TRIBOLIUM INFORMATION BULLETIN

Number 19

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California State College, San Bernardino

California

1976

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NOTICE

MINISTRY OF AGRICULTURE, FISHERIES & FOOD PEST INFESTATION CONTROL LABORATORY notifies the availability of two Pest Infestation Control Laboratory publications which should be purchased from the publisher:

H.M. Staionery Office
P.O. Box 569
London, SE 1 9NH

or via a bookseller.

AITKEN, A.D.
Insect travellers. Volume 1. Coleoptera.
(Tech. Bull. Minist. Agric. Fish. Fd. No. 31, 1975, 207pp)
ISBN 0 11 840891 5 Price £4.25

Pest Infestation Control Laboratory Report 1971-73
Published 1975, 301 pp. (Available April 1976)
ISBN 0 11 240977 6 Price £5.25

TRIBOLIUM INFORMATION BULLETIN

Number 19

March, 1976

Foreword

As this volume goes to press, there is a very strong possibility that financial support for the publication of the Tribolium Information Bulletin will no longer be available, and that future issues after Tribolium Information Bulletin 19 will have to go on a subscription basis again. I will notify contributors what the subscription rates will be in the near future. It is my hope that those contributors who can afford to will subscribe, and those who cannot but find this publication useful will have their institutional libraries subscribe.

I am indebted to Stephen Kim, Joyce Juster, and Jim Gooch for assistance in the preparation of Tribolium Information Bulletin 19. Its publication was made possible by U.S. Army Research Office Grant RDRD LP-11790-LS.

Stock Lists

Note: The present listing of stock lists does not necessarily reflect the availability of all stocks in the institutions listed. Each year the call for contributions request that contributors bring their lists up to date. Some contributors do, and these are indicated by the name of the contributor at the end of his list. But in other cases the lists have been contributed once, long ago, and with no attempt to update them. These lists are included because the material may still exist in those laboratories and may have special value to an investigator just beginning research or may give an idea to federal agencies where a given species can be found. The lists derived from previous issues of Tribolium Information Bulletin are followed by (Ed.). Those laboratories should be contacted to determine whether those cultures are still in existence.

Stock Lists

BALTIMORE, MARYLAND
THE JOHN HOPKINS UNIVERSITY
SCHOOL OF HYGIENE AND PUBLIC HEALTH

Tribolium confusum: bI and bIV
Tribolium castaneum: cI and cIV-a

Michael Nathanson

BERKELEY, CALIFORNIA
UNIVERSITY OF CALIFORNIA,
DONNER LABORATORY AND LAWRENCE RADIATION LABORATORY

Tribolium confusum

1. "+" - a wild type strain derived from Genetics Department, University of California, Berkeley.
2. Black - an autosomal semi-dominant body color mutant. From 1.
3. Miniature - an autosomal recessive body size mutant. From 1.
4. Short elytra - an autosomal dominant elytrum size mutant. Low viability in adults, indicating a recessive Lethal gene.
5. Blistered elytra - an autosomal recessive mutant. Low viability.

Tribolium brevicornis

Wild type derived from Genetics Department, University of California, Berkeley.

(Ed.)

BRIDGEPORT, CONNECTICUT
UNIVERSITY OF BRIDGEPORT,
DEPARTMENT OF BIOLOGY

Tribolium confusum

Wild type strains derived from Dr. Fraenkel's laboratory at the University of Illinois.

(Ed.)

Stock Lists

BURLINGTON, NORTH CAROLINA
CAROLINA BIOLOGICAL SUPPLY COMPANY

Tribolium castaneum

1. black — Chicago
2. jet
3. pearl
4. wild — McGill
5. high body weight
6. low body weight

Tribolium confusum

1. wild — Carolina (Ed.)

CARBONDALE, ILLINOIS
SOUTHERN ILLINOIS UNIVERSITY,
DEPARTMENT OF ZOOLOGY

I. Base populations

1. Purdue + foundation
2. Purdue *s* foundation (sooty)
3. Purdue *b* foundation (black)

II. Mutant

1. paddle (*pd*)
2. spotted (*sp*)
3. pygmy, red, paddle (*py r pd*)
4. pygmy (*py*)
5. red (*r*)
6. pygmy, red (*py r*)
7. pygmy, paddle, spotted (*py pd sp*)
8. pearl (*p*)
9. white (*w*)
10. ruby, light ocular diaphragm (*rb lod*)
11. Short antenna (*Sa*)
12. chestnut (*c*)
13. antennapedia (*ap*)
14. squint (*sq*)

III. Selected populations

Early: a population subjected to selection for a short larval period. Origin in Purdue Wild Foundation.

Late: a population subjected to selection for a long larval period. Origin in Purdue Wild Foundation.

D. C. Englert

CARLISLE, PENNSYLVANIA
DICKINSON COLLEGE, DEPARTMENT OF BIOLOGY

Tribolium confusum

I. Wild type strains

1. Six strains started from females captured in a feed bin in New York City, 1955.

2. Three strains, one each from T. Park, Chicago; J. Stanley, Montreal; S. Smith, Sault Ste. Marie, Canada.

3. One strain consisting of several above strains mixed together about three years ago.

4. One strain started with individuals taken from (1) above, which has been freed of eye mutations.

NOTE: Some of the wild strains listed in (1) and (2) are known to be carrying pearl-like mutations.

II. Mutant

1. Black - Sault Ste. Marie (1956)
2. Ebony - Chicago (1957)
3. Eyespot - sex-linked - from a wild strain in (I.1) above (1959)
4. Rough - from strain (II.1) above (1957)
5. Split - from a wild strain in (I.1) above (1956)
6. Striped - sex-linked - from (II.1) above (1957)
7. One strain each of Striped/black and split/black

Oryzaephilus surinamensis

One strain started from insects captured in New York City, 1955.

(Ed.)

CHARLOTTESVILLE, VIRGINIA
UNIVERSITY OF VIRGINIA,
DEPARTMENT OF BIOLOGY

Tribolium castaneum

I. Wild type strains

1.	Chicago	University of Chicago
2.	Purdue University Foundation	via Stony Brook
3.	Synthetic	San Bernardino

Stock Lists

II. Mutant strains

1. McGill black — University of Chicago via Stony Brook

(Ed.)

CHICAGO, ILLINOIS
UNIVERSITY OF ILLINOIS AT CHICAGO CIRCLE,
DEPARTMENT OF BIOLOGICAL SCIENCES

I. Wild type strains

A. *Callosobruchus maculatus*

B. *Oryzaephilus surinamensis*

C. *Tribolium castaneum*

1. "Chicago" (originally from Thomas Park)
2. "Brazil" (also known as cI) - (originally from Rio de Janiero)
3. cIV-a - an inbred strain (derived from "Chicago")

D. *Tribolium confusum*

1. "Chicago" (originally from Thomas Park)
2. bI (derived from "Chicago")
3. bII (derived from "Chicago")
4. bIII (derived from "Chicago")
5. bIV (derived from "Chicago")

II. Mutant

A. *Tribolium confusum*, ebony (an autosomal recessive body color mutant)

(Ed.)

COLLEGE PARK, MARYLAND
UNIVERSITY OF MARYLAND,
DEPARTMENT OF ZOOLOGY

I. Wild type strains

A. *Tribolium castaneum*

Stock Lists

1. Chicago (via Sokoloff)
2. University del Valle-1 Berkeley, 1964
3. University of Maryland-2 Cali, Colombia, 1964

Inbred strains.

4. ebony(originally from Edinburgh, via Boylan) Manitoba, 1964

B. Tribolium confusum

1. So. Illinois University-1 Carbondale, Ill., 1962

Inbred strains

2. CFI-11 Berkeley, Calif., 1965

II. Mutant

1. T. confusum Berkeley, Calif., 1959

ebony ($\underline{e}^{L\&H}$)

(Ed.)

CORAL GABLES, FLORIDA
UNIVERSITY OF MIAMI,
DEPARTMENT OF BIOLOGY

I. Wild type strains

1. Tribolium confusum Chicago
2. Tribolium castaneum Chicago

II. Mutant

1. Tribolium castaneum - "jet" Chicago
2. Tribolium castaneum - pearl type, origin in local stocks
3. Tribolium castaneum - jet x pearl
4. Tribolium confusum - "ebony"

(Ed.)

Stock Lists

CORVALLIS, OREGON
OREGON STATE UNIVERSITY,
DEPARTMENT OF ZOOLOGY

I. Wild type strains

A. Tribolium castaneum

1. Oregon — Urbana, 1966

B. Tribolium confusum

1. Oregon — Urbana, 1966

II. Mutant strains

A. Tribolium castaneum

1.	sa - 2 (+ls)	Berkeley, 1966
2.	dve, pd	Berkeley, 1967
3.	b, mc, p	Berkeley, 1966
4.	Sa_D - 2, s	Berkeley, 1967
5.	ap , s	Berkeley, 1966
6.	ser, py, r	Berkeley, 1967
7.	blob (bb)	Urbana, 1968
8.	aa, mc, j	Corvallis, 1974
9.	r^D, s	Berkeley, 1967
10.	weird eggs (wd), s	Corvallis, 1972
11.	nude eggs (nd), s	Corvallis, 1973

B. Tribolium confusum

1.	msg^{AS}	Berkeley, 1967
2.	dj/t	Berkeley, 1966
3.	thu	Berkeley, 1966
4.	b^U	Urbana, 1967
5.	thu^U	Berkeley, 1966
6.	ble^U	Urbana, 1967
7.	r^U	Urbana, 1968
8.	dep	Urbana, 1969
9.	b, spl	San Bernardino , 1973
10.	e^c	Corvallis, 1970

Ed.

Stock Lists

DAVIS, CALIFORNIA
UNIVERSITY OF CALIFORNIA, DEPARTMENT OF ANIMAL HUSBANDRY

I. Wild type strains (*T. castaneum*)

BC1	*T. castaneum*	Berkeley, 1967
DCI	*T. castaneum*	Davis, 1969

II. Mutant strains

BC2	*T. castaneum*, sooty	Berkeley, 1967
BC114	*T. castaneum*, sooty, inbred from strain 14a	Berkeley, 1967
SCp	*T. castaneum*, pearl eye	San Bernardino, 1969

III. Selected strains (all derived from BC1)

6-14 BC1-2, lines 1-8, 10, selected for large 21-day pupa for 23-36 generations, currently in generation 95.
15 BC1-2, line 9 selected for 58 generations; average 21-day pupa weight 6 mg, currently in generation 95.
16-18 BC1-2L, lines 1-3, selected for small 21-day pupa for 13 generations, currently in generation 90.
19-20 BC1-2, lines 1C, 2C, random selected control
21 BC1-2L, line 1C, random selected control

IV. Wild type strains (*T. confusum*)

BF1	*T. confusum*	Berkeley, 1967
DF1	*T. confusum*	Davis, 1967
DF3	*T. confusum*	Davis, 1969

V. Mutant strains

SFp (pearl eyes) San Bernardino, 1969

J. Medrano

DENTON, TEXAS
TEXAS WOMAN'S UNIVERSITY
DEPARTMENT OF BIOLOGY

I. Wild type strains and origin

A. *Tribolium confusum* (Chicago Standard)

B. *Tribolium castaneum* (Brazil C1)

H. E. Erdman

Stock lists

EAST LANSING, MICHIGAN
MICHIGAN STATE UNIVERSITY, BIOLOGY RESEARCH CENTER

Tribolium castaneum

I. Wild type strain

1. McGill — Chicago via Berkeley, 1964

II. Mutant strains

1. paddle — Chicago via Berkeley,
2. spotted — Berkeley,

(Ed.)

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

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.)
(Ed.)

HAMPTON, IOWA
FARMERS HYBRID COMPANY

I. Wild type strain

1. Chicago — via Berkeley, 1965

II. Mutant strains

1. r py
2. j mc
3. Be/+

(Ed.)

HUMACAO, PUERTO RICO
UNIVERSITY OF PUERTO RICO, COLLEGE OF HUMACAO
DEPARTMENT OF BIOLOGY

Tribolium castaneum

I. Wild type strain

1. Chicago

II. Mutant strains

1. paddle
2. pearl
3. Microcephalic
4. Bar eye, sooty
5. Short antennae (Sa-2)

(Ed.)

HUNTSVILLE, TEXAS
SAM HOUSTON STATE UNIVERSITY
BIOLOGY DEPARTMENT

Tribolium castaneum

I. Wild type strains

A. Purdue University Foundation
B. Huntsville, Texas wild type - source of squint-like (sl).

II. Mutant stains

A.	Bar eye (Be)	Berkeley , 1962
B.	black (b^D)	Carbondale, Ill., 1961
C.	light ocular diaphragm (lod^D)	Carbondale, Ill., 1961
D.	maroon (m)	Purdue + Foundation , 1962
E.	microcephalic (pearl) (mc, p)	Chazy, New York , 1959
F.	paddle (pd)	Chicago , 1955
G.	peach (r^{ph})	Carbondale, Ill., 1961
H.	pygmy (py)	Chazy, New York , 1960
I.	pink, ivory (p^{Pk}, i)	Chazy, N. Y.: Purdue + Foundation
J.	ring (rg)	Purdue + Foundation , 1961
K.	rose (rs)	Purdue + Foundation , 1964
L.	ruby (rb)	Carbondale, Ill., 1961
M.	ruby, jet (rb, j)	Carbondale, Ill., 1961
N.	ruby, peach (rb, r^{ph})	Purdue + Foundation , 1956
O.	sooty (s)	Chazy, New York , 1960
P.	squint (sq)	Huntsville, Texas , 1973
Q.	squint-like (sql)	

A. A. Dewees

Stock Lists

IMMACULATA, PENNSYLVANIA
IMMACULATA COLLEGE, CANCER RESEARCH UNIT

I. Wild type strains

1.	Alphitobius diaperinus	PIL
2.	Alphitobius laevigatus	PIL
3.	Gnathocerus cornutus	PIL
4.	Gnathocerus maxillosus	PIL
5.	Latheticus oryzae	Berkeley
6.	Tenebrio molitor	PIL
7.	Tenebrio obscurus	PIL
8.	Tribolium anaphe	Berkeley
9.	Tribolium brevicornis	Berkeley
10.	Tribolium castaneum	Berkeley
11.	Tribolium confusum	Berkeley
12.	Tribolium destructor	Berkeley
13.	Tribolium madens	Berkeley

II. Mutant Strain

1. Tribolium confusum melanotic stink glands (msg)

Note: The insect strains formerly maintained by one of us (S.K.L.) at the John Hopkins University, Chemistry Department, in Baltimore, Md., have been transferred to Immaculata College.

(Ed.)

IRVINE, CALIFORNIA
UNIVERSITY OF CALIFORNIA, DEPARTMENT OF ORGANISMIC BIOLOGY

Tenebrio molitor

(Ed.)

ITHACA, NEW YORK
CORNELL UNIVERSITY, DEPARTMENT OF ANIMAL SCIENCE

Tribolium castaneum

The Purdue Foundation wild type obtained form the Population Genetics Institute in April, 1965.

(Ed.)

Stock Lists

ITHACA, NEW YORK
CORNELL UNIVERSITY, DEPARTMENT OF ENTOMOLOGY AND LIMNOLOGY

I. Wild type strains

1. *Tribolium confusum* from Dr. H. Ducoff, University of Illinois.

2. *Tribolium confusum* infected with *Nosema whitei*.

(Dr. L. V. Knutson, same department, is said to have a wild type strain of *T. confusum*. Whether this strain is the same as that listed above is not known.

(Ed.)

JAMAICA, NEW YORK
ST. JOHN'S UNIVERSITY, DEPARTMENT OF BIOLOGY

Tenebrio molitor

(Ed.)

KENT, OHIO
KENT STATE UNIVERSITY, DEPARTMENT OF BIOLOGICAL SCIENCES

I. Wild type strains

A. *Tribolium castaneum*

Synthetic strain combined from Chicago wild type derived from Dr. Thomas Park and a strain obtained from Dr. Karl Schurr, Department of Biology, Bowling Green State University, Bowling Green, Ohio.

B. *Tribolium confusum*

Derived from stock maintained by Dr. L. V. Knutson, Department of Entomology, Cornell University, Ithaca, New York.

C. *Oryzaephilus surinamensis*

From infested flour.

Stock Lists

KINGSTON, R. I. 02881
UNIVERSITY OF RHODE ISLAND
DEPARTMENT OF ZOOLOGY

Tribolium castaneum

Purdue Foundation — via Purdue
Black Foundation — via Purdue
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

Jillson, D. D.

LAFAYETTE, INDIANA 47907
PURDUE UNIVERSITY
ANIMAL SCIENCES DEPARTMENT

Tribolium castaneum

I. Wild Type strains

A. Base populations for quantitative genetics studies:

1. Foundation + - wild type population synthesized in 1954 from a broad genetic base and maintained with no artificial selection and minimum of inbreeding.

2. Foundation s - same genetic base as Foundation + but marked with sooty (s).

3. Foundation b - synthesized in 1959 and marked with black (b), unrelated to Foundation +, broad genetic base, no selection, minimum inbreeding.

4. Foundation p - synthesized in 1959 and marked with pearl (p), unrelated to Foundations + and b, broad genetic base, no selection, minimum inbreeding.

Stock Lists

B. Laboratory stocks

5.	Arkansas	Fayetteville, 1954
6.	Brazil	Vicosa, 1958
7.	Capetown	South Africa, 1958
8.	Chicago	University of Chicago, 1954
9.	Carbondale	Illinois, 1958
10.	Columbia	South America, 1958
11.	Florida	Gainesville, 1958
12.	Georgia	Tipton, 1954
13.	Japan	Kyoto, 1958
14.	McGill	Montreal, Canada, 1958
15.	Minnesota	Minneapolis, 1958
16.	Texas	College Station, 1954
17.	Virginia	Blacksburg, 1954

II. Mutant strains

18.	antennapedia, ap	Purdue Sa Stock, 1962
19.	black, b^D	Carbondale, Illinois, 1964
20.	chestnut, c	Purdue + Foundation, 1961
21.	cordovan, b^{cd}	Purdue + Foundation, 1962
22.	corn oil sensitive, cos	Purdue + Foundation, 1966
23.	ivory, i	Purdue + Foundation, 1961
24.	jet, j^E	Purdue + Foundation, 1961
25.	maroon m	Purdue + Foundation, 1962
26.	paddle, pd	Chicago, 1955
27.	peach, r^{ph}	Carbondale, Illinois, 1964
28.	pearl, p^S	Fla. Inbred, (Purdue), 1963
29.	pygmy, py	Chazy, New York, 1960
30.	red, r^s	Purdue + Foundation, 1964
31.	ring, rg	Purdue + Foundation, 1961
32.	rose, rs	Purdue + Foundation,
33.	ruby, rb	Carbondale, Illinois, 1964
34.	Short antenna, Sa	Purdue + Foundation, 1960
35.	short antenna, sa_3	Purdue + Foundation, 1966
36.	sooty, s	Purdue + Foundation, 1956
37.	squint, sq	Chazy, New York, 1960
38.	wine r^w	Purdue + Foundation, 1963

(Ed.)

LARAMIE, WYOMING
UNIVERSITY OF WYOMING, DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY

Tribolium castaneum

I. Mutant strains

1. Fta c
2. Be s
3. pd py pte
4. sp
5. Spa s eju
6. p b
7. p lod
8. ap sq

(Ed.)

Stock Lists

LAURINGBURG, NORTH CAROLINA
ST. ANDREWS COLLEGE

Tribolium confusum

A wild stock that is infected with *Nosema whitei*.

(Ed.)

LEXINGTON, KENTUCKY
AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF KENTUCKY

Tribolium castaneum

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. Wild strains

1.	4 strains collected locally	Kentucky, 1970

III. Inbred Lines

1.	CSI-5	Berkeley via Minnesota
2.	CSI-10	Berkeley via Minnesota
3.	E-1	Edinburgh via Minnesota
4.	E-2	Edinburgh via Minnesota
5-9.	Five Inbred lines derived from different wild strains	Purdue

IV. Selected Strains

Several strains which have been selected for increased 21 day pupa weight.

R. Goodwill

Stock Lists

LIVERMORE, CALIFORNIA
BIOLOGICAL FRONTIERS INSTITUTE

Only wild type strains of T. confusum and T. castaneum are maintaimed. We have a number of stocks of these species received from Dr. I. Michael Lerner and described by him in Tribolium Information Bulletin #3 (p. 28). In addition we have a number of stocks of both species collected locally.

We have also a wild type strain of the saw-toothed grain beetle, Oryzaephilus surinamensis (L.).

(Ed.)

LORETTO, PENNSYLVANIA
ST. FRANCIS COLLEGE, BIOLOGY DEPARTMENT

I. Wild type strain

1. Tribolium confusum — Chicago via Berkeley
2. Tribolium castaneum — Chicago via Berkeley

(Ed.)

LOS ANGELES, CALIFORNIA
UNIVERSITY OF CALIFORNIA MEDICAL CENTER
DEPARTMENT OF MEDICAL MICROBIOLOGY

I. Wild type strain

1. Tribolium confusum — Chicago via Berkeley

(Ed.)

MADISON, NEW JERSEY
FAIRLEIGH DICKINSON UNIVERSITY
FLORHAM-MADISON CAMPUS
BIOLOGY DEPARTMENT

<u>Blattela germanica</u>, wild-type (VPI strain); Blackbody; red; ruby; rose; pallid; Prowing T (9;10)
<u>Periplaneta americana</u>, wild-type and white eye; wild-type from Hackensack (New Jersey) Meadowlands
<u>Blatta orientalis</u>
<u>Supella longipalpis</u>
<u>Symploce hospes</u>
<u>Leucophaea maderae</u>
<u>Nauphoeta cinerea</u>
<u>Diploptera punctata</u>
<u>Gromphadorhina portentosa</u>
<u>Pycnoscelus surinamensis</u>, several parthenogenetic forms
<u>Pycnoscelus indicus</u>, bisexual

I. Huber

MANHATTAN, KANSAS
DEPARTMENT OF ENTOMOLOGY
KANSAS STATE UNIVERSITY

LEPIDOPTERA

Phycitidae

<u>Cadra cautella</u> (Walk.), almond moth, from USDA, Manhattan, Kansas, 1971.
<u>Plodia interpunctella</u> (Hbn.), Indian-meal moth, Kansas.

Gelechiidae

<u>Sitotroga cerealella</u> (Oliv.), Angoumois grain moth, Kansas, about 1970.

A. <u>Sitotroga cerealella</u> (Oliv.), Red-eyed Angoumois grain moth, from stock cultures, 1967.

COLEOPTERA

Anobiidae

<u>Lasioderma serricorne</u> (F.), Cigarette beetle, Kansas, 1966.
<u>Stegobium paniceum</u> (L.), Drugstore beetle, from USDA, Richmond, Virginia, 1971.

Bostrichidae

<u>Rhyzopertha dominica</u> (F.), Lesser grain borer, Kansas.

Bruchidae

<u>Callosobruchus maculatus</u> (F.), Cowpea weevil, Kansas, 1971.

Stock Lists

Cucujidae

Cryptolestes ferrugineus (Steph.), Rusty grain beetle, Kansas.
Cryptolestes pusillus (Schon.), Flat grain beetle, Kansas.
Oryzaephilus surinamensis (L.), Saw-toothed grain beetle, Kansas.
Oryzaephilus mercator (Fauv.), Merchant grain beetle, from USDA, Savannah, Georgia, 1964.

Curculionidae

Sitophilus granarius (L.), Granary weevil, Kansas.
Sitophilus oryzae (L.), Rice weevil, Kansas, 1955.
Sitophilus zeamais Mots., Maize weevil, from Stuttgart, Arkansas, 1955.
Sitophilus zeamais Mots., Maize weevil, from Veracruz, Mexico, 1964.

Dermestidae

Megatoma piceus (Oliv.), Black carpet beetle, Kansas.
Trogoderma inclusum LeC., Larger cabinet beetle, from USDA, Manhattan, Kansas.
Trogoderma sternale Jayne, Manhattan, Kansas, 1971.
Trogoderma variabile Ballion, Kansas.

Ostomatidae

Tenebroides mauritanicus (L.), Cadelle, Kansas.

Ptinidae

Gibbium psylloides (Czemp.), Spider beetle, Chicago, Ill., 1966.

Silvanidae

Ahasverus advena (Waltl.), Foreign grain beetle, Manhattan, Kansas, 1969.

Tenebrionidae

Palorus ratzeburgi (Wissm.), Small-eyed flour beetle, Kansas, 1965.
Tenebrio molitor L., Yellow mealworm, Kansas.
Tenebrio obscurus F., Dark mealworm, Manhattan, Kansas, 1971.
Tribolium castaneum (Hbst.), Red flour beetle, Kansas.
Tribolium confusum J. du V., Confused flour beetle, Kansas.

R. B. Mills

Stock Lists

MIDLAND, MICHIGAN
THE DOW CHEMICAL COMPANY, BIOPRODUCTS DEPARTMENT

<u>Tribolium confusum</u>

Wild strain maintained in laboratory more than 20 years.

(Ed.)

MILWAUKEE, WISCONSIN 53201
THE UNIVERSITY OF WISCONSIN
ZOOLOGY DEPARTMENT

Wild type strains

1. Purdue Foundation +
2. Purdue Foundation <u>b</u>

Selected strains

1. Late: a population subjected to selection for a long larval period. Origin in Purdue Foundation +.
2. High chaetae: a population subjected to selection for increased pregenital chaetae number. Origin in Purdue Foundation <u>b</u>.
3. Low chaetae: a population subjected to selection for decreased pregenital chaetae number. Origin in Purdue Foundation <u>b</u>.

E. L. Lange

MOSCOW, IDAHO
UNIVERSITY OF IDAHO, DEPARTMENT OF ENTOMOLOGY

A. <u>Tribolium castaneum</u> - large and small selections, sooty marked, obtained from Berkeley last October.

B. <u>Tribolium madens</u> from the Boise Valley area, Idaho, started in November, 1967.

C. <u>Tribolium confusum</u> - probably of local origin, held under weekly subculturing for about three years.

D. <u>Tribolium castaneum</u> - of local origin, subcultured largely at weekly intervals for about five years, started from a very few individuals surviving neglect of cultures previously, somewhat sporadically, maintained for several years in the laboratory.

(Ed.)

Stock Lists

MUNCIE, INDIANA
BALL STATE UNIVERSITY, DEPARTMENT OF PHYSIOLOGY AND HEALTH SCIENCE

Tribolium castaneum, large stock, from Purdue University.

Tribolium castaneum, foundation stock, from Purdue University.

(Ed.)

NATICK, MASSACHUSETTS
U.S. ARMY NATICK LABORATORIES, PIONEERING RESEARCH LABORATORY

I. Wild type strains

Lepidoptera:

Anagasta kuhniella - USDA Lab., Georgia, 1969
Cadra cautella " " " "
Plodia interpunctella " " " 1964
Sitotroga cerealella " " " 1969
Tineola bisselliella - Univ. New Hampshire, Durham, N.H., 1965

Coleoptera:

Anthrenus flavipes - USDA Lab., Georgia, 1967
Attagenus megatoma " " " 1957
Cryptolestes pusillus - Kansas State Univ., Manhattan, Kansas, 1971
Dermestes maculatus - USDA Lab., Georgia, 1968
Gibbium psylloides - Kansas State Univ., Manhattan, Kansas, 1971
Lasioderma serricorne - USDA Lab., Georgia, 1968
Oryzaephilus surinamensis - USDA Lab., Georgia, 1968
Palorus ratzeburgi - Kansas State Univ., Manhattan, Kansas, 1971
Rhyzopertha dominica - USDA Lab., Georgia, 1969
Sitophilus granarius - " " " 1968
Sitophilus oryzae " " " 1968

Tenebrio molitor - Univ. New Hampshire, Durham, N.H., 1965
Tenebroides mauritanicus - USDA Lab., Georgia, 1968
Tribolium audax - Univ. California, Riverside, Calif., 1971
Tribolium brevicornis - Univ. California, Riverside, Calif., 1971
Tribolium castaneum - USDA, Georgia, 1956
Tribolium confusum - USDA, Georgia, 1969
Tribolium destructor - Univ. California, Riverside, Calif.
Tribolium madens - " " " "
Trogoderma variable - NLABS, Natick, Mass., 1968

Mutant:

Tribolium confusum - Ebony strain, A. Sokoloff, 1968

(Ed.)

Stock Lists

NEW YORK CITY 11367
QUEENS COLLEGE, DEPARTMENT OF BIOLOGY

<u>Tribolium castaneum</u>

Wild Type — Purdue Foundation +

R.E. Calhoun

NORMAN, OKLAHOMA
UNIVERSITY OF OKLAHOMA, DEPARTMENT OF ZOOLOGY

Coleoptera

<u>Tribolium castaneum</u> (Tenebrionidae) wild type, Chicago; Univ. of Chicago.

F.J. Sonleitner

NORTON, MASSACHUSETTS 02766
WHEATON COLLEGE, DEPARTMENT OF BIOLOGY

<u>Tribolium confusum</u>

Wild Type (Chicago)

<u>Tribolium castaneum</u>

Black (Chicago)

John C. Kricher

Stock Lists

NORTHRIDGE, CALIFORNIA
SAN FERNANDO VALLEY STATE COLLEGE
DEPARTMENT OF BIOLOGY

Tenebrio molitor infested with gregarines.

(Ed.)

NOTRE DAME, INDIANA
UNIVERSITY OF NOTRE DAME
DEPARTMENT OF BIOLOGY

I. Wild type strains

1.	CFI-11	Berkeley, 1965
2.	CFI-22	Berkeley, 1965
3.	CFI-11 x CFI-22	Berkeley, 1965
*4.	ND-11	Park, Univ. of Chicago, 1954

*Since 1956, maintained at the Air Force Weapons Laboratory, Kirtland, A.F.B., New Mexico.

(Ed.)

PITTSBURGH, PENNSYLVANIA
DUQUESNE UNIVERSITY
DEPARTMENT OF BIOLOGICAL SCIENCES

I. Wild type strains

1. Tribolium confusum (Chicago) used as internal host for Hymenolepis diminuta. Via Sokoloff (Ed.)

Stock Lists

POCATELLO, IDAHO
IDAHO STATE UNIVERSITY, DEPARTMENT OF BIOLOGY

I. Wild type strains

Tribolium castaneum--Synthetic strain marked with sooty from Berkeley.

Tribolium confusum--Synthetic strain from Berkeley.

(Ed.)

PULLMAN, WASHINGTON 99163
WASHINGTON STATE UNIVERSITY
DEPARTMENT OF ENTOMOLOGY

Tribolium confusum - synthetic wild type
Tribolium castaneum - sooty

Roger Akre

RICHLAND, WASHINGTON
BATTELLE-NORTHWEST, BIOLOGY DEPARTMENT

I. Wild type strains

1. *Tribolium confusum* Duval (Chicago Standard) — Univ. of Chicago
2. *Tribolium castaneum* Herbst (Brazil *cI*) — Univ. of Chicago

II. Mutant strain

1. *Tribolium castaneum* Herbst (Sooty) — Univ. of Calif., Berkeley

(Ed.)

RIVERSIDE, CALIFORNIA
UNIVERSITY OF CALIFORNIA, DEPARTMENT OF ENTOMOLOGY

A. *Cryptolestes turcicus* — PIL via Berkeley
B. *Gnathocerus cornutus* — PIL via Berkeley
C. *Tribolium anaphe* — PIL via Berkeley
D. *Tribolium destructor* — PIL via Berkeley
E. *Tribolium madens* — PIL via Berkeley
F. *Tribolium brevicornis*

(Ed.)

SALT LAKE CITY, UTAH
UNIVERSITY OF UTAH, DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY

I. Wild type strains

1. *Tribolium confusum*	Park, Chicago	196
2. *Tribolium castaneum*	J. Laurie, Utah	196
3. *Tenebrio molitor*	W.P. Larsen, via S. Muliak, Utah	196
4. *Oryzaephilus* sp.	wild, Utah	196

II. Mutant strain
1. melanotic stink glands

(Ed.

SAN BERNARDINO, CALIFORNIA
CALIFORNIA STATE COLLEGE, NATURAL SCIENCES DIVISION

I. Wild type strains

A. *Tribolium castaneum*

1. Chicago	Park	195
2. Consejo	Spain	196
3. Davis	Davis, CA.	196
4. Florida	Bell	197
5. McGill	Stanley	195
6. PIL		?
7. Sacramento		196
8. Veracruz	Mexico	196
9. Virginia		195

B. *Tribolium confusum*

1. Chicago	Park	195
2. McGill	Stanley	195
3. New York		196
4. Pennsylvania	MacDonald	?
5. San Bernardino		196
6. Yugoslavia		?
7. Syn +/+		

C. *Tribolium audax*

1. PIL	Slough	197

D. *Tribolium anaphe*

1. PIL	Blackman	197

E. *Tribolium brevicornis*

1. Riverside	California	196

F. Tribolium destructor
   1. PIL — Blackman 1976

G. Tribolium modens
   1. PIL — Slough 1963
   2. PIL — Slough 1971

H. Latheticus oryzae
   1. Tifton — Georgia 1970

I. Oryzaephilus surinamensis
   1. Synthetic from Cold Spring Harbor, New York and Oakland, California populations — 1968
   2. San Bernardino — 1968

J. Stegobium paniceum — San Bernardino 1969

K. Trogoderma inclusum — USDA Lab, Fresno 1968

II. Synthetic strains

A. Tribolium castaneum
   1. Berkeley. Synthetic strain from six different laboratory strains marked with sooty. Prepared in 1958
   2. Berkeley. Synthetic strain from seven laboratory strains not marked with body color genes. Prepared in 1964.

B. Tribolium confusum
   1. Berkeley. Synthetic strain from six wild type laboratory strains not marked with body color genes. Prepared in 1958.

III. Inbred Lines

A. Tribolium castaneum

1. Started 1971 from synthetic strain. Brother-sister matings not marked with sooty.
   a. CSI - 6   25 generations
   b. CSI - 10   34 generations

B. Tribolium confusum

1. Started October, 1958, from the Berkeley synthetic strain. Brother-sister matings, not marked with sooty color genes.
   a. CFI - 1   121 generations
   b. CFI - 3   108 generations
   c. CFI - 5   110 generations
   d. CFI - 11   114 generations

2. Started in 1964 from the Berkeley synthetic strain. Brother-sister matings not marked with body color genes.
   a. CFI - 13   81 generations
   b. CFI - 14   81 generations
   c. CFI - 15   75 generations
   d. CFI - 23   77 generations

IV. Mutants

A. Tribolium castaneum

Chromosome I

1.	paddle (pd)	Park	1955
2.	miniature appendages (ma^D)	Bell	1967
3.	red (r)	Chazy, N.Y.	1959
4.	red (r^D)	Berkeley	1963
5.	pygmy (py)	Chazy, N.Y.	1959
6.	spotted (sp)	Chazy, N.Y.	1959
7.	divergent elytra (dve)	Chazy, N.Y.	1959
8.	platinum eye (pte)	Berkeley	1965
9.	pokey (pok)	Berkeley	1962
10.	red modifier (r^{Mr})	Berkeley	1961
11.	py pd		
12.	py r		
13.	sp r^{Mr}		
14.	py, r		
15.	dve, pd		

Chromosome II

16. pearl (p)
17. pink (p^{pk}) — Park 1955
18. pegleg (pg) — Chazy, N.Y. 1959
19. p pg — Chazy, N.Y. 1959

Chromosome III

20. aureate (au) — Berkeley 1965
21. McGill black (McGb) — Stanley 1964
22. Chicago black (Cb) — Park 1955
23. Synthetic (McGb/Cb) — Chazy, N.Y. 1958
24. black (b^{s-1}) (Brazil background) — Berkeley 1963
25. light ocular diaphragm (lod) (pearl background) — Dewees 1971
26. light ocular diaphragm (lod^{d}) — Berkeley 1964
27. melanotic stink gland (msg) — Purdue 1964
28. tawny (b^{t}) — PIL 1965

Chromosome IV

29. fused antennal segments-2 (fas-2) — Berkeley
30. juvenile urogomphi (ju) — Berkeley 1962
31. reduced juvenile urogomphi (rju) — Berkeley 1963
32. Spatulate (Spa) — Berkeley 1964
33. deformed legs (dfl) — Chazy, N.Y. 1959
34. sternites incomplete (sti) — Berkeley 1963

Chromosome V

35. jet (j) — Park 1955
36. microcephalic (mc) — Chazy, N.Y. 1959
37. fused antennal segments 3a (fas-3a) — Berkeley 1963
38. maroon (m) — Eddleman 1970
39. ruby (rb) — Berkeley 1962
40. split (spl) — Berkeley 1963

Chromosome VI

41. Microphthalmic (Mo) — Chazy, N.Y. 1959

Chromosome VII

42.	short antenna (sa) = (ca)		1961
43.	chestnut (c) (ex-Eddleman)	Berkeley	1962
44.	blistered elytra (ble)	Berkeley	1962
45.	ble c		

Chromosome VIII

46.	antennapedia (ap^D)	Berkeley	1962
47.	elbowed antennae	Berkeley	1964
48.	squint (sq)	Chazy, N.Y.	1959
49.	bumpy (by)	Bell	1966

Chromosome IX

50.	missing abdominal sternites (mas)	Berkeley	1964
51.	prothoraxless (ptl)	Chazy, N.Y.	1959
52.	partially pointed abdominal sternites (ppas)	Berkeley	1963

Chromosome X

53.	abbreviated appendages (aa)	Cold Spring Harbor, N.Y.	1961
54.	Reindeer (Rd)	Dawson	1976

Unassigned

55.	akimbo (akb)	Berkeley	1964
56.	ballooned (bal)	Berkeley	1963
57.	banjo (bj)	Chazy, N.Y.	1960
58.	confusum-like (cf-1)	Sokoloff	1976
59.	Dachs (Dch)	Sokoloff	1976
60.	fused antennal segments-1 (fas-1)	Chazy, N.Y.	1959

61.	knobby prothorax (knp)	Berkeley	1966
62.	maxillopedia (max)	Berkeley	1965
63.	Nonpunctate prothorax (Npp)	Berkeley	1965
64.	nude eggs	Dawson	1975
65.	reduced gin traps (rgt)	Berkeley	1965
66.	tiny (ti) (=ty)	Berkeley	1962
67.	weird eggs	Dawson	1975

Multichromosomal

NOTE: The Roman numerals indicate the linkage groups involved. The symbol ? means the linkage group for that gene has not been established.

68.	p, pd	II,I
69.	p,pd, b	II,I,III
70.	p,sp	II,I
71.	p, py	II,I
72.	p,py, i	II,I,II
73.	p,py,pg	II,I,II
74.	p,au,lod	II,III,III
75.	p,au, mc	II,III,V
76.	p,b	II,III
77.	p,b,Mo	II,III,VI
78.	p,b, Fta	II,III,VII
79.	p,b,pe	II,III,?
80.	p,b,Mo,Be	II,III,VI,IV

81.	p,lod	II,III
82.	p,mc	II,V
83.	p,mc,sq	II,V,VIII
84.	p,mc,s	II,V,IV
85.	p,s	II,IV
86.	p, Npp	II,?
87.	p, Npp,j	II,?,V
88.	p,apt,Mo	II,?,VI
89.	p,mas	II,IX
90.	p,knp	II,?
91.	p,aa,ov	II,?,VIII
92.	p,j,fas-1	II,V,?
93.	p,ring	II,I
94.	p, Fta	II,VII
95.	pd,py,sp	I,I,I
96.	pd,dve	I,I
97.	pd,Mo	I,VI
98.	pd,py	I,I
99.	pd,r	I,I
100.	pd,py,r,s	I,I,I, IV
101.	pd,py,pte	I,I,I
102.	pd,b	I,III
103.	py,r,ser	I,I,I

104.	py,lod,r	I,III,I
105.	py,lod,i	I,III,II
106.	py,pd,r,s	I,I,I,IV
107.	py,b,r	I,III,I
104.	py,pd,pte	I,I,I
109.	py,s,sp	I,IV,I
110.	py,b	I,III
111.	py,r	I,I
112.	py,lod	I,III
113.	b,py	III,I
114.	b,p	III,II
115.	b,fas-4,mc	III,?,V

116.	b,ap,b	II,?,II
117.	b,Npp	II,?
118.	b,Npp,ptl	III,?,IX
119.	b,Npp,p	III,?,II
120.	b,ptl	III,IX
121.	b,ppas	III,IX
122.	j,sq	V,VIII
123.	j,Mo	V,VI
124.	j^{as},j^{hp},p	V,V,II
125.	s,ims	IV,IV
126.	s,h,ptl	IV,IV,IX
127.	s,mc	IV,V
128.	s,p,mc	IV,II,V
129.	s,Mo	IV,VI
130.	s,ap	IV,VIII
131.	s,elb	IV,VIII
132.	s,cas	IV,(?II)
133.	s,r	IV,I
134.	s,fas-2,rju	IV,IV,IV
135.	s,sp	IV,I
136.	s,sp,py	IV,I,I
137.	Npp,c	?,VII
138.	Npp,Fta	?,VII
139.	Npp,au	?,III
140.	au,lod	III,III
141.	au,mc	III,V
142.	Mo,lod,i	VI,III,II
143.	Mo,mas	VI,IX
144.	Mo,r	VI,I
145.	Mo,Df	VI,?
146.	ppas,i	IX,II
147.	c,mas	VII,IX
148.	Chr,ap	III, VII
149.	c,ble	VII,VII
150.	c,ju,ap	VII,IV,VIII
151.	Be,Rd,Chr	IV,X,III
152.	Chr,Rd	III,X
153.	Be,Rd	IV,X

B. Tribolium confusum

Chromosome I

1. eyespot (es)	McDonald	1961
2. red eye (r)	Berkeley	1962
3 alateprothorax (apt)		

Chromosome II

4. pearl (p)		
5. pearl	Slough	
6. ebony-2 (e^2)	PIL via Stanley	1960
7. creased abdominal sternites (cas)	Berkeley	1963
8. dirty pearl eye (dpe) (=fro)	Berkeley	1963
9. p,cas		

Chromosome III

10. Yugoslavian black (=b^Z)	Yugoslavia	1969
11. McGill black (McGb)(=b^{Mo})	Stanley	1960
12. black-2		
13. melanotic stink glands (msg)	Berkeley	1962
14. ruby spot (rus)	Chazy, N.Y.	1960
15. rus msg		
16. b rus		
17. McGillb/Chib		

Chromosome IV

18. thumbed (thu)	Berkeley	1963

Chromosome V

19. ebony (e)	Park via Stanley	1960
20. ebony ($e^{L\&H}$)	Berkeley	1959
21. blistered elytra (ble)	Chazy, N.Y.	1960
22. e,ble		

Chromosome VI

23. disjoined (dj)	Berkeley	1963

Unassigned (but possibly in III)

24. light ocular diaphragm (lod)(pearl)	Berkeley	1961

Mitochromosomal

25. p,dfl,msg
26. p,msg
27. p,lod,msg
28. p,lod,msg fas-2
29. p,lod,fas-2
30. p,lod,b
31. p,b
32. p,dt
33. p,e-2,cas
34. p,McGillb
35. p,b,cas
36. p,spl
37. es,msg,fas

38. eb,sti
39. es,e
40. es,dt
41. msg,r,dim
42. msg,r
43. msg,fas
44. b,ssm,spl
45. McGillb,fas
46. b,sh berkeley
47. b,rus
48. b,twa
49. b,spl
50. twa,spl,sh
51. twa,r
52. spl,ov-like
53. rus,ble
54. ele,fas-2
55. dj,e
56. r,sh

Unassigned

57.	bent femur (btf)	Berkeley	1964
58.	brown body		
59.	claret		
60.	creased abdominal sternites (cas-1)		1963
61.	deformed legs (dfl)	Berkeley	1965
62.	elongated elytra (ele)	Berkeley	1963
63.	Extra large	Vardell	1976
64.	fused antennal segments-1 (fas-1)	Berkeley	1962
65.	fused antennal segments-2 (fas-2)	Berkeley	1963
66.	overshot-like (ov-like)		
67.	rosy		
68.	ruby (rby)	Berkeley	1962
69.	short elytra (sh)	Berkeley	1961
70.	Short elytra (Sh)	Berkeley	1976
71.	twisted abdomen (twa)	Berkeley	1965
72.	umbilicus (umb) (=dent)	Berkeley	1962

C. Tribolium anaphe
none

D. Tribolium audax
none

E. Tribolium brevicornis
1. black (b)
2. maroon body color

F. Tribolium destructor

G. Tribolium madens

1.	fused antennal segments-1 (fas-1)	Berkeley	1964
2,	split (spl)	Berkeley	1964
3.	bent tibia (btt)	Berkeley	1964

Stock Lists

B. Coleoptera

1.	Anthrenus flavipes LeConte	Savannah, Ga.; and Durham, N.H.
2.	Attagenus megatoma (Fab.)	CSMA strains
3.	Callosobruchus maculatus (Fab.)	Fresno, California
4.	Cathartus quadricollis (Guérin-Méneville)	Unknown
5.	Cryptolestes pusillus (Schönherr)	Tifton, Ga.
6.	Dermestes maculatus De Geer	Madison, Wisconsin
7.	Gibbium psylloides (Czenpinski)	Unknown
8.	Lasioderma serricorne (Fab.)	Unknown
9.	Oryzaephilus mercator (Fauvel)	Unknown
10.	Oryzaephilus surinamensis (L.)	Manhattan, Kansas
11.	Rhyzopertha dominica (Fab.)	Unknown
12.	Stegobium paniceum (Linnaeus)	Madison, Wisconsin
13.	Sitophilus granarius (L.)	Manhattan, Kansas
14.	Sitophilus oryzae (L.)	Arkansas; California; Kansas; Louisiana; Minnesota; and Texas
15.	Sitophilus zeamaize Motschulsky	Estill, S.C.
16.	Stegobium paniceum (L.)	Madison, Wisconsin
17.	Tenebrio molitor (L.)	Manhattan, Kansas; and Durham, New Hampshire
18.	Tenebroides mauritanicus (L.)	Savannah, Ga.
19.	Tribolium castaneum (Herbst)	Unknown
20.	Tribolium confusum Jacquelin duVal	Manhattan, Kansas
21.	Tribolium madens Charpentier	Tifton, Ga.
22.	Trogoderma glabrum (Herbst)	Madison, Wisconsin; Riverside, Calif.
23.	Trogoderma inclusum LeConte	Madison, Wisconsin; Riverside, Calif.
24.	Trogoderma variabile Ballion	Fresno, Calif; Riverside, Calif.

II. Mutant strains

A. Plodia interpunctella

1.	Scaleless (scl)	Savannah, Ga.
2.	Melanic (m)	Savannah, Ga.

B. Tribolium castaneum

1.	Black mutant	Ocilla, Ga.
2.	Black mutant	Savannah, Ga.

Stock Lists

C. *Tribolium confusum*

1. Fused antennal segments	Savannah, Ga.
2. Short elytra	Savannah, Ga.
3. Crumpled elytra	Savannah, Ga.
4. Blade elytra	Savannah, Ga.
5. Umbilicus	Savannah, Ga.
6. Red eye pupae	Savannah, Ga.

D. New mutants

1. *T. confusum*, peg-leg (pl) - an autosomal recessive with appendages extremely reduced in length. Savannah, Ga.
2. *T. confusum*, separated elytra (sep) - elytra divergent from proximal end. Savannah, Ga.
3. *T. confusum*, creased elytra (cr) - elytra creased and distal portion divergent. Savannah, Ga.

R. Davis

SOUTH LANCASTER, MASSACHUSETTS
ATLANTIC UNION COLLEGE, BIOLOGY DEPARTMENT

Tribolium castaneum

I. Wild type strains
1. Brazil (C-1)
2. Chicago
3. McGill
4. Sacramento
5. Texas
6. Veracruz, Mexico
7. Virginia

II. Mutant strains
1. red (r^D)
2. red (r)
3. red (r^{Ho})
4. red modifier (M^r)
5. McGill black (McGb)
6. Chicago black (Cb)
7. black (B^S-1), Brazil black
8. sooty (s)
9. jet (j)
10. chestnut (c^S)

(Ed.)

Stock Lists

SOUTH ORANGE, NEW JERSEY
SETON HALL UNIVERSITY, DEPARTMENT OF BIOLOGY

I. Wild type strains

A. Laboratory strains

1. *Tribolium castaneum* - McGill — Montreal, Canada via University of California

2. *Tribolium castaneum* - Seton Hall — South Orange, New Jersey

3. *Tribolium castaneum* - inbred - 20 generations

4. *Tribolium confusum* — Fordham University

B. Base Populations for quantitative studies (*Tribolium castaneum*)

1. Foundation *b* - marked with black (*b*) body color - obtained via Purdue University, Lafayette, Indiana.

2. Foundation *p* - marked with pearl (*p*) eye color- obtained via Purdue University, Lafayette, Indiana.

II. Mutant strains

A. *Tribolium castaneum*

1.	ca	via University of California
2.	fas-3	via California State College
3.	paddle	via California State College
4.	red^{ho}	via California State College
5.	Short antennae (*Sa*)	Purdue + Foundation, 1960
6.	white	via California State College

Eliot Krause

STATE COLLEGE, MISSISSIPPI
USDA, ARS, BOLL WEEVIL RESEARCH LABORATORY

Anthonomus grandis

A. Wild type strains

1.	A & M	College Station, Texas
2.	Oktibbeha	State College, Miss.
3.	Thurberia	Tucson, Ariz.
4.	Iguala	Iguala, Mexico

B. Mutant strains

1. yellow (y)	A & M strain
2. slate (e)	Acala, Mexico
3. ebony (e)	A & M strain
4. pearl (p)	A & M strain

C. Insecticide resistant

1. Endrin Resistant ca. 20 g/weevil	Auburn University

W. Ivey

(Ed.)

STONY BROOK, NEW YORK
STATE UNIVERSITY OF NEW YORK, DIVISION OF BIOLOGICAL SCIENCES

Tribolium castaneum

I. Wild type

1. UPF Foundation	Purdue University
2. CS-4	University of California

II. Mutants

1. Sooty (s)	
2. paddle (pd)	University of Chicago
3. pearl (p)	University of Chicago
4. McGill black (McGb) University of Chicago Stock	University of California
5. McGill black (McGb) with UPF genetic background obtained by backcrossing to UPF for nine generations.	University of Kansas

Tribolium confusum

I. Wild type

1. Chicago (Sonleitner)	University of Chicago
2. New York	University of Chicago

II. Mutants

1. McGill black (McGb)	University of California
2. ebony (e)	University of Chicago

Robert R. Sokal

Stock Lists

ST. BERNARD, ALABAMA
ST. BERNARD ABBEY

I. Wild Type strains

A. <u>Tribolium castaneum</u>

1. Chicago — via San Bernardino

B. <u>Tribolium confusum</u> — via San Bernardino

1. New York

II. Mutant strains

A. <u>Tribolium castaneum</u>

1. McGill black — via San Bernardino
2. jet — via San Bernardino
3. Sooty — via San Bernardino
4. Chicago black — via San Bernardino

B. <u>Tribolium confusum</u>

1. pearl — via San Bernardino
2. McGill black — via San Bernardino
3. Ebony (Smith) — via San Bernardino

(Ed.)

Stock Lists

ST. PAUL, MINNESOTA 55108
UNIVERSITY OF MINNESOTA, DEPARTMENT OF ENTOMOLOGY, FISHERIES & WILDLIFE

Wild type strains

A. **Coleoptera**

Dermestidae

Attagenus megatoma (F.)	Madison, Wis., 1975 Savannah, Ga., 1974
Dermestes maculatus DeGeer	Zool. Dept. U. Minn., 1975
Trogoderma variabile Ballion	field collected, 1970

Cucujidae

Oryzaphilus surinamensis (L.)	Savannah, Ga., 1975
Cathartus quadricollis (Guerin-Meneville)	Savannah, Ga., 1974

Tenebrionidae

Cynaeus angustus (LeConte)	Winnipeg, 1974
Tribolium confusum duVal[1]	unknown

Bruchidae

Acanthoscelides obtectus (Say)	Winnipeg, 1974

Curculionidae

Sitophilus granarius (L.)[1]	unknown
Sitophilus oryzae (L.)[1]	unknown

B. **Lepidoptera**

Pyralidae

Anagasta kuehniella (Zeller)	Savannah, Ga., 1974
Cadra cautella (Walker)	Manhattan, Kansas, 1975
Plodia interpunctella (Hubner)	Manhattan, Kansas, 1972

Gelechiidae

Sitotroga cerealella (Oliver)	Manhattan, Kansas, 1972

Stock Lists

St. Paul, Minn. Dept. EWF cont't.

Tineidae

Tineola bisselliella (Hummel) Savannah, Ga., 1974

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[1]subcultured in the present laboratory for more than 25 years.

Phillip K. Harein
Ernesto De Las Casas
Florence V. Dunkel
Valerie F. Wright

Stock Lists

ST. PAUL MINNESOTA
UNIVERSITY OF MINNESOTA
DEPARTMENT OF GENETICS & CELL BIOLOGY

Tribolium castaneum

I. Wild type synthetic populations (all have been selected for pupa weight).

1. G-0 — Davis, 1974
2. G-3 — Davis, 1974
3. G-9 — Davis, 1974
4. P — Purdue, 1974

II. Synthetic strains (all marked with sooty)

1. C -- stabilized selected line, 95 generations of selection, originated from crosses of CSI-5 and CSI-10.
2. CSI-5 — Berkeley, 1963
3. CSI-10 — Berkeley, 1963
4. R -- randomly selected for 66 generations, from CSI-5 x CSI-10.
5. Relaxed lines -- selected for pupa weight for 50 generations, then maintained as a population cage with discrete generations for 55 generations.
6. S -- selected for pupa weight for 105 generations, from CSI-5 x CSI-10.
7. T -- selected for pupa weight for 50 generations, then relaxed for 23 generations, then selected for 32 more generations.

(All selection lines include two replicates designated by subscripts 1 and 2 (e.g., S_1 and S_2).

F. D. Enfield

ST. PAUL, MINNESOTA
UNIERSITY OF MINNESOTA, DEPARTMENT OF ANIMAL SCIENCE

A. Inbreds
   1. CSI-10 — University of California, Berkeley
   2. E 1 — Institute of Animal Genetics, Edinburgh
   3. E 2 — Institute of Animal Genetics, Edinburgh

B. Purdue Foundation, p

C. Segregating population selected for pupa weight, synthesized by crossing CSI-10 and E 2 lines.

(Ed.)

Stock Lists

Tribolium confusum

1. Wild type from Oklahoma
2. Mutant, ebony — Dawson, 1967
3. Mutant, McGill black — Dawson, 1967

Sokoloff, 1966

Tribolium brevicornis

1. Wild type — Yang, 1970

TEMPE, ARIZONA
ARIZONA STATE UNIVERSITY, DEPARTMENT OF ZOOLOGY

I. Synthetic strains

A. *Tribolium castaneum*
1. Berkeley, 1964 — via San Bernardino

B. *Tribolium confusum*
1. Berkeley, 1958 — via San Bernardino

II. Mutant strains

A. *Tribolium castaneum*
1. melanotic stink glands (*msg*), Berkeley, 1964 — via San Bernardino

B. *Tribolium confusum*
1. melanotic stink glands (*msg*), Berkeley, 1962 — via San Bernardino

Harry E. Wistrand

TIFTON, GEORGIA
ABRAHAM BALDWIN AGRICULTURAL COLLEGE

Tribolium castaneum

A. Wild type strain
1. Chicago

B. Mutant strains
1. black
2. squint

(All derived from stocks maintained at Berkeley. Ed.)

URBANA, ILLINOIS 61801
UNIVERSITY OF ILLINOIS AT URBANA CHAMPAIGN
DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS

Tribolium castaneum

1. Wild type — (maintained since 1960)

Stock List

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

Coleoptera

Anobiidae
Lasioderma serricorne (F.)
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
Cryptolestes ferrugineus (Steph.)
Poor condition, may be dead
Cryptolestes pusillus (Schon.)
Cryptolestes turcicus (Grouv.)

Curculionidae
Sitophilus granarius (L.)
Sitophilus oryzae (L.)

Dermestidae
Anthrenus flavipes LeC.
Weak culture
Attagenus megatoma (F.)
Trogoderma inclusum LeC.
Trogoderma variabile Ballion

Ostomidae
Lophocateres pusillus (Klug.)
Tenebroides mauretanicus (L.)

Ptinidae
Gibbium psylloides (Czemp.)

Silvanidae
Ahasverus advena (Waltl)
Oryzaephilus mercator (Fauv.)
O. mercator dead
O. surinamensis available

Stock List

DEPARTMENT OF HEALTH EDUCATION AND WELFARE
DIVISION OF MICROBIOLOGY (CONT'D)

Tenebrionidae

Alphitobius diaperinus (Panz.)
Gnathocerus maxillosus (F.)
Palorus ratzeburgi (Wissm.)
Tribolium audax Halstead
Tribolium castaneum (Herbst)
Tribolium confusum Duv.
Tribolium destructor Uytt.
Weak culture, may be diseased

Lepidoptera

Pyralidae

Ephestia elutella (Hubn.)
Plodia interpunctella (Hubn.) A.W. Vazquez

BELGIUM

GEMBLOUX
INSTITUT AGRONOMIQUE DE L'ETAT
ZOOLOGIE GENERALE

Tenebrio molitor L., Gembloux strain, race F, obtained originally from G.S. Fraenkel, University of Illinois, Urbana, and selected over a period of 25 years for rapid development and maximum weight of 120 mg. by Prof. J. Leclercq, Faculté des Sciences Agronomiques de l'Etat, Gembloux, Belgium.

LOUVAIN
F.A. JANSSENS MEMORIAL LABORATORY FOR GENETICS
AGRICULTURAL INSTITUTE OF THE UNIVERSITY

Tenebrio molitor

Wild type Belgium

Tribolium confusum

Two inbred and a wild type Berkeley, 1965

(Ed.)

Stock Lists

BRAZIL

CAMPINAS, SÃO PAULO
INSTITUTE AGRONOMICO, SEÇAO DE ENTOMOLOGIA

Anobiidae

Lasioderma serricorne (F) - Campinas, SP - wild type

Bostrochidae

Rhizopertha dominica (f) - Campinas, SP - wild type

Bruchidae

Acanthoscelides obsoletus (Say) - Campinas, SP - wild type

Curculionidae

Sitophilus oryzae (L.) - Campinas, SP - wild type

Silvanidae (Cucujidae)

Oryzaephilus surinamensis (.L) - Campinas, SP - wild type

Tenebrionidae

Tribolium castaneum (Herbst.) - Campinas, SP - wild type

(Ed.)

PIRACICABA, STATE OF SÃO PAULO
CENTRO DE ENERGIA NUCLEAR NA AGRICULTURA
DEPARTMENT OF RADIOENTOMOLOGY

Insect collections - Wild Strain
All of these insects are under controlled conditions of around 28°C and 75% RH
(when the machine is not broken...)

1- Tribolium confusum 1970
2- Zabrotes subfasciatus 1968
3- Acanthoscelides obtectus 1968

CENTRO DE ENERGIA NUCLEAR NA AGRICULTURA
DEPARTMENT OF RADIOENTOMOLOGY (CONT'D)

4-	Callosobruchus analis (?)	1975
5-	Tenebrio molitor	1970
6-	Araecerus fasciculatus	1968
7-	Laemophloeus ferrugineus	1968
8-	Lasioderma serricorne	1972
9-	Ephestia cautella (?)	1975
10-	Sitotroga cerealella	1971
11-	Sitophilus oryzae	1968
12-	Sitophilus zeamais	1968
13-	Rhyzopertha dominica	1971
14-	Oryzaephilus surinamensis	1968
15-	Periplaneta americana	1972

F.M. Wiendl

CZECHOSLOVAKIA

INSTYTUT OCHRONY ROSLIN
PRACEWNIA BADANIA BIKOSNIKOW FREZEXHSWALNI
POZEN, UL. MICZURINA 20

Sitophilus granarius L.
S. oryzae L.
Rhizopertha dominica F.
Trogoderma granarium Ev.
Tribolium confusum Duv.
T. destructor Uytt.
Tenebrio molitor L.
Oryzaephilus surinamensis L.
O. mecator Fauv.
Carpophilus hemipterus L.
Stegobium paniceum L.
Acanthoscelides obtectus Say
Anagasta kuhniella Zell.
Cadra cautella Wlk.
Plodia interpunctella Hubn.

(Ed.)

Stock Lists

DENMARK

LYNGBY
STATENS SKADEDYRLABORATORIUM
(DANISH PEST INFESTATION LABORATORY)

Alphitobius diaperinus
Anobium punctatum
Anthrenus museorum
Anthrenus vorax
Attagenus alfieri
Attagenus piceus
Dermestes frichii
Hylotrupes bajulus
Lasioderma serricorne
Oryzaephilus mercator
Oryzaephilus surinamensis
Rhizopertha dominica
Sitophilus granarius
Sitophilus oryzae
Stegobium (Sitodrepa) *paniceum*
Tenebrio molitor
Tenebrioides mauritanicus
Thylodrias contractus
Tribolium confusum
Tribolium destructor
Trogoderma granarium

(Ed.)

EASTERN NIGERIA

PORT HARCOURT
THE NIGERIAN STORED PRODUCTS RESEARCH INSTITUTE

I. Wild type strains

1.	*Dermestes maculatus* De Geer	Port Harcourt Strain, 1966
2.	*Oryzaephilus mercator* Fauv.	Port Harcourt Strain, 1966
3.	*Sitophilus zea-mais* Motschulsky	Kano Strain, 1965 (Ex Kano Lab. Stock) November, 1965
4.	*Tribolium castaneum* Hbst.	Kano Strain, 1965 (Ex Kano Lab. Stock) October, 1965

Stock Lists

5. Tribolium confusum DuVal. Kano Strain, 1965
(Ex Kano Lab. Stock) December, 1965
6. Trogoderma granarium Everts Kano Strain, 1965
(Ex Kano Lab. Stock) Novemoer, 1965

(Ed.)

EGYPT

GIZA
PLANT PROTECTION DEPARTMENT, MINISTRY OF AGRICULTURE

I. Wild type strains

1. Bruchus rufimanus Egypt, U.A.R.
2. Corcyra cephalonica Egypt, U.A.R.
3. Ephestia kühniella Egypt, U.A.R.
4. Latheticus oryzae Egypt, U.A.R.
5. Rhizopertha dominica Egypt, U.A.R.
6. Silvanus surinamensis Egypt, U.A.R.
7. Sitophilus granarius Egypt, U.A.R.
8. Sitophilus oryzae Egypt, U.A.R.
9. Tribolium castaneum Egypt, U.A.R.
10. Tribolium confusum Egypt, U.A.R.

(Ed.)

FRANCE

LYON, RHÔNE
LABORATORIRE DE ZOOLOGIE GÉNÉRALE, FACULTÉ DES SCIENCES

Tribolium castaneum

Wild type strain from Alès, France.

(Ed.)

VILLEURBANNE (LYON) RHÔNE
INSTITUT NATIONAL DES SCIENCES APPLIQUÉES, LABORATOIRE DE BIOLOGIE

A. Acanthoscelides obsoletus--wild type France
B. Blabera fusca
C. Clitumnus extradentatus
D. Galleria mellonella Saint Cyr au Mont d'Or
E. Oryzaephilus surinamensis--from imported dried apricots

VILLEURBANNE (LYON) RHÔNE
INSTITUT NATIONAL DES SCIENCES APPLIQUÉES, (CONT'D)

F.	*Periplaneta americana*	
G.	*Psendococcus citri*	Antibes
H.	*Sitophilus granarius*	Infestation Control Laboratory, Surbiton
I.	*Sitophilus oryzae*	P.I.L.,Slough
J.	*Sitophilus saskii* - wild type	Lyon
K.	*Stegobium paniceum*	P.I.L.,Slough
L.	*Tenebrio molitor*	
M.	*Tenebrio obscurus*	P.I.L, Slough
N.	*Tribolium castaneum* - wild type	Ales

(Ed.)

GERMANY

BIOLOGISCHES INSTITUT I
(ZOOLOGIE) DER
ALBERT-LUDWIGS-UNIVERSITAT
7800 FREIBURG IM BREISGAU

1. Stock list

Wild type strains:

1. Oryzaephilus surinamensis	Freiburg
2. Tenebrio molitor	Freiburg, commercial
3. Tribolium castaneum	from San Bernardino (vial not marked as to origin)
4. Tribolium confusum	" " " " "

Mutants:

A. Tribolium castaneum

5. alate prothorax (apt)
6. Bar eye (Be)
7. black (b^{s-1}) (Brazil background)
8. black (b^{s}) (Chicago background)
9. Fused tarsi and antennae (Fta)
10. jet (j)
11. Microphthalmic (Mo)
12. pygmy (py)
13. Short antenna (Sa)
14. sooty (s)

B. Tribolium confusum

15. black-3 (b-3)
16. ebony (e)
17. ebony-2 (e_2)
18. McGill black (McGb)

All from San Bernardino

Prof. Dr. K. Sander

Stock Lists

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

Coleoptera

Bruchidae

Acanthoscelides obtectus (Say)	?	1974

Cucujidae

Cryptolestes turcicus Grouv.	Munich,	1966

Ptinidae

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

Silvanidae

Oryzaephilus mercator (Fauv.)	Munich,	1966
Oryzaephilus surinamensis (L.)	Munich,	1959

Tenebrionidae

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

Lepidoptera

Phyticidae

Ephestia kuehniella (Zell.)	Munich,	1966

E. Naton

INDIA

GORAKHPUR, U.P.
UNIVERSITY OF GORAKHPUR, DEPARTMENT OF ZOOLOGY

Wild type strain

1. Tribolium castaneum from local godowns.

(Ed.)

HISSAR, HARAYANA
PUNJAB AGRICULTURAL UNIVERSITY, DEPARTMENT OF GENETICS

I. Wild type strains (Tribolium castaneum)

1. IZT I		
2. MAD I		
3. PAU I		
4. PAU II		
5. Chicago wild		via Sokoloff, Berkeley
6. Brazil		via Sokoloff, Berkeley
7. Inbred lines in 8th. generation of full sibbing.		

II. Mutant strains (Tribolium castaneum)

S-8	Py	via Sokoloff, Berkeley
S-12	P	via Sokoloff, Berkeley
S-20	Me	via Sokoloff, Berkeley
S-24	Squint	via Sokoloff, Berkeley
S-26	sa	via Sokoloff, Berkeley
S-28	mc	via Sokoloff, Berkeley
S-35	py r	via Sokoloff, Berkeley
S-53	jet	via Sokoloff, Berkeley

Stock Lists

S-71	sa	via Sokoloff, Berkeley
S-74	ju	via Sokoloff, Berkeley
S-81	Be s	via Sokoloff, Berkeley
S-90	py r M^r	via Sokoloff, Berkeley
S-100	b Mo	via Sokoloff, Berkeley
S-154	Be Fta	via Sokoloff, Berkeley
S-248	Fta c ca	via Sokoloff, Berkeley
S-253	lod p	via Sokoloff, Berkeley
S-304	msg	via Sokoloff, Berkeley
S-313	ser py r	via Sokoloff, Berkeley
S-325	Fta	via Sokoloff, Berkeley
S-333	Spa	via Sokoloff, Berkeley
S-341	r	via Sokoloff, Berkeley
S-346	Fas-3	via Sokoloff, Berkeley
S-483	pd	via Sokoloff, Berkeley

(Ed.)

BAHAUDU SHAH TAFAR MARJ, NEW DELHI-1
MAULANA AZAD MEDICAL COLLEGE, DEPARTMENT OF BIOCHEMISTRY

T. castaneum

Wild strain of local origin

(Ed.)

JABALPUR, MADHYA PRADESH
J.N. AGRICULTURAL UNIVERSITY
COLLEGE OF VETERINARY SCIENCE & A.H.
DEPARTMENT OF ANIMAL BREEDING & GENETICS

1. Random Stocks: R-1, R-2, R-3, R-4, R-5, R-6, R-7, R-8, R-9, R-10.
   PAU-1 (HSR-Wild).

2. Inbred Lines: I-1, I-2, I-3, I-4, I-5, I-6, I-7, I-8, I-9, I-10.

   These stocks have been inbred for 19 generations.

3. Mutant stocks: S-1 Chi-wild
   S-8 py
   S-10 p
   S-12 Chi b/b, Chi +/b, Chi +/+
   S-53 jet
   S-100 b Mo
   S-248 Fta c Ca
   S-304 msg
   S-313 ser py r
   S-333 Spa
   S-341 r

(Ed.)

Stock Lists

ISRAEL

TEL AVIV, ISRAEL
TEL AVIV UNIVERSITY, DEPARTMENT OF ZOOLOGY

1. Stock list

Tribolium castaneum

Wild type strains:

CS ++ (Purdue)

Mutant strains

CS bb (Chicago)
eu ++ (extra urogomphi, ++ body color)
eu bb (extra urogomphi, bb body color)
Paddle (Pd) obtained from San Bernardino Stock Center
Pearl (P) " " "
Sooty (S) " " "
Red (r) " " "

Tribolium confusum

mutant strain

CF bb (McGill)

Dr. David Wool

ITALY

PAVIA
UNIVERSITY PAVIA, CENTRO DE GENETICA

1. *Tribolium confusum* Duval, wild strain obtained from Professor A. Kock, Biological Institut, Regensburg.

2. id. id., strain of recent colonization from specimens collected in Pavia; small, difficult colony.

JAPAN

KYOTO
KYOTO UNIVERSITY, ENTOMOLIGICAL LABORATORY

Bruchidae

Callosobruchus chinensis

9 strains come from different localities in Japan. Black colored mutant derived from one of the geographical strains.

Callosobruchus maculatus

12 strains come from different localities in the world.

Louisiana, U.S.A.
Fresno Lab., U.S.D.A., Calif., U.S.A.
Savannah Lab., U.S.D.A., Georgia, U.S.A.
Ohio State Univ., Columbus, Ohio, U.S.A.
Kansas State Univ., Manhattan, Kansas, U.S.A.
Hong Kong
Chieng Mai, Thailand
Burma
Tel Aviv, Israel

Zabrotes subfasciatus

Curculionidae

Sitophilus zeamais

Sitophilus oryzae

Tenebrionidae

Tribolium confusum

Tribolium castaneum

S. Utida

Stock Lists

OKAYAMA
OKAYAMA UNIVERSITY, FACULTY OF AGRICULTURE
LABORATORY OF APPLIED ENTOMOLOGY

I. Wild type strains

1. *Oryzaephilus surinamensis* from Miyazaki, Japan
2. *Oryzaephilus mercator* from Miyazaki, Japan
3. *Cryptolestes pusillus* from Miyazaki, Japan
4. *Lasioderma serricorne* from Miyazaki, Japan
5. *Stegobium paniceum* from Miyazaki, Japan
6. *Alphitobius diaperinus* from Miyazaki, Japan
7. *Gnathocerus cornutus* from Miyazaki, Japan
8. *Latheticus oryzae* from Miyazaki, Japan
9. *Palorus subdepressus* from Miyazaki, Japan
10. *Palorus ratzeburgii* from Miyazaki, Japan
11. *Tribolium confusum* from Miyazaki, Japan
12. *Tribolium castaneum* from Miyazaki, Japan
13. *Callosobruchus chinensis* 10 strains from different districts in Japan
14. Rhyzopertha dominica from Miyazaki, Japan
15. Sitophilus zeamais from Okayama, Japan
16. Sitophilus oryzae from Okayama, Japan

T. Yoshida

MEXICO

CHAPINGO
CAMPO EXPERIMENTAL "EL HORNO"

Tribolium castaneum
Tribolium confusum

Both cultures have long been maintained in our rearing chambers. Their source is unknown.

(Ed.)

THE NETHERLANDS

AMSTERDAM
ROYAL TRIPICAL INSTITUTE
DEPARTMENT OF AGRICULTURAL RESEARCH

Cryptolestes ferrugineus	P.I.L.
Cryptolestes pusilloides	P.I.L.
Cryptolestes capensis	P.I.L.
Latheticus oryzae	unknown
Gnathocerus maxillosus	Malawi, 1971
Gnathocerus cornutus	Malawi, 1971
Carpophilus dimidiatus	Malawi, 1971
Caryedon serratus	Senegal, 1970
Callosobruchus maculatus	unknown
Tribolium castaneum - Lindane resistant	
Tribolium castaneum - Lindane resistant + non-specific malathion resistance	Malawi, 1970

Stock Lists

<u>Tribolium castaneum</u> (susceptible)	Malawi, 1971
<u>Tribolium confusum</u> (susceptible)	Malawi, 1971
<u>Sitophilus oryzae</u> (susceptible)	Malawi, 1971
<u>Sitophilus zeamais</u> I Lindane resistant	Malawi, 1971
<u>Sitophilus zeamais</u> II Lindane resistant	Malawi, 1971
<u>Oryzaephilus surinamensis</u> (small strain)	Thailand, 1972
<u>Oryzaephilus surinamensis</u>	unknown
<u>Oryzaephilus mercator</u> (small strain)	Thailand, 1970
<u>Oryzaephilus mercator</u>	Germany
<u>Trogoderma granarium</u>	Sudan, 1970
<u>Necrobia rufipes</u>	Ivory Coast, 1970
<u>Sitotroga cerealella</u>	unknown
<u>Plodia interpunctella</u>	China
<u>Corcyra cephalonica</u>	Ivory Coast
<u>Ephestia cautella</u>	Nigeria

(Ed.)

WAGENINGEN (THE NETHERLANDS)
LANDBOUWHOGESCHOOL
DEPARTMENT OF GENETICS

<u>Tribolium castaneum</u>

I. Wild type strains
  1. McGill wild type — Trib. Stock Center, San Bernardino
  2. Wageningen Foundation — Plant Protection Service, Netherlands

II. Mutant strain
  1. Chicago black — Trib. Stock Center, San Bernardino

Remark: The Wageningen Foundation stock, which is used as a pesticide tester, has, as I have been informed, been derived from several natural populations from all over the world (probably mostly from South East Asia). A black body colour mutant occuring in it is presently under investigation.

P. Stam

Stock Lists

PORTUGAL

LISBON
LABORATORIO DA DEFESA FITOSSANITARIA DOS PRODUTOS ARMAZENADOS
MINISTERIO DA ECONOMIA

The laboratory maintains the following cultures in the breeding room at 25° - 27° C and 65 - 70% R. H. The origin of the culture, the year of commencement and the culture media are given for each insect species.

Acanthoscelides obtectus (Say)--white bean	Coimbra, 1968
Anagasta kuhniella (Zell.)--bran and glycerine	Carcavelos, 1968
Cadra cautella (Walk.)--decorticated almonds	Algarve, Portugal, 1969
Callosobruchus maculatus (F.)--California black eye	Alcobaca, 1968
Gnathocerus cornutus (F.)--whole-meal flour and yeast	Portugal, 1969
Lasioderma serricorne (F.)--bran and dried yeast	Lisboa, 1964
Oryzaephilus surinamensis (L.)--broken wheat	Portugal, 1960
Plodia interpunctella (Hübn.)--bran and glycerine	Carcavelos, 1968
Rhyzopertha dominica (F.)--wheat	S. Tomé, W. Africa, 1969
Sitophilus granarius (L.)--wheat	Portugal, 1969
Sitophilus oryzae	Portugal, 1969
Sitotroga cerealella (Oliv.)--barley	Portugal, 1968
Tenebroides mauritanicus (L.)--broken maize, bran and dried yeast	Portugal, 1967
Tribolium castaneum (Herbst)--flour	Bissau (Guiné), 1957
Zabrotes subfasciatus--white bean	Lisboa, 1968

(Ed.)

SPAIN

MADRID
INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS
LABORATORIO DE GENETICA DE POBLACIONES

Tribolium castaneum

A. Wild type strains

1.	Consejo	CSIC, 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

Stock Lists

B. Mutant type strains

6. 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
7.	AN - I	high performance	at	33° C
8.	AN - II	high performance	at	33° C
9.	AF - I	high performance	at	28° C
10.	AF - II	high performance	at	28° C
11.	AT - I	high performance	at	38° C
12.	AT - II	high performance	at	38° C
13.	BN - I	low performance	at	33° C
14.	BN - II	low performance	at	33° C
15.	BF - I	low performance	at	28° C
16.	BF - II	low performance	at	28 C
17.	BT - I	low performance	at	38° C
18.	BT - II	low performance	at	38° C
19.	RN - I*	high cross performance	at	33° C
20.	SN - I*	high cross performance	at	33° C
21.	RN - II	high cross performance	at	33° C
22.	SN - II	high cross performance	at	33° C
23.	RF - I	high cross performance	at	28° C
24.	SF - I	high cross performance	at	28° C
25.	RF - II	high cross performance	at	28° C
26.	SF - II	high cross performance	at	28° C
27.	RT - I	high cross performance	at	38° C
28.	ST - I	high cross performance	at	38° C
29.	RT - II	high cross performance	at	38° C
	ST - II	high cross performance	at	38° C

* R & S corresponding lines were selected through a reciprocal recurrent selection.

31 - 38 Inbred lines with 26 generations of full sibbing.

39.	ATD-I	High	performance	at	different	levels	of	selct.
40.	ATD-LL	"	"	"	"	"	"	"
41.	BTD-I	"	"	"	"	"	"	"
42.	BTD-II	"	"	"	"	"	"	"
43.	CTD-I	"	"	"	"	"	"	"
44.	CTD-II	"	"	"	"	"	"	"
45.	DTD-I	"	"	"	"	"	"	"
46.	DTD-II	"	"	"	"	"	"	"
47.	ETD-I	"	"	"	"	"	"	"
48.	ETD-II	"	"	"	"	"	"	"
49.	FTD.I	"	"	"	"	"	"	"
50.	FTD=II	"	"	"	"	"	"	"

Stock Lists

D. Mutants

		Source and date
51.	antennapedia ap, VIII	Purdue, 1964
52.	Bar eye Be, IV	Purdue, 1968
53.	Black b, III	Sokoloff, 1964
54.	chestnut c, VII	Purdue, 1964
55.	cordoban cd, III	Purdue, 1964
56.	Diferencial Df, IV	Purdue, 1964
57.	fussed antennal segm. -2 fas-2, IV	Sokoloff, 1968
58.	ivory i, ?	Purdue, 1964
59.	jet j, V	Purdue, 1964
60.	juvenile urogomphy ju, IV	Purdue, 1964
61.	light ocular diaph. lod, III	Purdue, 1964
62.	maroon m, V	Purdue, 1964
63.	microcephalic mc, V	Purdue, 1964
64.	paddle pd, I	Purdue, 1964
65.	pearl p, II	Sokoloff, 1968
66.	pegleg pg, II	Purdue, 1968
67.	pink p^{pk}, II	Purdue, 1968
68.	pygmy py, I	Purdue, 1968
69.	red r, I	Purdue, 1968
70.	ring rg, I	Purdue, 1964
71.	rose, rs, I	Purdue, 1964
72.	ruby rb, ?	Purdue, 1964
73.	Short antenna Sa, VII	Purdue 1. 1964
74.	short elytra se, VIII	Purdue, 1964
75.	sooty s, IV	Purdue, 1964
76.	spotted so, I	Purdue, 1964
77.	squint sq, VIII	Purdue, 1964
78.	white w, ?	Purdue, 1964
79.	wine r^{w}, I	Purdue, 1968
80.	eye mutant ?	Madrid, 1967
81.	elytra mutant ?	Madrid 1967
82.	melanotic stink gland-like ?	Madrid, 1968

Tribolium confusum

A. Wild type strains

83.	Campanario	Campanario, Spain, 1973
84.	Santa Maria	Santa Maria, Spain, 1973
85.	Mandayona	Mandayona, Spain, 1973

B. Mutant type strains

86.	black b, III	Sokoloff, 1968
87.	creased abdominal sternites cas, II	Sokoloff, 1968
88.	ebony-2 e_{-2}, II	Sokoloff, 1968

(Ed.)

UNITED KINGDOM

AUSTRALIA

BRISBANE, QUEENSLAND
DEPARTMENT OF PRIMARY INDUSTRIES, ENTOMOLOGY LABORATORY

COLEOPTERA

A. Tribolium castaneum
   1. Wild type strains
   2. Black mutant (reoccurrence of b)
   3. Lindane resistant

B. Sitophilus oryzae
   1. Wild type strains
   2. DDT resistant (single semi-dominant sex-linked factor)
   3. Lindane and dieldrin resistant (single and multi-factor strains.)
   4. Black strain

C. Sitophilus zeamais--wild type

D. Sitophilus granarius--wild type

E. Oryzaephilus surinamensis
   1. Wild type strains
   2. Lindane resistant strains (impure)

F. Lasioderma serricorne--wild type

G. Rhizopertha dominica--wild type

H. Mezium americanum--wild type

LEPIDOPTERA

A. Cadra cautella--wild type

B. Phthorimaea operculella
   1. DDT-endrin resistant
   2. Red-eyed mutant (single autosomal recessive)

HYMENOPTERA

A. Microchelomus sp.--wild type

(Ed.)

Stock Lists

EDMONTON, ALBERTA
UNIVERSITY OF ALBERTA, DEPARTMENT OF ANIMAL SCIENCE

A.	Brazil	Purdue, 1965
B.	Capetown	Purdue, 1965
C.	Chicago	Chicago, 1965
D.	Consejo	Madrid, 1965
E.	Japan	Kyoto and Purdue, 1965
F.	Kano	Scotland, 1965
G.	Kenya	Scotland, 1965
H.	Kingston	Scotland, 1965
I.	Lisbon	Portugal, 1965
J.	Purdue Foundation +	Manitoba, 1963
K.	Scotland	Edinburgh, 1965
L.	Seychelles	Scotland, 1965
M.	Surrey	England, 1965
N.	Veracruz	Berkeley, 1965

(Ed.)

CANADA

BURNLEY, VICTORIA
VICTORIAN PLANT RESEARCH INSTITUTE, DEPARTMENT OF AGRICULTURE

COLEOPTERA

A. *Tribolium castaneum*
   1. Wild type strains
   2. Malathion specific resistant strain
   3. Malathion non-specific resistant strain

B. *Tribolium confusum*

1. Wild type strains
2. Malathion specific strain

C. *Oryzaephilus surinamensis*

1. Wild type strain
2. Malathion resistant strain

D. *Gnathocerus cornutus* wild type strain

E. *Cryptolestes ferrugineus* wild type strain

F. *Sitophilus oryzae* wild type strain

G. *Sitophilus zeamais* wild type strain

H. *Sitophilus granarius* wild type strain

I. *Rhyzopertha dominica* wild type strain

LEPIDOPTERA

A. *Plodia interpunctella* wild type strain

B. *Ephestia figulilella* wild type strain

(2.)

GUELPH, ONTARIO
UNIVERSITY OF GUELPH
DEPARTMENT OF ANIMAL & POULTRY SCIENCE

Tribolium castaneum

Wild type - mass mated stock derived from Purdue University Foundation Stock

Mutants:

Chromosome I

platinum eye
pygmy
red
pygmy red
spotted red

All from Tribolium Stock Centre -- San Bernardino

Chromosome II

pearl

A. *Sitophilus granarius* (L)

A. *Sitophilus granarius* (L) -- continued
   1. GG strain, dark, heavy and symbiotic
   2. MW strain, paler, lighter and aposymbiotic
   3. Two new strains as yet unclassified

B. *Sitophilus oryzae* (L.) -- small rice weevil

C. *Sitophilus zea-mais* (Mots.) -- large rice weevil

(Ed.)

MONTREAL, P.Q.
MCGILL UNIVERSITY, DEPARTMENT OF BIOLOGY

Tribolium castaneum

1. Berkeley CSI-3F — Sokoloff, 1970
2. Berkeley CS-synthetic, *sooty* — Sokoloff, 1970
3. Berkeley CS-synthetic, *pygmy* — Sokoloff, 1970
4. McGill *black* — Sokoloff, 1970
5. Chicago *black* — Sokoloff, 1970
6. Purdue Foundation — Scheinberg, 1967

(Ed.)

OTTAWA, ONTARIO
ANIMAL GENETICS SECTION, ANIMAL RESEARCH INSTITUTE
CENTRAL EXPERIMENTAL FARM

Tribolium castaneum

Purdue Foundation

RSILW - A population selected for high larval weight for 10 generations restricting developmental time and pupal weight (Derived from Purdue Foundation).

RSIDT - A population selected for short developmental time for 10 generations restricting larval weight and pupal weight (Derived from Purdue Foundation).

RSIPW - A population selected for short developmental time for 10 generations restricting larval weight and deve opmental time (Derived from Purdue Foundation).

Tribolium castaneum (Continued)

Purdue Foundation

TSLW - A population selected for high larval weight for 10 generations (Derived from Purdue Foundation).

TSDT - A population selected for short developmental time for 10 generations (Derived from Purdue Foundation).

TSPW - A population selected for high pupal weight for 10 generations (Derived from Purdue Foundation).

(Ed.)

QUEBEC, P.Q.
UNIVERSITE LAVAL, DEPARTMENT OF BIOCHEMISTRY

Tribolium confusum Duval

Strain: Laval

Origin: Quebec City

A. Lemonde

Stock Lists

QUEBEC, P.Q.
UNIVERSITE LAVAL, DEPARTMENT OF BIOLOGY

Tribolium confusum Duval

Strain: Laval
Origin: Quebec City

L. Huot

VANCOUVER, B. C.
UNIVERSITY OF BRITISH COLUMBIA, DEPARTMENT OF POULTRY SCIENCE

I. Wild type strains

A. *Tribolium confusum* inbred lines

1. CFI-2a — Berkeley, 1965
2. CFI-3 — Berkeley, 1965
3. CFI-5 — Berkeley, 1965
4. CFI-7 — Berkeley, 1965
5. CFI-8b — Berkeley, 1965

II. Mutant strains

A. *Tribolium confusum*

1. eyespot (*es*); chromosome I — Berkeley, 1965
2. red (*r*); chromosome I — Berkeley, 1965
3. dirty pearl eye (*dpe*); chromosome IV — Berkeley, 1965
4. ebony-2 (e_2); chromosome II — Berkeley, 1965
5. pearl riboflavinless (*pr*); chromosome II — Berkeley, 1965
6. pearl slough (*p*); chromosome II — Berkeley, 1965
7. ruby spot (*rus*); chromosome III — Berkeley, 1965
8. light ocular diaphragm (*lod*); chromosome III — Berkeley, 1965
9. *p*; *dre*; *cas*; multichromosomal — Berkeley, 1965
10. *r s*; *b*; multichromosomal — Berkeley, 1965
11. *St*; *b*; multichromosomal — Berkeley, 1965

Stock Lists

B. Tribolium castaneum

1.	red (r); chromosome I	Berkeley, 1965
2.	pearl (p); chromosome I	Purdue, 1967
3.	pearl riboflavinless (p^r) (formerly "ivory")	Berkeley, 1965
4.	pink (p^{pk}); chromosome II	
5.	light ocular diaphragm (p background); chromosome III	Berkeley, 1965
6.	jet H.L.E.; chromosome V	Berkeley, 1867
7.	Chestnut (c); chromosome VII	Berkeley, 1965
8.	s; r^D; multichromosomal	Berkeley, 1965

(Ed.)

VANCOUVER, B.C.
UNIVERSITY OF BRITISH COLUMBIA, POULTRY SCIENCE GENETICS LABORATORY

Tribolium confusum

Wild type
1. U.B.C. wild type - Vancouver, B.C.

Mutants
1. Riboflavinless, pearl-eye (p^r)

C.W. Roberts

WINNIPEG, MANITOBA
CANADA DEPARTMENT OF AGRICULTURE, RESEARCH STATION

I. Wild type strains

A. Coleoptera

1.	Acanthoscelides obtectus (Say) Bruchidae	Winnipeg
2.	Alphitobius diaperinus Panzer Tenebrionidae	Saskatchewan
3.	Cryptolestes ferrugineus (Steph.) Cucujidae	Manitoba
4.	Cryptolestes ferrugineus (Steph.) Cucujidae	P.I.L. United Kingdom
5.	Cryptolestes ferrugineus (Steph.) Cucujidae	Australia
6.	Cryptolestes turcicus (Grouv.) Cucujidae	Ontario
7.	Cryptolestes turcicus (Grouv.) Cucujidae	P.I.L. United Kingdom
8.	Cynaeus angustus Leconte Tenebrionidae	Manitoba
9.	Oryzaephilus mercator (Fauvel) Silvanidae	Ontario
10.	Oryzaephilus surinamensis (L.) Silvanidae	Manitoba
11.	Palorus subdepressus Wollaston Tenebrionidae	Manitoba
12.	Rhyzopertha dominica (Fab.) Bostrichidae	Australia

13. *Sitophilus granarius* (L.) Curculionidae — Manitoba
14. *Sitophilus oryzae* (L.) Curculionidae — Montreal
15. *Sitophilus zea-mais* Motschulsky Curculionidae — Japan
16. *Stegobium paniceum* (L.) Anobiidae — Winnipeg
17. *Tenebroides mauritanicus* (L.) Ostomidae — Manitoba
18. *Tenebrio molitor* L. Tenebrionidae — Manitoba
19. *Tribolium castaneum* (Herbst) Tenebrionidae — Manitoba
20. *Tribolium destructor* Uytten. Tenebrionidae — Winnipeg
21. *Tribolium confusum* (Du Val) Tenebrionidae — Ontario
22. *Trogoderma variabile* Ballion Dermestidae — Alberta

B. Lepidoptera

3. *Plodia interpunctella* (Hbn.) Phycitidae — Winnipeg

II. Mutants

A. Coleoptera

1. *Tribolium confusum* Du val — Winnipeg, Manitoba, 1963
ebony ($_e$ Smith and Loschiavo)

L.B. Smith

UNITED KINGDOM

GREAT BRITAIN

BIRMINGHAM, ENGLAND
THE UNIVERSITYOOF BIRMINGHAM
DEPARTMENT OF ZOOLOGY AND COMPARATIVE PHYSIOLOGY

Tenebrio molitor
Tenebrio obscurus
Blaps sp.
Tribolium sp.

Stock Lists

SCOTLAND, U.K.
UNIVERSITY OF DUNDEE
DEPARTMENT OF BIOLOGICAL SCIENCES

		Origin
1.	*Tribolium castaneum*	Libya
2.	*Latheticus oryzae*	Australia
3.	*Latheticus oryzae*	Ghana
4.	*Gnathocerus cornutus*	Egypt
5.	*Cathartus quadricollis*	Ghana

All above stocks have been kept in this laboratory at 27.5°C for three years.

F.L. Waterhouse

EDINBURGH
UNIVERSITY OF EDINBURGH
INSTITUTE OF ANIMAL GENETICS

Tribolium castaneum

A. Wild type strain

1. Chicago wild type

B. Mutant strains

1. Microphthalmic (*Mo*)
2. microcephalic, pearl (*mc*. *p*)
3. Bar eye, sooty (*Be* *s*/*+s*)
4. squint (*sq*)

Stocks obtained from Berkeley, California.

(Ed.)

Stock Lists

EDINBURGH UNIVERSITY
DEPARTMENT OF AGRICULTURE AND FISHERIES FOR SCOTLAND
AGRICULTURAL SCIENTIFIC SERVICES, EAST CRAIGS

Tribolium castaneum Herbst.

Wild type strain of unknown origin, collected from imported feedstuffs.

Tribolium confusum J. duV.

Wild type strain of unknown origin, collected from imported feedstuffs.

(Ed.)

GLASGOW, SCOTLAND
UNIVERSITY OF GLASGOW
DEPARTMENT OF ZOOLOGY

Wild type Strains:

Wild strain of T. castaneum from the Infestation Department Ministry of Agriculture & Fisheries, Glasgow

T. castaneum
ppas partially pointed abdominal sternites

(Ed.)

LONDON
QUEEN ELIZABETH COLLEGE, DEPARTMENT OF BIOLOGY

Bruchus pectinicornis
Latheticus oryzae
Sitophilus granarius
Tenebrio molitor
Tribolium anaphe
Tribolium castaneum
Tribolium madens
Trogoderma

All insects are derived from the Pest Infestation Laboratory, Slough, Bucks.

(ed.)

Stock Lists

NEWCASTLE UPON TYNE.
THE UNIVERSITY OF NEWCASTLE UPON TYNE, SCHOOL OF AGRICULTURE

Tribolium castaneum

A. Wild type

1. pearl (p)
2. black (b), tawny (b^t)
3. antennapedia (ap)
4. paddle (pd)
5. red (r)

Tribolium confusum

A. Wild type
1. ebony (e^2)
2. pearl (p)

All stocks derived from cultures at the Insectary of the Pest Infestation Control Laboratory, Slough, Bucks.

(ed.)

SLOUGH, BUCK S.
MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
THE INSECTARY OF THE PEST INFESTATION CONTROL LABORATORY

The object of this insectary is to provide constant supplies of storage insects and for this purpose the species listed are bred in controlled conditions. On request insects are sent, without charge to educational bodies if commercial firms are unable to supply them. The insects are maintained in constant temperature rooms at a relative humidity of 70%, except in the case of cockroaches where the relative humidity is 50%. As far as possible insects are bred free from disease. All new stocks pass through quarantine precautions before acceptance into the insectary.

Incorporated into the list is the name of the country from which the stock bred in this laboratory originated. However, it is only recently that records of this information have been kept, and since many species have been maintained in culture for over twenty years they are of unknown origin. Some species, such as Attagenus fasciatus, were sent to us from entomologists working abroad; but other species, such as Ephestia cautella, were obtained from infested produce brought to this country, so that there is only circumstantial evidence that produce and pests originated in the same country. In the latter case the name of the country is bracketed.

Limited stocks of the following species are cultured and may be available in small quantities at certain times of the year: Endrosis sarcitrella (L.), Hofmannophila pseudospretella (Staint.), Thylodria contractus Mots., Tribolium audax Halstead, Lepisma saccharina L., Amphibolus venator, Klug., and Bracon Hebetor Say.

ORDER	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REAR-ING TEMP°C
Family (-subfamily)				
Genus (sub genus), species.				
COLEOPTERA				
Anobiidae				
Lasioderma serricorne (F.)	Cigerette beetle		6	25
Stegobium paniceum (L.)	Biscuit beetle		6	25
Anthribidae				
Araecerus fascicultatus (Deg)	Coffee Bean Weevil		30	25
Bostrichidae				
Prostephanus truncatus (Horn)	Larger grain borer		30	25
Rhyzopertha dominica (F.)	Lesser grain borer		1	30
Bruchidae				
Acanthoscelides obtectus (Say)	Dried bean beetle	N. Germany	27	25
Acanthoscelides obtectus (Say)	Dried bean beetle	W. Africa	27	30

Stock Lists

ORDER	COMMON COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMP°
Bruchidae				
Acanthoscelides obtectus (Say)	Dried bean beetle	Portugal	27	30
Callosobruchus analis (F.)			29	30
Callosobruchus chinensis (L.)	Cowpea weevil		29	25
Callosobruchus maculatus (F.)		Sierra Lione	29	30
Callosobruchus maculatus (F.)		Burma	29	30
Callosobruchus phaseoli (Gyll.)		Malaya	cowpeas	25
Caryedon serratus (Oliv.) (+*gonagra* (F.))	Ground nut seed beetle		26a	30
Zabrotes subfasciatus (Boh.)			28	30
Cerylonidae				
Murmidius ovalis (Beck)		Ceylon	13	25
Cleridae				
Necrobia rufipes (Deg.)	Copra beetle		22	30
Cucujidae				
Cryptolestes capensis (Waltl)			10	25
Cryptolestes ferrugineus (Steph.)	Rust-red grain beetle		10	30
Cryptolestes pusilloides (Steel & Howe)		(Canada)	10	25
Cryptolestes pusillus (Schon.)	Flat grain beetle		10	25
Cryptolestes turcicus (Grouv.)			10	25
Cryptolestes ugandae (Steel & Howe)		(E. Africa)	10	25
Curculionidae				
Sitophilus granarius (L.)	Grain weevil	(Russia)	1	25
Sitophilus oryzae (L.)	Rice weevil	Britain	1	25
Sitophilus zeamais Motsch.	Maize weevil		1	25
Dermestidae (Anthrenodes)				
Anthrenocerus australis (Hope)	Australian carpet beetle	(Beitain)	20	25

Stock Lists

ORDER	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REAR-ING TEMP°C
Dermestidae (Anthrenodes)				
Anthrenus (Anthrenus) flavipes LeC. (=vorax Waterh.)	Furniture carpet beetle		20	30
Anthrenus (Nathrenus verbasci (L.)	Varied carpet beetle	Britain	20	20
Anthrenus (Anthrenodes) sarnicus Mroczkowski			32	20
Anthrenus (Florilinus) olgae Kalik		Poland	20	20
Attagenusbruneus Faldermann		Spain	19+ cholesterol	30
Attagenus sp.			17	20
Attagenus smirnovi Zhantiev		Kenya	17	25
Attagenus fasciatus (Thunberg) (=gloriosae (Fabricius))		Botswana	18	25
Attagenus megatome (F.) (=univolor (Brahm) & piceus (Ol.) nec.Thb.)	Black carpet beetle		20	30
Attagenus pellio (L.)	Fur beetle	Britain	20	20
Dermestes ater Deg.	Black larder beetle	Britain	21a	25
Dermestes frischii Kug.	Hide beetle	(Nigeria)	21a	25
Dermestes haemorrhoidalis Kuster		Britain	21a	25
Dermestes lardarius L.	Bacon beetle	Britain	21a	25
Dermestes maculatus Deg.	Leather beetle		21a	25
Dermestes peruvianus Castelnau		Britain	21a	25
Trogoderma angustum (Solier)		Germany	2	25
Trogoderma anthrenoides (Sharp)		U.S.A.	2	30
Trogoderma glabrum (Herbst)		U.S.A.	2	30
Trogoderma granarium Everts	Khapra beetle	(Britain)	2	30
Trogoderma grassmanii Beal		U.S.A.	18	30
Trogoderma irroratum Reitt.		Egypt	2	30
Trogoderma ornatus (Say)		U.S.A.	19+ wheat	30
Trogoderma simplex Jayne		U.S.A.	18	30
Trogoderma sternale plagifer Casey		New Mexico	19	30
Trogoderma variabile Ballion		U.S.A.	2	30
(=parabile Beal)		U.S.A.	2	30

Stock Lists

ORDER Family (-subfamily) Genus (sub genus), species.	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMPERATURE, °C
Languriidae				
Pharaxonotha kirschi (Reitt.)		Portugal	6a	20
Mycetophagidae				
Typhaea storcorea (L.)	Hairy grain beetle	Nigeria	4	25
Nitidulidae				
Carpophilus dimidiatus (F.)	Corn-sap beetle		14	25
Carpophilus hemipterus (L.)	Dried fruit beetle		15	25
Trogossitidae				
Lophocateres pusillus (Klug.)	Siamese grain beetle		11	30
Tenebroides mauritanicus (L.)	The Cadelle	Pakistan	12	30
Ptinidae				
Gibbium psylloides (Czemp)	Hump spider beetle	Britain	17a	20
Mezium affine Boield.		Britain	17a	20
Mezium americanum Lap.	American spider beetle		17a	20
Niptus hololeucus (Fald.)	Golden spider beetle	Britain	17a	20
Pseudeurostus hilleri (Reitt.)		Britain	17a	20
Ptinus clavipes Panz.	Brown spider beetle	Britain	17a	20
Ptinus exulans Erichson		Britain	17a	20
Ptinus pusillus Sturm.			17a	20
Ptinus sexpunctatus Panz.			17a	20
Ptinus tectus Boield.	Australian spider beetle		19a	25

ORDER	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REAR-ING TEMP°C
Stethomezium squamosum Hint.	African spider beetle	Britain	17a	20
Tipnus unicolor (P. & M.)		Kenya	17a	20
Trigonogenius globulus Sol.	Globular spider beetle	Ireland	17a	20
Trigonogenius particularis Pic		Kenya	18a	25
Silvanidae				
Ahasverus advena (Waltl)	Foreign grain beetle	(W. African)	10	25
Cathartus quadricollis (Guer.)	Square-necked grain beetle	W. Africa	10	25
Oryzaephilus mercator (Fauv.)	Merchant grain beetle		10	25
Oryzaephilus surinamensis (L.)	Saw-toothed grain beetle		10	25
Tenebrionidae				
Alphitobius diaperinus (Panz.)	Lesser mealworm		7	25
Alphitobius laevigatus (F.)	Black fungus beetle		7	25
Alphitophagus bifasciatus (Say)	Two banded fungus beetle	Britain	5	25
Gnathocerus cornutus (F.)	Broad-horned flour beetle		17	25
Gnathocerus maxillcsus (F.)	Slender-horned flour beetle		6	25
Latheticus oryzae Waterh.	Long-headed flour beetle		6	25
Coelopalorus foveicollis Blair		Trinidad	24	25
Palembus ocularis Casey		Jamaica	18+ maize	25
Palembus dermestoides (Fairmaire)		Malaya	18	25
Palorus laesicollis (Fairm.)		Kenya	24	25
Palorus ratzeburgii (Wissm.)	Small-eyed flour beetle		6	25
Palorus subdepressus (Woll.)	Depressed flour beetle	Turkey	7	25
Sitophagus holoeptoides Canst		Trinidad	18	25
Tenebrio molitor L.	Yellow mealworm		10a	25

Stock Lists

ORDER	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMP°C
Tenebrio obscurus F.	Dark mealworm		10a	25
Tribolium anaphe Hint.		Nigeria	17	25
Tribolium audax Halstead		Canada	17	25
Tribolium brevicornis LeC.		U.S.A.	23	25
Tribolium castaneum (Herbst)	Rust-red flour beetle	Britain	23	25
Tribolium confusum Duv.	Confused flour beetle		23	25
Tribolium destructor Uytt.	Dark flour beetle	(Holland)	17	25
Tribolium madens (Charp.)	Black flour beetle	(Yugo.)	17	25
DICTYOPTERA				
Blattellidae				
Blatella germanica (L.)	German cockroach		18a	27
Supella longipalpa (F.)	Brown banded cockroach		18a	26
Blattidae				
Blatta orientalis L.	Oriental cockroach		18a	27
Periplaneta american (L.)	American cockroach		18a	27
Periplaneta australasiae (F.)	Australian cockroach		18a	27
DIPTERA				
Muscidae				
Musca domestica L.	Housefly	Britain	25	27
HYMENOPTERA				
Formicidae				
Monomorium pharaonis (L.)	Pharaoh's ant	Britain	33	27
Chalcididae				
Chaetospila elegans (Westw.)			9	25
LEPIDOPTERA				
Pyralidae - Pyralinae				
Pyralis farinalis (L.)	M al moth		5	25
Pyralidae - Phycitinae				
Ephestia (*Anagasta*) *kuehniella* (Zell.)	Mediterranean flour moth	Britain	8a	25
Ephestia (*Cadra*) *cautella* (Walk.)	Tropical warehouse moth	(S. Africa)	8a	25

Stock Lists

ORDER	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REAR-ING TEMP°C
Ephestia (*Cadra*) *cautella* (Walk.)	Tropical warehouse moth	Cyprus	31a	30
Ephestia (*Ephestia*) *elutella* (Hubn.)	Warehouse moth	Britain	8a	25
Ephestia (*Cadra*) *figulilella* Gregs.	Raisin moth	Cyprus	31a	30
Pyralidae - Gallerinae				
Achroia grisella (F.O	Lesser wax moth		16a	25
Galleria mellonella (L.)	Honey comb moth		3	25
Galleria mellonella (L.)	Honey comb moth		16a	25
Corcyra cephalonica stainton	Rice moth	(Burma)	8	25
Gelechiidae				
Sitotroga cerealella (Oliv.)	Angoumois grain moth		1	25
Tineidae				
Tinea columberiella Wocke	Case bearing clothes moth		20	20
Tinea flavescentella Haworth		Britain	20	20
Tineola bisselliella Humm.	Common clothes moth		20	25
Tinea metonella (Pierce)			20	25

MUTANT STOCKS	MUTATION	COUNTRY OF ORIGIN OF STOCK	MEDIA	TEMP.
Anobiidae				
Lasioderma serricorne (F.)	Black	U.S.A.	6	25
Bostrichidae				
Rhyzopertha dominica (F.)	Black		1	30
Bruchidae				
Callosobruchus maculatus (F.)	Bens		29	30
Cucujidae				
Cryptolestes pusillus (Schon)	Black	Trinidad	10	30
Dermestidae				
Dermestes maculatus Deg.	Black/ Brown	Australia	21	25
Nitidulidae				
Carpophilus dimidiatus (F.)	Pearl-eyed		10	25

MUTANT STOCKS	MUTATION	COUNTRY OF ORIGIN OF STOCK	MEDIA	TEMP.
Silvanidae				
Ahasverus advena (Waltl)	Black	Britain	10	25
Oryzaephilus surinamensis (L.)	Small	Burma	10	25
Tenebrionidae				
Tribolium castaneum (Herbst)	Bar-eyed	Berkeley via Edinburgh	23	25
Tribolium castaneum (Herbst)	Giant		23	25
Tribolium confusum Duv.	Black		23	25
Tribolium confusum Duv.	Pearl-eyed		23	25
Tribolium confusum Duv.	Black and Pearl-eyed		23	25

CULTURE MEDIA

The letter "a" after a number (on previous pages) indicates that drinking water is added to the culture either in the form of damp blotting paper or as a corked tube of water containing a wick of blotting paper.

No.	FOOD	Weight Ratio (ounces)
1.	Wheat	
2.	Wheat + wheatfeed	7:3
3.	"Farex" + Yeast + Honey + Glycerol	2:1:1:1
4.	Wheat + wheatfeed +glycerol on a damp pad of cotton wool	7:3:1
5.	Wheat + wheatfeed on a damp pad	7:3
6.	Wheatfeed + yeast	10:1
7.	Wheatfeed + yeast on a damp pad	10:1
8.	Wheatfeed + yeast + glycerol	10:1:2
9.	Be tle culture (Family Bostrichidae)	
10.	Wheatfeed + rolled oats + yeast	5:5:1
11.	Wheatfeed + rolled oats + yeast + groundnuts	5:5:1:1
12.	Wheatfeed + rolled oats + yeast + groundnuts + cork	5:5:1:1
13.	Wheatfeed + rolled oats on a damp pad	2:1
14.	Rolled oats + yeast	10:1
15.	Rolled oats + yeast + sultanas	6:1:6
16.	Wheatfeed + rolled oats+ yeast + glycerine + honey + broo comb	5:5:1:2:2:2
17.	Wheatfeed + fishmeal + yeast	8:4:1
18.	Wheatfeed + rolled oats+ fishmeal + yeast	5:5:2:1
19.	Fishmeal + yeast	16:1

Stock Lists

No.	FOOD	Weight Ratio (ounces)
20.	Fishmeal + yeast + flannel	16:1
21.	Fishmeal + yeast + bacon ends	16:1
22.	Fishmeal + yeast + bacon ends + cheeze	16:1
23.	Wholemeal flour + yeast	12:1
24.	Wheatfeed + rolled oats + flour + yeast	3:3:3:1
25.	Wheatfeed + grassmeal + yeast + shortex	20:10:1:2
26.	Groundnuts	
27.	Haricot beans	
28.	Butter beans	
29.	Cowpeas + dried green peast	1:1
30.	Maize	
31.	Wheatfeed + flucose + yeast + flycer 1	8:2:1:2
32.	Wheatfeed + fishmeal + yeast + cholesterol	8:8:1:1

R.W. Howe

SLOUGH, BUCKS, U.K.
TROPICAL STORED PRODUCTS CENTRE
MINISTRY OF OVERSEAS DEVELOPMENT

I. Wild type strains

COLEOPTERA

Anobiidae
Lasioderma serricorne Cyprus, 1964

Silvanidae
Oryzaephilus surinamensis Crete, 1964
Oryzaephilus surinamensis Cyprus, 1964
Oryzaephilus surinamensis (bicornis) Crete, 1964
Oryzaephilus surinamensis (Small) Far East, 1967

NEW ZEALAND

PRIVATE BAG, AUCKLAND
ENTOMOLOGY DIVISION, D.S.I.R.

1. Stock lists: *Tribolium castaneum*
Tribolium confusum

Wild type strains from local infestations

Other Coleoptera: *Gnathocerus cornutus*
Sitophilus granarius
Sitophilus oryzae
Stegobium paniceum
Tenebrio molitor

2. New Mutants: Nil

3. Notes: Culture maintained for general purpose only; supply to schools and colleges for teaching and research.

Pritam Singh

PRIVATE BAG, HAMILTON
MINISTRY OF AGRICULTURE & FISHERIES
RUAKURA ANIMAL RESEARCH STATION

Stock List: *Tribolium castaneum*

1. Wild type strains derived from strains imported from Edinburgh.

2. Mutant strain carrying Chromosome II mutant pearl (*p*) obtained from Tribolium Stock Center, Berkeley, California.

H.H. Meyer

Stock Lists

YUGOSLAVIA

ZAGREB, KAČIĆEVA 9
INSTITUTE FOR PLANT PROTECTION
AGRICULTURAL FACULTY

I. Wild type strain

LEPIDOPTERA

Gelechiidae
Sitotroga cerealella (Oliv.)

Phycitidae
Anagasta kuhniella Zell.

COLEOPTERA

Bostrichidae
Rhizopertha dominica (F.)

Bruchidae
Acanthoscelides obtectus (Say)

Cucujidae
Cryptolestes spp. (Species not yet identified, but ferrugineus and pusillus are present)

Curculionidae
Sitophilus zeamais Motsch.

Sitophilus oryzae (L.)
Sitophilus granarius (L.)

Dermestidae
Attagenus megatoma (F.)
Attagenus piceus (Oliv.)
Trogoderma granarium Everts

Ostomatidae
Tenebrioides mauritanicus (L.)

Ptinidae
Mezium spp. (species not yet identified)

Silvanidae
Oryzaephilus surinamensis (L.)
Oryzaephilus surinamensis (L.) v. bicornis
Oryzaephilus mercator (Fauv.)

Stock Lists

Tenebrionidae

Gnathocerus cornutus (F.)
Palorus spp. (species not yet identified but *ratzeburgi* and *subdepressus* are present)
Tenebrio molitor L.
Tribolium castaneum (Herbst)
Tribolium confusum Duv.

All insects are originated from storehouses and mills from Croatia, Yugoslavia. They are reared in a lab under constant circumstances during 3-4 years. Only species *Trogoderma granarium* is of unknown origin, collected from imported foodstuffs. This species is not found in Yugostavia yet.

II. Mutants

Tribolium confusum

Chromosome III

Yugoslavian black (=$\underline{b}^{z}$)--Yugoslavia 1969 (report of A. Sokoloff, TIB 13)

Zlatko Korunić

NEW MUTANTS

A. *Tribolium castaneum*

reduced juvenile urogomphi #2. (*rju*-2, Sokoloff, 1976). Found in descendants of *b p* ♀ x irradiated ♂. Since recessive, it must have occurred in the *b p* stock to which the F_1 were backcrossed, especially since it was found in quite a number of vials set up with the same stock.

B. Dachs.

(*Dch*, Sokoloff, 1976 Dominant). Found in backcrosses of +/+ ♂ (irradiated at 4000 r) x *au lod p* ♀. F_1 were backcrossed to *au lod p*. Characterized by a shortening of the legs and the antennae. The legs are not affected at the coxa, trochanter or femur, but the tibia is reduced to about half the normal length. The tarsal segments fuse into a solid mass, which may be definitely separated by a tibio-tarsal joint, or the tibio-tarsal complex may fuse into a solid mass. The antennae segments exhibit a variable degree of fusions: the club segments and the distal funicular segments may be fused into a solid mass but the pedicel and scape are not affected. The first two proximal segments of the funicle may not be affected. Because of their short legs the walking behavior is greatly affected.

C. Confusum-like

(*cfl*, Sokoloff 1976). In a series of matings in which the F_1 (derived from normal *Tribolium castaneum* males irradiated with 4000 r x *au lod p*♀♀)and hence the F_1 were genotypically ++/*au lod*; +/*p*) were crossed back to *au lod*;*p* females. A number of vials yielded this peculiar mutation believed to have arisen in the *au lod p* test stock. The mutant head appears somewhat broader and the eye smaller. The interocular space is equivalent to about two eye widths, as in *Tribolium confusum*, instead of one eye width. The only other notable modification is a depressed appearance of the gular region. Sometimes the gular sutures are irregular. No other features of the beetle seem to be affected. Autosomal recessive.

New Mutants

D. Fused antennal segments -9

(fas -9, Sokoloff 1976). Experiments involving au lod p (Exp. 950) found a "fused antennal segments" mutant designated as fas-9. It is an autosomal recessive showing the distribution of fusions of the antennal segments shown in Table I. The fusions involve the funicle and the club. There is some variability in expression, (some beetles having a normal on one side or the other, and the other antenna showing fusions) but on the whole the mutant can be easily recognized by the fact that segments 6-8 of the funicle and 9-10 of the club are involved in fusions. Note that the club may be free of fusions while the funicle is affected, while there are no cases in which only the club shows fusions while the funicle is not affected. Note also that segments 4-5 and 5-6 may occasionally be involved in fusions.

Table I.

Distribution of antennal fusions of the mutant "fused antennal segments-9" (fas-9) in T. castaneum.

Right	Left	Males	Females
4-5, 6-8, 9-10	4-5, 6-8	1	
4-5, 6-8, 9-10	4-5, 6-8, 9-10		2
5-6, 7-8, 9-10	5-6, 7-8, 9-10	1	
5-6, 7-8, 9-10	5-6, 7-8	1	1
6-8	6-8	7	3
6-8, 9-10		12	25
6-8	6-8, 9-10	9	4
7-displaced/ 8 absent	6-8, 9-10	1	

Report of A. Sokoloff

Notes - Research

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Mortality of mutants reared at different temperatures.

A preliminary experiment has been carried out to test the effect of temperature on the survival of mutants reared continuously in each of three temperatures.

The mutants were obtained from the Tribolium Stock Center. About 30 adults from each mutant stock were introduced into a jar containing standard medium, and allowed to lay eggs for 24 hours. The eggs were then subdivided into six vials, each vial containing approximately 50 eggs. Two vials were placed in a walk-in chamber maintained at 29° C., two were placed in a cabinet at room temperature (24° C.), and two were placed in an incubator maintained at 36° C. The eggs were allowed to develop to the adult stage, and the number reaching the adult stage was recorded. The results, shown as average mortality for the two vials, are given in Table 1.

While the experimental results need to be greatly expanded for a more firm conclusion, the data clearly show that some mutants have the same mortality under all three temperatures (e.g., py); other mutants have a greater mortality at the higher temperature (e.g., mah., r, and j.); others exhibit a greater mortality at the lower temperature (e.g., p, b,; and finally, some exhibit a greater mortality whenever the temperature is raised or lowered (e.g., bt, s, j, sq, ptl). Each of the mutants, therefore, appears to have an optimum for its development.

Notes - Research

Table 1. Percent mortality of mutants reared at different temperatures from egg to adult.

Linkage group	Mutant	Temperature (°C) 24°	29°	36°
I	mah	26.4	37.0	58.7
	r	35.3	17.3	54.2
	py	25.9	30.1	27.0
II	p	34.1	7.0	24.8
III	b^t	42.2	18.2	49.1
	b	34.9	24.3	13.3
IV	Be	67.1	55.0	55.8
	s	40.8	12.5	65.2
V	j	37.0	16.0	59.4
VII	ble	41.5	35.0	66.7
	c	59.5	34.0	69.4
	sa	82.4	60.2	83.2
VIII	sq	72.4	39.7	60.4
IX	ptl	62.4	30.0	57.2

Supported in part by U.S. Army Research Office grant LP 11790-LS and contract 13545L.

Notes - research

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Lack of parthenogensis in *Tribolium audax* and *T. madens*.

Introduction

Halstead (1969) has shown that *T. audax* and *T. madens* are closely related species, since crosses between them produce a few, sterile, hybrids. Although a few ecological investigations have been undertaken these species have not been investigated from the genetic standpoint.

Aside from other insect orders in which this phenomenon is known to be common, parthenogenetic reproduction is quite rare in the Coleoptera (Suomalainen, 1969). Although this characteristic has shown to exist in a number of weevil species (Suomalainen, 1969), so far it has not been demonstrated in *Tribolium*. The purpose of this study was to determine whether parthenogenesis exists in *Tribolium*.

Materials and methods

From about 2000 pupae of *T. audax* and of *T. madens* allowed to develop into adults, twenty adult beetles were selected and isolated in vials containing fresh wholewheat flour and brewer's yeast. These females were allowed to lay eggs for three days, then transfered to new vials for four days. The four-day egg-lay flour was discarded. After the beetles were transferred into a new vial containing fresh flour the old three-day vial was examined for larval activity. If no activity was observed after two weeks the flour was discarded. At the end of two months, a new series of virgin female adults was started and the old series sacrificed. The vials were kept in an environmental chamber maintained at 29°C and 70 percent relative humidity.

Results and discussion

In the period of six months, over which this experiment was conducted I isolated 1866 *T. audax* and 2,061 *T. madens*. Not one beetle of either species exhibited parthenogenetic reproduction.

Based on these preliminary observations, it appears that in both *Tribolium audax* and *T. madens* the phenomenon of parthenogenesis is absent.

Literature cited

Halstead, D.G.H. 1969. A new species of *Tribolium* from North America previously confused with *Tribolium madens* (Charp.) (Coleoptera: Tenebrionidae). J. Stored Prod. Res. 4: 295-304.

Suomalainen, E. 1969. Evolution in parthenogenetic Curculionidae. Evolutionary Biology 3: 261-296.

My thanks to Professor A. Sokoloff for his valuable advice and assistance in this experiment. (This project was funded by Army Grant RDRD LP 11790-LS.).

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Absence of a genetic maternal effect on egg surface in *Tribolium audax* and *T. madens*.

Introduction

Dawson and Riddle (1975) discovered that females of *T. castaneum* lay sticky or non-sticky eggs. If the eggs are sticky they become flour-covered; if they are non-sticky the surface of the egg appears wet and transparent-like. They have termed this phenotypic trait as "weird egg". This trait is due to a maternal effect exhibited by females homozygous for a single recessive gene. The purpose of this study was to determine whether this trait exists in either *T. audax* or *T. madens* and to what extent.

Materials and methods

The following procedure was followed for both *T. audax* and *T. madens*: 40 single pair adult matings were isolated in small vials containing approximately two grams of wholewheat flour and brewer's yeast. Every three days the eggs were removed through the use of a fine sifter and examined to determine if the weird egg characteristic existed. If none of the eggs was of the weird type the flour and eggs were discarded and the parents returned to the vial. At the end of two weeks a new group of 40 pair-matings was started and the old group discarded. The vials were kept in an environmental chamber maintained at 29°C and 70 percent relative humidity.

Results and discussion

This experiment was conducted over a five month period at which time approximately 840 single pair matings were crossed for each species. The "weird" egg phenotypic characteristic was not found in any of the beetle eggs examined.

Literature Cited

Dawson, P.S. and R.A. Riddle 1975. A genetic maternal effect on egg surface in Tribolium castaneum. The Journal of Heredity 66: 31-32.

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The effect of sex and irradiation on crossing-over in Tribolium Castaneum

Markers on linkage group III of *Tribolium castaneum* were used to determine whether (1) sex has any influence on recombination and (2) whether irradiation has any influence on recombination in this linkage group.

Four wild type male *Tribolium castaneum* beetles were exposed to gamma rays at a dosage of 4000 rads. These males were mated with non-irradiated females homozygous for aureate (au) and light ocular diaphram (lod), located on linkage III and pearl (p), located on linkage group II. All the heterozygous F_1 males and females obtained were crossed back to au lod/au lod; p/p beetles of the opposite sex. The control (non-irradiated) group was treated the same way but the original males were not irradiated.

As seen in Tables 1 and 2, in non-irradiated beetles there was a significantly greater frequency of recombination in males (the heterogametic sex) than in females (28.17% vs. 17.41%, respectively). Irradiated males showed a significant increase in the frequency of recombination over non-irradiated males (31.41% vx. 28.17%, respectively) but the irradiated females did not differ significantly from non-irradiated females (19.31% vs. 17.41%, respectively).

This study shows that, for linkage group III, the frequency of recombination is greater in the male (the heterogametic sex) than in the female, and that irradiation can influence the recombination frequency in the male, but not in the female.

Supported in part by U.S. Army Research Office grant LP 11790-LS and contract 13545L.

Table 1. Parental and recombinant phenotypes observed in backcrosses of irradiated and non-irradiated female beetles. (i.e. ++*/au lod; +/p ♀ X au lod/au lod; p/p ♂).

CROSS	TOTAL NUMBER OF PROGENY	PARENTAL PHENOTYPES	RECOMBINANTS au-lod	
Females			n	%
Irradiated	2729	2202	527	19.31
Non-irradiated	2142	1769	373	17.41

Table 2. Parental and recombinant phenotypes observed in backcrosses of irradiated and non-irradiated male beetles. (i.e. ++*/au lod; +/p ♂ X au lod/au lod; p/p ♀).

CROSS	TOTAL NUMBER OF PROGENY	PARENTAL PHENOTYPES	RECOMBINANTS au-lod	
Males			n	%
Irradiated	2566	1760	806	31.41
Non-irradiated	2581	1854	727	28.17

Notes - Research

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Larval dispersal of three Tribolium species

Introduction

Numerous *Tribolium* researches have conducted studies on dispersal in the flour beetle. The principal focus has been upon the adult, particularly *T. confusum* and *T. castaneum* (e.g. Ghent 1966, Naylor 1959, 1961, Prus 1963, Wool 1969). Adults obviously possess the capacity for covering much greater distances than do larvae; however, the more meager dispersal ability of larvae should not be neglected. The ability of larval stages to travel over moderate distances may be an important component of species survival. Avoidance of cannibalism, access to grain of high nutritional quality, and lack of physical disturbances to tunnels may significantly increase larval survival. The larval distribution of three *Tribolium* species in homogeneous culture medium was investigated.

Materials and Methods

Tribolium castaneum corn-oil sensitive (Costantino, Bell and Rogler 1967), *T. madens*, and *T. brevicornis* were selected as experimental animals. These species show a gradient in adult body size: *T. castaneum* is the smallest, *T. brevicornis* is the largest. A factorial design was employed, whereby the larval distribution of each species was inspected at three time periods. Plexiglas boxes measuring 12 x 17 cm were filled to a depth of 1 cm with standard culture medium. The shallow depth of medium encourage horizontal dispersal. The experiment was begun by placing 50 eggs of a species into the center of a container. Six days after the eggs were introduced, three replicates of each species was sampled by dividing the container into 16 equal-sized quadrats, and recording the number of larvae in each quadrat. The procedure was repeated at 10 days and 14 days.

Results

Dispersal upon an homogeneous rectangular plane may be viewed as a radial pattern, with distance from the center as an important parameter. The 16 sampling quadrats were lumped into four "distance" categories of four quadrats each, representing distance from the container midpoint: 2.6 cm, 5.1 cm, 6.7 cm, and 7.9 cm. Table I lists the percentage of each larval population sampled within each distance category. After 6 days, T. brevicornis was found in moderate numbers throughout the containers; T. madens was more frequently sampled in the central quadrats, and fully 95% of the T. castaneum larvae were found in the center of the experimental containers. After 10 days, each species was located noticeably farther from the midpoint; with T. brevicornis found principally in the most distant quadrats. At 14 days, T. madens and T. castaneum larval distributions remained largely unchanged from the 10-day sample, whereas T. brevicornis larvae attained a uniform distribution throughout the containers.

A factorial analysis of variance was performed on the number of larvae of each species in each quadrat over time (Table II). The species and distance main effects had significant F-values at $p<.05$, as did the time x distance, species x distance and the time x species x distance interactions.

Discussion

T. brevicornis larvae clearly moved greater distances than did T. madens or T. castaneum larvae. Within 6 days, nearly one-third of the T. brevicornis larvae had reached the farthest corners of their containers, whereas nearly two-thirds of T. madens and practically all of T. castaneum larvae had not moved from their initial location. That differences in dispersal pattern are not due exclusively to larval size is seen by a comparison of mean larval lengths at each sampling period (Table III). At all three sampling periods, T. madens larvae were largest; T. brevicornis were intermediate in size except at day 10. However, the differences in length between species at a sampling period was much less than the difference between sampling days. If dis-

TABLE I

Mean percentage of larvae within each distance category at three time periods.

SPECIES	DISTANCE cm	DAYS 6	10	14
T. brevicornis	2.6	.32	.15	.27
	5.1	.27	.12	.24
	6.7	.10	.27	.25
	7.9	.31	.47	.24
T. madens	2.6	.61	.41	.46
	5.1	.12	.26	.21
	6.7	.12	.14	.20
	7.9	.14	.18	.14
T. castaneum	2.6	.95	.43	.41
	5.1	.04	.27	.17
	6.7	.01	.16	.25
	7.9	.00	.14	.17

TABLE II

Analysis of variance on number of larvae per quadrat.

Source of Variation	df	Mean Square	F
Time (T)	2	1.919	0.634
Species (S)	2	33.030	10.909*
Distance (D)	15	32.138	10.614*
T x S	4	6.294	2.079
T x D	30	9.847	3.252*
S x D	30	12.981	4.287*
T x S x D	60	4.900	1.618*
Residual	288	3.028	

* Significant at the .05 level

TABLE III

Mean larval length (mm) of three *Tribolium* species.

SPECIES	DAYS 6	10	14
T. castaneum	1.42±0.04	2.46±0.09	4.19±0.18
T. madens	1.69±0.04	2.54±0.08	4.61±0.12
T. brevicornis	1.53±0.05	2.40±0.05	4.23±0.30

persal distance were primarily a function of larval size, one would expect the dispersal distance of *T. castaneum* at 10 days to be greater than that of *T. brevicornis* at 6 days. One would expect *T. madens* larvae to have covered the greatest distance, for they were consistently the largest. The failure of these expected patterns to appear implies that larval dispersal ability is a complex phenomenon and not a simple function of larval size.

T. brevicornis larvae are notable in that their patterns of dispersal were substantially different from *T. madens* and *T. castaneum*. Larvae of the latter two species were distinguishable in dispersal pattern after 6 days, but were similar in the 10 and 14 day samples. Further testing in larger experimental containers might further delineate larval dispersal ability.

Literature Cited

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Prus, T. 1963. Search for methods to investigate mobility in *Tribolium*. Ecology 44: 801-803.

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Naturally occurring mutants in stored produce warehouses in Yugoslavia.

Examination of samples of flour beetles derived from a number of stored product warehouses near Zagreb, Yugoslavia, have yielded a number of mutations.

One, previously recorded, is an autosomal semidominant black body color mutant (b^{Z}) allelic with the previously described McGill black. A second mutation, referred to as maroon (mar) is a sex-linked recessive mutation modifying the normally black eye into a reddish one. The mar mutant is a much better marker for the X-chromosome than eyespot (es) or even the es^{lt} allele. The third mutation, christened "fused antennal segments-3 (fas-3)" is an autosomal recessive which produces fusions of the funicular and club segments of the antenna. It differs from fas-1 in that fas-1 does not involve the more proximal segments 3-4 of the funicle. It resembles fas-2 in that segments 3-4 and 5-6 of the funicle and 9-10 of the club are affected, but in addition in fas-3 segments 6-7 or 7-8 are involved in fusions. Often blocks of segments 6-10 or 7-10 or 8-10 are formed, resulting in a fairly solid mass. A further difference is that fas-3 antennae are often "elbowed," a characteristic seldom seen in fas-2.

Table I shows the distribution of fusions of antennameres in the two sexes.

Linkage studies of fas-3 and mar are in progress.

(This investigation was supported in part by U.S. Army Research Office grant LP11790-LS and contract 13545L)

Table I.

Antennal fusions in fas-3 T. confusum.

Segments fused in antennae	Male	Female
3-4, 5-6	3	
3-4, 5-6, 7-8	6	3
3-4, 5-6, 7-9	3	2
3-4, 5-6, 7-8, 9-10	2	3
3-4, 5-6, 8-9	1	2
3-4, 5-6, 7-10	2	
3-4, 5-6, 8-10		1
3-4, 5-7	1	
3-4, 5-7, 8-9		3
3-4, 5-8, 9-10		2
3-4, 6-7		3
3-4, 6-7, 8-9	8	6
3-4, 6-7, 8-10		1
3-4, 6-7, 9-10		1
3-4, 6-7, 9-11		1
3-4, 6-7, 8-9, 10-11	1	
3-4, 6-8		1
3-4, 6-9		1
3-4, 6-10	2	1
3-4, 7-8	4	1
3-4, 7-8, 9-10		2
3-4, 8-9	6	
3-4, 8-9, 10-11	1	
3-4, 9-10	2	

Notes - research

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On heterogeneity in cI strain of Tribolium castaneum Hbst.

Introduction

Four genetic strains of *T. castaneum* obtained from Prof. Dr. Thomas Park's laboratory show differences in many physiological features as fecundity, fertility, cannibalistic predation, longevity, mortality, duration of development and other characteristics (Park, Mertz, Petrusewicz 1961, Park, Mertz, Grodzinski, Prus 1965). These strains of *T. castaneum* together with 4 genetic strains of *T. confusum* were brought to Poland in 1963 and have been cultured at 29°C and 75% of relative humidity for many years. In 1966 a study of elements of energy budget was initiated (Klekowski, Prus, Żyromska-Rudzka 1967), using strain cI of *T. castaneum*. During measurements of production a heterogeneity was found within this strain. It is possible that the strain could evolve and change its characteristics or split into two sub-strains.

The aim of this paper was to describe the difference observed within cI strain, the number of larval instars being the criterion for division. Such features as growth curves, maximum weight, and the time of reaching this maximum as well as the duration of development were ascertained.

Methods

Two series of individual cultures, 25 in each, were run for over 100 days. The medium of each larva consisted of 2g of flour and baker's powdered yeast (95% and 5%, by weight). The cultures were synchronized, the difference in hatching time of the larvae did not exceed 4 hours. The larvae and other stages were weighed every second day and the number of exuviae was recorded. Each vial content was sifted through fine mesh and the larva with its exuvium were collected. The larva was weighed and placed again into 2 g of fresh medium. The small larvae were weighed with a quartz balance and the large larvae with a sartorius balance.

Results

Out of 50 individuals only 43 survived over 100 days, 22 females and 21 males. Of the 22 females, 8 had 6 larval instars and 14 - 7 larval instars (36.36% and 63.63%, respectively). Of 21 males, 6 had 6 larval instars and 15 had 7 larval instars (28.57% and 71.43%, respectively). In general, there were 14 individuals with 6 larval instars and 29 individuals with 7 larval instars (32.55% and 67.45%, respectively). The ratio is close to 1:2, which may have some genetic implications.

Notes - Research

The two groups of animals differed also in their growth curves (Fig.1). The 6-instar larvae grew faster than the 7-instar larvae but they obtained lower and earlier maximum weight. The difference in weight was permanent in prepupa, pupa, and adult stage, the 6-instar larvae were always lighter than 7-instar larvae (Fig.1).

Statistical comparisons were made between 6 and 7 instar individuals in respect of their maximum weight, the time of reaching this maximum weight, and the weight of adult beetles on the 72nd day of their life using the Student t-test (Table I). All comparisons of these features between 6 and 7 instar individuals showed significant differences at a probability level of 0.001. This points to differences in the course of growth and development of these two groups. However, the sex differences within these two groups of individuals in respect of the features examined were insignificant with an exception that the 7-instar females reached the maximum weight one day earlier than did the males (Table II).

The two groups of larvae differred also in duration of their development (Fig. 2). The complete development for a newly hatched larva to the adult stage in 6-instar males lasted 25.6 $\mp$ 0.82 days and in 6-instar females to 24.88 $\mp$ 0.97 days, or 25.02 $\mp$ 1.00 on the average (Table III). The total development of 7-instar males lasted 28.17 $\mp$ 0.69 days, and that of females - 29.29 $\mp$ 1.59 days, or 28.73 $\mp$ 1.13 on the average. The differences between the total duration of development in 6- and 7- instarmales and females are highly significant at a probability level of 0.001 (for males - t = 8.41, for females t = [illegible]). The difference between average duration of development for both sexes is also highly significant (t = 8.98).

Discussion

The results concerning duration of the development of the cI strain differ somewhat from those reported by Park, Mertz, Petrusewicz (1961). According to these authors the total duration is 26.12 days, whereas in the present paper it was 32.73 days (when the two groups were averaged and when the duration of an egg equalling 4.09 days was added). This discrepancy is obviously due to handling techniques (sifting, weighing, and measuring the larvae). The development occurred not continuously at 29°C but for about 8 hours every second day at a room temperature of 22°C which prolonged the total development. Beside, it was found by Mertz and Robertson (1970) that the handling of growing larvae has a significant effect on prolongation of the larval stage in <u>T. castaneum</u> (genetic strain cIV-a). Howe (1961) has pointed to heterogenous character of <u>Tribolium</u> cultures in respect to duratiom of development and individual weight. These results are in agreement with his findings.

Summary

By individual culturing Tribolium castaneum genetic strain cI, differences were found in several features of this strain. Two groups of individuals, both males and females, were distinguished. One group included individuals with 6- larval instars, the other one - 7 instars. The 6-larval instar group had lower maximum weight and shorter development cycle than 7-larval instar group. The differences in the course of growth and in duration of development were statistically significant.

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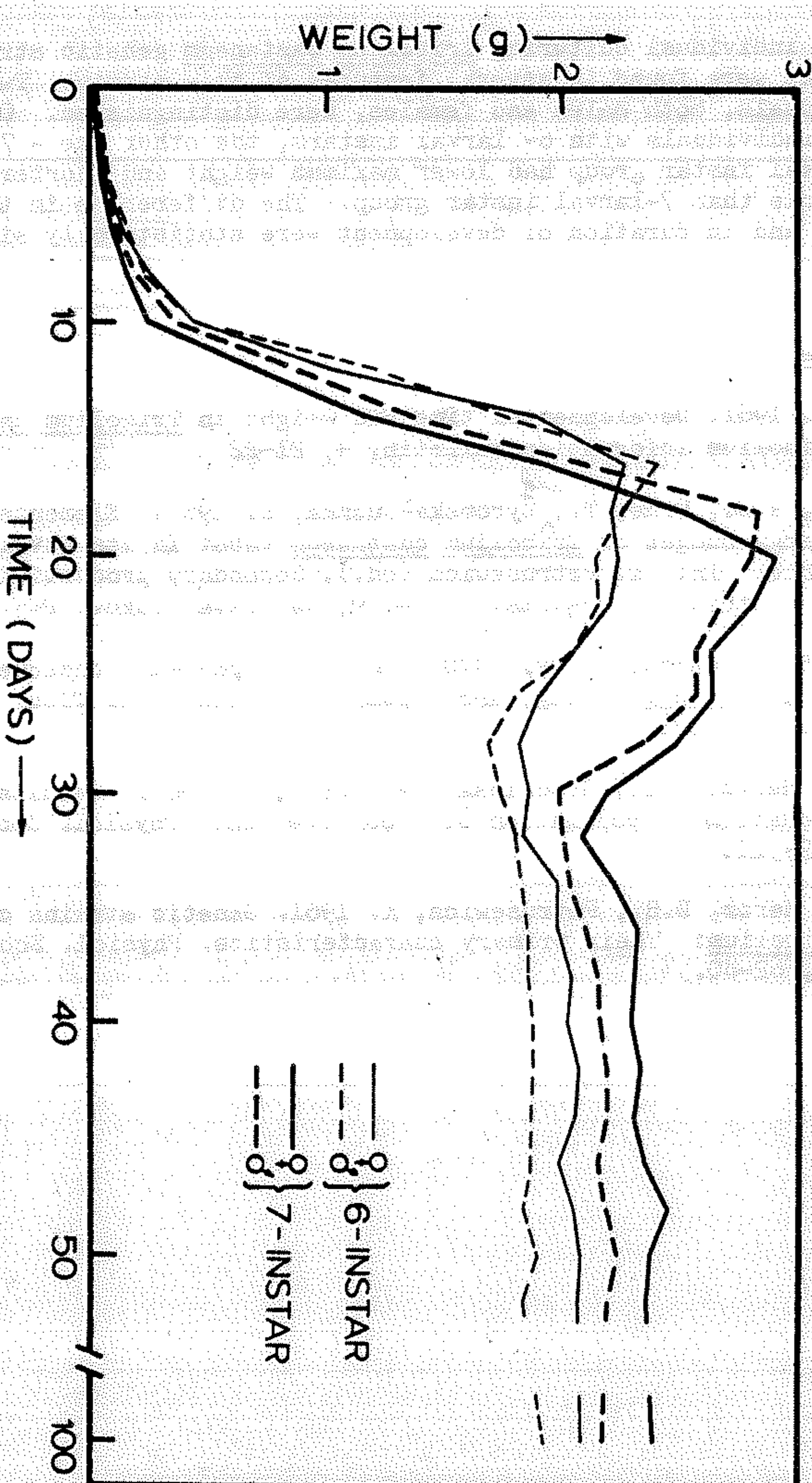

FIG.1. THE GROWTH CURVES OF 6- AND 7-INSTAR GROUPS OF CI STRAIN OF *T. CASTANEUM*

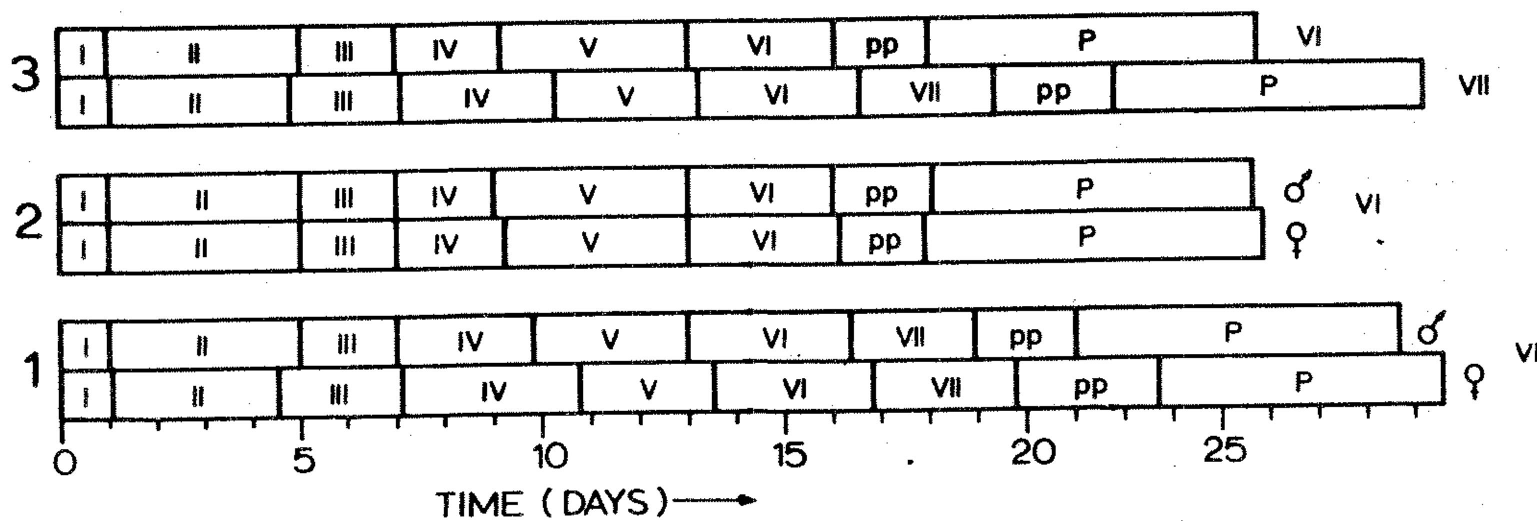

FIG. 2. DURATION OF SUCCESSIVE DEVELOPMENTAL STEGES IN TWO GROUPS OF INDIVIDUALS OF C I STRAIN OF *T. CASTANEUM*

Explanation to Figure 2:

1. - for VII instar - group, females and males, separately
2. - for VI instar - group, females and males, separately
3. - for VII and VI instar group, averaged both sexes

Table I. Differences between 6 and 7-instar individuals in respect to chosen features of growth and development

Sex	Males					Females				
Comparison	6-instar	7-instar	df	t	P	6-instar	7-instar	df	t	P
Maximum weight /mg/	2406.7 x/	2940.7	19	5,535	<0.001	2443.8	2970.7	20	5.570	<0.001
Time of reaching maximum weight /days/	16.0	18.4	19	39.200	<0.001	15.5	19.3	20	8.353	<0.001
Weight on 72nd day of life /mg/	1861.7	2203.3	19	4.437	<0.001	1950.0	2300.7	20	4.961	<0.001

x/ Numbers are mean values.

Table II. Differences between males and females in respect to chosen features of growth and development

Instar group	6-instar					7-instar				
Comparison	♂♂	♀♀	df	t	P	♂♂	♀♀	df	t	P
Maximum weight /mg/	2406.7 x/	2443.8	12	0.549	>0.5	2940.7	2970.7	27	0.345	>0.7
Time of reaching maximum weight/days/	16.0	15.5	12	1.228	>0.2	18.4	19.3	27	2.192	<0.05
Weight on 72nd day of life /mg/	1861.7	1950.0	12	1.063	>0.3	2203.3	2300.7	27	1.619	>0.05

x/ Numbers are mean values.

TableIII. Duration of subsequent instars and total development in 6- and 7-instar individuals of cI strain of *T. castaneum*

Group		Duration /days/									
		Instars							pre-pupa	pupa	Total Mean ± S.D.
		I	II	III	IV	V	VI	VII			
6-instar	♂	1.00	4.00	2.00	2.00	4.00	3.00	-	2.08	7.08	25.16±0.82
	♀	1.00	4.00	2.00	2.25	3.75	3.16	-	1.72	7.00	24.88±0.97
Mean		1.00	4.00	2.00	2.12	3.88	3.08	-	1.90	7.04	25.02±1.00
7-instar	♂	1.00	4.00	2.00	2.80	3.20	3.33	2.62	2.05	7.17	28.17±0.69
	♀	1.14	3.43	2.57	3.58	2.71	3.43	2.94	2.92	6.57	29.29±1.59
Mean		1.07	3.71	2.28	3.19	2.96	3.38	2.78	2.49	6.87	28.73±1.33

Notes - Research

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Dietary effects on population growthrates in Tribolium.

Introduction

Preliminary observation showed that lentil meal, while permitting the survival of *Tribolium castaneum* adults for many months did not allow population growth. This suggested that, incorporated into favorable foods, lentil would provide a source of heterogeneity whereby the rate of increase in numbers might be restricted. The mixing of lentil with 12:1 combination of wheat flour and yeast caused retardation of the growth of populations from small numbers of virgin adults. Subsequently a 1:1 mixture of yellow maize meal and fish meal was used as the favorable food.

Experiment 1 considers the effects on population growth of adding different amounts of lentil to a fixed amount of the maize meal/Fish meal mixture, whereas in Experiment 2 the total weight of ingredients remains constant and the proportions of lentil and favorable food vary. Experiments 3 and 4 are concerned with the effects of ingredient particle size variation.

Materials and Methods

-Experiments 1 & 2: the ingredients were ground and seived to obtain particles of 420-710 microns, and were placed in glass jars which were 5 cm in diameter and 6.5 cm high. The surface was seeded with five (Experiment 1) or four (Experiment 2) virgin adults of each sex aged up to five days. The jars were closed with organdie and kept in darkness. Randomized blocks designs with six replications were used. Experiment 1 was conducted at 25° and 70% RH, Experiment 2 at 30° and 54% RH. Live final instar larvae, pupae and adults were counted at intervals. Analyses of variance were performed on the square roots of the counts. Means were compared using Duncan's (1955) multiple range test. In Experiment 1 all treatments contained 5 g each of maize meal and fish meal; one treatment lacked lentil, the rest included 2.5, 5, 10, 20 and 40 g of lentil meal. In Experiment 2 there were 30 g of total ingredients per treatment; one treatment contained 15 g each of maize meal and fish meal; in the others the weights of each of these materials were 12, 10, 7.5, 5 and 3 g, in addition to which there were 6, 10, 15, 20 and 24 g respectively of lentil.

-Experiment 3: the basic medium consisted of 20 g of a 1:1 mixture of maize meal and fish meal of particle size 420-710 microns. 10 g lentil were incorporated as particles of 0-150, 150-420, 420-710 or 710-1000 microns, or as split lentils. The media were seeded with four virgin adults of each sex.

-Experiment 4: particles of 180-250 and 420-710 microns were used. 10 g of lentil of each size range were mixed with 20 g of 1:1 maize meal/fish meal of each size range. Five virgin females and three virgin males were used for seeding. The experiment was conducted at 30° and 75% RH.

Other details for Experiments 3 & 4 were as in Experiment 1.

Results

-Experiment 1& 2: numbers of larvae and pupae increased rapidly, then fell to zero. Adult numbers also peaked, but their decline was relatively gradual. In Experiment 1 the population growth rate fell with increase in lentil content. Peak adult numbers in the treatment containing 2.5 g lentil were anomalous in that they were smaller than those in the treatment containing 5 g lentil (Table 1). In Experiment 2 there was little evidence of a graded response to lentil content by the immaturestages. Adult numbers tended to fall with increase in lentil proportion (Table II).

-Experiment 3: 27 days after seeding there was marked retardation of larval development where the finest lentil particles were used. Overall retardation of population growth was greatest where the size of the lentil particles equalled that of the favorable food (Table III).

-Experiment 4: 41 days after seeding there were more pupae in the lentil-free treatments than in those containinglentil. In the lentil-free treatments, adult numbers were higher where the finer particles were used. The largest reduction in adult numbers was produced by the coarser grade of lentil in maize meal/Fish meal of the same particle size. With the finer maize meal/Fish meal, there was a slight tendency for the finer lentil to depress adult numbers more than the coarser grade (Table IV).

Discussion

The mixing of lentil with maize meal and fish meal substantially retarded population growth, even where the amount of favorable food remained constant. Bhattacharya and Pant (1969) found that lentil had a low food value for <u>Trogoderma granarium</u> because of a cholesterol deficiency and the presence of a growth-inhibiting factor. The possibility exists that in our experiments lentil ingestion occurred due to an inability to distinguish between or to separate different materials of similar particle size. Population growth retardation could have followed because of the nutritional qualities of the lentil. Reduced intake of favorable food might also have had an effect. Variation in environmental volume and packing density appeared not to be responsible for the results obtained. Extra consumption of time and energy during searching activities in lentil-containing mixtures conceivably led to diminished populations. Overcrowding seemed not to be a factor in the results, since population density was usually lower in lentil-containing treatments than in those lacking lentil. There was no evidence of increased cannibalism in the presence of lentil.

Table I. Experiment 1: mean numbers of live final instar larvae, pupae and adults.

	Days after seeding	Weight of lentil (g) in addition to 5g maize meal and 5 g fish meal					
		0	2.5	5.0	10.0	20.0	40.0
Larvae	36	116^{a}	75^{b}	72^{b}	69^{b}	34^{c}	11^{d}
Pupae	36	39^{a}	33^{a}	9^{b}	8^{b}	1^{c}	0^{c}
Adults	63	210^{a}	130^{c}	189^{ab}	142^{bc}	115^{c}	44^{d}

Table II. Experiment 2: mean numbers of live final instar larvae pupae and adults.

	Days after seeding	Weights (g) of maize meal (M), fish meal (F) and lentil (L)					
		M15 F15	M12 F12 L6	M10 F10 L10	M7.5 F7.5 L15	M5 F5 L20	M3 F3 L24
Larvae	37	20^{a}	21^{a}	23^{a}	20^{a}	21^{a}	12^{b}
Pupae	37	17^{a}	17^{a}	20^{a}	24^{a}	25^{a}	7^{b}
Adults	59	69^{a}	49^{ab}	47^{ab}	38^{ab}	28^{b}	6^{c}

Table III. Experiment 3: mean numbers of live final instar larvae, Pupae and adults.

	Days after seeding	Particle size (microns) of 10 g lentil mixed with 20 g 1:1 maize meal/fish meal of particle size 420-710 microns: None added	0-150	150-420	420-710	710-1000	Split lentils
Larvae	27	32^{a}	0^{d}	16^{bc}	11^{c}	26^{ab}	33^{a}
Pupae	55	12^{b}	19^{a}	11^{b}	9^{b}	10^{b}	7^{b}
Adults	55	212^{a}	141^{b}	140^{b}	88^{c}	107^{bc}	155^{ab}

Table IV. Experiment 4: mean numbers of live pupae and adults.

Particle size (microns) of 20 g 1:1 maize meal/fish meal		180-250	180-250	180-250	420-710	420-710	420-710
Particle size (microns) of 10 g lentil		None	180-250	420-710	None	180-250	420-710
	Days after seeding						
Pupae	41	150^{a}	69^{b}	71^{b}	117^{a}	81^{b}	53^{b}
Adults	68	290^{a}	84^{c}	93^{c}	202^{b}	104^{c}	58^{c}

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Tables

In the ~~following~~ above tables, means in the same row lacking a letter in common are significantly different.

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Infestibility of faba bean by Tribolium and other storage insects.

Infestation potential of 12 species of storage insects on two cultivars of faba bean (*Vicia faba* L. var. *minor*), which has recently been introduced into Canada as a potential protein supplement for animal feeds, was determined at 27 - 30°C and 70% RH. When survival and reproduction was used as criteria, whole seeds were resistant to attacks by all insect species except *Tribolium castaneum* (Herbst). Even *T. castaneum* died on whole beans of 'Ackerperle' and 'Diana' cultivars in 10 weeks, other 11 species died in 1-6 weeks - all without reproducing.

Cryptolestes ferrugineus (Steph.), *Oryzaephilus surinamensis* (L.), *T. castaneum* and *T. confusum* (du Val) reproduced on crushed beans; F_2 generation, however, was rarely produced even after 20 weeks. *T. castaneum* was the most successful pest of faba beans, continued multiplying slowly on crushed beans even after 32 weeks and performed equally well on both bean cultivars.

The following storage insects did not reproduce at all on crushed faba beans, but survived between 2 and 16 weeks: *Acanthoscelides obtectus* (Say), *Cryptolestes turcicus* (Grouv.), *Oryzaephilus mercator* (Fauvel), *Sitophilus granarius* (L.), *S. oryzae* (L.), *S. zeamais* Mots., *Tribolium audax* Halstead.

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Morphological traits and classification of *Tribolium*.

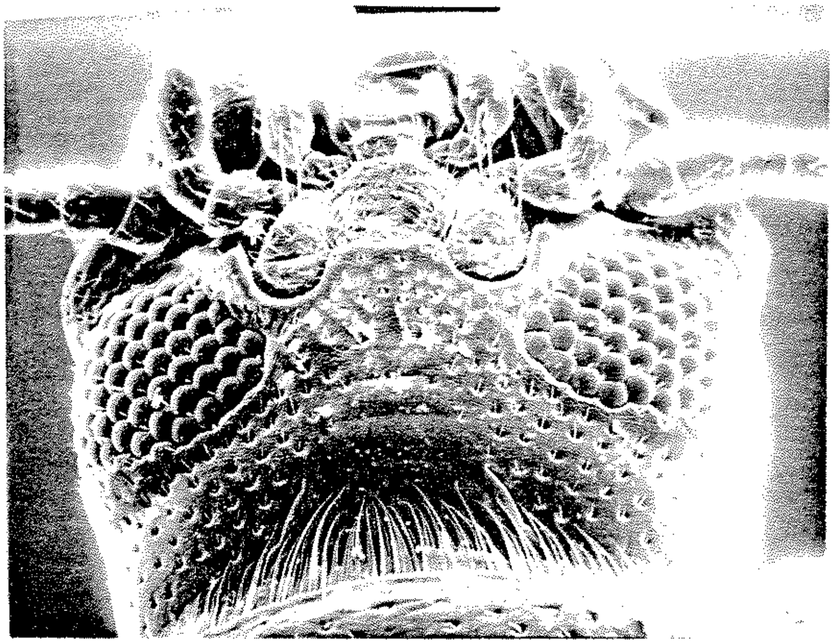
Taxonomists rely on many morphological traits to place an organism in its proper family, genus and species, and variation in one or more attributes still enables the taxonomist to place a specimen in its proper category.

To cite an extreme case as an example from *Tribolium*, a specimen of *labiopedia*, which modifies the labial palps into legs bringing the total legs to four pairs, would still enable even the most inexperienced taxonomist to place such a specimen among the insects instead of the arachnids, since the specimen looks more like an insect than a spider, and the possession of two pairs of wings, the anterior pair modified into elytra, would place it in the Coleoptera.

Mutants affecting the antennae and the tarsi present a special problem because the segment number in the antennae may be reduced (from the normal one of 11 segments to a much smaller number) and the number of tarsal segments may be considerably modified so that the characteristic formula of 5-5-4 tarsal segments in the first, second and third pair of legs no longer holds. Thus, for example, the tarsus may consist of at most one segment in *Fta* (Fused tarsi and antennae) and in many specimens of Dachs (*Dch*) the tibia is reduced in size and the tarsi fuse into a solid mass which may also be intimately fused with the tibia.

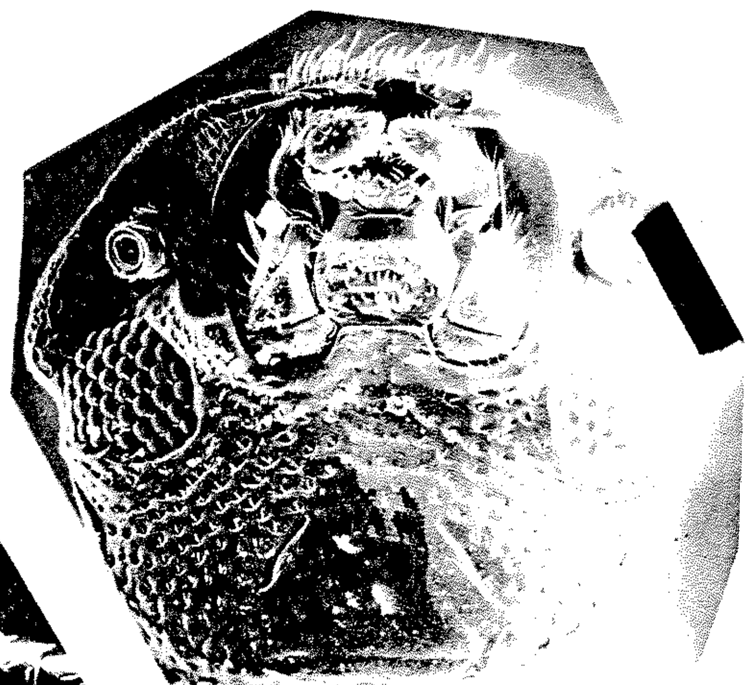
One of the reliable traits for separating *T. castaneum* from *T. confusum* is the size of and distance between the eyes: *T. castaneum* can be identified by having an interocular distance equivalent to one eye width (when the ventral aspect of the head of the beetle is examined) while *T. confusum* is recognized as having an interocular distance equivalent to two eye widths.

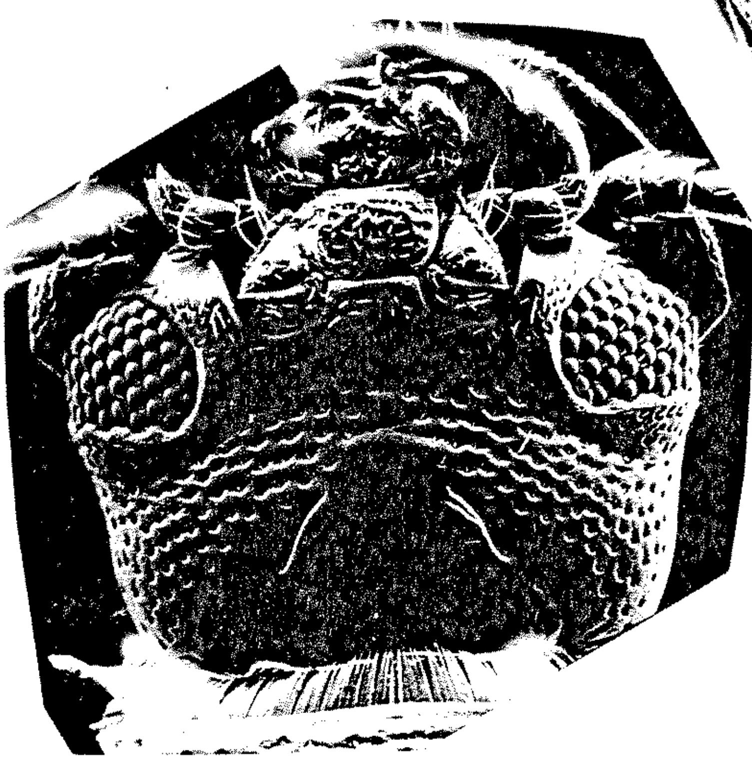
The interocular distance attribute is no longer reliable to classify one mutant of *T. castaneum* from *T. confusum*: in the "*confusum-like*" (*cfl*) mutation the head is considerably modified in shape so that the beetle resembles *T. confusum* more than *T. castaneum* (see Fig. 1). Indeed, when I first discovered it among some normal *T. castaneum* beetles I thought it was a contamination! Without the antennae as an accessory aid in classification I am certain the reader would have difficulty in determining whether the mutant belongs to *T. castaneum* or *T. confusum*.



T. castaneum

confusum-like





T. confusum

I thank Mr. Daryl Faustini for helping to obtain SEM micrographs of this interesting mutant.

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Relative position of the genes aureate, black, and light ocular diaphragm.

The relative position of the genes black (b) light ocular diaphragm (lod) and aureate (au) in linkage group III of *T. castaneum* is b-lod-au. The distances between the genes varies, depending on the cross: b++/+lod au ♀ x + lod au/+lod au ♂ give these recombination values: au-lod = 18.32; b-lod = 21.05; b-au = 37.93. The reciprocal crosses give au-lod = 27.67; b-lod = 13.97 and b-au = 39.79.

Clearly, recombination values between b - lod in the female are larger than in the male, while in lod-au they are larger in the female. For the larger distance covered by b-au the sex differences in recombination are not significant.

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Maze-learning in T. castaneum as influenced by selection for food preference.

By repeated runs in a T-shaped maze Lerner and Inouye (1968) demonstrated that *T. castaneum* adults are able to learn and that this ability could be increased by artificial selection. In their experiment no aversive stimulation was used. However, learning is known to play an important role in feeding of insects where feeding preferences could be modified by the previous experience (Dethier, 1966). Thus the present report is concerned with the effect of the presence of garlic powder, which seems to have an aversive effect on the behavior of *T. castaneum*, on the learning ability of the beetles to discriminate between garlic (40%) and standard medium.

Table 1. <u>Learning ability to distinguish between standard and garlic supplemented medium as influenced by artificial selection for either medium.</u>

Generation	Sex		Garlic Line Run 1	Garlic Line Run 2	Garlic Line Run 3	Normal Line Run 1	Normal Line Run 2	Normal Line Run 3
0		G	19 (41%)	10 (67%)	3(36%)	20	3	1
		N	27	5	5	28 (58%)	20 (87%)	15 (94%
		S	30	4	2	29	5	4
		Size	76	19	10	77	28	20
3	♂♂	G	5 (71%)	4 (100%)	2(100%)	2	0	0
		N	2	0	0	29 (93%)	19 (100%)	12(100%
		S	8	1	2	19	10	7
		Size	15	5	4	50	29	19
	♀♀	G	15 (71%)	9 (64%)	6 (67%)	1	0	0
		N	6	5	3	14 (93%)	12 (100%)	4(100%
		S	6	1	0	6	2	8
		Size	27	15	9	21	14	12
4	♂♂	G	13 (9%)	0 (0%)		4	4	1
		N	128	6		230 (98%)	160 (98%)	134(99%)
		S	13	7		68	66	25
		Size	154	13		302	230	160
	♀♀	G	3 (2%)			6	2	3
		N	121			212 (97%)	133 (99%)	72(96%)
		S	26			83	77	58
		Size	150			301	212	133

G = garlic medium, N = standard medium, S = Source and Size = sample size.

Values between brackets are percentages based on the total number of beetles that left the source.

TIB-19

The runs were performed in the same way as in the selection experiment (this issue of TIB). The only difference was that the beetles assigned for the learning experiment were run 3 times, each time using insects that had chosen the specified medium. The progeny of the beetles in each generation was split into two groups, one for the selection experiment (run once) and the other group for the learning experiment (run thrice.) Individuals used in the learning experiment were not used for the artificial selection for food preference. If the number of insects for any given run was extremely small the runs were not continued, as was the case in G4 for the garlic line.

Table 1 indicates that rerunning the beetles that chose the standard medium had improved their performance. This improvement was more pronounced in the initial generation GO (from 58%) to 94%) than for G3 and G4. These results indicate that selection for desirable behavior improves the ability to learn this behavior.

On the other hand, selection for an undesirable medium, such as garlic, resulted in an aversive response and did not change the learning ability of the beetles concerned. On the contrary, in G4 males learned not to choose garlic (negative learning). This negative response was more pronounced for females than for males. The improvement from GO to G3 in the learning ability of the males in the garlic line may be due to the ability of the males to adapt to garlic in their breeding environment up to G3. Lerner and Inouye (1968) have also found that selection for running speed can also result in selecting for ability to learn in the males but not in the females. The present observations led to the conclusion that food preference, although it has a genetic basis, could be altered by behavioral factors; one of which is learning.

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Artificial selection for food preference in T. castaneum.

In the present experiment, artificial selection was applied to examine the genetic basis of food preference for either standard medium (95%) whole wheat flour and 5% dried yeast) or garlic medium (40% garlic powder).

Material and Methods

Beetles less than one week old were used. They were starved for 24-hours before being introduced into the empty arm (Source) of a Y-shaped maze (Soliman, 1975). The beetles selecting the arm of the maze that contained the standard medium (Normal line) in the initial generation, GO, and subsequent generations were reared on that medium. Beetles selecting the garlic medium (Garlic line) were bred on garlic up to G3 after which they were bred on standard medium to produce progeny tested in G4. This was done due to the low viability of the beetles reared on garlic medium. In each generation after maze selection, the selected insects were left on the appropriate medium for 3 days after which eggs were collected for a period of 24-hours. Progeny of G3 and 4 were separated into sexes. No more than approximately 50 individuals were used in a single run. All beetles were incubated at 30°C and 70% R.H.

Results and Discussion

The results for the preference test in each generation of selection are summarized in Table 1 for the complete data. Fig. 1 presents the results of the percentages of the beetles that chose either medium calculated from the total number of beetles that left the source (active). From this graph it is evident that the preference of the Normal line for the standard medium has increased from an initial frequency of 50% at GO to a maximum of 96.7% for females and 94.2% for males at G3. However, there is a slight decrease at G4, where 88.4% of the active males and 86.1% of the active females preferred standard medium. It appears that both sexes behaved in a similar manner (X^2 = o.2 and 1.6 for G3 and 4).

Chi-squared values for the difference between the two media within each generation and line showed increasing significance from G1 to G4. In GO and G1 there was no difference in the preference of adults for either medium. The decrease in the garlic preference for the line selected for garlic preference is unexpected. From the selection results and the observed low viability of this line,

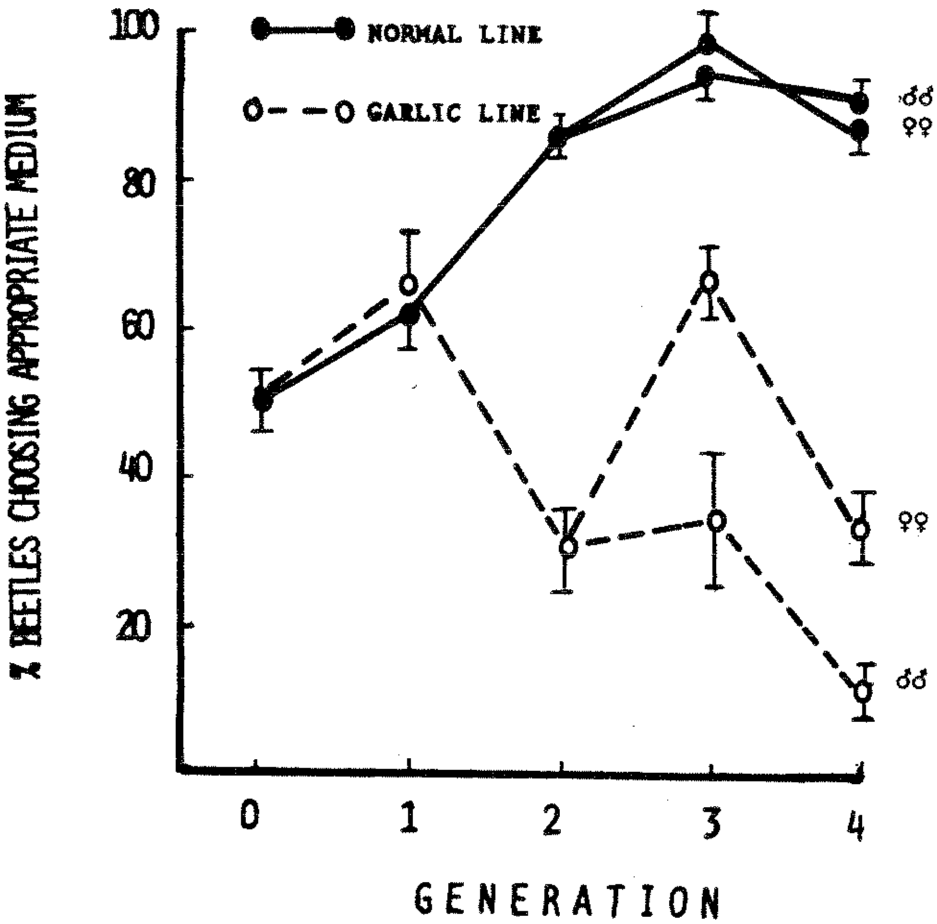

Fig. 1. Response to artificial selection for preference to either standard *Tribolium* medium or medium supplemented with 40% garlic powder. Standard deviations of percentages, SD, were calculated from the formula SD $=\sqrt{[P(1-q)N]}\,100$ where P is the percentage of beetles choosing a given medium [out of N number of beetles that left the source] expressed as a decimal fraction.

Table 1. Artificial selection for food preference of adults of *T. castaneum*.

Generation	Sex	Garlic line: Percentages of adults in each arm			Number tested	Normal line: Percentages of adults in each arm			Number tested
		Garlic	Standard	Source		Garlic	Standard	Source	
0						30.7	30.7	38.6	153
1		65.5	34.5	0	32	25.0	40.0	35.0	108
2		22.6	53.0	24.4	79	11.6	65.3	23.2	311
3	♂♂	22.5	42.5	35.0	40	3.9	62.8	33.3	51
	♀♀	52.7	27.3	20.0	55	2.3	68.1	29.6	44
4	♂♂	9.3	82.1	8.6	140	10.0	77.0	13.0	300
	♀♀	27.6	54.8	17.6	149	10.0	62.0	28.0	300

it seems that the concentration of 40% of garlic has a harmful effect, possibly as that previously observed for phenyl-thi-carbamide (Soliman, 1974). Therefore, it could be postulated that the observed results for the behavioral selection in this line are due to a negative feedback mechanism to counteract this harmful effect. The negative response to garlic was more pronounced for males than females. This sex difference could be due to some secondary sexual characteristic interferring with chemoperception of the two media which is probably localized in the antennae (Soliman, 1975). In the silk work moth (Bombyx) the male shows a strong behavioral reaction to bombykol while the female does not, which indicates that the female is lacking a receptor specific to bombykol and related substances (Schneider, 1963).

The present results indicate that the avility of the beetles to distinguish between the two media is under genetic control. It is worth mentioning that the rapid response obtained in such a short period of time has also been observed by Lerner and Inouye (1968) who selected for speed of maze-running in both T. castaneum and T. confusum. This rapid response may indicate that the number of genes which control food selection may be small in the present case. More detailed and controlled experiments will undoubtedly reveal useful information about the genetics of food and habitat selection by the flour beetles as a behavioral mechanism for adaptation to their variable and available environments under natural and semi-natural conditions. The use of the wide range of antennal mutants in Tribolium will enhance this field of investigation since food seeking and selection is mediated by the antennae, the sensory organ for the olfactory cues in the flour beetles (Soliman, 1975).

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Notes - Research

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Esterase isozyme of some Tribolium strains.

Introduction

Isozyme patterns detected by gel electrophoresis are useful genetic markers in a large number of animal and plant species. Separation of proteins by electrophoresis is now the most sensitive method available for detecting genetic variation, in animal and plant populations.

We know of only two preliminary reports on the use of this method with *Tribolium*. Since this beetle is one of the most commonly used laboratory insect in population research, we feel that additional information on isozyme patterns in this insect may be useful for many colleagues.

In this report we describe the results of extensive work with one group of enzymes--namely Esterases--in two species of *Tribolium*.

Materials and Methods

A general description and discussion of the methodology of gel electrophoresis from a genetic viewpoint is given by Lewontin (1974). We shall assume that the reader is familiar with the principles, and describe only those aspects relevant to our own work.

(1) Gel Preparation. We used 6% Acrylamide slab gels and a continuous, 0.1M Borate buffer system pH 8.2

(2) Homogenates. Single beetles were homogenized in 0.1 ml of 10% sucrose in 0.1M Tris-Borate-EDTA buffer, pH 9.2 (Shaw and Prasad, 1970). Bromphenol Blue was added to the homogenizing solution to form an anodally fast-migrating front line.

(3) Separation. Samples of about 25 microliters of the homogenate were introduced into pockets in the acrylamide gel. Gels were run in constant current of about 4 mA per cm of gel width, for about 2 hours, in the refrigerator.

(4) Staining was done in 0.1M phosphate buffer, pH 6.5, using α-Naphthyl Acetate as substrate and Fast Blue RR as dye (Shaw and Prasad, 1970). At room temperature, bands appeared within 15-30 minutes.

(5) Fixation and preservation of the gels. After staining for about 2 hours, the gels were fixed overnight in a 5:5:1 mixture of water: Methanol: Acetic Acid. They were then placed on filter paper and held tight by a piece of Nylon bolting cloth at room temperature for about 3 days. The gels dried and remained attached to the filter paper. (Acrylamide gels do not adhere to the nylon). The dry gels may be stored in this way for extended periods.

Results

All esterases we measured migrated to the anode (in other work, using starch gels, we found indications of some cathodally-migrating esterases, but these are not included in the report since they were not analysed in any detail). Four esterase systems could be detected which we numbered from the fastest (Est-1) to the slowest (Est-4).

There were differences in esterase patterns between adults, larvae and pupae.

I. Adult esterases

(a) Tribolium castaneum, the black strain CS bb (see stock list).

In the course of our work with this strain, several inbred lines were propagated in which different variants of Est-1 predominated. Four of these variants are illustrated in Fig. 1. The variants 1(S), 2(F), and 4(FS) were the most common. In some inbred lines there were two S bands. Very rarely, a fifth variant was found with a weak fast band migrating as fast as the anodal end of the F band.

EST-2 appeared as one or two bands (Figure 1).

EST-3 and EST-4 usually appeared as diffuse bands, and staining was variable.

(b) *T. castaneum* - the wild type strain, CS++ (see stock list).

In this strain we found only two of the EST-1 variants; either F or FS variants 2 and 4 in Figure 1. These variants were electrophoretically identical to those of CS bb. In more than 200 beetles electrophoresed the slow variant (S) was never found.

(c) *T. castaneum* - the eu strain (see stock list).

This strain was obtained from F_2 of a cross between a mutant CS bb female and a normal, CS++ male (Wool and Mendlinger, 1972, 1973). We have tested two substrains derived from it - eu++ and eu bb (phenotypically showing wild type or black body color) for esterases.

The esterase pattern of eu++ was similar to CS++, and that of eu bb was similar to CS bb.

(d) Tribolium confusum, the black strain CF bb (see stock list).

The esterase pattern of CF bb adults was clearly different from all CS strains. (Fig. 2, compare cells 4-5 with 6-7). The fast-migrating esterases migrated faster than the F band of EST-1.

II. Esterases of Immatures

The esterase patterns of immatures were different from the adult pattern. In all T. castaneum strains the changes in esterase patterns during ontogeny were similar. (Figure 3). EST-1 stained more strongly in larvae than in adults. In the pupal stage EST-1 disappeared (in fact, this happened already in the quiescent period before pupation) and reappeared in the older pupae, before adult emergence. The first band to appear in the pupa was the one described as variant 3. Another clear difference between larvae and adults was apparent in EST-4 which stained much more strongly in larvae.

In T. confusum (Fig. 2) the two fast migrating bands stained clearly in the larva, disappeared in the pupa, and reappeared as strongly-stained bands in the adult. However, in addition, a strong band appeared in the pupal stage, which was not visible in either larvae or adults. (Cells 1-3 in Fig. 2).

Those esterases which changed activity during ontogeny were located, in both species, in the alimentary canal. When the intestine was removed from the larvae and electrophoresed separately, all activity was found in the intestinal homogenate and not in the rest of the body.

III. Enzyme-substrate specificity.

The esterases were routinely stained using α- Naphthyl Acetate as substrate, but they stained just as well using β - Naphthyl Acetate and α- Naphthyl propionate. When α- Naphthyl Laurate were substituted, the EST-1 F bands stained well, but the S bands were weak or invisible.

Discussion

Esterases were chosen for this study because they are easily separated and stained. Further studies on other enzymes are under way.

Our experience with esterases shows that they can be useful genetic markers for Tribolium strains and species. One advantage of these markers is that they can be identified in the immature stages (most available morphological markers are detectable only in the adult stage). The esterase patterns of T. castaneum and

T. confusum are clearly different from each other, while different *T. castaneum* strains have the same bands, although not in the same frequencies.

The choice of esterases as markers must be done carefully, to avoid confounding genetic with ontogenetic differences. EST-1 bands cannot be used as markers in *T. castaneum* pupa because they disappear just before pupation. A similar behavior of esterase patterns during ontogenesis was described in Drosophila (e.g. Berger and Canter, 1973, Korochkin, 1974).

Genetically, we analyzed only EST-1 bands in detail. The F and S bands were first thought to represent two alleles at the same locus. The frequencies of S, FS, and F in the CS *bb* stock population were approximately 1 : 2 : 1; (about 150 beetles were electrophoresed). From the stock we easily derived strains with only F and only S phenotypes. However, later work forced us to reject this hypothesis, because of the following evidence:

1) We have 7 lines (derived from single pairs of a cross of CS++ x CS *bb*, both with FS phenotype) which consistently showed the FS phenotype in all their offspring for several generations (as though they are fixed for the "Heterozygous" condition).

2) When these "mixed" lines were crossed back to the S parent, there still was no segregation and all the offspring were FS.

3) In the collection of approximately 40 CS *bb* inbred lines derived from the stock, there are some which segregate only S and FS, or alternatively on F and FS, but not all three genotypes, as should be the case in a two allele, one locus model. These phenomena could be explained if homozygous FF or SS were severely selected against (lethal), but this is not the case since we have flourishing "homozygous" F and S strains.

We now suggest the following genetic model to explain our results. The EST-1 bands represent two loci, F and S, and each has an alternative "null" allele. The F site is composed of two closely-linked genes which we label Fl and Fs. The S site is located away from F so that some recombination is possible. The F and S genotypes could be

$$\frac{F_1,F_2\ 0}{F_1,F_2\ 0} \quad \text{and} \quad \frac{00\ S}{00\ S}$$

If the model is correct, the "fixed" FS lines could arise from a recombination event in a hybrid between F and S:

$$\frac{F_1F_2\ 0}{0\ 0\ \ S} \longrightarrow \frac{F_1f_2\ S}{F_1F_2\ S} + \frac{00\ 0}{00\ 0}$$

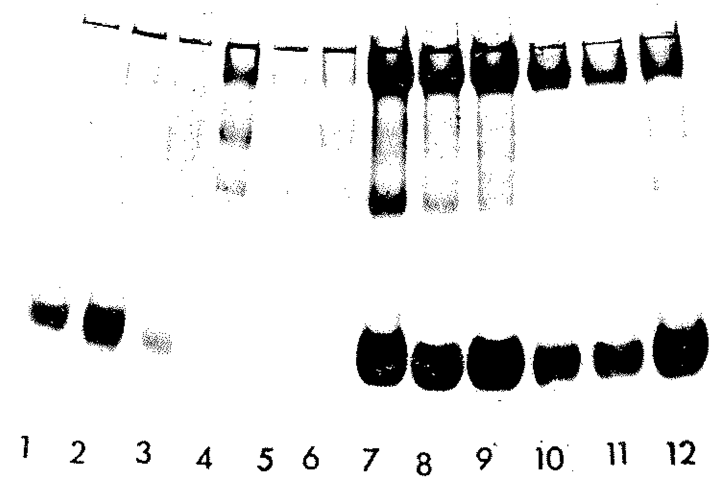

Fig. 1.

Four EST-1 variants of CS bb. (The fastest migrating system).
(1) Cell 9, a weak, slow (s) band.
(2) Cells 6-7, a fast, strongly-staining (F) band.
(3) Cells 3-5, a weak, fast band.
(4) Cells 1,2, both F and S.

Notice also the EST-2 bands (one band in cells 1,2,7,8,9; two bands in cells 3-5).

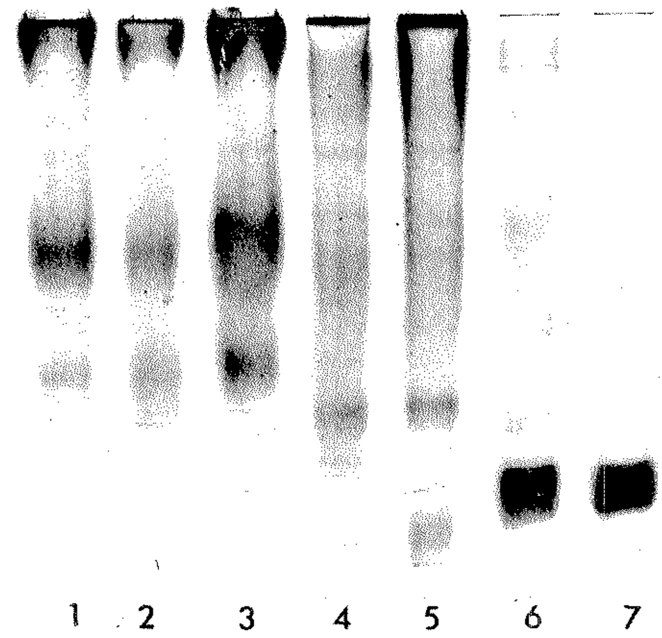

Fig. 2.

Esterases of CF bb.
Cells 1-3, pupae.
Cells 4-5, larvae.
Cells 6-7, CS bb **adults** (for comparison) **the FS variant** (4).

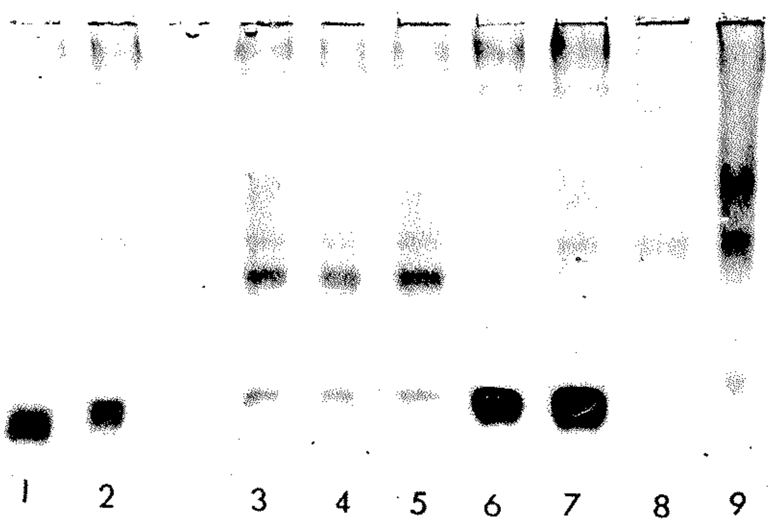

Fig. 3.

Esterases of CS bb. The F variant (2), from left: Cells 1-3, Adults; 4-6, Pupae; 7-12, Larvae.

Notice the clear bands of Est-2, Est-3 and Est-4 in the immatures, in particular Est-4 in the larvae.

The "double null" (no EST-1) case may be almost lethal because such cases were not detected. Recombinants having only one F band (such as variant 3 in fig. 1) are rare because linkage between F_1 and F_2 is very tight. We have some evidence to the effect that both F and S sites may be linked to the black locus (the similarity of eu bb to CS bb and of eu++ to CS++ also hints in this direction). More data are being gathered to verify the genetic model.

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Acknowledgements

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The response of Tribolium confusum to Penicillium isolates in the medium.

As part of a study of the relationship of storage fungi to stored product insects, we screened *Penicillium* isolates for nutritional and/or toxic effects on *Tribolium confusum*. *Penicillium*-wheat cultures were ground into a g our and fed to neonatal larvae. Table 1 lists some examples of the varying effects of the 18 species (26 is lates) tested. Enhancement of larval growth from an isolate like *P. chrysogenum* meant rapid larval growth, early pupation and early adult emergence. The adult was not larger than the control adult beetle. Some isolates had little or no effect on the beetles (*P. citrinum*). Others were definitely inhibitory with adults averaging somewhat smaller and larval periods longer. Mortality in this group was high. One isolate of *P. expansum* caused 52% mortality and one of *P. purpurogenum* 98%.

Many of the isolates were known mycotoxin producers. Several isolates of one species with known differences in production of toxic metabolites (example: *P. viridicatum*) gave variable results. These results were not consistent with toxic metabolite production. Consequently, we found no correlation between the ability of a *Penicillium* isolate to produce a mycotoxin and its effect on *T. confusum*.

Table 1. - Some examples of the effects of *Penicillium* isolates on the growth of *Tribolium confusum*.

Penicillium isolate:	Average weight (mg) Larva (20 da.)	Pupa	Adult
viridicatum	2.3	3.5	2.7
viridicatum	2.2	3.4	2.7
chrysogenum	2.3	3.4	2.6
cyclopium	2.1	3.4	2.7
patulum	1.9	3.5	2.8
CONTROL	1.2	3.5	2.7
citrinum	1.3	3.4	2.7
cyclopium	1.1	3.4	2.6
viridicatum	0.9	3.0	2.4
rubrum	0.4	2.9	2.5
expansum	0.2	2.8	2.2
purpurogenum	0.2	2.7	2.1
expansum	0.1	2.7	2.0

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Food preference of Tribolium confusum Duv. between sound wheat and wheat flour.

Tribolium confusum Duv. is considered to be a secondary pest which is associated with crushed or ground cereals and cereal products. In the present paper the food preference of T. confusum on two kinds of food, sound wheat and wheat flour, was studied by means of technique whereby the insects were free to chose their food.

An apparatus similar to that described by Loschiavo (1952) was used. It consisted of 2, 4 or 8 tin small sections 2 cm in height that were put together in a cylindrical chamber 14 cm in diameter. In the center of the chamber was a hole 2 cm in diameter. The chamber was put in a plastic vessel with cover (Yoshida, 1975). Each section was filled with equal weight of foods: 68, 34 or 17 g in 2, 4 or 8 sections respectively; sound wheat alternated with wheat flour. Ten unsexed adults of the beetle were introduced into the center hole and allowed to choose their food freely. The test insects were confined to the chamber 7 days at about 30°C and 75 per cent R.H. The chambers were then opened and the number of beetles in each section was counted. Some beetles were found outside of the chamber in the vessel. The experiments were replicated 5 times.

The result of the experiment was shown in Table 1.

Table 1. Distribution of 10 adults of Tribolium confusum in food preference between sound wheat and wheat flour.

Chamber Divided Into	Number of Beetles		
	Sound Wheat Mean ± S. E.	Wheat Flour Mean ± S. E.	Outside Mean ± S. E.
2 Sections	0.2 ± 0.447	9.0 ± 1.225	0.8 ± 0.837
4 Sections	0.6 ± 0.548	9.2 ± 0.447	0.2 ± 0.447
8 S ctions	0.6 ± 0.894	8.2 ± 1.643	1.2 ± 1.095

Almost all beetles preferred wheat flour to sound wheat. In addition to this it is worthy of note that the beetle showed a marked tendency to aggregation. The values of Morisita's I_δ index, a measure of dispersion of individuals in a population, were calculated (Morisita, 1959). The values are shown in Table 2.

Table 2. The values of I for distribution of *Tribolium confusum* among selected sections.

No. of Experiments	Values of I Chamber Divided Into 4 Sections	8 Sections
1	1.600	2.857
2	1.422	2.667
3	3.111	1.556
4	3.200	3.022
5	3.101	2.932

All of the values were larger than unity. The departure from randomness of the distribution was significant at the 5 per cent levels in all of the cases. This means that the distribution of beetles was contagious; 4 to 9 beetles were found frequently in one flour section.

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Notes - Technical

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A population cage for selection experiments involving Tribolium.

The population cages to be described were designed for use in selection experiments. The design fulfills several important criteria needed in our experiments: 1) allows clear separation between populations, 2) permits natural movement of beetles within and between chambers, 3) facilitates removal and replacement of vials of medium for census of progeny.

Covered, four-chambered plastic boxes, 8 3/8" x 2 3/4", (obtainable from Tri-State Plastics) are used (Figure 1). The extreme chambers house the two separate populations. Each chamber is large enough to contain five 50 x 25 mm shell vials which can be filled with the appropriate medium. The vials are easily removed for censusing progeny and for replacement with fresh medium. To allow for movement from one vial to another and from one chamber to another, simple additions to this basic cage are made. A small piece of paper, cut to size is put on the floor of each chamber to facilitate movement of the beetles on the smooth plastic. Movement of the beetles between chambers is facilitated by the use of adhesive tape "ladders" which can be attached to the partition walls and to the sides of the vials. The beetles are able to easily move from one vial to the next and from one chamber to the next.

Though these population cages were specifically designed for selection experiments, they can be adapted for use in many experiments which require some separation of populations while at the same time allow for beetle movement between populations.

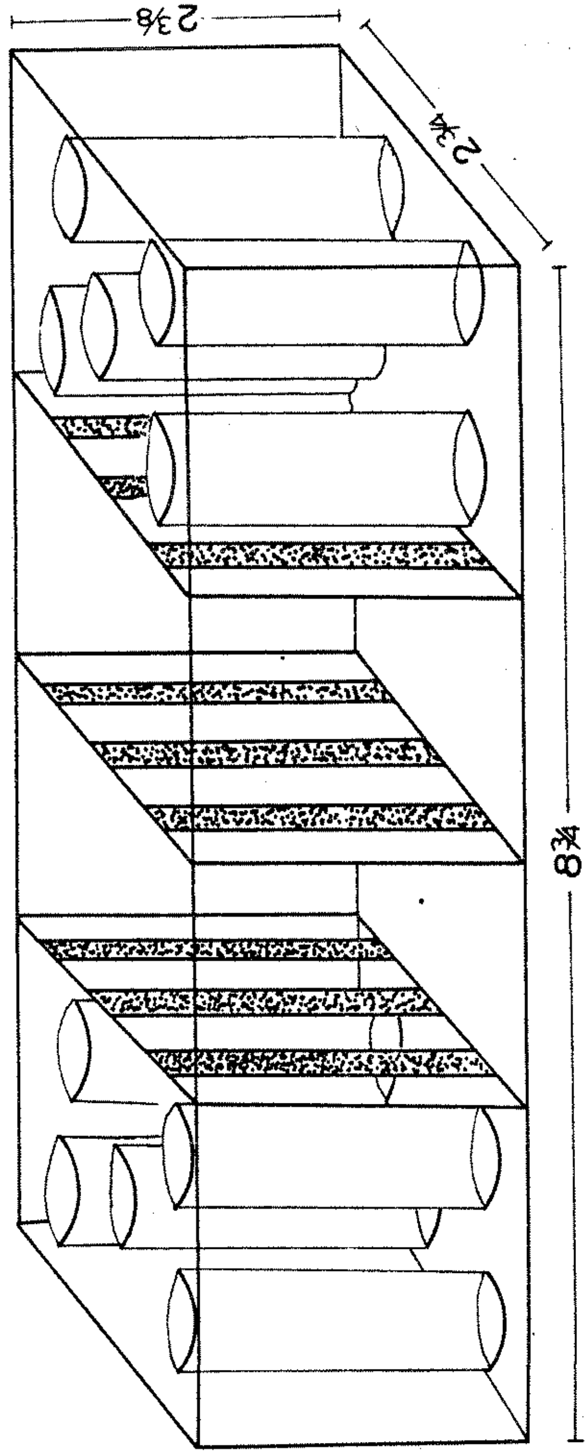

Figure 1. Side view of population cage.

Notes - Technical

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Method for photographing Tribolium metaphase chromosomes.

Living male pupae of the species under investigation were isolated and held for dissection. The best results were obtained from pupae which appeared to be in the middle of the pupal stage. Pupae which are too young for this procedure appear white and glisteny, those which are too old have attained dark melanization of their mandibles and compound eyes, and are generally of a darker color than most mid-stage pupae.

The best metaphase chromosomes were found in the pupal testes. The testes were dissected out of the pupae in a solution of 1% sodium citrate and placed immediately into a drop of acetocarmine dye solution on a glass slide. After five to ten minutes, the drop of dye containing the pupal testes was covered with a glass cover slip and then observed under the low power of a compound microscope. If any of the testicular lobes were present and undamaged, then the cover slip was covered with a piece of paper toweling and pressed upon gently with a finger or an eraser for approximately five seconds. After cleaning up any excess dye squeezed out from beneath the cover slip, the slide was once again observed under the compound microscope. If any areas were found showing metaphase activity under high-dry magnification (4000X), the cover slip was ringed with paraffin in preparation for oil immersion observation.

Oil immersion observation was done using a phase-contrast microscope at 1250X magnification. Cells exhibiting the best metaphase plates were photographed, using 4" by 5" cut film.

In order to increase the number of metaphase cells available, a method of administering colchicine to the pupae might prove useful. As of yet, this has not been tried.

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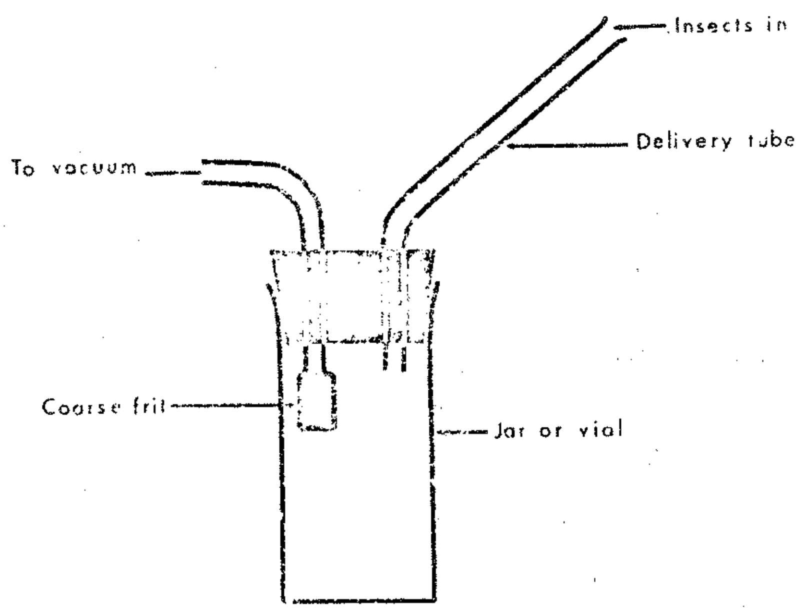
Helpful hints for the insectary.

A number of useful techniques have been developed at the Division of Microbiology insectary which may be helpful to other individuals working with stored product pests. Some are believed to have originated there, others have been gleaned from the entomological literature. It is hoped that the following items will facilitate culture propagation and handling by the reader.

A superior aspirator. Possibly the most useful tool for handling fast moving, or delicate insects, the aspirator poses at least a potential hazard. Even with a fine gauze or wire screen filter around the suction opening, the possibility of inhalation or ingestion of insect eggs occurs (1). Consequently the following fritted glass construction was developed. It also has the advantage of permitting high air flow rates when handling cultures by mechanical suction.



AN ENTOMOLOGICAL ASPIRATOR

Notes - Technical

Separation techniques for insect cultures. In addition to their obvious use in separating materials by size, sieves can be otherwise utilized in the insectary. After appropriate size-range separation a sieve fraction can still consist of insect larvae plus cast skins and culture medium residues. The first operation should be to blow most of the very light cast skins out of the sieve. If appreciable undesirable material remains, living insects can be separated by placing the retained material on a $60 sieve and allowing them to cling to the sieve fabric. The sieve is then tipped over to allow non-clinging items to fall into a pan. The live material is then jarred into a separate receiver. Repetitive handling in this manner can nearly quantitatively isolate live insects from c lture debris. Pupae may similarly be isolated "by default".

Other unusual techniques deserving mention include placing a mixture of adults, larvae and debris in a watch glass placed on a small beaker nested inside a considerably larger one. The most active fraction, usually adults, will be concentrated in the outer beaker. Similarly the mixture may be placed on a slanted plan and active material segregated at the lower end. Negative phototropism of certain species such as Alphitobius diaperinus may be utilized by placing the culture in a flat pan one-third of which is covered by a sheet of cardboard. Soon almost all adults will migrate to the dark portion.

Adult Oryzaephilus in crowded culture tend to walk upwards, so one convenient way to harvest them is to place the culture jar in a pail of CO_2 supplied by a regulator at ca 1 lb PSIG. The rim of the jar should be 1 - 1 1/2 inches above the rim of the outer pail. Insects will walk or fall into the pail where they will be rapidly narcotized. Excessive exposure to CO_2 will kill, however.

Maintaining security. Many times the investigator will want to handle fast moving live insects. If they fly, sleeve type cages are probably the only answer to absolute security, and even they have faults. For crawling forms an alternative to the expensive and cumbersome oil-moated handling table is to simply work with the culture jars standing in a tray of 70% alcohol or some reasonable equivalent. A polyethylene wash bottle filled with 70-90% isopropanol (more toxic) is handy for "shooting" escapees or generally killing off unnecessary cultures, etc.

Volumetric equipment for insect handling. When starting cultures, one of the most convenient ways of assuring that sufficient seeding adults are added is to use small dippers to measure them out. These may be made by fusing a 3 mm diameter Pyrex rod ca 3" long to the edge of a 1 ml beaker. Brass cartridge cases, thoroughly cleaned and suitably callibrated with soldered-on wire handles are also useful. Cal. .22 cartridges cut very short are useful scoops for measuring out a few mg. of moth eggs. The eggs should be weighed into a paper, transferred to a case, their level marked, and the case filed to approximately the correct height. Test dips of eggs may then be weighed to zero in on correct length.

Lids for culture jars. For quart and pint jars little problem of suitable lids occurs since two piece self-sealing caps are universally available. The outer band can be used to retain a piece of 40-mesh bronze screen and/or a filter paper disc. For larger or smaller jars, however, some easy method of cutting clean holes in metal lids must be sought. Radio chassis punches are the ideal solution. They are relatively inexpensive, and are available in 1/16 inch increments from 3/8 inch to 2 inch diameter. Consequently even small vials may be provided with wire screen closures. For 1 gallon wide mouthed jars the big meter-size punch 2-25/32 inches in diameter is excellent. (Greenlee No 730 M or equivalent). This provides the investigator with excellent rearing containers at minimal expense.

Storage of culture media. The large two, three, and five gallon wide-mouthed jars ("glass buckets") available from various laboratory supply houses, or the Atlantic Glass Co. are excellent storage containers. Their 132 mm cap size permits access by a large ladle or scoop for removal of contents. The screw cap construction excludes insects. They are also adequate substitutes for the more costly desiccators, normally used for constant humidity chambers. When used for this purpose the investigator's ingenuity must be taxed to design a suitable receptacle for the satured salt solutions required.

Introduction of egg laying. Certain insects such as the cadelle, Siamese grain bettle and the cigarette beetle prefer to oviposit in crevices. Artificial crevices (2) may be provided by placing a small piece of filter paper between two microscope slides, or 1 x 1 inch acrylic plastic squares held together with rubber bands. The paper should be ca 1/4 inch smaller in dimension than the outer members. Stacks of filter paper or blotting paper squares also are useful, but eggs cannot be seen when they are used.

Footnotes

(1) Hurd, P.D. 1954. "Myiasis" resulting from the use of the aspirator for the collection of insects. Science 119:814-815.

(2) Bond, E.J. and Monro, H.A., 1954. Rearing the cadelle (Tenebroides mauritanicus) as a test insect for insecticidal research. Can. Ent 86:402-408

Notes - Technical

Haydak's #1 medium.

Corn meal thru #30 sieve	4 parts by weight
Powdered skim milk #30 sieve	2 parts by weight
Wheat flour (white) *	2 parts by weight
Bran thru #30 sieve	2 parts by weight
Brewers' yeast	1 part by weight
Wheat germ * thru #30 sieve	1 part by weight

* or 2 parts whole wheat flour instead of white flour + germ.

Haydak's #2 medium.

Add enough 1+1 honey and U.S.P. glycerin mixture to the above mixture to produce a very dry, but slightly cohesive paste. (About 30 ml liquid to every 100g Haydak's #1).

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The division of microbiology insectary.

The object of this insectary is to provide constant supplies of storage insects, both living and preserved, for research. We ordinarily discourage colonization of stored food pests by District laboratories in order not to compromise their forensic posture by the presence of excessive numbers of the very insects whose fragments they are isolating from samples. It therefore behooves the Division of Microbiology to provide a centralized source of such insects. This is becoming more important recently, as economic considerations have forced many other sources which FDS could have utilized in the past, to curtail rearing activities. As far as can be determined, we now possess a broader spectrum of stored food cultures than any other institution in the United States! Uses of these stocks include reference material for identification of whole, and fragmentary insects, production of authentic insect fragments for recovery experiments, and living insects for life-history, package invasion, and pheromone attraction studies.

The more important beetle and moth pests of stored food are listed below, together with comments on the status of those currently maintained in culture. (As of April 1, 1976)

Coleoptera

Anobiidae

Lasioderma serricorne - Cigarette beetle

Cultures are currently in good condition, although they have nearly been destroyed in the past by *Pyemotes* mites. Considerable preserved material available.

Stegobium paniceum - Drugstore beetle

Cultures are not adequately vigorous. In spite of culturing several isolates of this species on several substrates, the species has never built up to satisfactory levels. Possibly we are dealing with enzootic disease. Experimental rearing on Purina Trout Chow may be successful. This species is susceptible to *Pyemotes* mites. Considerable preserved material available.

Notes - Technical

Anthribidae

Araecerus fasciculatus - Coffee bean weevil

Cultures have nearly died twice due to desiccation. This species requires more care than many storage pests. Colony may not survive. Some preserved material available.

Bostrichidae

Rhyzopertha dominica - Less grain borer

Good vigorous cultures. Susceptible to *Pyemotes* mites. considerable preserved material available.

Bruchidae

Acanthoscelides obtectus - Bean weevil

Good vigorous cultures. Susceptible to *Pyemotes* mites. Considerable preserved material available.

Callosobruchus analis - never cultured at DM

C. maculatus - Southern cowpea weevil

Formerly in culture, but killed by *Pyemotes* mites. Considerable preserved material on hand.

C. chinensis - never cultured at DM

Cleridae

Necrobia rufipes - Red legged ham beetle

Good vigorous cultures. Cultures can survive long periods of neglect. Moderate quantity of preserved specimens available. This uncommon species may not be cultured in any other U.S. laboratory.

Cucujidae

Cryptolestes ferrugineus - Rusty grain beetle

Cultures nearly dead.

C. pusillus - Flat grain beetle

Good vigorous cultures. Some preserved specimens on hand.

C. turcicus - "Turkish grain beetle"

Good vigorous cultures. Some preserved specimens on hand.

Curculionidae

<u>Sitophilus granarius</u> - Granary weevil

Cultures a bit "slow" - may be diseased or parasitized. Susceptible to <u>Pyemotes</u> mites. Considerable preserved material.

<u>S. oryzae</u> - Rice weevil

Cultures and <u>Pyemotes</u> susceptibility as above. Considerable preserved material.

<u>S. zeamais</u> - Maize weevil

Cultures killed by <u>Pyemotes</u> mites. No preserved material available except for ca. 100 adults.

Dermestidae

<u>Anthrenus flavipes</u> - Furniture carpet beetle

Cultures very weak, will probably survive. Cultures can, and usually do, survive long periods of neglect. Some preserved specimens available.

<u>A. verbasci</u> - never cultured at DM

<u>A. scrophulariae</u> - never cultured at DM

<u>Attagenus megatoma</u> - Black carpet beetle

Good vigorous cultures. Some preserved material available.

<u>A. pellio</u> - never cultured at DM

<u>Dermestes frischii</u> - never cultured at DM

<u>D. lardarius</u> - Larder beetle - never cultured at DM

<u>D. maculatus</u> -

Cultures died of desiccation. Some preserved material on hand.

<u>Trogoderma glabrum</u> -

Cultures dead, reason not determined. No preserved material available.

Notes - Technical

T. inclusum - Larger cabinet beetle

Good vigorous cultures. This species survives long periods of neglect. Some preserved material available.

T. variable -

Cultures growing acceptably. No preserved material available yet.

Languriidae

Pharaxonotha kirschii - Mexican grain beetle

Never cultured at DM

Mycetophagidae

Typhaea sterocorea - Hairy fungus beetle

Culture dead, reason not determined. No preserved specimens available.

Nitidulidae

Carpophilus dimidiatus - corn sap beetle

Never cultured at DM

C. hemipterus - Dried fruit beetle - never cultured at DM

C. freemani - never cultured at DM

C. lugubris - Dusky sap beetle

Cultures dead. *Carpophilus* require considerable care on a day to day basis. Larvae pupate in damp sand. This causes serious mould problems; however, if sand dries out, pupae die. No preserved material available.

Ostomidae

Lophocateres pusillus - Siamese grain beetle

Good vigorous cultures. Cultures survive long periods of neglect. No preserved material available yet.

Tenebroides mauritanicus - Cadelle

Good vigorous cultures. Susceptible to *Pyemotes* mites. Some preserved material available.

Ptinidae

Gibbium psylloides - Humped spider beetle

Good vigorous cultures recovered from a total of 3!! adults left as a result of Pyemotes infestation. Considerable preserved material on hand.

Mezium americanum - never cultured at DM

Ptinus fur - White marked spider beetle

Never cultured at DM

P. tectus - Australian spider beetle

Never cultured at DM

Trigonogenius globulus - never cultured at DM

Silvanidae

Ahasverus advena - Foreign grain beetle

Good vigorous cultures. Some preserved specimens available.

Cathartus quadricollis - Square necked grain beetle

Cultures killed by Pyemotes mites. Considerable preserved material on hand.

Oryzaephilus mercator - Merchant grain beetle

Cultures killed by Pyemotes mites. Considerable preserved material available.

O. surinamensis - Sawtoothed grain beetle

Good vigorous cultures. Susceptible to Pyemotes mites. Considerable preserved material available.

Tenebrionidae

Alphitobius diaperinus - Lesser meal worm

Good vigorous cultures. Considerable preserved material available.

A. piceus - Black fungus beetle - never cultured at DM

Cynaeus angustus - Larger black flour beetle

Cultures moderately vigorous. We should attempt to maintain large numbers of this uncommon species. A few preserved specimens on hand.

Gnathocerus cornutus - Broad horned flour beetle

Never cultured at DM

G. maxillosus - Slender horned flour beetle

Cultures moderately vigorous. Some preserved material available.

Latheticus oryzae - Long headed flour beetle - never cultured at DM

Palorus ratzeburgi - Small eyed flour beetle

Good vigorous cultures. Some preserved specimens on hand.

P. subdepressus - Depressed flour beetle

Never cultured at DM

Sitophagus hololeptoides

Diseased cultures obtained from ARS labs in Savannah. We were unable to establish a colony of this species.

Tenebrio molitor - Yellow mealworm

Cultures surviving. This species could be culled from the collection since it is available in most pet shops. Some preserved specimens on hand.

T. obscurus - Dark mealworm

Culture may be too small to permit reproduction, as males and females probably will not mature at the same time. Some preserved material on hand.

Tribolium audax - American black flour beetle

Good vigorous cultures. Considerable preserved material available.

T. castaneum - Red flour beetle

T. confusum - Confused flour beetle

Both of the above available as vigorous cultures and large amounts of preserved material.

T. destructor - False black flour beetle

Cultures a little weak, but appear to be established. Very few preserved specimens on hand.

Lepidoptera

Gelechiidae

Sitotroga cerealella - Angoumois grain moth

Cultures killed by *Pyemotes* mites. Some preserved larvae available.

Phycitidae

Ephestia kuehniella - Mediterranean flour moth

Never cultured by DM

E. cautella - Almond moth

Cultures killed by *Pyemotes* mites. Considerable preserved larvae available.

E. elutella - Tobacco moth

Cultures in acceptable condition. Considerable preserved larvae available.

E. figulilella - Raisin moth - never cultured at DM

Plodia interpunctella - Indian meal moth

Cultures in acceptable condition. Considerable preserved larvae available.

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Carbondale, Illinois (Continued)

*Fogle, Thomas A., B.S. Teaching Assistant. Population genetics. (7)

*George, Rachel, M.Sc. Teaching Assistant. Physiological genetics. (7)

Grinde, Katherine E., B.A. Graduate Fellow. General genetics. (7)

Kline, John P., M.S. Graduate Assistant. Population genetics. (7)

Lees, Judith A., B.A. Medical School Lab Preparation. General genetics. (7)

Chicago, Illinois
University of Illinois at Chicago Circle
Department of Biological Sciences

Cawthon, David A., B.A. Technician and graduate student. (5)
Craig, David D., M.S. Graduate student. (5)
Mertz, David B., Ph.D. Professor. (5)
Wagner, Janice, B.A. Graduate student. (5)
Wu, Ai-Chu, B.S. Graduate student. (5)

+Chicago, Illinois
University of Chicago
Department of Zoology

Lloyd, Monte, Ph.D., Population ecology
Park, Thomas, Ph.D., Professor

+Oak Park, Illinois
Oak Park River Forest High School
Biological Sciences Research Project

Geisert, Paul, Director, Biological Sciences Research Project (5)

Urbana, Illinois
University of Illinois
Department of Dairy Science

Grossman, M., Ph.D. Population and quantitative genetics. (7)

Urbana, Illinois
University of Illinois
Department of Physiology and Biophysics

Blakely, E., M.S. (Biophysics) - Radiation biology; cell culture. (40

Urbana, Illinois (Continued)

Chiu, M., M.S., (Physiology) - Radiation biology. (9)
Ding, G., M.S., (Microbiology) - Radiation biology; aging. (9,13)
Ducoff, H.S., Ph.D., Professor of Physiology and Biophysics and of Bioengineering - Radiation biology (repair mechanisms, life-span changes_: disease-resistance in insects. (9,13)
Garner, M., B.S., - Radiation biology. (9)
Lai, P., M.S., (Chemistry) - Radiation biophysics (repair mechanisms); cell culture. (3,9)
Plummer, S., B.S. - Radiation biology; aging. (9,13)
Wanna, S., M.S., (Biology) - Radiation biology; mathematical biology. (9,16)

West Lafayette, Indiana
Purdue University
Department of Biological Sciences

Fujii, K., Ph.D. (7)

Lafayette, Indiana
Purdue University
Department of Animal Sciences and USDA Agric. Research Service

Babb, Eleanor E., Genetics Research Technician
Bell, A. Earl, Ph.D. Professor (5,7)
Carbonell, Emilio, Dr. Ing. Agron., INIA Fellow. (5,7)
Gajic, Zivorad, Ph.D., Fulbright Research Scholar. (5,7)
Melhorn, Pamela L., B.S., Genetics Research Technician
Miles, Deborah A., B.S., Genetics Research Assistant
Muir, William M., M.S., Graduate Assistant
Picologlou, Susan M., M.S., Graduate Student
Rich, Stephen, B.S., Graduate Assistant
Wilson, Stanley P., Ph.D., U.S.D.A. Research Geneticist. (7)

+Muncie, Indiana
Ball State University
Department of Physiology and Health Science

Henzlik, Raymond E., Ph.D. Radiation effects. (9)

+Notre Dame, Indiana
University of Notre Dame
Department of Biology

Bender, Harvey A., Ph.D. Genetics. (7)
Griffing, Thomas C., Ph.D. Ecology. (5)

+Ames, Iowa
Iowa State University of Science and Technology
Department of Animal Science

*Freeman, A.D., Professor. (7)

Manhattan, Kansas
Kansas State University
Department of Entomology

Charlton, Loretta, Laboratory Assistant. (12)
Mills, Robert B., Ph.D. Associate Professor, Stored-product insects. (12)
Partida, Gregory J., Ph.D. Assistant Professor. (12)
White, Stephen, Undergraduate Hourly Employee. (12)

Lexington, Kentucky
University of Kentucky
Department of Animal Science

Goodwill, Robert, Ph.D., Population and quantitative genetics. (7)
Tan, Sam, B.S. Technician
Walker, Roger, B.S., Graduate Student, Population and quantitative genetics. (7)

Baltimore, Maryland
The John Hopkins University
School of Hygiene and Public Health
Department of Pathology

Nathanson, Michael (5)

+Beltsville, Maryland
United States Department of Agriculture
Agricultural Research Service
Animal Husbandry Research Division

Kinney, T.B., Jr., Ph.D., Population genetics (located at Lafayette, Indiana). (7)
Lepore, P.D., Ph.D. Biochemical genetics. (7,13)
Sarvella, P.A., Ph.D. Cytological genetics. (4,7)
Tindell, L.D., Ph.D. Population genetics (located at Athens, Georgia). (7)

+Natick, Massachusetts
Applied Entomology Group
Pioneering Research Laboratory
U.S. Army Natick Laboratories

Florentine, G.J., Ph.D. Research entomologist. Sensory physiology of insects. (13)
Gingrich, J., 1LT, Ph.D. Research entomologist. Effect of ultraviolet on cockroaches. (13)
Pratt, J.J., Jr., PhD. Group Head. Toxicology, insect nutrition, behavior of rodents. (2,10,13)
Smith, L.W., Jr., Ph.D. Research entomologist. Insect behavior and ecology. (2,5)

Entomology Group

Cohen, S., M.S. Biologist. Genetics. (7)
Raisbeck, B., Ph.D. Biologist. Insect Tissue Culture. (3)
Roth, L.M., Ph.D. Group Head. Behavior and reproduction in cockroaches. (2,13)

Norton, Massachusetts
Wheaton College
Department of Biology

Kircher, J.C.
Keim, Barbara Howell (5)

+South Lancaster, Massachusetts
Atlantic Union College
Department of Biology

Kissinger, D.G., Ph.D. Taxonomy, genetics and development of Curculionidae. (3,5,17)

+East Lansing, Michigan
Michigan State University
Department of Zoology

Slatis, Herman M., Ph.D. Population genetics. (7)

+East Lansing, Michigan
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Biology Research Center

*Scheidt, G.C.

+Midland, Michigan
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Bioproducts Department

Whitney, W.K., Ph.D. Insect physiology and toxicology. (13)

+St. Paul, Minnesota
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Boylan, W.J., Ph.D. Quantitative genetics. (7)

St. Paul, Minnesota
University of Minnesota
Institute of Agriculture
Department of Entomology, Fisheries, and Wildlife

De Las Casas, Ernesto, Ph.D. Research Associate. Micro-organisms associated with stored grain insects. (5,11,12)
Dunkel, F.V., Ph.D. Postdoctoral Fellow. Effect of food additives on stored grain insects and protozoan associates. (5,12)th
Harein, P.K., Ph.D. Professor. Stored product insect management. (12)
Wright, Valerie F., M.S. Research Assistant. Relationship of insects, fungi and mycotoxins in stored products.

St. Paul, Minnesota
University of Minnesota
Department of Genetics and Cell Biology

Braskerud, Ove A., B.A., Associate Scientists, Population genetics. (7)
Comstock, Ralph E., Ph.D. Professor. Population genetics. (7)
Enfield, Franklin D., Ph.D. Professor. Population genetics. (7)
Hartung, Nancy Z., B.A., Graduate Student, Population genetics. (7)
Kaufman, Pamela K., Ph.D., Postdoctoral Fellow, Population genetics. (7)

Kirksville, Missouri
N.E. Missouri State
Science Division

Bell, Max E., Ph.D. Ecology. (5)

Kirksville, Missouri (Continued)

Bywaters, James H., Ph.D. Genetics. (7)
Dimit, James E., M.A. Ecology. (5)
Hanks, David L., Ph.D. Microbiology. (11)
Jay, Austin E., Ph.D. Physiology. (13)
Kangas, Donald E., Ph.D. Limnology and ecology. (5)
Mock, Orin B., Ph.D. Endocrinology. (13)
Rosebery, Dean A., Ph.D. Wildlife.
Sells, Gary D., Ph.D. Physiology. (3)
Shaddy, James H., Ph.D. Entomology. (12)

Madison, New Jersey
Farleigh Dickinson University
Department of Biology

Huber, Ivan, Ph.D. Population biology and systematics of cockroaches; Genetic control of the German cockroach. (1,5,7,17)

South Orange, New Jersey
Seton Hall University
Department of Biology

Katz, Frank F., Ph.D. Parasitology. (11)
Krause, Eliot, Ph.D. Genetics and Population genetics. (7)

Ithaca, New York
New York State College of Agriculture
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Department of Animal Husbandry

Hogue, D.E., Ph.D. Nutrition. (10)
Van Vleck, L.D., Ph.D. Animal breeding. (7)

+Ithaca, New York
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Kuntson, Lloyd V., Ph.D.
Kramer, John P., Associate Professor. (11)
Tschinkel, Walter, Ph.D. (13,17)

New York City (Flushing), New York
Queens College of the City University of New York
Department of Biology

Calhoon, Robert E. (7,15,16)

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+Rochester, New York
University of Rochester

Waddington, C.H., C.B.E., Sc.D., D.SC., F.R.S. Professor. (7)

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Union College
Department of Biological Sciences

Boyer, John F., Ph.D. (5)

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State University of New York at Stony Brook
Department of Ecology and Evolution

Beckman, Brenda, Undergraduate student, Ecological genetics.
Faith, Daniel, B.A., Graduate student, Ecological genetics.
McCauley, David E., B.S., Graduate student, Ecological genetics.
Sokal, Robert R., Ph.D., Professor, Ecological genetics. (5,7)
Wasserman, Steven, B.A., Graduate student, Behavioral ecology.
Wieland, Judith, B.A., M.A., Graduate student, Ecological genetics.

NORTH CAROLINA

+Raleigh North Carolina
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Grosch, Daniel S., Ph.D. Professor of Genetics. Cytological and genetic effects of chemical and physical agents. (4,7,13)

NORTH DAKOTA

+Fargo, North Dakota
Metabolism and Radiation Research Laboratory
Insect Genetics and Radiation Biology Section

Chang, T.H., Ph.D. Insect tissue culture. (3)
Flint, Hollis M., Ph.D. Insect radiation sterilization. (9)
Klassen, Waldemar, Ph.D. Insect genetics. (7)
LaChance, Leo E., Ph.D. Insect genetics, radiobiology. (7,9)
Riemann, John G., Ph.D. Insect cytology. (4)
Wagoner, Dale E., Ph.D. Insect genetics. (7)

Grand Forks
University of North Dakota
Institute for Ecological Studies

Kannowski, Paul B., Ph.D. (2, 5, 13) Pheromones and behavior.

OHIO

Bowling Green
Bowling Green State University
Department of Biology

Schurr, Karl, Ph.D. (9,12,13)

+Marietta
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Brown, Wm. P., Ph.D. Population genetics. (7)

OKLAHOMA

Norman
University of Oklahoma
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Sonleitner, Frank J. Associate Professor. (5)

OREGON

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Dawson, Peter S., Ph.D. Population biology (5, 7).
Riddle, Russel A., Population biology (5, 7).

PENNSYLVANIA

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Dickinson College
Department of Biology

*McDonald, Daniel J., Ph.D. Population genetics. (7)

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Immaculata College
Cancer Research Unit

Ladisch, Rolf K., Ph.D. Research Associate. Insects *Tribolium* spp.; odorous secretion. (13)
Ladisch, Stephan K., Research Assistant.
Suter, Sister M. St. Agatha, Ph.D. Director and Biology Professor. Insects *Tribolium* spp.; odorous secretion. (13)

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Sillman, E.I., Ph.D.

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College of Agriculture and Mechanic Arts
Biology Department

*Gonzalez Ramos, Pedro, Ph.D. Genetics. (7)

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Scully, A.M.M., M.S., Graduate Assistant. (5,7)
Jillson, D., M.S., Graduate Assistant. (5,7)

TEXAS

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Sam Houston State University
Department of Biology

Dewees, Andrew A., Ph.D. Population genetics. (7)

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Box 2391, TWU Station
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Erdman, Howard E., Ph.D., Radiation biology, Ecology and genetics. (5,7,9)

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*Grundmann, A.W., Ph.D. Parasitology and medical entomology. (11)

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Howell, Barbara L., M.S. Graduate student.
Murray, J.J., Ph.D. Ecological genetics. (5,7)

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George Mason College
Department of Biology

*Stanley, M.S.M., Ph.D. Development of Tribolium confusum. (3)

WASHINGTON

+Seattle
University of Washington, Burke Museum

Hatch, Melville H. (17)

WASHINGTON, D.C.

Department of Health, Education & Welfare
Division of Microbiology

Vazquez, A.W., Ph.D. (5,12)

WISCONSIN

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Zoology Department

Lange, E.L., Ph.D., Assistant Professor. (7)

U.S.S.R.

Mowcow
All-Union Grain & Grain Products
Research Institute

Cherkovskaya, A. Ya.