FRASS

INSECT REARING NEWSLETTER

VOL. III January 1977 NO. 1

With this issue, FRASS takes on a very exciting "new section" - so to speak. At the XV International Congress of Entomology held in Washington, D. C. in August 1976, there was a symposium entitled, "Characterization and Evaluation of Insect Colonies". In supporting this particular topic, the Physiology and Biochemistry Section Committee wanted to focus more on the relatively small colonies used in laboratories, rather than large mass-rearing programs for inundative releases. This was planned as an "educational symposium" rather than a "specialist symposium". Unfortunately, as is often the case, there will be no formal proceedings available to those who could not attend. However, since the subject is of concern, or should be, to all correspondents of FRASS, the program agenda and abstracts of the presentations are all included as a separate section in this issue. We are indebted to the participants who took the time to write the abstracts as presented here.

In this third year of publication, the number of names on the FRASS list (mailing) has increased to approximately 500. Your comments indicate that FRASS should continue to be released as an informal publication. With the quantity and quality of food for thought received, laxative-like, FRASS will continue to be as it is now, loose and issued at least twice a year. However, the cost for maintaining publication cannot continue to be borne by FRASS coordinators, etc. Thus, the Insect Colonization Society has initiated steps to incorporate. On October 29, 1976, Norm Leppla wrote the following to the Florida Department of State, Division of Corporations:

"The Insect Colonization Society is an informal non-profit organization with more than 300 members located throughout the world. Our association was formed in 1974 and we have circulated a free semi-annual newsletter since 1975. However, membership dues will have to be charged to provide this service in the future.

We intend to perpetuate this society by seeking incorporation with non-profit status in Florida. Any pertinent information, application forms, or advice would be greatly appreciated."

We will update the incorporation progress in the next issue. Many thanks to those of you who have previously made comments and suggestions relative to "Incorporation". If there are others that have specific suggestions, recommendations, etc., please speak up. Remember, FRASS is <u>your</u> insect rearing newsletter.

In the interest of conserving natural resources, time, and $, a complete list of participants will not be included as a regular item in 1977. However, the following indices are available upon request from one of the FRASS coordinators:

Updated list of participants.

Current sources and prices for insect rearing supplies.

Arthropod cultures - who's rearing what and where, compiled from correspondence received from FRASS participants.

<u>Current coordinators are</u>:

<u>Southern U. S.</u>

N. C. Leppla, Insect Attractants & Basic Biology Lab., P. O. Box 14565, Gainesville, Florida 32604

J. R. Raulston, P. O. Box 1033, Brownsville, Texas 78520

F. D. Brewer, P. O. Box 225, Stoneville, Mississippi 38776

Western U. S.

M. A. Petterson, Vegetable Insects, P. O. Box 1209, Mesa, Arizona 85201

R. Patona, Cotton Insect Biology Lab., 2000 E. Allen Rd., Tuscon, Arizona 85719

J. L. Roberson, USDA, APHIS, 4135 E. Broadway Rd., Phoenix, Arizona 85040

North Central U. S.

W. A. Dickerson, Biological Control of Insects Research, P. O. Box A, Columbia, Missouri 65201

Northeastern U. S.

T. M. ODell, Editor, Vol. III, 1977, USDA, Forest Service, 151 Sanford St., Hamden, Connecticut 06514

WANTED -- Insect Rearing Techniques

J. A. Ciarletta - (1) Presently having problem rearing Limax flavus. For the last 10 months none of the eggs have hatched under identical conditions previously resulting in excellent hatching. Egg production no problem. Any suggestions? (2) Wanted - location of sources for obtaining additional cultures of Limax flavus eggs, young, or adults. Chemagro Agricultural Division, Mobay Chemical Corporation, P. O. Box 4913, Hawthorn Road, Kansas City, Missouri 64120.

W. Kelderman - I am presently rearing Plutella xylostella on a diet described by Biever and Boldt, with slight modifications - mainly dried cabbage leaves instead of rape leaves. It is not completely satisfactory -- any information on a suitable diet and/or nutritional requirements for Plutella would be appreciated. Project MAL/72/006, UNDP Office, P. O. Box 2544, Kuala Lumpur, Peninsular Malaysia.

W. Sterling - Currently rearing the cotton fleahopper, Pseudatomoscilis seriatus Reuter, on green beans, but would like a good artificial diet other than Vanderzant's Lygus diet. Assoc. Prof., Texas A&M University, College of Agriculture, Department of Entomology, College Station, Texas 77843.

R. D. Ward - Struggling with colonization of Phlebotomine sandflies; any new ideas would be welcome. The Wellcome Parasitology Unit, Instituto Evandro Chagas, Caixa Postal 3, 66.000 Belem, Para Brazil.

J. Woods - Would like to receive information on methods of rearing fruit pests. Consultant, Box 297, Marsing, Idaho 83639.

RESEARCH

J. P. Reinecke, USDA, ARS, Metabolism and Radiation Research Laboratory, State University Station, Fargo, North Dakota 58102:

> "I am rearing the pink bollworm, Pectinophera gossypiella (Saunders) (Lepidoptera: Gelechiidae), at the above laboratory. A few months ago, I was informed that the black filter paper that I use as an ovipositional site (Whatman No. 29) was no longer produced in any size. The black S and S paper that Whatman people suggested as the only black filter paper substitute was found by us to be less acceptable to the adult female and, more importantly, as toxic to the eggs as "No-Pest Strip".
>
> With some urgency, I tested a variety of construction papers (ten) against my remaining Whatman supply and discovered a replacement paper that the females found at least equally acceptable as an ovipositional site. The number of eggs laid in thirteen separate tests gave a fifty-fifty yield against the Whatman No. 29, and, interestingly, in ten of the thirteen tests, the females laid more eggs on the new test paper. The new paper absorbs moisture well, does not support mold, is dark blue (darker when wet), and nontoxic to the small eggs, which are easily counted on the dark background.

The paper is produced by the Riverside Paper Corp., Appleton, Wisconsin 54911 and bears their identification "15R dark blue". I purchased twelve hundred 9 x 12 inch sheets and had them cut professionally into 3 x 3 inch squares, giving me a total of 14,400 ovipositional papers at a cost of fifteen dollars and fifty cents -- quite a bit less than the Whatman paper.

I am passing this information on as a possible aid to others who may be in a similar situation. Of course, there is no guarantee that another batch of construction paper will perform as well or that another situation will find the paper adequate. The paper should be tested for suitability for each situation. If found suitable, it may be appropriate to acquire a large amount and carefully store the excess in a fashion that will retard deterioration after it has once been established that the large batch is, indeed, the same paper originally tested.

The paper has one other advantage: My staff has indicated that they are much happier counting eggs on the pretty blue paper than on gloomy black."

EMPLOYMENT - Position Wanted

C. H. Freeman - Experienced in mass rearing of Sitotroga cerealella, Trichogramma sp., Aphytis melinus. B. S. in conversation.

RECENTLY PUBLISHED ARTICLES

Calkins, C. O. and G. R. Sutter. 1976. Apanteles militaris and its host Pseudaletia unipuncta: Biology and rearing. Environ. Entomol. 5: 147-150.

Butt, B. 1975. Survey of synthetic diets for codling moths. "Sterility principle for insect control, 1974": 565-578. International Atomic Energy Agency, Vienna.

UP-DATE ON CURRENT SOURCES AND PRICES FOR INSECT REARING SUPPLIES

W. W. Cantelo - Fine nylon netting (15 denier - fine enough to stop phorid flies) can be obtained from Chester Knitting Mills, Cedar & Meredith Streets, Kennett Square, Pennsylvania 19348, for $. 50/yard (54" wide) or $1/yard (9' wide). It is available in several colors, but not white in the 9' width. They accept mail orders.

W. A. Dickerson

Wheat germ-raw	Niblack Foods 555 Flint Street Rochester, NY	$39. 50/cwt $. 3525/lb 2000 lb lots
WSB (wheat-soy blend)	Source unknown	
Yeast - torula	St. Regis Paper Co. Lake States Division 603 W. Davenport St. Rhinelander, Wisconsin 715-369-4100	$. 34/lb in drum $. 32/lb in bag

Containers and Other Supplies

Cups - plastic 1 oz	Thunderbird Container Corp. P. O. Box 12033 El Paso, Texas 79012 915-584-1151	$33. 85/5000 (case)
Lids - 1 oz paper (press in) 1. 476 diam.	Standard Cap & Seal P. O. Box 80336 Chamblee, Georgia 30341 404-457-6332	$20. 00/10,000
Tray 50 cell, #J-2	Trend Mfg. of America 1663 N. McDuff Ave. P. O. Box 6915 Jacksonville, Florida 32205 904-388-6525	$63. 15/M
Assorted paper towels	Scott Paper Company Bob Shell, Production Manager Scott Plaza Philadelphia, PA 19113	$17. 20/30 unit case (25 cases minimum)

Containers and Other Supplies, cont'd.

Cell-Pac (CP-25)	Autoclavable holders for Thunderbird 1 oz cups	Diamond National P. O. Box 697 Phoenix, Arizona 85001	$9.64/case (400 pks/case)
Choline Chloride - Crystals		ICM Pharmaceuticals 26201 Miles Road Cleveland, Ohio 44128	$2.30/200 gm bottle
Hexcell	Expanded resin-coated honeycomb HRH-10	Hexcell Corporation 6151 W. Century Blvd. Suite 1114 Los Angeles, CA 90045	

ADDITIONS TO ARTHROPOD CULTURE LIST

G. L. Reed - Acalymma vittata and Diabrotica undecimpunctata

D. K. Reed - Rhagoletis pomonella (Diptera)
Argyrotaenia velutinana (Lepidoptera
Grapholitha molesta (Lepidoptera)
Synanthedon pictipes (Lepidoptera)
Carpocapsa pomonella (Lepidoptera)
Conotrachelus nenuphar (Coleoptera)

Being cultured at USDA, ARS, 1118 Chestnut Street, P. O. Box 944, Vincennes, Indiana 47591.

N. E. A. Scopes - Primarily concerned with rearing phytophagous insects and their parasites.

D. J. Isenhour - Orius insidiosus (Say) (Hemiptera:Anthocoridae)

Biological Control of Insects Research Lab., Box A, Columbia, MO 65201

NEW PARTICIPANTS - 1976

J. Alexander, 3619 Marlbrough Way, College Park, MD 20740

M. D. Appleman, VIP, Research & Development, Daylin Lab., 2800 Jewell Ave., Los Angeles, CA 90058

E. F. Boller, Swiss Federal Research Station, CH-8820, Wadenswil, Switzerland

A. K. Burditt, Jr., Subtropical Horticultural Research Station, 1360 Old Cutler Rd., Miami, FL 33158

M. K. Busching, 405 Hayes St., W. Lafayette, IN 47906

P. O. A. Chaun, Dept. Agriculture, Crop Protection Services, Jalan Gallagher, off Jalan Curruthers, Kuala Lumpur, Peninsular Malaysia

E. J. Dietrick, P. O. Box 95, Oakview, CA 93022

H. D. Feese, Crop Science Dept., California Polytechnic State University, San Luis Obispo, CA 93407 (address change)

R. H. Goodwin, USDA, ARS, Insect Pathology Lab., Room 214, Bioscience Bldg. 011A, ARC-West, Beltsville, MD 20705

J. J. Jackson, Dept. Entomology, Fisheries & Wildlife, University of Minnesota, St. Paul, MN 55108

W. Kelderman, Project MAL/72/006, UNDP Office, P. O. Box 2544, Kuala Lumpur, Peninsular Malaysia

B. Kovalev, All Union Scientific Research Institute of Biological Methods for Plant Protection, 277031 Kishinev, USSR

J. Kring, Connecticut Agricultural Experiment Station, P. O. Box 1106, New Haven, Connecticut 06504

E. L. Mathney, Jr., 3103 McCarty Hall, University of Florida, Gainesville, FL 32611

W. A. Otieno, 333 Hilgard Hall, Dept. Entomological Sciences, University of California, Berkeley, CA 94720

P. F. Letchworth, Stauffer Chemical Company, Western Research Center, Box 760, Mountain View, CA 94042 (address change)

V. B. Polk, Stauffer Chemical Company, Western Research Center, Box 760, Mountain View, CA 94042

R. L. Ridgeway, USDA, ARS, National Program Staff, Room 334, Bldg. 005, BARC-West, Beltsville, MD 20705 (address change)

NEW PARTICIPANTS - 1976, cont'd.

M. Schuyler, Vero Beach Lab., P. O. Box 2290, Vero Beach, Florida 32960

N. E. A. Scopes, Glasshouse Crops Research Institute, Worthing Road, Rustington, Littlehampton, Sussex, BN16 3PU, England

M. Shapiro, Gypsy Moth Methods Development Laboratory, Otis Air Force Base, Falmouth, Massachusetts 02542

A. A. Sousa, Union Carbide Corporation, Technical Center South, Charleston, West Virginia 25303

W. Sterling, Texas A&M University, College of Agriculture, Department of Entomology, College Station, Texas 77843

R. D. Ward, Instituto Evandro Chagas, Caixa Postal 3, 66. 000 Belem, Para Brazil

J. Woods, Consultant, Box 297, Marsing, Idaho 83639

A. York, Department of Entomology, Purdue University, W. Lafayette, Indiana 47907

C. H. Freeman, Box 751, Gatlinburg, Tennessee 37738

D. Shible, Sandoz-Wonder Corporation, 18900 SW 280th St., Homestead, Florida 33030

B. H. Rohitha, Lincoln College, University College of Agriculture, Canterbury, New Zealand

ABSTRACTS OF PAPERS PRESENTED TO THE

XV INTERNATIONAL CONGRESS OF ENTOMOLOGY

WASHINGTON, D. C., August 1976

Agenda

Characterization and Evaluation of Insect Colonies

Organizer: A. G. Richards

Convener: A. G. Richards

Moderator: N. C. Leppla

A. G. Richards (University of Minnesota) Introduction

T. M. Peters (University of Massachusetts) Significant Variables in the Laboratory Rearing of Insects

D. H. Akey (USDA-Denver) Monitoring Physical and Biotic Parameters

H. R. Bancroft (Memphis State University) Biochemical Profiling

M. A. Hoy (University of California-Berkeley) Genetic Aspects of Insect Colonies

L. E. Munstermann (University of Notre Dame) Monitoring Genetic Quality

N. C. Leppla (USDA-Gainesville) Summary and Problems for the Future

SIGNIFICANT VARIABLES IN THE LABORATORY REARING OF INSECTS

T. M. PETERS
University of Massachusetts, Department ofEntomology

As an introduction of the symposium topic to the non-specialist, several interesting literature sources were discussed. Among these were ARS and WHO sources of colony nuclei and commercial sources. Compendia of rearing techniques which were presented ranged from Siverly's classroom culture book, through Smith's mass rearing book, to some of the specialized information in monographs and finally to an introduction of FRASS and its purposes.

Problems in initiating a colony were discussed with emphasis on the ecology of the founder population, inbreeding depression and bottleneck phenomena.

Population density maintained within the culture is significant. Examples of Allee-type and Drosophila-type responses to changes in density were shown for size, developmental rate, behavior, fecundity, and survivorship [1/]. Mechanisms which act as self-limiting ecomones were shown to operate in several cases, i.e. Culex, Chironomus, among others.

REFERENCES

1. Peters, T. M. and P. Barbosa. 1977. Influence of population density on size, fecundity, and developmental rate of insects in culture. Ann. Rev. Entomol. 22: 431-450.

MONITORING BIOTIC AND PHYSICAL PARAMETERS OF INSECT COLONIES

D. H. AKEY
ARS, Denver, Colorado

To "characterize" an insect colony, the investigator must consider the actual use of the reared insects. At least one test should be devised that measures the suitability of the insect to meet the intended use. Two or three other tests should be used to judge the general quality of the insects. Time is a limiting factor and priorities must be set for these tests. The insect species and the intended use will determine which life stage(s) should be monitored. Statistical considerations will influence the choice of tests: should the measurements be made on individuals or on populations and should discrete or continuous measurements be taken? Continuous measurements such as weights, lengths, and fecundity, can be made on individuals or groups and normally require fewer measurements for the same statistical precision than do discrete measurements. Included in the latter are "yes or no" judgements (Binomial) that are usually made on individuals such as - is a female inseminated, has an egg hatched, or has pupation occurred? The answers are pooled and a single percent will describe the parameter measured.

Colony production data that are commonly used include weights and lengths, efficiency (% adults produced), reproductive values (fertile eggs/female), generation time, competitiveness (mating, mobility), and physical toleration to temperature and humidity. In respect to body weight and length, live weights are the easiest to make but may be subject to fluctuations from water intake. This problem is avoided with dry weights but oven drying takes time, destroys the insects, and may leave such small residuals that microgram weighings are required. Length measurements are often made of eggs, body, wings, legs, and head. Sometimes, weight can be correlated to length and estimated weights can be predicted from given lengths. However, weights

BIOCHEMICAL PROFILING AS A MEANS OF CHARACTERIZATION AND EVALUATION OF INSECT COLONIES

H. R. BANCROFT
Memphis State University

Biochemical profiling, as an addition to existing means of characterizing and evaluating insect colonies involves the quantitative determination of five or more biochemicals from samples taken from a laboratory culture. In practice data is accumulated by much the same techniques as are employed in chemical medicine. Samples are prepared as whole body homogenates when practical, and the homogenate is extracted with proper solvents. The samples are analyzed for determination of biochemicals which are likely candidates, as determined by experimentation, to reflect the normal physiological state of the experimental animal. Once the profile of such a population is established monitoring of the health of the colony can be routinely accomplished. Adequacy of the diet may be reflected by the body levels of selected parameters.

The insect's response to treatment and stresses of various kinds will likely be reflected in departure from the established baseline of one or a combination of key biochemical parameters. Sampling from populations intended for toxicological research would allow certification of content of the test insects for lipids and other parameters of known effects upon toxicity.

Biochemical profiling has had limited success as a means of quality control in mass-reared cotton boll weevils (Bancroft et al. 1976). It is proposed that accumulation of such data over a considerable period of time, in a routine manner, could result in refinement of mass-rearing technology.

REFERENCE

Bancroft, H. R., C. A. Moore, and J. L. Frazier. 1976. Development of a biochemical profile for mass-reared boll weevils. Comp. Biochem. Physiol. 53C, 9-12.

and lengths are often inversely related to rearing temperature and weight estimations must be made for a given temperature. Some specialized measurements to test the suitability of an insect for a specific intended use are food utilization (nutritional indices), host preferences, insecticide resistance, vector competence (susceptibility to a disease agent), respiration (O_2 uptake), flight, sound production, hormone production, activity, visual sensitivity, and presence of microflora.

Quality control tests are necessary for the rearing medium. A diet should be tested for nutritional content and acceptability to the insect. The following parameters are commonly measured: pH, osmolarity, % protein, % carbohydrate, % lipid, trace metals, vitamins, secondary substances, preservatives, moisture, consistency, texture, microflora, and origin and standards of commercial foods and chows.

There are three other considerations in monitoring insect colonies. First, environmental conditions must be recorded and new technology that is now available offers time saving and versatility; e. g. , data acquisition systems (data loggers). Second, uniformity and the reduction of errors are promoted through the use of check-off style flow sheets. Third, the use of data processing and systems analysis for colony production data will enable the investigator to handle large quantities of data. All data that is generated should be summarized, analyzed, and applied back to the colony to maintain standard conditions.

MONITORING GENETIC QUALITY OF INSECT COLONIES

L. E. MUNSTERMANN
University of Notre Dame

Monitoring genetic quality of colonies by formal or cytogenetic methods is not generally feasible. However, the genetic variability of enzymes, intrinsic to almost all insect populations, permits detection of genetic change in colonized populations. Gel electrophoresis is used to separate and identify enzyme variants. Frequencies of the variants for 10 to 25 enzyme loci can then establish an "enzyme fingerprint" for a given colony. The fingerprint provides (1) a standard for detecting colony change over time, and (2) a means for comparing the genetic constitution of other colonies of the same species.

Application of these methods to Aedes aegypti colonies has demonstrated that (1) initial sampling methods affect colony quality, (2) bottlenecking can cause definite changes in the genetic variability of the colony, (3) long-term colonization may not produce genetic homogeneity, and (4) inbreeding applied over many generations can result in balanced polymorphisms. Monitoring of mass rearing programs such as the screwworm control project can allow not only the detection of changes in genetic quality, but may also pinpoint the causes of that change. (Supported by NIH Training Grant No. AI-00400 and NIH Research Grant No. AI-02753.)

GENETIC ASPECTS OF INSECT COLONIZATION

MARJORIE A. HOY
U. S. Forest Service, Hamden, Connecticut 06514
Presently with:
University of California, Dept. Entomological Sciences
Berkeley, California 94720

The genetic aspects of insect colonization need to be considered at all phases of insect colonization, including sampling, colony initiation, and colony maintenance. Each colonization procedure may require different methods, depending upon the needs of the research person, the genetic architecture of the species, the information available of the ecological genetics of that species or population and upon the variability of the species in time and space.

Colonies may suffer from genetic deterioration engendered through inbreeding, genetic bottlenecks, inadvertent selection, etc. A prime consideration is the use to which the colony will be put. That is, colonies reared for inundative biological control releases may be genetically different from those reared for inoculative releases. Colonies reared for laboratory physiological tests may have still different requirements such as uniformity of response. Several maintenance strategies may be used to achieve the stated goals including renewal, replacement, use of inbred lines, use of hybridized inbred lines, use of random bred lines, and production of strains genetically selected for specific attributes.

Selection for many behavioral, physiological, and developmental attributes is possible, assuming that the requisite genetic variability is present and that adequate selection procedures are used.

My personal belief is that genetic solutions to many of our problems can be achieved now if adequate attention were given to the necessity of spending the required time and money, for these solutions are <u>not</u> always simple, cheap, or rapid.

If we are to characterize and evaluate insect colonies, then we must have official, measurable, uniform standards. These standards may be "universal prototypes" defined by prescribed traits, or unique models measurable only in terms of deviation from specific field populations or laboratory strains. The degree of standardization will depend on our requirements for defining and ability to characterize insect colonies. The necessary methodology is currently being developed. Perhaps now is the time for us to consider a system for evaluating insect colonies for the future.

SUMMARY AND PROBLEMS FOR THE FUTURE

N. C. LEPPLA
USDA, Gainesville, Florida

A dependable supply of quality insects is essential to virtually every aspect of contemporary entomological research. Therefore, we must be able to: (1) Effectively establish colonies for research from parent field populations; (2) maintain these colonies adequately by thoroughly understanding their life histories; (3) characterize and evaluate the relative fitness of the colonized strains, and (4) implement the results of these detailed analyses to provide efficient maintenance of appropriate insect colonies. As the speakers have repeatedly stated, this challenge offers a unique opportunity for the development and application of new innovative techniques.

Peters and Akey emphasized that insect colonization is primarily an ecological discipline and that the first step is to determine all primary variables contributing to efficient production of a quality product. This system will ultimately depend on procedures like those that were discussed by Bancroft and Munstermann. Once methods have been standardized and the purposes for colonization determined, the challenge that Hoy presented will be to implement the most effective comprise.

Characterization and comparison are requisites to the evaluation of insect colonies. Characterization necessarily involves definition in terms of distinctive, measurable qualities or traits (structures, functions, rates, uniformity, etc.). Comparison requires the designation of suitable standards established by some authority, to serve as a model. Thus, an evaluation is a subjective judgement of the fitness of a colony relative to established criteria.

FRASS

INSECT REARING NEWSLETTER

JULY 1977

As this issue of FRASS goes to press the fight for peer recognition of Insect Colonization as a highly scientific, professional research area continues; equal consideration of research manuscripts for publication in ESA journals is the first objective. The following letter to the Editor tells it like it is.

> "... I would like to offer my assistance and encouragement in the formation of the Insect Colonization Society. The new society could not come at a better time in view of the Entomological Society of America refusing to publish any papers of a technical nature or relating to rearing research.
>
> The significance of publishing in an internationally distributed journal is not nearly as important today because of many services such as Current Contents and the USDA Current Awareness Literature Survey that circulates titles and abstracts.
>
> Entomology is in debt to researchers who in the past 20 years have developed systems which provide year round sources of insects. It is ironic that many entomologists look with disdain upon those who provide insects for their studies, despite the fact that they are relieved of the burden of providing insects for themselves. This is not a minority view, and unfortunately the Entomological Society of America is increasingly reflecting this view through its publication policies.
>
> Enlightened administrators in entomology, however, are beginning to value rearing research as the foundation of a viable research program, in which a plentiful supply of insects is made constantly available.

Indeed, we have come a long way since the days of each scientist spending 90%+ of his budget and available time to produce insects for his study. We need to attract more competent people into rearing research and to encourage them by recognizing them as co-scientists. One way is to form a society which recognizes their value and publishes their work."

Sincerely,

J. David Hoffman
Research Entomologist
USDA, ARS
Biological Control of Insects Research
Columbia, Missouri 65201

Thanks, Dave! And from the front line, the following from Norm Leppla:

"At the last Entomological Society of America Southeastern Branch Meeting in Charleston, Jim Packer, Managing Editor of ESA, and I discussed the advantages of publishing insect rearing research and other entomological techniques. He asked me to prepare and present a prospectus on the subject to the Governing Board of ESA at the National Meeting in November. I would appreciate your help in providing me a thorough and realistic report.

We are all aware of the tremendous financial investment and unfortunate duplication of effort that are involved in pursuing technological research. Yet, it is often difficult to publish techniques and practically impossible to retrieve information on techniques that is buried in methods sections or relatively obscure journals. ESA is committed to the communication of entomological research and technology. However, many of us engaged in the applied and support fields are dissatisfied with ESA's rejection of our contributions. Apparently a paradox exists. If this work is worth doing, it should be communicated. Otherwise, it should be replaced by more important endeavors.

Please review the following options and let me know your recommendations:

A. Technological Fields of Entomology (list others)

1. Colonization
2. Pheromones
3. Insecticides
4. Photography
5. Instrumentation
6. Climatology
7. Pest Management
8. Electron Microscopy
9. Biometrics
10. Collection and Preservation

B. Publication by ESA (select one or add yours)

1. Establish a new quarterly, semiannual, or annual refereed journal
2. Assign a section of one or more existing journals
3. Publish as regular articles that are refereed by subject specialists rather than general reviewers
4. Publish an annual bibliography of classified techniques abstracted from methods sections of ESA articles."

Norman C. Leppla
Research Entomologist
USDA, ARS
Insect Attractants & Basic Biology Laboratory
P. O. Box 14565
Gainesville, Florida 32604

Don't procrastinate. We need your support, ideas, recommendations-now!

For example, the following:

"In response to the July 1976 issue of FRASS, I will be happy to serve as Annual Coordinator or in any other capacity as needed. I believe FRASS is informative, serves a useful purpose, and should be upgraded to include short submitted manuscripts on techniques or methods of insect rearing which would be similar to a scientific note or some other standard format."

J. B. Beavers
Research Entomologist
U. S. Horticultural Research Laboratory
2120 Camden Road
Orlando, Florida 32604

To FRASS foreign correspondents - support, letters, etc. would be sincerely appreciated.

FRASS Coordinator-Editor Changes

The 1978 FRASS Editor will be:

Edgar King, Research Entomologist, USDA, ARS, Bioenvironmental Insect Control Laboratory, P. O. Box 225, Stoneville, Mississippi 38776.

Please continue to mail requests, pertinent rearing notes, etc. that you would like to appear in FRASS to the Area Coordinators; foreign exchange may be sent directly to Ed King.

Southern United States

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J. R. Raulston, P. O. Box 1033, Brownsville, Texas 78520

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R. Patona, Cotton Insect Biology Laboratory, 2000 E. Allen Road, Tuscon, Arizona 85719

J. L. Roberson, USDA, APHIS, 4135 E. Broadway Road, Phoenix, Arizona 85040.

North Central United States

J. D. Hoffman, Biological Control of Insects Research, P. O. Box A, Columbia, Missouri 65201

Northeastern United States

T. M. ODell, USDA, Forest Service, Forest Insect & Disease Laboratory, 151 Sanford Street, Hamden, CT 06514

Times and Places to Shoot the Frass

1. At the National ESA Meeting in Washington, D. C., 27 November-1 December. There will be an informal conference on insect rearing. Topics to be discussed (time permitting) include:

a. Publishing of insect rearing research

b. Shipment of colonized insects

c. Assessing the quality of colonized insects (informal as time permits and/or a chance for individuals to meet and communicate)

d. Communication between entomologists interested in rearing insects: The future of FRASS

e. Insect colonization: Career Opportunities?

Watch for the scheduling. If any of you have particular items to bring up, thoughts that are "bugging" you, etc. please let me know.

Tom ODell
Research Entomologist
USDA Forest Service
Forest Insect & Disease Laboratory
151 Sanford Street
Hamden, CT 06514

2. Eastern Branch ESA Meeting, 14-16 September 1977, to be held in Boston, MA. Will include the symposium, "Growing natural enemies apart from hosts: The potential of in vitro rearing", R. M. Weseloh, Moderator.

Colonization Research and Assistance

"Presently we are rearing or holding the following colonies at our facility:

1. Coleoptera, Oulema melanopus (L.), cereal leaf beetle
2. Coleoptera, Lema trilineata trivittata (Say), three lined potato beetle
3. Hymenoptera, Anaphes flavipes (Foerster), no common name
4. Hymenoptera, Tetrastichus julis (Walker), no common name
5. Hymenoptera, Diaparsis spp. , no common name
6. Hymenoptera, Lemophagus curtus (Townes), no common name

Thomas Burger is our laboratory supervisor. Please forward any requests to him."

Penelope R. DeWitt, Agriculturist, Cereal Leaf Beetle Parasite Rearing Laboratory, 2534 S. 11th Street, Niles, Michigan 49120

We are currently rearing about 100 strains of house flies, split about evenly between viable mutants and genetically engineered dysfunctions. We are therefore interested in any information we can utilize in keeping the strains vigorous and competitive. We are also doing some work on the stable fly, especially in mutant research and eventually chromosome mapping work.

House fly - Odell A. Johnson
Metabolism & Radiation Research Laboratory
State University Station
Fargo, North Dakota 58102

Stable fly - Curtis A. Nickel
Metabolism & Radiation Research Laboratory
State University Station
Fargo, North Dakota 58102

FRASS suggests that the following laboratory may be a help in providing information on keeping dipterous cultures vigorous and competitive:

> "... our laboratory maintains a colony of olive fruit fly, Dacus oleae. Three stocks of flies are maintained at the present time with a production capacity of 500,000 to 1,000,000 flies per week. The colony provides experimental insects in all phases of research in this lab and in several other laboratories.
>
> My research is on nutrition and metabolism of the olive fruit fly. These studies are aiming to production of good quality insects from artificial diets which are needed to develop certain methods for the control of this insect. Our studies include research on the chemical composition of the natural and artificial food and of the wild and laboratory type insects; on the performance and characteristics of larvae under natural and artificial conditions; and on the development of efficient and low-cost larval diets for standard quality mass production..."
>
> A. G. Manoukas
> Greek Atomic Energy Commission
> Nuclear Research Center "Demokritos"
> Aghia Paraskevi, Attiki, Greece
>
> A list of publications is available.

"We are rearing the black cutworm for identification and synthesis of the sex pheromone as well as for other pest management research projects. I would like to call your attention to a series of annotated bibliographies which cover mass rearing and other methods of rearing cutworms. There are eleven bibliographies completed -- single copies are free upon request."

Roy W. Rings, Professor
Ohio Agricultural Research & Development Center
Wooster, Ohio 44691

Recently Published Articles

Agee, H. R. 1977. Instrumentation and techniques for measuring the quality of insect vision with the electroretinogram. USDA, ARS-S-162: 1-13.

Bush, G. L., and R. W. Neck. 1976. Ecological genetics of the screwworm fly, Cochliomyia hominivorax (Diptera: Calliphoridae) and its bearing on the quality control of mass reared insects. Environ. Entomol. 5(5): 821-826.

Chambers, D. L. 1977. Quality control in mass rearing. Ann. Rev. Entomol. 22: 289-308.

Hoy, M. A. 1976. Genetic improvement of insects - fact or fantasy? Environ. Entomol. 5(5): 833-839.

Huettel, M. D. 1976. Monitoring the quality of laboratory reared insects: A biological and behavioral perspective. Environ. Entomol. 5(5): 807-814.

McDonald, I. C. 1976. Ecological genetics and the sampling of insect populations for laboratory colonization. Environ. Entomol. 5(5): 815-820.

Peter, T. M. and P. Barbosa. 1977. Influence of population density on size, fecundity, and developmental rate of insects in culture. Ann. Rev. Entomol. 22: 431-450.

Singh, P., and E. M. Jerram. 1976. Plastic damage by insects. N. Z. Entomol. 6(2): 188.

Singh, P., and F. E. Mabbett. 1976. Note on the life history of the magpie moth, Nyctemera annulata (Lepidoptera: Arctiidae). N. Z. J. Zool. 3(3): 277-278.

Publication announcement from Plenum Publishing Corporation, 227 W. 17th Street, New York, New York 10011:

Artificial Diets for Insects, Mites, and Spiders, by Pritam Singh, Entomology Division, Department of Scientific and Industrial Research, Auckland, New Zealand.

This volume presents the most comprehensive and up to date survey of knowledge on artificial diets for insects, mites, and spiders. Nearly 2,000 references from more than 100 journals and periodicals have been collated, and specific diets for more than 750 species which have been successfully grown in the laboratory are listed. Each diet is described with regard to composition, preparation, rearing, and development.

The species are arranged alphabetically within the taxonomic categories of order, family, genus, and species, and an index of species is provided to facilitate the location of a diet within the text. The introduction to diets covers historical background, terminology, formulation and evaluation of diets, and rearing methods.

Contents: Introduction. Format. General purpose diets. Commercial diets. Specific diets. Insects: Coleoptera, Dictyoptera, Diptera, Hemiptera, Orthoptera, Siphonaptera. Mites: Acarina. Spiders: Araneida. Addendum. Appendix. Bibliography. Index of authors. Approx. 600 pages. ISBN 0-306-65169-6. $90.00 ≈ 47.25

Upcoming Publications

Boller, E. F., and D. L. Chambers, Editors. 1977. Quality Control Handbook. IOBC.

Leppla, N. C., and T. R. Ashley, Editors. 1977. Facilities for Insect Research and Production. USDA Technical Bulletin.

Turner, W. K., N. C. Leppla, R. H. Guy, and F. L. Lee. 1978. Carbon dioxide production as an indication of quality of colonized insects. ARS Series.

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Insect Rearing Supplies

W. A. Dickerson, USDA-ARS, Biological Control of Insects Research, P. O. Box A, Columbia, Missouri 65201

1. I have 10 cases of Cell-Pac 25-cell paper trays for holding 1 oz cups. I will trade for insectary supplies of equal value ($10/case of 500).

2. Obtaining mylar lidding for plastic trays, 2-3 rolls at a time has become a problem. The minimum factory order is 12,000,000 sq. in., about 31 rolls. A roll contains about 4,000 linear feet of 7-1/4 in. wide material. I am willing to coordinate a minimum order purchase. If you use mylar and would like to consider such a purchase arrangement, please contact me as soon as possible. Cost will probably be less than $80/roll.

R. D. Dixon, Animal Repellents, Inc., Box 999, Griffin, GA 30224

1.	1 pint of Tac Trap	$1.30
2.	1 gallon of Tac Trap	9.10
3.	1, 5 gallon pail	38.50

Quality Control in Insect Colonization

This section is being initiated to:

1. Stimulate advances in quality control research
2. Promote quality control in all insect rearing establishments
3. Help FRASS correspondents deal with rearing problems which heretofore had been the responsibility of Murphy's Law.

"My quality control program is organized to include both research and testing phases; the cabbage looper, Trichoplusia ni (Hubner), is the experimental organism. The overall research objective is to intensively study the behavior of wild and colonized cabbage loopers in the laboratory and in nature. Laboratory investigations include: (1) the comparative life history of all developmental stages; (2) actographic analysis; (3) monitoring of respiration; and (4) associated visual observations. Similar kinds of information are being derived on the life history of larvae and mating among various combinations of moths maintained in field cages. Visual observations will be made in the field.

Testing of research results involves development and implementation of a realistic monitoring system for our model insectary. Currently, yields of each stage and mean pupal weights are recorded daily for the 50,000 pupae per month output. Environmental conditions in the adult and larval development rooms (temperature, RH, photoperiod, light quality, and cleanliness) and utilization of dietary ingredients are also noted. In the future, critical parameters identified by the research phase will be monitored in the insectary."

Norman C. Leppla
Research Entomologist
USDA, ARS
Insect Attractants & Basic Biology Laboratory
Gainesville, Florida 32604

"Gypsy Moth Mass Rearing - Quality Control -- The ARS-APHIS mass rearing research unit at Otis Air Force Base are developing procedures for assessing the quality of mass reared gypsy moths for various program needs. Performance data are being gathered on healthy wild populations to establish standards with which measurements of colonized strains can be compared. A brief description of this aspect of the research program is presented here.

Biotic Potential - The ability of the populations to thrive under colonized conditions in the rearing facility can be assessed by determining the biotic potential or innate capacity for increase. To determine the biotic potential, we are currently measuring (1) fecundity, i. e. incidence of mating, eggs/female and hatch, (2) developmental time, and (3) survival, i. e. adults recovered/no. infested.

Environment - Those components of the rearing environment that affect the biotic potential are being studied to determine the optimum environment for mass rearing. The environmental factors under assessment include (1) temperature, (2) humidity, (3) diet, (4) light, (5) handling and containment of developmental stages, and (6) incidence of viable and non-viable contaminants. Once these factors are evaluated and the optimal rearing environment established, a standardized set of environmental conditions for rearing will be prescribed as well as methods by which each of these factors can be routinely monitored to assure that the quality control of the rearing environment is maintained within an acceptable range of tolerance.

Efficacy - The final phase of the quality control research is that of determining efficacy of the mass reared insects to achieve program objectives. The programs involved include (1) virus production, (2) parasite rearing, (3) pheromone evaluation, and (4) evaluation of sterile male technique.

It is intended that suitable methods will be devised to measure efficacy of the mass reared stock for each of these programs. The appropriate quality control measurements will be made and standards established by ARS, APHIS, and Forest Service personnel. As required, modifications will be made with regard to strain of insect reared or the rearing environment to meet quality specifications."

Robert A. Bell
Research Entomologist
USDA, ARS
Gypsy Moth Methods Development Laboratory
Otis AFB, Falmouth, MA 02542

Abstracts of Pertinent Subject Material

presented at the

"Workshop on Ethology of Host Selection by Entomophagous Insects"

Texas A&M University
College Station, Texas

5-7 April 1977

Organizer and Moderator: S. B. Vinson

Abstracts contributed by:

J. David Hoffman, USDA, ARS, Biological Control of Insects Research, Columbia, Missouri 65201

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Stephen W. Ziser, Department of Entomology, Louisiana State University, Baton Rouge, Louisiana 70893

C. G. Jackson, USDA, ARS, Cotton Insects Biological Control, 2000 E. Allen Rd., Tuscon, Arizona 85719

Patrick Greany, USDA, Insect Attractants and Basic Biology Laboratory, P. O. Box 14565, Gainesville, Florida 32604

ARTIFICIAL REARING OF INSECT PARASITOIDS

J. David Hoffman

"Two wasp parasites: an egg parasite (Trichogramma pretiosum) and a pupal parasite (Pteromalus puparum) were reared from egg to adult in vitro (in a medium devoid of insect additives). Both parasites were induced to oviposit in artificial hosts containing non-host media. Future objectives are to obtain continuous development in artificial host eggs in larval blood plasma from Heliothis zea, improve the artificial rearing medium (i. e. YGF medium), and then to obtain continuous development in artificial eggs in the YGF medium. Development of an in vitro system for rearing biotic agents should provide for less complex rearing systems with reduced production cost. In vitro rearing should also provide for increased rearing reliability and greater rearing flexibility."

USE OF NATURAL AND UNNATURAL HOSTS FOR REARING

Edgar G. King

"Unnatural hosts have been used for mass production of several entomophagous arthropods. Concern has been expressed that these entomophages may change their host preferences as a result of preimaginal conditioning resulting in reduced effectiveness when released against the natural host. However, based on present evidence this factor (preimaginal conditioning) does not seem to be of valid concern. What appears to be more important is reduced 'vigor' of the entomophage because the host is not nutritionally adequate.

The bionomics of several entomophages have been shown to be affected when reared on different hosts or on the same host fed different diets. When the tachinid, Lixophaga diatraeae (Townsend), was reared on greater wax moth (Galleria mellonella L.) larvae, (and) fed a common cereal diet, fly longevity and attraction to the natural host, Diatraea

sacctiaralis (F.), were reduced. However, substitution of 120 g of wheat germ for 120 g of the cereal per kg of diet for rearing the greater wax moth plus use of older larvae for parasitization, reduction of superparasitization, and reduction of fly density in holding cages generally eliminated these problems. Thus, host suitability cannot be determined merely by screening hosts; host nutrition and other factors must also be considered. Nevertheless, in initial studies for determining the technical feasibility of using a specific entomophage for a biological control approach it should be reared, if possible, on the target host and the target host should be fed the commodity that is to be protected."

THE DEVELOPMENT OF AN ARTIFICIAL DIET FOR REARING EUCELATORIA SP.

Stephen W. Ziser

"More than 150 diets have been formulated based on the work of S. Grenier and co-workers and H. L. House. Eucelatoria maggots remained alive up to 60 days. Larval growth was minimal and the maggot's final size rarely exceeded 2-1/2 times the original length. Some maggots molted to second instar. The addition of lecithin, triolein, and trehalose to the basic diet may have enhanced larval growth. Tween 60 was the most suitable emulsifier. There was no significant increase in growth when the results of amino acid analyses of Eucelatoria larvae or Heliothis caterpillars were incorporated into the diet.

First, 2nd, and 3rd instar maggots were placed on various tissues and tissue extracts including: lipid and carbohydrate extracts, fat bodies, and hemolymph of Heliothis; maggot extracts; and carcasses of Heliothis perfused with artificial diets. No significant growth occurred on the extracts or combinations of extracts. Hemolymph and non-polar extracts

added to the diets may have slightly increased larval growth. Significant growth did occur and some larvae pupated when maggots were placed on the hosts' fat bodies and when artificial diet was perfused through parasitized Heliothis carcasses from which the gut was removed."

ACCEPTANCE, SUITABILITY, AND PREFERENCE OF FIVE LEPIDOPTEROUS PESTS OF COTTON AS HOSTS BY CHELONUS BLACKBURNI

C. G. Jackson

"Chelonus blackburni Cameron is a uniparental, egg-larval parasite of Lepidoptera. It was mass reared and released on pink bollworm-infested cotton, but parasitization rates in the field were disappointingly low, even though it has a very high reproductive capacity. Laboratory studies of host acceptance, suitability, and preferences were initiated to determine the involvement of these factors in the effectiveness of the parasite.

Six species of lepidopterous pests of cotton were offered as hosts: pink bollworms, Pectinophora gossypiella (Saunders), bollworms, Heliothis zea (Boddie), tobacco budworms, Heliothis virescens (F.), cabbage loopers, Trichoplusia ni (Hubner), beet armyworms, Spodoptera exigua (Hubner), and saltmarsh caterpillars, Estigmene acrea (Drury). All were parasitized except the saltmarsh caterpillars. However, C. blackburni is unable to distinguish previously parasitized eggs and superparasitization is common. Studies on suitability showed that of the five accepted species, only pink bollworms and bollworms were satisfactory hosts. When all five species were offered as hosts, preference was shown as follows: pink bollworms=cabbage loopers>bollworms>tobacco budworms>beet armyworms. In paired preference tests there was a consistent preference for pink bollworms."

AN UPDATE ON THE STATUS OF THE HOPKINS HOST SELECTION PRINCIPLE AND ITS RELEVANCE TO REARING AND RELEASE OF BENEFICIAL INSECTS

P. Greany

"Although Hopkins Host Selection Principle has evolved to become essentially synonymous with preimaginal conditioning (whereby the behavior of the adult insect is influenced by its larval feeding experiences), that was not the original connotation. Hopkins' original statement was that "an insect species which breeds in two or more hosts will prefer to continue to breed in the host to which it has become adapted". It is appropriate to extend his original statement to cases in which insects are artificially provided with unnatural hosts and then to expect their progeny to preferentially select these new host species. Most attempts to induce insects to adopt a preference for a new host species through preimaginal conditioning have failed, leading to the mistaken contention that the Hopkins Host Selection Principle is invalid.

Preimaginal conditioning has been demonstrated in several insects, however, and it apparently represents a mechanism by which genetically-based behavioral propensities are reinforced through experience. Preimaginal conditioning probably plays a role, although not of profound importance, in the host selection behavior of many beneficial insects. In addition, in rearing beneficial insects on unnatural hosts, it is important to consider not only whether normal conditioning stimuli are provided, but also the nutritional characteristics (qualitative and quantitative) of the laboratory host. Further, it is important that endoparasites retain the ability to resist the defense mechanisms of their normal hosts. These considerations apply not only to use of factitious hosts, but to use of artificial diets as well."