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California State College, San Bernardino

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NOTICE

If you wish a whole set of Tribolium Information Bulletins, we can supply TIB 1-12 in microfilm for $100.

TRIBOLIUM INFORMATION BULLETIN

Number 13

March, 1970

Notes - Research (continued)

Notes - Technical

Notes - Technical (continued)

FOREWORD

With this issue TIB "catches up". TIB 11 and 12 should have been published in 1968 and 1969, respectively, and TIB 13 should have been published somewhat earlier. With this issue, also, TIB becomes self-sustaining. At the present time it is difficult to estimate whether it will be able to survive on a subscription basis. Most investigators who formerly required anywhere from 3 to 20 free copies of TIB now either subscribe for only one copy, or have their libraries order one copy for their use; and graduate students apparently cannot afford to subscribe to TIB at such high subscription rates.

It is my hope, however, that even those who have failed to subscribe will still use TIB as a means of communicating some of their results. I shall be sending a call for contributions to TIB 14 around Christmas as usual.

I am grateful to the numerous colleagues who wrote in support of the Tribolium Information Bulletin, and particularly to those who made valuable suggestions on various ways in which TIB could continue to exist with the minimum expense. I wish to thank the local committee for the award of a small institutional grant which made the publication of TIB 11 possible, and to the following individuals who gave so much of their time in putting these issues together: Pat Cavataio, Sue Eldridge, Jim Gooch, Denise Inman, and my father Professor Dimitri Sokoloff.

A. Sokoloff

San Bernardino, California
March, 1970

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 melanotic stink glands (msg)

(Ed.)

BERKELEY, CALIFORNIA
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY

I. Wild type strains

Tribolium confusum — U. of Calif., Berkeley
Tribolium brevicornis — U. of Calif., Berkeley

II. Mutant

Tribolium confusum - isolated from the wild type stock.

(Ed.)

BRIDGEPORT, CONNECTICUT
UNIVERSITY OF BRIDGEPORT, DEPARTMENT OF BIOLOGY

Tribolium confusum

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

(Ed.)

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.)

Stock Lists

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. pygmy (py)
2. red (r)
3. pygmy, red (py r)
4. pygmy, paddle, spotted (py pd sp)
5. pearl (p)
6. pegleg (pg)
7. pearl, pegleg (p pg)
8. white (w)
9. Bar eye, sooty (Be s)
10. Deformed, sooty (Df s)
11. microcephalic, jet, maroon (mc j m)
12. ruby, light ocular diaphragm (rb lod)
13. Short antenna (Sa)
14. chestnut (c)
15. Short antenna, squint (Sa c)
16. antennapedia (ap)
17. 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.

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 generation of natural selection in very dense larval conditions. Origin from Purdue Pearl 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.

IV. Marker stocks

HBI: derived from crosses between the High Chaetae population and an inbred line. Y chromosome is marked in that it carries a region that produces a higher number of pregenital chaetae than the normal Y chromosome from Purdue Black Foundation.

V. Grossly deformed (gdf/+)

Scute: sct/sct produces reduced size and number of pupal and larval chaetae.

E. L. Lange

CARLISLE, PENNSYLVANIA
DICKINSON COLLEGE, DEPARTMENT OF BIOLOGY

Tribolium confusum

I. Wild type strains

1. Six strains started from females captured in a feed bin in New York City, 1955.
2. Three strains, one each from T. Park, Chicago; J. Stanley, Montreal; S. Smith, Sault Ste. Marie, Canada.
3. One strain consisting of several above strains mixed together about three years ago.
4. One strain started with individuals taken from (1) above, which has been freed of eye mutations.

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

II. Mutant

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

Oryzaephilus surinamensis

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

(Ed.)

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 stains

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

Stock Lists

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.)

DAVIS, CALIFORNIA
UNIVERSITY OF CALIFORNIA, DEPARTMENT OF ANIMAL HUSBANDRY

I. Wild type strains

BC1	T. castaneum	Berkeley, 1967
BF1	T. confusum	Berkeley, 1967
DF1	T. confusum	collected at Davis, 1967
DF3	T. confusum	collected at Davis, 1969
DC1	T. castaneum	collected at Davis, 1969

II. Mutant strains

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

G. A. E. Gall

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

Stock Lists

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

Tribolium castaneum

I. Wild type strain

1. Chicago via Berkeley, 1965

II. Mutant strains

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

(Ed.)

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

Tribolium castaneum

I. Wild type strain

1. Chicago

II. Mutant strains

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

(Ed.)

Stock Lists

IMMACULATA, PENNSYLVANIA
IMMACULATA COLLEGE, CANCER RESEARCH UNIT

I. Wild type strains

Alphitobius diaperinus	PIL
Alphitobius laevigatus	PIL
Gnathocerus cornutus	PIL
Gnathocerus maxillosus	PIL
Latheticus oryzae	Berkeley
Tenebrio molitor	PIL
Tenebrio obscurus	PIL
Tribolium anaphae	Berkeley
Tribolium brevicornis	Berkeley
Tribolium castaneum	Berkeley
Tribolium confusum	Berkeley
Tribolium destructor	Berkeley
Tribolium madens	Berkeley

II. Mutant strain

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 Dept., 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 from the Population Genetics Institute in April, 1965.

(Ed.)

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 strains 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.

(Ed.)

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 black (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. Carbondale	Illinois, 1958
9. Chicago	University of Chicago, 1954
10. Colombia	South America, 1958
11. Florida	Gainesville, 1958
12. Georgia	Tipton, 1954
13. Japan	Kyoto, 1958
14. McGill	Montreal, Canada, 1958
15. Minnesota	Minneapolis, 1958
16. Texas	College Station, 1954
17. Virginia	Blacksburg, 1954
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.)

LARMIE, 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.)

LAURINGBURG, NORTH CAROLINA
ST. ANDREWS COLLEGE

Tribolium confusum

A wild stock that is infected with Nosema whitei.

(Ed.)

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.)

LAWRENCE, KANSAS
UNIVERSITY OF KANSAS, DEPARTMENT OF ENTOMOLOGY

Tribolium castaneum

I. Wild type

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

Stock Lists

II. Mutants

1. sooty (s) — Purdue
2. paddle (pd) — University of Chicago
3. pearl (p) — University of Chicago
4. McGill black (McGb) - University of Chicago stock — University of California

Tribolium confusum

I. Wild type

1. Chicago — University of California
2. Chicago (Sonleitner) — University of Chicago
3. New York — University of Chicago

II. Mutants

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

(Ed.)

LORETTO, PENNSYLVANIA
ST. FRANCIS COLLEGE, BIOLOGY DEPARTMENT

I. Wild type strains

1. Tribolium castaneum — Chicago via Berkeley
2. Tribolium confusum — 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
KANSAS STATE UNIVERSITY, DEPARTMENT OF ENTOMOLOGY

I. Stock list

A. Sitotroga cerealella (Oliv.)

1. Angoumois grain moth from Anderson Co., Kansas, about 1960.
2. (Lab strain) AGM from Anderson Co., Kansas, about 1960.
3. (Red-eyed) AGM from Stock cultures, about 1966, K.B.
4. (Field strain) AGM from Riley Co., popcorn, about 1966, RBM.

B. Plodia interpunctella (Hbn.)

1. Indian Meal moth, from Kansas.

C. Cadra cautella

1. Almond moth from USDA Savannah, Georgia, 1966 RBM.

D. Ephestia elutella, Tobacco moth from USDA Savannah, Georgia, 1966.

E. Sitophilus oryzae (L.), Lesser rice weevil, from Kansas, (old strain) 1955.

1. Lesser rice weevil from Kansas, McLain Co., 1965.
2. Lesser rice weevil from USDA Atlanta, Georgia.

F. Sitophilus zeamais (Mot.) from Stuttgart, Arkansas, 1955.

1. Mexican Larger rice weevil, from Veracruz, Mexico, 1964.

G. Sitophilus granarius (L.), Granary weevil, from Kansas.
H. Oryzaephilus surinamensis (L.), Saw-toothed grain beetle, Kansas.
I. Cryptolestes pusillus (Schonh.), Flat grain beetle, from Kansas.
J. Cryptolestes ferrugineus, Rusty grain beetle, from Kansas.
K. Rhizopertha dominica (F.), Lesser grain borer, from Kansas.
L. Tribolium castaneum (Hbst.), Red flour beetle, from Kansas.
M. Tribolium confusum duVal, Confused flour beetle, Kansas.
N. Oryzaephilus mercator, Merchant beetle, Savannah, Georgia, 1964.
O. Palorus ratzeburgi, Small-eyed flour beetle, Kansas, 1965.
P. Gibbium psylloides (Czemp.), Spider beetle, Flour Mill Chicago, Ill., 1966.
Q. Lasioderma serricorne (F.), Cigarette beetle, Kellogg's All Bran, Manhattan, Kansas, 1966.
R. Trogoderma parabile, Carpet beetle, Kansas.
S. Tenebrio molitor, Yellow mealworm, Kansas.
T. Attagenue piceus (Oliv.), Black carpet beetle, Kansas, recent.

II. New Mutant

A. Sitotrya cerealella

1. red-eyed (bb), from Kansas.

(Ed.)

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.

(Ed.)

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

I. Wild type strains

Anagasta kuhniella	USDA Lab., Georgia, 1969
Anthrenus flavipes	USDA Lab., Georgia, 1967
Attagenus megatoma	USDA Lab., Georgia, 1956
Cadre cautella	USDA Lab., Georgia, 1969
Dermestes maculatus	USDA Lab., Georgia, 1968
Lasioderma serricorne	USDA Lab., Georgia, 1968
Oryzaephilus surinamensis	USDA Lab., Georgia, 1968
Plodia interpunctella	USDA Lab., Georgia, 1964
Rhyzopertha dominica	USDA Lab., Georgia, 1969
Sitophilus oryzae	USDA Lab., Georgia, 1968
Sitotroga cerealella	USDA Lab., Georgia, 1969
Tenebroides mauritanicus	USDA Lab., Georgia, 1968
Tribolium castaneum	USDA Lab., Georgia, 1956
Tenebroides molitor	Univ. New Hampshire, Durham, 1965
Tineola bisselliella	Univ. New Hampshire, Durham, 1965
Trogoderma parabile	Natick, 1968

Stock Lists

II. Mutant

Tribolium confusum - Ebony strain — A. Sokoloff, 1968

J. J. Pratt, Jr.

NORMAN, OKLAHOMA
UNIVERSITY OF OKLAHOMA, DEPARTMENT OF ZOOLOGY

I. Coleoptera

Tribolium castaneum (Tenebrionidae)

1. wild type, Chicago — University of Chicago

(Ed.)

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.)

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 cI) — Univ. of Chicago

II. Mutant strain

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

(Ed.)

RIVERSIDE, CALIFORNIA
UNIVERSITY OF CALIFORNIA, DEPARTMENT OF ENTOMOLOGY

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

Stock Lists

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	Stanley, 1958
12.	Sacramento	1961
13.	Texas	1958
14.	Veracruz, Mexico	1963
15.	Virginia	1958
16.	CS-2	Univ. of Calif.
17.	CS-3	USDA Lab., Kansas
18.	CS-4	USDA Lab., Georgia
19.	CS-13	Davis, Calif., 1961
20.	CS-14	Oakland, Calif., 1961

B. Tribolium confusum

1.	Chicago	Park, 1955
2.	Davis (impure, has pearl)	1961
3.	McGill	Stanley, 1958
4.	New York	1961
5.	Pennsylvania (free of eye color mutants)	McDonald, 1963
6.	Sacramento	1961
7.	San Bernardino	1968
8.	CF-1	Purdue University
9.	CF-2	Univ. of Calif., Berkeley
10.	CF-5	USDA Lab., Kansas
11.	CF-6	Univ. of Ill.
12.	CF-7	Washington State College
13.	CF-8	Univ. of Minn.
14.	CF-9	Oakland, Calif., 1958
15.	CF-13	Oakland, Calif., 1961
16.	CF-14	Oakland, Calif., 1961

C. Tribolium anaphe

1.	PIL	Pest Infestation Laboratory, Slough, 1963

D. Tribolium brevicornis

1.	Riverside	Riverside, California, 1965

E. Tribolium destructor

1.	PIL	Pest Infestation Laboratory, Slough, 1963

F. Tribolium madens

1.	PIL	Pest Infestation Laboratory, Slough, 1963

G. Gnathocerus cornutus

1.	Berkeley (1)	Oakland, Calif., 1959
2.	Berkeley (2)	Oakland, Calif., 1961
3.	PIL	Pest Infestation Laboratory, Slough, 1963

Stock Lists

H. *Latheticus oryzae*

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

I. *Oryzaephilus surinamensis*

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

J. *Cyrptolestes turcicus*

1. PIL Pest Infestation Laboratory, Slough, 1963

K. *Stegobium paniceum*

1. 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 (Chicago, Texas, Virginia, CS-2, CS-3, CS-4, CS-14) not marked with body color genes. Prepared in 1964.

B. *Tribolium confusum*

1. Berkeley. Synthetic strain from six wild type laboratory strains (CF-1, CF-2, CF-3, CF-4, CF-5, CF-6) not marked with body color genes. Prepared in 1958.

III. Inbred lines

A. *Tribolium castaneum*

1. Started October, 1958, from the Berkeley synthetic strain (now in 80 generation of brother-sister mating--all marked with *sooty*.)

   a. CSI-3F

B. *Tribolium confusum*

1. Started October 8, 1958, from the Berkeley synthetic strain now in 77-86 generation of brother-sister mating, not marked with body color genes.

   a. CFI-1
   b. CFI-2
   c. CFI-5
   d. CFI-8

Stock Lists

Chromosome III

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

Chromosome IV

43.	Bar eye (Be)	Chazy, New York, 1959
44.	cut prothorax (ctp)	Berkeley, 1962
45.	deformed legs (dfl)	Chazy, New York, 1959
46.	elongated juvenile urogomphi (eju)	Berkeley, 1963
47.	fused antennal segments-2 (fas-2)	Berkeley,
48.	incomplete mesosternum (ims)	Berkeley, 1962
49.	juvenile urogomphi (ju)	Berkeley, 1962
50.	reduced juvenile urogomphi (rju)	Berkeley, 1963
51.	Spatulate (Spa)	Berkeley, 1964
52.	sternites incomplete (sti)	Berkeley, 1963
53.	Be s	
54.	fas-2s	
55.	mahogany (my)	

Chromosome V

56.	jet (j)	Park, 1955
57.	microcephalic (mc)	Chazy, New York, 1959
58.	fused antennal segments-3 (fas-3) (=agg)	Berkeley, 1961
59.	fused antennal segments-3a (fas-3a)	Berkeley, 1963
60.	j spl mc	

Chromosome VI

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

Chromosome VII

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

e. CFI-11
f. CFI-12

2. Started in 1964 from the Berkeley synthetic strain, now in 44-46 generation of brother-sister mating, not marked with body color genes.

   a. CFI-13
   b. CFI-14
   c. CFI-15
   d. CFI-23
   3. 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.	deformed podomeres (dpm)	Berkeley, 1964
15.	pte pd	
16.	py pd	
17.	sp pd	
18.	py r pd	
19.	py r	
20.	r te	
21.	sp r	
22.	r pd	
23.	py r M^r	
24.	pte py pd	
25.	r te M^r	
26.	sp dve py pd	
27.	ser py r	
28.	te-1	

Chromosome II

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

Chromosome VIII

77. antennapedia (ap^D) Berkeley, 1962
78. antennapedia (ap^S) (=fas-6) Berkeley, 1963
79. squint (sq) Chazy, New York, 1959

Chromosome IX

80. missing abdominal sternites (mas) Berkeley, 1964
81. prothoraxless (ptl) Chazy, New York, 1959
82. prothoraxless-1 (ptl-1) Berkeley, 1965
83. partially pointed abdominal sternites (ppas) Berkeley, 1963

Chromosome X

84. abbreviated appendages (aa) Cold Spring Harbor, N. Y., 1961
85. 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.

86. py pd; p I, II
87. sp; p I, II
88. py; b I, III
89. py r; lod I, III
90. sp; j I, V
91. pd; Mo I, VI
92. sp; p; j I, II, V
93. p; lod II, III
94. p; b II, III
95. p; b; Mo II, III, VI
96. p; b; mc II, III, V
97. p; mc II, V
98. b; Mo III, VI
99. j; Mo V, VI
100. Be Fta IV, VII
101. Be Sa IV, VII
102. ju ctp c IV, VII
103. Mo; sa VI, VII
104. b (p) apt III, (II), ?
105. mc apt V, ?
106. apt j V, ?
107. Mo (c) mas VI, (VII), IX
108. (p) b mas (II), III ?
109. p Bamp/+ II, III ?
110. Bamp/+ ap^D III ?, IX
111. Bamp/+ ptl^{Hoy} III ?, IX
112. b max III, ?
113. j max V, ?
114. au Npp IV, ?
115. ap Npp VIII, ?
116. Be au IV
117. Fta ppas VII, ?
118. mc ppas V, IX
119. fas-3a ptl^{Hoy} III,IX
120. b ap^s III, VIII
121. au ctp IV
122. j ppas V, IX

Unassigned (but possibly in II)

123. creased abdominal sternites (cas) Berkeley, 1963
124. abnormal abdominal sternites (aas) Berkeley, 1965
125. akimbo (akb) Berkeley, 1964
126. alate prothorax (apt) Berkeley, 1964
127. antennae and tarsi fused (atf) Berkeley, 1961
128. ballooned (bal) Berkeley, 1963
129. banjo (bj) Chazy, New York, 1960
130. bead (bd) Bell, 1967
131. bent tibia (bt) Berkeley, 1961
132. Blunt abdominal and metathoracic projections (Bamp) (possibly in III) Berkeley, 1965

133.	bowed femur (bf)	Berkeley, 1963
134.	bowleg	Bell, 1967
135.	bumpy (by)	Bell, 1966
136.	Charcoal (Chr)	Berkeley, 1966
137.	deflected epimera (dep)	Berkeley, 1964
138.	deformed femur (dff)	Berkeley, 1964
139.	deformed tibia (dft)	Berkeley, 1964
140.	dented	Bell, 1967
141.	diminutive appendages (dim)	Berkeley, 1966
142.	elbowed antennae-1 (elb-1)	Berkeley, 1964
143.	elongated elytra (ele)	Berkeley, 1964
144.	elytra and tarsi affected (eta)	Berkeley, 1963
145.	extra urogomphi (eu) (black)	Chazy, New York, 1960
146.	fused antennal segments-1 (fas-1)	Chazy, New York, 1959
147.	Fused antennal segments-4 (Fas-4)	Berkeley, 1963
148.	Fused antennal segments-5 (Fas-5)	Berkeley, 1963
149.	jagged antecoxal piece (jac)	Berkeley, 1964
150.	knobby prothorax (knp)	Berkeley, 1966
151.	looped median groove (lmg)	Berkeley, 1964
152.	maxillopedia (max)	Berkeley, 1965
153.	minature appendages (ma^D r)	Bell, 1967
154.	Multi-urogomphi (Mu)	Bell, 1966
155.	Nonpunctate prothorax (Npp)	Berkeley, 1965
156.	overhang split (ohs)	Berkeley, 1966
157.	padded prothorax (pdp)	Berkeley, 1965
158.	pectinate antennae (pec)	Berkeley, 1964
159.	reduced gin traps (rgt)	Berkeley, 1965
160.	reduced pleurosternal suture (rps)	Berkeley, 1965
161.	reduced tarsi and antennae (rta)	Berkeley, 1966
162.	rough (ro)	Berkeley, 1964
163.	rugose elytra (rue)	Berkeley, 1966
164.	scalloped prothorax (scp)	Berkeley, 1965
165.	short median abdominal projection (smp)	Berkeley, 1966
166.	short split spinasternum (sss)	Berkeley, 1965
167.	split (sp)	1963
168.	split-back (sb)	Bell, 1966
169.	stumpy (stu)	Berkeley, 1965
170.	Tetra urogomphi (Tu)	Berkeley, 1965
171.	tiny (ti) (=ty)	1962
172.	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

Stock Lists

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
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.	incomplete 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)	McDonald, 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

1.	sternites incomplete (sti)	Berkeley, 1964
2.	creased abdominal sternites (cas)	Berkeley, 1965

Stock Lists

D. <u>Tribolium brevicornis</u>

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

E. <u>Tribolium destructor</u>

1. bent tibia (<u>btt</u>) Berkeley, 1964
2. creased abdominal sternites (<u>cas</u>) Berkeley, 1964
3. split (<u>spl</u>)

F. <u>Tribolium madens</u>

1. fused antennal segments-1 (<u>fas-1</u>) Berkeley, 1964
2. creased abdominal sternites (<u>cas</u>) Berkeley, 1964
3. split (<u>spl</u>) Berkeley, 1964
4. bent tibia (<u>btt</u>) Berkeley, 1964

G. <u>Gnathocerus cornutus</u>

1. pearl-1 (<u>p-1</u>) PIL, 1964
2. pearl-2 (<u>p-2</u>) Berkeley, 1962

Unassigned

3. light ocular diaphragm (<u>lod</u>) (pearl) Berkeley, 1962

H. <u>Latheticus oryzae</u>

Chromosome I

1. red-1 (<u>r-1</u>) from PIL +/+ stock, 1963

Chromosome II

2. creased abdominal sternites (<u>cas</u>) Berkeley, 1963
3. <u>p</u> <u>cas</u>
4. <u>p</u>

Unassigned

5. droopy elytra (<u>dre</u>) Chazy, New York, 1960
6. fused antennal segments-1 (<u>fas-1</u>) Berkeley, 1963

I. <u>Oryzaephilus surinamensis</u>

None

J. <u>Cryptolestes turcicus</u>

Chromosome I

1. red (<u>r</u>) PIL, 1963

Unassigned

2. crooked antennae (<u>cka</u>) — Berkeley, 1964
3. tunty (<u>rty</u>) — Berkeley, 1964
4. pink
5. tiny

M. <u>Palorus ratzeburgi</u>

None

N. <u>Stegobium paniceum</u>

None

A. Sokoloff

SANTA BARBARA, CALIFORNIA
UNIVERSITY OF CALIFORNIA, DEPARTMENT OF BIOLOGICAL SCIENCES

I. Wild type strains

A. <u>Tribolium castaneum</u>

1. "Chicago" — Park, 1966
2. derived from <u>cI</u> (Brazil) — Park, 1966
3. derived from <u>cIV-a</u> — Park, 1966

B. <u>Tribolium confusum</u>

1. "Chicago" — Park, 1966
2. derived from <u>bI</u> — Park, 1966
3. derived from <u>bIV</u> — Park, 1966

(Ed.)

SANTA FE, NEW MEXICO
SANTA FE PREPARATORY SCHOOL

I. Wild type strain

A. <u>Tribolium castaneum</u> — Chicago via Berkeley

B. <u>Tribolium confusum</u> — McGill via Berkeley

(Ed.)

SAVANNAH, GEORGIA
STORED PRODUCT INSECTS RESEARCH AND DEVELOPMENT LABORATORY

I. Wild type strains

A. Lepidoptera

1.	*Cadra cautella*	USDA, Tifton, Ga., 1964
2.	*Ephestia elutella*	Richmond, Virginia,
3.	*Plodia interpunctella*	
4.	*Sitotroga cerealla*	Tifton, Georgia, 1962
5.	*Tineola bisselliella*	Savannah, Georgia, 1962

B. Coleoptera

1.	*Anthrenus flavipes*	
2.	*Attagenus megatoma*	
3.	*Cryptolestes pusillus*	
4.	*Dermestes maculatus*	Madison, Wisconsin, 1967
5.	*Lasioderma serricorne*	
6.	*Oryzaephilus mercator*	
7.	*Oryzaephilus surinamensis*	Manhattan, Kansas, 1964
8.	*Rhyzopertha dominica*	
9.	*Sitophilus granarius*	Manhattan, Kansas, 1966
10.	*Sitophilus oryzae*	
11.	*Sitophilus zea-mais*	Estill, S. C., 1961
12.	*Tenebriodes mauritanicus*	Canada, 1960
13.	*Tenebrio molitor*	
14.	*Tribolium castaneum*	
15.	*Tribolium confusum*	Manhattan, Kansas, 1960
16.	*Trogoderma glabrum*	Madison, Wisconsin, 1967
17.	*Trogoderma inclusum*	Madison, Wisconsin, 1967

II. Mutant strain

A. *Tribolium confusum*-black — Savannah, Georgia, 1967

(Ed.)

SOUTH LANCASTER, MASSACHUSETTS
ATLANTIC UNION COLLEGE, BIOLOGY DEPARTMENT

Tribolium castaneum

I. Wild type strains

1. Brazil (C-1)
2. Chicago
3. McGill

4. Sacramento
5. Texas
6. Veracruz, Mexico
7. Virginia

II. Mutant strains

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

(Ed.)

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 confusum — Fordham University

B. Base Populations for quantitative genetic studies (Tribolium castaneum):

1. Foundation b - marked with black (b) body color- obtained via Purdue University, Lafayette, Indiana.
2. Foundation p - marked with pearl (p) eye color- obtained via Purdue University, Lafayette, Indiana.

II. Mutant strains

A. Tribolium castaneum

1. pygmy — via University of California
2. pearl — via University of California
3. McGill black — via University of California
4. Short antennae (Sa) — Purdue + Foundation, 1960

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 (s)	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.)

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

Michael Morgan

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

Tribolium castaneum

A. Wild type strains

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

B. Mutant strains

1. sooty (*s*)	Purdue University
2. paddle (*pd*)	University of Chicago
3. pearl (*p*)	University of Chicago
4. McGill black (McG*b*) - Univ. of Chicago stock	University of California
5. McGill black (McG*b*) with UPF genetic background obtained by backcrossing to UPF for nine generations	University of Kansas

Tribolium confusum

A. Wild type strains

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

B. Mutant strains

1. McGill black (McG*b*)	University of California
2. ebony (*e*)	University of Chicago

(Ed.)

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

Tribolium confusum	St. Paul, Minn.,
Tribolium castaneum	Berkeley, Calif., 1963
Sitophilus oryzae (large strain)	Manhattan, 1960
Sitophilus granarius	St. Paul, Minn.,
Oryzaephilus surinamensis	Savannah, 1963
Trogoderma parabile	St. Paul, Minn., 1965
Gibbum psylloides	St. Paul, Minn., 1965
Rhyzopertha dominica	Manhattan, 1963
Plodia interpunctella	St. Paul, Minn., 1963

(Ed.)

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
UNIVERSITY 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 his Tribolium stocks is not known. (Ed.)

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
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

Stock Lists

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.	r^{Mo}	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 BIOPHYSICS

Tribolium confusum

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

Also available:

Nemeritis canescens (Ichneumon.)

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

(Ed.)

WASHINGTON, 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.)

BELGIUM

GEMBLOUX
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. JANSSENS MEMORIAL LABORATORY FOR GENETICS
AGRICULTURAL INSTITUTE OF THE UNIVERSITY

Tenebrio molitor

Wild type — Belgium

Tribolium confusum

Two inbred and a wild type — Berkeley, 1965

(Ed.)

BRAZIL

CAMPINAS, SÃO PAULO
INSTITUTE AGRONOMICO, SECAO DE ENTOMOLOGIA

Anobiidae

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

Bostrichidae

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.)

CANADA

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 POULTRY SCIENCE

A. mass mated population obtained from A. B. Bell, Purdue, 1961.

B. two lines selected for larva weight for eight generations in a high humidity environment.

C. two lines selected for larva weight for eight generations in a low humidity environment.

D. two lines selected for high offspring number for eight generations in a high humidity environment.

E. two lines selected for high offspring number for eight generations in a low humidity environment.

(Ed.)

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 GENETICS

Tribolium castaneum

1.	Berkeley CS-synthetic	Berkeley, 1967
	Berkeley CSI-3, 5, 10, 14, 16	Berkeley, 1967
	Berkeley CS-pygmy	Berkeley, 1967
2.	Chicago wild	via D. Bray, 1966
3.	Purdue Foundation via E. Scheinberg	Ottawa, 1967
4.	Several strains selected for high pupal weight	via D. Bray, 1966

(Ed.)

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

Tribolium castaneum

Purdue Foundation

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

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

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

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

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

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

(Ed.)

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

Tribolium confusum Duval

Strain: Laval
Origin: Quebec City

(Ed.)

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

Tribolium confusum Duval

Strain: Laval
Origin: Quebec City

(Ed.)

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 II — Berkeley, 1965
4. ebony-2 (e_2); chromosome II — Berkeley, 1965
5. pearl riboflavinless (p^r); chromosome II — Berkeley, 1965
6. pearl slough (p); chromosome II — Berkeley, 1965
7. ruby spot (rus); chromosome III — Berkeley, 1965
8. light ocular diaphram (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 II — Berkeley, 1965
3. pearl riboflavinless (p^r)(formerly "ivory") — Purdue, 1967
4. pink (p^{pk}); chromosome II — Berkeley, 1965
5. light ocular diaphragm (p background); chromosome III — Berkeley, 1965
6. jet H. L. E.; chromosome V — Berkeley, 1967
7. chestnut (c); chromosome VII — Berkeley, 1965
8. s; r^D; multichromosomal — Berkeley, 1965

(Ed.)

WINNIPEG, MANITOBA
CANADA DEPARTMENT OF AGRICULTURE, RESEARCH STATION

I. Wild type strains

A. Coleoptera

1. Acanthoscelides obtectus (Say) Bruchidae — Winnipeg
2. Alphitobius diaperinus Panzer Tenebrionidae — Saskatchewan
3. Cryptolestes ferrugineus (Steph.) Cucujidae — Manitoba
4. Cryptolestes ferrugineus (Steph.) Cucujidae — PIL United Kingdom
5. Cryptolestes ferrugineus (Steph.) Cucujidae — Australia
6. Cryptolestes turcicus (Grouv.) Cucujidae — Ontario
7. Cryptolestes turcicus (Grouv.) Cucujidae — PIL United Kingdom
8. Cynaeus angustus Leconte Tenebrionidae — Manitoba

9. Oryzaephilus mercator (Fauvel) Silvanidae — Ontario
10. Oryzaephilus surinamensis (L.) Silvanidae — Manitoba
11. Rhyzopertha dominica (Fab.) Bostrichidae — Australia
12. Sitophilus granarius (L.) Curculionidae — Manitoba
13. Sitophilus oryzae (L.) Curculionidae — Montreal
14. Sitophilus zea-mais Motschulsky Curculionidae — Japan
15. Stegobium paniceum (L.) Anobiidae — Winnipeg
16. Tenebroides mauritanicus (L.) Ostomidae — Manitoba
17. Tenebrio molitor (L.) Tenebrionidae — Manitoba
18. Tribolium castaneum (Herbst) Tenebrionidae — Manitoba
19. Tribolium confusum (DuVal)
20. Tribolium madens Charp. Tenebrionidae — Manitoba
21. Trogoderma variabile Ballion Dermestidae — Alberta

B. Lepidoptera

1. Plodia interpunctella (Hbn.) Phycitidae — Winnipeg

II. Mutant strain

A. Coleoptera

1. Tribolium confusum DuVal — Winnipeg, Manitoba, 1963
ebony (e Smith and Loschiavo)

L. B. Smith

LYNGVY
STATENS SKADEDYRLABORATORIUM
(GOVERNMENT PEST INFESTATION LABORATORY)

Tribolium confusum

A couple of cultures is as a rule maintained, now and then supplemented with specimens sent to the Laboratory for inquiry. They descend from insects caught in Denmark, but some of these are likely to have been newly imported from abroad.

Tribolium destructor

This species is a rather common household pest in Denmark and we maintain a couple of cultures descending from this stock.

F. S. Andersen

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.)

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
LABORATOIRE 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
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	Ales

(Ed.)

GERMANY

MUNICH
BAYER, LANDESANSTALT FÜR BODENKULTUR
PFLANZENBAU U. PFLANZENSCHUTZ

Coleoptera

Cucujidae

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.)

GREAT BRITAIN

BIRMINGHAM, ENGLAND
THE UNIVERSITY OF BIRMINGHAM
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, ANGUS
UNIVERSITY OF ST. ANDREWS, QUEEN'S COLLEGE,
NATURAL HISTORY DEPARTMENT

Only those stocks unique to this laboratory are described. The unlisted stocks are all derived from cultures at the Pest Infestation Laboratory.

A. Wild stocks

1. Tribolium anaphe
2. Tribolium castaneum--Kenya. Collected in 1964 from stored maize in the Machakos district.
3. Tribolium castaneum--Kingston (Jamaica). Collected in 1964 from maize entering central storage.
4. Tribolium castaneum--Kano (Nigeria). Collected in 1964 from cassava flour in Northern Nigeria.
5. Tribolium castaneum--Umuahia (Nigeria). Collected in 1964 from cocoa beans in Eastern Nigeria.
6. Tribolium castaneum--Ibadan (Nigeria). Collected in 1963 from maize silos in Western Nigeria.
7. Tribolium castaneum--Tokyo (Japan). Obtained in 1965.

8. Tribolium castaneum--Rangoon (Burma). Obtained in 1965.
9. Tribolium confusum--Kenya. Collected in 1964 from stored maize in Machakos district.
10. Tribolium destructor
11. Tribolium madens
12. Cathartus quadricollis--Nigeria. Collected in 1961.

B. Mutant stocks

13. Tribolium castaneum--pearl (p). Isolated from P.I.L. stocks.
14. Tribolium castaneum--mahogany. Isolated from P.I.L. stocks.
15. Tribolium castaneum--black (Kingston). Isolated from (4).

(Ed.)

EDINBURGH
UNIVERSITY OF EDINBURGH, INSTITUTE OF ANIMAL GENETICS

Tribolium castaneum

A. Wild type strain

1. Chicago wild type

B. Mutant strains

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

Stocks obtained from Berkeley, California.

(Ed.)

EDINBURGH, 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 foodstuffs.

Tribolium confusum J. duV.

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

(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 Infestaion 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 Pest Infestation Laboratory, Slough, Bucks.

(Ed.)

SLOUGH, BUCKS
PEST INFESTATION LABORATORY

I. Wild type strains

DICTYOPTERA

Blattidae	Common Name	Culture Medium	Rearing Temp. °C
Nauphoeta cinerea (Oliv.)		5 + 33	27.5
Blatta orientalis L.	Common cockroach	5 + 33	27.5

		Common Name	Culture Medium	Rearing Temp. °C
	Blatella germanica (L.)+	German cockroach	5 + 33	27.5
	Periplaneta americana (L.)	American cockroach	5 + 33	27.5
	Periplaneta australasiae (F.)		5 + 33	27.5
	Pycnoscelus surinamensis (L.)		5 + 33	27.5
	Supella supellectilium (Serville)		5 + 33	27.5
THYSANURA				
Lepismatidae				
	Lepisma saccharina L.	Silver fish	7 + 33	25
	Thermobia domestica (Packard)	Firebrat	7 + 33	30
DIPTERA				
Calliphoridae				
	Calliphora erythrocephala	Blowfly	27a + 34	
Muscidae				
	Musca domestica L.	Housefly	10 + 34	
HYMENOPTERA				
Formicidae				
	Monomorium pharaonis (L.)	Pharaoh's ant	27	
Ichneumonidae				
	Nemeritis canescens (Grav.)		30	25
Braconidae				
	Bracon hebetor Say		31	25
Chalcidoidea				
	Dibrachys cavus (Walker)		31	25
LEPIDOPTERA				
Galleriidae				
	Aphomia gularia (Zell.)		2a + 20	25 + 30
	Achroia grisella (F.)	Lesser wax moth	4 + 33	25
	Galleria mellonella (L.)	Honeycomb moth	4 + 33	25
Gelechiidae				
	Sitotroga cerealella (Oliv.)		15 + 24 + 33	35

	Common Name	Culture Medium	Rearing Temp. °C
Phycitidae			
Anagasta kühniella Zell.	Mediterranean flour moth	2 + 33	25
Cadra cautella (Walk.)	Tropical warehouse moth	2 + 33	25
Ephestia elutella (Hübn.)	Warehouse moth	2 + 33	25
Plodia interpunctella (Hübn.)	Indian meal moth	2 + 33	25
Tineidae			
Tinea columbariella Wocke		11 + 19	25
Tinea pellionella (L.)	Case bearing clothes moth	11 + 19	25
Tinea flavescentella Haworth		11 + 19	25
Tineola bisselliella (Humm.)	Common or webbing clothes moth	11 + 19	25
Nemapogon granella (L.)	Common moth	2 + 33	25
Pyralidae			
Pyralis farinalis (L.)		8 + 33	20
COLEOPTERA			
Anobiidae			
Anobium punctatum (Deg.)	Furniture beetle	29	20
Lasioderma serricorne (F.)	Cigarette beetle	3	25
Stegobium paniceum (L.)	Biscuit beetle	3	25
Bostrichidae			
Rizopertha dominica (F.)	Lesser grain borer	15	30
Bruchidae			
Acanthoscelides obtectus (Say)	American seed beetle	21	30
Callosobruchus analis (F.)		23 + 18	30
Callosobruchus chinensis (L.)	Cowpea or lentile "weevil"	23 + 18	25
Callosobruchus maculatus+ (F.)		18	30
Callosobruchus rhodesianus (Pic)		22	30
Caryedon gonagra (F.)	Groundnut beetle	20	30
Zabrotes subfasciatus			
Collydiidae			
Murmidius ovalis			
Cleridae			
Necrobia rufipes (Deg.)	Copra beetle	11 + 16	30

	Common Name	Culture Medium	Rearing Temp. °C
Cucujiidae			
Cryptolestes ferrugineus (Steph.)	Red rust grain beetle	7	30
Cryptolestes pusilloides (Steel and Howe)		7	25
Cryptolestes turcicus+ (Grouv.)		7	25
Cryptolestes ugandae		7	25
Cryptolestes capensis (Waltl)		7	25
Cryptolestes pusillus (Schönherr)	Flat grain beetle	7	25
Curculionidae			
Sitophilus zeamais Motsch.	Rice weevil	15	25
Sitophilus oryzae (L.)	Lesser rice weevil	15	25
Sitophilus granarius (L.)	Grain weevil	15	25
Dermestidae			
Anthrenocerus australis (Hope)	Australian carpet beetle	11 + 19	25
Anthrenus verbasci (L.)	Varied carpet beetle	11 + 19	20
Anthrenus flavipes Lec. (= Anthrenus vorax Waterh.)	Furniture carpet beetle	11 + 19	25 + 30
Attagenus gloriosae			
Attagenus alfieri auct.		6 + 33	25
Attagenus megatoma (F.) (= picous (Oliv.))	Black carpet beetle	11 + 19	25
Dermestes ater Deg		11 + 16	25
Dermestes frischii Kug.	Hide beetle	11 + 16	25
Dermestes lardarius L.	Bacon beetle	11 + 16	25
Dermestes maculatus+ Deg.	Leather beetle	11 + 16	25
Dermestes haemorrhoidalis Knuster & Praze		11 + 16	25
Dermestes peruvianus Castelnau		11 + 16	25
Trogoderma granarium Everts.	Khapra beetle	8	30
Trogoderma inclusum (Creutz.)	Larger cabinet beetle	7	30
Trogoderma anthrenoides (Sharp)		8	30
Trogoderma parabile (Beale)		8	30
Trogoderma glabrum (Herbst)		8	30
Trogoderma irroratum Reitt.		8	30
Mycetophagidae			
Typhaea stercorea (L.)		8a	25
Nitidulidae			
Carpophilus dimidiatus+ (F.)	Corn-sap beetle	12	25
Carpophilus hemipterus (L.)	Dried fruit beetle	13	25

	Common Name	Culture Medium	Rearing Temp. °C
Ostomatidae			
Tenebriodes mauritanicus (L.)	The Cadelle	7 + 20 + 35	30
Lophocateres pusillus (Klug.)	Siamese grain beetle	7 + 20	30
Ptinidae			
Gibbium psylloides (Czenp)	Hump spider beetle	6 + 33	20
Mezium affine (Boield.)		6 + 33	20
Mezium americanum Lap.		6 + 33	
Niptus hololeucus (Fald.)	Golden spider beetle	6 + 33	20
Pseudeurostus hilleri (Reitt.)		6 + 33	20
Ptinus hirtellus Sturm.		6 + 33	20
Ptinus sexpunctatus Panz.		6 + 33	20
Ptinus tectus Boield.	Australian spider beetle	6 + 33	25
Stethomezium squamosum Hint.	African spider beetle	6 + 33	20
Trigonogenius globulus Sol.	Globular spider beetle	6 + 33	20
Trigonogenius particularis Pic		6 + 33	25
Tipnus unicolor P. & M.		6 + 33	20
Silvanidae			
Ahasverus advena^{+} (Waltl)	Foreign grain beetle	7	25
Cathartus quadricollis (Guer.)		7	25
Oryzaephilus surinamensis (L.)	Saw-toothed grain beetle	7	25
Oryzaephilus mercator (Fauv.)	Merchant grain beetle	7	25
Tenebrionidae			
Alphitophagus bifasciatus	Two-banded fungus beetle	8a	25
Alphitobius diaperinus (Panz.)	Lesser mealworm	1	25
Alphitobius laevigatus (F.)	Black fungus beetle	1	25
Alphitobius sp. (*viator*?)		1	25
Gnathocerus cornutus (F.)	Broad-horned flour beetle	3	25
Gnathocerus maxillosus (F.)	Slender-horned flour beetle	3	25
Latheticus oryzae Waterh.	Long-headed flour beetle	3	30
Palorus ratzeburgi (Wissm.)	Small-eyed flour beetle	3	25
Palorus subdepressus (Woll.)	Depressed flour beetle	1	25
Tenebrio molitor L.	Yellow mealworm	7 + 33	25
Tenebrio obscurus F.	Dark mealworm	7 + 33	25
Tribolium castaneum (Herbst)	Rust-red flour beetle	14	25
Tribolium confusum^{+} Duv.	Confused flour beetle	14	25
Tribolium destructor Uytt.	Dark flour beetle	3	25
Tribolium anaphe Hint.		6	25
Tribolium madens Charp.		6	25

Culture Medium

No.	Food	Weight Ratio (ounces)
1.	Wheatfeed on a wet pad	10
2.	Wheatfeed, glycerine	10 : 2
2a.	Rice bran, glycerine	10 : 2
3.	*Wheatfeed yeast	10 : 1
4.	Wheatfeed, rolled oats, glycerine, honey, brood-comb	5 : 5 : 2 : 2 : 2
5.	Wheatfeed, rolled oats, fishmeal, yeast	5 : 5 : 2 : 1
6.	Wheatfeed, fishmeal, yeast	8 : 4 : 1
7.	Wheatfeed, rolled oats, yeast	5 : 5 : 1
8.	Wheatfeed, wheat	6 : 14
8a.	Wheatfeed, wheat wet pad	6 : 14
9.	Wheatfeed, wholemeal flour	6 : 10
10.	Wheatfeed, grassmeal, yeast, stortex	5 : 3 : 1 : 1
11.	Fishmeal, yeast	16 : 1
12.	Rolled oats, yeast	10 : 1
13.	Rolled oats	
14.	Wholemeal flour, yeast	12 : 1
15.	Wheat	16
16.	Bacon ends	4
17.	Kibbled cocoa beans	10
18.	Dried peas	12
19.	Flannel	½
20.	Ground nuts	12
21.	Haricot beans	16
22.	Cowpeas	16
23.	Lentils	8
24.	Maize	12
27.	Liver, swiss roll, honey	
27a.	Liver	
29.	Wood	
30.	Moth culture (Fam. Phycitidae)	
31.	*Galleria mellonella*	
32.	*Sitophilus* spp.	
33.	Drinking tube	
34.	Sugar and water	
35.	Cork	

II. Mutants

A. *Ahasverus advena* (Silvanidae)

1. black form — Soulbury U.K., 1960

B. *Carpophilus dimidiatus* (Nitidulidae)

1. pearl (*p*) (from lab. stock of unrecorded origin) — 1960

* Yeast = dried powder (*Saccharomyces cerevisiae*)

C. Cryptolestes pusillus (Cucujidae)

1. black form — Trinidad, 1960

D. Cryptolestes turcicus (Cucujidae)

1. red (r) (from lab. stock of unrecorded origin) — 1960

E. Dermestes frichii (Dermestidae)

1. creased sternites (from lab. stock of unrecorded origin) — 1965

F. Dermestes maculatus (Dermestidae)

1. pearl (p) (from lab. stock of unrecorded origin) — 1960
2. fuscous (fu) — Australia, 1964
3. light wing (l) — Australia, 1964
4. second sex pit (ssp) — Australia, 1964
5. double antennae — S. Africa, 1964
6. dark antennae — India, 1964
7. light antennae — India, 1964
8. pink eye (from lab. stock of unrecorded origin) — 1964
9. white abdomen — Khartoum, 1964
10. rufous (ru) — Kenya, 1964
11. 2 y chromosomes — India, 1963
12. 3 y chromosomes
13. dented pronotum

G. Gnathocerus cornutus (Tenebrionidae)

1. pearl (p) (from lab. stock of unrecorded origin) — 1958

H. Latheticus oryzae (Tenebrionidae)

1. brown body (bwb) (from lab. stock of unrecorded origin) — 1962

I. Oryzaephilus surinamensis (Silvanidae)

1. pearl (p) — Australia, 1961

J. Rhyzopertha dominica (Bostrichidae)

1. black (b) (from lab. stock of unrecorded origin) — 1964

K. Sitophilus granarius (Curculionidae)

1. pearl (p) (from lab. stock of unrecorded origin) — 1964

L. Tribolium castaneum (Tenebrionidae)

Linkage Group I

1. pygmy, paddle (py pd) — Sokoloff, 1962

Linkage Group II

2. pearl (Mp) — Malta, 1959

Linkage Group III

3. black (b) — Sokoloff, 1962
4. tawny (b^t) — Australia, 1961
5. melanotic stink glands (msg) — Sokoloff, 1966

Linkage Group IV

6. sooty (s) — Sokoloff, 1962

Linkage Group V

7. microcephalic (mc) — Sokoloff, 1962
8. jet (j) — Sokoloff, 1965
9. jet (j^k) — Kingston, Jamaica, via St. Andrews (Dundee), 1965

Linkage Group VI

10. Microphthalmic (Mo) — Sokoloff, 1965

Linkage Group VII

11. short antenna (sa) — Sokoloff, 1965

Linkage Group VIII

12. antennapedia (ap^D) — Sokoloff, 1964

Linkage Group IX

13. prothoraxless (ptl) — Sokoloff, 1964

Linkage Group X

14. abbreviated appendages (aa) — Sokoloff, 1966

Multichromosomal

15. p; b^t
16. b; c
17. s; p

Unassigned

18. mahogany — St. Andrews, Scotland, 1965
19. long abdomen — St. Andrews, Scotland, 1965
20. pearl-like — St. Andrews, Scotland, 1965
21. aurate (au) — Sokoloff, 1966
22. pectinate (pec) — Sokoloff, 1966

M. *Tribolium confusum* (Tenebrionidae)

Linkage Group II

1. e_2p/e_2p

Linkage Group III

2. black (b) — Sokoloff, 1965

Linkage Group V

3. ebony (e) — Sokoloff, 1965

N. Trogoderma granarium (Dermestidae)

1. pearl (p) — U.K., 1958

(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.)

TOLWORTH, SURBITON, SURREY
MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
INFESTATION CONTROL LABORATORY

Insects in Culture	Culture Medium	Rearing Temp. °C
DICTYOPTERA		
Blattidae		
Blatta orientalis (L.)	7 + 33	25
Blattella germanica (L.)	7 + 33	25

	Culture Medium	Rearing Temp. °C
Callosobruchus chinensis (L.)	14	25.0
Callosobruchus chinensis (Strain 'A')	14	25.0
Callosobruchus maculatus (F.)	14	25.0
Callosobruchus rhodesianus (Pic.)	14	25.0
Caryedon gonagra F.	22	25.0
Cleridae		
Necrobia rufipes (Deg.)	21 + 24	25.0
Necrobia ruficollis (F.)	35 + 39	25.0
Cucujidae		
Cryptolestes ferrugineus (Steph.)	3 + 6	25.0
Cryptolestes pusilloides (Steel & Howe)	3 + 6	25.0
Cryptolestes pusillus (Schon.)	3 + 6	25.0
Cryptolestes turcicus (Grouv.)	3 + 6	25.0
Cryptolestes ugandae (Steele & Howe)	3 + 6	25.0
Curculionidae		
Sitophilus granarius (L.)	8	25.0
Sitophilus zea-mais (Motschulsky)	10	25.0
Sitophilus oryzae (L.)	8	25.0
Dermestidae		
Anthrenocerus australis (Hope)	25 + 29	25.0
Anthrenus verbasci (L.)	25 + 29	R
Anthrenus vorax (Waterh.)	25 + 29	25.0
Anthrenus fuscus (Oliv.)	25 + 29	R
Attagenus pellio (L.)	2 + 25	R
Attagenus piceus (Oliv.)	3 + 29 + 25	25.0
Attagenus alfierii (Pic.)	3 + 25	25.0
Dermestes ater (Deg.)	25	25.0
Dermestes frischii (Kug.)	25	25.0
Dermestes haemorrhoidalis (Kuster)	25	25.0
Dermestes lardarius (L.)	25	25.0
Dermestes maculatus (Deg.)	25	25.0
Dermestes peruvianus (Cast.)	25	25.0
Trogoderma glabrum (Herbst)	3	25.0
Trogoderma granarium (Everts)	13 + 24 + yeast	25.0
Trogoderma inclusum (Le Conte)	2	25.0
Trogoderma granarium (Egyptian Strain)	9 + 12	25.0
Trogoderma sternale (Casey)	28 + 32	25.0
Nitidulidae		
Carpophilus dimidiatus (F.)	16 + 24	25.0
Carpophilus hemipterus	6 + 27	25.0
Ostomatidae		
Lophocateres pusillus (Klug.)	2 + 6 + 33	25.0
Tenebriodes mauritanicus (L.)	6 + 10	25.0

	Culture Medium	Rearing Temp. °C
Blattella germanica (Resistant strain)	7 + 33	25.0
Periplaneta americana (L.)	7 + 33	25.0
Periplaneta australasiae (F.)	7 + 33	25.0
ORTHOPTERA		
Gryllidae		
Acheta domesticus (L.)	7 + 33	25.0
LEPIDOPTERA		
Galleriidae		
Achroia grisella (F.)	31	R
Paralipsa gularis (Zell.)	32	R
Corcyra cephalonica	18	25.0
Galleria mellonella (L.)	31	R
Gelechiidae		
Sitotroga cerealella (Oliv.)	10	25.0
Phycitidae		
Ephestia kühniella (Zell.)	1	R
Ephestia cautella (Walk.)	5	25.0
Ephestia elutella (Huebn.)	5	25.0
Plodia interpunctella (Huebn.)	5	25.0
Tineidae		
Tinea columbariella (Wocke)	25 + 29	25.0
Tinea pellionella (L.)	25 + 29	25.0
Tineola bisselliella (Hum.)	25 + 29	25.0
COLEOPTERA		
Anobiidae		
Lasioderma serricorne (F.)	3 + 19 + 24	25.0
Stegobium paniceum (L.)	3	25.0
Anthribidae		
Araecerus fasciculatus (Deg.)	10 + 11	25.0
Bostrichidae		
Rhyzopertha dominica (F.)	8	25.0
Bruchidae		
Acanthoscelides obtectus (Say.)	15	25.0
Callosobruchus analis (F.)	14	25.0

	Culture Medium	Rearing Temp. °C
Ptinidae		
Gibbium psylloides (Czenp.)	2	25.0
Mezium affine (Boield)	1	25.0
Mezium americanum (Laporte)	1	25.0
Niptus hololeucus (Fald.)	3 + 25 + 33	R
Ptinus clavipes (Panz)	3 + 25 + 33	R
Ptinus fur (L.)	3 + 25 + 33	R
Ptinus pusillus (Sturm)	1 + 33	UR & R
Ptinus sexpunctatus (Panz.)	3 + 25 + 33	25.0
Ptinus tectus (Boield.)	3 + 25 + 33	R
Stethomezium squamosum (Hinton)	3 + 33	25.0
Trigonogenius particularis (Pic.)	3	25.0
Silvanidae		
Ahasverus advena (Waltl)	3 + 21 + 33	25.0
Cathartus quadricollis (Guer.)	6	25.0
Oryzaephilus mercator (Fauv.)	16 + 24	25.0
Oryzaephilus surinamensis (L.)	6	25.0
Oryzaephilus surinamensis (small strain)	6	25.0
Tenebrionidae		
Alphitobius diaperinus (Panz.)	2 + 6 + 30	25.0
Alphitobius laevigatus (F.)	2 + 6 + 30	25.0
Alphitobius sp.	2 + 6 + 30	25.0
Gnathocerus cornutus (F.)	1	25.0
Gnathocerus maxillosus (F.)	3	25.0
Latheticus oryzae (Waterh.)	1	25.0
Palorus ratzeburgi (Wissm.)	1 + 6	25.0
Palorus subdepressus (Woll.)	2	25.0
Tenebrio obscurus (F.)	1 + 6 + 30	25.0
Tenebrio molitor (L.)	1 + 6 + 30	25.0
Tribolium anaphe (Hinton)	2 + 24 + 25	25.0
Tribolium castaneum (Herbst)	1	25.0
Tribolium confusum (J. du V.)	1	25.0
Tribolium destructor (Uyttenb.)	1	25.0
Tribolium madens (Charp.)	1	25.0
Languriidae		
Pharaxonotha kirschi (Reitt)	3 + 33	25

Culture Media
(Proportions by weight)

1. Whole-meal flour (20 pts.) and yeast (1 pt.)
2. Whole-meal flour (10 pts.), fine wheat feed (10 pts.) and yeast (1 pt.)
3. Fine wheat feed (20 pts.) and yeast (1 pt.)

4. Broad bran (dry)
5. Broad Bran (6 pts.) and glycerine (1 pt.)
6. Rolled oats (20 pts.) and yeast (1 pt.)
7. Crushed dog biscuit (20 pts.) and yeast (1 pt.)
8. Wheat
9. Crushed Wheat
10. Maize
11. Maize (Kibbled)
12. Crushed Maize
13. Barley
14. Dried peas
15. Haricot beans
16. Dried fruit
17. Cocoa beans
18. Cocoa beans (crushed)
19. Locust beans (Kibbled)
20. Wood
21. Copra
22. Ground-nuts (undecorticated)
23. Decorticated ground-nuts
24. Ground-nuts (decorticated and crushed)
25. Fish meal (20 pts.) and yeast (1 pt.)
26. Bacon
27. Dried figs and yeast
28. Dried insects
29. Woolen cloth
30. Damp cotton-wool pad
31. Honeycomb
32. Sweet almonds
33. Water supply - an inverted beaker over a cotton-wool pad in a petridish, or a 3" x 1" tube of water fitted with a biological stopper or filter paper strip.
34. Grass seed
35. Wood sawdust
36. Bread and butter
37. Sweet biscuits
38. Senna pods
39. Bones

M. G. Lanbourne

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.)

BAHADU 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-I (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

   HSR-Black

ISRAEL

TEL AVIV, ISRAEL
TEL AVIV UNIVERSITY, DEPARTMENT OF ZOOLOGY

I. Wild type strains

Tribolium castaneum

++ (Purdue) strain

Tribolium confusum

++ (Chicago) strain

Both obtained from Dr. Robert R. Sokal's laboratory, Stony Brook, N. Y., U.S.A.

II. Mutant strains

Tribolium castaneum

1. Black (bb)
2. Pearl (P)
3. Sooty (ss)

Tribolium confusum

1. (McGill) Black (bb)

All mutants obtained from Dr. Robert R. Sokal's laboratory, Stony Brook, N. Y., U.S.A.

ITALY

PAVIA
UNIVERSITY PAVIA, CENTRO DE GENETICA

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

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

(Ed.)

JAPAN

KYOTO
KYOTO UNIVERSITY, FACULTY OF AGRICULTURE

Bruchidae

Callosobruchus chinensis	Kyoto and many other districts in Japan Iran Thailand
Callosobruchus maculatus	Louisiana, U.S.A. California, U.S.A. Fresno Lab., U.S.D.A. Burma Israel Thailand Malaya
Zabrotes bifasciatus	Hong Kong

Curculionidae

Sitophilus zeamais	Kyoto
Sitophilus oryzae	Kyoto

Tenebrionidae

Tribolium castaneum	Kyoto

(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.)

MISIMA, SIZUOKA-KEN
NATIONAL INSTITUTE OF GENETICS

No stock list available.

(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, HAMILTON
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
GRASSLANDS 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 kühniella (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 (L.)--wheat	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.	Canarias	Canarias, Spain, 1966
2.	Consejo	CSIC, Madrid, Spain, 1964
3.	Purdue	Purdue, U.S.A., 1964

B. Mutant strain

4.	Black Purdue	Purdue, U.S.A., 1964

C. Experimental lines

Originated from the "Consejo" strain and selected for egg laying performance through 30 generations.

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

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

29 - 58. Inbred lines with 9 generations of full sibbing.

D. Mutants

59.	antennapedia ap, VIII	Purdue, 1964 and Sokoloff, 1968
60.	Bar eye Be, IV	Purdue, 1964
61.	black b, III	Sokoloff, 1964
62.	chicago black cb, III	Sokoloff, 1968
63.	chestnut c, VII	Purdue, 1964
64.	cordo an cd, III	Purdue, 1964
65.	Diferencial Df, IV	Purdue, 1968
66.	fused antennal segments-2 fas-2, IV	Sokoloff, 1968
67.	ivory i, ?	Purdue, 1964
68.	jet j, V	Purdue, 1964 and Sokoloff, 1968
69.	juvenile urogomphi ju, IV	Purdue, 1968
70.	light ocular diaphragm lod, III	Purdue, 1968
71.	maroon m, V	Purdue, 1964
72.	microcephalic mc, V	Purdue, 1964
73.	Microphthalmic Mo, VI	Sokoloff, 1968
74.	miniature appendaged D. ma^D	Purdue, 1968
75.	paddle pd, I	Purdue, 1964 and Sokoloff, 1968
76.	pearl p, II	Purdue, 1964 and Sokoloff, 1968
77.	pegleg pg, II	Purdue, 1968
78.	pink p^{pk}, II	Purdue, 1968
79.	pygmy py, I	Purdue, 1964 and Sokoloff, 1968
80.	red r, I	Purdue, 1964
81.	ring rg, I	Purdue, 1964
82.	rose rs, I	Purdue, 1964
83.	ruby rb, ?	Purdue, 1964
84.	Short antenna Sa, VII	Purdue, 1964
85.	short elytra sh, VIII	Purdue, 1968
86.	sooty s, IV	Purdue, 1964
87.	spotted sp, I	Purdue, 1964
88.	squint sq, VIII	Purdue, 1964
89.	white w, ?	Purdue, 1964
90.	wine r^w, I	Purdue, 1968

Tribolium confusum

A. Mutants

1.	black b, III	Sokoloff, 1968
2.	blistered elytra ble, V	Sokoloff, 1968
3.	creased abdominal sternites cas, II	Sokoloff, 1968
4.	disjoined dj, VI	Sokoloff, 1968
5.	ebony e, V	Sokoloff, 1968
6.	ebony-2 e_2, II	Sokoloff, 1968
7.	red r, I	Sokoloff, 1968
8.	ruby spot rus, III	Sokoloff, 1968

F. Orozco

NEW MUTANTS

REPORT OF P. S. DAWSON

Tribolium confusum

1. depressed (dep)--Dawson, 1968. Sex-linked recessive, similar to thu in expression. Good viability through pupal stage, but reduced in adults. Located about 3 units from red.

2. red (r^u)--Dawson, 1968. Allelic to red. Eye color remains light in adults, thus making this allele much more useful for mapping sex-linked genes. Good viability.

REPORT OF G. JOHNSON and A. SOKOLOFF

Tribolium castaneum

A spontaneous mutation appeared in a wild type strain of *T. castaneum*. Its expression is variable: in inbred strains beetles may have one or both eye reduced or missing altogether. The cranium is reduced behind the gena. Tests of allelism between this mutant and microcephalic (mc) indicate the two are allelic. While the effect on the eye is not uniform, the effect on the cranium is rather uniform suggesting complete penetrance for this gene. We are naming this allele of microcephalic mc-1, Johnson and Sokoloff.

REPORT OF A. SOKOLOFF

Tribolium confusum

Miss Maria Korunić Zlatko, of the Agricultural Faculty, Institute for Plant Protection, Zagreb, Yugoslavia, sent us a black mutant found in a local strain of *T. confusum*. Preliminary crosses with wild type suggested it was an autosomal, semi-dominant gene, the heterozygote being identifiable from either homozygote. Tests of allelism with McGill black indicated the two mutants were allelic. We are designating the new mutant $black^z$--Korunić Zlatko and Sokoloff.

REPORT OF M. P. TAGARRO and F. OROZCO

Tribolium castaneum

1. Eye mutant. Autosomal recessive found in "Consejo" strain affecting the pigment of the eye, it appears dark red surrounded by a black circle, identifiable in pupa and adult stage. Good viability and expressivity, complete penetrance.

Test for allelism with pink, chestnut, ruby, ivory and maroon was negative.

Linkage tests proved negative for II, III, V, VI and VII groups. Test in the VIII group shows a possible linkage. At present, doing a three points test-cross for IV, V and VIII groups.

2. Elytra mutant. Found in "Consejo" strain. Different tests show an irregular dominance, variable expression and good viability. It shows a similar phenotype to abbreviated appendages (*aa*) or split (*sp*). Test for allelism shows variable results owing to the changeable dominance.

3. Melanotic stink gland-like. Spontaneous in the eye mutant stock, it shows a dark spot in both sides of anterior prothorax, the abdomen appears also affected. Similar to melanotic stink gland. The mutation expression appears after 21 days of adult stage, with variable expressivity and penetrance.

NOTES - RESEARCH

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Epigenetic studies of the egg in Tribolium castaneum.

Flour beetle of the genus Tribolium constitute important primary and secondary pests in all kinds of cereal products. For this reason they have attracted the attention of investigators with a broad spectrum of interests. Since Chapman (1924) used and stressed the usefulness of Tribolium in population studies, Tribolium castaneum has received considerable attention from ecologists and geneticists. It has been used extensively in testing quantitative genetic theory; as a result the knowledge of its reproductive fitness has assumed considerable importance, this being one of the very important parameters in elucidating the theories of population genetics. Since the development of the egg is closely tied up with the components of fitness and it also is a prerequisite for studying the developmental genetics of oogenesis, it is necessary to fully understand the development of the egg before meaningful conclusions can be drawn with respect to fitness components.

To date several distinct approaches to the problem of yolk synthesis have been used. The development of sectioning and staining methods resulted in a period of extensive histological investigation of the ovary. This modern period of research on the insect ovary seems to have been initiated by Stein (1847) with his histological study of the female reproductive organs of beetles. The second major approach to insect vitellogenesis was stimulated by the appearance of special cytological methods (osmic acid, silver method; Janus green staining, etc.) insect vitellogenesis has been studied by various authors.

There is no report on the vitellogenesis in Tribolium castaneum. The study was taken up in two phases, in the first phase emerging females were dissected out and ovaries were teased. The ovariole number was recorded. The stages of maturation of egg were studied by staining of whole mounts with Feulgen stain. In the second phase the stages in development of the egg were studied by dissection of adult mature females and then a study of the stages of development from microtome sections after using apropriate stains was undertaken.

The ovarioles are described was panoistic type which lack nurse cells. Average ovariole number per ovary is 5.76 and per individual 11.51. Each ovariole anteriorly has a germarium which countinues into a germarial filament. These filaments are quite long. The germarium is followed by various egg chambers. The entire ovariole is surrounded by a thin membranous epithelial sheath. The germarium consists of germarial cells. The oocytes are formed posterioly and on sides of follicle cells in the construction region of the ovariole.

Early follicle cells are small and spindle shaped. They are seen in a group in the posterior part of the germarium. These follicle cells encircle oocytes. The follicle cells increase in size with time. The oocyte nucleus increases in size and is of variable position. During the process when oocytes are formed ooplasm is laid and goes on increasing in successive stage of development. The composition of ooplasm changes from dense mass in which vacuoles are laid which finally develop into yolk spheres. The whole oogenesis has been divided into seven stages according to our criteria. The time taken for the maturation of ovary has been studied. It has been seen that the ovary becomes mature to lay eggs 96 hours after emergence.

The time taken for the maturation of egg was studied in ovarioles from 0 hours to 168 hours of ages and was observed that no follicles were formed from 4 hours to 24 hours of age. When the ovary was 48 hours old 54% of the follicles were formed. The oocytes were formed between 24 to 48 hours of age. If we suppose that oocytes were formed at 36 hours of age then it would take approximately 60 hours for the maturation of egg. Cytochemical studies for RNA, DNA Polysaccharides and alkaline phosphatase activity were undertaken. The presence and absence of these at various stages of the development of egg has been studied in detail.

Literature Cited

1. Chapman, R. N. 1924. Nutritional studies on the confused flour beetle *Tribolium confusum* Duval. J. Gen. Physiol. 11:565-585.

2. Stein, F. 1847. Vergleichende Anatomie und Physiologie der insekten, I, Die weiblechen Geschlectsorgane der Käfer. Dunckeru. Humblot. Berlin, 139 pp.

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*Activity in *T. castaneum*.

Using the technique described by Amos (1967), the activity of *T. castaneum* adults is being examined to determine the possible existence of rhythmicity. Both sexes are being studied at two humidities (75 and 42% RH) under stable conditions (in darkness) and under diurnally fluctuating conditions where both temperature and light are varied. Analysis of data so far obtained suggests the absence of an activity rhythm under stable conditions whereas a distinct rhythm is present under fluctuating conditions. Partial correlation analysis indicates that activity is positively correlated with temperature and negatively correlated with light. Further work is underway using other stable (in light) and fluctuating conditions to determine more precisely the nature of adult activity.

Literature Cited

Amos, T. G. 1967. Apparatus for studying locomotor activity of small animals with the aid of time-lapse photography. J. Econ. Ent. 60: 886-887.

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*The biology and behavior of a stored products moth Ephestia (Cadra) cautella (Walker) (Lepidoptera, Phycitidae), as studied in controlled environments.

Laboratory studies using E. cautella tested the versatility of a gradient environment apparatus developed for use with Tribolium spp. (Onyearu, A. K. 1967) and also gave life history biology data to supplement that previously based on the uniformly controlled conditions of the constant temperature room.

Three different populations of E. cautella were employed, a laboratory one and two field populations (ex Nigeria, and ex Kenya). In the gradient environment the populations were able to select conditions most suitable for particular stages in their life history.

Adults of all three populations responded similarly in that they favoured the cool regions in the gradient environment. All laid their eggs in generally warmer conditions although the actual distributions of their oviposition sites differed in a number of respects. This suggests that adults move from the cooler to the warmer regions in order to oviposit. Further evidence for this view comes from the work of Amos et al 1968 who studied isolated E. cautella adults. They found that a female adult spent periods in the cool region of a gradient environment (17° to 32°C) interspersed with periods of a much shorter duration in the warmer regions, where oviposition occured. The distribution of the pupal sites were generally in warmer conditions than those of the oviposition sites.

In a number of ways the field populations were more strongly favoured over a much wilder range of conditions than the laboratory one, although they too differed between themselves.

Details of this study are being prepared for publication elsewhere.

This work was supported by grants R 1694 and R 1939 from the Ministry of Overseas Development.

Literature Cited

Amos, T. G., F. L. Waterhouse and N. A. Chetham 1968. Temporal distribution of Tribolium castaneum Herbst and Cadra cautella (Walker) on temperature gradients. Experientia 24:86.

Graham, W. M., A. K. Onyearu and F. L. Waterhouse 1965. Temperature and moisture gradient equipment. Can. Ent. 97(8):880-886.

Onyearu, A. K. 1967. The behaviour and biology of flour beetles, genus Tribolium as studied in laboratory gradients of temperature and humidity. Tribolium Inform. Bull. 10:121-122.

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Food-seeking behaviour of stored product insects.

A study is in progress to determine whether a particular constituent of white flour can serve as the primary stimulus for *Tribolium castaneum* in its food-seeking behavior. In conjunction with this work phase, electrophysiological techniques are being developed which will provide a basis for correlating behavioral responses with neural responses.

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Fecundity of *T. castaneum* females.

In an experiment to evaluate the reproductive performance of males from a line selected for large 21 day pupa weight, selection line males were mated, each to two BC1 females. BC1 was a highly fertile line, whereas the selection line was in reproductive difficulty. Egg collections were taken for 24 hours from individual females which had previously been held with the male for 6 days. The number of eggs were counted at the end of the collection period and fertility of larva on the 7th day. Of a total of 86 matings, 31 had no larva indicating either that mating did not take place or the male was sterile. The mean egg number for these 62 females was only 8.5 per 24 hours. The comparable figure for the remaining 150 females was 21.7. These data suggest the existence of a male stimulating effect on egg laying.

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Methyl bromide and phosphine residues in stored beans.

Studies on the degradation of methyl bromide and phosphine residues in beans treated with one or various applications of the fumigants.

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Pesticides residues in cacao beans.

The effect of residues of fumigants such as methyl bromide and phosphine on cacao beans has been under study in order to determine the influence of moisture content of the seeds on the absorption and fixation of the fumigants.

An identical study has been undertaken with contact insecticides based on DDT, Lindane, malathion and pyrethrins.

On both cases, a wide range of doses have been used, the residues anaylsed several times after the treatment.

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Preliminary studies on PAU-I strain of *Tribolium castaneum*.

I. Life Cycle

It was considered essential to study various stages of the life cycle and growth pattern in PAU-I strain of *Tribolium castaneum* before any quantitative genetics experiment could be started. The stock was maintained in the Population genetics laboratory of the Department of Genetics at Punjab Agricultural University, Hissar. The stock has been developed from samples collected from various parts of Hissar twon. The samples were mixed and the beetles allowed to breed at random under the laboratory conditions in a population cage for three generations. The random mating wild population was gradually adapted to standard laboratory conditions. The beetles were fed on medium containing 94.5% whole wheat flour, 5% dried yeast and 0.5% of Rovimix (Vitamin mixture containing A, B_2 and D_3). The whole wheat flour was sifted through a filter sieve 60 (0.250 m.m.).

The beetles are maintained in the air conditioned laboratory inside the temperature and humidity controlled cabinets maintained at 32°C and 70% relative humidity (32 ± 1°C; 70 ± 6% RH). All experimental populations are maintained on medium containing 94.5% whole wheat flour, 5% dried yeast and 0.5% vitamin mixture containing vitamins A, B_2 and D_3. This will refer to standard laboratory conditions if otherwise not mentioned.

The experiment was run in two replicates. In each replicate, five males were mated to five virgin females each. After 48 hours the females were removed from these vials and number of eggs laid were counted. Two progeny per dam were secured at random from among the larvae hatched on the third day for studying the larval period, pupal period and other aspects of life cycle. The following observations have been made.

Nos.	Character	Replicate I	Replicate II	Overall Avg.
1.	Number of eggs laid per female	18.2	19.8	19.0
2.	Percent hatchability	92.31%	95.96%	94.21%
3.	Percent eggs hatched on			
	Day 1.	1.20%	1.05%	1.12%
	Day 2.	54.76%	40.00%	47.00%
	Day 3.	41.67%	58.84%	49.72%
	Day 4.	0.00%	1.05%	0.56%
	Day 5.	2.38%	1.05%	1.68%
4.	Average larval period (days)	28.33	28.22	28.25
5.	Average pupal period (days)	7.50	7.10	7.30
6.	Average developmental cycle (egg to adult) in days	35.33	35.18	35.25
7.	Percent Mortality	5.00%	10.00%	7.51%

The same strain after being adapted to the laboratory conditions of 32°C temperature and 70% relative humidity for a period of about eight months showed that the average larval period was 17.00 days in PAU-I as against 17.16 days in a strain from Brazil and 18.05 days in Chicago wild. The pupal period was 5.81 days in PAU-I and 5.76 days in Brazil and 5.50 days in Chicago wild.

The figures from the second experiment are quite comparable to those of Brazil and Chicago stocks which have long been kept under laboratory conditions. It might, therefore, be due to the constant suitable environmental and feeding conditions provided to the beetles of PAU-I that their life cycle was stabilized after eight months in this laboratory.

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<u>Preliminary studies on PAU-I strain of *Tribolium castaneum*.</u>

II. Comparison of growth curve of PAU-I, Brazil wild and Chicago wild strains of *Tribolium castaneum*.

The synthesis and the life cycle of PAU-I strain of T. castaneum has been described in a communication in this bulletin elsewhere. The other two stocks Brazil and Chicago wild were obtained from Dr. Sokoloff then at Department of Genetics, University of California, Berkeley in 1967 and maintained by Dr. Bhat, Assoc. Prof., Department of Genetics, Punjab Agricultural University, Hissar. The three stocks were kept under standard laboratory conditions, bred at random for a number of generations before the start of the experiment. The beetles were kept on medium containing 94.5% whole wheat flour, 5% dried yeast and 0.5% vitamin mixture containing vitamin A, B_2 and D_3.

60 pair matings were kept from each strain. The adults were removed after 24 hours of mating. Four days after the eggs were hatched, one larva each was secured at random from each mating. The larvae were kept singly in labelled glass vials. The larvae were weighed from the fifth day of hatching and daily weights recorded up to 26 days after hatching.

Two growth curves have been drawn based on the data of body weight records. Figure 1 shows the growth curve of the three strains drawn from the averages of the individuals irrespective of their stage of life. The growth pattern for the three strains does not seem to differ very much. Highest body weight was attained on 12th day after hatching by PAU-I beetles as against the 14th day by other two strains. There was regular loss of body weight weight from there onwards. A drop in weight between the 14th and 16th days is one of the characteristic features which may be compared to pubertal flextion in large animals. The decrease in body weight continued upto 22nd day in PAU-I, 23rd day in Chicago wild and 24th day in Brazil wild stocks. Further increase in body weights was not significant.

Figure 1 does not give a lucid idea about the growth pattern with regard to the stages of life cycle. Figure 2 is a modification of the first one in that the averages of body weights have been plotted strictly according to the stages of life cycle. The body weights of the larvae have been plotted from 5th day to 17th day in PAU-I and Brazil stocks and upto 18th day in Chicago strain of T. castaneum. This is based on the fact that average larval period in these strains were 17.00, 17.16. and 18.05 days respectively. From day 18 in PAU-I and Brazil and day 19 in Chicago the body weights of the pupae have been plotted. The day of pupation in all the cases was taken as a zero day and the growth curve of the three strains was drawn. The discontinuity of the curves marks the end of larval growth period and zero day of the pupal growth period.

The curves are therefore divided into two larval and pupal growth curves. The larval curves are almost similar to that in Figure 1. The highest body weight is attained on day 13 in PAU-I (2.13 mg.), day 14 in Brazil (2.47 mg.) and day 14 in Chicago (2.10 mg.). A gradual decline in larval weight thereafter is indicative of the fact that the larvae were preparing for the next stage--the pupation (the larvae seem to eat at a lesser rate but the rate of moulting is maintained). This may be a possible reason for the loss in body weight of the larvae.

The pupal growth curve is characterized by a gradual and regular decline in the body weight. Continuous feeding at its own stored energy may be a cause for this regular decline in the body weight of pupae. Average time

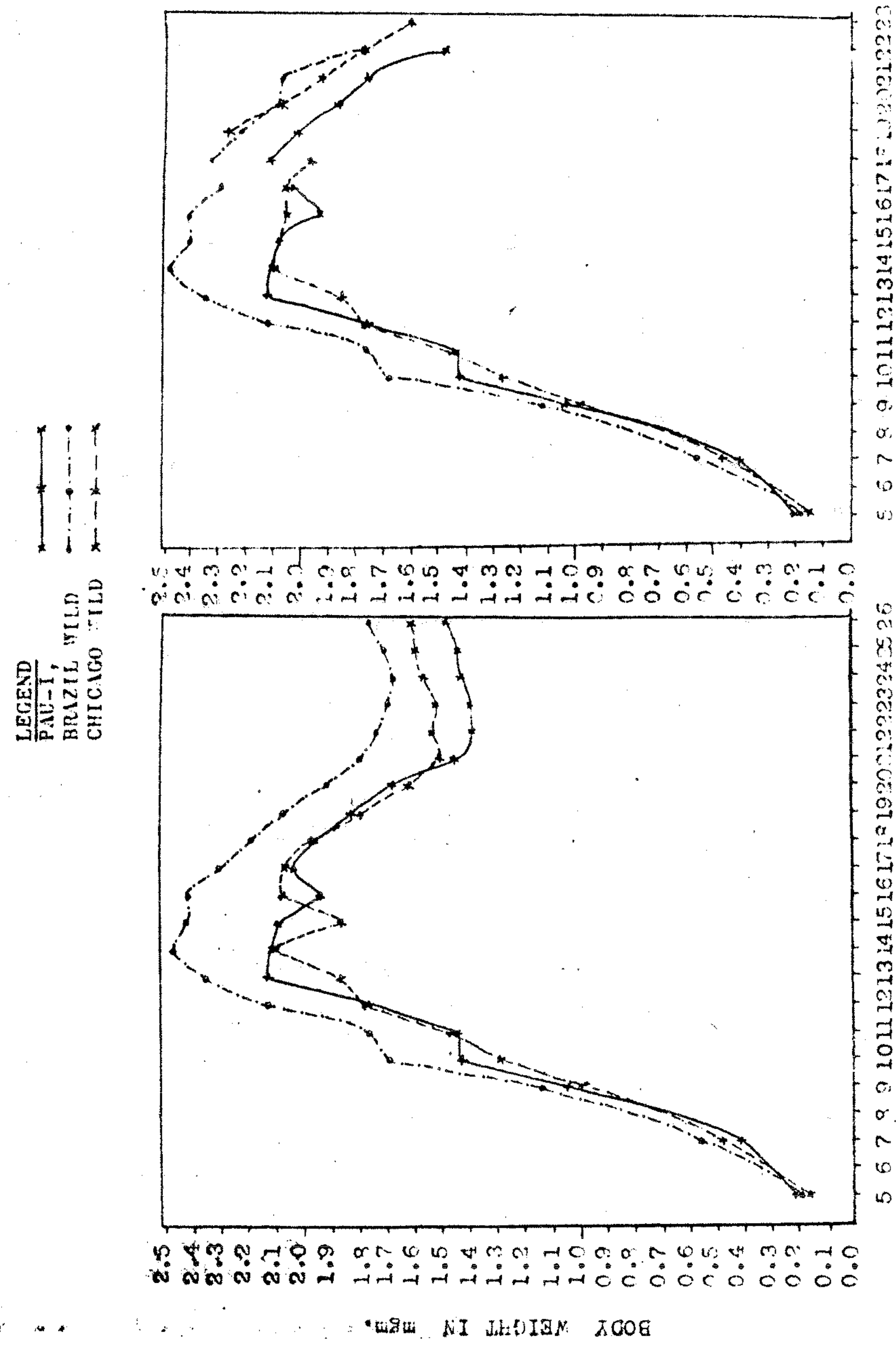

Figure 1: Growth curves drawn irrespective of the stage of life cycle.

Figure 2: Growth curves drawn separately for larvae and pupae. (Explanation in the text.)

taken for a pupa to become an imago was 5.81 days in PAU-I, 5.76 days in Brazil wild and 5.50 days in Chicago wild strains of *T. castaneum*.

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*An insect bioassay for feeding quality of cereals.

The confused flour beetle was used to detect differences in nutritive value among cereal varieties (Loschiavo, McGinnis and Metcalfe, 1969). Cereals to be assayed were finely ground in a ball mill. Since the length of larval period varies with the fineness of the grind and since the effect of particle size on larval development is not consistent among varieties, all material was pelleted prior to assay. Newly hatched larvae were placed in the medium, and the length of larval period (in days) used as the criterion of nutritive value. Feeding trials have been conducted with chicks to determine whether the beetles' assessment of nutritive value was meaningful for farm animals. Results of these comparative studies using five varieties of barley and three varieties of wheat were in general agreement.

Literature Cited

Loschiavo, S. R., A. J. McGinnis, and D. R. Metcalfe. 1969. Nutritive value of barley varieties assessed with the confused flour beetle. Nature 224:288.

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*Repellency to Tribolium confusum of diethyl ether extracts of wheat germ.

Soxhlet extracts of raw wheat germ with either diethyl either or n-hexane caused adults of *Tribolium confusum* to aggregate. An extract prepared by stirring wheat germ with diethyl ether for 18 hours repelled the beetles. Extracts similarly prepared with n-hexane stimulated aggregation. The level of repellency in the extracts varied widely depending upon the source and age of the diethyl ether. We have concluded that the repellent is an artifact of extraction and is the result of oxidative processes.

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*Sub-zero mortality responses of flour beetles.

Further studies of mortality at several sub-zero temperatures show that there is a delayed mortality effect up to one week after exposure. These studies also show that some species of Tribolium, e.g. *T. madens*, are very considerably more resistant to cold than species investigated so far (Nowosielski-Slepowron, et. al. 1968).

Literature Cited

Nowosielski-Slepowron, B. J. A., F. L. Waterhouse, and D. E. A. Strevens 1968. Sub-zero mortality responses of *Tribolium confusum* Duval (two stocks) and *T. castaneum* (Herbst) (two stocks) analyzed by weighted regression lines based on individual temperature L.D. 50's. Physiol. Zool 41:440-446.

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Some effects of auto-conditioned flour on various aspects of the biology of *Tribolium castaneum*.

The defensive quinoid secretion produced by the so-called "stink glands" of *Tribolium* species is rapidly taken up by a flour medium, which in time assumes a pinkish colour and has a characteristic odour. (Ladisch et al 1967). The effects of such auto-conditioned flour on the behavior of *T. castaneum* adults, oviposition with respect to female orientation, and the developmental period are being investigated. Using various degrees of conditioned flour, a repulsive effect on adult beetles was demonstrated, the adult distribution declining rapidly with increasing levels of conditioning, and a marked preference being shown for fresh flour. The definite avoidance reaction of the beetles would seem to indicate that the adult response is olfactory in nature. In a gradient environment the normal distribution of adults is altered by inserting a region of conditioned flour, there being a decrease in adult numbers in that region. This effect, however, is less marked at the higher, preferential temperatures.

The effect on oviposition was found to be correlated with adult behavior, the egg distributions obtained being similar to those of the adults. However a higher egg/female ratio was sometimes obtained in the more heavily conditioned flour than expected, this possibly being associated with the long-term survival of the population in unrenewed flour.

The rate of oviposition was found to decrease with increasingly conditioned flour, the adults being retained in the same flour medium over a period of time, and the egg output measured at intervals.

The developmental periods were found to be proportionately lengthened in increasing levels of conditioned flour and the mortality of eggs and small larvae increased.

These effects are being further investigated and the responses compared, in T. confusum, and other Tribolium species, such as T. brevicornis, and T. destructor, which in general produce larger amounts of the quinones.

Such factors as the inhibition of oviposition, and the lengthening of the developmental period, may be thought to have a contributory effect on the self-limiting mechanisms postulated to enable populations to survive for long periods in unrenewed flour.

Literature Cited

Ladisch, R. K., S. Ladisch and P. Howe 1967. Quinoid secretions in grain and flour beetles. Nat. 215, No. 5104.

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The effects of exposure to low temperatures on survival and fecundity in the flour beetles, Tribolium confusum and T. castaneum.

The survival and fecundity responses of flour beetles following exposures of the adults to subzero temperatures were investigated. Four populations were tested: an outbreeding stock and the inbred CFI-B of Tribolium confusum Duval, and an outbreeding stock and the inbred CS-5 of T. castaneum (Herbst).

The general aspects of the postexposure survival and fecundity responses were examined with the outbreeding T. confusum population exposed to -5°, -10° and -15°C for various durations. The survival response was influenced by latent lethal effects the expression of which became more immediate as the exposures became more harsh. The survivors showed 3 types of fecundity responses as compared to the unexposed beetles: sustained fecundity increase, temporary fecundity increase, and fecundity decrease. The increased postexposure fecundity was stimulated by exposures having sublethal and low lethal effects on survival.

Interspecies and intraspecies differences of postexposure survival and fecundity responses to -5°C were shown. T. confusum was more tolerant than T. castaneum, especially between the outbreeding stocks. Within species, especially confusum, the outbreeding stocks were more tolerant that the inbred stocks. Postexposure fecundity was stimulated in all the populations tested by certain exposure durations, but the inbreds had lower capabilities to interact favorably with the effects of the exposure than the outbreds.

The postexposure fecundity of the outbreeding T. confusum population following sublethal exposures to -5° was studied in greater detail. The results show: (1) The increased fecundity was stimulated by as short an exposure as 2.5 minutes. (2) Sublethal exposures stimulated the subsequent egg production of very young adults, less than 1 day old, and of adults 32 days of age. Physiological ageing affects both the postexposure survival and fecundity responses, however. (3) Exposure of the male sex did not contribute to the increased fecundity of exposed females, but differential exposure of the female and male sexes augmented the effects of delayed mating (lower fecundity level) when mating was experimentally curtailed until after the exposure. This augmentation was attributed to the changes in the adult's behavior and physiology. (4) Exposed beetles burrowed more quickly in the medium, and re-surfaced less frequently, in contrast with unexposed beetles which were surface-active. (5) Exposed females had higher oxygen consumption reflecting an increased metabolic rate. (6) Fecundity was disrupted by male absence less drastically with exposed than with unexposed females. However, egg fertility dropped more immediately in the former. (7) Low temperature exposure rendered the beetles insensitive to the fecundity-depressing factors found in adult-conditioned medium. (8) Low temperature exposures moderated the negative effect of high adult density on fecundity. There was a reduced egg cannibalism rate and an increased real fecundity among the exposed beetles. A relaxation of the density-dependent, self-regulating mechanism following sublethal exposures to low temperatures was implied by these findings.

(NOTE: The above abstract is of a paper which will appear in Ecological Monographs sometime in 1970. Ed.)

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Influence of antennae clipping on egg laying rate of *Tribolium castaneum* females.

A good system to differentiate individuals of *Tribolium* in the adult stage is to clip antennae (the right or the left one, both or none). It was of interest to know how that removal of antennae could possibly affect egg laying since a great part of the genetical research carried out in this laboratory is on that quantitative character. It seemed logical to assume that such a stress would probably reduce egg laying rate, and a series of experiments were run to check the validity of this assumption.

Four consecutive experients were run, each one designed according to the results of the preceding one. The strain "Consejo" was used in all four experiments. Egg laying rate was evaluated from the 7th to the 11th days after adult emergence for both virgin or fecundated females. Since the presence of the male is definitive to increase the egg laying rate (fecundated females lay highly significantly more than virgin ones), the influence of clipping was studied both in males and females.

Experiment 1. The following single pair matings were made:

20 females with NO antennae with TWO antennae males
20 " " ONE antenna " TWO " "

20 females with TWO antennae with TWO antennae males
20 " " TWO " " ONE antenna "
20 " " TWO " " NO antennae "

Average values of egg laying rate and statistical analysis are shown in Table 1. From that analysis no significant differences are detected. So a second experiment with two replications was run.

Table 1. Average egg laying rate (four days) and analysis of variance of the Experiment 1.

No. of antennae in males	No. of antennae in females			Analysis of Variance			
	2	1	0	S. of V.	d.f.	M.S.	F
2	70.95	60.35	69.85	Treatments	4	422.97	1.95
1	71.40	-	-	Error	94	217.00	
0	70.00	-	-	Total	98		

Experiment 2. Same type of matings as in Experiment 1, but with two replications. Table 2 gives the average figures for the egg laying rate and the statistical analysis. From that analysis it is shown that the treatments were highly significant, so it could be tentatively concluded that treatments have probably some effect on egg laying. For that reason a more complete experiment was run afterwards.

Table 2. Average egg laying rate and analysis of variance of Experiment 2.

No. of antennae in males	Replication	No. of antennae in females			Analysis of Variance			
		2	1	0	S. of V.	d.f.	M.S.	F
2	I	69.97	66.33	76.43	Treatments	4	6584.47	9.62++
1	I	64.53	-	-	Replications	1	38.34	
0	I	68.67	-	-	Trat. x Rep.	4	1887.38	2.76+
2	II	60.87	67.83	90.03	Error	189	684.74	
1	II	56.37	-	-				
0	II	67.93	-	-	Total	198		
2	I/II	65.42	67.08	83.23				
1	I/II	60.45	-	-				
0	I/II	68.29	-	-				

++) Significance at 0.01 level
+) " " 0.05 "

Experiment 3. In order to see the possible difference between the effect of clipping males and females on the egg laying rate of these last ones, a complete set of single pair matings was prepared combining the three possibilities (2, 1 or 0 antennae) in males with the three in females, completing a factorial design with the possibility of testing the effect of treatments both in the males as in the females. In each of those nine combinations were tested 22 matings. Table 3 has the average figures obtained for the egg laying rate and the corresponding statistical analysis. It is shown that both males and females give statistical significance, but while the males only present that significance at the 0.05 level, the females present an extremely high "F" value. The most important point is that it seems that in females the less antennae they have the more egg laying rate they give. The effect of the males is discussed later on.

Table 3. Average egg laying rate and analysis of variance of Experiment 3.

No. of antennae in males	No. of antennae in females: 2	1	0	mean
2	64.96	72.99	84.23	74.06
1	58.23	72.73	85.41	72.12
0	65.96	73.73	91.05	76.91
mean	63.05	73.15	86.90	74.37

Analysis of Variance

S.of V.	d.f.	M.S.	F
Males	2	383.10	4.32^{+}
Females	2	9458.33	106.66^{+++}
M x F	4	151.78	1.71
Error	387	88.68	
Total	395		

+) Significance at 0.05 level
++) " " 0.001 "

Experiment 4. This last experiment was centered only in females since the effect of clipping antennae seems to be very important only in them. It was divided in two parts: with fecundated and with virgin females. A new treatment was introduced, crossed with number of antennae as a factorial design, in order to understand better the clipping effect; it was the amount of medium in the individual female vial. When fecundated females were used, the corresponding males were normal, i.e. with both antennae. 48 females were evaluated for each of the nine combinations of "number of antennae" and "amount of medium". Finally, the three treatments of this last factor were:

(P) A little bit (about 0.25 grs.)
(N) Normal amount for egg laying evaluation (2 to 3 grs.)
(T) Three times the normal amount

Tables 4 and 5 present the averages of egg laying rates and statistical analysis for the virgin and fecundated females respectively. It can be seen that both factor analyzed result with effects highly significant and the lay of eggs increases when more medium is available and when less antennae are present, both in virgin as in fecundated females.

Table 4. Average egg laying rate and analysis of variance of the Experiment 4. Virgin females.

Amount of medium	No. of antennae in females: 2	1	0	mean	Analysis of Variance: S. of V.	d.f.	M.S.	F
P	17.17	18.77	39.11	25.02	Antennae	2	30,417.68	115.65+++
N	25.79	34.38	51.17	37.11	Medium	2	11,737.32	44.57+++
T	26.29	38.52	63.91	42.91	A x M	4	1,080.63	4.10++
mean	23.08	30.56	51.40	35.01	Error	419	263.35	
					Total	427		

++) Significance at 0.01 level
+++) " " 0.001 "

Table 5. Average egg laying rate and analysis of variance of the Experiment 4. Fecundated females.

Amount of medium	No. of antennae in females: 2	1	0	mean	Analysis of Variance: S. of V.	d.f.	M.S.	F
P	52.15	56.02	61.68	56.62	Antennae	2	6,201.65	16.93+++
N	75.15	79.65	93.63	82.81	Medium	2	59,177.41	161.52+++
T b	90.69	97.77	102.13	96.86	A x M	4	445.38	1.22
mean	72.66	77.81	85.81	78.76	Error	418	366.38	
					Total	426		

+++) Significance at 0.001

Considering the total of the four experiments, and by giving more importance to the two last ones due to the fact that they included a greater number of individuals, it seems reasonable to draw the following conclusions:

1) Most important conclusion is that, surprisingly enough, removal of antennae in Tribolium castaneum instead of reducing, enhances egg laying, either on virgin or on fecundated females. It seems also that females with both antennae clipped lay more than those with only one removed. What could be the cause for that significant effect, it is difficult to determine without doing more precise and diverse research, but two tentative explanations are suggested in a very simplified way; explanations related with two biological facts more or less verified in general: (a) Mechanism of reducing the reproductiveness when the environment is far away from the optimum. (b) Mechanism of increasing the reproductiveness when the individual does not feel itself well. In the case (a) it is probably that they detect the density of eggs per certain amount of medium and they slow down the laying if that density is high, and so with one or both antennae removed they do not detect well the number of eggs and so the oviposition continues. In the (b) case, perhaps the lack

of an important organ in the female decreases its vitality and mobility and so the organism reacts against that by activating its reproductive capacity.

2) As a consequence of the first conclusion it is clear that for experiments on egg production, clipping antennae as a system to mark individuals (e.g. three females mated to the same male) is not practical at all.

3) The possible effect of clipping antennae in males must be considered in a very different way. This could be an indirect effect through the facility or difficulty of female fecundation. When considering different males, a possible individual effect on the egg laying rate of fecundated females was shown to exist (TIB-9, March 1966), independently of the fecundation "per se". Since in the Experiment 3 no female gave as low figure as to consider it non-fecundated, some quantitative effect of the males could be consider to exist. However, given that the means for males with 0, 1 or 2 antennae do no follow a regular pattern as in females and that the significance is very far away from that in those females ($F = 4.32$ v. $F = 106.66$), it is difficult to conclude something definitive from these results. The replication of Experiment 3 would have probably drawn different rank orders for the three types of males and so by pooling replicates could cancel out those significant differences. In summary, clipping antennae in males does not seem to be as important as in females but caution must be taken with this fact before starting an egg laying experiment.

4) The conclusion of the positive influence of the amount of medium in the vial on the egg laying rate of individual females had been shown in experiments run before and it relates closely with point (a) in the conclusion 1) on the ability of the female to control the density of eggs on a certain amount of medium in order to prevent a stressful situation for the offspring. But given the results in Experiment 4 where the females without antennae were also influenced by the amount of medium, the interpretation of having more lay in the clipped females with the suggestion (a) seems less reasonable than with the (b) one.

5) The highly significant effect found for the interaction between antennae and medium with virgin females is only quantitative and not qualitative (same rank order inside of each factor) and it could be interpreted through the high level of significance of both main factors (as residual effect) or by some more essential facts related with the problems under (a) and (b); interpretation which deserves more investigation (more replications of the last experiment).

6) Finally, the problem of the cannibalism of eggs was not considered because little is known of it in this laboratory. The influence of cannibalism in reduction or increase in egg laying found could be studied by adequate methods.

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Microclimatic studies in cacao beans warehouses.

Climatic and microclimatic studies are in progress in some areas of S. Tomé Island where cacao beans warehouses are built.

The different temperature and relative humidity values in the warehouses have been determined in order to study the relation of these values with the presence of insect pests.

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A survey of the interest of inert dusts against pests of stored foodstuffs.

The most commonly used inert dusts and their efficacy as insecticides either in laboratory, experiments or large-scale trails are described in the present work. Most of the treatments, according to the literature on the subject, are made by mixing the inert dust with the product but its insecticidal efficacy depends upon biological and ecological factors, dust characteristics and method of application. The efficacy changes with age, sex and "instar"; immature stages of insects are usually more susceptible to inert dusts; for a given stage it seems that efficacy is greater for more advanced "instars". The resistance of adult insects seems to reach a maximum sometime after emergence and then a gradual fall takes place.

It has been observed that in some way the insecticidal power increases with increasing fineness and this is to a certain degree related to dust adhesiveness. Apart from exceptions, efficacy increases also with increasing hardness.

Generally, insecticidal efficacy increases with increasing temperature and decreasing both relative humidity and product moisture content.

As a rule they are the more effective the more their concentration is high and the more homogeneous has been the mixing of product and dust.

Although it has been assumed that inert dusts were harmless to man and domestic animals, some diseases may be due to them, v.g. silicosis, asbestosis and dermatitis. Moveover the dust dirties the product, the appearance of which becomes often bad, and a suitable cleaning processes must follow.

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*Feeding of *Tribolium confusum* on world species of *Fusarium* and *Gibberella zeae*.

Stored product insects are frequently associated with fungi infecting stored grain and other foodstuffs. Many of these insects have also been demonstrated to feed on fungi (Sikorowski 1964; Sinha 1965, 1966, 1968; Lenz 1968a, 1968b). As a part of general ecological study on interrelations among insects, mites and fungi in granary ecosystems (Sinha et al. 1969) a project was undertaken in 1961 to study the feeding specificity of adult *Tribolium confusum* on world species of *Fusarium* and *Gibberella*. Dr. W. L. Gordon, who was the foremost authority on the taxonomy of the fungus *Fusarium*, collaborated with me in this study by providing 116 strains of wild and mutant forms belonging to 11 cosmopolitan species of *Fusarium* (Gordon 1960) and 2 species of *Gibberella*. Unfortunately, the study had to be discontinued due to the sudden death of Dr. Gordon in 1963. This paper reports some results of the feeding experiments with *T. confusum* and each of 111 forms of *Fusarium* and 5 forms (2 species) of *Gibberella* isolated from a large variety of foodstuffs, such as cereals, coffee, potato, and ground nuts. The experimental procedures described earlier by Sinha (1966) were used and are briefly summarized here. Each strain of fungus was grown axenically on potato-sucrose agar (PSA) at pH 6 in 200 x 20 mm test tubes plugged with cotton. Test insects were taken from laboratory stock cultures maintained at 27 ± 1°C and 70 ± 2% RH on a mixture of wheat flour and brewer's yeast powder (20:1). Five surface sterilized adults were introduced into each tube; adults placed in PSA tubes without fungus served as controls. The insects were surface sterilized by immersing them in 1% sodium hypochlorite for 4 minutes and then rinsing in sterile distilled water 3 or 4 times; no detectable damage was apparent. Each tube was replicated 3 times within an experiment. The tubes were examined 3 and 7 days after the insects were introduced to determine amount of feeding. Production of excreta of the same color as the mycelium and spores in the culture indicated feeding.

No evidence of egg laying or breeding was observed on any fungal cultures. The fungal cultures tested are divided into 4 broad categories on the basis of their suitability as foods for *T. confusum*; figures in parenthesis indicate numbers of strains or species in each group. I. Generally favorable, rarely poor (12); II. Moderately favorable, occasionally poor (43): III. Generally poor, occasionally favorable (43); and IV. Unfavorable, rarely acceptable (12).

Because of the shortage of space, only the fungi of the first and the last category are listed with their original hosts and geographical origins.

I. Generally favorable fungal diet, rarely poor

Gibberella zeae Type VII (Schw.) Petch. (Stat. conid. *Fusarium graminearum* Schwabe); barley; Balmoral, Man., Canada. *G. zeae* Type X (Schw.) Petch.;

barley; Balmoral, Man., Canada. G. zeae Type VI (Schw.) Petch.; wheat; Normandin, Quebec, Canada. G. zeae Type XIII (Schw.) Petch.; wheat ear blight; New Zealand. F. graminearum Schwabe; wheat; Normandin, Quebec, Canada. Gibberella zeae (Schw.) Petch.; mutant 120; barley; Balmoral, Man., Canada. F. avenaceum (Fr.) Sacc.; Ontario, Canada. F. avenaceum, mutant J, salmon colored mutant; wheat ear blight; New Zealand. Gibberella zeae, mutant a; wheat ear blight; New Zealand. F. sambucinum Fckl. var. coeruleum Wr.; pine seedling (Pinus contorta Dugl.); British Columbia, Canada. F. oxysporum Schlecht f. dianthi (Prill. & Del.) S. & H.; carnations; Guernsey, Channel Is. F. sporotrichioides Sherb., wild type; winter wheat; British Columbia, Canada. F. culmorum (W.G.Sm.) Sacc.; scab, wheat; Winnipeg, Man., Canada.

IV. Unfavorable fungal diet, rarely acceptable

F. xylarioides Steyaert, Gibberella (Carbuncularia) xylarioides Heim et Saccas; coffee; Africa. F. merismoides Cda.; pear; Washington, U.S.A. F. sambucinum Fckl. var. coeruleum Wr., mutant, pine seedlings (Pinus contorta); British Columbia, Canada. F. moniliforme Sheldon; maize; India. F. coccidicola P. Henn.; citrus species; Trinidad. F. oxysporum Schlecht f. cepae (Hanz) Snyd. & Hansen; onion bulb root; Winnipeg, Man., Canada. F. stilboides Wr., mutant; coffee; Tanganyika. F. sambucinum (Fckl.) & ff6, Wr., mating type a; potato; Alberta, Canada. F. solani (Mart.) App. & Wr., dwarf mutant; roots of Citrus; West Bengal, India. F. semitectum Berk & Rav.; Manila hemp; North Borneo. F. tumidum Sherb.

Literature Cited

Lenz, M. 1960. The taxonomy and habitats of Fusarium species from tropical and temperate regions. Can. J. Bot. 38:643-658.

________. 1968a. Zur Wirkung von Schimmelpilzen auf verschiedene Tierarten. Pt. 1 Z. Angew Zool. 55(3):295-374.

________. 1968b. Zur Wirkung von Schimmelpilzen auf verschiedene Tierarten. Pt. 2. Z. Angew Zool. 55(4):385-425.

Sikorowski, P. P. 1964. Interrelation of fungi and insects to deterioration of stored grain. Wash. State Univ., Inst. Agr. Sci. Tech. Bull. 42, 35 pp.

Sinha, R. N. 1965. Development of Cryptolestes ferrugineus Stephens and Oryzaephilus mercator (Fauvel) on seed-borne fungi. Entomol. Exp. & Appl. 8:309-313.

________. 1966. Development and mortality of Tribolium castaneum and T. confusum (Coleoptera; Tenebrionidae) on seed-borne fungi. Ann. Entomol. Amer. 59:192-201.

________. 1968. Adaptive value of mycophagy in stored product Arthropoda. Evolution 22:785-795.

________, H. A. H. Wallace, and F. Chebib. 1969. Principal component analysis of interrelations among fungi, mites and insects in grain bulk ecosystems. Ecology 50:536-547.

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Effect of insect infestations on the baking and taste qualities of farinaceous foods.

Insect-infested flour is often rejected for aesthetic and probable health reasons without consideration of certain undesirable effects which may be related to changes in population density level and infestation period. In order to understand certain undesirable consequences of insects in flour, experiments are being conducted to ascertain the effects of insect infestations on the baking and taste qualities of bread prepared from insect-infested flour.

Bread prepared from flour previously infested with *Oryzaephilus surinamensis* (L.), *Tenebrio molitor* L., *Tribolium castaneum* (Herbst), and *Tribolium confusum* (Duval) ebony strain, disclosed a variety of baking and taste quality changes after 1, 2, and 3 month infestation periods.

Although bread made from flour infested with *O. surinamensis* and *T. molitor* revealed only minor changes in physical attributes, a "chemophenolic" taste and odor was detected. Bread prepared from flour infested with *T. castaneum* and *T. confusum* showed many changes including a progressive darkening of the crumb, reduction in slice size, and a distinct, offensive taste and odor which intensified after each infestation period.

Although the results are inconclusive, our data lend support to the hypothesis that quinone secretions of *Tribolium* spp. adversely affect the taste qualities of bread made from insect-infested flour, and may be an important factor in lowering its baking qualities.

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X-ray analysis of infested cacao beans.

Different films and exposure times are being used in order to obtain the best conditions for the X-ray analysis of cacao beans containing insect larvae.

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Hygroscopic equilibria of cacao beans.

Little bags containing cacao beans from S. Tomé Island were stored in eight different relative humidities in the range 60% to 95%. Daily weighing of the bags gave the rate of change in moisture content. For the highest humidities equilibrium was not obtained as mold growth was observed.

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*Aggregation response by adult Tribolium confusum to stimuli from components of the fungus Nigrospora sphaerica.

Nigrospora sphaerica is a fungus that is sometimes associated with grain in storage. We have found that flour beetles aggregate on pith discs treated with extracts of this fungus. More detailed extensive studies have shown that triglycerides present in the mycelia, and free fatty acids were important factors eliciting aggretation. A monounsaturated triglyceride fraction, obtained by separation according to the degree of unsaturation, was the most active. Bioassays of other components separated from the extracts, and of some synthetic triglycerides have contributed to an understanding of structure-activity relationships. The question of whether part of activity is due to synergism or to a potent minor component is under investigation.

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Characterization of substances in wheat germ eliciting aggregation response by Tribolium confusum.

Strong aggregation response of *Tribolium confusum* has been demonstrated on cereal products by an elaborate bioassay method (Loschiavo, 1965a, b). n-Hexane extract of wheat germ, which elicited a strong aggregation response, was used as a starting material. The aggregation factors were isolated and purified by employing column, thin layer, and gas-liquid chromatography. The aggregation factors have been shown to be triglycerides having 2 to 3 double bonds in one molecule and at least three compounds are responsible for the aggregation phenomenon. Candidate compounds are 1-palmito-2,3-diolein, 2-linoleo-1,3-dipalmitin, and 1-palmito-2-linoleo-3-olein.

Synthesis of these and other triglycerides are under way to elucidate the relationship between chemical structure and biological activity.

Literature Cited

Loschiavo, S. R. 1965a. Ann. Ent. Soc. Amer. 58:383-388.

________. 1965b. Ann. Ent. Soc. Amer. 58:576-588.

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*Larval weight and pupation in the absence of food in T. castaneum strains (a preliminary report).

Introduction. Robertson (1965) mentions the divisibility of the larval growth of a holometabolous insect into two phases: 1) a more or less exponential growth to a critical stage, in which a hormonal change occurs; 2) the period following this stage, when an individual can pupate and eclose even without food. When food is limited, the ability of individuals to reach the critical stage may determine their chance of leaving progeny.

In the laboratory, with a fixed amount of food and space and the absence of emigration (Zyromska-Rudzka, 1966), food becomes progressively limited with the increase in population density. In their discussion of the types of population response to increased density, Sokal and Karten (1964) note that in Tribolium, both survival and individual weight decrease with an increase in density. If the food supply were the only limiting factor and the population responded instantaneously to it, there should not be a decrease in both parameters.

The experiment reported here was designed to find out whether an individual Tribolium may attain a critical weight beyond which it can pupate and eclose in the absence of food. An obvious second step would be to find if, in a dense culture, individuals can reach this critical weight, thus indicating whether or not the diminishing food supply is the direct cause of the decrease in survival. This and other steps are planned, and the results should be considered preliminary.

Materials and methods. Of each of two T. castaneum strains (wild type (++) and black (bb) - see stock list), 120 larvae were recovered and weighed individually on a microanalytical balance to the nearest 10 micrograms. Similarly 40 hybrid (+b) larvae were weighed. Each larva was then transferred to a numbered empty vial. The vials were inspected daily and death, moulting, pupation or eclosion were recorded. Exuviae were removed from the vials.

Pupae were weighed and returned to the vials to eclose. Adults were weighed alive and then dried overnight at 100°C and weighed again.

The data were originally grouped into larval-weight classes ranging from 0 to 3.80 mg with a class interval of 0.2 mg. For parts of the final anaylsis they were regrouped into three categories - 0-1.60, 1.61-2.40, and more than 2.40 mg.

Results and discussion. The frequency distribution of the recovered larvae is shown in Table 1, together with that of the pupating and eclosing individuals. Larvae smaller than 1.60 mg never pupated without food (there were 42 ++ larvae, 38 bb larvae and 12 +b larvae in this category).

In the second category, 15 of 26 ++, 19 of 29 bb, and all 10 +b larvae pupated. The difference between the two pure strains was not significant, but +b was significantly different from them (P 0.05, by a test of proportions given in Snedecor, 1956, 9.9.1).

Almost all the larvae in the third category pupated (50 of 52 ++, and all 53 bb and 18 +b larvae). Pupal mortality was very low and only 3 of the 165 pupae did not eclose.

Larvae remained alive for long periods without food. Larvae less than 1.4 mg when recovered survived up to 12 days without food, and larvae 1.4-1.6 mg in weight lived up to 22 days in the empty vials. However, all but 2 of the 165 larvae which pupated did so no later than 9 days after removal from food.

The results seem to indicate a critical weight beyond which there is a good chance that food abundance will not be directly important for survival. The cannibalism by larvae (Park et al., 1965; Wool, 1969) and the harmful effects of flour conditioning (Karten, 1965) may, however, be increased if the food supply is diminished, thus resulting in low survival.

It is interesting to investigate the ability of starved larvae to recover and develop to pupation when food becomes available. If they do to a considerable extent, *Tribolium* could serve as an experimental model of a natural population well adapted to the uncertainty of environmental conditions.

The assistance of Mrs. Meral Kence is gratefully acknowledged.

Literature Cited

Karten, I. 1965. Genetic differences and conditioning in *Tribolium castaneum*. Physiol. Zool. 38:69-79.

Park, T., D. B. Mertz, W. Grodzinsky and T. Prus, 1965. Cannibalistic predation in populations of flour beetles. Physiol. Zool. 38:289-321.

Table 1. Frequency distribution of larvae, when removed from food, and of pupae and adults.

Larval weight classes	++			bb			+b		
	larvae	pupae	adults	larvae	pupae	adults	larvae	pupae	adults
0.0-0.20									
0.21-0.40									
0.41-0.60	2	-	-	2	-	-	1	-	-
0.61-0.80	3	-	-	0	-	-			
0.81-1.00	3	-	-	6	-	-	4	-	-
1.01-1.20	12	-	-	10	-	-	2	-	-
1.21-1.40	14	-	-	8	-	-	3	-	-
1.41-1.60	8	-	-	12	-	-	2	-	-
1.61-1.80	9	3	3	12	5	5	2	2	2
1.81-2.00	6	5	5	5	4	4	3	3	3
2.01-2.20	6	3	3	3	2	2	2	2	2
2.21-2.40	5	4	4	9	8	6	3	3	3
2.41-2.60	7	6	6	9	9	9	3	3	3
2.61-2.80	11	11	11	14	14	14	11	11	11
2.81-3.00	14	14	14	11	11	11	3	3	3
3.01-3.20	9	9	8	6	6	6			
3.21-3.40	6	6	6	10	10	10	1	1	1
3.41-3.60	2	2	2	2	2	2			
3.61-3.80	1	1	1	1	1	1			
3.81-4.00	1	1	1						
Total	120	65	64	120	72	70	40	28	28

Robertson, F. W. 1965. The analysis and interpretation of population differences. In: The genetics of colonizing species, H. G. Baker and L. Stebbins (eds.), Academic Press, pp. 95-154 (in particular, pp. 102-103).

Snedecor, G. W. 1956. Statistical methods. Iowa State College Press.

Sokal, R. R. and I. Karten 1964. Competition among genotypes in *Tribolium castaneum* at varying densities and gene frequencies (the *black* locus). Genetics 49:195-211.

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

Zyromska-Rudzka, H. 1966. Abundance and emigration of *Tribolium* in a laboratory model. Ekol. Polska Ser. A, 14:491-518.

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*Development studies of X-irradiated *Tribolium confusum* eggs.*

The effects of environmental factors, including temperature, magnetic field, ionizing radiation, etc., on the development of *T. confusum* have been investigated for many years in our laboratory (1, 2, 3). Recently we studied the dynamics of embryonic development and the effects of x-irradiation, delivered to the early egg stage, on the development at all stages. About 750 adults, less that 2-months-old, were placed in a 1-liter jar containing about 500 ml medium (4%flour-yeast) for 4 hours at 30°C and R.H. 30%. Eggs were then separated from adults and medium by the usual sifting methods, and x-irradiated at 24°C with a therapeutic x-ray unit (Philips) at 15 mA and 180 kV with a 1.0 mm Al filter. A dose rate of 300 R/min was used. The hatchability, number of eclosions, and the malformations of adults from irradiated eggs were carefully checked, and results are shown in Tables 1, and 2, and Figure 1.

When the hatchability in percentage is plotted against dose on a semi-log paper, the lethal dose of 50% was found to be about 400 R, and the extrapolated number about 2. Results suggest that a simultaneous two hits will cause hatching failure and that the egg could be at single cell stage. Using histological methods, we found that the 6-hr old egg is a multi-nucleated single cell. It seems that two simultaneous chromosome breaks will prevent a successful embryonic development of the 6-hr old egg.

The percentage of eclosion showed also a decrease with increase of dose delivered at an early egg stage. The effect of x-irradiation on eclosion, however, was found to be less severe than on hatchability. With a dose of

Table 1. Hatchability and Eclosion of X-irradiated *T. confusum* Eggs.

Dose (R)	No. Eggs	Total Larvae	% Hatchability		Total Adults	% Eclosion
0	200	175	87.5	(100)	166	95.0
100	"	151	75.5	(86)	137	90.8
200	"	133	66.5	(76)	111	83.5
300	"	95	47.5	(54)	84	88.2
400	"	75	37.5	(43)	65	86.6
500	"	73	36.5	(42)	62	85.0
600	"	84	42.0	(48)	78	92.8
700	"	45	22.5	(26)	37	82.2
800	"	32	16.0	(18)	25	78.3
900	"	18	9.0	(10)	12	66.8
1000	"	18	9.0	(10)	13	72.1

Table 2. Frequency and Type of Malformation of *T. confusum* Adults.

Dose (R)	No. Eggs	Total Adults	% Malformation	Type of Deformity Observed
0	200	166	0.00	----------
100	"	137	0.73	abnormal elytron
200	"	111	1.80	twisted abdomen
300	"	84	1.20	curved elytron
400	"	65	3.17	"pocket" abdomen
500	"	62	3.28	twisted abdomen
600	"	78	1.35	incomplete median projection
700	"	37	27.03	twisted abdomen, abnormal abdominal sclerite, fused antennal segments.
800	"	25	4.00	abnormal elytron
900	"	12	8.33	fused antennal segments
1000	"	13	7.69	abnormal elytron

900 R, for example, hatchability was decreased to 9%, but eclosion only to 66.8%. Possibly some radiation injuries were recovered at the larval and pupal stages, since the ability of recovery has been demonstrated in larvae and pupae (4, 5).

Deformity of the abdomen, of the antenna, and of the elytra were all observed at adult stage, as shown in Table 2 and Figure 1. An antennal deformity seems to be induced at relatively higher doses, and abnormal abdomen was found most frequently in this study. The frequency of the deformity generally showed an increase with dose. Since the number of adults that survived in this experiment is small at higher doses, a precise

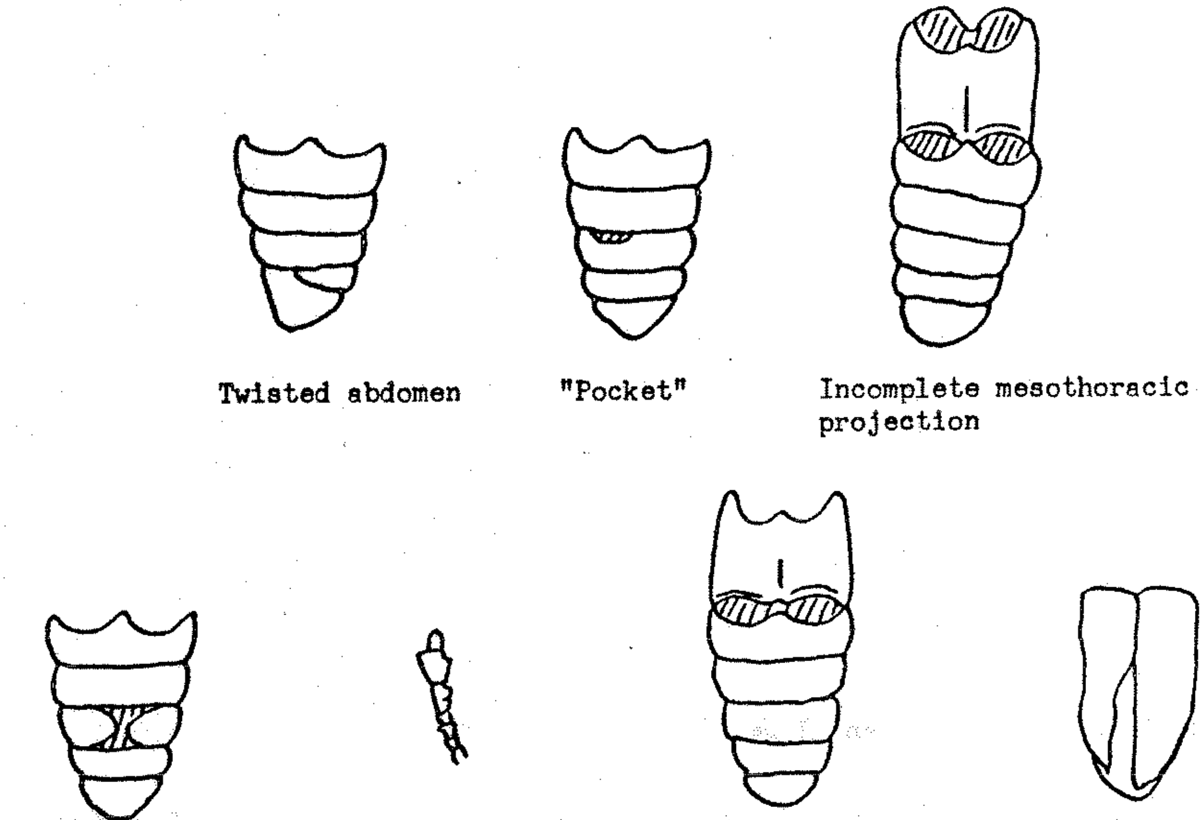

Figure 1. Malformations of adults irradiated at egg stage.

quantitative relationship between dose and amount of deformity can not be obtained at present, and more data are needed. Our preliminary data indicate that the type of deformity at adult stage is age dependent. Irradiated 2- and 3-day old eggs at 30°C, for instance, only showed abnormal antennae and elytra.

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Literature Cited

1. Beck, J. S. 1963. Effects of X-irradiation on cell differentiation and morphogenesis in a developing beetle wing. Radiation Res. 19: 569-581.

2. Buckhold, B., and J. V. Slater. 1969. Effect of temperature and X-irradiation on pupae of the flour beetle, *Tribolium confusum*. Radiation Res. 37:567-576.

3. Amer, N. 1965. The effects of magnetic field temperature on development of *Tribolium confusum*. Ph.D. Thesis, UCRL 16854.

4. Yang, T. C. H. 1968. X-ray response and recovery in Tribolium confusum larvae. Radiation Res. 35:516.

5. Yang, T. C. H., I. L. Silver, and B. Heinze. 1970. Kinetics in recovery in X-irradiated Tribolium confusum pupae. This issue of Tribolium Inform Bull.

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*Kinetics of recovery of X-irradiated Tribolium confusum pupae.

Recovery from injuries induced by ionizing radiation has been demonstrated recently in Tribolium larvae and adults (1, 2). In this laboratory young pupae have been extensively used to study the effects of radiation on differentiation and morphogenesis of organisms (3). A wing abnormality consisting of median elytral split, elytral blistering, and protrusion of the underlying membranous wings generally will develop to the adult stage when a dose of X-ray over 1200 R is given to 20- to 30-hr. old pupae. In this study, we chose wing abnormalities as the endpoint to determine the kinetics of recovery in pupae.

The methods used for collecting defined aged pupae have been reported elsewhere (4). In brief, prepupae, collected from stock culture, were placed in a 30°C incubator. At the end of 6 hours, pupae were harvested and kept at 30°C until they reached 18- to 24-hr. old. Pupae were irradiated at 24°C with a Philips x-ray unit at 180 keV and 15 mA with a 1.0 mm Al filter. The distance from the target to the specimen was 30 cm with a dose rate of 300 R/min. At the end of the second dose, pupae were transferred from 24°C back to 30°C incubator and scored after they eclosed as adults.

A quite rapid recovery was found in pupae at 24°C, as shown in Table 1. Wing abnormalities dropped from 75.0% to 18.4% within 7 hours, slightly rose to 28.6% at 8 hours, and dropped again to 17.4% at 9 hours. Since the radiosensitivity of pupae aged from 18- to 30hr. old (at 30°C) is the same, as shown be Buckhold and Slater (4), the change of number of abnormalities at different intervals observed in this experiment represents recovery, not change of radiosensitivity. This rapid and complicated pattern of recovery is very similar to that found in larvae. The reason for this similarity is probably due to the fact that in both larvae and pupae radiation injuries are occured in some tissues containing embryonic cells. It has been suggested, from radiosensitivity studies (4), that the wing formation in T. confusum is not completed until 39 hours postpupation (at 30°C). In the present study, the maximum interval used was 10 hours at 24°C, which, as the Q_{10} for pupal period is about 3.8, would approximately be equivalent to 5 hours at 30°C; the age of the pupae at the end of the second irradiation was, therefore, less than 30 hours old, and the observed changes in response to radiation with intervals represents the recovery of embryonic cells in wings.

Table 1. Radiation Response and Recovery in *T. confusum* Pupae.

Conditioning Dose (R)	Second Dose (R)	Interval (hr)	No. Pupae	% Wing Abnormalities
0	--	--	100	0.0
1350	--	--	100	5.0
1500	--	--	100	26.0
1650	--	--	100	48.0
1800	--	--	100	76.0
2000	--	--	100	94.0
0	--	--	100	0.0
1800	--	--	100	75.0
900	900	0.5	50	75.0
900	900	1.0	50	75.0
900	900	2.0	50	66.7
900	900	3.0	50	64.0
900	900	4.0	50	58.3
900	900	5.0	50	31.3
900	900	6.0	50	27.1
900	900	7.0	50	18.4
900	900	8.0	50	28.6
900	900	9.0	50	17.4
900	900	10.0	50	16.3

By comparing the per cent of wing abnormalities following split-doses with that of a dose-response curve produced by single exposures, we found that the residual injuries at 7 hours, the first peak, is about 450 R. This gives only about 39% recovery. The fact that no complete recovery in pupae is reached at first peak shows agreement with results obtained in larvae.

This work was supported by NASA and U.S.AEC.

Literature Cited

1. Yang, T. C. H. 1968. X-ray response and recovery in *Tribolium confusum* larvae. Radiation Res. 35:516.

2. Ducoff, H. S., A. P. Vaughan, and J. L. Crossland. 1969. Dose-fractionation studies on adult flour beetles. Radiation Res. 39:472.

3. Beck, J. S. 1963. Effects of X-irradiation on cell differentiation and morphogenesis in a developing beetle wing. Radiation Res. 19:569-581.

4. Buckhold, B., and J. V. Slater. 1969. Effect of temperature and X-irradtation on pupae of the flour beetle, *Tribolium confusum*. Radiation Res. 37:567-576.

NOTES - TECHNICAL

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Detection of lindane and DDT in beans using thin-layer chromotography process.

The technic described is mainly based on a method developed and improved by Martin F. Kovaks.

The insecticides are extracted by hexane and apotted on pre-washed plates of silica-gel after extract concentration.

The dilution has been done with an hexane mixture, acetone 98: 2 and it was used with the Mitchell chromogenous reagent with a base of silver nitrate.

Under U.V. lamps the insecticides are seen as brownish stains.

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Pest control of stored cacao beans.

The principal insect pests found in stored cacao beans of S. Tomé Island are the species *Oryzaephilus mercator* Fauv. and *Cadra cautella* Wlk.

Some studies are being carried on fumigation methyl bromide either in atmospheric chamber or under sheets, in order to control those insect pests.

Some contact insecticies are also under study.

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Application of the thin-layer chromatography technic to the detection of stored beans malathion.

Detection of malathion residues in silica gel G layers using as first solvent a mixture of hexane-acetone and as second a solution of 0.5% palladium chloride.

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Detection of organochlorinated insecticides in cacao beans.

Thin-layer chromotography technic is experimentally under study in the detection of organochlorinates in bagged cacao beans. The insecticides were used as dusts and sprays applied externally in the bags.

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Application of insecticide smokes to desinfest warehouses used for storage of bagged cacao beans.

In S. Tomé Island the species Cadra cautella (Walk.) has been detected very often as the main pest of the warehouses and also of the cacao beans.

Local experiments are under study to determine the efficacay of lindane, pyrethrins and piperonly butoxide against that pest, using the Swingfog, model SN 8.

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An alternate feeding medium for the Natidulid Carpophilus hemipterus.

The following is a highly suitable medium for rearing Carpophilus hemipterus:

5 cups	Chicken feed
3 cups	Raisins
¼ cup	Honey
5 tbls.	Glycerin
½ cup	Water

SOUSA LOBO, M. J.
Laboratório da Defesa Fitossanitária dos Produtos Armazenados
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Evaluation of hygroscopic equilibria of grain - a new technique.

The grain is enclosed in little nylon tulle bags and stored within large dessicators where different constant relative humidities are maintained until equilibrium is reached. Daily weight increments are converted into moisture content.

SOUSA LOBO, M. J.
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<u>Hygroscopic equilibria of cereal grains and pulses</u>.

The technique we referred above is being used for the establishment of hygroscopic equilibria curves for wheat, maize and beans, either by drying damp grains or moistening dried ones.

SOUSA LOBO, M. J.
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<u>A comparative study of different oven methods for the determination of cacao beans water content</u>.

Three oven methods (98-100°C x 2.5 h; 100-101°C x 4 h; 101-105°C x 16 h) are under test. The water content of cacao beans must be determined before they are introduced in different desicators where constant relative humidities from 70% to 95% have been established. The moisture increase of cacao beans added to the initial water content determination must be equal to the final evolution of water content.

SOUSA LOBO, M. J.
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Lisbon, Portugal

<u>Legislation and regulations on pesticides used in foodstorage</u>.

A survey of legislation and regulation from various countries concerning those pesticides used in stores and stored foodstuffs is being carried out, especially relating to residue tolerances, dose of applications and protection of operators.

BIBLIOGRAPHY

ANATOMY AND HISTOLOGY

Beament, J. W. L. 1968. Lipid layers and membrane models. Insect and physiology, p. 303-314.

Corbiere, G. 1969. Ultrastructure of Trichoid Sensilla in the antennae of Speophyces lucidulus (Delar.) larvae (Col. Bathysc). (Fr) Acad. Sci. C. R., Ser. D, 268(2):387-388.

Cudare, Z. 1968. Fat body change in potato beetle (Leptinotarsa decemlineata) ontogenesis. (La) Latv. PSR Zinat. Akad. Vestis 9:64-67.

Erber, D. 1968. Structure, function and development of the rectal apparatus for forming excrements (kotpresse) of central European Clytrinae and Cryptocephalinae (Coleoptera, Chrysomelidae). (Ge) Z. Morphol. Okol. Tiere 62(3):245-306.

Forsyth, D. J. 1968. The structure of the defence glands in the Dytiscidae, Noteridae, Haliplidae and Gyrinidae (Coleoptera). Roy. Entomol. Soc. London. Trans. 120(6):159-181.

Gemne, G. 1968. Crystalline regions on the axon membrane surface of insect photoreceptor cells. Life Sci. 7(24, pt.2):1239-1241.

Gouin, F. J. 1968. Morphology, histology and history of development of insects and myriapodas. IV. The head structure. (Ge) Fortschr. Zool. 19(2/3):194-282.

Hewlett, P. S. 1958. Secondary sexual characters in Alphitobius laevigatus (F.) and A. diaperinus (Panz.) (Col. Tenenbrionidae). Ent. Mon. Mag. 94:144.

Karpunina, N. N. 1967. Using anatomical histological and physiological features for determination of Colorado potato beetle age during its imago life. (Rus) Vses. Nauch.-Issled. Inst. Zashch. Rast. Tr. 27:107-119.

Kendall, D. A. 1968. The structure of the defence glands in Alleculidae and Lagriidae (Coleoptera). Roy. Entomol. Soc. London. Trans. 120(5):139-156.

Khan, N. R. and Musgrave, A. J., 1968. Some anatomical differences of possible taxonomic value in the female reproductive organs of Sitophilus (Curculionidae: Coleoptera). Can Entomol. 100(11):1226-1228.

Lawrence, P. A., 1968. The insect epidermal cell--a simple model of the embryo. Insect and physiology p. 53-68.

Locke, M., 1968. What every epidermal cell knows. Insect and physiology p. 69-82.

Noble-Nesbitt, J., 1968. Aspects of the structure, formation and function of some insect cuticles. Insect and physiology p. 3-16.

Peters, W., 1968. Occurance, composition and fine structure of peritrophic membranes in animals. (Ge) Z. Morphol. Okol. Tiere 62(1):9-57.

Sarin, K., Tembe, V. B., and Saxena, S. C., 1968. On the morphology and bionomies of the insects of economic importance. II. Head appendages in Alphitobius diaperinus (Panz.) (Tenebrionidae, Coleoptera). Zool. Anz. 180(5/6):423-435.

Slifer, E. H., 1968. The thin-walled olfactory sense organs on insect antennae. Insect and physiology p. 233-245.

Wigglesworth, V. B., 1948. The structure and deposition of the cuticle in the adult mealworm Tenebrio molitor L. Coleoptera. Quart. J. Micro. Sci. 89:197-217.

BEHAVIOR

Akre, R. D., and Torgerson, R. L., 1968. The behavior of Dioloeciton nevermanni, a staphylinid beetle associated with army ants (Neivamyrmex pilosus). Psyche 75(3):211-215.

Amos, T. G., and Waterhouse, F. L., 1967. Phasic behavior shown by two Carpophilus species (Coleoptera, Nitidulidae) in various humidity gradients and ecological significance. Oikos 18(2):345-350.

Armbrust, E. J., and Gyrisco, G. G., 1968. The influence of some physical and biological factors on the phototactic response of the alfalfa weevil, Hypera postica. Entomol. Soc. Amer. Ann. 61(6):1561-1566.

Bhattacharya, A. K., and Pant, N. C., 1969. Nutritional behavior of Trogoderma granarium Everts (Coleoptera: Dermestidae) on leguminous seeds. J. Stored Prod. Res. 4(4):305-315.

Chararas, C., 1969. Sex attraction of Phloeosinus bicolor Brul., Coleoptera. Scolytidae, specific parasite of cupressus. (Fr) Acad. Sci. C. R., Ser. D, 268(7):1080-1083.

Cross, W. H., Hardee, D. D., Nichols, F., Mitchell, H. C., Mitchell, E. B., Huddleston, P. M., and Tumlinson, J. H., 1969. Attraction of female boll weevils (Anthonomus grandis) to traps baited with male or extracts of males. J. Econ. Entomol. 62(1):154-161.

Crowson, R. A., 1968. Observations on Scottish acalles (Col., Curculionidae). Entomol. Mon. Mag. 104(1247/1249):117-118.

Faasch, H., 1968. Observations on biology and behavior of Cicindela hybrida L. and C. campestris L. and experimental analysis of their predatory activities. (Ge) Zool. Jahrbucher Abt. Syst. Okol. Geogr. Tiere 95(4):477-522.

Fiori, G., 1968. The cover-seeking behavior of desert and sub-desert Coleoptera. (It) Studi Sassaresi. Sez. III, 15(2):519-540.

Fleming, W. E., 1969. Attractants for the Japanese beetle (Popillia japonica). U. S. D. A. Tech. Bull. 1399, 87 p.

Franke, H., 1968. The Rhinoceros beetle (Oryctes nasicornis) has migrated. (Ge) Kosmos 64(11):458.

Giles, P. H., 1969. Observations in Kenya on the flight activity of stored products insects, particularly Sitophilus zeamais Motsch. J. Stored Prod. Res. 4(4):317-329.

Hardee, D. D., Cross, W. H., and Mitchell, E. B., 1969. Male boll weevils (Anthonomus grandis) are more attractive than cotton plants to boll weevils. J. Econ. Entomol. 62(1):165-169.

Hardee, D. D., Cross, W. H., Mitchell, E. B., Huddleston, P. M., Mitchell, H. C., Merkl, M. E., and Davich, T. B., 1969. Biological factors influencing responses of the female boll weevil (Anthonomus grandis) to the male sex pheromone in field and largecage tests. J. Econ. Entomol. 62(1):161-165.

Hayashi, N., 1968. Additional notes on the larvae of Lagriidae and Tenebrionidae occurring in Japan (Coleoptera: Cucujoidae). Sapporo, 12 p.

Kennedy, J. S., 1968. Behavior as physiology Insect and physiology p. 249-265.

Lerner, I. M., and Inouye, N., 1968. Behavior genetics with special reference to maze-running of Tribolium (pp. 51-62). In: Dronamraju, K. R., Ed. Haldone and Modern Biology. The John Hopkins Press, Maryland 384 pp.

Lovitt, A. E., Okumura, G. T., and Nelson, H. D., 1968. Techniques for preparing slide mounts of female genitalia of the khapra beetle, Trogoderma granarium, and related species. Entomol. Soc. Amer. Ann. 61(6): 1623-1624.

Ogden, J. C., 1968. An experimental and genetic analysis of dispersal behavior in Tribolium. Diss. Abstr. Sec. B, 29(5):1723B.

Ritter, F. J., 1967. Feeding stimulants for the Colorado beetle (Leptinotarsa decemlineata). Ghent. Rijksfac. Landbouwetensch. Meded. 1967: 291-305.

Schmitz, R. F., and Furniss, M. M., 1968. Secondary sex characters of Scolytus laricis. Entomol. Soc. Amer. Ann. 61(6):1626-1627.

Southgate, B. J., and Prevett, P. F. 1967. The groundnut seed beetle--a change of name. Trop. Stored Prod. Inform. 13:3.

Stein, W. 1968. The effect of wing dimorphism on the dispersal of Curculionidae species. (Ge) Z. Angew. Entomol. 61(4):442-445.

Stokes, Allen W. 1968. Animal behavior in laboratory and field 198 pp.

Symposium on Chemistry of Learning; Invertebrate Research, East Lansing, Michigan, 1966. Proceedings, edited by W. C. Corning and S. C. Ratner. New York, Plenum Press, 1967. 464 pp.

Tamaki, U., Noguchi, H., and Yushima, T. 1969. Artificial control of mating activity of the smaller tea tortrix, Adoxophyes orana FISCHER VON RÖSLERSTAMM, and a quantitative bioassay for the sex pheromone. Botyn-Kagakn, 34:107-110.

Tamaki, Y., Noguchi, H., and Yushima, T. 1969. Mating behaviors of the smaller tea tortrix, Adoxophyes orana FISCHER VON RÖSLERSTAMM, and evidence of sex pheromone production. Botyu-Kagaku 34: 97-102.

Tamaki, Y., Noguchi, H., and Yushima, T. 1969. Attractiveness of black-light, virgin female and sex pheromone extract for the smaller tea tortrix, Adoxophyes orana FISCHER VON RÖSLERSTAMM. Botyu-Kagaku 34:102-106.

Wilson, S. P., Blair, P. V., Kyle, W. H., and Bell, A. E. 1968. The influence of selection and mating systems on larval weight in Tribolium. J. Hered. 59(5):313-317.

INSECT TISSUE CULTURE AND EMBRYOLOGY

Akademiya Nauk SSSR. 1966. Voprosy funktsional'noi morfologii i embriologii nasekomykh. Problems of functional morphology and embryology of insects. Moskva, Nauka, 162 p.

Clements, A. N. 1968. Evolutionary aspects of metamorphosis. Insect and physiology pp. 83-87.

Luscher, M. 1968. Insects as a medium for the study of differentiation. Insect and physiology pp. 39-51.

________, and Staffeldt, E. 1969. Studies on the development of the mid-gut of the Tribolium castaneum adult. Argonne National Laboratory Annual Report (ANL-7635) pp. 52-54.

Ullmann, S. L. 1967. The development of the nervous system and other ectodermal derivatives in Tenebrio molitor (Insecta, Coleoptera). Roy. Soc. London. Phil. Trans. Ser. B. Biol. Sci. 252(773), 25 p.

CYTOLOGY AND ELECTRON MICROSCOPY

Black, S. H. 1968. Cytology of mildy disease bacteria. I. Morphogenesis of Bacillus popilliae in vivo. J. Invertebrate Pathol. 12(2):148-157.

Breland, O. P., Eddleman, C. D., and Biesele, J. J. 1968. Studies in insect spermatozoa. I. Entomol. News (Philadelphia) 79(8):197-216.

Breland, O. P., Barker, K. R., Eddleman, C. D., and Biesele, J. J. 1968. Centrioles in the spermatids of insects. Entomol. Soc. Amer. Ann. 61(4)1037-1039.

Grinchuk, T. M. 1968. Karyological study of natural population of Wilhelmia equina (Simuliidae, Diptera). (Rus) Tsitologiya 10(8):1002-1007.

Hinton, H. E., and Gibbs, D. F. 1969. An electron microscope study of the diffraction gratings of some carabid beetles. J. Insect Physiology 15(6):959-962.

Kiknadze, I. I., and Belyzeva, E. S. 1967. Nucleolus, the principles of its formation and its genetic significance. (Rus) Genetika 8:149-161.

Masurat, G. 1968. Comparative studies on correlations between the first annual appearance of insect pests and environmental factors. (Ge) Arch. Pflanzenschutz 4(1):3-29.

Peters, W. 1968. Electron microscopic study on the chitin content of structures. (Ge) Deut. Zool. Ges. Verhandl. 1967:681-695.

Phillips, D. M. 1969. Exceptions to the prevailing pattern of tubules (9 + 9 + 2) in the sperm flagella of certain insect species. J. Cell Biol. 40(1):28-43.

Schnetter, W. 1967. Transplant of cleavage nucleus and blastoderm nucleus in enucleated eggs of Leptinotarsa decemlineata (Coleoptera). (Ge) Deut. Zool. Ges. Verhandl. 1966:494-499.

Virkki, N. 1968. A chiasmate sex quandrivalent in the male of an alticid beetle, Cyrsylus volkameria (F.) Can. J. Genet. Cytol. 10(4):898-907.

ECOLOGY AND POPULATION ECOLOGY

Abramov, Yu. V. 1968. On the necrophagy in Copris lunaris L. (Coleoptera, Scarabaeidae). (Rus) Zool. Zh. 47(8):1251-1262.

Adeyemi, S. A. O. 1968. A laboratory study of competition between Tribolium castaneum (Hbst.) (Coleoptera, Tenebrionidae) and three moth species. Bull. Entomol. Res. 58:31-45.

Aitken, A. D. 1966. A strain of small Oryzaephilus surinamensis (L.) (Coleoptera, Silvanidae) from the Far East. J. Stored Prod. Res. 2: 45-55.

Amos, T. G. 1968. Some laboratory observations on the rates of development, mortality and oviposition of Dermestes frischii (Kug.) (Col., Dermestidae). J. Stored Prod. Res. 4(2):103-117.

Amos, T. G., and Dennler, S. N. 1969. A comparison of three strains of Oryzaephilus surinamensis (L.) (Col., Silvanidae) on a temperature-moisture gradient. J. Stored Prod. Res. 5:173-175.

Andreeva, L. V. 1967. Some predaceous insects that feed on fruit mites, and their biology. (Rus) Vestn. Sel'skokhoz. Nauk. (Alma-Ata) 10(1): 98-104.

Apostolov, L. G. 1968. The dynamics of pest insect populations in different age oak stands. (Rus) Nauch. Dokl. Vyssh. Shk. Biol. Nauk. 8:11-13.

Bobirnac, B., Sanda, E., Matei, I., and Serban, M. 1967. Studies of morphology, bioecology and control of Leptinotarsa decemlineatasay in Oltenia region. (Rum) Bul. Stiint. 9:375-397.

Bailey, S. W., and Lemon, R. W. 1968. Sound production by the larder beetle, Dermestes lardarius linnaeus (Coleoptera, Dermestidae). J. Stored Prod. Res. 4(3):271-273.

Bangsholt, F. 1968. Changes in the numbers of certain Danish Coleoptera. (Da) Entomol. Meddelelser 36(6):527-545.

Barbosa, M. A. F. 1967 Breves notas sobre a flora ecológica do arroz armazenado. Rev. Agron. 50(I-II):40-44.

Burov, V. N. 1968. The population density as a factor of population dynamics. (Rus) Zool. Zh. 47(10):1445-1461.

Carvalho, J. P., and Machado, M. U. M. 1967. A entomofauna dos produtos armazenados. Contribuicão para o estudo do Callosobruchus maculatus (Fabricius) (Coleoptera, Bruchidae). Bol. Soc. Ciênc. Natur. 2a série (11):133-240.

Cassuto, Daniel, Bell, A. E., and Anderson, V. L. 1970. Estimation of genetic gains in population with overlapping generations. British Poul. Science II (in press).

Chlodny, J. 1967. The amount of food consumed and production output of larvae of the Colorado beetle (Leptinotarsa decemlineatasay). Ekol. Pol. Ser. A, 15(25):531-541.

Coakley, J. M., Maxwell, F. G., and Jenkins, J. N. 1969. Influence of feeding, oviposition, and egg and larval development of the boll weevil (Anthonomus grandis) on abscission of cotton squares. J. Econ. Entomol. 62(1):244-245.

Costantino, R. F. 1968. The genetic structure of populations and developmental time. Genetics 60:409-418.

Costantino, R. F., Rogler, J. C., and Bell, A. E. 1968. Genetic analysis of a population of Tribolium: II. Metabolic pattern of corn oil sensitive anomaly. Heredity 23:477-483.

Crenshaw, J. W. 1966. Productivity and competitive ability in Tribolium. Am. Nat. 100:683-687.

Crenshaw, J. W., and Lerner, I. M. 1964. Productivity of inbred strains of Tribolium confusum Duval. Ecology 45:697-705.

Davidson, R. L., and Roberts, R. J. 1968. Influence of plants, manure and soil moisture on survival and liveweight gain of two Scarabaeid larvae. Entomol. Exp. Appl. 11(3):305-314.

Dawson, P. S. 1969. A conflict between Darwinian fitness and population fitness in Tribolium "competition" experiments. Genetics 62:413-419.

Dawson, P. S. 1967. Developmental rate and competitive ability in Tribolium. III. Competition in unfavorable environments. J. Stored Prod. Res. 3(3):193-198.

Englert, D. C., and Bell, A. E. 1969. Components of growth in genetically diverse populations of Tribolium castaneum. Canadian J. Genetics and Cytology 11:897-907.

Englert, D. C., and Bell, A. E. 1969. Components of growth in genetically

Ferron, P. 1967. Laboratory study of the ecological conditions favoring the development of Beauveria tenella, causal agent of mycosis in the white grub (Melolontha melolontha). (Fr) Entomophaga 12(3):257-293.

Fujii, K. 1967. Studies on interspecies competition between the Azuki Bean Weevil, Callosobruchus chinensis, and the Southern Cowpea Weevil, C. maculatus. II. Competition under different environmental conditions. Res. Population Ecol. 9(2):192-200.

________, 1969. "Geographical" variation in Tribolium castaneum. Canada J. Genet. and Cytol. 2:478.

________, 1969. "Geographical" variation in Tribolium castaneum. Intecol Bulletin 1:46.

Gibbs, G. W. 1968. The frequency of interbreeding between two sibling species of Dacus (Diptera) in wild populations. Evolution 22(4):667-683.

Girish, G. K., and Pingale, S. V. 1968. Ecology of stored grain insect pests. Bull. Grain Technol. 6(2):76-95.

Grony, M. 1968. Faunal and zoocenological analysis of the soil insect communities in the ecosystem of Shelterbelt and Field. Ekol. Pol. Ser. A. 16(14):28 p.

Grony, M. 1968. Dynamics of the soil insect communities in two biotopes of an agricultural landscape. Ekol. Pol. Ser. A. 16(36):23 p.

Halstead, D. G. H. 1968. Observations on the biology of Murmidius ovalis (Beck) (Coleoptera: Cerylonidae). J. Stored. Prod. Res. 4(1): 13-21.

________, and Hardin, R. T. 1969. Developmental time of "Geographical" populations of Tribolium castaneum. Genetics 61:56.

Ho, F. K., and Dawson, P. S. 1966. Egg connibalism by Tribolium larvae. Ecology 47:318-322.

Hokyo, N., and Kiritani, K. 1967. A method for estimating natural survival rate and mean fecundity of an adult insect population by dissecting the female reproductive organs. Res. Population Ecol. 9(2): 130-142.

Howe, R. W. 1968. A further consideration of the heterogeneity of the developmental period of Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) in constant environmental conditions. J. Stored Prod. Res. 4(3):221-231.

Howe, R. W. 1968. Changes in weight during development in two stored products beetles. J. Stored Prod. Res. 4(3):213-220.

Hunter, F. A. 1968. The fate of the insect and mite fauna in a derelict flour mill in the English Midlands. Proc. XII Int. Congr. Ent., London, Sec. 96, p. 645.

Hurlock, E. T. 1968. Some observations on the ability of bleached, oiled and untreated sultanas to support insect infestation. J. Stored Prod. Res. 4:87-89.

Inouye, N., and Lerner, I. M. 1965. Competition between Tribolium species (Coleoptera, Tenebrionidae) on several diets. J. Stored Prod. Res. 1:185-191.

Ito, Y. 1967. Life tables in population ecology. 1. (Ja) Biol. Sci. 18(3):127-134.

Jones, R. I. 1968. Indeterminism in competition experiments. S. Afr. J. Agr. Sci. 11(4):805-807.

Jones, B. E. 1967. Tribolium castaneum (Herbst) (Coleoptera, Tenebrionidae) observed flying from an unusual habitat in Britain. J. Stored Prod. Res. 3:185-187.

Kabanov, V. A. 1968. Biology of the click beetle (Melanotus fuscices Gyll.). (Rus) Nauch. Doki. Vyssh. Shk. Biol. Nauk. 12:13-17.

Kiritani, K., and Nakasuji, F. 1967. Estimation of the stage-specific survival rate in the insect population with overlapping stages. Res. Population Ecol. 9(2):143-152.

Kovitvadhi, K., and Kerr, S. H. 1968. Artificial diet for the Zoysiagrass billbug, Sphenophorus venatus vestitus (Coleoptera: Curculionidae), and notes on its biology. Fla. Entomol. 51(4):247-250.

Krause, E. 1968. A genetical investigation of biomass in two populations of Tribolium castaneum and its response under various criteria of selection. Ph. D. Thesis, Purdue University Library.

Labeyrie, V. 1968. Evolution of reproductive activity in the male of Acanthoscelides obtectus. (Fr) Ann. Epiphyt. 19(1):197.

Lange, E. L. 1970. The effects of natural selection upon populations of Tribolium castaneum (Herbst). Ph. D. Thesis, Purdue University Library, 106 pp.

Lefkovitch, L. P. 1968. Interaction between four species of beetles in wheat and wheatfeed. J. Stored Prod. Res. 4(1):1-8.

Lefkovitch, L. P. 1967. A laboratory study of Stegobium paniceum (L.) (Coleoptera: Anabiidae). J. Stored Prod. Res. 3(3):235-249.

Lefkovitch, L. P., and Currie, J. E. 1967. Factors affecting adult survival and fecundity in Lasioderma serricorne (F.) (Coleoptera: Anobiidae). J. Stored Prod. Res. 3(3):199-212.

Lerner, I. M., Sokoloff, A., and Ho, F. K. 1966. Genotype-environment interactions in the outcome of "competition" in Tribolium. I. Population cage studies. Tribolium Inform. Bull. 9:96-104.

Lerner, I. M., and Ho, F. K. 1961. Genotype and competitive ability in Tribolium species. Amer. Naturalist 95:329-343.

Lerner, I. M., and Dempster, E. R. 1962. Indeterminism in interspecific competition. PNAS 48:821-826.

Leslie, P. H., Park, T., and Mertz, D. B. 1968. The effect of varying the initial numbers on the outcome of competition between two Tribolium species. J. Anim. Ecol. 37:9-23.

McDonald, D. J. 1968. The response of Tribolium confusum to variations in the volume of its environment. Ecology 49(6):1166-1168.

McDonald, D. J. 1968. Mobility in Tribolium confusum. Ecology 49(4):770-771.

McFarlane, J. A. 1968. The productivity and rate of development of Sitophilus oryzae (L.) (Coleoptera, Curculionidae) in various parts of Kenya. J. Stored Prod. Res. 4(1):31-51.

Morgan, M. T. 1969. Habitat selection of laboratory populations of Tribolium. Entomological News Vol. 80, Nos. 8 and 9.

Morimoto, N. 1967. Ecological interpretation of insect aggregation. Shinshu Univ. Fac. Agr. J. 4(3):225-234.

Morris, R. F., and Royama, T. 1969. Logarithmic regression as an index of responses to population density; comment on a paper by M. P. Hassell and C. B. Huffaker. Can Entomol. 101(4):361-364.

Matthews, J. V. 1968. A paleoenvironmental analysis of three late pleistocene coleopterous assemblages from Fairbanks, Alaska. Quaestiones Entomol. 4(4):202-224.

Mathwig, J. E. 1968. Population decline of adults of Epicauta pennsylvanica (Coleoptera: Meloidae) during the fall of 1967. Kans. Entomol. Soc. J. 41(4):544-548.

McManus, M. L. 1969. The effect of climatic integrants on population fluctuations of the Columbian timber beetle Corthylus columbianus Hopkins (Coleoptera: Scolytidae). Diss. Abstr., Sec. B, 29(7):2479B.

Murai, M. 1967. A mathematical model for the survivorship curve. Res. Population Ecol. 9(2):75-82.

Nowosielski-Slepowron, B. J. A., Waterhouse, F. L., Strevens, D. E. A. 1968. Sub-zero mortality responses of Tribolium confusum Duval (two stocks) and T. castaneum (Herbst) (four stocks) analyzed by weighted regression lines based on individual temperature L.D. 50's. Physiol. Zool. 41:440-446.

Orozco, F. 1969. Comparing two systems of selection under environmental stresses and the problem of the genotype-environment interaction in Tribolium castaneum. Ph. D. Thesis, Purdue University Library, pp. 254.

Pace, A. E. 1967. Life history and behavior of a fungus beetle *Bolitotherus cornutus* (Tenebrionidae). Mich. Univ. Mus. Zool. Occas. Pap. 653:1-15.

Park, T., Leslie, P. H., and Mertz, D. B. 1964. Genetic strains and competition in populations of *Tribolium*. Physiol. Zool. 37:97-162.

Park, T. 1957. Experimental studies of interspecies competition. III. Relations of initial species proportion to competitive outcome in populations of *Tribolium*. Physiol. Zool. 30:22-40

Park, T. 1948. Experimental studies of interspecies competition. I. Competition between populations of flour beetles, *Tribolium confusum* Duval and *Tribolium castaneum* Herbst. Ecol. Monogr. 18:265-308.

Prus, T. 1968. Some regulatory mechanisms in populations of *Tribolium confusum* Duval and *Tribolium castaneum* Herbst. Ekol. Pol. Ser. A, 16(16):40 p.

Pukinskaya, G. A., and Gusev, G. V. 1967. Migration of the Colorado potato beetle and its spreading on the farm land. (Rus) Vses. Nauch.-Issled. Inst. Zashch. Rast. Tr. 27:82-91.

Punji, G. K. 1967. Dietary efficiency of natural foods for the growth and development of *Tribolium castaneum* Hbst. and *Corcyra cephalonica* Staint. Bull. Grain Technol. 5(4):209-213.

Reynolds, J. L. 1968. Assessment by progeny rearings of early changes in competing populations of *Tribolium confusum* Duval and *T. castaneum* Herbst. Diss. Abstr., Sec. B, 28(8):3325B.

Rockel, E. G. 1969. Population dynamics of the common horseflies and deerflies (Tabanidae: Diptera) breeding on a New Jersey salt marsh. Diss. Abstr., Sec. B, 29(7):2480B.

Selander, R. B., and Weedle, R. C. 1969. The ontogeny of blister beetles (Coleoptera, Meloidae). II. The effects of age of Triungulin larvae at feeding and temperature on development in *Epicauta segmenta*. Entomol. Soc. Amer. Ann. 62(1).27-39.

Simberloff, D. S. 1969. Experimental zoogeography of islands: a model for insular colonization. Ecology 50(2):296-314.

Shrode, R. R. 1960. Evidence that mating is random in *T. castaneum*. Tribolium Inform. Bull. 3:15-16.

Sinha, R. N. 1968. Adaptive significance of mycophagy in stored-product Arthropoda. Evolution 22(4):785-798.

Sinha, R. N., Wallace, H. A. H., and Chebib, F. 1969. Principal component analysis of interrelations among fungi, mites, and insects in grain bulk ecosystems. Ecology 50(4):536-547.

Sinha, R. N., Wallace, H. A. H., and Chebib, F. 1969. Canonical correlations of seed viability, seed-borne fungi, and environment in bulk grain ecosystems. Can. J. Bot. 47:27-34.

Sinha, R. N., Wallace, H. A. H., and Chebib, F. 1969. Feeding and reproduction of the grain and the mushroom mite on wood-inhabiting Hymenomycetes. J. Econ. Entomol. 62(4):837-840.

Sinha, R.,N., Wallace, H. A. H., and Chebib, F. 1969. Canonical correlation between groups of acarine, fungal and environmental variables in bulk grain ecosystems. Res. Popul. Ecol. 11:18-30.

Sinha, R. N. 1969. Reproduction of stored grain insects to varieties of wheat, oats, and barley. Ann. Entomol. Soc. Amer. 62(5):1011-1015.

Smith, K. G. 1965. Some aspects of the biology of Paralipsa (Aphomia) gularis (Zell) (Lepidoptera) in relation to its distribution. Proc. XII Int. Congr. Ent., London, p. 626.

Sokal, R. R. 1967. A comparison of fitness characters and their responses to density in stock and selected cultures of wild type and black Tribolium castaneum. Tribolium Inform. Bull. 10:142-147.

Sokal, R. R., and Sonleitner, F. J. 1968. The ecology of selection on hybrid populations of Tribolium castaneum. Ecol. Mono. 38(4):345-379.

Sokal, R. R. 1967. The effects of synchrony of egg batches on fitness characters and conpetition in Tribolium castaneum. Tribolium Inform. Bull. 10:135-141.

Sokoloff, A., Shrode, R. R., and Bywaters, J. H. 1965. Productivity in Tribolium castaneum. Physiol. Zool. 38:165-173.

Sokoloff, A., Lerner, I. M., and Ho, F. R. 1965. Self-elimination of Tribolium castaneum following xenocide of T. confusum. Amer. Nat. 99: 399-404.

Sokoloff, A., and Lerner, I. M. 1967. Laboratory ecology and mutual predation of Tribolium species. Amer. Naturalist 101:261-276.

Sokoloff, A. 1964 (1965). Studies of natural selection in Tribolium castaneum Herbst (Coleoptera) in two different media. Proc. XII Intern. Congr. Ent., London, 1:273-274.

Sokoloff, A., Franklin, I. R., and Lakhanpal, R. K. 1966. Comparative studies with Tribolium. II. Productivity of Tribolium castaneum (Herbst) and Tribolium confusum Duval in natural, synthetic and semisynthetic diets. J. Stored Prod. Res. 1:313-324.

Sokoloff, A., Franklin, I. R., Overton, L. F., and Ho, F. K. 1966. Comparative studies with Tribolium (Coleoptera, Tenebrionidae). I. Productivity of Tribolium castaneum (Herbst) and Tribolium confusum Duval on several commercially available diets. J. Stored Prod. Res. 1:295-311.

Soliman, M. H. 1968. Studies of geographical populations of Tribolium castaneum. M.Sc. Thesis, University of Alberta, Edmonton, Alberta.

Tagarro, M. P., and Rico, M. 1966. Effect of removing the male on egg laying rate of fecundated females in Tribolium castaneum. Tribolium Inform. Bull. 9:120-121.

Tashiro, H., and others. 1969. Biology of the European Chafer in Northeastern United States. N. Y. (State) Agr. Exp. Sta. Bull. 828:71 p.

Taylor, N. W. 1968. A mathematical model for two Tribolium populations in competition. Ecology 49(5):843-848.

Toba, H. H., Kishaba, A. N., Pangaldan, R., and Riggs, S. 1969. Laboratory rearing of pepper weevils (Anthonomus eugenii) on artificial diets. J. Econ. Entomol. 62(1):257-258.

Trojan, P. 1968. Egg reduction of the Colorado beetle (Leptinotarsa decemlineata Say) as a hunger-dependent reaction. Ecol. Pol. Ser. A, 16(6):13 p.

Utida, S. 1967. Damped oscillation of population density at equilibrium. Res. Population Ecol. 9(1):1-9.

Watt, K. E. F. 1968. A computer approach to analysis of data on weather, population fluctuations, and disease. Biol. Colloq. (Proc.), 28th Annu. Colloq.:145-159.

Wilbert, H. 1968. The regulation of animal populations according to cybernetic principles. (Ge) Umschau 68(24):746-750.

Wool, D. 1967. Some observations on mating frequencies in Tribolium castaneum strains. Tribolium Inform. Bull. 10:182-186.

Wool, D. 1969. The effects of larval age range on survival of two Tribolium castaneum strains in mixed cultures through pupal cannibalism. Res. Popul. Ecol. 11(1):40-44.

Wool, D. 1969. Differences in population parameters of two Tribolium castaneum strains in environments of different shapes. Res. Popul. Ecol. 11(1):45-56.

Wool, D. 1969. Depth distribution of adults and immatures of two Tribolium castaneum strains in pure and mixed cultures. Res. Population Ecol. 11(2):137-149.

Wool, D. 1969. Selection for fast and slow development in pure cultures of T. castaneum strains. Tribolium Inform. Bull. 11:108-112.

Yamada, Yukio, and Bell, A. E. 1968. Effects of selection for 13-day larval weight under two nutritional environments on growth characteristics in Tribolium castaneum. Proc. XII International Congress of Genetics 1:281.

GENERAL

Crowson, R. A. 1970. Classification of biology. Heinemann, London and Atherton Press.

Knowlton, G. F. 1969. Beneficial insects. Utah State Univ. Ext. Entomol. Mimeo Ser. 141:2 p.

Loschiavo, S. R. 1970. Pollution is everyone's problem. J. Man Science Teachers 11(3):10-22.

Papp, C. S. 1968. Scientific illustration; Theory and practice. Dubuque, Brown, 318 pp.

Rothman, H., and Woodhead, M. 1968. Publication trends in biological control. Nature 220(5171):1053-1054.

Rothman, H. 1969. The changing pattern of research in economic entomology. Sci. World 13(1):11-16.

Ryckman, R. E. 1969. Vapona for the control of museum pests. J. Med. Entomol. 6(1):98.

Schimitschek, E. 1968. Insects as food in folklore, religion and culture. (Ge) Handbuch Zool. 4(2):1-62.

Sokal, R. R., and Crovello, T. J. 1970. The biological species concept: a critical evaluation. Amer. Naturalist.

Sokal, R. R. 1970. Another new biology. BioScience 20(3):152-159.

Statens Skadedyrlaboratorium (Government Pest Infestation Laboratory) 1969. Annual Report 1968. Lyngby, Denmark.

Steinhaus, E. A. 1968. Be favorable to bold beginnings. J. Invertebrate pathol. 12(1):i-iv.

GENETICS AND PHENOTYPIC VARIATION

Baker, H. G., and Stebbins, G. L. 1965. The genetics of colonizing species. Academic.

Bell, A. E. 1968. Selection studies in Tribolium (invitational paper). Proc. XII International Congress of Genetics 2:202-203.

Bell, A. E. 1969. The nature of selection responses in Tribolium (invitational paper). Japan Journal of Genetics 44(1):299-309.

Costantino, R. F., Rogler, J. C., and Bell, A. E. 1968. Genetic analysis of a population of Tribolium. II. Metabolic pattern of corn oil sensitive anomaly. Heredity 23(4):477-483.

Craig, G. B. 1965. Genetic control of thermally-induced sex reversal in *Aedes aegypti*. Int. Congr. Entomol. XII Congr., London 1:263.

Davydova, E. D. 1968. Environmental and morphogenetic reasons for reduced wings in Lampyridae, Coleoptera. (Rus) Akademiya Nauk pp. 52-78.

Dawson, P. S. 1964. The genetics of developmental rate and its relationship to competitive ability in Tribolium. Ph. D. Thesis, University of California, Berkeley, California, 167 pp.

Englert, D. C. 1969. The influence of linkage phase on recombination rates in Tribolium. Genetics 61:s16.

Englert, D. C., and Bell, A. E. 1970. Selection for time of pupation in *Tribolium castaneum*. Genetics.

Falk, R., and Lifschytz, E. 1968. Non-random localization of lethals in Drosophila (Melanogaster). Mutation Res. 5(3):411-416.

Franklin, I. R. 1968. The effect of linkage on variance. Diss. Abstr., Sec. B, 28(10):4006B.

Gall, G. A. E. 1970. Biochemical genetics of Tribolium. I. The foundation population. J. Exp. Zool.

Gruzdev, A. D., and Belaya, A. N. 1968. The linkages in polytene chromosomes. (Rus) Tsitologiya 10(8):995-1001.

Knipling, E. F. 1964. The potential role of the sterility method for insect population control with special reference to combining this method with conventional methods. Agric. Res. Serv. Publ., 33-98. 54 pp.

Krause, E. 1969. A genetical investigation of biomass in two populations of *Tribolium castaneum* and its responses under various criteria of selection. Diss. Abstr., Sec. B, 29(8):2758B.

Kurihara, M. 1967. Studies on oogenesis of the lady beetle. I. Anatomical and histological observation on the reversible development of ovary in the lady beetle, Epilachna vigintioctomaculata Motschulsky, induced by the change of photoperiods. Iwate Univ. Fac. Agr. J. 8(3):223-233.

LaBrecque, G. C., and Smith, C. N. 1968. Principles of insect chemosterilization. New York, Appleton, 354 p.

Lange, E. L., and Bell, A. E. 1969. Genetic control of a sex influenced quantitative trait in Tribolium castaneum. Genetics 61:s35.

Lange, E. L., and Bell, A. E. 1970. The genetics of the pregenital chaetoe of Tribolium castaneum. Genetics.

Levene, H., Lerner, I. M., Sokoloff, A., Ho, F. K., and Franklin, I. R. 1965. Genetic load in Tribolium. Natl. Acad. Sci. Proc. 53:1042-1050.

McNew, R. W. 1968. The pygmy gene effect on pupal weight in Tribolium castaneum. M.S. Thesis, Purdue University Library, pp. 62.

Medvedev, L. N. 1968. Demarcative variability of sibling species of leaf beetles (Coleoptera, Chrysomelidae). (Rus) Zool. Zh. 47(6): 843-849.

Onyearu, A. K., and Graham, W. M. 1967. Life history studies of two body color mutants of Tribolium castaneum (Herbst) (Coleoptera, Tenebrionidae). J. Stored Prod. Res. 3(1):65-70.

Orozco, F. 1969. A pilot study with Tribolium castaneum of the influence of environmental stress of genetics parameters and response to selection. Inst. Nac. Invest. Agronómicas, 170 pp.

Orozco, F. 1969. Comparing two systems of selection under environmental stresses and the problem of the genotype-environment interaction in Tribolium castaneum. Ph. D. Thesis, Purdue University. Published by Inst. Nac. Invest. Agronomicas, 254 pp.

Orozco, F., and Tagarro, M. P. 1969. Respuesta a la selección y parámetros genéticos de la puesta de huevos en una estirpe de Tribolium castaneum. Boletin Inst. Nac. Invest. Agronómicas 61:203-220.

Roberts, C. W., and Juniloff, D. 1968. Evidence for gene homology of two pearl-eyed genes in Tribolium castaneum and Tribolium confusum. Can. J. Genet. Cytol. 10:139-142.

Rumball, W., and Rae, A. L. 1968. The effect of selection intensity of selection response in Tribolium. New Zeal. J. Agr. Res. 11(4): 745-756.

Shcherbakov, E. S. 1968. On the problem of heterosis inversions in different chromosomes as a means of increasing the adaptability of populations. (Rus) Genetika 4(6):182-184.

Slatis, H. M., Fakhrae, H., and Bancroft, R. A. 1969. One beetle with two genotypes (Tribolium castaneum (Herbst)) (Coleoptera, Tenebrionidae). J. Stored Prod. Res. 5:181-182.

Sokal, R. R. 1970. Senescence and genetic load: evidence from Tribolium. Science.

Sokal, R. R., Bryant, E. H., and Wool, D. 1970. Selection for changes in genetic facilitation. Heredity.

Sokoloff, A. 1966. The genetics of Tribolium and related species. Academic Press, New York, 212 pp.

Strong, R. G., and Arndt, R. G. 1962. Crossbreeding studies with seven speices of Trogoderma. J. Econ. Ent. 55:445-448.

Wilson, S. P., Blair, O. V., Kyle, W. H., and Bell, A. E. 1968. The influence of selection and mating systems on larval weight in Tribolium. J. Heredity 59:313-317.

Yamada, Yukio, and Bell, A. E. 1969. Selection for larval growth in Tribolium under two levels of nutrition. Genetical Reasearch 13:175-195.

Zolessi, L. C. de. 1968. Genetic study of chromatic variations and anatomical study of Chelymorpha variabilis Boh. (Ch. crucifera Boh.), 1854, (Coleoptera, Chrysomelidae, Cassidinae). (Sp) Soc. Uruguaya Entomol. Rev. 7:20-44.

INSECTICIDES AND INSECTICIDE RESISTANCE

Amaro, J. P. 1966. Estudo da influência de alguns factores bioecológicos na susceptibilidade do ácaro da farinha Acarus Siro L. (Acarina, Acaridae), aos fumigantes. Est. Ens. Doc. 120:215 pp. + 67 pp.

Beck, W. 1969. Problems of resistance of Colorado potato beetle (Leptinotarsa decemlineata) in Austria. (Ge) Berlin Biol. Bundesanst. Land- Forstwirtsch. Mitt. 132:160-162.

Bedard, W. D., and others. 1969. Western pine beetle: field response to its sex pheromone and a synergistic host terpene, myrcene. Science 164(3885):1284-1285.

Berck, B. 1969. Report on the 4th Seminar on pesticide residue anaylsis (W. Canada). Pesticide Progress 7:169-173.

Dyte, C. E., and Blackman, D. G. 1963. The rust-red flour beetle and DDT. Pest Infestn. Res. 1962, 38.

Gerolt, P. 1969. Mode of entry of contact insecticides. J. Insect Physiol. 15(4):563-580.

Gouveia, M. E. S. 1967. Le contrôle dans les denrées stockées au Portugal. Garcia de Orta, 15(2):153-158.

Gradidge, J. M. G., and Williams, G. C. 1965. Recent experience in the use of Malathoin to protect stored grain against insect attack. Proc. XII Int. Congr. Ent., London, p. 634.

Lobo, M. J. S. 1965. Resíduos de pesticidas nos alimentos. Problema para as organizacões internacionais. Agricultura 27:34-35.

Lobo, M. J. S. 1967. Etablissement des tolérances pour les résidus de pesticides. Rev. Agron. 50(4):281-288.

Loschiavo, S. R. 1969. Effects of the anitfeeding compound AC-24055 (4'-(3,3-dimethyl-1-triazeno) acetanilide) on the survival, development, and reproduction of some stored-products insects. Jour. of Econ. Entomol. 62(1):102-107.

Loschiavo, S. R., and Salamon, B. 1969. Laboratory tests of Bayer 77488 and Bayer 78182 in different formulations as contact insecticides against three stored-product insects. Jour. of Econ. Entomol. 62(1):112-114.

Loschiavo, S. R. 1970. 4'(3,3-dimethyl-1-triazeno)acetanilide to protect packaged cereals against stored-products insects. Food Tech.

Mec, R. 1967. Did the Colorado potato beetle already develop insecticide resistance. (Se) Biljna Zastita 11(10/11):252-254.

Parkin, E. A. 1965. The onset of insecticide resistance among field populations of stored-products insects. J. Stored Prod. Res. 1:3-8.

Sandner, H., and Cichy, D. 1967. Research on the effectiveness of fungal and bacterial insecticides. Ekol. Pol. Ser. A, 15(6): 325-333.

Schmidt, G. 1967. Thoughts about the application of common names in European plant protection. (Ge) Gesunde Pflanzen 19(10): 212-216.

Sousa, M. E. S. 1965. Perdas de eficácia verificadas em tratamentos de trigo com pós insecticidas, de DDT, Lindano e Malatião. Agricultura 27:28-32.

Sousa, M. E. S. 1967. Estudo do interesse de pós insecticidas "inertes" no combate a pragas dos productos armazenados. Garcia de Orta 15(3):367-408.

Sousa, M. E. S. 1967. Études des moyens de lutte contre les ravageurs des denrées stockées au Portugal. Rev. Agron. 50(4):275-280.

IRRADIATION AND USE OF ISOTOPES

Andreev, S. V., and others. 1968. The use of gamma radiation to sterilize agricultural insect pests. (Rus) Radiobiologiya 8(5):742-746.

________, 1968. Radiation exposure of flour beetles. I. The lethal effects of neutron or gamma irradiation on _Tribolium castaneum_. II. Radiosensitivity of _Tribolium castaneum_ adults irradiated at the larval stage. III. The effect of protracted gamma irradiation on the median survival time of flour beetles (Tribolium) during developmental stages. Argonne National Laboratory Biological and Medical Research Division Annual Report. (ANL-7535) pp. 109-116.

Bailey, S. W. 1966. The entomology of radiation disinfestation of grain. J. Stored Prod. Res. 2:171-173.

Brockway, A. P. 1956. The effects of X-irradiation on the pupae of the yellow mealworm, _Tenebrio molitor_ Linn. (Abs.) Biol. B. 111:297-298.

Brockway, A. P. 1955. The effects of X-radiation on larval and pupal stages of the yellow mealworm _Tenebrio molitor_ Linn. (Abs.) Biol. B. 109:355.

Bychkovskaya, I. B., Ochinskaya, G. K., and Volynova, T. P. 1968. Significance of the time facotr during irradiation of imago insects (experiments on grain weevils (_Calandra granaria_)). (Rus) Radiobiologiya 8(2):235-238.

Campbell, J. D., Stothers, S., Vaisey, M., and Berck, B. 1968. The influence of gamma irradiation on the storage and nutritional quality of mushrooms. J. of Food Science 33:540-542.

Chigusa, Sado. 1968. A study of the radiation effects on a quantitative character, pupal weight, under various genetic backgrounds in _Tribolium castaneum_. Ph. D. Thesis, Purdue University Library, pp. 275.

Cornwell, P. B., Editor. 1966. The entomology of radiation disinfestation of grain. Pergamon Press, Oxford.

Crenshaw, J. W. 1965. Radiation-induced increases in fitness in the flour beetle _Tribolium confusum_. Science 149:426-427.

________, and Ducoff, H. S. 1969. Radiosensitivity studies of X-irradiated _Tribolium castaneum_ larvae. Radiation Research 39:643-654.

________, Frigerio, N. A., and Sampson, M. J. 1969. The lethal effects of monoenergetic neutrons and ^{60}Co gamma rays on Tribolium castaneum. Argonne National Laboratory Annual Report (ANL-7635) pp. 50-52.

Jafri, R. H. 1961. Synergistic action of radiation and of Bacillus thuringiensis toxin on protozoan diseases of insects. 1st Internatl. Conf. Protozool., Praha, 1:510-515.

Jobin, L., Huot, L., and Perron, J. M. 1970. LD_{50} emergence and parameters as criteria of sensitivity to gamma radiation in Acheta domesticus. Jour. Econ. Entomol. 63:114-119.

Kloft, W. 1968. The use of radioactive isotopes and ionizing radiation in applied entomology. (Ge) Z. Angew. Entomol. 61(4):413-422.

Molchanova, V. A. 1967. Effect of ionizing radiation (X-rays) on development of Colorado potato beetle. (Rus) Vses. Nauch.-Issled Inst. Zashch. Rast. Tr. 27:240-244.

________, and Sacher, G. A. 1969. Developmental delay and lethality studies of X-irradiated T. castaneum eggs. Argonne National Laboratory Annual Report (ANL-7635) pp. 47-48.

________, and Sacher, G. A. 1969. Effects of X-irradiation on some physical properties of a developing Tribolium. Argonne National Laboratory Annual Report (ANL-7635) pp. 49-50.

Tracey, K. M., Jarowska, S., and Fodor, V. M. 1959. The effects of X-radiation on the lifecycle of Tenebrio molitor. (Abs.) Radiation Res. 11:473.

Von Borstel, R. C. 1963. Effects of radiation on germ cells of insects: dominant lethals, gametic inactivation and gonial cell killing. Symp. Use Appl. Radioisotpoes Radiation Contr. Plant Anim. Insect Pests. Proc., 1963 Symp. pp. 367-385.

Yang, C. H. 1968. Response and recovery studies on X-irradiated Tribolium confusum larvae. Diss. Abstr., Sec. B, 28(12, pt.1):4886B.

Yang, T. C. H. 1968. X-ray response and recovery in Tribolium castaneum larvae. Radiation research 35:516.

NUTRITION

Bhattacharya, A. K., and Pant, N. C. 1968. Dietary efficiency of natural, semi-synthetic and synthetic diets with special reference to qualitative amino acid requirements of the Khapra beetle, Trogoderma granarium Everts (Coleoptera: Dermestidae). J. Stored Prod. Res. 4(3):249-257.

Bolourchi, S., Friedemann, C. M., and Mickelsen, O. 1968. Wheat flour as a source of protein for adult human subjects. Amer. J. Clin. Nutr. 21(8):827-835.

Davis, G. R. F. 1967. Nutritional relationships in larvae of Oryzaephilus surinamensis. J. Insect Physiol. 13(11):1737-1743.

Davis, G. R. F. 1969. Effect of dietary serine on survival and rate of development of Oryzaephilus surinamensis (Coleoptera: Silvanidae). Can. Entomol. 101(1):27-31.

Davis, G. R. F. 1968. Quantitative requirements of the saw-toothed grain beetle, Oryzaephilus surinamensis, for dietary L-trytophan. J. Insect Physiol. 14(12):1693-1696.

Fraenkel, G., and Chang, P. I. 1954. Manifestations of a vitamin B_t (carnitine) deficiency in the larvae of the mealworm Tenebrio molitor L. Physiol. Zool. 27:40-56.

Fraenkel, G. 1954. Inhibitory effects of sugars. (Abs.) Fed. Amer. Soc. Expt. Biol. Fed. Proc. 13:457-458.

Fraenkel, G. 1955. Inhibitory effects of sugars on the growth of the mealworm, Tenebrio molitor L. J. Cell and Compar. Physiol. 45: 393-408.

Harley, K. L. S., and Willson, B. W. 1968. Propagation of a Cerambycid borer (Plagiohammus spinipennis) on a meridic diet. Can. J. Zool. 46(6):1265-1266.

Leclercq, J. 1955. Sur la valeur nutritive des farines d'orge pour Tenebrio molitor L. (Col.). Soc. Roy. d'Ent. de Belge B. and Ann. 91:66-69.

Leclercq, J. 1953. Mise en evidence de preferences alimentaires chez Tenebrio molitor L. (Coleoptera, Tenebrionidae). Arch. Intern. Physiol. 61:378-386.

Lipke, H., and Fraenkel, G. 1954. Toxicity of corn germ for Tenebrio molitor. (Abs.) Fed. Amer. Soc. Expt. Biol. Fed. Proc. 13:464-465.

Lipke, H., and Fraenkel, G. 1955. The toxicity of corn germ to the mealworm Tenebrio molitor. J. Nutr. 55:165-175.

Loschiavo, S. R., McGinnis, A. J., and Metcalfe, D. R. 1969. Insect feeding trials. Con. Agric. 14:24-25.

Loschiavo, S. R., McGinnis, A. J., and Metcalfe, D. R. 1969. Nutritive value of barley varieties assessed with the confused flour beetle. Nature 224:288.

McGinnis, A. J., and Kastings, R. 1969. Digestibility studies with cellulose U-C^{14} on larvae of the pale western cutworm, Agrotis orthogonia. J. Insect Physiol. 15:5-10.

Strong, F. E., and Kruitwagen, E. 1969. Feeding and nutrition of Lygus hesperus. III. Limited growth and development on a meridic diet. Entomol. Soc. Amer. Ann. 62(1):148-155.

Wirths, W. 1968. Survey of food habits in rural households in the republic of Germany from nutritional-physiological aspects. (Ge) Z. Ernahrungswiss 9(1):16-42.

PARASITES AND SYMBIONTS OF COLEOPTERA

Adcock, E. M. 1940. The permeability of gregarine protozoa from the gut of the mealworm. J. Exp. Biol. 17:449-463.

Angalet, G. W., Coles, L. W., and Stewart, J. A. 1968. Two potential parasites of the mexican bean beetle (Epilachna varivestis) from India. J. Econ. Entomol. 61(4):1073-1075.

Barbosa, M. A. F. 1966. Alguns caracteres culturais de três espécies de Neocosmospora. Garcia de Orta 14(3):391-400.

Brand, T. von, and Morris, J. A. 1943. Resistance of trophozoites and spores of mealworm gregarines to low temperatures. Biodynamica 4:75-80.

Brand, T. von. 1943. The resistance of the trophozoites of mealworm gregarines to anaerobic conditions. Biodynamica 4:163-165.

Brunson, M. H., and Colls, L. W. 1968. The introduction, release, and recovery of parasites of the alfalfa weevil (Hypera postica) in Eastern United States. U.S.D.A. Prod. Res. Rep. 101, 12 p.

Ciaccio, G., and Girond, P. 1953. Le ver de farine, Tenebrio molitor et la chrysallide de Bombyx mori pluvent conserver Rickettsia prowazeki et Rickettsia mooseri. Cong. Internaz. di Microbiol. Riassunti delle Comun. 6:585.

Ciaccio, G. 1955. Conservation du virus Columbia SK sur Tenebrio molitor et sur Bombyx mori. Cong. Internatl. de Path. Comparee 7:43.

Ciaccio, G. 1955. Le virus Columbia SK plut se conserver sur Tenebrio molitor et sur Bombyx mori. Soc. de Path. Exot. B. 48:308-312.

Corbel, J. 1968. New gregarines as intestinal parasites of Orthoptera. (Fr) Ann. Parasitol. Humaine Comp. 43(3):291-320.

Daniels, M. I. 1938. A cytological study of the gregarine parasites of Tenebrio molitor, using the ultra-centrifuge QJ. Micros. Sci. 80:293-320.

Dunkel, F. V., and Boush, G. M. 1968. Biology of the gregarine Phxinia frenzeli in the black carpet beetle, Attagenus megatoma. J. Invertebrate Pathol. 11(2):281-288.

Hamilton, E. W. 1968. Pseudomonas aeruginosa in species of diabrotica (Undecimpunctata howardi and D. virgifera). J. Invertebrate Pathol. 12(2):188-191.

Hrubant, G. R., and Rhodes, R. A. 1968. Agglutinability of spore forming pathogens with antiglobulins to mildy disease bacteria. J. Invertebrate Pathol. 11(3):371-376.

Hurpin, B., and Robert, P. 1968. Experiments on simultaneous infections of the common cockchafer, Melolontha melolontha. J. Invertebrate Pathol. 11(2):203-213.

Laird, M. Gregarines from laboratory colonies of flour beetles, Tribolium castaneum Herbst and Tribolium confusum Duval, at Montreal. Can. J. Zool. 37:378-381.

Lipa, J. J. 1968. Stempellia scolyti (Weiser) N. Comb. and Nosema scolyti N. sp., Microsporidian parasites of four species of Scolytus (Coleoptera). Acta Protozool. 6(7):69-78.

Lipa, J. J. 1968. Nosema coccinellae N. sp., a new microsporidian parasite of Coccinella septempunctata, Hippodamia tredecimpunctata and Myrrha octodecimguttata. Acta Protozool. 5(23):369-374.

Lipa, J. J. 1968. On two microsporidians: Nosema whitei Weiser from Tribolium confusum and Nosema weiseri N. sp. from Rhyzopertha dominica. Acta Protozool. 5(24):375-380.

Lipa, J. J. 1968. Plistophora geoturpina sp. N., a microsporidian parasite of dung beetles Geotrupes spp. (Coleoptera, Scarabaeidae). Acta Protozool. 6(27/35):341-344.

Loschiavo, S. R. 1969. A coccidian pathogen of the dermestid Trogoderma parabile. Jour. of Invert. Path. 14:89-92.

MacDougall, Sister Mary Muriel 1942. A study of temperature effects on gregarines of Tenebrio molitor larvae. J. Parasitol. 42: 233-240.

Pfeffer, E. 1910. Untersuchungen uber die gregarinen im darm der larve von Tenebrio molitor. Archiv. f. Protist. 19:107-118.

Poinar, G. O., and Welch, H. E. 1968. A new nematode, Filipjevimermis leipsandra sp. N. (Mermithidae), parasitic in Chrysomelid larvae (Coleoptera). J. Invertebrate Pathol. 12(3):259-262.

Rangaswami, G. 1968. Studies on microbiology and pathology of insect pests of crop plants. Hebbal, Bangalore, University of Agricultural Science 94 p.

Richter, I. E. 1959. Bewegungsphysiologische Untersuchungen an polycystiden Gregarinen unter Anwendung des Mikrozeitrafferfilmes. Protoplasma 51(2):197-241.

Tanada, Y. 1967. Effect of high temperatures on the ressistance of insects to infectious diseases. J. Sericult. Sci. Jap. 36(4):333-340.

Taylor, R. M. 1967. Catalogue of Arthropod-borne viruses of the world; a collection of data on registered Arthropod-borne animal viruses. Washington, U. S. Public Health Service, 98 p.

Theodorides, J. 1951. Contributions à l'étude ecologique des parasites et commensan de coleoptères 2. Internat'l. Cong. Ent. Trans. 9:454-459.

Theodorides, J. 1955. Les eugregarines du genre gregarina parasites de coleoptères tenebrionides. Ann. de Parasitol Humaine et Compar. 30:5-21.

Tyler, P. S. 1962. On an infection of *Tribolium* spp. by the sporozoan *Triboliocystes garnhami* Dissanaike. J. Insect Path. 4: 270-272.

Weiser, J. 1963. Sporozoan infections. *In*: Insect pathology, an advanced treatise. Vol. 2, 689 pp., Academic Press, New York.

West, A. F. 1958. A species of *Nosema* (Sporozoa: Microsporidia) parasitic in the flour beetle *Tribolium confusum*. (Abs.) J. Parasitol. 44:41.

Weyer, F. 1952. Die Künsthche infektion von kleiderläusen (*Pediculus humanus humanus*) und mehlkäferlarven (*Tenebrio molitor*) mit *Rickettsia conori* (zeckenbissfieber). Acta Trop. 9:170-183.

Zacharuk, R. Y., and Tinline, R. D. 1968. Pathogenicity of *Metarrhizium anisopliae*, and other fungi, for five elaterids (Coleoptera) in Saskatchewan. J. Invertebrate Pathol. 12(3):294-309.

Zoltowski, Z. 1953. Étude sur la possibilité de l'adaptation du *Tenebrio molitor* L. au tube digestif de l'homme. (Polish) Acta Parasitol. Polon. 1:231-257.

PESTS

Alden, C. H., and Farlinger, D. F. 1931. The artificial rearing and colonization of Trichogramma minutum. J. Econ. Ent. 24:480-483.

Annand, P. N. 1944. Report of the chief of the Bureau of Entomology and Plant Quarantine, Reasearch Administration, 58 pp.

Anonymous, Entomology and Zoology. Rep. S. Carolina Exp. Sta. 49: (1935-1936):39-50.

Anonymous, Grain pests. Bur. Bio-Technology, Leeds, Bull. 2:52.

Anonymous, Department of Entomology and Zoology. Ann. Rep. Tech. Serv. Dept. Agric. Haiti, 1928-29. Bull. 17:157-166.

Anonymous, Queensland. Annual Report of the Department of Agriculture and Stock for the year 1942-43. 28 pp.

Anonymous, Report on the Agricultural Department, St. Vincent, for the year ended 31st March, 1914. Barbados.

Armstrong, M. T. 1965. Grain beetles grow fat on the 1964 harvest. Farmers Weekly pp. 88-89. January.

Armstrong, M. T. 1965. Insect dangers in home grown grain this harvest. Milling. January.

Armstrong, M. T. 1965. The problems of insect control in flour mills in Great Britain. Milling. pp. 573-574. June.

Armstrong, M. T. 1965. Preventing infestation of farm stored grain without using chemicals. Proc. II Int. Congr. Ent., London, p. 628.

Ashman, F. 1966. An assessment of the value of dilute dust insecticides for the protection of stored maize in Kenya. J. Appl. Ecol. 3:169-179.

Arkhangelskii, N. N. 1926. Some observations on various methods of controlling pests of stored products. Bull. N. Caucasian Plant Prot. Sta. 1:100-119.

Atkinson, D. J. 1936. Some experiments on the control of the bamboo shot-hole borer Dinoderus spp. in bamboo dunnage (Bostrychidae, Coleoptera). Burma For. Bull. 32, 17 pp.

Azemard 1914. Les insectes parasites des Arachides au Senegal. L'Agron Colon., Paris 1:106-110.

Back, E. A., and Cotton, R. T. 1924. Ethyl acetate--carbon tetrachloride mixture. J. Econ. Ent. 17:663.

Back, E. A. 1939. The cigarette beetle as a pest of cottonseed meal. J. Econ. Ent. 32:739-749.

Baeta Neves, C. M. 1967. Breve notícia da reunião da O.E.P.P. sobre a "Protecção dos Produtos Armazenados". Rev. Agron. 50(4): 308-310.

Baeta Neves, C. M. 1967. Algumas referências historicas à corrupcão do trigo e da farinha. Da identidade dos Provedores de saude e dos Inspectores fitassanitários. Gazeta das Aldeias 2584: 82-84 e 96.

Baeta Neves, C. M. 1969. Reunião do grupo de trabalho para o estudo dos produtos armazenados de origem mediterrânica. Gazeta das Aldeias 74(263):274-278, 286.

Baeta Neves, C. M. 1968. O inquérito às condicões fitossanitárias do Armazenamento em Portugal e algumas das suas conclusoes em relacão aos cereais panificáveis e às farinhas. II Colóquio dos Cereais, Farinhas e Pão, Junho/Julho - Grémio dos Industriais de Panificacão de Lisboa.

Ballard, E. 1913. Pests of stored grain. Suppl. #4 to the Nyasand Government Gazette, Zomba 20:298.

Barnes, J. H., and Grove, A. J. 1916. The insects attacking stored wheat in the Punjab, and methods of combating them; including a chapter on the chemistry of respiration. Mem. Dept. of Agric. in India, Calcutta 4:165-280.

Bekman, Yu I. 1929. Observations on the introduction of seed pests. Izv. Prikl. Ent. 4:151-166.

Belyaev, I. M., Shesterikova, M. N., and Pop v, P. V. 1930. Materials for the study of pests of stored oil seed. Schr. zent. biochem. Forsch Inst. Nahrunpu. Genussmittelind 1:344-432.

Berliner, E. 1915. Wilt-disease of the meal-worm caterpillar (Ephestia kuhniella Zell.) and its causal agent Bacillus thuringiensis sp. n. Z. f. Angew. Entom. Berlin 2:29-56.

Bezant, E. T. 1965. Food handling premises in Britain as an ecological niche for Dermestes (Coleoptera, Dermestidae). Proc. XII Int. Congr. Ent., London, Sect. 96, pp. 647-648.

Bills, G. T. 1967. The second established colony of Periplaneta brunnea (Burn) (Dictyoptera, Blattidae) in an airport in Britain. Ent. Mon. Mag. 102:130.

Bills, G. T. 1965. The occurance of Periplaneta brunnea (Burn) (Dictyoptera, Blattidae) in an international airport in Britain. J. Stored Prod. Res. 1:203-204.

Bioletti, F. T. 1915. Control of raisin insects. Calif. Univ. Agric. Call., Berkeley, Circ. no. 134. 11 pp.

Bissell, T. L. 1936. Insects infesting cotton seed. J. Econ. Ent. 29:634.

Bissell, T. L. 1935. Insects infesting cottonseed meal. J. Econ. Ent. 28:835.

Bodkin, G. E. 1916. Report of the Economic Biologist. Rept. Dept. Sci. and Agric. Br. Guiana, for the nine months ended 31st December 1915, Georgetown. 10 pp.

Bogdanov-Katkov, N. N., and Dunin, M. S., Ed. 1935. Diseases and pests of chufa Cyperus esculentus. Trans. Inst. Grain Legum. Crops. Res. 6, 144 pp. Moscow.

Bouhelier, R., and Hudault, E. 1943. Contribution à l'étude du bromine de méthyle utilisé pour la désinsectisation des produits vegetaux. Bull. Chamb. Agric. Casablanca 14:9-33.

Bowers, W. S. 1968. Potential control of insects with juvenile hormone. U.S.D.A. Yearbook Agr. 1968:94-98.

Bridwell, J. C. 1919. Some notes on Hawaiian and other Bethylidae (Hymenoptera) with descriptions of new species. Hawaii Ent. Soc. Proc. (1918) 4:21-38.

Bridwell, J. C. 1920. Some notes on Hawaiian and other Bethylidae (Hymenoptera) with the description of a new genus and species; 2nd paper. Proc. Hawaiian Entom. Soc. Honolulu 4:291-314.

Brindley, T. A. 1930 The growth and development of Ephestia kuehniella Zeller (Lepidoptera) and Tribolium confusum Duval (Coleoptera) under controlled conditions of temperature and relative humidity. Ann. Ent. Soc. Amer. 23:741-757.

Britton, W. E. 19181 17th Report Connecticut State Entomologist for 1917. Conn. Agric. Expt. Sta., New Haven Bull 203:231-370.

Bull, J. O., and Soloman, M. E. 1958. The yield of Lasioderma serricorne (F.) (Coleoptera, Anobiidae) from a given quantity of foodstuff. Bull. Ent. Res. 49:193-200.

Burges, H. D. 1964 (1965). Possibilities of biological control of stored products insects. Internat'l. Congr. Ent. London XII Congr. Proc. 1:659.

Burkhardt, F. 1922. Beiträge zur Biologie von Tribolium navale, Fabr. ferrugineum Fabr.). Zeitschr. wiss. Insektenbiol, Berlin 17:1-3.

Caldwell, N. E. H. 1947. Stored products pests in northern Queensland. Qd. J. Agric. Sci. 4:7-11.

Caldwell, N. E. H., and Brimblecombe, A. R. 1946. Distribution of beetles of the genus Tribolium (Coleoptera: Tenebrionidae) in stored foodstuffs in Queensland. Qd. J. Agric. Sci. 3:92-95.

Chao, Y., Simkover, H. G., Telford, H. S., and Stallcop, P. 1953. Field infestation of stored grain insects in eastern Washington. J. Econ. Ent. 46:905-907.

Carpenter, S. J. 1947. Control of stored food insects with benzene hexachloride. J. Econ. Ent. 40:136-137.

Cartwright, O. L. 1930. The rice weevil and associated insects in relation to shuck length and corn varieties. Bull. S. Carolina Agric. Expt. Sta. 266, 28 pp.

Chapman, R. N. 1919. Insects in relation to wheat flour and wheat flour substitutes. J. Econ. Ent. 12:66-70.

Chapman, R. N. 1923. The possibility of transmitting a Calendra infestation from wheat to macaroni through the processes of milling and manufacturing. J. Econ. Ent. 16:341-348.

Chatterji, S., Sarup, P., and Ramdas Menon, M. G. 1962. Biological observations of Palorus shikhae Sarup, Chatterji and Menon, a predator of some stored cereal pests. Indian J. Ent. 23:241-243.

Chiaromonte, A. 1933. Considerazioni entomologiche sulla coltura delle cerealinella Somalia Italiana. Agric. Colon 27:484-487.

Chopra, R. L. 1928. Annual report of the entomologist to the government. Punjab Lyallpur, for the year 1925-1926. Rep. Dept. Agric. Punjab 1925-26. 1:67-125.

Chorley, J. K. 1943-1944. Report of the acting chief entomologist for the year(s) 1942, 1943. 16 pp.

Clément, P. 1945. Quelques Coléoptères des bananes sechées. Bull. Soc. Ent. Fr. 49:125-127.

Commun, R. 1931. Etudes de la division de Phytopathogie . . 1930. Bull. Econ. Indochine 34:771B-779B.

Cooke, F. C. 1932. Investigations on coconuts and coconut products. Gen. Ser. Dept. Agric. S.S. and F.M.S. 8, 99 pp.

Corbett, G. H., Yusope, M., and Hassan, A. 1937. Insects associated with copra in Malaya. Sci. Ser. Dep. Agric. S S. and F.M.S. 20:1-91.

Corbett, G. H., and Panniah, D. 1920. Alleged damage caused by insects on stored rubber seed. Agric. Bull. F.M.S. Kuala Lumpur 8:95.

Cotterell, G. S. 1952. The insects associated with export produce in southern Nigeria. Bull. Ent. Res. 43:145-152.

Cotton, R. T., Wagner, G. B., and Young, H. D. 1937. The problem of controlling insects in flour warehouses. Amer. Miller 65:22, 24, 26, 79.

Cotton, R. T., and Frankenfeld, J. C. 1946. Insect infestation in powdered hand soap. J. Econ. Ent. 39:419-420.

Cotton, R. T., 1938. Control of insects attacking grain in farm storage. Farmers Bull. U.S.D.A. 1811, 14 pp.

Cotton, R. T., and St. George, R. A. 1929. The meal worms. Tech. Bull. U.S.D.A. 95, 38 pp.

Cotton, R. T. 1952. Insect pests of stored grain and grain products. Burgess Pub. Co., Minneapolis.

Crabtree, D. G., and Robinson, W. H. 1953. Pivalyl, the new insecticidal rodenticide. Pest Control 21:22, 24, 58.

Dal Monte, G. 1950. Osservazione su alcune partite di grano importate in Italia nel primo semestre del 1950. Redia 35:225-250.

Darling, H. S. Annual report of the Agricultural Entomologist. Rep. Dept. Agric. Uganda 1944-45, pt. 2:25-30.

Dean, G. A. 1913. Further data on heat as a means of controllling mill insects. J. Econ. Ent. 6:40-55.

________, 1915. Insects destructive to grain and grain products stored in bins and granaries. Kansas Agric. Expt. Sta., Manhattan. Circular No. 47, 4 pp.

de Charmoy, D. d'E. 1915. Insects injurious to stored grain in Mauritius. Dept. Agric. Mauritius, Port Louis. Bull. 2: 16.

De Coursey, J. D. 1931. A method of trapping the confused flour beetle Tribolium confusum Duval. J. Econ. Ent. 24:1079-1081.

de Fremery, P. 1929. Over omnivore insecten in copra. Ber. Afd. Handelsmus. Kol. Inst. 44, 10 pp.

De, R. K. 1956. Effects of streptomycin on some stored grain insects. J. Econ. Ent. 48:774-775.

Diakonoff, A. 1938. Insecten in Sawarie noten. Ent. Ber. 10:12-14.

Dievzeide, R. 1926. Le papillon gris de la farine (Ephistia kuehniella Zeller). Rev. Zool. Agric. et Appl. 25:17-25.

________, and Tempère, G. 1924. Sur quelques insectes des entrepots. Rev. Zool. Agric. et Appl. 23:116-119.

Doane, R. W. 1918. Some problems in the control of insects in stored foods in California. J. Econ. Ent. 11:313-320.

________, R. W. 1925. Feeding cowa insect-infested coconut meal. J. Econ. Ent. 18:689-696.

Dresner, E. 1949. Culture and use of entomogenous fungi for the control of insect pests. Contr. Boyce Thompson Inst. 15:319-335.

Duckett, A. B. 1915. Para-dichlorobenzene as an insect fumigant. U.S.D.A., Washington D. C. Bull. 167, 7 pp.

Dupont, P. R. 1916. Insect notes. Ann. Rept. on Agric. and Crownlands for the year 1915, Vicotria Seychelles, 1916:20-22.

Dupont, R. A. 1915. Insect notes. Extract from Agric. Rept. Seychelles, 1915.

Duport, L. 1912, 1913. Notes sur quelques Maladies et Ennnemis des plantes cultivées en extrême Orient. Extrait du Bulletin Economique de l'Indochine, Hanoi-Haiphong Nouvelle Serie 99, Nov.-Dec. 1912 et 102, 105 May-June, Nov.-Dec. 1913, 147 pp.

Durrant, J. H. 1921. Insects associated with grain, etc. Repts. Grain Pests (War) Committee, Royal Society, London 9:33-52.

________, and Beveridge, W. W. O. 1913. A preliminary report of the temperature reached in army biscuits during baking with special reference to the destruction of the imported flour moth Ephestia kuhniella Zeller. J. Roy. Army Md. Corps, London 20:615-634.

Edwards, W. H. 1932. Report of the government entomologist. Ann Rep. Dept. Agric. Jamaica 1931:22-24.

Ehrhorn, E. M. 1923. Reports of the chief plant inspector, February and March 1923. Hawaiian Forester and Agriculturist 20:63-67.

Ehrhorn, E. M. 1925. Reports of the chief plant inspector, February-July 1925. Hawaiian Forester and Agricul. 22:96-101.

Entomological Investigations. 17th Rep. Coun. Sci. Industr. Res. Aust. 1942-43:15-20.

Evans, J. W. 1930. The control of the codling moth in Australia. Notes on the possible utilization of Trichogramma (Hym., Chalidoidea). J. Council Sci. Ind. Res. 3:106-116.

Feytaud, J. 1924. Les insectes de l'Arachide. Rev. Zool. Agric. et Appl. 23:85-92.

Fisher, H. C. 1920. Report of the health department of the Panama Canal for the calender year 1919. Mount Hope, C. Z., 134 pp.

Fletcher, T. B. 1923. Report of the Imperial Entomologist, 1922-23. Sci. Repts. Agric. Res. Inst., Pusa, 1922-1923:61-75. Calcutta.

________, 1917-1918. Report of the Imperial Entomologist. Scient. Repts. Agric. Res. Inst., Pusa, 1917-1918:84-166. Calcutta.

________, 1916-1917. Report of the Imperial Entomologist. Sci. Repts. Agric. Res. Inst., Pusa for 1916-1917:71-90. Calcutta.

________, 1914. Report of the Imperial Entomologist. Rept. Agric. Res. Inst. and Coll., Pusa for 1913-14:62-75.

Franssen, C. J. H. 1929. De teelt op Java van eenige gewassen behoorende tot het geslacht Allium. Landbouw 4:567-602.

Frappa, C. 1938. Les insectes misibles au manioc sur pied et aux tubercules de manioc en magasin à Madagascar. Rev. Bot. Appl. 18:17-29; 104-109.

________, 1929. Les insectes misibles au riz sur pied et au riz en magasin à Madagascar. Riz et Riziculture 3:167-184.

Freeman, J. A. 1960. The influence of climate on insect populations of flour mills. Internationaler Kongress fur Entomologie, Wien, August 1960. Verhandlungen. Band II. Sektion IX Vorrat-schädlinge. IXa Holzschädlinge-Holzschutz. II:301-308.

________, 1951. Pest infestation control in brewries and maltings. J. Inst. Brew. 57:326-337.

________, 1968. Problems in the carriage of infested commodities in freight containers. Proc. Int. Contain. Symp., London.

________, 1967. On the infestation of almonds, with special reference to those imported into Great Britain from Mediterranean countries. Stored Products Conference, Lisbon. EPPO Publications, Series A, No. 46E.

Freeman, J. A. 1967. Problems of infestation of commodities carried by sea with with special reference to imports into Great Britain. Stored Products Conference, Lisbon. EPPO Publications, Series A, No. 46E.

________, 1967. The control of infestation in Greek currants. Stored Products Conference, Lisbon. EPPO Publications, Series A, No. 46E.

________, 1966. Pest control of farm products. Fatis Review 13(4):124-127.

________, 1965. On the infestation of rice and products imported into Britain. Proc. XII Int. Congr. Ent., London, Sect. 9b, p. 633.

________, 1967. Legislative and commercial measures for prevention and control of infestation in agricultural products. Stored Products Conference, Lisbon. EPPO Publications, Series A, No. 46E.

________ 1967. Implications for infestation control of the use of freight containers in international trade. Stored Products Conference, Lisbon. EPPO Publications, Series A, No. 46E.

Gradidge, J. M. G., Aitken, A. D., and Whalley, P. E. S. 1967. Clothes moths and carpet beetles; their life-history, habits and control. BM (Natural History) Economics Series, No. 14, Publication No. 554.

Gahan, A. B. 1931. On certain Hymenopterous parasites of stored grain insects. J. Wash. Acad. Sci. 21:213-221.

________, 1930. Synonymical and descriptive notes on parasitic Hymenoptera. Proc. U.S. Nat. Mus. 77, 12 pp.

________, 1922. Report on a small collection of parasitic Hymenoptera from Java and Sumatra. Treubia 3:47-52.

________, 1917. Description of some new parasitic Hymenoptera. U.S. Nat. Mus. Proc. 53:195-217.

Gallego, M. F. L. 1967. Preliminary list of insects of economic and secondary importance affecting the chief crops, domestic animals, and man in Colombia. (Sp) Colombia Fac. Nac. Agron. Rev. 26(65):32-66.

Gavalov, I. I. 1927. On some injurious insects observed in the Crimea 1922-1925. Acta Soc. Ent. Stavropol 3:8-16.

Geijokes, D. C. 1940. Voorraddinsectin van rijst in Suriname met aanwijzingen ter bestrijding. Bull. Dep. Landb. Suriname 55, 36 pp.

Gerhardt, P. D., and Lindgrid, D. L. 1955. Penetration of various packaging films by common stored product insects. J. Econ. Ent. 47: 282-287.

Ghosh, C. C. 1925. Report of the Entomologist, Mandalay, and Sericultural work for the year ended 30th June 1925. 1018 pp.

Gibson, A. 1914. The control of insects infesting mills and warehouses. Agric. Gaz. Canada 1:961-963.

Gibson, A. 1917. Reports on insects of the year; Div. No. 1, Ottawa District. 47th Ann. Dept. Entom. Soc. Ontario for 1916, Toranto, pp. 15-17.

Girault, A. A. 1912. Insects injurious to stored grains and their ground products. 27th Report of the State Entomologist of the state of Illinois, pp. 56-82.

Golebiowska, Z., Filipek, P., and Krzymanska, J. The damage potential of Sitophilus granarius L., S. oryzae L., and Rhizopertha dominica F. to grain of wheat and rye. (Pol) Poznan. Inst. Ochrony Roslin. Prace Nauk. 10(1):31-56.

Govdrich, E. S. 1921. Note on the Hymenoptera parasitic on beeltes infesting grain. Repts. Grain Pests (War) Committee, Royal Society, London 9:5-7.

Gough, H. C. 1939. Factors affecting the resistance of the flour beetle Tribolium confusum Duv., to hydrogen cyanide. Ann. Appl. Biol. 26:533-571.

Gouveia, A. J. S. 1967. Quelques aspects des conditions phytosanitaires des produits d'outre-mer au port de Lisbonne. Garcia de Orta 15(3):409-418.

Gowdey, C. C. 1923. Report of the Government Entomologist. Ann Rept. Jamaica Dept. Agric. 1922, pp. 23-23.

Gowdey, C. C 1922. Annual Report of the Government Entomologist. Ann. Rept. Jamaica Dept. Agric. 1921, pp. 40-41.

Grady, A. G. 1928. Studies in breeding insects throughout the year for insecticide tests. J. Econ. Ent. 21:598-612.

Graham, W. M. 1962. Trapping Tribolium in storage experiments. Trop. Agriculture 39:53-56.

Grossman, E. F. 1931. Heat treatment for controlling insect pests of stored corn. Bull. Florida Agric. Expt. Sta. 39, 24 pp.

Grove, A. J. 1914. Some experiments with maize stored in bins. Agric. J. of India, Calcutta 9:92-98.

Gurney, W. B. 1918. The insect pests of maize. Agric. Gaz. N.S.W. Sydney, 29:641-650.

Haberman, H. 1967. A new insect pest (Tribolium destructor) in the Estonian fauna. (Es) Eesti Loodus 10(8):504.

Hall, S. A. 1968. Wiles of sex attractants used in war on pests. U.S.D.A. Yearbook Agr. 1968:77-84.

Hargreaves, H. 1922. Annual Report of the Government Entomologist, 1921. Uganda Dept. Agric. Ann. Rept 1921, pp 57-64.

Heimpel, A. M. 1967. Preparations of insect viruses in microbiological control of pests. (Ge) Umschau 67(23):759-763.

Herford, G. M. 1939. Common pests of grain godowns in Hong Kong. Hong Kong Nat. 9:102-107.

Hewlett, P. S. 1954. A micro-drop applicator and its use for the treatment of certain small insects with liquid insecticides. Ann. Appl. Biol. 41:45-64.

Hinds, W. E. 1914. Reducing insect injury to stored grain. J. Econ. Ent. 7:203-211.

Hodson, A. C. 1934. Origin and differentiation of sex organs of Tribolium confusum Duval. Ann. Ent. 27:278-288.

Holborn, J. M. 1957. The susceptibility to insecticides of laboratory cultures of an insect species. J. Sci. Fd. Agric. 8:182-188.

Horn, W. 1934. Em ziveiter Beitrag uber Insekten, welche Blei, besanders Bleimäntel von Luftkabelm, durchbohren. Arb. Physiol. Angew. Ent. Berl. 1:291-300.

Howe, R. W. 1962. The effect of temperature and relative humidity on the rate of development and the mortality of Tribolium madens (Charp.) (Coleoptera, Tenebrionidae). Ann. Appl. Biol. 50:649-660.

________, 1952. Entomological problems of food storage in northern Nigeria. Bull. Ent. Res. 43:111-144.

________, 1962. Observations on the rate of growth and disruption of moulting in the larvae and pupae of Tribolium castaneum (Herbst) (Coleoptera, Tenebrionidae) at sub-threshold temperatures. Ent. Exp. Appl. 5:211-222.

Hsiu, Chu sieh. 1936. The interrelation of self-heating of stored grain and granary pests. Ent. and Phylopath. 4:80-83.

Hurlock, E. T. 1967. Short communication:-some observations on the amount of damage caused by Oryzaephilus surinamensis (L.) (Coleoptera, Silvanidae) to wheat. J. Stored Prod. Res. 3:75-78.

Imms, A. D., and Chatterjee, N. C. 1915. On the structure and biology of Tachardia lacca Kerr, with observations on certain insects predaceous or parasitic upon it. Indian Forest Mem. Forest Zool. Sec. Calcutta 3, 42 pp.

Jarvis, E. 1919. Insects attacking peanuts in Queensland. Queensland Agric. J., Brisbane 12:200-204.

Jack, R. W. (N. D.) Insect pests of tobacco in Southern Rhodesia. Dept. Agric. Salisbury, Rhodesia Bull. 140, 18 pp.

Jack, H. W. 1923. Rice in Malaya. Malayan Agric. J. 11:103-119; 139-161.

Jensen, J. A. S., Petersen, H. N., and Tauber, O. E. 1959. Confirmation by culture and staining methods of absence of symbiotic flora in Tribolium confusum Duval. J. Econ. Ent. 52:756-757,

Jepson, W. F. 1948. An annotated list of insects associated with groundnuts in East Africa. Bull. Ent. Res. 39:231-236.

Kalshoven, L. G. E. 1935. Insecten in versche en in opgeschnurde tengkawang pitten (Shorea en Isoptera spp., fam. Dipterocarpaceae).

Kane, J., and Green, A. A. The protection of bagged grain from insect infestation using fenitrothion. J. Stored Prod. Res. 4(1): 59-68.

Kansas Agric. Expt. Station 1926-28. Injurious insects and other pests. pp. 67-82.

Karg, J., and Trojan, P. 1968. Fluctuations in numbers and reduction of the Colorado beetle (Leptinotarsa decemlineata Say) in natural conditions. Ekol. Pol. Ser. A, 16(5), 23 pp.

Kemner, N. A. 1936. Tva nya skadedjur inomhus Tribolium destructor Uyttenb. och Sitotroga cerealella Oliv. Opusc. Ent. 1:56-58.

Kerby, A. H. 1920. Plant Pathology. Nigeria: Ann. Rept. Dept. of Agric. Southern Provinces for 1919. Lagos, 1920, pp. 17-18.

Knipling, E. F., and Sullivan, W. N. 1957. Insect mortality at low temperature. J. Econ. Ent. 50:368-369.

Krishnamurti, B., and Seshagini Rao, D. 1944. Results of certain experiments and observations carried out recently in the matter of control of insect pests of food grains in storage. Mysore Agric. J. 22:91-101.

________, and Seshagiri Rao, D. 1944. Results of a further series of experiments and observations on the control of insect pests of food grains in storage. Mysore Agric. J. 22:122-127.

Krishnamurti, B., and Appanna, M. 1945. Influence of mercury on insect eggs. Part I. Curr. Sci. 14:7-10.

Kunhi Kannan, K. 1919. Pulse beetles (store forms). Mysore State Dept. Agric. Bangalore, Entom. Ser. Bull. 6, 31 pp.

Kunike, G. Beiträge zur Lebensweise und Bekämpfung der Mehlmotte Ephestia kuehniella Z. (Pyralidae, Phycitinae). Z. Angew. Ent. 25:588-608.

Kuwayama, S. 1928. The principal insect pests of the rice plant in Hokkaido. Bull. Hokkaido Agric. Expt. Sta. 47, 107 pp.

Lal, K. B. 1944. Insect pests of stored grain in the United Provinces and their control. Allahabad Dept. Agric. V.P. 9 pp.

Lamborn, W. A. 1914. The agricultural pests of the southern provinces, Nigeria. Bull. Ent. Res., London 5:197-214.

Larter, L. N. H. 1937. Report of the government botanist. Rep. Dept. Sci. Agric., Jamaica 1936:71-72.

Laubmann, M. 1958. Beitrag zur Kenntuis der Biologie von Tribolium destructor (Uytt). Anz. Schadlingsk 31:138-140.

________, 1961. Influence of larval feeding on rate of increase and length of life of Tribolium destructor Uytt. Anz. Schadlingsk 34:120-122.

Laudani, H., Gillenwater, H. B., Kantack, B. H., and Phillips, M. F. 1959. Protection of Citrus pulp against insect infestation with surface application of pyrethrum-piperonyl butoxide wettable powder. J. Econ. Ent. 52:224-227.

Laudani, H., Highland, H., and Jay, E. 1966. Treated bags keep corn meal insect-free during overseas shipment. Am. Miller and Processor. February.

Leech, H. B. 1943. Black flour beetle Tribolium madens Charp. in British Columbia (Coleoptera, Tenebrionidae). Canad. Ent. 75:40.

Leefmans, S. 1925. Schadelijke insecten in importartikelen in blik. De indische Culturen 10:736-739.

________, 1934. Ziekten en plagen der culturgewassen in Nederlandsch Oost-Indie in 1931. Meded. Inst. Plziekt. 82:1-92.

Lepesme, P. 1939. Sur le régime et l'importance economique de quelques Corynetidae (Col., Cleridae). Rev. Franc Ent. 6:17-20.

Lepigre, A. 1936. Contribution a l'étude de la désinsectisation des grains par le melange d'oxyde d'éthylène et d'acide carbonique. Notes sur le bormure de méthyle. Bull. Soc. Enc. Industr. Nat. 1936:385-462.

Lever, R. J. A. W. 1945. Entomological Notes. Agric. J., Fiji 16:8-11.

________, 1934. Insects of the cocoanut palm in the British Solomon Islands. List 3. Brit. Solomon Is. Agric. Gaz. 2:7-8.

________, 1939. Entomological Notes. Agric. J., Fiji 10:83-87.

Lindgren, D. L., and Sinclair, W. B. 1945. Sorption of HCN by insect pupae. J. Econ. Ent. 38:617.

Linsley, E. G. 1944. Protection of dried packaged foodstuffs from insect damage. J. Econ. Ent. 37:377-379.

Lloyd, C. J., and Hewlett, P. S. The relative susceptibility to pyrelthrum in oil of Coleoptera and Lepidoptera infesting stored products. Bull. Ent. Res. 49:177-185.

Lobo, M. J. S. 1966. Panorama actual do problema do combate aos insectos dos produtos armazenados por irradiacão. Agricultura 31: 24-27.

Loschiavo, S. R., and Smith, L. B. 1970. Distribution of the merchant grain beetle, Oryzaephilus mercator, Fauvel (Silvanidae: Coleoptera) in Canada. Can. Ent.

Lyon, A. V. 1924. Problems of the viticultural industry. Commw. Australia Inst. Sci. and Ind. Bull. 28, 84 pp.

MacDougall, R. S. 1913. Insect pests in Scotland in 1912. Trans. Highland and Agric. Soc. of Scotland. 17 pp.

MacKenna, J. 1919. Report on the progress of agriculture in India for 1917-1918. Calcutta, pp. 85-99.

Mackie, W. W. 1925. Prevention of insect attack on stored grain. Calif. Agric. Expt. Sta. Circ. 282, 8 pp.

Mahdihassan, S. 1923. Classification of lac insects from a physiological standpoint. J. Sci. Assoc. Maharajah's Coll., Vizianagaram 1:47-99.

McCarthy, T. 1922. Insects infesting stored grain in New South Wales. Agric. Gaz. N.S.W. 33:253-259.

Malenotti, E. 1923. La cura del grano nei magazzini. R. Osservatorio fitopatologico per Verona e Province limitsofe, 12 pp.

Manzek, 1926. Massenauftreten von Insekten. Ent. Bl. 22:44-45.

Maqsud Nasir, M. 1949. Recent work on mercury as an insecticide against insect pests of stored grain. Bull. Ent. Res. 40:299-304.

Marlatt, C. L. 1931. Report of the chief of the bureau of entomology. U.S.D.A. Washington D. C., 87 pp.

Martin, H. 1958. Pests and diseases of date palm in Libya. FAO Plant Prot. Bull. 6:120-123.

Maskew, F. 1916. Quarantine division report for the month of October, 1916. Mthly. Bull. Cal State Comiss. Hortic. 5:451-453.

________, 1920. Quarantine division report for the months of April and May, 1920. Mthly. Bull. Cal. State Dept. Agric. 9:298-302.

________, 1919. Reports for the months of August and September, 1919. Mthly Bull. Cal State Dept. Agric. 8:544-547.

Mathlein, R. 1951. Svartbruna mjölbaggen och dess bekampande (<u>Tribolium destructor</u> and its control). Vüxtskyddsnotiser 1951:37-38.

________, 1948. Ett skadekjur i importerade fodermedel. Vüxtskyddsnotiser 1948:29.

Mikulski, J. S. 1936. The effect of constant and alternating temperatures on the survival of some developmental stages of <u>Tribolium confusum</u> Duv. (Col.). Bull. Int. Acad. Polom. 1936B 2:361-372.

________, 1936. On the changes of developmental velocity of some developmental stages of <u>Tribolium confusum</u> Duv. (Col.) when influenced by constant and alternating temperatures. Bull. Int. Acad. Polon. 1936B 2:373-385.

Miller, Z. Pests of stored grain and their control. (Southern Husbandry) Ekaterinoslav 7:175-179.

Mokrzecki, S. A. 1916. A short review of the work of the Salgir pomological station at Simferopol for 1913-1915, 40 pp.

Monro, H. A. V. 1950 (1951). The relation of space fumigants to the problem of insect resistance to insecticides. 81st Rep. Ent. Soc. Ont. 1950.

________, and Delisle, R. 1945. Methyl bromide fumigation of plant products in railroad freight cars with special reference to work supervised by the Dominion Department of Agriculture during 1944. Sci. Agric. 25:794-816.

Moore, W. 1918. Fumigation with chlorpicrin. J. Econ. Ent. 4:357-362.

Moritz, Z. 1920. Pests of stored products. Stavropol Govt. Div. Control Agric. Pests, 12 pp.

Morril Jr., A. W. 1953. Army insect control operations in the Far East. J. Econ. Ent. 46:270-276.

Morstatt, H. 1913. Liste schädlicher Insekten. Der Pflanzer, Daressalam 9:288-296.

________, 1920. Die Schädlinge und Krankheiten der Sarghumhirse (Mtama) in Ostafrika. Arb. Bwl. Reichsanst. Land- u Forstwirtsch Berlin 10:243-268.

Nagano, K. 1967. Last year's outbreak of rice insect pests. (Ja) Nogyo 994:51-61.

Newbery, E. A. 1918. Lophocateres pusillus, Klug, a cosmopolitan beetle in London. Entomologists Mthly. Mag., London 54:162-163.

Okuni, T. 1928. Report of the studies on Stored grain pests. II. Rept. Govt. Res. Inst. Dept. Agric. 34, 121 pp.

Oosthuizen, M. J. 1945. The relative susceptibility of maize and wheaten products to invasion by the rust-red flour beetle Tribolium castaneum Hbst. J. Ent. Soc. Sthn. Afr. 8:137-149.

Ozer, M. 1968. Insect pests of grain in the field in Turkey. Ankara Univ. Fac. Agr. Yearbook 7:151-160.

Parkin, E. A. 1967. Problems of grain storage. Ann. Appl. Biol. 59:324-326.

Parker, H. L. 1916. Tribolium confusum Duval, as a museum pest (Col.). Entomol. News 5:234.

Parker, W. 1913. A sealed paper carton to protect cereals from insect attack. U.S.D.A. Washington, Bull. 15, 8 pp.

Padmonabha Aiyar, K. S. 1945. Notes on Laemophloeus sp. (minutus) in stored flour. Indian J. Ent. 6:164-165.

Page, A. B. P., and Shafik, M. 1936. Control of mites on insect-stocks and on fungus cultures by means of fumigation. Bull. Soc. R. Ent. Egypte 20:110-143.

________, and Scott, E. I. C., and Varley, E. R. 1956. The insecticidal effect of Nigerian diatomite. Colon. Pl. Anim. Prod. 5:201-207.

Payne, N. M. 1927. Two factors of heat energy involved in insect cold hardiness. Ecology 8:194-196.

Payne, N. M. 1925. Some effects of Tribolium on flour. J. Econ. Ent. 18:737-744.

Pence, R. J. 1961. Tribolium and cockroach control with kepone bait in fabric insect culture cabinets. J. Econ. Ent. 54:821-822.

Pingale, S. V. 1954. Biological control of some stored grain pests by the use of a bug predator, Amphibolus venator Klug. Indian J. Ent. 16:300-302.

Portchinsky, I. A. 1913. Insects injurious to grain in stores and warehouses. Mem. Bureau of Entomol. of the Scientific Committee of the Central Board of Land Administration and Agriculture. St. Petersburg, 10, 84 pp.

Province of British Columbia Dept. of Agric. Twelfth Annual Report for the year 1917. Victoria, B. C. 1918, 132 pp.

Rahman, K. A., and Gutcharn Singh Sohi. 1946. Mercury as a preventive against stored grain pests. Bull. Ent. Res. 37:131-141.

Ramirez, R. 1921. Gorgojos y palomillas di los graneros y las harinas. Sec. Agric. y Fomento Circ. 5, 7 pp.

________, 1921. Plagas de la agricultura en el Distrito Federal. Rev. Agric. San Jacinto, D. F. 9:662-663.

Reyne, A. 1924. Verslag van den Entomoloog. Dept. Landbouw Nijv. & Handet Suriname, Verslag 1923, pp. 35-48.

Richards, O. W., and Herford, G. V. B. 1930. Insects found associated with cacao, spices and dried fruits in London warehouses. Ann. Appl. Biol. 17:367-395.

Richards, O. W., and Thompson, W. S. 1932. A contribution to the study of the genera Ephestia, Gn. (including strymax, dyar), and Plodia Gn. (Lepidoptera, Phycitidae) with notes on parasites of the larvae. Ent. Soc. London, Trans. 80:169-250.

Richards, P. B. 1915. Methods and materials for the control of insect pests Part VIII. Agric. Bull. Fed. Malay States Kuala Lumpur 4:33-42.

Riley, W. A. 1921. Division of entomology and economic zoology. 29th Ann. Rept. Minnesota Agric. Expt. Sta. 1920-21. Univ. Farm, St. Paul, pp. 55-60.

Risbec, J. 1941. Les insectes de l'arachide. Trav. Lab. Ent. Sect. Soudan Rech Agron. 21 pp.

Ritchie, A. H. 1918. Annual report of entomologist. Jamaica Dept. of Agric. Ann. Report. for year ended 31st March 1918. pp. 34-40.

________, 1926. Memorandum on bulrush millet (Pennisetum typhoideum). 7 pp. Morogoro, Tanganyika.

Rvepke, W. 1918. Entomologische Onderzoekingen. Meded. Proefstation Midder-Java, Salatiga 32:13-14.

Roubaud, E. 1916. Les insectes et la degenerescence des arachides au Senegal. Separate, undated from L'Ann. et Mem. de Com. d' Etudes hist et scien. de l'Afrique acc. francaise (sine loco), 76 pp.

Russo, G. 1927. Informe de la sección de Entomología. Repub. Dominicana Estac. Nac. Agron. de Moca, Lab. Entom. 35 pp.

Ryabov, M. A. 1926. The possibilities of applying the parasitic method of control in the case of granary pests. Bull. N. Caucasian Plant Prot. Sta. 1:19-50.

Sacharov, N. 1915. The injurious insects noticed in the govt. of Astrachan from 1912 to 1914. From the report of the Station for 1914. 29 pp.

Salt, R. W. 1936. Studies on the freezing process in insects. Tech. Bull. Minn. Agric. Exp. Sta. 116, 41 pp.

Saunders, J. P., and Krueger, H. 1957. A rapid method for counting larvae of the confused flour beetle. J. Econ. Ent. 50:693.

Scheibner, R. A. 1968. Common garden insect pests. Ky. Univ. Ext. Misc. 365, 7 pp.

Schøyen, T. H. 1916. Beretning om skadeinsekter og plantesygdommer land og havevruket 1915. Kristiania 1916, pp. 37-92.

Schwitzgebel, R. B., and Walkden, H. H. 1944. Summer infestation of farm stored grain by migrating insects. J. Econ. Ent. 37:21-24.

Sepasgozarian, H. 1968. A new storage pest in Iran: Sitophagus hololeptiodes Canst. (Col.: Tenebrionidae). (Ge) Iran. Inst. Rech. Entomol. Phytopathol. Entomol. Phytopathol. Appl. 27:101-102.

Sevastyanov, I. A. 1935. Extracts from reports of the Central Asiatic Institute of Plant Protection (SAIZRA) for the year 1934. Plant Prot. 1935:136-140.

Sharangapani, M. V., and Pingale, S. V. 1957. A study of movement of some insect pests through grain stored in bags. Indian J. Ent. 18:243-250.

Shelyuzhko, L. A. 1935. A survey of insect pests of Nicotiana rustica and cigar tobacco plants. Sborn. Rab. Ent. Otd. VIMPa. pp. 70-97.

Shmalko, V. S. 1939. On the elaboration of a local method of eliminating insects. Plant Prot. 18:176-181.

Simmonds, H. W. 1924. Report by the acting entomologist for the year 1923. Fiji Dept. Agric. Ann. Report 1923, p. 8.

Sinclair, W. B., and Ramsey, R. C. 1944. The picric acid method for determining minute amounts of hydrocyanic acid in fumigated insects. Hilgaria 16:291-300.

Sinha, R. N. 1969. Infestation of stored grain by insects and mites. Proc. Symposium on Biol. Contam. of Grain and Animal byproducts. Univ. of Minn., Minneapolis. pp. 99-102.

Sloan, W. J. S. 1946. The status of heat treatment of plant cotton seed for the control of pink bollworm Pectinophora scutigera Hold., in Queensland. Qd. J. Agric. Sci. 3:80-85.

Smallman, B. N. 1945. Relation of insect damage to thianime content of biscuits. J. Econ. Ent. 38:106-110.

Smith, H. D. 1943. Laboratory rearing of Microbracon vestidida Vier. on the bean weevil, with notes on the life history of the parasite. J. Econ. Ent. 36:101-104.

Smith, K. G. 1966. Pests in wheat and mill products:- Possible pests in wheat and mill products. Cleanliness of premises, routine and specialized pest control. Practice of flour milling, Chapter 21.

Smith Jr. L. W., Pratt Jr., J. J., Nii, I., and Umina, A. P. 1970. The effect of insect infestations on the bading and taste of bread made from hard-wheat flour. I-Preliminary experiments with species of Tribolium, Tenebrio, Trogoderma, and Oryzaephilus. J. Stored Prod. Res.

Statens Skadedyrlaboratorium. 1950. Arsberetning 1948-1949. 26 pp.

Statens Skadedyrlaboratorium. 1951. Arsberetning 1949-1950. 41 pp.

Stermer, R. A. 1959. Spectral response of certain stored-products insects to electromagnetic radiation. J. Econ. Ent.

Storey, G. 1916. Report on the first two years working of the plant protection law (Law No. 5 of 1913). Ministry of Agric. Egypt. Tech. and Scient. Services Bull 1, 37 pp.

Srivastava, A. S., and Awasthi, G. P. 1958. An insecticide from the extract of a plant Adhatoda vasica Nees, harmless to man. Proc. 10th Int. Congr. Ent. 2:245-246.

Strong, L. A. 1922. Burearu of Plant Quarantine. A synopsis of work for the months of March, April, May, June and July, 1922. Mthly. Bull. Cal. Dept. Agric. 11:775-780.

Swaine, G. 1957. Trials on the underground storage of maize of high moisture content in Tanganyika. Bull. Ent. Res. 48:397-406.

Sweetman, M. D., and Palmer, L. S. 1928. Insects as test animals in vitamin research. I. Vitamin requirements of the flour beetle Tribolium confusum Duval. J. Biol. Chem. 77:33-52.

Swenk, M. H. 1922. Insect pests of stored grain and their control. Nebraska Agric. Expt. Sta. Lincoln, Circ. 15, 14 pp.

Swenson, K. G., and Tunnock, A. 1957. Beetles infesting stored grain in the Willamette Valley of Oregon. J. Econ. Ent. 50:117-118.

Takahashi, R. 1937. Kurze Vebersicht der gegenwärtigen Kenntnisse über die Vorratschädlinge auf der Insel Formosa. Mitt. Ges. Vorratschutz 13:4-6.

Thomas, I. 1966. Farm and granary pests. J. R. Agric. Soc. 127:187-205.

Tiensuu, L. 1947. Mass occurrence of insects in stored maize. Ann. Ent. Fenn. 13:153-170.

Trehan, K. N., and Rajarao, S. A. 1945. A note on the predatory habits of Tribolium beetles. Curr. Sci. 14:209-210.

Trojan, P. 1968. Estimated food consumption by the Colorado beetle (Leptinotarsa decemlineata Say) under conditions of natural reduction. Ekol. Pol. Ser. A, 16(18), 9 p.

Tucker, R. W. E. 1931. Sugar-cane borers. The mass breeding of Trichogramma minutum to control Diatraea succharalis in Barbados during 1930. Trop. Agriculture 8:283-288.

Tullgren, A. 1912-1916. Injurious animals in Sweden during 1912-1916. Meddelande fran Centralanstalten för Jorsbruksförsök No. 152; Entomologiska Avdelningen 27:104.

Uyttenboogaart, D. L. 1934. Revision des genus Tribolium (Col., Ten.). Ent. Bl. 30:20-31.

van Emden, F. 1929. Ueber die Rolle der Feuchtigkeit im Leben der Speicherschädlinge. Anz. Schädlingsk 5:58-60.

van Heurn, F. C. 1919. Verslag van den Directeur, 1 July 1918- 30 Juni 1919, Meded. Algem. Prosefst. A.V.R.O.S. Medan, Algem. Ser. 7, 66 pp.

Vappula, N. A. 1934. Tuholaisten esiintyminen. 1932. (The occurrence of injurious animals in Finland in 1932.) Valtion Maatalousk Tied. 64, 5 pp.

Velasco, H. 1955. Insectos presentes en el equipo de movimento de granos de los silos de Guacara, Estado Carabobo, Venezuela. Agron. Trop. 5:87-97.

Vitkovsky, N. N. 1914. Pests of grain and flour in the govt. of Ekaterinoslav as observed in the current year. pp. 44-55.

Voute, A. D. 1937. Bevolkingsproblemen. I. De toename van een populatie van Tribolium en van de inheemische bevolking van de Tengger, Naturk. Tijdschr. Ned-Ind. 97:163-167.

Walker, D. W. 1960. Populations fluctuations and control of stored grain insects. Tech. Bull. Wash. Agric. Exp. Sta. 31, 66 pp.

Warren, L. O. 1954. Teasinte as a host for stored grain insects. J. Econ. Ent. 47:630-632.

Wasserburger, H. J. 1967. Know your enemies. 9. Storage and food chamber pests. (Ge) Mitt. Deut. Landwirt-Ges. 82(50):1647-1649.

Watters, F. L., and Cox, G. A. 1957. A water-trap for detecting insects in stored grain. Canad. Ent. 89:188-192.

Whitney, L. A. 1927. Report of associate plant inspector, October-December 1927. Hawaii For. Agric. 24:145-150.

Wilkinson, D. S. 1926. Entomological notes. Cyprus Agric. J. 21:10-12.

Wilkinson, H. 1939. Entomological Section. Annual Report. Rep. Dept. Agric. Kenya 1937, 2:86-101.

Wilson, F. 1945. The control of insect pests in Victorian bulk wheat depots. J. Coun. Sci. Indust. Res. Aust. 18:103-109.

________, and Gay, E. J. 1946. The fumigation of wheat in bag stacks. Bull. Coun. Sci. Indust. Res. Aust. 207, 24 pp.

Wilson, H. F. 1940. Lures and traps to control clothes moths and carpet beetles. J. Econ. Ent. 33:651-653.

Wolcott, G. N. 1922. Insectos que atacanlos productos almacenados. Porto Rico Insular Expt. Sta. 65, 8 pp.

Yang, Chio-ching. 1934. Some preliminary notes on stored grain insects of Sioshan, Chekiang, May 1934. Ent. and Phytopath. 2:416-421.

Yokohama, K. 1927. Experiments on the resistance of Dermestes coarctatus Harold and Tribolium ferrugineum Fabricius to abnormally high temperature. Bull. Imp. Seric. Expt. Sta. Japan 2:103-117.

Yokoyama, K. 1925. Resistance to heat in *Dermestes coarctatus*, H., and *Tribolium ferrugineum*, Fab. Imp. Seric. Expt. Sta., Rept. 7: 119-167.

Yukasovic, P., Stojanovic, T., and Kosovac, V. 1966. Les insectes attaquant aux graines de tournesol (Hélianthe, Helianthus annuus L.) en Yougoslavie. J. Stored Prod. Res. 2:69-74.

Zacher, E. 1918. The pests of stored products and their control. Kaiserl. Biol. Anstalt Land- u. Forstwirtsch., Berlin, Flubglatt. 63, 8 pp.

Zacher, F. 1926. Schädlinge in Rohkakao, Schokolade, Marzipan und ähnlichen Erzeugnissen. Verh. Deutsch. Ges. angew. Ent. 5. Mittgliederversamml.

________, 1913. Die Afrikanischen Baumwallschädlinge. Arbert K. Biol. Anst. Land- und Forstwirtschaft, Berlin 9:121-130.

Zvierezomb-Zubkovsky, E. 1917. A few words on insects underneath the floor of grain stores. J. Appl. Ent., Kiev 1:44-46.

________, 1918. Brief report on the work of the Don Bureau for the control of pests of agricultural plants for 1917, and review of the pests of agriculture in the Don province. Rostoff, 1918. 36 pp.

PHYSIOLOGY AND BIOCHEMISTY

Aggarwal, S. K. 1968. Pinocytosis during vitellogenesis in the mealworm, Tenebrio molitor L. (Coleoptera, Tenebrionidae). Acta Entomol. Bohemoslov. 65(4):272-275.

Amos, T. G. 1968. The effect of light on the humidity reactions of Carpophilus dimidiatus and Tribolium castaneum. Entomol. Exp. Appl. 11(3):331-340.

________, 1969. Reactions of Carpophilus spp. (Coleoptera, Nitidulidae) to humidity with reference to gradient steepness. Anim. Behav. 17(1):9-13.

Atkins, M. D. 1968. Scolytid pheromones--ready or not. Can Entomol. 100(10):1009-1049.

Beament, J. W. L., and Treherne, J. E., ed. 1968. Insects and physiology; essays presented to Sir Vincent Wigglesworth--on his retirement from the Quick Chair of Biology and Directorship of the unit of Insect Physiology in the University of Cambridge. American Elsevier Publishing Company, New York. 378 pp.

Beenakkers, A. M. T. 1969. Carbohydrate and fat as a fuel for insect flight: a comparative study. J. Insect Physiol. 15(3): 353-361.

Berendes, H. D., and Boyd, J. B. 1969. Structural and functional properties of polytene nuclei isolated from salivary glands of Drosophila hydei.

Berck, B. 1968. Sorption of phosphine by cereal products. J. Agric. Food Chem. 13:419-425.

Berck, B. 1968. Effects on growth and development of T. confusum Duval exposed to cereal products treated with phosphine. Ann. Pesticide Res. Repts. of Nat'l. Comm. on Pesticide Use in Agric., Ottawa 7:304-305.

Berridge, M. J. 1968. Ion and water transport across epithelia. Insect and physiology, pp. 329-347.

Bettini, S., and Grasso, A. 1967. Physiologic resistance of insects to insecticides with special attention to biochemistry. (It) lst Super. Sanit Ann. 3(3/4):359-377.

Boas, H. 1952. A case of universal exanthem produced by the rice flour beetle Tribolium destructor. Ugeskrift for Laeger 114:1641.

Borden, J. H., and Slater, C. E. 1968. Induction of flight muscle degeneration by synthetic juvenile hormone in Ips confusus (Coleoptera: Scolytidae). A. Vergleichende Physiol. 61(3): 366-368.

Brega, A., Falaschi, A., de Carli, L., and Pavan, M. 1968. Studies on the mechanism of action of pederine. J. Cell Biol. 36(3): 485-496.

Browning, T. O. 1968. Water and the eggs of insects. Insect and physiology, pp. 315-328.

Bursell, E., and Clements, A. N. 1967. The cuticular lipids of the larva of Tenebrio molitor L. (Coleoptera). J. Insect Physiol. 13(11):1671-1678.

Burtt, E. T. 1968. Some problems of insect vision. Insect and physiology, pp. 217-232.

Byrne, H. D. 1969. The oviposition response of the alfalfa weevil Hypera postica (Gyllenhal). Md. Agr. Exp. Sta. Bull. 160, 42 pp.

Calkins, C. O. 1969. Effect of temperature, light, and date of collection on the feeding rate of the sweetclover weevil Sitona cylindricollis. J. Econ. Entomol. 62(1):169-171.

Chang, P. I., and Fraenkel, G. 1953. Histopathology of vitamin B_T (carnitine) deficiency in larvae of meal worm Tenebrio molitor. Physiol. Zool. 27:259.

Claudsley-Thompson, J. L. 1953. Studies in diurnal rhythms. IV. Photoperiodisms and geotaxis in Tenebrio molitor L. (Coleoptera: Tenebrionidae). Roy-Ent. Soc. London. Proc. Ser. A, Gen. Ent. 28:117-132.

Colhoun, E. H. 1968. Pharmacological tantalizers. Insect and physiology pp. 201-213.

Crowson, R. A. 1967. The natural classification of the families of Coleoptera. Middlesex, Classey, 1967. 214 pp.

Davey, K. G. 1968. The physiology of reproduction: some lessons from insects. Insect and physiology, pp. 351-364.

David, W. A. L. 1968. The physiology of the insect integument in relation to the invasion of pathogens. Insect and physiology, pp. 17-35.

Davis, G. R. F. 1968. Dietary alanine and proline requirements of the beetle, Oryzaephilus surinamensis. J. Insect Physiol. 14(9): 1247-1250.

Desai, L., and Tencer, R. 1968. Effects of histones and polylysine on the synthetic activity of the giant chromosomes of salivary glands of Dipteran larvae. Exp. Cell Res. 52(1):185-197.

Desveaux-Chabrol, J. 1968. Recent acquisitions on the biology of histones. (Fr.) Ann. Biol. 7(7/8):369-427.

Eckert, M. 1968. Adaptation to light and darkness by the acone apposition eyes of insects. (Ge) Zool. Jahrbucher Abt. Allg. Zool. Physiol. Tiere 74(1):102-120.

Edwards, J. S. 1968. Some questions for the insect nervous system. Insect and physiology, pp. 163-173.

Eisner, T., and Blumberg, D. 1959. Quinone secretions: a widespread defensive mechanism of anthropods. (Abs.) Anat. Rec. 134: 558-559.

Engelhardt, M., Rapoport, H., and Sokoloff, A. 1965. Comparison of the content of the odoriferous gland reservoirs in normal and mutant Tribolium confusum. Science 150:632-633.

Etienne, J. 1956. La carnitine, facteur de croissance. Ann. de la Nutr. et de l'Aliment. 10:113-126.

Fairbanks, L. D., and Burch, G. E. 1968. Wholebody turnover of sodium in adult Drosophila (Drosophiladae) and Megaselia (Phoridae). Physiol. Zool. 41(4):401-423.

Florentine, G. J. 1967. An abdominal receptor of the American cockroach, Periplaneta americana (L.), and its response to airborne sound. Jour. Insect Physiol. 13:215-218.

________, 1968. Response characteristics and probably behavioral roles for abdominal vibration receptors of some cockroaches. J. Insect Physiol. 14:1577-1588.

Furlenmeier, A., Furst, A., Langemann, A., Waldvogel, G., Hocks, P., Kerb, U., and Wiechert, R. 1967. On insect hormones. IX. Synthesis of ecdysone. (Ge) Helv. Chim. Acta 50(8):2387-2396.

Geyer, A., Herda, G., and Schmialek, P. 1968. The effect of farnesyl methyl ether on the metabolism of Tenebrio molitor (Coleoptera) during pupal phase. (Ge) Acta Entomol. Bohemoslov. 65(4):253-262.

Giese, A. C., ed. 1968. Photophysiology: current topics. Volume IV. Academic Press, New York, 373 pp.

Happ, G. M. 1968. Quinone and hydrocarbon production in the defensive glands of Eleodes longicollis and Tribolium castaneum (Coleoptera, Tenebrionidae). J. Insect Physiol. 14(12):1821-1837.

Harein, P. K., and Press, A. F. 1968. Mortality of stored-peanut insects exposed to mixtures of atmospheric gases at various temperatures. J. Stored Prod. Res. 4(1):77-82.

Hassell, M. P., and Huffaker, C. B. 1969. The appraisal of delayed and direct density-dependence. Can. Entomol. 101(4):353-361.

Hayes, D. K., and others. 1968. Oxygen uptake of single insects determined with a polarographic oxygen electrode. Anal. Bio-chem. 26(1):51-60.

Heitz, E. 1954. Nouvelles actions repulsives excrcées par la peau au le corps de divers animaux sur des animaux de même espèce. Soc. de Biol. Compt. Rend. 148:717-719.

Howe, R. W., and Hole, B. D. 1968. The susceptibility of developmental stages of Sitophilus granarius (L.) (Coleoptera, Curculionidae) to moderately low temperatures. J. Stored Prod. Res. 4(2): 147-156.

Hueper, W. C. 1965. Experimental studies on 8-hydroxyquinoline in rats and mice. Arch. Path. 79:245-250.

Hurlock, E. T. 1965. Some observations of the loss in weight caused by Sitophilus granarius (L.) (Coleoptera, Curculionidae) to wheat under constant experimental conditions. J. Stored Prod. Res. 1:193-195.

Kadoum, A. M. 1969. Effect of radiofrequency electric field treatment on protein metabolism in yellow mealworm (Tenebrio molitor) larvae. J. Econ. Entomol. 62(1):220-223.

Karlson, P., and others. 1969. The amino acid composition of various types of cuticle of Limulus polyphemus. J. Insect Physiol. 15(3):495-507.

Kawai, S., and Tamaki, Y. 1969. Honeydew excretion of Cerophastes pseudoceriferas Green (Homoptera: Coccidae) and its application to evaluate insecticides. Jap. J. Appl. Ent. Zool. 13:150-158.

Kunkel, H. A., Trams, A., and Claudius, V. 1967. The mutagenic effect of N-nitroso-N-methylacetamid on Drosophila melanogaster. (Ge) Biophysik 4(1):90-91.

Ladisch, R. K. 1964. Quinone toxins and allied synthetics in carcinogenisis. Proc. Pa. Acad. Sci. 38:144-149.

________, and Suter, Str. M. St. A. 1965. Tetritoxin: synthesis and toxicity rating. Proc. Pa. Acad. Sci. 39:42-47.

________, Ladisch, S. K., and Howe, P. M. 1967. Quinoid secretions in grain and flour beetles. Proc. Pa. Acad. Sci. 41:213-219.

Lall, R. M. 1968. The influence of temperature and humidity on the development of Tenebrio molitor L. Diss. Abstr., Sec. B, 29(1):415B.

Lambremont, E. N., and Wood, R. 1968. Glyceryl ethers in insects: identification of alkyl and alk-l-enyl glyceryl ether phospholipids. Lipids 3(6):503-510.

Laverdure, A. M. 1968. Study of the evolution of proteins during the post embryonal development of Tenebrio molitor (Coleoptera) by gel starch electrophoresis. (Fr) Acad. Sci. C. R., Ser. D, 267(23):1996-1998.

Leclerq, J. 1955. New data about dl-carnitine as a growth factor of Tenebrio molitor larvae. Volding 16:785-790.

________, 1954. Remplacement de la carnitine naturelle par la "dlcarnitine" synthetique dana le régime nutritif de Tenebrio molitor L. Biochem. et Biophys. Acta 13:160.

Lees, A. D. 1968. The diversity of biological clocks in insects. Insect and physiology, pp. 89-99.

Lefkovitch, L. P. 1967. Larval movement of Lasioderma serricorne (F.) (Coleoptera: Anobiidae) in a plane. Res. Population Ecol. 9(1):45-57.

Lenz, M. 1968. The effect of molds on various species of animals. 1. (Ge) Z. Angew. Zool. 55(3):295-374.

Lilly, C. E., and McGinnis, A. J. 1968. Quantitative responses of males of Limonius californicus (Coleoptera: Elateridae) to female sex pheromone. Can. Entomol. 100(10):1071-1078.

Loschiavo, S. R. 1969. Effects of the antifeeding compound AC-24055 (4(3,3-di-methyly-l-triazeno) acetanilide) on the survival, development, and reproduction of some stored-products insects. J. Econ. Entomol. 6 (1):102-107.

Luff, M. L. 1968. Some effect of formalin on the number of Coleoptera caught in pitfall traps. Entomol. Mon. Mag. 104(1247/1249): 115-116.

Lundberg, S. 1968. Current protective regulations for insects. (Sw) Entomol. Tidskr. 89(1/2):1-2.

Maddrell, S. H. P. 1968. Neurosecretion in insects. Insect and physiology, pp. 103-118.

Masner, P., Huot, L., Corrivault, G. W., and Prudhomme, J. C. The effect of reserpine on the function of gonads and its neuro-endocrine regulation in Tenebrionid beetles. J. Insect Physiology (in press).

Mayer, K. 1968. Utilization of attractants in pest control. 2. Sex attractants. (Ge) Gesunde Pflanzen 20(9):179-180, 182, 184-189.

McGinnis, A. J. 1969. Use of glutamic acid-U-C^{14} to determine nutritionally essential amino acids. Ent. Exp. Appl. 12:467-468.

Miller, P. L. 1968. The origins of motor acts in insects. Insect and physiology, pp. 267-299.

Miller, W. H., Bernard, G. D., and Allen, J. L. 1968. The optics of insect compound eyes. Science 162(3855):760-767.

Moore, R. F., and Taft, H. M. 1969. Effect of melatonin on egg production of the boll weevil, Anthonomus gradis. Entomol. Soc. Amer. Ann. 62(1):252.

Mordue, W. 1967. Cortisol and growth in insects. Compar. Biochem. Physiol. 23(3):721-727.

________, 1967. The influence of feeding upon the activity of the neuro-endocrine system during oocyte growth in Tenebrio molitor. Gen. Compar. Endocrinol. 9(3):406-415.

Murray, D. R. P. 1968. The importance of water in the normal growth of larvae of Tenebrio molitor. Entomol. Exp. Appl. 11(2): 149-168.

Naton, E. 1967. Accomplishment of the blockade of carnitine by the gamma-butyrobetaine in the larvae of Tribolium destructor Uyttenb. (Coleoptera, Tenebrionidae) and some other storage pests. (Ge) J. Stored Prod. Res. 3(1):49-63.

Novak, V. J. A. 1968. The juvenile hormone and the problem of animal morphogenesis. Insect and physiology, pp. 119-132.

Perron, J. M., Corrivault, G. W., and Huot, L. 1969. Neuroleptic substances and behavior of insects. VI. Influence of reserpine on body weight of Tribolium confusum Duval. (Fr) Compar. Biochem. Physiol. 28(1):215-220.

Po-Chedley, D. S. 1960. Electrophoretic patterns of mealworm proteins. Nature 183:62.

Regnier, F. E., and Law, J. H. 1968. Insect pheromones. J. Lipid Res. 9(5):541-551.

Shevkunova, V. S. 1968. The phagocytic reactions and bactericidal action of insect hemolymph. (Rus) Akad. Nauk SSSR. Sib. Otd. Izv. Ser. Biol.-Med. Nauk 1:90-94.

Smith, D. S. 1968. The trophic role of glial cells in insect ganglia. Insect and physiology, pp. 189-198.

Soderstrom, E. L. 1968. Phototactic response of adults of confuses flour beetle and red flour beetle and larvae of black carpet beetle to flashes of blue-white light. J. Econ. Ent. 61(4):973-975.

Suter, Sr. M. St. A., and Ladisch, R. K. 1963. Toxicity of insect quinones to mice. Proc. Pa. Acad. Sci. 37:137-141.

Taher, M. 1968. Some physiological effects of sublethal doses of DDT on flour beetles (Tribolium confusum). Diss. Abstr., Sec. B, 28(12, pt.1):5067B.

Tamaki, Y., Yushima, T., and Kawai, S. 1969. Wax secretion in a scale insect, Ceroplastes pseudoceriferus Green (Homoptera: Coccidae). Appl. Ent. Zool., 4:126-134.

Tamaki, Y. 1969. Waxy covering of scale insects--secretion, construction and chemical natures. Botyu-Kagaku 34:86-96.

________, 1969. X-ray diffraction studies on waxy covering of scale insects (Homoptera: Coccoidae). Appl. Ent. Zool. 4:79-86.

Tenckhoff-Eikmanns, I. 1959. Licht-und Erd-schwerorientierung heim Mehlkäfer Tenebrio molitor L. und bei einigen anderen Insekten. Zool. Beitr. 4:307-341.

Treherne, J. E. 1968. Axonal function and ionic regulation in insect central nervous tissues. Insect and physiology, pp. 175-188.

Tschinkel, W. R. 1969. Phenols and quinones from the defensive secretions of the Tenebrionid beetle, Zophobas rugipes. J. Insect Physiol. 15(2):191-200.

Vuillaume, M., and Grouselle, M. 1968. Tetrapyrrolic green pigments in insects. (Fr) Soc. Chim. Biol. Bull. 50(3):681-683.

Wang, C. M., and Patton, R. L. 1968. The separation and characterization of the haemolymph proteins of several insects. J. Insect Physiol. 14(8):1069-1075.

Wessing, A. 1968. Functional morphology of excretion organs of insects. (Ge) Deut. Zool. Ges. Verhandl. 1967:633-681.

Weis-Fogh, T. 1968. Metabolism and weight economy in migrating animals, particularly birds and insects. Insect and physiology, pp. 143-159.

Wiesmann, R. 1967. Physiological bases for attracting and capturing insects. (Ge) Schweiz, Entomol. Ges. Mitt. 40(1/2):37-55.

Wilde, J. de, and Boer, J. A. de. 1969. Humoral and nervous pathways in photoperiodic induction of diapause in Leptinotarsa decemlineata. J. Insect Physiol. 15(4):661-675.

Williams, C. M. 1968. The present status of the brain hormone. Insect and physiology, pp. 133-139.

Wool, D. 1969. The effect of brief periods of freezing on population parameters of black and wild type T. castaneum. Tribolium Inform. Bull. 11:113-117.

Wright, R. H. 1968. How animals distinguish odours. Sci. J. 4(7):57-62.

Wynder, E. L., Kmet, J., Dungal, N., and Segi, M. 1963. The epidemiological investigation of gastic cancer. Cancer 16:1461-1496.

Yana, A., and Baldy, C. 1967. Note breve sur le principe de l'effet choc multiple (A brief note on the principle of multiple-shock impact). I-II. Tunisie. Inst. Nat. Rech. Agron. Doc. Tech. 29, 10 pp.

Yinon, U., and Shulov, A. 1967. New findings concerning pheromones produced by Trogoderma granarium (Everts), (Coleoptera, Dermestidae). J. Stored Prod. Res. 3(3):251-254.

Yinon, U., and Shulov, A. 1969. Response of some stored-product insects to Trogoderma granarium pheromones. Ent. Soc. Amer. Ann. 62(1):172-175.

Zlotkin, E., and Levinson, H. Z. 1968. Influence of cecropia oil on cuticular phenols in Tenebrio molitor. J. Insect Physiol. 14(8):1195-1204.

SPACE AND AERIAL ECOLOGY

Holzapfel, E. P., and Harrell, J. C. 1968. Transoceanic dispersal studies of insects. Pacific Insects 10(1):115-153.

Taylor, L. R. 1967. The effect of weather on the height of flight of insects. Int. Biometeorol. Congr. Proc., 3d Congr.:583-584.

________, 1963. The mode of action of weather on insect flight. Int. Biometeoral. Congr. Proc., 3d Congr.:579-582.

STATISTICAL METHODS

Berck, B., and Gunther, F. A. 1970. Rapid determination of sorption affinity of phosphine by fumigation within a gas chromatographic column. J. Agric. Food. Chem. 18:148-153.

Berck, B., Westlake, W. E., and Gunther, F. A. 1970. Microdetermination of phosphine by GLC with microcoulometric, thermionic, and flame photometric detection. J. Agric. Food. Chem. 18:143-147.

Chauthani, A. R. 1968. Bioassay technique for insect viruses. J. Invertebrate Pathol. 11(2):242-245.

Constantino, R. F. 1968. A criterion of transformation for age-weight data on insect larval growth. Growth 32(1):71-73.

Ohnesorge, B. 1968. The problem of statistical determination of density dependent mortality. (Ge) Z. Angew. Entomol. 61(4):403-406.

Rohlf, F. J., and Sokal, R. R. 1969. Statistical tables. W. H. Freeman & Co., San Francisco and London, 253 pp.

Sinha, R. N. 1969. Computer and the use of the multivariate statistics in stored grain research. Proc. Symposium on Biol. Contam. of Grain and Animal byproducts. Univ. of Minn., Minneapolis. pp. 7-16.

Sokal, R. R., and Rohlf, F. J. 1969. Biometry. W. H. Freeman & Co., San Francisco and London. 776 pp.

TAXONOMIC STUDIES

Aitken, A. D. 1965. A new species of Oryzaephilus (Coleoptera, Silvanidae) from East Africa. Proc. R. Ent. Soc., London (B), 34(9010): 123-126.

Ardoin, P. 1967. Revision of African Amarygmini. II. (Fr) Inst. Fondamental Afr. Noire Bull., Ser. A, Sci. Natur. 29(4):1568-1619.

________, 1967. New species and sub-species in Tenebrionidae of Madagascar (Coleoptera). (Fr) Soc. Entomol. France. Bull. 72(5/6): 179-182.

________, 1967. New Tenebrionidae species from Laos (Coleoptera). (Fr) Soc. Entomol. France. Bull. 72(7/8):252-255.

Ashman, F., and Higgs, G. A. 1968. A horned strain of Oryzaephilus surinamensis (L.) (Coleoptera, Silvanidae) from the Mediterranean region. J. Stored Prod. Res. 4(3):203-211.

Bachmayer, F., and Vasicek, W. 1967. Insect remains of the perm, from Zobing at Krems in lower Austria. (Ge) Naturhist. Mus. Wien Ann. 71:13-18.

Bogachev, A. V. 1967. New genus and species of Tenebrionidae from the Apsheron Peninsula. (Rus) Akad. Nauk Azerbaidzh. SSR. Inst. Zool. Tr. 26:157-163.

Crowson, R. A. 1968. Concerning immunota onomy of Coleoptera. Syst. Zoology 17:95-97.

________, 1967. The natural classification of the families of Coleoptera. E. W. Classey, London.

Emerson, A. E. 1968. A revision of the fossil genus Ulmeriella (Isoptera, Hodotermitidae, Hodotermitinae). Amer. Mus. Novitates 2332: 1-21.

Freude, H. 1967. Revision of the Epitragini (Coleoptera, Tenebrionidae). (Ge) Munich Mus. G. Frey Entomol. Arb. 18:137-307.

Haarlov, N. 1967. Arthropoda (Acarina, Diptera) from subfossil layers in West Greenland. Meddelelser Gronland 184(3), 30 pp.

Halstead, D. G. H. 1967. Notes on the systematics and distribution of some Tribolium species (Coleoptera: Tenebrionidae). J. Stored Prod. Res. 3(3):269-272.

Kiriakoff, S. G. 1967. Has there been a revolution in Taxonomy? (Numerical taxonomy). (Fr) Soc. Roy. Entomol. Beig. Bull. Ann. 103(5/6): 163-174.

Krieg, A. 1968. A taxonomic study of Bacillus thuringiensis Berliner. J. Invertebrate Pathol. 12(3):366-378.

Okada, T. A revision of the subgenus Hirtodrosophila of the old world, with descriptions of some new species and subspecies (Diptera, Drosophilidae, Drosophila). Mushi 41(1):1-36.

Peck, S. B. 1968. A new cave catopid beetle from Mexico, with a discussion of its evolution. Psyche 75(2):91-98.

Sleeper, E. L. 1968. A new fossil weevil from Nevada (Coleoptera: Curculionidae). Southern Calif. Acad. Sci. Bull. 67(3): 196-198.

Smith, Jr., L. W., and Pratt, Jr. J. J. 1969. Note on the occurrence of Trogoderma parabile Beal in Massachusetts. Coleopterist's Bulletin 23(1):19.

Steyskal, G. C. 1968. The number and kind of characters needed for significant numerical taxonomy. Syst. Zool. 17(4):474-477.

Stormer, L. 1969. Oldest known terrestrial Arachnids. Science 164(3885): 1276-1277.

Tichomirova, A. L. 1968. The comparative data on Hygrophilous staphylinids (Coleoptera, Staphylinidae). (Rus) Zool. Zh. 47(10): 1498-1505.

Woodroffe, G. E. 1962. The status of the foreign grain beetle, Ahasverus advena (Waltl.) (Col., Silvanidae) as a pest of stored products. Bull. Ent. Res. 53:537-540.

TECHNIQUE

Adler, V. E. 1969. Modified container for study of photoperiodism. J. Econ. Entomol. 62(1):269-270.

Anderson, G. R., Melanson, H. G., and Klassen, W. 1969. A portable temperature alarm for insect-rearing rooms. J. Econ. Entomol. 62(1):274.

Barnes, D. K., Norwood, B. L., Hanson, C. H., Ratcliffe, R. H., and Blickenstaff, C. C. 1969. A mass screening procedure for isolating alfalfa seedlings with resistance to the alfalfa weevil (Hypera postica). J. Econ. Entomol. 62(1):66-69.

Basford, N. L., Butler, J. E., Leone, C. A., and Rohlf, F. J. 1968. Immunologic comparisons of selected Coleoptera with an analysis of relationships using numerical taxonomy methods. Syst. Zool. 17:388-406.

Berck, B. 1968. Potentiometric determination of phosphine. J. Agric. Food Chem 13:415-418.

________, 1968. Improved methods for determination of free phosphine residues. Ann. Pesticide Res. Repts. of Nat'l. Comm. on Pesticide Use in Agric., Ottowa 7:305-306.

________, 1969. Measurement of phosphine by GLC and microcoulometric, thermionic, and flame photometric detection, and separation from sulfur-containing gases. Proc. 4th Annual Pest. Residue Anal. Seminar, Univ. of Manitoba, Winnipeg 4:69-77.

Daum, R. J., and McKibben, G. H. 1969. A vacuum probe for manipulating insects. J. Econ. Entomol. 62(1):267-269.

Despeignes, J., and Battest , M. R. 1968. Preservation of Arthropods in a transparent plastic. (Fr) Ann. Parasitol. Humaine Comp. 43(5):613-614.

Dessart, P., and Jung, A. 1918. Softening of Coleoptera. (Fr) Entomops 12:143-144.

Feir, D., and O'Connor, G. M. 1969. Liquid nitrogen fixation: A new method for hemocyte counts and mitotic indices in tissue sections. Entomol. Soc. Amer. Ann. 62(1):246-247.

Gaprindashvili, N. K., Yashvili, G. V., Kharazishvili, K. V., Gumberidze, O. D., and Tvaradze, M. S. 1968. Data for the development of a method for laboratory cultivation of Rhizophagus grandis Gyll. (Rus) Akad. Nauk Gruz. SSR. Soobshch. 50(3):735-740.

Hall, T. F., Breeland, S. G., and Anderson, P. K. 1969. The use of Cherry-laurel (Prunus caroliniana) foliage for preparation of an effective insect-killing jar. Entomol. Soc. Amer. Ann. 62(1):242-244.

Hartstack, A. W., and Hollingsworth, J. P. 1968. An automatic device for dividing and packaging light trap insect catches according to time intervals. U.S. Agr. Res. Serv. ARS-42-146, 14 pp.

Ito, Y. 1968. Techniques for controlling insects by taking advantage of mating habits. 3. (Ja) Nogyo Gijutsu 23(9):1-6.

Jackson, D. A. 1969. A technique for removing appendages from small, dry-mounted insects for microscopic examination. Entomol. Soc. Wash. Proc. 71(1):93.

Kaszab, Z. 1967. Species in the genus Philhammus fairm (Coleoptera, Tenebrionidae). (Ge) Budapest. Termeszettud. Muz. Evk. Ann. Hist.-Nautr. Mus. Nat. Hung. 59:291-296.

Keith, D. L., Roselle, R. E., and Anderson, L. W. 1969. Common soybean insects. Nebr. Univ. Ext. EC 69-1521, 2 pp.

Kimoto, S. 1967. Some quantitative analysis on the Chrysomelid fauna of the Ryukyu Archipelago. Esakia 6:27-54.

Knipling, E. F. 1963. The self-destruction method in insect control. Umschau 63:632-636.

Nielsen, R., and Rasmussen, H. 1968. Fractionation of extracts of firefly tails by gell filtration. Acta Chem. Scand. 22(6):1757-1762.

Nijholt, W. W., and Chapman, J. A. 1968. A flight trap for collection living insects. Can. Entomol. 100(11):1151-1153.

Patton, R. L., Edwards, L. J., and Gilmore, S. K. 1968. Delivering safe levels of CO_2 for insect anesthesia. Entomol. Soc. Amer. Ann. 61(4):1046-1047.

Rasmussen, H., and Nielsen, R. 1968. An improved analysis of adenosine triphosphate by the luciferase method. Acta Chem. Scand. 22(6):1745-1756.

Ricker, D. W., and Goeden, R. D. 1968. A fume ventilator for dissecting microscopes. Entomol. Soc. Amer. Ann. 61(4):1043-1044.

Roberts, D. W., and Granados, R. R. 1968. An inexpensive device for pulling glass microneedles for injection of small arthropods. Entomol. Soc. Amer. Ann. 61(4):1042-1043.

Roth, M., Gutierrez, J., and Couturier, G. 1968. Comparison of various types of sticky traps. (Fr) Soc. Entomol. France. Ann. (n.s.) 4(1):81-90.

Sokoloff, A. 1962. A simple technique for ridding Tribolium cultures of parasites. Tribolium Inform. Bull. 5:48.

Stadelbacher, E. A. 1969. Chambers for incubating individual insect eggs and egg parasites. J. Econ. Entomol. 62(1):253-254.

Stewart, P. A., and Lam, J. J. 1969. Measuring newly hatched phytophagous larvae in the field or greenhouse. J. Econ. Entomol. 62(1):259.

Wigglesworth, V. B. 1950. A new method for injecting the tracheae and tracheoles of insects. Quart. J. Micr. Aci. 91:217-224.

Whitten, M. J. 1969. Automated sexing of pupae and its usefulness in control by sterile insects. J. Econ. Entomol. 62(1):272-273.

Wilson, E. O., and Simberloff, D. S. 1969. Experimental zoogeography of islands: Defaunation and monitoring techniques. Ecology 50(2): 267-278.

Yurkiewiez, W. J. 1968. Glass fiber-silica gel sheets for insect phospholipid fractionation. Entomol. Soc. Amer. Ann. 61(4):1026-1027.

TERATOLOGY

Lenko, K. 1968. A case of micromelous teratology in Crathoplus squamiferus (Coleoptera, Rutelidae). (Sp) Soc. Urdguaya Entomol. Rev. 7:45-47.

Steinhaus, E. A., and Zeikus, R. D. 1968. Teratology of the beetle Tenebrio molitor. III. Ultrastructural alterations in the flight musculature of the pupal-winged adult. J. Invertebrate Pathol. 12(1):40-52.

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Iwao, S., Phase polymorphism in army worms census method.
Mizuta, K. Aggregation in Lepidoptera.
Mogi, M. Ecology of Coccinelid.
Murai, M. Statistical side of population ecology.
Nakamura, H. Geographical variation in azuki bean weevil.
Okamoto, K. Host-parasite interaction.
Sano, I. Phase-polymorphism in Bruchid.
Sinha, R. N. Ecology of stored products pests.
Takahashi, F. Experimental population ecology.
Utida, S. Ecology of Bruchid.

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