INVESTIGATIONS OF SAMPLING AND STATISTICAL METHODS FOR THE ASSESSMENT OF COTTON PLANTS

R. O. Kuehl, Statistician, University of Arizona
Agricultural Experiment Station
C. D. Bonham, Associate Professor, University of Arizona
R. E. Fye, Entomologist, E.R.D., ARS, U.S.D.A.

Objective

To determine the methods to properly assess populations of cotton insects for purposes of biological and chemical control of injurious cotton insects.

Summary of Progress

During 1969, additional data were obtained to determine (1) the distribution of insects in the fields; (2) the effect of ecological factors on insect distribution; and (3) the proper sampling units for the various tests.

The 1968-69 data are currently being analyzed and will soon provide an improved method of assessing cotton insects in the field. The 1967 data for distribution of insects in the field have been reported.

The insects studied include: (1) the bollworm, Heliothis zea (Boddie), (2) the pink bollworm, Pectinophora gossypiella (Saunders), (3) the cabbage looper, Trichoplusia ni (Hübner), (4) the beet armyworm, Spodoptera exigua, (5) the salt-marsh caterpillar, Estigmene acrea (Drury), (6) the boll weevil, Anthonomus grandis (Boheman), (7) predators, and (8) parasites.

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BIOLOGICAL CONTROL INVESTIGATIONS

D. E. Bryan, Entomologist, E.R.D., A.R.S., U.S.D.A.
G. D. Butler, Jr., Entomologist, E.R.D., A.R.S., U.S.D.A.
R. E. Fye, Entomologist, E.R.D., A.R.S., U.S.D.A.
Adair Stoner, Entomologist, E.R.D., A.R.S., U.S.D.A.
C. G. Jackson, Entomologist, E.R.D., A.R.S., U.S.D.A.
Eugene Neeman, Agr. Res. Technician, E.R.D., A.R.S., U.S.D.A.

Objective

To determine the feasibility of using native and introduced parasites and predators to control insects damaging cotton.

Summary of Progress

In the early 1940's a tachinid species with a relatively short life cycle and poorly developed host preference was introduced into Hawaii from California and was identified as Eucelatoria armigera (Coquillett). Our studies

showed that this species differs biologically from the Eucelatoria sp. (we mistakenly called this E. armigera in our recent publication) which is indigenous in Arizona and West Texas. The immature stages of the Hawaiian species are as much as 10 days shorter at 15°C and 1.5 days shorter at 30°C; also it readily attacks a variety of lepidopterous larvae including Heliothis spp. and the beet armyworm Spodoptera exigua (Hübner), which served as the laboratory host. In this host, the total time to develop varies from 35.8 ± 2.2 days at 15°C to 9.1 ± 0.4 days at 30°C. In contrast, the Arizona species attacks Heliothis spp. most readily and the cabbage looper, Trichoplusia ni (Hübner), only rarely. Attempts to interbreed the two species were not successful.

The tachinid parasite Leschenaultia adusta (loew) developed from egg to adult in the salt-marsh caterpillar (Estigmene acrea (Drury)), in a maximum of 89.3 ± 2.8 days at 15°C and a minimum of 17.6 ± 0.8 days at 30°C when temperatures were constant. Parasitized larvae did not survive at 35°C. The maximum total number of eggs produced by a single female was 4572, considerably more than the mean total of 1939 + 1365 for all females tested. The mean preoviposition period was determined to be 7.6 ± 1.0 days; the mean total days oviposition was 9.1 ± 6.5; and the mean longevity was 17.0 ± 6.8 days at 26.7 ± 1.1°C.

Palexorista laxa (Curran) was acquired from the Commonwealth Institute of Biological Control, Bangalore, India, where it is considered one of the important parasites of Heliothis spp. This tachinid has a high potential progeny production and averages about 5 puparia per parasitized host larva. The duration of the egg and larval stages ranged from 18.1 ± 3.4 days at 15°C to 4.1 ± 1.6 days at 32.2°C; the duration of the pupal stage ranged from 35.8 ± 1.8 days at 15°C to 6.5 ± 0.5 days at 32.2°C. Or at 35°C, the duration for both developmental periods was longer and the percentage of successful adult emergence was reduced to 10%. The optimum rearing temperature would appear to be between 25° and 30°C.

The ichneumonid parasite, Hyposoter pilosulus (Provancher) was reared in the laboratory in the salt-marsh caterpillar at several constant temperatures. Observations showed that it oviposited in small larvae and pupated within the body wall of the dead host. Time for development from oviposition through the pupal stage varied from 56.9 ± 4.0 days at 15°C to 17.9 ± 1.1 days at 30°C. Temperatures of 32.2°C and higher were lethal.

Studies of Geocoris punctipes (Say) indicated that this insect may maintain itself on plant foods and development (with moderate longevity) may occur through several nymphal instars: however, animal food is apparently required for proper development and fecundity. Adults switched from an animal to a plant diet had moderate longevity and laid some viable eggs. On 13 of the 26 plant foods offered, G. punctipes developed from the 2nd instar to the adult stage and 22 of the 26 plants gave longevities that were better than that given by a diet of water only.

When seven experimental artificial diets were tried with nymphs of Nabis alternatus Parshley, the most successful was a diet containing sources of casein and yeast hydrolysates. When the literature was reviewed to find

which acids are present in the haemolymph of the pea aphis Acyrthosiphon pisum (Harris) (a known prey of N. alternatus), it was found that asparagine, gamma-amino-butyric acid, glutamine, and homoserine, which do occur in this haemolymph, were missing in the hydrolysates used in the diets. These acids were therefore incorporated into the most successful of the 7 diets and found to give fair results. In a test with only 28 nymphal N. alternatus, 89.3, 82.1, 60.7, 35.7, and 3.6 percent reached the 2nd, 3rd, 4th, and 5th instars and adulthood, respectively.

Regression equations were developed for prediction of total plant area and volume and total leaf area of the three varieties of cotton plants by using plant height as the independent variable. Thus, the surface areas of Hopicala, Deltapine Smoothleaf, and Pima S-2 may be estimated by using the general regression equation:

$$Y = a + b X,$$

where Y = log value of the estimated area or volume,

a = a determined intercept,

b = a determined regression coefficient,

X = log value of the mean measured height.

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INSECT GENETIC INVESTIGATIONS

A. C. Bartlett, Geneticist, E.R.D., A.R.S., U.S.D.A.

Objective

To develop genetic methods of controlling insects injurious to cotton.

Summary of Progress

Radiation effects on pink bollworm Pectinophora gossypiella (Saunders). Male pink bollworm larvae treated with 6000 to 7000 rads of gamma radiation showed no significant decrease in eclosion compared with the controls. Male adults from these irradiated larvae had a high incidence of sterility, but some F_1 progeny were produced when these male F_1 individuals were allowed to mate with normal females, the progeny showed a continuing high degree of sterility (1% maturity in the F_2 generation compared with 23% maturity in the controls). Also, the female F_1 individuals showed some sterility when they were allowed to mate with normal males, but fertility was higher than for the males (13% maturity versus 23% in the control). The egg production following these F_1 matings was not noticeably affected. F_1 males mating with F_1 females produced only 1% mature F_2 progeny.