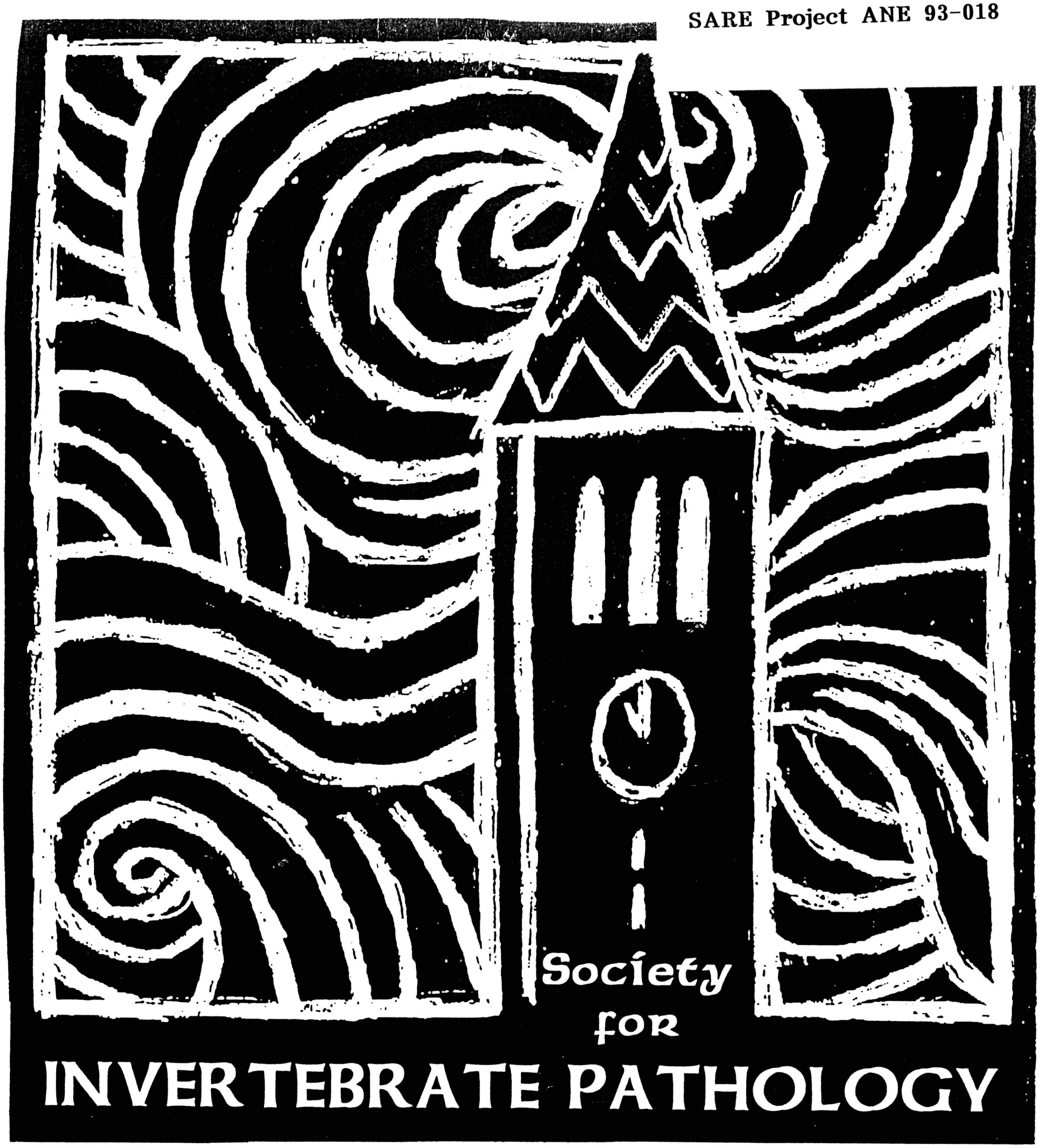
SARE Project ANE 93-018



PROGRAM and ABSTRACTS

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butyric acid. Traces of isovaleric, valeric, isobutyric and caproic acids were detected in some extracts.

Metronidazole significantly decreased the cockroach weight gain, prolonged generation time and reduced the bacterial population in the gut. Filamentous bacteria, a typical microbial feature of the control colony, were eliminated. Cuticular spines projecting into the colonic lumen were underdeveloped and lacked normal bacterial colonization. Concentrations of acetic and propionic acid were significantly lowered while that of butyric acid was unaffected. Bacterial symbionts in the cockroach fat body were not affected. Supplementary feeding of acetic

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The results suggest a significant role of the bacterial volatile fatty acids as the source of energy and/or biosynthetic precursors in the cockroach metabolism, especially during insect growth. The significance of the colon as the site for bacterial colonization and attachment is also proposed. It is likely that the presence of intestinal symbionts helps to maintain a broad nutritional versatility of omnivorous cockroaches which may be a factor that include this group among the most succesful insect species.

Late-Received Abstracts

Tuesday, 2:00 – STUDENT POSTER

Insecticidal activity of avidin

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Avidin is a biotin-binding protein which is present and purified from chicken egg whites. Its physiological function was assumed to be an antibiotic and antinutritional agent directed towards organisms that require biotin. A previous study (T.D. Morgan, B. Oppert, T.H. Czapla & K.J. Kramer. *Entomol. exp. appl.* 69: 97-108, 1993) showed that avidin inhibited insects when present at 10-1000 ppm in a laboratory diet containing wheat germ.

In our study of *Bacillus thuringiensis* (BT) endotoxins, we found that the CryIAc active toxin could bind weakly to biotin-containing proteins. We decided to investigate whether the biotin-binding ability of BT toxins paly a role in their toxicities. An avidin bioassay on *Manduca sexta* larvae was conducted. We found that avidin was very toxic to *Manduca* when it was added on its natural fod, tomato leaves, with LC_{50} values of 100 ng to 1 μg/ml (the leaves were dipped in the avidin solution and air-dried). The toxicity was nullified when avidin was premixed with excess biotin. In contrast, on laboratory artificial diet (R.T. Yamamoto. *J. Econ. Entomol.* 62: 1427-32, 1969), avidin is not toxic at 10 μg/ml.

Our interest in avidin relates to the biological roles of biotin in insects, especially the possibility that it functions to maintain the high pH of *M. sexta* gut. Since high gut pH may be necessary to digest plant leaves containing tannins, we also did a bioassay of condensed tannin in the presence and absence of avidin. The results showed that at a concentration of 400 μg/ml of tannin, the average weights of insects with avidin were lower 2-fold than those without avidin. Finally, our attempts to develop a biotin-free defined diet for *Manduca* have not been successful. We found casein and dry yeast could be removed from the diet. However, wheat germ was necessary for growth of *Manduca*.

Tuesday, 2:00 – STUDENT POSTER

Evaluation of biological agents for management of *Leptinotarsa decemlineata* (Say) (Coleoptera: Chrysomelidae)

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A strategy for biological management of the Colorado potato beetle (CPB) which proved successful in northern Maine in 1993, was tested in central Maine in 1994 where beetle densities and potential damage to potatoes are greater. This strategy combined releases of the stinkbug predator, *Perillus bioculatus*, and foliar applications of the microbial insecticides, *Bacillus thurengiensis* (*Bt*) and *Beauveria bassiana* (*Bb*). Eight treatment combinations (2 × 2 × 2 factorial) comparing all possible combinations of these agents were replicated in three blocks. Bb was supplied by Mycotech Bioproducts and applied at a rate of 5×10^{13} conidia/ha in 0.01% Silwet® and the *Bt* utilized was Foil® applied at a rate of 2.3l/ha. Microbial treatments consisted of four foliar applications made at weekly intervals beginning June 27, 1994. P. bioculatus treatments consisted of two releases of 2 predators per plant (2nd and 3rd instar nymphs) on June 22 and July 6.

All CPB lifestages were sampled weekly through early August. Fifteen larvae were collected (12 to 36 hours after each application) from each plot and held in the laboratory to account for mortality and sporulation. Summer adult emergence was also monitored and defoliation ratings were estimated at the end of the season for each plot.

CPB densities were significantly reduced in plots treated with *Bt* and *P. bioculatus*, but no significant reduction was obtained in the *Bb* treated plots. Emergence of summer adults were significantly ower in all the biological treatments compared with control, no interactions were observed among treatments. From the collected larvae, a significantly higher post spray mortality and sporulation was observed from the *Bb* plots. Defoliation ratings ranged from 0.3% (from the three way biological control combination) to 53% in the control plots with no significant difference between the non-control treatments.

Potato cropping systems research in Maine: comparison of conventional versus low-input and biological pest management systems

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Since 1991, the University of Maine's multi-disciplinary Potato Ecosystem Project has conducted a 6-ha experiment comparing three pest management and two soil management systems. The pest management systems under study are: 1) a conventional system based on Maine Coop. Extention Service recommendations for the amount and type of pesticides to use based on published economic threshold values, 2) a reduced input system using the same rates and types of pesticides used for the conventional treatment, but not applied until pest densities reach twice the published economic thresholds, and 3) a biological systems using only cultural, biological and biorationale materials. The biological pest management program for the Colorado potato beetle has depended on foliar applications of *Bacillus thurengiensis* and *Beauveria bassiana* in combination with releases of the stinkbug predator *Perillus bioculatus*. Since 1992 conventional plots have exceeded economic threshold more frequently, requiring more insecticide applications for the Colorado potato beetle than the biological or reduced input treatments, and Colorado potato beetle larval densities have been significantly lower in biological plots compared with the reduced input and conventional treatments since 1993. Since 1993, the densities of overwintered adults colonizing the plots has also declined in the biological in comparison to the conventional and reduced input treatments, indicating that the biological treatment may be having a between year effect on beetle densities.

Tuesday, 11:55 – SYMPOSIUM

Interaction between viruses and other control agents

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Entomopathogenic viruses interact with biocontrol agents in a variety of ways. Some viruses interfere with infectivity of other viruses, some enhance infectivity of other virus. Some viruses activate latent viruses which may result in the production of recombinant viruses. While none of the viruses used in biocontrol have been shown to be pathogenic to parasitoids, parasitic hymenoptera may harbor their own pathogenic viruses. Parasitoids may or may not show a preference for healthy over virus-infected host larvae. Parasitoids and predators can play an important part in the transmission and dispersal of viruses. However, in many cases, if a parasitoid stings an infected host then a noninfected host the virus will kill the host before the parasitoid can complete development. Some dipteran parasitoids, tachinids and sarcophagids, can complete development in a dead host better hymenopteran parasitoids. Some viruses inhibit development of parasitoids in infected hosts. Some parasitoids may lower the susceptibility of the host to virus, thus helping to conserve the parasitoid, or parasitoids may develop more rapidly in virus- infected hosts. The combination of parasitoid and virus infection may lead to faster kill of the host. In other cases, venom from some parasitoids can cause substantial in initial viral morality and also reduce the total mortality due to virus. In order to determine the most effective combination of biocontrol agents for use against a particular pest it is necessary to understand the interactions between the various biocontrol agents.

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One of the oldest commercially significant diseases of bivalve molluscs is Malpeque Disease of American oysters (*Crassostrea virginica*) which was reported from Malpeque Bay, Prince Edward Island, Canada, in 1915. The mortalities caused by the disease were not recognised as being due to an infectious agent, however, until the 1930's when the disease spread via apparently healthy oysters from Malpeque Bay to the rest of Prince Edward Island. Since that time, intense investigations have centered on determining the cause of the disease. Several parasites and putative pathology have been implicated, based principally on histopathology profiles, parasite cultures and other observations from moribund oysters. These include the gill turbellarian, *Urastoma cyprinae* (Prolecithophora: Hypotrichinidae), the protistan flagellate *Hexamita inflata*, a *Labyrinthomyxa*-like organism (Labyrinuthuloides) and abnormal (neoplasia-like) haemocyte morphology. The gill turbellarian was subsequently found on oysters throughout the Gulf of St. Lawrence and a tentative inverse correlation to oyster condition varies significantly with environmental conditions. *Hexamita inflata* was observed and cultured from moribund oyster tissues, but was later found to be an opportunistic anaerobic saprobiont, rather than a primary tissue pathogen. This type of "flagellate parasite" is commonly found in a wide-range of bivalve species over a broad geographic range and was, therefore, deemed to be an unlikely aetiologic agent of Malpeque Disease. The *Labyrinthomyxa*-like organism and abnormal haemocyte morphology, however, both require further investigation into their role in the pathogenesis of Malpeque Disease.

Unfortunately, since the last epidemic in the late 1960's and early 1970's, the oyster stocks in the Gulf of St. Lawrence have shown no sign of the disease and are considered to be resistant to the causative agent. In addition, no evidence of abnormal haemocyte morphology or a Labyrinthulid-type protistan has been detected in present-day oyster populations. The characteristic lesions associated with Malpeque Disease show no conclusive signs of the causative agent and comparisons with lesions from American oysters from the eastern United States, as well as other oyster species from Europe and North America, show interesting similarities, but do not provide more concrete evidence for the cause of Malpeque Disease.

The "disappearance" of characteristic symptoms, as well as the *Labyrinthulid*-like parasite, in "resistant" oyster populations reflects a common characteristic of many serious diseases of bivalves. Routine detection techniques are frequently insufficient to detect "latent" stages of infectious parasites, especially in alternate hosts or at unrecognised or cryptic stages of development. Development of more sensitive, immunologic or nucleic acid, diagnostic tools can only be achieved if the disease re-appears and the causative agent can be isolated and its pathogenic role in disease development verified. Until such time we continue to be haunted by the disease risks associated with the historic presence of this mysterious oyster malady.