestia cautella	Bedstock		
Ephestia elutella	Lab.		
Ephestia elutella	Millwall	Britian	1969
Ephestia kuehniella	Welsh Buffer Depot	Britain	
Ephestia kuehniella	Rhydymwyn	Britain	1988
Ephestia kuehniella		Britain	1949
Galleria mellonella	B	U.S.A.	1992
Galleria mellonella		U.S.A.	1987
Plodia interpunctella	88	Turkey	1977
Plodia interpunctella		Britain	1968
Plodia interpunctella	121	Chicargo	1977
Plodia interpunctella	102	Tanzania	1977
Sitotroga cerealella	623	U.S.A.	1972
Sitotroga cerealella	A68	Nepal	1981
Tinea pellionella		Britain	1989
Tineola bisselliella	U.S.A. Lab. strain		
Tineola bisselliella	U.K Wild strain		
Tineola bisselliella		Britain	1989

MUTANTS

Carpophilus dimidiatus	pearl-eye		
Cryptolestes turcicus	Red-eye mutant		
Dermestes maculatus	Black-brown	Australia	1964
Dermestes maculatus	Pearl-eye	Australia	1964
Lasioderma serricorne	Black mutant	U.S.A.	1975
Oryzaephilus mercator	0779 pearl-eye	Pacific Islands	1978
Oryzaephilus surinamensis	small	East Pakistan	1964
	484 -sp eye,lod	speckled eye, light ocular diaphragm	
	484-sp eye	speckled eye	1994
	484 black dd		
Tribolium castaneum	black		1983

SLOUGH, BUCKS, U.K.
TROPICAL DEVELOPMENT AND RESEARCH INSTITUTE (FORMERLY TPI)
STORAGE DEPARTMENT
OVERSEAS DEVELOPMENT ADMINISTRATION
PEST BIOLOGY AND INSPECTION SECTION

TROPICAL DEVELOPMENT AND RESEARCH INSTITUTE (TDRI)

The Tropical Development and Research Institute (TDRI) was formed 1 April, 1983, following the amalgamation of the Tropical Products Institute and the Centre for Overseas Pest Research. The Director of the Institute is Dr. Malcolm Thain who was formerly Director of the Tropical Products Institute.

The Institute, part of the Overseas Development Administration and funded from the aid programme, will provide technical assistance to developing countries. The budget will total over eight million pounds in the financial year 1983/84.

TDRI will continue to work on post-harvest technology and pest and vector management for the benefit of developing countries, by controlling the pests harmful to agriculture, stored products and public health, and by improved processing, storage and marketing of agricultural fisheries products.

The main emphasis of its work in scientific research and development, marketing, information, advice and training will centre on the improvement of food supplies in accordance with the major objectives of the British overseas aid programme. Work will also continue on certain non-food crops of particular importance to developing countries. These activities will be carried out, as at present, in the UK and overseas in countries throughout the developing world.

Since post harvest technology and pest and vector management are broad and varied subjects, TDRIwill concentrate its activities in those areas where it has a comparative advantage in terms of experience, knowledge and cost-effectiveness. Close cooperation will continue with government organizations, universities and industry in developing countries, the UK and other industrialized countries, and with multilateral and bilateral aid agencies.

Requests from developing country govenments qualifying for British aid will be channelled through the Overseas Development Administration, which may commission TDRI to carry out the work if it lies within the scope of its terms of reference, and if resources are available. In addition, TDRI may, subject to the claims on its resources commissioned by ODA, accept contracts for relevant work on behalf of developing countries from multilateral aid agencies and other organizations.

TDRI is based in London, although relocation to a new site outside the central London area is under consideration. It currently employs over 450 staff.

Requests for information, advice, investigations or training should be sent to:

The Director
Tropical Development and Research Institute
56-62 Gray's Inn Road
London WC1X 8LU
England (Telephone 01-242 5412)

All stocks are maintained at 27 degrees centigrade and 70% R.H. The stocks listed below are those currently maintained for ongoing research projects. Other storage pest species are kept in culture from time to time for training or short research projects.

I. Wild type strains

A. Coleoptera

Bostrichidae
1. Prostephanus truncatus -- Mexico, Tanzania

Bruchidae
1. Acanthoscelides obtectus -- Swaziland; Turkey
2. Callosobruchus analis -- MAFF Lab., Slough; Indonesia
3. Callosobruchus chinensis -- Nepal; Kenya
4. Callosobruchus maculatus -- Brazil, 2 strains; Nigeria, 2 strains; Oman; Senegal; Sierra leone; Turkey; Upper Volta; Yemen.
5. Caryedon serratus -- Unknown
6. Zabrotes subfasciatus -- Uganda (collected from cowpeas and bred on cowpeas); Colombia.

Curculionidae
1. Sitophilus oryzae -- Peru (pulse-feeding strain breeding on split peas)
2. S. zeamais -- Mexico

B. Lepidoptera

Galleriinae: Corcyra cephalonica -- Malawi

Gellechiidae: Sitotroga cerealella -- Sudan

Phycitinae: Ephestia cautella -- Brazil

CHEMICAL CONTROL SECTION

(stocks of some major beetles pests are maintained, under selection pressure with insecticide where necessary, in order to enable the FAO recommended methods for the detection and measurement of resistance to be carried out. Incoming strains from abroad are screened and the methods are demonstrated in training programs.)

Wild type strains

Coleoptera

Bostrichidae

Prostephanus truncatus--Strains tested for phosphine resistance: Botswana; Indonesia; Mali (8 strains) Nepal; Nigeria; Pakistan (2 strains) Singapore; Sri Lanka (4 strains); Tunisia; Zimbabwe.

Bruchidae

Acanthoscelides obtectus -- Ethiopia

Callosobruchus chinensis -- India

Curculionidae

Sitophilus oryzae -- Insecticide-susceptible strain (reference strain) -- via MAFF Lab, Slough

S. oryzae -- Malathion and lindane resistant strain (A,76) -- via MAFF Lab., Slough.

Tenebrionidae

Tribolium castaneum -- Multiple insecticide-resistant strain (CTC 12) -- australia

T. castaneum -- Malathion-specific resistant strains (Kano C) -- Nigeria

T. castaneum -- Insecticide-susceptible strain (reference strain) -- MAFF Lab, Slough

Dr. P. F. Prevett
Deputy Head of Department

TDRI is based in London, although relocation to a new site outside the central London area is under consideration. It currently employs over 450 staff.

Requests for information, advice, investigations or training should be sent to:

The Director
Tropical Development and Research Institute
56-62 Gray's Inn Road
London WC1X 8LU
England (Telephone 01-242 5412)

All stocks are maintained at 27 degrees centigrade and 70% R.H. The stocks listed below are those currently maintained for ongoing research projects. Other storage pest species are kept in culture from time to time for training or short research projects.

I. Wild type strains

A. Coleoptera

Anobiidae

1. Lasioderma serricorne	a. Unknown
2. Stegobium paniceum	a. ex-MAFF

Bostrichidae

1. Dinoderus distinctus	a. Tanzania
2. D. minutus	a. Indonesia
3. D. porcellus	a. Togo
4. Prostephanus truncatus	a. Costa Rica
	b. Mexico (3 strains)
	c. Nigeria
	d. Tanzania (4 strains)
	e. Togo
	f. Kenya
5. Rhyzopertha dominica	a. Ex-MAFF
	b. Angola‡
	c. Kenya (3 strains)‡‡‡
	d. Mali ‡
	e. Morocco ‡
	f. Nepal‡
	g. Sri Lanka

Bruchidae

1. Acanthoscelides obtectus --	a. Colombia (2 strains)
	b. Uganda
	c. Zimbabwe
2. Callosobruchus analis --	a. MAFF Lab.
3. Callosobruchus chinensis --	a. Indonesia
4. Callosobruchus maculatus --	a. Uganda
5. Caryedon serratus	a. India
6. Zabrotes subfasciatus --	b. Uganda

Curculionidae	
1. *Sitophilus oryzae*	
i. Normal strains	a. Ex-MAFF
	b. India
	c. Morocco
	d. Zimbabwe
ii. Pulse-feeding	a. Burma
2. *S. zeamais* --	a. Ex-MAFF
	b. India
Dermestidae	
1. *Dermestes ater*	a. Ex-MAFF
2. *D. maculatus*	a. Jamaica
3. *Trogoderma granarium*	a. India
	b. Sudan
Histeridae	
1. *Teretriosoma nigrescens*	a. Mexico
Lophocateridae	
1. *Lophocateres pusillus*	a. Philippines
Silvanidae	
1. *Ahasverus advena*	a. Ex-MAFF
2. *Oryzaephilus sp.*	a. Kenya (4 strains)
3. *Oryzaephilus surinamensis*	a. Ex-MAFF
Tenebrionida	
1. *T. castaneum*	a. Ex-MAFF
	b. Botswana‡
	c. Indonesia (2 strains)
	d. Kenya ‡
	e. Mali‡
	f. Mozambique
	g. Pakistan‡
	h. Philippines +
	i. Sri Lanka
	j. Thailand (3 strains)‡‡‡+
	k. Zimbabwe (2 strains)‡
2. *Latheticus oryzae*	a. Ex-MAFF
3. *Gnatocerus cornutus*	a. Ex-MAFF
4. *Palorus subdepressus*	a. Ex-MAFF

Key
‡ Number of strains which have to date been found to be Phosphine resistant.
+ Malathion resistance noted.
‡ Pirimiphos methyl resistance noted.

B. Lepidoptera

Pyralidae

1. Corcyra cephalonica	a. Ex-MAFF
2. Ephestia cautella	a. Ex-MAFF
	b. Ethiopia
3. Ephestia elutella	a. Ex-MAFF

Gellechiidae:

1. Sitotroga cerealella	a. Sudan

CHEMICAL CONTROL SECTION

(stocks of some major beetles pests are maintained, under selection pressure with insecticide where necessary, in order to enable the FAO recommended methods for the detection and measurement of resistance to be carried out. Incoming strains from abroad are screened and the methods are demonstrated in training programs.)

Wild type strains

Coleoptera

Bostrichidae

Prostephanus truncatus--Strains tested for phosphine resistance: Botswana; Indonesia; Mali (8 strains) Nepal; Nigeria; Pakistan (2 strains) Singapore; Sri Lanka (4 strains); Tunisia; Zimbabwe.

Bruchidae

Acanthoscelides obtectus -- Ethiopia

Callosobruchus chinensis -- India

Curculionidae

Sitophilus oryzae -- Insecticide-susceptible strain (reference strain) -- via MAFF Lab, Slough

S. oryzae -- Malathion and lindane resistant strain (A.76) -- via MAFF Lab., Slough.

Tenebrionidae

Tribolium castaneum -- Multiple insecticide-resistant strain (CTC 12) -- australia

T. castaneum -- Malathion-specific resistant strains (Kano C) -- Nigeria

T. castaneum -- Insecticide-susceptible strain (reference strain) -- MAFF Lab, Slough

Dr. Chris P. Haines

Stock Lists

YUGOSLAVIA

INSTITUTE FOR BIOLOGICAL RESEARCH
"SINIŠA STANKOVIĆ"
UNIVERSITY OF BELGRADE
DEPARTMENT OF INSECT PHYSIOLOGY & BIOCHEMISTRY

1. *Morimus funereus*, L. (Cerambycidae - Coleoptera), wild type, Fruška Gora & Derdap, Serbia (geographic origin)

2. *Cerambyx cerdo*, L. (Cerambycidae - Coleoptera), wild type, Fruška Gora, Serbia

3. *Tenebrio molitor*, L. (Tenebrionidae - Coleoptera), wild type, Fruška Gora, Serbia

4. *Lymantria dispar*, L. (Lymantriidae - Lepidoptera), wild type, Despotovac, Serbia

Dr. Zlatko Prolic, Ph. D.

R.W. BEEMAN'S TRIBOLIUM HOME PAGE

A. Sokoloff
Biology Department
California State University
San Bernardino, California 92407.

*R.W. Beeman's Tribolium Home Page

For those who are not aware that Tribolium has a Home Page prepared by R.W. Beeman and accessible at the address http://bru.usgmrl.ksu.edu/beeman/tribolium it is included in this issue of the Tribolium Information Bulletin. It was last edited August `3, 1998, and it contains information on techniques on how to handle beetles in the laboratory as well as an up-to-date description of mutants and their linkage relationships, something which was also available from their extensive stock lists published in the TIB. On behalf of its readers, the Editor thanks Dr. Beeman and his group for their efforts in making the Home Page as current as possible.

Welcome to the *Tribolium* Home Page

This site contains data and articles about the genetics of the red flour beetle, *Tribolium castaneum*, and related species. Work being done in Dr. Beeman's laboratory involves both standard and molecular approaches.

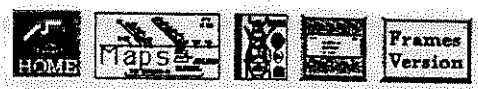
- Standard Genetics
  - **Beetle Handling**
  - **Linkage Maps**
  - **Mutants**
- **Medea: Maternal-Effect Selfish Genes**
- **Insecticide Resistance in *Tribolium***

- Download these Web Pages for local use on your PC.

To Dr. Beeman's Page
To Biological Research Unit

Send comments or questions to
beeman@usgmrl.ksu.edu
haas@usgmrl.ksu.edu

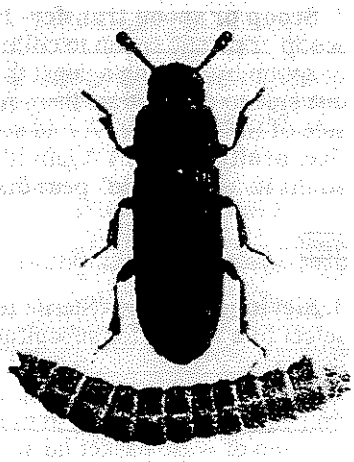
Last Edited: August 13, 1998



BEETLE WRANGLING TIPS

(An Introduction to the Care and Handling of *Tribolium castaneum*)

Index



A. Subculturing

1. Paper transfer- The use of paper strips to transfer adult beetles from an older stock jar to a new one is the quickest and easiest method. Paper strips approximately 5" X 1" are used for sub culturing pint and quart jars. In a bottle with many beetles on the surface of the flour, put the paper strip into the mass of beetles,and wait for them to cover the bottom 1/4 - 1/3 of the strip. (If the jar has fewer adults on top, tilt the jar slightly to one side. Adults will gather in the low side, where you can collect them on the paper strip.)Then quickly but **carefully** withdraw the strip from the first jar and insert it into the jar of new flour. Shake the paper strip and tap it against the sides of the jar to remove the beetles. Repeat the process until the desired number of beetles is transferred. Discard that paper strip and use a fresh one for the next jar you subculture.

Smaller 5" X 3/4" paper strips are used for sub culturing square bottles or vials. The smaller strips may be cut even narrower for easier insertion into the smaller containers. Alternately, a 3/4" strip can be "bowed" along the narrow edge with the fingers to provide easier insertion into the vial and a more effectively shaped paper strip surface for collecting a smaller population of beetles which are being tilted to one side of the curved surface of a vial (or corner of a bottle)to concentrate them.

(Note: Use one clean strip of paper for each culture jar sub cultured.It's best not to lay the strip down on any surface while sub culturing a jar because of the possibility of a stray egg, larva or adult clinging to it, and being introduced into your jar as a contaminant.)

Use paper transfer whenever possible...it helps prevent transfer of disease via equipment if disease is a problem, and minimizes the possibility of contamination from a stray egg or small larva left in the sieve

or pan.It also selects for the healthiest, most vigorous beetles (with the exception of stocks of beetles with short /defective legs that have difficulty climbing a paper strip.

It's a good idea to spot check each stock sub cultured at the time of each subculture. Just place an extra 10 beetles in a petri dish, cool on ice, and inspect the beetles for proper phenotype. Discard the beetles used for spot check. (If your stock is very small, and every beetle counts,save them, but be very conscientious of good "ot;t;;**sterile technique**."(i.e., "bang" each petri dish lid and bottom on the tabletop before each use to dislodge any stray eggs or larvae.)

TOP

2. Scoop or spoon transfer- For Dch-3, and other mutants with very short / defective legs, use a small scoop or plastic spoon to collect adults from one jar or bottle and transfer to another."Sterilize" the scoop or spoon by rapping against the table top several times on both sides. Tilt the bottle so adults move to one side to concentrate them for scooping. Scoop carefully to prevent mashing any beetles against the side of the container. Avoid scooping flour as much as possible. (You just want to collect **live, healthy** adults.) Again,it's a good idea to spot check each stock as you subculture it. Place about 10 adults in a "sterilized" petri dish as mentioned above.

TOP

3. Sieving transfer ("Sterile technique")-When paper or scoop transfers are not possible, sieve and select live beetles for subculture by using the following protocol:

Bang sieves, receiving pans, and aluminum sorting pans firmly and thoroughly on wastebasket lid immediately before **and** immediately after use. Bang the plastic transfer funnel lip sharply on the tabletop or wastebasket lid several times.

Inspect banged equipment visually for presence of clinging larvae or adults. If larvae are stuck in the sieve, try to dislodge by additional banging. If this fails, **gently** poke at them with a brush to encourage them to go on through or withdraw, whichever is the shorter route to getting out. Be careful not to damage them while they are caught in the sieve.If they bleed onto the sieve, their blood and body fluids will corrode the screen.

"Squeegee" sterilize brushes between thumbnail and index finger before using each time.

Always sieve into a receiving pan, never onto the table top! **Sieve**any flour which contains larvae as **quickly** as possible, with**continuous**agitation dump siftings **immediately** into sorting pan to minimize the opportunity for larvae to try to crawl through screen and get stuck.For those caught in screen, dislodge first by banging sieve against receiving pan (first up-side-down, then right-side-up). Dislodge any remaining larvae by poking or "tickling" through screen gently with brush. Don't use **lateral** brushing action to dislodge stuck larvae --- rough treatment can squash larvae, and hemolymph from injured larvae can corrode screen of sieve!!

After sieving diseased stocks, wipe down the sieve and receiving pan with alcohol and dry completely (place on a heat source such as a scope light source, or top of hot incubator, to evaporate excess moisture and solvent)

TOP

4. Pan sorting (after sieving)

a. Adults - Count or sort the beetles collected in the aluminum pan by brushing adults into a petri dish with a small to medium sized brush.If your sample has a very large number of adults in it, flying beetles can be a problem. (Beetles seem to get more excited and want to fly away when crowded, or when conditions are hot and humid.) You can minimize the problem by first putting all the collected beetles in one or more petri dishes and place lids on the dishes. Then return smaller portions of beetles to the

aluminum pan for sorting a bit at a time.

b. Pupae - If collecting pupae from a jar with a spoon, you can exclude many adults by tilting the jar to one side. Adults will move to the low side, and you can scoop from the center (Be sure to"sterilize"the spoon first by wiping off and rapping it against the table top several times on both sides!). Sieve, then brush adults and larvae into one petri dish, and brush pupae into another dish.

Note: Sorting adults, pupae, or larvae with a brush is easier if accumulations of exuvia (castoff skins) are first removed. One method to remove them is by **gently** blowing them out of the pan, using a side-to-side and near-to-far sweeping motion with your breath, blowing them into a waste basket. It usually takes 3 to four "sweepings"to get most of the exuvia out. (Be careful to blow gently enough that only exuvia, and some dead adults are blown out --not the live adults, pupae and larvae. Dead beetles and exuvia are lighter than live ones and careful blowing helps to separate them.).

Another way of separating pupae from adults and larvae is to sift the whole jar, place the adults, larvae and pupae (the siftings), into a petri dish or other clean container, then work with small amounts of the siftings.For each lot, blow off the skins, then shake down the adults and pupae,leaving the **larvae**. Pour the adults and pupae onto a petri dish lid in a covered sieve receiving pan, and let the **adults** run off,leaving mostly **pupae**. Exuvia can also be removed by vacuuming the siftings from a quart jar before placing in the aluminum sorting pan.

TOP

5. Use of topping - Topping (coarsely ground wheat) is used to give beetles traction on the flour so they can right themselves if they fall onto their backs (while many beetles in a container can help each other get up, a lone beetle can get stranded on its back and starve to death!).
Use topping if:

a. Population density is low due to disease or mutation.

b. Adults have impaired ability to right themselves due to a mutation affecting leg size or shape. For instance, it is wise to use topping with stocks of Dch-3 since they can't get around as well as beetles with normal sized and shaped front legs, and since they have lower fertility than other strains.

TOP

6. Subculturing schedule - If using a 30°C incubator temperature, subculture heavily used stocks weekly.Other stocks may be subcultured every other week or monthly.

7. Diseased stocks - Diseased stocks should be subcultured every two days to dilute the disease organisms. **Transfer only live beetles!** Dead or moribund beetles should be discarded.

TOP

B. TROUBLE SHOOTING

If a stock is not producing progeny, check the following:

1. Are there any adults still alive? If there are live adults, check to see if they are all males (some disease seems to plug up and kill the females first).
2. Is there evidence of disease.....dead, dried, and sometimes darkened, larvae and pupae? ("Licorice stick" is a good description of dead larvae's appearance. Dead pupae appear discolored and mummified, and are often chewed on by the adults.)
3. Are there mites in with the adults, or clinging to the adults? To differentiate between grain mites, psocids, and parasitic mites, you can look at this web page to see what grain mites and psocids look like.

- Parasitic mites tend to hang all over the adults, sometimes to the point of giving them a frosted look, and also hide under the wings and elytra. They seem to prefer female beetles, possibly as a way of being near eggs which they may feed on.
- A permanent or long term cure is possible. Follow this link to view the section on parasitic mites in the "Disease & Mites" part of this guide.

TOP

C. TROUBLE PREVENTION

1. Keep all containers of beetles or culture flour closed or covered when not being used or worked with.
2. Bang pans and sieves up-side-down vigorously against wastebasket lid before and after each use to remove any remaining eggs or small larvae.
3. Wipe off and rap spoons and scoops against table top before each use.
4. "Squeegee" sterilize brushes before each use.
5. If beetle adults, larvae or pupae are found on the table top as a result of sieving, discard unless you saw it fall and are **100%** certain of its origin! (It helps to begin with a spotless working surface and floor.This helps increase the probability of an **accurate** recovery of a dropped or spilled beetle. It does not insure against accidently picking up a "fly-in" in place of the intended beetle!).
6. Don't house beetles in airtight containers, and don't push corks tightly into mouths of vials. Insects need fresh air!

TOP

D. Disease & Mites

Eggs may also be collected on Gold Medal flour (or other equally fine flour), and a new stock begun from the debris-free eggs. Allow the adults to lay eggs on the fine flour for 24 hour periods of time. Each day, collect the eggs by double sieving. This method involves using two sizes of sieves,a #25 and a #50, stacked one on top of the other . The #25 is placed on top, with the #50 between the #25 and the receiving pan. Adults remain on the #25 sieve and can be placed temporarily in a covered, sterilized petri dish. The eggs will be retained on the #50 sieve, and can then be transfered to a clean petri dish. (Alternately, if the two sieves being used are warped and difficult to separate after sifting, egg collection can be done in two separate siftings: separate the adults from the flour using only the #25 sieve first, then sieve out the eggs using only the #50 sieve.) All extraneous material (frass, debris) can then be removed from the collected eggs using a small brush. Put cleaned eggs in jar or bottle of fresh flour for development. This works for ridding a stock of **mites** as well as **disease**.

Parasitic mites can easily retard or destroy an otherwise healthy stock. The mites hang all over the adults, sometimes to the point of giving them a frosted look. They seem to prefer females. A permanent or long term cure can be achieved, with a lot of work.

1. Initially, a subset of adults needs to be cleaned. This means putting them on ice and removing the mites with a vacuum probe or aspirator. Mites are persistent, and can also hide (safely) under the elytra.
2. When the beetles are recovered, put them in fine flour with topping for egg collection.
3. Collect the eggs 1-3 days later (depending on the number of adults ovipositing).
4. Now come the hardest part. Put the eggs on some dark paper or other good-contrast surface, under the microscope. With an insect pin and a small vial of ethanol, remove EVERYTHING that is not a plump, healthy egg. Dip the head of the pin in the ethanol, and then blot up the trash. Swish and repeat.
5. Be careful of mites that are feeding on the eggs, as they swell up almost egg-size, and the egg wraps around them as it is depleted. Also look for loose mites roving the surface. Roll the eggs over.
6. Put the now "sterile" eggs in new flour. Keep infested cultures and healthy cultures separate. Disinfect your equipment.

TOP

E. Developmental Rates of *Tribolium castaneum*

Rearing Temperature	30°C	34°C
Egg	3 days	2 days
Larva	20 days	15 days
Pupa	4 days	3 days
Reproductive Maturation	5 days	4 days
Total time egg to egg	32 days	24 days

(The reproductive lifetime is 3-4 months for females and 4-6 months for males. Isolated males have been known to live for up to a year)

Note: At 22°C, development is much slower.

TOP

F. Sexing *Tribolium*

Separating the sexes is necessary in order to run a number of genetics tests. Both adults and pupae can be sexed. If the intended cross must be a virgin cross, it is necessary to sex the beetles as pupae to insure no previous mating has taken place. Following are some materials and methods which have worked well in our laboratory, plus suggested alternate materials you might use.

TOP

1. **Pupae** (Sexing beetles as pupae rather than as adults is easiest since pupae move very little compared to the adults,and do not need to be immobilized by cooling them on ice.)

a. Materials (Microscope, light source, working surface, manipulating tools)

Microscope: A stereoscope is needed to sex the pupae. You will want to be able to magnify the pupae by at least 20 - 30X.A zoom lens stereoscope is very handy.

Light source: A good light source will reduce eyestrain if you are going to be looking at many pupae. The best is a fiberoptics light system. It is both a cooler light source than conventional lights,and those on gooseneck pipes can be aimed at exactly the area you need to focus on. We use a fiber optics light with two light pipes. If you use a standard light, be careful not to overheat your pupae by having the light source too close to them.

Working surface: A small plate of a non-static generating material (approx. 3" x 4") is very handy for separating the sexes. We use a 3" x 4" piece of styrofoam backed posterboard.This has a thickness of about 1/4" which makes it easy to pick up,is light weight, and has a smooth surface to work on. We have chosen a deep blue color, since that color provides a good contrast to the color of the pupae. Any dark color will do. Light colors should be avoided because they cause a glare from the lights.

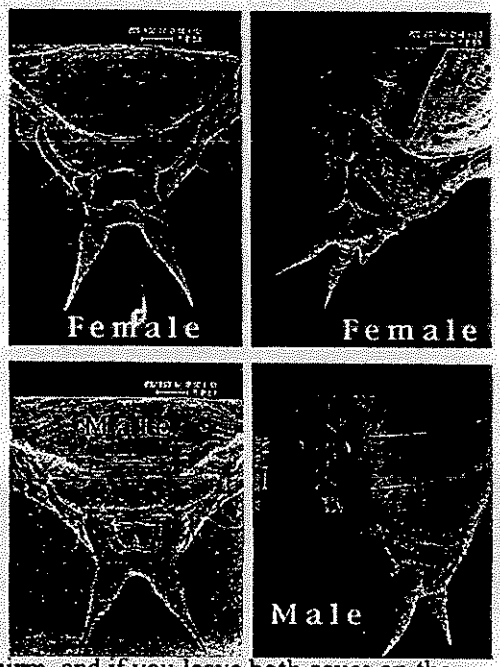
Manipulating tools: A small natural bristle brush can be used to move the pupae on the "plate".

Alternately, a commercial or a homemade vacuum probe can be used to manipulate the pupae. We use a version available through the Jensen Tool catalog, which is hooked up to the vacuum system in our building. (The same probe could also be connected to small electrical vacuum pump). A much simpler version can be made from a plastic drinking straw, a 2-foot piece of flexible rubber tubing (approx. 1/8" internal diameter), and a plastic pipette tip. In this case, the vacuum is supplied by the user's mouth.

Other: **Plastic petri dishes or other small containers** can be used to temporarily hold the pupae both before and after sexing. These same containers, or small bottles or vials which contain about 1" of flour can be used to hold the pupae until they eclose to adulthood. Any container used for this purpose should have a lid which would keep the wandering adults from escaping. (The lid also needs to have small air holes placed in the top if it is a very tight fitting lid. Petri dish lids do not need air holes.) A **plastic funnel** is handy for pouring pupae or adults from a sorting pan into a bottle or jar.

TOP

b. Methods



1. Tilt dish and tap some onto the sexing plate.
2. Using a small brush or vacuum probe, line up the pupae in a horizontal line about half way down the plate (have them all facing the same direction, i.e. all heads up or all heads down).
3. As you look at each pupa under the microscope to determine the sex, brush one sex into a new line above the original line, and the other sex into a new line below the original line. When this process is done, you should have two new lines in place of the old one; one with males and one with females. Use the diagrams at right to identify males and females. (Tip: Ignore the two pointed structures at the very end of the pupa - these are the urogomphi, not the genital papillae. The female papillae, which are much larger than those of the male, are two finger-like structures just anterior to the pointed urogomphi. The male papillae are enough smaller that they look like just fingertips rather than fingers.).
4. Double check your work. To do this, it is important to brush one of the sexes off of the plate into a petri dish or other container while you double check the other sex. (Pupae can't walk, but they can roll or squirm, and if you leave both sexes on the plate while double checking them, one could squirm into the wrong line or group, undoing your careful sexing!) Look at each pupae again to verify its sex, placing missexed pupae in the correct group. You might want to check your pupae a third time just to be sure while you're getting the hang of it.
5. Label your containers and place each sex in a separate container with flour to allow them to eclose to adulthood. (You can use them for crosses once the adults have darkened to brown.).

TOP

2. Adults

a. Materials (ice bucket, ice block)

Ice bucket: Any container which can hold crushed ice can be used to precool adult beetles. The

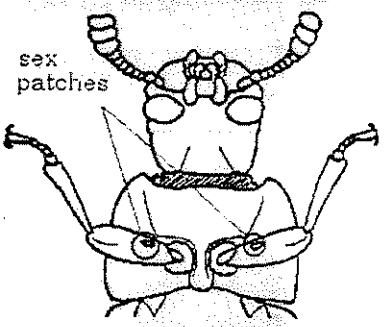
small styrofoam boxes or buckets which are used for picnics or fishing are perfect for this.

Ice block: This is used to keep the beetles immobile while you are looking at them under the microscope. We use small, flat plastic tissue culture bottles which we fill with water about 1/4"at a time until they are mostly full. (Don't fill any container completely full because it will crack or burst when frozen!) Any low-profile container which can hold crushed ice could be used; for instance, a large petri dish full of crushed ice. The pre-cooled beetles are then placed in a smaller, low-profile container (such as a smaller petri dish lid), and this smaller container of beetles is placed on the larger low-profile container filled with ice. You should be able to place this assemblage under your stereoscope.The beetles should remain immobile long enough for you to be able to sex them. (Tip: The ice eventually melts, allowing the beetles to "wake up", so you will want to limit the number of beetles you sex at onetime to a number compatible with the "staying power" of your cooling equipment.).

TOP

b. Methods

1. Collect adults from stock (using methods mentioned above in Wrangling Tips) and place in a covered petri dish or other container for temporary holding. Put the container of beetles on the crushed ice in the ice bucket to precool them before putting them on the ice block.
2. Tap a small number of adults from the petri dish into a smaller flat container on the ice block.
3.
4. Line up the adults as with the pupae above, and separate them into two new lines according to sex. Use the diagram at right to distinguish between males and females. The males have a small patch of short bristles on the inside of the first pair of legs, about 1/3 the distance out from the bases. If the patches have picked up flour, they will appear like two domes of flour or flour paste, and will be fairly easy to see. If they have not yet picked up flour, they will appear as slightly darker, textured spots on the legs. (Changing the angle of light or changing the position of the beetle can help make the patches more visible if you are having trouble seeing them.)



Male RFB

5. Recheck the sexes while still on the ice block.
6. Brush each sex into a separate petri dish or other covered holding container until all the beetles are sexed.
7. (Reminder: Work with only a small number of beetles at a time. This will allow you to do the sorting and rechecking before the ice block starts to melt and the beetles wake up and try to walk off!)
8. Use the beetles for your crosses. If they are sexed as adults, they are usually used right away rather than being held in flour like the pupae mentioned above. If you do place them in containers for use later, remember that the females are probably already fertilized and will be producing offspring in their jar.

TOP

Last Edited: August 13, 1998

Linkage Groups

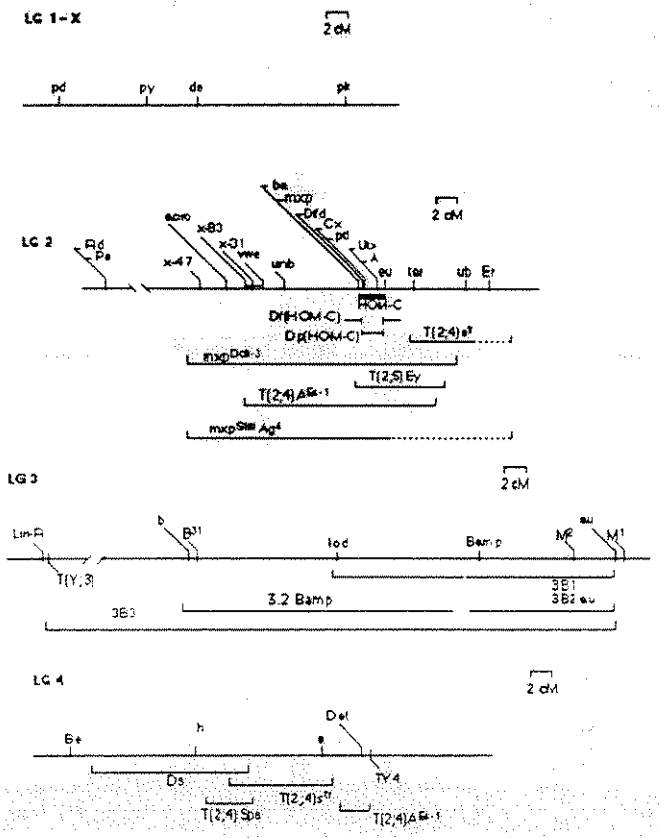
- LG 1-4 (large image)
- LG 5-9 (large image)

- LG 1 = X
- LG 2
- LG 3
- LG 4
- LG 5
- LG 6
- LG 7
- LG 8
- LG 9

Last Edited: August 13, 1998

Tribolium castaneum chromosomes 1-4

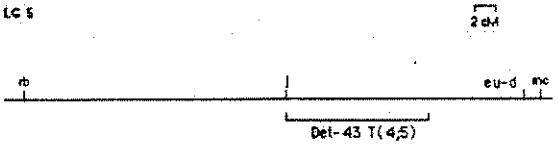
Select a Linkage Group:

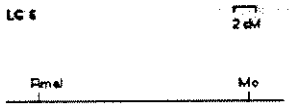


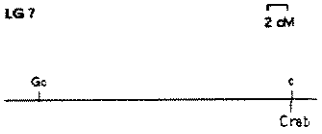
Last Edited: August 13, 1998

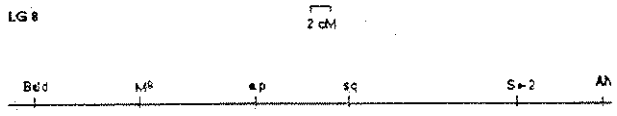
Tribolium castaneum chromosomes 5-9

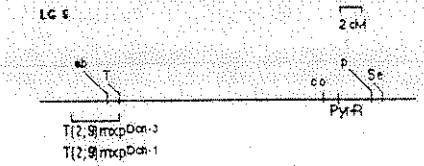
Select a Linkage Group:







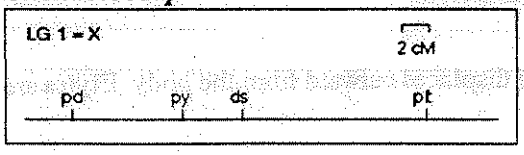




Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 1

Clickable Map



Mutant	Name/note
ds	displaced sternellum
pd	paddle
plt	platinum eye
py	pygmy

Last Edited: August 13, 1998

ds-X (displaced sternellum, X-linked)

- **Structure affected:** Sternellum on ventral prothorax and elytra
- **Linkage Group:** 1 = X
- **Origin:** Spontaneous, from Stm,Cx5/Ey; s/s stock
- **Description:** The sternellum is shortened and slightly displaced outward from the body. Elytra are short, exposing the dorsal tip of the abdomen.

Last Edited: August 13, 1998

pd (paddle)

- **Structure affected:** Antennae.
- **Linkage Group:** 1 = X
- **Origin:**
- **Description:** Antennal segments are fused, giving antenna a "canoe paddle" appearance.

Last Edited: August 13, 1998

plt (platinum eye)

- **Structure affected:** eye
- **Linkage Group:** 1 = X
- **Origin:** spont.
- **Description:** white-eye

Last Edited: August 13, 1998

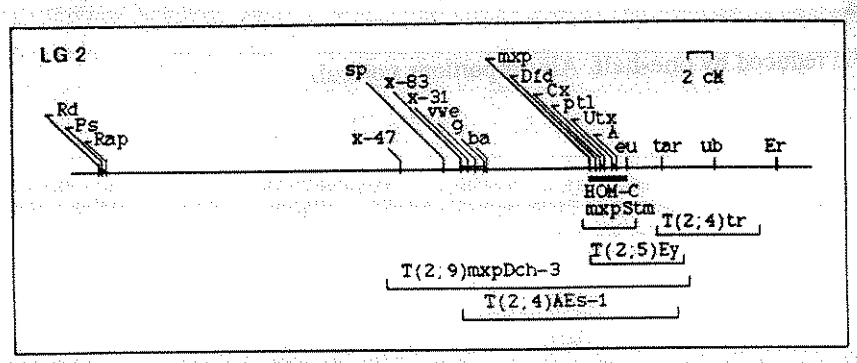
py (pygmy)

- **Structure affected:** global
- **Linkage Group:** 1 = X
- **Origin:** spontaneous
- **Description:** Body mass reduced by one-half. All proportions normal.

Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 2

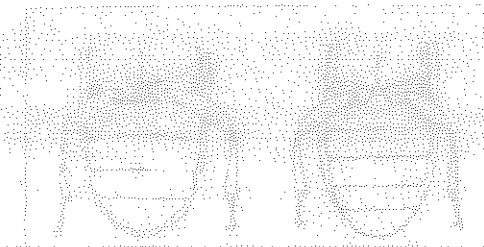
Clickable Map



Mutant	Name/note
A	Abdominal
ba	broken antenna
Cx	Cephalothorax
Dfd	Deformed
Er	Eyes reduced
eu	extra ungomphi
glossy	glossy cuticle
mxp	maxillopedia
mxpStm	Stumpy
Ps	Pinched sternellum
ptl	prothoraxless
Rap	Recurved anterior pronotum
Rd	Reindeer
sp	shoulder pads
T(2;4) AEs-1	Extra sclerite
T(2;4) tr	tremblor
T(2;5)Ey	Eyeless
T(2;9) mxpDch-3	Dachsund
tar	tar
ub	unbuckled

Utx	Ultrathorax
vwe	vestigial wings and elytra
x-31	lethal
x-47	lethal
x-83	lethal

Last Edited: August 13, 1998



A (Abdominal)

LG 2

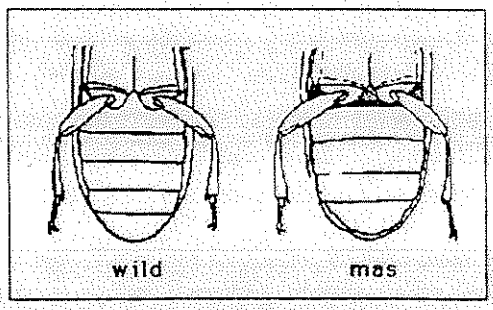
ES-1 (Extra sclerite)

- **Structure affected:** Ventral abdominal segment 2.
- **Linkage Group:** T(2;4)
- **Origin:**
- **Description:**
  - Homeotic transformation of ventral part of abdominal segment 2 (normally forming the socket of the coxae of the third pair of legs) towards segment 3.
  - Excellent crossover suppressor and balancer (second only to Ey in usefulness).
  - No crossover suppr. between HOM-C and Rd.
  - Ag/Es1 spontaneously generates viable Df(HOM-C) gametes at a frequency of 1/1000 when outcrossed (see Ag).
  - Generated euD when outcrossed (BB, p. 32).
  - Translocation demonstrated cytologically, both cis and trans with Spa.

---

mas (missing abdominal sternite)

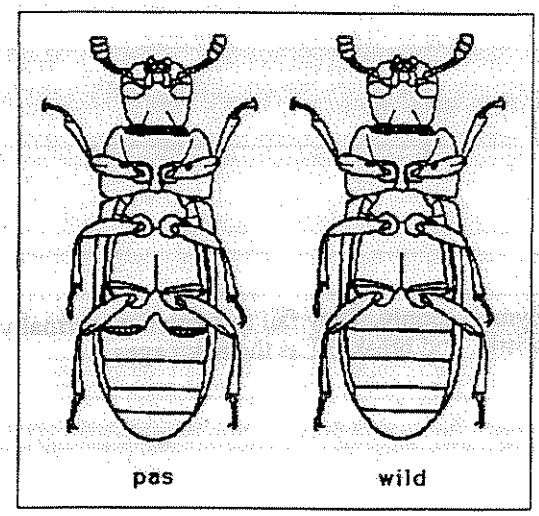
- **Structure affected:** 3rd abdominal sclerite
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** mas is an abdominal 3 to abdominal 2 transformation.



---

pas (pointed abdominal sternite)

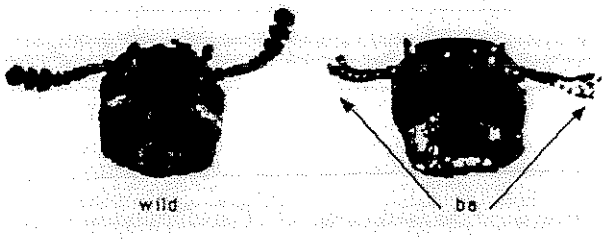
- **Structure affected:** 4th abdominal sclerite
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** pas is an abdominal 4 to abdominal 3 transformation.



Last Edited: August 13, 1998

ba (broken antenna)

- **Structure affected:** Antennae.
- **Linkage Group:** 2
- **Origin:** Ethylmethanesulfonate-induced.
- **Description:** Antennae appear defective in hemolymph supply. They fail to sclerotize normally after adult eclosion, then become melanotic and brittle, and break off as the adult ages.



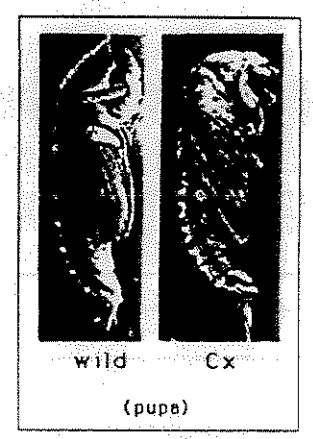
Last Edited: August 13, 1998

Cx (Cephalothorax)

LG 2

Cx

- **Structure affected:** Labium and prothorax.
- **Linkage Group:** 2
- **Origin:** Gamma radiation-induced.
- **Description:** Complex homeotic transformations of labium and prothorax.



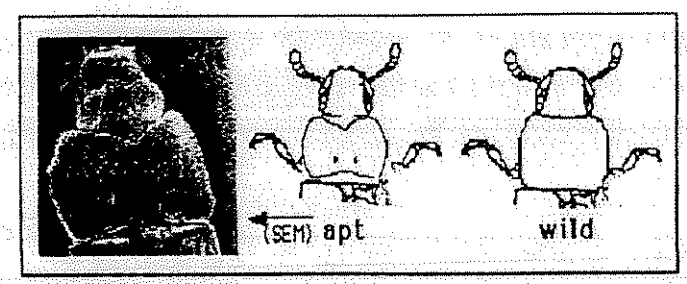
Ag

- **Structure affected:** Antenna.
- **Linkage Group:** 2
- **Origin:** G. GA-1.
- **Description:** A galea-like projection is found on the basal segment (scape) of the antenna. (Ag/Es1 spontaneously generates viable Df(HOM-C) gametes at a frequency of 1/1000 when outcrossed. These uncover Cx, ptl, Utx and A, but complement mxp and eu).

---

apt

- **Structure affected:** dorsal pronotum.
- **Linkage Group:** 2
- **Origin:** spontaneous; A. Sokoloff, Berkeley, CA.
- **Description:** The dorsal pronotum is taking on characteristics of the dorsum of the next most posterior segment, the mesothorax (T2). In its strongest expression, the anterior margin of the pronotum has a large midline indentation, and the posterior midline is beginning to look like the T2 scutellum (the little roundly triangular structure just posterior to the pronotum).



Last Edited: August 13, 1998

Dfd (Deformed)

- **Structure affected:** No gene-specific mutants known. Identified as molecular homolog of Drosophila Deformed gene.
- **Linkage Group:** 2
- **Origin:**
- **Description:**

Last Edited: August 13, 1998

Er (Eyes reduced)

- **Structure affected:** Eyes and surrounding head capsule
- **Linkage Group:** 2
- **Origin:** Gamma irradiation of Ag mutant
- **Description:**
  - First recovered as an Mc on an Ag chromosome. The two genes later segregated away from each other.
  - The male first recovered was F1 of Ag/Es.
  - Head is reduced posterior to the genal shelf. Most of the dorsal component of the eye is missing. Ventral expression of eye is more complete, though somewhat reduced due to a reduction of that portion of the head capsule itself. **In contrast to Ey, Er most often has good bilateral expression of the ventral eye**.

Last Edited: August 13, 1998

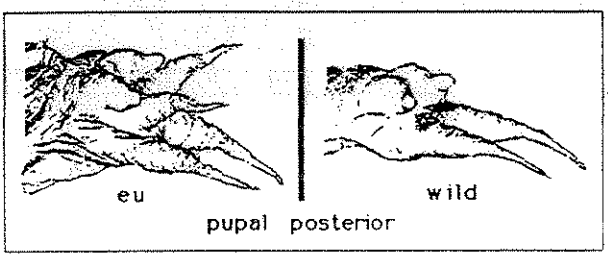
eu (extra urigomphi)

LG 2

Description/Notes

eu (extra urigomphi)

- **Structure affected:** urogomphi (paired "horns" at posterior tip of abdomen of larvae and pupae).
- **Linkage Group:** 2
- **Origin:** Spontaneous.
- **Description:** Supernumerary pair of urogomphi develop via homeotic transformation of abdominal segment 9 toward 10.



euD (dominant allele)

- **Structure affected:** Posterior abdominal segments (A10 & A11)
- **Linkage Group:** T(2; 5)
- **Origin:** Gamma irradiation of Rd,mas,p males, Beeman Lab, USGMRL, Manhattan, KS
- **Description:**
  - Translocation: T(2;5), confirmed cytologically
  - Male sterile
  - extra urogomphi (unilaterally or bilaterally), found in larvae and pupae
  - Genital papillae of male and female pupae are abnormal
  - Male aedaegus non-rotated, rendering males functionally sterile
  - Female ovipositors with split lateral sclerite, causing dorsal-ventral flattening of ovipositor
  - euD/eu beetles have reiterated genital papillae in the females, and lack an aedaegus in males
  - Appears to be hyper-mutator stock

Last Edited: August 13, 1998

g (glossy)

- **Structure affected:** cuticle, global
- **Linkage Group:** 2
- **Origin:** EMS mutagenesis of sooty. Dch3 /Ey chromosome extraction (Dch3/unb)
- **Description:**
  - Color has been found to be "light pumpkin", compared to wild-type.
  - The exterior surface, with the exception of elytra, has a higher reflectivity than normal, due to a reduction of the "surface microsculpture" between the setiferous pits.
  - The elytra are sometimes divergent (usually not).
  - T1 epimera tend to be slightly incomplete, not quite extending as far under the sternellum as with wild-type.
  - Ventral sclerites also have an imperfect T1-T2 juncture at the T2 coxae.

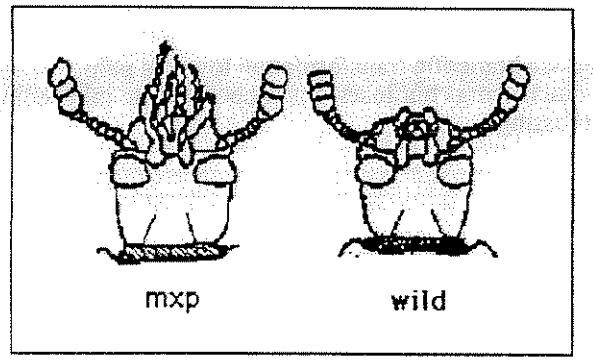
Last Edited: August 13, 1998

mxp (maxillopedia)

LG 2

mxp (maxillopedia)

- **Structure affected:** maxillary & labial palps
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** mxp/mxp causes transformation of the labial and maxillary palps into legs.

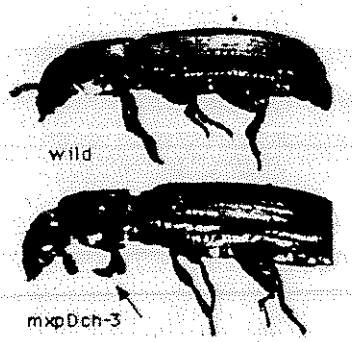


Dch-1 (Dachshund)

- **Structure affected:** Antennae and legs.
- **Linkage Group:** T(2;9)
- **Origin:** Radiation-induced.
- **Description:** Dominant, gain-of-function (GOF). Antennae & legs shorter than normal (partially transformed towards palp) in heterozygotes. Dch-1/Dch-3 heteroallelic adults have complete and dramatic transformation of legs into palps.

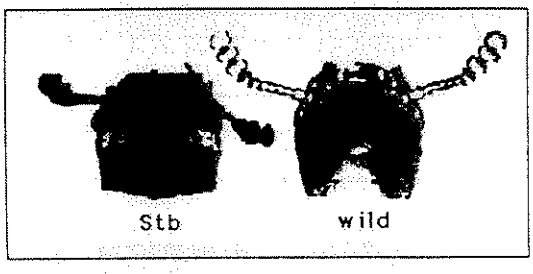
Dch-3 (Dachshund)

- **Structure affected:** Prothorax.
- **Linkage Group:** T(2;9)
- **Origin:** Radiation-induced.
- **Description:** GOF. Prothoracic legs are dramatically reduced. Remainder of prothorax is reduced to a lesser extent, presumably via a homeotic transformation toward labial or maxillary segment. Effect restricted to prothorax. Antennae are normal.



Stb (Stubby)

- **Structure affected:** Antennae.
- **Linkage Group:** 2
- **Origin:** EMS, GA-1
- **Description:** GOF. Funicle of antennae reduced via homeotic transformation towards palp. Sometimes behaves as an X-linked trait (upon outcrossing) but loses this property upon inbreeding, only to regenerate the property again upon outcrossing.



Stm (Stumpy)

- **Structure affected:** Antennae.
- **Linkage Group:** 2
- **Origin:** Ethylmethane sulfonate.
- **Description:** GOF. Club and funicle of antennae reduced.
  - Near-lethal with lethal mxp alleles
  - Complements viable mxp.
  - Homozygous stock is fertile.
  - Other stocks balanced with Stm are only slightly leaky.
  - Lab-S RFLP matches Stm RFLP in a clone from the A gene, so Stm probably is a Lab-S chromosome.
  - No translocation found cytologically by Giovani Mocelin.

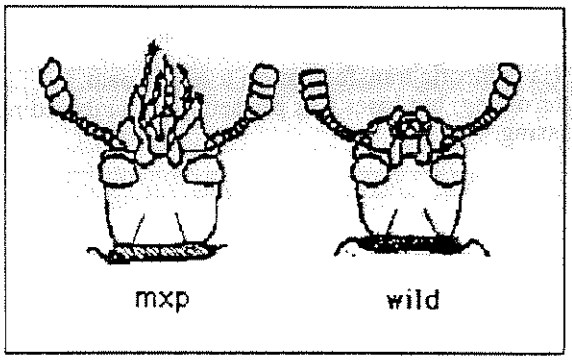
Last Edited: August 13, 1998

mxp (maxillopedia)

LG 2

mxp (maxillopedia)

- **Structure affected:** maxillary & labial palps
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** mxp/mxp causes transformation of the labial and maxillary palps into legs.

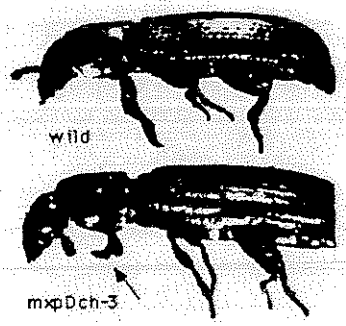


Dch-1 (Dachshund)

- **Structure affected:** Antennae and legs.
- **Linkage Group:** T(2;9)
- **Origin:** Radiation-induced.
- **Description:** Dominant, gain-of-function (GOF). Antennae & legs shorter than normal (partially transformed towards palp) in heterozygotes. Dch-1/Dch-3 heteroallelic adults have complete and dramatic transformation of legs into palps.

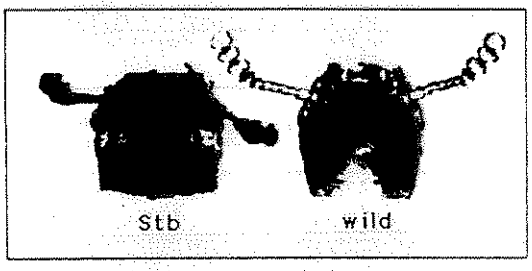
Dch-3 (Dachshund)

- **Structure affected:** Prothorax.
- **Linkage Group:** T(2;9)
- **Origin:** Radiation-induced.
- **Description:** GOF. Prothoracic legs are dramatically reduced. Remainder of prothorax is reduced to a lesser extent, presumably via a homeotic transformation toward labial or maxillary segment. Effect restricted to prothorax. Antennae are normal.



Stb (Stubby)

- **Structure affected:** Antennae.
- **Linkage Group:** 2
- **Origin:** EMS, GA-1
- **Description:** GOF. Funicle of antennae reduced via homeotic transformation towards palp. Sometimes behaves as an X-linked trait (upon outcrossing) but loses this property upon inbreeding, only to regenerate the property again upon outcrossing.



Stm (Stumpy)

- **Structure affected:** Antennae.
- **Linkage Group:** 2
- **Origin:** Ethylmethane sulfonate.
- **Description:** GOF. Club and funicle of antennae reduced.
  - Near-lethal with lethal mxp alleles
  - Complements viable mxp.
  - Homozygous stock is fertile.
  - Other stocks balanced with Stm are only slightly leaky.
  - Lab-S RFLP matches Stm RFLP in a clone from the A gene, so Stm probably is a Lab-S chromosome.
  - No translocation found cytologically by Giovani Mocelin.

Last Edited: August 13, 1998

Ps (Pinched sternellum)

- **Structure affected:** T1 sternellum and dorsum, T3 antecoxal sutures, basal segments of legs, antennae and maxillary palps.
- **Linkage Group:** 2
- **Origin:** Reversion of Skl1 / Stm balanced mutants
- **Description:**
  - The original beetle was Ps and Stm.
  - Setae are commonly found on coxae, as are setae and spikes on the antennal scape and maxillary palps.
  - Prothorax has dorsal dents and bulges, and both a dorsal and a ventral anterior midline dip.
  - T3 antecoxal sutures are disrupted about 2/3 the way out from midline.

Last Edited: August 13, 1998

ptl (prothoraxless)

- **Structure affected:** prothorax
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** pronotum is reduced in size, and prothoracic legs are stunted and malformed.

Last Edited: August 13, 1998

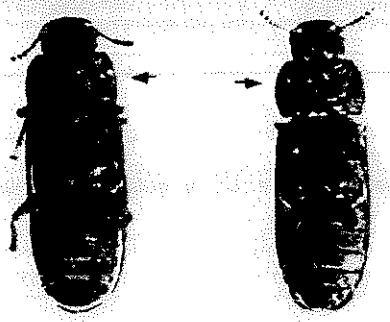
Rap (Recurved anterior pronotum)

- **Structure affected:** Dorsal pronotum (T1)
- **Linkage Group:** 2
- **Origin:** Spontaneous mutant found in the Ga-1 (wild-type) stock
- **Description:**
  - Dorsal protonum has anterior midline dip, bilateral shallow dents, and enlarged anterio-lateral margins.
  - This dominant is homozygous viable. The phenotype very strong in homozygotes, but easily recognizable in heterozygotes.

Last Edited: August 13, 1998

tar

- **Structure affected:** anterior quinone glands
- **Linkage Group:** 2
- **Origin:** EMS
- **Description:** The anterior stink glands are darkly pigmented, usually a red-brown to purple-brown rather than the normal clear yellow, and seem incapable of secretion. Posterior stink glands are not affected.

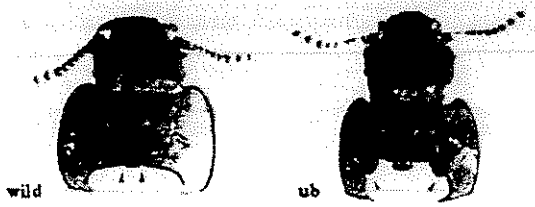


wild tar

Last Edited: August 13, 1998

ub (unbuckled)

- **Structure affected:** Prothorax, appendages.
- **Linkage Group:** 2
- **Origin:** Beeman Lab, USGMRL, Manhattan, KS. Spontaneous mutant recovered from F2 of ab X pas30,p cross.
- **Description:**
  - T1 epimera deflected ventro-posteriorly.
  - T2 metepimera are displaced from the plane of surrounding sclerites ("flaps").
  - Antenna, legs, gemale genital stylii, and mouthparts are more slender than those of wild-type.
  - Genital papillae of female pupae have a small, round sclerotization at the ventral midline anterior margin. Expression ranges from a barely visible dot to an enlarged structure taking up the full middle third of the papillar base. These larger ones usually have a darker sclerotized center. (Larvae have not been seen with these dots).



Last Edited: August 13, 1998

Utx (Ultrathorax)

- **Structure affected:** Elytra, mesothorax (T2)
- **Linkage Group:** 2
- **Origin:** EMS mutagenesis using Lab-S or GA-1 wild-type strains.
- **Description:**
  - Dominant with warped elytra (gain-of-function, based on dosage analysis) and protruding T2 epimera ("flaps").
  - Recessive A1 to T3 transformation (loss-of-func?) seen in homozygous embryos.
  - Utx1 acts as a lethal only in the Utx1/Es1 bal. stock. Using Stm, Ey or mxpNG-1 as balancer, apparent Utx1 homozygotes are generated. These have "membranous antecoxae" (recessive) phenotype in addition to warped elytra and flaps. We cannot reconcile this phenomenon with the lethal embryo (A1 to T3) phenotype seen in the Utx1/Es1 stock. Utx1 derived from "homozygous" stock regains lethality when placed opposite Es1!
  - Recombination with apt, but not A.

Last Edited: August 13, 1998

vwe (vestigial wings and elytra)

- **Structure affected:** wings & elytra
- **Linkage Group:** 2
- **Origin:** EMS
- **Description:** Wings & elytra of pupae are extremely reduced & vestigial. Pupae unable to eclose. Occasional adult escapers with well-differentiated (but miniature) wings & elytra.

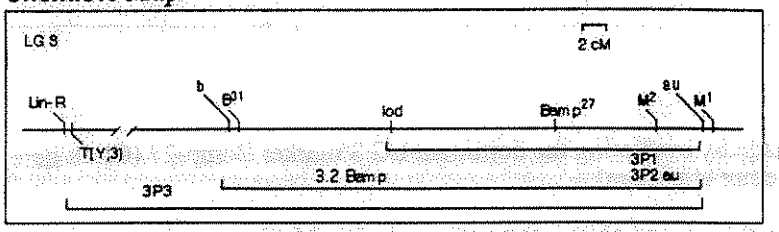
Last Edited: August 13, 1998

This is a lethal mutation lacking a visible phenotype

Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 3

Clickable Map



Mutant	Name
3.2 Bamp	(3P2 based crossover suppressor w/ 40+ cM range)
3P1	(Bamp-27 based crossover suppressor w/ 30 cM range)
3P2	(Bamp-27 based crossover suppressor w/ 30 cM range, and recessive au)
3P3	(Bamp-27 based crossover suppressor w/ 45+ cM range)
au	aureate
b	black body - b itself is incompletely recessive, but other alleles are completely resessive.
Bamp-27	Blunt abdominal and metathoracic points
Bamp-31	Blunt abdominal and metathoracic points
Lin-R	Lindane resistance
lod	light ocular diaphragm
M^1	Medea
M^2	Medea
T(Y;3)	Translocation

Last Edited: August 13, 1998

3B. . . family of Bamp-27 based LG 3 crossover suppressors

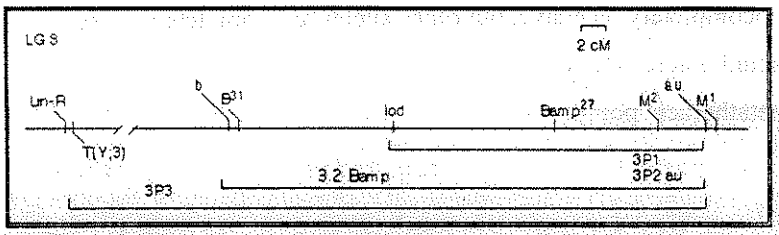
LG 3

Description/notes

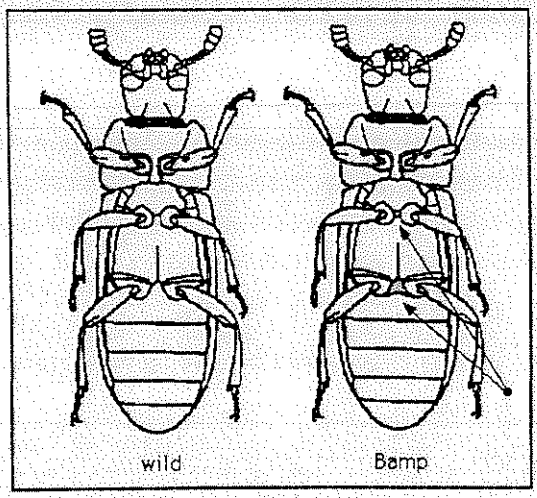
These crossover suppressors were made by irradiating the dominant LG 3 marker Bamp-27 (Click here to go to the Bamp-27 page, or see picture at bottom).

- **3P1** has the dominant Bamp phenotype, and covers approximately 30 cM (See map below).
- **3P2** is essentialy 3P1, with a new or recombined recessive au mutation attached (Click here to go to the au page, or see picture at bottom).
- **3P3** is one of the largest crossover suppressors available in *Tribolium*, covering approximately 15% of the genome. It allows approximately 1% single or double recombinants along most of its length. It has only the dominant Bamp phenotype (See map below)
- **3.2 Bamp** is a radiation-extended 3P2 crossover suppressor. Therefore it has the dominant Bamp and the recessive au. It covers about 40 cM. In the presence of 3.2, M1 and b recombine 2%, apparently at the b end of the 3.2 Bamp CS.

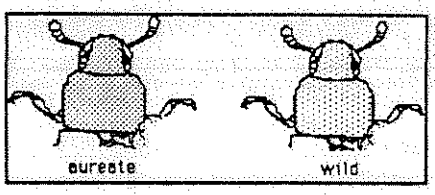
LG 3 linkage map



Bamp-27 phenotype (dominant)



au phenotype (recessive)



Last Edited: August 13, 1998

au (aureate)

- **Structure affected:** entire surface of cuticle
- **Linkage Group:** 3
- **Origin:** spontaneous
- **Description:** setae (hairs) on general body surface are 2-3 times as dense as normal, giving a frosted or hairy appearance.

Last Edited: August 13, 1998

b (black)

- **Structure affected:** cuticle
- **Linkage Group:** 3
- **Origin:** spontaneous
- **Description:** black body color.

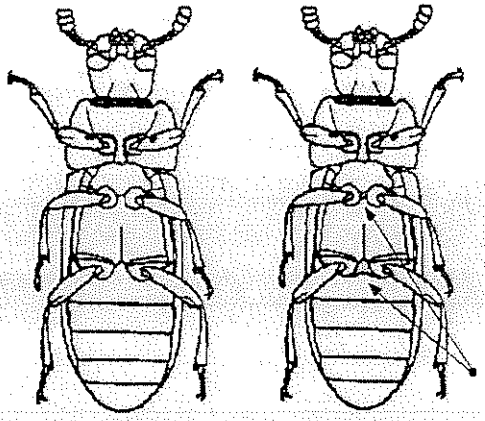
Last Edited: August 13, 1998

Bamp-27 (Blunt abdominal and metathoracic projections)

LG 3

Bamp-27 (Blunt abdominal and metathoracic projections)

- **Structure affected:**
- **Linkage Group:** 3
- **Origin:** Gamma irradiation of Ga-1
- **Description:**
  - The anterior midline projection of the T3 (third thoracic) sternum, which usually forms a firm junction with the posterior midline of the T2 sternum at the T2 legs, lacks its usual point, leaving a small gap at the T2-T3 juncture.
  - The anterior midline projection of the A3 (third abdominal) sternum, which usually forms a firm junction with the posterior midline of the T3 sternum at the T3 legs, has a reduced point, leaving a noticable gap at the T3-A3 juncture.
  - This was the irradiated chromosome for the 33B . . . family of LG 3 crossover suppresors.
  - Very fertile.
  - No translocations found by cytology.



Last Edited: August 13, 1998

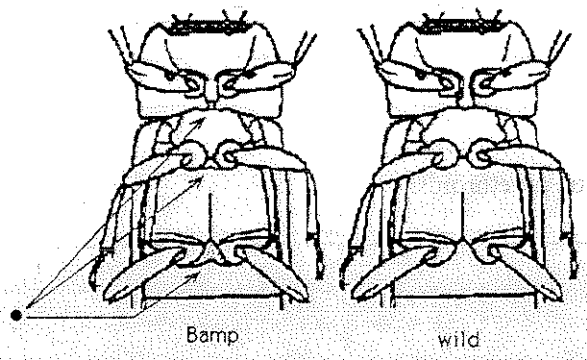
Bamp-31 (Blunt abdominal and metathoracic projections)

LG 3

Bamp-31 (Blunt abdominal and metathoracic projections)

Blunt abdominal and metathoracic points

- **Structure affected:** T1 Sternellum and A3 point.
- **Linkage Group:** 3
- **Origin:** ChrE (lethal)
- **Description:**
  - The most obvious and easily identified feature of Bamp31 is its shortened, narrowed T1 sternellum. The blunted abdominal and metathoracic projections are more subtile than that found in other Bamp alleles. This allele also commonly has disrupted gular sutures and divergent, "rumpled" elytra.



Last Edited: August 13, 1998

Insecticide Resistance

Lin-R (Lindane resistance)

- **Linkage Group:** 3
- **Origin:** spontaneous
- **Description:** resistant to lindane and cyclodiene insecticides because of a mutation in the GABA(A) receptor.

Rmal (Malathion resistance)

- **Linkage Group:** 6
- **Origin:** spontaneous
- **Description:** resistant to malathion and phenthoate insecticides because of a modification in a carboxylesterase enzyme.

Pyr-R (Pyrethroid resistance)

- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** resistant to alpha-cyano synthetic pyrethroids.

Last Edited: August 13, 1998

lod (light ocular diaphragm)

- **Structure affected:**
- **Linkage Group:** 3
- **Origin:** Spontaneous
- **Description:** Ocular diaphragm (ring around outer perimeter of eye) is unpigmented rather than the normal black pigmentation. Can only be recognized in mutant eye color background, such as pearl, ruby, etc.

Last Edited: August 13, 1998

Medea

MEDEA is an acronym for Maternal-Effect Dominant Embryonic Arrest

Medea-killed larvae

Medea factors all share several characteristics:

- They breed true through the female line.
- They segregate in the male.

When a heterozygous Medea female (M/+) is crossed to a wild type male (+/+), the M gene and its homolog segregate normally. However, all progeny that do not inherit the Medea allele die at or shortly after egg hatch. The lethality is maternal, but the "rescue" is zygotic. The rescuing M allele can be inherited from either parent.

There have been four well-studied Medea factors. Of these, two (M-1 and M-4) are currently maintained at the Tribolium Stock Center. Almost all M strains in the field carry M-4. Of these, about a third also carry M-1. M-4 is the only Medea factor present in North American and European strains, being found in about half of them. Australian and Indian strains are almost devoid of Medea factors. South American, Asian, and African strains often have 2 or more M factors.

M^1 (Medea)

- **Linkage Group:** 3
- **Description:** The first and most-studied Meda factor.

M^2 (Medea)

- **Linkage Group:** 3
- **Description:** This Medea factor faded away and is no longer detectable.

M^3 (Medea)

- **Linkage Group:** 8
- **Description:** This Medea factor faded away and is no longer detectable.

M^4 (Medea)

- **Linkage Group:** Unknown
- **Description:** This Medea has an interesting distribution within the United States.

Last Edited: August 13, 1998

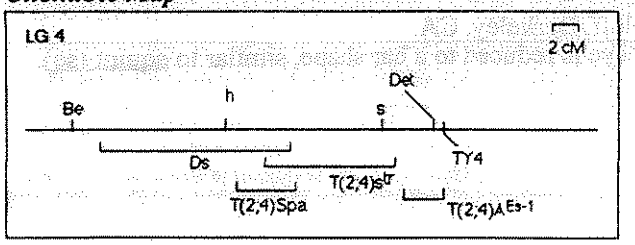
T(Y;3)

- **Structure affected:** None
- **Linkage Group:** T(Y;3)
- **Origin:** gamma-induced on a Ga-1 chromosome
- **Description:**
  - Translocation between LG3 and the Y chromosome
  - Mutant always carried by males.
  - Translocation demonstrated cytologically.

Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 4

Clickable Map

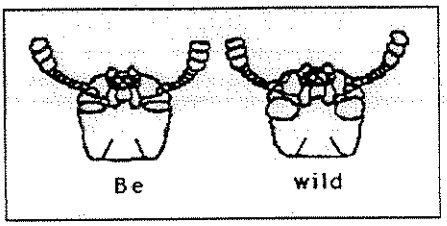


Mutant	Name/note
Be	Bar eye
h	hazel eye
s	sooty
Det-43	Divergent elytral tips
T(Y;4)	Translocation
Ds	Displaced sternellum
T(2;4)Spa	Spatulate
T(2;4) tr	tremblor
T(2;4)AEs-1	Eyeless

Last Edited: August 13, 1998

Be (Bar eye)

- **Structure affected:** eye
- **Linkage Group:** 4
- **Origin:** Sponteneous, dominant. A. Sokoloff, Berkeley, CA.
- **Description:** The number of facets in the eye is reduced to a bar shape, similar to squint (sq).



Last Edited: August 13, 1998

h (hazel)

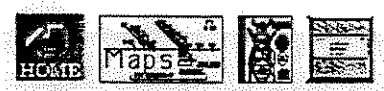
- **Structure affected:** eye color
- **Linkage Group:** 4
- **Origin:** spontaneous
- **Description:** hazel or tan eye color, allelic with "white"

Last Edited: August 13, 1998

s (sooty)

- **Structure affected:** cuticle
- **Linkage Group:** 4
- **Origin:** spontaneous
- **Description:** cuticle is dark blackish brown, instead of the normal rust-red.

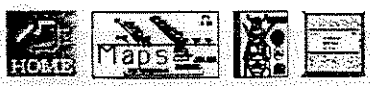
Last Edited: August 13, 1998



Det-43 (Divergent elytral tips)

- **Structure affected:** Elytra
- **Linkage Group:** T(4; 5)
- **Origin:** Gamma-induced on a GA-1 chromosome, Beeman Lab, US Grain Marketing Research Lab., Manhattan, KS.
- **Description:**
  - Elytra are divergent at the tips and have a characteristic "knob and bend" at about 2/3 their length at the lateral margins. This characteristic is fully penetrant.
  - It is a T(4;5) translocation.

Last Edited: August 13, 1998



T(Y;4)

- **Structure affected:** None
- **Linkage Group:** T(Y; 4)
- **Origin:** gamma-induced on a Ga-1 chromosome
- **Description:**
  - Translocation between LG4 and the Y chromosome
  - Translocation demonstrated cytologically.

Last Edited: August 13, 1998

Ds (displaced sternellum)

- **Structure affected:** T1 (prothoracic) sternellum, elytra, global
- **Linkage Group:** 4
- **Origin:** Spontaneous, from Peter Dawson's lab, Oregon State Univ.
- **Description:**
  - Sternellum is shortened and displaced outwardly from the body wall.
  - The elytra are slightly shortened.
  - Length of appendages and of the overall body are slightly reduced.
  - Reduces the recombination frequency between h and s from around 17% to 7.7%.
  - No evidence of chromosome translocation detected in tests for pseudolinkagae or upon cytological exam.
  - Most likely associated with an inversion with one breakpoint between h and s and the other breakpoint on the opposite side of h.

Last Edited: August 13, 1998

Spa (Spatulate antenna)

- **Structure affected:** Antenna
- **Linkage Group:** T(2; 4)
- **Origin:** Alexander Sokoloff lab, Berkeley, CA
- **Description:** Antennal club and funicle fusion, giving antenna a shortened look.

Last Edited: August 13, 1998

tr (tremblor)

- **Structure affected:** None (behavior affected)
- **Linkage Group:** T(2; 4)
- **Origin:** EMS mutagenesis of sooty
- **Description:**
  - Translocation: t(2;4)
  - Originally, adults had a tremorous gait. This trait has lessened with time.
  - The stock remains balanced with Es, but while balanced with Ey, viable homozygotes were recovered which are sooty colored.

Last Edited: August 13, 1998

A (Abdominal)

LG 2

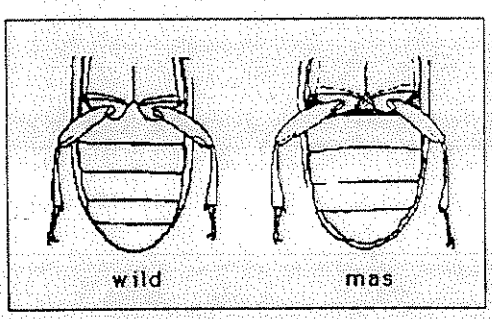
ES-1 (Extra sclerite)

- **Structure affected:** Ventral abdominal segment 2.
- **Linkage Group:** T(2;4)
- **Origin:**
- **Description:**
  - Homeotic transformation of ventral part of abdominal segment 2 (normally forming the socket of the coxae of the third pair of legs) towards segment 3.
  - Excellent crossover suppressor and balancer (second only to Ey in usefulness).
  - No crossover suppr. between HOM-C and Rd.
  - Ag/Es1 spontaneously generates viable Df(HOM-C) gametes at a frequency of 1/1000 when outcrossed (see Ag).
  - Generated euD when outcrossed (BB, p. 32).
  - Translocation demonstrated cytologically, both cis and trans with Spa.

---

mas (missing abdominal sternite)

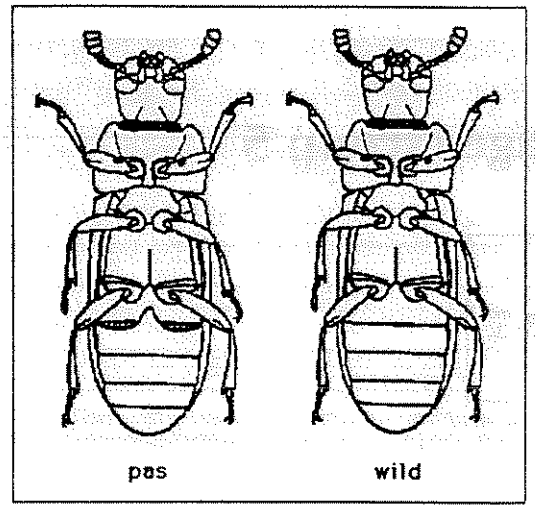
- **Structure affected:** 3rd abdominal sclerite
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** mas is an abdominal 3 to abdominal 2 transformation.



---

pas (pointed abdominal sternite)

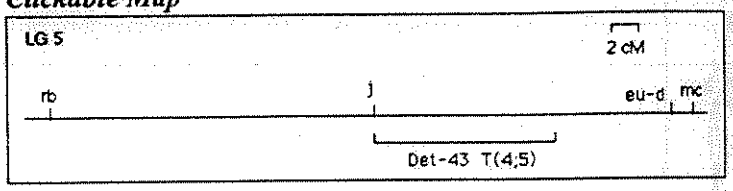
- **Structure affected:** 4th abdominal sclerite
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** pas is an abdominal 4 to abdominal 3 transformation.



Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 5

Clickable Map



Mutant	Name/note
Det-43	Divergent elytral tips
eu-D	extra undigomphi
j	jet
mc	microcephalic
T(2;5) Ey	Eyeless
rb	ruby

Last Edited: August 13, 1998

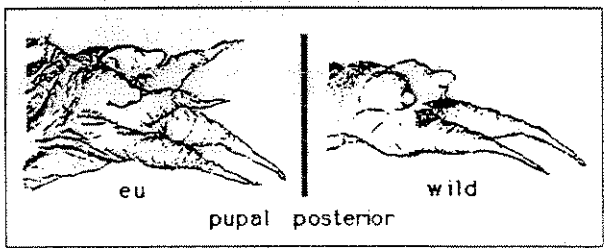
eu (extra urigomphi)

LG 2

Description/Notes

eu (extra urigomphi)

- **Structure affected:** urogomphi (paired "horns" at posterior tip of abdomen of larvae and pupae).
- **Linkage Group:** 2
- **Origin:** Spontaneous.
- **Description:** Supernumerary pair of urogomphi develop via homeotic transformation of abdominal segment 9 toward 10.



euD (dominant allele)

- **Structure affected:** Posterior abdominal segments (A10 & A11)
- **Linkage Group:** T(2; 5)
- **Origin:** Gamma irradiation of Rd,mas,p males, Beeman Lab, USGMRL, Manhattan, KS
- **Description:**
  - Translocation: T(2;5), confirmed cytologically
  - Male sterile
  - extra urogomphi (unilaterally or bilaterally), found in larvae and pupae
  - Genital papillae of male and female pupae are abnormal
  - Male aedaegus non-rotated, rendering males functionally sterile
  - Female ovipositors with split lateral sclerite, causing dorsal-ventral flattening of ovipositor
  - euD/eu beetles have reiterated genital papillae in the females, and lack an aedaegus in males
  - Appears to be hyper-mutator stock

Last Edited: August 13, 1998

j (jet body)

- **Structure affected:** Cuticle, global
- **Linkage Group:** 5
- **Origin:** Alexander Sokoloff lab, Berkeley, CA
- **Description:** Jet-black body color

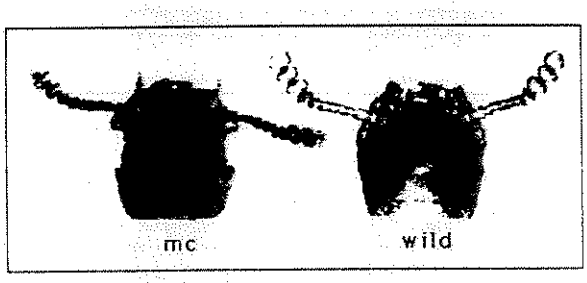
Last Edited: August 13, 1998

mc (microcephalic)

LG 5

mc (microcephalic)

- **Structure affected:** eyes and head
- **Linkage Group:** 5
- **Origin:** spontaneous (from Sokoloff)
- **Description:**
  - Width of head is reduced posterior to genal shelf.
  - Eyes are variably reduced, ranging from slight reduction in eye size and number of facets, to complete reduction with no facets. Not bilaterally uniform.
  - One strain occasionally has an "eye-growth" which appears on a sclerotized encroachment into the anterior edge of the eye. The growth ranges from very small and fine, and often appears segmented in its largest and strongest expression.



Ey (Eyeless)

- **Structure affected:** eyes and head
- **Linkage Group:** T(2; 5)
- **Origin:** Gamma irradiatin of GA-1 (wild-type).
- **Description:**
  - Dominant allele of mc on LG 5, with a similar range of expression (see mc). Ey is a T(2;5).
  - The lethality seems to be associated with LG 2, since Dp(2)/Ey/Ey is viable (where Dp is derived from mxpDch/Es1).
  - Ey is a good HOM-C balancer, (good crossover suppression, fertile, fully penetrant, heterozygotes extremely viable, homozygous lethal). Only one recombinant (out of ca. 2000) has been observed, placing Ey closer to the mxp-apt region than to the A region.

Last Edited: August 13, 1998

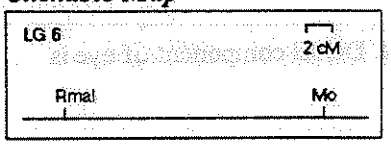
rb (ruby eyes)

- **Structure affected:** Eyes
- **Linkage Group:** 5
- **Origin:** Alexander Sokoloff lab, Berkeley, CA
- **Description:** Reddish eye color.

Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 6

Clickable Map

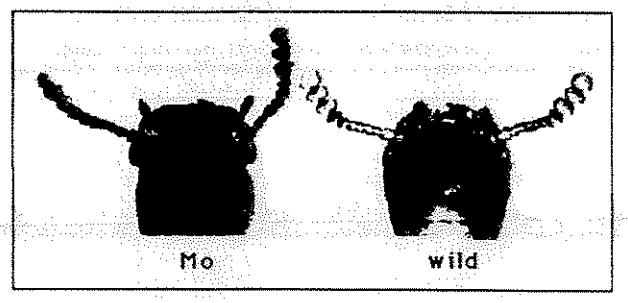


Mutant	Name/note
Mo	Micro-opthalmic
Rmal	Resistance to malathion

Last Edited: August 13, 1998

Mo (Micro-opthalmic)

- **Structure affected:** Head and eye
- **Linkage Group:** 6
- **Origin:** Alexander Sokoloff, Univ. California at Berkeley
- **Description:** Width of head capsule reduced behind genal shelf. Dorsal component of eye is reduced or missing. Good bilateral expression.



Last Edited: August 13, 1998

Insecticide Resistance

Lin-R (Lindane resistance)

- **Linkage Group:** 3
- **Origin:** spontaneous
- **Description:** resistant to lindane and cyclodiene insecticides because of a mutation in the GABA(A) receptor.

Rmal (Malathion resistance)

- **Linkage Group:** 6
- **Origin:** spontaneous
- **Description:** resistant to malathion and phenthoate insecticides because of a modification in a carboxylesterase enzyme.

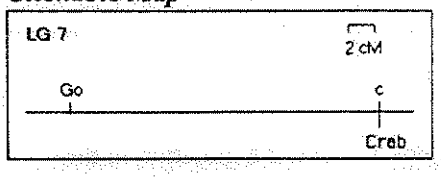
Pyr-R (Pyrethroid resistance)

- **Linkage Group:** 9
- **Origin:** spontaneous
- **Description:** resistant to alpha-cyano synthetic pyrethroids.

Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 7

Clickable Map



Mutant	Name/note
c	chestnut eye
Crab	Crab legs
Go	Goliath

Last Edited: August 13, 1998

c (chestnut eye)

- **Structure affected:** Eye
- **Linkage Group:** 7
- **Origin:** Alexander Sokoloff, University of California at Berkeley
- **Description:** Red-brown colored eye

Last Edited: August 13, 1998

Crab

- **Structure affected:** legs
- **Linkage Group:** 7
- **Origin:** EMS mutagenesis, 1986 (Beeman lab, Manhattan, KS)
- **Description:**
  - Tibia shortened, thickened, and bowed, giving them a crab-like look.
  - Male "sex patches" on T1 femur occasionally found on T1 tibia.
  - Linked to c, (chestnut eye color) (0%)

Last Edited: August 13, 1998

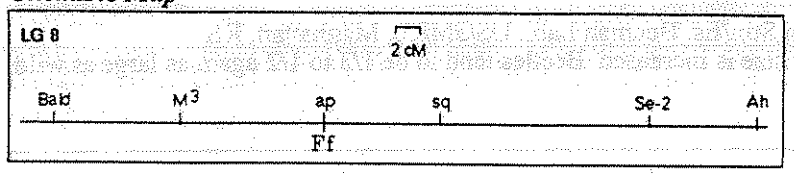
Go (Goliath)

- **Structure affected:** Body size, global
- **Linkage Group:** 7
- **Origin:** Gamma-induced in Stm/Es. Beeman Lab., USGMRL, Manhattan, KS
- **Description:** Overall body size is increased. Beetles tend to be 1/3 to 1/2 again as large as wild type siblings.

Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 8

Clickable Map



Mutant	Name/note
Ah	Arrowhead
ap	antennapedia
Ff	Fused funicle
Bald	Bald
M^3	Medea
Se-2	Split elytra
sq	squint

Last Edited: August 13, 1998

Ah (Arrowhead)

- **Structure affected:** Eye and head.
- **Linkage Group:** 8
- **Origin:** Giovani Mocelin at Jeff Stuart's Lab, Purdue University
- **Description:**
  - This mutant looks like a moderate version of Ey, with extreme expression of all eye facets missing found only rarely.
  - Ah first showed up when males from isogenic line M1/M1 (from Big IV/I/II) were irradiated and crossed to MMS females.
  - It maps on LG8 in this order: Bald-ap-sq-Ah, about 25 cM from sq (it may be very near Se-2).
  - The original Ah was a female.
  - They appear to be homozygous viable.

Last Edited: August 13, 1998

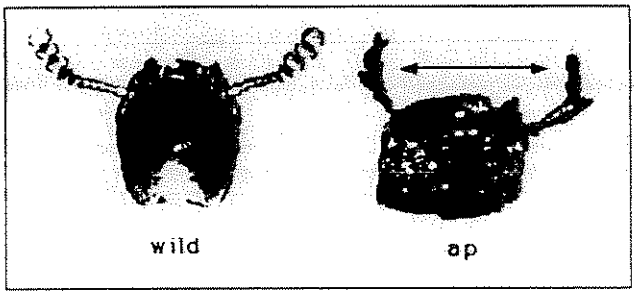
ap (antennapedia)

LG 8

---

ap (antennapedia)

- **Structure affected:** Antennae.
- **Linkage Group:** 8
- **Origin:** Spontaneous.
- **Description:** Homeotic transformation of antenna to leg.



F (Fused funicle)

- **Structure affected:** Antennae.
- **Linkage Group:** 8
- **Origin:** Ff originated from an experiment in which Ds (Lg4) was irradiated with gamma rays.
- **Description:**
  - May be a dominant ap allele.
  - Dominance confirmed in a outcross to Ga-1. Penetrance is ~100%.
  - Characteristic phenotype - normal club, funnicle with fusion to usually 4-5 segments. The distal 1-2 segments are enlarged to a size intermediate between that of a funnicle and club segment, giving the club an enlarged 4-segment look usually.

Last Edited: August 13, 1998

Bald

- **Structure affected:** Entire cuticle.
- **Linkage Group:** 8
- **Origin:** EMS, Lab-S or Ga-13.
- **Description:** Patches of setae (cuticular hairs) missing over entire surface of adult body. Gives overall glossy appearance to cuticle.

Last Edited: August 13, 1998

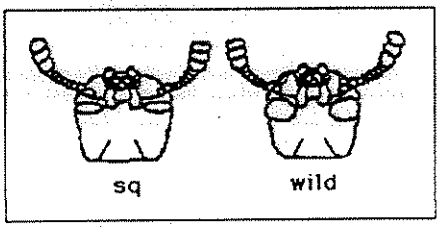
Se-2 (Short elytra 2)

- **Structure affected:** Elytra
- **Linkage Group:** 8
- **Origin:** From ab stock, Scott Thomson, (while working in Beeman lab)
- **Description:**
  - Elytral tips are divergent, exposing wings and membranous dorsal abdomen.
  - Enough wing surface is usually exposed to cause the wings to no longer be neatly folded underneath. Wings are often rumpled, giving the beetle a "cotton-tail" look.
  - Elytra are rarely "short".

Last Edited: August 13, 1998

sq (squint)

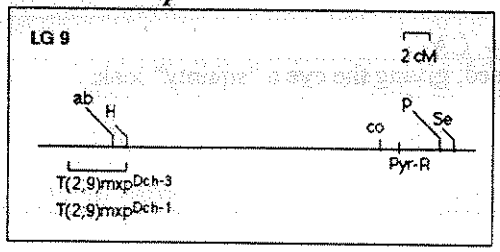
- **Structure affected:** eye
- **Linkage Group:** 8
- **Origin:** Sponteneous recessive, A. Sokoloff, Berkeley, CA.
- **Description:** The number of facets in the eye is reduced, giving the eye a "squinty" look.



Last Edited: August 13, 1998

Tribolium castaneum Linkage Group 9

Clickable Map



Mutant	Name/note
ab	antenna bifurcata
co	cola body
p	pearl eye
Pyr-R	Pyrethroid resistance
Se	Split elytra
T(2;9) mxpDch-1	Dachsund
T(2;9) mxpDch-3	Dachsund
H	H factor

Last Edited: August 13, 1998

ab (antenna bifurcata)

- **Structure affected:** Antennae and trochanter of legs
- **Linkage Group:** 9
- **Origin:** Colombia
- **Description:**
  - The antennae are branched, usually at the pedicel (second segment out from head). Size of the branch varies from a small projection, up to 1/3 the length of the antenna. The projection sometimes appears to be segmented.
  - Spikes on the trochanter usually appear at basal edge and vary in size. Some appear segmented. Less commonly found than branches on antennae.
  - Male sterile.

Last Edited: August 13, 1998

co (cola body)

- **Structure affected:** cuticle
- **Linkage Group:** 9
- **Origin:** spontaneous
- **Description:** dark brown body color

Last Edited: August 13, 1998

p (pearl eye)

- **Structure affected:** Eyes
- **Linkage Group:** 9
- **Origin:** Alexander Sokoloff, University of California at Berkeley
- **Description:** White colored eye

Last Edited: August 13, 1998

Insecticide Resistance

Lin-R (Lindane resistance)

- **Linkage Group:** 3
- **Origin:** spontaneous
- **Description:** resistant to lindane and cyclodiene insecticides because of a mutation in the GABA(A) receptor.

Rmal (Malathion resistance)

- **Linkage Group:** 6
- **Origin:** spontaneous
- **Description:** resistant to malathion and phenthoate insecticides because of a modification in a carboxylesterase enzyme.

Pyr-R (Pyrethroid resistance)

- **Linkage Group:** 9
- **Origin:** spontaneous
- **Description:** resistant to alpha-cyano synthetic pyrethroids.

Last Edited: August 13, 1998

Se (Short elytra)

- **Structure affected:** Elytra
- **Linkage Group:** 9
- **Origin:** Spontaneous, from Ey/Stm X Rd,mas,p (Beeman lab, Manhattan, KS).
- **Description:**
  - Expression is variable, ranging from very short elytra noticably rounded posteriorly, to almost normal length with a subtle posterior rounding.
  - Closely linked to **p** (pearl eye)

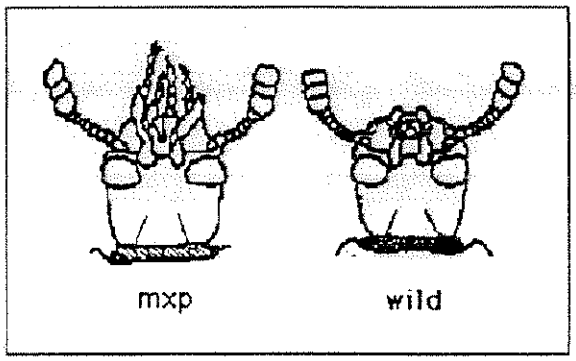
Last Edited: August 13, 1998

mxp (maxillopedia)

LG 2

mxp (maxillopedia)

- **Structure affected:** maxillary & labial palps
- **Linkage Group:** 2
- **Origin:** spontaneous
- **Description:** mxp/mxp causes transformation of the labial and maxillary palps into legs.

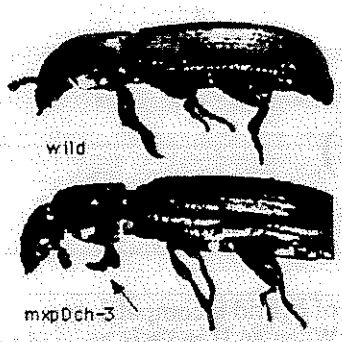


Dch-1 (Dachshund)

- **Structure affected:** Antennae and legs.
- **Linkage Group:** T(2;9)
- **Origin:** Radiation-induced.
- **Description:** Dominant, gain-of-function (GOF). Antennae & legs shorter than normal (partially transformed towards palp) in heterozygotes. Dch-1/Dch-3 heteroallelic adults have complete and dramatic transformation of legs into palps.

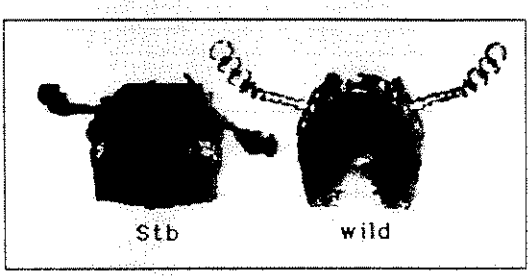
Dch-3 (Dachshund)

- **Structure affected:** Prothorax.
- **Linkage Group:** T(2;9)
- **Origin:** Radiation-induced.
- **Description:** GOF. Prothoracic legs are dramatically reduced. Remainder of prothorax is reduced to a lesser extent, presumably via a homeotic transformation toward labial or maxillary segment. Effect restricted to prothorax. Antennae are normal.



Stb (Stubby)

- **Structure affected:** Antennae.
- **Linkage Group:** 2
- **Origin:** EMS, GA-1
- **Description:** GOF. Funicle of antennae reduced via homeotic transformation towards palp. Sometimes behaves as an X-linked trait (upon outcrossing) but loses this property upon inbreeding, only to regenerate the property again upon outcrossing.



Stm (Stumpy)

- **Structure affected:** Antennae.
- **Linkage Group:** 2
- **Origin:** Ethylmethane sulfonate.
- **Description:** GOF. Club and funicle of antennae reduced.
  - Near-lethal with lethal mxp alleles
  - Complements viable mxp.
  - Homozygous stock is fertile.
  - Other stocks balanced with Stm are only slightly leaky.
  - Lab-S RFLP matches Stm RFLP in a clone from the A gene, so Stm probably is a Lab-S chromosome.
  - No translocation found cytologically by Giovani Mocelin.

Last Edited: August 13, 1998

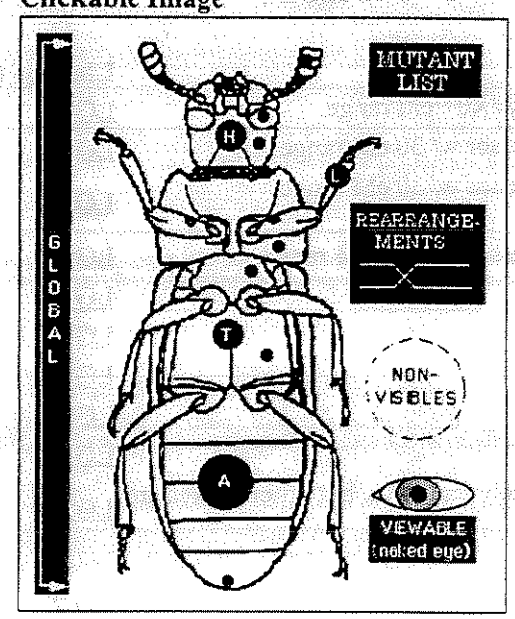
H (Hybrid incompatability factor)

- **Structure affected:**
- **Linkage Group:** 9
- **Origin:** Tiw-1 strain (India)
- **Description:** There are three kinds of strains involved in this type of hybrid incompatibility, namely H strains, neutral strains and non-permissive (NP) strains. When an H male is crossed to a neutral female, F1 hybrids are viable. However, when an H male is crossed to an NP female at 25 C, the progeny all die as larvae. Incompatibility is less severe at 32 C. Crosses between neutral and NP strains are fully compatible.

Last Edited: August 13, 1998

Mutants by Region Affected

Clickable Image



- Whole Mutant List
- Head
  - Antennna
  - Eyes
  - Shape
  - Mouthparts
- Thorax
  - T1
  - T2 (not elytra)
  - T3
  - Elytra
  - Legs
- Abdomen-general
- Abdomen-genital region
- Elytra
- Gross (naked eye/hand lens)
- Legs
- "Invisible" (lethals; resistance; Medea)
- Rearrangements
- Global

Last Edited: August 13, 1998

Mutant List in Alphabetical Order

Mutant	Name/note	Linkage Group
3.2 Bamp	3P2 based crossover suppressor w/ 40+ cM range.	LG 3
3P1	Bamp-27 based crossover suppressor w/ 30 cM range.	LG 3
3P2	Bamp-27 based crossover suppressor w/ 30 cM range, and recessive au.	LG 3
3P3	Bamp-27 based crossover suppressor w/ 45+ cM range.	LG 3
A	Abdominal	LG 2
ab	antenna bifurcata	LG 9
Ah	Arrowhead	LG 8
ap	antennapedia	LG 8
au	aureate	LG 3
b	black body - b itself is incompletely recessive, but other alleles are completely resessive	LG 3
ba	broken antenna	LG 2
Bald	Bald	LG 8
Bamp-27	Blunt abdominal and metathoracic points	LG 3
Bamp-31	Blunt abdominal and metathoracic points	LG 3
Be	Bar eye	LG 4
c	chestnut	LG 7
co	cola body	LG 9
Crab	Crab legs	LG 7
Cx	Cephalothorax	LG 2
Det-43	Divergent elytral tips	T(4; 5)
ds	displaced sternellum	LG 1 = X
Ds	Displaced sternellum	LG 4
Er	Eyes reduced	LG 2
eu	extra urigomphi	LG 2
eu-D	extra urigomphi	T(2; 5)
glossy	glossy cuticle	LG 2
Go	Goliath	LG 7
h	hazel	LG 4
H	Hybrid incompatability factor	LG 9
j	jet body	LG 5
Lin-R	Lindane resistance	LG 3
lod	light ocular diaphragm	LG 3
M^1	Medea factor	LG 3

M^2	Medea factor	LG 3
M^4	Medea factor	unknown
M^9	Medea factor	LG 8
mc	microcephalic	LG 5
Mo	Micro-opthalmic	LG 6
mxp	maxillopedia	LG 2
mxpStb	Stubby	LG 2
mxpStm	Stumpy	LG 2
p	pearl	LG 9
pd	paddle	LG 1 = X
plt	platinum	LG 1 = X
Ps	Pinched sternellum	LG 2
ptl	prothoraxless	LG 2
py	pygmy	LG 1 = X
Pyr-R	Pyrethroid resistance	LG 9
rb	ruby	LG 5
Rd	Reindeer	LG 2
Rmal	Resistance to malathion	LG 6
s	sooty body	LG 4
Se	Split elytra	LG 9
Se-2	Split elytra	LG 8
sp	shoulder pads	LG 2
Spa	Spatulate	T(2; 4)
sq	squint	LG 8
T(2;4) AEs-1	Extra sclerite	T(2; 4)
T(2;4) tr	tremblor	T(2; 4)
T(2;5)Ey	Eyeless	LG 5
T(2;9) mxpDch-1	Dachsund	T(2; 9)
T(2;9) mxpDch-3	Dachsund	T(2; 9)
T(Y;3)	translocation	LG 3
T(Y;4)	translocation	LG 4
tar	tar	LG 2
ub	unbuckled	LG 2
Utx	Ultrathorax	LG 2
vwe	vestigial wings and elytra	LG 2

Last Edited: August 13, 1998

Head

Mutant	Name/note	Linkage Group
ab	antenna bifurcata	LG 9
Ah	Arrowhead	LG 8
ap	antennapedia	LG 8
ba	broken antenna	LG 2
Be	Bar eye	LG 4
c	chestnut	LG 7
Er	Eyes reduced	LG 2
Ff	Fused funicle	LG 8
h	hazel	LG 4
lod	light ocular diaphragm	LG 3
mc	microcephalic	LG 5
Mo	Micro-opthalmic	LG 6
mxp	maxillopedia	LG 2
mxpStb	Stubby	LG 2
mxpStm	Stumpy	LG 2
p	pearl	LG 9
pd	paddle	LG 1 = X
plt	platinum	LG 1 = X
Ps	Pinched sternellum	LG 2
rb	ruby	LG 5
Rd	Reindeer	LG 2
sp	shoulder pads	LG 2
Spa	Spatulate	T(2; 4)
sq	squint	LG 8
T(2;5)Ey	Eyeless	LG 5
T(2;9) mxpDch-1	Dachsund	T(2; 9)

Last Edited: August 13, 1998

Head-antennae

Mutant	Name/note	Linkage Group
ab	antenna bifurcata	LG 9
ap	antennapedia	LG 8
ba	broken antenna	LG 2
Ff	Fused funicle	LG 8
pd	paddle	LG 1 = X
mxpStb	Stubby	LG 2
mxpStm	Stumpy	LG 2
Rd	Reindeer	LG 2
Spa	Spatulate	T(2; 4)
T(2;9) mxpDch-1	Dachsund	T(2; 9)

Last Edited: August 13, 1998

Head-eyes

Mutant	Name/note	Linkage Group
Ah	Arrowhead	LG 8
Be	Bar eye	LG 4
c	chestnut	LG 7
Er	Eyes reduced	LG 2
h	hazel	LG 4
lod	light ocular diaphragm	LG 3
mc	microcephalic	LG 5
Mo	Micro-opthalmic	LG 6
p	pearl	LG 9
plt	platinum	LG 1 = X
rb	ruby	LG 5
sq	squint	LG 8
T(2;5)Ey	Eyeless	T(2; 5)

Last Edited: August 13, 1998

Head-shape

Mutant	Name/note	Linkage Group
Ah	Arrowhead	LG 8
Bamp-31	Blunt abdominal and metathoracic points	LG 3
Cx	Cephalothorax	LG 2
Er	Eyes reduced	LG 2
mc	microcephalic	LG 5
Mo	Micro-opthalmic	LG 6
T(2;5)Ey	Eyeless	LG 5

Last Edited: August 13, 1998

Head-mouthparts

Mutant	Name/note	Linkage Group
mxp	maxillopedia	LG 2
Ps	Pinched sternellum	LG 2
sp	shoulder pads	LG 2

Last Edited: August 13, 1998

Thorax

Mutant	Name/note	Linkage Group
3.2 Bamp	3P2 based crossover suppressor w/ 40+ cM range.	LG 3
3P1	Bamp-27 based crossover suppressor w/ 30 cM range.	LG 3
3P2	Bamp-27 based crossover suppressor w/ 30 cM range, and recessive au.	LG 3
3P3	Bamp-27 based crossover suppressor w/ 45+ cM range.	LG 3
acro	acromegaly	LG 2
ap	antennapedia	LG 8
apt	alate prothorax	LG 2
Bamp-27	Blunt abdominal and metathoracic points	LG 3
Bamp-31	Blunt abdominal and metathoracic points	LG 3
Cx	Cephalothorax	LG 2
Det-43	Divergent elytral tips	T(4; 5)
Ds	Displaced sternellum	LG 4
ds	displaced sternellum	LG 1 = X
mxp	maxillopedia	LG 2
Ps	Pinched sternellum	LG 2
ptl	prothoraxless	LG 2
Rap	Recurved anterior pronotum	LG 2
Se	Split elytra	LG 9
sp	shoulder pads	LG 2
tar	tar	LG 2
ub	unbuckled	LG 2
Utx	Ultrathorax	LG 2
vwe	vestigial wings and elytra	LG 2

Last Edited: August 13, 1998

Thorax-T1

Mutant	Name/note	Linkage Group
apt	alate prothorax	LG 2
Bamp-31	Blunt abdominal and metathoracic points	LG 3
Cx	Cephalothorax	LG 2
ds	displaced sternellum	LG 1 = X
Ds	Displaced sternellum	LG 4
mxp	maxillopedia	LG 2
Ps	Pinched sternellum	LG 2
ptl	prothoraxless	LG 2
Rap	Recurved anterior pronotum	LG 2
sp	shoulder pads	LG 2
tar	tar	LG 2
ub	unbuckled	LG 2

Last Edited: August 13, 1998

Thorax-T2

Mutant	Name/note	Linkage Group
3.2 Bamp	3P2 based crossover suppressor w/ 40+ cM range.	LG 3
3P1	Bamp-27 based crossover suppressor w/ 30 cM range.	LG 3
3P2	Bamp-27 based crossover suppressor w/ 30 cM range, and recessive au.	LG 3
3P3	Bamp-27 based crossover suppressor w/ 45+ cM range.	LG 3
acro	acromegaly	LG 2
ap	antennapedia	LG 8
Bamp-27	Blunt abdominal and metathoracic points	LG 3
Det-43	Divergent elytral tips	T(4; 5)
ds	displaced sternellum	LG 1 = X
Ds	Displaced sternellum	LG 4
Se	Split elytra	LG 9
Se-2	Split elytra	LG 8
Utx	Ultrathorax	LG 2
vwe	vestigial wings and elytra	LG 2

Last Edited: August 13, 1998

Thorax-T3

Mutant	Name/note	Linkage Group
3.2 Bamp	3P2 based crossover suppressor w/ 40+ cM range.	LG 3
3P1	Bamp-27 based crossover suppressor w/ 30 cM range.	LG 3
3P2	Bamp-27 based crossover suppressor w/ 30 cM range, and recessive au.	LG 3
3P3	Bamp-27 based crossover suppressor w/ 45+ cM range.	LG 3
Bamp-27	Blunt abdominal and metathoracic points	LG 3
Bamp-31	Blunt abdominal and metathoracic points	LG 3
Ps	Pinched sternellum	LG 2
vwe	vestigial wings and elytra	LG 2

Last Edited: August 13, 1998

Elytra

Mutant	Name/note	Linkage Group
Det-43	Divergent elytral tips	T(4; 5)
Ds	Displaced sternellum	LG 4
Se	Split elytra	LG 9
Se-2	Split elytra	LG 8
sp	shoulder pads	LG 2
Utx	Ultrathorax	LG 2
vwe	vestigial wings and elytra	LG 2

Last Edited: August 13, 1998

Legs

Mutant	Name/note	Linkage Group
ab	antenna bifurcata	LG 9
Crab	Crab legs	LG 7
Rd	Reindeer	LG 2
T(2;9) mxpDch-1	Dachsund	T(2; 9)
T(2;9) mxpDch-3	Dachsund	T(2; 9)

Last Edited: August 13, 1998

Abdomen-general

Mutant	Name/note	Linkage Group
3.2 Bamp	3P2 based crossover suppressor w/ 40+ cM range.	LG 3
3P1	Bamp-27 based crossover suppressor w/ 30 cM range.	LG 3
3P2	Bamp-27 based crossover suppressor w/ 30 cM range, and recessive au.	LG 3
3P3	Bamp-27 based crossover suppressor w/ 45+ cM range.	LG 3
A	Abdominal	LG 2
Bamp-27	Blunt abdominal and metathoracic points	LG 3
sp	shoulder pads	LG 2
T(2;4) AEs-1	Extra sclerite	T(2; 4)

Last Edited: August 13, 1998

Abdomen-genital

Mutant	Name/note	Linkage Group
A	Abdominal	LG 2
eu	extra ungomphi	LG 2
eu-D	extra ungomphi	T(2; 5)

Last Edited: August 13, 1998

Gross (naked eye; hand lens)

Mutant	Name/note	Linkage Group
A	Abdominal	LG 2
b	black body - b itself is incompletely recessive, but other alleles are completely resessive.	LG 3
Be	Bar eye	LG 4
co	cola body	LG 9
Crab	Crab legs	LG 7
Det-43	Divergent elytral tips	T(4; 5)
Go	Goliath	LG 7
h	hazel	LG 4
Mo	Micro-opthalmic	LG 6
p	pearl	LG 9
plt	platinum	LG 1 = X
Ps	Pinched sternellum	LG 2
py	pygmy	LG 1 = X
rb	ruby	LG 5
Rd	Reindeer	LG 2
s	sooty body	LG 4
j	jet body	LG 5
Se-2	Split elytra	LG 8
sp	shoulder pads	LG 2
T(2;9) mxpDch-3	Dachsund	T(2; 9)
vwe	vestigial wings and elytra	LG 2

Last Edited: August 13, 1998

"Invisible" mutants

Rearrangements (no marker)

Mutant	Linkage Group
T(Y;3)	LG 3
T(Y;4)	LG 4

Hybrid Incompatibility

Mutant	Name/note	Linkage Group
H	Hybrid incompatability factor	LG 9

Insecticide Resistance

Mutant	Name/note	Linkage Group
Lin-R	Lindane resistance	LG 3
Pyr-R	Pyrethroid resistance	LG 9
Rmal	Resistance to malathion	LG 6

MEDEA (maternal effect)

Mutant	Linkage Group
M^1	LG 3
M^2	LG 3
M^3	LG 8
M^4	

Last Edited: August 13, 1998

Rearrangements

Mutant	Name/note	Linkage Group
3.2 Bamp	3P2 based crossover suppressor w/ 40+ cM range.	LG 3
3P1	Bamp-27 based crossover suppressor w/ 30 cM range.	LG 3
3P2	Bamp-27 based crossover suppressor w/ 30 cM range, and recessive au.	LG 3
3P3	Bamp-27 based crossover suppressor w/ 45+ cM range.	LG 3
A	Abdominal	LG 2
Bamp-27	Blunt abdominal and metathoracic points	LG 3
Bamp-31	Blunt abdominal and metathoracic points	LG 3
Cx	Cephalothorax	LG 2
Det-43	Divergent elytral tips	T(4; 5)
eu-D	extra urigomphi	LG 5
mxpStm	Stumpy	LG 2
Spa	Spatulate	T(2; 4)
T(2;4) AEs-1	Extra sclerite	T(2; 4)
T(2;4) tr	tremblor	T(2; 4)
T(2;5)Ey	Eyeless	T(2; 5)
T(2;9) mxpDch-1	Dachsund	T(2; 9)
T(2;9) mxpDch-3	Dachsund	T(2; 9)
T(Y;3)	Translocation	LG 3
T(Y;4)	Translocation	LG 4

Last Edited: August 13, 1998

Global

Mutant	Name/note	Linkage Group
au	aureate	LG 3
b	black body	LG 3
Bald	Bald	LG 8
co	cola body	LG 9
ds	displaced sternellum	LG 1 = X
glossy	glossy cuticle	LG 2
Go	Goliath	LG 7
j	jet body	LG 5
py	pygmy	LG 1 = X
s	sooty body	LG 4
sp	shoulder pads	LG 2

Last Edited: August 13, 1998

Medea

MEDEA is an acronym for Maternal-Effect Dominant Embryonic Arrest

Medea-killed larvae

Medea factors all share several characteristics:

- They breed true through the female line.
- They segregate in the male.

When a heterozygous Medea female (M/+) is crossed to a wild type male (+/+), the M gene and its homolog segregate normally. However, all progeny that do not inherit the Medea allele die at or shortly after egg hatch. The lethality is maternal, but the "rescue" is zygotic. The rescuing M allele can be inherited from either parent.

There have been four well-studied Medea factors. Of these, two (M-1 and M-4) are currently maintained at the Tribolium Stock Center. Almost all M strains in the field carry M-4. Of these, about a third also carry M-1. M-4 is the only Medea factor present in North American and European strains, being found in about half of them. Australian and Indian strains are almost devoid of Medea factors. South American, Asian, and African strains often have 2 or more M factors.

M^1 (Medea)

- **Linkage Group:** 3
- **Description:** The first and most-studied Meda factor.

M^2 (Medea)

- **Linkage Group:** 3
- **Description:** This Medea factor faded away and is no longer detectable.

M^3 (Medea)

- **Linkage Group:** 8
- **Description:** This Medea factor faded away and is no longer detectable.

M^4 (Medea)

- **Linkage Group:** Unknown
- **Description:** This Medea has an interesting distribution within the United States.

Last Edited: August 13, 1998

TRIBOLIUM INFORMATION BULLETIN 39

BIBLIOGRAPHY

A. Tenebrio and other Coleoptera except Tribolium, 1998-1999

B. Tribolium, 1998- early 1999

C. Coleoptera: Tenebrionidae and other families, 1993-1999

BIBLIOGRAPHY

Tenebrio and other Tenebrionidae, 1993-1999. Key to Subjects.

1. Anatomy, Histology and Morphology
2. Behavior and Behavioral Ecology and Evolutionary Ecology
3. Cytology and Fine Structure
4. Tissue Culture, Embryology and Development
5. Ecology and Population Biology
6. General
7. Genetics and Animal Breeding
8. Insecticides, Insecticide Resistance, Attractant and Repellents
9. Irradiation and Use of Isotopes
10. Nutrition
11. Parasitology and Symbiosis
12. Pests
13. Biochemistry, Physiology and Molecular Biology
14. Space and Aerial Ecology
15. Speciation and Evolutionary Biology
16. Statistical Methods and Mathematical Models
17. Taxonomy
18. Technique
19. Teratology

A. Tenebrio and other Coleoptera except Tribolium, 1998-1999

1. Anatomy, Physiology, and Morphology

Dallai,-R.; Lupetti,-P.; Lane,-N.J.
The organization of actin in the apical region of insect midgut cells after deep etching. J-struct-biol. Orlando, Fla. : Academic Press 1998. Vol. 122:283-292.

Meyer,-W.; Jungnickel,-H.; Jandke,-M.; Dettner,-K.; Spiteller,-G.
TI: On the cytotoxicity of oxidized phytosterols isolated from photoautotrophic cell cultures of Chenopodium rubrum tested on meal-worms Tenebrio molitor.
Phytochemistry-Oxford. Oxford : Elsevier Science Ltd. Mar 1998. v. 47 (5) p. 788-797.

2. Behavior, Behavioral Ecology, and Chemical and Evolutionary Ecology

Enders,-M.M.; Schule,-H.; Henschel,-J.R.
Sexual dimorphism, fighting success and mating tactics of male Onymacris plana Peringuey (Coleoptera: Tenebrionidae) of the Namib Desert.
SO: Ethology. Berlin : Paul Parey, 1986-. Dec 1998. v. 104 (12) p. 1003-1019

O'Leary,-S.A.; Stack,-C.M.; Chubb,-M.A.; Burnell,-A.M.
The effect of day of emergence from the insect cadaver on the behavior and environmental tolerances of infective juveniles of the entomopathogenic nematode Heterorhabditis megidis (strain UK211).
J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. Aug 1998. v. 84 (4) p. 665-672.

Rasa,-O.A.E.
Biparental investment and reproductive success in a subsocial desert beetle: the role of maternal effort.
SO: Behav-ecol-sociobiol. Berlin, Ger. : Springer-Verlag. Aug 1998. v. 43 (2) p. 105-113.

Rasa,-O.A.E.
Division of labour and extended parenting in a desert tenebrionid beetle.

Ethology. Berlin : Paul Parey, 1986-. Jan 1999. v. 105 (1) p. 37-56.

3. Cytology, Fine Structure and Chromosome Evolution

4. Tissue Culture, Embryology, and Development

Gorb,-S.N.
Frictional surfaces of the elytra-to-body arresting mechanism in tenebrionid beetles (Coleoptera: Tenebrionidae): design of co-opted fields of microtrichia and cuticle ultrastructure.
SO: Int-j-insect-morphol-embryol. Exeter, U.K. : Elsevier Science Ltd. July 1998. v. 27 (3) p. 205-225.

5. Ecology, Population Biology and Environmental Entomology

Clercq,-P.-de; Merlevede,-F.; Tirry,-L.
Unnatural prey and artificial diets for rearing Podisus maculiventris (Heteroptera: Pentatomidae).
SO: Biol-control. Orlando, Fla. : Academic Press. June 1998. v. 12 (2) p. 137-142.

Pascual-Villalobos, M.J.; Robledo, A.
Anti-insect activity of plant extracts from the wild flora in southeastern Spain. Biiochem. Syst. Ecol. Oxford, U.K. Elsevier Science Ltd. 1999. V/ 27:1-10.

Polis,-G.A.; Barnes,-J.D.; Seely,-M.K.; Henschel,-J.R.; Enders,-M.M.
Predation as a major cost of reproduction in Namib desert tenebrionid beetles.
SO: Ecology. Washington, D.C. : Ecological Society of America. Oct 1998. v. 79 (7) p. 2560-2566.

Riddick, E. W. and Barbosa, P. Impact of Cry3A-intoxicated Leptinotarsa decemlineata (Coleoptera: Chrysom,elidae) and pollen on consumption, development and fecundity of Coleomegilla maculata (ColeopteraL Coccinellidae). Ann. Entom. Soc. Am. Lanham, Md.: Entomological Society of America 01:303-307.

Strohmeyer,-H.H.; Stamp,-N.E.; Jarzomski,-C.M.; Bowers,-M.D.
Prey species and prey diet affect growth of invertebrate predators.
Ecol-entomol. Oxford, U.K. : Blackwell Science Ltd. Feb 1998. v. 23 (1) p. 68-79.

Sverdrup-Thygeson,-A.; Midtgaard,-F.
Fungus-infected trees as islands in boreal forest: spatial distribution of the fungivorous beetle Bolitophagus reticulatus (Coleoptera, Tenebrionidae).
SO: Ecoscience. Sainte-Foy, Quebec : Universite Laval, 1994-. 1998. v. 5 (4) p. 486-493.

BIBLIOGRAPHY

6. General

7. Genetics, , Cytoplasmic Inheritance or Incompatibility, Developmental Genetics, and Animal Breeding

Bills, S., Podilla, G.K. and Hiremath, S.
Genetic engineering of an ectomycorrhizal fungus Laccaria bicolor for use as a biological control agent. Mycologia, Bronx: New York Botanical Garden 1909-. 1999. |Vol. 91:237-242

Giddings,-G.; Mytton,-L.; Griffiths,-M.; McCarthy,-A.; Morgan,-C.; Skot,-L.
TI: A secondary effect of transformation in Rhizobium leguminosarum transgenic for Bacillus thuringiensis subspecies tenebrionis delta-endotoxin (cryIIIA) genes.
SO: Theor-appl-genet. Berlin; Springer-Verlag. Nov 1997. v. 95 (7) p. 1062-1068.

Moran,-R.; Garcia,-R.; Lopez,-A.; Zaldua,-Z.; Mena,-J.; Garcia,-M.; Armas,-R.; Somonte,-D.; Rodriguez,-J.; Gomez,-M.
TI: Transgenic sweet potato plants carrying the delta-endotoxin gene from Bacillus thuringiensis var. tenebrionis.
SO: Plant-sci. Shannon [Clare] : Elsevier Scientific Publishers Ireland Ltd., c1985-. Dec 31, 1998. v. 139 (2) p. 175-184.

Stuart,-J.J.; Ray,-S.; Harrington,-B.J.; Neal,-J.J.; Beeman,-R.W.
TI: Genetic mapping of a major locus controlling pyrethroid resistance in Tribolium castaneum (Coleoptera: Tenebrionidae).
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Dec 1998. v. 91 (6) p. 1232-1238.

8. Insecticides, Insecticide Resistance, Repellents or Attractants

Arthur,-F.H.
TI: Effects of a food source on red flour beetle (Coleoptera: Tenebrionidae) survival after exposure on concrete treated with cyfluthrin.
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. June 1998. v. 91 (3) p. 773-778.

Arthur,-F.H.
TI: Residual studies with cyfluthrin wettable powder: toxicity toward red flour beetles (Coleoptera: Tenebrionidae) exposed for short intervals on treated concrete.
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Feb 1998. v. 91 (1) p. 309-319.

Crawford,-P.J.; Brooks,-W.M.; Arends,-J.J.
TI: Efficacy of field-isolated strains of Beauveria bassiana (Moniliales: Moniliaceae) as microbial control agents of the lesser mealworm (Coleoptera: Tenebrionidae).

Papadopoulos, A.I., Stamkow, E, TI. Kostaropoulos, I. and Papadppoulou-Mourkidou, E. 1999. Effect of organophosphate and pyrethroid insecticides on the expression of GSTs from Tenebrio molitor larvae. Pestic. Biochem. Physiol. Orlando, Fla. Acad. Press 1999. 63:26-33.

9.Irradiation and Use of Isotopes

10. Nutrition and Nutritional Value

Barker,-D.; Fitzpatrick,-M.P.; Dierenfeld,-E.S.
Nutrient composition of selected whole invertebrates.
Zoo-biol. New York, N.Y. : Wiley-Liss, Inc. 1998. v. 17 (2) p. 123-134.

Tallamy,-D.W.; Stull,-J.; Ehresman,-N.P.; Gorski,-P.M.; Mason,-C.E.
Cucurbitacins as feeding and oviposition deterrents to insects.
Environ-entomol. Lanham, Md. : Entomological Society of America. June 1997. v. 26 (3) p. 678-683.

11. Parasitology and symbiosis

Carver,-F.J.; Hurd,-H.
The effects of metacestodes of Hymenolepis diminuta on the bean-shaped accessory glands in male Tenebrio molitor.
Parasitology. Cambridge : Cambridge University Press. Feb 1998. v. 116 (pt.2) p. 191-196.

Cho, M.Y.; Lee,-H.S.; Lee,-K.M.; Homma,-K.; Natori,-S.; Lee,-B.L.
Molecular cloning and functional properties of two early-stage encapsulation-relating proteins from the coleopteran insect, Tenebrio molitor larvae.
Eur-j-biochem. Oxford, UK : Blackwell Science Ltd. June 1999. v. 262 (3) p. 737-744.

Clopton,-R.E.
Revision of the genus Xiphocephalus and description of Xiphocephalus ellisi n. sp. (Apicomplexa: Eugregarinida: Stylocephalidae) from Eleodes opacus (Coleoptera: Tenebrionidae) in the western Nebraska sandhills.
J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. Feb 1999. v. 85 (1) p. 84-89.

Cloutier,-C.; Jean,-C.
Synergism between natural enemies and biopesticides: a test case using the stinkbug Perillus bioculatus (Hemiptera: Pentatomidae) and Bacillus thuringiensis tenebrionis against Colorado potato beetle (Coleoptera: Chrysomelidae).
J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908- Oct 1998. v. 91 (5) p. 1096-1108.

Crawford, P.J., Brooks, W.M. Arends, J.J. Efficacy of field isolated strains of Beauveria bassiana (Moniliales:Moniliaceae) as amicrobial control agents of the lesser mealworm (Coleoptera: Tenebrionidae) as microbial control agents of the lesser mealworm (Coleoptera: Tenebrionidae). J. econ entomol. 1998. V. 91:1295-1301.

Hanelt,-B.; Janovy,-J.-Jr.
The life cycle of a horsehair worm, Gordius robustus (Nematomorpha: Gordioidea).
J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. Feb 1999. v. 85 (1) p. 139-141.

Sato,-K.; Komoto,-M.; Sato,-T.; Enel,-H.; Kobayashi,-M.M.; Yaginuma,-T.
Baculovirus-mediated expression of a gene for trehalase of the mealworm beetle, Tenebrio molitor, in insect cells, SF-9, and larvae of the cabbage armyworm, Mamestra brassicae.
Insect-biochem-mol-biol. Exeter : Elsevier Science Ltd. Dec 1997. v. 27 (12) p. 1007-1016.

Tobin,-P.C.; Pitts,-C.W.
Flotation method for extracting insects from poultry manure samples.
J-med-entomol. Lanham, Md. : The Entomological Society of America. Jan 1999. v. 36 (1) p. 121-123.

12. Pests Pesticides and Pest Control

Alyokhin, A.V. and Ferro, D. N. 1999
Modifications in dispersal and oviposition of Bt-resistant and Bt susceptible Colorado potato beetles as a result of exposure to Bacillus thuringiensis subsp. Tenebroides Cry3A toxin. Entomol. Exp. Appl. Dordrecht: Kluwer Academic Publishers 1999. Vol. 90:93-101.

Bowen,-D.J.; Ensign,-J.C.
Purification and characterization of a high-molecular-weight insecticidal protein complex produced by the entomopathogenic bacterium Photorhabdus luminescens.
Appl-environ-microbiol. Washington : American Society for Microbiology. Aug 1998. v. 64 (8) p. 3029-3035.

Castrillo,-L.A.; Brooks,-W.M.
Differentiation of Beauveria bassiana isolates from the darkling beetle, Alphitobius diaperinus, using isozyme and RAPD analyses.
SO: J-invertebr-pathol. Orlando, Fla. : Academic Press. Nov 1998. v. 72 (3) p. 190-196.

Geden,-C.J.; Arends,-J.J.; Rutz,-D.A.; Steinkraus,-D.C.
TI: Laboratory evaluation of Beauveria bassiana (Moniliales: Moniliaceae) against the lesser mealworm, Alphitobius diaperinus (Coleoptera: Tenebrionidae), in poultry litter, soil, and a pupal trap.
SO: Biol-control. Orlando, Fla. : Academic Press. J-invertebr-pathol. Orlando, Fla. : Academic Press. Nov 1998. v. 72 (3) p. 190-196.

Mracek,-Z.; Becvar,-S.; Kindlmann,-P.; Webster,-J.M.
Infectivity and specificity of Canadian and Czech isolates of Steinernema kraussei (Steiner, 1923) to some insect pests at low temperatures in the laboratory.

Nematologica. Leiden : Brill,. Aug 1998. v. 44 (4) p. 437-448.

O'Leary, S.A., Stack, C.M.. Chubb, M.A. and Burnell, A.M.. The effect of daya of emergence from the insect cadaver on the behavior and environmental tolerances of infective juveniles of the entomopathogenic nematode Heterorhabditis megidis (strain UK211). J. parassitology, Lawrence, Kan. Amer Soc. Parasitologists 1998. V/ 84:665-672.

8.Pesticides

Papadopoulos,-A.I.; Stamkou,-E.I.; Kostaropoulos,-I.; Papadopoulou-Mourkidou,-E.
Effect of organophosphate and pyrethroid insecticides on the expression of GSTs from Tenebrio molitor larvae. Pestic-biochem-physiol. Orlando, Fla. : Academic Press. Jan 1999. v. 63 (1) p. 26-33.

Pascual-Villalobos,-M.J.; Robledo,-A.
TI: Anti-insect activity of plant extracts from the wild flora in southeastern Spain.
SO: Biochem-syst-ecol. Oxford, U.K. : Elsevier Science Ltd. Jan 1999. v. 27 (1) p. 1-10.

Riddick,-E.W.; Dively,-G.; Barbosa,-P. Effect of a seed-mix deployment of Cry3A-transgenic and nontransgenic potato on the abundance of Lebia grandis (Coleoptera: Carabidae) and Coleomegilla maculata (Coleoptera: Coccinellidae).
Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. Sept 1998. v. 91 (5) p. 647-653

Salin, C., Vernon, P. and Vannier
The supercooling and high temperature stupor points of the adult lesser meal worm Alphitobius diaperinus (Coleoptera: Tenebrionidae). J stored prod Res. 1998. V. 34. 385-394

Thurston,-G.S.
Biological control of elm leaf beetle.
J-arboric. Champaign, IL : International Society of Arboriculture. May 1998. v. 24 (3) p. 154-159.

13. Physiology, Biochemistry and Molecular Biology

Aribi,-N.; Quennedey,-A.; Pitoizet,-N.; Delbecque,-J.P.
TI: Ecdysteroid titres in a tenebrionid beetle, Zophobas atratus: effects of grouping and isolation.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Sept 1997. v. 43 (9) p. 815-821.

Baernholdt,-D.; Andersen,-S.O.
TI: Sequence studies on post-ecdysial cuticular proteins from pupae of the yellow mealworm, Tenebrio molitor.
SO: Insect-biochem-mol-biol. Exeter : Elsevier Science Ltd. July 1998. v. 28 (7) p. 517-526.

Bjerke,-R.; Zachariassen,-K.E.
TI: Effects of dehydration on water content, metabolism and body fluid solutes of a carabid beetle from dry savanna in East Africa.

SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Nov 1997. v. 118A (3) p. 779-787.

Chiou,-S.J.; Cerstiaens,-A.; Kotanen,-S.P.; Loof,-A.-de.; Schoofs,-L.
TI: Insect larvae contain substances toxic to adults: the discovery of paralysins.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. May/June 1998. v. 44 (5/6) p. 405-411.

Duman,-J.G.; Li,-N.; Verleye,-D.; Goetz,-F.W.; Wu,-D.W.; Andorfer,-C.A.; Benjamin,-T.; Parmelee,-D.C.
TI: Molecular characterization and sequencing of antifreeze proteins from larvae of the beetle Dendroides canadensis.
SO: J-comp-physiol,-B-Biochem-syst-environ-physiol. Berlin, Germany : Springer. Apr 1998. v. 168 (3) p. 225-232.

Felisberti,-F.; Ventura,-D.F.; Hertel,-H.
TI: Cerebral extraocular photoreceptors in beetles.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Dec 1997. v. 118A (4) p. 1353-1357.

Ferreira,-C.; Torres,-B.B.; Terra,-W.R.
TI: Substrate specificities of midgut beta-glycosidases from insects of different orders.
SO: Comp-biochem-physiol,-Part-B,-Biochem-mol-biol. New York, NY : Elsevier Science Inc. Jan 1998. v. 119B (1) p. 219-225.

Giddings,-G.; Mytton,-L.; Griffiths,-M.; McCarthy,-A.; Morgan,-C.; Skot,-L.
TI: A secondary effect of transformation in Rhizobium leguminosarum transgenic for Bacillus thuringiensis subspecies tenebrionis delta-endotoxin (cryIIIA) genes.
SO: Theor-appl-genet. Berlin; Springer-Verlag. Nov 1997. v. 95 (7) p. 1062-1068.

Howard,-R.W.; Miller,-J.S.; Stanley,-D.W.
TI: The influence of bacterial species and intensity of infections on nodule formation in insects.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Feb 1998. v. 44 (2) p. 157-164.

Hack,-M.A.
TI: The effects of mass and age on standard metabolic rate in house crickets.
SO: Physiol-entomol. Oxford : Blackwell Science Ltd. Dec 1997. v. 22 (4) p. 325-331.

Khebbeb,-M.E.H.; Delachambre,-J.; Soltani,-N.
TI: Lipid metabolism during the sexual maturation of the mealworm (Tenebrio molitor): effect of ingested diflubenzuron.
SO: Pestic-biochem-physiol. Orlando, Fla. : Academic Press. 1997. v. 58 (3) p. 209-217.

Lee,-K.H.; Hong,-S.Y.; Oh,-J.E.; Kwon,-M.Y.; Yoon,-J.H.; Lee,-J.H.; Lee,-B.L.; Moon,-H.M.
TI: Identification and characterization of the antimicrobial peptide corresponding to C-terminal beta-sheet domain of tenecin 1, an antibacterial protein of larvae of Tenebrio molitor.
SO: Biochem-j. London, U.K. : Portland Press Ltd. Aug 15, 1998. v. 334 (pt.1) p. 99-105.

Lee, Y.T.; Kim,-D.H.; Suh,-J.Y.; Chung,-J.H.; Lee,-B.L.; Lee,-Y.; Choi,-B.S.

Structural characteristics of Tenecin 3, an insect antifungal protein.
SO: Biochem-mol-biol-int. London, U.K. : Taylor & Francis Ltd. Mar 1999. v. 47 (3) p. 369-376.

Kostaropoulos,-I.; Papadopoulos,-A.I.
Glutathione S-transferase isoenzymes expressed in the three developmental stages of the insect Tenebrio molitor.
Insect-biochem-mol-biol. Exeter : Elsevier Science Ltd. Nov 1998. v.28 (11) p. 901-909.

Mathelin,-J.; Quennedey,-B.; Bouhin,-H.; Delachambre,-J.
Characterization of two new cuticular genes specifically expressed during the post-ecdysial molting period in Tenebrio molitor.
Gene. Amsterdam : Elsevier Science. May 12, 1998. v. 211 (2) p. 351-359.

Meyer,-W.; Jungnickel,-H.; Jandke,-M.; Dettner,-K.; Spiteller,-G.
On the cytotoxicity of oxidized phytosterols isolated from photoautotrophic cell cultures of Chenopodium rubrum tested on meal-worms Tenebrio molitor.
Phytochemistry-Oxford. Oxford : Elsevier Science Ltd. Mar 1998. v. 47 (5) p. 788-797.

Mouillet,-J.F.; Delbecque,-J.P.; Quennedey,-B.; Delachambre,-J.
Cloning to two putative ecdysteroid receptor from Tenebrio molitor and their developmental expression in the epidermis during metamorphosis.
Eur-j-biochem. Berlin : Springer-Verlag Berlin. Sept 1997. v. 248 (3) p. 856-863.

Naidu,-S.G.
Haemolymph amino acid, sugar and glycerol levels in the Nambi Desert tenebrionid Stips stali during dehydration and rehydration.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Feb 1998. v. 119A (2) p. 477-484.

Reddy,-S.T.; Venkateswerlu,-G.
TI: Intracellular proteases in sporulated Bacillus thuringiensis subsp. tenebrionis: detection and analysis by gelatin zymography.
SO: Biochem-mol-biol-int. Marrickville, N.S.W., Australia : Academic Press. Dec 1997. v. 43 (5) p. 935-943.

Rondot,-I.; Quennedey,-B.; Delachambre,-J.
TI: Structure, organization and expression of two clustered cuticle protein genes during the metamorphosis of an insect, Tenebrio molitor.
SO: Eur-j-biochem. Berlin : Springer-Verlag Berlin. June 1998. v. 254 (2) p. 304-312.

Rothemund,-S.; Liou,-Y.C.; Davies,-P.L.; Sonnichsen,-F.D.
TI: Backbone structure and dynamics of a hemolymph protein from the mealworm beetle Tenebrio molitor.
SO: Biochemistry. Washington, D.C. : American Chemical Society. Nov 11, 1997. v.36 (45) p. 13791-13801

Salin,-C.; Vernon,-P.; Vannier,-G.
TI: The supercooling and high temperature stupor points of the adult lesser mealworm Alphitobius diaperinus (Coleoptera: Tenebrionidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Oct 1998. v. 34 (4) p. 385-394.

Strobl,-S.; Maskos,-K.; Betz,-M.; Wiegand,-G.; Huber,-R.; Gomis-Ruth,-F.X.; Glockshuber,-R.
TI: Crystal structure of yellow meal worm alpha-amylase at 1.64 angstroms resolution.

SO: J-mol-biol. London ; New York : Academic Press, 1959-. May 8, 1998. v. 278 (3) p. 617-628.

Tebayashi,-S.; Hirai,-N.; Suzuki,-T.; Matsuyama,-S.; Nakakita,-H.; Nemoto,-T.; Nakanishi,-H.
TI: Identification of (+)-acoradiene as an aggregation pheromone for Gnatocerus cornutus (F.) (Coleoptera: Tenebrionidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Apr/July 1998. v. 34 (2/3) p. 99-106.

Vacha,-M.
The influence of a static, homogenous magnetic field (B = 320 mT) on extracardiac pulsations of Tenebrio molitor pupae (Coleoptera: Tenebrionidae).
J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Nov 1997. v. 43 (11) p. 979-989.

14. Space and Aerial Ecology

15. Speciation and Evolutionary Genetics

Plohl,-M.; Mestrovic,-N.; Bruvo,-B.; Ugarkovic,-D.
TI: Similarity of structural features and evolution of satellite DNAs from Palorus subdepressus (Coleoptera) and related species.
SO: J-mol-evol. New York, N.Y. : Springer-Verlag. Feb 1998. v. 46 (2) p. 234-239.

Pons,-J.; Bruvo,-B.; Juan,-C.; Petitpierre,-E.; Plohl,-M.; Ugarkovic,-D.
TI: Conservation of satellite DNA in species of the genus Pimelia (Tenebrionidae, Coleoptera).
SO: Gene. Amsterdam : Elsevier Science

16. Statistical Methods

17. Taxonomy

Bremer,-H.J.; Triplehron,-C.A.
The Latin American species of the genus Corticeus Piller and Mitterpacher (Coleoptera: Tenebrionidae, Hypophloeini). I. The species described by Reitter and Pic, and description of two new species.
Coleopt-bull. Sacramento, CA : Coleopterists Society. Mar 1999. v. 53 (1) p 56-63.

Maxwell,-J.A.; Young,-D.K.
A significant eastern range extension for Eleodes tricostatus (Say) (Coleoptera: Tenebrionidae).
Coleopt-bull. Sacramento, CA : Coleopterists Society. Mar 1998. v. 52 (1) p. 90-92.

Palmer,-M.
Taxonomy, phylogeny, and biogeography of a species-group of west-Mediterranean Tentyria (Coleoptera: Tenebrionidae).
Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. May 1998. v. 91 (3) p. 260-268.

Philips,-T.K.; Steiner,-W.E.-Jr.; Triplehorn,-C.A.
TI: A new species of Central American Platydema Laporte and Brulle (Coleoptera: Tenebrionidae) recently established in Florida.
SO: Coleopt-bull. Sacramento, CA : Coleopterists Society. Sept 1998. v. 52 (3) p. 291-296.

18. Technique

Tobin, P.C. and Pitts, C.W. Flotation method for extracting insesects from poultry manure samples. J. med. Entomol. Lanham, Md. The Entomological Society of America 1999. V. 36:121-123.

19. Teratology

BIBLIOGRAPHY

TRIBOLIUM INFORMATION BULLETIN Volume 39

B. Tribolium 1998-early 1999

1 Anatomy, Histology and Morphology

2. Behavior and Behvioral Ecology

Arnaud, Ludovic; Haubruge, Eric. Mating behaviour and male mate choice in Tribolium castaneum (Coleoptera, Tenebrionidae). Behaviour, v.136, n.1, Jan., 1999.:67-77.

Bloch Qazi, M. C.; Kobel, A. M.; Lewis, S. M.. Female control over sperm precedence in a flour beetle. American Zoologist, v.37, n.5, 1997.:114A.

Hagstrum, David W.; Flinn, Paul W.; Gaffney, Jerry J.. Temperature gradient on Tribolium castaneum (Coleoptera: Tenebrionidae) adult dispersal in stored wheat. Environmental Entomology, v.27, n.1, Feb., 1998.:123-129.

Hasan, Md. Mahbub Mating competitiveness of adult males of Tribolium spp.(Coleoptera: Tenebrionidae) developing from irradiated pupae. Journal of Stored Products Research, v.35, n.3, July, 1999.:307-316.

Kotaki, Toyomi; Nakakita, Hiroshi; Kuwahara, Masahiko. Crowding inhibits pupation in Tribolium freemani (Coleoptera: Tenebrionidae): Effects of isolation and juvenile hormone analogues on development and pupation. Applied Entomology and Zoology, v.28, n.1, 1993.:43-52.

Lewis, Sara M.; Austad, Steven N.. Sexual selection in flour beetles: The relationship between sperm precedence and male olfactory attractiveness. Behavioral Ecology, v.5, n.2, 1994.:219-224.

Lewis, Sara M.; Jutkiewicz, Emily. Sperm precedence and sperm storage in multiply mated red flour beetles. Behavioral Ecology and Sociobiology, v.43, n.6, Nov. 1, 1998.:365-369.

Zotov, V. A.; Chernyshev, V. B.. Circadian rhythm of activity in the tenebrionid beetle Blaps faustii (Coleoptera, Tenebrionidae) from the Kara-Kum Desert (Turkmenistan). Zoologicheskii Zhurnal, v.77, n.12, Dec., 1999.:1389-1393.

3

Ahmad, S. A.; Hopkins, T. L.. Phenol beta-glucosyltransferases in six species of insects: Properties and tissue localization. Comparative Biochemistry and Physiology B Comparative Biochemistry, v.104, n.3, 1993.:515-519.

Barcelo, Francisco; Gutierrez, Francisco; Barjau, Ignasi; Portugal, Jose. A theoretical perusal of the satellite DNA curvature in tenebrionid beetles. Journal of Biomolecular Structure and Dynamics, v.16, n.1, Aug., 1998.:41-50.

Dallai,-R.; Lupetti,-P.; Lane,-N.J.
TI: The organization of actin in the apical region of insect midgut cells after deep etching.
SO: J-struct-biol. Orlando, Fla. : Academic Press. 1998. v. 122 (3) p. 283-292.

Gorb, Stanislav N.. Ultrastructure of the thoracic dorso-medial field (TDM) in the elytra-to-body arresting mechanism in tenebrionid beetles (Coleoptera: Tenebrionidae). Journal of Morphology, v.240, n.2, May, 1999.:101-113.

Hirashima, Akinori; Hirokado, Shiori; Tojikubo, Risa; Takeya, Ryuko; Taniguchi, Eiji; Eto, Morifusa. Metamorphosis of the red flour beetle, Tribolium freemani Hinton (Coleoptera: Tenebrionidae): Alteration of octopamine content modulates activity of juvenile-hormone esterase, ecdysteroid level, and pupation. Archives of Insect Biochemistry and Physiology, v.37, n.1, 1998.:33-46.

Nagamatsu, Yasunori; Toda, Satoshi; Yamaguchi, Fumihide; Ogo, Masashi; Kogure, Masato; Nakamura, Masahiro; Shibata, Yasuyo; Katsumoto, Tetsuo. Identification of Bombyx mori midgut receptor for Bacillus thuringiensis insecticidal CryIA(a) toxin. Bioscience Biotechnology and Biochemistry, v.62, n.4, April, 1998.:718-726.

Plohl, Miroslav; Lucijanic-Justic, Vlatka; Ugarkovic, Durdica; Petitpierre, Eduard; Juan, Carlos. Satellite DNA and heterochromatin of the flour beetle Tribolium confusum. Genome, v.36, n.3, 1993.:467-475.

Rondot, Isabelle; Quennedey, Brigitte; Delachambre, Jean.
Structure, organization and expression of two clustered cuticle protein genes

during the metamorphosis of an insect, Tenebrio molitor. European Journal of Biochemistry, v.254, n.2, June, 1998.:304-312.

Ruedas, Luis A.; Cook, Joseph A.; Yates, Terry L.; Bickham, John W..
Conservative genome size and rapid chromosomal evolution in the South American tuco-tucos (Rodentia: Ctenomyidae). Genome, v.36, n.3, 1993.:449-458.

Trepte, Hans,-H. Ultrastructural analysis of balbiani ring genes of Chironomus pallidivittatus in different states of Balbiani ring activity. Chromosoma (Berlin), v.102, n.7, 1993.:433-445.

Ugarkovic, D. L.; Plohl, M.; Lucijanic-Justic, V.; Borstnik, B..
Detection of satellite DNA in Palorus ratzeburgii: Analysis of curvature profiles and comparison with Tenebrio molitor satellite DNA. Biochimie (Paris),v.74, n.12, 1992 (1993).:1075-1082.

Wolf,-K.W.
TI: Fine structure of the kinetochores in six species of the Coleoptera.
SO: Genome. Ottawa, Ontario, Canada : National Research Council of Canada. June 1997. v. 40 (3) p. 379-385.
CN: DNAL QH431.G452

4

Hirashami, Akinori; Nagano, Takeshi; Takeya, Ryuko; Eto, Morifusa.
Effect of larval density on whole-body biogenic amine levels of Tribolium freemani Hinton. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.106, n.2, 1993.:457-461.

Quennedey, Andre; Quennedey, Brigitte. Development of the wing discs of Zophobas atratus under natural and experimental conditions: Occurrence of a gradual larval-pupal commitment in the epidermis of tenebrionid beetles. Cell & Tissue Research, v.296, n.3, June, 1999.:619-634.

Zanuncio,-J.C.; Saavedra,-J.L.D.; Oliveira,-H.N.; Degheele,-D.; Clercq,-P.-de.
TI: Development of the predatory stinkbug Brontocoris tabidus (Signoret) (Heteroptera: Pentatomidae) on different proportions of an artificial diet and pupae of Tenebrio molitor L. (Coleoptera: Tenebrionidae).
SO: Biocontrol-sci-technol. Abingdon, Oxfordshire : Carfax Publishing Co,. Dec 1996. v. 6 (4) p. 619-625.

5

BIBLIOGRAPHY

Aloia, A.; Colombini, I.; Fallaci, M.; Chelazzi, L.. Behavioural adaptations to zonal maintenance of five species of tenebrionids living along a Tyrrhenian sandy shore. Marine Biology (Berlin), v.133, n.3, April, 1999.:473-487.

Benoit, Hugues P.; McCauley, Edward; Post, John R.. Testing the demographic consequences of cannibalism in Tribolium confusum. Ecology (Washington D C), v.79, n.8, Dec., 1998.:2839-2851.

Bloch Qazi, Margaret C.; Herbeck, Joshua T.; Lewis, Sara M.. Mechanisms of sperm transfer and storage in the red flour beetle (Coleoptera: Tenebrionidae). Annals of the Entomological Society of America, v.89, n.6, 1996.:892-897.

Bremer, Hans J.; Girard, Claude. The entomological fauna of dead termitaries of Macrotermes. Occurrence of Alphitobius lamottei Ardoin in the chamber of dead termitaries (Coleoptera, Tenebrionidae, Alphitobiini). Revue Francaise d'Entomologie (Nouvelle Serie), v.18, n.4, 1996 (1997).:135-137.

Cicchino, Armando C.. Role of fimicolous Coleoptera as "natural enemies" of the horn fly in Argentina. Status of their knowledge and perspectives. Revista de la Sociedad Entomologica Argentina, v.58, n.1-2, 1999.:172-179.

Cloutier,-C.; Jean,-C.
TI: Synergism between natural enemies and biopesticides: a test case using the stinkbug Perillus bioculatus (Hemiptera: Pentatomidae) and Bacillus thuringiensis tenebrionis against Colorado potato beetle (Coleoptera: Chrysomelidae).
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Oct 1998. v. 91 (5) p. 1096-1108.

Crum, D. A.; Weiser, L. A.; Stamp, N. E.. Effects of prey scarcity and plant material as a dietary supplement on an insect predator. Oikos, v.81, n.3, April, 1998.:549-557.

Cushing, J. M.; Dennis, Brian; Desharnais, R. A.; Costantino, R. F.. Moving toward an unstable equilibrium: Saddle nodes in population systems. Journal of Animal Ecology, v.67, n.2, March, 1998.:298-306.

Dennis, Brian; Desharnais, R. A.; Cushing, J. M.; Costantino, R. F.. Transitions in population dynamics: Equilibria to periodic cycles to aperiodic cycles. Journal of Animal Ecology, v.66, n.5, 1997.:704-729.

Fields, P. G.; White, N. D. G.. Survival and multiplication of stored-product beetles at simulated and actual winter temperatures. Canadian Entomologist, v.129, n.5, Sept.-Oct., 1997.:887-898.

BIBLIOGRAPHY

Hendricks, Paul; Hendricks, Lisa M.. Field observations on the myrmecophilous beetle Araeoschizus airmeti Tanner (Coleoptera: Tenebrionidae) at harvester ant (Hymenoptera: Formicidae) mounds. Great Basin Naturalist, v.59, n.3, July, 1999.:297-299.

Henson, Shandelle M.; Cushing, J. M.; Costantino, R. F.; Dennis, Brian; Desharnais, Robert A.. Phase switching in population cycles. Proceedings of the Royal Society of London Series B Biological Sciences, v.265, n.1411, Nov. 22, 1998.:2229-2234.

Hoback, W. Wyatt; Stanley, David W.; Higley, Leon G.; Barnhart, M. Christopher. Survival of immersion and anoxia by larval tiger beetles, Cicindela togata. American Midland Naturalist, v.140, n.1, July, 1998.:27-33.

Haubruge, E.; Arnaud, L.; Mignon, J.; Gage, M.J.G.. Fertilization by proxy: Rival sperm removal and translocation in a beetle. Proceedings of the Royal Society Biological Sciences Series B, v.266, n.1424, June 7, 1999.:1183-1187.

Jacobson, K. M.; Jacobson, P. J.. Rainfall regulates decomposition of buried cellulose in the Namib Desert. Journal of Arid Environments, v.38, n.4, April, 1998.:571-583.

Krasnov, B. R.; Shenbrot, G. I.. Structure of communities of ground-dwelling animals at the junction of two phytogeographic zones. Journal of Biogeography, v.25, n.6, Nov., 1998.:1115-1131.

McIntyre, Nancy E.; Wiens, John A.. Interactions between habitat abundance and configuration: Experimental validation of some predictions from percolation theory. Oikos, v.86, n.1, July, 1999.:129-137.

Naidu,-S.G.
TI: Haemolymph amino acid, sugar and glycerol levels in the Nambi Desert tenebrionid Stips stali during dehydration and rehydration.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Feb 1998. v. 119A (2) p. 477-484.

Oussou, Richard D.; Meikle, W. G.; Markham, R. H.. Factors affecting larval survivorship and development rate of Teretriosoma nigrescens Lewis. Insect Science and its Application, v.18, n.1, Jan.-March, 1998.:53-58.

Parajulee, Megha N.; Phillips, Thomas W.; Hogg, David B.. Functional response of Lyctocoris campestris (F.) adults: Effects of predator sex, prey species, and experimental habitat. Biological Control, v.4, n.1, 1994.:80-87.

BIBLIOGRAPHY

Pascual-Villalobos,-M.J.; Robledo,-A.
TI: Anti-insect activity of plant extracts from the wild flora in southeastern Spain.
SO: Biochem-syst-ecol. Oxford, U.K. : Elsevier Science Ltd. Jan 1999. v. 27 (1) p. 1-10.

Polis, Gary A.; Barnes, Joseph D.; Seely, Mary K.; Henschel, Joh R.; Enders, Margit M.. Predation as a major cost of reproduction in Namib Desert tenebrionid beetles. Ecology (Washington D C), v.79, n.7, Oct., 1998.:2560-2566.

Riddick,-E.W.; Dively,-G.; Barbosa,-P.
TI: Effect of a seed-mix deployment of Cry3A-transgenic and nontransgenic potato on the abundance of Lebia grandis (Coleoptera: Carabidae) and Coleomegilla maculata (Coleoptera: Coccinellidae).
SO: Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. Sept 1998. v. 91 (5) p. 647-653.

Riddick,-E.W.; Barbosa,-P.
TI: Inpact of Cry3A-intoxicated Leptinotarsa decemlineata (Coleoptera: Chrysomelidae) and pollen on consumption, development, and fecundity of Coleomegilla maculata (Coleoptera: Coccinellidae).
SO: Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. May 1998. v. 91 (3) p. 303-307.

Rivera-Cervantes, Luis Eugenio; Moron, Miguel Angel. The Coleoptera community associated with rotten logs in a cloud forest of Sierra de Manantlan, Jalisco, Mexico. Folia Entomologica Mexicana, v.0, n.85, 1992 (1994).:65-76.

Roig-Junent, Sergio A.; Claver, Silvia. The entomofauna from the Monte and its conservation in natural protected areas. Revista de la Sociedad Entomologica Argentina, v.58, n.1-2, 1999.:117-127.

Stewart, Jeff G.; Feldman, Jennifer; LeBlanc, Debby A.. Resistance of transgenic potatoes to attack by Epitrix cucumeris (Coleoptera: Chrysomelidae). Canadian Entomologist, v.131, n.4, July-Aug., 1999.:423-431.

Strohmeyer, Heather Horan; Stamp, Nancy E.; Jarzomski, Christine M.; Bowers, M. Deane. Prey species and prey diet affect growth of invertebrate predators. Ecological Entomology, v.23, n.1, Feb., 1998.:68-79.

Sugg, Patrick M.; Edwards, John S.. Pioneer aeolian community development on pyroclastic flows after the eruption of Mount St. Helens, Washington, U.S.A. Arctic and Alpine Research, v.30, n.4, Nov., 1998.:400-407.

Sverdrup-Thygeson,-A.; Midtgaard,-F.

TI: Fungus-infected trees as islands in boreal forest: spatial distribution of the fungivorous beetle Bolitophagus reticulatus (Coleoptera, Tenebrionidae).
SO: Ecoscience. Sainte-Foy, Quebec : Universite Laval, 1994-. 1998. v. 5 (4) p. 486-493.

Tikku, K.; Saxena, Bhaskar P.. Induction of sterility in testis of Tribolium castaneum (Herbst) by suboptimal temperature. Indian Journal of Experimental Biology, v.35, n.12, Dec., 1997.:1348-1352.

Via, Sara. Cannibalism facilitates the use of a novel environment in the flour beetle, Tribolium castaneum. Heredity, v.82, n.3, March, 1999.:267-275.

Vilenkin, B. Y.; Chikatunov, V. I.. Co-occurrence of species with various geographical ranges, and correlation between area size and number of species in geographical scale. Journal of Biogeography, v.25, n.2, March, 1998.:275-284.0

Whitehead, P. F.. Further observations on Tribolium castaneum (Herbst) (Col., Tenebrionidae), especially in arboreal contexts. Entomologist's Monthly Magazine, v.135, n.1616-1619, Jan.-April, 1999.:76.

Yoshimatsu, Shin-Ichi; Arimura, Kazuhiro; Shimanuki, Tadayuki. Comparison of population growth rates of confused flour beetle, Tribolium confusum Jacquelin (Coleoptera: Tenebrionidae), on endophyte-infected or endophyte-uninfected seeds of ground tall fescue and perennial ryegrass. Japanese Journal of Applied Entomology and Zoology, v.42, n.4, Nov., 1998.:227-229.

Hass,-B.; Griffin,-C.T.; Keating,-J.G.; Downes,-M.J.
TI: Application of the most probable number method to estimations of entomopathogenic nematode populations in soil.
SO: Ann-appl-biol. Warwick : Association of Applied Biologists. Dec 1997. v. 131 (3) p. 471-480.

6

Henschel, Joh R.. Dune spiders of the Negev Desert with notes on Cerbalus psammodes (Heteropodidae). Israel Journal of Zoology, v.44, n.2, 1998.:243-251.

7

Andreev, Dmitri; Kreitman, Martin; Phillips, Thomas W.; Beeman, Richard W.; ffrench-Constant, Richard H.. Multiple origins of cyclodiene insecticide resistance in Tribolium castaneum (Coleoptera: Tenebrionidae).

BIBLIOGRAPHY

Journal of Molecular Evolution, v.48, n.5, March, 1999.:615-624.

Beeman, Richard W.; Friesen, Kenlee S.. Properties and natural occurrence of maternal-effect selfish genes ('Medea' factors) in the Red Flour Beetle, Tribolium castaneum. Heredity, v.82, n.5, May, 1999.:529-534.

Beeman, R. W.; Stauth, D. M.. Rapid cloning of insect transposon insertion junctions using 'universal' PCR. Insect Molecular Biology, v.6, n.1, 1997.:83-88.

Berghammer, Andreas; Bucher, Gregor; Maderspacher, Florian; Klingler, Martin. A system to efficiently maintain embryonic lethal mutations in the flour beetle Tribolium castaneum. Development Genes and Evolution, v.209, n.6, June, 1999.:382-388.

Bennett, Randy; Cheatham, Joanna; Vaughan, Cecily; Whiting, Mike; Brown, Sue; Denell, Rob. Molecular and genetic analysis of the Ubx homologs in Beetles and Strepsiptera. Developmental Biology, v.198, n.1, June 1, 1998.:201.

Beeman, Richard W.; Stuart, Jeffrey J.; Brown, Susan J.; Denell, Robin E.. Structure and function of the homeotic gene complex (HOM-C) in the beetle, Tribolium castaneum. Bioessays, v.15, n.7, 1993.:439-444.

Bengston, Mervyn; Collins, Patrick J.; Daglish, Gregory J.; Hallman, Vivienne L.; Kopittke, Rosemary; Pavic, Hervoika. Inheritance of phosphine resistance in Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.92, n.1, Feb., 1999.:17-20.

Bills,-S.; Podila,-G.K.; Hiremath,-S.
TI: Genetic engineering of an ectomycorrhizal fungus Laccaria bicolor for use as a biological control agent.
SO: Mycologia. Bronx : New York Botanical Garden, 1909-. Mar/Apr 1999. v. 91 (2) p. 237-242.

Brown, S.; Holtzman, S.; Kaufman, T.; Denell, R.. Characterization of the Tribolium Deformed ortholog and its ability to directly regulate Deformed target genes in the rescue of a Drosophila Deformed null mutant. Development Genes and Evolution, v.209, n.7, July, 1999.:389-398.

Brown, Susan J.; Patel, Nipam H.; Denell, Robin E.. Embryonic expression of the single Tribolium engrailed homolog. Developmental Genetics, v.15, n.1, 1994.:7-18.

Brown, Susan J.; Parrish, Janet K.; Beeman, Richard W.; Denell, Robin E.. Molecular characterization and embryonic expression of the

BIBLIOGRAPHY

even-skipped ortholog of Tribolium castaneum. Mechanisms of Development, v.61, n.1-2, 1997.:165-173.

Castrillo, Louela A.; Wiegmann, Brian M.; Brooks, Wayne M.. Genetic variation in Beauveria bassiana populations associated with the darkling beetle, Alphitobius diaperinus. Journal of Invertebrate Pathology, v.73, n.3, May, 1999.:269-275.

Collins, P. J.. Inheritance of resistance to pyrethroid insecticides in Tribolium castaneum (Herbst). Journal of Stored Products Research, v.34, n.4, Oct., 1998.:395-401.

Doctor, J.; McKeon, B.; Oshop, G.; Pincus, M.; Pletcher, M.; Sanchez-Salazar, J.; Teahan, T.; Zahorchak, A.. The decapentaplegic and 60A genes of the red four beetle, Tribolium castaneum, are similar to Drosophila and vertebrate members of the TGF-beta superfamily in sequence, structure, and expression. Developmental Biology, v.198, n.1, June 1, 1998.:201.

Donahaye, E.. Biological differences between strains of Tribolium castaneum selected for resistance to hypoxia and hypercarbia, and the unselected strain. Physiological Entomology, v.18, n.3, 1993.:247-250.

Fialho, Roberto F.; Stevens, Lori. Molecular evidence for single Wolbachia infections among geographic strains of the flour beetle Tribolium confusum. Proceedings of the Royal Society of London Series B Biological Sciences, v.264, n.1384, 1997.:1065-1068.

Giddings,-G.; Mytton,-L.; Griffiths,-M.; McCarthy,-A.; Morgan,-C.; Skot,-L. TI: A secondary effect of transformation in Rhizobium leguminosarum transgenic for Bacillus thuringiensis subspecies tenebrionis delta-endotoxin (cryIIIA) genes. SO: Theor-appl-genet. Berlin; Springer-Verlag. Nov 1997. v. 95 (7) p. 1062-1068.

Goodnight, Charles J.; Schwartz, James M.. A bootstrap comparison of genetic covariance matrices. Biometrics, v.53, n.3, 1997.:1026-1039.

Hoffmann, Ary A.; Turelli, Michael. Cytoplasmic incompatibility in insects. O'Neill, S. L. Hoffman, A. A. Werren, J. H. Influential passengers: Inherited microorganisms and arthropod reproduction., 1997.:42-80.

Hurst, Laurence D.. Scat+ is a selfish gene analogous to Medea of Tribolium castaneum. Cell, v.75, n.3, 1993.:407-408.

Jelenkovic, Gojko; Billings, Sharon; Chen, Qi; Lashomb, James; Hamilton, George; Ghidiu, Gerald. Transformation of eggplant with synthetic cryIIIA gene produces a high level of resistance to the Colorado potato beetle.

BIBLIOGRAPHY

Journal of the American Society for Horticultural Science, v.123, n.1, Jan., 1998.:19-25.

Juan, Carlos; Vazquez, Patricia; Rubio, Jose M.; Petitpierre, Eduard; Hewitt, Godfrey M.. Presence of highly repetitive DNA sequences in Tribolium flour beetles. Heredity, v.70, n.1, 1993.:1-8.

Koncagul, S.; Berger, P. J.. Estimates variance components in lines of Tribolium castaneum selected for pupa weight. Journal of Animal Science, v.75, n.SUPPL. 1, 1997.:35.

Mathelin, Jocelyne; Quennedey, Brigitte; Bouhin, Herve; Delachambre, Jean. Characterization of two new cuticular genes specifically expressed during the post-ecdysial molting period in Tenebrio molitor. Gene (Amsterdam), v.211, n.2, May 12, 1998.:351-359.

Misra, H. P.; Bhatia, Parvathy. Cross-resistance of laboratory-selected fenvalerate-resistant strain of rust-red flour beetle (Tribolium castaneum). Indian Journal of Agricultural Sciences, v.67, n.10, Oct., 1997.:485-487.

Pons,-J.; Bruvo,-B.; Juan,-C.; Petitpierre,-E.; Plohl,-M.; Ugarkovic,-D.
TI: Conservation of satellite DNA in species of the genus Pimelia (Tenebrionidae, Coleoptera).
SO: Gene. Amsterdam : Elsevier Science. Dec 31, 1997. v. 205 (1/2) p. 183-190.

Pray, Leslie A.. The effect of inbreeding on population-level genetic correlations in the red flour beetle Tribolium castaneum. Evolution, v.51, n.2, 1997.:614-619.

Pray, Leslie A.; Goodnight, Charles J.. The effect of inbreeding on phenotypic variance in the red flour beetle Tribolium castaneum. Evolution, v.51, n.1, 1997.:308-313.

Rohr, Klaus B.; Tautz, Diethard; Sander, Klaus. Segmentation gene expression in the mothmidge Clogmia albipunctata (Diptera, Psychodidae) and other primitive dipterans. Development Genes and Evolution, v.209, n.3, March, 1999.:145-154.

Rondot,-I.; Quennedey,-B.; Delachambre,-J.
TI: Structure, organization and expression of two clustered cuticle protein genes during the metamorphosis of an insect, Tenebrio molitor.
SO: Eur-j-biochem. Berlin : Springer-Verlag Berlin. June 1998. v. 254 (2) p. 304-312.

Sanchez-Salazar, Jorge; Pletcher, Mathew T.; Bennett, Randy L.;

BIBLIOGRAPHY

Brown, Susan J.; Dandamudi, Tulasi J.; Denell, Robin E.; Doctor, John S.. The Tribolium decapentaplegic gene is similar in sequence, structure, and expression to the Drosophila dpp gene. Development Genes and Evolution, v.206, n.4, 1996.:237-246.

Schroeder, Reinhard; Jay, Daniel G.; Tautz, Diethard. Elimination of EVE protein by CALI in the short germ band insect Tribolium suggests a conserved pair-rule function for even skipped. Mechanisms of Development, v.80, n.2, Feb., 1999.:191-195.

Schulz, Cordula; Schroeder, Reinhard; Hausdorf, Bernhard; Wolff, Christian; Tautz, Diethard. A caudal homologue in the short germ band beetle Tribolium shows similarities to both, the Drosophila and the vertebrate caudal expression patterns. Development Genes and Evolution, v.208, n.5, July, 1998.:283-289.

Silvela, Luis; de la Pena, Isabel; Gomez-Ruano, Ramiro. Selection under negative linkage disequilibrium. Random mating versus inbreeding. Heredity, v. 82, n.6, June, 1999.: 598-604.

Sommer, Ralf J.; Tautz, Diethard. Expression patterns of twist and snail in Tribolium (Coleoptera) suggest a homologous formation of mesoderm in long and short germ band insects. Developmental Genetics, v.15, n.1, 1994.:32-37.

Stuart, Jeffrey J.; Ray, Suparna; Harrington, B. Jane; Neal, Jonathan J.; Beeman, Richard W.. Genetic mapping of a major locus controlling pyrethroid resistance in Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.91, n.6, Dec., 1998.:1231-1238.

Sulston, Ingrid A.; Anderson, Kathyrn V.. Altered patterns of gene expression in Tribolium segmentation mutants. Developmental Genetics, v.23, n.1, 1998.:56-64.

Tautz, D.; Klingler, M.; Schroeder, R.; Wolff, C.. Conservation and divergence of the segmentation gene hierarchy in insects. American Zoologist, v.37, n.5, 1997.:172A.

Thomson, M. Scott; LaBonne, Awilda M.. Maternal effect of a hybrid inviability gene in Tribolium castaneum. Genetica (Dordrecht), v.104, n.2, 1998.:155-159.

Van Eeden, Fredericus J. M.; Holley, Scott A.; Haffter, Pascal; Nuesslein-Volhard, Christiane. Zebrafish segmentation and pair-rule patterning. Developmental Genetics, v.23, n.1, 1998.:65-76.

Wade, Michael J.; Johnson, Norman A.; Jones, Rachel; Siguel, Vera; McNaughton, Michael. Genetic variation segregating in natural populations of

Tribolium castaneum affecting traits observed in hybrids with T. freemani. Genetics, v.147, n.3, 1997.:1235-1247.

Wade, Michael J.; Griesemer, James R.. Populational heritability: Empirical studies of evolution in metapopulations. American Naturalist, v.151, n.2, Feb., 1998.:135-147.

Wade, Michael J.; Johnson, Norman A.; Toquenaga, Yukihiko. Temperature effects and genotype-by-environment interactions in hybrids: Haldane's rule in flour beetles. Evolution, v.53, n.3, June, 1999.:855-865.

Xu, Xin; Xu, Pin-Xian; Amanai, Kazuhito; Suzuki, Yoshikai. Double-segment defining role of even-skipped homologs along the evolution of insect pattern formation. Development Growth & Differentiation, v.39, n.4, 1997.:515-522.

Zettler,-J.L.; Arthur,-F.H.
TI: Dose-response tests on red flour beetle and confused flour beetle (Coleoptera: Tenebrionidae) collected from flour mills in the United States.
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Oct 1997. v. 90 (5) p. 1157-1162.

8

Abdel-Razek, A. S.; Salama, H. S.; White, N. D. G.; Morris, O. N.. Effect of Bacillus thuringiensis on feeding and energy use by Plodia interpunctella (Lepidoptera: Pyralidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Canadian Entomologist, v.131, n.4, July-Aug., 1999.:433-440.

Arthur, Frank H.. Degradation of cyfluthrin EC and WP residues on painted steel: Effects of commercial sealants on residual persistence. Journal of Stored Products Research, v.30, n.2, 1994.:163-170.

Arthur, Frank H.. Differential effectiveness of deltamethrin dust on plywood, concrete, and tile surfaces against three stored-product beetles. Journal of Stored Products Research, v.33, n.2, 1997.:167-173.

Arthur, Frank H.. Effects of a food source on red flour beetle (Coleoptera: Tenebrionidae) survival after exposure on concrete treated with cyfluthrin. Journal of Economic Entomology, v.91, n.3, June, 1998.:773-778.

Arthur, Frank H.. Efficacy of unsynergised deltamethrin and

deltamethrin + chlorpyrifos-methyl combinations as protectants of stored wheat and stored corn (Maize). Journal of Stored Products Research, v.30, n.1, 1994.:87-94.

Arthur, Frank H.; Brown, Steve L.. Evaluation of diatomaceous earth (Insecto) and Bacillus thuringiensis formulations for insect control in stored peanuts. Journal of Entomological Science, v.29, n.2, 1994.:176-182.

Arthur, Frank H.. Residual efficacy of cyfluthrin emulsifiable concentrate and wettable powder formulations on porous concrete and on concrete sealed with commercial products prior to insecticide application. Journal of Stored Products Research, v.30, n.1, 1994.:79-86.

Arthur, Frank H.. Residual studies with cyfluthrin wettable powder: Toxicity toward red flour beetles (Coleoptera: Tenebrionidae) exposed for short intervals on treated concrete. Journal of Economic Entomology, v.91, n.1, Feb., 1998.:309-319.

Arthur, Frank H.. Residual toxicity of cyfluthrin wettable powder against Tribolium confusum (Coleoptera: Tenebrionidae) exposed for short time intervals on concrete. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:19-25.

Arthur, Frank H.. Survival of red flour beetles (Coleoptera: Tenebrionidae) on concrete partially treated with cyfluthrin. Journal of Economic Entomology, v.92, n.4, Aug., 1999.:981-987.

Arthur, Frank H.. Residual efficacy of cyfluthrin applied alone or in combination with piperonyl butoxide or piperonyl butoxide + chlorpyrifos-methyl as protectants of stored corn. Journal of Entomological Science, v.29, n.2, 1994.:276-287.

Arthur, Frank H.. Residual toxicity of cyfluthrin wettable powder against Tribolium confusum (Coleoptera: Tenebrionidae) exposed for short time intervals on concrete. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:19-25.

Arthur, Frank H.; Throne, James E.. Pirimiphos-methyl degradation and insect population growth in aerated and unaerated corn stored in southeast Georgia: Small bin tests. Journal of Economic Entomology, v.87, n.3, 1994.:810-816.

Bell, H. A.; Edwards, J. P.. The activity of (S)-hydroprene space spray against three stored products pests in a simulated food production environment. Journal of Stored Products Research, v.35, n.2, April, 1999.:117-126.

Bhattacharyya, P. R.; Nath, S. C.; Bordoloi, D. N.. Insecticidal

activity of Ranunculus sceleratus (L.) against Drosophila melanogaster and Tribolium castaneum. Indian Journal of Experimental Biology, v.31, n.1, 1993.:85-86.

Bowen,-D.J.; Ensign,-J.C.
TI: Purification and characterization of a high-molecular-weight insecticidal protein complex produced by the entomopathogenic bacterium Photorhabdus luminescens.
SO: Appl-environ-microbiol. Washington : American Society for Microbiology. Aug 1998. v. 64 (8) p. 3029-3035.

Chander, Harish; Nagender, A.; Ahuja, D. K.; Berry, S. K..
Laboratory evaluation of plant extracts as repellents to the rust red flour beetle, Tribolium castaneum (Herbst), on jute fabric. International Pest Control, v.41, n.1, Jan.-Feb., 1999.:18-20.

Chiam , Wan Yee; Huang, Yan; Chen, Shao Xing; Ho, Shuit Hung. Toxic and antifeedant effects of allyl disulfide on Tribolium castaneum (Coleoptera: Tenebrionidae) and Sitophilus zeamais (Coleoptera; Curculionidae). Journal of Economic Entomology, v.92, n.1, Feb., 1999.:239-245.
Danfa, A.; Van Der Valk, H.C.H.G.. Laboratory testing of Metarhizium spp. and Beauveria bassiana on Sahelian non-target arthropods. Biocontrol Science and Technology, v.9, n.2, June, 1999.:187-198.

Church, C. J.; Abd-Elghafar, S. F.; Knowles, C. O.. Influence of formamidines on batrachotoxin in a 20-alpha-benzoate binding to neural membranes from pyrethroid susceptible and resistant tobacco budworm moths Heliothis virescens. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.105, n.3, 1993.:443-449.

Collins, P. J.; Lambkin, T. M.; Bridgeman, B. W.; Pulvirenti, C..
Resistance to grain-protectant insecticides in coleopterous pests of stored cereals in Queensland, Australia. Journal of Economic Entomology, v.86, n.2, 1993.:239-245.

Daniewski, Wlodzimierz M.; Gumulka, Maria; Pankowska, Elzbieta; Ptaszynska, Katarzyna; Bloszyk, Elzbieta; Jacobsson, Ulla; Norin, Torbjorn. 3,8-ethers of lactarane sesquiterpenes. Phytochemistry (Oxford), v.32, n.6, 1993.:1499-1502.

Dolly, K.; Parikh, S.. Evaluating the efficacy of spark (A newly synthesized insecticide) against eggs and pupae of Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Journal of Animal Morphology and Physiology, v.45, n.1-2, June-Dec., 1998.:38-40.

Dowdy, Alan K.. Mortality of red flour beetle, Tribolium castaneum (Coleoptera: Tenebrionidae) exposed to high temperature and diatomaceous earth combinations. Journal of Stored Products Research, v.35, n.2, April, 1999.:175-182.

BIBLIOGRAPHY

Dunkel, Florence V.; Sears, L. Joseph. Fumigant properties of physical preparations from mountain big sagebrush, Artemisia tridentata Nutt. ssp. vaseyana (Rydb.) beetle for stored grain insects. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:307-321.

Elek, Jane A.; Longstaff, Barry C.. Effect of chitin-synthesis inhibitors on stored-product beetles. Pesticide Science, v.40, n.3, 1994.:225-230.

Fleurat-Lessard, Francis; Vidal, Maryl-Laure; Budzinski, Helene. Modelling biological efficacy decrease and rate of degradation of chlorpyrifos-methyl on wheat stored under controlled conditions. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:341-354.

Ho, S. H.; Ma, Y.; Huang, Y.. Anethole, a potential insecticide from Illicium verum Hook F., against two stored product insects. International Pest Control, v.39, n.2, 1997.:50-51.

Ho, S. H.; Leong, Edmund C. W.; Lau, W. Y.. Attractancy of crude pandan (Pandanus amaryllifolius Roxb.) extracts to Tribolium castaneum (Herbst). International Pest Control, v.35, n.2, 1993.:44-45.

Hilbeck, Angelika; Eckel, Craig; Kennedy, George G.. Impact of Bacillus thuringiensis - insecticides on population dynamics and egg predation of the Colorado potato beetle in North Carolina potato plantings. Biocontrol (Dordrecht), v.43, n.1, 1998.:65-75.

Horowitz, A. R.; Weintraub, Phyllis G.; Ishaaya, I.. Status of pesticide resistance in arthropod pests in Israel. Phytoparasitica, v.26, n.3, July, 1998.:231-240.

Huang, Y.; Hee, S. K.; Ho, S. H.. Antifeedant and growth inhibitory effects of alpha-pinene on the stored-product insects, Tribolium castaneum (Herbst) and Sitophilus zeamais Motsch. International Pest Control, v.40, n.1, Jan.-Feb., 1998.:18-20.

Huang, Yan; Ho, Shuit Hung; Kini, R. Manjunatha. Bioactivities of safrole and isosafrole on Sitophilus zeamais (Coleoptera: Curculionidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.92, n.3, June, 1999.:676-683.

Huang, Y.; Ho, S. H.. Toxicity and antifeedant activities of cinnammaldehyde against the grain storage insects, Tribolium castaneum (Herbst) and Sitophilus zeamais Motsch. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:11-17.

BIBLIOGRAPHY

Lin, Hao; Bloomquist, Jeffrey R.; Beeman, Richard W.; Clark, J. Marshall. Mechanisms underlying cyclodiene resistance in the red flour beetle, Tribolium castaneum (Herbst). Pesticide Biochemistry and Physiology, v.45, n.2, 1993.:154-165.

Liu, Z. L.; Ho, S. H.. Bioactivity of the essential oil extracted from Evodia rutaecarpa Hook f. et Thomas against the grain storage insects, Sitophilus zeamais Motsch. and Tribolium castaneum (Herbst). Journal of Stored Products Research, v.35, n.4, Oct., 1999.:317-328.

Martinez-Torres, David; Devonshire, Alan L.; Williamson, Martin S.. Molecular studies of knockdown resistance to pyrethroids: Cloning of domain II sodium channel gene sequences from insects. Pesticide Science, v.51, n.3, Nov., 1997.:265-270.

Matthews, Wendy A.; Maliphant, Paula. The fate and insecticidal activity of pirimiphos-methyl in stored wheat grain. Pesticide Science, v.37, n.1, 1993.:93-97.

McFarlane, J. A.; Gudrups, I.; Fletcher, H.. Biotype differences affecting the pest status of stored-grain insects. International Journal of Pest Management, v.39, n.1, 1993.:35-43.

Moralejo, Maria A.; Garcia-Casado, Gloria; Sanchez-Monge, Rosa; Lopez-Otin, Carlos; Romagosa, Ignacio; Molina-Cano, Jose L.; Salcedo, Gabriel. Genetic variants of the trypsin inhibitor from barley endosperm show different inhibitory activities. Plant Science (Limerick), v.89, n.1, 1993.:23-29.

Moran,-R.; Garcia,-R.; Lopez,-A.; Zaldua,-Z.; Mena,-J.; Garcia,-M.; Armas,-R.; Somonte,-D.; Rodriguez,-J.; Gomez,-M.
TI: Transgenic sweet potato plants carrying the delta-endotoxin gene from Bacillus thuringiensis var. tenebrionis.
SO: Plant-sci. Shannon [Clare] : Elsevier Scientific Publishers Ireland Ltd., c1985-. Dec 31, 1998. v. 139 (2) p. 175-184.

Morgan, T. D.; Oppert, B.; Czapla, T. H.; Kramer, K. J.. Avidin and streptavidin as insecticidal and growth inhibiting dietary proteins. Entomologia Experimentalis et Applicata, v.69, n.2, 1993.:97-108.

Mullie, Wim C.; Diallo, Alpha Oumar; Gadji, Baba; Ndiaye, Massar D.. Environmental hazards of mobile ground spraying with cyanophos and fenthion for Quelea control in Senegal. Ecotoxicology and Environmental Safety, v.43, n.1, May, 1999.:1-10.

BIBLIOGRAPHY

Nordbo, Ebbe; Kristensen, Kristian; Kirknel, Erik. Effects of wind direction, wind speed and travel speed on spray deposition. Pesticide Science, v.38, n.1, 1993.:33-41.

Obeng-Ofori, D.; Reichmuth, C.. Bioactivity of eugenol, a major component of essential oil of Ocimum suave (Wild.) against four species of stored-product Coleoptera. International Journal of Pest Management, v.43, n.1, 1997.:89-94.

Obeng-Ofori, D.; Reichmuth, Ch.. Plant oils as potentiation agents of monoterpenes for protection of stored grains against damage by stored product beetle pests. International Journal of Pest Management, v.45, n.2, April-June, 1999.:155-159.

Papadopoulos,-A.I.; Stamkou,-E.I.; Kostaropoulos,-I.; Papadopoulou-Mourkidou,-E.
TI: Effect of organophosphate and pyrethroid insecticides on the expression of GSTs from Tenebrio molitor larvae.
SO: Pestic-biochem-physiol. Orlando, Fla. : Academic Press. Jan 1999. v. 63 (1) p. 26-33.

Pemonge,-J.; Pascual-Villalobos,-M.J.; Regnault-Roger,-C.
TI: Effects of material and extracts of Trigonella foenum-graecum L. against the stored product pests Tribolium castaneum (herbst) (Coleoptera: Tenebrionidae) and Acanthoscelides obtectus (Say) (Coleoptera: Bruchidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. July 1997. v. 33 (3) p. 209-217.

Petrushkina, Elena A.; Polonic, Natalia B.; Ivanova, Galina B.. Synthesis and juvenile hormone activity of benzimidazolylterpenes possessing a 2,7-dimethyloctane skeleton. Pesticide Science, v.55, n.6, June, 1999.:650-652.

Pike, Vanessa. Laboratory assessment of the efficacy of phosphine and methyl bromide fumigation against all life stages of Liposcelis entomophilus (Enderlein). Crop Protection, v.13, n.2, 1994.:141-145.

Pradeep, P. K.; Radhakrishnan, N.. Preliminary screening of certain locally available plants for the possible repellent properties agaisnt the Rust Red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Journal of Animal Morphology and Physiology, v.45, n.1-2, June-Dec., 1998.:32-37.

Rajendran, Somiahnadar. Responses of phosphine-resistant strains of two stored-product insect pests to changing concentrations of phosphine. Pesticide Science, v.40, n.3, 1994.:183-186.

BIBLIOGRAPHY

Rani, Pathipati Usha. Bioactivity and residual toxicity of deltamethrin, incorporated into rice bran and rice husk, against the pests of stored products. International Pest Control, v.39, n.6, Nov.-Dec., 1997.:186-188.

Saleem, Mushtaq A.; Shakoori, Abdul Rauf; Mantle, David. Macromolecular and enzymatic abnormalities induced by a synthetic pyrethroid, Ripcord (cypermethrin), in adult beetles of a stored grain pest, Tribolium castaneum (Herbst.) (Coleoptera: Tenebrionidae). Archives of Insect Biochemistry and Physiology, v.39, n.4, 1998.:144-154.

Shaaya, E.; Kostjukovski, M.; Eilberg, J.; Sukprakarn, C.. Plant oils as fumigants and contact insecticides for the control of stored-product insects. Journal of Stored Products Research, v.33, n.1, 1997.:7-15.

Subramanyam, B.; Madamanchi, N.; Norwood, S.. Effectiveness of Insecto applied to shelled maize against stored-product insect larvae. Journal of Economic Entomology, v.91, n.1, Feb., 1998.:280-286.

Talukder, F. A.; Howse, P. E.. Deterrent and insecticidal effects of extracts of pithraj, Aphanamixis polystachya (Meliaceae), against Tribolium castaneum in storage. Journal of Chemical Ecology, v.19, n.11, 1993.:2463-2471.

Ramzan, M.; Rataul, H. S.; Pudge, B. K.. Efficacy of turmeric powder as a protectant of stored dehusked rice. International Pest Control, v.35, n.4, 1993.:92-93.

Rice, William C.; Cogburn, Robert R.. Activity of the entomopathogenic fungus Beauveria bassiana (Deuteromycota: Hyphomycetes) against three coleopteran pests of stored grain. Journal of Economic Entomology, v.92, n.3, June, 1999.:691-694.

Saleem, Mushtaq A.; Shakoori, A. R.. Effect of cypermethrin on the free amino acids pool in an organophosphorus insecticide-resistant and a susceptible strain of Tribolium castaneum. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.105, n.3, 1993.:549-553.

Seck, D.; Lognay, G.; Haubruge, E.; Wathelet, J.-P.; Marlier, M.; Gaspar, C.; Severin, M.. Biological activity of the shrub Boscia senegalensis (Pers.) Lam. ex Poir. (Capparaceae) on stored grain insects. Journal of Chemical Ecology, v.19, n.2, 1993.:377-389.

Sedlacek, John D.; Barney, Robert J.; Weston, Paul A.; Price, Bryan D.. Efficacy of malathion against Coleopteran populations in newly-harvester versus year-old stored corn. Journal of Entomological Science, v.33, n.3, July, 1998.:282-291.

BIBLIOGRAPHY

van der Valk, Harold C.H.G.; Niassy, Abdoulaye; Beye, Alioune B..
Does grasshopper control create grasshopper problems? - Monitoring side-effects of fenitrothion applications in the western Sahel. Crop Protection, v.18, n.2, March, 1999.:139-149.

Vinuela, E.; Ondracek, J.; Jacas, J.; Adan, A.; Rejzek, M.; Wimmer, Z.. Laboratory evaluation of five new JHA derivatives from 2-(4-hydroxybenzyl)-1-cyclohexanone against Tribolium castaneum (Herbst.). Journal of Stored Products Research, v.30, n.2, 1994.:149-155.

Wegerhoff, Rainer; Gaethje, Heiko; Shailaja, Donempudi. Effects of fenvalerate on the development of olfactory perception in a beetle. Neuroreport, v.9, n.14, Oct. 5, 1998.:3241-3245.

Weissenberg, Martin; Levy, Arieh; Svoboda, James A.; Ishaaya, Isaac. The effect of some Solanum steroidal alkaloids and glycoalkaloids on larvae of the red flour beetle, Tribolium castaneum, and the tobacco hornworm, and Manduca sexta. Phytochemistry (Oxford), v.47, n.2, Jan., 1998.:203-209.

White, Noel D. G.; Jayas, Digvir S.; Demianyk, Colin J..
Degradation and biological impact of chlorpyrifos-methyl on stored wheat and pirimiphos-methyl on stored maize in western Canada. Journal of Stored Products Research, v.33, n.2, 1997.:125-135.

White, N. D. G.; Jayas, D. S.. Effectiveness of carbon dioxide in compressed gas or solid formulation for the control of insects and mites in stored wheat and barley. Phytoprotection, v.74, n.2, 1993.:101-111.

Wongo, Lawrence E.. Biological activity of sorghum tannin extracts on the stored grain pests Sitophilus oryzae (L.), Sitotroga cerealella (Olivier) and Tribolium castaneum (Herbst). Insect Science and its Application, v.18, n.1, Jan.-March, 1998.:17-23.

Wontner-Smith, T. J.; Chakrabarti, B.; Cardwell, S. K.; Barnett, G.. Reduction of emissions of methyl bromide from chamber fumigations. International Pest Control, v.40, n.1, Jan.-Feb., 1998.:14-17, 20.

Zettler, J. Larry; Arthur, Frank H.. Dose-response tests on red flour beetle and confused flour beetle (Coleoptera: Tenebrionidae) collected from flour mills in the United States. Journal of Economic Entomology, v.90, n.5, Oct., 1997.:1156-1162.

Zettler, J. Larry; Leesch, J. G.; Gill, Richard F.; Mackey, Bruce E..
Toxicity of carbonyl sulfide to stored product insects. Journal of Economic

Entomology, v.90, n.3, 1997.:832-836.

9

Hasan, Md. Mahbub. Mating competitiveness of adult males of Tribolium spp (Coleoptera: Tenebrionidae) developing from irradiated pupae. Journal of Stored Products Research, v.35, n.3, July, 1999.:307-316.

Misra, H. P.; Bhatia, Parvathy. Gamma radiation susceptibility of strains of Tribolium castaneum (Herbst) resistant and susceptible to fenvalerate. International Journal of Pest Management, v.44, n.3, July-Sept., 1998.:145-147.

Shayesteh, N.; Barthakur, N. N.. Mortality and behavior of two stored-product insect species during microwave irradiation. Journal of Stored Products Research, v.32, n.3, 1996.:239-246.

10

Barker,-D.; Fitzpatrick,-M.P.; Dierenfeld,-E.S.
TI: Nutrient composition of selected whole invertebrates.
SO: Zoo-biol. New York, N.Y. : Wiley-Liss, Inc. 1998. v. 17 (2) p. 123-134.

Clements, Fiona; Hope, Perdita; Daniels, Chris; Chapman, Ian; Wittert, Gary. Thermogenesis in the marsupial Sminthopsis crassicaudata: Effect of catecholamines and diet. Australian Journal of Zoology, v.46, n.4, 1998.:381-390.

De Clercq, Patrick; Merlevede, Frederik; Tirry, Luc. Unnatural prey and artificial diets for rearing Podisus maculiventris (Heteroptera: Pentatomidae). Biological Control, v.12, n.2, June, 1998.:137-142.

Phillips, T. W.; Jiang, X.-L.; Burkholder, W. E.; Phillips, J. K.; Tran, H. Q.. Behavioral responses to food volatiles by two species of stored-product Coleoptera, Sitophilus oryzae (Curculionidae) and Tribolium castaneum (Tenebrionidae). Journal of Chemical Ecology, v.19, n.4, 1993.:723-734.

11

Abdel-Razek, A. S.; Salama, H. S.; White, N. D. G.; Morris, O. N..

BIBLIOGRAPHY

Effect of Bacillus thuringiensis on feeding and energy use by Plodia interpunctella (Lepidoptera: Pyralidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Canadian Entomologist, v.131, n.4, July-Aug., 1999.:433-440.

Beveridge, Natasha; Elek, Jane A.. Bacillus thuringiensis var. tenebrionis shows no toxicity to the predator Chauliognathus lugubris (F.) (Coleoptera: Cantharidae). Australian Journal of Entomology, v.38, n.1, Jan. 25, 1999.:34-39.

Blankespoor,-C.L.; Pappas,-P.W.; Eisner,-T.
TI: Impairment of the chemical defence of the beetle, Tenebrio molitor, by metacestodes (cysticercoids) of the tapeworm, Hymenolepis diminuta.
SO: Parasitology. Cambridge : Cambridge University Press. July 1997. v. 115 (pt.1) p. 105-110.

Carver, F. J.; Hurd, H.. The effect of metacestodes of Hymenolepis diminuta on the bean-shaped accessory glands in male Tenebrio molitor. Parasitology, v.116, n.2, Feb., 1998.:191-196.

Castrillo,-L.A.; Brooks,-W.M.
TI: Differentiation of Beauveria bassiana isolates from the darkling beetle, Alphitobius diaperinus, using isozyme and RAPD analyses.
SO: J-invertebr-pathol. Orlando, Fla. : Academic Press. Nov 1998. v. 72 (3) p. 190-196.

Clopton, R. E.. Revision of the genus Xiphocephalus and description of Xiphocephalus ellisi n. sp. (Apicomplexa: Eugregarinida: Stylocephalidae) from Eleodes opacus (Coleoptera: Tenebrionidae) in the western Nebraska sandhills. Journal of Parasitology, v.85, n.1, Feb., 1999.:84-89.

Evans, W. S.; Wong, A.; Hardy, M.; Currie, R. W.; Vanderwel, D..
Evidence that the factor used by the tapeworm, Hymenholepis diminuta, to direct the foraging of its intermediate host, Tribolium confusum, is a volatileattractant. Journal of Parasitology, v.84, n.6, Dec., 1998.:1098-1101.

Geden,-C.J.; Arends,-J.J.; Rutz,-D.A.; Steinkraus,-D.C.
TI: Laboratory evaluation of Beauveria bassiana (Moniliales: Moniliaceae) against the lesser mealworm, Alphitobius diaperinus (Coleoptera: Tenebrionidae), in poultry litter, soil, and a pupal trap.
SO: Biol-control. Orlando, Fla. : Academic Press. Oct 1998. v. 13 (2) p. 71-77.

Hanelt,-B.; Janovy,-J.-Jr.
TI: The life cycle of a horsehair worm, Gordius robustus (Nematomorpha: Gordioidea).
SO: J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. Feb 1999. v. 85 (1) p. 139-141.

BIBLIOGRAPHY

Hurd, H.. Parasite manipulation of insect reproduction: Who benefits? Parasitology, v.116, n.SUPPL., 1998.:S13-S21.

Nakamura, F.; Okamoto, K.. Reconsideration of the effects of selfing on the viability of Hymenolepis nana. International Journal for Parasitology, v.23, n.7, 1993.:931-936.

Nishina, Masami; Matsushita, Kazuhiro; Kato, Kenzo; Takahashi, Masakazu; Kono, Yoshiaki. Characterization of tissue water in Tribolium confusum parasitized by metacestodes of Hymenolepis diminuta. Journal of Invertebrate Pathology, v.72, n.1, July, 1998.:93-95.

Novak, M.; Modha, A.; Blackburn, B. J.. D-(1-13C)glucose metabolism of Tribolium confusum parasitized by hymenolepid metacestodes. Journal of Invertebrate Pathology, v.62, n.3, 1993.:302-307.

O'Leary,-S.A.; Stack,-C.M.; Chubb,-M.A.; Burnell,-A.M.
TI: The effect of day of emergence from the insect cadaver on the behavior and environmental tolerances of infective juveniles of the entomopathogenic nematode Heterorhabditis megidis (strain UK211).
SO: J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. Aug 1998. v. 84 (4) p. 665-672.

Pappas, Peter W.; Barley, Amy J.. Beetle-to-beetle transmission and dispersal of Hymenolepis diminuta (cestoda) eggs via the feces of Tenebrio molitor. Journal of Parasitology, v.85, n.2, April, 1999.:384-385.

Pappas, P. W.; Rutherford, K. H.; Barley, A. J.. Thermal tolerance of Hymenolepis diminuta eggs does not limit the parasite's distribution. Journal of Helminthology, v.73, n.1, March, 1999.:85-86.

Parajulee, Megha N.; Phillips, Thomas W.. Effects of prey species on development and reproduction of the predator Lyctocoris campestris (Heteroptera: Anthocoridae). Environmental Entomology, v.22, n.5, 1993.:1034-1042.

Rice, William C.; Cogburn, Robert R.. Activity of the entomopathogenic fungus Beauveria bassiana (Deuteromycota: Hyphomycetes) against three coleopteran pests of stored grain. Journal of Economic Entomology, v.92, n.3, June, 1999.:691-694.

Shostak, Allen W.; Smyth, Kerri A.. Activity of flour beetles (Tribolium confusum) in the presence of feces from rats infected with rat tapeworm (Hymenolepis diminuta). Canadian Journal of Zoology, v.76, n.8, Aug., 1998.:1472-1479.

BIBLIOGRAPHY

Stevens, Lori. Cytoplasmically inherited parasites and reproductive success in Tribolium flour beetles. Animal Behaviour, v.46, n.2, 1993.:305-310.

Watwood,-S.; Janovy,-J.-Jr.; Peterson,-E.; Addison,-M.A. Gregarina triboliorum (Eugregarinida: Gregarinidae) n. sp. from Tribolium confusum and resolution of the confused taxonomic history of Gregarina minuta Ishii, 1914. J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. June 1997. v. 83 (3) p. 502-507.

Webb, T. J.; Hurd, H.. Direct manipulation of insect reproduction by agents of parasite origin. Proceedings of the Royal Society Biological Sciences Series B, v.266, n.1428, Aug. 7, 1999.:1537-1541.

Webb,-T.J.; Major,-M.; Ellams,-K.M.; Hurd,-H.
TI: The interplay between patency, microsomal Na+/K+ ATPase activity and juvenile hormone, in Tenebrio molitor parasitized by Hymenolepis diminuta.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Apr 1997. v. 43 (4) p. 337-343.

Yan, Guiyun; Stevens, Lori; Schall, Jos J.. Behavioral changes in Tribolium beetles infected with a tapeworm: Variation in effects between beetle species and among genetic strains. American Naturalist, v.143, n.5, 1994.:830-847.

Yan, Guiyun. Consequence of larval tapeworm infection for the fitness of the intermediate hosts, flour beetles (Tribolium spp.). Canadian Journal of Zoology, v.75, n.2, 1997.:271-279.

Yan, Guiyun; Stevens, Lori; Goodnight, Charles J.; Schall, Joseph J.. Effects of a tapeworm parasite on the competition of Tribolium beetles. Ecology (Washington D C), v.79, n.3, April, 1998.:1093-1103.

Yan, Guiyun; Phillips, Thomas W.. Influence of tapeworm infection on the production of aggregation pheromone and defensive compounds in Tribolium castaneum. Journal of Parasitology, v.82, n.6, 1996.:1037-1039.

12

Adler, Cornel. Protection of stored products with nitrogen and carbon dioxide. Reichmuth, C. Communications from the Federal Biological Institute for Agriculture and Forestry Berlin-Dahlem; 100 years research in plant protection: Important areas of research in stored product protection., 1998.:277-293.

Alyokhin,-A.V.; Ferro,-D.N.

BIBLIOGRAPHY

TI: Modifications in dispersal and oviposition of Bt-resistant and Bt-susceptible Colorado potato beetles as a result of exposure to Bacillus thuringiensis subsp. tenebrionis Cry3A toxin.
SO: Entomol-exp-appl. Dordrecht : Kluwer Academic Publishers. Jan 1999. v. 90 (1) p. 93-101.

Alyokhin, Andrei V.; Ferro, David N.. Relative fitness of Colorado potato beetle (Coleoptera: Chrysomelidae) resistant and susceptible to the Bacillus thuringiensis Cry3A toxin. Journal of Economic Entomology, v.92, n.3, June, 1999.:510-515.

Arthur, Frank H.. Evaluation of prallethrin aerosol to control stored product insect pests. Journal of Stored Products Research, v.29, n.3, 1993.:253-257.

Arthur, Frank H.. Survival of red flour beetles (Coleoptera: Tenebrionidae) on concrete partially treated with cyfluthrin. Journal of Economic Entomology, v.92, n.4, Aug., 1999.:981-987.

Bowditch,-T.G. Penetration of polyvinyl chloride and polypropylene packaging films by Ephestia cautella (Lepidoptera: Pyralidae) and Plodia interpunctella (Lepidoptera: Pyralidae) larvae, and Tribolium confusum (Coleoptera: Tenebrionidae) adults. J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Aug 1997. v. 90 (4) p. 1028-1031.

Buchelos, C. Th.; Athanassiou, C. G.. Beetle species in store-rooms of Central and Southern Greece containing grain, flour, bran and hay: A survey of 44 species. Annales de l'Institut Phytopathologique Benaki, v.18, n.2, 1998.:129-133.

Burks, Charles S.; Hagstrum, David W.. Rapid cold hardening capacity in five species of coleopteran pests of stored grain. Journal of Stored Products Research, v.35, n.1, Jan., 1999.:65-75.

Butz,-P.; Fritsch,-E.; Huber,-J.; Keller,-B.; Ludwig,-H.; Tauscher,-B.
TI: Ultra-high pressure decontamination of insect biocontrol preparations.
SO: Planta-med. Stuttgart : Georg Thieme Verlag,. 1995. v. 5 (2) p. 243-246.

Caroli,-L.; Glazer,-I.; Gaugler,-R.
TI: Entomopathogenic nematode infectivity assay: comparison of penetration rate into different hosts.
SO: Biocontrol-sci-technol. Abingdon, Oxfordshire : Carfax Publishing Co,. June 1996. v. 6 (2) p. 227-233.

Carrizo-F,-R.; Sosa,-M.E.; Favier,-L.S.; Penna,-F.; Guerreiro,-E.; Giordano,-O.S.; Tonn,-C.E.

TI: Growth-inhibitory activities of benzofuran and chromene derivatives toward Tenebrio molitor.
SO: J-nat-prod. Washington, D.C. : American Society of Pharmacognosy. Oct 1998. v. 61 (10) p. 1209-1211.

Castrillo, Louela A.; Brooks, Wayne M.. Differentiation of Beauveria bassiana isolates from the darkling beetle Alphitobius diaperinus, using isoenzyme and RAPD analyses. Journal of Invertebrate Pathology, v.72, n.3, Nov., 1998.:190-196.

Clercq,-P.-de; Merlevede,-F.; Tirry,-L.
TI: Unnatural prey and artificial diets for rearing Podisus maculiventris (Heteroptera: Pentatomidae).
SO: Biol-control. Orlando, Fla. : Academic Press. June 1998. v. 12 (2) p. 137-142.

Collins, D. A.; Cook, D. A.. Periods of protection provided by different formulations of pirimiphos-methyl and etrimfos, when admixed with wheat, against four susceptible storage beetle pests. Crop Protection, v.17, n.6, Aug., 1998.:521-528.

Crawford, Peter J.; Brooks, Wayne M.; Arends, James J.. Efficacy of field-isolated strains of Beauveria bassiana (Moniliales: Moniliaceae) as microbial control agents of the lesser mealworm (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.91, n.6, Dec., 1998.:1295-1301.

Cong Hao, Nguyen; Cuu Thi Huong Giang, Nguyen; Cuu Koha, Nguyen; Thanh Son, Nguyen. Synthesis and application of insect attractants in Vietnam. Resources Conservation and Recycling, v.18, n.1-4, 1996.:59-68.

Daglish, G. J.. Efficacy of six grain protectants applied alone or in combination against three species of Coleoptera. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:263-268.

Damcevski, K. A.; Annis, P. C.; Waterford, C. J.. Effect of grain on apparent respiration of adult-stored-product Coleoptera in an air-tight system: Implications for fumigant testing. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:331-339.

Daniewski, Wlodzimierz M.; Gumulka, Maria; Anczewski, Waldemar; Masnyk, Marek; Bloszyk, Elzbieta; Gupta, Kuldip K.. Why the yew tree (Taxus baccata) is not attacked by insects. Phytochemistry (Oxford), v.49, n.5, Nov., 1998.:1279-1282.

Dowdy, Alan K.. Mortality of red flour beetle, Tribolium castaneum

(Coleoptera: Tenebrionidae) exposed to high temperature and diatomaceous earth combinations. Journal of Stored Products Research, v.35, n.2, April, 1999.:175-182.

Ferro,-D.N.; Slocombe,-A.C.; Mercier,-C.T.
TI: Colorado potato beetle (Coleoptera: Chrysomelidae): residual mortality and artificial weathering of formulated Bacillus thuringiensis subsp. tenebrionis.
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Apr 1997. v. 90 (2) p. 574-582.

Fields, P. G.; Korunic, Z.. Post-harvest insect control: Diatomaceous earth and low temperatures. Phytoprotection, v.77, n.3, 1996.:141.

Gueye, M. T.; Delobel, A.. Relative susceptibility of stored pearl millet products and fonio to insect infestation. Journal of Stored Products Research, v.35, n.3, July, 1999.:277-283.

Hagstrum, David W.; Flinn, Paul W.; Gaffney, Jerry J.. Temperature gradient on Tribolium castaneum (Coleoptera: Tenebrionidae) adult dispersal in stored wheat. Environmental Entomology, v.27, n.1, Feb., 1998.:123-129.

Horne, P. A.; Edward, C. L.. Effects of tillage on pest and beneficial beetles in the Wimmera region of Victoria, Australia. Australian Journal of Entomology, v.37, n.1, April 3, 1998.:60-63.

Hu, Mei-Ying; Klocke, James A.; Chiu, Shin-Foon; Kubo, Isao. Response of five insect species to a botanical insecticide, rhodojaponin II. Journal of Economic Entomology, v.86, n.3, 1993.:706-711.

Huang, Yan; Ho, Shuit Hung; Kini, R. Manjunatha. Bioactivities of safrole and isosafrole on Sitophilus zeamais (Coleoptera: Curculionidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.92, n.3, June, 1999.:676-683.

Huang, Y.; Tan, J. M. W. L.; Kini, R. M.; Ho, S. H.. Toxic and antifeedant action of nutmeg oil against Tribolium castaneum (Herbst) and Sitophilus zeamais Motsch. Journal of Stored Products Research, v.33, n.4, Oct., 1997.:289-298.

Kaya,-H.K.; Burlando,-T.M.; Choo,-H.Y.; Thurston,-G.S.
TI: Integration of entomopathogenic nematodes with Bacillus thuringiensis or pesticidal soap for control of insect pests.
SO: Biol-control. Orlando, Fla. : Academic Press, Inc. Sept 1995. v. 5 (3) p. 432-441.

Kazmierczak, Richard F., ; Norton, George W.; Knight, Alan L.; Rajotte, Edwin G.; Hull, Larry A.. Economic effects of resistance and

withdrawal of organophosphate pesticides on an apple production system. Journal of Economic Entomology, v.86, n.3, 1993.:684-696.

Langenbruch, Gustav-Adolf. Communications from the Federal Biological Institute for Agriculture and Forestry Berlin-Dahlem; 100 years research in plant protection: The Colorado potato beetle in Germany: Investigation and control with special emphasis on the role of the Federal Biological Research Centre for Agriculture and Forestry and its preceded and parallel institutions. Parey Buchverlag Berlin Kurfuerstendamm 57, D-10707 Berlin, Germany 1998.. ;Langenbruch, G.-A. Author. Communications from the Federal Biological Institute for Agriculture and Forestry Berlin-Dahlem; 100 years research in plant protection: The Colorado potato beetle in Germany: Investigation and control with special emphasis on the role of the Federal Biological Research Centre for Agriculture and Forestry and its preceded and parallel institutions.:120p. Series: Mitteilungen aus der Biologischen Bundesanstalt fuer Land- und Forstwirtschaft Berlin-Dahlem 341 0067-5849

Lee, Keun Hyeung; Hong, Sung Yu; Oh, Jong Eun. Synthesis and structure-function study about tenecin 1, an antibacterial protein from larvae of Tenebrio molitor. FEBS Letters, v.439, n.1-2, Nov. 13, 1998.:41-45.

Mahmood, Tariq; Ahmad, Mohammad Sajjad; Ahmad, Hafiz. Dispersion of stored grain insect pests in a wheat-filled silo. International Journal of Pest Management, v.42, n.4, 1996.:321-324.

Morimoto, Nobuo; Imura, Osamu; Kiura, Takuji. Potential effects of global warming on the occurrence of Japanese pest insects. Applied Entomology and Zoology, v.33, n.1, Feb., 1998.:147-155.

Milner,-R.J.
TI: History of Bacillus thuringiensis.
SO: Agric-ecosyst-environ. Amsterdam; New York : Elsevier, 1983-. May 1994. v. 49 (1) p. 9-13.

Mracek,-Z.; Becvar,-S.; Kindlmann,-P.; Webster,-J.M.
TI: Infectivity and specificity of Canadian and Czech isolates of Steinernema kraussei (Steiner, 1923) to some insect pests at low temperatures in the laboratory.
SO: Nematologica. Leiden : Brill,. Aug 1998. v. 44 (4) p. 437-448.
CN: DNAL 436.8-N342

Nwana, Ifedioramma E.. A survey of storage Coleoptera which attack dried cocoyam chips in Nigeria. Journal of Stored Products Research, v.29, n.1, 1993.:95-98.

Obeng-Ofori, D.; Reichmuth, C.; Bekele, J.; Hassanali, A..

BIBLIOGRAPHY

Biological activity of 1,8 cineole, a major component of essential oil of Ocimum kenyense (Ayobangira) against stored product beetles. Journal of AppliedEntomology, v.121, n.4, 1997.:237-243.

Obeng-Ofori, D.; Reichmuth, C. H.; Bekele, A. J.; Hassanali, A.. Toxicity and protectant potential of camphor, a major component of essential oil of Ocimum kilimandscharicum, against four stored product beetles. International Journal of Pest Management, v.44, n.4, Oct.-Dec., 1998.:203-209.

Obeng-Ofori, D.. The behaviour of 9 stored product beetles at pitfall trap arenas and their capture in millet. Entomologia Experimentalis et Applicata, v.66, n.2, 1993.:161-169.

Ofuya, T. I.; Reichmuth, C.. Control of two bruchid pests of stored grain legumes in a nitrogen atmosphere. Crop Protection, v.12, n.5, 1993.:394-396.

Padin, S. B.; Dal Bello, G. M.; Vasicek, A. L.. Pathogenicity of Beauveria bassiana for adults of Tribolium castaneum (Col.: Tenebrionidae) in stored grains. Entomophaga, v.42, n.4, 1997.:569-574.

Pagani, M.; Fogliazza, D.; Cerioli, C.; Pietri, A.. Ergosterol content in flour from tender wheat infested by Tribolium confusum du Val and Ephestia kuhniella Zeller. Journal of Applied Entomology, v.117, n.3, 1994.:318-320.

Parajulee, Megha N.; Phillips, Thomas W.. Response variation of predatory pirate bugs to prey insects in stored grain ecosystems. Bulletin of the Ecological Society of America, v.74, n.2 SUPPL., 1993.:382.

Pascual-Villalobos, Maria J.; Robledo, Antonio. Anti-insect activity of plant extracts from the wild flora in southeastern Spain. Biochemical Systematics and Ecology, v.27, n.1, Jan., 1999.:1-10. Saleem,-M.A.; Shakoori,-A.R.; Mantle,-D.

Pemonge, Jerome; Pascual-Villalobos, Maria Jesus; Regnault-Roger, Catherine. Effects of material and extracts of Trigonella foenum-graecum L. against the stored product pests Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) and Acanthoscelides obtectus (Say) (Coleoptera: Bruchidae). Journal of Stored Products Research, v.33, n.3, 1997.:209-217.

Pernas, Monica; Sanchez-Monge, Rosa; Gomez, Luis; Salcedo, Gabriel. A chestnut seed cystatin differentially effective against cysteine proteinases from closely related pests. Plant Molecular Biology, v.38, n.6, Dec., 1998.:1235-1242.

Peveling, R.; Attignon, S.; Langewald, J.; Ouambama, Z.. An assessment of the impact of biological and chemical grasshopper control agents

on ground-dwelling arthropods in Niger, based on presence/absence sampling. Crop Protection, v.18, n.5, June, 1999.:323-339.

Prates, H. T.; Santos, J. P.; Waquil, J. M.; Fabris, J. D.; Oliveira, A. B.; Foster, J. E.. Insecticidal activity of monoterpenes against Rhyzopertha dominica (F.) and Tribolium castaneum (Herbst). Journal of Stored Products Research, v.34, n.4, Oct., 1998.:243-249.

Reed, C.; Pedersen, J. R.; Cuperus, G. W.. Efficacy and cost effectiveness of grain protectants applied to farm-stored wheat at harvest and later. Journal of Economic Entomology, v.86, n.5, 1993.:1590-1598.

Rostom, Zaky M. F.. Survey of some granivorous and non-granivorous insects and mites of stores in Saudi Arabia. Journal of Stored Products Research, v.29, n.1, 1993.:27-31.

Salama, H. S.; Ali, A. M. M.; Sharaby, A.. The induction of Bacillus thuringiensis new types by foreign DNA. Journal of Applied Entomology, v.115, n.4, 1993.:350-354.

Salin,-C.; Vernon,-P.; Vannier,-G.
TI: The supercooling and high temperature stupor points of the adult lesser mealworm Alphitobius diaperinus (Coleoptera: Tenebrionidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Oct 1998. v. 34 (4) p. 385-394.

Seaton, K. A.; Joyce, D. C.. Effects of low temperature and elevated CO-2 treatments and of heat treatments for insect disinfestation on some native Australian cut flowers. Scientia Horticulturae (Amsterdam), v.56, n.2, 1993.:119-133.

Seck, Dogo; Lognay, Georges. Study of the biological activity and identification of the principal agents responsible for the efficacy of Securidaca longepedunculata Fresen on insects of stored foods. Robertson, H. G. Insects in African economy and environment., 1997.:98.

Sedlacek, John D.; Weston, Paul A.; Price, Bryan D.; Rattlingourd, Patti L.. Survey of insect pests in shelled corn stored on-farm in Kentucky. Journal of Entomological Science, v.33, n.2, April, 1998.:171-179.

Sharma, H. C.; Lopez, V. F.. Comparison of economic injury levels for sorghum head bug, Calocoris angustatus, on resistant and susceptible genotypes at different stages of panicle development. Crop Protection, v.12, n.4, 1993.:259-266.

BIBLIOGRAPHY

Sheiman, Inna M.; Balobanova, Emma F.; Kreshchenko, Natalia D.. Regulation of development of the grain beetle Tenebrio molitor by neuropeptides. Invertebrate Reproduction and Development, v.36, n.1-3, Sept., 1999.:105-110.

Shuman, Dennis; Coffelt, James A.; Vick, Kenneth W.; Mankin, Richard W.. Quantitative acoustical detection of larvae feeding inside kernels of grain. Journal of Economic Entomology, v.86, n.3, 1993.:933-938.

Sterk, G.; Hassan, S. A.; Baillod, M.; Bakker, F.; Bigler, F.; Bluemel, S.; Bogenschuetz, H.; Boller, E.; Bromand, B.; Brun, J.; Calis, J. N. M.; Coremans-Pelseneer, J.; Duso, C.; Garrido, A.; Grove, A.; Heimbach, U.; Hokkanen, H.; Jacas, J.; Lewis, G.; Moreth, L.; Polgar, L.; Roversti, L.; Samsoe-Petersen, L.; Sauphanor, B.; Schaub, L.; Staeubli, A.; Tuset, J. J.; Vainio, A.; van de Veire, M.; Viggiani, G.; Vinuela, E.; Vogt, H.. Results of the seventh joint pesticide testing programme carried out by the IOBC/WPRS-Working Group 'Pesticides and Beneficial Organisms'. Biocontrol (Dordrecht), v.44, n.1, 1999.:99-117.

Stein, W.; Gorham, J. R.. New results about stored-product protection (animal pests): V. Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz, v.100, n.1, 1993.:91-107.

Svoboda J. A.; Lusby, W. R.. Variability of sterol utilization in stored-products insects. Experientia (Basel), v.50, n.1, 1994.:72-74.

Tabashnik, Bruce E.; Finson, Naomi; Johnson, Marshall W.; Moar, William J.. Resistance to toxins from Bacillus thuringiensis ssp. kurstaki causes minimal cross-resistance to Bacillus thuringiensis ssp. aizawai in the diamondback moth (Lepidoptera: Plutellidae). Applied and Environmental Microbiology, v.59, n.5, 1993.:1332-1335.

Tallamy,-D.W.; Stull,-J.; Ehresman,-N.P.; Gorski,-P.M.; Mason,-C.E.
TI: Cucurbitacins as feeding and oviposition deterrents to insects.
SO: Environ-entomol. Lanham, Md. : Entomological Society of America. June 1997. v. 26 (3) p. 678-683.

Tapp,-H.; Stotzky,-G.
TI: Monitoring the insecticidal toxins from Bacillus thuringiensis in soil with flow cytometry.
SO: Can-j-microbiol. Ottawa : National Research Council of Canada. Nov 1997. v. 43 (11) p. 1074-1078.

Tebayashi, Shin-Ichi; Hirai, Nobuhisa; Suzuki, Takahisa; Matsuyama, Shigeru; Nakakita, Hiroshi; Nemoto, Tadashi; Nakanishi, Hiroshi. alpha-Cedren-14-al: Minor aggregation pheromone component of Gnatocerus cornutus

BIBLIOGRAPHY

(F.) (Coleoptera: Tenebrionidae). Journal of Pesticide Science, v.23, n.4, 1998.:402-406.

Throne, James E.; Cunningham, R. Leo. Ability of selected stored-product insects to infest polyurethane foams containing canary corn (maize) dextrin. Journal of Stored Products Research, v.30, n.2, 1994.:171-173.

Thurston,-G.S.
TI: Biological control of elm leaf beetle.
SO: J-arboric. Champaign, IL : International Society of Arboriculture. May 1998. v. 24 (3) p. 154-159.

Trewin, Brigitte; Reichmuth, C.. Efficacy of the diatomaceous earth Dryacide against stored product pest insects. Anzeiger fuer Schaedlingskunde Pflanzenschutz Umweltschutz, v.70, n.3, 1997.:51-54.

Tunc, I.; Erler, F.; Dagli, F.; Calis, O.. Insecticidal activity of acetone vapours. Journal of Stored Products Research, v.33, n.2, 1997.:181-185.

White, N. D. G.; Jayas, D. S.. Microfloral infection and quality deterioration of sunflower seeds as affected by temperature and moisture content during storage and the suitability of the seeds for insect or mite infestation. Canadian Journal of Plant Science, v.73, n.1, 1993.:303-313.

White, Noel D. G.; Jayas, Digvir S.; Demianyk, Colin J.. Movement of grain to control stored-product insects and mites. Phytoprotection, v.78, n.2, 1997.:75-84.

White, N. D. G.; Mills, J. T.; Kenaschuk, E. O.; Oomah, B. D.; Dribnenki, P.. Quality changes occurring in stored solin, high linolenic acid and standard flaxseed (Linum usitatissimum L.). Canadian Journal of Plant Science, v.79, n.1, Jan., 1999.:35-42.

Wicklow, Donald T.; McAlpin, Cesaria E.; Nelsen, Terry C.. Survival and reproduction of stored-product beetles on seeds cached by a desert rodent and by Native Americans. Environmental Entomology, v.23, n.2, 1994.:414-419.

Wightman,-J.A.; Wightman,-A.S.
TI: An insect, agronomic and sociological survey of groundnut fields in southern Africa.
SO: Agric-ecosyst-environ. Amsterdam; New York : Elsevier, 1983-. Dec 1994. v. 51 (3) p. 311-331.

Williams, Lawrence A. D.; Mansingh, Ajai. Pesticidal potentials of tropical plants-I. Insecticidal activity in leaf extracts of sixty plants. Insect Science and its Application, v.14, n.5-6, 1993.:697-700.

Wolfenbarger,-D.A.; Hamed,-A.A.; Luttrell,-R.G.
TI: Toxicity of Bacillus thuringiensis var. tenebrionis and Ca-thuringiensin against the boll weevil Anthonomus grandis (Boh.) [Coleoptera: Curculionidae].
SO: Proc-Beltwide-Cotton-Conf. Memphis, Tenn. : National Cotton Council of America, 1991-. 1997. v. 2 p. 1296-1300.

Wongo, Lawrence E.. Biological activity of sorghum tannin extracts on the stored grain pests Sitophilus oryzae (L.), Sitotroga cerealella (Olivier) and Tribolium castaneum (Herbst). Insect Science and its Application, v.18, n.1, Jan.-March, 1998.:17-23.

Yoshimatsu, Shin-Ichi; Arimura, Kazuhiro; Shimanuki, Tadayuki.
Comparison of population growth rates of confused flour beetle, Tribolium confusum Jacquelin (Coleoptera: Tenebrionidae), on endophyte-infected or endophyte-uninfected seeds of ground tall fescue and perennial ryegrass. Japanese
Journal of Applied Entomology and Zoology, v.42, n.4, Nov., 1998.:227-229.

13

Abado-Becognee, K.; Fleurat-Lessard, F.; Creppy, E. E.; Melcion, D..
Effects of fumonisin B1 on growth and metabolism of larvae of the yellow mealworm, Tenebrio molitor. Entomologia Experimentalis et Applicata, v.86, n.2,Feb., 1998.:135-143.

Aribi,-N.; Quennedey,-A.; Pitoizet,-N.; Delbecque,-J.P.
TI: Ecdysteroid titres in a tenebrionid beetle, Zophobas atratus: effects of grouping and isolation.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Sept 1997. v. 43 (9) p. 815-821.

Baernholdt, Dorte; Andersen, Svend Olav. Sequence studies on post-ecydsial cuticular proteins from pupae of the yellow mealworm, Tenebrio molitor. Insect Biochemistry and Molecular Biology, v.28, n.7, July, 1998.:517-526.

Benken, Theodor; Mueller, Josef K.; Peschke, Klaus. Oligonucleotide DNA fingerprinting optimized to determine parentage in three beetle species. Electrophoresis, v.19, n.2, Feb., 1998.:158-163.

Bjerke,-R.; Zachariassen,-K.E.
TI: Effects of dehydration on water content, metabolism and body fluid solutes of a carabid beetle from dry savanna in East Africa.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Nov 1997. v. 118A (3) p. 779-787.

BIBLIOGRAPHY

Bloch Qazi, Margaret C.; Boake, Christine R.B.; Lewis, Sara M.. The femoral setiferous glands of Tribolium castaneum males and production of the pheromone 4,8-dimethyldecanal. Entomologia Experimentalis et Applicata, v.89, n.3, Dec., 1998.:313-317.

Bloch Qazi, Margaret C.; Aprille, June R.; Lewis, Sara M.. Female role in sperm storage in the red flour beetle, Tribolium castaneum. Comparative Biochemistry and Physiology A, v.120, n.4, Aug., 1998.:641-647.

Carroll,-J.; Damme,-J.-van.; Boets,-A.; Rie,-J.-van.; Ellar,-D.J.
TI: Intramolecular proteolytic cleavage of Bacillus thuringiensis Cry3A delta-endotoxin may facilitate its coleopteran toxicity.
SO: J-invertebr-pathol. Orlando, Fla. : Academic Press. July 1997. v. 70 (1) p. 41-49.

Carver, Fiona J.; Gilman, Jane L.; Hurd, Hilary. Spermatophore production and spermatheca content in Tenebrio molitor infected with Hymenolepis diminuta. Journal of Insect Physiology, v.45, n.6, June, 1999.:565-569.

Chiou,-S.J.; Cerstiaens,-A.; Kotanen,-S.P.; Loof,-A.-de.; Schoofs,-L.
TI: Insect larvae contain substances toxic to adults: the discovery of paralysins.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. May/June 1998. v. 44 (5/6) p. 405-411.

Cho, Mi Young; Choi, Hye Won; Moon, Ga Young; Kim, Mi Hee; Kwon, Tae Hyuk; Homma, Ko-ichi; Natori, Shunji; Lee, Bok Luel. An 86 kDa diapause protein 1-like protein is a component of early-staged encapsulation-relating proteins in coleopteran insect, Tenebrio molitor larvae. FEBS Letters, v.451, n.3, May 28, 1999.:303-307.

Cho,-M.Y.; Lee,-H.S.; Lee,-K.M.; Homma,-K.; Natori,-S.; Lee,-B.L.
TI: Molecular cloning and functional properties of two early-stage encapsulation-relating proteins from the coleopteran insect, Tenebrio molitor larvae.
SO: Eur-j-biochem. Oxford, UK : Blackwell Science Ltd. June 1999. v. 262 (3) p. 737-744.

Cloutier, Conrad; Jean, Christine. Synergism between natural enemies and biopesticides: A test case using the stinkbug Perillus bioculatus (Hemiptera: Pentatomidae) and Bacillus thuringiensis tenebrionis against Colorado potato beetle (Coleoptera: Chrysomelidae). Journal of Economic Entomology, v.91, n.5, Oct., 1998.:1096-1108.

Cristofoletti, Plinio T.; Terra, Walter R.. Specificity, anchoring, and subsites in the active center of a microvillar aminopeptidase purified from Tenebrio molitor (Coleoptera) midgut cells. Insect Biochemistry and

Molecular Biology, v.29, n.9, Sept., 1999.:807-819.

Duman, J. G.; Li, N.; Verleye, D.; Goetz, F. W.; Wu, D. W.; Andorfer, C. A.; Benjamin, T.; Parmelee, D. C.. Molecular characterization and sequencing of antifreeze proteins from larvae of the beetle Dendroides canadensis. Journal of Comparative Physiology B Biochemical Systemic and Environmental Physiology, v.168, n.3, April, 1998.:225-232.

Eizaguirre, Matilde; Prats, Jordi; Abellana, Meritxell; Lopez, Carmen; Llovera, Monserrat; Canela, Ramon. Juvenile hormone and diapause in the Mediterranean corn borer, Sesamia nonagrioides. Journal of Insect Physiology, v.44, n.5-6, May-June, 1998.:419-425.

El-Sayed, G. N.; Ignoffo, C. M.; Leathers, T. D.; Gupta, S. C.. Cuticular and non-cuticular substrate influence on expression of cuticle-degrading enzymes from conidia of an entomopathogenic fungus, Nomuraea rileyi. Mycopathologia, v.122, n.2, 1993.:79-87.

Evans, W. S.; Wong, A.; Hardy, M.; Currie, R. W.; Vanderwel, D.. Evidence that the factor used by the tapeworm, Hymenolepis diminuta, to direct the foraging of its intermediate host, Tribolium confusum, is a volatileattractant. Journal of Parasitology, v.84, n.6, Dec., 1998.:1098-1101.

Felisberti,-F.; Ventura,-D.F.; Hertel,-H.
TI: Cerebral extraocular photoreceptors in beetles.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Dec 1997. v. 118A (4) p. 1353-1357.

Ferreira, Clelia; Torres, Bayardo B.; Terra, Walter R.. Substrate specificities of midgut beta-glycosidases from insects of different orders. Comparative Biochemistry and Physiology B, v.119, n.1, Jan., 1998.:219-225.

Furuya, Kenji; Schegg, Kathleen M.; Schooley, David A.. Isolation and identification of a second diuretic hormone from Tenebrio molitor. Peptides (New York), v.19, n.4, 1998.:619-626.

Grieneisen,-M.L.; Mok,-A.; Kieckbusch,-T.D.; Schooley,-D.A.
TI: The specificity of juvenile hormone esterase revisited.
SO: Insect-biochem-mol-biol. Oxford : Elsevier Science Ltd. May 1997. v 27 (5) p. 365-376.

Hack,-M.A.
TI: The effects of mass and age on standard metabolic rate in house crickets.
SO: Physiol-entomol. Oxford : Blackwell Science Ltd. Dec 1997. v. 22 (4) p. 325-331.

BIBLIOGRAPHY

Hirashima,-A.; Hirokado,-S.; Tojikubo,-R.; Takeya,-R.; Taniguchi,-E.; Eto,-M.
TI: Metamorphosis of the red flour beetle, Tribolium freemani Hinton (Coleoptera: Tenebrionidae): alteration of octopamine content modulates activity of juvenile-hormone esterase, ecdysteroid level, and pupation.
SO: Arch-insect-biochem-physiol. New York, N.Y. : Wiley-Liss. 1998. v. 37 (1) p. 33-46.

Hirashima, Akinori; Nagano, Takeshi; Oishi, Rou; Eto, Morifusa. Stereoselective response of Tribolium castaneum herbst and Musca domestica L. against optically active 2-methoxy-5-phenyl-1,3,2-oxazaphospholidine 2-sulfide. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.104, n.3, 1993.:395-399.

Hirashima, Akinori; Nagano, Takeshi; Eto, Morifusa. Stress-induced changes in the biogenic amine levels and larval growth of Tribolium castaneum Herbst. Bioscience Biotechnology and Biochemistry, v.57, n.12, 1993.:2085-2089.

Hopkins, P. M.; Chung, A. C.-K.; Durica, D. S.. Limb regeneration in the fiddler crab, Uca pugilator: Histological, physiological and molecular considerations. American Zoologist, v.39, n.3, June, 1999.:513-526.

Howard, Ralph W.; Miller, Jon S.; Stanley, David W.. The influence of bacterial species and intensity of infections on nodule formation in insects. Journal of Insect Physiology, v.44, n.2, Feb., 1998.:157-164.

Islam, Nitalie; Bacala, Raymond; Moore, Albert; Vanderwel, Desiree. Biosynthesis of 4-methyl-1-nonanol: Female-produced sex pheromone of the yellow mealworm beetle, Tenebrio molitor (Coleoptera: Tenebrionidae). Insect Biochemistry and Molecular Biology, v.29, n.3, March, 1999.:201-208.

Khebbeb,-M.E.H.; Delachambre,-J.; Soltani,-N.
TI: Lipid metabolism during the sexual maturation of the mealworm (Tenebrio molitor): effect of ingested diflubenzuron.
SO: Pestic-biochem-physiol. Orlando, Fla. : Academic Press. 1997. v. 58 (3) p. 209-217.

Kostaropoulos, Iason; Papadopoulos, Athanasios I.. Glutathione S-transferase isoenzymes expressed in the three developmental stages of the insect Tenebrio molitor. Insect Biochemistry and Molecular Biology, v.28, n.11, Nov., 1998.:901-909.

Lee, Keun Hyeung; Hong, Sung Yu; Oh, Jong Eun; Kwon, Mi Yun; Yoon, Jeong Hyeok; Lee, Ji Hye; Lee, Bok Luel; Moon, Hong Mo. Identification and characterization of the antimicrobial peptide corresponding to C-terminal beta-sheet domain of tenecin 1, an antibacterial protein of larvae of Tenebrio molitor. Biochemical Journal, v.334, n.1, Aug. 15, 1998.:99-105.

BIBLIOGRAPHY

Lee,-Y.T.; Kim,-D.H.; Suh,-J.Y.; Chung,-J.H.; Lee,-B.L.; Lee,-Y.; Choi,-B.S.
TI: Structural characteristics of Tenecin 3, an insect antifungal protein.
SO: Biochem-mol-biol-int. London, U.K. : Taylor & Francis Ltd. Mar 1999. v. 47 (3) p. 369-376.

Lee, Hyun Seong; Cho, Mi Young; Lee, Kwang Moon; Kwon, Tae Hyuk; Homma, Ko-Ichi; Natori, Shunji; Lee, Bok Luel. The pro-phenoloxidase of coleopteran insect, Tenebrio molitor, larvae was activated during cell clump/cell adhesion of insect cellular defense reactions. FEBS Letters, v.444, n.2-3, Feb. 12, 1999.:255-259.

Liou, Yih-Cherng; Thibault, Pierre; Walker, Virginia K.; Davies, Peter L.; Graham, Laurie A.. A complex family of highly heterogeneous and internally repetitive hyperactive antifreeze proteins from the beetle Tenebrio molitor. Biochemistry, v.38, n.35, Aug. 31, 1999.:11415-11424.

Liou, Y.-C.; Thibault, P.; Walker, V. K.; Davies, P. L.; Graham, L. A.. Repeating structure and isoform heterogeneity of a hyperactive antifreeze protein from beetle, Tenebrio molitor. FASEB Journal, v.13, n.7, April 23, 1999.:A1561.

Meyer, Werner; Jungnickel, Harald; Jandke, Markus; Dettner, Konrad; Spiteller, Gerhard. On the cytotoxicity of oxidized phytosterols isolated form photoautotrophic cell cultures of Chenopodium rubrum tested on meal-worms Tenebrio molitor. Phytochemistry (Oxford), v.47, n.5, March, 1998.:789-797.

Moran, R.; Garcia, R.; Lopez, A.; Zaldua, Z.; Mena, J.; Garcia, M.; Armas, R.; Somonte, D.; Rodriguez, J.; Gomez, M.; Pimentel, E.. Transgenic sweet potato plants carrying the delta-endotoxin gene from Bacillus thuringiensis var. tenebrionis. Plant Science (Shannon), v.139, n.2, Dec. 31, 1998.:175-184.

Mouillet,-J.F.; Delbecque,-J.P.; Quennedey,-B.; Delachambre,-J.
TI: Cloning to two putative ecdysteroid receptor from Tenebrio molitor and their developmental expression in the epidermis during metamorphosis.
SO: Eur-j-biochem. Berlin : Springer-Verlag Berlin. Sept 1997. v. 248 (3) p. 856-863.

Mukherjee, S. N.; Rawal, S. K.; Ghumare, S. S.; Sharma, R. N.. Hormetic concentrations of azadirachtin and isoesterase profiles in Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Experientia (Basel), v.49, n.6-7, 1993.:557-560.

Nahoum, Virginie; Farisei, Francesca; Le-Berre-Anton, Veronique; Egloff, Marie P.; Rouge, Pierre; Poerio, Elia; Payan, Francoise. A plant-seed

inhibitor of two classes of alpha-amylases: X-ray analysis of Tenebrio molitor larvae alpha-amylase in complex with the bean Phaseolus vulgaris inhibitor. Acta Crystallographica Section D Biological Crystallography, v.55, n.1, Jan., 1999.:360-362.

Naidu, S. G.. Haemolymph amino acid, sugar and glycerol levels in the Namib Desert tenebrionid Stips stali during dehydration and rehydration. Comparative Biochemistry and Physiology A, v.119, n.2, Feb., 1998.:477-484.

Nicolai, Maryse; Delbecque, Jean-Paul; Delachambre, Jean; Lenoir-Rousseaux, Jean-Jacques. Is tubulin the sole antigen recognized by a putative anti-bursicon antibody? Comparative Biochemistry and Physiology B, v.122, n.1, Jan., 1999.:39-45.

Odell, Jason P.. Energetics of metamorphosis in two holometabolous insect species: Manduca sexta (Lepidoptera: Sphingidae) and Tenebrio molitor (Coleoptera: Tenebrionidae). Journal of Experimental Zoology, v.280, n.5, April 1, 1998.:344-353.

Oppert, Brenda; Morgan, Thomas D.; Culbertson, Christina; Kramer, Karl J.. Dietary mixtures of cysteine and serine proteinase inhibitors exhibit synergistic toxicity toward the red flour beetle, Tribolium castaneum. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.105, n.3, 1993.:379-385.

Perera, Srini C.; Ladd, Tim R.; Dhadialla, T. S.; Krell, Peter J.; Sohi, Sardar S.; Retnakaran, Arthur; Palli, Subba R.. Studies on two ecdysone receptor isoforms of the spruce budworm, Choristoneura fumiferana. Molecular and Cellular Endocrinology, v.152, n.1-2, June 25, 1999.:73-84.

Potekhin, Sergey A.; Loseva, Olga I.; Tiktopulo, Elizabeth I.; Dobritsa, Anatoly P.. Transition state of the rate-limiting step of heat denaturation of Cry3A delta-endotoxin. Biochemistry, v.38, n.13, March 30, 1999.:4121-4127.

Reddy,-S.T.; Venkateswerlu,-G.
TI: Intracellular proteases in sporulated Bacillus thuringiensis subsp. tenebrionis: detection and analysis by gelatin zymography.
SO: Biochem-mol-biol-int. Marrickville, N.S.W., Australia : Academic Press. Dec 1997. v. 43 (5) p. 935-943.

Renault, D.; Salin, C.; Vannier, G.; Vernon, P.. Survival and chill-coma in the adult lesser mealworm, Alphitobius diaperinus (Coleoptera: Tenebrionidae), exposed to low temperatures. Journal of Thermal Biology, v.24, n.4, Aug., 1999.:229-236.

Rodriguez, J. B.; Zhong, L.; Docampo, R.; Wimmer, Z.; Gros, E. G..
Growth inhibitory effect of juvenile hormone analogues on epimastigotes of Trypanosoma cruzi. Bioorganic & Medicinal Chemistry Letters, v.8, n.22, Nov. 17, 1998.:3257-3260.

Rothemund,-S.; Liou,-Y.C.; Davies,-P.L.; Sonnichsen,-F.D.
TI: Backbone structure and dynamics of a hemolymph protein from the mealworm beetle Tenebrio molitor.
SO: Biochemistry. Washington, D.C. : American Chemical Society. Nov 11, 1997. v.36 (45) p. 13791-13801.

Saleem, Mushtaq A.; Shakoori, Abdul Rauf; Mantle, David.
Macromolecular and enzymatic abnormalities induced by a synthetic pyrethroid, Ripcord (cypermethrin), in adult beetles of a stored grain pest, Tribolium castaneum (Herbst.) (Coleoptera: Tenebrionidae). Archives of Insect Biochemistry and Physiology, v.39, n.4, 1998.:144-154.

Salin, C.; Vernon, P.; Vannier, G.. Effects of temperature and humidity on transpiration in adults of the lesser mealworm, Alphitobius diaperinus (Coleoptera: Tenebrionidae). Journal of Insect Physiology, v.45, n.10, Oct., 1999.:907-914.

Salin, C.; Vernon, P.; Vannier, G.. The supercooling and high temperature stupor points of the adult lesser mealworm Alphitobius diaperinus (Coleoptera: Tenebrionidae). Journal of Stored Products Research, v.34, n.4, Oct., 1998.:385-394.

Sato,-K.; Komoto,-M.; Sato,-T.; Enel,-H.; Kobayashi,-M.M.; Yaginuma,-T.
TI: Baculovirus-mediated expression of a gene for trehalase of the mealworm beetle, Tenebrio molitor, in insect cells, SF-9, and larvae of the cabbage armyworm, Mamestra brassicae.
SO: Insect-biochem-mol-biol. Exeter : Elsevier Science Ltd. Dec 1997. v. 27 (12) p. 1007-1016.

Shayesteh, N.; Barthakur, N. N.. Electrohydrodynamic mortality of insects: A plausible mechanism. International Journal of Biometeorology, v.40, n.2, 1997.:86-90.

Shen,-Z.; Corbin,-D.R.; Greenplate,-J.T.; Grebenok,-R.J.; Galbraith,-D.W.; Purcell,-J.P.
TI: Studies on the mode of action of cholesterol oxidase on insect midgut membranes.
SO: Arch-insect-biochem-physiol. New York, N.Y. : Wiley-Liss. 1997. v. 34 (4) p. 429-442.

Strobl, Stefan; Maskos, Klaus; Wiegand, Georg; Huber, Robert;

BIBLIOGRAPHY

Gomis-Rueth, F. Xavier; Glockshuber, Rudi. A novel strategy for inhibition of alpha-amylases: Yellow meal worm alpha-amylase in complex with the Ragi bifuncitonal inhibitor at 2.5 A resolution. Structure (London), v.6, n.7, July 15, 1998.:911-921.

Strobl, Stefan; Maskos, Klaus; Betz, Michael; Wiegand, Georg; Huber, Robert; Gomis-Rueth, F. Xavier; Glockshuber, Rudi. Crystal structure of yellow meal worm alpha-amylase at 1.64 A resolution. Journal of Molecular Biology, v.278, n.3, May 8, 1998.:617-628.

Tartes, U.; Vanatoa, A.; Kuusik, A.. Diversity in coordination of gas exchange, circulation and abdominal movements in insect pupae. Comparative Biochemistry and Physiology Part A Molecular & Integrative Physiology, v.124, n.SUPPL., Aug., 1999.:S111.

Tebayashi,-S.; Hirai,-N.; Suzuki,-T.; Matsuyama,-S.; Nakakita,-H.; Nemoto,-T.; Nakanishi,-H.
TI: Identification of (+)-acoradiene as an aggregation pheromone for Gnatocerus cornutus (F.) (Coleoptera: Tenebrionidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Apr/July 1998. v. 34 (2/3) p. 99-106.

Unruh, Lisa M.; Xu, Rongda; Kramer, Karl J.. Benzoquinone levels as a function of age and gender of the red flour beetle, Tribolium castaneum. Insect Biochemistry and Molecular Biology, v.28, n.12, Dec., 1998.:969-977.

Wang, Xiu-hong; Smith, Ross; Fletcher, Jamie I.; Wilson, Harry; Wood, Chris J.; Howden, Merlin E. H.; King, Glenn F.. Structure-function studies of omega-atracotoxin, a potent antagonist of insect voltage-gated calcium channels. European Journal of Biochemistry, v.264, n.2, Sept. 1, 1999.:488-494.

Watson, I.; Churchill, D.; Caveney, S.. Characterization of a chloride current in the larval epidermis of the beetle Tenebrio molitor. Journal of Insect Physiology, v.45, n.10, Oct., 1999.:895-906.

Weaver, Robert J.; Edwards, John P.. Neuropeptide inhibitors of juvenile hormone synthesis in the mealworm and tomato moth. Vaudry, H. Tonon, M.-C. Roubos, E. W. de Loof, A. Annals of the New York Academy of Sciences; Trends in comparative endocrinology and neurobiology: From molecular to integrative biology., May 15, 1998.:450-452.

Wietstock, Steven M.; Marron, Susan M.; Maxim, Dan; Gott, Bruce. Genomic analysis of DNA isolated from Tenebrio and Tribolium beetles. FASEB Journal, v.7, n.7, 1993.:A1228.

Willis, Judith H.. Cuticular proteins in insects and crustaceans. American Zoologist, v.39, n.3, June, 1999.:600-609.

Vacha,-M.
TI: The influence of a static, homogenous magnetic field (B = 320 mT) on extracardiac pulsations of Tenebrio molitor pupae (Coleoptera: Tenebrionidae).
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Nov 1997. v. 43 (11) p. 979-989.

15

Beeman, Richard W.; Brown, Susan J.; Stuart, Jeffrey J.; Denell, Rob. The evolution of genes regulating developmental commitments in insects and other animals. Wiley-Liss, Inc. ; Wiley-Liss, Ltd. 605 Third Avenue, New York, New York 10158-0012, USA; Chichester, England 1993.. ;Spradling, A. C. Ed. Symposium of the Society for Developmental Biology; Evolutionary conservation of developmental mechanisms.:71-84.

Binner, Priska; Sander, Klaus. Pair-rule patterning in the honeybee Apis mellifera: Expression of even-skipped combines traits known from beetles and fruitfly. Development Genes and Evolution, v.206, n.7, 1997.:447-454.

Chikatunov,-V.; Lillig,-M.; Pavlicek,-T.; Blaustein,-L.; Nevo,-E.
TI: Biodiversity of insects at a microsite, 'Evolution Canyon', Nahal Oren, Mt. Carmel, Israel. Coleoptera: Tenebrionidae.
SO: J-arid-environ. London, New York, Academic Press. Oct 1997. v. 37 (2) p. 367-377.

Hancock, J. M.; Shaw, P. J.; Bonneton, F.; Dover, G. A.. High sequence turnover in the regulatory regions of the development gene hunchback in insects. Molecular Biology and Evolution, v.16, n.2, Feb., 1999.:253-265.

Hurst, Gregory D. D.; McVean, Gilean A. T.. Selfish genes in a social insect. Trends in Ecology & Evolution, v.13, n.11, Nov., 1998.:434-435.

Maderspacher, Florian; Bucher, Gregor; Klingler, Martin. Pair-rule and gap gene mutants in the flour beetle Tribolium castaneum. Development Genes and Evolution, v.208, n.10, Dec., 1998.:558-568.

Maxton-Kuechenmeister, Joerg; Handel, Klaus; Schmidt-Ott, Urs; Roth, Siegfried; Jaeckle, Herbert. Toll homolog expression in the beetle Tribolium suggests a different mode of dorsoventral patterning than in Drosophila embryos. Mechanisms of Development, v.83, n.1-2, May, 1999.:107-114.

Missios, S.; Pincus, M.; Zahorchak, A.; McKeon, B.; Oshop, G.;

BIBLIOGRAPHY

Trecki, J.; Nasr, D.; Doctor, J.. The decapentaplegic and 60A genes of the red flour beetle, Tribolium castaneum, are similar to Drosophila dpp and 60A in sequence, structure, and expression. Developmental Biology, v.210, n.1, June 1, 1999.:188.

Moermans, R.; Casteels, H.; Van Hecke, P.. Evolution of cacao-pests over a six year period. Anzeiger fuer Schaedlingskunde Pflanzenschutz Umweltschutz, v.71, n.8, Jan., 1998.:149-151.

Nagy, Lisa M.; Carroll, Sean. Conservation of wingless patterning functions in the short germ embryos of Tribolium castaneum. Nature (London), v.367, n.6462, 1994.:460-463.

Peterson, Michael D.; Popadic, Aleksandar; Kaufman, Thomas C.. The expression of two engrailed-related genes in an apterygote insect and a phylogenetic analysis of insect engrailed-related genes. Development Genes and Evolution, v.208, n.10, Dec., 1998.:547-557.

Plohl, Miroslav; Mestrovic, Nevenka; Bruvo, Branka; Ugarkovic, Durdica. Similarity of structural features and evolution of satellite DNAs from Palorus subdepressus (Coleoptera) and related species. Journal of Molecular Evolution, v.46, n.2, Feb., 1998.:234-239.

Rice, William R.. Intergenomic conflict, interlocus antagonistic coevolution, and the evolution of reproductive isolation. Howard, D. J. Berlocher, S. H. Endless forms: Species and speciation., 1998.:161-270.

Shippy, Teresa D.; Brown, Susan J.; Denell, Robin E.. Molecular characterization of the Tribolium abdominal-A ortholog and implications for the products of the Drosophila gene. Development Genes and Evolution, v.207, n.7, March, 1998.:446-452.

Singh, A. K.; Thorpe, G. R.. A solution procedure for three-dimensional free convective flow in peaked bulks of grain. Journal of Stored Products Research, v.29, n.3, 1993.:221-235.

Sommer, Ralf J.; Tautz, Diethard. Involvement of an orthologue of the Drosophila pair-rule gene hairy in segment formation of the short germ-band embryo of Tribolium (Coleoptera). Nature (London), v.361, n.6411, 1993.:448-450.

Stuart, Jeffrey J.; Brown, Susan J.; Beeman, Richard W.; Denell, Robin E.. The Tribolium homeotic gene Abdominal is homologous to abdominal-A of the Drosophila bithorax complex. Development (Cambridge), v.117, n.1, 1993.:233-243.

Tautz, Diethard; Wolff, Christian; Schroeder, Reinhard; Rohr, Klaus; Eckert, Christoph. Evolution of insect segmentation. Developmental Biology, v.210, n.1, June 1, 1999.:243.

Wade, Michael J.; Patterson, Harold; Chang, Nancy W.; Johnson, Norman A.. Postcopulatory, prezygotic isolation in flour beetles. Heredity, v.72, n.2, 1994.:163-167.

Wade, Michael J.; Johnson, Norman A.. Reproductive isolation between two species of flour beetles, Tribolium castaneum and T. freemani: Variation within and among geographical populations of T. castaneum. Heredity, v.72, n.2, 1994.:155-162.

Wolff, Christina; Schroeder, Reinhard; Schulz, Cordula; Tautz, Diethard; Klingler, Martin. Regulation of the Tribolium homologues of caudal and hunchback in Drosophila: Evidence for maternal gradient systems in a short germ embryo. Development (Cambridge), v.125, n.18, Sept., 1998.:3645-3654.

16

Costantino, R. F.; Desharnais, R. A.; Cushing, J. M.; Dennis, Brian. Chaotic dynamics in an insect population. Science (Washington D C), v.275, n.5298, 1997.:389-391.

Costantino, R. F.; Cushing, J. M.; Dennis, Brian; Desharnais, Robert A.; Henson, Shandelle M.. Resonant population cycles in temporally fluctuating habitats. Bulletin of Mathematical Biology, v.60, n.2, March, 1998.:247-273.

Rohani, Pejman; Miramontes, Octavio. Chaos or quasiperiodicity in laboratory insect population? Journal of Animal Ecology, v.65, n.6, 1996.:847-849.

17

Ando, Kiyoshi. A new species from Indochina in the genus Gnesis Pascoe (Coleoptera, Tenebrionidae). Bulletin de la Societe Entomologique de France, v.104, n.1, March, 1999.:101-103.

Bremer,-H.J.; Triplehron,-C.A.
TI: The Latin American species of the genus Corticeus Piller and Mitterpacher (Coleoptera: Tenebrionidae, Hypophloeini). I. The species described by Reitter and Pic, and description of two new species.
SO: Coleopt-bull. Sacramento, CA : Coleopterists Society. Mar 1999. v. 53 (1) p 56-63.

BIBLIOGRAPHY

Brustel, Herve; Roge, Jean. On several rare or little known Coleoptera species from southwestern France (second part). Entomologiste (Paris), v.55, n.3, June, 1999.:91-101.

Brustel, Herve; Van Meer, Cyrille. Some remarkable elements of the saproxylic entomofauna from Pyrenees and neighbouring regions (Coleoptera). Bulletin de la Societe Entomologique de France, v.104, n.3, Aug., 1999.:231-240.

Chitra, S.; Narayanan, R. B.; Balakrishnan, A.; Jayaraman, Kunthala. A rapid and specific method for the identification of Bacillus thuringiensis strains by indirect immunofluorescence. Journal of Invertebrate Pathology, v.71, n.3, May, 1998.:286-287.

Endrody-Younga, S.. Afrobyrsax capensis spec. nov., with a tropical West African relationship (Coleoptera: Tenebrionidae: Bolitophagini). Annals of the Transvaal Museum, v.36, n.30, 1998.:421-423.

Endrody-Younga, S.. The American tribe Evaniosomini in southern Africa (Coleoptera: Tenebrionidae). Annals of the Transvaal Museum, v.36, n.31, 1998.:425-426.

Epps, Tammy M.; Britten, Hugh B.; Rust, Richard W.. Historical biogeography of Eusattus muricatus (Coleoptera: Tenebrionidae) within the Great Basin, western North America. Journal of Biogeography, v.25, n.5, Sept., 1998.:957-968.

Ferrer, Julio; Moragues, Gerard. Contribution to the knowledge of the neotropical Tenebrionidae: The genus Phymatestes Pascoe, 1868 (Coleoptera), 1st part: The group of Ph. tuberculatus. Bulletin de la Societe Entomologique de France, v.103, n.4, Oct., 1998.:373-392.

Ferrer, Julio; Moragues, Gerard. The genus Flabellostrongylium Pic (1938), redescription, systematic discussion and description of a new species from French Guyana (Coleoptera, Tenebrionidae). Bulletin de la Societe Entomologique de France, v.104, n.3, Aug., 1999.:293-297.

Gompel, Nicolas; Soldati, Fabien; Soldati, Laurent. Description of the female of Litoborus (Paralitoborus) escalerai Antoine, 1930 (Coleoptera Tenebrionidae). Bulletin de la Societe Entomologique de France, v.104, n.1, March, 1999.:35-37.

Husband, Robert W.; Hasan, M. Mahbub. A new podapolipus (Acari: Podapolipidae) from Alphitobius sp. (Coleoptera: Tenebrionidae) from Bangladesh. International Journal of Acarology, v.24, n.1, March, 1998.:53-57.

BIBLIOGRAPHY

Husband, Robert W.. A review of Podapolipus (Acari: Podapolipidae) from Coleoptera and description of two new species from the Unites States. International Journal of Acarology, v.24, n.1, March, 1998.:59-67.

Matthews, E. G.. Classification, phylogeny and biogeography of the genera of Adeliini (Coleoptera: Tenebrionidae). Invertebrate Taxonomy, v.12, n.5, 1998.:685-824.

Maxwell, Judith A.; Young, Daniel K.. A significant eastern range extension for Eleodes tricostatus (Say) (Coleoptera: Tenebrionidae). Coleopterists Bulletin, v.52, n.1, March, 1998.:90-92.

Medvedev, G. S.. Contribution to the knowledge of darkling beetles of the genus Lasiostola Sol. (Coleoptera: Tenebrionidae). Entomological Review (English Translation of Entomologicheskoye Obozreniye), v.72, n.8, 1993 (1994).:64-76.

Mitchell, B. R.. Corticeus unicolor Pill. & Mitt. (Col.: Tenebrionidae) new to Warwickshire. Entomologist's Record and Journal of Variation, v.111, n.2, March-April, 1999.:56.

Molina-Rugama, Adrian J.; Zanuncio, Jose C.; Zanuncio, Teresinha V.; Oliveira, Marcio L. R. De. Reproductive strategy of Podisus ostralis (Stal) (Heteroptera: Pentatomidae) females under different feeding intervals. Biocontrol Science and Technology, v.8, n.4, Dec., 1998.:583-588.

Nikitsky, N. B.. To knowledge of beetles from the family Synchroidae (Coleoptera, Tenebrionoidea) of the world fauna. Zoologicheskii Zhurnal, v.78, n.1, Jan., 1999.:42-48.

Palmer, Miquel. Taxonomy, phylogeny, and biogeography of a species-group of West-Mediterranean Tentyria (Coleoptera: Tenebrionidae). Annals of the Entomological Society of America, v.91, n.3, May, 1998.:260-268.

Papp, Charles S.. Two new Stenosini species in the genus Araeoschizus LeConte from Baja California, Mexico (Coleoptera: Tenebrionidae). Bulletin Southern California Academy of Sciences, v.97, n.3, Dec., 1998.:89-95.

Philips, T. K.; Steiner, W. E., ; Triplehorn, C. A.. A new species of Central American Platydema Laporte and Brulle (Coleoptera: Tenebrionidae) recently established in Florida. Coleopterists Bulletin, v.52, n.3, Sept., 1998.:291-296.

Pollock, Darren A.. Nomenclatural changes in pythidae and pyrochroidae (Coleoptera). Coleopterists Bulletin, v.52, n.4, Dec., 1998.:388-390.

Pollock, Darren A.. Revision of the Neotropical genus Ischyomius with a discussion on its systematic position (Insecta: Coleoptera: Tenebrionoidea: Pythidae). Annals of Carnegie Museum, v.67, n.3, Aug. 13, 1998.:245-264.

Triplehorn,-C.A.
TI: A review of the genus Liodema Horn (Coleoptera: Tenebrionidae) with description of a new species from Costa Rica and Panama.
SO: Proc-Entomol-Soc-Wash. Washington [D.C.] : The Society , 1986-. Apr 1998. v. 100 (2) p. 324-330.

Triplehorn,-C.A.; Merkl,-O.
TI: Review of the genus Loxostethus triplehorn, with descriptions of three new species (Coleoptera: Tenebrionidae: Diaperini).
SO: Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. Nov 1997. v. 90 (6) p. 736-741.

18

Alonso-Amelot, Miguel E.; Avila, Jorge L.; Otero, L. Daniel; Mora, Flor; Wolff, Berenice. A new bioassay for testing plant extracts and pure compounds using red flour beetle Tribolium castaneum Herbst. Journal of Chemical Ecology, v.20, n.5, 1994.:1161-1177.

Berghammer, Andreas; Bucher, Gregor; Maderspacher, Florian; Klingler, Martin. A system to efficiently maintain embryonic lethal mutations in the flour beetle Tribolium castaneum. Development Genes and Evolution, v.209, n.6, June, 1999.:382-388.

Buchelos, C. Th.; Athanassiou, C. G.. Unbaited probe traps and grain trier: A comparison of the two methods for sampling Coleoptera in stored barley. Journal of Stored Products Research, v.35, n.4, Oct., 1999.:397-404.

Chitra, S.; Narayanan, R. B.; Balakrishnan, A.; Jayaraman, Kunthala. A rapid and specific method for the identification of Bacillus thuringiensis strains by indirect immunofluorescence. Journal of Invertebrate Pathology, v.71, n.3, May, 1998.:286-287.

Dowdy, Alan K.; Mullen, Michael A.. Multiple stored-product insect pheromone use in pitfall traps. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:75-80.

Hagstrum, David W.; Flinn, Paul W.. Comparison of acoustical

detection of several species of stored-grain beetles (Coleoptera: Curculionidae, Tenebrionidae, Bostrichidae, Cucujidae) over a range of temperatures. Journal of Economic Entomology, v.86, n.4, 1993.:1271-1278.

Ho,-S.H.; Fan,-L.; Boon,-K.S.
TI: Development of a PC-based automatic monitoring system for Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) in a rice warehouse.
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Oct 1997. v. 33 (4) p. 277-281.

Mankin, R. W.; Shuman, D.; Coffelt, J. A.. Acoustic counting of adult insects with differing rates and intensities of sound production in stored wheat. Journal of Economic Entomology, v.90, n.4, 1997.:1032-1038.

Trematerra, P.. Capture of stored-grain Coleoptera with WB Probe II Trap: Influence of grain type. Anzeiger fuer Schaedlingskunde Pflanzenschutz Umweltschutz, v.71, n.7, Nov., 1998.:135-137.

Tobin,-P.C.; Pitts,-C.W.
TI: Flotation method for extracting insects from poultry manure samples.
SO: J-med-entomol. Lanham, Md. : The Entomological Society of America. Jan 1999. v. 36 (1) p. 121-123.

Vela-Coiffier, E. L.; Fargo, W. S.; Bonjour, E. L.; Cuperus, G. W.; Warde, W. D.. Immigration of insects into on-farm stored wheat and relationships among trapping methods. Journal of Stored Products Research, v.33, n.2, 1997.:157-166.

Weston, Paul A.; Barney, Robert J.. Comparison of three trap types for monitoring insect populations in stored grains. Journal of Economic Entomology, v.91, n.6, Dec., 1998.:1449-1457.

BIBLIOGRAPHY

18

Alonso-Amelot, Miguel E.; Avila, Jorge L.; Otero, L. Daniel; Mora, Flor; Wolff, Berenice. A new bioassay for testing plant extracts and pure compounds using red flour beetle Tribolium castaneum Herbst. Journal of Chemical Ecology, v.20, n.5, 1994.:1161-1177.

Berghammer, Andreas; Bucher, Gregor; Maderspacher, Florian; Klingler, Martin. A system to efficiently maintain embryonic lethal mutations in the flour beetle Tribolium castaneum. Development Genes and Evolution, v.209, n.6, June, 1999.:382-388.

Ho,-S.H.; Fan,-L.; Boon,-K.S.
TI: Development of a PC-based automatic monitoring system for Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) in a rice warehouse.
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Oct 1997. v. 33 (4) p. 277-281.

BIBLIOGRAPHY

C. Coleoptera: Tenebrionidae and other families, 1993 - 1999

1

Dallai, Romano; Lupetti, Pietro; Lane, Nancy J.. The organization of actin in the apical region of insect midgut cells after deep etching. Journal of Structural Biology, v.122, n.3, 1998.:283-292.

de Brito-Gitirana, L.; Storch, V.. The influence of starvation on the hepatocyte ultrastructure in Hemidactylus Frenatus (Lacertilia: Gekkonidae) with special regard to peroxisomes. Annals of Anatomy, v.180, n.3, June, 1998.:193-202.

Gorb, St anislav N.. Frictional surfaces of the elytra-to-body arresting mechanism in tenebrionid beetles (Coleoptera: Tenebrionidae): Design of co-opted fields of microtrichia and cuticle ultrastructure. International Journal of Insect Morphology and Embryology, v.27, n.3, July, 1998.:205-225.

Gorb, Stanislav N.. Ultrastructure of the thoracic dorso-medial field (TDM) in the elytra-to-body arresting mechanism in tenebrionid beetles (Coleoptera: Tenebrionidae). Journal of Morphology, v.240, n.2, May, 1999.:101-113.

Hopkins, J. D.; Steelman, C. D.; Carlton, C. E.. Internal reproductive system of the adult male lesser mealworm Alphitobius diaperinus (Coleoptera: Tenebrionidae). Journal of the Kansas Entomological Society, v.66, n.4, 1993 (1994).:446-450.

Moron-Rios, Alejandro; Moron, Miguel Angel. Comparative morphological and histological analysis of the larval digestive tract of five species of monticolous saproxylophilous coleopterans of the state of Hidalgo, Mexico. Folia Entomologica Mexicana, v.0, n.83, 1991(1992).:87-131.

2

Alyokhin, Andrei V.; Ferro, David N.. Mating ability of Colorado potato beetle (Coleoptera: Chrysomelidae) males fed transgenic potato (Solanaceae) foliage. Canadian Entomologist, v.131, n.4, July-Aug., 1999.:539-540.

Alyokhin, Andrei V.; Ferro, David N.. Modifications in dispersal and oviposition of Bt-resistant and Bt-susceptible Colorado potato beetles as a result of exposure to Bacillus thuringiensis subsp. tenebrionis Cry3A toxin. Entomologia Experimentalis et Applicata, v.90, n.1, Jan., 1999.:93-101.

Arnaud, Ludovic; Haubruge, Eric. Mating behaviour and male mate

choice in Tribolium castaneum (Coleoptera, Tenebrionidae). Behaviour, v.136, n.1, Jan., 1999.:67-77.

Bloch Qazi, M. C.; Kobel, A. M.; Lewis, S. M.. Female control over sperm precedence in a flour beetle. American Zoologist, v.37, n.5, 1997.:114A.

Breuner, Creagh W.; Greenberg, Allison L.; Wingfield, John C.. Noninvasive corticosterone treatment rapidly increases activity in Gambel's white-crowned sparrows (Zonotrichia leucophrys gambelii). General and Comparative Endocrinology, v.111, n.3, Sept., 1998.:386-394.

Enders, Margit M.; Schuele, Holger; Henschel, Joh R.. Sexual dimorphism, fighting success and mating tactics of male Onymacris plana Peringuey (Coleoptera: Tenebrionidae) in the Namib Desert. Ethology, v.104, n.12, Dec., 1998.:1003-1019.

Hagstrum, David W.; Flinn, Paul W.; Gaffney, Jerry J.. Temperature gradient on Tribolium castaneum (Coleoptera: Tenebrionidae) adult dispersal in stored wheat. Environmental Entomology, v.27, n.1, Feb., 1998.:123-129.

Hasan, Md. Mahbub. Mating competitiveness of adult males of Tribolium spp (Coleoptera: Tenebrionidae) developing from irradiated pupae. Journal of Stored Products Re earch, v.35, n.3, July, 1999.:307-316.

Kimura, Yuji; Masaki, Sinzo. Hourglass and oscillator expression of photoperiodic diapause response in the cabbage moth Mamestra brassicae. Physiological Entomology, v.18, n.3, 1993.:240-246.

Kotaki, Toyomi; Nakakita, Hiroshi; Kuwahara, Masahiko. Crowding inhibits pupation in Tribolium freemani (Coleoptera: Tenebrionidae): Effects of isolation and juvenile hormone analogues on development and pupation. Applied Entomology and Zoology, v.28, n.1, 1993.:43-52.

Krasnov,-B.; Shenbrot,-G.
TI: Seasonal variation in spatial organization of a darkling beetle (Coleoptera: Tenebrionidae) community.
SO: Environ-entomol. Lanham, Md. : Entomological Society of America. Apr 1997. v. 26 (2) p. 178-190.

Lewis, Sara M.; Austad, Steven N.. Sexual selection in flour beetles: The relationship between sperm precedence and male olfactory attractiveness. Behavioral Ecology, v.5, n.2, 1994.:219-224.

Lewis, Sara M.; Jutkiewicz, Emily. Sperm precedence and sperm storage in multiply mated red flour beetles. Behavioral Ecology and

Sociobiology, v.43, n.6, Nov. 1, 1998.:365-369.

Mencinger, Bojana. Prey recognition in larvae of the antlion Euroleon nostras (Neuroptera, Myrmeleontidae). Acta Zoologica Fennica, v.0, n.209, May 6, 1998.:157-161.

Rasa, O. Anne E.; Bisch, Sonia; Teichner, Theresa. Female mate choice in a subsocial beetle: Male phenotype correlates with helping potential and offspring survival. Animal Behaviour, v.56, n.5, Nov., 1998.:1213-1220.

Rasa,-O.A.E.
TI: Division of labour and extended parenting in a desert tenebrionid beetle.
SO: Ethology. Berlin : Paul Parey, 1986-. Jan 1999. v. 105 (1) p. 37-56.

Rasa, O. Anne E.. Biparental investment and reproductive success in a subsocial desert beetle: The role of maternal effort. Behavioral Ecology and Sociobiology, v.43, n.2, Aug., 1998.:105-113.

Schatral, Andrea. Diet influences male-female interactions in the bushcricket Requena verticalis (Orthoptera: Tettigoniidae). Journal of Insect Behavior, v.6, n.3, 1993.:379-388.

Tebayashi, S.; Hirai, N.; Suzuki, T.; Matsuyama, S.; Nakakita, H.; Nemoto, T.; Nakanishi, H.. Identification of (+)-acoradiene as an aggregation pheromone for Gnatocerus cornutus (F.) (Coleoptera: Tenebrionidae). Journal of Stored Products Research, v.34, n.2-3, April-July, 1998.:99-106.

Telford, Steven R.; Jennions, Michael D.. Establishing cryptic female choice in animals. Trends in Ecology & Evolution, v.13, n.6, June, 1998.:216-218.

Vela-Coiffier, E. L.; Fargo, W. S.; Bonjour, E. L.; Cuperus, G. W.; Warde, W. D.. Immigration of insects into on-farm stored wheat and relationships among trapping methods. Journal of Stored Products Research, v.33, n.2, 1997.:157-166.

Zotov, V. A.; Chernyshev, V. B.. Circadian rhythm of activity in the tenebrionid beetle Blaps faustii (Coleoptera, Tenebrionidae) from the Kara-Kum Desert (Turkmenistan). Zoologicheskii Zhurnal, v.77, n.12, Dec., 1999.:1389-1393.

3

Ahmad, S. A.; Hopkins, T. L.. Phenol beta-glucosyltransferases in six species of insects: Properties and tissue localization. Comparative

BIBLIOGRAPHY

Biochemistry and Physiology B Comparative Biochemistry, v.104, n.3, 1993.:515-519.

Barcelo, Francisco; Gutierrez, Francisco; Barjau, Ignasi; Portugal, Jose. A theoretical perusal of the satellite DNA curvature in tenebrionid beetles. Journal of Biomolecular Structure and Dynamics, v.16, n.1, Aug., 1998.:41-50.

Dallai,-R.; Lupetti,-P.; Lane,-N.J.
TI: The organization of actin in the apical region of insect midgut cells after deep etching.
SO: J-struct-biol. Orlando, Fla. : Academic Press. 1998. v. 122 (3) p. 283-292.

Gorb, Stanislav N.. Ultrastructure of the thoracic dorso-medial field (TDM) in the elytra-to-body arresting mechanism in tenebrionid beetles (Coleoptera: Tenebrionidae). Journal of Morphology, v.240, n.2, May, 1999.:101-113.

Hirashima, Akinori; Hirokado, Shiori; Tojikubo, Risa; Takeya, Ryuko; Taniguchi, Eiji; Eto, Morifusa. Metamorphosis of the red flour beetle, Tribolium freemani Hinton (Coleoptera: Tenebrionidae): Alteration of octopamine content modulates activity of juvenile-hormone esterase, ecdysteroid level, and pupation. Archives of Insect Biochemistry and Physiology, v.37, n.1, 1998.:33-46.

Nagamatsu, Yasunori; Toda, Satoshi; Yamaguchi, Fumihide; Ogo, Masashi; Kogure, Masato; Nakamura, Masahiro; Shibata, Yasuyo; Katsumoto, Tetsuo. Identification of Bombyx mori midgut receptor for Bacillus thuringiensis insecticidal CryIA(a) toxin. Bioscience Biotechnology and Biochemistry, v.62, n.4, April, 1998.:718-726.

BIBLIOGRAPHY

Plohl, Miroslav; Lucijanic-Justic, Vlatka; Ugarkovic, Durdica; Petitpierre, Eduard; Juan, Carlos. Satellite DNA and heterochromatin of the flour beetle Tribolium confusum. Genome, v.36, n.3, 1993.:467-475.

Rondot, Isabelle; Quennedey, Brigitte; Delachambre, Jean. Structure, organization and expression of two clustered cuticle protein genes during the metamorphosis of an insect, Tenebrio molitor. European Journal of Biochemistry, v.254, n.2, June, 1998.:304-312.

Ruedas, Luis A.; Cook, Joseph A.; Yates, Terry L.; Bickham, John W.. Conservative genome size and rapid chromosomal evolution in the South American tuco-tucos (Rodentia: Ctenomyidae). Genome, v.36, n.3, 1993.:449-458.

Trepte, Hans,-H. Ultrastructural analysis of balbiani ring genes of Chironomus pallidivittatus in different states of Balbiani ring activity. Chromosoma (Berlin), v.102, n.7, 1993.:433-445.

Ugarkovic, D. L.; Plohl, M.; Lucijanic-Justic, V.; Borstnik, B..
Detection of satellite DNA in Palorus ratzeburgii: Analysis of curvature profiles and comparison with Tenebrio molitor satellite DNA. Biochimie (Paris),v.74, n.12, 1992 (1993).:1075-1082.

Wolf,-K.W.
TI: Fine structure of the kinetochores in six species of the Coleoptera.
SO: Genome. Ottawa, Ontario, Canada : National Research Council of Canada. June 1997. v. 40 (3) p. 379-385.
CN: DNAL QH431.G452

4

Hirashami, Akinori; Nagano, Takeshi; Takeya, Ryuko; Eto, Morifusa.
Effect of larval density on whole-body biogenic amine levels of Tribolium freemani Hinton. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.106, n.2, 1993.:457-461.

Quennedey, Andre; Quennedey, Brigitte. Development of the wing discs of Zophobas atratus under natural and experimental conditions: Occurrence of a gradual larval-pupal commitment in the epidermis of tenebrionid beetles. Cell & Tissue Research, v.296, n.3, June, 1999.:619-634.

Zanuncio,-J.C.; Saavedra,-J.L.D.; Oliveira,-H.N.; Degheele,-D.; Clercq,-P.-de.
TI: Development of the predatory stinkbug Brontocoris tabidus (Signoret) (Heteroptera: Pentatomidae) on different proportions of an artificial diet and pupae of Tenebrio molitor L. (Coleoptera: Tenebrionidae).
SO: Biocontrol-sci-technol. Abingdon, Oxfordshire : Carfax Publishing Co,. Dec 1996. v. 6 (4) p. 619-625.

5

Aloia, A.; Colombini, I.; Fallaci, M.; Chelazzi, L.. Behavioural adaptations to zonal maintenance of five species of tenebrionids living along a Tyrrhenian sandy shore. Marine Biology (Berlin), v.133, n.3, April, 1999.:473-487.

Benoit, Hugues P.; McCauley, Edward; Post, John R.. Testing the demographic consequences of cannibalism in Tribolium confusum. Ecology (Washington D C), v.79, n.8, Dec., 1998.:2839-2851.

Bloch Qazi, Margaret C.; Herbeck, Joshua T.; Lewis, Sara M..
Mechanisms of sperm transfer and storage in the red flour beetle (Coleoptera:

BIBLIOGRAPHY

Tenebrionidae). Annals of the Entomological Society of America, v.89, n.6, 1996.:892-897.

Bremer, Hans J.; Girard, Claude. The entomological fauna of dead termitaries of Macrotermes. Occurrence of Alphitobius lamottei Ardoin in the chamber of dead termitaries (Coleoptera, Tenebrionidae, Alphitobiini). Revue Francaise d'Entomologie (Nouvelle Serie), v.18, n.4, 1996 (1997).:135-137.

Cicchino, Armando C.. Role of fimicolous Coleoptera as "natural enemies" of the horn fly in Argentina. Status of their knowledge and perspectives. Revista de la Sociedad Entomologica Argentina, v.58, n.1-2, 1999.:172-179.

Cloutier,-C.; Jean,-C.
TI: Synergism between natural enemies and biopesticides: a test case using the stinkbug Perillus bioculatus (Hemiptera: Pentatomidae) and Bacillus thuringiensis tenebrionis against Colorado potato beetle (Coleoptera: Chrysomelidae).
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Oct 1998. v. 91 (5) p. 1096-1108.

Crum, D. A.; Weiser, L. A.; Stamp, N. E.. Effects of prey scarcity and plant material as a dietary supplement on an insect predator. Oikos, v.81, n.3, April, 1998.:549-557.

Cushing, J. M.; Dennis, Brian; Desharnais, R. A.; Costantino, R. F.. Moving toward an unstable equilibrium: Saddle nodes in population systems. Journal of Animal Ecology, v.67, n.2, March, 1998.:298-306.

Dennis, Brian; Desharnais, R. A.; Cushing, J. M.; Costantino, R. F.. Transitions in population dynamics: Equilibria to periodic cycles to aperiodic cycles. Journal of Animal Ecology, v.66, n.5, 1997.:704-729.

Fields, P. G.; White, N. D. G.. Survival and multiplication of stored-product beetles at simulated and actual winter temperatures. Canadian Entomologist, v.129, n.5, Sept.-Oct., 1997.:887-898.

Hendricks, Paul; Hendricks, Lisa M.. Field observations on the myrmecophilous beetle Araeoschizus airmeti Tanner (Coleoptera: Tenebrionidae) at harvester ant (Hymenoptera: Formicidae) mounds. Great Basin Naturalist, v.59, n.3, July, 1999.:297-299.

Henson, Shandelle M.; Cushing, J. M.; Costantino, R. F.; Dennis, Brian; Desharnais, Robert A.. Phase switching in population cycles. Proceedings of the Royal Society of London Series B Biological Sciences, v.265, n.1411, Nov. 22, 1998.:2229-2234.

BIBLIOGRAPHY

Hoback, W. Wyatt; Stanley, David W.; Higley, Leon G.; Barnhart, M. Christopher. Survival of immersion and anoxia by larval tiger beetles, Cicindela togata. American Midland Naturalist, v.140, n.1, July, 1998.:27-33.

Haubruge, E.; Arnaud, L.; Mignon, J.; Gage, M.J.G.. Fertilization by proxy: Rival sperm removal and translocation in a beetle. Proceedings of the Royal Society Biological Sciences Series B, v.266, n.1424, June 7, 1999.:1183-1187.

Jacobson, K. M.; Jacobson, P. J.. Rainfall regulates decomposition of buried cellulose in the Namib Desert. Journal of Arid Environments, v.38, n.4, April, 1998.:571-583.

Krasnov, B. R.; Shenbrot, G. I.. Structure of communities of ground-dwelling animals at the junction of two phytogeographic zones. Journal of Biogeography, v.25, n.6, Nov., 1998.:1115-1131.

McIntyre, Nancy E.; Wiens, John A.. Interactions between habitat abundance and configuration: Experimental validation of some predictions from percolation theory. Oikos, v.86, n.1, July, 1999.:129-137.

Naidu,-S.G.
TI: Haemolymph amino acid, sugar and glycerol levels in the Nambi Desert tenebrionid Stips stali during dehydration and rehydration.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Feb 1998. v. 119A (2) p. 477-484.

Oussou, Richard D.; Meikle, W. G.; Markham, R. H.. Factors affecting larval survivorship and development rate of Teretriosoma nigrescens Lewis. Insect Science and its Application, v.18, n.1, Jan.-March, 1998.:53-58.

Parajulee, Megha N.; Phillips, Thomas W.; Hogg, David B.. Functional response of Lyctocoris campestris (F.) adults: Effects of predator sex, prey species, and experimental habitat. Biological Control, v.4, n.1, 1994.:80-87.

Pascual-Villalobos,-M.J.; Robledo,-A.
TI: Anti-insect activity of plant extracts from the wild flora in southeastern Spain.
SO: Biochem-syst-ecol. Oxford, U.K. : Elsevier Science Ltd. Jan 1999. v. 27 (1) p. 1-10.

Polis, Gary A.; Barnes, Joseph D.; Seely, Mary K.; Henschel, Joh R.; Enders, Margit M.. Predation as a major cost of reproduction in Namib Desert tenebrionid beetles. Ecology (Washington D C), v.79, n.7, Oct., 1998.:2560-2566.

Riddick,-E.W.; Dively,-G.; Barbosa,-P.

BIBLIOGRAPHY

TI: Effect of a seed-mix deployment of Cry3A-transgenic and nontransgenic potato on the abundance of Lebia grandis (Coleoptera: Carabidae) and Coleomegilla maculata (Coleoptera: Coccinellidae).
SO: Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. Sept 1998. v. 91 (5) p. 647-653.

Riddick,-E.W.; Barbosa,-P.
TI: Inpact of Cry3A-intoxicated Leptinotarsa decemlineata (Coleoptera: Chrysomelidae) and pollen on consumption, development, and fecundity of Coleomegilla maculata (Coleoptera: Coccinellidae).
SO: Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. May 1998. v. 91 (3) p. 303-307.

Rivera-Cervantes, Luis Eugenio; Moron, Miguel Angel. The Coleoptera community associated with rotten logs in a cloud forest of Sierra de Manantlan, Jalisco, Mexico. Folia Entomologica Mexicana, v.0, n.85, 1992 (1994).:65-76.

Roig-Junent, Sergio A.; Claver, Silvia. The entomofauna from the Monte and its conservation in natural protected areas. Revista de la Sociedad Entomologica Argentina, v.58, n.1-2, 1999.:117-127.

Stewart, Jeff G.; Feldman, Jennifer; LeBlanc, Debby A.. Resistance of transgenic potatoes to attack by Epitrix cucumeris (Coleoptera: Chrysomelidae). Canadian Entomologist, v.131, n.4, July-Aug., 1999.:423-431.

Strohmeyer, Heather Horan; Stamp, Nancy E.; Jarzomski, Christine M.; Bowers, M. Deane. Prey species and prey diet affect growth of invertebrate predators. Ecological Entomology, v.23, n.1, Feb., 1998.:68-79.

Sugg, Patrick M.; Edwards, John S.. Pioneer aeolian community development on pyroclastic flows after the eruption of Mount St. Helens, Washington, U.S.A. Arctic and Alpine Research, v.30, n.4, Nov., 1998.:400-407.

Sverdrup-Thygeson,-A.; Midtgaard,-F.
TI: Fungus-infected trees as islands in boreal forest: spatial distribution of the fungivorous beetle Bolitophagus reticulatus (Coleoptera, Tenebrionidae).
SO: Ecoscience. Sainte-Foy, Quebec : Universite Laval, 1994-. 1998. v. 5 (4) p. 486-493.

Tikku, K.; Saxena, Bhaskar P.. Induction of sterility in testis of Tribolium castaneum (Herbst) by suboptimal temperature. Indian Journal of Experimental Biology, v.35, n.12, Dec., 1997.:1348-1352.

Via, Sara. Cannibalism facilitates the use of a novel environment in the flour beetle, Tribolium castaneum. Heredity, v.82, n.3, March, 1999.:267-275.

BIBLIOGRAPHY

Vilenkin, B. Y.; Chikatunov, V. I.. Co-occurrence of species with various geographical ranges, and correlation between area size and number of species in geographical scale. Journal of Biogeography, v.25, n.2, March, 1998.:275-284.0

Whitehead, P. F.. Further observations on Tribolium castaneum (Herbst) (Col., Tenebrionidae), especially in arboreal contexts. Entomologist's Monthly Magazine, v.135, n.1616-1619, Jan.-April, 1999.:76.

Yoshimatsu, Shin-Ichi; Arimura, Kazuhiro; Shimanuki, Tadayuki. Comparison of population growth rates of confused flour beetle, Tribolium confusum Jacquelin (Coleoptera: Tenebrionidae), on endophyte-infected or endophyte-uninfected seeds of ground tall fescue and perennial ryegrass. Japanese Journal of Applied Entomology and Zoology, v.42, n.4, Nov., 1998.:227-229.

Hass,-B.; Griffin,-C.T.; Keating,-J.G.; Downes,-M.J.
TI: Application of the most probable number method to estimations of entomopathogenic nematode populations in soil.
SO: Ann-appl-biol. Warwick : Association of Applied Biologists. Dec 1997. v. 131 (3) p. 471-480.

6

Henschel, Joh R.. Dune spiders of the Negev Desert with notes on Cerbalus psammodes (Heteropodidae). Israel Journal of Zoology, v.44, n.2, 1998.:243-251.

7

Andreev, Dmitri; Kreitman, Martin; Phillips, Thomas W.; Beeman, Richard W.; ffrench-Constant, Richard H.. Multiple origins of cyclodiene insecticide resistance in Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Molecular Evolution, v.48, n.5, March, 1999.:615-624.

Beeman, Richard W.; Friesen, Kenlee S.. Properties and natural occurrence of maternal-effect selfish genes ('Medea' factors) in the Red Flour Beetle, Tribolium castaneum. Heredity, v.82, n.5, May, 1999.:529-534.

Beeman, R. W.; Stauth, D. M.. Rapid cloning of insect transposon insertion junctions using 'universal' PCR. Insect Molecular Biology, v.6, n.1, 1997.:83-88.

BIBLIOGRAPHY

Berghammer, Andreas; Bucher, Gregor; Maderspacher, Florian; Klingler, Martin. A system to efficiently maintain embryonic lethal mutations in the flour beetle Tribolium castaneum. Development Genes and Evolution, v.209, n.6, June, 1999.:382-388.

Bennett, Randy; Cheatham, Joanna; Vaughan, Cecily; Whiting, Mike; Brown, Sue; Denell, Rob. Molecular and genetic analysis of the Ubx homologs in Beetles and Strepsiptera. Developmental Biology, v.198, n.1, June 1, 1998.:201.

Beeman, Richard W.; Stuart, Jeffrey J.; Brown, Susan J.; Denell, Robin E.. Structure and function of the homeotic gene complex (HOM-C) in the beetle, Tribolium castaneum. Bioessays, v.15, n.7, 1993.:439-444.

Bengston, Mervyn; Collins, Patrick J.; Daglish, Gregory J.; Hallman, Vivienne L.; Kopittke, Rosemary; Pavic, Hervoika. Inheritance of phosphine resistance in Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.92, n.1, Feb., 1999.:17-20.

Bills,-S.; Podila,-G.K.; Hiremath,-S.
TI: Genetic engineering of an ectomycorrhizal fungus Laccaria bicolor for use as a biological control agent.
SO: Mycologia. Bronx : New York Botanical Garden, 1909-. Mar/Apr 1999. v. 91 (2) p. 237-242.

Brown, S.; Holtzman, S.; Kaufman, T.; Denell, R.. Characterization of the Tribolium Deformed ortholog and its ability to directly regulate Deformed target genes in the rescue of a Drosophila Deformed null mutant. Development Genes and Evolution, v.209, n.7, July, 1999.:389-398.

Brown, Susan J.; Patel, Nipam H.; Denell, Robin E.. Embryonic expression of the single Tribolium engrailed homolog. Developmental Genetics, v.15, n.1, 1994.:7-18.

Brown, Susan J.; Parrish, Janet K.; Beeman, Richard W.; Denell, Robin E.. Molecular characterization and embryonic expression of the even-skipped ortholog of Tribolium castaneum. Mechanisms of Development, v.61, n.1-2, 1997.:165-173.

Castrillo, Louela A.; Wiegmann, Brian M.; Brooks, Wayne M.. Genetic variation in Beauveria bassiana populations associated with the darkling beetle, Alphitobius diaperinus. Journal of Invertebrate Pathology, v.73, n.3, May, 1999.:269-275.

Collins, P. J.. Inheritance of resistance to pyrethroid

insecticides in Tribolium castaneum (Herbst). Journal of Stored Products Research, v.34, n.4, Oct., 1998.:395-401.

Doctor, J.; McKeon, B.; Oshop, G.; Pincus, M.; Pletcher, M.; Sanchez-Salazar, J.; Teahan, T.; Zahorchak, A.. The decapentaplegic and 60A genes of the red four beetle, Tribolium castaneum, are similar to Drosophila and vertebrate members of the TGF-beta superfamily in sequence, structure, and expression. Developmental Biology, v.198, n.1, June 1, 1998.:201.

Donahaye, E.. Biological differences between strains of Tribolium castaneum selected for resistance to hypoxia and hypercarbia, and the unselected strain. Physiological Entomology, v.18, n.3, 1993.:247-250.

Fialho, Roberto F.; Stevens, Lori. Molecular evidence for single Wolbachia infections among geographic strains of the flour beetle Tribolium confusum. Proceedings of the Royal Society of London Series B Biological Sciences, v.264, n.1384, 1997.:1065-1068.

Giddings,-G.; Mytton,-L.; Griffiths,-M.; McCarthy,-A.; Morgan,-C.; Skot,-L. TI: A secondary effect of transformation in Rhizobium leguminosarum transgenic for Bacillus thuringiensis subspecies tenebrionis delta-endotoxin (cryIIIA) genes. SO: Theor-appl-genet. Berlin; Springer-Verlag. Nov 1997. v. 95 (7) p. 1062-1068.

Goodnight, Charles J.; Schwartz, James M.. A bootstrap comparison of genetic covariance matrices. Biometrics, v.53, n.3, 1997.:1026-1039.

Hoffmann, Ary A.; Turelli, Michael. Cytoplasmic incompatibility in insects. O'Neill, S. L. Hoffman, A. A. Werren, J. H. Influential passengers: Inherited microorganisms and arthropod reproduction., 1997.:42-80.

Hurst, Laurence D.. Scat+ is a selfish gene analogous to Medea of Tribolium castaneum. Cell, v.75, n.3, 1993.:407-408.

Jelenkovic, Gojko; Billings, Sharon; Chen, Qi; Lashomb, James; Hamilton, George; Ghidiu, Gerald. Transformation of eggplant with synthetic cryIIIA gene produces a high level of resistance to the Colorado potato beetle. Journal of the American Society for Horticultural Science, v.123, n.1, Jan., 1998.:19-25.

Juan, Carlos; Vazquez, Patricia; Rubio, Jose M.; Petitpierre, Eduard; Hewitt, Godfrey M.. Presence of highly repetitive DNA sequences in Tribolium flour beetles. Heredity, v.70, n.1, 1993.:1-8.

Koncagul, S.; Berger, P. J.. Estimates variance components in lines of Tribolium castaneum selected for pupa weight. Journal of Animal Science,

v.75, n.SUPPL. 1, 1997.:35.

Mathelin, Jocelyne; Quennedey, Brigitte; Bouhin, Herve; Delachambre, Jean. Characterization of two new cuticular genes specifically expressed during the post-ecdysial molting period in Tenebrio molitor. Gene (Amsterdam), v.211, n.2, May 12, 1998.:351-359.

Misra, H. P.; Bhatia, Parvathy. Cross-resistance of laboratory-selected fenvalerate-resistant strain of rust-red flour beetle (Tribolium castaneum). Indian Journal of Agricultural Sciences, v.67, n.10, Oct., 1997.:485-487.

Pons,-J.; Bruvo,-B.; Juan,-C.; Petitpierre,-E.; Plohl,-M.; Ugarkovic,-D.
TI: Conservation of satellite DNA in species of the genus Pimelia (Tenebrionidae, Coleoptera).
SO: Gene. Amsterdam : Elsevier Science. Dec 31, 1997. v. 205 (1/2) p. 183-190.

Pray, Leslie A.. The effect of inbreeding on population-level genetic correlations in the red flour beetle Tribolium castaneum. Evolution, v.51, n.2, 1997.:614-619.

Pray, Leslie A.; Goodnight, Charles J.. The effect of inbreeding on phenotypic variance in the red flour beetle Tribolium castaneum. Evolution, v.51, n.1, 1997.:308-313.

Rohr, Klaus B.; Tautz, Diethard; Sander, Klaus. Segmentation gene expression in the mothmidge Clogmia albipunctata (Diptera, Psychodidae) and other primitive dipterans. Development Genes and Evolution, v.209, n.3, March, 1999.:145-154.

Rondot,-I.; Quennedey,-B.; Delachambre,-J.
TI: Structure, organization and expression of two clustered cuticle protein genes during the metamorphosis of an insect, Tenebrio molitor.
SO: Eur-j-biochem. Berlin : Springer-Verlag Berlin. June 1998. v. 254 (2) p. 304-312.

Sanchez-Salazar, Jorge; Pletcher, Mathew T.; Bennett, Randy L.; Brown, Susan J.; Dandamudi, Tulasi J.; Denell, Robin E.; Doctor, John S.. The Tribolium decapentaplegic gene is similar in sequence, structure, and expression to the Drosophila dpp gene. Development Genes and Evolution, v.206, n.4, 1996.:237-246.

Schroeder, Reinhard; Jay, Daniel G.; Tautz, Diethard. Elimination of EVE protein by CALI in the short germ band insect Tribolium suggests a conserved pair-rule function for even skipped. Mechanisms of Development, v.80, n.2, Feb., 1999.:191-195.

BIBLIOGRAPHY

Schulz, Cordula; Schroeder, Reinhard; Hausdorf, Bernhard; Wolff, Christian; Tautz, Diethard. A caudal homologue in the short germ band beetle Tribolium shows similarities to both, the Drosophila and the vertebrate caudal expression patterns. Development Genes and Evolution, v.208, n.5, July, 1998.:283-289.

Silvela, Luis; de la Pena, Isabel; Gomez-Ruano, Ramiro. Selection under negative linkage disequilibrium. Random mating versus inbreeding. Heredity, v. 82, n.6, June, 1999.: 598-604.

Sommer, Ralf J.; Tautz, Diethard. Expression patterns of twist and snail in Tribolium (Coleoptera) suggest a homologous formation of mesoderm in long and short germ band insects. Developmental Genetics, v.15, n.1, 1994.:32-37.

Stuart, Jeffrey J.; Ray, Suparna; Harrington, B. Jane; Neal, Jonathan J.; Beeman, Richard W.. Genetic mapping of a major locus controlling pyrethroid resistance in Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.91, n.6, Dec., 1998.:1231-1238.

Sulston, Ingrid A.; Anderson, Kathyrn V.. Altered patterns of gene expression in Tribolium segmentation mutants. Developmental Genetics, v.23, n.1, 1998.:56-64.

Tautz, D.; K'.ngler, M.; Schroeder, R.; Wolff, C.. Conservation and divergence of the segmentation gene hierarchy in insects. American Zoologist, v.37, n.5, 1997.:172A.

Thomson, M. Scott; LaBonne, Awilda M.. Maternal effect of a hybrid inviability gene in Tribolium castaneum. Genetica (Dordrecht), v.104, n.2, 1998.:155-159.

Van Eeden, Fredericus J. M.; Holley, Scott A.; Haffter, Pascal; Nuesslein-Volhard, Christiane. Zebrafish segmentation and pair-rule patterning. Developmental Genetics, v.23, n.1, 1998.:65-76.

Wade, Michael J.; Johnson, Norman A.; Jones, Rachel; Siguel, Vera; McNaughton, Michael. Genetic variation segregating in natural populations of Tribolium castaneum affecting traits observed in hybrids with T. freemani. Genetics, v.147, n.3, 1997.:1235-1247.

Wade, Michael J.; Griesemer, James R.. Populational heritability: Empirical studies of evolution in metapopulations. American Naturalist, v.151, n.2, Feb., 1998.:135-147.

Wade, Michael J.; Johnson, Norman A.; Toquenaga, Yukihiko. Temperature effects and genotype-by-environment interactions in hybrids: Haldane's rule

in flour beetles. Evolution, v.53, n.3, June, 1999.:855-865.

Xu, Xin; Xu, Pin-Xian; Amanai, Kazuhito; Suzuki, Yoshikai.
Double-segment defining role of even-skipped homologs along the evolution of insect pattern formation. Development Growth & Differentiation, v.39, n.4, 1997.:515-522.

Zettler,-J.L.; Arthur,-F.H.
TI: Dose-response tests on red flour beetle and confused flour beetle (Coleoptera: Tenebrionidae) collected from flour mills in the United States.
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Oct 1997. v. 90 (5) p. 1157-1162.

8

Abdel-Razek, A. S.; Salama, H. S.; White, N. D. G.; Morris, O. N..
Effect of Bacillus thuringiensis on feeding and energy use by Plodia interpunctella (Lepidoptera: Pyralidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Canadian Entomologist, v.131, n.4, July-Aug., 1999.:433-440.

Arthur, Frank H.. Degradation of cyfluthrin EC and WP residues on painted steel: Effects of commercial sealants on residual persistence. Journal of Stored Products Research, v.30, n.2, 1994.:163-170.

Arthur, Frank H.. Differential effectiveness of deltamethrin dust on plywood, concrete, and tile surfaces against three stored-product beetles. Journal of Stored Products Research, v.33, n.2, 1997.:167-173.

Arthur, Frank H.. Effects of a food source on red flour beetle (Coleoptera: Tenebrionidae) survival after exposure on concrete treated with cyfluthrin. Journal of Economic Entomology, v.91, n.3, June, 1998.:773-778.

Arthur, Frank H.. Efficacy of unsynergised deltamethrin and deltamethrin + chlorpyrifos-methyl combinations as protectants of stored wheat and stored corn (Maize). Journal of Stored Products Research, v.30, n.1, 1994.:87-94.

Arthur, Frank H.; Brown, Steve L.. Evaluation of diatomaceous earth (Insecto) and Bacillus thuringiensis formulations for insect control in stored peanuts. Journal of Entomological Science, v.29, n.2, 1994.:176-182.

Arthur, Frank H.. Residual efficacy of cyfluthrin emulsifiable concentrate and wettable powder formulations on porous concrete and on

concrete sealed with commercial products prior to insecticide application. Journal of Stored Products Research, v.30, n.1, 1994.:79-86.

Arthur, Frank H.. Residual studies with cyfluthrin wettable powder: Toxicity toward red flour beetles (Coleoptera: Tenebrionidae) exposed for short intervals on treated concrete. Journal of Economic Entomology, v.91, n.1, Feb., 1998.:309-319.

Arthur, Frank H.. Residual toxicity of cyfluthrin wettable powder against Tribolium confusum (Coleoptera: Tenebrionidae) exposed for short time intervals on concrete. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:19-25.

Arthur, Frank H.. Survival of red flour beetles (Coleoptera: Tenebrionidae) on concrete partially treated with cyfluthrin. Journal of Economic Entomology, v.92, n.4, Aug., 1999.:981-987.

Arthur, Frank H.. Residual efficacy of cyfluthrin applied alone or in combination with piperonyl butoxide or piperonyl butoxide + chlorpyrifos-methyl as protectants of stored corn. Journal of Entomological Science, v.29, n.2, 1994.:276-287.

Arthur, Frank H.. Residual toxicity of cyfluthrin wettable powder against Tribolium confusum (Coleoptera: Tenebrionidae) exposed for short time intervals on concrete. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:19-25.

Arthur, Frank H.; Throne, James E.. Pirimiphos-methyl degradation and insect population growth in aerated and unaerated corn stored in southeast Georgia: Small bin tests. Journal of Economic Entomology, v.87, n.3, 1994.:810-816.

Bell, H. A.; Edwards, J. P.. The activity of (S)-hydroprene space spray against three stored products pests in a simulated food production environment. Journal of Stored Products Research, v.35, n.2, April, 1999.:117-126.

Bhattacharyya, P. R.; Nath, S. C.; Bordoloi, D. N., Insecticidal activity of Ranunculus sceleratus (L.) against Drosophila melanogaster and Tribolium castaneum. Indian Journal of Experimental Biology, v.31, n.1, 1993.:85-86.

Bowen,-D.J.; Ensign,-J.C.
TI: Purification and characterization of a high-molecular-weight insecticidal protein complex produced by the entomopathogenic bacterium Photorhabdus luminescens.
SO: Appl-environ-microbiol. Washington : American Society for Microbiology. Aug 1998. v. 64 (8) p. 3029-3035.

BIBLIOGRAPHY

Chander, Harish; Nagender, A.; Ahuja, D. K.; Berry, S. K..
Laboratory evaluation of plant extracts as repellents to the rust red flour beetle, Tribolium castaneum (Herbst), on jute fabric. International Pest Control, v.41, n.1, Jan.-Feb., 1999.:18-20.

Chiam , Wan Yee; Huang, Yan; Chen, Shao Xing; Ho, Shuit Hung. Toxic and antifeedant effects of allyl disulfide on Tribolium castaneum (Coleoptera: Tenebrionidae) and Sitophilus zeamais (Coleoptera; Curculionidae). Journal of Economic Entomology, v.92, n.1, Feb., 1999.:239-245.
Danfa, A.; Van Der Valk, H.C.H.G.. Laboratory testing of Metarhizium spp. and Beauveria bassiana on Sahelian non-target arthropods. Biocontrol Science and Technology, v.9, n.2, June, 1999.:187-198.

Church, C. J.; Abd-Elghafar, S. F.; Knowles, C. O.. Influence of formamidines on batrachotoxin in a 20-alpha-benzoate binding to neural membranes from pyrethroid susceptible and resistant tobacco budworm moths Heliothis virescens. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.105, n.3, 1993.:443-449.

Collins, P. J.; Lambkin, T. M.; Bridgeman, B. W.; Pulvirenti, C..
Resistance to grain-protectant insecticides in coleopterous pests of stored cereals in Queensland, Australia. Journal of Economic Entomology, v.86, n.2, 1993.:239-245.

Daniewski, Wlodzimierz M.; Gumulka, Maria; Pankowska, Elzbieta; Ptaszynska, Katarzyna; Bloszyk, Elzbieta; Jacobsson, Ulla; Norin, Torbjorn. 3,8-ethers of lactarane sesquiterpenes. Phytochemistry (Oxford), v.32, n.6, 1993.:1499-1502.

Dolly, K.; Parikh, S.. Evaluating the efficacy of spark (A newly synthesized insecticide) against eggs and pupae of Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Journal of Animal Morphology and Physiology, v.45, n.1-2, June-Dec., 1998.:38-40.

Dowdy, Alan K.. Mortality of red flour beetle, Tribolium castaneum (Coleoptera: Tenebrionidae) exposed to high temperature and diatomaceous earth combinations. Journal of Stored Products Research, v.35, n.2, April, 1999.:175-182.

Dunkel, Florence V.; Sears, L. Joseph. Fumigant properties of physical preparations from mountain big sagebrush, Artemisia tridentata Nutt. ssp. vaseyana (Rydb.) beetle for stored grain insects. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:307-321.

Elek, Jane A.; Longstaff, Barry C.. Effect of chitin-synthesis inhibitors on stored-product beetles. Pesticide Science, v.40, n.3, 1994.:225-230.

BIBLIOGRAPHY

Fleurat-Lessard, Francis; Vidal, Maryl-Laure; Budzinski, Helene. Modelling biological efficacy decrease and rate of degradation of chlorpyrifos-methyl on wheat stored under controlled conditions. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:341-354.

Ho, S. H.; Ma, Y.; Huang, Y.. Anethole, a potential insecticide from Illicium verum Hook F., against two stored product insects. International Pest Control, v.39, n.2, 1997.:50-51.

Ho, S. H.; Leong, Edmund C. W.; Lau, W. Y.. Attractancy of crude pandan (Pandanus amaryllifolius Roxb.) extracts to Tribolium castaneum (Herbst). International Pest Control, v.35, n.2, 1993.:44-45.

Hilbeck, Angelika; Eckel, Craig; Kennedy, George G.. Impact of Bacillus thuringiensis - insecticides on population dynamics and egg predation of the Colorado potato beetle in North Carolina potato plantings. Biocontrol (Dordrecht), v.43, n.1, 1998.:65-75.

Horowitz, A. R.; Weintraub, Phyllis G.; Ishaaya, I.. Status of pesticide resistance in arthropod pests in Israel. Phytoparasitica, v.26, n.3, July, 1998.:231-240.

Huang, Y.; Hee, S. K.; Ho, S. H.. Antifeedant and growth inhibitory effects of alpha-pinene on the stored-product insects, Tribolium castaneum (Herbst) and Sitophilus zeamais Motsch. International Pest Control, v.40, n.1, Jan.-Feb., 1998.:18-20.

Huang, Yan; Ho, Shuit Hung; Kini, R. Manjunatha. Bioactivities of safrole and isosafrole on Sitophilus zeamais (Coleoptera: Curculionidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.92, n.3, June, 1999.:676-683.

Huang, Y.; Ho, S. H.. Toxicity and antifeedant activities of cinnammaldehyde against the grain storage insects, Tribolium castaneum (Herbst) and Sitophilus zeamais Motsch. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:11-17.

Lin, Hao; Bloomquist, Jeffrey R.; Beeman, Richard W.; Clark, J. Marshall. Mechanisms underlying cyclodiene resistance in the red flour beetle, Tribolium castaneum (Herbst). Pesticide Biochemistry and Physiology, v.45, n.2, 1993.:154-165.

Liu, Z. L.; Ho, S. H.. Bioactivity of the essential oil extracted from Evodia rutaecarpa Hook f. et Thomas against the grain storage insects, Sitophilus zeamais Motsch. and Tribolium castaneum (Herbst). Journal of Stored

Products Research, v.35, n.4, Oct., 1999.:317-328.

Martinez-Torres, David; Devonshire, Alan L.; Williamson, Martin S.. Molecular studies of knockdown resistance to pyrethroids: Cloning of domain II sodium channel gene sequences from insects. Pesticide Science, v.51, n.3, Nov., 1997.:265-270.

Matthews, Wendy A.; Maliphant, Paula. The fate and insecticidal activity of pirimiphos-methyl in stored wheat grain. Pesticide Science, v.37, n.1, 1993.:93-97.

McFarlane, J. A.; Gudrups, I.; Fletcher, H.. Biotype differences affecting the pest status of stored-grain insects. International Journal of Pest Management, v.39, n.1, 1993.:35-43.

Moralejo, Maria A.; Garcia-Casado, Gloria; Sanchez-Monge, Rosa; Lopez-Otin, Carlos; Romagosa, Ignacio; Molina-Cano, Jose L.; Salcedo, Gabriel. Genetic variants of the trypsin inhibitor from barley endosperm show different inhibitory activities. Plant Science (Limerick), v.89, n.1, 1993.:23-29.

Moran,-R.; Garcia,-R.; Lopez,-A.; Zaldua,-Z.; Mena,-J.; Garcia,-M.; Armas,-R.; Somonte,-D.; Rodriguez,-J.; Gomez,-M.
TI: Transgenic sweet potato plants carrying the delta-endotoxin gene from Bacillus thuringiensis var. tenebrionis.
SO: Plant-sci. Shannon [Clare] : Elsevier Scientific Publishers Ireland Ltd., c1985-. Dec 31, 1998. v. 139 (2) p. 175-184.

Morgan, T. D.; Oppert, B.; Czapla, T. H.; Kramer, K. J.. Avidin and streptavidin as insecticidal and growth inhibiting dietary proteins. Entomologia Experimentalis et Applicata, v.69, n.2, 1993.:97-108.

Mullie, Wim C.; Diallo, Alpha Oumar; Gadji, Baba; Ndiaye, Massar D.. Environmental hazards of mobile ground spraying with cyanophos and fenthion for Quelea control in Senegal. Ecotoxicology and Environmental Safety, v.43, n.1, May, 1999.:1-10.

Nordbo, Ebbe; Kristensen, Kristian; Kirknel, Erik. Effects of wind direction, wind speed and travel speed on spray deposition. Pesticide Science, v.38, n.1, 1993.:33-41.

Obeng-Ofori, D.; Reichmuth, C.. Bioactivity of eugenol, a major component of essential oil of Ocimum suave (Wild.) against four species of stored-product Coleoptera. International Journal of Pest Management, v.43, n.1, 1997.:89-94.

Obeng-Ofori, D.; Reichmuth, Ch.. Plant oils as potentiation agents of monoterpenes for protection of stored grains against damage by stored product beetle pests. International Journal of Pest Management, v.45, n.2, April-June, 1999.:155-159.

Papadopoulos,-A.I.; Stamkou,-E.I.; Kostaropoulos,-I.; Papadopoulou-Mourkidou,-E.
TI: Effect of organophosphate and pyrethroid insecticides on the expression of GSTs from Tenebrio molitor larvae.
SO: Pestic-biochem-physiol. Orlando, Fla. : Academic Press. Jan 1999. v. 63 (1) p. 26-33.

Pemonge,-J.; Pascual-Villalobos,-M.J.; Regnault-Roger,-C.
TI: Effects of material and extracts of Trigonella foenum-graecum L. against the stored product pests Tribolium castaneum (herbst) (Coleoptera: Tenebrionidae) and Acanthoscelides obtectus (Say) (Coleoptera: Bruchidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. July 1997. v. 33 (3) p. 209-217.

Petrushkina, Elena A.; Polonic, Natalia B.; Ivanova, Galina B.. Synthesis and juvenile hormone activity of benzimidazolylterpenes possessing a 2,7-dimethyloctane skeleton. Pesticide Science, v.55, n.6, June, 1999.:650-652.

Pike, Vanessa. Laboratory assessment of the efficacy of phosphine and methyl bromide fumigation against all life stages of Liposcelis entomophilus (Enderlein). Crop Protection, v.13, n.2, 1994.:141-145.

Pradeep, P. K.; Radhakrishnan, N.. Preliminary screening of certain locally available plants for the possible repellent properties agaisnt the Rust Red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Journal of Animal Morphology and Physiology, v.45, n.1-2, June-Dec., 1998.:32-37.

Rajendran, Somiahnadar. Responses of phosphine-resistant strains of two stored-product insect pests to changing concentrations of phosphine. Pesticide Science, v.40, n.3, 1994.:183-186.

Rani, Pathipati Usha. Bioactivity and residual toxicity of deltamethrin, incorporated into rice bran and rice husk, against the pests of stored products. International Pest Control, v.39, n.6, Nov.-Dec., 1997.:186-188.

Saleem, Mushtaq A.; Shakoori, Abdul Rauf; Mantle, David. Macromolecular and enzymatic abnormalities induced by a synthetic pyrethroid, Ripcord (cypermethrin), in adult beetles of a stored grain pest, Tribolium castaneum (Herbst.) (Coleoptera: Tenebrionidae). Archives of Insect Biochemistry and Physiology, v.39, n.4, 1998.:144-154.

BIBLIOGRAPHY

Shaaya, E.; Kostjukovski, M.; Eilberg, J.; Sukprakarn, C.. Plant oils as fumigants and contact insecticides for the control of stored-product insects. Journal of Stored Products Research, v.33, n.1, 1997.:7-15.

Subramanyam, B.; Madamanchi, N.; Norwood, S.. Effectiveness of Insecto applied to shelled maize against stored-product insect larvae. Journal of Economic Entomology, v.91, n.1, Feb., 1998.:280-286.

Talukder, F. A.; Howse, P. E.. Deterrent and insecticidal effects of extracts of pithraj, Aphanamixis polystachya (Meliaceae), against Tribolium castaneum in storage. Journal of Chemical Ecology, v.19, n.11, 1993.:2463-2471.

Ramzan, M.; Rataul, H. S.; Judge, B. K.. Efficacy of turmeric powder as a protectant of stored dehusked rice. International Pest Control, v.35, n.4, 1993.:92-93.

Rice, William C.; Cogburn, Robert R.. Activity of the entomopathogenic fungus Beauveria bassiana (Deuteromycota: Hyphomycetes) against three coleopteran pests of stored grain. Journal of Economic Entomology, v.92, n.3, June, 1999.:691-694.

Saleem, Mushtaq A.; Shakoori, A. R.. Effect of cypermethrin on the free amino acids pool in an organophosphorus insecticide-resistant and a susceptible strain of Tribolium castaneum. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.105, n.3, 1993.:549-553.

Seck, D.; Lognay, G.; Haubruge, E.; Wathelet, J.-P.; Marlier, M.; Gaspar, C.; Severin, M.. Biological activity of the shrub Boscia senegalensis (Pers.) Lam. ex Poir. (Capparaceae) on stored grain insects. Journal of Chemical Ecology, v.19, n.2, 1993.:377-389.

Sedlacek, John D.; Barney, Robert J.; Weston, Paul A.; Price, Bryan D.. Efficacy of malathion against Coleopteran populations in newly-harvester versus year-old stored corn. Journal of Entomological Science, v.33, n.3, July, 1998.:282-291.

van der Valk, Harold C.H.G.; Niassy, Abdoulaye; Beye, Alioune B.. Does grasshopper control create grasshopper problems? - Monitoring side-effects of fenitrothion applications in the western Sahel. Crop Protection, v.18, n.2, March, 1999.:139-149.

Vinuela, E.; Ondracek, J.; Jacas, J.; Adan, A.; Rejzek, M.; Wimmer, Z.. Laboratory evaluation of five new JHA derivatives from 2-(4-hydroxybenzyl)-1-cyclohexanone against Tribolium castaneum (Herbst.).

Journal of Stored Products Research, v.30, n.2, 1994.:149-155.

Wegerhoff, Rainer; Gaethje, Heiko; Shailaja, Donempudi. Effects of fenvalerate on the development of olfactory perception in a beetle. Neuroreport, v.9, n.14, Oct. 5, 1998.:3241-3245.

Weissenberg, Martin; Levy, Arieh; Svoboda, James A.; Ishaaya, Isaac. The effect of some Solanum steroidal alkaloids and glycoalkaloids on larvae of the red flour beetle, Tribolium castaneum, and the tobacco hornworm, and Manduca sexta. Phytochemistry (Oxford), v.47, n.2, Jan., 1998.:203-209.

White, Noel D. G.; Jayas, Digvir S.; Demianyk, Colin J.. Degradation and biological impact of chlorpyrifos-methyl on stored wheat and pirimiphos-methyl on stored maize in western Canada. Journal of Stored Products Research, v.33, n.2, 1997.:125-135.

White, N. D. G.; Jayas, D. S.. Effectiveness of carbon dioxide in compressed gas or solid formulation for the control of insects and mites in stored wheat and barley. Phytoprotection, v.74, n.2, 1993.:101-111.

Wongo, Lawrence E.. Biological activity of sorghum tannin extracts on the stored grain pests Sitophilus oryzae (L.), Sitotroga cerealella (Olivier) and Tribolium castaneum (Herbst). Insect Science and its Application, v.18, n.1, Jan.-March, 1998.:17-23.

Wontner-Smith, T. J.; Chakrabarti, B.; Cardwell, S. K.; Barnett, G.. Reduction of emissions of methyl bromide from chamber fumigations. International Pest Control, v.40, n.1, Jan.-Feb., 1998.:14-17, 20.

Zettler, J. Larry; Arthur, Frank H.. Dose-response tests on red flour beetle and confused flour beetle (Coleoptera: Tenebrionidae) collected from flour mills in the United States. Journal of Economic Entomology, v.90, n.5, Oct., 1997.:1156-1162.

Zettler, J. Larry; Leesch, J. G.; Gill, Richard F.; Mackey, Bruce E.. Toxicity of carbonyl sulfide to stored product insects. Journal of Economic Entomology, v.90, n.3, 1997.:832-836.

9

Hasan, Md. Mahbub. Mating competitiveness of adult males of Tribolium spp (Coleoptera: Tenebrionidae) developing from irradiated pupae. Journal of Stored Products Research, v.35, n.3, July, 1999.:307-316.

Misra, H. P.; Bhatia, Parvathy. Gamma radiation susceptibility of strains of Tribolium castaneum (Herbst) resistant and susceptible to fenvalerate. International Journal of Pest Management, v.44, n.3, July-Sept., 1998.:145-147.

Shayesteh, N.; Barthakur, N. N.. Mortality and behavior of two stored-product insect species during microwave irradiation. Journal of Stored Products Research, v.32, n.3, 1996.:239-246.

10

Barker,-D.; Fitzpatrick,-M.P.; Dierenfeld,-E.S.
TI: Nutrient composition of selected whole invertebrates.
SO: Zoo-biol. New York, N.Y. : Wiley-Liss, Inc. 1998. v. 17 (2) p. 123-134.

Clements, Fiona; Hope, Perdita; Daniels, Chris; Chapman, Ian; Wittert, Gary. Thermogenesis in the marsupial Sminthopsis crassicaudata: Effect of catecholamines and diet. Australian Journal of Zoology, v.46, n.4, 1998.:381-390.

De Clercq, Patrick; Merlevede, Frederik; Tirry, Luc. Unnatural prey and artificial diets for rearing Podisus maculiventris (Heteroptera: Pentatomidae). Biological Control, v.12, n.2, June, 1998.:137-142.

Phillips, T. W.; Jiang, X.-L.; Burkholder, W. E.; Phillips, J. K.; Tran, H. Q.. Behavioral responses to food volatiles by two species of stored-product Coleoptera, Sitophilus oryzae (Curculionidae) and Tribolium castaneum (Tenebrionidae). Journal of Chemical Ecology, v.19, n.4, 1993.:723-734.

11

Abdel-Razek, A. S.; Salama, H. S.; White, N. D. G.; Morris, O. N.. Effect of Bacillus thuringiensis on feeding and energy use by Plodia interpunctella (Lepidoptera: Pyralidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Canadian Entomologist, v.131, n.4, July-Aug., 1999.:433-440.

Beveridge, Natasha; Elek, Jane A.. Bacillus thuringiensis var. tenebrionis shows no toxicity to the predator Chauliognathus lugubris (F.) (Coleoptera: Cantharidae). Australian Journal of Entomology, v.38, n.1, Jan. 25, 1999.:34-39.

Blankespoor,-C.L.; Pappas,-P.W.; Eisner,-T.

TI: Impairment of the chemical defence of the beetle, Tenebrio molitor, by metacestodes (cysticercoids) of the tapeworm, Hymenolepis diminuta.
SO: Parasitology. Cambridge : Cambridge University Press. July 1997. v. 115 (pt.1) p. 105-110.

Carver, F. J.; Hurd, H.. The effect of metacestodes of Hymenolepis diminuta on the bean-shaped accessory glands in male Tenebrio molitor. Parasitology, v.116, n.2, Feb., 1998.:191-196.

Castrillo,-L.A.; Brooks,-W.M.
TI: Differentiation of Beauveria bassiana isolates from the darkling beetle, Alphitobius diaperinus, using isozyme and RAPD analyses.
SO: J-invertebr-pathol. Orlando, Fla. : Academic Press. Nov 1998. v. 72 (3) p. 190-196.

Clopton, R. E.. Revision of the genus Xiphocephalus and description of Xiphocephalus ellisi n. sp. (Apicomplexa: Eugregarinida: Stylocephalidae) from Eleodes opacus (Coleoptera: Tenebrionidae) in the western Nebraska sandhills. Journal of Parasitology, v.85, n.1, Feb., 1999.:84-89.

Evans, W. S.; Wong, A.; Hardy, M.; Currie, R. W.; Vanderwel, D.. Evidence that the factor used by the tapeworm, Hymenholepis diminuta, to direct the foraging of its intermediate host, Tribolium confusum, is a volatileattractant. Journal of Parasitology, v.84, n.6, Dec., 1998.:1098-1101.

Geden,-C.J.; Arends,-J.J.; Rutz,-D.A.; Steinkraus,-D.C.
TI: Laboratory evaluation of Beauveria bassiana (Moniliales: Moniliaceae) against the lesser mealworm, Alphitobius diaperinus (Coleoptera: Tenebrionidae), in poultry litter, soil, and a pupal trap.
SO: Biol-control. Orlando, Fla. : Academic Press. Oct 1998. v. 13 (2) p. 71-77.

Hanelt,-B.; Janovy,-J.-Jr.
TI: The life cycle of a horsehair worm, Gordius robustus (Nematomorpha: Gordioidea).
SO: J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. Feb 1999. v. 85 (1) p. 139-141.

Hurd, H.. Parasite manipulation of insect reproduction: Who benefits? Parasitology, v.116, n.SUPPL., 1998.:S13-S21.

Nakamura, F.; Okamoto, K.. Reconsideration of the effects of selfing on the viability of Hymenolepis nana. International Journal for Parasitology, v.23, n.7, 1993.:931-936.

Nishina, Masami; Matsushita, Kazuhiro; Kato, Kenzo; Takahashi, Masakazu; Kono, Yoshiaki. Characterization of tissue water in Tribolium confusum parasitized by metacestodes of Hymenolepis diminuta. Journal of

Invertebrate Pathology, v.72, n.1, July, 1998.:93-95.

Novak, M.; Modha, A.; Blackburn, B. J.. D-(1-13C)glucose metabolism of Tribolium confusum parasitized by hymenolepid metacestodes. Journal of Invertebrate Pathology, v.62, n.3, 1993.:302-307.

O'Leary,-S.A.; Stack,-C.M.; Chubb,-M.A.; Burnell,-A.M.
TI: The effect of day of emergence from the insect cadaver on the behavior and environmental tolerances of infective juveniles of the entomopathogenic nematode Heterorhabditis megidis (strain UK211).
SO: J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. Aug 1998. v. 84 (4) p. 665-672.

Pappas, Peter W.; Barley, Amy J.. Beetle-to-beetle transmission and dispersal of Hymenolepis diminuta (cestoda) eggs via the feces of Tenebrio molitor. Journal of Parasitology, v.85, n.2, April, 1999.:384-385.

Pappas, P. W.; Rutherford, K. H.; Barley, A. J.. Thermal tolerance of Hymenolepis diminuta eggs does not limit the parasite's distribution. Journal of Helminthology, v.73, n.1, March, 1999.:85-86.

Parajulee, Megha N.; Phillips, Thomas W.. Effects of prey species on development and reproduction of the predator Lyctocoris campestris (Heteroptera: Anthocoridae). Environmental Entomology, v.22, n.5, 1993.:1034-1042.

Rice, William C.; Cogburn, Robert R.. Activity of the entomopathogenic fungus Beauveria bassiana (Deuteromycota: Hyphomycetes) against three coleopteran pests of stored grain. Journal of Economic Entomology, v.92, n.3, June, 1999.:691-694.

Shostak, Allen W.; Smyth, Kerri A.. Activity of flour beetles (Tribolium confusum) in the presence of feces from rats infected with rat tapeworm (Hymenolepis diminuta). Canadian Journal of Zoology, v.76, n.8, Aug., 1998.:1472-1479.

Stevens, Lori. Cytoplasmically inherited parasites and reproductive success in Tribolium flour beetles. Animal Behaviour, v.46, n.2, 1993.:305-310.

Watwood,-S.; Janovy,-J.-Jr.; Peterson,-E.; Addison,-M.A. Gregarina triboliorum (Eugregarinida: Gregarinidae) n. sp. from Tribolium confusum and resolution of the confused taxonomic history of Gregarina minuta Ishii, 1914. J-parasitol. Lawrence, Kan. : American Society of Parasitologists, 1914. June 1997. v. 83 (3) p. 502-507.

Webb, T. J.; Hurd, H.. Direct manipulation of insect reproduction by agents of parasite origin. Proceedings of the Royal Society Biological

Sciences Series B, v.266, n.1428, Aug. 7, 1999.:1537-1541.

Webb,-T.J.; Major,-M.; Ellams,-K.M.; Hurd,-H.
TI: The interplay between patency, microsomal Na+/K+ ATPase activity and juvenile hormone, in Tenebrio molitor parasitized by Hymenolepis diminuta.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Apr 1997. v. 43 (4) p. 337-343.

Yan, Guiyun; Stevens, Lori; Schall, Jos J.. Behavioral changes in Tribolium beetles infected with a tapeworm: Variation in effects between beetle species and among genetic strains. American Naturalist, v.143, n.5, 1994.:830-847.

Yan, Guiyun. Consequence of larval tapeworm infection for the fitness of the intermediate hosts, flour beetles (Tribolium spp.). Canadian Journal of Zoology, v.75, n.2, 1997.:271-279.

Yan, Guiyun; Stevens, Lori; Goodnight, Charles J.; Schall, Joseph J.. Effects of a tapeworm parasite on the competition of Tribolium beetles. Ecology (Washington D C), v.79, n.3, April, 1998.:1093-1103.

Yan, Guiyun; Phillips. Thomas W.. Influence of tapeworm infection on the production of aggregation pheromone and defensive compounds in Tribolium castaneum. Journal of Parasitology, v.82, n.6, 1996.:1037-1039.

12

Adler, Cornel. Protection of stored products with nitrogen and carbon dioxide. Reichmuth, C. Communications from the Federal Biological Institute for Agriculture and Forestry Berlin-Dahlem; 100 years research in plant protection: Important areas of research in stored product protection., 1998.:277-293.

Alyokhin,-A.V.; Ferro,-D.N.
TI: Modifications in dispersal and oviposition of Bt-resistant and Bt-susceptible Colorado potato beetles as a result of exposure to Bacillus thuringiensis subsp. tenebrionis Cry3A toxin.
SO: Entomol-exp-appl. Dordrecht : Kluwer Academic Publishers. Jan 1999. v. 90 (1) p. 93-101.

Alyokhin, Andrei V.; Ferro, David N.. Relative fitness of Colorado potato beetle (Coleoptera: Chrysomelidae) resistant and susceptible to the Bacillus thuringiensis Cry3A toxin. Journal of Economic Entomology, v.92, n.3, June, 1999.:510-515.

BIBLIOGRAPHY

Arthur, Frank H.. Evaluation of prallethrin aerosol to control stored product insect pests. Journal of Stored Products Research, v.29, n.3, 1993.:253-257.

Arthur, Frank H.. Survival of red flour beetles (Coleoptera: Tenebrionidae) on concrete partially treated with cyfluthrin. Journal of Economic Entomology, v.92, n.4, Aug., 1999.:981-987.

Bowditch,-T.G. Penetration of polyvinyl chloride and polypropylene packaging films by Ephestia cautella (Lepidoptera: Pyralidae) and Plodia interpunctella (Lepidoptera: Pyralidae) larvae, and Tribolium confusum (Coleoptera: Tenebrionidae) adults. J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Aug 1997. v. 90 (4) p. 1028-1031.

Buchelos, C. Th.; Athanassiou, C. G.. Beetle species in store-rooms of Central and Southern Greece containing grain, flour, bran and hay: A survey of 44 species. Annales de l'Institut Phytopathologique Benaki, v.18, n.2, 1998.:129-133.

Burks, Charles S.; Hagstrum, David W.. Rapid cold hardening capacity in five species of coleopteran pests of stored grain. Journal of Stored Products Research, v.35, n.1, Jan., 1999.:65-75.

Butz,-P.; Fritsch,-E.; Huber,-J.; Keller,-B.; Ludwig,-H.; Tauscher,-B.
TI: Ultra-high pressure decontamination of insect biocontrol preparations.
SO: Planta-med. Stuttgart : Georg Thieme Verlag,. 1995. v. 5 (2) p. 243-246.

Caroli,-L.; Glazer,-I.; Gaugler,-R.
TI: Entomopathogenic nematode infectivity assay: comparison of penetration rate into different hosts.
SO: Biocontrol-sci-technol. Abingdon, Oxfordshire : Carfax Publishing Co,. June 1996. v. 6 (2) p. 227-233.

Carrizo-F,-R.; Sosa,-M.E.; Favier,-L.S.; Penna,-F.; Guerreiro,-E.; Giordano,-O.S.; Tonn,-C.E.
TI: Growth-inhibitory activities of benzofuran and chromene derivatives toward Tenebrio molitor.
SO: J-nat-prod. Washington, D.C. : American Society of Pharmacognosy. Oct 1998. v. 61 (10) p. 1209-1211.

Castrillo, Louela A.; Brooks, Wayne M.. Differentiation of Beauveria bassiana isolates from the darkling beetle Alphitobius diaperinus, using isoenzyme and RAPD analyses. Journal of Invertebrate Pathology, v.72, n.3, Nov., 1998.:190-196.

Clercq,-P.-de; Merlevede,-F.; Tirry,-L.
TI: Unnatural prey and artificial diets for rearing Podisus maculiventris (Heteroptera: Pentatomidae).
SO: Biol-control. Orlando, Fla. : Academic Press. June 1998. v. 12 (2) p. 137-142.

Collins, D. A.; Cook, D. A.. Periods of protection provided by different formulations of pirimiphos-methyl and etrimfos, when admixed with wheat, against four susceptible storage beetle pests. Crop Protection, v.17, n.6, Aug., 1998.:521-528.

Crawford, Peter J.; Brooks, Wayne M.; Arends, James J.. Efficacy of field-isolated strains of Beauveria bassiana (Moniliales: Moniliaceae) as microbial control agents of the lesser mealworm (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.91, n.6, Dec., 1998.:1295-1301.

Cong Hao, Nguyen; Cuu Thi Huong Giang, Nguyen; Cuu Koha, Nguyen; Thanh Son, Nguyen. Synthesis and application of insect attractants in Vietnam. Resources Conservation and Recycling, v.18, n.1-4, 1996.:59-68.

Daglish, G. J.. Efficacy of six grain protectants applied alone or in combination against three species of Coleoptera. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:263-268.

Damcevski, K. A.; Annis, P. C.; Waterford, C. J.. Effect of grain on apparent respiration of adult-stored-product Coleoptera in an air-tight system: Implications for fumigant testing. Journal of Stored Products Research, v.34, n.4, Oct., 1998.:331-339.

Daniewski, Wlodzimierz M.; Gumulka, Maria; Anczewski, Waldemar; Masnyk, Marek; Bloszyk, Elzbieta; Gupta, Kuldip K.. Why the yew tree (Taxus baccata) is not attacked by insects. Phytochemistry (Oxford), v.49, n.5, Nov., 1998.:1279-1282.

Dowdy, Alan K.. Mortality of red flour beetle, Tribolium castaneum (Coleoptera: Tenebrionidae) exposed to high temperature and diatomaceous earth combinations. Journal of Stored Products Research, v.35, n.2, April, 1999.:175-182.

Ferro,-D.N.; Slocombe,-A.C.; Mercier,-C.T.
TI: Colorado potato beetle (Coleoptera: Chrysomelidae): residual mortality and artificial weathering of formulated Bacillus thuringiensis subsp. tenebrionis.
SO: J-econ-entomol. Lanham, Md. : Entomological Society of America, 1908-. Apr 1997. v. 90 (2) p. 574-582.

Fields, P. G.; Korunic, Z.. Post-harvest insect control: Diatomaceous earth and low temperatures. Phytoprotection, v.77, n.3, 1996.:141.

BIBLIOGRAPHY

Gueye, M. T.; Delobel, A.. Relative susceptibility of stored pearl millet products and fonio to insect infestation. Journal of Stored Products Research, v.35, n.3, July, 1999.:277-283.

Hagstrum, David W.; Flinn, Paul W.; Gaffney, Jerry J.. Temperature gradient on Tribolium castaneum (Coleoptera: Tenebrionidae) adult dispersal in stored wheat. Environmental Entomology, v.27, n.1, Feb., 1998.:123-129.

Horne, P. A.; Edward, C. L.. Effects of tillage on pest and beneficial beetles in the Wimmera region of Victoria, Australia. Australian Journal of Entomology, v.37, n.1, April 3, 1998.:60-63.

Hu, Mei-Ying; Klocke, James A.; Chiu, Shin-Foon; Kubo, Isao. Response of five insect species to a botanical insecticide, rhodojaponin II. Journal of Economic Entomology, v.86, n.3, 1993.:706-711.

Huang, Yan; Ho, Shuit Hung; Kini, R. Manjunatha. Bioactivities of safrole and isosafrole on Sitophilus zeamais (Coleoptera: Curculionidae) and Tribolium castaneum (Coleoptera: Tenebrionidae). Journal of Economic Entomology, v.92, n.3, June, 1999.:676-683.

Huang, Y.; Tan, J. M. W. L.; Kini, R. M.; Ho S. H.. Toxic and antifeedant action of nutmeg oil against Tribolium castaneum (Herbst) and Sitophilus zeamais Motsch. Journal of Stored Products Research, v.33, n.4, Oct., 1997.:289-298.

Kaya,-H.K.; Burlando,-T.M.; Choo,-H.Y.; Thurston,-G.S.
TI: Integration of entomopathogenic nematodes with Bacillus thuringiensis or pesticidal soap for control of insect pests.
SO: Biol-control. Orlando, Fla. : Academic Press, Inc. Sept 1995. v. 5 (3) p. 432-441.

Kazmierczak, Richard F., ; Norton, George W.; Knight, Alan L.; Rajotte, Edwin G.; Hull, Larry A.. Economic effects of resistance and withdrawal of organophosphate pesticides on an apple production system. Journal of Economic Entomology, v.86, n.3, 1993.:684-696.

Langenbruch, Gustav-Adolf. Communications from the Federal Biological Institute for Agriculture and Forestry Berlin-Dahlem; 100 years research in plant protection: The Colorado potato beetle in Germany: Investigation and control with special emphasis on the role of the Federal Biological Research Centre for Agriculture and Forestry and its preceded and parallel institutions. Parey Buchverlag Berlin Kurfuerstendamm 57, D-10707 Berlin, Germany 1998.. ;Langenbruch, G.-A. Author. Communications from the Federal Biological Institute for Agriculture and Forestry Berlin-Dahlem; 100 years research in

plant protection: The Colorado potato beetle in Germany: Investigation and control with special emphasis on the role of the Federal Biological Research Centre for Agriculture and Forestry and its preceded and parallel institutions.:120p. Series: Mitteilungen aus der Biologischen Bundesanstalt fuer Land- und Forstwirtschaft Berlin-Dahlem 341 0067-5849

Lee, Keun Hyeung; Hong, Sung Yu; Oh, Jong Eun. Synthesis and structure-function study about tenecin 1, an antibacterial protein from larvae of Tenebrio molitor. FEBS Letters, v.439, n.1-2, Nov. 13, 1998.:41-45.

Mahmood, Tariq; Ahmad, Mohammad Sajjad; Ahmad, Hafiz. Dispersion of stored grain insect pests in a wheat-filled silo. International Journal of Pest Management, v.42, n.4, 1996.:321-324.

Morimoto, Nobuo; Imura, Osamu; Kiura, Takuji. Potential effects of global warming on the occurrence of Japanese pest insects. Applied Entomology and Zoology, v.33, n.1, Feb., 1998.:147-155.

Milner,-R.J.
TI: History of Bacillus thuringiensis.
SO: Agric-ecosyst-environ. Amsterdam; New York : Elsevier, 1983-. May 1994. v. 49 (1) p. 9-13.

Mracek,-Z.; Becvar,-S.; Kindlmann,-P.; Webster,-J.M.
TI: Infectivity and specificity of Canadian and Czech isolates of Steinernema kraussei (Steiner, 1923) to some insect pests at low temperatures in the laboratory.
SO: Nematologica. Leiden : Brill,. Aug 1998. v. 44 (4) p. 437-448.
CN: DNAL 436.8-N342

Nwana, Ifedioramma E.. A survey of storage Coleoptera which attack dried cocoyam chips in Nigeria. Journal of Stored Products Research, v.29, n.1, 1993.:95-98.

Obeng-Ofori, D.; Reichmuth, C.; Bekele, J.; Hassanali, A..
Biological activity of 1,8 cineole, a major component of essential oil of Ocimum kenyense (Ayobangira) against stored product beetles. Journal of AppliedEntomology, v.121, n.4, 1997.:237-243.

Obeng-Ofori, D.; Reichmuth, C. H.; Bekele, A. J.; Hassanali, A..
Toxicity and protectant potential of camphor, a major component of essential oil of Ocimum kilimandscharicum, against four stored product beetles. International Journal of Pest Management, v.44, n.4, Oct.-Dec., 1998.:203-209.

Obeng-Ofori, D.. The behaviour of 9 stored product beetles at pitfall trap arenas and their capture in millet. Entomologia Experimentalis et

Applicata, v.66, n.2, 1993.:161-169.

Ofuya, T. I.; Reichmuth, C.. Control of two bruchid pests of stored grain legumes in a nitrogen atmosphere. Crop Protection, v.12, n.5, 1993.:394-396.

Padin, S. B.; Dal Bello, G. M.; Vasicek, A. L.. Pathogenicity of Beauveria bassiana for adults of Tribolium castaneum (Col.: Tenebrionidae) in stored grains. Entomophaga, v.42, n.4, 1997.:569-574.

Pagani, M.; Fogliazza, D.; Cerioli, C.; Pietri, A.. Ergosterol content in flour from tender wheat infested by Tribolium confusum du Val and Ephestia kuhniella Zeller. Journal of Applied Entomology, v.117, n.3, 1994.:318-320.

Parajulee, Megha N.; Phillips, Thomas W.. Response variation of predatory pirate bugs to prey insects in stored grain ecosystems. Bulletin of the Ecological Society of America, v.74, n.2 SUPPL., 1993.:382.

Pascual-Villalobos, Maria J.; Robledo, Antonio. Anti-insect activity of plant extracts from the wild flora in southeastern Spain. Biochemical Systematics and Ecology, v.27, n.1, Jan., 1999.:1-10. Saleem,-M.A.; Shakoori,-A.R.; Mantle,-D.

Pemonge, Jerome; Pascual-Villalobos, Maria Jesus; Regnault-Roger, Catherine. Effects of material and extracts of Trigonella foenum-graecum L. against the stored product pests Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) and Acanthoscelides obtectus (Say) (Coleoptera: Bruchidae). Journal of Stored Products Research, v.33, n.3, 1997.:209-217.

Pernas, Monica; Sanchez-Monge, Rosa; Gomez, Luis; Salcedo, Gabriel. A chestnut seed cystatin differentially effective against cysteine proteinases from closely related pests. Plant Molecular Biology, v.38, n.6, Dec., 1998.:1235-1242.

Peveling, R.; Attignon, S.; Langewald, J.; Ouambama, Z.. An assessment of the impact of biological and chemical grasshopper control agents on ground-dwelling arthropods in Niger, based on presence/absence sampling. Crop Protection, v.18, n.5, June, 1999.:323-339.

Prates, H. T.; Santos, J. P.; Waquil, J. M.; Fabris, J. D.; Oliveira, A. B.; Foster, J. E.. Insecticidal activity of monoterpenes against Rhyzopertha dominica (F.) and Tribolium castaneum (Herbst). Journal of Stored Products Research, v.34, n.4, Oct., 1998.:243-249.

Reed, C.; Pedersen, J. R.; Cuperus, G. W.. Efficacy and cost effectiveness of grain protectants applied to farm-stored wheat at harvest and later. Journal of Economic Entomology, v.86, n.5, 1993.:1590-1598.

BIBLIOGRAPHY

Rostom, Zaky M. F.. Survey of some granivorous and non-granivorous insects and mites of stores in Saudi Arabia. Journal of Stored Products Research, v.29, n.1, 1993.:27-31.

Salama, H. S.; Ali, A. M. M.; Sharaby, A.. The induction of Bacillus thuringiensis new types by foreign DNA. Journal of Applied Entomology, v.115, n.4, 1993.:350-354.

Salin,-C.; Vernon,-P.; Vannier,-G.
TI: The supercooling and high temperature stupor points of the adult lesser mealworm Alphitobius diaperinus (Coleoptera: Tenebrionidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Oct 1998. v. 34 (4) p. 385-394.

Seaton, K. A.; Joyce, D. C.. Effects of low temperature and elevated CO-2 treatments and of heat treatments for insect disinfestation on some native Australian cut flowers. Scientia Horticulturae (Amsterdam), v.56, n.2, 1993.:119-133.

Seck, Dogo; Lognay, Georges. Study of the biological activity and identification of the principal agents responsible for the efficacy of Securidaca longepedunculata Fresen on insects of stored foods. Robertson, H. G. Insects in African economy and environment., 1997.:98.

Sedlacek, John D.; Weston, Paul A.; Price, Bryan D.; Rattlingourd, Patti L.. Survey of insect pests in shelled corn stored on-farm in Kentucky. Journal of Entomological Science, v.33, n.2, April, 1998.:171-179.

Sharma, H. C.; Lopez, V. F.. Comparison of economic injury levels for sorghum head bug, Calocoris angustatus, on resistant and susceptible genotypes at different stages of panicle development. Crop Protection, v.12, n.4, 1993.:259-266.

Sheiman, Inna M.; Balobanova, Emma F.; Kreshchenko, Natalia D.. Regulation of development of the grain beetle Tenebrio molitor by neuropeptides. Invertebrate Reproduction and Development, v.36, n.1-3, Sept., 1999.:105-110.

Shuman, Dennis; Coffelt, James A.; Vick, Kenneth W.; Mankin, Richard W.. Quantitative acoustical detection of larvae feeding inside kernels of grain. Journal of Economic Entomology, v.86, n.3, 1993.:933-938.

Sterk, G.; Hassan, S. A.; Baillod, M.; Bakker, F.; Bigler, F.; Bluemel, S.; Bogenschuetz, H.; Boller, E.; Bromand, B.; Brun, J.; Calis, J. N. M.; Coremans-Pelseneer, J.; Duso, C.; Garrido, A.; Grove, A.; Heimbach, U.;

BIBLIOGRAPHY

Hokkanen, H.; Jacas, J.; Lewis, G.; Moreth, L.; Polgar, L.; Roversti, L.; Samsoe-Petersen, L.; Sauphanor, B.; Schaub, L.; Staeubli, A.; Tuset, J. J.; Vainio, A.; van de Veire, M.; Viggiani, G.; Vinuela, E.; Vogt, H.. Results of the seventh joint pesticide testing programme carried out by the IOBC/WPRS-Working Group 'Pesticides and Beneficial Organisms'. Biocontrol (Dordrecht), v.44, n.1, 1999.:99-117.

Stein, W.; Gorham, J. R.. New results about stored-product protection (animal pests): V. Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz, v.100, n.1, 1993.:91-107.

Svoboda, J. A.; Lusby, W. R.. Variability of sterol utilization in stored-products insects. Experientia (Basel), v.50, n.1, 1994.:72-74.

Tabashnik, Bruce E.; Finson, Naomi; Johnson, Marshall W.; Moar, William J.. Resistance to toxins from Bacillus thuringiensis ssp. kurstaki causes minimal cross-resistance to Bacillus thuringiensis ssp. aizawai in the diamondback moth (Lepidoptera: Plutellidae). Applied and Environmental Microbiology, v.59, n.5, 1993.:1332-1335.

Tallamy,-D.W.; Stull,-J.; Ehresman,-N.P.; Gorski,-P.M.; Mason,-C.E.
TI: Cucurbitacins as feeding and oviposition deterrents to insects.
SO: Environ-entomol. Lanham, Md. : Entomological Society of America. June 1997. v. 26 (3) p. 678-683.

Tapp,-H.; Stotzky,-G.
TI: Monitoring the insecticidal toxins from Bacillus thuringiensis in soil with flow cytometry.
SO: Can-j-microbiol. Ottawa : National Research Council of Canada. Nov 1997. v. 43 (11) p. 1074-1078.

Tebayashi, Shin-Ichi; Hirai, Nobuhisa; Suzuki, Takahisa; Matsuyama, Shigeru; Nakakita, Hiroshi; Nemoto, Tadashi; Nakanishi, Hiroshi. alpha-Cedren-14-al: Minor aggregation pheromone component of Gnatocerus cornutus (F.) (Coleoptera: Tenebrionidae). Journal of Pesticide Science, v.23, n.4, 1998.:402-406.

Throne, James E.; Cunningham, R. Leo. Ability of selected stored-product insects to infest polyurethane foams containing canary corn (maize) dextrin. Journal of Stored Products Research, v.30, n.2, 1994.:171-173.

Thurston,-G.S.
TI: Biological control of elm leaf beetle.
SO: J-arboric. Champaign, IL : International Society of Arboriculture. May 1998. v. 24 (3) p. 154-159.

Trewin, Brigitte; Reichmuth, C.. Efficacy of the diatomaceous earth Dryacide against stored product pest insects. Anzeiger fuer Schaedlingskunde Pflanzenschutz Umweltschutz, v.70, n.3, 1997.:51-54.

Tunc, I.; Erler, F.; Dagli, F.; Calis, O.. Insecticidal activity of acetone vapours. Journal of Stored Products Research, v.33, n.2, 1997.:181-185.

White, N. D. G.; Jayas, D. S.. Microfloral infection and quality deterioration of sunflower seeds as affected by temperature and moisture content during storage and the suitability of the seeds for insect or mite infestation. Canadian Journal of Plant Science, v.73, n.1, 1993.:303-313.

White, Noel D. G.; Jayas, Digvir S.; Demianyk, Colin J.. Movement of grain to control stored-product insects and mites. Phytoprotection, v.78, n.2, 1997.:75-84.

White, N. D. G.; Mills, J. T.; Kenaschuk, E. O.; Oomah, B. D.; Dribnenki, P.. Quality changes occurring in stored solin, high linolenic acid and standard flaxseed (Linum usitatissimum L.). Canadian Journal of Plant Science, v.79, n.1, Jan., 1999.:35-42.

Wicklow, Donald T.; McAlpin, Cesaria E.; Nelsen, Terry C.. Survival and reproduction of stored-product beetles on seeds cached by a desert rodent and by Native Americans. Environmental Entomology, v.23, n.2, 1994.:414-419.

Wightman,-J.A.; Wightman,-A.S.
TI: An insect, agronomic and sociological survey of groundnut fields in southern Africa.
SO: Agric-ecosyst-environ. Amsterdam; New York : Elsevier, 1983-. Dec 1994. v. 51 (3) p. 311-331.

Williams, Lawrence A. D.; Mansingh, Ajai. Pesticidal potentials of tropical plants-I. Insecticidal activity in leaf extracts of sixty plants. Insect Science and its Application, v.14, n.5-6, 1993.:697-700.

Wolfenbarger,-D.A.; Hamed,-A.A.; Luttrell,-R.G.
TI: Toxicity of Bacillus thuringiensis var. tenebrionis and Ca-thuringiensin against the boll weevil Anthonomus grandis (Boh.) [Coleoptera: Curculionidae].
SO: Proc-Beltwide-Cotton-Conf. Memphis, Tenn. : National Cotton Council of America, 1991-. 1997. v. 2 p. 1296-1300.

Wongo, Lawrence E.. Biological activity of sorghum tannin extracts on the stored grain pests Sitophilus oryzae (L.), Sitotroga cerealella (Olivier) and Tribolium castaneum (Herbst). Insect Science and its Application, v.18, n.1, Jan.-March, 1998.:17-23.

Yoshimatsu, Shin-Ichi; Arimura, Kazuhiro; Shimanuki, Tadayuki.
Comparison of population growth rates of confused flour beetle, Tribolium confusum Jacquelin (Coleoptera: Tenebrionidae), on endophyte-infected or endophyte-uninfected seeds of ground tall fescue and perennial ryegrass. Japanese
Journal of Applied Entomology and Zoology, v.42, n.4, Nov., 1998.:227-229.

13

Abado-Becognee, K.; Fleurat-Lessard, F.; Creppy, E. E.; Melcion, D..
Effects of fumonisin B1 on growth and metabolism of larvae of the yellow mealworm, Tenebrio molitor. Entomologia Experimentalis et Applicata, v.86, n.2,Feb., 1998.:135-143.

Aribi,-N.; Quennedey,-A.; Pitoizet,-N.; Delbecque,-J.P.
TI: Ecdysteroid titres in a tenebrionid beetle, Zophobas atratus: effects of grouping and isolation.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Sept 1997. v. 43 (9) p. 815-821.

Baernholdt, Dorte; Andersen, Svend Olav. Sequence studies on
post-ecydsial cuticular proteins from pupae of the yellow mealworm, Tenebrio molitor. Insect Biochemistry and Molecular Biology, v.28, n.7, July, 1998.:517-526.

Benken, Theodor; Mueller, Josef K.; Peschke, Klaus. Oligonucleotide
DNA fingerprinting optimized to determine parentage in three beetle species.
Electrophoresis, v.19, n.2, Feb., 1998.:158-163.

Bjerke,-R.; Zachariassen,-K.E.
TI: Effects of dehydration on water content, metabolism and body fluid solutes of a carabid beetle from dry savanna in East Africa.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Nov 1997. v. 118A (3) p. 779-787.

Bloch Qazi, Margaret C.; Boake, Christine R.B.; Lewis, Sara M.. The
femoral setiferous glands of Tribolium castaneum males and production of the pheromone 4,8-dimethyldecanal. Entomologia Experimentalis et Applicata, v.89, n.3, Dec., 1998.:313-317.

Bloch Qazi, Margaret C.; Aprille, June R.; Lewis, Sara M.. Female
role in sperm storage in the red flour beetle, Tribolium castaneum.
Comparative Biochemistry and Physiology A, v.120, n.4, Aug., 1998.:641-647.

Carroll,-J.; Damme,-J.-van.; Boets,-A.; Rie,-J.-van.; Ellar,-D.J.

TI: Intramolecular proteolytic cleavage of Bacillus thuringiensis Cry3A delta-endotoxin may facilitate its coleopteran toxicity.
SO: J-invertebr-pathol. Orlando, Fla. : Academic Press. July 1997. v. 70 (1) p. 41-49.

Carver, Fiona J.; Gilman, Jane L.; Hurd, Hilary. Spermatophore production and spermatheca content in Tenebrio molitor infected with Hymenolepis diminuta. Journal of Insect Physiology, v.45, n.6, June, 1999.:565-569.

Chiou,-S.J.; Cerstiaens,-A.; Kotanen,-S.P.; Loof,-A.-de.; Schoofs,-L.
TI: Insect larvae contain substances toxic to adults: the discovery of paralysins.
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. May/June 1998. v. 44 (5/6) p. 405-411.

Cho, Mi Young; Choi, Hye Won; Moon, Ga Young; Kim, Mi Hee; Kwon, Tae Hyuk; Homma, Ko-ichi; Natori, Shunji; Lee, Bok Luel. An 86 kDa diapause protein 1-like protein is a component of early-staged encapsulation-relating proteins in coleopteran insect, Tenebrio molitor larvae. FEBS Letters, v.451, n.3, May 28, 1999.:303-307.

Cho,-M.Y.; Lee,-H.S.; Lee,-K.M.; Homma,-K.; Natori,-S.; Lee,-B.L.
TI: Molecular cloning and functional properties of two early-stage encapsulation-relating proteins from the coleopteran insect, Tenebrio molitor larvae.
SO: Eur-j-biochem. Oxford, UK : Blackwell Science Ltd. June 1999. v. 262 (3) p. 737-744.

Cloutier, Conrad; Jean, Christine. Synergism between natural enemies and biopesticides: A test case using the stinkbug Perillus bioculatus (Hemiptera: Pentatomidae) and Bacillus thuringiensis tenebrionis against Colorado potato beetle (Coleoptera: Chrysomelidae). Journal of Economic Entomology, v.91, n.5, Oct., 1998.:1096-1108.

Cristofoletti, Plinio T.; Terra, Walter R.. Specificity, anchoring, and subsites in the active center of a microvillar aminopeptidase purified from Tenebrio molitor (Coleoptera) midgut cells. Insect Biochemistry and Molecular Biology, v.29, n.9, Sept., 1999.:807-819.

Duman, J. G.; Li, N.; Verleye, D.; Goetz, F. W.; Wu, D. W.; Andorfer, C. A.; Benjamin, T.; Parmelee, D. C.. Molecular characterization and sequencing of antifreeze proteins from larvae of the beetle Dendroides canadensis. Journal of Comparative Physiology B Biochemical Systemic and Environmental Physiology, v.168, n.3, April, 1998.:225-232.

Eizaguirre, Matilde; Prats, Jordi; Abellana, Meritxell; Lopez, Carmen; Llovera, Monserrat; Canela, Ramon. Juvenile hormone and diapause in the Mediterranean corn borer, Sesamia nonagrioides. Journal of Insect Physiology,

v.44, n.5-6, May-June, 1998.:419-425.

El-Sayed, G. N.; Ignoffo, C. M.; Leathers, T. D.; Gupta, S. C..
Cuticular and non-cuticular substrate influence on expression of cuticle-degrading enzymes from conidia of an entomopathogenic fungus, Nomuraea rileyi.
Mycopathologia, v.122, n.2, 1993.:79-87.

Evans, W. S.; Wong, A.; Hardy, M.; Currie, R. W.; Vanderwel, D..
Evidence that the factor used by the tapeworm, Hymenolepis diminuta, to direct the foraging of its intermediate host, Tribolium confusum, is a volatileattractant. Journal of Parasitology, v.84, n.6, Dec., 1998.:1098-1101.

Felisberti,-F.; Ventura,-D.F.; Hertel,-H.
TI: Cerebral extraocular photoreceptors in beetles.
SO: Comp-biochem-physiol,-Part-A-Mol-integr-physiol. New York : Elsevier Science, c1998-. Dec 1997. v. 118A (4) p. 1353-1357.

Ferreira, Clelia; Torres, Bayardo B.; Terra, Walter R.. Substrate specificities of midgut beta-glycosidases from insects of different orders.
Comparative Biochemistry and Physiology B, v.119, n.1, Jan., 1998.:219-225.

Furuya, Kenji; Schegg, Kathleen M.; Schooley, David A.. Isolation and identification of a second diuretic hormone from Tenebrio molitor.
Peptides (New York), v.19, n.4, 1998.:619-626.

Grieneisen,-M.L.; Mok,-A.; Kieckbusch,-T.D.; Schooley,-D.A.
TI: The specificity of juvenile hormone esterase revisited.
SO: Insect-biochem-mol-biol. Oxford : Elsevier Science Ltd. May 1997. v 27 (5) p. 365-376.

Hack,-M.A.
TI: The effects of mass and age on standard metabolic rate in house crickets.
SO: Physiol-entomol. Oxford : Blackwell Science Ltd. Dec 1997. v. 22 (4) p. 325-331.

Hirashima,-A.; Hirokado,-S.; Tojikubo,-R.; Takeya,-R.; Taniguchi,-E.; Eto,-M.
TI: Metamorphosis of the red flour beetle, Tribolium freemani Hinton (Coleoptera: Tenebrionidae): alteration of octopamine content modulates activity of juvenile-hormone esterase, ecdysteroid level, and pupation.
SO: Arch-insect-biochem-physiol. New York, N.Y. : Wiley-Liss. 1998. v. 37 (1) p. 33-46.

Hirashima, Akinori; Nagano, Takeshi; Oishi, Rou; Eto, Morifusa.
Stereoselective response of Tribolium castaneum herbst and Musca domestica L. against optically active 2-methoxy-5-phenyl-1,3,2-oxazaphospholidine 2-sulfide.
Comparative Biochemistry and Physiology C Comparative Pharmacology and

Toxicology, v.104, n.3, 1993.:395-399.

Hirashima, Akinori; Nagano, Takeshi; Eto, Morifusa. Stress-induced changes in the biogenic amine levels and larval growth of Tribolium castaneum Herbst. Bioscience Biotechnology and Biochemistry, v.57, n.12, 1993.:2085-2089.

Hopkins, P. M.; Chung, A. C.-K.; Durica, D. S.. Limb regeneration in the fiddler crab, Uca pugilator: Histological, physiological and molecular considerations. American Zoologist, v.39, n.3, June, 1999.:513-526.

Howard, Ralph W.; Miller, Jon S.; Stanley, David W.. The influence of bacterial species and intensity of infections on nodule formation in insects. Journal of Insect Physiology, v.44, n.2, Feb., 1998.:157-164.

Islam, Nitalie; Bacala, Raymond; Moore, Albert; Vanderwel, Desiree. Biosynthesis of 4-methyl-1-nonanol: Female-produced sex pheromone of the yellow mealworm beetle, Tenebrio molitor (Coleoptera: Tenebrionidae). Insect Biochemistry and Molecular Biology, v.29, n.3, March, 1999.:201-208.

Khebbeb,-M.E.H.; Delachambre,-J.; Soltani,-N.
TI: Lipid metabolism during the sexual maturation of the mealworm (Tenebrio molitor): effect of ingested diflubenzurdn.
SO: Pestic-biochem-physiol. Orlando, Fla. : Academic Press. 1997. v. 58 (3) p. 209-217.

Kostaropoulos, Iason; Papadopoulos, Athanasios I.. Glutathione S-transferase isoenzymes expressed in the three developmental stages of the insect Tenebrio molitor. Insect Biochemistry and Molecular Biology, v.28, n.11, Nov., 1998.:901-909.

Lee, Keun Hyeung; Hong, Sung Yu; Oh, Jong Eun; Kwon, Mi Yun; Yoon, Jeong Hyeok; Lee, Ji Hye; Lee, Bok Luel; Moon, Hong Mo. Identification and characterization of the antimicrobial peptide corresponding to C-terminal beta-sheet domain of tenecin 1, an antibacterial protein of larvae of Tenebrio molitor. Biochemical Journal, v.334, n.1, Aug. 15, 1998.:99-105.

Lee,-Y.T.; Kim,-D.H.; Suh,-J.Y.; Chung,-J.H.; Lee,-B.L.; Lee,-Y.; Choi,-B.S.
TI: Structural characteristics of Tenecin 3, an insect antifungal protein.
SO: Biochem-mol-biol-int. London, U.K. : Taylor & Francis Ltd. Mar 1999. v. 47 (3) p. 369-376.

Lee, Hyun Seong; Cho, Mi Young; Lee, Kwang Moon; Kwon, Tae Hyuk; Homma, Ko-Ichi; Natori, Shunji; Lee, Bok Luel. The pro-phenoloxidase of coleopteran insect, Tenebrio molitor, larvae was activated during cell clump/cell adhesion of insect cellular defense reactions. FEBS Letters, v.444, n.2-3, Feb. 12, 1999.:255-259.

BIBLIOGRAPHY

Liou, Yih-Cherng; Thibault, Pierre; Walker, Virginia K.; Davies, Peter L.; Graham, Laurie A.. A complex family of highly heterogeneous and internally repetitive hyperactive antifreeze proteins from the beetle Tenebrio molitor. Biochemistry, v.38, n.35, Aug. 31, 1999.:11415-11424.

Liou, Y.-C.; Thibault, P.; Walker, V. K.; Davies, P. L.; Graham, L. A.. Repeating structure and isoform heterogeneity of a hyperactive antifreeze protein from beetle, Tenebrio molitor. FASEB Journal, v.13, n.7, April 23, 1999.:A1561.

Meyer, Werner; Jungnickel, Harald; Jandke, Markus; Dettner, Konrad; Spiteller, Gerhard. On the cytotoxicity of oxidized phytosterols isolated form photoautotrophic cell cultures of Chenopodium rubrum tested on meal-worms Tenebrio molitor. Phytochemistry (Oxford), v.47, n.5, March, 1998.:789-797.

Moran, R.; Garcia, R.; Lopez, A.; Zaldua, Z.; Mena, J.; Garcia, M.; Armas, R.; Somonte, D.; Rodriguez, J.; Gomez, M.; Pimentel, E.. Transgenic sweet potato plants carrying the delta-endotoxin gene from Bacillus thuringiensis var. tenebrionis. Plant Science (Shannon), v.139, n.2, Dec. 31, 1998.:175-184.

Mouillet,-J.F.; Delbecque,-J.P.; Quennedey,-B.; Delachambre,-J.
TI: Cloning to two putative ecdysteroid receptor from Tenebrio molitor and their developmental expression in the epidermis during metamorphosis.
SO: Eur-j-biochem. Berlin : Springer-Verlag Berlin. Sept 1997. v. 248 (3) p. 856-863.

Mukherjee, S. N.; Rawal, S. K.; Ghumare, S. S.; Sharma, R. N.. Hormetic concentrations of azadirachtin and isoesterase profiles in Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Experientia (Basel), v.49, n.6-7, 1993.:557-560.

Nahoum, Virginie; Farisei, Francesca; Le-Berre-Anton, Veronique; Egloff, Marie P.; Rouge, Pierre; Poerio, Elia; Payan, Francoise. A plant-seed inhibitor of two classes of alpha-amylases: X-ray analysis of Tenebrio molitor larvae alpha-amylase in complex with the bean Phaseolus vulgaris inhibitor. Acta Crystallographica Section D Biological Crystallography, v.55, n.1, Jan., 1999.:360-362.

Naidu, S. G.. Haemolymph amino acid, sugar and glycerol levels in the Namib Desert tenebrionid Stips stali during dehydration and rehydration. Comparative Biochemistry and Physiology A, v.119, n.2, Feb., 1998.:477-484.

Nicolai, Maryse; Delbecque, Jean-Paul; Delachambre, Jean; Lenoir-Rousseaux, Jean-Jacques. Is tubulin the sole antigen recognized by a

putative anti-bursicon antibody? Comparative Biochemistry and Physiology B, v.122, n.1, Jan., 1999.:39-45.

Odell, Jason P.. Energetics of metamorphosis in two holometabolous insect species: Manduca sexta (Lepidoptera: Sphingidae) and Tenebrio molitor (Coleoptera: Tenebrionidae). Journal of Experimental Zoology, v.280, n.5, April 1, 1998.:344-353.

Oppert, Brenda; Morgan, Thomas D.; Culbertson, Christina; Kramer, Karl J.. Dietary mixtures of cysteine and serine proteinase inhibitors exhibit synergistic toxicity toward the red flour beetle, Tribolium castaneum. Comparative Biochemistry and Physiology C Comparative Pharmacology and Toxicology, v.105, n.3, 1993.:379-385.

Perera, Srini C.; Ladd, Tim R.; Dhadialla, T. S.; Krell, Peter J.; Sohi, Sardar S.; Retnakaran, Arthur; Palli, Subba R.. Studies on two ecdysone receptor isoforms of the spruce budworm, Choristoneura fumiferana. Molecular and Cellular Endocrinology, v.152, n.1-2, June 25, 1999.:73-84.

Potekhin, Sergey A.; Loseva, Olga I.; Tiktopulo, Elizabeth I.; Dobritsa, Anatoly P.. Transition state of the rate-limiting step of heat denaturation of Cry3A delta-endotoxin. Biochemistry, v.38, n.13, March 30, 1999.:4121-4127.

Reddy,-S.T.; Venkateswerlu,-G.
TI: Intracellular proteases in sporulated Bacillus thuringiensis subsp. tenebrionis: detection and analysis by gelatin zymography.
SO: Biochem-mol-biol-int. Marrickville, N.S.W., Australia : Academic Press. Dec 1997. v. 43 (5) p. 935-943.

Renault, D.; Salin, C.; Vannier, G.; Vernon, P.. Survival and chill-coma in the adult lesser mealworm, Alphitobius diaperinus (Coleoptera: Tenebrionidae), exposed to low temperatures. Journal of Thermal Biology, v.24, n.4, Aug., 1999.:229-236.

Rodriguez, J. B.; Zhong, L.; Docampo, R.; Wimmer, Z.; Gros, E. G.. Growth inhibitory effect of juvenile hormone analogues on epimastigotes of Trypanosoma cruzi. Bioorganic & Medicinal Chemistry Letters, v.8, n.22, Nov. 17, 1998.:3257-3260.

Rothemund,-S.; Liou,-Y.C.; Davies,-P.L.; Sonnichsen,-F.D.
TI: Backbone structure and dynamics of a hemolymph protein from the mealworm beetle Tenebrio molitor.
SO: Biochemistry. Washington, D.C. : American Chemical Society. Nov 11, 1997. v.36 (45) p. 13791-13801.

Saleem, Mushtaq A.; Shakoori, Abdul Rauf; Mantle, David. Macromolecular and enzymatic abnormalities induced by a synthetic pyrethroid, Ripcord (cypermethrin), in adult beetles of a stored grain pest, Tribolium castaneum (Herbst.) (Coleoptera: Tenebrionidae). Archives of Insect Biochemistry and Physiology, v.39, n.4, 1998.:144-154.

Salin, C.; Vernon, P.; Vannier, G.. Effects of temperature and humidity on transpiration in adults of the lesser mealworm, Alphitobius diaperinus (Coleoptera: Tenebrionidae). Journal of Insect Physiology, v.45, n.10, Oct., 1999.:907-914.

Salin, C.; Vernon, P.; Vannier, G.. The supercooling and high temperature stupor points of the adult lesser mealworm Alphitobius diaperinus (Coleoptera: Tenebrionidae). Journal of Stored Products Research, v.34, n.4, Oct., 1998.:385-394.

Sato,-K.; Komoto,-M.; Sato,-T.; Enel,-H.; Kobayashi,-M.M.; Yaginuma,-T.
TI: Baculovirus-mediated expression of a gene for trehalase of the mealworm beetle. Tenebrio molitor, in insect cells, SF-9, and larvae of the cabbage armyworm, Mamestra brassicae.
SO: Insect-biochem-mol-biol. Exeter : Elsevier Science Ltd. Dec 1997. v. 27 (12) p. 1007-1016.

Shayesteh, N.; Barthakur, N. N.. Electrohydrodynamic mortality of insects: A plausible mechanism. International Journal of Biometeorology, v.40, n.2, 1997.:86-90.

Shen,-Z.; Corbin,-D.R.; Greenplate,-J.T.; Grebenok,-R.J.; Galbraith,-D.W.; Purcell,-J.P.
TI: Studies on the mode of action of cholesterol oxidase on insect midgut membranes.
SO: Arch-insect-biochem-physiol. New York, N.Y. : Wiley-Liss. 1997. v. 34 (4) p. 429-442.

Strobl, Stefan; Maskos, Klaus; Wiegand, Georg; Huber, Robert; Gomis-Rueth, F. Xavier; Glockshuber, Rudi. A novel strategy for inhibition of alpha-amylases: Yellow meal worm alpha-amylase in complex with the Ragi bifuncitonal inhibitor at 2.5 A resolution. Structure (London), v.6, n.7, July 15, 1998.:911-921.

Strobl, Stefan; Maskos, Klaus; Betz, Michael; Wiegand, Georg; Huber, Robert; Gomis-Rueth, F. Xavier; Glockshuber, Rudi. Crystal structure of yellow meal worm alpha-amylase at 1.64 A resolution. Journal of Molecular Biology, v.278, n.3, May 8, 1998.:617-628.

Tartes, U.; Vanatoa, A.; Kuusik, A.. Diversity in coordination of

gas exchange, circulation and abdominal movements in insect pupae. Comparative Biochemistry and Physiology Part A Molecular & Integrative Physiology, v.124, n.SUPPL., Aug., 1999.:S111.

Tebayashi,-S.; Hirai,-N.; Suzuki,-T.; Matsuyama,-S.; Nakakita,-H.; Nemoto,-T.; Nakanishi,-H.
TI: Identification of (+)-acoradiene as an aggregation pheromone for Gnatocerus cornutus (F.) (Coleoptera: Tenebrionidae).
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Apr/July 1998. v. 34 (2/3) p. 99-106.

Unruh, Lisa M.; Xu, Rongda; Kramer, Karl J.. Benzoquinone levels as a function of age and gender of the red flour beetle, Tribolium castaneum. Insect Biochemistry and Molecular Biology, v.28, n.12, Dec., 1998.:969-977.

Wang, Xiu-hong; Smith, Ross; Fletcher, Jamie I.; Wilson, Harry; Wood, Chris J.; Howden, Merlin E. H.; King, Glenn F.. Structure-function studies of omega-atracotoxin, a potent antagonist of insect voltage-gated calcium channels. European Journal of Biochemistry, v.264, n.2, Sept. 1, 1999.:488-494.

Watson, I.; Churchill, D.; Caveney, S.. Characterization of a chloride current in the larval epidermis of the beetle Tenebrio molitor. Journal of Insect Physiology, v.45, n.10, Oct., 1999.:895-906.

Weaver, Robert J.; Edwards, John P.. Neuropeptide inhibitors of juvenile hormone synthesis in the mealworm and tomato moth. Vaudry, H. Tonon, M.-C. Roubos, E. W. de Loof, A. Annals of the New York Academy of Sciences; Trends in comparative endocrinology and neurobiology: From molecular to integrative biology., May 15, 1998.:450-452.

Wietstock, Steven M.; Marron, Susan M.; Maxim, Dan; Gott, Bruce. Genomic analysis of DNA isolated from Tenebrio and Tribolium beetles. FASEB Journal, v.7, n.7, 1993.:A1228.

Willis, Judith H.. Cuticular proteins in insects and crustaceans. American Zoologist, v.39, n.3, June, 1999.:600-609.

Vacha,-M.
TI: The influence of a static, homogenous magnetic field (B = 320 mT) on extracardiac pulsations of Tenebrio molitor pupae (Coleoptera: Tenebrionidae).
SO: J-insect-physiol. Oxford, U.K. : Elsevier Science Ltd. Nov 1997. v. 43 (11) p. 979-989.

15

Beeman, Richard W.; Brown, Susan J.; Stuart, Jeffrey J.; Denell, Rob.
The evolution of genes regulating developmental commitments in insects and other animals. Wiley-Liss, Inc. ; Wiley-Liss, Ltd. 605 Third Avenue, New York, New York 10158-0012, USA; Chichester, England 1993.. ;Spradling, A. C. Ed.
Symposium of the Society for Developmental Biology; Evolutionary conservation of developmental mechanisms.:71-84.

Binner, Priska; Sander, Klaus. Pair-rule patterning in the honeybee Apis mellifera: Expression of even-skipped combines traits known from beetles and fruitfly. Development Genes and Evolution, v.206, n.7, 1997.:447-454.

Chikatunov,-V.; Lillig,-M.; Pavlicek,-T.; Blaustein,-L.; Nevo,-E.
TI: Biodiversity of insects at a microsite, 'Evolution Canyon', Nahal Oren, Mt. Carmel, Israel. Coleoptera: Tenebrionidae.
SO: J-arid-environ. London, New York, Academic Press. Oct 1997. v. 37 (2) p. 367-377.

Hancock, J. M.; Shaw, P. J.; Bonneton, F.; Dover, G. A.. High sequence turnover in the regulatory regions of the development gene hunchback in insects. Molecular Biology and Evolution, v.16, n.2, Feb., 1999.:253-265.

Hurst, Gregory D. D.; McVean, Gilean A. T.. Selfish genes in a social insect. Trends in Ecology & Evolution, v.13, n.11, Nov., 1998.:434-435.

Maderspacher, Florian; Bucher, Gregor; Klingler, Martin. Pair-rule and gap gene mutants in the flour beetle Tribolium castaneum. Development Genes and Evolution, v.208, n.10, Dec., 1998.:558-568.

Maxton-Kuechenmeister, Joerg; Handel, Klaus; Schmidt-Ott, Urs; Roth, Siegfried; Jaeckle, Herbert. Toll homolog expression in the beetle Tribolium suggests a different mode of dorsoventral patterning than in Drosophila embryos. Mechanisms of Development, v.83, n.1-2, May, 1999.:107-114.

Missios, S.; Pincus, M.; Zahorchak, A.; McKeon, B.; Oshop, G.; Trecki, J.; Nasr, D.; Doctor, J.. The decapentaplegic and 60A genes of the red flour beetle, Tribolium castaneum, are similar to Drosophila dpp and 60A in sequence, structure, and expression. Developmental Biology, v.210, n.1, June 1, 1999.:188.

Moermans, R.; Casteels, H.; Van Hecke, P.. Evolution of cacao-pests over a six year period. Anzeiger fuer Schaedlingskunde Pflanzenschutz Umweltschutz, v.71, n.8, Jan., 1998.:149-151.

BIBLIOGRAPHY

Nagy, Lisa M.; Carroll, Sean. Conservation of wingless patterning functions in the short germ embryos of Tribolium castaneum. Nature (London), v.367, n.6462, 1994.:460-463.

Peterson, Michael D.; Popadic, Aleksandar; Kaufman, Thomas C.. The expression of two engrailed-related genes in an apterygote insect and a phylogenetic analysis of insect engrailed-related genes. Development Genes and Evolution, v.208, n.10, Dec., 1998.:547-557.

Plohl, Miroslav; Mestrovic, Nevenka; Bruvo, Branka; Ugarkovic, Durdica. Similarity of structural features and evolution of satellite DNAs from Palorus subdepressus (Coleoptera) and related species. Journal of Molecular Evolution, v.46, n.2, Feb., 1998.:234-239.

Rice, William R.. Intergenomic conflict, interlocus antagonistic coevolution, and the evolution of reproductive isolation. Howard, D. J. Berlocher, S. H. Endless forms: Species and speciation., 1998.:161-270.

Shippy, Teresa D.; Brown, Susan J.; Denell, Robin E.. Molecular characterization of the Tribolium abdominal-A ortholog and implications for the products of the Drosophila gene. Development Genes and Evolution, v.207, n.7, March, 1998.:446-452.

Singh, A. K.; Thorpe, G. R.. A solution procedure for three-dimensional free convective flow in peaked bulks of grain. Journal of Stored Products Research, v.29, n.3, 1993.:221-235.

Sommer, Ralf J.; Tautz, Diethard. Involvement of an orthologue of the Drosophila pair-rule gene hairy in segment formation of the short germ-band embryo of Tribolium (Coleoptera). Nature (London), v.361, n.6411, 1993.:448-450.

Stuart, Jeffrey J.; Brown, Susan J.; Beeman, Richard W.; Denell, Robin E.. The Tribolium homeotic gene Abdominal is homologous to abdominal-A of the Drosophila bithorax complex. Development (Cambridge), v.117, n.1, 1993.:233-243.

Tautz, Diethard; Wolff, Christian; Schroeder, Reinhard; Rohr, Klaus; Eckert, Christoph. Evolution of insect segmentation. Developmental Biology, v.210, n.1, June 1, 1999.:243.

Wade, Michael J.; Patterson, Harold; Chang, Nancy W.; Johnson, Norman A.. Postcopulatory, prezygotic isolation in flour beetles. Heredity, v.72, n.2, 1994.:163-167.

Wade, Michael J.; Johnson, Norman A.. Reproductive isolation between two species of flour beetles, Tribolium castaneum and T. freemani: Variation within and among geographical populations of T. castaneum. Heredity, v.72, n.2, 1994.:155-162.

Wolff, Christina; Schroeder, Reinhard; Schulz, Cordula; Tautz, Diethard; Klingler, Martin. Regulation of the Tribolium homologues of caudal and hunchback in Drosophila: Evidence for maternal gradient systems in a short germ embryo. Development (Cambridge), v.125, n.18, Sept., 1998.:3645-3654.

16

Costantino, R. F.; Desharnais, R. A.; Cushing, J. M.; Dennis, Brian. Chaotic dynamics in an insect population. Science (Washington D C), v.275, n.5298, 1997.:389-391.

Costantino, R. F.; Cushing, J. M.; Dennis, Brian; Desharnais, Robert A.; Henson, Shandelle M.. Resonant population cycles in temporally fluctuating habitats. Bulletin of Mathematical Biology, v.60, n.2, March, 1998.:247-273.

Rohani, Pejman; Miramontes, Octavio. Chaos or quasiperiodicity in laboratory insect population? Journal of Animal Ecology, v.65, n.6, 1996.:847-849.

17

Ando, Kiyoshi. A new species from Indochina in the genus Gnesis Pascoe (Coleoptera, Tenebrionidae). Bulletin de la Societe Entomologique de France, v.104, n.1, March, 1999.:101-103.

Bremer,-H.J.; Triplehron,-C.A.
TI: The Latin American species of the genus Corticeus Piller and Mitterpacher (Coleoptera: Tenebrionidae, Hypophloeini). I. The species described by Reitter and Pic, and description of two new species.
SO: Coleopt-bull. Sacramento, CA : Coleopterists Society. Mar 1999. v. 53 (1) p 56-63.

Brustel, Herve; Roge, Jean. On several rare or little known Coleoptera species from southwestern France (second part). Entomologiste (Paris), v.55, n.3, June, 1999.:91-101.

Brustel, Herve; Van Meer, Cyrille. Some remarkable elements of the saproxylic entomofauna from Pyrenees and neighbouring regions (Coleoptera). Bulletin de la Societe Entomologique de France, v.104, n.3, Aug., 1999.:231-240.

BIBLIOGRAPHY

Chitra, S.; Narayanan, R. B.; Balakrishnan, A.; Jayaraman, Kunthala. A rapid and specific method for the identification of Bacillus thuringiensis strains by indirect immunofluorescence. Journal of Invertebrate Pathology, v.71, n.3, May, 1998.:286-287.

Endrody-Younga, S.. Afrobyrsax capensis spec. nov., with a tropical West African relationship (Coleoptera: Tenebrionidae: Bolitophagini). Annals of the Transvaal Museum, v.36, n.30, 1998.:421-423.

Endrody-Younga, S.. The American tribe Evaniosomini in southern Africa (Coleoptera: Tenebrionidae). Annals of the Transvaal Museum, v.36, n.31, 1998.:425-426.

Epps, Tammy M.; Britten, Hugh B.; Rust, Richard W.. Historical biogeography of Eusattus muricatus (Coleoptera: Tenebrionidae) within the Great Basin, western North America. Journal of Biogeography, v.25, n.5, Sept., 1998.:957-968.

Ferrer, Julio; Moragues, Gerard. Contribution to the knowledge of the neotropical Tenebrionidae: The genus Phymatestes Pascoe, 1868 (Coleoptera), 1st part: The group of Ph. tuberculatus. Bulletin de la Societe Entomologique de France, v.103, n.4 Oct., 1998.:373-392.

Ferrer, Julio; Moragues, Gerard. The genus Flabellostrongylium Pic (1938), redescription, systematic discussion and description of a new species from French Guyana (Coleoptera, Tenebrionidae). Bulletin de la Societe Entomologique de France, v.104, n.3, Aug., 1999.:293-297.

Gompel, Nicolas; Soldati, Fabien; Soldati, Laurent. Description of the female of Litoborus (Paralitoborus) escalerai Antoine, 1930 (Coleoptera Tenebrionidae). Bulletin de la Societe Entomologique de France, v.104, n.1, March, 1999.:35-37.

Husband, Robert W.; Hasan, M. Mahbub. A new podapolipus (Acari: Podapolipidae) from Alphitobius sp. (Coleoptera: Tenebrionidae) from Bangladesh. International Journal of Acarology, v.24, n.1, March, 1998.:53-57.

Husband, Robert W.. A review of Podapolipus (Acari: Podapolipidae) from Coleoptera and description of two new species from the Unites States. International Journal of Acarology, v.24, n.1, March, 1998.:59-67.

Matthews, E. G.. Classification, phylogeny and biogeography of the genera of Adeliini (Coleoptera: Tenebrionidae). Invertebrate Taxonomy, v.12, n.5, 1998.:685-824.

BIBLIOGRAPHY

Maxwell, Judith A.; Young, Daniel K.. A significant eastern range extension for Eleodes tricostatus (Say) (Coleoptera: Tenebrionidae). Coleopterists Bulletin, v.52, n.1, March, 1998.:90-92.

Medvedev, G. S.. Contribution to the knowledge of darkling beetles of the genus Lasiostola Sol. (Coleoptera: Tenebrionidae). Entomological Review (English Translation of Entomologicheskoye Obozreniye), v.72, n.8, 1993 (1994).:64-76.

Mitchell, B. R.. Corticeus unicolor Pill. & Mitt. (Col.: Tenebrionidae) new to Warwickshire. Entomologist's Record and Journal of Variation, v.111, n.2, March-April, 1999.:56.

Molina-Rugama, Adrian J.; Zanuncio, Jose C.; Zanuncio, Teresinha V.; Oliveira, Marcio L. R. De. Reproductive strategy of Podisus rostralis (Stal) (Heteroptera: Pentatomidae) females under different feeding intervals. Biocontrol Science and Technology, v.8, n.4, Dec., 1998.:583-588.

Nikitsky, N. B.. To knowledge of beetles from the family Synchroidae (Coleoptera, Tenebrionoidea) of the world fauna. Zoologicheskii Zhurnal, v.78, n.1, Jan., 1999.:42-48.

Palmer, Miquel. Taxonomy, phylogeny, and biogeography of a species-group of West-Mediterranean Tentyria (Coleoptera: Tenebrionidae). Annals of the Entomological Society of America, v.91, n.3, May, 1998.:260-268.

Papp, Charles S.. Two new Stenosini species in the genus Araeoschizus LeConte from Baja California, Mexico (Coleoptera: Tenebrionidae). Bulletin Southern California Academy of Sciences, v.97, n.3, Dec., 1998.:89-95.

Philips, T. K.; Steiner, W. E., ; Triplehorn, C. A.. A new species of Central American Platydema Laporte and Brulle (Coleoptera: Tenebrionidae) recently established in Florida. Coleopterists Bulletin, v.52, n.3, Sept., 1998.:291-296.

Pollock, Darren A.. Nomenclatural changes in pythidae and pyrochroidae (Coleoptera). Coleopterists Bulletin, v.52, n.4, Dec., 1998.:388-390.

Pollock, Darren A.. Revision of the Neotropical genus Ischyomius with a discussion on its systematic position (Insecta: Coleoptera: Tenebrionoidea: Pythidae). Annals of Carnegie Museum, v.67, n.3, Aug. 13, 1998.:245-264.

Triplehorn,-C.A.
TI: A review of the genus Liodema Horn (Coleoptera: Tenebrionidae) with description

of a new species from Costa Rica and Panama.
SO: Proc-Entomol-Soc-Wash. Washington [D.C.] : The Society , 1986-. Apr 1998. v. 100 (2) p. 324-330.

Triplehorn,-C.A.; Merkl,-O.
TI: Review of the genus Loxostethus triplehorn, with descriptions of three new species (Coleoptera: Tenebrionidae: Diaperini).
SO: Ann-Entomol-Soc-Am. Lanham, Md. : Entomological Society of America. Nov 1997. v. 90 (6) p. 736-741.

18

Alonso-Amelot, Miguel E.; Avila, Jorge L.; Otero, L. Daniel; Mora, Flor; Wolff, Berenice. A new bioassay for testing plant extracts and pure compounds using red flour beetle Tribolium castaneum Herbst. Journal of Chemical Ecology, v.20, n.5, 1994.:1161-1177.

Berghammer, Andreas; Bucher, Gregor; Maderspacher, Florian; Klingler, Martin. A system to efficiently maintain embryonic lethal mutations in the flour beetle Tribolium castaneum. Development Genes and Evolution, v.209, n.6, June, 1999.:382-388.

Buchelos, C. Th.; Athanassiou, C. G.. Unbaited probe traps and grain trier: A comparison of the two methods for sampling Coleoptera in stored barley. Journal of Stored Products Research, v.35, n.4, Oct., 1999.:397-404.

Chitra, S.; Narayanan, R. B.; Balakrishnan, A.; Jayaraman, Kunthala. A rapid and specific method for the identification of Bacillus thuringiensis strains by indirect immunofluorescence. Journal of Invertebrate Pathology, v.71, n.3, May, 1998.:286-287.

Dowdy, Alan K.; Mullen, Michael A.. Multiple stored-product insect pheromone use in pitfall traps. Journal of Stored Products Research, v.34, n.1, Jan., 1998.:75-80.

Hagstrum, David W.; Flinn, Paul W.. Comparison of acoustical detection of several species of stored-grain beetles (Coleoptera: Curculionidae, Tenebrionidae, Bostrichidae, Cucujidae) over a range of temperatures. Journal of Economic Entomology, v.86, n.4, 1993.:1271-1278.

Ho,-S.H.; Fan,-L.; Boon,-K.S.
TI: Development of a PC-based automatic monitoring system for Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) in a rice warehouse.
SO: J-stored-prod-res. Oxford, U.K. : Elsevier Science Ltd. Oct 1997. v. 33 (4) p. 277-

BIBLIOGRAPHY

281.

Mankin, R. W.; Shuman, D.; Coffelt, J. A.. Acoustic counting of adult insects with differing rates and intensities of sound production in stored wheat. Journal of Economic Entomology, v.90, n.4, 1997.:1032-1038.

Trematerra, P.. Capture of stored-grain Coleoptera with WB Probe II Trap: Influence of grain type. Anzeiger fuer Schaedlingskunde Pflanzenschutz Umweltschutz, v.71, n.7, Nov., 1998.:135-137.

Tobin,-P.C.; Pitts,-C.W.
TI: Flotation method for extracting insects from poultry manure samples.
SO: J-med-entomol. Lanham, Md. : The Entomological Society of America. Jan 1999. v. 36 (1) p. 121-123.

Vela-Coiffier, E. L.; Fargo, W. S.; Bonjour, E. L.; Cuperus, G. W.; Warde, W. D.. Immigration of insects into on-farm stored wheat and relationships among trapping methods. Journal of Stored Products Research, v.33, n.2, 1997.:157-166.

Weston, Paul A.; Barney, Robert J.. Comparison of three trap types for monitoring insect populations in stored grains. Journal of Economic Entomology, v.91, n.6, Dec., 1998.:1449-1457.

PUBLICATION LISTS SUBMITTED BY SUBSCRIBERS, 1999

PUBLICATION LISTS SUBMITTED BY

DR. J.E THRONE, GRAIN MARKETING

AND PRODUCTION RESEARCH CENTER

BIOLOGICAL RESEARCH UNIT,

MANHATTAN, KANSAS 66502

Grain Marketing and Production Research Center
Biological Research Unit
1515 College Avenue
Manhattan, KS 66502
Telephone: 785-776-2704/FAX 785-537-5584

Publications for 1998-1999:

CONTROL TECHNOLOGIES

Arthur, F.H. 1998. Residual Studies with Cyfluthrin Wettable Powder: Toxicity Toward Red Flour Beetles (Coleoptera: Tenebrionidae) Exposed for Short Intervals on Treated Concrete. Journal of Economic Entomology. Vol. 91, No. 1, pp. 309-319.

Arthur, F.H. 1998. Residual Toxicity of Cyfluthrin Wettable Powder Against Tribolium confusum (Coleoptera: Tenebrionidae) Exposed for Short Time Intervals on Concrete. Journal of Stored Product Research. Vol. 34, No. 1, pp. 19-25.

Arthur, F.H., J.E. Throne, D.E. Maier, and M.D. Montross. 1998. Feasibility of aeration for management of maize weevil populations in corn stored in the southern United States: model simulations based on recorded weather data. American Entomologist 44: 118-123.

Dowdy, A.K. and M.A. Mullen. Multiple Stored-Product Insect Pheromone Use in Pitfall Traps. ournal of Stored Product Research. Vol. 34, No. 1, pp. 75-80.

Dowdy, A.K. 1999. Mortality of red flour beetle, *Tribolium castaneum* (Coleoptera: Tenebrionidae) exposed to high temperature and diatomaceous earth combinations. Journal of Stored Products Research 35: 175-182.

Flinn, P.W. 1998. Temperature effects on efficacy of *Choetospila elegans* (Hymenoptera: Pteromalidae) to suppress *Rhyzopertha dominica* (Coleoptera: Bostrichidae) in stored wheat. Journal of Economic Entomology 91: 320-323.

Johnson, D. E., Oppert, B., AND McGaughey, W.H. 1998. Spore coat protein synergizes *Bacillus thuringiensis* crystal toxicity for the Indianmeal Moth (*Plodia interpunctella*). Current Microbiology, Vol. 36, pp. 278-282.

McGaughey, W.H., Gould, F., and W. Gelerntner. 1998. Bt Resistance Management. Nature Biotechnology. Vol. 16, No. 2, pp. 144-149.

ECOLOGY

Dowell, F.E., J.E. Throne, D. Wang, and J.E. Baker. 1999. Identifying stored-grain insects using near-infrared spectroscopy. Journal of Economic Entomology 92: 165-169.

Hagstrum, D.W., P.W. Flinn, and Bh. Subramanyam. 1998. Predicting insect density from probe trap catch in farm-stored wheat. Journal of Stored Products Research 34: 251-262.

Hagstrum, D.W., Flinn, P.W., and J.J. Gaffney. Temperature Gradient on Tribolium castaneum (Coleoptera: Tenebrionidae) Adult Despersal in Stored Wheat. Environmental Entomology. Vol. 27, No. 1, pp. 123-129.

Howard, R.W., M.Charlton, and R.E. Charlton. 1998. Host-finding, host recognition, and host-acceptance behavior of *Cephalonomia tarsalis* (Hymenoptera: Bethylidae). Annals of the Entomological Society of America 91: 879-889.

Mullen, M.A., E.P. Wileyto, and F.H. Arthur. 1998. Influence of trap design and location on the capture of *Plodia interpunctella* (Indianmeal moth) in a release recapture study. Journal of Stored Product Research 34: 33-36.

Throne, J.E., D.W. Hagstrum, and J. Nawrot. 1998. Computer model for simulating almond moth (Lepidoptera: Pyralidae) population dynamics. Environmental Entomology 27: 344-354.

GENETICS

Beeman, R.W. and K.S. Friesen. 1999. Properties and natural occurrence of maternal-effect selfish genes ("Medea" factors) in the red flour beetle, *Tribolium castaneum*. Heredity, in press.

Zhu, Y.C., A.K. Dowdy, and J.E. Baker. 1999. Detection of single-base substitution in an esterase gene and its linkage to malathion resistance in the parasitoid *Anisopteromalus calandrae* (Hymenoptera: Pteromalidae). Pesticide Science 55: 398-404.

INSECTICIDE RESISTANCE

Baker, J.E., J.A. Fabrick, and K.Y. Zhu. 1998. Esterases and malathion carboxylesterase in resistant and susceptible strains of the parasitoid *Anisopteromalus calandrae*. Insect Biochemistry and Molecular Biology 28: 1039-1050.

Baker, J.E., Perez-Mendoza, J., Beeman, R.W., and Throne, J.E. 1998. Fitness of a Malathion-Resistant Strain of the Parasitoid Anisopteromalus calandrae (Hymenoptera: Pteromalidae). Journal of Economic Entomology. Vol. 91, No. 1, pp. 50-55.

PHYSIOLOGY

Ding, X., B. Gopalakrishnan, L.B. Johnson, F.F. White, X. Wang, T.D. Morgan, K.J. Kramer, and S. Muthukrishnan. 1998. Resistance to tobacco budworm feeding by transgenic plants expressing an insect chitinase gene. Transgenic Research 7: 77-84.

Howard ,R.H. 1998. Ontogenetic, reproductive, and nutritional effects on the cuticular hydrocarbons of the host-specific ectoparasitoid Cephalonomia tarsalis (Hymenoptera: Bethylidae). Annals of the Entomological Society of America. Vol. 91, No. 1, pp.101-112.

Huang, Xin, Xu, R., Hawley, M.D., Hopkins, T.L. and Kramer, K.J. 1998. Electrochemical oxidation of n-acyldopamines and regioselective reactions of their quinones with n-acetylcysteine and thiourea. Archives of Biochemistry & Biophysics, Vol. 352, No1, pp.19-30.

Oppert, B., and K.J. Kramer. 1998. Economical proteinase activity blot. American Biotechnology Lab 16: 20.

PUBLICATIONS LIST SUBMITTED BY T. PRUS, 1999.

4. Current bibliography:

Prus, T. 1998. Intrapopulation differentiation in black mutants of *Tribolium*. Pol. J. Ecol. , 46: 5-12 (ecology)

Prus, M. 1998. Response of stored product pest life strategy to chemical treatment: Effect of tricalcium phosphate (TCP) on *Tribolium* strains (*T. castaneum* Herbst and *T. confusum* Duval). Pol. J. Ecol., 46: 13-22 (ecology)

RESEARCH, TEACHING AND TECHNICAL NOTES

RAPD-Based Genetic Linkage Maps of *Tribolium castaneum*

Richard W. Beeman* **and Susan J. Brown†**

**Grain Marketing and Production Research Center, U.S. Department of Agriculture, Agricultural Research Service, Manhattan, Kansas 66502 and †Division of Biology, Kansas State University, Manhattan, Kansas 66506*

ABSTRACT

A genetic map of the red flour beetle (*Tribolium castaneum*) integrating molecular with morphological markers was constructed using a backcross population of 147 siblings. The map defines 10 linkage groups (LGs), presumably corresponding to the 10 chromosomes, and consists of 122 randomly amplified polymorphic DNA (RAPD) markers, six molecular markers representing identified genes, and five morphological markers. The total map length is 570 cM, giving an average marker resolution of 4.3 cM. The average physical distance per genetic distance was estimated at 350 kb/cM. A cluster of loci showing distorted segregation was detected on LG9. The process of converting RAPD markers to sequence-tagged site markers was initiated: 18 RAPD markers were cloned and sequenced, and single-strand conformational polymorphisms were identified for 4 of the 18. The map positions of all 4 coincided with those of the parent RAPD markers.

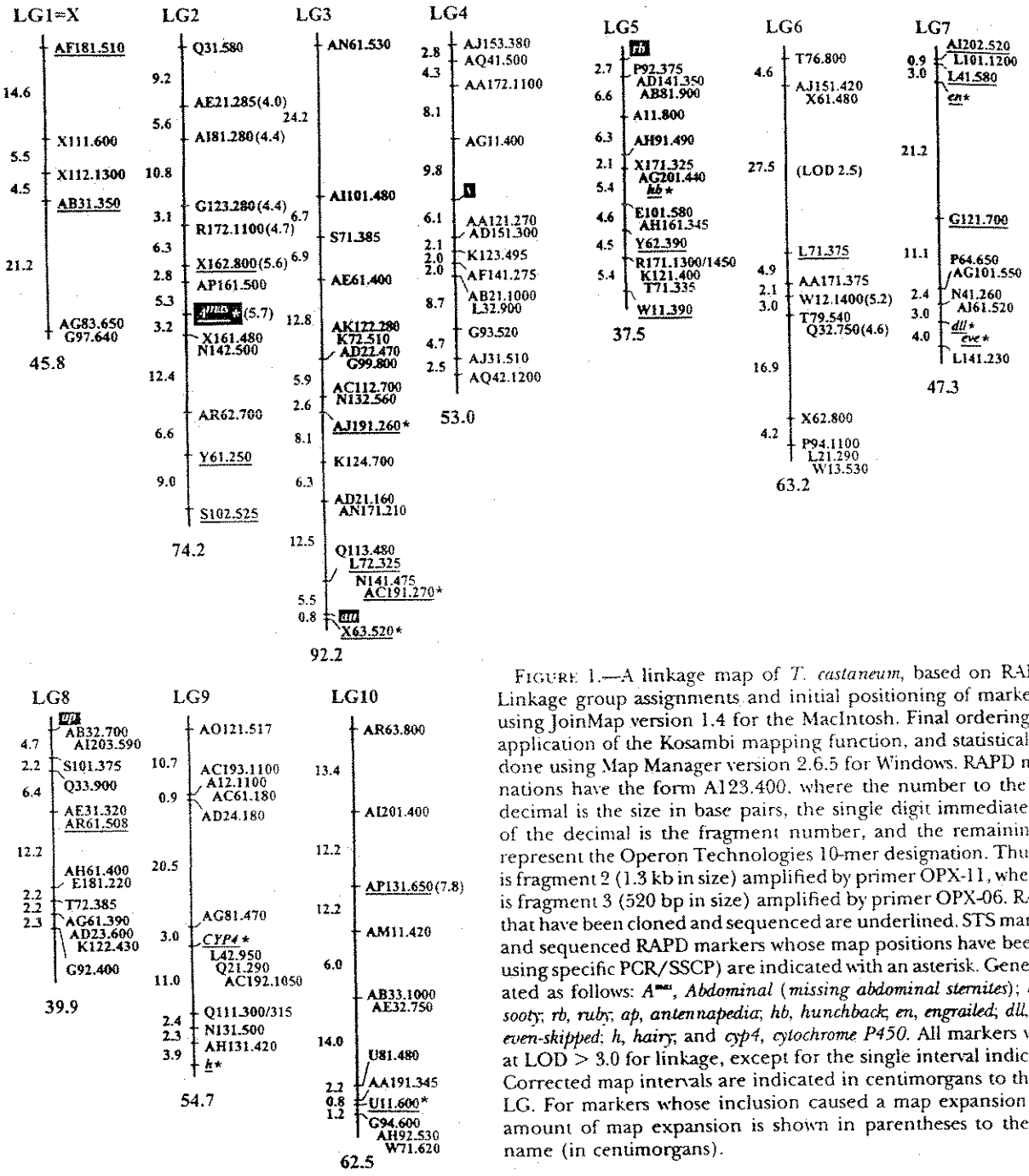


FIGURE 1.—A linkage map of *T. castaneum*, based on RAPD marker Linkage group assignments and initial positioning of markers was don using JoinMap version 1.4 for the MacIntosh. Final ordering of marker application of the Kosambi mapping function, and statistical analysis w done using Map Manager version 2.6.5 for Windows. RAPD marker des nations have the form A123.400, where the number to the right of t decimal is the size in base pairs, the single digit immediately to the l of the decimal is the fragment number, and the remaining characte represent the Operon Technologies 10-mer designation. Thus, X112.13 is fragment 2 (1.3 kb in size) amplified by primer OPX-11, whereas X63.5 is fragment 3 (520 bp in size) amplified by primer OPX-06. RAPD marke that have been cloned and sequenced are underlined. STS markers (clon and sequenced RAPD markers whose map positions have been confirm using specific PCR/SSCP) are indicated with an asterisk. Genes are abbre ated as follows: A^{mes}, *Abdominal* (*missing abdominal sternites*); *au, aureate; sooty; rb, ruby; ap, antennapedia; hb, hunchback; en, engrailed; dll, distalless; e even-skipped; h, hairy*; and *cyp4, cytochrome P450*. All markers were mapp at LOD > 3.0 for linkage, except for the single interval indicated on LC Corrected map intervals are indicated in centimorgans to the left of ea LG. For markers whose inclusion caused a map expansion of >4.0, t amount of map expansion is shown in parentheses to the right of t name (in centimorgans).

LITERATURE CITED

ALVAREZ-FUSTER, A., C. JUAN and E. PETITPIERRE, 1991 Genome size in *Tribolium* flour beetles: inter- and intraspecific variation. Genet. Res. **58:** 1–5.

ANTOLIN, M. F., C. F. BOSIO, J. COTTON, W. SWEENEY, M. R. STRAND *et al.*, 1996 Intensive linkage mapping in a wasp (Bracon hebetor) and a mosquito (Aedes aegypti) with single-strand conformation polymorphism analysis of random amplified polymorphic DNA markers. Genetics **143:** 1727–1738.

BEEMAN, R. W., and D. M. STAUTH, 1997 Rapid cloning of insect transposon insertion junctions using "universal" PCR. Insect Mol. Biol. **6:** 83–88.

BEEMAN, R. W., and J. J. STUART, 1990 A gene for lindane + cyclodiene resistance in the red flour beetle (Coleoptera: Tenebrionidae). J. Econ. Entomol. **83:** 1745–1751.

BEEMAN, R. W., J. J. STUART, R. E. DENELL, W. H. MCGAUGHEY and B. A. DOVER, 1992 *Tribolium* as a model insect for study of resistance mechanisms, pp. 202–208 in *Molecular Mechanisms of Insecticide Resistance—Diversity Among Insects*, edited by C. A. MULLIN and J. SCOTT. ACS Symposium Series 505, New York.

BEEMAN, R. W., J. J. STUART, M. S. HAAS and K. S. FRIESEN, 1996a Chromosome extraction and revision of linkage group 2 in *Tribolium castaneum*. J. Hered. **87:** 224–232.

BEEMAN, R. W., M. S. THOMSON, J. M. CLARK, M. A. DECAMILLIS, S. J. BROWN *et al.*, 1996b *Woot*, an active, *gypsy*-class retrotransposon in the flour beetle, *Tribolium castaneum*, is associated with a recent mutation. Genetics **143:** 417–426.

BLACK, W. C., IV, and N. M. DUTEAU, 1997 RAPD-PCR and SSCP analysis for insect population genetic studies, pp. 361–373 in *The Molecular Biology of Insect Disease Vectors: A Methods Manual*, edited by J. CRAMPTON, C. B. BEARD and C. LOUIS. Chapman & Hall Publishers, New York.

BROWN, S. J., J. K. HENRY, W. C. BLACK, IV and R. E. DENELL, 1990 Molecular genetic manipulation of the red flour beetle: genome organization and cloning of a ribosomal protein gene. Insect Biochem. **20:** 185–193.

BROWN, S. J., J. K. PARRISH, R. E. DENELL and R. W. BEEMAN, 1994 Genetic control of early embryogenesis in the red flour beetle, *Tribolium castaneum*. Am. Zool. **34:** 343–352.

CAI, D., M. KLEINE, S. KIFLE, H. J. HARLOFF, N. N. SANDAL *et al.*, 1997 Positional cloning of a gene for nematode resistance in sugar beet. Science **275:** 832–834.

HUNT, G. J., and R. E. PAGE, JR., 1995 Linkage map of the honey bee, *Apis mellifera*, based on RAPD markers. Genetics **139:** 1371–1382.

KESSELI, R. V., I. PARAN and R. W. MICHELMORE, 1994 Analysis of a detailed genetic linkage map of *Lactuca sativa* (lettuce) constructed from RFLP and RAPD markers. Genetics **136:** 1435–1446.

KNAPIK, E. W., A. GOODMAN, M. EKKER, M. CHEVRETTE, J. DELGADO *et al.*, 1998 A microsatellite genetic linkage map for zebrafish. Nat. Genet. **18:** 338–343.

LIVAK, K., 1984 Organization and mapping of a sequence on the *Drosophila melanogaster* X and Y chromosomes that is transcribed during spermatogenesis. Genetics **107:** 611–634.

ORITA, M., H. IWAHANA, H. KANAZAWA, K. HAYASHI and T. SEKIYA, 1989 Detection of polymorphisms of human DNA by gel electrophoresis as single-strand conformational polymorphisms. Proc. Natl. Acad. Sci. USA **86:** 2766–2770.

POSTLETHWAIT, J. H., S. L. JOHNSON, C. N. MIDSON, W. S. TALBOT, M. GATES *et al.*, 1994 A genetic linkage map for the Zebrafish. Science **264:** 699–703.

SEGRE, J. A., J. L. NEMHAUSER, B. A. TAYLOR, J. H. NADEAU and E. S. LANDER, 1995 Positional cloning of the nude locus: genetic, physical, and transcription maps of the region and mutations in the mouse and rat. Genomics **28:** 549–559.

SMITH, S. G., 1952 The cytology of some Tenebrionid beetles (Coleoptera). J. Morphol. **91:** 325–364.

SOKOLOFF, A., 1977 *The Biology of Tribolium*. Vol. III. Clarendon Press, Oxford.

STAM, P., 1993 Construction of integrated genetic linkage maps by means of a new computer package: JoinMap. Plant J. **5:** 739–744.

STEPHAN, W., and S. J. MITCHELL, 1992 Reduced levels of DNA polymorphism and fixed between-population differences in the centromeric region of *Drosophila ananassae*. Genetics **132:** 1039–1045.

STUART, J. J., and G. MOCELIN, 1995 Cytogenetics of chromosome rearrangements in *Tribolium castaneum*. Genome **38:** 673–680.

THOMSON, M. S., K. S. FRIESEN, R. E. DENELL and R. W. BEEMAN, 1995 A hybrid incompatibility factor in *Tribolium castaneum*. J. Hered. **86:** 6–11.

WILLIAMS, J. G., A. R. KUBELIK, K. J. LIVAK, J. A. RAFALSKI and S. V. TINGEY, 1990 DNA polymorphisms amplified by arbitrary primers are useful as genetic markers. Nucleic Acids Res. **18:** 6531–6535.

Communicating editor: G. A. CHURCHILL

Homeotic evidence for an appendicular labrum in *Tribolium castaneum*

M. Susan Haas and Richard W. Beeman
USDA Grain Marketing Research Laboratory
Biological Research Unit
Manhattan, Kansas USA

Introduction

The labrum has long been a subject of controversy and lively debate (Rempel, 1975). It has most often been considered a cuticular structure of the acron, though some have suggested that it is a segmental appendage.

We report the first arthropod mutation associated with a homeotic transformation of the labrum. In the gamma irradiation induced *Tribolium castaneum* mutant, *Antennagalea-5 (Ag^5)*, both antennal and labral structures are transformed to resemble gnathal appendages. Our results suggest that the labrum is a fused structure composed of two pairs of appendage endites and is serially homologous to the gnathal appendages.

Materials and Methods

Beetles were reared at 30° C on whole-wheat flour containing 5% (w/w) brewer's yeast. The *maxillopedia-Stumpy / Abdominal-Miscaudal sclerotization (mxp^{Stm}/A^{Mcsl})* balanced stock (Beeman et al, 1989) was used for the reversion mutagenesis. mxp^{Stm}/A^{Mcsl} males ca. 1 wk old were dosed with 4 kR of gamma irradiation (15 minute exposure), then divided into 5 groups of 285 each (1425 total) and held for 2 days at 30°C. 195 virgin *sooty (s)* females ca. 2 weeks old were then added to each of the five groups of males. Males were discarded after two days and females were allowed to oviposit for several weeks. F1 adults were screened for reversion (loss) of either of the dominant mutations mxp^{Stm} (homeotic transformation of antennae to maxillary palps) or A^{Mcsl} (homeotic transformation of ventral abdominal segment 8 to segment 7) and would be recognized by their wild-type phenotype. In the absence of genetic reversion, all progeny would carry either the mxp^{Stm} or the A^{Mcsl} mutation. In addition to revertants, new dominant mutations were also detected. These mutants were outcrossed to *Gal* to remove incidental mutations, with progeny crossed to the balancer chromosome *Abdominal-Extra sclerite (A^{Esl})* (Beeman et al., 1989) to establish balanced mutants stocks.

Specimens were prepared for laser confocal microscopy as follows: Frozen or 70% ethanol-preserved adult beetle heads were manually cleaned of debris or cleared in NaOH and rinsed, then blotted dry on tissue paper and mounted directly on double-stick tape on a 75 x 25-mm glass microscope slide. Mouthparts and antennae were dissected from cleared or uncleared specimens and mounted in Euparal (ASCO Laboratories) on a 75 x 25-mm glass microscope slide.

A Zeiss LSM400 laser confocal microscopy system was used to image most specimens. Optical sections ranged from 40 to 570 um and were recorded in the 4 line average mode with picture size of 512 X 512 pixels. Some specimens were imaged using a Spot Camera II (Diagnostics) digital camera on an Olympus SZH-10 stereoscope or an Olympus BX60 compound microscope. Images were archived and digitally processed using Corel Photo Paint, then arranged and labeled using Corel Draw.

Results and Conclusions

This reversion mutagenesis generated the new dominant mutant, *Antennagalea-5 (Ag^5)* on the mxp^{Stm} chromosome. In Ag^5, the distal antennal scape bears setae borne on a dorsal enlargement. The Ag^5 scape also has a membranous base rather than the normal sclerotized "knob".

Dominant modifications of the anterior region of the adult head capsule are also found. In Ag^5 heterozygotes, the anterior rim of the head is always indented at the epicranial arms due to the shortening of the clypeus, exposing portions of the dorsal labrum, mandibles and antennae normally covered by the anterior rim.

The labrum also undergoes grossly detectable morphological transformations in ~2.7 % of the beetles. Changes range from a midline longitudinal membranous strip and/or a slight elongation of the labrum to a striking transformation of both the labrum and clypeus into enlarged complex structures which can include a strongly sclerotized tooth-like tip (Figs. 2 & 3). The most strongly expressed tooth-like tips resemble the distal mandible. Palp-like structures have not been found in any transformed labrum examined thus far, suggesting that the wild-type labrum probably consists of the two endites only.

The apparent appendicular nature of the labrum raises a variety of interesting questions. The labrum has often been assumed to be a part of the acron. However, by definition, the acron is a structure that has no appendages. The labrum therefore must not be located on the acron, and likely represents a segment. Butt (1960) proposed that the labrum is the fused appendages of the intercalary segment. Matsuda (1960) pointed out that the existence of such an labro-intercalary segment would mean that "this segment would carry two pairs of appendages"; a complete pair from the labrum and another complete pair from the intercalary segment. By definition, each insect segment has only one pair of appendages (Manton, 1977; Kukalova-Peck, 1992). However, if the labrum is composed of endites only (galea and lacinia homologs) as our study proposes, and if the transitory appendages of the intercalary segment represent only the repressed palps (telopodites), then the sum of labral and intercalary appendages equals just one complete appendage pair. This configuration eliminates the basis of Matsuda's protest.

References

Beeman, R. W., Stuart, J. J., Haas, M. S., and Denell, R. E. 1989 Genetic analysis of the homeotic gene complex (HOM-C) in the beetle, *Tribolium castaneum*. Dev. Biol. 133:196-209

Butt, F. H. 1960 Head development in the arthropods. Biological Reviews, Vol. 35. Ed. H. Munro Fox, Cambridge at the University Press.

Kukalová-Peck, J. 1992. The "Uniramia" do not exist: the ground plan of Pterygota as revealed by Permian Diaphanoptera from Russia (Insecta: Paleodictyopteroidea). Can J Zool 70:236-255

Manton, S.M. 1977 The Arthropoda: habits, functional morphology, and evolution. Clarendon Press. Oxford.

Matsuda, R. 1965 Morphology and evolution of the insect head. The American Entomological Institute, Ann Arbor, Michigan

Rempel, J. G. 1975 The evolution of the insect head: The endless dispute. Quaestiones Entomologicae. 11:7-25

Snodgrass, R. E. 1960 Facts and theories Concerning the Insect Head. Smithsonian Miscellaneous Collections, Vol. 142, No. 1, pp.1-61

Figures

(Left and right arrows show labrum and clypeus)

Fig. 1
Wild-type head, lateral view

Fig. 2
Ag5 with transformed labrum

Fig. 3
Ag5, close-up of transformed labrum

Dose-mortality responses of the flour beetles to Triflumuron and Cyromazine

A.H.M. Kamaruzzaman, M.A. Mazid, S. Parween[1], K.A.M.S.H. Mondal[2] and W. Islam

Institute of Biological Sciences, Rajshahi University, Rajshahi 6205, Bangladesh.
[1] Department of Zoology, Rajshahi University, Rajshahi 6205, Bangladesh.
[2] Corresponding author.

1. Introduction

The red flour beetle, *Tribolium castaneum* Herbst and the confused flour beetle, *Tribolium confusum* DuVal are major pests of the stored food commodities throughout the world (Sokoloff, 1972). At present control of the stored-product insect pests by pathogens and parasitoids, botanicals and insect growth regulators are gaining importance over the conventional insecticides to avoid the presence of the chemical residue in the human food (Wilkin and Fishwick, 1981, Mondal, 1993) and incidence of insect resistance to insecticides (Dyte, 1974; Dyte and Blackman,1967,1970; Champ and Dyte, 1976; Metcalf, 1980; Georghiou and Mellon, 1983; Champ, 1986).

The insect growth regulators (IGRs) being non-persistent, biodegradable and more selective to the insect species than the conventional pesticides (Menn and Henrick, 1981), have attracted attention of the entomologists to use these compounds against the stored products insect pests. According to the mode of action, IGRs are categorized into three classes, viz., juvenile hormone analogues, chitin synthesis inhibitors and ecdysone agonists (Willis, 1974; Staal, 1975; Wing and Aller, 1990). As a whole the IGRs retard growth and development of the insects. Among these compounds the chitin synthesis inhibitors disturb or even abort moulting in the developing insects, and these insects either become crippled or die. The early larvae of several stored-product insects when exposed for a longer period to low doses of these compounds produced significant larval mortality, which is a cumulative toxic effect on different larval instars (Mian and Mulla, 1982; Ishaaya and Yablonski, 1987).At very low doses these compounds affected larval development and population growth in *T. castaneum* (Mondal and Port, 1995; Mondal *et al.*, 1998). However, toxicity of these compounds decreases with larval age when exposed for a shorter period (Carter, 1975; Mian and Mulla, 1982; Mayuravalli and Reddy, 1986).

In the present study toxicity of two chitin synthesis inhibitors viz. Triflumuron and Cyromazine against *T. castaneum* and *T. confusum* was determined.

2. Materials and Methods

2.1. **Insects used and culture:**

Species	Strain	Origin of Culture	Food media used	Rearing temperature^{0}C
T. castaneum	Normal	Institute of Biological Sciences, Rajshahi University, Bangladesh.	Whole wheat flour and Brewers yeast (19:1)	30
	FSS II	Slough Laboratory, UK		
	CTC 12	Slough Laboratory, UK		
T. confusum		Institute of Biological Sciences, Rajshahi University, Bangladesh.		

2.2. **IGRs used:**

Chemical name	Common name	Code name	Company	Formulation
Triflumuron	Baycidal/Alsystin	BAY SIR 8415	Bayer AG	25% WP
Cyromazine	Larvadex/Trigard/ Vetetazine	CGA 72 662	Ciba Geigy	98% WP

2.3. **Preparation of doses:** Different doses of the test compounds were made by adding appropriate weight of each compound with the standard food medium and mixing them thoroghly with an electrical blender.

2.4. **Screening of doses:** A preliminary screening of the doses of each compound was performed on different larval instars, neonates and adults, exposed for different period (section 2.5) to determine 0% and 100% mortality. Then a series of five doses were chosen for each larval instar and adult stage of the beetles.

2.5. **Exposure period:** Different stages of the beetles were exposed to the treatment for following period:
(i) Larvae from first to sixth instars (Mondal, 1984), of both species were exposed to different doses of both compounds for 48 hours.
(ii) Newly hatched larvae (neonates) of both species were exposed to the treatment up to pupation.
(iii) Newly emerged adults were exposed to the treated food separately. The adults were exposed for 10 and 20 days to triflumuron and cyromazine treated food respectively.

2.6. **Methodology:** Individuals of each larval instar, neonates, sexed and unsexed adults were kept in separate flat bottom glass vial (50x25 mm) containing approximately 0.5g of either treated or untreated food. The top of the vial was plugged with cotton.

2.7. **Replication:**
(i) Fifty individuals of each larval instar, neonates and adults of FSS II and CTC 12 strains of *T. castaneum* were exposed to either untreated or triflumuron treated food. The experiments were replicated five times.

(ii) Forty individuals of each larval instars and neonates of normal laboratory strains of *T. castaneum* were exposed to either untreated or cyromazine treated food. Twenty adults were used in similar way. All the experiments were replicated five times.
(iii) Thirty individuals of each larval instars, neonates and adults were exposed either to triflumuron treated or untreated food. The experiments were replicated five times.
(vi)Forty individuals of each larval instars and neonates of normal laboratory strains of *T. confusum* were exposed to either untreated or cyromazine treated food. Twenty adults were used in similar way. All the experiments were replicated five times.

2.8. **Analysis of data:** The percentage mortality data were subjected to statistical analysis (Busvine, 1971) and the dose-mortality response was expressed as a mediam lethal dose (LD_{50}). The percentage mortality obtained was corrected using Abbott's formula (Abbott, 1925) wherever necessary.

3. Results

3.1. **Larvae:** Older larvae of both *T. castaneum* and *T. confusum* showed tolerance to triflumuron treated food at 48 hours exposer (Table 1). The first instar larvae of FSS II and CTC 12 strains of *T. castaneum* and the second instar larvae of *T. confusum* were found to be more susceptible to triflumuron. CTC 12 strain of *T. castaneum* was more tolerant to triflumuron than FSS II strain. Both strains of *T. castaneum* were found to be more tolerant to the compound compared to *T. confusum*.
Tolerance to cyromazine increased with the larval age of both species of the beetle (Table 2). The second instar larvae were most susceptible to cyromazine. *T. confusum* larvae showed more tolerance to the compound than *T. castaneum* larvae.

3.2. **Neonates:** In long exposer the LD_{50} for both species of the beetles was very low in triflumuron treated food, and comparatively higher doses of cyromazine were required to obtain the LD_{50} level (Table 3). *T. confusum* larvae were found to be tolerant to both compounds than *T. castaneum* larvae at long exposer.

3.3. **Adults:** The males of both species were found to be more susceptible to both compounds than the females. Adult CTC 12 beetles were more tolerant to triflumuron than adult FSS II beetles. *T. confusum* adults were found to be more resistant than *T. castaneum* adults in both treatments (Table 4).

4. Discussion

Chitin synthsis inhibitors (CSIs) act against the larval stage of insects, which usually fail to survive due to incomplete moulting or disrupted cuticle formation (Fox, 1990). Both triflumuron and cyromazine are stomach toxicants, and need the larvae to feed on the treated food. If the larvae feed on these compounds at the beginning of instar, the lethal effect appears during any of the next moults (Hammann and Sirrenberg, 1980; Zoebelein *et al.*, 1980). Hence at short exposer period higher doses of these compounds are needed for the toxic effect compared to the dose required at longer exposer. Similar results were reported by Ishaaya *et al.* (1984) and Ishaaya and Yablonski (1987) when *T. confusum* larvae were treated with other CSI compounds. Young larvae are normally susceptible to CSI treatments (Mian and Mulla, 1982). Susceptibility of the second instar larvae of the laboratory strains of both species as obtained in the present study, might be due to the voracious nature of these larvae than the younger ones. The older larvae generally show tolerance to CSI compounds (Neal, 1974; Rathburn and Boike, 1975; Busvine *et al.*, 1976;

Hammann and Sirrenberg, 1980, Retnakaran and Wright, 1987; Natarajan *et al.*, 1988; DeMark and Bennett, 1989), possibly due to their better ability to metabolize these compounds (Neumann and Guyer, 1987; Clarke and Jewess, 1990).

By virtue of mode of action, CSI compounds would not be lethal to the adults (Grosscurt and Jongsma, 1987). In the present study at higher doses of the compounds and long exposer adult mortality was observed in both species. In adults CSI compounds very often disrupt the gut and associated organs (Clarke *et al.*, 1977; Becker, 1978,1980; Mitsui *et al.*, 1984; Soltani, 1984, Pelsue, 1985 and Parween, 1997), resulting digestive disorders (Ishaaya and Ascher, 1977), starvation and ultimate death (Soltani, 1984; Neumann and Guyer, 1988). Moreover, triflumuron treated food disrupted the reproductive systems in both sexes of adult *T. castaneum* (Parween, 1996). All these effects might have resulted in the lethal effects in adults, those fed on triflumuron or cyromazine treated food in the present experiment.

5. Conclusion

Both Triflumuron and Cyromazine can control the flour beetles effectively at low doses if the young larvae are allowed to feed on treated food for whole larval life. A short treatment to either the larvae or to the adults would not be effectively toxic and will need very high dose. The confused flour beetles were found to be slightly tolerant to the CSI treatment. However, the multi-resistant strain (CTC 12) of *T. castaneum* was found to be slightly tolerant to triflumuron than the susceptible strain (FSS II) (Table 5). The present result indicates that both Triflumuron and Cyromazine may be used in the management of *Tribolium* which is important from both the Integrated Pest Management (IPM) and Global Environment Protection (GEP) point of views.

Acknowledgements: Selina Parween is grateful the Department of Agricultural and Environmental Science, University of Newcastle upon Tyne, UK, for laboratory facilities, The British Council for financial assistance and Rajshahi University, Bangladesh for granting study leave. Financial support to both A.H.M. Kamaruzzaman and M.A. Mazid by the Institute of Biological Sciences, Rajshahi University, Bangladesh is also gratefully acknowledged.

References

Abbott, W. S. (1925) A method of computing effectiveness of an insecticide. *J. Econ. Entomol.*, **18**,265-267.

Becker, B. (1978) Effects of 20-hydroxyecdysone, juvenile hormone, dimilin and captan on *in vitro* synthesis of peritrophic membranes in *Calliphora erythrocephala*. *J. Econ. Entomol.*, **24**,699-705.

Becker, B. (1980) Effect of Polyoxin -D on *in vitro* synthesis of peritrophic membranes in *Calliphora erythrocephala*. *Insect Biochem.*, **10**,101-106.

Busvine, J.R. (1971) *Critical review of the techniques for testing insecticides.* Commonwealth Agricultural Bureaux (CAB), UK.

Busvine, J.R., Rongsriyam, Y. and Bruno, D. (1976) Effects of some insect development inhibitors on mosquito larvae. *Pestic. Sci.*, **7**,153-160.

Carter, S.W. (1975) Laboratory evaluation of three novel insecticides inhibiting cuticle formation against some susceptible and resistant stored products beetles. *J. Stored Prod. Res.*, **11**,187-193.

Champ, B.R. (1986) Occurence of resistance to insecticides in grain storage pests. In: *Pesticides and Humid Tropical Grain Storage Systems* (B.R. Champ and E. Highley eds.),pp.229-255. Australian Centre for International Agricultural Research, Canberra.

Champ, B.R. and Dyte, C.E. (1976) *Report of the F.A.O. Global survey of Pesticide Susceptibility of Stored Grain Pests. F.A.O. Plant Products Protection Series* No.5, 297pp.

Clarke, B.S. and Jewess, P.J. (1990) The uptake, excretion and metabolism of the acylurea insecticide, flufenoxuron in *Spodoptera littoralis* larvae, by feeding and topical application. *Pestic. Sci.*, **28**,357-365.

Clarke, L., Temple, G.H.R. and Vincent, J.F.V. (1977) The effects of a chitin inhibitor-dimilin on the production of peritrophic membrane in the locust, *Locusta migratoria. J. Insect Physiol.*, **23**,241-246.

DeMark, J.J. and Bennett, G.W. (1989) Efficacy of chitin synthesis inhibitors on nymphal German cockroaches (Dictyoptera:Blattellidae). *J. Econ. Entomol.*, **82**(6), 1633-1637.

Dyte, C.E. (1974) Problems arising from insecticide resistance in storage pests. *EPPO Bull.*, **4**,275-289.

Dyte, C.E. and Blackman, D.G. (1967) Selection of a DDT-resistant strain of *Tribolium castaneum* (Herbst) (Coleoptera:Tenebrionidae). *J.Stored Prod. Res.*, **2**,211-228.

Dyte, C.E. and Blackman, D.G. (1970) The spread of insecticide resistance in *Tribolium castaneum* (Herbst) (Coleoptera:Tenebrionidae). *J.Stored Prod. Res.*, **6**,225-261.

Fox, P. (1990) *Insect Growth regulators*. PJB Publ. Ltd. Richmond, UK.102pp.

Georghiou, G.P. and Mellon, R.B. (1983) Pesticide resistance in time and space. In: *Pest Resistance to Pesticides* (G.P. Georghiou and T. Sairo eds.),pp.1-46, Plenum Press, New York.

Grosscurt, A.C. and Jongsma, B. (1987) Mode of action and insecticidal properties of diflurobenzuron. In: *Chitin and Benzoylphenylureas* (J.E. Wright and A. Retnakaran eds.),pp.75-99.Dr. W. Junk Publ. The Netherlands.

Hammann, I. and Sirrenberg, W. (1980) Laboratory evaluation of SIR 8514, a new chitin synthesis inhibitor of the benzoylated urea class. *Pflazenschutz Nachrichten Bayer* **33**(1),1-34.

Ishaaya, I. and Ascher, K.R.S. (1977) Effect of diflurobenzuron on growth and carbohydrate hydrolases of *Tribolium castaneum*. *Phytoparasitica* **5**,149-158.

Ishaaya, I. and Yablonski, S. (1987)Toxicity of two benzoylphenyl ureas against insecticide resistant mealworms. In: *Chitin and Benzoylphenylureas* (J.E. Wright and A. Retnakaran eds.), pp.133-140. Dr. W. Junk Publ. The Netherlands.

Ishaaya, I., Nemny, N. E. and Ascher, K.R.S. (1984) The effect of IKI-7899, a new chitin synthesis inhibitor, on larvae of *Tribolium castaneum* and *Spodoptera littoralis*. *Phytoparasitica* **12**(3-4),193-197.

Mayuravalli, V.V.L. and Reddy, G.P.V. (1986) Bioefficacy of the chitin inhibitor SIR 8514 against the rice moth *Corcyra cephalonica* Staint. *Entomol.*, **11**(2-3),183-186.

Menn, J.J. and Henrick, C.A. (1981) Juvenoids: Bioactivity and prospects for insect management. In: *Regulation for Insect Development and Behaviour* (M. Kloza ed.), pp. 735-748. Wroclaw Technical University Press, Poland.

Metcalf, R.L.(1980) Changing role of insecticides in crop protection. *Ann. Rev. Entomol.*, **25**,219-256.

Mian, L.S. and Mulla, M.S. (1982) Biological activity of IGRs against four stored product coleopterans. *J. Econ. Entomol.*, **75**,80-85.

Mitsui, T., Nobusawa, C. and Fukami, J.I. (1984) Mode of inhibition of chitin synthesis by diflubenzuron in the cabbage army worm, *Mamestra brassicae* L. *J. Pestic. Sci.*, **9**, 19-26.

Mondal, K.A.M.S.H. (1984) A method of determining the larval instars of *Tribolium castaneum* Herbst. *International Pest Control* **26**(4),98-99.

Mondal, K.A.M.S.H. (1993) Flour beetles Tribolium spp. (Coleoptera:Tenebrionidae) as pests and their control. *Agricultural Zoology Reviews* **6**,95-119.

Mondal, K.A.M.S.H. and Port, G.R. (1995) Effects of cyromazine on larval growth and adult population of susceptible and malathion-resistant striains of *Tribolium castaneum* Herbst. *J. bio. sci., Rajshahi Univ.*, **3**,1-10.

Mondal, K.A.M.S.H., Parween, S., Reichmuth, Ch. and Akhtar, N. (1998) Effect of triflumuron on the development of the red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera:Tenebrionidae). *Presented in the 7th International Working Conference on Stored Product Protection*, Beijing, China 14-17 Oct. 1998.

Natarajan, V., Kumaraswami, T. and Balasubramoniam, M. (1988) Ovicidal and larvicidal effects of moult inhibitor (Bay SIR 8514) on *Spodoptera litura* F. *Entomon.*, **13**(2), 193-194.

Neal, J.W. (1974) Alfalfa weevil control with the unique growth disrupter TH 6040 in small plot tests. *J. Econ. Entomol.*, **67**,300-301.

Neumann, R. and Guyer, W. (1987) Biochemical and toxicological differences in mode of action of the benzoylureas. *Pestic. Sci.*, **20**,147-156

Neumann, R. and Guyer, W. (1988) A new chitin synthesis inhibitor CGA 112 113: its biochemical mode of action as compared to diflurobenzuron. *Proc. 10th Int. Congr. Plant Protection, Brighton*, pp.445-451.

Parween, S. (1996) *The effect of Triflumuron on malathion-susceptible (FSS II) and malathion-resistant (CTC 12) strains of Tribolium castaneum Herbst.* Ph.D. thesis, University of Newcastle upon Tyne, U.K. 229pp.

Parween, S. (1997) Effect of Triflumuron on the adult midgut of *Tribolium castaneum* Herbst (Coleoptera:Tenebrionidae). *Univ. J.Zool. Rajshahi University* **16**,11-18.

Pelsue, F.W. 1985. Histopathological effects of two insect chitin inhibitors in the alimentary canal of chironomid midges (Diptera:Chironomidae). *Bull. Soc. Vector Ecol.*, **10**(2),72-89.

Rathburn, C.B. and Boike, A.H. (1975) Laboratory and small scale field tests of altosid and dimilin for the control of *Aedes taeniorhynchus* and *Culex nigripalpus* larvae. *Mosq. News* **35**,540-546.

Retnakaran, A. and Wright, J.E. (1987) Control of insect pests with benzoylphenyl ureas. In: *Chitin and Benzoylphenylureas* (J.E. Wright and A. Retnakaran eds.), pp.205-282. Dr. W. Junk Publ., Dordrecht, The Netherlands.

Sokoloff, A. (1972) *The Biology of Tribolium.* **Vol.1**,300pp. Oxford University Press.

Soltani, N. (1984) Effects of ingested diflubenzuron on the longevity and the peritrophic membrane of adult mealworms (*Tenebrio molitor* L.). *Pestic. Sci.*, **15**,221-225.

Staal, G.B. (1975) Insect growth regulators with juvenile hormone activity. *Ann. Rev. Entomol.*, **20**,417-460.

Wilkin, D.R. and Fishwich, F.B. (1981) Residues of the organophosphorous pesticides in wholemeal flour and bread produced from treated wheat. *Proc. British Crop Prot. Conf. Pests and Diseases, 1981*, **1**,183-187.

Willis, J.H. (1974) Morphogenetic action of insect hormones. *Annual Rev. Entomol.*, **19**, 97-115.

Wing, H.D. and Aller, H.E. (1990) Ecdysteroid agonists as novel insect growth regulators. In: *Pesticides and Alternatives* (J.E. Casida ed.),pp.251-257, Elsivier Science Publishers B.V., Amsterdam, Oxford, New York.

Zoebelein, G., Hammann, I. and Sirrenberg, W. (1980) BAY SIR 8514, a new chitin synthesis inhibitor. *Z. angew. Entomol.*, **98**, 289-297.

Table 1. Dose-mortality responses of larvae of FSS II and CTC 12 strains of *T. castaneum* and normal *T. confusum* exposed to triflumuron for 48 hours.

Species & strain	Larval Instar	LD_{50} (ppm)	95% confidence limit (ppm) upper	lower	Slope	$\chi 2$ value (DF)
T. castaneum						
FSS II	1st	68.15	88.03	52.76	3.04	48.78(3)
	2nd	6263.19	7566.68	5184.26	4.83	67.79(3)
	3rd	7792.67	8697.50	6981.96	6.03	30.59(3)
	4th	16078.03	20337.82	12710.47	3.86	76.08(3)
	5th	20054.55	22082.83	18213.00	6.08	28.78(3)
	6th	28069.00	29572.19	266625.37	11.15	15.24(2)
CTC 12	1st	1596.34	1817.79	1401.86	6.31	55.49(3)
	2nd	6830.88	8434.25	5532.32	3.32	46.19(3)
	3rd	17672.16	19644.85	15897.57	8.66	70.28(3)
	4th	18126.26	19444.58	16897.33	10.75	44.99(3)
	5th	22255.09	23882.76	20738.31	11.63	25.07(2)
	6th	45966.42	50883.58	41524.41	8.03	45.24(3)
T. confusum	1st	10.98	12032.29	10026.88	2.32	2.007(3)
	2nd	357.04	388.29	323.29	2.27	6.707(3)
	3rd	5116.37	5547.43	4718.81	2.42	3.31(3)
	4th	8770.19	9983.91	7704.02	3.18	13.115(3)
	5th	11863.74	12901.00	10909.88	2.28	5.37(3)
	6th	15769.14	17926.11	13871.71	2.66	8.95(3)

Table 2. Dose-mortality responses of larvae of normal strains of *T. castaneum* and *T. confusum* exposed to cyromazine for 48 hours.

Species	Larval Instar	LD_{50} (ppm)	95% confidence limit upper	lower	Slope	$\chi 2$ value (DF)
T. castaneum						
	1st	27202.60	32108.70	23046.12	2.87	17.81(3)
	2nd	483.68	545.04	429.23	1.61	0.54(3)
	3rd	3848.40	4313.20	3433.69	1.72	1.04(3)
	4th	8129.59	8129.59	9945.19	1.86	10.65(3)
	5th	18038.37	18038.37	16214.90	1.83	3.78(3)
	6th	39528.56	39528.56	44901.33	3.02	11.41(3)
T. confusum	1st	27553.02	32679.44	23230.79	2.89	19.38(3)
	2nd	500.79	563.58	445.01	1.63	0.41(3)
	3rd	4171.61	4673.95	3723.25	1.73	0.40(3)
	4th	8684.01	10505.24	7178.53	1.89	9.66(3)
	5th	18376.46	20563.97	16421.64	1.73	5.50(3)
	6th	39799.99	42510.89	37261.99	2.99	6.08(3)

Table 3. Dose-mortality responses of neonates of *T. castaneum* and *T. confusum* exposed to triflumuron and cyromazine up to pupation

Species & strain	Compound	LD_{50} (ppm)	95% confidence limit (ppm) upper	lower	Slope	$\chi 2$ value (DF)
T. castaneum	Triflumuron					
FSS II		1.81×10^{-5}	5.24×10^{-5}	6.26×10^{-5}	1.12	73.68(2)
CTC 12		1.54×10^{-4}	3.36×10^{-4}	7.11×10^{-5}	0.79	28.94(3)
T. confusum		0.153	0.137	0.17	3.76	11.62(3)
T. castaneum	Cyromazine	152.86	177.63	131.55	1.97	4.48(3)
T. confusum		168.98	196.37	145.41	1.92	2.83(3)

Table 4. Dose-mortality responses of adults of *T. castaneum* and *T. confusum* exposed to triflumuron and cyromazine for 10 and 20 days respectively.

Species & strain	Sex	LD_{50} (ppm)	95% confidence limit (ppm) upper	lower	Slope	$\chi 2$ value (DF)
Triflumuron						
T. castaneum						
FSS II	Male	12643.77	13620.66	11736.92	7.93	24.11(3)
	Female	12833.97	13782.86	11950.42	6.47	21.37(3)
	Unsexed	12080.44	13579.90	10746.55	5.95	39.39(3)
CTC 12	Male	15470.18	17215.39	13901.87	6.89	33.59(3)
	Female	17888.70	18944.68	16891.57	5.78	18.78(3)
	Unsexed	15386.49	17396.23	13608.93	5.43	31.69(3)
T. confusum	Male	21956.70	23824.74	20235.12	3.51	7.34(3)
	Female	23232.45	25260.13	21367.52	3.35	3.50(3)
	Unsexed	20566.12	23701.46	17845.54	3.56	9.17(3)
Cyromzine						
T. castaneum	Male	56197.17	65471.70	47870.85	2.79	8.09(3)
	Female	57580.57	68388.15	48480.89	2.81	9.30(3)
	Unsexed	55947.23	66680.83	46941.42	2.76	9.53(3)
T. confusum	Male	58426.82	64112.92	53245.03	2.97	6.25(3)
	Female	59449.07	65493.08	53962.85	2.83	6.04(3)
	Unsexed	56645.43	66806.22	48030.03	2.77	8.44(3)

Table 5: Resistance of the larvae and adults of the resistant CTC-12 strain of *T. castaneum* to triflumuron

Life stage	Exposure period	LD50 values FSS II	LD50 values CTC-12	E.R.F.*
Larva				
1st instar	48 hrs	68.15	1596.34	23.42
2nd "	"	6263.197	6830.88	1.09
3rd "	"	7792.67	17672.16	2.27
4th "	"	16078.03	18126.26	1.13
5th "	"	20054.55	22255.09	1.11
6th "	"	28069.00	45966.42	1.64
Adult				
Male	10 days	12643.77	15470.18	1.22
Female	"	12833.97	17888.70	1.39
Unsexed	"	12080.44	15386.49	1.27
Neonate	16 days	2.28^{-06}	2.85^{-05}	12.50

* Estimated Resistant Factor = $\frac{\text{LD50 for resistant strain}}{\text{LD50 for susceptible strain}}$

STABILIZATION OF RICE BRAN BY PHYSICO-CHEMICAL TREATMENTS DURING INSECT INFESTATION

M. A. Malek[1], B. Parveen[1] and K.C.Dey[2]
1. BCSIR Laboratories Dhaka, Dhaka-1205, Bangladesh
2. BCSIR Laboratories Rajshahi, Rajshahi-6206, Bangladesh

Summary
Rice bran contain 16-20% oil. The present study shows that the chemical and heat treatments significantly ($P<0.001$) reduced the insect infestation of rice bran by *Tribolium castaneum* Herbst and *Tribolium confusum* Duval compared to control. The process based on the principle that lipase activity will be low at low p^H of hydrochloric acid at 40 litre / ton of bran for lowering the p^H of rice bran from 6.0 to 4.0. This simple method which takes less than 4 minutes for a batch of 15kg will be useful for stabilization of rice bran in rice mills where steam or electricity is unavailable.

INTRODUCTION
The bran is the most important by-product of the rice milling industry and is valued as a cattle feed, it also yields an edible oil. It comparises the germ, the pericarp and aleurone layer and is often found mixed with varying quantities of husk. The bran contains up to 25% oil used for edible and other purposes. The oil is extracted in large quantities in Japan and to a lesser extent in the USA. In India rice bran oil industry has made rapid strides during the recent years. Rice bran is as good an edible oil as refined ground nut and cotton seed oil and has better keeping qualities due to the presence of antioxidants (α and γ tocopherols).It is suitable for use as a salad and cooking oil and in the preparation of shortenings and vanaspati (hydrogenated oil). Rice bran oil is reported to prevent cancer in the liver of rats. The bran should be extracted soon after it is milled, other wise it deteriorates quickly; an extremely active lipase begins to act as soon as the bran is removed from rice and caused free fatty acid in the oil to increase rapidly at the rate of 1% per hour during the first few hours of the storage of the bran. Heating of the bran immediately after it is milled at about 100°C for a period of 2 hours is found to inactivate the lypolytic enzyme system and increase the storage life of the bran considerably (Anon, 1966). Several problems of raw bran management have restricted production of edible grade rice bran oil. One of the problem is high lipase activity in the bran which quickly hydrolyzes the oil into fatty acids. Another problem for storing the rice bran is high insect infestation in the stores. These two problems are need to be solved by adapting the methods of stabilization of rice bran which is described in the present experiment. Rice bran has considerable potential as a contributor to world oil supply.

MATERIALS AND METHODS
Freshly milled raw rice bran, containing an average of 15% oil was obtained from a local rice mill. Commercial hydrochloric acid (28-30%) was used for acid treatment.

Acid treatment: Rice bran was spread in a layer of about 5 cm thick and the required amount of hydrochloric acid was sprayed on and mixed well by hand using protective gloves.

Heat treatment: 5kg bran of IRRI-8 was heated in an oven at temperature 105°C for 3 hours to prevent the lipase activity during storage.

Analytical Method: Oil content of rice bran with free fatty acid (FFA) content of extracted oil were determined at every 10 days interval by using AOCS (American Oil Chemical Society) method (Anon, 1973). The pH of bran was determined at every 10 days intervals with an aqueous suspension of the bran (10g/100ml) using an Ellico pH meter.

Insect infestation study: 100 gm of rice bran from acid and heat treatments were kept individually in a gunny bag with40 adults of *Tribolium castaneum* Herbst and *Tribolium confusum* Duval. 100gm of fresh rice bran with same number of the two species of *Tribolium* was kept individual in a gunny bag and this was considered as control. Six replications were taken for each treatment. After every 30 days the total number of larvae of each species from each treatment was removed by sieving the bran. This was continued up to 3 months at room temperature. All the gunny bags were placed in a wooden tray and covered by steel frame against rodent damage.

RESULTS AND DISCUSSION

Rice bran lipase is known to have a pH optimum of 7.5-8.0 (Sastry, 1973) with activity declined with either an increase or decrease in pH. The pH of rice bran had to be lowered to 4.0 to achieve a commercially acceptable low level of enzyme activity. The pH of commercial bran varies from 6.0 to 6.9 and about 4 ml of hydrochloric acid (28-30% strength) was required for 100g of rice bran (or 40 litre/ton of bran) to lower the pH to 4.0. In all the experiments on acid stabilization of rice bran, a minimum of 40ml of hydrochloric acid per kg of bran was used. The efficacy of hand mixing of hydrochloric acid with rice bran in controlling its lipase activity as measured by increasing in the free fatty acid (FFA) content of the bran oil (Table-2). FFA content of oil from untreated raw bran increased rapidly to 52.7 after 90 days of storage but the increase was much slower from 2.8 to 9.3 after 90 days storage in the hydrochloric acid treated bran. The observed increase in FFA from 2.8 to 9.3% probably resulted from non uniformity in distribution of hydrochloric acid in the bran mass with some pockets of bran remaining at higher pH. This was evident from variations of up to one pH unit among different portions of the treated bran. Increasing the quantity of hydrochloric acid from 40mg/kg to 50ml/kg of bran did not further improve (FFA increase from 3.0 to 7.4 in 90 days) the efficacy of the process. Acid stabilized bran was not easily infested. In the present experiment 40 adults insects of *T. castaneum* and *T. confusum* were individually introduced into acid stabilized, heat stabilized and untreated bran (100gm each). Rapid proliferational of *T. castaneum* and *T. confusum* were observed within a month in heat stabilized (803 and 476 larvae respectively) and untreated (833 and 525 larvae respectively). The bran turned dark and moldy after about two months. The acid treated bran on the other hand had only 144 and 104 larvae of *T. castaneum* and *T. confusum* respectively and showed no viable mold growth after three months of storage. It is concluded from this experiment that the occurrence of the larvae of *T.castaneum* and *T. confusum* was highly significant in both the treatments on individual month basis except in case of occurrence of *T. confusum* in first month (Table-1). Acid stabilization appears to facilitate extraction of the crude oil.

Feed quality of bran does not appear to be affected by the acid treatment. Prabhakar and Venkatosh (1986) assessed the feed quality of acid stabilized bran for poultry, using 264 layers over a period of one year at 20, 30 and 40% levels of bran in the composite diet. They found no statistically significant difference among acid stabilized, heat stabilized and untreated bran with regard to feed consumption, egg weight, albumin and yolk indices, shell thickness and Haugh units. However, at all three levels of bran in the diet, the layers fed acid stabilized bran always recorded less feed consumption per egg (137.69g/egg) compared to heat stabilized (168.0g/egg) or untreated (150.0g/egg) bran. Also the number of hen house eggs was always higher for the acid stabilized bran fed group (6410 in 13 weeks, mean wt 58.8±0.95) or compared to heat stabilized 6167, mean wt 58.8±0.95) or untreated (6109, mean wt 57.6±6.95) bran. This simple chemical method for stabilization of rice bran might provide an answer to the problems of handling raw bran in developing countries (like Bangladesh) with numerous small rice mills which lack adequate steam and electricity and where stabilization of rice bran using heat is expensive.

ACKNOWLEDGMENTS

The authors greatly acknowledge the facilities provided by the Director BCSIR Laboratories Rajshahi Thanks are also extended to Dr. Golbar Hossian CSO of this Laboratories for supplying rice bran samples and for his suggestions about the experiments.

REFERENCES

Anon. 1966. The Wealth of India (Raw Materials) Publications and Information Directorate, CSIR New Delhi India 1st Edition. **Vol.7** pp.330

Anon. 1973. AOCS Official and Tentative Method, American Oil Chemist's Society 3rd Edition AOCS Champaign Series No. **11** pp. 150

Prabhakar, J. V. and Venkatosh, K.V.L. 1986. A simple chemical method for stabilization of rice bran. *J. Ameri. Oil. Chem. Soc.* **63(5)** : 644-646

Sastry, B. S. 1973. Enzyme in rice bran, Ph.D. Thesis, University of Mysore, Mysore, India. pp.275

Table 1. Effect of heat and acid treatments to the rice bran on the occurrence of the larvae of *Tribolium castaneum* Herbst and *Tribolium confusum* Duval.

No. of observations (month)	Number of Larvae							
	T. castaneum				*T. confusum*			
	Acid treatment Mean± S. E.	Heat treatment Mean± S. E.	Normal Mean ± S. E.	F-values	Acid treatment Mean ± S. E.	Heat treatment Mean ± S. E.	Normal Mean ± S. E.	F-values
1st	2.66± 0.494	38.0 ± 5.2599	30.30 ± 3.480	25.89***	3.33 ± 0.6146	9.833 ± 2.340	10.50 ± 3.939	2.19 9N.S.
2nd	34.66 ± 3.480	189.50 ± 20.408	223.0 ± 13.214	50.26***	23.00 ± 2.394	124.66 ± 14.79	103.83± 12.53	28.8 3***
3rd	34.833 ± 4.04	173.833± 13.99	163.33 ± 19.08	31.17***	25.66 ± 2.836	103.66 ± 5.469	148.0 ± 6.93	133.9 7***

N.S. = Not significant
*** = Highly significant (P.0.001)

Table. 2 Efficacy of hand mixing of hydrochloric acid for stabilization of rice bran.

Period (days)	Normal		Treated with HCL 40ml/kg bran	
	pH	FFA Oleic acid/100g oil	pH	FFA Oleic acid/ 100g oil
0	6.99	2.3	3.9	2.8
10	6.80	15.5	4.0	3.0
20	6.70	17.5	4.1	3.5
30	6.6	27.4	4.3	4.2
40	6.4	35.0	4.3	4.5
50	6.3	47.5	4.2	4.7
60	6.2	49.0	4.3	5.3
70	6.1	50.5	4.2	6.3
80	6.1	57.5	4.1	8.3
90	6.0	52.7	4.1	9.3

Alexander Sokoloff. Biology Department, California State University, San Bernardino, California, 92407.

*Tribolium brevicornis—a review.

Tribolium brevicornis is a species of Tribolium first reported by John LeConte (1865, 1866) from the vicinity of Fort Tejon, California. Originally it was named Aphanotus brevicornis, but Hinton (1948) in his revision of the genus included it in the genus Tribolium.

Davidson (1893) and Nininger (1916) recorded the beetles in the nests of Xylocopa, and Hicks (1929) from nests of another bee, Anthidium mormonum fragariellum. Linsley, (1943, 1944) found that nests of Xylocopa orpifex discovered in a decaying log were infested with Tribolium brevicornis. No numerical data were provided.

Okumura and Strong (1965) collected T. brevicornis in Alpine and Mono counties in California, and in a subsequent study Strong (1970) trapped this beetle near barns in nine (unspecified) localities in California. Again, there was no mention of the numbers of these beetles. Although T. brevicornis appears to be primarily Californian, it has been found in Parma, Idaho. In this area, the alfalfa bee, Megachile pacifica is raised commercially in "bee boards" (pieces of wood drilled with holes set out to provide nesting sites for the bee) to increase the yield of alfalfa seed. Tribolium brevicornis has become a major pest, destroying many nests of the alfalfa bee. T. brevicornis may have been imported into Idaho in lumber originating from California (R.W. Smith, personal communication).

Cultures of Tribolium have been maintained in the laboratory at the University of Idaho, Moscow Idaho, and at the University of California, Riiverside, California for many years. These domesticated strains will be referred to as the Riverside and the Idaho strains, and they are available at the Tribolium Stock Canter, California State University, San Bernardino , California.

A third strain of T. brevicornis was discovered by accident be the author during a field collecting trip of the author and his Entomology class to Waterman Canyon, just North of the city of San Bernardino. While the students dispersed in all directions to collect insects in the creek or on the banks of Waterman Creek, the author looked for insects under the bark of trees. Under the bark of an alder tree Alnus rhombifolia downed during a previous winter storm, I found some beetles that looked familiar. Instead of dropping them into an alcohol vial I put them in a dry vial to examine more closely in the laboratory. They looked similar in color and general body shape as T. brevicornis from Riverside, and the compound eye being bisected into two lobes by the gena in the two samples seem to indicated that the beetles at Waterman Canyon were indeed T. brevicornis. Matings between Waterman Canyon males with Riverside females showed that the beetles were compatible to produce F1, and the crosses between F1 beetles produced F2 which were perfectly fertile was further evidence that the two strains belonged to the same species and that the new strain could be maintained in the laboratory on standard flour beetle feed (whole wheat flour plus brewer's yeast in the proportion in a proportion of 19:1 by weight).

When it became evident that these beetles thrived in such a medium, sizable populations of the Waterman strain were obtained. These populations, referred as Waterman Canyon II and Waterman Canyon III gave us the opportunity to study the manner in which feral populations become domesticated. In other words, can feral strains, feeding on immature stages of Xylocopa and perhaps on live and even dead adults of the carpenter bee in nature adapt readily to a laboratory feed on which they have never fed?

Two portions of the dead alder tree about a meter in length were taken to the laboratory and sectioned with a band saw into strips 3 X 3 cm in width and height, exposing the galleries of the carpenter bee later identified as Xylocopa tabaniformes orpifex. Within these galleries were found a large number of Tribolium brevicornis adults and a few larvae and pupae. Some of these larvae were extracted from the dead bodies of carpenter bees on which they were feeding. In the laboratory the feral beetles were placed in beetle medium and their fecundity and fertility determined. Some samples of eggs collected in egg farms in which the flour has been dyed with neutral red were exposed separately to males and females to determine the rate of cannibalism. Other samples of eggs were placed in different nutrients, and their developmental rates to the adult stage and the viability from egg to the adult determined.

Flying ability was measured by the technique devised by Lerner and Inouye and described in Sokoloff (1977).

All of the above attributes were compared with those obtained from the Riverside and Idaho populations strains which are considered as being highly domesticated, since they have been kept in their respective laboratories for many generations. Samples of feral and domesticated strains were measured to obtain total body length and body weight. The beetles were then introduced in flour, allowed to lay eggs,

and the eggs were placed in corresponding vials. Upon hatching, the larvae were placed in one of three diets: a carbohydrate diet consisting of whole wheat flour; 2) a protein diet consisting of ground, dehydrated insects (Tenebrio, Tribolium and Apis larvae) and 3) a carbohydrate and protein diet made of combining diets 1 and 2. The beetles were reared in an incubator maintained at 32o C and about 70%R.H The adult body weight and total body length measurements were continued into the F1 and F2 of the feral population to assess the variability of these organisms when reared under optimal conditions. Other methods used will be described as needed

Results

1. Size

All T. brevicornis collected at Waterman Canyon as adults were sexed and weighed, and subsequently total body length was determined by etherizing the beetles and measuring them with an ocular micrometer. These measurements were later compared with those from samples of the Riverside and Idaho strains, and with the F1 and F2 descendants of the Waterman strain reared under controlled optimal laboratory conditions. The results are shown in Tables 1 and 2

The data indicate that the mean body size of feral beetles of both sexes collected at the Waterman Canyon compare well within the mean size of the domesticated Riverside strain. However, it should be noted that the feral strain, as shown by the coefficient of variation (and as expected) is much more variable in size. This is true for the samples designated as Waterman Canyon II P1 and Waterman Canyon III P1. The F1 and the F2 descendants of the Waterman Canyon , reared under optimal conditions, have considerable increase in body size, and a great reduction in variability.

2. Size in relation to diet.

It is noteworthy that T. brevicornis males are significantly larger than females in respect to weight and body length,. This is unusual since T. castaneum and T. confusum females are generally larger than males, as shown by Howe (1968) for Tribolium and Sokoloff (1955) for species of the pseudoobscura subgroup of Drosophila. It also seems unusual for insects in general, since females in species of insects will be larger than males. (Mulder and Sokoloff, 1982).

Tables 3 and 4 summarize body weight and body length when the beetles are reared on different diets.The greatest values are obtained when the beetles are reared on whole wheat (without yeast) or on ground dry insects. An improvement in body weight is observed when the beetles are reared on a mixture of ground dry insects and whole wheat, but the body weight on this mixture is not comparable to that obtained on whole wheat flour plus yeast.

3. Hatchability in different diets

The results are shown in Table 5. Larvae reared on whole wheat or on a mixture of dried insects and whole wheat give comparable values—about 60 per cent of the larvae become adults in these two media. Larvae reared on dried insects alone have a low survival value (about 11 per cent of the larvae become adults) but these adults are of size comparable to that of beetles reared on whole wheat alone. (see Tables 3 and 4)

Roberts (1975) determined the developmental period of Tribolium brevicornis in quart Mason jars filled with one of three media (CY, SY and WY) placing 1000 eggs in each jar, The containers were then placed in an incubator maintained at 32oC and 60% R.H. They were left untouched for 21 days. From then on the contents of each jar were sifted and the adults counted and removed. This procedure was repeated daily until all the larvae had either died or emerged as adults. The length of time involved was different for each medium

The mean and standard deviation for development in CY was 39 +/-7.86 days, in WY was 47.2 +/- 7.34 days and in SY was 52 +/- 7.34 days.

4. Fertility

Fertility of the feral strains seems to of the same order of magnitude as that of domesticated strains such as the Riverside strain as shown in Table 6.

5. **Egg cannibalism**

Preliminary comparisons show that the Waterman canyon strain is much more cannibalistic than the domesticated Idaho and Riverside strains. Exposure of 50 eggs of T. brevicornis to 9 adult beetles of each sex resulted in the loss of 24 per cent of the eggs when the adults were from the feral strain. In comparable experiments only 4 per cent of the eggs were cannibalized by the Riverside strain and 0 per cent by the Idaho strain.

6. **Dispersing ability**

This was tested by the method of Prus (1963). The Waterman Canyon strain showed a greater tendency to disperse: 47 %. The F1, reared on standard medium, had a lowered tendency to disperse (about 23%). The Idaho and Riverside strains did not show any tendency to disperse out of the test vials.

Another criterion for dispersal, flying ability, was tested using the simple method of Lerner and Ho: Beetles to be tested are placed in a glass petri dish and introduced in a plastic bread or shoe box. At the opposite end of the box is placed another glass petri dish containing food. Flour beetles cannot climb out of the open glass dishes. If any beetles are found outside of the petri dish in the shoe box or in the petri dish containing flour, the beetles must have either hopped out of their dish or flown out to reach the dish containing food. None of the beetles in any of the strains tested showed any tendency to fly when the beetles are tested at room temperature, although when beetles are found to fall on their backs they are capable of, and will, extend their membranous wings.

7. Dispersion and Nutrition.

Roberts (1975) investigated dispersion of T. brevicornis as a function of two parameters: 1) population density, and 2) nutritional source provided. He used the technique of Prus (1963) to assess the effect of crowding and the effect of medium on dispersal. Into three sets of vials 4 grams of a medium WY, CY, or SY and beetles at a density of 2, 8, 12, 25, 50, 75, 100 and 200. were introduced. Each vial was connected to an empty vial by a piece of vinyl tubing, with a slender piece of thread running through it . One end of the thread lay on the surface of the medium. The other end hung half way down in the empty vial. At the end of 24, 48, and 72 hours the vials were examined, and the number of beetles recorded as a measure of dispersion. The results are shown in the accompanying Tables 9-11. His experiments show definite differences in the dispersal rates of the beetles for the various media examined. Dispersion rates in WY are the lowest followed by CY and SY. This dispersion undoubtedly reflects to some degree the preferences of T. brevicornis. There is dispersion in every trial for SY, with rates of .0138 beetles / hr. to .7500/hr. These rates remain relatively low until a population density of 50 beetles is reached, and from that point on dispersion takes place at a rapid pace. In WY there is relatively low dispersal until a density of 75 beetles is reached, and from that point on dispersion takes place at a rapid pace. WY had a dispersal rate 50-75% lower than either of the other two media. The dispersal from CY was generally intermediate between the other two extremes. Only when the initial population reached 200 did the rate of dispersal exceed that of SY.

These results may be attributable to the fact that these beetles were raised in a WY environment and subsequently the beetles, when placed in any other food source, were unsatisfied and attempted to locate the food source with which they were accustomed. These results are in conflict with those anticipated as a result of the findings in the first area of investigation. It is however noteworthy that while the dispersal rates are high for SY, they are definitely lower for this organism than they are for other species of Tribolium. Furthermore, the dispersal figures for SY are not much higher than those for CY, which is an acknowledged food source for this species.

8. **Resistance to starvation and lack of water**

To test these attributes, pupae were isolated in an empty petri dish and allowed to become adults. 100 of these adults, who were never fed or given a drink, were placed in a petri dish, the dish was covered and placed in a plastic box. The beetles were kept at room temperature (maintained at 25o and about 60% R.H) and checked periodically for mortality. This experiment was performed twice. The first indicated that the beetles can live over 200 days without being given food or water (Sokoloff, 1971). The second experiment confirmed the conclusions that this species is highly resistant to starvation.At the end of 63 days there were 89 live and 3 dead beetles; at 69 days there were 88 live and 2 dead; at 76 days 87 live and 2 dead; at 90 days, 87 live and the 2 dead beetles which had been eaten except for their heads. After 104 days there were 86 live and 3 dead. After 119 days there were still 86 live but only 2 dead beetles, one of which was intact and the other almost completely devoured except for the head. Fifty percent of the beetles died between days 210 and 217. The longest survivor died at the end of nine months. With an LD50 of about 210 days, T. brevicornis is the species most resistance to starvation. T. castaneum has an LD50 of less than 44 days, T. confusum less than 38 days, and T. madens less than 50 days (Sokoloff and Cavataio, 1971).

9. **Production of quinones**.

Among the species of Tribolium analyzed by R.K. Ladisch for quinones and hydroquinones (see Table 15.6 in Sokoloff, 1975, for complete data) T. brevicornis is the species which secretes these organic substances most actively. On the basis of mean micrograms per beetle the 20 specimens for each species of Tribolium tested give the following values: (the first values are Quinones and the second Hydroquinones, respectively: T. anaphe:73.1 + 6.73 and 6.9 +0.44; T. brevicornis 225.7 + 28.72 and 15.76 +1.04; T. castaneum 39.5 +3.43 and 2.38 +0.25; T. confusum 33.08 + 2.62 and 2.72 + 0.2; T. destructor 135.5 +12.29 and 4.65 +0.34; and T. madens 197.7 + 15.18 and 7.9 +0.86. Thus, in terms of body weight units, T. brevicornis is the species of Tribolium which produced the highest amounts of quinones and hydroquinones.

10. Effect of etherization

Etherization of five minutes will anaesthetize the beetles sufficiently to obtain sex ratio of the sample, or to obtain the phenotype of wild type and mutants in genetics crosses. Etherization has little effect on fecundity, normal levels of egg-laying activity being reestablished in three days. Longer exposures to ether cause a delay in egg-laying activity—the longer the exposure to ether, the greater the period of recovery. LD50 for surviving exposure to ether is about 25 minutes.

Roberts (1975) studied the effect of exposure to ether on mortality and fecundity of T. brevicornis. He isolated 425 pupae and allowed them to become adults. When the beetles were 7-14 days old he subdivided the females into eight groups, each containing 50 of them. 50 males were added to each group. The eight groups were then etherized with anesthesia grade ether (J.T. Baker Chemical Company):for 2, 5, 7, 10, 15, 20, 22, and 25 min., respectively.

After sufficient time for revival had been given (24 hours) the number of dead in each group was counted and the percentage of mortality determined. Every 24 hours the cultures were examined, the eggs were counted, and the mean number of eggs per female determined. This process was carried out for 13 days, until all the females had returned to their normal egg laying schedules.

Roberts found that T. brevicornis females, under optimal conditions (32oC and 70% R. H.) lay 3.38 eggs /24 hour period, which is much less than the egg-laying rate determined by Gray, 1948 and Park and Frank, 1948 who determined an egg laying rate of 15 eggs/day for T. castaneum and T. confusum.

Exposure to ether for 5 minutes had little effect on fecundity of the beetles, and within three days after exposure the females had recovered their normal egg-laying rat e. Time in excess of five minutes produced a marked decrease in the number of eggs laid per day. In general the longer the time of exposure,

to ether, the more dramatic the reduction in fecundity, and the greater the time required for the females to recover to their normal egg-laying rate.

The LD50 of etherization in T. brevicornis is 25 minutes, about the same time observed by Sokoloff (1960a, b) for T. castaneum.

11. Effect of diet on survival and development

Roberts (1975) studied the effects of three media : corn plus yeast (CY), wheat plus yeast (WY) and soy plus yeast (SY) on survival and development of T. brevicornis to the adult stage. He concluded that there are definite and discrete differences in the developmental rates of Tribolium brevicornis in the three media examined (CY, WY, and SY): The most rapid development occurred in beetles raised in CY. The earliest emergence occurred at 28 days and the latest at 55 days of development. The mean developmental period in WY was 47.2 +/- 9.49 days, with extremes being 36 and 65 days. Development was by far the longest in SY, with a mean of 52 +/- 7.34 days required for the beetles to reach adulthood, the extremes being the same as in CY. It is interesting to note that the developmental period in CY is still considerably longer (18 days) than that for either T. castaneum or T. confusum.

The percentage of eggs surviving to adulthood varied also with the medium. Those in WY had the greatest chance of reaching adulthood, with 62.5% of the eggs attaining this stage of development, while those in CY had considerably less chance ((37% chance of becoming adults), and those in SY had even a lower probability (31.7%). There are of course many causes of larval mortality, and since the conditions in all three environments were alike we would ordinarily expect to see the same level of emergence. Since this was not the case, we can assume that some of the discrepancies may be due to differences in the media themselves. It appears then that WY is the best medium for the development of this species, followed by CY and finally SY. This experiment shows that Tribolium brevicornis can develop in a medium consisting of SY. However, it would seem that this medium does not provide the necessary nutritional factors for rapid development: in contrast to the more rapid development of this organism in the other two media examined.

12. Feeding and oviposition site preferences in Tribolium

Mickel (1946) and Standish (1947), working respectively with Tribolium confusum and T. castaneum reported that these two species of flour beetles could not tolerate or successfully produce offspring in soybean products. This work was verified by Fraenkel et al (1950) and Lin and Richards (1952). Albers et al. (1974) showed the same dislike in two other species of Tribolium: T. madens and T. audax. Albers et al (1974) showed that T. brevicornis, when given the choice of selecting between corn plus yeast (CY), wheat plus yeast (WY) and soy plus yeast.
(S plus Y) has a distinct preference for SY over the other offerings. These preferences of T. audax, T. brevicornis, T. castaneum, T. confusum and T. madens were determined by introducing beetles of these species into choice plastic chambers in which the media to be chosen were introduced in equal parts into adjacent compartments of equal size separated by a divider which would separate the flour but allowed passage of the beetles from one to the other compartment as they wished. The chambers were placed in an incubator maintained at 32oC and about 60% relative humidity for a period of 48 hours. After this period the contents of each side of the chamber were aspirated into a vial, the material was then sifted with a coarse sieve to remove the adults, and a fine screen to isolate the eggs. The adults were then sexed and counted and the number of eggs laid in each medium was recorded.The results are summarized in Table 17. Analysis of the data led to the following conclusions:

Given the choice of WY and SY all the species except T. brevicornis were found more often in WY than in SY. T. brevicornis adults were found about equally distributed in the two media.

Given the choice of CY and WY, T. confusum, T. madens and T. audax (all in the confusum species group) seem to prefer the corn plus yeast medium over the wheat plus yeast medium. T. castaneum, on the other hand, is found more often in the wheat plus yeast medium. T. brevicornis is found about equally frequently in these two media.

Given the choice of CY and SY, T. audax, T. madens, T. castaneum and T. confusum adults seldom are found in soy plus yeast. T. brevicornis, on the other hand, is found equally frequently in the

two media. By itself, the occurrence of the adults in a medium at a given instant (in this case when the two media are separated) does not necessarily mean a preference for that particular medium. A stronger case can be advanced if the number of eggs found in the medium corresponds to the prevalence of adults.
According to the data in Table 1:

Given the choice of WY and SY, T. castaneum, T. audax and T. madens prefer to lay their eggs in wheat rather than in soy. T. confusum accepts both media as an oviposition site, while T. brevicornis seems to prefer soy to wheat medium as an egg-laying site.
Given the choice of WY and CY, T.castaneum prefers wheat, T.audax and T. confusum clearly prefer corn to wheat, and T. madens and T. brevicornis use the two media about equally frequently as an oviposition site.

Given the choice of CY and SY it is clear that T. audax, T. madens, T. castaneum and T. confusum females prefer CY to deposit their eggs. The data for T. brevicornis, on the other hand, reinforces the conclusion that the preferred medium by females of this species appears to be soy.

A previous study (Sokoloff, 1972 and Sokoloff and Cavataio 1972) showed that T. brevicornis is unusual in that it can survive for as long as nine months without food or water. This study shows that T. brevicornis, in contrast to the other species, can exploit soy flour in spite of the presence of toxic substances which affect the developmental rate of Tribolium castaneum and T. confusum.

It appears that the major reason for the marked aversion to this medium is the presence of a crystalline trypsin inhibitor, which composes approximately 2% of the total weight of a given soy sample. Bowman (1944) and Ham and Standstedt (1945) were the first to successfully demonstrate the ability of soluble fractions of raw soybean to inhibit trypsin. This substance was later isolated by Kunitz (1946). Additional work by Liener (1953) and Almquist and Merritt (1953) working with vertebrates provided a great wealth of evidence for the presence of anti-trypsins in soybean. Like, Fraenkel and Liener (1954) determined that of all the inhibitors present in soy, it the anttrypsins that were the most effective in halting growthand development in all species of Tribolium. Building upon work first commenced by Borchers and Akerson (1952) they discovered that the addition of 20% yeast to soy produced beneficial effects upon the growth of Tribolium. According to most insect nutritionists, this is due to an antagonism between the principle in raw soybean which is toxic to the larvae and the nutrients present in yeast. Most entomologists believe that pests of stored products possess specific sensory mechanisms which enable them to select yeast particles at the expense of the ration. Soybean inhibitors which are toxic to insects have made soy immune and basically impregnable to attack from flour beetles.

Using the preliminary findings of Sokoloff et al, 1966, Sokoloff 1975, and Albers et al (1974) Roberts carried out experiments concentrating on T. brevicornis. In his experiments, Roberts isolated 2000 T. brevicornis pupae according to sex in a jar containing a great excess of WY medium. The pupae were allowed to develop into adults and to mature for 10 days. 50 beetles (25 of each sex) were then introduced into each of four plastic containers such as those designed by Inouye (1965). Each of these choice chambers contained equal quantities of two media arranged in the following combinations: CY-WY, CY-SY, WY-SY, SY-S. The media were separated by a plastic divider, which had sizeable perforations to allow the free passage of the beetles from one side to the other. The fifty beetles were placed in the center of the container, with approximately 25 beetles on each side of the divider. Sthe chambers were then closed with lids containing small openings for ventilation and placed in an incubator at 32o C. and a relative humidity of 60% for a period of 48 hours. After the time interval had expired the contents of each side of the chamber were aspirated into a vial. The medium was then sifted with a coarse sieve to remove the adults and the number of eggs laid in each medium recorded. Altogether there were ten replicate choice chambers set up for each combination of media. The data are shown in Tables 12-15. The results were as follows:

13. Preference of Medium in Adults

The data showing the preference of medium by adults are given in Tables 12-15. The results can be summarized as follows:

1. Given the choice of CY and WY a majority of the beetles showed a preference for CY. With a mean 28.3 +/- 1.86 in that medium as compared with 21.8 +/-1.93 beetles in the WY. The females had a distinct preference for CY over the other offering, while the males were comparatively indifferent
2. Given the choice of CY and SY the beetles were found fairly equally distributed, with about 25.2 +/- 2.29 beetles in CY as compared to 24.8 +/- 2.29 in the SY. In this case neither sex showed a preference for either medium.
3. Given the choice of WY and SY, T. brevicornis mostly chooses SY. A mean of 27.4 +/-1.74 beetles were found in the SY in contrast to 22.6 +/- 1.76 in the WY. The males appeared to be apathetic in choosing a medium, while the females showed a marked preference for SY.
4. Given the choice of SY and S, the beetles were found to demonstrate no preference for either medium. There was a mean of 25.2 +/- 1.52 beetles in S as compared to 24.8 +/-1.89 in SY. Neither sex showed a specific preference for either medium.

14. Oviposition Site Preference

1. Given the choice between WY and CY, T. brevicornis showed greater preference for CY than for WY. With a mean of 105.6 +/- 3.76 eggs deposited in CY to that of 82.9 +/- 4.38 in WY.
2. Given the choice between CY and SY T. brevicornis is found to lay its eggs abouit evenly in the two media, with a mean of 03.5 +/-4.75 eggs being laid in Cy to 96.4 +/- 4.94 in SY.
3. Given the choice of WY and SY, T. brevicornis has an overwhelming preference for SY with a mean of 103.1 +/- 4.23 eggs being laid in SY as compared with 68.3 +/- 3.62 eggs laid in WY.
4. Given the choice between SY and S, T. brevicornis reveals no partiality. Its eggs are deposited equally throughout the two media with a mean of 90.7 +/- 3.19 eggs laid in SY as compared with 89.9 +/-4.2 eggs in S.

From the data, which largely corroborate those obtained by Albers et al (1974), Roberts concludes that T. brevicornis has the following preference for the media studied :

1. Nutritional preference: CY>SY>S>WY.
2. Ovipositional preference: CY>SY>S>WY

The results clearly show that T. brevicornis can tolerate , survive and flourish on soybean products, as well as or better than in other media as compared to other species.

Sokoloff et al. (1965) referred to Orr and Watt's (1957) table summarizing the amino acid, mineral and vitamin content of the four flour food sources used in this experiment The table shows that soy is richer or as rich as yeast and the other two grains, corn and wheat in amino acids and certain minerals as alluded to by Block and Bolling (1951) Block and Weiss (1956) and Watt and Merrill (1963), However soy contains various toxic substances:

Soyin 2.5%
Trypsin inhibitor 2%
A Ph 4.2 extract of soybean
A Kaolin treated acid extract of soybean
Ethyl alcohol soluble inhibitor
An alkaline extract of soybean and Soyin (from Lipke, 1954)

These substances affect the developmental rate and greatly impede the digestive processes of T. castaneum, T. confusum, T. audax and T. madens and thus make it very poor nutritional and ovipositional site for these species.

From the results obtained by Roberts, and others mentioned above, it appears that T. brevicornis possesses some unique qualifications that allows it to exploit this medium more effectively that the other species of Tribolium investigated.

14. Exposure to radiation

The egg is the stage most sensitive to radiation (1,000 rads).

15. T. brevicornis as host to Hymenolepis diminuta

T. brevicornis is a potential host of Hymenolepis diminuta. Mankau (1977) has shown that size is a factor in the infection Tribolium spp. and Eleodes sp. by Hymenolepis diminuta.

16.Cytology of T. brevicornis

S. G. Smith (1952) conducted cytological studies in 191species of Coleoptera distributed in 127 genera, 66 families and 51 superfamilies. He concluded that the primitive number in these beetles the primitive number of chromosomes is nine pairs of autosomes, an X of he size of the autosomes, and a minute y, both being V-shaped and associated during maturation divisions at two terminal contact points in the form of a parachute. The formula 9AA + X +y is characteristic of the Tenebrionoidea as a whole, but a number of species have fewer chromosomes. They are considered to be derived species.

Within the genus T. castaneum has 9 pairs of autosomes, an X about the sixe of the autosomes, and a small y.,these two appearing in the form of a parachute, conforming with the primitive condition; T. madens has also this primitive formula, but in addition has a small number of supernumeraries which differ from such species as Diabrotica in that they are able to form bivalents in the spermatocyte (Smith 1956, 1960); T. confusum and T. destructor are derived species, the firsst having 8 pairs of autosomes , a large X, and a large Y (neo-X and neo-Y): and the size of the neo-X and neo-Y being again reduced in T. destructor.. (For further details see Sokoloff, 1972). Halstead (1969) compared the cytology of T. audax a species closely related to T. madens and found no detectable differences differences (both having nine pairs of autosomes plus three pairs of supernumeraries. Plus Xyp (parachute shaped)

Moore and Sokoloff (1982) have found that Tribolium brevicornis and Tribolium anaphe have nine pairs of autosomes. Both species had a somatic chromosome number of 18. There was no evidence of a heteromorphic sex chromosome pair in these two species. See Fig . 00.

Discussion

The data gathered in the present study suggest that the domesticated and feral strains of T. brevicornis differ in three of the attributes tested: body size, cannibalism and dispersion.

The feral population has a greater difference in body size. This difference is primarily in the coefficient of variability, the Waterman Canyon strain exhibiting much greater variability than the domesticated Riverside and Idaho strains. The means of the three strains are comparable, which indicates that, overall, the feral strain is able to obtain sufficient food during the development to produce beetles comparable in size to those reared in the laboratory under optimal conditions. It is noteworthy that among the beetles derived from nature, a certain proportion are very smalk beetles-about one ninth of one tenth of the weight of the largest beetles. This small size apparently is due to environmental and not to genetic causes becaause both sexes are represented among the small beetles, and furthermore, when small females are isolated they produce F1 comparable in size to the progeny produced by larger females.

The feral population showed a much greater tendency toward egg-cannibalism (20% of the eggs were destroyed by the Waterman Canyon strain) than the domesticated strains (less than 8% for the Riverside strain and 0% for the Idaho strain). This is particularly surprising for the Idaho strain, since beetles in Moscow, Idaho, have become predaceous of larvae of Megachile pacifica, the alfalfa leafcutter bee (which commercial growers raise in an attempt to improve the yield of alfalfa).

The feral population showed a much grater tendency to disperse than the Riverside or Idaho strain. When the feral population was compared with their F1, it was clear that the latter did not disperse as readily as the parental population.

In respect to the other attributes (length of development, fecundity, fertility, mortality of the juvenile stages, etc.) the three strains give similar results.

Successful stored-producs pests, according to Howe (1962) need the ability to eat dry foods and use and conserve the water produced in the breakdown of carbohydrates. On the basis of evidence derived from the laboratory and from scant observations in the field, it is highly probable that the various species of Tribolium are omnivorous. Initially, they probably lived under the bark of trees, and Howe (l.c.) and this reporter (Sokoloff, 1974) believe that the beetles were primarily carnivorous, eating as larvae or adults, eggs and pupae of their own or other species of insects. They were secondarily herbivorous, perhaps consuming fungi and bacteria as a source of vitamins and minerals and perhaps carbohydrates as a source of metabolic water.

Our attempts at providing a clearcut answer to the question of the role of T. brevicornis in nature, in the decaying log biocoenosis, were not completely successful. T. brevicornis has also started to move as predators into another man-made environment, the bee-boards where the alfalfa leafcutter bee Megachile pacifica raises its young (Polk,1979). This illustrates the great plasticity of these insects: they can survive as carnivores (on the larvae or pupae in bee nests), or as herbivores (on wheat flour or other stored products) equally well.

Summary

Data are presented to show that, a normal inquiline of Xylocopa tabaniformes orpifex differs from domesticated strains in body size (feral populations more variable than domesticated strains) and two behavioral traits: cannibalism and dispersal (feral strains are more cannibalistic and have greater tendency to disperse).

The primary ecological niche of T. brevicornis is not completely established, owing to the necessity to disturb the habitat by sawing into the log. However, the differences in behavior and the gut contents of these insects suggest that in nature these beetles play either the role of predators or scavengers of Xylocopa.

Interestingly, T. brevicornis was found in Xylocopa nests but did not occur in a beehive of Apis mellifera found only three meters away in a downed sycamore, even though the latter would provide a richer source of food than the nests of Xylocopa . Apparently the hygienic behavior of the honey bee is very effective, and discourages the establishment of T. brevicornis in bee nests while Xylocopa bees have not developed this hygienic behavior . In any case, adults and larvae of T. brevicornis have been found in the galleries of Xylocopa. Larvae of T. brevicornis have been collected from pupae of Xylocopa on which the larvae of brevicornis were feeding. Furthermore, recently collected adult beetles from dead bodies of Xylocopa contained fragments of Xylocopa exoskeletons in their digestive tracts The evidence gathered so far indicates that T. brevicornis is probaby a secondary or tertiary consumer, engaging in scavenging, predatory and possibly cannibalistic activities within the decaying log biocoenosis. (Sokoloff et al.1983).

T. brevicornis and T. audax have only 9 pairs of chromosomes.In both species there is no evidence of a distinguishing heteromorphic X-Y pair.

Acknowledgments

Some of the data reported here were compiled by Gary Mulder, Richard Moore and Lee D. Roberts as part of their theses leading to their Masters Degree. I am grateful to them for allowing me to quote from their work. This investigation was in part supported by U.S. Army Research grants DRXROCB-14447-l and RDTDLP 11790-LS and contract 13545L and faculty development grants from the California State University, San Bernardino.

Literature Cited

Albers, J.C., Perkins, R. Roberts, L>D., Sandri, J.j. and Sokoloff, A. 1974. Feeding and oviposition preference in T. audax, T. madens, T. castaneum T. confusum and T. brevicornis. Tribolium Inf. Bull. 17:73-74

Almquist, H.J. and Merritt, J.B. 1953. Effect of crystalline trypsin on the raw soybean growth inhibitor. Proc. Soc. Exptl Biol. Med. 79: 269-272.

Almquist H.J, and Merritt, J.B.. 1953. Effect of raw soybean meal on the growth of the chick. Proc. Soc. Exptl Biol. Med. 79:279-298.

Block, R.J. and Bolling, D. 1951. The amino acid composition of proteins and foods. Thomas Ltd. Springfield, Ill.

Bochers, R. and Ackerson, C. W. 1952 Nutritive value of legume seeds. XI. Counteracting the growth inhibitor in raw soybean. Proc. Soc. Exptl. Med. 78:81-83.

Bowman, D. E. 1944. Fractions derived from soybeans and Navy beans which retard tryptic digestion of casein. Proc. S. Exptl Biol. Med. 57:139-140.

Fraenkel, G. Blewett, M. and Coles, M. 1950.. The nutrition of the mealworm, Tenebrio molitor L. (Tenebrionidae, Coleoptera) Physiol. Zool. 23: 92-108.

Gray, H.E. 1948. The Biology of flour bveetles. The N.W. Miller 236:3a, 11a, 181.

Halstead, D.G.H. 1969. A new species of Tribolium from North America previously confused with Tribolium madens (Charp.) (Coleoptera: Tenebrionidae). J. Stored Prod. Res 4:295-304.

Ham. W. E. and Standstedt, Rhe proteolytic inhibiting substance in the extract from unheated soy bean medium and its effects upon growth in the chick. J. Biol. Chem. 161:636-637.

Kunitz, M. 1946. The inhibiting extract in soybean. J. Gen. Physiol. 29:149-153.

Liener, I.E. 1953. Soyin, a toxic protein from the soybean. J. Nutrition 49:527-531.

Lin. S., Richards, A.G. 1952. Studies in the nutritive value of soybean flour to Tribolium confusum. J. N.Y. Ent. Soc. 60:107-118.

Lipke, H.., Fraenkel, G., and Liener, I.E. 1954. Effect of soybean inhibitors on growth of Triboliuim confusum. J. Agric., Fd. Chem. 2: 410-414.

Mickel, E.E. and Standish, J., 1946. Susceptibility of edible soya propducts to attack by Tribolium confusum. Univ. Minn. Agric. Exp. Stn. Tech. Bull. 175:1-28.

Mickel, C.E. and Standish, J. 1947. Susceptibility of processed soy flour and soy grits in sstorage to attack by T. castaneum (Herbst). Univ. Minn. Agric., Stn Bull. 178-1-20.

Moore, R. D. and A. Sokoloff. 1982. The determination of chromoosome number of Tribolium brevicornis and Triboliuim anaphe. Tribolium Inf. Bull. 22:116-117.

Mulder , G. and Sokoloff, A. Observations on Populations of Tribolium brevicornis Le Conte (Coleoptera, Tenebrionidae).III. Preliminary comparisons between feral and domesticated populations. J. Adv. Zool. 1982:33-45.

Orr, M. L. and Watt, .K. 1957. Amino Acid Content of Foods. U. S. Dept. of Agric. Home Econ. Res. Rep. 4: 1-82.

Park, T., Frank, M.B. 1948. The fecundity and development of the flour beetle T. confusum and T. castaneum at three constant temperatures. Ecology 29:368-374.

Prus, T. 1963. Search for methods to investigate mobility in Tribolium. Ecology 44:801-803.

Smith, S. G. 1952. The evolution of heterochromatin in the genus Tribolium. Chromosoma 4:585-610

Smith, S. G. 1956. Extreme chromosomal polymorphism in a coccinellid beetle. Experientia 12:1-4.

Smith, S. G. 1960. Chromosome number of Coleoptera. II. Can. J. Genet. Cytol. 2:66-88.

Sokoloff, A. 1960. Safe periods of etherization of T. castaneum. TIB52.

Sokoloff, A. 1960. Effect of ether on fecundity of T. castaneum. TIB36.

Sokoloff, A., Franklin, I. R. Overton, L.F.and Ho, F.K. 1966. Comparative studies with Tribolium. I. Productivity of T. castaneum and T. confusum on several commercially available diets. J. Stored Prod. Res. 1: 295-311.

Sokoloff, A., Franklin, I.R. and Lakhanpal, 1966. Comparative studies with Tribolium II. Productivity of T. castaneum and T. confusum in natural, semisynthetic and synthetic diets. J. Stored Prod. Res. 1:312--324.

Sokoloff, 1971. Resistance of Tribolium to starvation and lack of water. TIB 14: 85-86.

Sokoloff, A. 1972. The Biology of Tribolium with Special Emphasis on Genetic Aspects. Oxford University Press, Vol. !

Sokoloff, A. 1975. The Biology of Tribolium with Special Emphasis on Genetic Aspects. Voil. 2.

Sokoloff. A. 1977. The Biology of Tribolium with Special Emphasis on Genetic Aspects. Vol. 3.

Sokoloff, A., .C. Albers, P. Cavataio. S.K. Mankau, S. McKibben, S. Mills, R. Perkins, L.D. Roberts, and J.J. Sandri. 1880 Observations on Populations of Tribolium brevicornis (Le Conte) (Coleoptera, Tenebrionidae). I. Laboratory observations of domesticated strains. Res. on Population Ecology 22:1-12.

Sokoloff, A., R. Wilson, G. Mulder and Daryl Faustini 1983 Observations on Populations of Tribolium brevicornis Le Conte (Coleopstera: Tenebrionidae). II. The habitat niche of a local population in Sousthern California. Pan Pacific Entomologist 58_177-183.

Watt, B.K. and Merrill, A.L. 1963. Composition of foods—raw, processed, prepared. U.S. Dept. Agric. Handbook 8:1-180.

Table 1

Body length of various strains of T. brevicornis reared in standard medium at 32°C and 70% R. H.

	Males					Females				
Strain	N	$\bar{m}$	σ	SE	CV(%)	N	$\bar{m}$	σ	SE	CV(%)
Riverside	61	6.257	.4414	.0565	7.05	60	5.952	.3073	.0397	5.16
Waterman Canyon II P_1	49	5.963	1.002	.143	16.80	50	6.146	.7299	.1032	11.88
Waterman Canyon III P_1	84	5.542	.906	.0989	16.35	88	5.602	.7900	.08422	14.10
Waterman Canyon II F_1	90	6.709	.3798	.0400	5.66	90	6.672	.3784	.03989	5.67
Waterman Canyon II F_2	61	6.8	.3710	.0475	5.46	60	6.59	.3900	.5035	5.92

Table 2

Body weight of various strains of T. brevicornis reared in standard medium at 32°C and 70% R.H.

	Males					Females				
Strain	N	$\bar{m}$	σ	SE	CV(%)	N	$\bar{m}$	σ	SE	CV(%)
Riverside	61	9.879	1.783	.2282	18.05	60	8.422	1.434	.1851	17.03
Waterman Canyon II P_1	49	9.780	3.930	.5615	40.18	50	9.912	2.977	.4210	30.03
Waterman Canyon III P_1	84	8.140	4.0762	.4448	50.08	88	6.715	3.020	.3219	44.97
Waterman Canyon II F_1	90	12.783	1.768	.1863	13.83	90	12.784	2.024	.2134	15.83
Waterman Canyon II F_2	61	13.948	2.171	.2780	15.56	60	12.975	1.796	.2319	14.04

Table 3

Body weight of T. brevicornis (Waterman Canyon II strain) reared under different diets at 32°C and 70% R.H.

	Males					Females				
	N	$\bar{m}$	σ	SE	CV(%)	N	$\bar{m}$	σ	SE	CV(%)
A. Whole Wheat	32	7.37	1.67	.2952	22.66	26	6.92	2.01	.3942	28.11
B. Ground Dry Insects	25	7.30	2.31	.462	31.64	20	7.15	2.59	.5791	36.22
C. Mixture of A + B	35	9.65	2.29	.4092	23.95	25	9.09	2.53	.506	27.83
D. Whole Wheat + Yeast	22	12.973	1.613	.3439	12.43	20	12.545	1.330	.2974	10.60

Table 4

Body length of various strains of T. brevicornis reared in standard medium at 32°C and 70% R.H.

	Males					Females				
	N	$\bar{m}$	σ	SE	CV(%)	N	$\bar{m}$	σ	SE	CV(%)
A. Whole Wheat	29	5.88	.500	.9285	8.50	29	5.73	.402	.07466	7.02
B. Ground Dry Insects	22	5.688	.529	.1128	9.30	23	5.655	.500	.1043	8.84
C. Mixture of A + B	30	6.109	.441	.08052	7.22	30	6.032	.502	.06714	8.32

Table 5

Hatchability of T. brevicornis larvae reared in different diests at 32°C and 70% R.H.

	Initial Larvae (N)	Dead (N)	Survival (Larva to adult) (%)
A. Whole Wheat	100	42	58
B. Dried Insects	400	355	11.25
C. A & B	100	40	60

Table 6

Fertility of various T. brevicornis strains incubated at 32°C and 70% R.H.

Strain	Sample Size	Survival to larval stage	Fertility (%)
Riverside	89	58	65
Waterman Canyon I	110	84	76
Waterman Canyon II	156	96	61.5

Table No. 1. Dispersion from Wheat plus Yeast

# beetles per test	Dispersion after 24 hours	Dispersion after 48 hours	Dispersion after 72 hours
2	0	0	0
8	0	0	0
12	0	0	0
25	0	0	1
50	7	7	8
75	9	11	17
100	12	16	18
200	8	21	31

Table No. 2. Dispersion from Soy plus Yeast

# beetles per test	Dispersion after 24 hours	Dispersion after 48 hours	Dispersion after 72 hours
2	1	1	1
8	0	0	1
12	2	2	2
25	1	1	2
50	13	20	24
75	31	40	43
100	36	39	48
200	26	50	54

Table No. 3 Dispersion from CY

# beetles per test	Dispersion after 24 hours	Dispersion after 48 hours	Dispersion after 72 hours
2	1	1	1
8	2	2	2
12	0	0	0
25	1	3	3
50	3	3	12
75	9	13	18
100	23	28	32
200	32	55	59

Table No.10 Dispersal in terms of Percent Analysis

# beetles per test	% beetles leaving SY	% beetles leaving WY	% beetles leaving CY
2	50%	-	50%
8	12.5%	-	25%
12	16.6%	-	-
25	8%	4%	12%
50	48%	16%	24%
75	57.3%	22.6%	24%
100	48%	18%	32%
200	27%	15.5%	29.5%

Table No. 11 Dispersal rate of T. brevicornis in different media as a function of density at the end of 72 hours.

# beetles in vial	SY	WY	CY
2	.0138/hr	-	-
8	.0138/ hr	-	.0138/ hr
12	.0277/ hr	-	.2111/ hr
25	.0277/ hr	.0138/ hr	.0416/ hr
50	.3333/ hr	.1111/ hr	.1666/ hr
75	.5970/ hr	.2361/ hr	.2500/ hr
100	.6666/ hr	.2500/ hr	.4400/ hr
200	.7500/ hr	.4300/ hr	.8190/ hr

Table No. 12, Choice Chamber WY-CY

	Wheat plus Yeast				Corn plus Yeast			
	males	females	Total	eggs	males	females	Total	Eggs
1	11	13	24	99	14	12	26	127
2	13	15	28	78	12	10	22	89
3	9	12	21	95	16	13	29	97
4	12	5	17	37	13	20	33	103
5	12	9	21	66	13	16	29	111
6	13	13	26	110	12	12	24	101
7	14	6	20	64	11	19	30	99
8	13	13	26	114	12	12	24	93
9	12	9	21	113	13	17	30	104
10	9	5	14	53	16	20	36	132
Total	118	100	218	829	132	151	283	1056

X and standard deviation:

	WY	**CY**
Males	11.8 +,-1.19	13.2 +,- 1.23
Females	9.9 +, - 1.88	15.1 +,- 1.91
Total	21.8 +,- 1.93	28.5 +,- 1.96
Eggs	82.9 +,- 4.38	105.6 +,- 3.76

Table No. 13, Choice Chamber CY-SY

	Corn plus Yeast				Soy plus Yeast			
	males	females	total	eggs	males	females	total	Eggs
1	12	11	23	103	13	14	27	109
2	15	6	21	71	10	19	29	134
3	7	5	12	49	18	20	38	79
4	14	19	33	128	11	6	17	82
5	21	8	29	103	4	17	21	114
6	11	15	26	103	14	10	24	123
7	18	12	30	95	7	13	20	85
8	11	10	21	102	14	15	29	112
9	8	21	29	122	17	4	21	54
10	13	15	28	59	12	10	22	72
total	130	122	252	935	120	128	248	964

X and standard deviation:

	CY	**SY**
Males	13 +,- 1.91	12 +,- 1.88
Females	12.2 +,- 2.17	12.8 +,- 2.18
Total	25.2 +,- 2.29	24.8 +,- 2.29
Eggs	93.5 +,- 4.75	96.4 +,- 4.94

Table No.14. Choice Chamber WY-SY

	Wheat plus Yeast				Soy plus Yeast			
	males	females	total	eggs	males	females	total	eggs
1	13	9	22	68	12	16	28	131
2	12	8	20	59	13	17	30	142
3	11	8	19	66	14	17	31	98
4	11	18	29	85	14	7	21	72
5	13	11	24	64	12	14	26	105
6	11	7	18	51	14	18	32	112
7	15	6	21	52	10	19	29	106
8	15	11	26	88	10	14	24	98
9	14	11	25	91	11	14	25	95
10	12	10	22	59	13	15	28	72
Total	127	99	226	683	123	151	274	1031

X and standard deviation:

	WY	**SY**
Males	12.2 +,- 1.20	12.3 +,- 1.20
Females	9.9 +,- 1.59	15.5 +,- 1.59
Total	22.6 +,- 1.74	27.4 +,- 1.74
Eggs	68.3 +,- 3.62	103.1 +,- 4.23

Table No.15. Choice Chamber SY-S

	Soy plus Yeast				Soy			
	males	females	total	eggs	males	females	total	eggs
1	13	13	26	96	12	12	24	89
2	12	13	25	97	13	12	25	90
3	18	14	32	89	7	11	18	84
4	12	11	23	69	13	14	27	48
5	12	14	26	98	13	11	24	67
6	11	8	19	89	14	17	31	137
7	11	13	24	90	14	12	26	106
8	14	11	25	105	11	14	25	109
9	15	16	31	102	10	9	19	84
10	10	7	17	92	15	18	33	85
Total	128	120	248	907	122	130	252	899

X and standard deviation:

	SY	**S**
Males	12.8 +,- 1.39	12.2 +,- 1.43
Females	12.0 +,-1.59	13.0 +,- 1.66
Total	24.8 +,-1.89	25.2 +,- 1.52
Eggs	90.7 +,-3.19	89.9 +,- 4.28

Table 16 **Amino Acid, Mineral and Vitamin Content of Seven Foods in mg/100g Edible Portion**

Ingredient	Food						
	Corn	Brown rice	White rice	Soybean flour (full-fat)	Whole wheat flour	White wheat (patent)	Brewer's yeast (dried)
Amino Acid*							
Tryptophan	47	81	82	541	164	129	710
Threonine	311	294	298	1547	383	302	2353
Isoleucine	361	352	356	2112	577	483	2398
Leucine	1011	646	655	3030	862	809	3226
Lysine	225	296	300	2483	365	239	3300
Methionine	145	135	137	528	203	138	836
Cystine	101	102	103	698	292	210	548
Phenylalanine	246	237	240	1226	495	348	1384
Tyrosine	354	377	382	1943	657	577	1902
Valine	398	524	531	2062	616	453	2723
Arginine	275	432	438	2842	636	466	2250
Histidine	161	126	128	937	271	210	1251
Alanine	776	-	-	1616	465	317	3456
Aspartic Acid	968	354	359	4766	725	455	5232
Glutamic Acid	1377	1027	1041	7211	4156	3653	6334
Glycine	265	513	520	1641	812	381	2427
Proline	651	363	368	2641	1389	1254	1983
Serine	441	381	386	2565	614	542	2657
Minerals							
Ash	800	1200	500	4600	1700	430	7100
Calcium	6	32	24	199	41	16	210
Phosporus	(164)	221	94	558	372	87	(1753)
Sodium	(1)	9	5	1	3	2	(51)
Potassium	-	214	92	1660	370	95	1894
Vitamins							
Thiamine	0.20	0.34	0.07	0.85	0.55	0.06	15.61
Riboflavin	0.06	0.05	0.03	0.31	0.12	0.05	4.28
Niacin	1.4	4.7	1.6	2.1	4.3	0.9	37.9

* Adapted from ORR and Watt (1957). The above foods have the following protein content and nitrogen conversion factors: corn – 7.8% protein, n * 6.25; rice, brown – 7.5% protein, n*5.95; rice, polished – 7.6% protein, n*5.95; soybean flour (full-fat) – 35.9% protein, n*5.71; wheat flour-whole – 13.3% protein, n*5.83; patent flour – 10.5% protein, n*5.70; and brewer's yeast (dried) – 7.4% protein, n*6.25 (here the total n is equivalent to 36.9 protein).

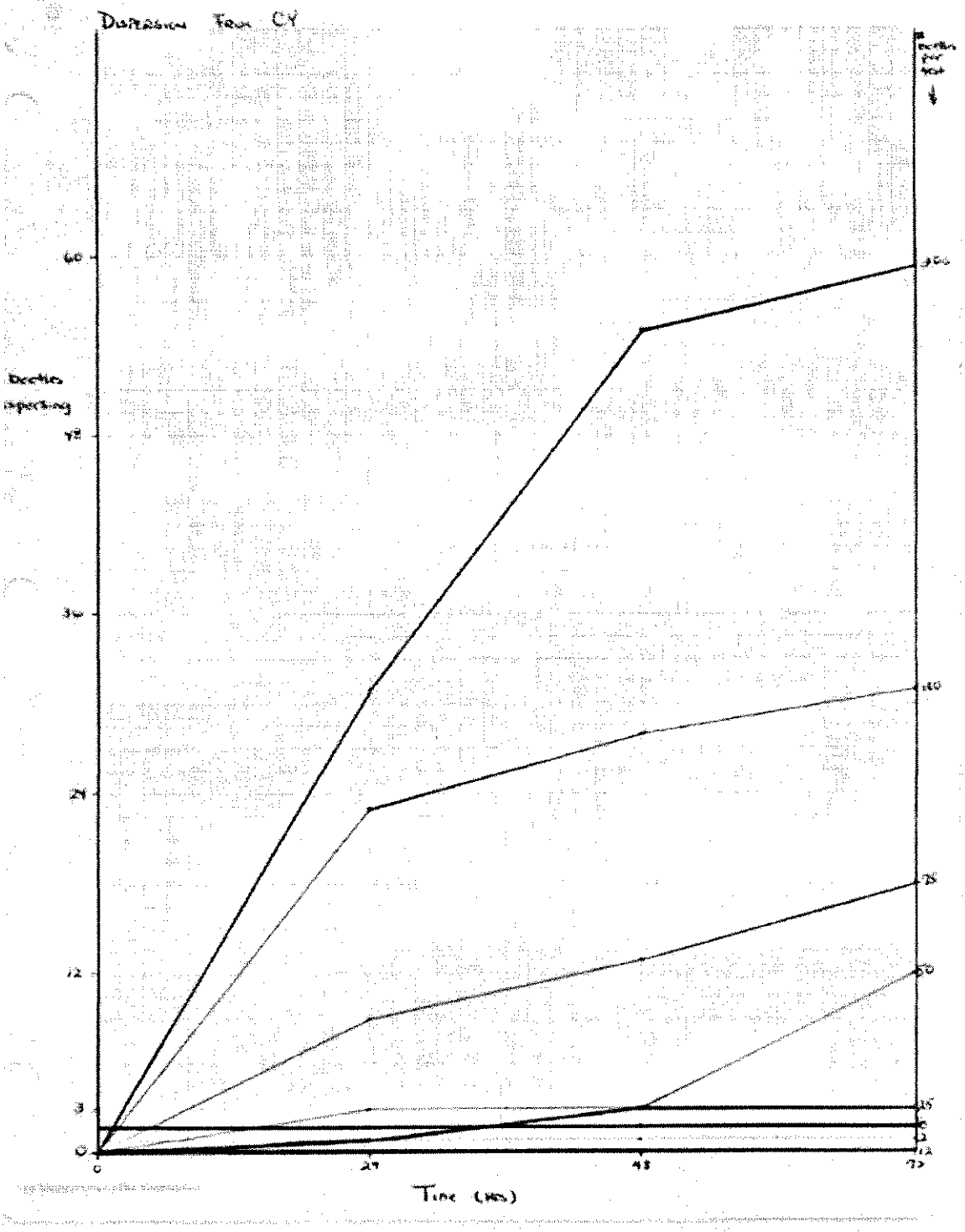
Table #6 a **Amino Acid, Mineral and Vitamin Content of Seven Foods in mg/100g Edible Portion**

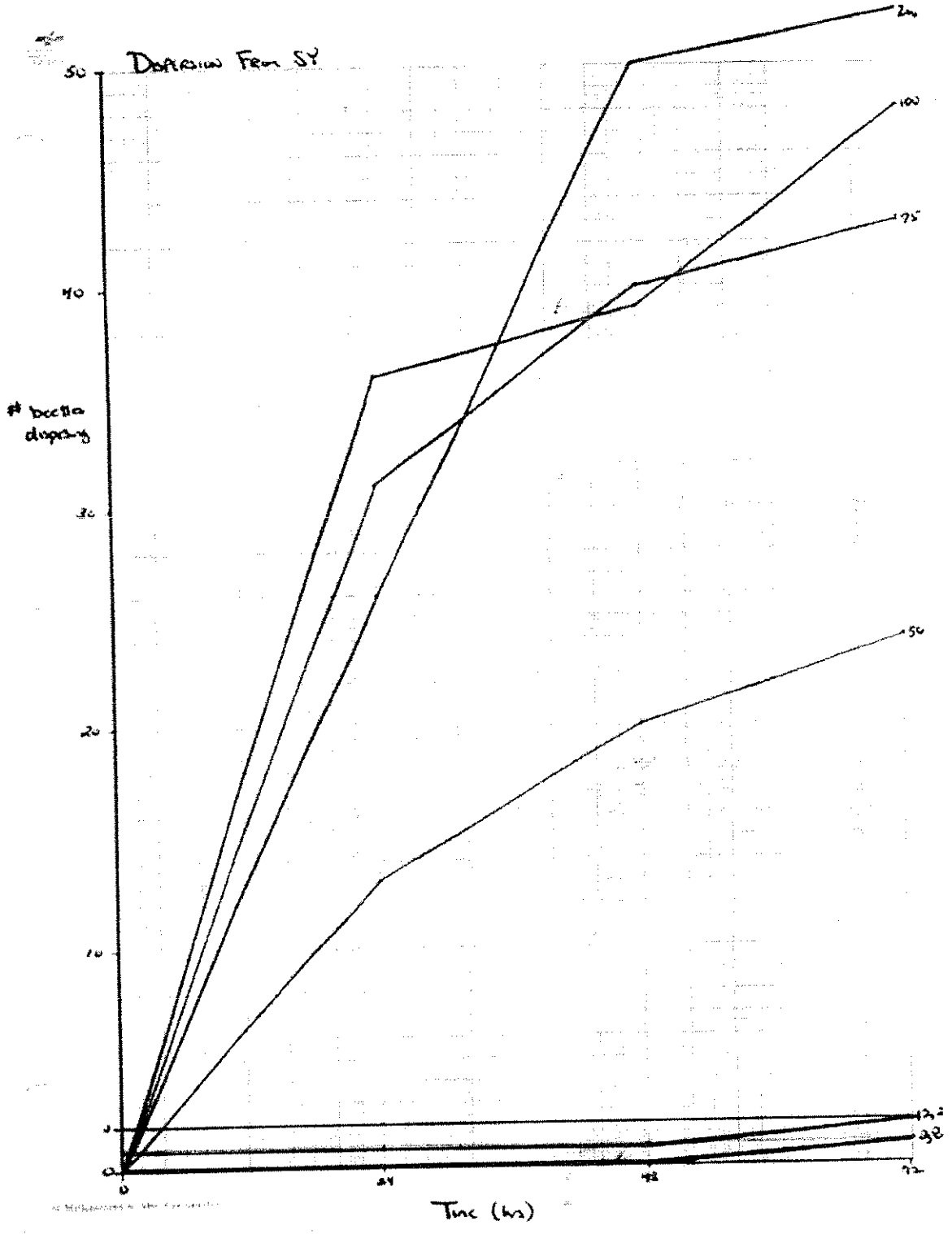
Ingredient	Food						
	Corn	Brown rice	White rice	Soybean flour (full-fat)	Whole wheat flour	White wheat (patent)	Brewer's yeast (dried)
Amino Acid*							
Tryptophan	47	81	82	541	164	129	710
Threonine	311	294	298	1547	383	302	2353
Isoleucine	361	352	356	2112	577	483	2398
Leucine	1011	646	655	3030	862	809	3226
Lysine	225	296	300	2483	365	239	3300
Methionine	145	135	137	528	203	138	836
Cystine	101	102	103	698	292	210	548
Phenylalanine	246	237	240	1226	495	348	1384
Tyrosine	354	377	382	1943	657	577	1902
Valine	398	524	531	2062	616	453	2723
Arginine	275	432	438	2842	636	466	2250
Histidine	161	126	128	937	271	210	1251
Alanine	776	-	-	1616	465	317	3456
Aspartic Acid	968	354	359	4766	725	455	5232
Glutamic Acid	1377	1027	1041	7211	4156	3653	6334
Glycine	265	513	520	1641	812	381	242[illegible]
Proline	651	363	368	2641	1389	1254	1983
Serine	441	381	386	2565	614	542	265[illegible]
Minerals							
Ash	800	1200	500	4600	1700	430	7100
Calcium	6	32	24	199	41	16	210
Phosporus	(164)	221	94	558	372	87	(1753)
Sodium	(1)	9	5	1	3	2	(51)
Potassium	-	214	92	1660	370	95	1894
Vitamins							
Thiamine	0.20	0.34	0.07	0.85	0.55	0.06	15.61
Riboflavin	0.06	0.05	0.03	0.31	0.12	0.05	4.28
Niacin	1.4	4.7	1.6	2.1	4.3	0.9	37.9

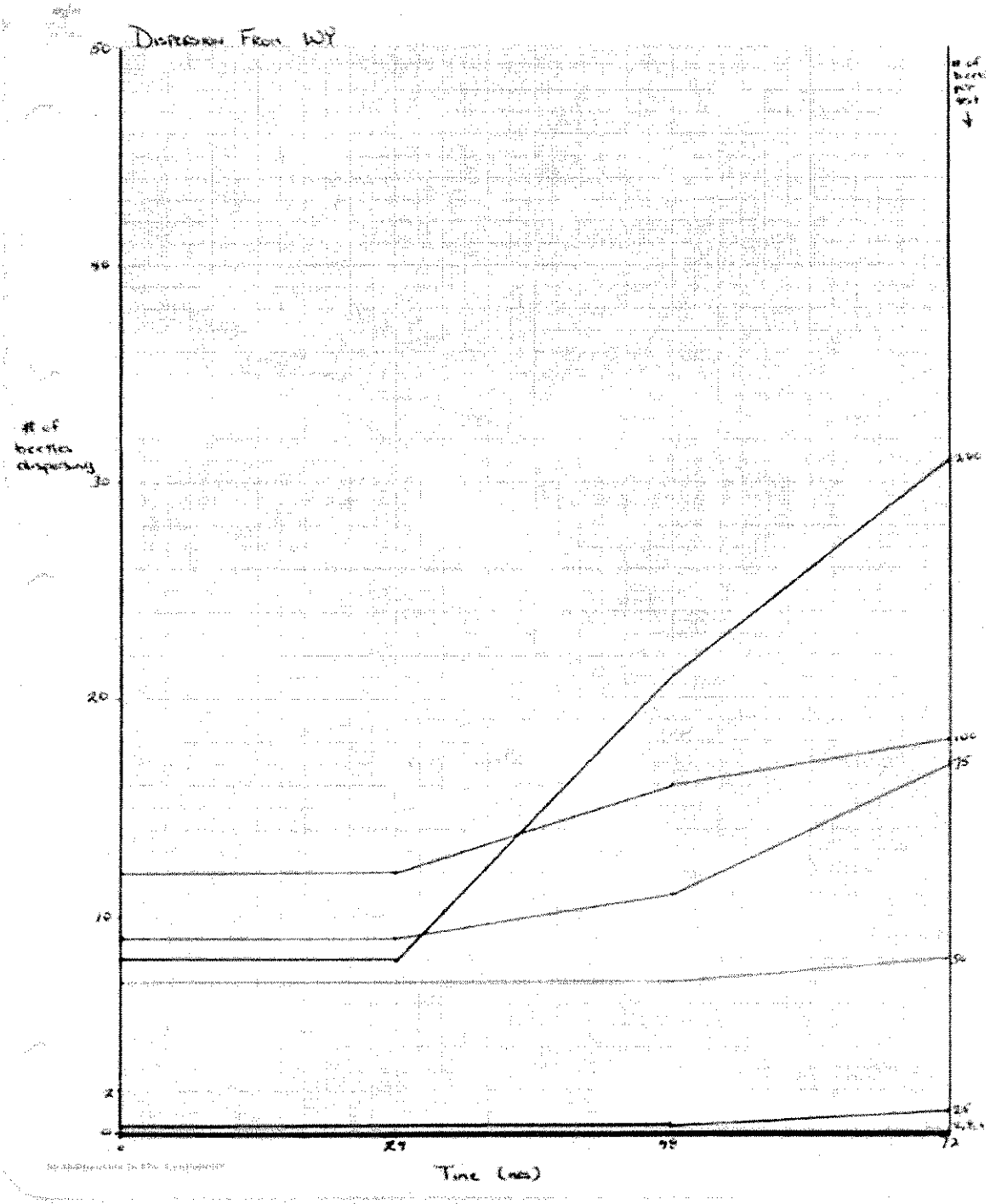
* Adapted from ORR and Watt (1957). The above foods have the following protein content and nitrogen conversion factors: corn – 7.8% protein, n * 6.25; rice, brown – 7.5% protein, n*5.95; rice, polished – 7.6% protein, n*5.95; soybean flour (full-fat) – 35.9% protein, n*5.71; wheat flour-whole – 13.3% protein, n*5.83; patent flour – 10.5% protein, n*5.70; and brewer's yeast (dried) – 7.4% protein, n*6.25 (here the total n is equivalent to 36.9 protein).

Table 17. Food choice and oviposition of 5 species of Tribolium

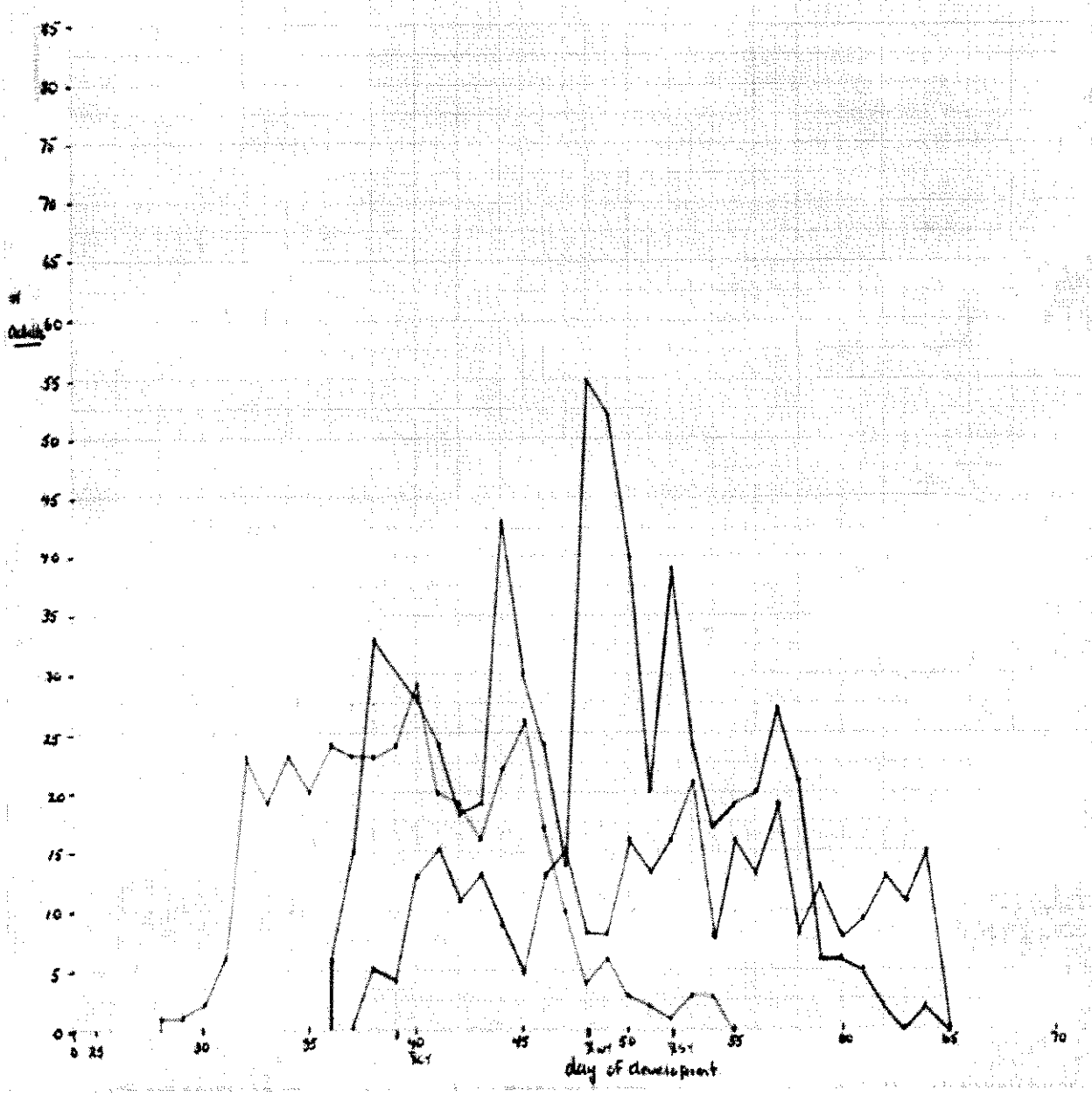
	T. audax			T. brevicornis			T. castaneum			T. confusum			T. madens		
	M	F	Eggs	M	F	Eggs	M	F	Eggs	M	F	Eggs	M	F	Eggs
Media															
WY	22	13	222	11	10	41	17	24	225	12	12	38	14	25	51
SY	3	5	27	16	10	67	0	1	9	1	7	49	5	6	12
WY	10	7	39	10	11	48	13	16	175	7	8	61	6	14	49
CY	14	16	188	12	13	36	6	12	15	12	20	117	15	12	58
CY	25	24	278	13	11	57	14	26	31	13	36	186	28	20	87
SY	0	0	0	14	13	106	0	1	3	1	0	3	2	0	0

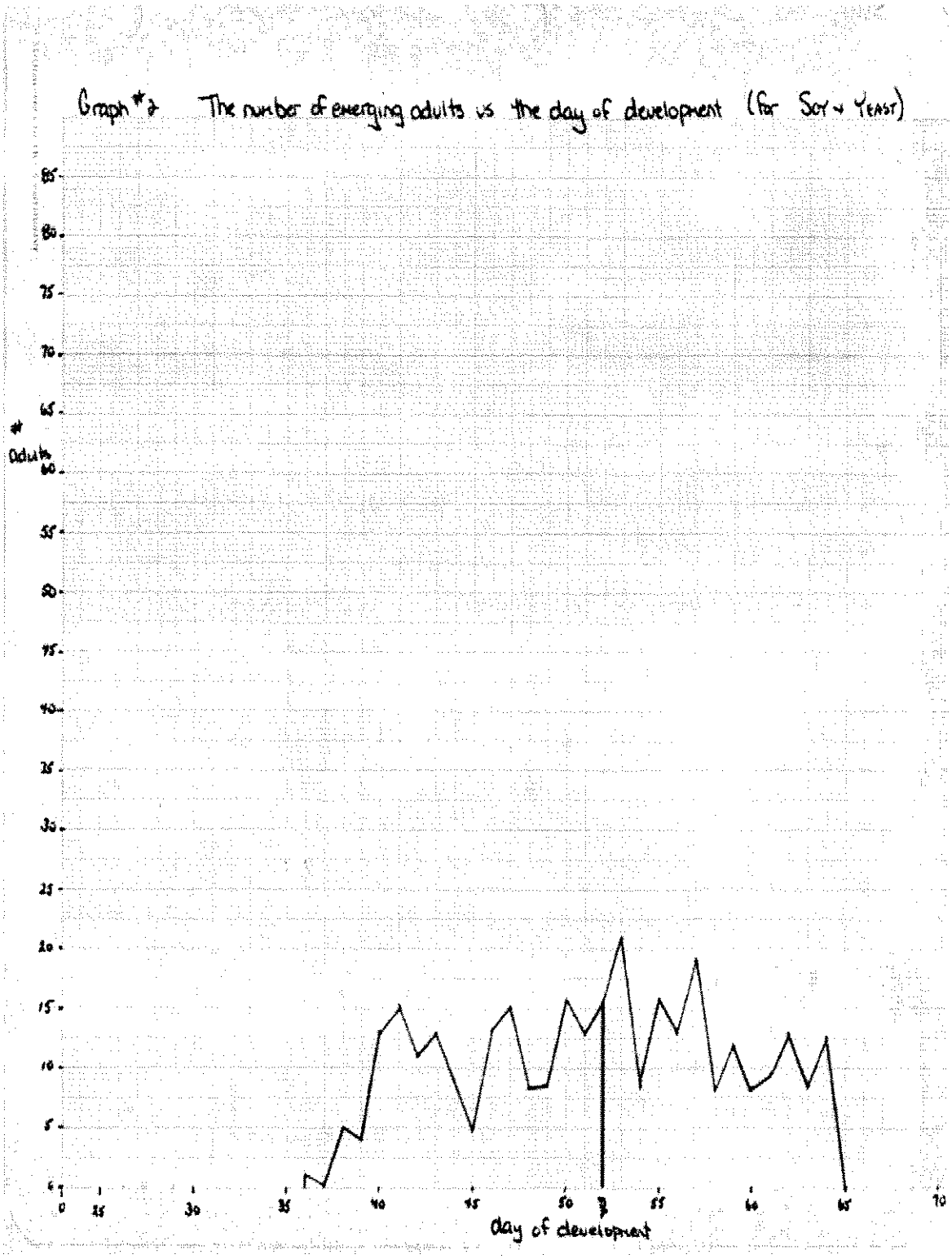

Diffusion from CY
60
12
3
0
0
24
48
72
Time (hrs)

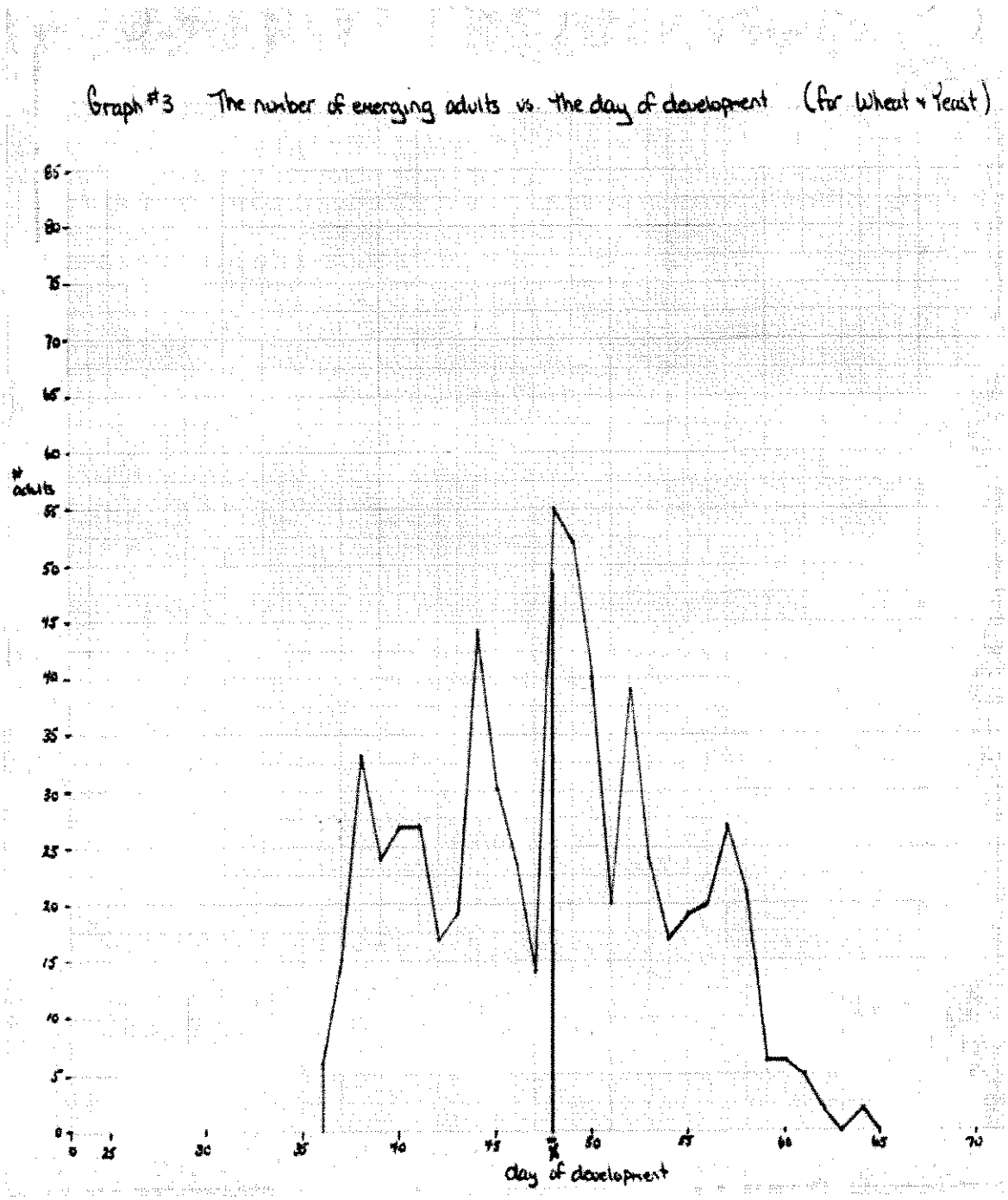

Diffusion From SY
50
40
30
20
10
0
beetle dispersing
0
24
48
72
Time (hrs)
200
100
75
50
32


Dispersion From W2
50
40
30
20
10
2
0
# of beetles dispersing
Time (min)
100
75
50
25

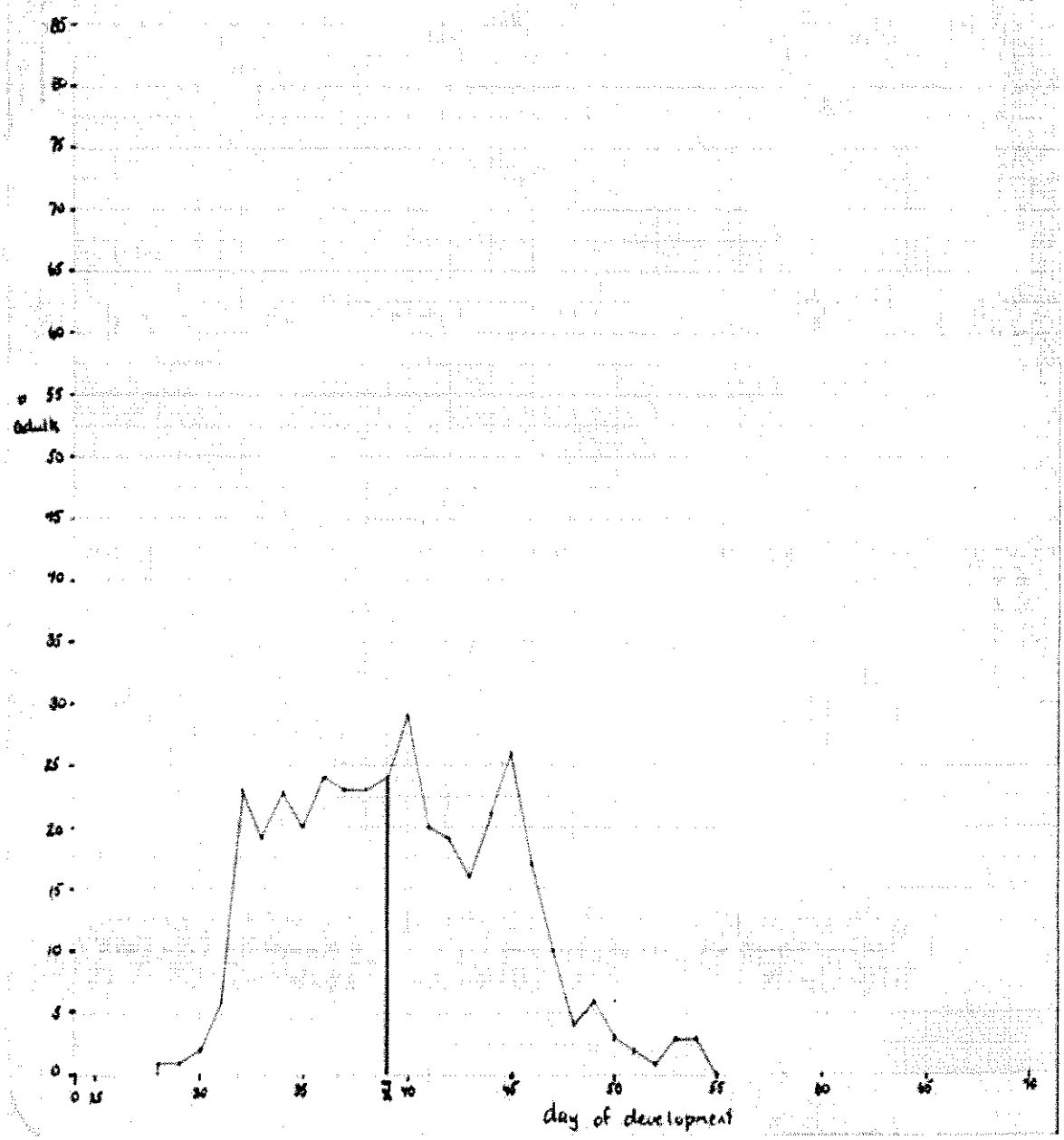
GRAPH #1 The number of emerging adults vs. the day of development. (for each media studied)

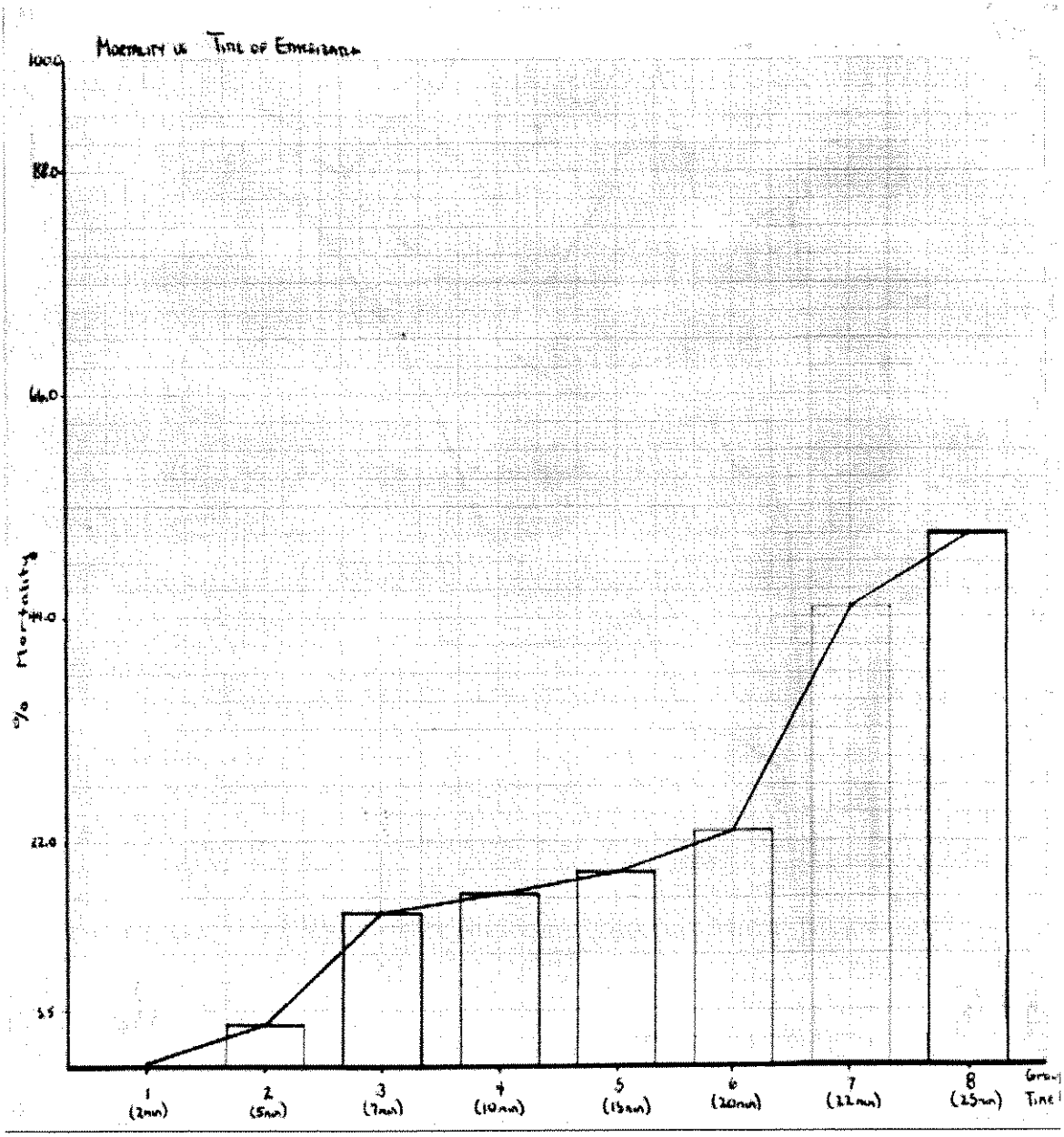


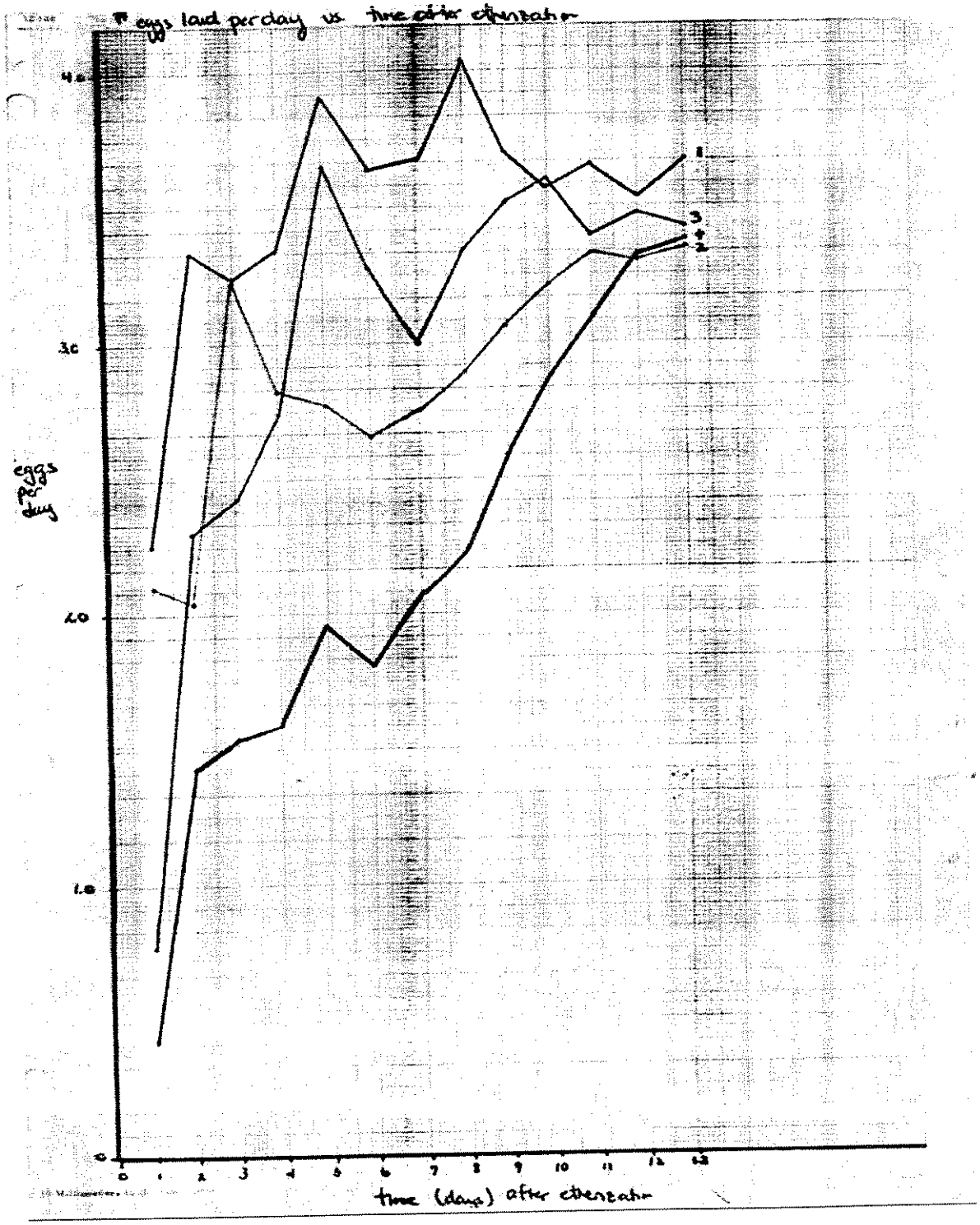

Graph #2 The number of emerging adults vs the day of development (for Sor-4 Yeast)
Adults
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
15
30
35
40
45
50
55
60
65
70
Day of development


Graph #3 The number of emerging adults vs. the day of development (for Wheat + Yeast)
adults
Day of development

Graph # 4 The number of emerging adults vs. the day of development (for Con x Yeas




Mortality vs Time of Emergence
100.0
88.0
66.0
44.0
22.0
5.5
% Mortality
1 (2mm)
2 (5mm)
3 (7mm)
4 (10mm)
5 (15mm)
6 (20mm)
7 (22mm)
8 (25mm)


eggs laid per day vs time after eclosion
4.0
3.0
2.0
1.0
0
eggs per day
0 1 2 3 4 5 6 7 8 9 10 11 12 13
time (days) after eclosion
1
3
4
2

I. Determination of Mean Egg Laying Schedule .... 400 females examined over 72 hour period.

Day	# eggs	# eggs per female	
1	1353	3.38 ± .64	
2	1383	3.46 ± 1.02	$\bar{x} = 3.38 \pm .64$
3	1324	3.31 ± .916	

II. Results

Group	Time (Hour (age)	# Dead Tot	♀	% Mortality	Days after Emergence # egg per female 1	2	3	4	6	6	7	8	9	10	11	12	13
1	2	0	0	0	2.22	3.34	3.24	3.36	3.90	3.69	3.68	3.88	3.70	3.58	3.64	3.54	3.68
2	5	4	2	4	2.10	2.04	3.25	2.83	2.77	2.66	2.75	2.89	3.06	3.33	3.33	3.89	3.35
3	7	15	7	15	.767	2.30	2.42	2.74	3.65	3.28	3.00	3.35	3.51	3.61	3.39	3.48	3.42
4	10	17	8	17	.428	1.42	1.54	1.89	1.95	1.81	2.07	2.24	2.59	2.82	3.09	3.31	3.38
5	15	19	10	19	.200	.925	1.08	1.30	1.43	1.40	1.55	1.85	2.22	2.31	2.70	2.85	3.28
6	20	23	12	23	.921	.763	1.79	1.82	2.89	3.11	3.39	3.29	3.18	3.66	3.37	3.15	3.16
7	22	45	22	45	.178	.421	1.57	1.96	2.96	3.03	3.19	2.89	3.46	3.79	3.54	3.46	3.36
8	25	52	24	52	.166	.458	.875	1.25	1.06	1.63	2.00	2.29	2.79	3.06	2.88	3.25	3.46

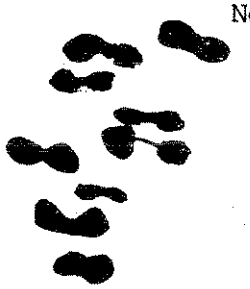


Figure 1. Side view of first meiotic metaphase in a cell from the testes of T. brevicornis showing bipartite chromosomes.

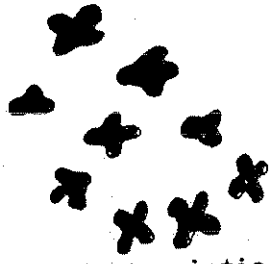


Figure 2. Side view of first meiotic metaphase in a cell from the testes of T. brevicornis showing quadripartite chromosomes.

Figure 3. Polar view of spermatogonial mitosis in the testes of T. anaphe.

Sokoloff, A., Sirotnik, B. and Beeman, C. California State University, San Bernardino, 92404.

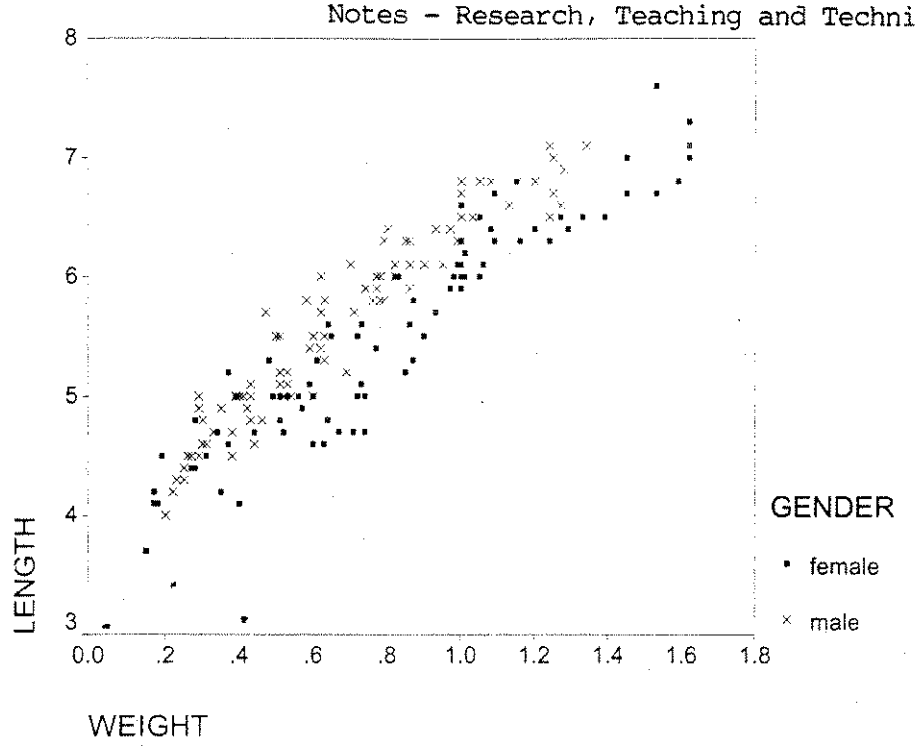
*Length and weight in Tribolium brevicornis Le Conte.

Tribolium brevicornis is one of 33 species known in Tribolium whose biological characteristics have been fairly well determined (See review by Sokoloff in this issue of the Tribolium Information Bulletin). In studying its biological attributes it has been found that males seemed larger than females, which is unusual, since in Insecta females are generally larger than males. (see Sokoloff 1955 and Sokoloff 1972 for information on this topic for Tribolium species and Drosophila species in the pseudoobscura subgroup. It will be seen that males are generally smaller than females).

Measurements of length of a small sample of beetles seemed to verify this visual impression. Since size can be determined by length of the whole animal and its weight, we decided to have data on both of these traits, and thus to be able to decide which data are less arduous to obtain. To this end a sample of 88 males and about 83 females was obtained from a culture, separated by sex, anesthetized, and each weight and length obtained from every individual in the sample. Using Pearson's Correlation the correlation for the two sexes separately and for all cases is significant is significant at the .01 level (2-tailed) as shown in Tables 1, 2, and 3 and depicted in Fig. 1.

By visual inspection (not statistical testing) males of a particular weight tend to be larger than females of the same weight. The difference is slight.

From a practical standpoint, it is probably much easier and more accurate to obtain individuals' weights with a good microbalance than to determine length of each beetle with an ocular micrometer.


8
7
6
5
4
3
LENGTH
0.0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
WEIGHT
GENDER
female
male

Correlations

GENDER = male

Correlations[a]

		LENGTH	WEIGHT
LENGTH	Pearson Correlation	1.000	.953**
	Sig. (2-tailed)	.	.000
	N	88	88
WEIGHT	Pearson Correlation	.953**	1.000
	Sig. (2-tailed)	.000	.
	N	88	88

**. Correlation is significant at the 0.01 level (2-tailed).

a. GENDER = male

GENDER = female

Correlations[a]

		LENGTH	WEIGHT
LENGTH	Pearson Correlation	1.000	.940**
	Sig. (2-tailed)	.	.000
	N	83	83
WEIGHT	Pearson Correlation	.940**	1.000
	Sig. (2-tailed)	.000	.
	N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

a. GENDER = female

Correlations

Correlations -- ALL CASES

		LENGTH	WEIGHT
LENGTH	Pearson Correlation	1.000	.917**
	Sig. (2-tailed)	.	.000
	N	171	171
WEIGHT	Pearson Correlation	.917**	1.000
	Sig. (2-tailed)	.000	.
	N	171	171

**. Correlation is significant at the 0.01 level (2-tailed).

Notes - Research, Teaching and Technical

Grain Marketing and Production Research Center
Biological Research Unit
1515 College Avenue
Manhattan, KS 66502
Telephone: 785-776-2704/FAX 785-537-5584
James E. Throne, Research Leader

RESEARCH HIGHLIGHTS AND TECHNOLOGY TRANSFER FOR 1998-1999

We have collaborated with...

INDUSTRIAL FUMIGANTS AND WHITMIRE, INC., to evaluate a new encapsulated formulation of cyfluthrin as a wheat protectant. (Franklin H. Arthur)

THERMO TRILOGY CORP., Columbia, MD, to evaluate neem products for storage pest control. (James E. Baker)

RALSTON PURINA, INTERNATIONAL PAPER CO., AND SEALED AIR CORP. to develop insect resistant packaging. (Michael A. Mullen)

In molecular research...

GENOME MAP FOR STORED-PRODUCT INSECT PEST. Constructed a complete genome molecular map of the red flour beetle using randomly amplified polymorphic (RAPD) DNA markers, visible mutant markers, and specific gene markers. The map is now being used to facilitate map-based cloning of important insect control genes. (Richard W. Beeman)

NEW MECHANISM OF INSECT RESISTANCE TO BIOPESTICIDE DETERMINED. A proteinase-mediated mechanism of insect resistance to the entomocidal toxins of *Bacillus thuringiensis* has been identified and characterized. Resistant insects lack a proteolytic enzyme that is critical for activation of the precursor forms of the toxins. This knowledge will be helpful in developing strategies for managing resistance to biopesticides in the field. (Brenda Oppert and Karl J. Kramer)

Development of...

THE USE OF NEAR-INFRARED REFLECTANCE SPECTROSCOPY for detection of insect larvae in grain kernels, for disinfestation of insect-infested grain, and for identification of insects. (Floyd E. Dowell/James E. Baker/James E. Throne)

THE USE OF SPATIAL MODEL OF RUSTY GRAIN BEETLE DENSITY and bin temperature to simulate effects of time of aeration, bin size, and latitude on insect populations in stored wheat. Starting automatic aeration controllers at harvest suppressed insects below economic levels until the spring. (Paul W. Flinn and David W. Hagstrum)

BIOCHEMICAL TECHNIQUES TO EVALUATE PROTEINASES IN MIXTURES. Insect proteinases are studied to identify those that may be targeted by biopesticides. Techniques were developed to promote rapid and efficient identification of digestive proteinases in moth and beetle pests of stored products. Researchers from areas other than agriculture have used these assays to study proteinases prior to purification. (Brenda Oppert)

A NEW PHEROMONE TRAP FOR THE INDIANMEAL MOTH. This trap can be used in public areas, but is hidden from view. (Michael A. Mullen and Alan K. Dowdy)

Control of insect pests using...

HEAT AND DIATOMACEOUS EARTH. Laboratory tests indicate that the use of diatomaceous earth in combination with heat has the potential of reducing the temperature or time necessary to effect adequate insect management. (Alan K. Dowdy)

AREA-WIDE IPM FOR SUPPRESSION OF INSECT PESTS IN STORED WHEAT. A 5-year Area-Wide IPM project was recently funded by ARS to determine whether more uniform application of insect pest management across the marketing system could reduce insect problems in stored wheat. The program should

reduce the frequency of pesticide application, the cost of pest management, and the risk of insect problems. (David W. Hagstrum/Paul W. Flinn/James E. Throne/Frank H. Arthur/Alan K. Dowdy/Michael A. Mullen)

OPEN FORUM

OPEN FORUM

Note: This paper, published in 1996 in the Tribolium Information Bulletin 36:83-85 has been shortened and somewhat modified to fit a two-page requirement for the TIB On-Line

Sokoloff, A. Biology Department . California State University, San Bernardino, CA 92407.

*Interactions in Tribolium: Competition or predator-prey?

Population biologists have developed classification systems to define rigorously social interactions between lower organisms. Some interactions between associated populations are of benefit (+), other interactions are harmful (-), and others are neither beneficial nor harmful (0) .In commensalism of two species one benefits while the other is not harmed (+/0). In competition both species are harmed in some way (-/-). In predator-prey or parasite-host inter- actions one species benefits and the other is harmed (+/-) (one species serves as food for the other). We are concern- ed here only in the last two interactions.

As the reviews of King and Dawson (1972) and Sokoloff (1975) have summarized, the late Thomas Park and his students and collaborators studied interactions between Tribolium castaneum (CS) and T. confusum (CF). He concluded that the interaction between these stored-product pests was competition: one of the species or the other was eliminated depending on the environmental conditions used. In the mid-sixties Park et al (1965) and Soko-loff and Lerner (1967) independently came to the conclusion that the interaction observed when these two species are placed in the same vial is a predator-prey interaction and not (as originally assumed by Park and his collaborators and others) a competition interaction. Sokoloff and Lerner thought that under certain conditions (such as rearing CS and CF in whole wheat flour enriched with brewer's yeast at 29° C and 70% R.H. the interaction is one of mutual predation because food is present in abundance and regularly renewed, and under these conditions CS is the winner.. Under the same conditions, but utilizing other media such as corn, CS was eliminated by CF. Again the amount of food is probably in excess , since once CS is eliminated CF experiences a threefold increase in population size. But here the possibil- ity that competition has occurred cannot be ruled out , because certain nutritional required nutri- ents are in limited supply in corn. Evidence that a shortage of these requirements causes CS to become a more ac- tive cannibal was obtained by Inouye and Lerner (1965).

At the time when these experiments were carried out neither Park et al (1965) nor Sokoloff and Lerner (1967) had any experimental basis to show that temperature may be a useful guide to resolve what kind of interaction (competition or predator-prey) is prevailing in the experiment. Bowker (1978) showed in her measurements of energetics of populations of single and mixed species of CF and CS that when beetles are reared at 25° or 30° C predator-prey interactions predominate, while at 35°C competition interactions predominate. Unfortunately, her paper did not attract the attention of Triboliumists: Her paper is not cited by any of the papers on competition or other interaction studies in the last 20 years.

In my opinion, recent students of interactions in Tribolium species, judging from the contents and their titles and the temperatures at which the experiments have been carried out, have misidentified the type of interaction they are observing, perhaps because of an inadequate search of the available literature. To a certain extent reliance on the literature published and available in data bases leads to errors in interpretation such as those I have described here. I have made available the facilities of the Tribolium Information Bulletin as an open forum to discuss the topic. So far only one Triboliumist has shown interest, but the open forum will remain open for a couple of years.

Literature Cited

Bowker, L.S. 1979. The energetics in populations of Tribolium confusum and Tribolium castaneum. Environm. Entomol. 15:1264-1267.

Inouye, N. and Lerner, I.M. 1965. Competition between Tribolium species (Coleoptera: Tenebrionidae) on several diets. J. stored Prod. Res. 1:186-191.

King, C. E. and Dawson, P.S. 1972. Population biology and the Tribolium model. Evol. Biol. 5:133-227.

Park, T., Mertz, D. B. , Grodzinski, W. and Prus, T. 1965. Cannibalistic predation in populations of flour beetles. Physiol. Zool. 38:289-321.

Sokoloff, A. 1975. The Biology of Tribolium with Special Emphasis on Genetic Aspects. Oxford Univ. Press, Vol. 2.

Sokoloff, A. and Lerner, I.M. 1967. Laboratory ecology and mutual predation of Tribolium species.AmerNat.101:261-276.

The following is Dr. Charles Goodnight's opinion about the topic "Interactions in Tribolium: Competition or predator-prey" prepared for the Open Forum.

The interaction between Tribolium confusum and T. castaneum clearly has elements of both competition and predation. It is hard not to consider the eating of one species by another to be anything other than predation. However, when distinguishing between these two processes it is perhaps more important to consider whether the dynamics of the system are better modeled as competition or as predation. As an evolutionary biologist I will not embarrass myself by expressing an opinion on the ecological dynamics. From an evolutionary perspective the evolution of the interaction appears to be best considered to be one of competition (either T. confusum or T. castaneum surviving) at the individual, group and community level. I am doing this selection both on communities (both species transferred between generations) and on systems where only one of the species can evolve, with the other drawn from a stock population each generation. Those data are still very preliminary. As before I am finding no evidence of evolution by individual selection, however there is evidence that group or community selection is changing the outcome of competition.

Several years ago we published a study of the effect of coexistence on the interaction between T. castaneum and T. confusum (Goodnight and Craig, 1996). In this study we set up 10 two species communities and 10 pairs of single species populations. These lines were maintained for 18 generations using discrete generation husbandry (see Goodnight and Craig 1996 for details). The advantage of discrete generation husbandry is that the two communities coexist with neither species going extinct. Nevertheless they interact sufficiently that there is ample opportunity for co-evolution to occur. At the end of 18 generations we set up continuous "Park style" competition (Park, 1948). The two species communities were allowed to compete, and the single species populations were combined into two species communities for the first time. We set 15 replicates for each lineage. Under this continuous form of husbandry it is inevitable that one of the species will go extinct, although the last community had both species surviving for 1000 days.

The outcome of this experiment was that there was no evidence that the two species communities co-evolved, that is there was no significant amount in the treatment component in the outcome of competition. However, there was a huge variation among lineages within treatments in the outcome of the competitive interaction. From this we conclude that there was no consistent evolution of the outcome of competition by individual selection, but the outcome would evolve if group or community selection were imposed. Note that our design could not distinguish between a lack of evolution by individual selection and a balanced "red queen" situation in which the competitive ability of the two species was evolving, but the overall outcome was not changing.

I am currently testing the prediction that competitive outcome can evolve by group and community selection, but not individual selection in an experiment in which I am selecting for the outcome of competition (either T. confusum or T. castaneum surviving) at the individual, group and community level. I am doing this selection both on communities (both species transferred between generations) and on systems where only one of the species can evolve, with the other drawn from a stock population each generation. These data are still preliminary. As before, I am finding no evidence of

I am currently testting the predicition that competitive outcome can evolve by group and community selection, but not individual selection in an experiment in which I am selecting for the outcome of competition

Although certainly not definitive, these experiments suggest to me that from an evolutionarly perspective the two species T. castaneum/T. confusumcommunities are behaving as competitive systems rather than predator-prey systems. The reason for this is that the predator-prey systems are directional, with one species (the predator) benefiting at the expense of the other species (the prey). It seems likely that I could have so a directional change due to individual selection in a directional system, but perhaps not in a competitive system. It is particularly telling that there is no change in the outcome of competition due to individual even when only one of the species is allowed to evolve (Goodnight unpublished data). In a predator-prey system I would suspect that either becoming a more efficieny predator or more resistant predation would be a reasonalble outcome. On the other hand, in a competitive system it is often argued that intraspecific competition should be as intense a selective force as interspecific competition. Thus, the failure of competitive outcome to evolve due to individual selection is perhaps less surprising.

Literature Cited

Goodnight, C. J. and D.M. Craig. 1996. Theeffect of coexistence on competitiveoutcome in Tribolium castaneum and T. confusum. Evolution 50:1241-1250.

Park, T. 1948. Experimental studies of interspecies competition. I. Competition between populations of flour beetles, Tribolium confusum Duval and Tribolium castaneum Herbst, Ecological Monographs 18:265-305.

GEOGRAPHICAL DIRECTORY

GEOGRAPHICAL DIRECTORY

NOTE: An asterisk denotes the individual who, as far as known, has worked or is working on Coleoptera. The plus sign (+) before the geographical locality indicates there was no current contribution. Since the information was obtained from previous issues of TIB, there is no guarantee that the information is accurate.

AUSTRALIA

+Brisbane, Queensland
Department of Primary Industries
Entomology Laboratory
Meiers Road, Indooroopilly

*Champ, B.R., B.Agr.Sc., Ph.D., D.I.C. Entomologist, storage pests, insecticide resistance. (7, 12)

Indooroopilly, Queensland, Australia
Queensland Department of Primary Industries
Entomology Branch

Bengston, M., Ph.d. Grain protectants, fumigants, stored products pest management.
Collins, P. J., Ph.d. Insecticide and fumigant resistance, fumigation, stored products pest management.
Daglish, G. J. Ph.D. Grain protectants, fumigants, stored products pest management.

Melbourne, Victoria
Plant Research Institute
Department of Agriculture
Burnley, Victoria 3121

Braby, M.F. (8, 12, 18)
Williams, F., B.Sc., A.R.C.S., Ph.D., D.I.C., M.I. Biol. (8, 12, 18)

BANGLADESH

Rajshahi 6205
University of Rajshahi, Department of Zoology

Mahbub Hasan, M.D., Research Fellow
Khalequzzaman, M., Professor
Khan, A.R.
Mondal, K.A.M. Shahadat Hossain, Ph. D.
Rahman, S.M.
Saleh Reza, A.M.

DIRECTORY - GEOGRAPHICAL

BELGIUM

+Gembloux
Institut Agronomique de l'Etat
Zoologie Generale

Leclercq, Jean, Ph.D.

+Gembloux B-5030
Faculté Universitaire des Sciences Agronomiques
Unite de Zoologie General et Appliquée
2 Passage des Deportes

Ludovic, Arnaud, Dr.

+Louvain
F.A. Janssens Memorial Laboratory for Genetics
Agricultural Institute of the University
Heverlee, Louvain

*Lints, F.A., Ph.D. Premier Assistant U.C.S. Physiological genetics. (7)
Wattiaux, J.M., Ph.D. Charge de Recherches au F.N.R.S. Age effects. (13)

CANADA

+Guelph, Ontario
Department of Animal and Poultry Science
Ontario Agriculture College
University of Guelph

Friars, G.W., Ph.D. Population genetics. (7)

+Cooperative Electron Microscopy:

Grinyer, I., Scientist. Department of Avian Pathology and Wildlife Diseases, University of Guelph. (4)

+Saskatoon, Saskatchewan
University Campus
Research Station
Research Branch, Agriculture Canada

Davis, G.R.F., Ph.D. Insect nutrition and Biochemistry. (10, 13)

Winnipeg, Manitoba R3T 2M9
Ecology of Field and Stored Product Pests Section
Agriculture and Agri-Food Canada
Research Station
Stored Products Section
195 Dafoe Road

Dr. David Abramson: Mycotoxicology, Analytical Chemistry.
Mr. Colin J. Demianyk: Biologist; Insects Ecology, Industry Relations
Dr. Paul G. Field: Entomology, Physiology, Insect Behavior.
Dr. John T. Mills: Mycology, Ecology.
Dr. Noel D.G. White Section Head: Entomology, Insecticides, Physical controls.

CHINA, PEOPLE'S REPUBLIC OF

Beijing
Beijing Agricultural University
Department of Animal Science

Zhang, L. M.Sc. (7)
Zhang, Qimeng B.Sc., Statistics
BAI, LIHUA, Technician
CHANG, CHUN. Graduate student

COLOMBIA

Bogota, D.E., Colombia, S.A.
Universidad Nacional
Depto. de Biologia
Apdo Aereo 23227

Nunez, F. Genetics of Tribolium. Natural insecticides.

CROATIA

Zagreb
Rudjer Boskovic Inst.

Domazet-Loso, Tomislav, Dr.

FRANCE

+Villeurbanne (Lyon) Rhone
Laboratoire de Biologie
Institut National des Sciences Appliquees

Laviolette, P. Professeur. Head of the department.

GERMANY

Zoologisches Institut

der Universität München

Luisenstrasse 14, 80333 München

Tautz, Diethard (Professor)	Evolution and development; Segmentation in Drosophila, Tribolium and zebrafisch.
Schroeder, Reinhard (Postdoc)	Head- and terminal gap genes; antibodies, antisense, CALI technique.
Wolff, Christian (Postdoc)	Function of Tribolium upstream elements in Drosophila.
Klingler, Martin (Res. Associate)	Embryonic lethal mutations in Tribolium affecting segmentation, appendage formation; transposon-mediated transformation; evolution of enhancer elements.
Berghammer, Andreas (Ph.D. stud.)	Transformation of Tribolium
Bucher, Gregor (Ph.D. student)	Tribolium gap-gene mutants
Maderspacher, Florian (Ph.D. st.)	Triblium pair-rule mutants

Martin Klingler

DIRECTORY - GEOGRAPHICAL

GREAT BRITAIN

+Newcastle upon Tyne
The University of Newcastle upon Tyne, School of Agriculture

List of members working on *Tribolium* and other coleopterous species.

1. Name: **Abdul Rahman Dhuyo**

Degree held: M.Sc. (Agri. Entomology)

Field of work: Biological control of *Prostephnus* and *Tribolium* species.

2. Name: **Abdur Rauf**

Degree held: M.Sc. (Agri. Entomology)

Field of work: Enzymatic mechanism of resistance to insecticides in *Tribolium* and *Sitophilus* species.

3. Name: **Fazalullah.M Bughio**

Degree held: M.Sc. (Agri. Entomology)

Field of work: Rice grain resistance to *Tribolium* and *Sitophilus* species.

4. Name: **Ovais Safader Pathan**

Degree held: M.Sc. (Agri. Entomology)

Field of work: Wheat grain resistance to *Tribolium* species.

CHATHAM, KENT, ME4 4TB, U.K.
Storage Department
Natural Resources Institute (NR.)
Central Ave.,
Chatham Maritime

Brice, J. B. Sc. Storage and fumigation technology.

Compton, J.A.F. B.Sc., MsC. Farm and village level storage management
Dales, M.J. B. Sc. PhD. Control of stored-product insects (Chemical dusts, botanicals, IGR's). aFumigation with carbon dioxide.
Donaldson, J. M.Phil. Farming systems, training, project management
Farrell, G. B. Sc. M.Phil. Farming systems, training, project management
Freeman, N. Biology and behavior of stored product pests.
Giles, P.H., B.Sc., D.I.C., Dip.Agric.Sci., M.I.Biol. Stored products technology. Biology and control of insect pests. (12)
Golob, P., B.Tech., Ph.D. Control of stored product pests, especially with insecticides. (8, 12, 18)
Gudrups, I. B.Sc. PhD F.R.E.S. biology and Behavior of stored products pests.
Haines, C.P., B.Sc., Ph.D. Stored products entomology and acarology. Control by pheromones and natural predators. (2, 6, 12, 17)
Hodges, R.J., B.Sc., Ph.D. Stored products entomology. Control and inspection procedures using pheromones. (12)
Orchard, J. Ph. D. Biochemist, resistance of grains to insect attack.
Prevett, P.F., B.Sc., Ph.D., D.I.C., A.R.C.S., M.I. Biol. Deputy Head of Centre. Biology and control of storage insects. (6, 12, 17)
Taylor, R.W.D. B. Sc. Control of stored-product pests, especially awith fumigants.
Wright, M. B.Sc., M.Sc., PhD. Storage technologist. Project management.

NORWICH, NR4 7TJ
University of East Anglia
School of Biological Sciences

Hewitt, G. M.
Rubio, J. M.
Vazquez, P.

SLOUGH, BERKS.
ADAS Central Science Laboratory

Adams, R.G.	Insect identification
Bell, Dr. C.H.	Non chemical control, fumigation, development biology.
Binns, T.J.	Insecticide efficacy and resistance
Cogan, P.M.	Insect monitoring
Cox, Dr. P.D.	Stored product entomology
Mills, Dr. K.A.	Fumigation, controlled atmospheres, gene-
Muggleton, Dr. J.	Insecticide resistance, population genetics
Prickett, Dr. A.J.	Insecticides, resistance statistics (S, 7,
Walter, Miss C.	Insecticide biochemistry

Infestation Risk Evaluation Group
Mrs. S. Henderson
Mrs. C. Trowe

INDIA

Delhi
University of Delhi
Department of Zoology

Saxena, K.N., Senior Scientist (12, 13)

New Delhi 11 00 12

Saxena, J.D., Ph.D. Insecticide Resistance (7,8)
Sinha, S.R. M.Sc. Dip. Journ. Insecticide Resistance
Srivastava, Chitra, Ph.D. Insecticide Resistance

Ludhiana 141 004
Punjab agricultural University
Department of Entomology

Bakhetia, D.R.C. professor cum Head
Chawla, R.P. Ph.D. Insecticide resistance, lab. bioefficacy.
Jaia, B.S. Ph.D. Insecticide resistance, lab. bioefficacy
Ramzan, M. Ph.D. Biology lab and field evaluation of grain protectants.
Udeaan, A.S. Ph.D. fumigants resistance.

DIRECTORY - GEOGRAPHICAL

ISRAEL

Jerusalem

Vision Research Laboratory
Hadassah University hospital

Yinon, U, Ph. D.

The Hebrew University of Jerusalem
Department of Genetics

Ritte, Uzi. Ph. D.

Tel-Aviv
Tel-Aviv University
Department of Zoology

Front, Lilach	B.Sc.	Graduate student
Levi , Tamar		Technician
Wool, David	Ph.D.	Professor
Zeigerman, Haim	B.Sc.	Graduate student

JAPAN

IBARAKI 305, TSUKUBA
University of Tsukuba
Institute of Biological Sciences

Fujii, Koichi, Professor, Ph. D. Population ecology of stored product insects
Nishimura, Kinya, Ph.D. Research Associate. Population ecology of parasitic wasps

DIRECTORY - GEOGRAPHICAL

IBARAKI 305
Kan -nondai, Tsukuba
National Food Research Institute
Ministry of Agriculture, Forestry and Fisheries
Stored Product Entomology Laboratory

Fujii, Hiroshi, Ph.D.
Ikenaga, H.
Imura, O. Ecology and Genetics
Mitsui, E. Ecology
Nakakita, H., Ph. D. Physiology and Fumigants

IBARAKI 305
Tsukuba Norindanchi, P.O. Box 5
National Institute of Animal Industry

Takebe, A., Ph.D.

OKAYAMA
Okayama University
Faculty of Agriculture
Laboratory of Applied Entomology

Yoshida, T., Population ecology and biology of stored product insects (2,5,10)

MEXICO

Mexico City 20, D. F.
Universidad Nacional Autonoma de Mexico, Instituto de Biologia
Departamento de Zoologia, Laboratorio de Entomologia

Ramos-Elorduy de Conconi, Julieta, Ph. D. (9)

NEW ZEALAND

+AUCKLAND, Private Bag
Entomology Division
Department of Scientific and Industrial Research

Singh, Pritam, Ph. D. Rearing

Watt, J.C., Ph. D., Systematics (5, 17)

POLAND

30-060 KRAKOW
Institute of Environmental Biology
Jagiellonian University
M. Karasia 6.
Jasienski, M.
Korzeniak, U.
Korona, R.
Krawczyk, J.
Lomnicki, A.
Ombach, J.

WARSAW
Szkola Glowna Gospodarstwa Wiejskiego
Katedra Entomologii Stosowanej

Boczek, Jan Ph.D. (5,7,13)

05 092 Lomianki
Dziekanow Lesny near Warsaw
Institute of Ecology, Polish Academy of Sciences
Laboratory of Ecophysiology of Invertebrates
Tel. (48 22) 353046 Tlx 817378 Fax (48 22) 349100
Bijok, Pawel Ph.D. (5,7,13)
Prus, Miroslawa, Ph.D. (5,7,13)
Prus, Tadeusz, Assistant Professor, Laboratory head (5,7,13)
Macko, Anna, M. Sc. (5,7,13)

PAKISTAN

UNIVERSITY OF THE PUNJAB
DEPARTMENT OF ZOOLOGY
CELL AND MOLECULAR BIOLOGY LABORATORY

PROF. DR. ABDUL RAUF SHAKOORI, D. Sc. (Stuttgart)
Insecticide Toxicology/Pesticide Resistance/Biopesticides/Molecular Biology

DR. MUSHTAQ A. SALEEM, Ph. D (Punjab)
Insecticide toxicology

MR. ABDUL MUJEEB, M. Sc. (Punjab)
Insecticide resistance, Insecticide toxicology

MS. MAMOONA ISHAQ
Insecticide resistance

MS. BUSHARA MUNIR
Insecticide Toxicology

POLAND

INTERNATIONAL CENTRE OF ECOLOGY
POLISH ACADEMY OF SCIENCES
05-092 LOMIANKI, DZIEKANOW LESNY NEAR WARSAW

1) PROFESSOR DR. TADEUSZ PRUS (Population, phenotypic differentiation)
2) DR. PAWEL BIJOK (Ecophysiology, phenotypic differentiation)
3) DR. MIROSLAWA PRUS (Impact of TCP on populational and physiological parameters)

SENEGAL

ISRA-CNRA - Centre National de Recherches Agronomiques - B.P. 53 Bambey
(221) 973 60 50/51/54 - Fax (221) 973 60 52 - Code NINEA : 0120 212

D. SECK Ph.D (IPM, Natural Protection)
E. ALIAS MCS (Technology Post Harvest)
B. SIDIBE BSC (IMP, Natural Protection)

SPAIN

MADRID
Instituto Nacional de Investigationes Agronomicas
Laboratorio de Genetica de Poblaciones

*Barrera, Antonio; Prto. Agr. Population Genetics. (7)
Campo, Jose Luis; Dr. Ing. Agr. Population Genetics and Poultry Breeding. (7)
Carceles, Francisco; Prto. Agr. Poultry Breeding. (7)
*Diez-Barra, Rafael; Prto. Agr. Population Genetics. (7)
*Frias, Angel; Prto. Agr. Population Genetics. (7)
*Fuentes, Ma. Carmen; Dr. Ing. Agr. Population Genetics. (7)
*Jodar, Bartolome; Dr. Ing. Agr. Population Genetics. (7)
*Lopez-Fanjul, Carlos; Dr. Ing. Agr. and Ph.D. Popul. Genetics. (7)
*Orozco, Fernando; Dr. Ing. Agr. and Ph.D. Head of Department Population Genetics and Poultry Breeding. (7)
*Ruano, Ramiro G.; Dr. Veterinario. Population Genetics. (7)
*Silvela, Luis; Dr. Ing. Agr. and Ph.D. Population Genetics. (7)
*Tagarro, Ma. Pilar; Prto. Agr. Population Genetics. (7)

*Actually working with Triticale.

+Madrid
Escuela Tecnica Superior de Ingenieros Agronomos
Catedra de Genetica

Espinos, A., Prof. Enc. Lab. Genetica General. (7)
Nuez, F., Prof. Enc. Lab. Mejora Genetica. (7)

PALMA DE MALLORCA 07071

PALMA DE MALLORCA 07071
Universitat de les Illes Balears
Departamento de Biologia Ambiental
Laboratorio de Genetica

List of Members

Prof. E. Petitpierre - Cytogenetics, cytotaxonomy and Evolutionary Genetics of Chrysomelidae and Tenebrionidae. Satellite DNA and heterochromatin of Tenebrionidae.

Dr. Carlos Juan - Molecular phylogeny and phylogeography of Tenebrionidae and Chrysomelidae. Satellite DNA and heterochromatin of Tenebrionidae.

Dr. Claudia Garin (Argentinian postdoc) - Molecular phylogeny of Chrysolina and Oreina (Chrysomelidae).

Mr. Juan Pons - Satellite DNA, heterochromatin and evolution of Pimelia (Tenebrionidae), particularly those of the Canary Islands.

Mr. Jesús Gómez-Zurita - Molecular phylogeny and evolutionary cytogenetics of Timarcha (Chrysomelidae).

UNITED STATES

CALIFORNIA

+BERKELEY, CALIFORNIA 94720
University of California
Donner Radiation Laboratory

Hayes, T.L., Ph.D. (4)

SAN BERNARDINO, California 92407
California State University
School of Natural Sciences
Department of Biology

Brownlee, Aaron, M.S.
[illegible], student assistant
Mankau, Sarojam, Ph. D. (11)
Sokoloff, Alexander Ph. D. (5,7)

S. SAN FRANCISCO, California 94080
Exelixis Pharmaceuticals, Inc.
260 B Littlefield Avenue

Margolis, Jonathan

CONNECTICUT

STORRS, CONNECTICUT

University of Connecticut
Department of Biology

Bancroft, J. S.

DIRECTORY - GEOGRAPHICAL

FLORIDA

GAINESVILLE, Florida
U.S.D.A.
Biology Research Laboratory

Agee, H.R., Research Entomologist
Ashley, T.T., Asst. Prof., Univ. of Florida
Calkins, C.O., Research Entomologist
Callahan, P.S., Research Entomologist
Chambers, D.L., Research Entomologist-Laboratory Director
*Coffelt, J.A., Research Entomologist
Doolittle, R.E., Research Chemist
*Ferkovich, S.M., Research Entomologist
Greany, Ph.D., Asst. Prof., Univ. of Florida
Hamilton, P.W., Research Entomologist
Huettel, M.D., Asst. Prof., Univ of Florida
Leppla, N.C., Research Entomologist
*Marzke, F.O., Research Entomologist
Mayer, M.S., Research Entomologist
Mitchell, E.R., Research Entomologist
McLaughlin, J.R., Asst. Prof., Univ. of Florida
*Oberlander, H., Research Physiologist
Sharp, J.L., Asst. Prof., Univ. of Florida
Silhacek, D., Research Chemist
*Sower, L., Research Entomologist
Spencer, N.R., Research Entomologist
Stanley, J.M., Agricultural Engineer
Tingle, F.L., Research Entomologist
Tumlinson, J.H., Research Chemist
Turner, W.K., Agricultural Engineer
*Vick, K., Research Entomologist
Webb, J.C., Agricultural Engineer

*Working with stored products insects.

DIRECTORY - GEOGRAPHICAL

IDAHO

+POCATELLO, Idaho 83201
Idaho State University
Department of Biology

Minshall, G. Wayne (5)

ILLINOIS

CARBONDALE, Illinois 62901
Southern Illinois University at Carbondale
Department of Zoology

Englert, DuWayne C., Ph.D., Professor (5,6,7)

CHICAGO, Illinois 60637
University of Chicago
Department of Ecology and Evolution

Wade, Michael J., Ph.D. Departmental Chair. Ecology, Population Ecology, Genetics and Phenotypic Variation, Speciation (2, 5, 7)
Johnson, Norman A. Ph. D. Research Associate

River Forest, Ill.
Rosary College
Dept of Natural Sciences

Craig, David M.

INDIANA

BLOOMINGTON, IN 47405
Indiana University
Jordan Hall
Department of Biology

Wade, Michael J., Ph.D.

WEST LAFAYETTE, IN 47907
Purdue University
Department of Animal Sciences

Muir, W.M. Ph.D. Population and Quantitative Genetics (7,16)

Directory - Geographical

KANSAS

Manhattan, Kansas
Kansas State University
Department of Biology

Denell Lab

Program Director: Rob Denell

Research Associate Professor and co-PI: Sue Brown

Research Assistants: Mardi Denell (Bookkeeping and genetics)
Kay Hummels (Immunohistochemistry)
Barbara Van Slyke (molecular biology)

Graduate Students: Teresa Short (molecular analysis of HOMC, *mxp*)
Marcé Lorenzen (transformation of Tribolium)
Carmelle Curtis (molecular analysis of HOMC, *Cx*)
Wensheng Nie (molecular analysis of HOMC, *lab*)

Manhattan, Kansas
Grain Marketing Research Laboratory
Biological Research Unit

Beeman Lab

Program Director: Dick Beeman

Research Assistants: Sue Haas (homeotic genes, genetic stocks)
Sara Brown (genetic mapping)
Beth Stone-Smith (genetic mapping)
Kathy Leonard (genetic mapping)

Graduate Students: Marcé Lorenzen (transformation of Tribolium)

Directory - Geographical

Biological Research Unit
Grain Marketing and Production Research Center
1515 College Avenue
Manhattan, Kansaas66502

Research Staff and Areas of Research Emphasis

Dr. Frank H. Arthur (785) 776-2783, **arthur@usgmrl.ksu.edu**	Applied Insect Management, Control Strategies
Dr. James E. Baker (785) 776-2785, ***baker@usgmrl.ksu.edu***	Parasitoid Biology and Toxicology, Digestive Physiology
Dr. Richard W. Beeman (785) 776-2710, ***beeman@usgmrl.ksu.edu***	Insect Molecular Genetics, Insecticide Resistance
Dr. James F. Campbell (785) 776-2717, ***campbell@usgmrl.ksu.edu***	Insect Behavior
Dr. Alan K. Dowdy (785) 776-2719, ***dowdy@usgmrl.ksu.edu***	Insect Ecology, Molecular Biology
Dr. Paul W. Flinn (785) 776-2707, ***flinn@usgmrl.ksu.edu***	Insect Modeling, Expert Systems, Biological Control
Dr. David W. Hagstrum (785) 776-2718, ***hagstrum@usgmrl.ksu.edu***	Insect Ecology, Modeling, Sampling, Acoustic Detection
Dr. Ralph W. Howard (785) 776-2706, ***howard@usgmrl.ksu.edu***	Chemical Ecology, Biological Control, Insect Hormone Physiology
Dr. Karl J. Kramer (785) 776-2711, ***kramer@usgmrl.ksu.edu***	Insect Biochemistry and Physiology, Biopesticides
Dr. Jeffrey C. Lord (785) 776-2705, ***lord@usgmrl.ksu.edu***	Insect Pathology, Microbial Control of Insects
Dr. Michael A. Mullen (785) 776-2782, ***mullen@usgmrl.ksu.edu***	Insect Monitoring, Insect Resistant Packaging
Dr. Brenda S. Oppert (785) 776-2780, ***oppert@usgmrl.ksu.edu***	Insect Physiology/Toxicology
Dr. James E. Throne (785) 776-2796, ***throne@usgmrl.ksu.edu***	Ecology, Modeling, Seed Resistance to Insects
Dr. Yu-Cheng Zhu (785) 776-2767, ***zhu@usgmrl.ksu.edu***	Molecular Biology, Pesticide Resistance

DIRECTORY - GEOGRAPHICAL

MICHIGAN

ALMA, Michigan 48801
Alma Collegete University
Biology Department

*Grimmes, Karin A.,Ph. D.
Kadish, Anna
Roberts, Melissa M.
Wietstock, Steven M. Ph.D.

MINNESOTA

Department of Entomology
Stored Grain Pest Management Program Tel. 612-624-9[illegible]

Subramanyam, Bhadriraju. Ph. D. Ecology, sampling, and management.
Narayanamma Madamanchi, M.S. Evaluation of chemicals.
Susan Norwood, B.S. (Senior) Laboratory technician.
Mike Tufte, B.S. (Senior) Laboratory technician.

ST. PAUL, Minnesota 55101
University of Minnesota
Department of Genetics and Cell Biology

Braskerud, Ove A. B.A. Associate Scientist (7)
Comstock, Ralph E. Ph.D. Professor (7)
Enfield, Franklin D. Professor (7)

NEW JERSEY

SOUTH ORANGE, New Jersey 07079
Seton Hall University
Department of Biology

Krause, Eliot Ph.D. Genetics and Population Genetics (7)
Kotin, Carol. Undergraduate. Behavioral Genetics

NEW YORK

ITHACA, New York 14850
New York State College of Agriculture
Cornell University
Department of Animal Husbandry

Hogue, D.E., Ph.D. Nutrition (10)
Van Vleck, L.D.,Ph.D. Animal breeding (7)

+ITHACA, New York 14850
New York State College of Agriculture
Cornell University

Knutson, Lloyd V., Ph.D.
Kramer, John h., Associate Professor. 11)

Ohio

+Marietta, Ohio 45750
Marietta College
Department of Biology

Brown, Wm. P. Ph.D. Population genetics (7).

OKLAHOMA

+Norman, Oklahoma 73069
University of Oklahoma
Department of Zoology

Sonleitner, Frank J. Associate Professor (5).

STILLWATER, OK 74078
Oklahoma State University Stillwater
Entomology Department
127 Noble Research Center

Phillips, Tom

RHODE ISLAND

+Kingston, Rhode Island 02881
University of Rhode Island
Department of Zoology, Biological Sciences.
Building 401-792-2372

Costantino, R.F., ph.D., Associate Prof. Population Biology (5, 7).

TEXAS

KERRVILLE, TEXAS 78028-9184
USDA, REE, ARS, SPA, KNIPLING-BUSHLAND
U.S. Livestock Insects Research Lab
2700 Fredericksburgh Rd.

Graham, O.H., Ph.D.

VERMONT

+Burlington, Vermont 05401
University of Vermont
Department of Zoology

Goodnight, Charles J., Ph. D.
Schwartz, James M., Ph. D.
Stevens, Lori, Ph D.
Pray, Leslie (Ph. D. candidate)
Yan Guiyun, M. S. (Ph. D. candidate)
Goff, Peter, (M.S. candidate)

VIRGINIA

Charlottesville, VA 22904
University of Virginia
Deparment of Biology

Howell, Barbara L., M.S. Graduate Student.
Murray, J.J. Ph.D. Ecological genetics (5,7).
Wasserman, Steven S. Ph. D. Assistant Professor

WISCONSIN

KENOSHA, Wisconsin 53141-2000
University of Wisconsin - Parkside
900 Wood Road, P.O. Box 2000
Biology. Sciences

Thomson, Melvin S.

U. S. S. R.

Moscow
All-Union Grain and Grain Products Research Institute

Cherkovskaya, A. Ya.

YUGOSLAVIA

INSTITUTE FOR BIOLOGICAL RESEARCH
"SINIŠA STANKOVIĆ"
UNIVERSITY OF BELGRADE
DEPARTMENT OF INSECT PHYSIOLOGY & BIOCHEMISTRY

ALEKSANDRA ĐURĐEVIĆ	Ass.Res.	Digestive Ezymes,
JELICA LAZAREVIĆ	M.Sc.	Digestive Ezymes
LARISA AL ARID	Ass.Res.	Gen : characterization
SNEŽANA LEKOVIĆ	M.Sc.	Heat stress–Neuroendocrine sys.
SUZANA ĐORĐEVIĆ	Dr.Sci.(PhD)	Stress & Metabolism, Neurohormone
VERA NENADOVIĆ	Dr.Sci.(PhD)	Neuroendocrine syst. - Development
VESNA PERIĆ–MATARUGA	Dr.Sci.(PhD)	Antioxydative Enzymes, Detoxyfication
ZLATKO PROLIĆ	Dr.Sci.(PhD)	Development, Magnetic Field

PERSONAL DIRECTORY

Y. M. ABBOUD
SCHOOL OF BIO. SCIENCES,
BATH UNIV., CLAVERTON
DOWN
BATH BA2 7AY, UK.

A. ABDULAHI
MINISTRY OF AGRIC.,
P.O.BOX 62347
ADDIS ABABA, ETHIOPIA

J. ABELS
F. T. S. LABORATORIES
P.O. BOX 5163
122-126 CHRISTIE ST.
NEWARK, N.J. 07105-5163.

C. ABIVARDI
DEPT. OF ENTOMOLOGY
SWISS FEDERAL INST. OF
TECH.,
CH-8092 ZURICH,
SWITZERLAND

E. ADEM
INSTITUTO DE FISICA, UNAM
APARTADO POSTAL 20-364
DELEGACION ALVARO
OBREGON 01000
D. F., MEXICO

AI. AFIFI
BIOL. CONTORL LAB.
DEPT. OF ENTOMOLOGY AND
PESTICIDES,
FACULTY OF AGRIC.
CAIRO UNIV.,
CAIRO, EGYPT

B.A. AFZELIUS
DEPT. ULTRASTRUCTURE
RES.. BIOL. BLDG. E4,
STOCKHOLM UNIV.,
S-106 91 STOCKHOLM,
SWEDEN

M.S. AHMAD
PAKISTAN AGRIC. RES.
COUNCIL
ISLAMABAD, PAKISTAN

R. AHMAD
DEPT. STUDIES BIO-SCIENCES
MANGALORE UNIV.
MANGALAGANGOTHRI
KONAJE-574 199, INDIA

S. A. AHMAD
DEPT. OF ENTOMOLOGY
KANSAS STATE UNIV.
MANHATTAN KS 66506-4004, USA

MYY. AHMED
INTITUT FUR ANGEWANDTE
ZOOLOGIE, UNIVERSITET
BONN,
D-5300 BONN,
GERMAN FEDERAL REPUBLIC

K.N. AHMED
BCSIR LAB. RAJSHAHI UNIV.
RAJSHAHI-6206, BANGLADESH

M. AHMED
PEST MANAGEMENT RES. INST.
KARACHI UNIV. CAMPUS
KARACHI 75270, PAKISTAN

N. AKHTAR
DEPT. ZOOL., RAJSHAHI UNIV
RAJSHAHI 6205, BANGLADESH

S. A. M. AL-ALAWY
PLANT PROTECTION RES. CENT.
GENERAL BODY APPLIED
AGRIC. RES.
ABU-GHRAIB, IRAQ

E. M. T. AL-HAFIDH
SCHOOL AGRIC. UNIVERSITY
NEWCASTLE UPON TYNE
NE1 7RU UK

M. S. ALAM
STORAGE RES. LAB.
PARC, KARACHI UNIV. CAMPUS
KARACHI, PAKISTAN

P.J. ALBERT
DEPT. BIOL. CONCORDIA
UNIV.,
1455 DE MAISONNEUVE
BLVD. W., MONTREAL, PQ
H3G 1M8,
CANADA

Y. N. ALDRYHIM
PLANT PROTECTION DEPT.
COLLEGE OF AGRIC.,
KING SAUD UNIV.
RIYADH 11451, SAUDI ARABIA

A. ALI
ENTOMOLOGY SECTION
AYUB AGRIC. INST.
FAISALABAD, PAKISTAN

SH. ALI
BCSIR LAB., RAJSHAHI UNIV.
DHAKA, BANGLADESH

M. A. ALIKHAN
DEPT. BIOL., LAURENTIAN
UNIV
SUDBURY, ONT., CANADA

J. ALLOTEY
DEPT. BIOL. SCI., RIVERS
STATE UNIV., SCI. TECHNOL.
PORT HARCOURT, NIGERIA

M. E. ALONSO-AMELOT
GRUPO QUIMICA ECOLOGIA,
DEPT. QUIMICA, FACULTAD
CIENCIAS, UNIV. DE LOS
ANDES
MERIDA 5101 VENEZUELA

HF ALRUBEAI
PLANT PROTECTION DEPT.,
NUCLEAR RES. CENTER.
P.O.BOX 765
BAGHDAD, IRAQ

A. ALVAREZ-FUSTER
LAB. GENETICA DEPT
BIOL. AMBINETAL, CIENCIES
UNIV. ILES BALEARS 07071
PALMA DE MALLORCA, SPAIN

P.M. AMBADKAR
DIV. ENTOMOL., DEP.
ZOOLOGY, M.S. UNIV.
BARODA
BARODA 390 002, INDIA

B.N. ANDEREGG
U.S. GRAIN MARKETTING RES.
LAB
ARS, USDA, MANHATTAN
KANSAS 66502, USA

D. ANDREEV
DEP. ENTOMOL.,
UNIV. WIS. MADISON,
MADISON,
WIS 53706, USA

JC. ANDRIES
UNIVERSITE DES SCIENCES
ET TECHNIQUES DE LILLE,
SERVICE DE BIOLOGIE
ANIMALE
ET LABORATOIRE ASSOCIE
AU
CNRS NO. 148
'ENDOCRINOLOGIE DES
INVERTEBRES' 59655
VILLENEUVE-D'ASCQ LILLE
FRANCE

S.C. ANIOKE
NATIONAL ROOT CROPS RES.
INST., UMUDIKE P.M.B. 7008
UMUAHIA, NIGERIA

C. ARME
PARASITOL. RES. LAB.,
CENT. APPL.. ENTOMOL.
PARASITOL., DEPT. BIOL. SCI.,
KEELE UNIV., KEELE, STAFFS.
ST5 5BG, UK

G. ARNQVIST
ECOLOGY DEPT.
UNIV OF UMEA.
SE 901-87 UMEA, SWEDEN

F. ARTHUR
KANSAS STATE UNIVERSITY
USDA USGMRL
MANHATTAN, KS 66502

Y. ASO
DEPT. OF ENTOMOLOGY
KANSAS STATE UNIV.,
MANHATTAN, KANSAS 66506

ATANASOV
INSTITUT ZA ZASHCHITA NA
RASTENIYATA,
KOSTINBROD, BULGARIA

A. B. ATTYGALLE
CORNELL UNIVERSITY
ITHACA, NY 14850

A. AUDAS
COLL. SCI. TECHNOL.,
ST CLOUD STATE UNIV.,
720 4TH AVE. SOUTH,
ST. CLOUD, MN 56301-4498

K. T. AWADALLAH
BIOLOGICAL CONTROL LAB.
DEPT. ENTOMOLOGY &
PESTICIDES, FAC. AGRIC.,
CAIRO UNIV., EGYPT

JS. AWKNAVAR
DEPT. OF AGRIC.
ENTOMOLOGY
UNIV. OF AGRIC. SCI.,
DHARWAD 580 005, INDIA

P. AZIZ
FOOD TECHNOL.
FERMENTATION DIV., PCSIR
LAB.
FEROZPUR RD,
LAHORE-54600, W. PAKISTAN

BAKANOVA
ALL UNION RES. INST.
PROPHYLAXIS TOXICOL.
DISINFECT., MOSCOW,
RUSSIA

M. BALASUBRAMANIAN
TAMIL NADU AGRIC. UNIV.,
DEPT. OF AGRIC.
ENTOMOLOGY,
COIMBATORE-641 003 INDIA

J.S. BANCROFT
U-43
DEPT. OF BIOLOGY
UNIV. OF CONNECTICUT
STORRS, CT 06269

P.S. BARKER
CANADA DEPT. OF AGRIC.,
RES. STATION WINNIPEG,
MANITOBA.

FM. BARRETT
DEPT.OF ZOOL., TORONTO
UNIV.,
ONTARIO, M5S 1A1, CANADA

P.K. BASAK
A.B.N. SEAL COLLEGE,
COOCH-BEHAR,
WEST BENGAL, INDIA

L.K. BASS
DEP. ENTOMOL.,
UNIV. MARYLAND,
COLLEGE PARK, MD. 20742

J. BAUMGARTNER
INSTITUT FUR
GEFLUGELFORSCHUND,
POULTRY RES. INST.,
900 28 IVANKA PRI DUNAJL,
CZECHOSLOVAKIA

A. BAUR
INST. MIKROBIOL.,
SCHITTSPHANSTRASSE 10,
6100 DARMSTADT, GERMANY

R. BECKER
USDA-ARS, 800 BUCHANAN
ST.,
ALBANY, CA 94710

W.A. BECKER
DEPT. OF POULTRY SCIENCE,
WASHINGTON STATE UNIV.,
PULLMAN WASHINGTON
99163

S.R. BEEVI
COLLEGE OF AGRIC.,
KERALA AGRIC. UNIV.,
VELLAYANI 695 522, INDIA

R.W. BEEMAN
DEPT. OF ENTOMOLOGY,
KANSAS STATE UNIV., AND
U.S. GRAIN MRKTING RES.
LAB., ARS,
USDA, MANHATTAN,
KANSAS 66502

C.J. BELFIKORE
DEP. MOL. BIOL. UNIV.
WYOMING, P.O.BOX 3944,
LARAMIE, WY 82071

M.E. BELL
NORTHEAST MISSOURI STATE
COLLEGE, KIRKSVILLE,
MISSOURI 63501

AK. BEKON
LABORATOIRE DE ZOOLOGIE
AGRICOLE., ENSA 08 BP 35
ABIDJAN, 08 IVORY COAST,
AFRICA

M. BENGSTON
ENTOMOLOGY BRANCH,
DEPT. PRIMARY INDUSTRIES
INDOOROOPILLY,
BRISBANE 4068, AUSTRALIA

R. BEN-SHLOMO
DEP. GENETICS, HEBREW
UNIV.,
JERULALEM, JERUSALEM
91904, ISRAEL

R.L. BENNETT
DIV. OF BIOLOGY,
KANSAS STATE UNIV.,
MANHATTAN,
KANSAS 66506-4901, USA

A.J. BENSON
SOUTHERN ILLINOIS UNIV.
AT CARBONDALE, DEPT. OF
ZOOL.,
CARBONDALE, ILL 62901

H.K. BERGER
BUNDESANSTALT FUR
PFLANZENSCHUTS, A-1020
VIENNA, AUSTRIA

P. BHATIA
NUCLEAR RES. LAB.,
INDIAN AGRIC. RES. INST.,
NEW DELHI 110012, INDIA

P.R. BHATTACHARYYA
DIV. MEDICINAL ECONOMIC
PLANTS, REGIONAL RES.
LAB.,
JORHAT 785 006, INDIA

PAWEL BIJOK
INST. OF ECOLOGY,
DZIEKANOW LESNY NEAR
WARSAW, 05-092 LOMIANKI,
POLAND

O. S. BINDRA
DEPT. OF ENTOMOLOGY,
PUNJAB AGRIC. UNIV.,
LUDHIANA, PUNJAB, INDIA

PN. BLACK
DEPT. OF ZOOLOGY,
UNIV. OF VERMONT,
BURLINGTON, VT 05405

MARGARET C. BLOCH
BIOLOGY DEPT., TUFTS UNIV.,
MEDFORD
MASSACHUSETTS 02155

C.H. BELL
ADAS SLOUGH LAB.,
MINISTRY AGRIC. FISHERIES
FOOD, LONDON RD, SLOUGH,
BERKS SL3 7HJ, UK

C.R.B. BOAKE
DEP. ZOOL., UNIV.
TENNESSEE, M313 WALTERS,
KNOXVILLE, TENN. 37996-0810

CJ. BOASE
CHESTERFORD PARK RES.
STATION, SAFFRON WALDEN,
ESSEX, CB10 1XL, UK

J. BOCZEK
SZKOLA GLOWNA
GOSPODARSTWA
WIEJSKIEGO, KATEDRA
ENTOMOLOGII
STOSOWANG, WARSAW,
POLAND

K.S. BOON
DEPT. ZOOL., NATL. UNIV.
SINGAPORE, LOWER KENT
RIDGE RD.,
SINGAPORE 0511,SINGAPORE

H. BOUHIN
UNIVERSITE DE BOURGOGNE,
DIJON, FRANCE

M. BOUNIAS
UNIV. D'AVIGNON,
BIOMATHEMATIQUE ET
TOXICOL., 23 RUE DU 58E R. I.,
F 84000 AVIGNON, FRANCE

JOHN F. BOYER
DEPT. OF BIOL. SCI., UNION
COLLEGE, SCHENECTADY,
NEW YORK 12308

LESLIE S. BOYER/BOWKER
BIOL. SCI. DEPT., CA.
POLYTECHNIC STATE, SAN
LUIS OBISPO, CA 93407

D.A. BRADBROOK
DEP. BIOL. SCI., EXETER UNIV.
PERRY RD. EXETER EX4 4QG,
DEVON, UK

T. BRIERS
LEUVEN, CATHOLIC UNIV.,
ZOOLOGICAL INST.,
B-3000 LEUVEN, BELGIUM

P.A. BRINDLE
AMERICAN CYANAMID,
PRINCETON, NJ 08540

E.H. BROWN
UNIV. OF ILLINOIS,
DEPT. OF GENETICS AND
DEV'T., 515 MORRILL HALL,
URBANA,
ILLINOIS 61801

W.P. BROWN
MARIETTA COLLEGE,
MARIETTA, OHIO 45750

L.A. BUSCARLET
DPVE, CNETRE DE
CADARACHE, 13108 SAINT
PAUL LEZ DURANCE, FRANCE

A. CABALLERO
DEPT. GENET., FAC. CIENCIAS BIOL., UNIV. COMPLUTENSE, 28040 MADRID, SPAIN

R.E. CALHOUN
DEPT. OF BIOL., QUEENS COLLEGE OF THE CITY UNIV. OF NY, NEW YORK (FLUSHING) N.Y., 11367

E.L. CAMADRO
UNIV.NACIONAL DE MAR DEL PLATA, BALCARCE, BUENOS AIRES, ARGENTINA

J.J. CAMPO
INSTITUTO NACIONAL DE INVESTIGACIONES AGRONOMICAS, MADRID, SPAIN

R.J. CANO
BIOL. SCI. DEP., CALIF. POLYTECHNIC STATE UNIV., SAN LUIS OBISPO, CA 93407

F. CARCELES
INSTITUTO NACIONAL DE INVESTIGACIONES AGRONOMICAS, MADRID, SPAIN

I. CARRERAS
LABORATORIO DE GENETICA, DEPARTAMENTO DE BIOLOGIA AMBIENTAL, UNIVERSITAT DE LES ILLES BALEARES, PALMA DE MALLORCA 07071 SPAIN

J.L. CENIS
DPTO. PROTECCION VEGETAL, CIDA, 30150 LA ALBERCA, SPAIN

E.F. CHAGAS
DAS. DEPTO DE BIOLOGIA, UNIVERSIDADE FEDERAL DO MARANHAO, 65000 SAO LUIS, MARANHAO, BRAZIL

B.S. CHAHAL
DEPT. OF ENTOMOLGY, PUNJAB AGRIC. UNIV., PUNJAB, LUDHIANA -141004, INDIA

H. CHANDER
CENTRAL FOOD TECHNOL. RES. INST., REGIONAL CENTRE, GILL RD., LUDHIANA -141 006, INDIA

N.W. CHANG
DEP. ECOL. EVOL., UNIV. CHICAGO CHICAGO, IL 60637

C. H. C. CHENG
DEP. PHYSIOL. BIOHPYSICS, UNIV. ILL., 524 BURRILL HALL, 407 S. GOODWIN, URBANA, IL 61801

Y. CHIBA
BIOL. INST., YAMAGUCHI UNIV., YAMAGUCHI, JAPAN

W. K. CHON
DEP. AGRIC. BIOL., COLL. AGRIC., KOREA UNIV., SEAOUL 136-701 KOREA

L. CHOROMANSKI
INSTYTUT PARAZYT. PAN. PASTEURA 3, 00-973 WARSAW, POLAND

D. CHOUDHURY
DIV. OF AGRIC. CHEM. INDIAN AGRIC. RES. INST., NEW DELHI 110012, INDIA

D. CIDARIA
INSTITUTO G. DONEGANI, NOVARA, ITALY

J.N. CLARKE
RUAKURA AGRIC. RES. CENTRE, PRIVATE BAG, HAMILTON, NEW ZEALAND

R.E. CLOPTON
SCHOOL BIOL. SCI., UNIV. NEBRASKA-LINCOLN, LINCOLN, NE 68588-011

R. COFIE-AGBLOR
DEPT. AGRIC. ENGINEERING, UNIV. MANITOBA, WINNIPEG, MAN. R3T 2N2, CANADA

R.R. COGBURN
RICE RES. UNIT, USDA ARS. BEAUMONT, TX 77713

E. COHEN
DEPT. OF ZOOL., TEL AVIV UNIV. ISRAEL

P.J. COLLINS
ENTOMOL. BRANCH, DEP. PRIMARY INDUSTRIES, MEIERS RD., INDOOROOPILLY, QUEENSL. 4068, AUSTRALIA

D.B. CONN
DEP. BIOL. SCI., UNIV. CINCINNATI, OH 45221

JL. CONNAT
LABORATOIRE DE ZOOLOGIE. FACULTE DES SCIENCES 2110. DIJON, FRANCE.

J. CONNER
DEP. ECOL. ETHOL. AND EVOL., UNIV. OF ILLINOIS, SHELFORD VIVARIUM, 606 E. HEALEY, S., CHAMPAIGN, IL 61820

F.J.W. CORRAL
DEPTO. DE INVESTIGACION Y POSGRADO EN ALIMENTOS DE LA UNIVERSIDAD DE SONORA, APDO. POSTAL 1658, HERMOSILLO, SONORA, MEXICO

G.W. CORRIVAULT
DEPT. OF BIOL., UNIVERSITE LAVAL, QUEBEC, CANADA

D.M. CRAIG
DEP. NATURAL SCI., ROSARY
COLLEGE, RIVER FOREST,
IL 60305, USA

P. CRAVEDI
ISTITUTO DE ENTOMOLOGIA,
FACOLTA DI AGRARIA,
PIACENZA, ITALY

R.A. CRENSHAW
ZOOL. DEPT., UNIV. OF
GLASGOW W2, UK

K. CROSSNER
DEPT. OF BIOL.,
SETON HALL UNIV.,
S. ORANGE, NJ 07079

P. CUNAT
INST. DE AGROQUIMICA Y
TECNOL. DE ALIMENTOS,
CSIC, JAIME ROIG 11, 46010
VALENCIA,
SPAIN

G.W. CUPERUS
DEP. ENTOMOL., OKLAHOMA
STATE UNIV. STILLWATER,
OKLA. 74078

J.R. CUTLER
AGRIC. SCIENTIFIC SERVICES,
DEPT. OF AGRIC. & FISHERIES
FOR SCOTLAND EDINBURGH,
SCOTLAND, GREAT BRITAIN

G.J. DAGLISH
DIV. PLANT PROTECTION,
QUEENSLAND DEP. PRIMARY
INDUSTRIES, MEIERS RD.,
INDOOROOPILLY,
AUSTRALIA 4068

PJ. DAILEY
DEPT. OF ZOOL., VERMONT
UNIV., BURLINGTON, VT 05405

W.M. DANIEWSKI
INST. ORGANIC CHEM., POLISH
ACAD. SCI., UL. KASPRZAKA 44,
01-224, WARSAWA, POLAND

D. DARMADJA
FAKULTAS, KEDOTERAN
HEWAN AND PETERNAKAN,
UNIVERSITAS UDAYANA,
DENPASAR, BALI, INDONESIA

L.B. DAVENPORT
ARMSTRONG STATE COLLEGE,
SAVANNAH, GEORGIA 31419

J. DAVID
FACULTE DES SCIENCES DE
LYON, LYON, RHONE, FRANCE

J. DELACHAMBRE
DEP. DE BIOLOGIE ANIMALE,
UNIV. DE ANNABA BP 12, 23000
ANNABA, ALGERIE, FRANCE

J. P. DELBECQUE
DEPT. DE BIOL ANIMAL,
UNIV. DE ANNABA,
BP 12, 23000 ANNABA,
ALGERIE, FRANCE

M.A. DELGADO
SOUTHERN ILLINOIS UNIV. AT
CARBONDALE, DEPT. OF ZOOL.,
CARBONDALE, ILLINOIS 62901

E. SOLAR DEL
INSTITUTO DE ECOLOGIA,
UNIVERSIDAD AUSTRAL DE
CHILE, CASILLA 57-D,
VALDIVIA, CHILE

A. DELOBEL
MUSEUM NATL. HIST.
NATURELLE, ANTENNE
ORSTOM, ENTOMOL.,
45 RUE DE BUFFON,
F-75005, PARIS, FRANCE

R.A. DESHARNAIS
DEPT. BIOL.,
CALIF. STATE UNIV.,
LOS ANGELES, CA 90032-8201

J.E. DETURCK
CABRINI COLLEGE, KING OF
PRUSSIA RD., RADNOR, PA 19087

J. DEXTER
ST. ANSELM COLLEGE, DEPT. OF
BIOL., ST. ANSELM DRIVE,
MANCHESTER, NH 03102

C. DEVAKUMAR
DIV. OF AGRIC. CHEMICALS,
INDIAN AGRIC. RES. INST.
NEW DELHI 110012, INDIA

FREDRICK S. DHANASEKARAN
INST. OF PLANT PROTECTION &
TOXICOLOGY, PADAPPAI, TAMIL
NADU, INDIA

S. DHINGRA
DEV. ENTOMOLOGY
INDIAN AGRIC. RES. INST.,
NEW DELHI 110012, INDIA

S. DIBS
BIRZEIT UNIV., FAC. OF SCI.,
DEPT. OF BIOL. & BIOCHEM.,
BIRZEIT, WEST BANK,
JERUSALEM, ISRAEL

R. DIEZ-BARRA
INSTITUTO NACIONAL DE
INVESTIGACIONES
AGRONOMICAS, MADRID, SPAIN

B. H. DIETZ
MUSEU DE ZOOLOGIA
UNIVERSIDADE DE SAO PAULO,
AV. NAZARE 481, 04263-000

N. DION
DEPARTEMENT DE
ZOOTECHNIC, UNIVERSITE
LAVAL, QUEBEC, PQ, G1K 7P4,
CANADA

G.D. DODD
PESTICIDES DIVISION,
WELLCOME FOUNDATION LTD.,
CREWE, CHESHIRE, CW1 1UB, UK

M. DOLCI
ISTITUTO DI CHIMICA FACOLTA
DI AGRARIA, 10126 TURIN,
ITALY

E. DONAHAYE
DEPT. STORED PROD., ARO,
VOLCANI CENTER,
BET DAGAN 50250, ISRAEL

N. DORTBUDAK
AMBAR ZARARLILARI
LABORATUVARI, BOLGE ZIRAI
MUCADELE ARASTIRMA
ENSTITUSU, ANKARA, TURKEY

L.C. DRICKAMER
WILLIAMS COLLEGE,
THOMPSON BIOL. LAB.,
WILLIAMSTOWN, MA 01267

J.S. DUGUET
ROUSSEL UCLAF, HPE, 163 AVE.
GAMBETTA, 75020 PARIS,
FRANCE

F.V. DUNKEL
DEP. ENTOMOL., MONTANA
STATE UNIV., BOZEMAN,
MT 59717, USA

C.M. EASTON
DEP. BIOL. SCI.,
BINGHAMTON UNIV.
BINGHAMTON, NY 13902-6000

E. EGAAS
NORWEGIAN PLANT
PROTECTION INST., AAS,
NORWAY

A.A. EISA
PLANT PROTECTION DEPT.,
FACULTY OF AGRIC., MINUFIYA
UNIV., SHEBIN EL-KOM, EGYPT

A.A.B. ELEGAMI
DEP. BIOCHEM., FAC. AGRIC.,
UNIV. KHARTOUM, KHARTOUM,
SUDAN

M.M. EL-MOFTY
ZOOL. DEPT., FAC. SCI.,
ALEXANDRIA UNIV.,
ALEXANDRIA, EGYPT

A.K.M. EL-NAHAL
DEPT. ECON. ENTOMOL.
PESTICIDES, FAC. AGRIC.,
CAIRO UNIV.,
GIZA, EGYPT

J.R. ELORDUY DE CONCONI
INSTITUTO DE BIOLOGIA UNAM,
LABORATORIO DE BIOLOGIA
UNAM, APDO. POSTAL 70-153,
MEXICO 20, D.F., MEXICO

FMA. EL-SAYED
PLANT PROTECTION INST.,
AGRIC. RES. CENTRE,
DOKKI, EGYPT

H.K. EL-SHERIF
PLANT PROTECTION DEPT.
ENTOMOLOGY DIV., FACULTY
OF AGRIC., ALEXANDRIA UNIV.,
ALEXANDRIA, EGYPT

L.C. EMEBIRI
DEP. CROP PROD., S.A.A.T., FED.
UNIV., TECHNOL., OWERRI,
P.M.B. 1526 NIGERIA

D.C. ENGLERT
DEPT. OF ZOOL., SOUTHERN
ILLINOIS UNIV.,
CARBONDALE, ILLINOIS 62901

R.D. ENRIZ
AREA DE QUIMICA GENERALE
INORGANICA, UNIVERSIDAD
NACIONAL DE SAN LUIS,
CHACABUCO PEDERNERA,
5700 SAN LUIS, ARGENTINA

X. ESPADALER
DEP. ANIM. BIOL. ECOL.,
AUTONOMOUS UNIV.
BARCELONA, 08193
BELLATERRA, SPAIN

A. ESPINOS
ESCUELA TECNICA SUPERIOR DE
INGENIEROS AGRONOMOS,
VALENCIA, SPAIN

P. ESTAL
DEL. CATEDRA DE
ENTOMOLOGIA AGRICOLA,
E.T.S.I. AGRONOMOS,
28040 MADRID, SPAIN

D.E. EVANS
CSIRO DIV. OF ENTOMOLOGY,
CANBERRA, ACT, AUSTRALIA

W.S. EVANS
DEP. BIOL., UNIV. WINNIPEG,
WINNIPEG, MAN.,
CANADA R3B 2E9

A. A. FARAGALLA
DEP. PLANT PROTECTION,
COLLEGE OF AGRIC., KING SAUD
UNIV., RIYADH 11451,
SAUDI ARABIA

W.S. FARGO
DEP. ENTOMOL., DIV. AGRIC.,
OKLAHOMA STATE UNIV.,
STILLWATER, OKLA. 74078

R. FARKAS
SLOVENSKA ENTOMOLOGICKA
SPOLOCNOST' PRI SAV,
BRATISLAVA,
CZECHOSLOVAKIA

D.L. FAUSTINI, PH. D.
PHILIP MORRIS RES. CENTER,
P.O. BOX 26583,
RICHMOND VA, 23261

R.L. FERNANDO
DEPT. ANIMAL SCI. UNIV. OF
ILLINOIS, URBANA,
ILLINOIS 61801, USA

C. FERREIRA
UNIVERSIDADE DE SAO PAULO,
SAO PAULO, BRASIL

S.W. FISHER
OHIO STATE UNIV., COLUMBUS,
COLUMBUS, OHIO 43220

D. FOGLIAZZA
INSTITUTO DI ENTOMOLOGIA,
FACOLTA DI AGRARIA,
PIACENZA, ITALY

J. FRANCOIS
LABORATOIRE DE ZOOLOGIE,
FACULTE DES SCIENCES,
UNIVERSITE DE DIJON,
F-21100 DIJON FRANCE

R.A. FRENCH
COLL. VET. MEDICINE., UNIV.
ILL., 2001 S. LINCOLN AVE.,
URBANA, IL 61801

V. FRENCH
INST. OF CELL, ANIMAL &
POPULATION BIOL., UNIV. OF
EDINBURGH,
EDINBURGH EH9 3JT, UK

A. FRIAS
INSTITUTO NACIONAL DE
INVESTIGACIONES
AGRONOMICAS, MADRID, SPAIN

GW. FRIARS
SALMON GENETICS RES.
PROGRAM, ATLANTIC SALMON
FEDERATION, BOX 429 ST.
ANDREWS, NB EOG 2XO,
CANADA

MARCUS. FRIEDRICH, PH. D.
STUDENT. INSTITUT FUR
ZOOLOGIE. LUISENSTRASSE 14
D-80333 MUNCHEN, GERMANY

MA. C. FUENTES
INST. NACIONAL DE
INVESTIGACIONES
AGRONOMICAS, MADRID, SPAIN

C. FUGANTI
CNR CENT. DI STUDIO PER LE
SOSTANZE ORGANICHE
NATURALI, DIP. DI CHIM.
POLITECNICO DI MILANO,
20133 MILAN, ITALY

H. FUJII
STORED PROD. ENTOMOL. LAB.,
NATIONAL FOOD RES. INST.,
KAN-NONDIA, TSUKUBA,
IBARAKI 305, JAPAN

JI. FUKAMI
LAB INSECT TOXICOLOGY, INST.
PHYS. & CHEM. RES. WAKO,
SAITAMA 351, JAPAN

K. FURUYA
DEPT. BIOCHEM., UNIV.
NEVADA, RENO, NV 89557

R.S. GANDHI
DIV. CATTLE BREEDING, NATL. DAIRY RES. INST., KARNAL, INDIA

C. GARCIA
FACULTAD DE BIOLOGIA, AREA DE GENETICA, DEPARTAMENTO DE BIOLOGIA FUNDAMENTAL, SANTIAGO DE COMPOSTELA, GALICIA, SPAIN

CASADO G. GARCIA
DEP. BIOQUIMICA, E.T.S. INGENIEROS AGRONOMOS, CIUDAD UNIV., 28040 MADRID, SPAIN

GAUR, G.K
DIV. ANIMAL GENETICS
INDIAN VETERINARY RES. INST.
IZATNAGAR, 243122(UP) INDIA

Y. GAZIT
DEP. ENTOMOL., ARO, VOLCANI CENT. BET DAGAN, 50250, ISRAEL

GH. GERBER
RES. STATION, AGRIC. CANADA, WINNIPEG, MANITOBA R3T 2M9, CANADA

J. GERDY
DEPT. OF BIOL., BENISON UNIV., GRANVILLE, OHIO 43023

D.P. GIGA
DEP. SCI., UNIV. ZIMBABWE, P.O. BOX MP 167, HARARE, ZIMBABWE

G. GOERGEN
INSTITUT ORGANISCHE CHEMIE, RICHARD WILLSTAETTER-ALLEE, D-7500 KARLSRUHE, GERMANY

P. GOLD
HEALTH SCI.; STATE UNIV. OF NEW YORK, BUFFALO, NY 14214

J.P.D. GOLDRING
DEP. BIOCHEM., UNIV. WITWATERSRAND, P.O. 2050 WITS, JOHANNESBURG, S. AFRICA

B.R. GOMEZ
INSTITUTO DE NUTRICION DE CENTRO AMERICA Y PANAMA. GUATEMALA, GUATEMALA, C.A.

CHARLES J. GOODNIGHT
DEPT. OF ZOOL., UNIV. OF VERMONT, BURLINGTON, VERMONT 05405-0086

D.M. GORDON
DEPT. ZOOL., KING'S COLL., UNIV. OF LONDON, LONDON WC2R 2LS, UNITED KINGDOM

GRAHAM, O. H.
USDA, REE, ARS, SPA, KNIPLING-BUSHLAND.
U.S. LIVESTOCK INSECTS RES LAB.
2700 FREDERICKSBURG, TEXAS
78028-184.

D. GRAUR
DEPT. OF ZOOL., GEORGE S. WISE FACULTY OF LIFE SCIENCES, TEL AVIV UNIV., P.O. BOX 39040, RAMAT AVIV, TEL AVIV 69978, ISRAEL

C.T. GRIFFIN
DEP. BIOL., ST. PATRICK'S COLL., MAYNOOTH CO. KILDARE, IRELAND

K.A. GRIMNES
DEPT. BIOL., ALMA COLLEGE, ALMA, MI 48801

A. GRISSE
FAKULTEIT LANDBOUWWETENSCHAPPEN, RIJKSUNIVERSITEIT GENT, COUPURE 653, B-9000 GHENT, BELGIUM

D. GROSSER
INSTITUT FUR HOLZFORSCHUNG, UNIVERSITAT MUNCHEN, D-8000 MUNICH 40, GERMANY

P. GROVER
BIOL. DIV., INDIAN INST. OF CHEM. TECHNOL, HYDERABAD-500 007, ANDHRA PRADESH, INDIA

A.K. GUPTA
DIV. OF DAIRY CATTLE GENETICS, AND BREEDING, NATIONAL DAIRY RES. INST., KARNAL, HARYANA, 132 001, INDIA

G.P. GUPTA
ENTOMOLOGICAL SUBSTATION, IARI, HADDO, PORT BLAIR, ANDAMAN AND NICOBAR ISLANDS, INDIA

H.C. GUPTA
AGRIC. EXP. STN., DURGAPURA JAIPUR, INDIA

M. GUPTA
DIV. ENTOMOL., INDIAN AGRIC. RES. INST., NEW DELHI 110012 INDIA

GUPTA RBL
PLANT PATHOLOGY LAB., AGRIC. STATION, DURGAPURA, JAIPUR 302 015, INDIA

S. GUPTA
DIV. OF PARASITOLOGY, CENTRAL DRUG RES. INST., LUCKNOW 226001, INDIA

P. GUTHRIE
DEPT. OF BIOL. CENTRAL STATE UNIV., EDMOND, EDMOND, OKLAHOMA 73034

F. HAAS
DEPT. OF SYSTEMATIC ZOOL.,
TUBINGEN, GERMANY

S. HAEBEL
DEP. MOL. BIOL., ODENSE UNIV.,
CAMPUSVEY 55,
DK-5230 ODENSE M, DENMARK

S.M. HAFEZ
PLANT PROTEC. DEP., FAC.
AGRIC., AIN SHAMS UNIV.,
SHOUBRA EL-KHEIMA, EGYPT

D.W. HAGSTRUM
U.S. GRAIN MKTING RES. LAB.,
USDA ARS, MANHATTAN,
KANS. 66502, USA

P.P. HALARNKAR
DEP. BIOCHEM.,
UNIV. NEVADA,
RENO NV 89557, USA

D.W. HALL
TROPICAL STORED PROD.
CENTRE, SLOUGH, BUCKS,
ENGLAND

W.R. HALLIDAY
RICERCA INC., P.O.BOX 1000,
PAINESVILLE, OHIO 44077-1000

M. HALLIHAN
UNIV. OF CHICAGO, DEPT. OF
BIOL., CHICAGO, IL. 60637

M.K. HAMALAINEN
INST. OF PEST INVESTIGATION,
AGRIC. RES., BOX 18, SF-01301
VANTAA 30, FINLAND

D. HAMEL
FAK. POLJOVREDNIH ZNANOSTI,
INST. ZA ZASTITU BILJA,
ZAGREB, YUGOSLAVIA

D. HANES
FACULTAD DE VETERINARIA,
CATEDRA DE GENETICA,
CORDOBA, SPAIN

L. HANKIN
CONNECTICUT AGRIC.
EXPERIMENT STATION,
BOX 1106,
NEW HAVEN, CT 06504

D.L. HANKS
N.E. MISSOURI STATE COLLEGE,
KIRKSVILLE, MISSOURI 63501

CM. HAPP
DEPT. ZOOL., VERMONT UNIV.,
BURLINGTON, VT 05405

M.M. HAQUE
DEPT. OF ZOOL., UNIV. OF
RAJSHAHI, RAJSHAHI 6205,
BANGLADESH

P.K. HAREIN
UNIV. OF MINNESOTA, DEPT. OF
ENTOMOL., FISHERIES, &
WILDLIFE, ST. PAUL,
MINNESOTA

HARISH-CHANDER
CENTRAL FOOD TECHNICAL
RES. INST. REGIONAL CENTRE,
LUDHIANA 141006, INDIA

DG. HARNISH
DEPT. PATHOLOGY, MCMASTER
UNIV., HAMILTON, ONT.,
CANADA

M. HASAN
DEPT. ZOOL., UNIV. OF
RAJSHAHI, RAJSHAHI,
BANGLADESH

S.B. HASAN
INFEST. CONTROL & PESTIC.
CENTRAL FOOD TECHNOL. RES.
INST., MYSORE 570013,
KARNATAKA, INDIA

A. HASTINGS
DIV. ENVIRON. STUDIES, INST.
THEORETICAL DYNAMICS, UNIV.
CALIF.,
DAVIS, CALIF. 95616, USA

G. HAUBOLD
INSTITUT FUR MIKROBIOLOGIE
UND EXPERIMENTELLE
THERAPIE, JENA, -THURINGEN;
FRIEDRICH SCHILLER UNIV,
JENA, GERMANY

IJ. HAVUKKALA
DEPT. OF PURE & APPLIED BIOL.,
IMPERIAL COLLEGE OF SCIENCE
& TECHNOL., LONDON, UK

M. HEATH, PH.D.
UNIV. OF ILLINOIS, DEPT. OF
PHYSIOL. & BIOPHYSICS,
URBANA, ILLINOIS 61801

E. HEBANOWSKA
INST. CHEM., UNIV. GDANSK,
SOBIESKIEGO 18, 80-952
GDANSK, POLAND

GA. HERRON
N.S.W. AGRIC. & FISHERIES,
BIOL. & CHEM. RES. INST.,
PMB 10, RYDALMERE, NSW 2116,
AUSTRALIA

G.M. HEWITT
SCHOOL OF BIOL. SCI., UNIV. OF
EAST ANGLIA,
NORWICH NR4 7TJ,
GREAT BRITAIN

A. HIRASHIMA
DEP. AGRIC. CHEM., KYUSHU
UNIV. FUKUOKA 812, JAPAN

S.H. HO
DEPT. OF ZOOL., NATIONAL
UNIV. OF SINGAPORE,
LOWER KENT RIDGE RD.,
SINGAPORE 0512
SINGAPORE

W.D. HOHENBOKEN
DEP. ANIM. SCI., VA.
POLYTECHNIC INST.,
VA. STATE UNIV.,
BLACKSBURG, VA 24061

J.D. HOPKINS
DEP. ENTOMOL., ARKANSAS
AGRIC. EXPERIMENT STATION
UNIV. ARKANSAS,
FAYETTEVILLE, AK 72701

T.L. HOPKINS
KANSAS STATE UNIV.,
DEPT. OF ENTOMOL.,
MANHATTAN, KANSAS 66506

P.M. HORTON
DEPT. ENTOMOL., FISHERIES &
WILDLIFE, CLEMSON UNIV.
SOUTH CAROLINA 29631, USA

R.W. HOWARD
U.S. GRAIN MKTING RES. LAB.,
ARS, USDA,
MANHATTAN, KS 66502

M.Y. HU
DEP. PLANT PROT.,
SOUTH CHINA AGRIC. UNIV.
CHANGZHOU, CHINA

MS. HUQ
INST. OF FOOD SCI. & TECHNOL.,
BSCIR, DHANMANDI, DHAKA,
BANGLADESH

H. HURD
CENT. APPLIED ENTOMOL.
PARASITOL., DEP. BIOL. SCI.,
KEELE UNIV., KEEL,
STAFFORDSHIRE ST5 5BG, UK

L.D. HURST
DEP. GENETICS, UNIV.
CAMBRIDGE,
CAMBRIDGE CB2 3JE, UK

M. HUSAIN
ZOOL. SECTION, BCSIR LAB.,
RAJSHAHI, BANGLADESH

M.M. HUSSAIN
ZOOL. SECTION, BSCIR LAB.,
RAJSHAHI, BANGLADESH

M.W. HUSSAIN
DEP. BOTANY, GOVERNMENT
COLL., LAHORE, PAKISTAN

S.M. ILYAS
CENTRAL RICE RES. INST.,
CUTTACK 753 006,
ORISSA, INDIA

O. IMURA
POPULATION ECOL. LAB., NATL.
INST. AGRO-EVIRON. SCI.,
KANNONDAI, TSUKUBA,
IBARAKI 305, JAPAN

O. IMURA
NATIONAL FOOD RES. INST.,
STORED PROD. EMTOMOL. LAB.,
TSUKUBA, JAPAN

J.A. INGEMANSEN
PLANT SCI. DEP. (ENTOMOLOGY
SECTION),
SOUTH DAKOTA STATE UNIV.
BROOKINGS, SD 57007, USA

Y.K. IP
NATL. UNIV. OF SINGAPORE,
KENT RIDGE, SINGAPORE

J. IQBAL
ENTOMOL. RES. LAB., NATL.
AGRIC. RES. CENT.,
ISLAMABAD, PAKISTAN

M. IRSHAD
ENTOMOLOGICAL RES. LAB
NARC
ISLAMABAD, PAKISTAN

I. ISHAAYA
DEPT. OF ENTOMOL., AGRIC.
RES. ORGANISATION,
THE VOLCANI CENTER, BET
DAGAN, 50250, ISRAEL

D.G. JAMES
YANCO AGRIC. INST., N.S.W.
AGRIC., YANCO, NSW 2703,
AUSTRALIA

M.C. JANUS
MRC UNIT DEV'T. INTEGRATION
OF BEHAVIOUR, CAMBRIDGE,
UNIV., MADINGLY,
CAMBRIDGE CB3 8AA, UK

M. JASIENSKI
INST. OF ENVIRONMENTAL
BIOL., JAGIELLONIAN UNIV.,
M. KARASIA 6, 30-060 KRAKOW,
POLAND

E. JAY
STORED-PROD. INSECTS RES. &
DEV'T. LAB., ARS, USDA,
SAVANNAH, GA 31403, USA

P.R. JEFFRIES
PESTICIDE CHEM. TOXICOLOGY
LAB.,
DEP. ENTOMOL. SCI.,
UNIV. CALIF., BERKELEY,
BERKELEY, CALIF 94720

R.C. JHALA
DEP. ENTOMOLOGY,
GUJARAT AGRIC. UNIV.,
NAVSARI, INDIA

G. JOHNSON
DEPT. OF BIOL. SCI.
CALIF. STATE UNIV., HAYWARD,
HAYWARD, CALIFORNIA 94540

N.A. JOHNSON, PH.D.
DEPT. OF ECOLOGY &
EVOLUTION, UNIV. OF CHICAGO,
CHICAGO, IL 60637-1573

S.L. JOHNSTON
MIAMI UNIV., HAMILTON,
HAMILTON, OHIO 45012

S. JOOD
DEPT. OF FOOD & NUTRITION,
C.C.S. HARYANA AGRIC. UNIV.,
HISAR 125 004, INDIA

C. JUAN
LAB GENETICA, DEP. BIOLOGIA
AMBIENTAL, UNIV. ILLES
BALEARS, PALMA DE
MALLORCA 07071, SPAIN

S. KACZMAREK
KATEDRA BIOLOGII WYZSZEJ,
SZKOLY PEDAGOGICZNEJ, UL.
ARCISZWSKIEGO 22B 76-200
SLUPSK, POLAND

D. KALEMBA
INSTYTUT PODSTAW CHEMII
ZYWNOSCI, POLITECHNIKA
LODZKA,
LODZ, POLAND

G.W. KALMUS
DEP. BIOL.,
EAST CAROLINA UNIV.,
GREENVILLE, N.C. 27858

V.K. KALRA
SEP. ENTOMOL.,
HARYANA AGRIC. UNIV.,
HISAR 125 004, INDIA

K. KALTHOFF, PH. D.
UNIV. OF TEXAS,
DEPT. OF ZOOL.,
AUSTIN, TEXAS 78712

S. KANDASAMY
TAMIL NADU AGRI. UNIV., DEPT.
OF ENTOMOL.,
MADURAI-625104, INDIA

M.A. KANDIL
DEP. ECONOMIC ENTOMOL. &
PESTICIDES, FAC. AGRIC., CAIRO
UNIV.,
EGYPT

D.E. KANGAS
N.E. MISSOURI STATE COLLEGE,
KIRKSVILLE, MISSOURI 63501

P.B. KANNOWSKI, PH. D.
PHEROMONES & BEHAVIOR,
INST. FOR ECOLOGICAL
STUDIES,
UNIV. OF N. DAKOTA.
GRAND FORKS
N. DAKOTA 58202

ASH. KANSOUH
DEPT. OF PLANT PROTECTION,
COLLEGE OF AGRIC.,
KING SAUD UNIV.,
RIYADH, SAUDI ARABIA

I.F. KARPILOVA
INST. SOIL SCI. PHOTOSYNTH.,
ACAD. SCI. RUSS.,
PUSHCHINO, RUSS.

F.F. KATZ
SETON HALL UNIV.,
S. ORANGE, NJ 07079

B. KAUFMAN
DEPT. ZOOL. GEORGE S. WEISE
FACULTY LIFESCIENCES,
TEL AVIV UNIV.
RAMAT AVIV 69978,
ISRAEL

J.Y. KEARNS
CENTRE APPLIED ENTOMOL.
PARASITOL., DEPT. BIOL. SCI.,
KEELE UNIV., KEELE,
STAFFORDSHIRE ST5 5BG, UK

M.P. KELLY
CENTRAL SCIENCE LAB., MAFF,
LONDON RD., SLOUGH, BERKS.,
SL37HJ, UK

R.P. KELLY
ST. PETER'S COLLEGE, DEPT. OF
BIOL., KENNEDY BLVD.,
JERSEY CITY, NJ 07303

M. KHALEQUZZAMAN
DEP. ZOOL., UNIV. RAJSHAHI,
RAJSHAHI-6250, BANGLADESH

S.K. KHALIL
N.W.F.P. AGRIC. UNIV.,
PESHAWAR, PAKISTAN

A.R. KHAN
ZOOL. DEPT., RAJSHAHI UNIV.,
RAJSHAHI, BANGLADESH

L.A.M. KHANAM
BSCIR LABORATORIES,
RAJSHAHI, BANGLADESH

S.U.K. KHATTACK
NUCLEAR INSTITUTE FOR
AGRIC. & BIOL., FAISALABAD,
PAKISTAN

M.L. KINKADE
N.E. LOUISIANA UNIV.,
DEPT. OF BIOL.,
MONROE, LOUISIANA 71209

B. KINZEL
USDA, ARS, WASHINGTON
DC 20250-2350

K. KIRITANI
PREFECTURAL INST. OF AGRIC.
& FOREST SCI., OOSONE,
NANGOKU, KOCHI, JAPAN

P. KISHORE
DIV. ENTOMOL., INDIAN AGRIC.
RES. INST., NEW DELHI 110012,
DELHI, INDIA

A. KISPERT
MAX-PLANCK INST.
ENTWICKLUNGSBIOLOGIE,
ABTEILUNG ZELLBIOLOGIE,
D-72076. TUBINGEN, GERMANY

MARTIN KLINGLER
RES. ASSOCIATE. INST. FUR
ZOOLOGIE. LUISENSTRASSE 14,
D-80333, MUNCHEN, GERMANY

R. KOK
DEP. AGRIC. ENGINEERING,
MACDONALD COLLEGE, MCGILL
UNIV., STE. ANNE DE BELLEVUE,
QUE. H9X 1C0, CANADA

A.V. KONAREV
VSESOYUZNYI N. I INSTITUT
ZASHCHITY RASTENII,
LENINGRAD, USSR

R. KORONA
INST. OF ENVIRONMENTAL ENTOMOL., JAGIELLONIAN UNIV., M. KARASIA 6, 30-060 KRAKOW, POLAND

U. KORZENIAK
INST. OF ENVIRONMENTAL ENTOMOL., JAGIELLONIAN UNIV., M. KARASIA 6, 30-060 KRAKOW, POLAND

TOYOMI KOTAKI
STORED PROD. ENTOMOL. LAB., NATL. FOOD RES. INST., TSUKUBA, IBARAKI 305, JAPAN

J. KRAWCZYK
INST. OF ENVIRONMENTAL ENTOMOL., JAGIELLONIAN UNIV., M. KARASIA 6, 30-060 KRAKOW, POLAND

J.P. KRAMER
DEPT. OF PARASITOLOGY, CORNELL UNIV., ITHACA, NY 14850

K.J. KRAMER
DEPT. OF ENTOMOL., KANSAS STATE UNIV., MANHATTAN, KANSAS 66506

E. KRAUSE
SETON HALL UNIV., S. ORANGE, NJ 07079

D.D. KRESS
ANIMAL & RANGE SCIENCES DEPT. MONTANA STATE UNIV., BOZEMAN, MT 59715

V.C. KRICHER
WHEATON COLLEGE, NORTON, MASSACHUSETTS 02766

A. KRIEG
BIOLOGISCHE BUNDESANSTALT FUR LAND- UND FORSTWIRTSCHAFT, INSTITUT FUR BIOLOGISCHE SCHADLINGSBEKAMPFUNG,

D-6100 DARMSTADT, GERMANY

T.S. KRISHNAMURTHY
INFESTATION CONTROL & PROTECTANTS AREA, CENTRAL FOOD TECHNOLOGICAL RES. INST., MYSORE-570 013, INDIA

E.M. KROEKER
FRASER VALLEY COLLEGE, ABBOTSFORD, BRITISH COLUMBIA, CANADA

T.N. KROGH
DEP. MOL. BIOL. ODENSE UNIV., DK-5230 ODENSE M, DENMARK

SG. KULKARNI
CENTRAL FOOD TECHNOL. RES. INST. REGIONAL CENTRE, GILL RD., LUDHIANA 141 006, INDIA

S.A. KUMAR
UNIV. OF GORAKHPUR, GORAKHPUR, INDIA

A. KUUSIK
INST. PLAT PROT., EST. AGRIC. UNIV., EE2400 TARTU, ESTONIA

D. LANG
UNIV. OF ILLINOIS AT CHICAGO CIRCLE,
DEPT. OF BIOLOGICAL SCIENCE
CHICAGO, ILLINOIS 60037

A.M. LAVERDURE
LAB DE BIOCHEM. ET PHYSIOL. DU DEV., C.N.R.S. URA 686
IFREMER URM 4, ECOLE NORMALE SUPERIEURE,
46 RUE D'ULM,

75230 PARIS CEDEX 05
FRANCE

RJ. LAVIGNE
PO BOX 3354,
UNIV. OF WYOMING,
LARAMIE, WY 82071-3354

S.A. LAWSON
LAB. FOREST ZOOL., DEP. FORESTRY, UNIV. TOKYO,
YAYOI 1-1-1, BUNKYO-KU,
TOKYO 113,
JAPAN

C.E. LEACH
INSECT ATTRACTANTS, BEHAVIOR & BASIC BIOL. RES. LAB., ARS, USDA,
GAINESVILLE, FLORIDA 32601

J. LECLERCQ
ZOOLOGIE GENERAL, INSTITUT AGRONOMIQUE DE L'ETAT,
GEMBLOUX, BELGIUM

R.E.JR. LEE
DEP. ZOOL., MIAMI UNIV.,
OXFORD, OHIO 45056

A. LEMOINE
UNIVERSITE BOURGOGNE, URA CNRS 674 DEV'T. COMMUNICATION CHIMIQUE,
6 BLVD. GABRIEL,
F-21000 DIJON, FRANCE

J.J. LENOIR-ROUSSEAUX
LAB ZOOLOGIE, UA CNRS 674,
UNIV. BOURGOGNE, BD GABRIEL, 21000 DIJON, FRANCE

G.N.J. LE PATOUREL
DEP. PURE AND APPLIED BIOL.,
IMPERIAL COLL.,
SILWOOD PARK, ASCOT, BERKS.,
SL5 7PY, ENGLAND

B.R. LEROI
UNIVERSITE F. RABELAIS,
AVENUE MONGE, PARC GRANDMONT,
37200 TOURS
FRANCE

F. F. LESSARD
INRA, LABORATOIRE DES INSECTES DES DENREES, BP 131,
F-33140 PONT DE LA MAYE,
FRANCE

E.A. LEVCHENKO
VSESOYUZNYI SELECKTIONNO-GENETICHESKII INSTITUT,
ODESSA, UKRAINIAN SSR

M.D. LI
DEP. GENETICS CELL BIOL.,
270 BIOSCIENCE CENTER, UNIV. MINNESOTA
ST. PAUL, MINN. 55108

C. LIANG
DEP. BIOCHEM.
KANSAS STATE UNIV.,
MANHATTAN, KS 665-6, USA

H. LIN
DEP. ENTOMOL., UNIV. MASSACHUSETTS, AMHERST,
MASSACHUSETTS 01003

J.J. LIPA
INST. OF PLANT PROTECTION,
MICZURINA 20,
60-318 POZNAN, POLAND

J.K. LIU
INST. ORGANIZ CHEM.,
LANZHOU UNIV.,
LANZHOUS 730000,
CHINA

M.K. LOHAR
DEP. ENTOMOL., SINDH AGRIC. UNIV., TANDOJAM, PAKISTAN

A. LOMNICKI
INSTITUTE OF ENVIRONMENTAL BIOL.,
JAGIELLONIA UNIV.,
M. KARASIA 6, 30-060, KRAKOW,
POLAND

G.L. LOOKJART
KANSAS STATE UNIV., DEPT. OF ENTOMOL.,
MANHATTAN, KANSAS 66506

J.M. LUCO
LAB. ALIMENTOS, FAC. QUIM. BIOQUIM. Y FARMACIA, UNIV. NACIONAL SAN LUIS,
CHACABUCO Y PEDERNERA,
5700 SAN LUIS, ARGENTINA

W.I. LUTTERSCHMIDT
DEP. ZOOL.,
UNIV. OF OKLAHOMA,
NORMAN, OK 73019

MACOY, L
28695 SW SANDALWOOD PL,
WILSONVILLE, OR 97070

F.J. MADRID
AGROBIOTECH. INT. IN.,
35 MOUNT ALLISON BAY,
WINNIPEG, MANITOBA,
R3T 3L4, CANADA

M. MAEMA
MOLTENO INST., UNIV.
CAMBRIDGE, DOWNING ST.,
CAMBRIDGE, CB2 3EE,
UNITED KINGDOM

M.M. MALIK
ENTOMOLOGY DIV., NUCLEAR
INST. FOR AGRICULTURE &
BIOL., PO BOX 128,
FAISALABAD,
PAKISTAN

V. MALLA-REDDY
ISTITUTO G. DONEGANI S.P.A.,
CENTRO RICERCHE NOVARA,
28100 NOVARA, ITALY

H.C. MANI
ENTOMOLOGY LAB.,
DEPT. ZOOLOGY,
GORAKHPUR UNIV.,
GORAKHPUR 273001,
UTTAR PRADESH, INDIA

G. MARCUZZI
UNIVERSITA DI PADOVA,
ISTITUTO DI BIOLOGIA
ANIMALE, 35131 PADOVA, ITALY

J.P. MARGHAM
LIVERPOOL POLYTECHNIC,
DEPT. OF BIOL.,
LIVERPOOL L33AF,
ENGLAND

M. MARKKULA
DEPT. PEST INVESTIGATION,
AGRIC. RES. CENTRE, SF-3160
JOKIOINEN, FINLAND

P. MASSARDO
ISTITUTO G. DONEGANI S.P.A
CENTRO RICERCHE NOVARA,
28100 NOVARA, ITALY

K. MATSUSHITA
DEPT. OF MEDICAL ZOOLOGY,
SAITAMA MEDICAL SCHOOL,
38 MOROHONGO MOROYAMA,
IRUMA-GUN, SAITAMA 350-04,
JAPAN

W.A. MATTHEWS
ADAS CENTRAL SCI. LAB.,
MINISTRY OF AGRIC, FISHERIES
FOOD, LONDON RD., SLOUGH,
BERKS SL3 7HJ, UK

GN. MBATA
DEPT. OF ZOOL.,
UNIV. OF IBADAN,
IBADAN, NIGERIA

T.P. MCGOVERN
ORGANIC CHEM SYNTHESIS
LAB., AGRIC. ENVI. QUALITY,
NEW DELHI 110 012, INDIA

V.K. MEHTA
NUCLEAR RES. LAB., INDIAN
AGRICULTURAL RES. INST.,
NEW DELHI 110 012, INDIA

V.K. MEHATA
DEP. ZOOL. SHIVAJI COLL.,
NEW DELHI, 110027, INDIA

R. MIETKIEWSKI
AGRIC. & PEDAGOGICAL UNIV.,
UL. PRUSA 12, 08110 SIEDLCE,
POLAND

G. MILANDER
SOPRUSE PST. 221-79,
200034 TALLINN, ESTONIA

K.A. MILLS
MINISTRY OF AGRIC., FISHERIES
& FOOD, SLOUGH LAB.,
SLOUGH, BERKS., SL3 7HJ, UK

T.P. MIRONAVA
AKADEMIYA AGRARNYCH
NAUK, MINSK, BELARUS

T. MIYAKA
SHIRAOKA RES. STA OF BIOL.
SCI., NISSAN CHEMICAL IND.
LTD., SHIRAOKA-CHO,
MINAMI SAITAMA-GUN,
SAITAMA 349'02, JAPAN

S. MOHAN
DEPT. OF ENTOMOL.,
TAMIL NADU AGRIC. UNIV.,
COIMBATORE 641 003,
INDIA

S. MOHIUDDIN
PCSIR LAB COMPLEX,
KARACHI 75280, PAKISTAN

G.P. MOLINARI
SEZ., ISTITUTO DI CHIMICA
AGRARIA ED AMBIENTALE,
UNIV. CATTOLICA SACRO
CUORE, PIACENZA, ITALY

KAMSH MONDAL
DEP. ZOOL.
UNIV. RAJSHAHI,
RAJSHAHI 6205, BANGLADESH

M.A. MORALEJO
DEP. BIOQUIM., E.T.S.
INGENIEROS AGRONOMOS,
CIUDAD UNIVERSITARIA,
28040 MADRID, SPAIN

B. MORALLO-REJESUS
UNIV. OF THE PHILIPPINES AT
LOS BANOS, LAGUNA 3720,
PHILIPPINES

T.D. MORGAN
U.S. GRAIN MARKETING RES.
LAB., ARS USDA,
MANHATTAN, KS 66502

K. MORI
DEP. AGRIC. CHEM.,
UNIV. TOKYO,
YAYOI 111, BUNKYO-KU,
TOKYO 113, JAPAN

NADIRA-AKHTAR
DEPT. OF ZOOL., RAJSHAHI UNIV., RAJSHAHI 6205, BANGLADESH

L.M. NAGY
HOWARD HUGHES MED. INST., LAB.
MOLECULAR BIOL. UNIV. WIS., MADISON, WI 53706

M. NAITO
LAB. OF ANIMAL BREEDING, TOKYO UNIV., TOKYO, JAPAN

H. NAKAKITA
NATIONAL FOOD RES. INST., MINISTRY OF AGRIC., FORESTRY AND FISHERIES. TSUKUBA, IBARAKI 305, JAPAN

F. NAKAMURA
DEPT. OF MED. BIOL., SCHL OF MEDICINE, SHOWA UNIV., 1-5-8 HATANODAI, SHINAGAWA-KU. TOKYO, 142, JAPAN

T. NAKANE
THE NATIONAL SCI. MUSEUM, VENO PARK, TOKYO, JAPAN

P. NARDON
INSTITUT NATIONAL DES SCIENCES APPLIQUEES, VILLEURBANNE (RHONE), FRANCE

R.P. NATH
DEP. OF NEMATOL., RAJENDRA AGRIC. UNIV., PUSA, SAMASTIPUR 848125, INDIA

J.A. NATHANSON
DEPT. OF NEUROL. HARVARD MED. SCH., MASSACHUSETTS GENERAL HOSPITAL, BOSTON, MA 02114, USA

E. NATON
BAYER, LANDESANSTALT F. BODENKULTUR, PFLANZENBAU U. PFLANZENSCHUTZ, PFLANZENSCHUTZ, 8 MUNICH 38 POSTFACH, GERMANY

S. NAVARRO
DEPT. STORED PROD., AGRIC. RES. ORGANIZATION, BET DAGAN, ISRAEL

J. NAWROT
INST. ORGANIC CHEM. BIOCHEM. CZECHOSLOVAK ACADEMY SCI., 16610 PRAGUE. CZECHOSLOVAKIA

V. NEELAM
DIV. OF ENTOMOLOGY, INDIAN AGRICULTURAL RES. INST., NEW DELHI 110 012, INDIA

P. NEHRA
DEPT. ZOOL. UNIV. OF RAJASTHAN, JAIPUR 302 004, INDIA

V. NEMEC
INST. ENTOMOL. CZECH ACAD. SCI., BRANISOVSKA 31, 370 05 CESKE BUDEJOVICE, CZECHOSLOVAKIA

Z .Z. NI
DEPT. OF GRAIN STORAGE, NAN JING FOOD ECONOMY COLLEGE, NAN JING, JIANG SU PROVINCE, CHINA

S. NICOLSON
UNIV. OF CAPE TOWN, RONDEBOSCH, SOUTH AFRICA

F. NICOTRA
ISTITUTO DI CHIMICA ORGANICA DELL 'UNIVERSITA DEGLI STUDI, AND CENTRO DI STUDIO PER LE SOSTANZE ORGANICHE NATURALI DEL CNR, MILAN, ITALY

M. NISHINA
DEP. MED. ZOOL., SAITAMA MED. SCH., 38 MOROHONGO MOROYAMA, IRUMA-GUN, SAITAMA 350-04, JAPAN

T. NOMURA
FAC. ENG., KYOTO SANGYO UNIV., KITA, KYOTO 603, JAPAN

R. NORSEGAARD
INST. OF GENETICS, SOLVEGATAN 29, S-233 62 LUND, SWEDEN

M. NOVAK
BIOL. DEP., UNIV. WINNIPEG, MAN., R3B 2E9 CANADA

F. NUNEZ
DEPT. DE BIOLOGIA, U.N., APDO AEREO 23227, BOGOTA, D.E., COLOMBIA, SOUTH AMERICA

I.E. NWANA
COLL. AGRIC. & VET. MED., IMO STATE UNIV. P.M.B. 2000, OKINGWE, NIGERIA

V.N. ODINOKOV
INST. CHEM., BASHKIR SCI.
CENT., URAL DEP. ACAD. SCI.
RUSSIA, UFA

OHTSUBO
DEP. BIOL. SCI., UNIV. DURHAM,
SCI. LAB.,
SOUTH RD., DURHAM, NH1 3LE,
UNITED KINGDOM

E. OKURA
OKAYAMA UNIV., LAB. OF
GENETICS, OKAYAMA, JAPAN

J. OLIBERIUS
VYZKUMNY USTAV ROSTLINNE
VYROBY, 161 06 PRAGUE
6-RUZYNE, CZECHOSLOVAKIA

JV DE. OLIVERIA
ESTACAO EXPERIMENTAL DO
ARROZ DO IRGA, AV. BONIFACIO
CARVALHO BERNARDES, 1494,
94900 CACHOEIRINHA, RS,
BRASIL

J. OMBACH
INST. OF ENVIRONMENTAL
BIOL., JAGIELLONIAN UNIV.,
M. KARASIA 6, 30-060, KRAKOW,
POLAND

R.J. O'NEIL
PURDUE UNIV.,
WEST LAFAYETTE, INDIANA
47907

S.L. O'NEILL
DEP. EPIDEMIOLOGY PUBLIC
HEALTH, YALE UNIV.
SCHOOL OF MED.
P.O. BOX 3333,
NEW HAVEN, CONN 06510

D.W. ONSTAD
SEC. OF ECON. ENTOMOL.,
ILLINOIS NAT. HIST. SURVEY &
UNIV. OF ILLINOIS,
607 E. PEABODY DRIVE,
CHAMPAIGN, ILL. 61820

B. OPPERT
U.S. GRAIN MARKETING RES.
LAB., ARS USDA
MANHATTAN, KS 66502

G.C. PAESEN
IVEM-NERC, MANSFIELD RD.,
OXFORD OX1 3SR, UK

M. PAGANI
IST. ENTOMOL. PATOLOGIA
VEGETALE, FACOLTA AGRARIA,
U.C.S.C., VIA EMILIA
PARMENSE 84, I-29100 PIACENZE,
ITALY

J. PALEOLOG
INST. BIOL. PODSTAW PROD.
ZWIERZECEJ AKAD. ROLNICZA,
UL. AKAD. 13, 20934 LUBLIN.
POLAND

G.P. PANDEY
INDIAN GRAIN STORAGE INST.,
HAPUR 245 101, UTTAR
PRADESH, INDIA

N. J. PARK
SCREENING DIV., KOREA RES.
INST. CHEM. TECHNOL.
P.O.BOX 107, YUSUNG,
TAEJEON 305-606,
SOUTH KOREA

B.S. PARMAR
DIV. OF AGRICULTURAL
CHEMICALS,
INDIAN AGRIC. RES. INST.,
NEW DELHI, 110012, INDIA

B. PARVEEN
DEPT. OF ZOOLOGY
UNIVERSITY OF RAJSHAHI
BANGLADESH

I.C. PASALIU
INDIAN AGRIC. RES. INST.,
NEW DELHI 110 012, INDIA

D. P. PASHLEY
ENTOMOLOGY DEPT.
LA. STATE UNIV.
BATON ROUGHE,
LOUISIANA 70803

C. PASPALAS
LAB ANIMAL PHYSIOL. DEP.
ZOOL., SCH. BIOL. UNIV.
THESSALONIKI, GR-54006
THESSALONIKI, MACEDONIA,
GREECE

N. PASTER
DEPT. OF STORED PROD., ARO,
THE VOLCANI CENTER,
P.O. BOX 6 BET DAGAN, 50250,
ISRAEL

N.H. PATEL
DEP. EMBRYOL., CARNEGIE
INST. WASHINGTON,
115 WEST UNIV. PARKWAY,
BALTIMORE, MD 21210

A. PATHIRATNE
DEP. ZOOL. UNIV. KELANIYA.
KELANIYA, SRI LANKA

LEK. PEDERSEN
RES. DEPT., CHEMINOVA A/S
PO BOX 9, 7620, LEMVIG,
DENMARK

F. PERCIVAL
WESTMOUNT COLLEGE,
995 LA PAZ RD.,
SANTA BARBARA, CA 93103

C. PEREIRA
PURDUE UNIV.,
DEPT. OF ENTOMOL.,
WEST LAFAYETTE, IN 47907

D. PERMUAL
DEPT. BIOL., IMPERIAL COLL. AT
SILWOOD PARK, ASCOT, BERKS.
SL5 7PY, ENGLAND

C.S. PETERS
GRADUATE GROUP, APPLIED
MATHEMATICS, UNIV. CALIF.,
DAVIS, CALIF., 95616

L. PETERSON
RIO HONDO COLLEGE, BIOL.
DEPT., 3600 WORKMAN MILL RD.,
WHITTIER, CALIFORNIA 90608

E. PETITPIERRE
DEPT. OF GENETICS, FAC. OF
SCI., DEPT. DE BIOL.
AMBIENTAL, UNIV. DE LES
ILLES BALEARS, PALMA DE
MALLORCA, 07071, SPAIN

E. PEZOWICZ
KATEDRA ZOOL. SGGW-AR,
WARSAW, POLAND

M. PICOLLO DE VILLAR
CENTRO DE INVESTIGACIONES
DE PLAGAS E INSECTICIDAS
(CIPEIN), CITEFA, CONICET, J.
ZUFRIATEGUI 4380,

1603 VILLA MARTELLI,
ARGENTINA

ROGERO PIERANTONI, DIECTOR
LAB. OF BIOPHYSICS &
CYBERNETICS, NATIONAL RES.
CENTER,
CAMUGLI, ITALY

A.M. PIERCE
DEP. CHEM., SIMON FRASER
UNIV. BURNABY,
BC, V5A 1S6,
CANADA

V. PIKE
NAT. RESOURCES INST.,
CHATHAM MARITIME,
CHATHAM, KENT ME4 4TB,
UNITED KINGDOM

K.S. PILLAI
AGRICULTURAL ENTOMOLOGY,
CENTRAL TUBER CROPS RES.
INST.,
THIRUVANANTHAPURAM
K695 017, INDIA

M. PLOHL
DEP. ORG. CHEM. BIOCHEM.,
RUDER BOSKOVIC INST.,
BIJENICKA 54,
P.O.BOX 1016,
41000 ZAGREB, CROATIA

D. POLESKI
ST. ANSELMS COLLEGE, BIOL.
DEPT., ST. ANSELMS DRIVE,
MANCHESTER, NH 03102

V.V. POPOV
INST. OF APPLIED MOLECULAR
BIOL. AND GENETICS, 23
VUCHETICH ST., MOSCOW,
125206, USSR

D. POST
UNIV. OF WISCONSIN,
BIOL. DEPT.,
STEVENSPOINT, W. I. 54481

P. PRACROS
LAB. RECHERCHES SUR LES
INSECTES DES DENREES, INRA
STATION DE ZOOLOGIE,
33140 PONT DE LA MAYE,
BORDEAUX, FRANCE

A. PRAKASH
CENTRAL RICE RES. INST.,
CUTTACK 753 006, ORISSA,
INDIA

JOHN W. PRESS
STORED-PROD. INSECT RES. &
DEV'T. LAB.
3401 EDWIN ST.,
SAVANNAH, GA 31405

P. F. PREVETT
TROPICAL DEV'T & RES. INST.
SLOUGH, BERKS., U.K.

A. PROVANSAL-BAUDEZ
LABORATOIRE DE ZOOLOGIE,
UNIVERSITE DE DIJON,
21100 DIJON, FRANCE

T. PRUS
DEP. ECO. BIOENG., INST. ECOL.,
POLISH ACAD. SCI., DZIEKANOW
LESNY, 05-092 LOMIANKI,
POLAND

R.J. RABINDRA
AGRICULTURAL COLLEGE &
RES. INST., COIMBATORE,
INDIA 641003

R.J. RABINDRA
CENT. PLANT PROTECT.
STUDIES,
TAMIL NADU AGRIC. UNIV.,
COIMBATORE, 641 003
INDIA

A.E. RADKOZUBOV
INST. PHYSIOL. ACT.
SUBSTANCES, RUSS. ACAD, SCI.
CHERNOGOLOVKA, RUSSIA

M.A. RAHIM
FOOD TECHNOL. DIV. MARDI,
P.O. BOX 12301,
50774 KUALA LAMPUR,
MALAYSIA

S.M. RAHMAN
DEPT. OF ZOOL.,
RAJSHAHI UNIV.,
RAJSHAHI, BANGLADESH

G.M. RAHOO
SIND AGRICULTURAL
COLLEGE, TANDOJAM,
PAKISTAN

R.S. RAI
INDIAN GRAIN STORAGE INST.,
FIELD STA., P.A.K. CAMPUS,
PUNJAB AGRIC. UNIV.,
LUDHIANA 141004, INDIA

B. RAISBECK
U.S. ARMY NATICK LAB.,
NATICK, MASS 01760

S. RAJENDRAN
INFESTATION CONTROL &
PROTECTANTS DEPT.,
CENTRAL FOOD
TECHNOLOGICAL INST.,
MYSORE 570 013, INDIA

P. RAKAMMA
CENTRAL TUBER CROPS RES.
INST., SREEKARIYAM,
TRIVANDRUM 695 017, KERALA,
INDIA

RAMASHRIT, S.
RAJENDRA AGRICULTURAL
UNIV., PUSA (SAMASTIPUR),
BIHAR 848 125, INDIA

RAMESHWAR-SINGH.
AGRICULTURAL RES. STAT.,
NAVGAON (ALWAR)
RAJASTHAN, INDIA

M. RAMIREZ,
INSTITUTO DE BIOLOGIA,
UNAM, DEPARTAMENTO DE
ZOOLOGIA,
APDO POSTAL 70-153,

MEXICO 20, D.F.
MEXICO

J. RAMOS-ELORDUY DE
CONCONI
LAB. DE ENTOMOLOGIA,
DEPT. DE ZOOLOGIA
INST. DE BIOLOGIA,
UNIV. NACIONAL DE MEXICO,
MEXICO 20, D.F.
MEXICO

P.U. RAMZAN
DEP. ENTOMOL. PUNJAB
AGRIC. UNIV., LUDHIANA,
PAKISTAN

J.R. RANGASWAMY
CENTRAL FOOD
TECHNOL. RES. INST.,
MYSORE 570 013,
INDIA

P.U. RANI
ENTOMOL. TOXICOL. DIV.,
REGIONAL RES. LAB.,
HYDERABAD 500 007
INDIA

G. REDDY
U.S. ARMY MED. BIOENG.,
R & D LAB.,
FORT DETRICK, MD 21701

D. P. REES
GRAIN TECHNOL. DEPT., NRI.
CENTRAL AVE.,
CHATHAM MARITIME,
CHATHAM, KENT ME 4 4TB,
UNITED KINGDOM

G.F. REIDY
LIVER RES. UNIT, DEPT. OF
MEDICINE, WESTMEAD
HOSPITAL, WESTMEAD,
NSW 2145 AUSTRALIA

P.J. RICE
PESTICIDE TOXICOL. LAB.,
DEP. ENTOMOL.,
IOWA STATE UNIV.,
AMES, I. A. 50011

K.S. RICHARDS
PARASIT. RES. LAB., DEP. OF
BIOL. SCI., UNIV. OF KEELE,
STAFFS. ST5 5BG,
UNITED KINGDOM

P. RICL
ZA SKOLOU 470, 254 01 JILOVE
U PRAHY, CZECHOSLOVAKIA

E.M. RISHA
DEP. ECONOMIC ENTOMOL.,
FAC. AGRIC., UNIV. CAIRO,
GIZA, EGYPT

U. RITTE
DEPT. OF GENETICS, THE
HEBREW UNIV. OF JERUSALEM,
ISRAEL

D.B. RIVERS
DEP. ENTOMOLOGY,
OHIO STATE UNIV.
1735 NEIL AVE.
COLUMBUS, OH 43210

R.I. RO
DEP. ZOOL. UNIV. LUND,
HELGONANAGEN 3, S-223 62
LUND, SWEDEN

T. ROBINSON
DEP. ECOL. EVOL.,
1101, E. 57TH ST.,
UNIV. CHICAGO,
CHICAGO, IL 60637

C.A. ROBOTTI
UNIVERSITA DI TORINO,
VIA ACADEMIA ALBERTINA
TURIN 10123, ITALY

J.G. RODRIGUEZ
DEPT. OF ENTOMOL., UNIV. OF
KENTUCKY,
LEXINGTON, KY 40546-0091

P. RODRIGUEZ
UNIV. OF TEXAS,
SAN ANTONIO, TX 78285

J.C. ROJAS LEON
DEP. PARASITOL., AREA CIENC.
AGRON., UNIV. AUTON. DE
CHIAPAS, VILLAFLORES,
CHIAPAS, MEXICO

W.C. ROLLING
UNIV. OF CALIF.,
COLLEGE OF AGRIC.,
DEPT. OF ANIMAL
HUSBANDRY,
DAVIS, CA 95616

I. RONDOT
URA CNRS 675, FAC. SCI.
GABRIEL, F-21000 DIJON,
FRANCE

S.A. ROSLAVTSEVA
RES. INST. TOXICOL.
DISINFECT.,
MOSCOW, RUSSIA

Z.M.F. ROSTOM
ENTOMOL. DEP. FAC. SCI., AIN
SHAM UNIV., ABBASSIAH,
CAIRO, EGYPT.

D. ROY
UNIV. OF KALNANY,
DISTR OF NADGA,
W. BENGAL, INDIA 741235

M.K. ROY
INDIAN AGRIC. RES. INST.,
NEW DELHI 110 012, INDIA

P. ROY
BIDHAN CHANDRA KRISHI
VISWA VIDYALS. DEPT. OF
AGRICULTURAL ENTOMOL.,
KALYANI 741235
(WEST BENGAL). INDIA

M. ROZEK
INST. OF SYSTEMATIC &
EXPERIMENTAL ZOOL., POLISH
ACADEMY OF SCIENCES,
31-016 KRAKOW, POLAND

M. ROZOK
POLISH ACAD. SCIENCE,
KRAKOW, 26.IX.87,
POLAND

RUPPEL
DEPT. OF ENTOMOL.,
MICHIGAN STATE UNIV.,
EAST LANSING, MI 48824

R.G. RUANO
INSTITUTO NACIONAL DE
INVESTIGACIONES
AGRONOMICAS, MADRID,
SPAIN

A W. RUMBALL
DEPT. OF SCIENTIFIC &
INDUSTRIAL RES.,
PALMERSTON NORTH,
NEW ZEALAND

M .F. RYAN
DEPT. ZOOL, UNIV. COLLEGE
DUBLIN, BELFIELD, DUBLIN 4,
IRISH REPUBLIC

RO. RYAN
DEPT. OF BIOCHEM.,
ARIZONA UNIV.,
TUCSON, AZ 85721

E. K. SADO
KAINJI LAKE RES. INST.,
PMB 6006, NEW BUNSA,
KWARA STATE, NIGERIA

E. SAKAL
DEP. BIOCHEM. & HUMAN
NUTRITION, FAC. AGRIC.,
HEBREW UNIV. JERUSALEM,
REHOVOT 76100, ISRAEL

H.S. SALAMA
PESTS PLANT PROTECTION
DEP., NATIONAL RES. CENTRE,
DOKKI CAIRO, EGYPT

M.A. SALEEM
DEP. ZOOLOGY,
UNIV. PUNJAB., QUAIDI-I-AZAM
CAMPUS,
LABORE, PAKISTAN

M.M. SALEM
DEPT. OF PLANT PROTECTION,
COLLEGE OF AGRIC.,
P.O. BOX 2460, RIYADH 11 451
SAUDI ARABIA

P. R. SAMSON
BUREAU SUGAR EXP. STR.
P. B. BOX 651
BUNDABERG, QUEENSLD, 4670
AUSTRALIA

E. SANCHEZ-MONGE
ESCUELA TECNICA SUPERIOR
DE INGENIEROS AGRONOMOS,
MADRID, SPAIN

R. SANCHEZ-MONGE
CENTRE R+D INSTITUT DE
RECERCA I TECNOLOGIA
AGROALIMENTARIES UPC,
LLEIDA, SPAIN

K. SANDER
BIOLOGISCHES INSTITUT I
(ZOOLOGIE) DES UNIVERSITAT.
FREIBURG, GERMANY

L. SANDVOL
RES. & EXTENSION CENTER,
UNIV. OF IDAHO,
ABERDEEN, ID 83210

A. SANYAL
DIV. AGRIC. CHEM. INDIAN
AGRIC. RES. INST.,
NEW DELHI 110012, INDIA

A. SARAC
AKDENIZ UNIV., FAC. AGRIC.,
PLANT PROTECTION DEP.
PK 126, ANTALYA, TURKEY

K. SARIN
DEPT. ZOOL.,
RAJASTHAN UNIV.,
JAIPUR 302004,
INDIA

D.K. SARKAR
DIV. OF AGRICULTURAL
CHEMICALS, INDIAN
AGRICULTURAL RES. INST.,
NEW DELHI 12, INDIA

A. SATTAR
NUCLEAR INST., FOOD AGRIC.,
TARNAB, PESHAWAR,
PAKISTAN

D.B. SAUER
PLANT PATHOLOGY, U.S.,
GRAIN MARKETING RES. LAB.,
ARS, USDA,
MANHATTAN, KS 66052

B.P. SAXENA
DIV. INSECT PHYSIOL.,
REGIONAL RES. LAB.,
JAMMU TAAWI 180001,
INDIA

S.C. SAXENA
DEP. ZOOL., UNIV. RAJASTHAN,
JAIPUR-302004, INDIA

V.S. SAXENA
DIV. ENTOMOL., INDIAN
AGRIC. RES. INST.,
NEW DELHI 110012,
INDIA

PD. SAYABOC
NATIONAL POSTHARVEST INST.
FOR RES. & EXTENSION,
MUNOZ, ECIJA, PHILIPPINES

BC. SCHIFFERS
UNITE DE CHIMIE ANALYTIQUE
& PHYTOPHARMACIE,
FACULTE DES SCIENCES
AGRONOMIQUES
DE GEMBLOUX,
5030 GEMBLOUX,
BELGIUM

G.H. SCHMIDT
LEHREGEBIET ZOOL.-
ENTOMOL., UNIV. HANNOVER,
D-3000 HANNOVER 21,
GERMANY

REINHARD
SCHRODER
POSTDOCTORAL FELLOW.
INSTITUT FUR ZOOLOGIE.
LUISENSTRASSE 14. D-80333
MUNCHEN, GERMANY

J.L. SCHUETTE
MICHIGAN STATE UNIV.,
HICKORY CORNERS, MI 49060

S. SCHUTT
INSTITUTIONEN FOR
MILJOVARD, HELSINKI UNIV.,
SF 00710, HELSINKI 71, FINLAND

D. SECK
INST. SENEGALAIS
RECHERCHES AGRICOLES,
LAB. ENTOMOL.,
BP 17 NIOMO DU RIP, SENEGAL

R. SEGURA-CORREA
LAB. FITOQUIMICA, DEP.
FARMACIA, FAC. QUIMICA,
UNIV. NAC. AUTON. DE
MEXICO,
APDO POSTAL 70-265
MEXICO D.F. 04511, MEXICO

Y.E. SEIFELNASR
DEPT. CROP PROTECTION,
FAC. OF AGRICULTURE,
UNIV. OF KHARTOUM,
SHAMBAT, SUDAN

G.D. SELLS
N.E. MISSOURI STATE
COLLEGE,
KIRKSVILLE, MO 63501

B. SENER
DEP. PHARMACOLOGY, FAC.
PHARMACY, GAZI UNIV.,
06630 ANAKARA, TURKIYE

T. SENGUPTA
PROTOZOOLOGY LAB.,
DEP. ZOOL., UNIV.KALYANI,
KALYANI 741 235,
WEST BENGAL

J.M. SERRANO
DEP. GENETICA, FAC. CIENCIAS
BIOL., UNIV. COMPLUTENSE,
28040 MADRID, SPAIN

V.M. SEVALA
DEP. BIOL. YORK UNIV.
4700 KEELE ST.,
NORTH YORK, ON M3J 1P3
CANADA

J.R. SEVILLE
CADBURY LTD., BOURNVILLE,
UNITED KINGDOM

A.R. SHAKOORI
DEP. ZOOL., UNIV. PUNJAB,
NEW CAMPUS, LAHORE,-20,
PAKISTAN

S. SHANKER
INDIAN GRAIN STORAGE INST.,
HAPUR 245 101, INDIA

E. SHAAYA
DEPT. OF STORED PRODUCTS,
ARO, BET DAGAN 50250, ISRAEL

J.H. SHADDY
NORTHEASTERN MISSOURI
STATE COLLEGE,
KIRKSVILLE, MO 63501

A. SHARMA
DEPT. ZOOL., UNIV.
RAJASTHAN, JAIPUR-302004,
INDIA

D.K. SHARMA
DIV. AGRIC. CHEMICALS,
INDIAN AGRIC. RES. INST.,
NEW DELHI 110 012, INDIA

D.L. SHARMA
DEP. PHYSICS, PUNJAB
AGRICULTURAL UNIV.,
LUDHIANA 141004, INDIA

R. N. SHARMA
DIV. OF ENTOMOL. NATIONAL
CHEMICAL LAB., PUNE 411 008,
INDIA

M.E.H. SHAZALI
DEP. PURE & APPLIED ZOOL.,
UNIV. RAJASTHAN,
JAIPUR 302004, INDIA

A.P. SHRIVASTAVA
DEFENCE MATERIALS &
STORES RES. & DEV'T.
ESTABLISHMENT.,
KANPUR-208 013, INDIA

P.N. SHRIVASTAVA
AGRICULTURAL UNIV.,
JABALPUR, MADHYA PRADESH.
INDIA

H.S. SHUKLA
DEP. OF BOTANY,
UNIV. OF GORAKHPUR,
GORAKHPUR 273 009,
INDIA

R.M. SHUKLA
CENTRAL INSECTICIDES LAB.,
DIRECTORATE PLANT
PROTECT.,
QUARANTINE STORAGE,

FAR IDABAD,
HARYANA 121 001

S. SIGHAMONY
ENTOMOL. DIV. REGIONAL R
LAB., HYDERABAD 500 009,
INDIA

J. SILANDER
THE UNIV. OF CONNECTICUT
BIOLOGICAL SCIENCES,
BOX U42, STORRS,
CONNECTICUT 06268

L. SILVELA
INSTITUTO NACIONAL DE
INVETIGACIONES
AGRONOMICAS, MADRID,
SPAIN

E.R. SINCLAIR
ENTOMOL. BRANCH, DEPT. O
PRIMARY INDUSTRIES,
INDOOROOPILLY,
QUEENSLAND 4068, AUSTRILI

N.B. SINGH
CANADA DEPT. OF AGRIC.,
RES. STATION, WINNIPEG,
MANITOBA, CANADA

P. SINGH
DEPT. OF SCIENTIFIC &
INDUSTRIAL RES.
ENTOMOLOGY DIV.,
AUCKLAND,
NEW ZEALAND

R. SINGH
DEPT. ENTOMOL.,
SUKHADIA UNIV.,
UDAIPUR, INDIA

R.N. SINGH
ENTOMOL. LAB., DEP. ZOOL.,
UNIV., GORAKHPUR,
GORAKHPUR 273 009,
UTTAR PRADESH, INDIA

V. SINGH
DIRECTORATE OF OILSEEDS
RES., RAJENDRANAGAR,
HYDERABAD -500 030, INDIA

K.K. SINHA
MYCOTOXIN LAB., DEPT.
BOTANY, BHAGALPUR UNIV
BHAGALPUR, 812 007, INDIA

A. SIVAPRAGASAM
COCOA/COCONUT DIV., MARDI.
PO BOX 25, 36307
SUNGAI SUMUN, PERAK,
MALAYSIA

K. SLAMA
LAB. ECOL. PHARMACOL.
INTERECO, KLADENSKA 11,
160 00 PRAHA 6,
CZECH REPUBLIC

J.V. SLATER
S.U.N.Y., DEPT. OF BIOL.,
NEW PALTZ, NY 12561

H. SMET
AOOL. INST.,
NAAMSESTRAAT 59,
3000 LEUVEN,
BELGIUM

LINCOLN SMITH, PH. D.
DEP. ZOOL. MARSH LIFE SCI.
BUILDING,
UNIV. VERMONT,
BURLINGTON, VT. 05405-0086

T. R. SOBRAMANIAN
DEPT. OF ENTOMOL.,
AGRICULTURAL COLLEGE &
RES. INST.,
COIMBATORE 641 003
INDIA

E.L. SODERSTROM
HORTICULTURAL CROPS RES.
LAB., USDA ARS,
2021 SOUTH PEACH AVE.,
FRESNO, CA 93727

B. SOLOMON
ARS, SEA, USDA,
PEORIA, ILLINOIS 61601

N. SOLTANI
LABORATOIRE DE ZOOLOGIE
(ERA NO, 231, UNIV. DE DIJON)
FACULTES DES SCIENCES,
BD. GABRIEL 21100, DIJON,
FRANCE

N. SOLTANI-MAZOUNI
DEP. DE BIOLOGIE ANIMALE,
UNIVERSITE DE ANNABA 232000
ANNABA, ALGERIE,
FRANCE

F.J. SONLEITNER
DEPT. ZOOL., UNIV.
OKLAHOMA,
NORMAN, OKLA. 73019

B.A. SOOMRO
SIND AGRICULTURAL
COLLEGE, TANDOJAM,
PAKISTAN

M.E. SOSA
CATEDRA ENTOMOL. DEP.
BIOQUIM. Y CIENCIAS BIOL.,
UNIV. NACIONAL SAN LUIS,
CHACABUCO Y PEDERNERA,
5700 SAN LUIS, ARGENTINA

DR. SOSA-GOMEZ
CIRPON CASILLA DE CORREO 90
SAN MIGUEL DE TUCUMAN,
AGRENTINA

D. V. SOSHKIN
DIV. ENTOMOL., K.A.
TIMIRYAZEV MOSC. AGRIC.
ACAD.,
MOSCOW, RUSSIA

R. SOUISSE
LABORATOIRE DE BIOLOGIE
ANIMALE,
FACULTE DES SCI. DE TUNIS,
CAMPUS UNIVERSITAIRE,
LA BELVEDERE, TUNISIA

J.J. SPIES
DEP. BOTANY GENETICS,
UNIV. ORANGE FREE STATE,
BOX 339,
BLOEMFONTEIN 9300,
SOUTH AFRICA

A. SPRINGHETTI
ISTITUTO DI ZOOLOGIA,
UNIVERSITA DEGLI STUDI,
44100 FERRARA, ITALY

J.L SRIVASTAVA
INDIAN GRAIN STORAGE INST.,
HAPUR 245 101,
UTTAR PRADESH, INDIA

M.K. SRIVASTAVA
DEPT. OF ZOOL., ALLAHABAD
UNIV., ALLAHABAD 211 002,
INDIA

R.P. SRIVASTAVA
DEP. ENTOMOL., COLL. AGRIC.
G. B. PANT UNIV. AGRIC. &
TECHNOL.,
PANTNAGAR-263 145,
NAINTAL (U.P.) INDIA

U.S. SRIVASTAVA
DEPT. OF ZOOL.,
ALLAHABAD UNIV.,
ALLAHABAD 211 002, INDIA

E. STAHL
PHARMAKOGNOSIE UND
ANALYTISCHE PHYTOCHEMIE,
UNIV. SAARLANDES
FACRICHTUNG 15.1,
D-6600 SAARBRUCKEN,
GERMAN FEDERAL REPUBLIC

P. STAM
DEPT. OF GENETICS.
WAGENINGEN THE
NETHERLANDS

M.S.M. STANLEY
GEORGE MASON COLLEGE,
FAIRFAX, VIRGINIA 22039

V. STEJSKAL
VYZKUMNY USTAV
POTRAVINARSKY, RADIOVA 7,
CS-102 31 PRAGUE 10,
CZECH REPUBLIC.

L. STEVENS
DEPT. OF ZOOLOGY
UNIV. OF VERMONT
BURLINGTON, VT 05405-0086

K.B. STOREY
CARLETON UNIVERSITY,
OTTAWA, ONT., CANADA

H. STRATIL
BIOLOGISCHE BUNDESANSTALT
FUR LAND UND
FORSTWIRTSCHAFT, INSTITUT
FUR VORRATSCHUTZ,
KOENIGIN LUISE STR. 19,
1000 33 BERLIN

J.J. STUART
DIV. BIOL.,
KANSAS STATE UNIV.,
MANHATTAN, KS 66506

X Z. SU
PARASITOLOGY RES. LAB.,
XIA MEN UNIV.,
CHINA

H.C.F. SU
STORED PROD. INSECTS RES.
DEV. LAB., ARS, USDA,
SAVANNAH, GA 31403

A.S. SUBBARAMAN
BIO-ORGANIC DIV., BHABHA
ATOMIC RES. CENTRE,
TROMBAY, BOMBAY 400 085,
INDIA

B. SUBRAMANYAM
DEP. ENTOMOL., WATERS
HALL, KANSAS STATE UNIV.,
MANHATTAN, KS. 66056.

BHADRIRAJU SUBRAMANYAM,
STORE-GAIN PEST
MANAGEMENT PROGRAM,
DEPT. OF ENTOMOL., UNIV. OF
MINNESOTA

L. SUSS
ISTITUTO DI ENTOMOLOGIA
AGRARIA, UNIVERSITA DEGLI
STUDI, VIA CELORIA 2, 20133,
MILAN, ITALY

T. SUZUKI
INST. APPL. BIOCHEM., UNIV.
TSUKUBA, TSUKUBA,
IBARAKI 305, JAPAN

J.A. SVOBODA
INSECT NEUROBIOL. HORMONE
LAB., AGRIC. RES. SERVICE,
BELTSVILLE, MA 20705

F. SZAFRANSKI
FACULTE DES SCIENCES,
UNIVERSITE DE KISANGANI,
BP 1655, KISANGANI, ZAIRE.

J. SZAFRANEK
DEP. CHEM., UNIV. GDANSK,
SOBIESKIEGO 18, 80-952
GDANSK, POLAND

SAVARD, JOËL
INSTITUT FÜR GENETIK
UNIVERSITÄT zu Köln
Weyertal 121
50931, Köln, Germany.

M.P. TAGARRO
INSTITUTO NACIÓNAL DE
INVESTIGACIÓNES
AGRONÓMICAS, MADRID,
SPAIN

J. TAIJING
DEP. PARASITOL., UNIV. OF
ALLAHABAD, 211 002, INDIA

F. TAKAHASHI
HIROSHIMA UNIV., FAC. OF
INTEGRATED ARTS & SCIENCES,
HIGASHI-SENDA-MACHI,
NAKA-KU, HIROSHIMA 730,
JAPAN

A. TAKEBE
NATIONAL INST. OF ANIMAL
INDUSTRY
TSUKUBA NORINDANCHI
P. O. BOX 5
IBARAKI 305, JAPAN

M. TAKIGUCHI
NAGOYA UNIV. CHIGUSA,
NAGOYA, JAPAN

F.A. TALUKDER
DEP. BIOL., UNIV. 7PX
SOUTHAMPTON, BASSETT
CRESCENT EAST,
SOUTHAMPTON SO16
UNITED KINGDOM

Y. TANAKA
LAB. PESTICIDE & BIO-ORGANIC
CHEM., TOKYO UNIV.,
SETAGAYA-KU, TOKYO 156,
JAPAN

X.J. TANG
SOUTHWEST AGRIC. UNIV.,
CHONG QING, SI CHUAN,
CHINA

U. TARTES
INST. ZOOL. BOTANY,
VANEMUISE 21, EE-2400 TARTU,
ESTONIA

D. TAUTZ
ZOOLOGISCHES INSTITUT DER
UNIVERSITAT MUNCHEN,
LUISENSTRASSE 14,
8000 MUNICH, GERMANY

M.F.S. TAWFIK
BIOL. CONTROL LAB., DEP.
ENTOMOL. & PESTICIDES, FAC.
AGRIC., CAIRO UNIV.,
EGYPT

I. THOMAS
PEST INFESTATION LAB.,
SLOUGH, BUCKS, ENGLAND

K.P. THOMAS
ADAS CENT. SCI. LAB.,
MINISTRY AGRIC., FISHERIES &
FOOD, LONDON RD., SLOUGH,
BERKS.,
UNITED KINGDOM

M.S. THOMSON
DEP. BIOL. SCI.,
UNIV. WISCONSIN-PARKSIDE,
KENOSHA, WI 53141

JAMES E. THRONE
U. S. GRAIN MARKETING
RES. LAB
1515 COLLEGE AVE.
MANHATTAN, KS 66502

G.S. THURSTON
CANAD. FOREST SERV.,
MARITIMES,
P.O.BOX 4000,
FREDERICTON, NB E3B 5P7
CANADA

B.J. TIGAR
MINISTRY OF AGRIC. FISHERIES
FOOD, ADAS SLOUGH LAB.,
LONDON RD.,
SLOUGH, BERKS. SL3 7HJ,
UNITED KINGDOM

S. C. TIWARI
DEP. ZOOL.,
UNIV. ALLAHABAD
ALLAHABAD 221 002, INDIA

S.S. TOMAR
DIV. AGRI. CHEM., INDIAN
AGRIC. RES. INST.
NEW DELHI 110 012, INDIA

M.A. TORO
INSTITUTO NACIONAL DE
INVESTIGACIONES AGRARIAS,
DEPARTAMENTO DO GENETICA,
CARRETERA DE LA CORUNA
KM. 7, MADRID-35,
SPAIN

B. TOTH
BARANYA MEGYEI
NOVENYEGESZSEGUGYI ES
TALAJVEDELMI ALLOMAS PES,
HUNGARY

P. TREMATERRA
INST. OF AGRIC. ENTOMOL.,
UNIV. OF MILAN,
20133 MILAN, ITALY

V.Q. TRUNG
INFESTATION CONTROL &
PROTECTANTS AREA. CENTRAL
FOOD TECHNOL. RES. INST.,
MYSORE 570 013, INDIA

Y. TSUDA
LAB. OF APPLIED ENTOMOL.,
COLLEGE OF AGRIC.,
OKAYAMA UNIV.
OKAYAMA 700, JAPAN

D. TSVETKOV
INSTITUT ZA ZASHCHITA NA
RASTENIYATA, KOSTINBROD,
BULGARIA

J. H. TUPY
DEPT. OF ZOOL.,
UNIV. OF TORONTO,
ONT. M5S 1A1, CANADA

A.V. TUZINKEVICH
LAB. MATHEMATICAL
MODELLING ECOL. SYSTEMS,
INST. AUTOMATION CONTROL
PROCESS, FAR EAST DEP.,

VP. TYSHCHENKO
LENINGRADSKII
GOSUDARSTVENNYI UNIV.,
LENINGRAD,
USSR

A.S. UDEAAN
DEP. ENTOMOL., PUNJAB
AGRICULTURAL UNIV.,
LUDHIANA-141004, INDIA

G.W. UETZ
DEP. ZOOL.,
UNIV. CINCINNATI,
CINNCINATI, OH 45221-0006

D. UGARKOVIC
DEP. MOL. GENETICS, RUDER
BOSKOVIC INST., BIJENICKA 54,
41000 ZAGREB, CROATIA

T. USUI
LAB. OF INSECT TOXICOL., INST.
OF PHYSCIAL & CHEM. RES.,
WAKO, TOKYO 194, JAPAN

S.B. VERMA
DEP. GENETICS & ANIM.
BREEDING, BIHAR VET.
COLLEGE,
PATNA. 800 014, INDIA

K. VEVERKA
RES. INST. PLANT PROD.,
PRAGUE-RUZYNE,
CZECHOLOVAKIA

V. VIA
DEP. ENTOMOL. SECTION ECOL.
SYSTEMATICS, CORNELL UNIV.
ITHACA, NY 14853-0999

VIJAY-SINGH
DIV. OF ENTOMOL. INDIAN
AGRICULTURAL RES. INST.,
NEW DELHI 110 012, INDIA

E. VINUELA
UNIDAD DE PROTECCION DE
CULTIVOS, E.T.S.I. AGRONOMOS
CIUDAD UNIV.,
E28040, MADRID, SPAIN

S. VIR
CENTRAL ARID ZONE RES. INST.,
JODHPUR, INDIA

N.C. VISSER
DEP. BOT. GENET., UNIV.
ORANGE FREE STATE,
P.O.BOX 339,
BLOEMFONTEIN 9300,
SOUTH AFRICA

C. VIALANEIX
LABORATOIRE DE CHIMIE DES
AGRORESSOURCES, ECOLE
NATIONALE SUPERIORE DE
CHIMIE, INP TOULOUSE 31077,
FRANCE

K.V. VATTI
LENINGRAD STATE UNIV.,
DEPT. OF GENETICS,
LENINGRAD 199164, USSR

E.V. VEA
DEPT. OF ENTOMOL., FISHERIES
& WILDLIFE,
UNIV. OF MINNESOTA,
ST. PAUL, MINNESOTA 55101

G. VON DE KLASHORT
KONINKLIJK INSTITUT VOOR DE
TRUPEN, AMSTERDAM-OOST,
THE NETHERLANDS

Michael J. Wade
Dept. of Biology
Indiana University
Jordan Hall
Bloomington, IN 47405

K. WADHWANI
MYCOL. LAB., BOT. DEP.
LUCKNOW UNIV.,
LUCKNOW 226 007 INDIA

M. WAHID
NUCLEAR INST. FOOD & AGRIC.
TARNAB,
PESHAWAR, PAKISTAN

WALI-UR-REHMAN
PAKISTAN FOREST INST.,
PESHAWAR, PAKISTAN

S. WALIA
DIV. AGRIC. CHEMICALS,
INDIAN AGRIC. RES. INST.,
NEW DELHI, 110 0012, INDIA

J.R. WARCHALEWSKI
AKADEMIA ROLNICZA,
KATEDRA BIOCHEMII I ANALIZY
ZYWNOSCI,
UL. MAZOWIECKA 48,
60-623 POSNAN, POLAND

H. WARTOMO
FAKULTAS PETERNAKAN,
UNIVERSITAS HADJA MADA,
YOGYAKARATA, INDONESIA

CM. WARUI
PYRETHRUM BUREAU,
PO BOX 420,
NAKURU, KENYA

H. WASHIO
LAB. OF NEUROPHYSIOLOGY,
MITSUBISHI-KASEI INST. OF LIFE
SCI.,
MACHIDA, TOKYO 194,
JAPAN

J.C. WATT
ENTOMOL. DIV., D.S.I.R.
AUCKLAND, NEW ZEALAND

G.R.B. WEBSTER
DEPT. OF SOIL SCIENCE,
MANITOBA UNIV.,
WINNIPEG R3T 2N2,
CANADA

H. WEIDNER
ZOOLOGISCHES INSTITUT UND
ZOOLOGISCHES MUSEUM DER
UNIVERSITAT, HAMBURG,
GERMANY

J. WEIJER
UNIV. OF ALBERTA, EDMONTON,
ALBERTA, CANADA

R.A. WEINZIERL
OFFICE AGRIC. ENTOMOL.,
UNIV. ILL.,
CAMPAIGN, ILL. 61820

H. WELDMAN
ZOOLOGISCHES INSTITUTE,
ZOOLOGISCHES MUSEUM DER
UNIVERSITAT,
HAMBURG, GERMANY

G. WELSH
DONNER LAB. & LAWRENCE
RADIATION LAB.,
UNIV. OF CALIF.,
BERKELEY, CALIF. 94720

J.F. WELSH
HUMBOLDT STATE UNIV.,
ARCATA, CALIF. 95521

J.O. JR. WHITAKER
DEP. LIFE SCI., INDIANA STATE
UNIV., TERRE HAUTE 47809,
INDIANA

N.D.G. WHITE
AGRIC. CAN. RES. STA.,
195 DAFOE RD.,
WINNIPEG MANITOBA R3T 2M9,
CANADA

D.T. WICKLOW
NATL. CTR. AGRIC.
UTILIZATION RESOURCES.,
USDA ARS,
PEORIA, IL 61604

G. WILDE
DEP. ENTOMOL.,
KANSAS STATE UNIV.,
MANHATTAN, KS 66506

PAUL E. WILEY, PH. D.
STORED-PROD. INSECT RES. &
DEV'T LAB. 3401 EDWIN ST.
SAVANNAH, GA 31405

D.R. WILKIN
STORAGE PESTS DEPT., MAFF,
SLOUGH, BERKS. SL3 7HJ,
UNITED KINGDOM

R.M. WILKINS
DEP. AGRIC. ENVIRON. SCI.,
KING GEORGE VI BLDG., UNIV.,
NEWCASTLE UPON TYNE,
NE1 7RU, UNITED KINGDOM

J.O. WILLIAMS
NIGERIAN STORED PROD. RES.
INST.,
P.M.B. 3032, KANO,
NIGERIA

L.A.D WILLIAMS
PESTICIDE & PEST RES. GROUP,
FACULTIES OF NATURAL &
MEDICAL SCIENCES,
DEPT. OF ZOOL.,
UNIV. OF WEST INDIES,
KINGSTON 7, JAMAICA

P. WILLIAMS
DEPT. OF AGRIC., VICTORIAN
PLANT RES. INST.,
BURNLEY, VICTORIA,
AUSTRALIA

K.W. WOLF
MEDIZINISCHEN UNIVERSITET
ZU LUBECK, LUBECK, GERMANY

R.G. WINKS
CSIRO, DIV. ENTOMOL.,
P. O. BOX 1700,
CANBERRA, ACT 2601,
AUSTRALIA

V.P. WRIGHT
DEPT. OF ENTOMOL.,
KANSAS STATE UNIV.,
MANHATTAN, KS 66506

W.K. WINTERSTEEN
DEP. ENTOMOL., IOWA STATE
UNIV., AMES, IOWA 50011

H. WISTRAND
AGNES SCOTT COLLEGE
DECATUR, GEORGIA 30303

V.R. WOHLGEMUTH
BIOLOGISCHE BUNDESANSTALT
FUR LAND- UND
FORSTWIRTSCHAFT, INSTITUT
FUR VORRATSSCHUTZ,
KOENIGIN LUISE STRASSE 19,
D-1000 BERLIN 33,
GERMANY

CHRISTIAN WOLFF, PH. D.
STUDENT. INSTITUT FUR
ZOOLOGIE. LUISENSTRASSE 14,
MUCHEN, GERMANY

F.J. WONG-CORRAL
DEP. INVESTIGACION Y
POSGRADO EN ALIMENTOS,
UNIVERSIDAD DE SONORA,
APDO. POSTAL 1658,
HERMOSILLO, SONORA,
MEXICO

L.E. WONGO
DEP. GRAIN SCI. INDUSTRY,
SHELLENBERGER HALL,
KANSAS STATE UNIV.,
MANHATTAN KS 66506

T.J. WONTNER-SMITH
CENTRAL SCIENCE LAB.,
LONDON RD., SLOUGH,
BERKSHIRE SL3 7HJ,
UNITED KINGDOM

D. WOOL
DEPT. ZOOL.,
GEORGE S. WISE FAC. LIFE SCI.,
TEL AVIV UNIVERSITY,
ISRAEL

X. Z. XIONG
DEPT. OF PLANT PROTECTION,
SOUTHWEST AGRICULTURAL
UNIVERSITY,
CHONG QING 630 716,
SICHUAN, CHINA

T. YABE
KANAGAWA PREFECTURAL
PUBLIC HEALTH
LABORATORIES, ASAHI-KU,
YOKOHAMA 241, JAPAN

T.D. YADAV
DIV. ENTOMOL., INDIAN AGRIC.
RES. INST., NEW DELHI 110 012,
INDIA

Y. YAMADA
AGRIC. UNIV. OF MALAYSIA
43400 UPM SERDANG
SELANGOR, MALAYSIA

D. YAMAMOTO
MISTSUBISHI KASEI INST. OF
LIFE SCI., MACHIDA, TOKYO,
JAPAN

MASUMUNE YAMAMOTO, PH.D
TAIJIN CHEMICALS LTD.,
OSAKA, EKIMAI DAI I BLDG., 3-
1-700 UMEDA, 1 CHOME, KITA-
KU, OSAKA 530, JAPAN

G. YAN
DEP. ZOOL., UNIV. VERMONT,
MARSH LIFE SCI BLDG.,
BURLINGTON, VT 05405-0086

T.C. YANG
UNIV. OF CALIF., DONNER
RADIATION LAB.,
BERKELEY, CA 94720

K. YAO
CENTRAL CHINA COLLEGE OF
AGRICULTURE
PLANT PROTECTION DEPT.,
WU HANG, HU PEI,
CHINA

U. YINON
VISION RES. LAB.,
HADASSAH UNIV. HOSPITAL,
JERUSALEM, ISRAEL

A.M. YOUNG
MILWAUKEE PUBLIC MUSEUM,
300 WEST WELLS STREET,
MILWAUKEE, WI 53233

T. YOSHIDA
LAB. OF APPLIED ENTOMOL.,
COLLEGE OF AGRIC.,
OKAYAMA UNIV., OKAYAMA
700 JAPAN

A. YUCEL
DICLE UNIVERSITESI ZIRAAT
FAKUELTESI, SANLIURFA,
TURKEY

ZABZA
INST. ORGANIC CHEM.,
BIOCHEM. BIOTECHNOLOGY
TECHNICAL UNIV. WROCLAW,
WYBRZEZE S. WYSPINSKIEGO
27, 50-370 WROCLAW, POLAND

F.N. ZAKI
DEP. PLANT PROTECTION,
PLANT PROTECTION LAB., NATL.
RES CENTRE,
SH.. EL TAHIR, DOKKI, CAIRO,
EGYPT

T.V. ZANUNCIO
DEP. BIOL. ANIM., UNIV. FED.
VICOSA:36570-000 VICOSA,
MINAS GERAIS, BRAZIL

E. ZDARKOVA
VYZKUMMY USTAV
POTRAVINARSKEHO
PRUMYSLU, 150 38 PRAGUE 5,
CZECHOSLOVAKIA

J. L. ZETTLER
U.S. G.M.R. LAB
MANHATTAN, KS 66502

L. ZHANG
DEP. ANIM. SCI.,
BEI JING AGRIC. UNIV.,
BEI JING, 100094, CHINA

D. ZISSLER
BIOLOGISCHES INSTITUT I
(ZOOLOGIE) DER UNIVERSITAT
FREIBURG I. BR. GERMANY