

THE FRASS NEWSLETTER:



INSECT REARING GROUP

VOL. 12 No. 1 September 1989

Monitoring the Advances and Challenges in Insect Rearing

FRASS: Who wants it?!?!

by Jay Pershing
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More specifically, who wants the opportunity to edit the FRASS Newsletter for 1990? The opportunity will be presented during the business portion of the Insect Rearing Formal Conference, ESA National Meeting at San Antonio. If you're interested, but unable to attend, please contact by writing or calling at the address and phone number given above.

Before I sign off I would like to take the time to express some thoughts on the opportunity and responsibility provided by editing FRASS. The responsibility of the editor(s) include compiling, organizing and distributing information in the form of a newsletter. Information for the newsletter may be obtained in any number of ways; but, depends on the effort put forth by the editor(s). A regional editorial board was established at last year's rearing conference, ESA National Meeting, 1988, in Louisville, as a mechanism for increasing input (e.g., articles, announcements and advertisements). It will be the editor's responsibility to fill these positions if this organizational structure is to be maintained.

The Frass Newsletter is 100% voluntary; therefore, when I use the term responsibility, I use it loosely. In other words, the volunteer decides when, how and where the FRASS Newsletter takes shape.

Unequivocally, the benefits of editing FRASS are numerous. It is an excellent way to be involved in the rearing community and provide a service in a profession where the unknowns are greater than the known and where the art in many cases is more important than the science. The skill base is out there, and from my experience, the people with the skill are willing to share their knowledge and insight. The FRASS Newsletter is one vehicle in bringing together these skills. I, for one, am very much indebted to the pioneers of this newsletter.

For 1989, I would like to thank all those who have contributed to this issue of FRASS. I must confess, I have not replied to all correspondence that I have received, some of which is grossly overdue. For those whom I have not taken the time to address, beware, I will!

Finally, I would like to comment on the continued publication of FRASS. Tom ODell (see Announcements, this issue) has made the statement that the key to FRASS achieving its purpose is consistency. Tom further says "since the editing is all voluntary, publication consistency is dependent on priorities relative to the other commitments of the editors-- it's a fact of life. But, it has to be recognized that consistency is the main ingredient to the success of FRASS (or any other newsletter) as a communication vehicle for all of us bug pushers." Well said Tom! I could not agree more. Unfortunately, I do not always practice what I preach and I am only now finally getting out the first issue of FRASS for 1989. however, better late than never!

I will be waiting eagerly by the phone and watching the morning's mail for questions and comments about the editorship of Frass. Then we can all look forward to meeting our new editor(s) at the 1989 ESA National meeting in San Antonio!

NOV 21 1989

ICIPE: The International Centre of Insect Physiology and Ecology
by Dr. R.S. Ociheng, ICIPE, Nairobi Kenya

The International Centre of Insect Physiology and Ecology (ICIPE) is located in Nairobi, Kenya, with the sole aim of improving food production for the resource limited, small-scale farmers in the tropic. It is also required to train people in those areas, in Scientific Leadership.

The research areas of the ICIPE are given in the mandate targeting arthropod pests of Medical and Agricultural importance. The core research programmes are meant to achieve the requirements of the mandate by working on selected objectives in the field of basic Biology and Ecology of the arthropods. This can only be achieved when the core programmes have a dependable supply of quality target arthropod pests. Experimental work such as in bioassays and maintenance of selected insect pathogens, also requires a dependable supply of certain laboratory animals. After carrying out feasibility studies, the ICIPE was convinced that target arthropods and laboratory animals could not be purchased locally at an economic cost. Also, it was not possible to achieve high quality standards required by the centre. An Insect Mass Rearing Technology Unit (IMRT) was therefore formed to meet this essential demand and quality criteria of the ICIPE.

CRITERIA FOR SELECTION OF ARTHROPODS TO REAR
The IMRT acts as a support and service unit to the various core programmes. This means that only arthropod pests and laboratory animals of interest to the ICIPE research programmes are maintained.

WHY THE CENTRALIZED SYSTEM?

ICIPE recognizes that centralized systems are the most affective in operation and resource allocation. The IMRT experience has since proved that the centralization of operations is the most effective in utilization of man power, equipment and financial resources.

STRUCTURE OF IMRT

The Unit has its headquarters at the ICIPE Duduville complex in Nairobi, Kenya. It also has a branch at Mbita Point Field Station at the shores of lake Victoria. The facilities at Duduville are used for rearing Phytophagous and haematophagous insects as well as animal breeding. The Unit is split into two sections. The Support Services Section and the Research and Development (R & D) Section. The Support Services section is charged with the routine production of target insects and animals required for the experimental research by the various programmes. The R & D Section formulates and tests food sources in rearing and breeding, develops standard rearing procedures (SRP), designs Insect Rearing Management (IRM) programmes and develops quality assessment procedures for incorporation into quality

control of the Support Services Section. The R & D Section also maintains a reference bureau with an up-to-date reference list for insect rearing and animal breeding.

WHAT ARE THE TARGET ARTHROPODS REARED

- At the IMRT headquarters in Nairobi, the Unit rears and maintains the following:
1. Chilo partellus (spotted stem borer). This is a cereals stem borer. It damages sorghum, maize, millet and rice.
 2. Mosquitoes: various species are reared and maintained.
 3. Glossina pallidipes: This is a tsetse fly species that is a vector of trypanosomiasis. (Sleeping sickness).
 4. Glossina morsitans morsitans: This is also a tsetse species that carries nagana in cattle. They are widely spread all over Africa.
 5. Spodoptera exempta (the African Armyworm): This is a browsing insect pest that chews and feeds on all leaves of cereal crops.

At Mbita Point Field Station (MPFS), the following pests are reared:

1. Chilo partellus
2. Maruca testulalis: This is a legume pod borer of major importance in the tropics.
3. Neoseiulus teke: This is a phytoseiid predatory mite of the Cassave Green Spider Mite: It is reared on artificial diet developed at the ICIPE.
4. Russeola fusca: Maize stem borer. This is a major pest at the high altitude farming areas.
5. Eldana saccharina: This is a sugar cane stem borer but it also attacks other cereal crops such as maize and sorghum.
6. Glossina pallidipes.
7. Glossina fuscipes: This is a riverine tsetse species of major importance. It is a vector of sleeping sickness as well.

A MORE EFFICIENT METHOD TO RECOVER SUNFLOWER MOTHE PUPAE

by R.L. Wilson
USDA, ARS, No. Ctr. Reg. Plt. Intro. Stn., Iowa State University, Ames, IA 50011

Sunflower moths, Homoeosoma electellum (Hulst), are reared in our laboratory using a modified Adkisson et al. (1960) diet. The basic modification we made to the diet preparation was to use a commercially available vitamin mix and to cook the agar in microwave oven. This diet provides an excellent growth medium for the insect.

A small problem occurs when the larvae pupate. They form pupation cells throughout the diet container. In order to recover the pupae, we have to pick them from the container walls, from the lids, and from within the diet itself. This pupal recovery stage is very time consuming and makes the rearing process some what inefficient.

Cardboard rings, originally designed for European corn borer rearing (Reed et al. 1972), were placed around the top of the diet containers to give the sunflower moth larvae places to crawl into and pupate. In order to increase larval preference for using the cardboard rings, we recycled, for future generations, only those pupae that had been found in the rings.

Over a period of 7 generations, the pupation rate in the rings increased from 33.2% to 92.6%. Using the rings not only makes pupal recovery easier but it also saves time. It took 2 hr to recover 110 pupae by hand picking through the diet containers, while 250 pupae were recovered in the same amount of time from the cardboard rings.

Literature Cited:

- Adkisson, P.L., E.S. Vanderzant, D.L. Bull, and W.E. Allison. 1960. A wheat germ medium for rearing the pink bollworm. *J. Econ. Entomol.* 53: 759-762,
- Reed, G.L., W.B. Showers, J.L. Huggans, and S.W. Carter. 1972. Improved procedures for mass rearing the European corn borer. *J. Econ. Entomol.* 65: 1472-1476.

USE OF ANTIBIOTICS TO CONTROL BACTERIA IN THE DIGESTIVE TRACTS OF WESTERN CORN ROOTWORM

by Terry F. Branson and Jan J. Jackson
Northern Grain Insects Research Laboratory,
USDA, ARS, Brookings, SD 57006

Our laboratory colonies of the western corn rootworm (*Diabrotica virgifera virgifera* Leconte) have been plagued for years with bacteria in the adults' digestive tracts. These bacteria produce toxins, which decrease fecundity and longevity. The bacteria are flushed out of the gut and are consequently no longer a problem when adults are fed fresh plant material (pieces of winter squash, leaves of seedling corn, immature corn ears, lettuce), but feeding fresh plant material also has problems: it is much more expensive than an artificial diet (prohibitively so with large colonies), and it promotes infections of gregarines (protozoa), which can become a serious problem. As a result, for many years we have been feeding adult rootworms dry diets in either granular (Branson et al., 1975) or patty form (Branson and Jackson, 1988), and we have learned to tolerate our problem with bacteria.

Lately, we have been adding a commercially available mixture of the antibiotics lincomycin (1 part) and spectinomycin (2 parts) to a granular dry diet (0.3% by weight) and feeding this during the two-week mating and preoviposition period. After this period, the adults are fed our normal patty diet, with no antibiotic added, throughout their oviposition period. This regime has controlled the bacteria to the point that they are no longer adversely affecting our rootworm colonies.

We have found, however, that not all antibiotics are equally useful. Streptomycin, for example, when mixed with the diet at only 1% by weight causes females to lay sterile eggs. Two weeks after they are removed from this antibiotic, however, females will again lay fertile eggs, so the sterility appears to be reversible.

Literature Cited:

- Branson, T.F., and J.J. Jackson. 1988. Improved method for rearing *Diabrotica virgifera virgifera* (Coleoptera; Chrysomelidae). *J. Econ. Entomol.* 81: 410-414.
- Branson, T.F., P.L. Guss, J.L. Krysan, and G.R. Sutter, 1975. Corn rootworms: laboratory rearing and manipulation. U.S. Dept. Agric., Agric. Res. Serv. Bull. NC-28. 18 pp.

FRASS NEWSLETTER is a cooperative effort among the INSECT REARING GROUP, designed to provide a vehicle for communication among scientists involved in all aspects of insect rearing. FRASS is published bi-annually by the INSECT REARING GROUP that consists of the 300+ FRASS subscribers from 28 countries. This is your newsletter and its effectiveness as a communication tool depends on the continuous input of information from you. Your input is very important and needed to keep the INSECT REARING GROUP informed on the current state of the art and to promote its advancement.

Please give your support by sending to the FRASS Editor (Jay Pershing): Editorial comments, short papers on new rearing techniques, information requests, requests for starter colonies, your source lists for supplies, items for sale or trade, new publication citations or abstracts, announcements, appropriate meeting dates, or other related news items. But don't let these suggestions limit your input. What information would you like to publish in FRASS?.

FRASS EDITORS

- 1975 N. C. Leppla, USDA-ARS
1976 W. A. Dickerson, USDA-ARS
1977 T. M. Odell, USDA-ARS
1978 E. G. King, USDA-ARS
1979 J. D. Hoffman, USDA-ARS
1980 R. E. Wheeler, Chevron Chemical
1981 G. Rymeus, Zoecon Industries
1982-84 No issues, concentrated on other activities
1985 D. R. Edwards, FMC
1986 S. Burkhart, FMC
1987 R. E. Wheeler, Chevron Chemical*
1988 J. C. Pershing, Monsanto Agricultural Co.
1989 J.C. Pershing, Monsanto Agricultural Co.
*Frass is available to those scientists interested in rearing. Send subscription requests to: Ron Wheeler Chevron Chemical Corp.P.O. Box 4010 Richmond, CA 94804

UPCOMING EVENTS

The 1989 ESA Annual Meeting
Convention Center, San Antonio, Texas
December 10-14, 1989

FORMAL CONFERENCE: INSECT REARING
Scheduled for Wednesday morning, December 13,
1989.

THEME: "CAN INSECT REARING CHANGE YOUR
GENES?"

1989 Formal Conference Chair - Alan C. Bartlett
USDA, ARS, Western Cotton Research Laboratory,
4135 East Broadway,
Phoenix, AZ 85040
Telephone 602-261-3524

INTRODUCTION (5 minutes)
Alan C. Bartlett

GENETIC CHANGES IN FRUIT FLY POPULATIONS UNDER
LABORATORY COLONIZATION (30 minutes)
Stephen H. Saul
Department of Entomology, University of Hawaii,
Honolulu, HI 96822
Telephone 808-948-6740

STRAIN DETERIORATION IN THE SCREWORM ERADICATION
PROGRAM, NATURE VS NURTURE (30 minutes)
David B. Taylor USDA, ARS Biosciences Research
Laboratory, P.O. Box 5674, State University
Station, Fargo, ND 58105
Telephone 701-239-1270

CAN DOMESTICATION CHANGE THE PINK BOLLWORM (30
minutes)
Alan C. Bartlett

UNEXPECTED GENETIC EFFECTS OF COLONIZATION AND
INBREEDING: ALLOZYME TRACKING IN CULICIDAE (30
minutes)
Lionard E. Munstermann
Department of Biological Sciences, University of
Notre Dame, Notre Dame, IN 46556
Telephone 219-239-5445

BREAK

PANEL DISCUSSION (all participants) (30 minutes)

SUBMITTED PAPERS (60 minutes)
*Note: submitted papers are still being accepted.
Please send your title to Conference Chair - Alan
C. Bartlett.

BUSINESS MEETING (25 minutes)

ANNOUNCEMENTS

"STRAGGLING": A DEVELOPMENTAL
PHENOMENON IN GYPSY MOTH
by Tom Odell
USDA Forest Service, Hamden, CT 06514

A strain of gypsy moth, NJSS (New Jersey Standard Strain), has been in continuous culture since 1967 and is presently in its 33rd generation. In the last five generations a growth problem, known as straggling, has significantly reduced production of the insect for RD&A programs, including sterile male and virus production. In the NJSS, straggling can be quantitatively defined as the length of time in the first larval stage. Percent hatch, time to pupation, and pupal weight all can be correlated with "intensity" of straggling. Straggling also has been identified in close-to-wild strains, a non-diapause strain and, we believe, can be found in wild larvae. We are presently investigating the etiology of this abnormal (we think) growth problem. From conversations with others rearing lepidoptera, retarded growth is a consistent problem. We are studying the etiology of straggling in NJSS, and would like to know if others have observed and/or studied this phenomenon. Or, better still; have found a "treatment" for it. Please write or call: Tom Odell, Research Entomologist, USDA Forest Service, 51 Mill Pond Road, Hamden, CT 06514 USA. Ph. # 203-773-2024.

INSECT REARING TRAINING COURSE: Insect Rearing, DSIR, Plant Protection, Auckland, New Zealand is now offering a 12-week full-time training course for Insectary Managers. The course offers on-the-job training in a modern, well established insectary which pioneered the Insect Rearing Management (IRM) concept.

The course content include:
-Training in rearing research methods and laboratory management
-Preparation of IRM plan
-Quality control protocols in insect production
-Staff supervision and relationships

The course is guaranteed to increase the capabilities of Insectary Managers and lays emphasis on economic insect production to meet research goals.

The course Director is Dr. Pritam Singh. Please let Dr. Singh know if you are interested in participating: a mailing list is being developed for further information.

CONTACT

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RECENT PULICATIONS ON: INSECT REARING, NUTRITION, DIETETICS AND QUALITY CONTROL

compiled by Dr. Pritam Singh, Entomology
Division, Department of Scientific and
Industrial Research, Auckland, NZ

- Aijaz, R., K. Samad, M.F.Khan, and M.M.H. Baig. 1987. Evaluation of best and cheapest artificial diet for rearing Drosophila melanogaster. Pak. J. Zool. 19: 302-306.
- Alder, P.H. and R.L.C. Alder. 1988. Behavioral time budget for larvae Heliothis zea (Lepidoptera: Noctuidae) on artificial diet. Ann. Entomol. Soc. Am. 81: 682-688.
- Alrubeal, H.F. 1987. Growth and development of Ectomyelosis ceratoniae (Lepidoptera: Pyralidae) under laboratory mass-rearing conditions. J. Stored Prod. Res. 23: 133-135.
- Baker, J.E. 1988. Dietary modulation of - amylase activity in eight geographical strains of Sitophilus oryzae and Sitophilus zaeamays. Entomologia Exp. Appl. 46: 47-54.
- Barker, J.F. 1988. Laboratory rearing of the banded sunflower moth, Cochylis hospes, (Lepidoptera: Cochylidae). J. Kansas Entomol. Soc. 61: 350-352.
- Beck, S.D. 1988. Thermoperiod and larval development of Agrotis ipsilon (Lepidoptera: Noctuidae). Ann. Entomol. Soc. Am. 81: 831-835.
- Beier, M.S., J.C. Beier, A.A. Merdan, B.M.El Sawaf, and M.A. Kadder. 1987. Laboratory rearing techniques and adult life table parameters for Anopheles sergentii from Egypt. J. AM. Mosq Control Assoc. 3: 266-270.
- Blackman, R.L. 1988. Rearing and handling aphids. pp. 59-68. in World Crop Pests, Aphids. Vol 2B. A.K. Minks and Harrewijn, P. (eds.). Elsevier Science Publishers, Amsterdam, The Netherlands.
- Bordat, D. and M. Renand. 1987. Mussidia nigrivenella Ragonot (Lepidoptera: Pyralidae): Development of mass rearing on synthetic diets. Agron. Trop. 42: 139-144.
- Branson, T.F., J.J. Jackson and G.R. Sutter. 1988. Improved method for rearing Diabrotica virgifera virgifera (Coleoptera: Chrysomelidae). J. Econ. Entomol. 81: 410-414.
- Branson, T.F. and J.J. Jackson. 1988. An improved diet for adult Diabrotica virgifera virgifera (Coleoptera: Chrysomelidae). J. Kansas Entomol. Soc. 61: 353-355.
- Buschinger, A. and E. Pfeifer. 1988. Effects of nutrition on brood production and slavery in ants (Hymenoptera: Formicidae). Insectes Sociaux. 35: 61-69.
- Chi, G.K. and W.M. Getz. 1988. Mass rearing and harvesting based on an age-stage two sex-life table; a potato tuberworm (Lepidoptera: Gelechiidae) case study. Environ. Entomol. 17: 18-25.
- Clare, G.K., J.P. Ochieng-Odero, S.J. Dalzell, and P. Singh. 1987. A practical rearing method for leafrollers (Lepidoptera: Tortricidae). N.Z. J. Zool. 14: 597-601.
- Clare, G.K. and P. Singh. 1988. A laboratory rearing method for Epalaxiphora axenana on artificial diet and host plant. N.Z. Entomol. 11: 42-46.
- Clare, G.K. and P. Singh. 1988. A laboratory rearing of Ctenopseutis obliquana on an artificial diet. N.Z. J. Zool. 15: 435-438.
- Cohen, A.C. and N.M. Urias. 1988. Food utilization and egestion rates of the predator Geocoris punctipes (Hemiptera: Heteroptera) fed artificial diets with rutin. J. Entomol Sci. 23: 174-179.
- Das, P., A.K. Somchoudhury and A.B. Mukherjee. 1987. Rearing of mushroom mites on artificial diets. Environ. Entomol. 15: 685-687.
- de Saint Georges-Grèdelet, D. 1987. Physical and nutritional requirements of house-dust mite Dermatophagoides pteronyssinus and its fungal association. Acarologia 28: 345-353.
- Dover, B.A., R. Noblet, R.F. Moore, and D. Culbertson. 1988. An improved artificial diet for Mexican bean beetles based on host preference. J. Agr. Entomol. 5: 79-96.
- Fay, H.A.C. 1988. A starter diet for mass-rearing larvae of the Mediterranean fruit fly, Ceratatis capitata (Wied.). Z. Angew. Entomol. 105: 496-501.
- Foster, R.E. and R.H. Cherry. 1987. Survival of fall armyworm, Spodoptera frugiperda, (Lepidoptera: Noctuidae) exposed to cold temperatures. Fla Entomol. 70: 419-422.
- Garcia-Salzar, C., H. Podoler, and M.E. Whalon. 1988. Effects of temperature on diapause

- induction in the codling moth, Cydia pomonella (L.) (Lepidoptera: Olethreutidae). Environ. Entomol. 17: 626-628.
- Gardiner, B.O.C. 1987. Rearing the painted lady Cynthia Cardui L. with particular reference to the use of semisynthetic diet. Entomol. Rec. J. Var. 99: 205-214.
- Giret, M. and R. Couilloud. 1987. Production of Heliothis armigera (Hubner) (Lepidoptera: Noctuidae): technique for rearing caterpillars in groups. Cotton fibres Trop. 42: 211-216.
- Grant, J.F. and M. Shepard. 1987. Development of Brachymieria ovata (say) (Hymenoptera: Chalcididae) in freeze stored pupae of Lepidoptera species. Environ. Entomol 16: 1207-1210.
- Griffith, J.S.R. and P.T. Haskell. 1988. Culture of Heliothis armigera (Lepidoptera: Noctuidae) using novel group rearing techniques and a semi-artificial diet. Trop. Pest. Manag. 34: 349-355.
- Herard, F., M.A. Keller and W.J. Lewis. 1988. Rearing Microplitis demolitor Wilkinson for use in studies of semiochemical mediated searching behavior. J. Entomol. Sci. 23: 105-111.
- Hobson, J.M. and P. Singh. 1987. Laboratory colonization of Planotortrix excessana. N.Z. J. Zool. 14: 81-83.
- Hodek, I. and A. Honek. 1988. Sampling, rearing and handling of aphid predators. pp. 311-322. in A.K. Minks and P. Harrewijn (eds.). Elsevier Science Publishers, Amsterdam, The Netherlands.
- Hooper, G.H.S. 1987. Effect of pupation environment on the quality of pupae and adults of the Mediterranean fruit fly. Entomologia Exp. Appl. 44: 155-159.
- Hooper, G.H.S. 1987. Application of quality control procedures to large scale rearing of the Mediterranean fruit fly. Entomologia Exp. appl. 44: 161-167.
- Isenhour, D.J. and B.R. Wiseman. 1988. Incorporation of callus tissue into artificial diet as a means of screening genotypes for resistance to the fall armyworm and the corn earworm (Lepidoptera: Noctuidae). J. Kansas Entomol. Soc. 61: 303-307.
- Jones, W.A. Jr. and F.D. Brewer. 1987. Suitability of various host plant seeds and artificial diets for rearing Nezara viridula (L.). J. Agric. Entomol. 4: 223-232.
- Karunamoorthy, G. and C.M. Lalitha. 1987. Rearing of the Australian sheep blowfly Lucilia cuprina (Wiedemann). Cheiron. 16: 132-134.
- Kawashima, K. 1987. Rearing of the peach fruit moth, Carposina niponensis Walsingham (Lepidoptera: Carposinidae) on artificial diet. Jpn. J. Apl. Entomol Zool. 37: 257-260.
- Khattak, S.U. and J.F. Howell. 1987. Soya, a substitute ingredient for casein in the codling moth larval rearing medium. Pak. J. Sci. Ind. Res. 30: 857-858.
- Kindle, H., R., Koning and B. Lanzrein. 1988. In vitro uptake of vitellogenin by follicles of the cockroach Nauphoeta cinerea: comparison of artificial media with haemolymph media and role of vitellogenin concentration and of juvenile hormone. J. Insect Physiol. 34: 541-548.
- Klingauf, F.A. 1987. Feeding, Adaptation and Excretion. pp. 225-253. in Minks, A.K. and P. Harrewijn, Aphids their Biology, Natural Enemies and Control. Vol. 1B. Elsevier Science Publishers, Amsterdam, The Netherlands.
- Koyama, K. 1988. Artificial rearing and nutritional physiology of the planthoppers and leafhoppers (Hemiptera: Delphacidae and Deltocephalidae) on a holidic diet. JARQ. 22: 20-27.
- Lenz, M., T. Amburgey, Z.R. Dao. H. Kuehne, J.K. Mauldin, A.F. Preston and M. Westcott. 1987. Inter laboratory studies on termite-wood decay fungi associations: 1. Determination of maintenance conditions for several species of termites (Isoptera: Mastotermitidae, Termopsidae, Rhinotermitidae, Termitidae). Sociobiology 13: 1-58.
- Li, L.Y., M.F. Guo, H. Wu, and H. Chen. 1988. An artificial diet for Eocantthecona furcellata. Chinese J. Biol. Cont. 4: 45.
- Mackauer, M. and S. Kambhampati. 1988. Sampling and rearing of aphid parasites. pp. 205-216. in World Crop Pests, Aphids. Vol 2B, A.K. Minks and P Harrewijn (eds.), Elsevier Press, Amsterdam, The Netherlands.
- Mandeville, J.D., B.A. Mullens and J.A. Meyer. 1988. Rearing and host age suitability of Fannia canicularis (L.) (Diptera: Muscidae) for parasitization by Muscidifurax zaraptor Kogan and Legner (Hymenoptera: Pteromalidae). Can. Entomol. 120: 153-159.

- Martin, M.M. and H.M. Van't Hof. 1988. The cause of reduced growth of Manduca sexta larvae on a low-water diet: increased metabolic processing costs or nutrient limitation? *J. Insect Physiol.* 34: 515-525. *
- McFarlane, J.E. and A. Alli. 1988. Nutritional studies on the group effect in Acheta domesticus (L.). *J. Insect Physiol.* 34: 1-10.
- Meisner, P. 1987. Mass rearing of Diabrotica balteata LeConte (Coleoptera, Chrysomelidae). *MIT DUETS GESEL ALLGEM ANGEWANDT ENTOMOL* 5: 170-173.
- Mittler, T.E. 1988. Application of artificial feeding techniques for aphids. pp. 135-170. in A.K. Minks and P. Harrewijn (eds.). Elsevier Science Publishers, Amsterdam, The Netherlands.
- Motobayashi, T., Y. Kunimi, Y. Morita, and D. Tsuchiya. 1988. Effect of nutritional composition of medium and duration of culture time on conidial production of Beauveria bassiana isolated from the pine sawyer, Monochamus alternatus Hope (Coleoptera: Cerambycidae). *JPN J. Appl. Entomol. Zool.* 32: 187-191.
- Ng, S.S., F Davis and W.P. Williams. 1987. Coordinating supplies of southwestern corn borers (Lepidoptera: Pyralidae) and fall armyworms (Lepidoptera: Noctuidae) by manipulating development time using temperature. *J. Econ. Entomol.* 80: 1340-1344.
- Nitao, J.K. and M.R. Berenbaum. 1988. Laboratory rearing of the parsnip webworm, Depressaria pastinacella (Lepidoptera: Oecophoridae). *Ann. Entomol. Soc. Am.* 81: 485-487.
- Parasuraman, S. and A.A. Kareem. 1988. A synthetic diet for rice leafhopper. *IRRN* 13: 4.
- Peterson, S.S., J.M. Scriber and J.G. Coors. 1988. Silica, cellulose and their interactive effects on the feeding performance of the southern armyworm, Spodoptera eridania (Cramer) (Lepidoptera: Noctuidae). *J. Kansas Entomol. Soc.* 61: 169-177.
- Rotundo, G., R. Cavalloro and E. Tremblay. 1988. In vitro rearing of Lysiphlebus fabarum (Hymenoptera: Braconidae). *Entomophaga.* 33: 261-267. *
- Schmidt, D.J. and J.C. Reese. 1988. The effects of physiological stress on black cutworm, Agrotis ipsilon, larval growth and food utilization. *J. Insect Physiol.* 34: 5-10. *
- Simpson, S.J., M.S.J. Simmonds and W.M. Blaney. 1988. A comparison of dietary selection behaviour in larval Locusta migratoria and Spodoptera littoralis. *Physiol. Entomol.* 13: 225-238.
- Singh, P., N.C. Leppla and F. Adams. 1988. Feeding behavior and dietary substrates for rearing larvae of the Caribbean fruit fly, Anastrepha suspensa. *Fla. Entomol.* 71: 380-383.
- Singh, P. and G.K. Clare. 1988. A note on rearing of the monarch butterfly, Danaus plexippus (L.) on artificial diet. *N.Z. Entomol.* 11: 73-75.
- Strand, M.R., S.B. Vinson, W.C. Nettles Jr., and Z.N. Xie. 1988. In vitro culture of the egg parasitoid Telenomus heliothidis: the role of teratocytes and medium consumption in development *Entomologia Exp Appl.* 46: 71-78.
- Suenaga, O., K. Kurokawa and Y. Wada. 1987. A cube sugar technique for laboratory rearing of adult mosquitoes. *Trop. Med.* 29: 47-54.
- Tamarina, N.A. 1987. Entomological technology: The state of the art and its prospects. *Entomol. Rev.* 66: 142-145. *
- Taylor, D.B. 1988. Comparison of two gelling agents for screwworm (Diptera: Calliphoridae) larval diets. *J. Econ. Entomol.* 81: 1414-1419.
- Timmins, W.A., K. Bellward, A.J. Stamp, and S.E. Reynolds. 1988. Food intake, conversion efficiency, and feeding behaviour of tobacco hornworm caterpillars given artificial diet of varying nutrient and water content. *Physiol. Entomol.* 13: 313-314.
- Vargas, R.I., H.B. Chang, M. Komura, and D. Kawamoto. 1987. Mortality, stadia duration, and weight loss in three species of mass-reared fruit fly pupae (Diptera: Tephritidae) held with and without vermiculite at selected relative humidities. *J. Econ. Entomol.* 80: 972-974.
- Wineriter, S.A. and T.J. Walker. 1988. Group and individual rearing of field crickets (Orthoptera: Gryllidae). *Ent. News.* 99: 53-62.
- Wittmann, D. and W. Engels. 1987. On which diet can worker honeybees be reared in vitro? *Apidologie.* 18: 279-288.
- Woodring, J.P., O.W. Meier and R. Rose. 1988. Effect of development, photoperiod, and stress on octopamine levels in the house

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cricket, Acheta domesticus. J. Insect Physiol. 34: 759-765.

Zera, A.J. and K.C. Tiebel. 1988. Brachypterizing effect of group rearing, juvenile hormone III and methoprene in the wing-dimorphic cricket, Gryllus rubens. J. Insect Physiol 34: 489-498.

Zong, L.B., C.Z. Zhong, Z.L. Lei, C.W. Peng, and Z.Y. Wu. 1987. Storing eggs of Orius similis in low temperatures. Chinese J. Biol. Cont. 3: 45.

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