TRIBOLIUM INFORMATION BULLETIN

Number 16

Editor: A. Sokoloff, School of Natural Sciences

California State College, San Bernardino

California

1973

NOTE

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TRIBOLIUM INFORMATION BULLETIN

Number 16

March, 1973

[illegible]

Notes - Research (continued)

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Bibliography (continued)

Foreword

During the past year I was notified by the National Science Foundation that grants for the maintenance of stock centers were being curtailed. The Tribolium Stock Center will be among those which will lose their support.

I have written to about 75 different private foundations in order to seek support for the operation of the Tribolium Stock Center, but their replies have been in the negative. I have also written to the USDA thinking that of all Federal agencies they would at least try to find some funds to provide minimal support, and it appears that the same problems that have befallen NSF have beset the USDA. They have a shortage of money and all their funds have been committed for the present fiscal year.

Hence, it appears that unless a proposal for a research grant is approved and financial support begins to come in the fall of 1973 that the Tribolium Stock Center will cease to exist.

I am writing this now in the hopes that colleagues who are in a position to do so will accept the responsibility for the maintenance of some of the stocks when and if contacted.

I will try to maintain some of the stocks which I consider to be most important, but with no funds available this number may be minimal. If this comes to pass, starting January 1 1974, I will have to charge a minimal fee for these stocks.

I anticipate that the Tribolium Information Bulletin will continue to be published even if the Tribolium Stock Center ceases to exist. Should I for some reason decide not to edit TIB any longer,

[illegible]

During the past year I was notified by the National Science Foundation that grants for the establishment of stock centers were being curtailed. The Drosophila Stock Center will be among those which will lose their support.

I have written to about 75 different private foundations in order to seek support for the operation of the Drosophila Stock Center, but their replies have been in the negative. I have also written to [illegible] of all Federal agencies they would be likely to find some funds to provide annual support, and [illegible] that the same problems that have [illegible] the NSF.

Other [illegible] have been consulted [illegible]

[illegible]

that the Drosophila Stock Center will cease to exist.

I am writing this now in the hope that colleagues who are in a position to do so will accept the responsibility for the maintenance [illegible]

I intend to maintain the stocks which I consider to be most important, but with no funds available this number may be minimal. If this comes to pass, starting January 1, 1970, I will have to charge a minimal fee for these stocks.

I anticipate that the Drosophila Information Service will continue to be published even if the Drosophila Stock Center ceases to exist, should I for some reason decide not to edit DIS any longer, [illegible]

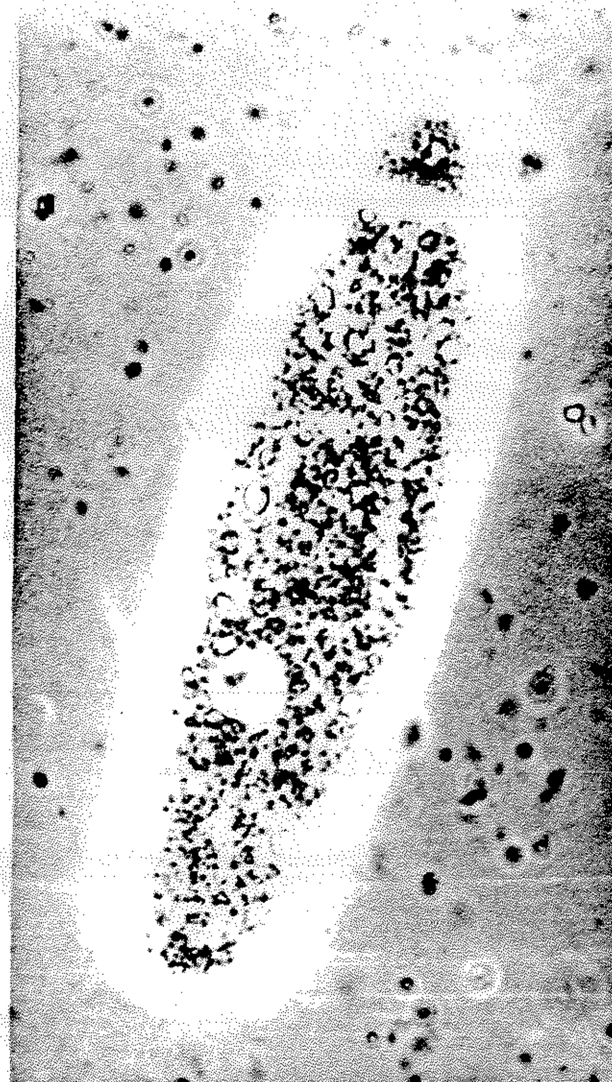
I will let colleagues know so that this means of communication can be continued.

My thanks to Janice Brown, Pat Cavataio, Peggy Hodge and Pat Miller for putting TIB 16 together.

A. Sokoloff

San Bernardino, Calif.
1973

A gregarine parasite of *Tribolium castaneum* (Herbst)



The above photograph, contributed by Dr. P. S. Dawson, Oregon State University, Corvallis, Oregon, shows a clear picture of a gregarine parasite found in a culture originally obtained from the Tribolium Stock Center. Unfortunately no details as to the size of the gregarine are available at this writing. (Ed.)

Stock Lists

BALTIMORE, MARYLAND
THE JOHN HOPKINS UNIVERSITY, DEPARTMENT OF CHEMISTRY

Known to have the following stocks:

I. Wild type strains

Gnathocerus cornutus pearl
Latheticus oryzae +/+
Tribolium anaphe +/+ (Ho)
Tribolium brevicornis +/+
Tribolium destructor +/+
Tribolium madens +/+
Tenebrio molitor +/+

II. Mutant

Tribolium confusum melantic stink glands (*msg*) (Ed.)

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

Tribolium confusum

1. "+" - a wild type strain derived fron 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.

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

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. ring, spotted (*rg sp*)
4. pygmy, red, paddle (*py r pd*)
5. pygmy (*py*)
6. red (*r*)
7. pygmy, red (*py r*)
8. pygmy, paddle, spotted (*py pd sp*)
9. pearl (*p*)
10. pearl, pegleg (*p pg*)
11. white (*w*)
12. microcephalic, jet, maroon (*mc j m*)
13. ruby, light ocular diaphragm (*rb lod*)
14. Short antenna (*Sa*)
15. chestnut (*c*)
16. Short antenna, squint (*Sa c*)
17. antennapedia (*ap*)
18. squint (*sq*)

III. Selected populations

Black: a population subjected to twelve generations of natural selection in very dense larval conditions. Origin from Purdue Black Foundation. Four sublines present.

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

Stock Lists

High Chaetae: a population subjected to nine generations of selection for increased pregenital chaetae number. Origin from Purdue Black Foundation.

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

Low Chaetae: a population subjected to nine generations of selection for decreased pregenital chaetae number. Origin from Purdue Black Foundation.

Pearl: a population subjected to twelve generations of natural selection in very dense larval conditions. Origin from Purdue Black Foundation. Five sublines present.

Purdue: a population subjected to twelve generations of natural selection in very dense larval conditions. Origin from Purdue Wild Foundation. Five sublines present.

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. Stanely, 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.)

Stock Lists

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

II. Mutant strains

1. McGill black	University of Chicago via Stony Brook

CHICAGO, ILLINOIS
UNIVERSITY OF CHICAGO, DEPARTMENT OF ZOOLOGY

Tribolium castaneum

"Chicago" - a wild type strain
"paddle" - a sex-linked recessive antennal mutant.
"pearl" - an autosomal recessive eye mutant
"Chicago black" - an autosomal semi-dominant body color mutant

Tribolium confusum

"Chicago" - a wild type strain
"ebony" - an autosomal recessive body color mutant.

Latheticus oryzae

"Chicago" - a wild type strain
"pearl" - an autosomal recessive eye mutant

(Known to have a number of inbred strains.)

(Ed.)

COLLEGE PARK, MARYLAND
UNIVERSITY OF MARYLAND, DEPARTMENT OF ZOOLOGY

I. Wild type strains

A. Tribolium castaneum

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

*Formerly listed as Tribolium confusum in March, 1966, Tribolium Information Bulletin-9 and earlier issues. Whether the error occurred through original misidentification or an originally mixed species culture is not known.

Inbred strains.

4. E 2 (originally from Edinburgh, via Boylan) — Manitoba, 1964

B. Tribolium confusum

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

Inbred strains

2. CFI-11 — Berkeley, California, 1965

II. Mutant

1. T. confusum — Berkeley, California, 1959

2. Ebony ($e^{L\&H}$)

(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.)

CORVALLIS, OREGON
OREGON STATE UNIVERSITY, DEPARTMENT OF ZOOLOGY

I. Wild type strains

A. Tribolium castaneum

1. Berkeley — Berkeley, 1966
2. Chicago — Urbana, 1966
3. del Valle — Maryland, 1966
4. Oregon — Urbana, 1967
5. Vivarium — Urbana, 1967

Stock Lists

B. Tribolium confusum

1.	Berkeley	Berkeley, 1966
2.	Chicago	Urbana, 1966
3.	Kansas	Kansas, 1966
4.	Oklahoma	Urbana, 1966
5.	Oregon	Urbana, 1967

II. Mutant strains

A. Tribolium castaneum

1.	sa-2 (+/s)	Berkeley, 1966
2.	dve, pd	Berkeley, 1967
3.	fas-3a	Berkeley, 1967
4.	b, mc, p	Berkeley, 1966
5.	bal, c (+/s)	Berkeley, 1966
6.	pd	Urbana, 1966
7.	Be	Berkeley, 1966
8.	mc	Berkeley, 1967
9.	aa (+/p)	Berkeley, 1967
10.	ctp, ju	Berkeley, 1966
11.	Mo	Berkeley, 1966
12.	b	Berkeley, 1966
13.	ap^D, s	Berkeley, 1966
14.	j	Berkeley, 1966
15.	p, s, ap^D	Berkeley, 1966
16.	Fta, c	Berkeley, 1966
17.	ser, py, r	Berkeley, 1967
18.	Spa (+/c)	Berkeley, 1966
19.	r^b, s	Berkeley, 1967
20.	sq	Berkeley, 1967
21.	b	Urbana, 1967
22.	sh^s	Berkeley, 1967
23.	p, lod	Berkeley, 1967
24.	Sa-2, s	Berkeley, 1967
25.	r^u	Urbana, 1968

B. Tribolium confusum

1.	sh, b	Berkeley, 1966
2.	mag^{AS}	Berkeley, 1967
3.	we	Berkeley, 1966
4.	dj, p, lod	Berkeley, 1966
5.	thu^s, e	Berkeley, 1966
6.	dj	Berkeley, 1966
7.	e	Urbana, 1966
8.	thu	Berkeley, 1966
9.	p	Berkeley, 1966
10.	p, lod	Berkeley, 1966
11.	b^u	Urbana, 1967
12.	thu^u	Berkeley, 1966
13.	ble^u	Urbana, 1967
14.	r^u	Urbana, 1968
15.	dep	Urbana, 1969
16.	sh^c	Corvallis, 1970

P. S. Dawson

DAVIS, CALIFORNIA
UNIVERSITY OF CALIFORNIA, DEPARTMENT OF ANIMAL HUSBANDRY

I. Wild type strains (T. castaneum)

BC1	T. castaneum	Berkeley, 1967
DC1	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.
15 BC1-2, line 9 selected for 48 generations; average 21-day pupa weight 6-10 mg.
16-18 BC1-2L, lines 1-3, selected for small 21-day pupa for 30 generations.

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

G. A. E. Gall

DENTON, TEXAS
TEXAS WOMAN'S UNIVERSITY, DEPARTMENT OF BIOLOGY

I. Stock

Wild type
T. confusum — Chicago Standard, from Dr. Park, University of Chicago

T. castaneum — Chicago Standard, from Dr. Park, University of Chicago

II. New mutants

None

H. 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.)

EAST LANSING MICHIGAN
MICHIGAN STATE UNIVERSITY, DEPARTMENT OF ZOOLOGY

Tribolium confusum

I. Wild type strain

1. Chicago wild, Chi +/+ — Berkeley, 1964

II. Mutant strains

1. ruby eyespot (rus) — Berkeley, 1964
2. melanotic stink glands (msg^{Ho}) — Berkeley, 1964
3. light ocular diaphragm, pearl (lod p) — Berkeley, 1964
4. black, melanotic stink glands, ruby eyespot (b msg rus) — Berkeley, 1964
5. black, ruby eyespot (b rus) — Berkeley, 1964
6. McGill black, light ocular diaphragm, pearl (McGill b lod p) — Berkeley, 1964

Tribolium castaneum

Wild type strain
black strain

(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.)

Stock Lists

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

<u>Tribolium castaneum</u>

I. Wild type strain

1. Chicago

II. Mutant strains

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

(Ed.)

HUNTSVILLE, TEXAS
SAM HOUSTON STATE UNIVERSITY
DEPARTMENT OF BIOLOGY

<u>Tribolium castaneum</u>

I. Wild type strain
Purdue + Foundation

II. Mutant strains

1. light ocular diaphragm, $\underline{lod}^{D}$ — Carbondale, Illinois, 1961
2. maroon, <u>m</u> — Purdue + Foundation
3. peach, $\underline{r^{ph}}$ — Carbondale, Illinois, 1961
4. pink, $\underline{p^{pk}}$ — Chazy, New York
5. pink, ivory, $\underline{p^{pk}}$, <u>i</u> — Chazy, New York & Purdue + Foundation
6. ruby, <u>rb</u>
7. ruby, jet, microcephalic, <u>rb</u> <u>j</u> <u>mc</u>
8. ruby, jet <u>rb</u> <u>j</u>
9. ruby, maroon, <u>rb</u> <u>m</u>
10. ruby, peach, <u>rb</u> $\underline{p^{ph}}$

A. A. Dewees

IMMACULATA, PENNSYLVANIA
IMMACULATA COLLEGE, CANCER RESEARCH UNIT

I. Wild type strains

Stock Lists

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 anaphae	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, RHODE ISLAND
UNIVERSITY OF RHODE ISLAND, DEPARTMENT OF ZOOLOGY

I. Stock list

Purdue foundation via Purdue
Black foundation via Purdue
Pearl foundation via Purdue

Sensitive strain - homozygous for the cos allele (corn oil sensitive) derived from Purdue foundation.

LAFAYETTE, INDIANA
PURDUE UNIVERSITY, POPULATION GENETICS INSTITUTE

Tribolium castaneum

I. Wild Type strains

A. Base populations for quantitative genetics studies:

1. Foundation + - wild type population formed 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 - marked with (b) and unrelated to Foundation +, broad genetic base, no selection, minimum inbreeding.

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

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

Stock Lists

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

18-30. Inbred lines with 10-50 generations of full sibbing.

II. Mutant strains

31. antennapedia, ap — Purdue Sa Stock, 1962
32. Bar eye, Be — Berkeley, 1962
33. black, b^D — Carbondale, Illinois, 1964
34. chestnut, c — Purdue + Foundation, 1961
35. cordovan, b^{cd} — Purdue + Foundation, 1962
36. corn oil sensitive, cos — Purdue + Foundation, 1966
37. ivory, i — Purdue + Foundation, 1961
38. jet, j^E — Purdue + Foundation, 1961
39. light ocular diaphragm, lod^D — Carbondale, Illinois, 1964
40. maroon m — Purdue + Foundation, 1962
41. paddle, pd — Chicago, 1955
42. peach, r^{ph} — Carbondale, Illinois, 1964
43. pearl, p — Chicago, 1955
44. pearl, p^M — Malta via Pest Infest. Lab., 1966
45. pearl, p^S — Fla. Inbred, (Purdue), 1963
46. pygmy, py — Chazy, New York, 1960
47. red, r — Chazy, New York, 1960
48. red, r^s — Purdue + Foundation, 1964
49. ring, rg — Purdue + Foundation, 1961
50. rose, rs — Purdue + Foundation,
51. ruby, rb — Carbondale, Illinois, 1964
52. Short antenna, Sa — Purdue + Foundation, 1960
53. short antenna, sa_3 — Purdue + Foundation, 1966
54. sooty, s — Purdue + Foundation, 1956
55. squint, sq — Chazy, New York, 1960
56. 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 maintained. 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.)

MANHATTAN, KANSAS
DEPARTMENT OF ENTOMOLOGY
KANSAS STATE UNIVERSITY

LEPIDOPTERA

Phycitidae

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

Gelechiidae

Sitotroga cerealella (Oliv.), Angoumois grain moth, Kansas, about 1970.

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

Stock Lists

COLEOPTERA

Anobiidae

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

Bostrichidae

Rhyzopertha dominica (F.), Lesser grain borer, Kansas.

Bruchidae

Callosobruchus maculatus (F.), Cowpea weevil, Kansas, 1971.

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.

Stock Lists

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

MIDLAND, MICHIGAN
THE DOW CHEMICAL COMPANY, BIOPRODUCTS DEPARTMENT

Tribolium confusum

Wild strain maintained in laboratory more than 20 years.

(Ed.)

MOSCOW, IDAHO
UNIVERSITY OF IDAHO, DEPARTMENT OF ENTOMOLOGY

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

B. Tribolium madens from the Boise Valley area, Idaho, started in November, 1967.

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

D. Tribolium castaneum - 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.)

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.

Stock Lists

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

NORMAN, OKLAHOMA
UNIVERSITY OF OKLAHOMA, DEPARTMENT OF ZOOLOGY

Coleoptera

Tribolium castaneum (Tenebrionidae) wild type, Chicago; Univ. of Chicago.

F. J. Sonleitner.

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 interned host for *Hymenolepis diminuta*. — Via Sokoloff

(Ed.)

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.)

Stock Lists

RICHLAND, WASHINGTON
BATTELLE-NORTHWEST, BIOLOGY DEPARTMENT

I. Wild type strains

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

(Ed.)

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

I. Wild type strains
1. *Tribolium confusum* — Park, Chicago, 1962
2. *Tribolium castaneum* — J. Laurie, Utah, 1962
3. *Tenebrio molitor* — W. P. Larsen, via S. Muliak, Utah, 1961
4. *Oryzaephilus* sp. — wild, Utah, 1962

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. Arkansas — Bell, 1970
2. Brazil — ex Park via Howard Erdman, 1963

3. Capetown — Bell, 1970
4. Chicago — Park, 1955
5. Columbia — Bell, 1970
6. Consejo — Spain, 1968
7. Davis — Davis, Calif., 1961
8. Georgia — Bell, 1970
9. Florida — Bell, 1970
10. Japan — Bell, 1970
11. McGill — Stanely, 1958
12. Sacramento — 1961
13. Texas — 1958
14. Veracruz, Mexico — 1963
15. Virginia — 1958

B. <u>Tribolium confusum</u>

1. Chicago — Park, 1955
2. Davis — 1961
3. McGill — Stanley, 1958
4. New York — 1961
5. Pennsylvania — McDonald, 1963
6. Sacramento — 1961
7. San Bernardino — 1968

C. <u>Tribolium audax</u>

1. PIL — Slough, 1971

D. <u>Tribolium anaphe</u>

1. PIL — Slough, 1963

E. <u>Tribolium brevicornis</u>

1. Riverside — Calif., 1965

F. <u>Tribolium destructor</u>

1. PIL — Slough, 1963

G. <u>Tribolium madens</u>

1. PIL — Slough, 1963
2. PIL — Slough, 1971

H. <u>Latheticus oryzae</u>

1. Kansas — 1970
2. Savannah — Georgia, 1970
3. Tifton — Georgia, 1970

I. <u>Oryzaephilus surinamensis</u>

1. Synthetic from Cold Spring, Harbor, N.Y. and Oakland, Calif. populations. — 1968
2. San Bernardino — 1968

J. <u>Cryptolestes turcicus</u>

1. PIL — Slough, 1963

K. Stegobium paniceum — San Bernardino, 1969

L. 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 form 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 now in the 9th generation of brother-sister mating and not marked with sooty.

B. Tribolium confusum

1. Started October, 1958, from the Berkeley synthetic strain (now in 90-99 generation of brother-sister mating, not marked with body color genes).

a. CFI-1
b. CFI-2
c. CFI-5
d. CFI-8
e. CFI-11
f. CFI-12

2. Started in 1964 from the Berkeley synthetic strain, (now in 56-58 generation of brother-sister mating, not marked with body color genes.)

a. CFI-13
b. CFI-14
c. CFI-15
d. CFI-23
e. CFI-24

IV. Mutants

A. Tribolium castaneum

Chromosome I

1. paddle (pd) — Park, 1955
2. paddle-1 (pd-1) — Berkeley, 1965

3.	red (r)	Chazy, New York, 1959
4.	red (r^{Ho})	Berkeley, 1962
5.	red (r^{D})	Berkeley, 1963
6.	pygmy (py)	Chazy, New York, 1959
7.	spotted (sp)	Chazy, New York, 1959
8.	divergent elytra (dve)	Chazy, New York, 1959
9.	truncated elytra (te)	Chazy, New York, 1959
10.	platinum eye (pte)	Berkeley, 1965
11.	pokey (pok) (as heterozygotes)	Berkeley, 1962
12.	red modifier (r^{Mr})	Berkeley, 1961
13.	serrate (ser)	Berkeley, 1963
14.	pte pd	
15.	py pd	
16.	sp pd	
17.	py r pd	
18.	py r	
19.	te r	
20.	sp r	
21.	r pd	
22.	py r^{Mr}	
23.	pte py pd	
24.	r te Mr	
25.	sp dve py pd	
26.	ser py r	
27.	te-1	

Chromosome II

28.	pearl (p)	Park, 1955
29.	pink (p^{Pk})	Chazy, New York, 1959
30.	pegleg (pg)	Chazy, New York, 1959
31.	p pg	

Chromosome III

32.	aureate (au)	Berkeley, 1965
33.	McGill black (mcGb)	Stanley, 1964
34.	Chicago black (Cb)	Park, 1955
35.	Synthetic (McGb/Cb)	Chazy, New York, 1958
36.	black (b^{S-1}) (Brazil background)	Berkeley, 1963
37.	black (b^{S}) (Chicago background)	Chazy, New York, 1960
38.	light ocular diaphragm (lod) (pearl background)	
39.	light ocular diaphragm (lod^{d})	Dewees, 1971
40.	melanotic stink glands (msg)	Berkeley, 1964
41.	scar (sc)	Purdue, 1964
42.	tawny (b^{t})	PIL, 1965

Chromosome IV

39.	cut prothorax (ctp)	Berkeley, 1962
40.	elongated juvenile urogomphi (eju)	Berkeley, 1965
41.	fused antennal segments-2 (fas-2)	Berkeley,
42.	incomplete mesosternum (ims)	Berkeley, 1962
43.	juvenile urogomphi (ju)	Berkeley, 1962
44.	reduced juvenile urogomphi (rju)	Berkeley, 1963
45.	Spatulate (Spa)	Berkeley, 1964
46.	deformed legs (dfl)	Chazy, New York, 1959
47.	sternites incomplete (sti)	Berkeley, 1963
48.	fas-2s	
49.	mahogany (my)	

Chromosome V

50.	jet (j)	Park, 1955
51.	microcephalic (mc)	Chazy, New York, 1959
52.	fused antennal segments-3 (fas-3) (=agg)	Berkeley, 1961
53.	fused antennal segments-3a (fas-3a)	Berkeley, 1963
54.	j spl mc	
55.	maroon (m)	Eddleman, 1970

Chromosome VI

56.	Microphthalmic (Mo)	Chazy, New York, 1959

Chromosome VII

57.	Short antenna (Sa)	
58.	Short antenna (Sa-1) (=Gn)	Berkeley, 1959
59.	Short antenna (Sa-2) (=Ds)	Berkeley, 1962
60.	Short antenna (Sa-3) (=Cua)	Chazy, New York, 1959
61.	short antenna (sa) (=ca)	1961
62.	chestnut (c) (ex Eddleman)	Berkeley, 1962
63.	blistered elytra (ble)	Berkeley, 1962
64.	short antenna (sa-2) (=vg)	Berkeley, 1962
65.	Fused tarsi and antennae (Fta)	
66.	Fta ble	
67.	sa c	
68.	Fta c	
69.	Sa c	
70.	Fta ca c	
71.	ble c	

Stock Lists

Chromosome VIII

72. antennapedia (ap^D) Berkeley, 1962
73. antennapedia (ap^S) (=fas-6) Berkeley, 1963
74. squint (sq) Chazy, 1959

Chromosome IX

75. missing abdominal sternites (mas) Berkeley, 1964
76. prothoraxless (ptl) Chazy, New York, 1959
77. prothoraxless-1 (ptl-1) Berkeley, 1965
78. partially pointed abdominal sternites (ppas) Berkeley, 1963

Chromosome X

79. abbreviated appendages (aa) Cold Spring Harbor, N. Y., 1961
80. abbreviated appendages-1 (aa-1) (=cspl) Chazy, New York, 1960

Multichromosomal

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

81. py pd; p I, II
82. sp; p I, II
83. py; b I, III
84. py r; lod I, III
85. sp; j I, V
86. pd; Mo I, VI
87. sp; p; j I, II, V
88. p; lod II, III
89. p; b II, III
90. p; b; Mo II, III, VI
91. p; b; mc II, III, V
92. p; mc II, V
93. b; Mo III, VI
94. j; Mo V, VI
95. ju ctp c IV, VII
96. Mo; sa VI, VII
97. b (p) apt III, (II), ?
98. mc apt V, ?
99. apt j V, ?
100. Mo (c) mas VI, (VII), IX
101. (p) b mas (II), III ?
102. p Bamp/+ II, III ?
103. Bamp/+ap^D III ?, IX
104. Bamp/+ ptl^{Hoy} III ?, IX
105. b max III, ?

Stock Lists

106. j max V, ?
107. au Npp IV, ?
108. ap Npp VIII, ?
109. Be au IV
110. Fta ppas VII, ?
111. mc ppas V, IX
112. fas-3a ptl[Hoy] III, IX
113. b ap[s] III, VIII
114. au ctp IV
115. j ppas V, IX
116. pp[k] V, IX
117. rb m ?; V

Unassigned (but possibly in II)

118.	creased abdominal sternites (cas)	Berkeley, 1963
119	abnormal abdominal sternites (aas)	Berkeley, 1965
120.	akimbo (akb)	Berkeley, 1964
121.	alate prothorax (apt)	Berkeley, 1964
122.	antennae and tarsi fused (atf)	Berkeley, 1961
123.	ballooned (bal)	Berkeley, 1963
124.	banjo (bj)	Chazy, New York, 1960
125.	bead (bd)	Bell, 1967
126.	bent tibia (bt)	Berkeley, 1961
127.	Blunt abdominal and metathoracic projections (Bamp) (possibly in III)	Berkeley, 1965
128.	bowed femur (bf)	Berkeley, 1963
129.	bowleg	Bell, 1967
130.	bumpy (by)	Bell, 1966
131.	Charcoal (Chr)	Berkeley, 1966
132.	deflected epimera (dep)	Berkeley, 1964
133.	deformed femur (dff)	Berkeley, 1964
134.	deformed tibia (dft)	Berkeley, 1964
135.	dented	Bell, 1967
136.	diminutive appendages (dim)	Berkeley, 1966
137.	elbowed antennae-1 (elb-1)	Berkeley, 1964
138.	elongated elytra (ele)	Berkeley, 1964
139.	elytra and tarsi affected (eta)	Berkeley, 1963
140.	extra urogomphi (eu) (black)	Chazy, New York, 1960
141.	fused antennal segments-1 (fas-1)	Chazy, New York, 1959
142.	Fused antennal segments-4 (Fas-4)	Berkeley, 1963
143.	Fused antennal segments-5 (Fas-5)	Berkeley, 1963
144.	jagged antecoxal piece (jac)	Berkeley, 1964
145.	knobby prothorax (knp)	Berkeley, 1966
146.	lopped median groove (lmg)	Berkeley, 1964
147.	maxillopedia (max)	Berkeley, 1965
148.	minature appendages (ma[D] r)	Bell, 1967
149.	Multi-urogomphi (Mu)	Bell, 1966
150.	Nonpunctate prothorax (Npp)	Berkeley, 1965
151.	padded prothorax (pdp)	Berkeley, 1965

Stock Lists

152.	pectinate antennae (pec)	Berkeley, 1964
153.	reduced gin traps (rgt)	Berkeley, 1965
154.	reduced pleurosternal suture (rps)	Berkeley, 1965
155.	reduced tarsi and antennae (rta)	Berkeley, 1966
156.	rough (ro)	Berkeley, 1964
157.	ruby (rby)	Berkeley, 1962
158.	rugose elytra (rue)	Berkeley, 1966
159.	scalloped prothorax (scp)	Berkeley, 1965
160.	short median abdominal projection (smp)	Berkeley, 1966
161.	short split spinasternum (sss)	Berkeley, 1965
162.	split (sp)	1963
163.	split-back (sb)	Bell, 1966
164.	stumpy (stu)	Berkeley, 1965
165.	Tetra urogomphi (Tu)	Berkeley, 1965
166.	tiny (ti) (=ty)	1962
167.	umbilicus (umb)	Berkeley, 1964

B. *Tribolium confusum*

Chromosome I

1.	Striped (St)	McDonald, 1961
2.	eyespot (es)	McDonald, 1961
3.	light eyespot (es^{lt})	Berkeley, 1963
4.	red (r)	Berkeley, 1962
5.	antennae and elytra reduced (aer)	Berkeley, 1962
6.	labiopedia (lp)	Berkeley, 1962
7.	pointed abdominal segments (pas)	Berkeley, 1963
8.	thickened elytral tips (tet)	Berkeley, 1963
9.	lethal-1 (l_1) (in heterozygotes)	Berkeley, 1962
10.	crumpled (cru)	Berkeley, 1964
11.	prothoraxless-like (ptll)	Berkeley, 1964
12.	St es	
13.	es lp	
14.	es lp (synthetic background)	
15.	es^{lt} lp	
16.	St es lp	
17.	alate prothorax (apt)	Berkeley, 1965

Chromosome II

18.	pearl (p)	PIL, via Stanley, 1960
19.	pearl (p^S)	Berkeley, 1962
20.	ebony-2 (e_2)	PIL, via Stanley, 1960
21.	creased abdominal sternites (cas)	Berkeley, 1963
22.	dirty pearl eye (dpe) (=fro)	Berkeley, 1963
23.	e_2p	PIL, via Stanley, 1960
24.	p cas	

Chromosome III

25.	Yugoslavian black (=b^z)	Yugoslavia, 1969

Stock Lists

26. McGill black (McGb) (=b^{Ho}) Stanley, 1960
27. black-3 (b-3) Berkeley, 1964
28. ruby spot (rus) Chazy, New York, 1960
29. melanotic stink glands (msg) Berkeley, 1962
30. rus msg
31. b rus
32. b msg

Chromosome IV

33. thumbed (thu) Berkeley, 1963
34. thumbed^{s} (thu^{s}) (=$rsp^{P. S. D.}$) Berkeley, 1963

Chromosome V

35. ebony (e) Park, via Stanley, 1960
36. ebony ($e^{L\&H}$) Berkeley, 1959
37. synthetic ($e/e^{L\&H}$) Berkeley, 1961
38. blistered elytra (ble) Chazy, New York, 1960
39. e ble

Chromosome VI

40. disjoined (dj) Berkeley, 1963

Unassigned (but possibly in III)

41. light ocular diaphragm (lod) (pearl) Berkeley, 1961

Multichromosomal

42. p; lod
43. p; rus
44. b; sp
45. rus; sp
46. rus; ble
47. b (;) lod; p
48. b twa
49. ems dt msg
50. jac dt b
51. McGill b p
52. bent femur (btf) Berkeley, 1964
53. bent tibia (btt) Berkeley, 1962
54. black-3 (b-3) Berkeley, 1964
55. crumpled elytra (cru) Berkeley, 1964
56. creased abdominal sternites (cas-1) 1963
57. deflected epimera (dep) Berkeley, 1964
58. deformed legs (dfl) Berkeley, 1965
59. elongated elytra (ele) Berkeley, 1963
60. fused antennal segments-1 (fas-1) Berkeley, 1962
61. fused antennal segments-2 (fas-2) Berkeley, 1963

62.	incomplete meso-metathoracic suture (ims)	Berkeley, 1965
63.	imcomplete metathoracic projections (imp)	Berkeley, 1964
64.	knobby prothorax (knp)	Berkeley, 1964
65.	legless (lgl)	Berkeley, 1966
66.	medial abdominal groove (mag)	Berkeley, 1964
67.	nude (nd)	Berkeley, 1964
68.	pockets (poc)	Berkeley, 1965
69.	prosternumless (psl)	Berkeley, 1966
70.	Reduced eye (Re)	Berkeley, 1965
71.	rough (ro) (black)	McDonald, 1960
72.	ruby (rby)	Berkeley, 1962
73.	scar (sc) (=engraved metasternum)	Berkeley, 1962
74.	separated epimera (sep)	Berkeley, 1964
75.	short elytra (sh)	Berkeley, 1961
76.	split (sp)	Berkeley, 1961
77.	sternites incomplete (sti)	Berkeley, 1963
78.	stilted legs (stl)	Berkeley, 1962
79.	stunted (stt)	Berkeley, 1966
80.	tiny (ty)	Berkeley, 1961
81.	twisted abdomen (twa)	Berkeley, 1965
82.	umbilicus (umb) (=dent)	Berkeley, 1962
83.	warped elytra (we)	Berkeley, 1962
84.	wingless (wgl)	Berkeley, 1965

C. *Tribolium anaphe*

None

D. *Tribolium audax*

None

E. *Tribolium brevicornis*

1. creased abdominal sternites (cas)
2. split (spl)
3. fused antennal segments (fas)

F. *Tribolium destructor*

None

G. *Tribolium madens*

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

H. *Latheticus oryzae*

None

I. *Oryzaephilus surinamensis*

None

Stock Lists

J. Cryptolestes turcicus

Chromosome I

1. red (r) PIL, 1963

K. Stegobium paniceum

None

A. Sokoloff

SANTA FE, NEW MEXICO
SANTA FE PREPARATORY SCHOOL

I. Wild type strain
   A. Tribolium castaneum — Chicago via Berkeley
   B. Tribolium confusum — McGill via Berkeley

(Ed.)

SAVANNAH, GEORGIA
STORED PRODUCT INSECTS RESEARCH AND DEVELOPMENT LABORATORY

I. Wild type strains
   A. Lepidoptera
      1. Anagasta kuehniella (Zeller) — N.C. State at Raleigh, N.C.
      2. Cadra cautella (Walker) — Tifton, Ga.
      3. Ephestia elutella (Hübner) — Richmond, Va.
      4. Plodia interpunctella (Hübner) — Modesto, Calif.
      5. Sitotroga cerealella (Olivier) — Tifton, Ga.
      6. Tineola bisselliella (Hummel) — Savannah, Ga.; Ottawa, Canada and Durham, New Hampshire

   B. Coleoptera
      1. Anthrenus flavipes Le Conte — Savannah, Ga.; and Durham, N.H.
      2. Attagenus megatoma (Fab.) — CSMA strains
      3. Callosobruchus maculatus (Fab.) — Fresno, California
      4. Carthartus 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. Mezium americanum (Lap.) — Gainesville, Fla.
      10. Oryzaephilus mercator (Fauvel) — Unknown
      11. Oryzaephilus surinamensis (L.) — Manhattan, Kansas
      12. Rhyzopertha dominica (Fab.) — Unknown
      13. Stegobium paniceum (Linnaeus) — Madison, Wisconsin
      14. Sitophilus granarius (L.) — Manhattan, Kansas
      15. Sitophilus oryzae (L.) — Arkansas; California; Kansas; Louisana; Minnesota; and Texas

Stock Lists

16. *Sitophilus zeamais* Motschulsky — Estill, S.C.
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, California
23. *Trogoderma inclusum* LeConte — Madison, Wisconsin Riverside, California
24. *Trogoderma variabile* Ballion — Fresno, Calif.; Riverside, Calif.

II. Mutant strains

A. Almond moths

1. White Eye *Cadra* (susceptible) No selection pressure kept on this strain of moths.

2. White Eye *Cadra* (resistant) Leesburg X White Eye. Kept under selection pressure of malathion (320 mg./ml.) (.5 uliter/insect)

B. Red flour beetle (*T. castaneum*)

1. Red flour beetle (Shinglers) 50-fold resistant. Kept under selection pressure of malathion at 15 mg./ml. at .5 uliter/insect

C. Black flour beetle

1. Black Savannah strain (susceptible) (*T. castaneum*)
2. Black Tifton strain (susceptible) (*T. castaneum*)
3. Black *T. confusum* (susceptible)

Note: Insects kept at maintenance level only (2-3 jars).

D. New mutants

1. *Plodia interpunctella*
Scaleless (scl) - an autosomal recessive that results in wings devoid of scales.

Melanic (m) - a sex-linked recessive that results in uniformly dark forewings.

Stock Lists

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

(Ed.)

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 quantative 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.

Stock Lists

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.	pearl	via University of California
5.	pygmy	via University of California
6.	red nO	via California State College
7.	Short antennae (Sa)	Purdue + Foundation, 1960
8.	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

Stock Lists

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

ST. BERNARD, ALABAMA
ST. BERNARD ABBEY

I. Wild Type strains

A. Tribolium castaneum
  1. Chicago — via San Bernardino

B. Tribolium confusum
  1. New York — via San Bernardino

II. Mutant strains

A. Tribolium castaneum

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

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

Stock Lists

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

Stock list of stored product insects

Tribolium confusum
Sitophilus oryzae (large strain)
Sitophilus granarius
Oryzaephilus surinamensis
Trogoderma parabili
Rhyzopertha dominica
Plodia interpunctella
Ephestia spp.
Attagenus magatoma

Ernesto De las Casas
Phillip K. Harein

ST. PAUL, MINNESOTA
UNIVERSITY OF MINNESOTA

Tribolium castaneum

A. Inbreds
1. CSI-5 — Univ. of Calif. Berkeley, 1963
2. CSI-10 — Univ. of Calif. Berkeley, 1963

B. Segregating populations (marked with sooty)
1. Random bred (no selection) since 1963 from a single cross.
2. Random bred with selection for pupa weight.

(Ed.)

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.)

SYCAMORE, ILLINOIS
DE KALB AGRICULTURAL ASSOCIATION, INC.

Dr. R. R. Shrode has moved to the University of Tennessee; fate of the *Tribolium* stocks is not known.

(Ed.)

Stock Lists

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
UNIVERSITY OF ILLINOIS, DEPARTMENT OF ZOOLOGY

I. Wild type strains

A. Tribolium castaneum

1. Berkeley	Berkeley, 1966
2. Chicago	Urbana, 1966
3. Carbondale	Maryland, 1966
4. del Valle	Maryland, 1966
5. Kansas	Kansas, 1966

B. Tribolium confusum

1. Berkeley	Berkeley, 1966

Stock Lists

2. Chicago — Urbana, 1966
3. Kansas — Kansas, 1966
4. Maryland — Maryland, 1966
5. Minnesota — Minnesota, 1966
6. Oklahoma — Urbana, 1966

II. Inbred lines

A. *Tribolium castaneum*

1. CSI-2 — Berkeley, 1966
2. CSI-3 — Berkeley, 1966
3. CSI-5 — Berkeley, 1966
4. CSI-10 — Berkeley, 1966
5. CSI-12 — Berkeley, 1966
6. CSI-14 — Berkeley, 1966
7. CSI-15 — Berkeley, 1966
8. CSI-16 — Berkeley, 1966
9. CSI-22 — Berkeley, 1966

B. *Tribolium confusum*

1. CFI-1 — Berkeley, 1966
2. CFI-2 — Berkeley, 1966
3. CFI-3 — Berkeley, 1966
4. CFI-5 — Berkeley, 1966
5. CFI-7 — Berkeley, 1966
6. CFI-8 — Berkeley, 1966
7. CFI-11 — Berkeley, 1966
8. CFI-12 — Berkeley, 1966
9. CFI-13 — Berkeley, 1966
10. CFI-14 — Berkeley, 1966
11. CFI-15 — Berkeley, 1966
12. CFI-16 — Berkeley, 1966
13. CFI-18 — Berkeley, 1966
14. CFI-19 — Berkeley, 1966
15. CFI-20 — Berkeley, 1966
16. CFI-21 — Berkeley, 1966
17. CFI-22 — Berkeley, 1966
18. CFI-23 — Berkeley, 1966
19. CFI-24 — Berkeley, 1966

III. Mutant strains

A. *Tribolium castaneum*

1. *sa-2* (+/*s*) — Berkeley, 1966
2. *i* — Purdue, 1967
3. *w* — Purdue, 1967
4. *b*, *mc*, *p* — Berkeley, 1966
5. *bal*, *s* — Berkeley, 1966
6. *pd* — Urbana, 1966
7. *Be* — Berkeley, 1966
8. *mc* — Berkeley, 1967
9. *aa* (+/*p*) — Berkeley, 1967

10. rHo Berkeley, 1966
11. Mo Berkeley, 1966
12. b Berkeley, 1966
13. ap^D, s Berkeley, 1966
14. j Berkeley, 1966
15. r (+/py) Berkeley, 1966
16. Fta/+, c Berkeley, 1966
17. c Berkeley, 1966
18. Spa/+, +/c Berkeley, 1966
19. p Berkeley, 1967
20. sq Berkeley, 1967
21. msg Berkeley, 1967
22. sh^S Berkeley, 1967
23. p, lod Berkeley, 1967
24. Sa-2, s Berkeley, 1967
25. rg Berkeley, 1967
26. fas-3a Berkeley, 1967
27. r^D, s Berkeley, 1967
28. dve, pd Berkeley, 1967
29. h Urbana, 1967
30. rs Purdue, 1967
31. rb Purdue, 1967
32. j, m Purdue, 1967
33. ctp, ju Berkeley, 1967

(Ed.)

URBANA, ILLINOIS
UNIVERSITY OF ILLINOIS, DEPARTMENT OF PHYSIOLOGY AND BIOLPHYSICS

Tribolium confusum

A. Wild type G. Fraendel, 1960
B. McGill black A. Sokoloff, 1966

Also available:

Nemeritis canescens (Ichneumon.)

From University of Cambridge Zoology Department. Carried on *Anagasta kuehniella*.

(Ed.)

WASHIGTON, D. C.
THE CATHOLIC UNIVERSITY OF AMERICA, DEPARTMENT OF BIOLOGY

R. H. Arnett moved to Purdue University; fate of *Tribolium* stocks at the above institution is not known. (Ed.)

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.)

BURNLEY, VICTORIA
VICTORIAN PLANT RESEARCH INSTITUTE, DEPARTMENT OF AGRICULTURE

COLEOPTERA

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

B. Tribolium confusum
   1. Wild type strains
   2. Malathion specific resistant 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

BELGIUM

GEMPLOUX
INSTITUT AGRONOMIQUE DE L'ETAT, ZOOLOGIE GENERALE

Tenebrio molitor

F strain - selected for small weight since 1950
G strain - selected for large weight since 1950

(Ed.)

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

Tenebrio molitor

Wild type

Tribolium confusum

Two inbred and a wild type — Berkeley, 1965 (Ed.)

BRAZIL

CAMPINAS, SAO PAULO
INSTITUTE AGRONOMICO, SECAO DE ENTOMOLGIA

Anobiidae

Lasioderna 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.)

BURNLEY, VICTORIA
VICTORIAN PLANT RESEARCH INSTITUTE, DEPARTMENT OF AGRICULTURE

COLEOPTERA

A. Tribolium castaneum
   1. Wild type strains
   2. Malathion 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

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.)

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

Tribolium castaneum

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

R. Fairfull

Stock Lists

GUELPH, ONTARIO
UNIVERSITY OF GUELPH, DEPARTMENT OF ZOOLOGY

A. *Sitophilus granarius* (L)
   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

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 developmental time (derived from Purdue Foundation).

Stock Lists

TSLW - A populations 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

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

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 diaphragn (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

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. Ahasverus advena (Waltl) Silvanidae — Manitoba
3. Alphitobius diaperinus Panzer Tenebrionidae — Saskatchewan
4. Anthicus floralis L. Anthicidae — Manitoba
5. Cryptolestes ferrugineus (Steph.) Cucujidae — Manitoba
6. Cryptolestes ferrugineus (Steph.) Cucujidae — PIL United Kingdom
7. Cryptolestes ferrugineus (Steph.) Cucujidae — Australia

Stock Lists

8. *Cryptolestes turcicus* (Grouv.)
Cucujidae — Ontario

9. *Cryptolestes turcicus* (Grouv.)
Cucujidae — PIL United Kingdom

10. *Cynaeus angustus*
Leconte Tenebrionidae — Manitoba

11. *Oryzaephilus mercator* (Fauvel)
Silvanidae — Ontario

12. *Oryzaephilus surinamensis* (L.)
Silvanidae — Manitoba

13. *Rhyzopertha dominica* (Fab.)
Bostrichidae — Australia

14. *Sitophilus granarius* (L.)
Curculionidae — Manitoba

15. *Sitophilus oryzae* (L.)
Curculionidae — Montreal

16. *Sitophilus zea-mais*
Motschulsky Curculionidae — Japan

17. *Stegobium paniceum* (L.)
Anobiidae — Winnipeg

18. *Tenebroides mauritanicus* (L.)
Ostomidae — Manitoba

19. *Tenebrio molitor* (L.)
Tenebrionidae — Manitoba

20. *Tribolium castaneum* (Herbst)
Tenebrionidae — Manitoba

21. *Tribolium confusum* (DuVal)

22. *Tribolium madens*
Charp. Tenebrionidae — Manitoba

23. *Trogoderma variabile*
Ballion Dermestidae — Alberta

B. Lepidoptera

1. *Nemapogon granella* (L.)
Tineidae — Ontario

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

3. *Pyralis farinalis* L.
Pyralidae — Manitoba

II. Mutant strain

A. Coleoptera

Tribolium castaneum Herbst
Tenebrionidae — Winnipeg
(Black body color from lab stock)

Tribolium confusum DuVal — Winnipeg, Manitoba, 1963

L.B. Smith

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

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

(Ed.)

Stock Lists

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.

Note: Dr. M. A. Hafeez is at present in London. Fate of above stocks is unknown.

(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	
F.	Periplaneta americana	
G.	Pseudococcus citri	Antibes
H.	Sitophilus granarius	Infestation Control Laboratory, Surbiton

Stock Lists

I.	Sitophilus oryzae	P.I.L., Slough
J.	Sitophilus sasakii--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	Alès

(Ed.)

GERMANY

MUNICH
BAYER, LANDESANSTALT FÜR BODENKULTUR
PFLANZENBAU U. PFLANZENSCHUTZ

Coleoptera

Cucjidae

Cryptolestes turcicus (Grouv.)	Munich, 1966

Curculionidae

Sitophilus granarius (L.)	Munich, 1966
Sitophilus zea-mais (Motsch.)	1966

Ptinidae

Gibbium psylloides (Czemp.)	Regensburg, 1960

Silvanidae

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

Tenebrionidae

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

Lepidoptera

Phyticidae

Anagasta Kuehniella (Zell.)	Munich, 1966

(Ed.)

Stock Lists

BIRMINGHAM, ENGLAND
THE UNIVERSITY OF BIRNINGHAM
DEPARTMENT OF ZOOLOGY AND COMPARATIVE PHYSIOLOGY

Tenebrio molitor
Tenebrio obscurus
Blaps sp.
Tribolium sp.

(Ed.)

DUNDEE, ANGUS
UNIVERSITY OF DUNDEE, DEPARTMENT OF NATURAL HISTORY

Only the stock unique to this laboratory is listed.
Wild stock
1. Tribolium castaneum - Kenya. Collected in December, 1967, from stored maize in the Nairobi district.

(Ed.)

DUNDEE
DUNDEE UNIVERSITY
DEPARTMENT OF BIOLOGICAL SCIENCES

	Origin
Tribolium castaneum	Slough
T. confusum	
T. madens	
T. destructor	
T. brevicornis	
T. castaneum - M..S.G	Sokoloff
T. castaneum - M.S.G.	Slough
T. confusum - Black mutant	Slough
T. confusum - Pearl Eye	Slough
Ephestion cautella	Slough
Gnathocerus maxillosus	Slough
G. cornutus - Slough, New Zealand	Egypt
Latheticus oryzae - Normal and Dark	Slough
Sitophilus zeamais	Slough

F. L. Waterhouse

ENDINBURGH
UNIVERSITY OF ENDINBURGH, INSTITITE 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.)

ENDINBURGH, SCOTLAND
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.)

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.)

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, BUCKS
MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
THE INSECTARY OF THE PEST INFESTATION CONTROL LABORATORY

Stocks Lists

1. The existing list will stand for another year. I think we have added a couple of minor species but these do not justify a revision.

2. Our mutant strains were all sent to you so we have none to list.

Current bibliography.

We have only five papers to list this year under three headings; Insecticide resistance, ecology, and pests. We have several in press that had better wait until next year.

ORDER Family (-subfamily) Genus (sub genus), species.	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMPERATURE °C
Cucujidae				
Cryptolestes capenis (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				
Anthrenocerus australis (Hope)	Australian carpet beetle	(Britain)	20	25
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			35	20
Anthrenus (Florilinus) olgae Kalik			20	20
Attagenus sp? (alfieri of Hinton 1945)		Kenya	17	25
Attagenus fasciatus (Thunberg) (=gloriosae (Fabricius)		Botswana	18	25
Attagenus unicolor Brahm (=megatoma (F.) & 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

Stock Lists

ORDER Family (-subfamily) Genus (sub genus), species.	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMPERATURE °C
Gelechiidae				
Sitotroga cerealella (Oliv.)	Angoumois grain moth		1	25
Tineidae				
Tinea columberiella Wocke	Case bearing clothes moth		20	25
Tinea flavescentella Haworth		Britain	20	25
Tineola bisselliella (Humm.)	Common clothes moth		20	25
Tenea Pellionella (L.)			20	25
COLEOPTERA				
Anobiidae				
Lasioderma serricorne (F.)	Cigarette beetle		6	25
Stegobium paniceum (L.)	Biscuit beetle		6	25
Antribidae				
Araecerus fasciculatus (Deg.)			39	25
Bostrichidae				
Rhyzopertha dominica (F.)	Lesser grain borer		1	30
Bruchidae				
Acanthoscelides obtectus (Say)	Dried Bean beetle	W. Africa	27	30
Callosobruchus analis (F.)			29	30
Callosobruchus chinensis (L.)	Cowpea weevil		29	25
Callosobruchus maculatus (F.)		Sierra Leone	29	30
Callosobruchus rhodesianus (Pic)			29	30
Caryedon serratus (Oliv.) (=gonagra (F.))	Groundnut seed beetle		26a	30
Zabrotes subfasciatus (Boh.)			28	30
Cerylonidae				
Murmidius ovalis (Beck)		Ceylon	13	25
Cleridae				
Necrobia rufipes (Deg.)	Copra beetle		22	30
Necrobia ruficollis (F.)			40	25

Stock Lists

I. Wild type strains

ORDER Family (-subfamily) Genus (sub genus), species.	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMPERATURE °C.
DICTYOPTERA				
Blattidae				
Blatta orientalis L.	Oriental cockraoch		18a	27
Blattella germanica (L.)	German cockroach		18a	27
Periplaneta americana (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
Braconidae				
Bracon hebetor Say		America	31	25
LEPIDOPTERA				
Pyralidae - Pyralinae				
Pyralis farinalis (L.)	Meal Moth		5	25
Pyralidae - Phycitinae				
Ephestia (Anagasta) kuehniella (Zell.)	Mediterranean flour moth	Britain Britain	8a 8a	25 25
Ephestia (Cadra) cautella (Walk.)	Tropical warehouse moth	(S. Africa)	8a	25
Ephestia (Ephestia) elutella (Hubn.)	Warehouse moth	Britain	8a	25
Ephestia (Cadra) calidella (Guen.)		Cyprus	34a	30
Ephestia (Cadra) figulilella Gregs.		Cyprus	34a	30
Plodia interpunctella (Hubn.)	Indian meal moth	Britain	8a	25
Pyralidae - Galleriae				
Achroia grisella (F.)	Lesser wax moth		16a	25
Galleria mellonella (L.)	Honeycomb moth		16a	25
Paralipsa gularis (Zell.)			26	25

ORDER Family (-subfamily) Genus (sub genus), species.	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMPERATURE °C
Dermestes peruvianus Castelnau		Britain	21a	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 inclusum LeC.	Larger cabinet beetle		10	25
Trogoderma irroratum Reitt.		Egypt	2	30
Trogoderma variabile Ballion (=parabile Beal)		U.S.A.	2	30
Trogoderma simplex Jayne		U.S.A.	18	30
Trogoderma sternale plagifer Casey		New Mexico	32	30
Mycetophagidae				
Typhaea stercorea (L.)	Hairy grain beetle	Nigeria	4	25
Nitidulidae				
Carpophilus dimidiatus (F.)	Corn-sap beetle		14	25
Carpophilus hemipterus (L.)	Dried fruit beetle		15	25
Carpophilus marginellus			23a	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 pusillus Sturm.			17a	20
Ptinus sexpunctatus Panz.			17a	20
Ptinus tectus Boield	Australian spider beetle		19a	25
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

ORDER Family (-subfamily) Genus (sub genus), species.	COMMON NAME	COUNTRY OF ORIGIN OF STOCK	CULTURE MEDIUM	REARING TEMPERATURE °C
Silvanidae				
Ahasveras advena (Waltl)	Foreign grain beetle	(West Africa)	10	25
Cathartus quadricollis (Guer.)	Square-necked grain beetle	W. Africa	10	25
Oryzaephilus mercator (Fauv.)	Merchant grain beetle		10	25
Oryzaephilus surinamemsis	Saw-toothed grain beetle		10	25
Tenebrionidae				
Alphitobius diaperinus (Panz.)	Lesser mealworm		7	25
Alphitobius laeviagatus (F.)	Black fungus beetle		7	25
Alphitobius viator Muls. & God.		Sierra Leone	7	25
Alphitophagus bifasciatus (Say)	Two-banded fungus beetle	Britain	5	25
Gnathocerus cornutus (F.)	Broad-horned flour beetle		17	25
Gnathocerus maxillosus (F.)	Slender horned flour beetle		6	25
Latheticus oryzae Waterh.	Long headed flour beetle		6	30
Palorus laesicollis (Fairm.)		Kenya	24	25
Palorus ratzeburgii (Wissm.)	Small-eyed flour beetle		6	25
Palorus subdepressus (Woll.)	Depressed flour beetle	Turkey	7	25
Tenebrio molitor L.	Yellow mealworm		10a	25
Tenebrio obscurus F.	Dark mealworm		10a	25
Tribolium anaphe Hint.		Nigeria	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	(Yugoslavia)	17	25
Languriidae				
Pharaxonotha kirschi (Reitt.)			6a	25

The letter "a" after a number 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.

CULTURE MEDIA

No.	Food	Weight Ratio (Ounces)
1.	Wheat	
2.	Wheat + wheatfeed	7:3
3.	Wheat + wheatfeed + glycerol	7:3:1
4.	Wheat + wheatfeed + glycerol on a damp pad of cotton wool	7:3:1
5.	Wheat + wheatfeed on a damp pad	7:3:1
6.	Wheatfeed + yeast	10:1
7.	Wheatfeed + yeast on a damp pad	10:1
8.	Wheatfeed + yeast + glycerol	10:1:3
9.	Wheatfeed + yeast + glycerol on a damp pad	10:1:3
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 + dates	6:1:6
16.	Wheatfeed + rolled oats + yeast + glycerine + honey + brood 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
20.	Fishmeal + yeast + flannel	16:1
21.	Fishmeal + yeast + bacon ends	16:1
22.	Fishmeal + yeast + bacon ends + cheese	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 peas	1:1
30.	Liver + sugar and water	
31.	Moth culture (Sub-family Phycitinae)	
32.	Fishmeal + Yeast + dried cockroaches	
33.	Liver, swiss roll and honey	
34.	Wheatfeed + glucose + yeast	5:2:1
35.	Wheatfeed + fishmeal + yeast + cholesterol	8:8:1:1
36.	Crushed dog biscuit + yeast	20:1
37.	Bread and butter	
38.	Sweet biscuits	
39.	Maize	
40.	Wood sawdust + bones	

1. Resistant strains

A. Tribolium castaneum (Tenebrionidae)

1.	DDT resistant	South Africa, 1960
2.	Non-specific resistant	Australia, 1968
3.	Lindane specific resistant	Zambia, 1970
4.	Malathion specific resistant	Nigeria, 1963
5.	Insecticide susceptible	Unknown, 1970

II. Mutants

MUTANT STOCKS	MUTATION	COUNTRY OF ORIGIN OF STOCK	MEDIA	TEMP.
Bostrichidae				
Rhyzopertha dominica (F.)	Black		1	30
Bruchidae				
Callosobruchus maculatus (F.)	Giant		29	30
Cucujidae				
Cryptolestes pusillus (Schön)	Black	Trinidad	10	30
Dermestidae				
Dermestes maculatus Deg.	Black/ Brown	Australia	21	25
Nitidulidae				
Carpophilus dimidiatus (F.)	Pearl-eyed		10	25
Silvanidae				
Ahasveras advena (Waltl)	Black	Britain	10	25
Oryzaephilus surinamensis (L.)	Small	Burma	10	25
Tenebrionidae				
Latheticus oryzae Waterh.	Dark		6	30

MUTANT STOCKS	MUTATION	COUNTRY OF ORIGIN OF STOCK	MEDIA	TEMP.
Tribolium confusum Duv.	Black		23	25
T. confusum	Pearl-eyed	Malta	23	25
T. confusum	Pearl-eyed	Britain	23	25
T. confusum	Pearl-eyed		23	25
T. confusum	Black and Pearl-eyed		23	25

(Ed.)

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

LEPIDOPTERA

Phycitidae

Cadra cautella	Cyprus, 1964
Cadra cautella	Rhodesia, 1965
Cadra figulilella	Cyprus, 1967
Plodia interpunctella	South Africa, 1965
Plodia interpunctella	N. Nigeria, 1965

(Ed.)

Stock Lists

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
S-71	sa	via Sokoloff, Berkeley
S-74	ju	via Sokoloff, Berkeley
S-81	Bes	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

ISRAEL

TEL AVIV, ISRAEL
TEL AVIV UNIVERSITY, DEPARTMENT OF ZOOLOGY

1. Stock list

Tribolium castaneum:

Wild type
++ (Purdue)

Mutants
black (bb)
sooty (ss)
extra urogomphi (eu)

Tribolium confusum

Mutants
black (mcGill) (bb)

Two other strains listed in TIB-15 were lost by infection.

All strains except eu were obtained from Dr. R. R. Sokal's laboratory, Stony Brook, N.Y. USA in 1970. The CS bb and CS ss stocks were recently contaminated by wild type beetles and therefore contain some wild-type genetic background.

Dr. David Wool

ITALY

PAVIA
UNIVERSITY PAVIA, CENTRO DE GENETICA

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

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

JAPAN

KYOTO
KYOTO UNIVERSITY, FACULTY OF AGRICULTURE
ENTOMOLOGICAL LABORATORY

1. Wild type

Bruchidae	
Callosobruchus chinensis	Kyoto
	11 other districts in Japan
Callosobruchus maculatus	Louisiana, U.S.A.
	California, U.S.A. (Fresno, Lab., U.S.D.A.)
	Burma
	Israel
	Thailand
Zabrotes bifasciatus	Hong Kong
Curculionidae	
Sitophilus zeamais	Kyoto
Sitophilus oryzae	Kyoto
Tenebrionidae	
Tribolium castaneum	Kyoto

2. Mutant strain
   Black mutant from a strain of Callasobruchus Chinensis

MISIMA, SIZUOKA-KEN
NATIONAL INSTITUTE OF GENETICS

No stock list available.

(Ed.)

MIYAZAKI
MIYAZAKI UNIVERSITY, DEPARTMENT OF BIOLOGY

Alphitobius diaperinus--wild type strains
Callosobruchus shinensis--Kyoto strains
Martianus dermestoides--wild type strains
Palorus ratzeburgi--wild type strains
Sitophilus oryzae --wild type strains
Sitophilus zeamais--wild type strains
Tenebrio obscurus--wild type strains
Tribolium castaneum--wild type strains
Tribolium confusum--wild type strains

(Ed.)

MEXICO

CHAMPINGO
CAMPO EXPERIMENTAL "EL HORNO"

Tribolium castaneum
Tribolium confusum

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

(Ed.)

NEW ZEALAND

NELSON
DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
ENTOMOLOGY DIVISION

Stegobium paniceum--from infested rat food pellets at Otago University, Dunedin
Oryzaephilus surinamensis--from infested rat food pellets at Otago University, Dunedin
Gnathocerus cornutus--from infested rat food pellets at Otago University, Dunedin
Sitophilus oryzae--from spaghetti in galleys of overseas ships at Port Nelson
Sitophilus zeamais--from rice in galleys of overseas ships at Port Nelson

(Ed.)

PRIVATE BAG, HAMITON
RUAKURA AGRICULTURAL RESEARCH CENTRE, DEPARTMENT OF AGRICULTURE

Tribolium castaneum

1. Wild type strains derived from imported strain from Edinburgh.
2. Mutant strain carrying the chromosome II mutant pearl (p) and obtained from Tribolium Stock Center, Berkeley, California.

A. R. Quartermain

PRIVATE BAG, PALMERSTON NORTH
DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
GRASSLAND DIVISION

Tribolium castaneum

1. Heavy and light population resulting from 18 generations of selection for increased and decreased pupal weight.

2. Strong, moderate and weak populations resulting from 20 generations of within-family selection for increased pupal weight at three selection intensities.

(Ed.)

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 AGRONOMICAS
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

B. Mutant type strains

5.	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
6.	AN - I	high performance	at	33° C
7.	AN - II	high performance	at	33° C
8.	AF - I	high performance	at	28° C
9.	AF - II	high performance	at	28° C
10.	AT - I	high performance	at	38° C
11.	AT - II	high performance	at	38° C
12.	BN - I	low performance	at	33° C
13.	BN - II	low performance	at	33° C

		Selected for		Temperature
14.	BF - I	low performance	at	28° C
15.	BF - II	low performance	at	28 C
16.	BT - I	low performance	at	38° C
17.	BT - II	low performance	at	38° C
18.	RN - I*	high cross performance	at	33° C
19.	SN - I*	high cross performance	at	33° C
20.	RN - II	high cross performance	at	33° C
21.	SN - II	high cross performance	at	33° C
22.	RF - I	high cross performance	at	28° C
23.	SF - I	high cross performance	at	28° C
24.	RF - II	high cross performance	at	28° C
25.	SF - II	high cross performance	at	28° C
26.	RT - I	high cross performance	at	38° C
27.	ST - I	high cross performance	at	38° C
28.	RT - II	high cross performance	at	38° C
29.	ST - II	high cross performance	at	38° C

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

30 - 37 Inbred lines with 26 generations of full sibbing.

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

D. Mutants

		Source and date
50.	antennapedia ap, VIII	Purdue, 1964
51.	Bar eye Be, IV	Purdue, 1968
52.	Black b, III	Sokoloff, 1964
53.	chestnut c, VII	Purdue, 1964
54.	cordoban cd, III	Purdue, 1964
55.	Diferencial Df, IV	Purdue, 1964
56.	fussed antennal segm. -2 fas-2, IV	Sokoloff, 1968
57.	ivory i, ?	Purdue, 1964
58.	jet j, V	Purdue, 1964
59.	juvenile urogomphy ju, IV	Purdue, 1964
60.	light ocular diaph. lod, III	Purdue, 1964

61. maroon m, V Purdue, 1964
62. microcephalic mc, V Purdue, 1964
63. paddle pd, I Purdue, 1964
64. pearl p, II Sokoloff, 1968
65. pegleg pg, II Purdue, 1968
66. pink p^k, II Purdue, 1968
67. pygmy py, I Purdue, 1968
68. red r, I Purdue, 1968
69. ring rg, I Purdue, 1964
70. rose, rs, I Purdue, 1964
71. ruby rb, ? Purdue, 1964
72. Short antenna Sa, VII Purdue I. 1964
73. short elytra se, VIII Purdue, 1964
74. sooty s, IV Purdue, 1964
75. spotted so, I Purdue, 1964
76. squint sq, VIII Purdue, 1964
77. white w, ? Purdue, 1964
78. wine r^w, I Purdue, 1968
79. eye mutant ? Madrid, 1967
80. elytra mutant ? Madrid 1967
81. melanotic stink gland-like ? Madrid, 1968

Tribolium confusum
82. black b, III Sokoloff, 1968
83. creased abdominal sternites cas, II Sokoloff, 1968
84. ebony-2 e_{-2}, II Sokoloff, 1968

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.)

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 (=b^z)--Yugoslavia 1969 (report of A. Sokoloff, TIB 13)

Zlatko Korunić

Stock Lists

CZECHOSLOVAKIA

INSTYTUT ORHRONY ROSLIN
PRACEWNIA BADANIA BIKOSNIKOW FRZEXHSWALNI
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.
Carpohilus hemipterus L.
Stegobium paniceum L.
Acanthoscelides obtectus Say
Anagasta kühniella Zell.
Cadra cautella Wlk.
Plodia interpunctella Hüb.

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*Laboratory studies of the foreign grain beetle, Ahasverus advena (Waltl), reared on certain grain storage molds.

The foreign grain beetle is commonly found in and around bins of wheat and other grains, where it is though to be dependent upon molds.

Development was studied on pure cultures of 7 common storage molds, grown in 60 x 20mm disposable, plastic petri dishes on a malt agar medium containing 4% NaCl. One 0- to 6-hr-old beetle egg (initially surface-sterilized with 1% sodium hypochlorite) was placed in each petri dish (40 or 50 replicates per mold). Dishes were maintained in humidity chambers with 85% RH and 27°C while daily observations were made.

The percentages of hatched larvae which developed to adults on each mold, and the mean developmental period (oviposition to adult) were: Aspergillus amstelodami (87.3%, 18.1 days), Penicillium citrinum (91.2, 19.1), Cladosporium sp. (89.4, 21.4), A. candidus (33.3, 26.3). None completed development on A. ochraceus, A. flavus, A. niger, or Malt-4 agar controls.

Percentage mortality in the initial egg stage did not correspond to the above percentages of specimens reaching adulthood.

The results indicated wide differences in suitability of common storage molds for supporting development of foreign grain beetles.

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*Penetration of plastic containers by Rhysopertha dominica

Insects collected in grain storages during a survey were placed in polystyrene tubes with some grain and sent to the laboratory for examination. One tube, wall thickness 1.5 mm containing grain and Rhysopertha dominica (F.) was found to have several small holes bored in it when it was examined 7 months after being placed in a constant temperature room at 25°C and 70% R.H. Further evidence that R. dominica is able to penetrate plastic containers came from observations made on an infestation in wheat in a plastic bin make of low density polythene having a thickness of approximately 3 mm. Numerous holes were bored in the bin during a 9 month period. Davey and Amos (1961) showed that R. dominica is able to penetrate a wide range of packaging materials, including polythene and various other plastics. It was considered that R. dominica was probably responsible for the holes in the polystyrene though penetration of this material had not been recorded before.

To test the hypothesis that R. dominica will bore through polystyrene a trial was commenced using two 150 ml polystyrene tubes with a wall thickness of 1.5 mm. The tubes were part filled with kibbles wheat, one containing 50 g and the other 75 g. One R. dominica adult per gram of grain was added to each tube. The tubes were then covered with muslin and placed in a constant temperature cabinet at 28°C and 50-60% R.H. where they were examined periodically. After 6 months both tubes were partially bored in several places on their sides and bases. The tube which contained 75 g of wheat was holed at the junction of the side and base, the hole being made within the first 4 months of the experiment. Nearly 300 adult R. dominica crawled through this hole during the experiment. Insect populations in both tubes were just over 60 insects per gram after 6 months and over half the food material in the tubes had been consumed.

Literature Cited

Davey, Pauline M., and Amos, T.G., 1961. Testing of paper and other sack materials for penetration by insects which infest stored products. J. Sci. Food Agric. 3:177-187.

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*The influence of temperature on the performance of single and mixed species populations of flour beetles.

Populations constantly explore new environments and under favorable conditions with requisite gene pools maximum exploitation takes place. In order to assess the population performance when chronic gamma radiation was an environmental factor, single- and mixed-species populations of flour beetles were begun at 25, 29 and 32° with 70 percent relative humidity. This paper describes the dynamics of these populations during the eight months before radiation was started and while the populations were adapting to their new environments.

Twenty pairs of virgin sexually mature beetles were used to establish each population. Mixed-species populations were started with 10 pair of each species. Populations in standard size test tubes were given 5g of food which was renewed montnly. Larvae, pupae and adults were counted at each monthly census and returned with eggs to new food.

The numbers of individuals in each population component (age group) were temperature dependent. For a given temperature the numbers of larvae were comparable for all populations. More larval component oscillations occured at higher than at lower temperatures. Numbers of pupae were consistently low because of their short (4-6 days) duration in the life cycle and because sampling time was once a month. The adult components were more stable and apparently largely responsible in determining the numbers and numbers and magnitudes of the oscillations of the larval components.

On the basis of total numbers of individuals of all life cycle stages *T. castaneum* was more fit than *T. confusum* at 25 and 32°C; *T. confusum* had the advantage at 29°C. However, differentiated as to species, the numbers of adults of *T. confusum* were substantially greater than those of *T. castaneum* at all temperatures in mixed species populations.

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*Effects of Chronic ^{60}Co (Gamma) Radiation, Dose Rate, Temperature and Cohabitation on Population Performance of Flour Beetles, *Tribolium confusum* Du Val and *T. castaneum* Herbst (Coleoptera; Tenebrionidae).

Significant progress has been made using radiations to control and, in some cases, to eradicate insects which are harmful to man and his foods. Because of the magnitude and the multiplicity of problems associated with radiation control of insects which infest stored grain and cereal products, pertinent research has been slow and meager. The present investigation concerned the possible control of flour beetles, *Tribolium confusum* and *T. castaneum*, by chronic irradiation. The population performance was determined by measuring the reproductive capacities which were modified by the chronic gamma radiation exposures. At three dose levels of ^{60}Co gamma radiation, namely 24, 49, and 170 R/day, the effects were considered due to genetic aberrations rather than to physiological impairment.

At each exposure, five replicate populations of single species (20 pairs in each) and of mixed species (10 pairs of each species) were established in 5 g of food in lucite test-tubes. Larvae, pupae and adults were counted monthly and along with eggs were transferred to new food. Populations were cultured at 25 and 32°C in 70-75% relative humidity and after eight months radiation began.

In general, at 25 C the single-species reproductive performance measured as the number of larvae and adults, was impaired by exposure to radiation. Poorest performance appeared at 170 R/day; whereas, 24 and 49 R/day resulted in reduced, but comparable productivity. Larval segments of the populations were more radiation sensitive than adult segments and were eliminated at 170 R/day. Numbers of adults reached zero less rapidly than those of larvae at 170 R/day indicating no adult replacement, but a gradual elimination of those adults present before radiation began or those which developed early in the radiation history. Parameters of radiation sensitivity of productibity were accentuated at 32°C.

Responses to radiation of mixed-species populations were comparable to those of single-species populations at 25C. The reason(s) for the greater survivals at 32°C of larvae and adults in mixed-species populations compared to those at 25°C remains obscure. A synergistic effect of mixed-species interaction might be ruled out since a comparable response was not observed at 25°C.

The observed radiation effects can be explained radiobiologically in that the developing immature stages characterized by growth and cell divisions are more radiation sensitive than adult stages characterized by no growth and few cell divisions (except for meiosis). Each life cycle stage acts, in effect, like a sieve allowing only the "fittest" to proceed to the next developmental stage.

Data from this experiment showed that 170 R/day dose rate was sufficient to stop larval development; but 49 R/day was not enough to eliminate flour beetle populations. The feasibility of implanting radiation sources in a grain storage facility to control insects is discussed.

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Dietary and Density Dependent Factors in the Induction of Population Autocide of Flour Beetles, *Tribolium confusum*:

The response of the adult flour beetle, *Tribolium confusum*, to stress imposed by malathion and crowding was investigated. Stress imposed by malathion concentrations of 1.0 ppm or greater with population densities of 75 or more adult beetles was adequate to initiate the production of the gas with resulting death of all beetles. A color change in the flour (white to pink) was a secondary effect resulting from the presence of the quinone gas.

NOTES - RESEARCH

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Comparison of Sifting Methods for Recovering Tribolium Eggs from Flour Medium

INTRODUCTION

Experiments with *Tribolium* often require that eggs be recovered from vials containing small amounts of flour. Therefore, it would be advantageous to sift eggs from large numbers of vials with a minimum of effort, expense, and waste. In an attempt to increase the efficiency with which eggs can be separated from flour medium, mechanical shaking was compared with hand shaking for several characteristics.

MATERIALS AND METHODS

Eighty females were randomly chosen from a sample of the random-mating Purdue Black Foundation population. For each of 4 days, 20 males and 20 females, newly emerged, were obtained, allowed to mature for 5 days, and randomly mated in 20 pairs, the male being identified by a clipped antenna. At the end of a 4-day mating period, the females were moved to individual vials containing about 1 gram of fresh medium, for a 48-hour egg lay. The medium was fine whole-wheat flour first sifted through a U. S. #80 sieve, and then enriched with 5% dried brewers yeast. The incubator was maintained at about 32°C and 70% relative humidity.

Methods of shaking (hand and mechanical) and operators (technicians 1 and 2), were tested in a 2 x 2 factorial experiment in 4 blocks (hatch days), with 5 matings in each of the 4 treatment combinations on each hatch-day. Because of non-fertile matings, the number of useful matings per cell was sometimes less than 5, the harmonic mean number of useful matings observed being 4.2 per treatment combination.

Shaking time (seconds), egg number, egg counting time (seconds), and percent hatchability (number of larvae + pupae) x 100/number of eggs were observed. These variables were studied to determine whether the two factors or their interaction differentially affected the efficiency of sifting flour, possible loss of eggs, efficiency of counting eggs, and possible damage to eggs during the process of shaking.

The contents of each vial was dumped into a small barrow-funnel sifter, similar to one described by Burns (1969), using standard size 3 silk bolting cloth on which to recover the eggs. The flour was sifted into the same vial from which it came, to determine whither any eggs passed through the cloth during the sifting process.

The mechanical shaker was a Vortex-Genie Mixer Model K-550-G (Scientific Industries, Inc.) secured in an inverted position on a ring stand and operated at maximum speed. Shaking was initiated by pressing upward on the rubber holder, which fit just inside the opening of the barrow portion of the sifter. For hand shaking, the funnel sifter was held in one hand and tapped several times against the other hand.

After shaking the sifter until no more flour appeared to be coming through the cloth, the sifter was slammed several times, with the top opening covered, into a half-pint bottle to remove residual flour. The shaking time was measured from the initiation of shaking till the residual flour was removed.

The eggs were counted using a linear egg counting stage (Muir and Grossman, 1973). The eggs from each mating were then placed into about 2 gm of fresh medium and put into the incubator to hatch. Two weeks later, the larvae and pupae resulting from each mating were counted.

The data were analyzed by the method of unweighted means (Snedecor and Cochran, 1967, p. 475). Egg counting time analysis used egg number as a covariate.

RESULTS AND DISCUSSION

Shaking time: There was a significant ($P < 0.1$) operator difference and a significant ($P < 0.1$) interaction of method and operator affecting shaking time (Tables I and II), suggesting that technicians may differ in their speed of shaking and that the operator's speed may vary with method. If this is not the case, or if it is unimportant, mechanical shaking has the advantage of being less tiring.

Egg Number: Interaction of methods and operators was significant ($P < .05$) suggesting that the number of eggs recovered differs from operator to operator in one or both methods of shaking. Technician 2 reported higher egg counts using mechanical shaking, perhaps counting more flour particles among the eggs recovered using the mechanical shaker. This is probable because Technician 2 was the less experienced; however, this interaction might be reduced by training in distinguishing eggs from particles of flour. About 1 egg per mating passed through the bolting cloth with no evident difference between factors.

Table I. Numbers of observations, means and their standard errors for shaking time, egg number, percent hatchability, and egg counting time.

	No. of Obs.	Shaking Time	Egg Number	% Hatch-ability	Counting Time	Counting Time[1]
Method of Shaking:						
Hand (M1)	35	15.0±0.88	27.5±3.22	54.8±5.04	10.8±0.77	11.2±0.48
Mechanical (M2)	34	15.0±0.89	30.3±3.26	51.5±5.11	12.6±0.78	12.2±0.49
Operators:						
Technician 1 (01)	35	13.7±0.88	29.6±3.22	54.9±5.04	11.4±0.77	11.2±0.48
Technician 2 (02)	34	16.2±0.89	28.2±3.26	51.4±5.11	12.0±0.78	12.2±0.49
Interactions:						
M1 x 01	17	12.6±1.26	32.8±4.62	63.8±7.23	11.8±1.10	10.7±0.67
M1 x 02	18	17.2±1.22	22.6±4.48	46.4±7.03	9.9±1.07	11.7±0.60
M2 x 01	18	14.8±1.22	26.6±4.48	46.6±7.03	11.0±1.07	11.7±0.67
M2 x 02	16	15.2±1.30	34.6±4.76	57.1±7.46	14.4±1.13	12.8±0.66
Overall	69	14.9±0.62	28.9±2.29	53.2±3.59	11.7±0.55	11.7±0.34

[1]Means and standard errors adjusted for the within cell regression of egg counting time on egg number.

Table II. Unweighted means analysis of variance and covariance of shaking time, egg number, percent hatchability, and egg counting time.

Source	d.f.[1]	Mean Squares on an Individual Basis				
		Shaking Time[2]	Egg Number[2]	% Hatch-ability[2]	Counting Time[2]	Counting Time[3]
Total	68					
Days	3	73.54	349.61	1111.74	67.87	23.60
Methods (M)	1	3.21	263.78	204.33	83.17*	19.53
Operators (O)	1	99.82*	.76	195.64	18.52	16.43
M x O	1	93.77*	1892.10**	2999.72*	127.05**	1.41
Error	9	27.05	363.02	891.49	20.71	8.22
Regression	(1)					1693.44***
Within cell	(52) 53	6.26	386.10	664.76	37.92	6.08

[1] Number in parenthesis refers to d.f. used in analysis of covariance.
[2] Analysis of variance.
[3] Analysis of covariance; mean squares adjusted for within cell regression of egg counting time on egg number.
* Significant at 10 percent level of probability.
** Significant at 5 percent level of probability.
*** Significant at 1 percent level of probability.

Percent hatchability: There was a significant ($P < 0.1$) interaction affecting percent hatchability of individual matings, perhaps reflecting errors of counting flour particles as eggs. A correlation between the errors of egg number and percent hatchability ($r = .21$) may obscure the question of damage to the eggs by different shaking methods. If the interaction is unimportant, the results suggest that there is no differential damage to the eggs due to the methods of shaking.

Egg counting time: There was a significant ($P < 0.1$) method difference and a significant ($P < 0.05$) interaction affecting egg counting time, again perhaps reflecting errors of counting flour particles as eggs. Because a longer time is probably needed to reach higher counts, egg number was introduced as a covariate. There was a significant linear regression of counting time on egg number, the regression coefficient being 0.287 ± 0.017 sec/egg. Covariance adjustment left no significant effect on counting time.

CONCLUSIONS

For sifting *Tribolium* eggs from small amounts of flour medium, shaking time, number of eggs recovered, percent hatchability, and counting time were about equal for hand shaking and mechanical shaking. Operators may differ in these characteristics depending on their method of shaking. If the interaction of methods and operators is unimportant, the results suggest that there is no greater loss of eggs, no more damage to the eggs, and that it took no longer to count the eggs when they were recovered using the mechanical shaker.

Using the mechanical shaker reduces fatigue of the hands and arms of the operators, especially when there are large numbers of vials to shake.

Literature Cited

Burns, G. H., 1969. Recovering of *Tribolium* eggs, larvae, pupae, or adults from small amounts of flour. T.I.B. 11:120.

Muir, W.M. and M. Grossman, 1973. A linear egg counting stage for use with *Tribolium*. Submitted to T.I.B.

Snedecor, G.W. and W.G. Cochran, 1967. Statistical Methods, Sixth edition, Iowa State University Press, Ames, Iowa.

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*Thermal perception by the Red Flour Beetle, Tribolium castaneum.

Systematic removal of terminal antennal segments of adult Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) was performed and the effects of the operations on the insect's behavioral response to thermal stimulation observed. Removal of the 2 terminal segments caused a reduction in response; however, the most dramatic loss in the ability to perceive heat occured after removal of the 3 terminal segments.

IRWIN, D.G., Smith, L.W., Jr. and J.J. Pratt, Jr.

*Effects of carbon dioxide and nitrogen on the secretion of para-benzoquinones by Tribolium castaneum (Herbst).

Tribolium castaneum (Herbst) is known to expel a defense secretion of parabenzoquinones under certain conditions of physical and thermal stress. Experiments were undertaken to determine the effects of a possible chemical stress on T. castaneum by subjecting adults to increased percentages of carbon dioxide or nitrogen in dry air. Carbon dioxide percentages from 40 to 96 per cent caused the beetles to secrete considerable quantities of p-benzoquinones. These secretions did not occur in air containing increased percentages of N_2. The data indicate that T. castaneum secretes p-benzoquinones only in a condition of partial narcosis. Results of this study are pertinent to current concepts in fumigation of grain storage containers which advocate purging with CO_2 or N_2.

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*Disc gel electrophoresis of the fatty acid sensitive mutant of T. castaneum

Electrophoresis has been shown to be an effective and sensitive tool for studying the protein composition of various insect tissues (1. 2. 3). The most commonly studied tissues are the hemolymph and the fertilized eggs, while whole animal homogenates are studied less frequently.

Our objective in this note is to compare the unsaturated fatty acid sensitive genotype of T. castaneum (4, 5, 6, 7, 8) with its wild-type foundation population using disc gel electrophoresis of the soluble proteins from whole animal homogenates.

MATERIALS and METHODS

The Sensitive, genetically homozygous corn oil sensitive (cos/cos), and the Purdue Foundation populations were used. Each population was cultured on diet O (percentage composition: wheat flour 90, dried brewers yeast 5 and glucose nomohydrate 5) and diet 5 (percentage composition: whear flour 90, dried brewers yeast 5 and corn oil 5) and maintained in a controlled chamber at 70 ± 3 percent relative humidity and 33 ± .25°C. Randomly selected samples of approximately 20 mg of larvae were harvested at 6, 7, 8, 9, and 10 days after egg collection and killed by freezing.

After the samples were collected, the proteins were extracted by the following method: 1) wash in Tris-glycine buffer, pH 8.3; 2) homogenize in 0.7 ml buffer with teflon pestle for one minute; cool in ice bath and repeat two more times; 3) centrifuge at 10,000 g for 30 minutes; 4) filter supernatant through glass wool and store in the freezer. The protein content of each sample was determined by the Biuret method and all samples were diluted to approximately 1 mg protein per ml.

Electrophoresis was carried out on a separating gel of 7% acrylamide with tris-gly buffer, pH 8.3. No stacking gel was used. Instead, 24 1 of the protein solution was layered directed on the gel. The gels were pre-electrophoresed at 3 ma/gel for ½ hour, and the proteins run at 2 ma/gel for 55 minutes. The gels were then fixed in a 12% solution of trichloro-acetic acid (TCA) for ½ hour followed by staining with coomasie blue in 10% TCA for 2 hours. Destaining was accomplished by elution in 10% TCA.

The gels were scanned using a Gilford spectrometer at λ = 586.7 nm. The tracings obtained were used as the basis for the line drawings of the gels presented. Band widths were measured at ½ peak height. The relative mobilities reported were calculated using the fastest moving band as 100; all others have values less than 100. That this fast-moving band was common to all samples was evidenced by a characteristic yellow color when placed in 12% TCA.

Coomasie Brilliant Blue Staining Solution

200 mg	Coomasie blue
50 ml	methanol
50 ml	water
10 ml	glacial acetic acid
27.5 ml	50% TCA

Gel Solutions: A) 1N HCl 48 ml
Tris 36.3 g
Temed 0.23 ml
water to 100 ml

C) Acrylamide 28 g
Bis 1.735 g
water to 100 ml

Catalyst: 1.14% ammonium persulfate

Working Solution: A : C : H_2O : AP
1 : 2 : 1 : 4 (Adapted from Davis (9).)

RESULTS

Figure 1 - 11 show the results of the electrophoresis. The band number is given on the left and the relative mobility values (F_{mb}) are on the right of each drawing. Figures 1 and 2 show what are probably the most reliable results since they were drawn from

Several things can be seen from figures 1 and 2. First, there seems to be a relatively little difference between the patterns of Sensitive larva grown on diets 0 and 5. Although there is one less band present in the day 8 Sensitive larva-diet 5 (S-5-8), it is probably due to poor resolution of bands 4 and 5 shown in the S-0-8 pattern. Similarly, the patterns of S-0-9 and S-5-9 show very little difference.

On the other hand, the patterns of the Purdue larvae show marked differences on the two diets. In both day 8 and day 9, there are fewer bands present in the pattern from diet 5 larvae than the diet 0 larvae. In both cases, a new slow-moving band appears in the diet 5 pattern. However, it is difficult to make any general statement concerning the bands that appear to be absent from the diet 5 patterns. In day 8, there is a loss of bands near the middle of the pattern, R_{mb} 30-40; but in day 9, it is a rapidly moving band that disappears. Finally, P-5-9 appears unique in that there is no band with R_{mb} 10; all other patterns show such a band.

If one compares the electropherograms of the Sensitive larvae with those of the Purdue larvae, one can see quite striking differences. While there are several bands in common among the day 9 patterns (R_{mb} 10, 20-22, 43-45, 53-56, 89-91 and 100), there are many differences. Looking first at the diet 5 larvae - day 8, one can see two bands on the Purdue pattern that are completely absent from the Sensitive pattern - R_{mb} 3 and 26. While the band at R_{mb} 26 appears common to all Purdue electropherograms, the band at R_{mb} 3 is unique to Purdue - diet 5. In addition, band 4 with R_{mb} 33 present in S-5-8 is absent in the P-5-8 pattern. Turning one's attention to the diet 0 - day 8 patterns, one again sees quite obvious differences. Although all bands present in the Sensitive pattern are present in the Purdue pattern, the Purdue patterns show two bands that are missing from the Sensitive pattern - R_{mb} 26 and 65.

In the case of the day 9 electropherograms, it is more difficult to pick out specific differences between the Purdue and Sensitive patterns. There are very few bands common to both the Sensitives and Purdue electropherograms. However, it appears as though there is a general increase in mobility of the Purdue proteins relative to the Sensitive proteins. This may be due to abnormalities in the gel - larger pore size - rather than to any significant changes in the protein make-up. One can see an overall increase in the number of bands in the Purdue patterns similar to that observed in the day 8 electropherograms.

Figures 3 - 7 show patterns that were obtained from single determinations of the respective samples, therefore, less confidence is placed in these results than in those discussed above. The patterns are generally more complex so it is more difficult to make any specific comments on the differences observed. It is perhaps sufficient to note that there are differences related to both genotype and diet.

Figures 8 - 11 show a longitudinal comparison based on age of the electropherograms of identical genotype and diet. Here again, the picture is extremely complex and it is difficult to make any specific comment on the changes. Generally one can say that the electrophoretic pattern is dependent on age.

DISCUSSION

Obvious differences are visible in the patterns of Purdue and Sensitive larvae. Perhaps these differences are characteristic of the mutation - only further replication and study will verify or discredit this idea. The reader must be cautioned that no effort was made to characterize the proteins beyond their mobility in an electric field. Therefore, the presence or absence of any one band cannot be interpreted as a direct result of any variation in lipid metabolism between the two strains.

It is necessary to inject a note of caution when interpreting these results While two important variables have been experimently controlled in this study - age and diet - many others are still operational in unpredictable ways. The preparation of the samples themselves could cause very significant variations in the patterns. While every effort was made to keep the homogenization procedure as uniform as possible, variations could still result. For example, as the larvae aged, fewer animals were needed to make up the 20 mg.; consequently, individual differences become increasingly important and the disruption of cells and subcellular particles was probably not uniform in all samples. Subcellular particles such as mitochondria contain many enzymes that would result in changes in the electropherograms. One possible solution is the use of sonication to completely disrupt every component of the homogenate. The isolation of mitochondira and the subsequent study of the enzymes involved in lipid metabolism contained therein may be valuable. Comparative disc gel electrophoresis might be useful as an initial step in this approach.

This study also shows the need to carefully control environmental factors when using disc gel electrophoresis for the study of taxonomic relationships. Diet obviously plays a large role in the electrophoretic pattern obtained. Other authors have also noted the effect that environment plays in the variation of electropherograms (10).

Fig. 1. -- Proteins extracted from day eight larva.

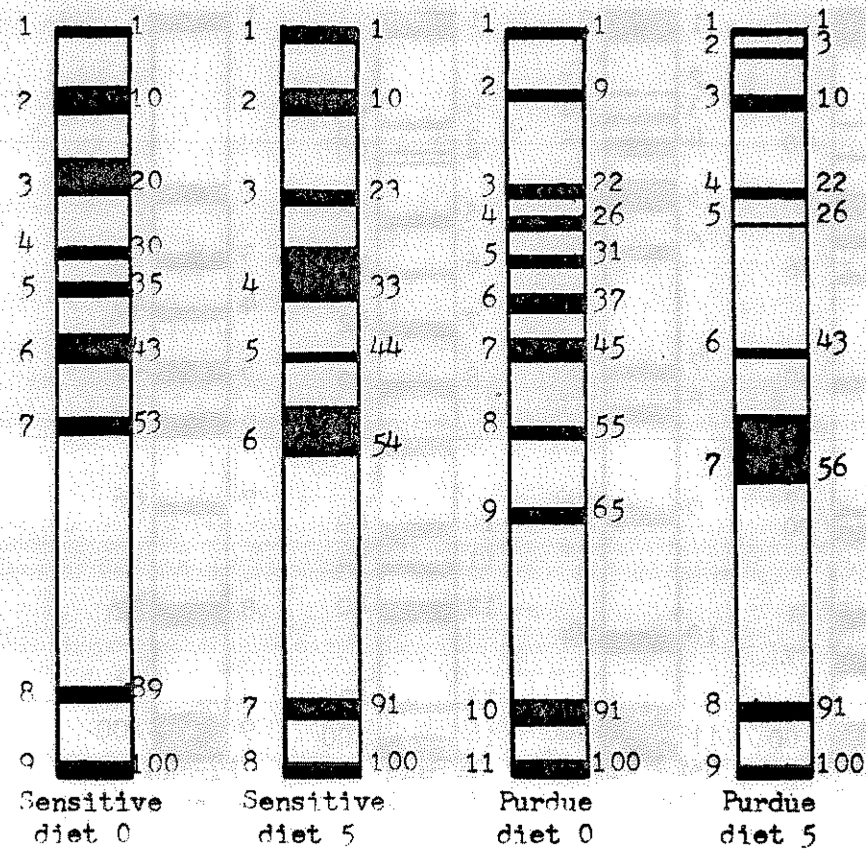


Fig. 2. -- Proteins extracted from day nine larva.

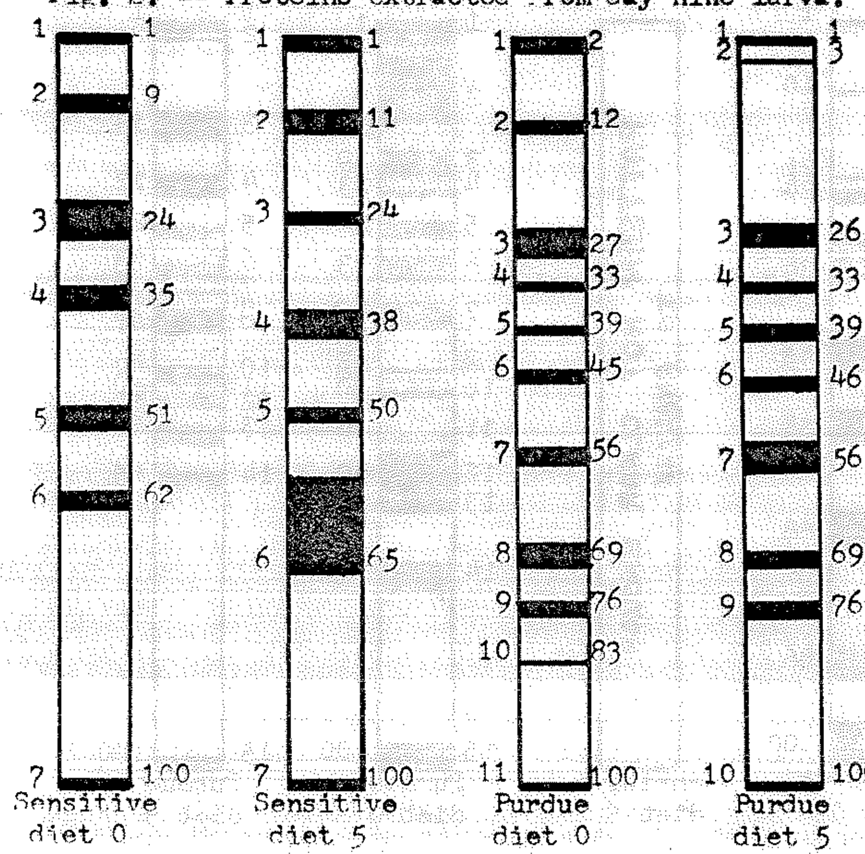


Fig. 3. -- Proteins extracted from day six larva - 1 mg/ml

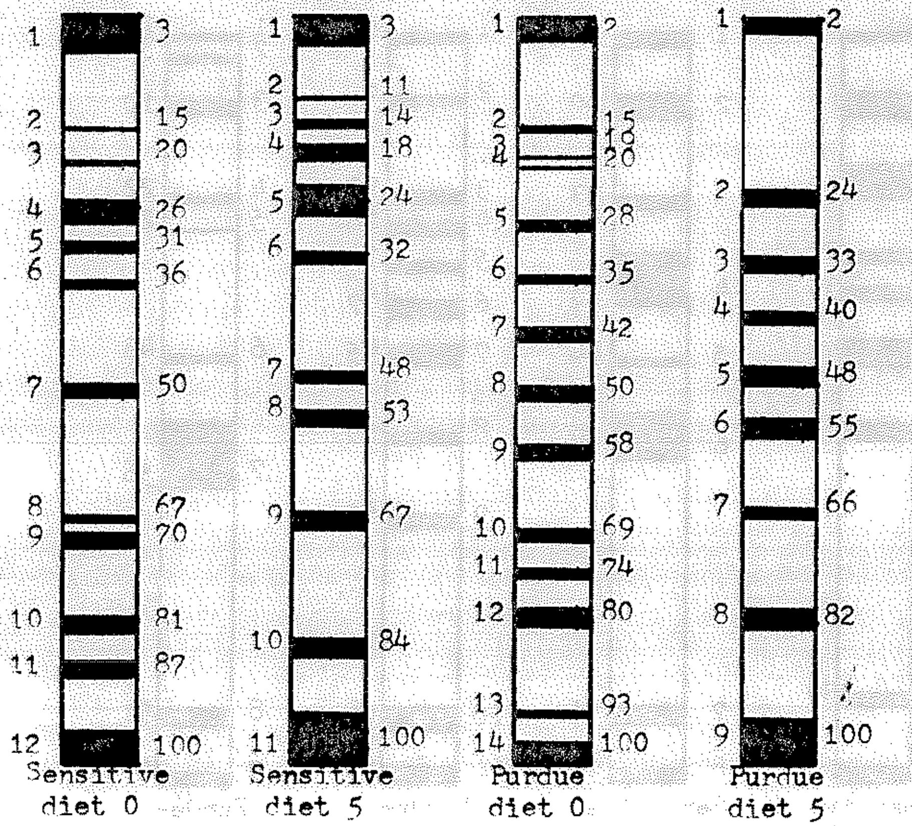


Fig. 4. -- Proteins extracted from day seven larva - 1 mg/ml

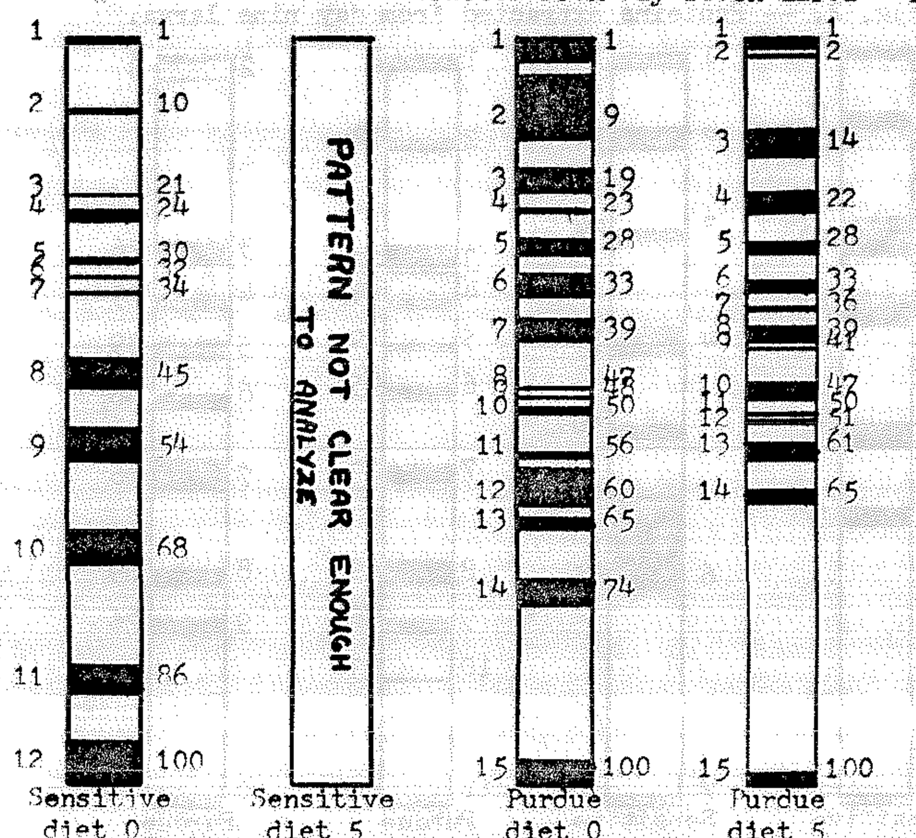


Fig. 5. -- Proteins extracted from day eight larva - 1 mg/ml.

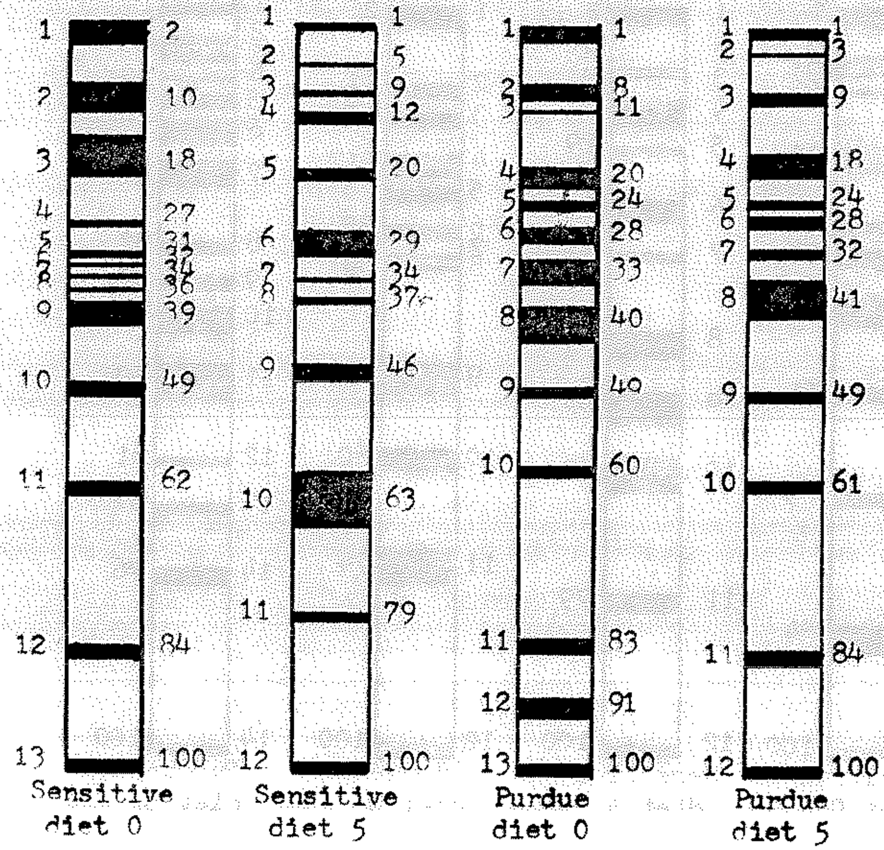


Fig. 6. -- Proteins extracted from day nine larva - 1 mg/ml.

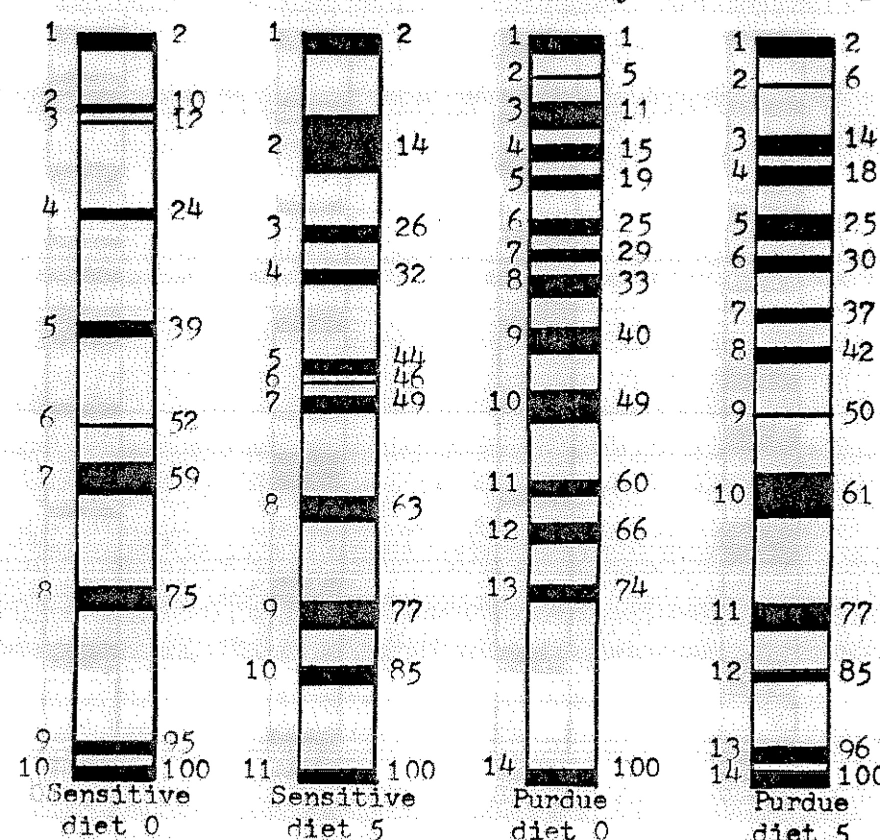


Fig. 7. -- Proteins extracted from day ten larva - 1 mg/ml.

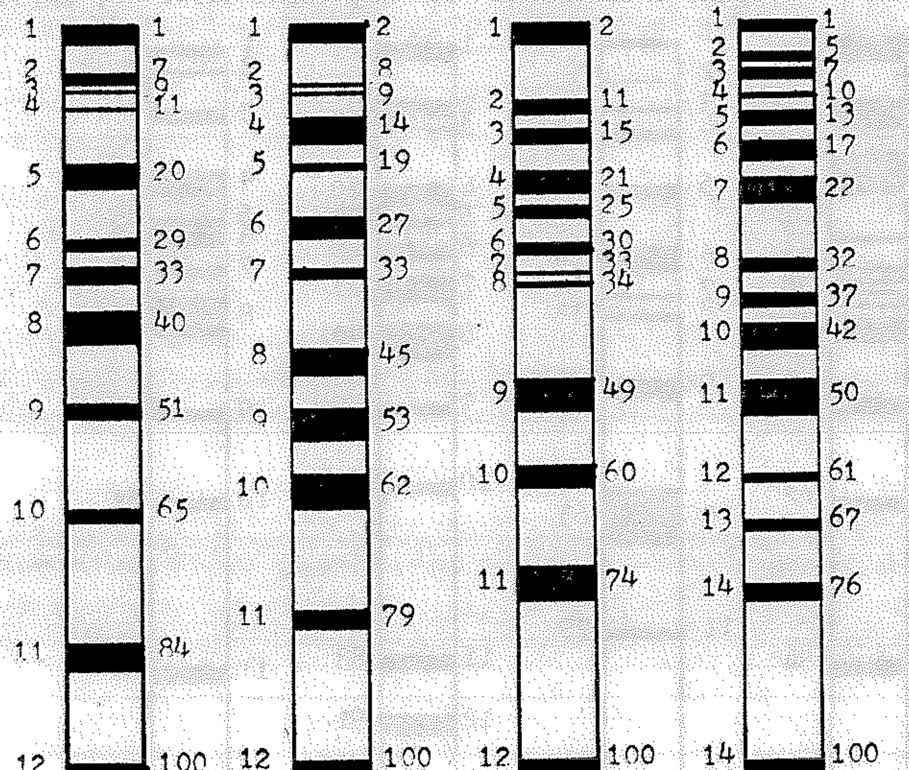


Fig. 8. -- Proteins extracted from Sensitive larva - diet 0.

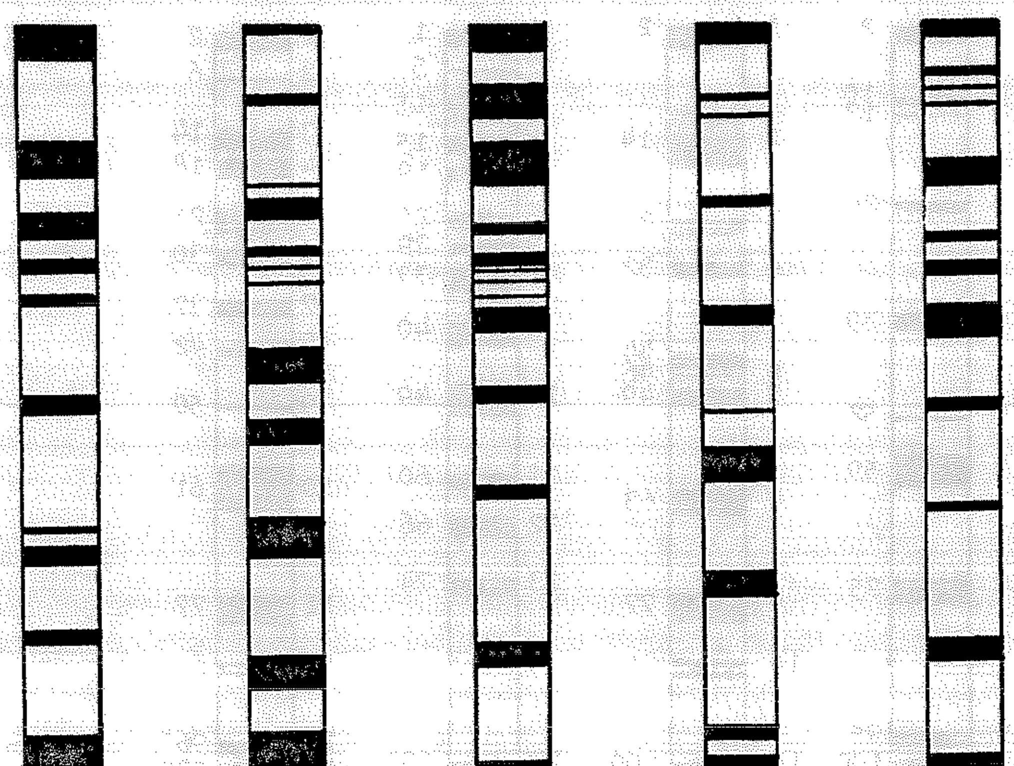


Fig. 9. -- Proteins extracted from densitive larva - diet 5.

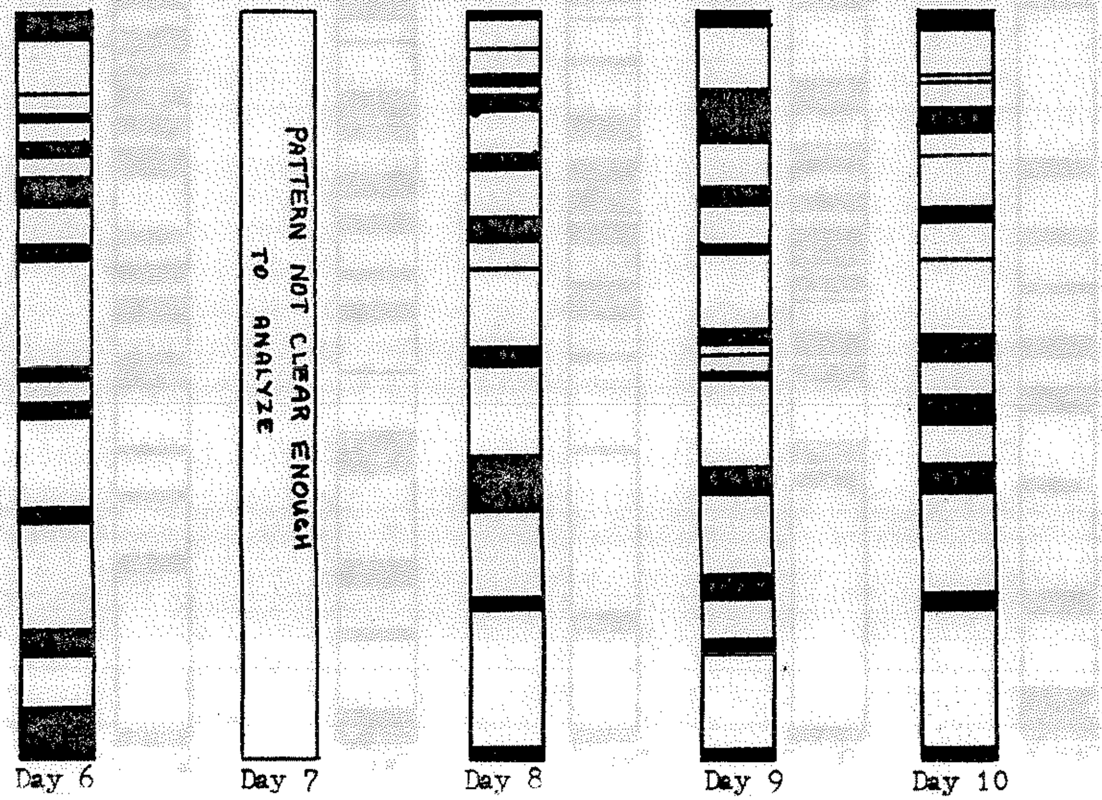


Fig. 10. -- Proteins extracted from Purdue larva - diet 0.

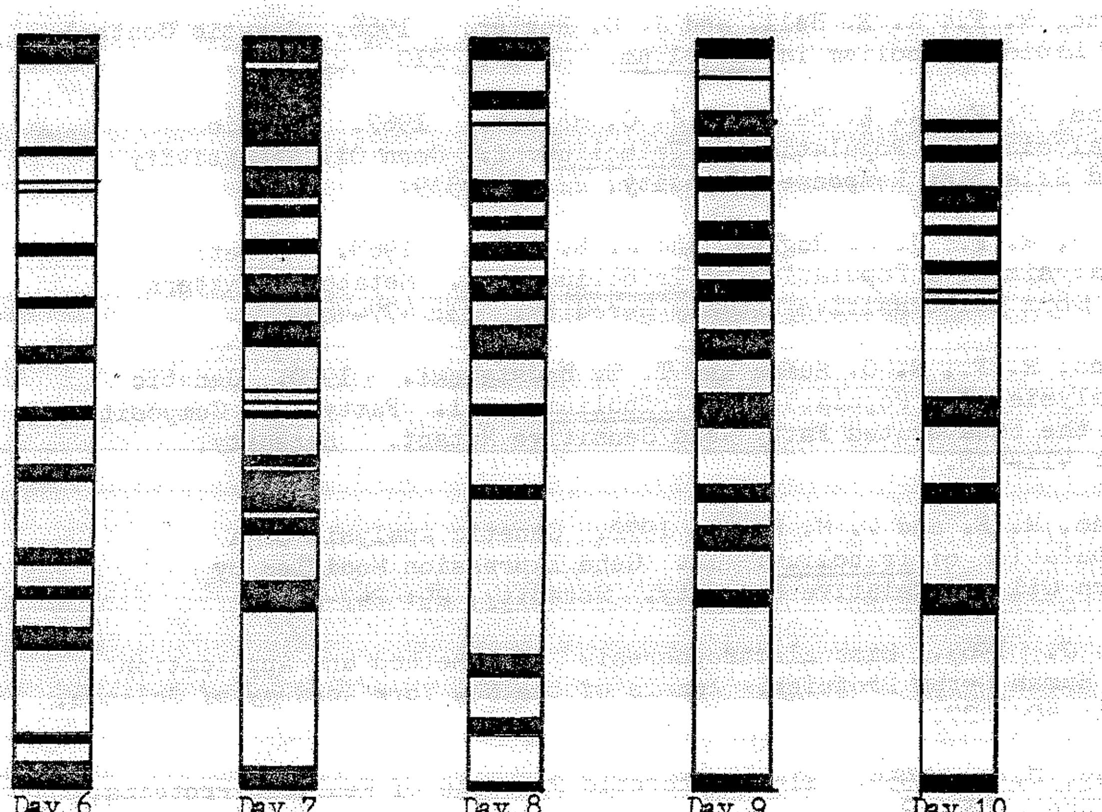
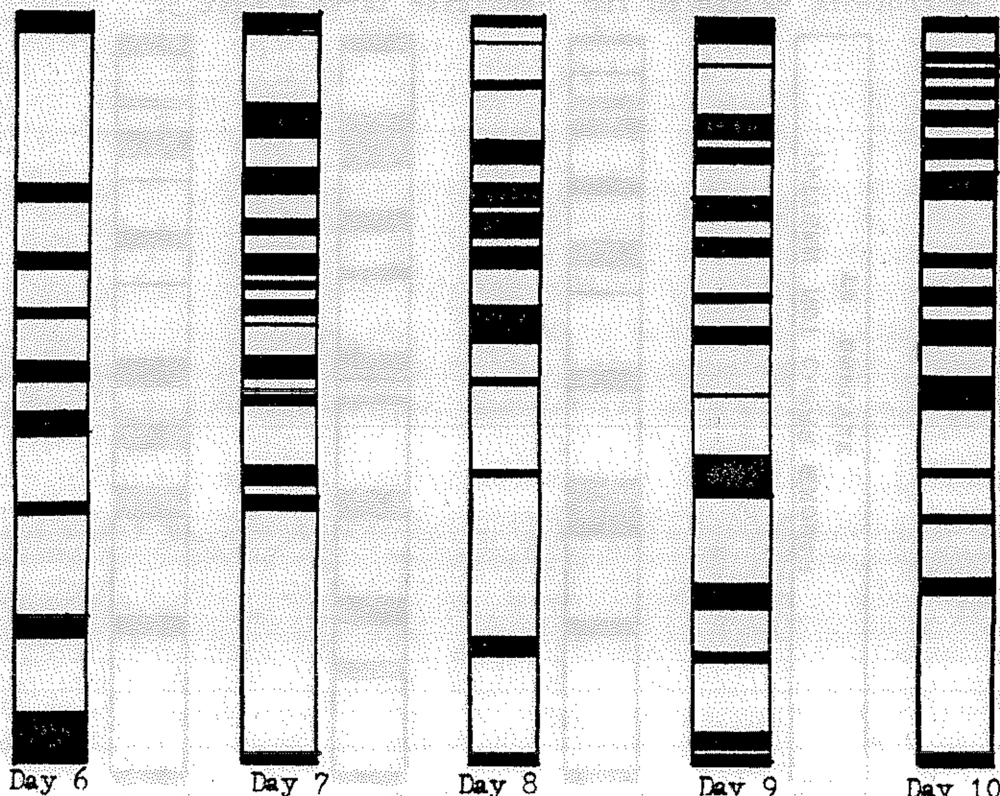


Fig. 11. -- Proteins extracted from Purdue larva - diet 5.



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*A Case of Incomplete Development of Hymenolepis diminuta Ova in a Tribolium confusum Beetle.

Tribolium confusum has been established as a successful intermediate host for the rat tapeworm, Hymenolepis diminuta. The tapeworm ova are passed out of the rat host with the fecal matter. When they are ingested by a suitable species of beetle, the eggs hatch in the intestine and the oncospheres then penetrate the intestinal wall and enter the haemocoel where they develop into cysticercoids.

H. diminuta ova were obtained by dissecting the tapeworms from an infected white rat. The ova were concentrated by centrifugation. A microscopic count revealed approximately 250 ova per drop. A drop of the ova suspension was placed on an oatmeal flake allowing the inoculum to be absorbed. Four such flakes were placed in each of the petri dishes containing the beetles. The petri dishes were covered and taped to prevent dessication of the ova. After most of the oatmeal flakes were consumed, the beetles were fed their regular diet of 95% unbleached flour and 5% brewer's yeast. From the 15th thru the 22nd day, all the beetles were dissected under a dissecting microscope and the cysticercoids counted.

Four different species of beetles, Tribolium castaneum, T. confusum, T. madens and T. brevicornis were obtained from the Tribolium Stock Center at C.S.C.S.B. Each species contained approximately 50 males and 50 females. They were separated into groups of 25 beetles of the same sex of each species, and were placed into separate petri dishes.

Of the 78 T. confusum beetles that survived 77% were found to contain mature infective cysticercoids of H. diminuta. One of the males contained no cysticeroids, but instead, harboured about 450 tapeworm ova in the haemocoel. The ova were found to be fully intact showing no sign of difestion or disintegration. A permanent preparation of the ova was made.

NOTES - RESEARCH

H. diminuta ova contain an oncosphere enclosed by 4 membranes and an outer egg shell. The outermost membrane is very thin and invisible in intact eggs. The second membrane is the vitelline membrane which becomes distended during the hatching process. The oncosphere coat forms the third membrane inside of which is the thin inner membrane.

Voge and Berntzen (1961) in their study of "in vitro" hatching of H. diminuta oncosphere have shown that the rupture of the egg shell of the ova is necessary for the successful hatching and continued development of cysticercoids. Upon careful examination of the beetle and its mouth parts, one of its mandibles appear defective. (Fig. 1) It seems likely that the defective mandibles enabled the beetle to ingest the ova without rupturing the egg shell and the intact egg shell prevented the digestive enzumes of the beetle from acting upon the ova.

The presence of approximately 450 eggs within a single beetle suggests that a large number of ova can be consumed by a single beetle even though only a few develop into cysticercoids.

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Voge, M. and A. K. Berntzen. 1961. "In vitro" hatching of oncospheres of Hymenolepis diminuta. Journal of Parasitology 47, (5): 813-818.

Fig. 1. Head of a T. confusum beetle. Note that its left mandible has a broken tooth. Consequently, the egg-shells of the ingested H. diminuta eggs were not broken.

NOTES - RESEARCH

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*Preferential cannibalism of pupae in hybrid populations of *Tribolium castaneum*.

Some preliminary evidence for differential pupal palatability among strains (UPF and Chicago black) of *Tribolium castaneum* and their hybrids was reported in an earlier issue of this bulletin (Kence, 1971).

To further investigate the matter, larvae of each strain and of their hybrids were offered all three types of pupae, including their own kind, in contrast with the previous study where larvae had a choice only between two unlike types of pupae. Larval cultures of each strain and their hybrids were set up with 13-day old larvae (since egg laying) in 6-dram shell vials containing 4g flour at a density 50/g. There were two replicates for each type of larval culture. Age of pupae used in the experiment was always less than or equal to 24 hours. We introduced 75 pupae into each culture with the three types in equal proportions (25:25:25). Each batch of pupae was left in the cultures for 24 hours. At the end of this period the remaining pupae were removed to holding vials and new batches of pupae were introduced into the cultures. This procedure was repeated for three consecutive days. The numbers and types of the surviving pupae were determined after eclosion.

Numbers of pupae of the two strains and their hybrids cannibalized by each type of larvae are given in Table 1. In this experiment overall cannibalism rate was considerable lower than in the previous study, since the larval density employed was 50/g rather than 100/g. Density 50/g was considered to be a better approximation to larval densities observed in the population cage experiments of Sokal and Sonleitner (1968) and Sokal and Fujii (1972). All types of larvae prefer to ear UPF pupae when offered a choice among the three types of pupae. Tests of goodness of fit to a 1:1:1 ratio produced significant *G*-value for pooled data and lack of significance for heterogeneity substantiates the conclusion that UPF pupae are always preferred. This also agrees well with the findings of the two-choice study, where *+b* and *bb* larvae preferred UPF pupae, and UPF larvae did not seem to differentiate between *+b* and *bb* pupae.

The mechanisms by which larvae can differentiate among different types of pupae is not known. Larvae may find the UPF pupae more "tasty". Unless UPF pupae have some sort of chemical cue (odor) associated with their taste, this mechanism is not very likely. Or pupae may differ in their ability to escape predation by physical means, such as wriggling out of an attack. In any case, preferential cannibalism of UPF pupae by larvae is probably one of the selective agents contributing to the increase of the frequency of black gene in hybrid populations of Tribolium castaneum.

Table 1. Number of cannibalized pupae

		Pupae						
		++	+b	bb	df	G	P	
Larvae	++	35	22	26	2	3.143		.05
	+b	31	21	16	2	5.058		.05
	bb	58	32	35	2	9.268	.01	
Total					6	17.469	.001	
Pooled		124	75	77	2	15. 792	.001	
Heterogeneity					4	1.677		.05

Literature Cited

Kence, A. 1971. Genetic differences in palatability of pupae and voracity of larvae of Tribolium castaneum. Tribolium Infomm. Bull 14: 79-80.

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*The effect of cannibalism in mixed cultures of short-antennae and wild type strains of T. castneum.

Cannibalism has been recognized as a factor in the regulation of Tribolium populations (Woll, 1969). Kence (1971) showed that preferential cannibalism occurs in certain populations containing both mutant and wild type strains. Sokal (1967) and Wool (1969) suggested that by using genetic strains with differential developmental times, it is possible to manipulate the effects of cannibalism.

MATERIALS AND METHODS

Random observations of populations containing short-antennae (Sa-2), a dominant mutant with homozygous lethal effects, and wild type indicated a shortage of the mutant. To study this in more detail, a preliminary study was undertaken. Eggs were collected from various mass matings of 10 males and 10 virgin females involving Sa-2 and wild type. The eggs collected at 24 hr. intervals, to maintain similar age ranges, were placed in 3/4 oz. creamers containing either 2g. or 4g. of fresh stan - ard whole wheat flour media. The experiment was maintained at $91^{0} \pm 1^{o}$ F and 70 ± 2.0% R.H. When the pupa emerged as adults, they were classified as to phenotype.

RESULTS AND DISCUSSION

The mean number of emerging adults for the various matings of Sa-2 and wild type at various densities and depths are reported in Tables 1a and 1b. Differences between the various densities and the 2g. verses 4g depths were generally found to be non-significant.

Daily observations of emergence (not shown here) indicated that wild type adults emerged first. This reaffirms earlier observations by Krause et al, 1962. Since developmental time differences can lend themselves to the possibility of cannibalism of immatures, a chi-square analysis of expected numbers was conducted. These values were found not to be significantly different from expected Mendelian ratios.

Cannibalism may occur at any stage of development: larva-egg, larva-pupa, adult-larva and adult-pupa. However, is cannibalism in this system of a random nature (that is, is there accidental meeting of predatory-prey)? kence (1971) using genotypic combinations at the black locus found b/b larva preferred +/+ pupa, but +/+ and +/b larva showed no preference. The data reported in this study (Table 1a and 1b) indicated that if cannibalism is operating in this system, it seems to be working in a random fashion. It is possible that the high mortality (which ranged from 45% to 70% at 2g. depth and 54% to 68% at 4g, depth) may have masked the effects of cannibalism. No significant differences in mortality were noted even though it is known that Sa/Sa mutants die in the egg stage (Krause et al, 1962). Reasons for the high mortality in this particular study are not known.

SUMMARY

Contrary to original observations, expected phenotypic numbers among resulting progeny did not indicate dominance of one genotype over the other. In addition the effect of preferential cannibalism of the slower developing strain, short-antennae, on the wild type, or vice versa, could not be established in this preliminary study.

Literature Cited

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Sokal, R. R. 1967. A comparison of fitness characters and their response to density in stock and selected cultures of wild type and black *Tribolium* castaneum. T.I.B. 10: 142-147.

Wool, D. 1969. The effect of larval age range on survival of two *Tribolium castaneum* strains in mixed cultures through pupal cannibalism. Res. Pop. Ecol. 11: 40-44.

Table 1. Mean phenotypic results of eggs from various matings involving the short-antennae (Sa-2) mutant subjected to various densities.

(a) 2g media stratification

Eggs from mating : male x female	density	number of samples	mean number ± standard error of Wild	Sa-2
wild x wild	25/g	3	22.2±1.0	-
	50/g	2	45.0±2.0	-
	100/g	2	83.5±2.5	-
	150/g	2	112.5±2.5	-
Sa2 x wild	25/g	2	13.0±1.0	7.0±1.0
	50/g	2	23.5±2.5	20.0±3.0
	100/g	2	53.0±0.0	39.0±0.0
	150/g	2	45.0±5.0	64.5±6.5
wild x Sa-2	25/g	2	15.5±0.5	12.0±2.0
	50/g	2	22.5±2.5	22.0±1.0
	100/g	2	35.0±2.0	49.2±5.5
	150/g	2	52.0±2.0	55.0±6.0
Sa-2 x Sa-2	25/g	2	8.0±2.0	15.0±2.0
	50/g	2	11.5±2.5	24.5±3.5
	100/g	2	20.5±1.5	37.5±2.5
	150/g	2	28.0±3.0	59.0±7.0

(b) 4g media stratification

Eggs from mating Male x Female	density	number of samples	mean number ± Standard error of Wild	Sa-2
wild x wild	5/g	6	7.0±0.6	-
	20/g	3	28.6±3.5	-
	40/g	3	53.0±3.8	-
	80/g	2	118.5±4.5	-
Sa-2 x wild	5/g	6	3.3±0.5	4.1±0.3
	20/g	3	18.6±3.5	15.6±0.7
	40/g	3	27.0±1.5	27.6±0.7
	80/g	2	69.0±3.0	55.5±1.5
wild x Sa-2	5/g	6	4.8±0.7	4.5±0.7
	20/g	3	22.6±1.9	14.6±1.8
	40/g	3	31.6±1.3	34.3±0.9
	80/g	2	75.5±1.5	68.5±2.5
Sa-2 x Sa-2	5/g	6	3.3±0.6	3.5±0.8
	20/g	3	12.3±1.4	14.3±2.3
	40/g	3	20.0±1.0	32.0±2.5
	80/g	2	36.0±0.0	75.0±2.0

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An effect of inbreeding on adult survival under starvation in T. castaneum.

The purpose of the experiment reported here was to compare the ability of inbred and outbred *T. castaneum* adults to withstand starvation.

MATERIALS AND METHODS

Wild type *T. castaneum* (see stock list) were used for the experiment. Two groups of lines, originating from the same parents were propagated by brother-sister pair mating for 1 and 6 generations, respectively prior to the experiment (I1, I6 in the accompaning table). Two outbred groups (o1, 06), also pair mated, served as controls. Apart from the mating system, all lines were identically treated.

Several replicate vials were made of each group. In every vial, a fixed number of pupae - three days old - were introduced, with no food (pupae were used to avoid feeding of emerging adults.) All vials were maintained at 30°C and 70% RH and checked periodically for mortality. Live adults were counted. Dead ones were not removed from the vials. The experiment was terminated when all adults had died.

RESULTS

The accompanying figure illustrates the mean percent of surviving adults during the experiment. It is clear that I6 adults survived, on the average, a shorter period of starvation than the other three group. The average number of days required for mortality of 50% of the I6 individuals was shorter by about 1 day (see table). The difference between I6 and 06 was highly significant (P 0.01 by the Wilcoxon two sample test). There were no significant differences among the other three groups (P 0.05 by the Kruskal - Wallis test.)

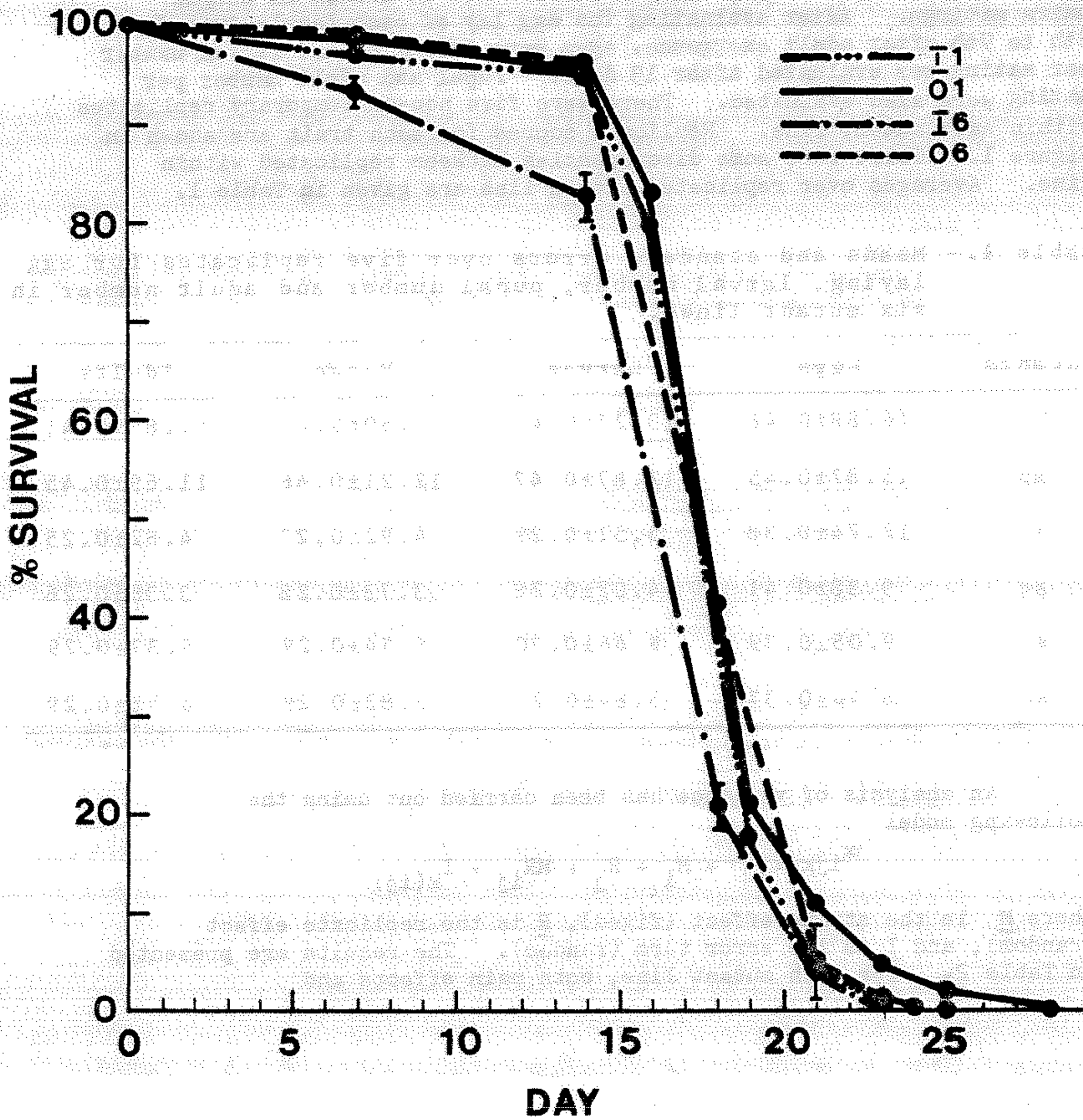
DISCUSSION

It is clear that adults from the I6 group (Inbred for six generations) survived less than outbred individuals. Genetic changes produced by inbreeding may have impaired the ability of larva, to accumulate food in their body during larval development, or affected adult survival directly in other ways.

It is interesting to compare these results with those reported by A. Sokoloff and P. Cavataio in in T.I.B. 1971 (14: 86-88). Their beetles were maintained at a lower temperature (25°) and survived much longer. The discussion at the end of their note is also valid for the present study, in particular the ability of beetles to acquire nutrition from necrophagy.

Group	Number of replicate vials	Number of pupae input per vial	Time to Mortality of 50% (days)
I 1	23	10	17.49 ± 0.1
O 1	27	10	17.59 ± 0.1
I 6	20	15	16.13 ± 0.1
O 6	5	15	17.37 ± 0.2

Percent of survival of adults at periodic censuses of the four experimental groups.



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A study on fitness components in six mutant lines of *Tribolium castaneum*

A study was carried out on the egg laying and other fitness traits of sex recessive mutant lines of *Tribolium castaneum*. The characters studied were, 24-hours egg laying of fecundated 9-days old females, and larval and adult number obtained per each female lay. The mutants used in this experiment were, squint (sq), antennapedia (ap), jet (j), sooty (s), black (b) and short elytra (sh). In each mutant line 30 males and 30 females were mated at random in single pairs matings. After evaluating the egg lay of each female from days 8th to 9th after adult emergence, eggs were incubated and larval number per mating was evaluated after 13 days. Pupal and adult number per mating were also evaluated. There were five non-contemporary replicates within each mutant line. Replicate scores for each trait are shown in Figure 1. There were some discrepancies between replicated within line. Averages over replicates within line are given in Table 1.

Table 1.- Means and standard errors over five replicates for egg laying, larval number, pupal number and adult number in six mutant lines.

Mutants	Eggs	Larvae	Pupae	Adults
b	16.88±0.46	13.27±0.44	12.50±0.43	11.87±0.41
ap	15.87±0.45	12.87±0.47	12.21±0.46	11.69±0.45
j	12.74±0.38	5.51±0.29	4.92±0.27	4.62±0.25
sq	9.38±0.41	4.02±0.28	3.73±0.28	3.36±0.26
s	9.05±0.39	5.66±0.30	5.54±0.29	5.37±0.29
sh	8.16±0.37	5.84±0.29	5.82±0.29	5.58±0.29

An analysis of variance has been carried out using the following model

$$x_{ijk} = \mu + M_i + R_j + MR_{ij} + I_{k(ij)}$$

where $\underline{M}$ is the strain effect (fixed), $\underline{R}$ is the replicate effect (random), and $\underline{I}$ is the error term (random). The results are presented in Table 2. For each mutant line, both main effects and

Table 2.- Analysis of variance. (Mean squares).

	d.f.	Eggs	Larvae	Pupae	Adults
Mutants	5	1763,65**	2063,40**	1843,61**	1699,21**
Replicates	4	148,39**	65,25**	62,35**	56,56**
M x R	20	76,42**	45,00**	42,84**	38,34**
Error	697	18,37	15,36	14,48	13,79

** Significant at 1% level

interactions were highly significant ($P < 0.01$). The interaction effect is more of the quantitative type rather than qualitative, in particular for the larvae and adult countings. This interaction probably comes from the large magnitude of the main effects; so, the the average over the replicates for each mutant is considered a good estimate of the laying ability.

Newman Keuls multiple range tests were carried out and the results for egg laying and larval number are presented in Tables 3 and 4. For egg laying lines b and ap were best, line j ranked second, and lines sq, sh and s were worst. For larval number two groups can be clearly differentiated, lines b and ap were also best, followed by the other four lines. The strain ranking for the two traits considered were

Egg number means $\quad$ b > ap > j >> sq > s > sh
Larval number means $\quad$ b > ap >> sh > s > j > sq

Percentage of eggs producing larvae (EL), larvae producing adults (LA) and eggs producing adults (EA) were calculated in order to give a

Table 3.- Newman Keuls multiple range test for egg laying.

Mean	sh 8.16	s 9.05	sq 9.38	j 12.78	ap 15.78
b 16.88	8.72** K_6	7.83** K_5	7.50** K_4	4.14** K_3	1.01 K_2
ap 15.87	7.71** K_5	6.82** K_4	6.49** K_3	3.13 K_2	
j 12.74	4.58** K_4	3.69** K_3	3.36** K_2		
sq 9.38	1.22 K_3	0.33 K_2			

** Significant at 1% level

Table 4.- Newman Keuls multiple range test for larval number.

Mean		sq	j	s	sh	ap
		4.02	5.51	5.66	5.84	12.87
b	13.27	9.25**	7.76**	7.61**	7.43**	0.40
ap	12.87	8.85**	7.36**	7.21**	7.03**	
sh	5.84	1.82	0.33	0.18		
s	5.66	1.64	0.15			
j	5.51	1.49				
sq	4.02					

** Significant at 1% level

better interpretation to the individual counts. Those percentages are given in Table 5. From this table it follows that lines b and ap are best for EA, lines s and sh are intermediate, and lines j and sq are worst. It is also apparent how EL and LA could add to the final product EA in different ways; of course, those percentages keep no

Table 5.- Percentages and their standard error of eggs producing larvae (EL), larvae producing adults (LA) and eggs producing adults (EA) in six mutant lines.

	b	ap	j	sq	s	sh
EL	78±1.21	81±1.56	44±4.64	43±2.75	64±3.40	72±1.08
LA	90±1.91	90±1.39	84±1.92	84±3.67	94±2.17	92±3.94
EA	70±2.07	73±1.64	37±2.96	36±2.87	60±2.46	67±3.44

relation to the number of eggs laid, as shown in Table 1. Although the EL percentage, which measures fertility, hatchability and juvenile livability is greatest in b and ap than in s and sh, the percentage LA is nearly the same in these four lines.

Phenotypic correlations between the viability percentages EL, EA and EP (eggs producing pupae) and egg number are given in Table 6. These correlations between egg laying and viability percents are quite high excepting those for j and sq. The statistical differences between lines within each group of high or low viability are not significant. However, there is a tendency for b and ap to present slightly higher figures for EL. The low, though positive, correlations

Table 6.- Phenotypic correlations between EL, EP, EA and egg laying in six mutant lines.

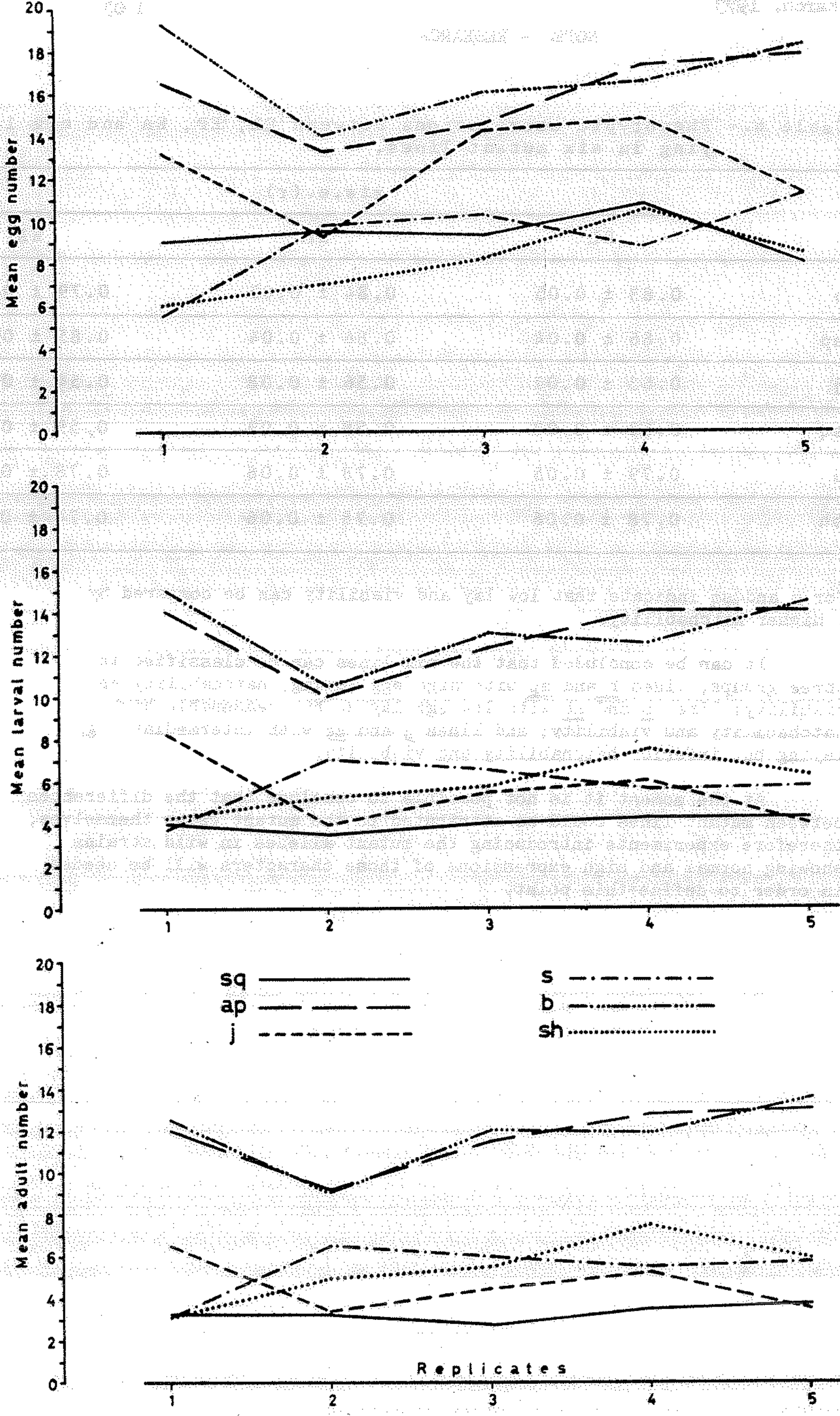
	r±s.e.(r)		
	EL	EP	EA
b	0.83 ± 0.05	0.84 ± 0.05	0.79 ± 0.05
ap	0.86 ± 0.04	0.86 ± 0.04	0.85 ± 0.05
j	0.63 ± 0.07	0.56 ± 0.08	0.54 ± 0.08
sq	0.60 ± 0.08	0.58 ± 0.09	0.59 ± 0.08
s	0.79 ± 0.05	0.78 ± 0.06	0.78 ± 0.06
sh	0.78 ± 0.06	0.78 ± 0.06	0.74 ± 0.06

for j and sq indicate that low lay and viability can be compared by a higher hatchability.

It can be concluded that the six lines can be classified in three groups, lines b and ap with high egg laying, hatchability and viability; lines s and sh with low egg laying but reasonable high hatchability and viability; and lines j and sq with intermediate egg laying but inferior hatchability and viability.

At the moment it is not possible to conclude that the differences between mutant lines could be attributed to the mutant genes themselves, therefore experiments introducing the mutant alleles in wild strains showing normal and high expressions of those characters will be needed in order to define this point.

Figure 1


Mean egg number
Mean larval number
Mean adult number
sq
ap
j
s
b
sh
Replicates
0
2
4
6
8
10
12
14
16
18
20
1
2
3
4
5

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Rhythmometry relationship of oxygen consumption and insecticide sensitivity in the adult confused flour beetle, *Tribolium confusum* duVal.

The rhythms of oxygen consumption and sensitivity to dichlorvos in 21-day old adults of *T. confusum* were determined. Insects had been reared at 25°C under a 12-hour light (06^{00} -18^{00}), 12-hour dark (18^{00} - 06^{00}) photoperiod. The oxygen uptake was recorded every hour for 7 days with a Gilson differential respirometer under 12L:12D photoperiod at 25°C. Insecticide tests were conducted every hour of a 24-hour period. The beetles were allowed to crawl for 6 minutes on a filter paper that had been uniformly coated with dichlorvos.

The oxygen consumption of 21-day old *T. confusum* adults showed circadian rhythmicity, with the peak occurring between 02^{00} and 03^{00}. The maximum rate of oxygen consumption, averaged from 5 experiments, was 2.18 microliters per milligram weight per hour. The mean lowest rate, obtained between 14^{00} and 14^{00}, was 1.54 ul/mg weight/hr. Sensitivity of adults to dichlorvos also showed circadian rhythmicity. The average of 7 experiments showed LC50 values (expressed as micrograms dichlorvos per square centimeter of treated surface) ranging from a low of 18.41 to a high of 20.43. Maximum LC50 was obtained between 12^{00} and 13^{00}, and minimum LC50 between 00^{00} and 01^{00}. These results show that maximum sensitivity to dichlorvos occurs about 2 hours before the peak of oxygen consumption.

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***Length of embryonic developmental period of the mutant extra urogomphi (eu) of *T. castaneum*.**

INTRODUCTION

The mutant *eu* of *T. castaneum* was first detected by Lasley and Sokoloff (1969). A recurrent mutation was discovered at out laboratory (Woll and Mendlinger, 1972) and investigated in detail later (Wool and Mendlinger, 1973). The mutation causes a morphological change in the terminal appendages of the larva and the pupa (4 or 3 appendages instead of the normal 2). It was shown that the mutation has incomplete penetrance at 30°C, but almost complete penetrance at 25°C. The present note deals with the length of embryonic development of this mutant at these two temperatures.

METHODS

Three egg farms were set up at 25°C and three at 30°C with large numbers of adults (recovered and separated by sex and phenotype in the pupal stage). The adult combinations were 4 x 4, 3 x 3 and 2 x 2 (the numbers refer to the number of appendages in the pupa). The adults were allowed to oviposit for 6 hours. The eggs were then recovered and placed in empty plastic petri dishes at the same temperatures as they were laid. (The eggs were not counted). The egg samples were checked daily and hatching larvae removed and counted. Ten replicate samples were obtained from each egg farm, but the sizes of the samples were unequal.

RESULTS

The pooled data of all replicate samples from each of the 6 egg farms are illustrated in the fugure. The median time for embryonic development was about 4.7 - 4.9 days at 25°C and about 3.45 - 3.48 days at 30°C. The shape of the distribution of hatching times also varied at the two temperatures, in particular with 3 x 3 and 4 x 4 phenotypes. At 30°C, the distribution was much more leptokurtic than at 25°C. The 2 x 2 phenotype showed a less leptokurtic distribution at both temperatures. The median length of embryonic developmental time of 2 x 2 was shorter than that of 3 x 3 and 4 x 4 at both temperatures. G - tests of independence (Sokal and Rohlf, 1969) indicated that the distribution of hatching times of 2 x 2 was significantly different from the others (p 0.05) at both temperatures. The distributions of 3 x 3 and 4 x 4 were not significantly different.

DISCUSSION

The information on the length of embryonic development at the two temperatures is important, because the number of appendages (urogomphi) in the mutant (the phenotypic expression of the gene) is determined during embryonic life, and there appears to be a connection between developmental rate and the expression of the mutation in the phenotype, possibly through the accumulation of a "growth substance". The longer embryonic development is, the more likely is the homozygous <u>eu</u> individual to express the mutation. (Wool and Mendlinger, 1973). The present results support this suggestion.

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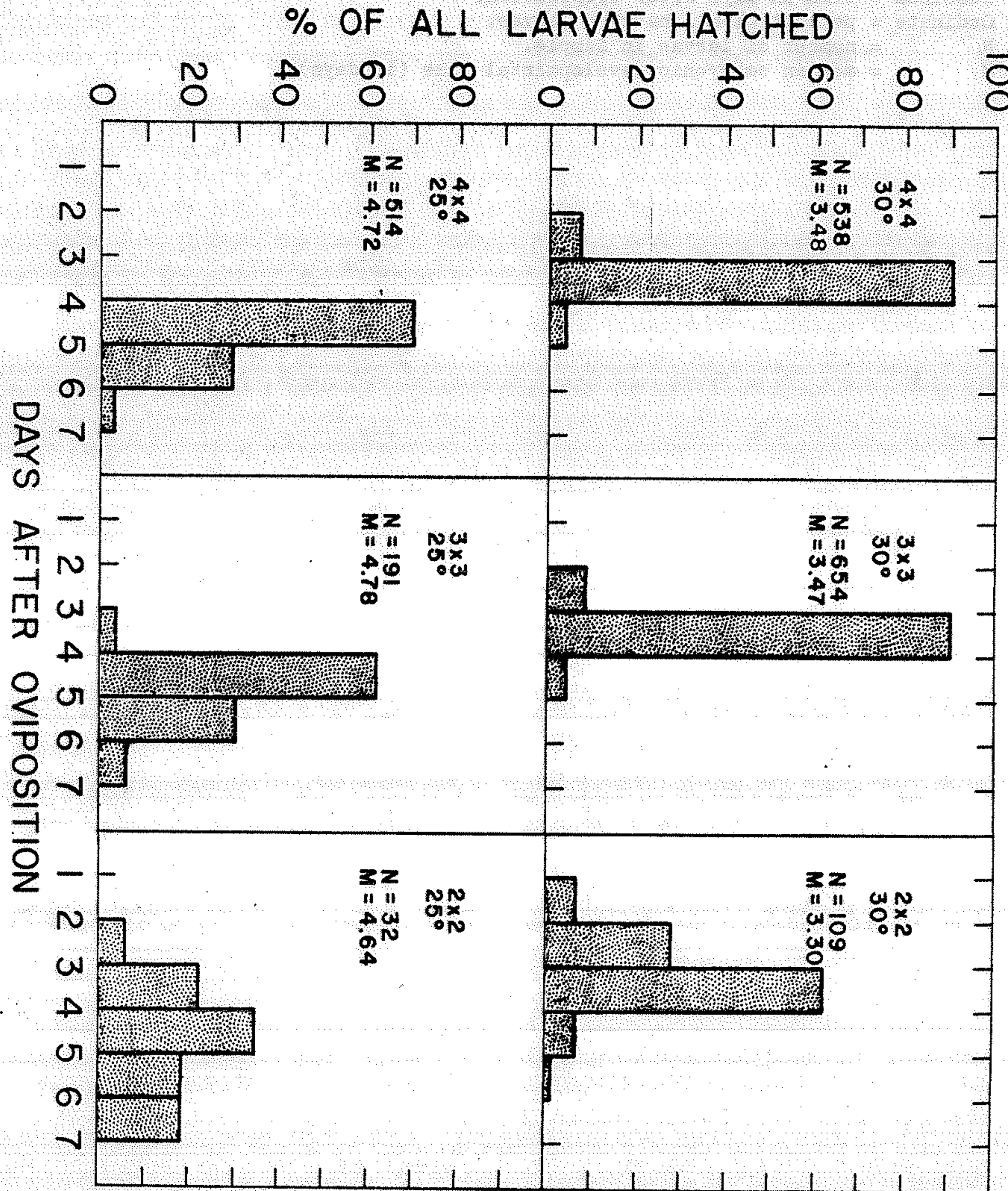
Caption for the figure. Distribution of hatching larvae from 6-hour egg batches of 3 phenotypic classes of the *eu* mutant of *T. castaneum*.

Abscissa = time in days after oviposition.
Ordinate = percent of all hatched larvae.
N = number of larvae in sample.
M = median embryonic developmental time (in days).


% OF ALL LARVAE HATCHED
DAYS AFTER OVIPOSITION
4x4
30°
N = 538
M = 3.48
3x3
30°
N = 654
M = 3.47
2x2
30°
N = 109
M = 3.30
4x4
25°
N = 514
M = 4.72
3x3
25°
N = 191
M = 4.78
2x2
25°
N = 32
M = 4.64

NOTES - RESEARCH

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The effect of certain mycotoxins on Tribolium confusum

Fungi of the genus *Fusarium* and *T. confusum* are often found together as contaminants of grain. The estrogenic metabolite of *Fusarium*, F-2, and another metabolite, T-2 toxin, are presently being studied for their effects on *T. confusum*.

MATERIALS AND METHODS

Beetles were reared in whole wheat flour plus 5% yeast with the desired concentration fo mytoxin added. All environmental conditions were held constant.

RESULTS

F-2 has little effect on fertility or fecundity when ingested by adults. However, after a 6-day treatment period, the offspring of these adults showed decreased fecundity (50%) when compared to a control. All concentrations of F-2 (from 10 - 10,000 ppm) slowed development from larva to adult. T-2 toxin at a concentration of 100 ppm increased fecundity by 30-40% in the first 60 days of treatment. This toxin has a greater retarding effect on development than F-2 (Table I).

Table I. Weight of larvae reared in 3 concentrations of T-2 toxin.

T-2 toxin concentration	Weight (mg)/larva a/	
	15 days	20 days
0 (control)	1.6	3.4
1 ppm	1.4	3.1
10 ppm	0.9	2.5
100 ppm	0.2	0.5

a/ average weight of 100 larvae.

Larvae reared on flour with 100 ppm T-2 weigh after 25 days what a normal larva would weigh at 15 days. Mortality is about 20%. Surviving larvae develop into undersized pupae and adults. Second generation fecundity is not affected. However, fertility is reduced 10%. This research is still in progress.

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Effect of F-2 and T-2 mycotoxins on the ATPase enzyme system of *T. confusum.*

Studies are in progress to determine the *in vivo* effect of F-2 and T-2 mycotoxins incorporated in food medium at concentrations of 10,000 ppm and 100 ppm, respectively, on the APTase (adenosine triphosphatase) enzyme system in larvae, pupae and adults of *T. confusum*. Preliminary results show about 65% stimulation of ATPase activity in the larval stage and 25% inhibition in both pupae and adults. Experiments are being designed to find out if these effects of F-2 and T-2 mycotoxins have any relationship to those of the insecticide DDT.

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*Compound eyes as possible detectors of irradiation in flour beetles.

Immediate and reflex-like reactions to irradiation in invertebrates have been observed and studied by many investigators. When dark-adapted moths (Noctuidae) were exposed to x-rays, Smith *et al* (1963) showed that the flight movement (wing beat) was initiated immediately (less than one sec). This reflex response was thought to be resulted from visual stimulation. Terwilliger and Levy (1964) also reported that a transient cessation of locomotor activity in the fiddler crab on termination of irradiation duplicated an "off" response to light and was abolished by removal of the eye stalks.

Whether *Tribolium* can be stimulated by radiation and how the beetles detect the radiation does not appear to have been studied or reported before. The subject is of interest to people who use *Tribolium* as experimental animals for pest control, genetics, ecology, nutrition, general physiology, behavior, and radiobiology studies. This report summarizes out recent findings about the sensitivity of *Tribolium* beetles to different types of radiations and the possible mechanism(s) involved in the detection of radiation by flour beetles.

About one-month old normal *T. confusum* and *T. brevicornis* adults, raised in flour-yeast medium at 30°C, were selected and adapted to red light or dark for at least one hour before radiation was given. Radiation included alpha particles, x-rays, and gamma-rays. All experiments were done at room temperature. Through a TV-camera and microscope set-up, with a low intensity red light, the reaction of beetles to irradiation could be seen on a TV screen. Beetles were irradiated only when all of them had stopped moving.

It was found that adults responded to 40-Mev alpha particles (3000 rads/min) with noticeable body movement at a dose of 20 rads. Both normal and antennae-amputated adults were used and they showed the same sensitivity to alpha particles irradiation. With a better control of lighting conditions, beetles responded to x-rays (200 kV, 15 mA, 1.0 mm Cu + 1.0 mm Al filter, 16 R/min) at a dose as low as 2 to 3 R.

When the red plastic chamber in which the beetles were kept was partially shielded with a piece of lead, adults ran into the shield area during x-irradiation. Beetles with both amputated antennae and maxillary palps showed the same kind of response. A direct hit of radiation to adults, therefore, appears to be the cause of response, and the antennae and maxillary palps are not the radiation receptors.

On order to check whether the eyes of beetle are involved in detecting radiation, onw group of adults were x-irradiated under red light and the another under white light. Results, given in Table 1, clearly indicate that beetles can be stimulated by radiation more easily under red light than in white light. Evidences accumulated through all these radiation experiments suggest that the compound eyes of the beetles might be the radiation receptors.

Table 1. Radiation detection in *T. brevicornis* beetles.

Trial No.	Light Condition	Exposure time*	No. Adults Responded
1	red light	5 sec	5/10
	white light	5 sec	1/10
2	red light	10 sec	4/5
	white light	10 sec	0/5
3	red light	30 sec	3/5
	white light	30 sec	0/5

*Radiation condition: Norelco MG 150 x-ray unit. 150 kV; 12 mA; 1 mm Al + 0.5 mm Cu filter; 140 R/min.

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NOTES - TECHNICAL

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A linear egg counting stage for use with Tribolium

Studies with *Tribolium* commonly require counting eggs. Therefore, it would be highly advantageous to increase the accuracy and speed of counting. To achieve this, we designed the Linear Egg Counting Stage which allows eggs to be arranged in a line, making them easy to count under a microscope.

The Stage is simple and inexpensive to construct. Paint one side of two clean glass microscope slides with black spray paint. If glossy paint is used, the eggs will be reflected making it easier to distinguish eggs from flour particles. When dry, place the slides side by side on a strip of transparent tape approximately 2 mm apart with the painted sides down. Bring the free edges of the slides up to form a "V" and place the slides into a rectangular frame (Figure 1). The top of a cover-glass box works nicely. Tape the slides to the top of the frame being careful the slides are level with the edge of the frame. Glue the ends of the slides to the frame with a small amount of glue and let dry. White glue will leave a smooth surface when dry, allowing the eggs to be easily poured out.

To use the Stage, pour the eggs into the "V" and gently tap the frame to spread out the eggs. Place the Stage under a microscope and count from one end to the other.

LINEAR EGG COUNTING STAGE

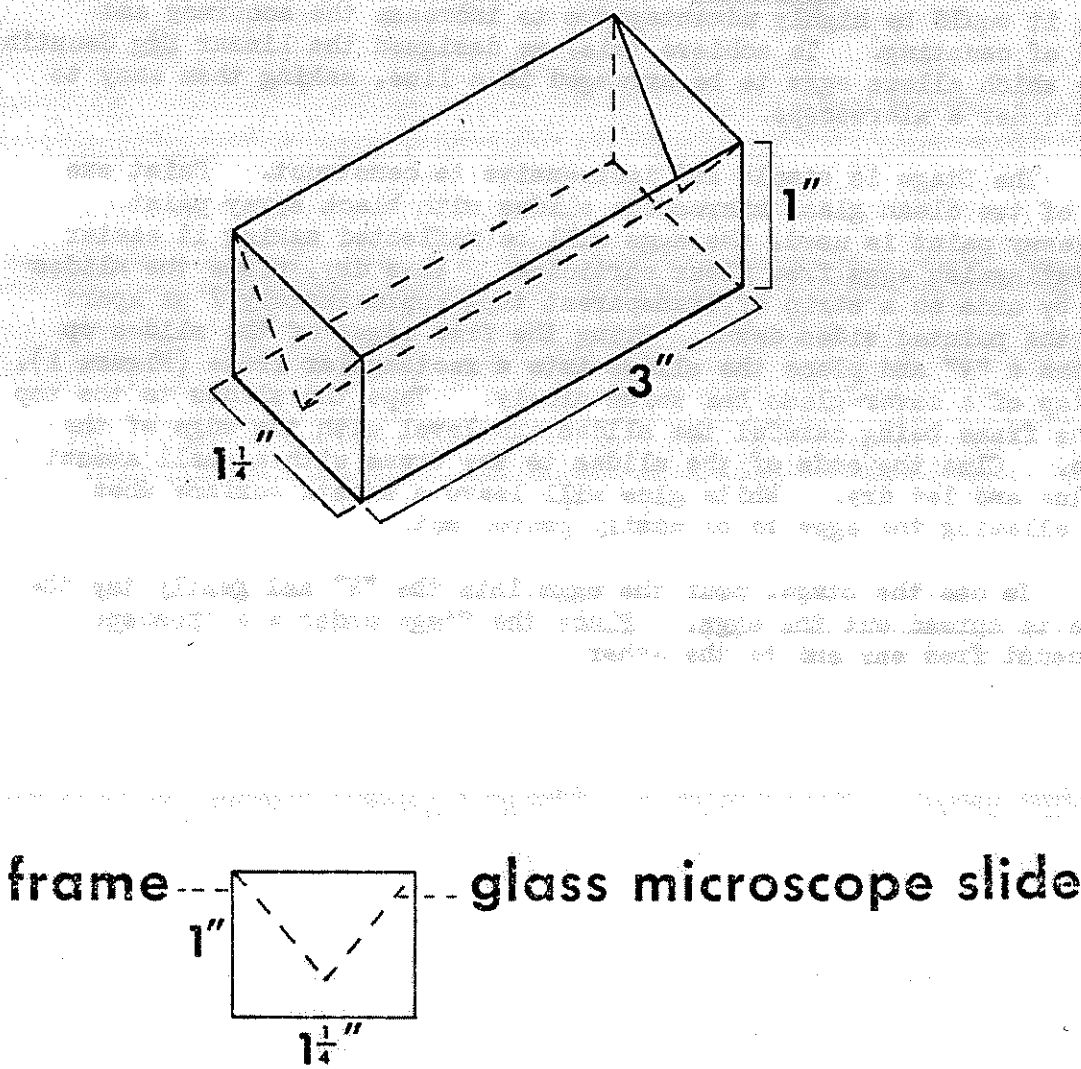

Figure 1. Diagram of linear egg counting stage.

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NOTE: (+) in the following section (DIRECTORY - ALPHABETICAL) indicates no current contribution; information obtained from previous issues of TIB.

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