TRIBOLIUM INFORMATION BULLETIN

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NOTE

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OF TIB 36

ANNOUNCEMENT I

WITH THIS ISSUE (TIB 36) THE EDITOR INITIATES A NEW SECTION OF THE TIB: AN OPEN FORUM FOR DISCUSSION OF CURRENT PROBLEMS IN TRIBOLIUM OR IN POPULATION BIOLOGY IN GENERAL. THE FIRST TOPIC OF DISCUSSION IS ENTITLED "INTERACTIONS IN TRIBOLIUM: COMPETITION OR PREDATOR-PREY?", A TOPIC WHICH HAS BEEN IN THE EDITOR'S MIND FOR SOME TIME, BUT IT SOLIDIFIED RECENTLY AS A RESULT OF A REVIEW OF THE LITERATURE SINCE 1977 (WHEN VOLUME III OF THE BIOLOGY OF TRIBOLIUM WITH SPECIAL EMPHASIS ON GENETIC ASPECTS WAS PUBLISHED.

THE TITLE IS SELF-EXPLANATORY. I HOPE THAT COLLEAGUES AND/OR THEIR STUDENTS WILL RESPOND TO THE PAPER'S QUESTION FOR INCLUSION IN LATER ISSUES OF TIB. THE REPLY MAY BE SHORT OR LONG, TECHNICAL OR NON-TECHNICAL, AND MAY VOICE AN OPINION, EITHER PRO OR CONTRA THE QUESTION. IT MAY INCLUDE MATHEMATICAL EQUATIONS TO PROVE THAT COMPETITION AND PREDATOR-PREY ARE OR ARE NOT DIFFERENT INTERACTIONS, OR THEY MAY BE CONSIDERED THE SAME TYPE OF INTERACTION.

IF ENOUGH INFORMATION IS AVAILABLE, WE MAY SUBMIT THE CONTRIBUTIONS TO A JOURNAL FOR PUBLICATION, AND PERHAPS WE CAN ORGANIZE A SYMPOSIUM AT A FUTURE MEETING.

THE TRIBOLIUM INFORMATION BULLETIN CAN ONLY SURVIVE BY CONTRIBUTIONS OF COLLEAGUES' RESEARCH FOR ITS EXISTENCE. PLEASE BE AS GENEROUS OF YOUR TIME AS POSSIBLE BY RESPONDING WHEN CALLS FOR CONTRIBUTIONS ARRIVE IN YOUR HANDS.

A. SOKOLOFF

ANNOUNCEMENT II

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

June 1996

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

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STOCK LISTS

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
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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
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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

CORAL GABLES, FLORIDA
UNIVERSITY OF MIAMI
DEPARTMENT OF BIOLOGY

I wild type strains

1. Tribolium confusum (Chicago)
2. T. castaneum (Chicago)

II Mutant

1. T. confusum - ebony (SOKOLOFF)
2. T. castaneum - jet (from Chicago wild)
3. T. castaneum - Chicago black (Sokoloff)
4. T. castaneum - dark soooty (Sokoloff)

Earl R. Rich

Present Tribolium wok limited to homosexual behavior in melanic mutants.

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
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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
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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)

R. W. Beeman Laboratory August 12, 1994 Manhattan, Kansas

Mutant	Full Name or description	Link. Group	Stocks	Source
1S65	Crossover supressor	2;9	1S65/mas,p	Manhattan
3P1	crossover supressor	3	3P1/au14	Purdue
3P2	crossover supressor	3	3P2/au14, 3P2/X(ab-2s)	Purdue
A(Ag1),Stm	abdominal (fr. Ag), cis Stm	2	A(Ag1), Stm /ptlD60	Manhattan
A(Ag2)	abdominal (from Ag)	2	A(Ag2)/Ey	Manhattan
A(mc)	abdominal (from mc)	2	A(mc),p/Stm,Cx5	Manhattan
A10	Abdominal 10	2	A10 / Ey	Manhattan
A10	Abdominal 10	2	A10,mxpA10/Utx1,mxp,apt	Manhattan
A10,mxpA10	Abdominal 10, mxp fr. A10	2	A10,mxpA10/Utx1,mxp,apt	Manhattan
A12	Abdominal 12	2	A12/Ey	Manhattan
A15, Stm	Abdominal 15, Stm cis	2	A15,Stm/Ey	Manhattan
A20 Rdiel	Dieldrin resistant	2	A20 Rdiel	Unknown
A4	Abdominal 4	2	A4/Stm,Cx5	Manhattan
A8	Abdominal 8	2	A8/Stm,Cx5	Manhattan
ab	antenna bifurcada	9	ab,pas30,p	Bogota, Colombia
ab	antenna bifurcada	9	ub,ab	Bogota, Colombia
ab	antenna bifurcada	9	ab/ab	Bogota, Colombia
ab	antenna bifurcada	9	ue,ab,msg,p,mxp,apt,pas30	Bogota, Colombia
AD100,Stm,Cx5	Notched gena,Stm,Cx5 (cis)	2	AD100,Stm,Cx5/Es1	Manhattan
Ag	Antennagalea	2	Ag/Es1	Manhattan
Ag	Antennagalea	2	Ag/mxpNG	Manhattan
Ag+RptlD1	Ag revertant-dominant ptl	2	Ag+RptlD1/Es1	Manhattan
Ag2, Stm	Antennagalea 2, Stm (cis)	2	Ag2,Stm/Ey	Manhattan
Ag5, Stm	Antennagalea 5, Stm (cis)	2	Ag5,Stm/Es1	Manhattan
AgPin	Antennagalea (Pinhead)	2	AgPin/Stm,Cx5	Manhattan
Ah	Arrowhead	8	Ah	Purdue
ap	antennapedia	8	b, ap	San Bernadino
ap	antennapedia	8	Bald,ap,sq1/ap,sq1	San Bernadino
ap	antennapedia	8	Bald,ap,sq2/ap,sq2	San Bernadino
ap	antennapedia	8	MMS (s.c,ap,au,mas)	San Bernadino
ap(psi)	ap(pleurosternal sutures incompl.	8	ap(psi)	Manhattan
Api	Antennapalpus	2	Api, apt, ub	Manhattan
Api	Antennapalpus	2	Api,apt,mas,pas	Manhattan
Api	Antennapalpus	2	Api/Api	Manhattan
apt	alate prothorax	2	apt, mas, p	Manhattan
apt	alate prothorax	2	apt, pas	San Bernadino
apt	alate prothorax	2	b, apt, sa, c	San Bernadino
apt	alate prothorax	2	ba,mxp,apt,pas30	San Bernadino
apt	alate prothorax	2	Quad(mxp,apt,mas,pas	San Bernadino
apt	alate prothorax	2	quint	San Bernadino
apt	alate prothorax	2	s,h,b(t),mxp,apt,pas30	San Bernadino
apt	alate prothorax	2	s,h,j2,mxp,apt,pas30	San Bernadino
apt	alate prothorax	2	Utx1,mxp,apt/mxpX9,Es1	San Bernadino
apt	alate prothorax	2	s,j,b(t),mxp,apt,pas30,h	San Bernadino
au	aureate	3	au	San Bernadino
au	aureate	3	b(t),p,lod,au,msg	San Bernadino
au	aureate	3	au,lod isoline (JS)	San Bernadino
au	aureate	3	mas, p,au	San Bernadino
au	aureate	3	MMS (s.c,ap,au,mas)	San Bernadino
au14	aureate 14, lethal	3	3P1/au14, 3P2/au14	Purdue
b	black body color	3	b	San Bernadino
b	black body color	3	b, ap	San Bernadino
b	black body color	3	b, apt, sa, c	San Bernadino
b(ST)	black, dominant	3	Chr/b(ST)	Manhattan
b(t)	tawny body color	3	b(t)	San Bernadino
b(t)	tawny body color	3	b(t),p,lod,au,msg	San Bernadino
b(t)	tawny body color	3	s,h,b(t),mxp,apt,pas30	San Bernadino
b(t)	tawny body color	3	s,j,b(t),mxp,apt,pas30,h	San Bernadino
ba	broken antennae	2	ba, pas30	Manhattan
ba	broken antennae	2	ba, pas30	Manhattan
Bald	Bald (reduced setiferous pits)	8	Bald	Manhattan
Bald	Bald (reduced setiferous pits)	8	Bald,ap,sq1/ap,sq1	Manhattan

Bald	Bald (reduced setiferous pits)	8	Bald,ap,sq2/ap,sq2	Manhattan
Bamp14	Blunt anterior metastern. projection `	3	Bamp14	Manhattan
Bamp27	Blunt anterior metastern. projection :	3	Bamp27	Manhattan
Bamp27,au	Blunt anterior metastern. projection 2	3	Bamp27,au/au	Manhattan
Bamp29	Blunt anterior metastern. projection :	3	Bamp29	Manhattan
Bamp31	Blunt anterior metastern. projection :	3	Bamp31/+	Manhattan
Bamp31	Blunt anterior metastern. projection :	3	Bamp31/Chr	Manhattan
Bamp58	Blunt anterior metastern. projection !	3	Bamp58	Manhattan
BampSp	Blunt anterior metastern. projection f	3	BampSp	Manhattan
Be	Bar eye	4	Be	San Bernadino
Be	Bar eye	4	Be, s	San Bernadino
box	box (abdominal)	2	box / Es	Manhattan
c	chestnut eye	7	b, apt, sa, c	San Bernadino
c	chestnut eye	7	sa,c	San Bernadino
c	chestnut eye	7	MMS (s.c,ap,au,mas)	San Bernadino
Cg	Cleft gular (sutures)	?	Cg	Manhattan
Chr	Charcoal body color	3	Bamp31/Chr	San Bernadino
Chr	Charcoal body color	3	Chr	San Bernadino
Chr	Charcoal body color	3	Chr/b(ST)	San Bernadino
ChrE	Charcoal (Elytra indented)	3	ChrE	Manhattan
co	cola body color	9	co,p	Manhattan
co	cola body color	9	Se,co	Manhattan
co	cola body color	9	Se,co,p	Manhattan
Crab	Crab (warped legs)	7	Crab	Manhattan
Crab	Crab (warped legs)	7	Crab,s	Manhattan
Crab	Crab (warped legs)	7	Crab/PL4	Manhattan
CTC 12 Rabon R	Rabon resistant	?	CTC 12 Rabon R	Australia
Cv	Cross-veined elytra	?	Cv	Purdue
Cx20	Cephalothorax 20	2	Cx20/Es1	Manhattan
Cx6	Cephalothorax 6	2	Cx6/Es1	Manhattan
Dch1	Dachshund 1	2;9	Dch1/Es1	San Bernadino
Dch13,Stm	Dachshund 13, Stm (cis)	2	Dch13,Stm/Es1	Manhattan
Dch4	Dachshund 4	2	Dch4 / Es	Manhattan
Det43	Divergent elytral tips	4;5	Det43,h,s/Es,h,s	Manhattan
Det43	Divergent elytral tips	4;5	Det43/Es1	Manhattan
Df(Dch1)	Deficiency (from Dch1)	2	Df(Dch1)/Ey	Manhattan
Df(Lu)/Df(Lu)	Deficiency (from Lu)	2?	Df(Lu)/Df(Lu)	Manhattan
Df1-3/Ey	Deficiency	2	Df1-3/Ey	Manhattan
Df1-5/Ey	Deficiency	2	Df1-5/Ey	Manhattan
Dp	Duplication (from Dch1)	2	Dp/Es1/A10	Manhattan
Dp	Duplication (from Dch1)	2	Dp/Es1/Df(Dch)	Manhattan
Dp	Duplication (from Dch1)	2	Dp/Es1/Df1-3	Manhattan
Dp	Duplication (from Dch1)	2	Dp/Es1/pas30	Manhattan
Dp	Duplication (from Dch1)	2	Dp/Ey/Ey	Manhattan
Dp	Duplication (from Dch1)	2	Dp/Stm,ptlD57/pas30	Manhattan
DpLu	Duplication (from Lu)	2	DpLu/Ey	Manhattan
DpSpa	Duplication (from Spa)	2	DpSpa/Es1/pas30	Manhattan
Ds	Displaced sternellum	4	Ds/Spa (no Medea)	Manhattan
ds(euD)	displaced sternellum (from euD)	?	ds(euD)	Manhattan
ds-X	displaced sternellum, x-linked	4?;X	ds-X	Manhattan
dve(mas,pas)	divergent elytra (from mas,pas stock	?	dve(mas,pas)	Manhattan
Em,A16s	Enlarged mentum, abdominal (cis)	2	Em,A16s/Stb	Manhattan
Er	Eye reduced	2	Er	Manhattan
Er	Eye reduced	2	Er,quint	Manhattan
Er	Eye reduced	2	Er,ub	Manhattan
Es	Extra sclerite (abdominal)	2;4	AD100,Stm,Cx5/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Ag+RptlD1/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Ag/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Ag5,Stm/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	box / Es	Manhattan
Es	Extra sclerite (abdominal)	2;4	Cx20/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Cx6/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Dch1/Es1	Manhattan

Es	Extra sclerite (abdominal)	2;4	Dch13,Stm/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Det43/Es	Manhattan
Es	Extra sclerite (abdominal)	2;4	Dp/Es1/A10	Manhattan
Es	Extra sclerite (abdominal)	2;4	Dp/Es1/Df(Dch)	Manhattan
Es	Extra sclerite (abdominal)	2;4	Dp/Es1/Df1-3	Manhattan
Es	Extra sclerite (abdominal)	2;4	Dp/Es1/pas30	Manhattan
Es	Extra sclerite (abdominal)	2;4	DpSpa/Es1/pas30	Manhattan
Es	Extra sclerite (abdominal)	2;4	Es/tr	Manhattan
Es	Extra sclerite (abdominal)	2;4	Ey/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	g/Es	Manhattan
Es	Extra sclerite (abdominal)	2;4	lp69/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Spa/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stb,Df(mas)/Es	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stb/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stbd/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stm+RSptlD/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stm,Ag4/Es	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stm,Cx5/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stm,Ns/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stm-Es1/+NDJ	Manhattan
Es	Extra sclerite (abdominal)	2;4	Stm-Skl4-Es/+ NDJ	Manhattan
Es	Extra sclerite (abdominal)	2;4	StmR1/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	StmR2/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	StmR5/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	StmR6/Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Utx1,mxp,apt/mxpX9,Es1	Manhattan
Es	Extra sclerite (abdominal)	2;4	Utx1/Es	Manhattan
Es	Extra sclerite (abdominal)	2;4	vwe/Es	Manhattan
Es(Skl6)	Extra sclerite (from Skl6)	2	Es(Skl6)	Manhattan
Es1+R1/Stm	Extra sclerite revertant 1	2	Es1+R1/Stm	Manhattan
Es1+R9/Ey	Extra sclerite revertant 9	2	Es1+R9/Ey	Manhattan
Es2/Ey	Extra sclerite 2	2	Es2/Ey	Manhattan
Es3/Ey	Extra sclerite 3	2	Es3/Ey	Manhattan
eu	extra urogomphi	2	eu	San Bernadino
eu	extra urogomphi	2	eu, apt, mas	San Bernadino
eu	extra urogomphi	2	eu, mas	San Bernadino
eu	extra urogomphi	2	eu, mas, pas	San Bernadino
euD	Extra urogomphi (Abd B)	2	euD	Manhattan
Ey	eyeless	2;5	A(Ag2)/Ey	Manhattan
Ey	eyeless	2;5	A10 / Ey	Manhattan
Ey	eyeless	2;5	A12/Ey	Manhattan
Ey	eyeless	2;5	A15,Stm/Ey	Manhattan
Ey	eyeless	2;5	Ag2,Stm/Ey	Manhattan
Ey	eyeless	2;5	Dch3 / Ey	Manhattan
Ey	eyeless	2;5	Df(Dch1)/Ey	Manhattan
Ey	eyeless	2;5	Df(Lu)/Df(Lu)	Manhattan
Ey	eyeless	2;5	Df1-3/Ey	Manhattan
Ey	eyeless	2;5	DpLu/Ey	Manhattan
Ey	eyeless	2;5	Ey/Es1	Manhattan
Ey	eyeless	2;5	Lu,Skl6/Ey	Manhattan
Ey	eyeless	2;5	ptlD16,Stm/Ey	Manhattan
Ey	eyeless	2;5	Mcs1R1/Ey	Manhattan
Ey	eyeless	2;5	Mcs1R2/Ey	Manhattan
Ey	eyeless	2;5	Mcs1R5/Ey	Manhattan
Ey	eyeless	2;5	mxpD1,Skl6/Ey	Manhattan
Ey	eyeless	2;5	mxpX9,Es1/Ey	Manhattan
Ey	eyeless	2;5	Df1-5/Ey	Manhattan
Ey	eyeless	2;5	ptlD57,Stm/Ey	Manhattan
Ey	eyeless	2;5	ptlD60/Ey	Manhattan
Ey	eyeless	2;5	Skl4/Ey	Manhattan
Ey	eyeless	2;5	Skl4R1/Ey	Manhattan

Ey	eyeless	2;5	Skl4R2/Ey	Manhattan
Ey	eyeless	2;5	Stm,Cx5/Ey,A14	Manhattan
Ey	eyeless	2;5	Stm,Cx5/Ey; s/s	Manhattan
Ey,A14	Eyeless, Abdominal 14 (cls)	2	Stm,Cx5/Ey,A14	Manhattan
Ey-Lethal-Free	lethal free from Eyless	NA	Ey-Lethal-Free	Manhattan
fs(sa)	short antennae, female sterile	?	fs(sa)	Manhattan
Fta	Fused tarsi and antennae	?	Fta	San Bernadino
g	glossy	2	g	Manhattan
g	glossy	2	g/Dch3	Manhattan
g	glossy	2	g/Es	Manhattan
Ga-1	Georgia 1, wild type	NA	Ga-1	Georgia
Ga-1	Georgia 1, wild type	NA	Ga-9s	Georgia
Gi	Giant (body size)	NA	Gi	San Bernadino
Go	Goliath (body size)	7	Go	Manhattan
h	hazel eye	4	Det43/Es	San Bernadino
h	hazel eye	4	h, s	San Bernadino
h	hazel eye	4	s,h,b(t),mxp,apt,pas30	San Bernadino
h	hazel eye	4	s,h,j2,mxp,apt,pas30	San Bernadino
Hw	Hairy wing	2	Hw/Es,mxpX9	Manhattan
Hw	Hairy wing	2	Hw/Stm,Cx5	Manhattan
Is	Incomplete sternellum	?	Is	Manhattan
j1	jet, body color	5	j,mc	San Bernadino
j1	jet, body color	5	rb,j	San Bernadino
j1	jet, body color	5	s,j,b(t),mxp,apt,pas30,h	San Bernadino
j2	jet, body color	5	j2	Cedar Rapids
j2	jet, body color	5	s,h,j2,mxp,apt,pas30	Cedar Rapids
ju	juvenile urogomphi	4?	ju,ptl	Manhattan
Lab-S Rusty	Lab strain, rusty, wild-type	NA	Lab-S Rusty	Manhattan
LF-3 (JS)	Lethal free	3	LF-3 (JS)	Purdue
lod	light optical diaphragm	3	au,lod isoline (JS)	San Bernadino
lod	light optical diaphragm	3	b(t),p,lod,au,msg	San Bernadino
lp69	labiopedia 69	2	lp69/Es1	Manhattan
lp69	labiopedia 69	2	lp69/Utx1,mxp,apt	Manhattan
Lu	Lucifer (dorsal head horns)	2	Lu / Stm,Cx5	Manhattan
Lu	Lucifer (dorsal head horns)	2	Lu,Skl6/Ey	Manhattan
Lu	Lucifer (dorsal head horns)	2	Lu,Skl6/Stb	Manhattan
Lu	Lucifer (dorsal head horns)	2	Lu/Stbd	Manhattan
m.l. 9.14	(Male linked)	2	9.14 (male linked)	Manhattan
M1	Medea 1	3	M1 - iso 3B1 (G)	Manhattan
M1	Medea 1	3	M1 isoline (JS)	Manhattan
M1	Medea 1	3	M1,au,M3	Manhattan
M1	Medea 1	3	M1,au,p,lod	Manhattan
M1	Medea 1	3	M1,b	Manhattan
M1	Medea 1	3	M1/M1, Bamp27	Manhattan
M3	Medea 3	3	M3,au	Manhattan
M3	Medea 3	3	M1,au,M3	Manhattan
mas	missing abdominal sternite	2	1S65/mas,p	San Bernadino
mas	missing abdominal sternite	2	apt, mas, p	San Bernadino
mas	missing abdominal sternite	2	mas	San Bernadino
mas	missing abdominal sternite	2	mas, p,au	San Bernadino
mas	missing abdominal sternite	2	mas, pas	San Bernadino
mas	missing abdominal sternite	2	ptl, mas, pas	San Bernadino
mas	missing abdominal sternite	2	Quad(mxp,apt,mas,pas	San Bernadino
mas	missing abdominal sternite	2	quint	San Bernadino
mas	missing abdominal sternite	2	MMS (s,c,mas,ap,au)	San Bernadino
mas2	missing abdominal sternite 2	2 ?	mas2	Manhattan
mc	microcephalic	5	j,mc	San Bernadino
mc	microcephalic	5	mc,rb,j	San Bernadino
mc	microcephalic	5	mc,j	San Bernadino
mc(eg)	microcephalic (eye growth)	5	mc(eg),p,lod	San Bernadino
Mc-2,Utx1	Microcephalic-2,Ultrathorax(cls)	2	Mc-2,Utx1/mxpNG	Manhattan
Mcs1	Miscadestral sclerite	2	Mcs1/Stm	Manhattan
Mcs1R1	Miscadestral sclerite, revertant 1	2	Mcs1R1/Ey	Manhattan

Mcs1R2	Miscadestral sclerite, revertant 2	2	Mcs1R2/Ey	Manhattan
Mcs1R4	Miscadestral sclerite, revertant 4	2	Mcs1R4/mxpNG	Manhattan
Mcs1R5	Miscadestral sclerite, revertant 5	2	Mcs1R5/Ey	Manhattan
Mo	Micro opthalmic	6	Mo	San Bernadino
msg	melanotic stink gland	?	b(t),p,lod,au,msg	San Bernadino
msg	melanotic stink gland	?	msg, pas	San Bernadino
msg	melanotic stink gland	?	ue,ab,msg,p,mxp,apt,pas30	San Bernadino
m t	melanotic tumors	?	m t	San Bernadino
mxp	maxillopedia	2	ba,mxp,apt,pas30	San Bernadino
mxp	maxillopedia	2	mxp, apt	San Bernadino
mxp	maxillopedia	2	mxp, apt, pas30	San Bernadino
mxp	maxillopedia	2	mxp, mas	San Bernadino
mxp	maxillopedia	2	ptl, mxp	San Bernadino
mxp	maxillopedia	2	A10,mxpA10/Utx1,mxp,apt	San Bernadino
mxp	maxillopedia	2	Quad(mxp,apt,mas,pas	San Bernadino
mxp	maxillopedia	2	quint	San Bernadino
mxp	maxillopedia	2	s,h,b(t),mxp,apt,pas30	San Bernadino
mxp	maxillopedia	2	s,h,j2,mxp,apt,pas30	San Bernadino
mxp	maxillopedia	2	s,j,b(t),mxp,apt,pas30,h	San Bernadino
mxp	maxillopedia	2	Utx1,mxp,apt/mxpX9,Es1	San Bernadino
mxp(Dch3)	maxillopedia dauchshund 3	2	X-31 pearl s.l./Dch3	Manhattan
mxp(Dch3)	maxillopedia dauchshund 3	2	X-31/Dch3	Manhattan
mxp(Dch3)	maxillopedia dauchshund 3	2	Dch3 / Ey	Manhattan
mxp(Dch3)	maxillopedia dauchshund 3	2	Dch3/X(ab-1s)	Manhattan
mxp(Dch3)	maxillopedia dauchshund 3	2	g/Dch3	Manhattan
mxp(Df1-3)	maxillopedia (from deficiency)	2	mxp(Df1-3)/Es	Manhattan
mxp170	maxillopedia 170, lethal	2	mxp170/Es1	Manhattan
mxp19	maxillopedia 19, lethal	2	mxp19/Es1	Manhattan
mxp8	maxillopedia 8, lethal	2	mxp8/Es1	Manhattan
mxpD1,Skl6/Ey	Maxillopedia, dom. 1, Skl6 (cis)	2	mxpD1,Skl6/Ey	Manhattan
mxpNG	maxillopedia, Notched Gena, lethal	2	mxpNG/Es1	Manhattan
mxpNG	maxillopedia, Notched gena	2	Ag/mxpNG	Manhattan
mxpNG	maxillopedia, Notched gena	2	Mc-2,Utx1/mxpNG	Manhattan
mxpNG	maxillopedia, Notched gena	2	Mcs1R4/mxpNG	Manhattan
mxpX9, Es	lethal maxillopedia, Es (cis)	2;4	Utx1,mxp,apt/mxpX9,Es1	Manhattan
mxpX9, Es	lethal maxillopedia, Es (cis)	2;4	mxpX9,Es1/Ey	Manhattan
mxpX9, Es	lethal maxillopedia, Es (cis)	2;4	Hw/Es,mxpX9	Manhattan
mxpX9,Es1/Ey	maxillopedia X9, lethal, Es (cis)	2;4	mxpX9,Es1/Ey	Manhattan
NDG-2 (#59)	Wild-type	NA	NDG-2 (#59)	Manitoba
p	pearl eye	9	1S65/mas,p	San Bernadino
p	pearl eye	9	ab,pas30,p	San Bernadino
p	pearl eye	9	apt, mas, p	San Bernadino
p	pearl eye	9	mas, p,au	San Bernadino
p	pearl eye	9	Se,co,p	San Bernadino
p	pearl eye	9	Se,p	San Bernadino
pas	pointed abdominal sternite	2	apt, pas	San Bernadino
pas	pointed abdominal sternite	2	ptl, mas, pas	San Bernadino
pas	pointed abdominal sternite	2	mas, pas	San Bernadino
pas	pointed abdominal sternite	2	Quad(mxp,apt,mas,pas	San Bernadino
pas	pointed abdominal sternite	2	quint	San Bernadino
pas30	pointed abdominal sternite 30	2	ab,pas30,p	Manhattan
pas30	pointed abdominal sternite 30	2	ba,mxp,apt,pas30	Manhattan
pas30	pointed abdominal sternite 30	2	s,h,b(t),mxp,apt,pas30	Manhattan
pas30	pointed abdominal sternite 30	2	s,h,j2,mxp,apt,pas30	Manhattan
pas30	pointed abdominal sternite 30	2	s,j,b(t),mxp,apt,pas30,h	Manhattan
pas30	pointed abdominal sternite 30	2	ub,pas30	Manhattan
pas30	pointed abdominal sternite 30	2	ue,ab,msg,p,mxp,apt,pas30	Manhattan
pd	paddle antenna	X	py, pd, plt	San Bernadino
PL4	Pseudo Linker 4	7;2	Crab/PL4	Manhattan
plt	platinum eye	X	py, pd, plt	San Bernadino
pnk (NDG-2)	pink eye, from NDG-2	?	pnk (NDG-2)	Manhattan
Ps	Pinched sternellum	2	Ps	San Bernadino
ptl	prothoraxless	2	ju,ptl	San Bernadino

ptl	prothoraxless	2	ptl	San Bernadino
ptl	prothoraxless	2	ptl, mas, pas	San Bernadino
ptl	prothoraxless	2	ptl, mxp	San Bernadino
ptlD16,Stm	Dom. prothoraxless 16, Stm (cis)	2	ptlD16,Stm/Ey	Manhattan
ptlD2	Dom. prothoraxless 2	2	ptlD2/Stb	Manhattan
ptlD26Y	Dom. prothoraxless 26, Y-linked	2;Y	ptlD26Y	Manhattan
ptlD57,Stm	Dom. prothoraxless 57, Stm (cis)	2	ptlD57,Stm/Ey	Manhattan
ptlD60	dominant prothoraxless 60	2	A(Ag1), Stm /ptlD60	Manhattan
ptlD60	dominant prothoraxless 60	2	ptlD60/Ey	Manhattan
py	pygmy	X	py, pd, plt	San Bernadino
py	pygmy	X	py, ser	San Bernadino
Pyr-R	Pyrethroid resistant	9	co,Pyr-R	Peter Collins
QTC 279 (Pyr-R)	Pyrethroid resistant	9?	QTC 279 (Pyr-R)	Peter Collins
Rap	Recurved anterior pronotum	2	Rap	Manhattan
rb	ruby eye	5	mc,rb,j	San Bernadino
rb	ruby eye	5	rb,j	San Bernadino
Rd	Reindeer, homozygous viable	2	Rd/Rd	Dawson
Rd	Reindeer, homozygous viable	2	Rd, mas, p	Dawson
Rd	Reindeer, homozygous viable	2	Rd,mc,p	Dawson
Rd	Reindeer, homozygous viable	2	Rd,pas30	Dawson
Rd(CS)	Reindeer, crossover suppressor	2	Ps/Rd(CS)	Manhattan
Rdiel BC9 Lab-S	Dieldrin resistant from Lab-S	NA	Rdiel BC9 Lab-S	Unknown
Rmal-2 (Cogburn)	Malation resistant	NA	Rmal-2 (Cogburn)	Texas
Russell 1 BC4s	spontaneous sooty ?	NA	Russell 1 BC4s	Russell, KS
Russell 2 BC4s	spontaneous sooty ?	NA	Russell 2 BC4s	Russell, KS
s	sooty	4	Crab,s	San Bernadino
s	sooty	4	s	San Bernadino
s	sooty	4	Det43,h,s/Es,h,s	San Bernadino
s	sooty	4	h, s	San Bernadino
s	sooty	4	s,h,b(t),mxp,apt,pas30	San Bernadino
s	sooty	4	s,h,j2,mxp,apt,pas30	San Bernadino
s	sooty	4	s,j,b(t),mxp,apt,pas30,h	San Bernadino
s	sooty	4	Be, s	San Bernadino
s	sooty	4	Ga-9s	San Bernadino
s	sooty	4	MMS (s.c.ap,au,mas)	San Bernadino
sa	short antenna	?	b, apt, sa, c	San Bernadino
sa	short antenna	?	sa,c	San Bernadino
Sa-8	Short antenna-8	?	Sa-8	Manhattan
sa-X	short antenna, X-linked	X	sa-X	Manhattan
Se	Short elytra	9	Se	Manhattan
Se	Short elytra	9	Se,co,p	Manhattan
Se	Short elytra	9	Se,p	Manhattan
se 46	short elytra 46	?	se 46	Purdue
Se-2	Short elytra 2	8	Se-2	Manhattan
Se12	Short elytra 12	?	Se12	Purdue
ser	serrate antenna	X	py, ser	San Bernadino
Skl2s	Socketless spontaneous 2	2	Skl2s/Stm,Cx5	Manhattan
Skl4/Ey	Socketless 4	2	Skl4/Ey	Manhattan
Skl4R1	Socketless 4, revertant 1	2	Skl4R1/Ey	Manhattan
Skl4R2	Socketless 4, revertant 2	2	Skl4R2/Ey	Manhattan
Skl4R3	Socketless 4, revertant 3	2	Skl4R3/Stm,Cx5	Manhattan
Skl6	Socketless 6	2	Skl6/Stm,Cx5	Manhattan
Skl6R1	Socketless 6, revertant 1	2	Skl6R1/Stm,Cx5	Manhattan
small	small body size	?	small	Purdue
sp	shoulder pads	2	sp/Dch3	Manhattan
sp	shoulder pads	2	sp/Stm,Ag4	Manhattan
Spa	Spatulate antennae	2;4	Ds/Spa (no Medea)	San Bernadino
Spa	Spatulate antennae	2;4	Spa/Es1	San Bernadino
sq (Tiw-2)	squint (from Tiw-1)	?	sq (Tiw-2)	India
sq-B	squint (from Burma)	?	sq-B	Burma
sq1	squint eye 1	8	Bald,ap;sq1/ap,sq1	San Bernadino
sq1	squint eye 1	8	sq1	San Bernadino

sq2	squint eye 2	8	ap,sq2	Manhattan
sq2	squint eye 2	8	Bald,ap,sq2/ap,sq2	Manhattan
Stb	Stubby antennae	2;X	Em,A16s/Stb	Manhattan
Stb	Stubby antennae	2;X	Lu,Ski6/Stb	Manhattan
Stb	Stubby antennae	2;X	Stb/Es	Manhattan
Stb,Df(mas)	Stubby, deficiency in mas	2	Stb,Df(mas)/Es	Manhattan
Stbd	Stuboid (short antennae)	2	Lu/Stbd	Manhattan
Stbd	Stuboid (short antennae)	2	Stbd/Es	Manhattan
Stm	Stumpy	2	Stm/Stm	Manhattan
Stm+RSptlD	Stm spontan. revert. ptl	2	Stm+RSptlD/Es1	Manhattan
Stm,Ag4	Stm, Antennagalea 4	2	X-83/Stm,Ag4	Manhattan
Stm,Ag4	Stm, Antennagalea 4	2	X-47/Stm,Ag4	Manhattan
Stm,Ag4	Stm, Antennagalea 4	2	vwe/Stm,Ag4	Manhattan
Stm,Ag4	Stm, Antennagalea 4	2	sp/Stm,Ag4	Manhattan
Stm,Ag4	Stm, Antennagalea 4	2	g/Stm,Ag4	Manhattan
Stm,Ag4	Stm, Antennagalea 4	2	X-31/Stm,Ag4	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	A4/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	A8/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	AgPln/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Lu / Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Ski2s/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	AD100,Stm,Cx5/Es1	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	AD100,Stm,Cx5/Es1	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Ski2s/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Ski4R3/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Ski6/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Ski6R1/Stm,Cx5	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Stm,Cx5/Es1	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Stm,Cx5/Ey,A14	Manhattan
Stm,Cx5	Stm, Cephalothorax 5, cis	2	Stm,Cx5/Ey; s/s	Manhattan
Stm,Ns	Stm, Narrow sternellum (cis)	2	Stm,Ns/Es1	Manhattan
Stm-Es1/+NDJ	Non-disjunction	?	Stm-Es1/+NDJ	Manhattan
Stm-Ski4-Es/+ NDJ	Non-disjunction	?	Stm-Ski4-Es/+ NDJ	Manhattan
Stm-Ski6/+NDJ	Non-disjunction	?	Stm-Ski6/+NDJ	Manhattan
StmR1	Stm revertant 1	2	StmR1/Es1	Manhattan
StmR2	Stm revertant 2	2	StmR2/Es1	Manhattan
StmR5	Stm revertant 5	2	StmR5/Es1	Manhattan
StmR6	Stm revertant 6	2	StmR6/Es1	Manhattan
T(Y;3)	Translocation Y-3	Y;3	T(Y;3)	Manhattan
T(Y;4)	Translocation Y-4	Y;4	T(Y;4)	Manhattan
T. brevicornis	Tribolium brevicornis	NA	T. brevicornis	Manhattan
T. confusum (apt,mas,stl)	T.c. with apt, mas, stl	?	T. confusum (apt,mas,stl)	San Bernadino
T. confusum (b,au,lod,p)	T.c. with b,au,lod,p	?	T. confusum (b,au,lod,p)	San Bernadino
T. confusum (PRC)	Tribolium confusum	NA	T. confusum (PRC)	P.R. China
T. freemani	Tribolium freemani	NA	T. freemani	Japan
T. madans	Tribolium madans	NA	T. madans	Manhattan
tar	anterior melanotic stink glands	2	tar	Manhattan
tib	tibialess (from ab)	9?	tib	Manhattan
Tiw-1	?	NA	Tiw-1	India
Tiw-1 (iso 43)	Tiw-1 isoline	NA	Tiw-1 (iso 43)	India
Tiw-1(iso 43) pink	pink eye from Tiw-1	NA	Tiw-1(iso 43) pink	India
tr	tremblor	2;4	Es/tr	Manhattan
tr	tremblor	2;4	tr	Manhattan
ub	unbuckled T1 epimera	2	Ey,ub/Es,ub	Manhattan
ub	unbuckled	2	ub	Manhattan
ub	unbuckled	2	ub, ab	Manhattan
ub	unbuckled	2	ub,g	Manhattan
ub	unbuckled	2	ub,pas30	Manhattan
ub	unbuckled	2	Quint(ub,mxp,apt,mas,pas)	Manhattan
ue	unsclerotized elytra	?	ue	Manhattan
ue	unsclerotized elytra	?	ue,ab,msg,p,mxp,apt,pas30	Manhattan
Utx(New)	Ultrathorax (New)	2	Utx(New)	Manhattan
Utx1	Ultrathorax	2	A10,mxpA10/Utx1,mxp,apt	Manhattan

Utx1	Ultrathorax	2	lp69/Utx1,mxp,apt	Manhattan
Utx1	Ultrathorax	2	Utx1,mxp,apt/mxpX9,Es1	Manhattan
Utx1	Ultrathorax	2	Utx1/Es	Manhattan
Utx1	Ultrathorax	2	Utx1/Utx1	Manhattan
Utx2,Stm	Ultrathorax 2, Stm (cis)	2	Utx2,Stm/Es1	Manhattan
vwe	vestigial wings and elytra	2	vwe/Dch3	Manhattan
vwe	vestigial wings and elytra	2	vwe/Es1	Manhattan
vwe	vestigial wings and elytra	2	vwe/Stm,Ag4	Manhattan
w	white eye	4	w	San Bernadino
X(ab-1s)	Lethal revertant from ab	9	Dch3/X(ab-1s)	Manhattan
X(ab-2s)	lethal revertant from ab stock	3	3P2/X(ab-2s)	Manhattan
X-31	lethal 31	2	X-31/Dch3	Manhattan
X-31 pearl s.l.	lethal 31 with pearl	2	X-31 pearl s.l./Dch3	Manhattan
X-47	lethal 47	2	X-47/Stm,Ag4	Manhattan
X-83	Lethal 83	2	X-83/Stm,Ag4	Manhattan

SUE HAAS.

SAN BERNARDINO, CALIFORNIA
CALIFORNIA STATE UNIVERSITY
BIOLOGY DEPARTMENT

I. *Tribolium anaphe*
1. Wild
2. Splprps (I)

II. *Tribolium audax*

III. *Tribolium brevicornis*

1. Wild	Riverside, 1969
2. Wild	Idaho 1975
3. Wild	San Bernardino, 1977
4. spl	

IV. *Tribolium castaneum*

A. Wild type strains

1. Chicago	Park, 1955
2. Consejo	Spain, a968
4. Davis	Davis, Ca, 1961
6. Florida	Bell, 1970
8. McGill	Stanley, 1958
10. PIL	?
12. Sacramento	1961
14. Texas	1958
16. Veracruz	Mexico, 1963
17. Virginia	
19. Synthetic 1 (has s)	Prepared 1958
20. Synthetic 2 (no body color)	Prepared 1958
23. New York UPF	1976
24. San Bernardino	1976
25. CS-4 (from New York)	1976

B. Mutants

1. Sex-linked

26. dve--divergent elytra	Chazy, 1959
30. pd--paddle	Park, 1955
34. pte	Berkeley, 1965
36. py--pygmy	Chazy, 1959
38. r--red	Chazy, 1959
39. r^D--red	Berkeley
54. pd, r--paddle, red	
55. py, r, M^r--pygmy, red, red modifier	
59. r, sp--red spotted	
61. pd, pte--paddle, platinum eye	

Autosomal

63. p--pearl II New York 1976
64. p^{Pk}--pink II Chazy, 1959
65. p pearl II Park 1955
66. p^{S} pearl II
76. au--aureate III
78. b--black III
81. b^{S-1} -- black, Brazil
82. b--black Chicago 1955
84. b--black McGill 1959
85. b--black McGill via New York, 1976
86. b--black NASA 1959
88. b--black synthetic (Chicago/McGill)
90. Chr--Charcoal III
91. lod p--light ocular diaphragm, pearl III,II
94. msg--melanotic stink glands III
96. mt--mottled III
98. b^{t}--tawny III
105. fas-2--fused antennal segments-2 IV
107. ap, ju--antennapedia, juvenile urogomphi
113. s--sooty (Berkeley synthetic background) IV
114. s--sooty (New York) IV
135. j--jet V
136. j^{AS}--jet V
139. mc--microcephalic V Chazy, 1959
140. mc-1 microcephalic-1 (eyeless) V Hayward 1967
143. fas-3a fused antennal segments 3a V Berkeley, 1963
148. m--maroon V Purdue 1970
150. rb--ruby V Berkeley, 1962
156. Mo--Microphthalmic VI Chazy, 1959
162. sa=ca--short antenna VII Cold Sprg. Hbr. 1960
165. c--chetnut VII Purdue, 1962
168. ju-7--juvenile urogomphi VII-IV Purdue
170. ble--blistered elytra VII Berkeley 1962
173. c, Rd VII,II Corvallis 1975
180. ap^{S}--antennapedia VIII Berkeley 1962
186. sq^{D}--squint VIII Chazy 1959
189. apt--alate prothorax IX Berkeley 1963
192. ptl--prothoraxless IX Chazy 1959
194. ppas--partially pointed abdominal sternites Berk. 1963
196. mas--missing abdominal sternites II Berkeley 1964
228. Dch--Dachs II San Bernardino 1976
230. fas-1--fused antennal segments-1 Chazy 1959
233. imp--incomplete mesothoracic projections
238. mxp--maxillopedia II berkeley 1965
240. Npp--Non-punctate prothorax, a phenodeviant

245. pec--pectinate
252. sc--scar Purdue
259. w--white Purdue
261. fas-8--fused antennal segments-8
271. Gi--Giant PIL
278. la--long abdomen PIL
280. Veracruz small
288. fas-9 fused antennal segments-9 San Bernardino, 1975
295. pd,p--paddle, pearl I, II
296. pd,p,b--paddle, pearl black I, II, III
297. sp,p--spotted, pearl I, II
299. py,i,p--pygmy, ivory, pearl I, II, II
301. p, au, lod--pearl, aureate, light ocular diaphragm II, III, III.
302. p, au, mc--pearl, aureate, microcephalic II, III, V
303. p,b--pearl, black (II, III)
304. p,au,lod,msg--pearl, aureate, light ocular diaphragm, melanotic stink glands (II, III, III, III)
306. p,b,pe--pearl, black, pointed elytra (II, III,?)
308. p,mc--pearl, microcephalic II, V
310. p,s--pearl, sooty II, IV
312. p,j,Npp--pearl, jet, Non-punctate prothorax II, V
313. p,apt,Mo--pearl, alate prothorax, Microphthalmic II, II, VI.
315. p,mas--pearl, missing abdominal segments II, II
316. p, knp--pearl, knobby prothorax II, II
317. p,aa--pearl, abbreviated appendages II, V
322. p,Fas-4,b--pearl, Fused antennal segments-4, black II, ?, III
415. mxp,s--maxillopedia, sooty II, IV
416. au, s--aureate, sooty III,IV
417. h, s--hazel, sooty III, IV
428. c, Npp--chestnut, Nonpunctate prothorax VII, ?
430. au,Npp--aureate, Nonpunctate prothorax III, ?
436, au,mc--aureate, microcephalic III, V
442. Df,s,Mo--Deformed, sooty, Microphthalmic ?, IV, VI
444. i,lod,Mo--ivory, light ocular diaphragm, Microphthalmic II, III, VI
445. i,ppas-ivory, partially pointed abdom. sternites II, ?
448. Chr,ap--Charcoal, antennapedia III, VIII
450. au,ble--aureate, blistered elytra III, VII
ELL Pk
454. p /p II
462. mas, mc--missing abdominal segments, microcephalic II,V
469. i,lod--ivory, light ocular diaphragm II,III
470. lod,rb--light ocular diaphragm, ruby III, ?
473. fas-6--fused antennal segments-6

V. <u>*Tribolium confusum*</u>

Wild type strains

1. Chicago Park, 1955

2. Chicago via Sokal, 1975
3. McGill via McDonald
4. McGill Stanley, 1958
5. New York 1961
6. Sacramento
7. San Bernardino 1968
8. Yugoslavia 1975

Synthetic strains

1. Berkeley

Mutant strains

apt--alate prothorax I
apt,fas-2--alate prothorax, fused antennal segments-2
b-black III
b,cas,p--black, creased abdominal segments, pearl
b,lod,p--black, light ocular diaphragm, pearl
b,p--black, pearl
b,rus--black, ruby spot
b,rus,spl--black, ruby spot, split
b,twa--black, twisted abdomen
b-2--black-2
b-2/b McGill--synthetic black
bZ,rZ--black Zagreb, red Zagreb
(black strains from Carlisle, Pa., Chicago, Donner lab, Georgia, McGill, Sault Ste. Marie, Winnipeg and Yugoslavia)
b-Chicago/b McGill--synthetic black
b-Mcgill,fas--black, fused antennal segments
b-Mcgill,p--black, pearl
b-SSM,spl--black, split
ble--blistered elytra V
ble,e--blistered elytra, ebony V,V
car,p--carmine, pearl
cas--creased abdominal segments II
cla-claret
cru--crumpled I
dpe--dirty pearl eye II
dj--disjoined VI
dt--dent (see umb--umbilicus)
dt,p--dent, pearl
e--ebony V Chicago, 1955
(other ebony alleles)
e,fas-3--ebony, fused antennal segments-3 V, ?
e-2--ebony-2 (not allelic with e) II
e-2,fas-1--ebony, fused antennal segments-1
ele--elongated elytra
ele,fas-2--elongated elytra, fused antennal segments-2
es--eyespot I
es,fas-1--eyespot, fused antennal segments-1
es,fas,msg--eyespot, fused antennal segments melanotic stink glands I, ?, III
es,fas,sti--eyespot, fused antennal segments, sternites incomplete

eu,fas-2--extra urogomphi, fused antennal segments-2
fas-2--fused antennal segments-2 II
fas-2,lod,msg,p--fused antennal segments-2, light ocular diaphragm, melanotic stink glands, pearl II,III,III,II
fas-2,lod,p--fused antennal segments-2, light ocular diaphragm pearl II,III,II
fas-2,msg--fused antennal segments-2, melanotic stink glands II,III
fas-3--fused antennal segments-3
fro--frosted
lod,rus--light ocular diaphragm, ruby spot
msg--melanotic stink glands III
msg,rus--melanotic stink glands, ruby spot III,III
msg,twa--melanotic stink glands, twisted abdomen III,?
ov-like--overshot-like
p-pearl II
p-Slough-pearl
p^{R} --pearl riboflavinless II
r-red I
r,sh--red, short elytra
r^{U} --red
r^{Z} --red from Zagreb
rby--ruby
rus--ruby spot III
sh--short elytra (Berkeley)
sh,sp,twa--short elytra, split, twisted abdomen
sp--split III
sp-1--split-1
twa--twisted abdomen
thu--thumbed IV
thu^{S} --an allele of thu. IV
thu, Xl--thumbed, Extra large
umb--umbilicus

VI. <u>Tribolium destructor</u>

VII. <u>Tribolium freemani</u>

VIII. <u>Tribolium madens</u>

A. Sokoloff

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

<u>*T. castaneum*</u>

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.
Red (R^{Ho} ^{ho})	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

<u>*Tribolium confusum*</u> Via Carolina Biological Supply

Eliot Krause

STORRS, CONNECTICUT 06268
COLLEGE OF LIBERAL ARTS AND SCIENCES
THE BIOLOGICAL SCIENCES GROUP

1. Tribolium brevicornis (two vials)

2. Tribolium castaneum

   a. Chicago
   b. Veracruz
   c. Berkeley synthetic, marked with s.
   d. Chicago black, b.
   e. mc, p (microcephalic, pearl
   f. pygmy
   g. Davis Low Body Weight
   h. Davis High Body Weight

3. Tribolium confusum

   a. Chicago
   b. Yugoslavia
   c. Inbred (Group L CFI-B, culture 8d; Generation 123)
   d. b,p (black, pearl
   e. dj, e (disjoined, ebony)
   f. sh (short elytra

(Ed.).

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 brain 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.

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.

T. 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

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

Ephestia cautella Wild Queensland

Patrick J. Collins, Senior Entomologist

Unit of general and applied Zoology
Faculty of agriculture, Gembloux , Belgium
2, Passage des Déportés, 5030 Gembloux, Belgium

Insect stock list (11/8/96)

Coleoptera

Callosobruchus maculatus	Senegal, 1989
Cryptolestes ferrugineus	Senegal, 1995
Oryzaephilus surinamensis (6 wild strains)	Belgium, 1991
Prostephanus truncatus	Togo, 1993
Rhizoperta dominica	Canada, 1991
Sitophilus granarius (6 wild strains)	Belgium, 1991
Sitophilus zeamais	Senegal, 1995
Tenebrio molitor	Belgium, 1995
Tribolium castaneum (3 strains)	
Asm (sensitive)	Abidjan, 1989
Prm (malathion specific-resistant)	Philippines, 1989
Bj (black, malathion specific-resistant)	Belgique, 1993

LUDOVIC ARNAUD

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

COLOMBIA

SANTA FE DE BOGOTA, D.C.,
UNIVERSIDAD NACIONAL DE COLOMBIA
FACULTAD DE CIENCIAS
DEPARTAMENTO DE BIOLOGIA
APDO. AEREO #14490

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	II	Bog.	1980
11. Black	b^N	III	Bog.	1983
12. colossal pupae	cp	?	Bog.	1993
13. Charcoal	Chr^b	III	Bog.	1979
14. Disjuncted elytra	ed	?	Bog.	1990
15. Fused antennameres	af	?	Bog.	1980
16. Glass legs	pv	?	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	III	Bog.	1983
23. Miniature appendaged	ma^V	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

NAME	SYMBOL	LINKAGE GROUP
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) 88,000+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 (McGb)

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 [redacted]unchen
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)

Marcus Friedrich

(Note: Marcus Friedrich has finished his Ph.D. thesis. He is now at the California Institute of Technology, Pasadena, California).

Tel Aviv University .Israel

Tribolium Stock List

(Note : TSC Tribolium Stock Center, San Bernardino, Calif.)

T.castaneum

Wild Type Strains :	Origin :
CS++ Ishaaya	Israel,before 1972
CTC-12 (Insecticide resistant)	Slough (England), 1977
Kano C (Malathion resistant)	Slough (England), 1977

Mutant Strains :	
CS bb	Stony brook, 1970
EU++ (extra urogomphi)	Derived from CSbb, 1973
CSmc (microcephalic)	Derived from PPxbb, 1979
CS Paddle	TSC, 1988
CS Pearl	TSC, 1977
CS Pygmy	TSC, 1979

T.confusum

Wild Type Strains :	
CF Chicago	TSC, 1977
CF Tarovet	Israel, 1994

Mutant Strains :	
CF bb	Stony Brook, 1970
CF xl (extra large)	TSC, 1979

T.brevicornis

++ (Riverside) — TSC, 1979

T.freemani

Japan, 1982

DAVID WOOL

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	-	"

<u>Triboliun confusum</u>

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

J.D. Saxena.

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 surinamen sis (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
sCbl 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

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

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
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^w 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 — Sokoloff, 1977
66. pink p^{Pk} 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

UNITED KINGDOM

CENTRAL SCIENCE LABORATORY

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Mrs C Trowe or Mrs S Henderson
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Berks, SL3 7HJ UK

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International code +44 -753 534626
Fax: 0753 824058
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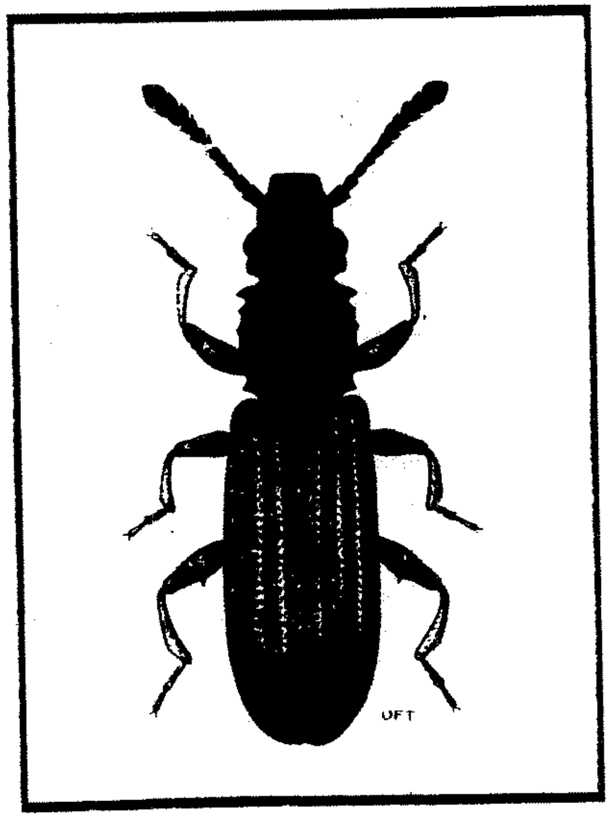

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Coleoptera

Ahasverus advena
Alphitobius diaperinus
Anthrenocerus australis
Anthrenus flavipes
Anthrenus flavipes seminiveus
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

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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 serricorne			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

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

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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

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Wild type strains

Coleoptera

Bostrichidae

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Dr. Chris P. Haines

RESEARCH, TEACHING AND TECHNICAL NOTES

Male Spermatophores in *Tribolium castaneum*

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In the course of investigating the processes of sperm storage and sperm precedence in *Tribolium castaneum* (Lewis and Austad 1990, 1994; Bloch Qazi et al. 1996), we discovered that *T. castaneum* males transfer sperm to females in a simple spermatophore. Description of the time course of sperm movement into the female spermatheca for long-term storage is provided by Bloch Qazi et al. (1996). Here we describe female reproductive anatomy of *T. castaneum* in greater detail, and provide an illustration of the spermatophore.

Methods

Beetles were taken from a laboratory stock culture derived from the Berkeley synthetic strain. Beetles were sexed as pupae and kept individually in flour at 29°C and 70% RH in a dark incubator. Beetles were virgins and were 1-4 wk post-eclosion. Pairs of beetles were observed in circular mating arenas until copulation occurred, after which females were removed and dissected.

Results and Discussion

The spermatophore consists of a membranous sperm sac approximately 0.07 μl in volume, which is attached posteriorly to a gelatinous rod. The spermatophore is deposited in the female bursa copulatrix, and fills most of the bursa as can be seen in Figure 1.

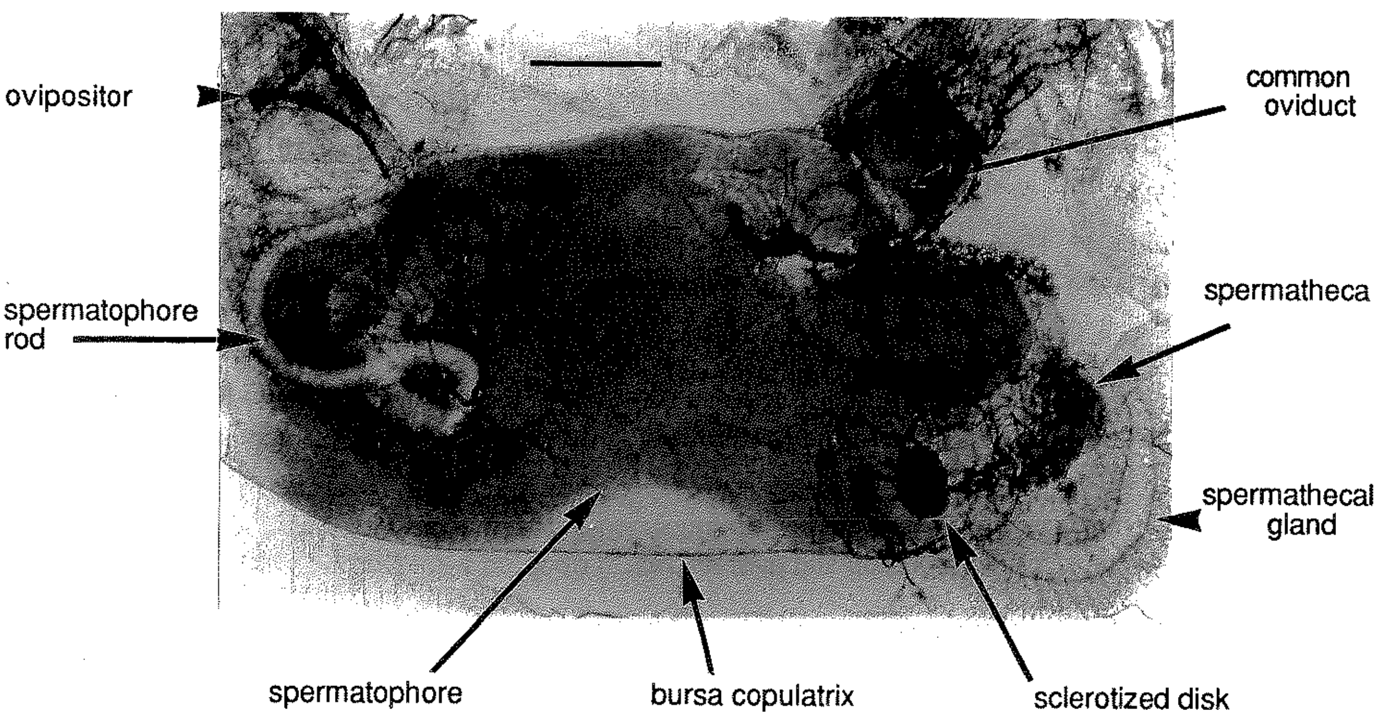

Figure 1. Spermatophore of *T. castaneum* male deposited within the bursa copulatrix of a female. The spermatophore consists of a sperm-filled membranous vesicle (visible as dark shading) that is attached posteriorly to a clear, gelatinous rod. Within 10 min after mating, sperm begin to appear within the convoluted tubules of the female spermatheca. Sperm are generally not found in the common oviduct, but here have been displaced by coverslip pressure. Scale bar is 100 μm.

Shortly after the spermatophore is deposited in the bursa, the sperm sac membrane ruptures and sperm are released. Within 10 min after mating, actively swimming sperm begin to appear within the convoluted tubules of the spermatheca, and sperm numbers in the spermatheca are stable by about 1 h post-mating (Bloch Qazi et al. 1996). The structure of the female spermatheca in *T. castaneum* was described by Sinha (1953) and Surtees (1961). It consists of three long, blind-ended tubules connected to the anterior bursa by a short common duct about twice the width of the tubules. The spermathecal duct and tubules are surrounded by circular muscle tissue, and the entire spermatheca is enclosed within a thin muscular sheath. It is worthwhile to point out that the spermatheca and spermathecal gland were incorrectly identified by El Kifl (1953: also cited in Figures 4.4d and f in Sokoloff 1972). The function of the feather-like spermathecal gland, the duct of which opens into the female bursa through a sclerotized ring, is not known.

The spermatophore of *T. castaneum* is less complex than that described for *Tenebrio molitor* (Gadzama & Happ 1974, Happ & Happ 1975). It is not known what roles may be played in the formation of the spermatophore by the two pairs of *T. castaneum* male accessory glands described by Rummel and Grimnes (1991), the RAG and TAG. *T. castaneum* males can mate repeatedly with extremely short remating intervals, but been shown to transfer spermatophores containing decreasing sperm numbers across these consecutive matings (Bloch Qazi et al. 1996).

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*GROWTH AND DEVELOPMENT OF *LASIODERMA SERRICORNE* (F.) (COLEOPTERA : ANOBIIDAE) ON VARIOUS FOOD MATERIALS

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Abstract: Growth and development of cigarette beetle, *Lasioderma serricorne* (F.) on various dried fish (Punti, *Barbus ticto*; Taki, *Channa punctatus*; Sol, *C. striatus*), and powdered leaves of Thankuni (*Centella asiatica*) and Tobacco (*Nicotiana tabacum*) are compared and reported in the present study. The effect of these foods is highly significant on all the growth and developmental parameters studied. Growth indices revealed that Tobacco leaf powder is the best food of *Lasioderma serricorne* followed by Punti fish, Thankuni leaf powder, Taki and Sol fish.

INTRODUCTION

Lasioderma serricorne (F.) commonly known as cigarette beetle, is one of the most destructive pests infesting a wide variety of commodities including tobacco, tobacco products, spices, timber seeds and various other stored food (Runner, 1919; Tanhet and Bare, 1951; Alam, 1971; Rizk *et al.*, 1980; Jang *et al.*, 1982; Malek *et al.*,1988). Besides these *L. serricorne* breeds in animal matter such as dried insects, dried fishes and fish meal, leather and wax (Howe, 1957; Lefkovitch and Currie, 1963; Ashworth, 1993). Due to its adaptation to a wide range of food stuff this beetle become pervasive pest of stored commodities. However, two major constraints, i.e. low temperature and low humidity limit its propagation. Cigarette beetle is now commonly encountered and is of considerable economic importance in tropical to temperate climates (U.S.D.A., 1972). Early reports have shown that the damage is caused by the adult beetles (Jones, 1913; Howe, 1957). Recent reports have stated that adults do feed on tobacco to a limited extent (Milne, 1963; Minor, 1978), but the major damage to the stored and processed tobaccos is caused by the feeding larvae (U.S.D.A., 1972; Minor, 1978; Ashworth, 1993).

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Although cigarette beetle infests a large variety of food stuffs, very little information is available on dietary effects of various dried fishes, and leaves other than tobacco plant. the present investigation was therefore aimed to study the various aspects of biology of *L. serricorne* on three species of indigenous dried fish, and powdered leaves of Thankuni (*Centella asiatica*) and Tobacco (*Nicotiana tabacum*).

MATERIALS AND METHODS

The beetles were initially collected from stored turmeric infested with *L. serricorne*. Stock culture was then maintained in sterilized wheat flower (95%) with brewers yeast powder (5%) at 13% moisture content. The culture was maintained in an incubator set at 28±1°C temperature and 70±2% relative humidity.

For assessing the growth and development on various food media eggs of the adult beetles were collected. A large number of beetles were put on a layer of wholemeal flower in beaker (500 ml) for oviposition. Eggs were sieved after 48 hours and incubated at 30±1°C. Five different food media were selected, viz. dried fishes (Punti, Taki and Sol), and powdered leaves of Thankuni and Tobacco. For each food medium 250 neonate larvae (24 hours old) were taken in a group of 50 in small beaker (250 ml) containing 50 gm of crushed food medium. The top of the beakers were covered with fine netted cloth secured with rubber band. Larval measurements were taken at four stages, i.e. after 7 days, 14 days, 21 days and at maturity. The larvae were weighed on an electronic balance. The length and width of the larvae were measured with an ocular micrometer (40x). Before forming a cocoon larval period was recorded, and freshly formed pupae were weighed and measured. Sex separation was conducted following Halstead (1963). Male and female pupae were placed in separate vials to record the adult emergence. The pupal period was recorded, and freshly formed adults (after 24 hours of emergence) were weighed and measured. The experiment was carried out in an incubator at 30±1°C, and each of the five beakers in a food medium represents a replication.

A similar set of experiment was conducted only to record the adult emergence (without any disturbance) under similar condition of temperature and humidity in an incubator. The growth indices (GI) of *L. serricorne* on different food media were calculated using the following formula.

$$GI = \frac{\text{Adult recovery (\%)}}{\text{Total larval and pupal period}}$$

RESULTS AND DISCUSSION

The growth of *Lasioderma serricorne* larvae on three species of dried fish, viz. Punti (*Barbus ticto*), Taki (*Channa punctatus*) and Sol (*C. striatus*), and powdered leaves of Thankuni (*Centella asiatica*) and Tobacco (*Nicotiana tabacum*) is presented in Table 1 and those of the pupae and adults in Table 2. Analysis of variance indicated that the effect of food on the growth of the larvae in all the ages is highly significant (P<0.001). Adult and pupal measurements also varied significantly (P<0.001) due to the effect of food.

Table 1. Growth of *Lasioderma serricorne* larvae on various dried fish (*B. ticto, C. punctatus* and *C. striatus*) and powdered leaf of *C. asiatica* and *N. tabacum*

Larval age	Food medium	Mean weight, mg ± SE	Mean length, mm ± SE	Mean width, mm ± SE
7 days	*B. ticto*	0.42±0.025	0.604±0.019	0.229±0.013
	C. punctatus	0.36±0.024	0.576±0.011	0.205±0.008
	C. striatus	0.32±0.012	0.420±0.009	0.194±0.005
	C. asiatica	0.38±0.020	0.590±0.007	0.213±0.010
	N. tabacum	0.45±0.022	0.650±0.018	0.235±0.001
	CD at 5%	0.068	0.042	0.025
	1%	0.094	0.058	0.034
14 days	*B. ticto*	0.84±0.089	1.06±0.012	0.445±0.013
	C. punctatus	0.64±0.050	1.03±0.007	0.376±0.011
	C. striatus	0.60±0.027	0.82±0.015	0.360±0.011
	C. asiatica	0.70±0.031	1.03±0.011	0.388±0.007
	N. tabacum	0.87±0.020	1.11±0.010	0.452±0.010
	CD at 5%	0.118	0.038	0.035
	1%	0.162	0.052	0.048
21 days	*B. ticto*	1.30±0.031	2.31±0.053	0.700±0.017
	C. punctatus	1.14±0.050	2.19±0.055	0.673±0.012
	C. striatus	1.03±0.025	1.88±0.047	0.630±0.008
	C. asiatica	1.24±0.024	2.23±0.066	0.680±0.010
	N. tabacum	1.40±0.050	2.45±0.051	0.723±0.005
	CD at 5%	0.090	0.170	0.032
	1%	0.124	0.234	0.044
Mature larva	*B. ticto*	4.10±0.171	3.65±0.191	1.26±0.089
	C. punctatus	3.68±0.013	3.31±0.117	1.11±0.107
	C. striatus	3.46±0.172	2.60±0.156	0.92±0.062
	C. asiatica	3.86±0.108	3.45±0.151	1.23±0.067
	N. tabacum	4.20±0.105	3.80±0.174	1.41±0.036
	CD at 5%	0.430	0.438	0.245
	1%	0.593	0.604	0.338

Examination of means in Table 1 revealed that the weight, length and width of the 7 days to mature larvae was maximum in the larvae fed on Tobacco leaf powder followed by Punti fish, Thankuni leaf powder, Taki and Sol fish. In pupae and adults, these measurements were in the same order except the weight of male adults, where the highest value was observed in Tobacco leaf powder followed by Punti fish, Taki fish, Thankuni leaf powder and Sol fish. The results on the larval measurements are in conformity with

Table 2. Growth of *L. serricorne* pupae and adults on various dried fish (*B. ticto, C. punctatus* and *C. striatus*), and powdered leaves of *C. asiatica* and *N. tabacum*

Developmental stages	Food medium	Mean weight, mg ± SE	Mean length, mm ± SE	Mean width, mm ± SE
Pupa (Male)	*B. ticto*	3.10±0.090	3.12±0.130	1.40±0.068
	C. punctatus	2.30±0.074	3.04±0.089	1.36±0.058
	C.striatus	2.05±0.050	2.61±0.096	1.11±0.050
	C. asiatica	2.78±0.161	3.07±0.040	1.37±0.055
	N. tabacum	3.46±0.120	3.41±0.135	1.52±0.076
	CD at 5%	0.3184	0.3083	0.2046
	1%	0.4387	0.4249	0.2819
Pupa (Female)	*B. ticto*	4.05±0.083	3.31±0.101	1.52±0.078
	C. punctatus	2.90±0.115	3.11±0.117	1.40±0.072
	C.striatus	2.60±0.106	2.71±0.104	1.21±0.052
	C. asiatica	3.10±0.115	3.21±0.103	1.44±0.066
	N. tabacum	4.38±0.096	3.50±0.143	1.65±0.093
	CD at 5%	0.3327	0.3436	0.2046
	1%	0.4585	0.4735	0.2819
Adult (Male)	*B. ticto*	2.62±0.217	2.87±0.116	1.41±0.084
	C. punctatus	2.31±0.092	2.80±0.110	1.36±0.081
	C.striatus	2.10±0.90	2.20±0.101	1.15±0.059
	C. asiatica	2.30±0.151	2.82±0.127	1.38±0.075
	N. tabacum	2.75±0.088	3.00±0.171	1.62±0.079
	CD at 5%	0.4220	0.3203	0.2219
	1%	0.5815	0.4414	0.3057
Adult (Female)	*B. ticto*	3.40±0.151	2.97±0.140	1.79±0.090
	C. punctatus	2.88±0.139	2.92±0.136	1.51±0.062
	C.striatus	2.55±0.097	2.42±0.090	1.52±0.064
	C. asiatica	3.16±0.121	2.95±0.100	1.59±0.061
	N. tabacum	3.61±0.159	3.31±0.100	1.94±0.098
	CD at 5%	0.4130	0.3703	0.2194
	1%	0.5691	0.5102	0.3024

that of Sivik *et al.* (1957). The present findings also corroborate the results of Jones (1913) and Lefkovitch (1963) who noted significant variation in the size of the adults due to quality of larval food and female beetles were larger than the males. In the present investigation larval and pupal period showed a range of 29.10±0.74- 36.00±1.14 days and 8.39±0.61- 11.00±0.71 days respectively, in different foods (Fig. 1), which is very close to the findings of Samuel *et al.* (1984). Variation in the duration of different developmental stages depending on the quality and availability of food have also been reported by Howe (1957) and Sivik *et al.* (1957).

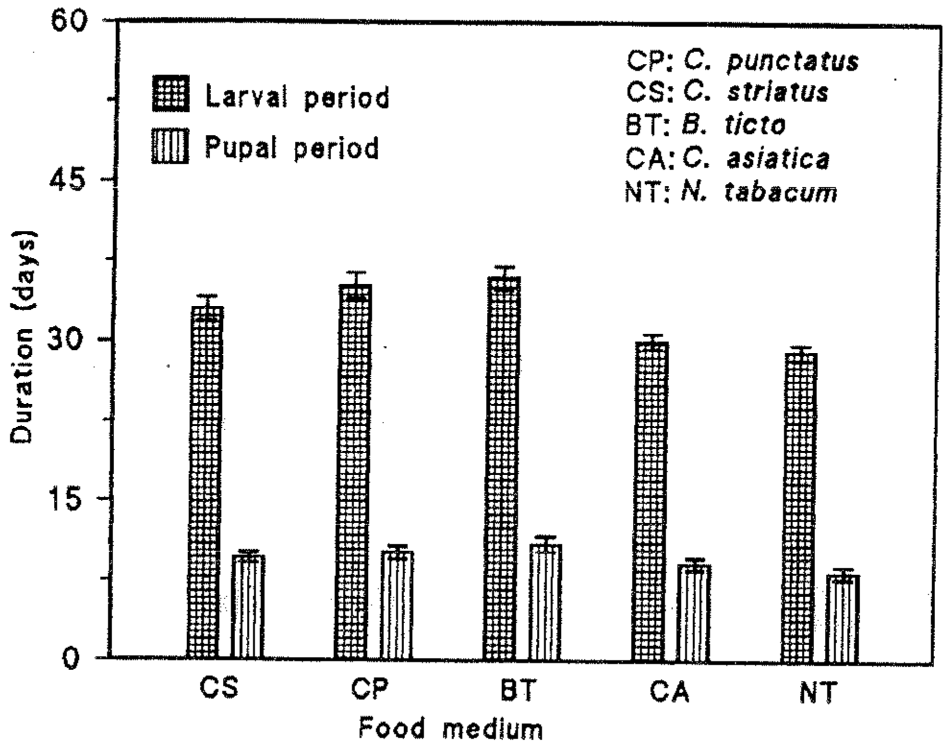

Fig. 1 Larval and pupal period of *L. serricorne* on various dried fish (*C. punctatus, C striatus* and *B. ticto*) and powdered leaves of *C. asiatica* and *N. tabacum*

The pupal recovery and adult emergence is also affected by the food. The highest pupal recovery and adult emergence is obtained in tobacco and the lowest in Sol fish. The results of growth index have been shown in Table 3. The growth index followed the order Tobacco leaf powder> Punti fish> Thankuni leaf powder > Taki fish> Sol fish.

Although the highest larval and pupal period of *L. serricorne* are noted in Punti fish but its growth index is second in order, which proved that Punti fish is the best food medium among the dried fishes. The

Table 3. Effect of various dried fish, (*B.ticto, C. punctatus* and *C. striatus*), and powdered leaf of *C. asiatica* and *N. tabacum* on the pupal recovery and adult production in *L. serricorne*

Food medium	Number of Larvae	Pupation number (%)	Adult emergence number (%)	*d-values	Growth index (GI)
B. ticto	250	140 (56.00)	133 (53.20)	0.90	1.13
C. punctatus	250	119 (47.60)	111 (44.40)	2.89	0.98
C. striatus	250	93 (37.20)	85 (34.00)	5.35	0.80
C. asiatica	250	134 (53.60)	127 (50.60)	1.48	1.29
N. tabacum	250	151 (60.40)	143 (57.20)	-	1.53

*d = Standardized normal deviate.

result varied from the findings of Howe (1957) who reported increased mortality of *L. serricorne* with the increase in duration of stages of life cycle due to effect of food, temperature and humidity. However, we used constant temperature in the present study, which might be a cause of variation in the results.

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Tribolium Inf. Bull. California Univ.

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*DOSE-MORTALITY RESPONSE OF THE RED FLOUR BEETLE, *TRIBOLIUM CASTANEUM* (HERBST) (COLEOPTERA : TENEBRIONIDAE) TO FENOM®

The present investigation was carried out to find out the effect of the pyrethroid, Fenom® on various larval instars of three strains of *Tribolium castaneum* (Herbst), viz. CR-I, CTC-12 and FSS-II. The insecticide gave a good check of the larvae at the doses used in all the strains of the beetle.

The red flour beetle, *Tribolium castaneum* (Herbst) is a major pest of stored commodities, especially cereals, millets and pulses. Most strains of the beetles are resistant to chemical pesticides. *T. castaneum* has already become resistant to several insecticides (Speirs et al., 1967; Vincent & Lindgren 1967; Champ & Campbell-Brown 1970; Dyte 1970, 1972; Cichy 1971). Champ (1986) recently reviewed the problem of pesticide resistance in grain storage pests.

When a non-specific type of resistance occurs, no permitted contact insecticides prove fully effective. Pests are normally in contact with treated surfaces for very short periods in fabric treatments. Very long exposures to higher doses are necessary to kill resistant strains (Dyte et al., 1975) and changes in the behaviour of the beetles make it even more difficult (Pinniger 1975). The use of hard-core pesticides is not permissible where safety is of prime importance. The present investigation was aimed at determining the contact action of Fenom® on the larvae of *T. castaneum*.

Three standard starins of *T. castaneum*, viz. CR-I, CTC-12, and FSS-II, were maintained in the Crop Protection Laboratory, Institute of Biological Sciences, Rajshahi University, in 500ml beakers, each containing 80gm of flour : yeast (19:1) medium (Park and Frank 1948). Pupae were sexed (Halstead 1963) and freshly emerged adults were allowed to mate. Eggs laid by female beetles were incubated and neonate larvae were transferred to the standard flour : yeast medium to get insects of various experimental stages.

The insecticides used, Fenom® 10 EC, is a new synthetic pyrethroid produced by the CIBA-GEIGY Ltd. Its chemical component is (R,S)-α-cyano-3-phenoxybenzil (R,S) -cis, "trans" 3-(2,2-dichlorovenyl) 2,2-dimethyl cyclopropane-carboxylate. It has a mode of action typical of the pyrethroids. The doses, e.g. 2, 4, 8 and 16 ppm, were prepared by mixing the required amounts of the pyrethroid with distilled water.

Petridishes were treated by washing them with the various concentrations of the insecticide and for each stage (1st-6th instar larvae). Fourty insects were used for each dose and the experiments were

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replicated thrice. Mortality was assessed at 18-, 24-, 30- and 36-hour post-treatment and for 1st instar larvae, mortality was assessed at 6-, 12-, 18- and 24-hour post-treatment. The experiments were carried out at 30±2°C.

The LD_{50} values and the statistical analyses are given in Tables - 1A, 1B and 1C. It is evident that a higher proportion of first-fourth instar *T. castaneum* larvae were killed at all concentrations of Fenom®. The action was contact and age specific with a significantly lower mortality among fifth and sixth instar larvae. There was no significant variation in mortality due to strains.

Fenom® is primarily used on field pests. The only report on its use on storage pests is that of Faruki (1993). The pyrethroid gave significantly higher mortalities of the Tropical Warehouse Moth, *Cadra cautella* (Walker) when used independently, and produced synergism in combination with *Bacillus thuringiensis* var. *kurstaki* and gamma irradiation. This insecticide may be used for the control of *T. castaneum* and other storage pests. However, further works with an array of doses are required.

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Table 1A : LD_{50} values and statistical analyses on dose-mortality response of *T. castaneum* Larvae (strain : CR - I).

Stage of treatment	Exposure time (hours)	LD50 value (ppm)	Regression equation	X^2-value
1st instar larvae	6	42.526	Y=3.079+1.179x	9.091
	12	9.993	Y=3.028+1.972x	5.685
	18	2.937	Y=4.235+1.635x	2.919
	24	1.379	Y=4.738+1.874x	12.357
2nd instar larvae	18	1.169	Y=4.953+0.689x	0.114
	24	0.650	Y=5.126+0.670x	0.336
	30	0.355	Y=5.364+0.684x	0.524
	36	0.293	Y=5.417+0.926x	4.641
3rd instar larvae	18	4.301	Y=4.350+1.026x	0.199
	24	2.986	Y=4.497+1.060x	1.249
	30	2.209	Y=4.603+1.154x	1.700
	36	1.771	Y=4.708+1.178x	1.727
4th instar larvae	18	11.633	Y=3.801+1.126x	1.183
	24	7.971	Y=4.092+1.007x	0.061
	30	6.159	Y=4.306+0.879x	1.511
	36	4.411	Y=4.350+1.008x	1.057
5th instar larvae	18	17.116	Y=2.689+1.874x	14.212
	24	16.977	Y=3.067+1.571x	9.112
	30	15.032	Y=3.386+1.371x	10.308
	36	12.324	Y=3.601+1.282x	5.427
6th instar larvae	18	1087.849	Y=2.457+0.838x	1.907
	24	800.326	Y=2.778+0.765x	0.829
	30	269.705	Y=2.912+0.859x	0.738
	36	44.074	Y=2.942+1.252x	2.798

Table 1B : LD_{50} values and statistical analyses on dose-mortality response of *T. castaneum* larvae (Strain : CTC - 12).

Stage of treatment	Exposure time (hours)	LD50 value (ppm)	Regression equation	X^2-value
1st instar larvae	6	64.731	Y=3.809+0.658x	1.015
	12	6.808	Y=3.976+1.229x	0.089
	18	2.470	Y=4.492+1.293x	0.327
	24	1.195	Y=4.891+1.401x	1.375
2nd instar larvae	18	1.497	Y=4.864+0.774x	0.984
	24	0.861	Y=5.050+0.767x	1.415
	30	0.386	Y=5.456+0.609x	3.542
	36	0.179	Y=5.389+0.941x	7.112
3rd instar larvae	18	20.548	Y=3.700+0.990x	1.958
	24	13.453	Y=3.614+1.051x	1.030
	30	7.865	Y=4.042+1.070x	2.333
	36	5.072	Y=4.184+1.158x	12.414
4th instar larvae	18	10.953	Y=3.341+1.596x	10.953
	24	8.919	Y=3.594+1.479x	5.054
	30	7.908	Y=3.819+1.315x	2.841
	36	5.474	Y=3.801+1.624x	1.595
5th instar larvae	18	52.203	Y=3.310+0.984x	14.882
	24	32.437	Y=3.475+1.009x	3.978
	30	20.336	Y=3.540+1.116x	3.183
	36	17.731	Y=3.680+1.056x	1.959
6th instar larvae	18	11308.870	Y=2.918+0.514x	4.421
	24	341.082	Y=3.060+0.766x	5.113
	30	152.444	Y=3.209+0.821x	1.949
	36	62.182	Y=3.318+0.938x	1.857

Table 1C : LD_{50} values and statistical analyses on dose-mortality response of *T. casteneum* larvae (Strain : FSS - II).

Stage of treatment	Exposure time (hours)	LD50 value (ppm)	Regression equation	X^2-value
1st	6	39.791	Y=3.190+1.132x	2.947
instar	12	6.600	Y=4.019+1.188x	0.790
larvae	18	0.886	Y=5.041+0.775x	0.344
	24	0.718	Y=5.228+1.583x	3.326
2nd	18	1.376	Y=4.868+0.944x	6.119
instar	24	0.523	Y=5.251+0.892x	4.784
larvae	30	0.325	Y=5.432+0.885x	4.010
	36	0.212	Y=5.633+0.941x	1.504
3rd	18	5.950	Y=4.120+1.136x	0.486
instar	24	4.672	Y=4.087+1.363x	0.401
larvae	30	3.343	Y=4.304+1.328x	0.383
	36	2.141	Y=4.575+1.284x	0.628
4th	18	7.048	Y=4.114+1.045x	4.699
instar	24	5.495	Y=4.132+1.173x	3.432
larvae	30	4.366	Y=4.255+1.164x	3.897
	36	0.471	Y=4.519+0.930x	8.236
5th	18	20.794	Y=3.302+1.203x	2.546
instar	24	20.460	Y=3.258+1.333x	1.900
larvae	30	1.412	Y=3.570+1.091x	1.363
	36	1.307	Y=3.772+0.932x	0.823
6th	18	1297.592	Y=2.318+0.862x	0.378
instar	24	677.092	Y=2.788+0.781x	3.976
larvae	30	100.200	Y=2.596+1.202x	3.522
	36	51.132	Y=3.239+1.030x	5.837

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*Histological characterization of the reproductive accessory complex of Tribolium anaphe (Coleoptera:Tenebrionidae)

Introduction

It has been a continuing task in our laboratory to examine the reproductive accessory complexes within various Tribolium species. In general, male beetles of the family Tenebrionidae possess two pairs of paired glands: long thin tubular accessory glands (TAGs) with short, uniform cells and a thicker set of glands with various types of long thin cells and opaque secretions. The second set of glands have been named according to their general shape. Thus, these glands have been identified as BAGs, or bean-shaped accessory glands in Tenebrio molitor (Dailey, et al., 1980), RAGs, or rod-shaped accessory glands, in Tribolium anaphe (Hafeez and Gardiner, 1964), Tribolium castaneum (Murad and Ahmad, 1977) and Tribolium freemani (Rummel and Grimnes, 1991) and PAGs, or pear-shaped accessory glands, in Tribolium brevicornis (O'Dell, et al.,1990).

Our research has focused on both gland morphology and on characterizing the cells which compose the two glands in the complex in several species within the genus Tribolium. Previous work on beetles in the castaneum species group and the brevicornis species group indicate that the reproductive glands are very similar. Five distinctly different cell types were found in the PAGs of T. brevicornis (O'Dell, et al., 1990; Sevener, et al.,1992) and in the RAGs of T. freemani (Roberts and Grimnes, 1994). To date, we had not yet fully investigated a member of the confusum group, and so we undertook a histological study of the accessory reproductive complex of T. anaphe.

Materials and Methods

All insect colonies were maintained at 30°C on a 19:1 mixture of whole wheat flour:Brewer's yeast. Adult beetles were collected from flour and dissected. For whole mount staining, glands were stained immediately in 0.03% Oil Red O (ORO) in 70% ethanol and later destained and stored in 30% ethanol. For serial sections, gland were preserved in 10% formalin, dehydrated through xylene and embedded in Paraplast. Sections (6 um) were stained in Mallory's trichrome (Gray, 1964), Cason's trichrome (Kiernan, 1990) or Periodic acid-Schiff's reagent (using a kit obtained from EM diagnostics through Baxter).

Results and Discussion

The methods used in this study demonstrated that five distinct cell types exist in the RAG, or rod-shaped accessory gland of T. anaphe (Figure 1). Cell types were numbered in a manner consistent with the cell types of T. freemani and T. brevicornis from the references above. The results of each staining sequence will be discussed below. Diagrams are shown of the dorsal side of the RAG only. No data are reported for the TAG of T. anaphe, since in many cases the tissue did not preserve well.

Oil Red O, a lipid stain which partitions into non-polar materials within cells, was found in two distinct locations in the RAG (Figure 2). One intensely staining patch of cells (type 5) was located at the posterior end of the gland, close to the junction of the seminal vesicles and the ejaculatory duct. A second, larger group of cells across the middle of the gland was also stained (type 2). Only whole mount studies were performed with this stain as the solvents for histology often extract non-polar materials and render staining impossible.

Mallory's trichrome was differentially taken up by cells of the RAG (Figure 3). The most posterior cell type (type 3) remained relatively clear of stain. Intense orange stain was detected in a narrow band (type 4 cells) which separated cell types 2 and type 5. The other three cell types seemed to stain blue, but differed in their uptake of the stain. Type 5 cells, which ran along the medial center of the gland, stained an intense dark blue, while in the main body of the gland (type 2) the cells often contained yellow inclusions. The most anterior cells of the gland (type 1 cells) picked up a faint but distinctive blue stain. The secreted material in the lumen was brightly stained with the same colors observed in the cells, indicating that the colors are being taken up, in part, by secretory molecules destined for the female during mating.

Glands were also stained with Cason's trichrome (Figure 4). Three different cell types were stained distinctly, and their location in cross section mapped consistently with the cell type locations determined with Mallory's trichrome. The most intensely stained cell type was a dark purple color (type 4 cells), and cells at the anterior tip of the gland were a pale blue (type 1). A third patch of cells stained a strong blue (type 5). With Cason's stain, neither cell type 2 or cell type 3 picked up any stain.

The last stain used in this study was the Periodic acid-Schiff's base reaction (PAS), which stains carbohydrates and carbohydrate-containing macromolecules like glycoproteins. The results are summarized in Figure 5. Cell type 4 was stained deep purple and this is a positive stain for carbohydrate presence, possibly indicating the presence of secretory glycoproteins. Two other cell types were distinguished, type 3 (faint pink) and type 5 (grey blue), but type 1 and 2 both stained a strong magenta color and appeared identical on the basis of PAS staining. Some of the lumen contents also stained positive with PAS, indicating carbohydrate material of some kind is being passed to the female. This finding is consistent with the PAG of T. brevicornis (Sevener, et al.,1992) which contains a single cell type loaded with PAS-positive material, possibly secretory glycoproteins.

Conclusions

In the course of this study, we have identified five distinctly different cell types in the rod-shaped reproductive accessory gland of T. anaphe. These findings are generally quite consistent with the characterizations of T. brevicornis and T. freemani, in number of cell types, general location of cell types and staining phenomena seen. Although there are differences between the three species, it is clear that they are well adapted to the function of producing proteins and other secretions to pass to the female during mating. The identity of individual cell components has not been established, but all three species groups demonstrated antigenic similarity based on ELISA results (Clayton, et al., 1992).

Detailed immunohistochemistry studies to further characterize the glands of Tribolium species are currently underway.

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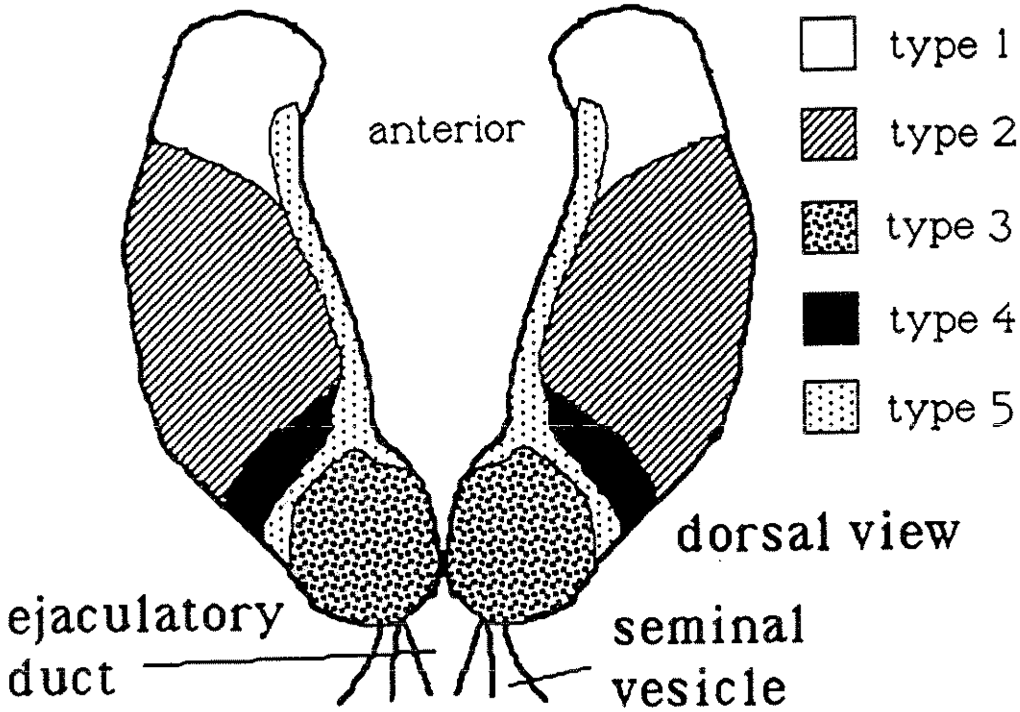

Figure 1. Cell type locations in the RAG of T. anaphe
Dorsal view, TAGs on opposite side (not shown)

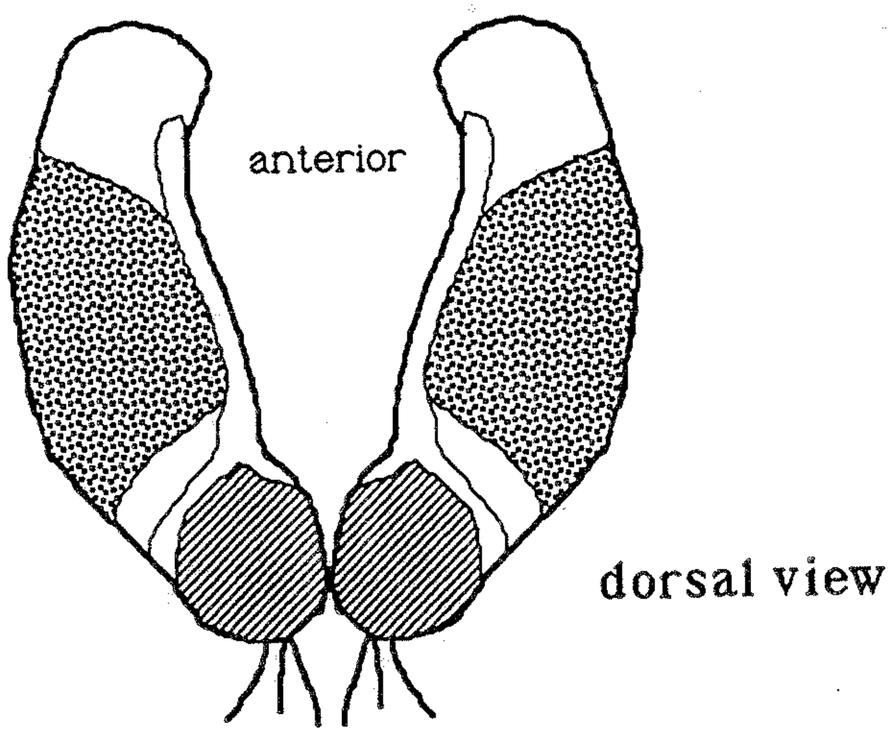

Figure 2. Oil Red O staining of T. anaphe RAG

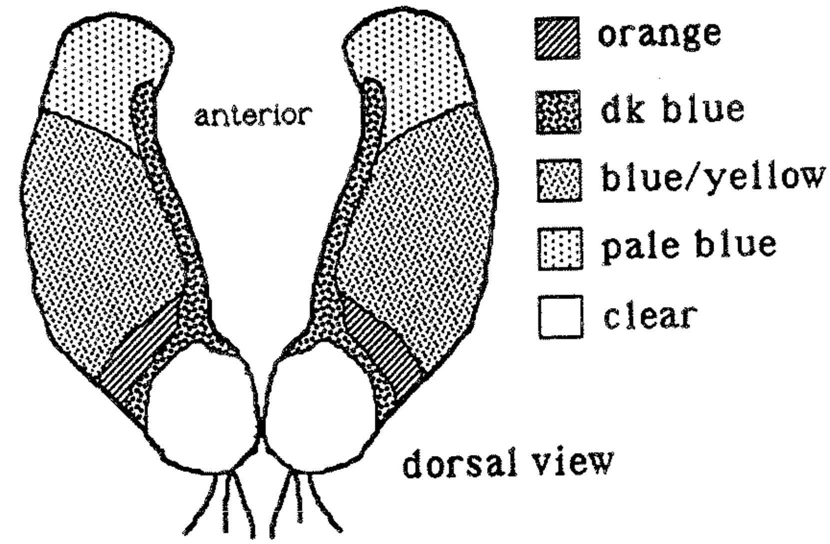

Figure 3. Mallory's trichrome staining of T. anaphe RAG

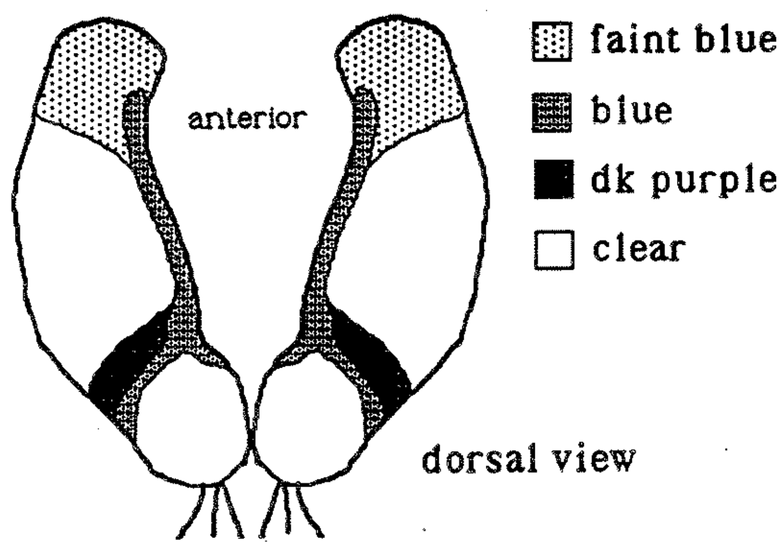

Figure 4. Cason's trichrome staining of T. anaphe RAG

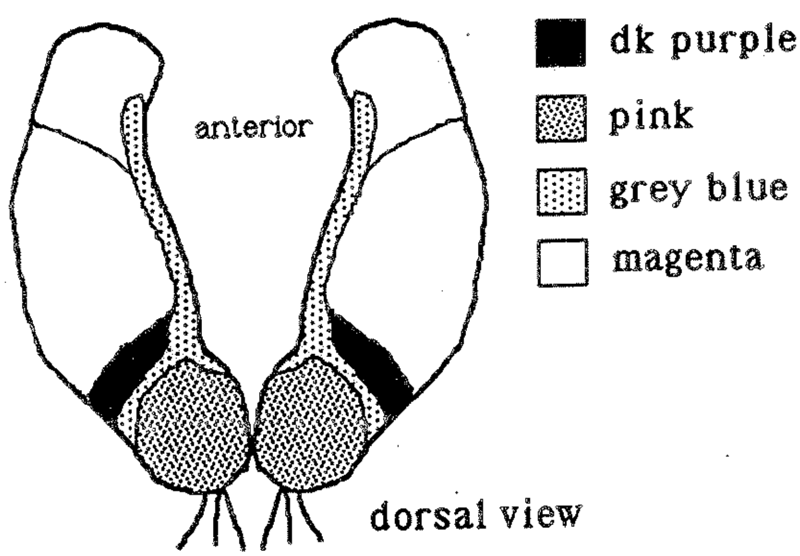

Figure 5. PAS staining of T. anaphe RAG

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Confocal imaging of *Tribolium castaneum* embryos

Introduction

Tribolium has recently emerged as an important organism for comparative studies of embryonic patterning (for reviews see Brown and Denell, 1996 and Denell et al., 1996). Its short life cycle, ease of culture and amenity to genetic studies have contributed to its impact in this field. To facilitate our study of Tribolium embryogenesis, we have developed a method to visualize embryos by fluorescence confocal microscopy. Confocal microscopy provides better resolution than conventional epifluorescence microscopy because whole-mount specimens are optically sectioned, and only fluorescence originating in the focal plane is seen (Cheng and Kriete, 1990). A series of optical sections is then used to form a computer-generated three-dimensional reconstruction of the embryo. The fluorescent dyes commonly used to visualize nucleic acids (e.g. Hoechst and DAPI) are excited by wavelengths of light in the UV range. As UV lasers are not standard equipment on most confocal microscopes, it is desirable to use a nucleic acid-specific fluorophore with an excitation wavelength which can be produced by an Argon-Krypton laser (488, 568 or 647 nm). We have used both propidium iodide (Sigma) and YOYO-1 (Molecular Probes, Inc.) and find that YOYO-1 gives a sharper image.

Materials and Methods

Beetles were allowed to lay eggs for one hour at 31°C in Gold Medal flour supplemented with five-percent fine sifted yeast. Eggs were then collected by sieving and allowed to develop to the desired stage at 31°C. The eggs were dechorionated for two minutes in 50% bleach and washed thoroughly with water. The eggs were shaken for 20 minutes in a 1:1 mix of heptane and fixative (1X PBS; 4 % formaldehyde; 50 mM EGTA). The lower (fixative) phase was removed and one volume of methanol was added. The eggs were shaken by hand for 1 minute to devitellinate the embryos. As much of the upper phase (heptane) as possible and half of the methanol was removed. Two volumes of methanol were added and the tube was shaken to dissolve any remaining heptane. The embryos were transferred to 1.5 ml eppendorf tubes and stored at -20°C.

Embryos were rehydrated for 5 minutes in 50% methanol/50% PBS + 0.01% Triton-X-100 and then twice for 5 minutes in PBS + 0.01 % Triton-X-100 (PBT). Embryos were treated with 100 ug/ml RNase A in PBT for 30 minutes at 37°C , rinsed three times in PBT and stored at 4°C in PBT.

Embryos were washed twice for 5 minutes in PBT. PBT was removed from the tube and replaced with 100 ul 50% glycerol in PBT + 2 ul YOYO-1 (diluted 1:100 in PBT). The embryos were transferred to a Probe-Clip Imaging Chamber (RPI) and viewed on a Zeiss invert confocal laser scanning microscope (LSM-410) using the following settings: Argon laser 488 nm; Excitation filter BP 485; Dichroic Mirror FT 488/568 to objective; no dichroic mirror between objective and photomultiplier tubes (PMT's) such that all light passing through Emission Filter LP 590 is detected by PMT 1. 3-D reconstructions were made from optical sections using Carl Zeiss LSM software. Images were saved as TIF files, edited for contrast in Adobe Photoshop and printed on a Tektronix IISDX dye sublimation printer.

Results and Discussion

Three-dimensional reconstructions of 16 and 18 hour embryos treated with YOYO-1 are shown in Figure 1. YOYO-1 is a dimeric cyanine nucleic acid stain which is excited at 488 nm and fluoresces in a range from 480 - 600 nm. As YOYO-1 binds both DNA and RNA, we have found that embryos must be treated with RNase to avoid ubiquitous fluorescence. In these embryos, distinct nuclei can be identified in the yolk, amnion, and serosa. The large size of nuclei in the amnion and serosa is probably a result of their polyploid state (Falciani et al., 1996). The shape of the embryo proper is revealed by the fluorescence of its small, densely packed nuclei. Features such as segmental divisions and the ventral midline are clearly seen.

Confocal microscopy is proving extremely valuable in studying details of embryogenesis. Three-dimensional images aid greatly in analyzing development of mutant embryos. In addition, fluorescent staining of nuclei can be paired with fluorescent or non-fluorescent *in situ* hybridization, allowing gene expression patterns to be viewed three-dimensionally. Although propidium iodide has been widely used to visualize nuclei in insect embryos, to our knowledge this is the first report of YOYO-1 being used for this purpose. We have used both dyes and find that YOYO-1 staining produces sharper images. This staining method should be applicable to embryos of other insects, including Drosophila.

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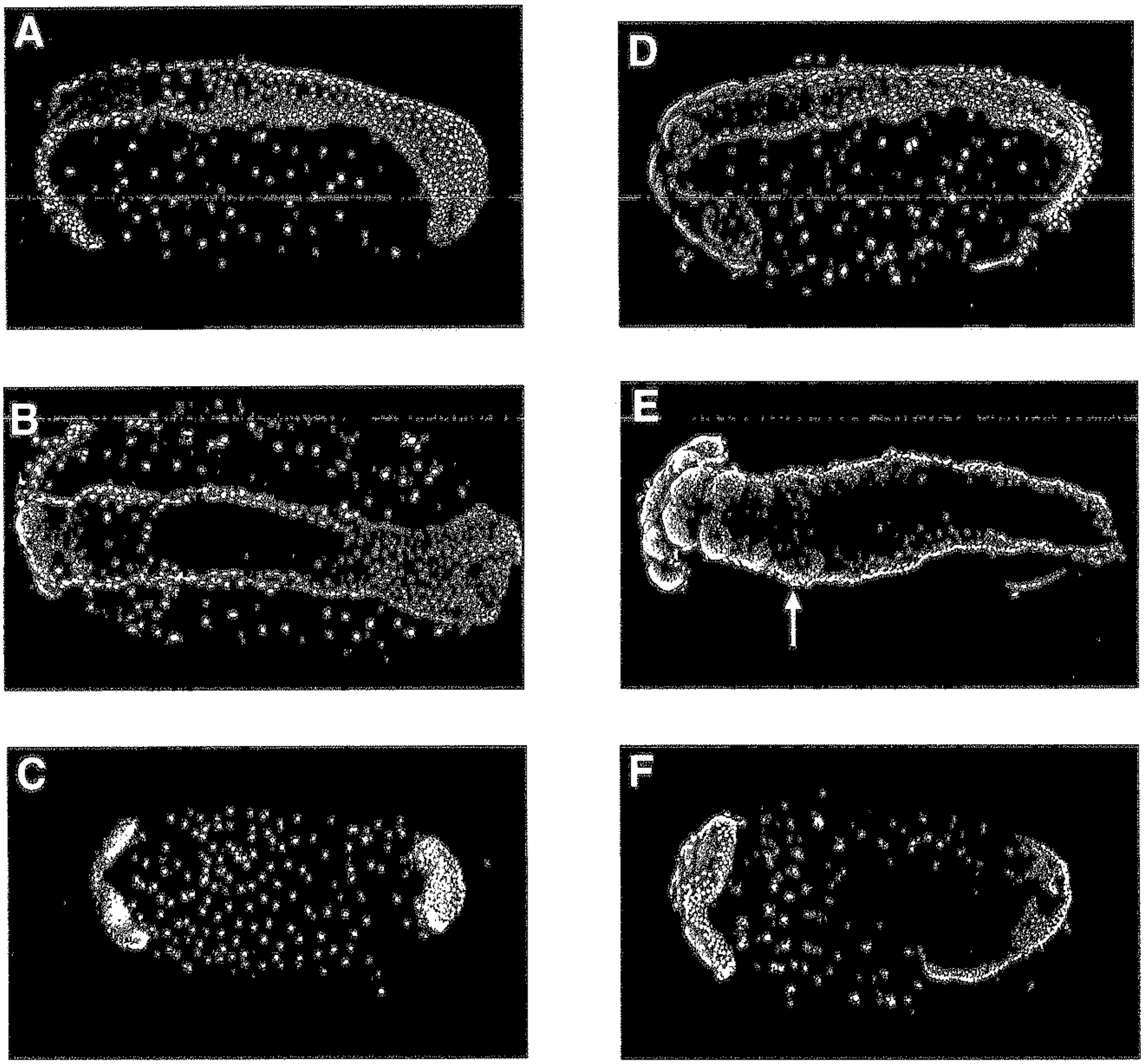
Figure 1. Three-dimensional reconstructions of 16 (A-C) and 18 (D-F) hour Tribolium embryos treated with the fluorescent nucleic acid stain YOYO-1 and visualized by confocal microscopy. In all cases, anterior is to the right. A) Lateral view of a 16 hour embryo. At this stage the germ band extends around both poles of the egg. The nuclei of the amnion and serosa can be seen overlying the embryo proper. B) Ventral view of a 16 hour embryo. The gnathal and thoracic segments have formed. C) Dorsal view of a 16 hour embryo. Only the head lobes and the tail are visible. The dense yolk does not allow the rest of the embryo to be seen. D) Lateral view of an 18 hour embryo. The germ band has extended further around the perimeter of the yolk. E) Ventral view of an 18 hour embryo free of yolk. Segmentation is apparent throughout the germ band. The first thoracic segment is indicated by an arrow. The ventral midline is also distinctly visible. Appendage buds are forming on anterior segments. F) Dorsal view of an 18 hour embryo. During this phase of germ band elongation, the caudal end of the embryo has moved on the along the dorsal surface of the egg, and is now closer to the head.


A
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*Interactions in Tribolium: Competition or predator-prey?

Population biologists have developed classification systems to define rigorously social interactions between lower organisms (Haskell 1949; Burkholder 1952. Odum (1959, 1971) reported nine interactions, while Malcolm (1966) lists ten. Some of the interactions between associated populations are of benefit (+), others are harmful (-), while other interactions are neither beneficial nor harmful (0). In comensalism one species benefits, but the other is unaffected (represented by (+/0); in competition both species are harmed in some way (-,-). In predator/prey or in parasite-host interactions one species benefits and the other is harmed (+,-) (one species serves as food for the other).

Abrams (1987) has criticized the attaching of symbols to the variously named interactions because the benefit or harm of a species is vaguely defined. Nevertheless, Keddy (1989) citing Haldane (1985) aptly states: "All human concepts are only limited attempts to organize a complexity beyond the organizational capacities of our nervous system, so we should be realistic about why we need definitions and proceed with the task at had-- to use the definition as an initial reference point for studying nature. We can expect our definitions to evolve as we learn about the phenomenon itself".

A case in point is our understanding of the type of interaction in flour beetles of the genus _Tribolium_. For many years the late Thomas Park, his students and collaborators studied the interspecies interaction of _Tribolium castaneum_ (CS) and _T. confusum_ (CF), two cosmopolitan species of stored products which infest and spend most of their lives tunneling the flour in which they live. Park studied these beetles under different conditions of temperature and relative humidity. As the reviews of King and Dawson (1972) and Sokoloff (1975) have shown, from this early work he concluded that the interaction was one of 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 Sokoloff and Lerner (1967) independently came to the conclusion that the interaction observed when _T. castaneum_ and _T. confusum_ are incarcerated in the same vial is a predator-prey interaction and not (as originally assumed by Park and his collaborators and others) competition. Sokoloff and Lerner thought that under certain conditions (such as rearing _T. castaneum_ and _T. confusum_ in whole wheat flour enriched with brewers' yeast) at 29°C. and 70% R.H. the interaction was one olf mutual predation because food was present in abundance. Under the same conditions but utilizing other media such as corn, _T. castaneum_ was eliminated by CF by competition rather than predator-prey interactions, since food was still abundant, but for CS certain required nutrients were in limited supply. Thus the cannibalism of eggs or other non-feeding stages by CS should greatly increase when CS and CF are reared in corn. If this is true, then competition would be at an entirely different level than usually considered, i.e. not for food as such, but for certain nutritional requirements in short supply in the food.

Evidence that a shortage of these requirements causes CS to become a more active cannibal was obtained by Inouye and Lerner (1965).

At this time the information that rearing T. castaneum and T. confusum at 25°C. or 30°C. together produced predominantly a predator-prey interaction, but rearing the same species together at 35°C. produced predominantly a competition interaction was not available. This information was obtained experimentally by Bowker (1978). Unfortunately, the paper by Bowker (perhaps because of its title or the journal where it was published) did not attract the attention of Triboliumists: Her paper is not cited by any of the papers I have seen in the last 20 years. But it seems to me that her findings provided a means of determining what kind of interaction is taking place in the experiment. It will not be a black and white criterion, but it is the best we have so far: if the flour beetles are reared at 25° or 30° C. then predator-prey interactions predominate. If the beetles are reared at a temperature higher than 30°C. then competition interactions predominate. The use of 35°C or higher is not recommended because rearing CS at this temperature decreases viability and increases sterility. Some people fail to see any difference in these interactions, but to put it simply, in predator-prey one species survives at the expense of the other. In competition both cohabiting species may survive, but there may be a reduction in the weight or biomass of the survivors, and as density increases mortality and other traits may be affected. If the competition is mild, both competing species survive. If the competition is severe, both may survive, one may survive or neither may survive depending on the conditions at which the competitors are placed and their physiological response to those conditions. Neither Park et al. nor Sokoloff and Lerner (1967) at that time could suggest a method of insuring which interaction was taking place. This was because, as Sokoloff and Lerner pointed out, competition and predator-prey interactions can be modified by the same factors. For T. castaneum and T. confusum these factors were:

1. Selection for a particular genotype affecting productivity, developmental rate, and competitive ability.
2. Food.
3. Initial density.
4. Other environmental factors: presence or absence of disease, temperature differences, and differences in relative humidity.

Bowker's (1979) experiments and conclusions, in my opinion, at least provide the future experimenters an a priori knowledge of the type of interaction that will occur in the experiments by choosing the proper temperature: if the experimenter wishes to study predator-prey interactions, s(he) will carry out his experiments in the range of 25-30° C., where predator-prey interactions predominate. If the experimenter wishes to study competition interactions, then the temperature of choice would be 35°C., where this type of interactions predominate. The choice of temperature conditions will enable the investigator to choose a more appropriate title for the paper being submitted for publication, i.e. the inclusion of the term "competition" in the paper's title when the beetles are reared at around 35° C., and "predator-prey" when the beetles are reared at 25° or 30° C.

This paper is open for discussion. Anyone wishing to express an opinion about the subject is welcome to submit a paper to the Editor, for inclusion in a future issue of the Tribolium Information Bulletin.

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A simple technique to relieve *Tribolium castaneum* (Coleoptera : Tenebrionidae) of *Acarophenax tribolii* (Acarina : Pyemotidae)

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Acarophenax tribolii is a common parasitic mite of different stored product beetles (Lepesme, 1944). Young females of this species are found on adult beetles and their pupae, especially where the cuticle is thin, on the inter-segmental membranes and, on the adult, on the large area of soft cuticle beneath the flight wings (Evans *et al.*, 1961). We have observed, in case of big infestation, till about hundred of adult mites on the rear dorsal extremity of the *Tribolium castaneum* adult elytras and between leg articulations. After feeding, young female leaves the host and commences to feed on the eggs of the beetle until after a few days her body becomes so distended that she is incapable of walking. On the third day, the gravid female dies and from 4-14 young females emerge through the enlarged genital orifice. The single male produced by the female fecundates these young females before they leave the parent body (Evans *et al.*, 1961). This acari, responsible of the destruction of newly laid eggs, is therefore very damaging in laboratory populations.

We have experimented a method to eliminate this acari from *T. castaneum* rears. Infested adults were isolated in an open Petri dish. The dishes were placed during 10 hours in a dessicator containing a 5 % formol solution. This first treatment permitted to kill all the acari present upon the beetles and then to diminish the eggs destruction. The adults were transfered in fresh rearing medium (wheat flour and brewers yeast - 10/1) for 24 hours. After these laying period, eggs were isolated and placed in the above disinfection conditions during 6 hours. Next this second treatment, eggs were incubated in a fresh rearing medium at 30 ± 3°C and 60 ± 5 % HR. A new culture could then begin.

All the material used and incubators were also disinfected by maintaining it at 60°C during 12 hours.

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We want to thank L. Van Asselt from the IRSNB (Institut Royal des Sciences Naturelles de Belgique) for the identification of the acari.

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