Lima beans are the most expensive ingredient in the diet used exclusively by this laboratory. In tests in which the amount of beans was halved it was determined that the length of larval stages increased and pupal weight decreased for bollworms and tobacco budworms. However, these negative attributes are not as important as cost reduction when large amounts of diet (60 gals/day) are prepared in the course of parasite production.

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SAMPLING AND STATISTICAL INVESTIGATIONS

R.E. Fye, G.D. Butler Jr.,
R.O. Kuehl and F.L. Watson

Objectives

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

Summary of Progress

Enumeration samples of various pests and predators associated with cotton were collected over a three-year period in commercial cotton fields to evaluate their statistical properties. Samples from relatively low density populations agreed with Poisson expectations of the negative binomial distribution. The number of plants per sample unit influenced the statistical distribution of the samples. Cotton insect populations tend to be clustered but the clustering is only detected under very intensive sampling or when population density is high.

Most populations of fruiting forms and pests and predators in the upper two and three six-inch increments of the cotton plants were found to be correlated with the populations in the remainder of the plants. However, the correlations were not of sufficient magnitude to allow estimates for the lower portions to be derived from counts made in the upper two or three six-inch increments. From 70 to 100% of all forms of the insects observed were found in the upper two feet of the cotton plants inspected.

Mean seasonal populations of the larvae of bollworm, Heliothis zea (Boddie), cabbage looper, Trichoplusia ni (Hübner), beet armyworm, Spodoptera exigua (Hübner), and saltmarsh caterpillar, Estigmene acrea (Drury), were similar in the outer tier of one acre blocks and the inner portion of cotton fields treated with insecticides. The insecticides probably were responsible for the evenness of the populations. Large variance attended the sample means and differences between the inner and outer portions of the fields were inconsistent and frequently reversed on successive dates. Therefore, it is probable that fields treated with insecticides may be reliably sampled in any area of the field.

Movement of Lygus hesperus (Knight) adults from one field to another is an important characteristic affecting population dynamics. In tests on central Arizona fields it was determined that non-attractant truck-mounted traps collected more L. hesperus adults one hour after sunset and one hour before sunrise than at any other time during the day. Some flight occurred in the night but none in the daytime. In tests from .76 m to 2.90 m above ground level, flight was heaviest up to 2.45 m. Flight occurred at 2.90 m indicating that some flight may take place above that level. Insects flying at these levels are likely to be carried long distances by the high winds that frequently accompany evening storms in the summer months.

A computer program (WATBUG) was developed with the Department of Agricultural Engineering, University of Arizona, that will determine the rate of development of the different stages of an insect in relation to fluctuating temperatures. Actual temperatures at one-hour intervals can be used as input or the program will estimate hourly temperatures from daily maximum and minimum temperatures. In addition, this program can model insect populations when such factors are known such as sex ratio, adult longevity, number of eggs laid per female, percent laying eggs, percent of life during which eggs are laid, reproductive diapause, various mortality factors, and other pertinent parameters. Specific mortality can be introduced to simulate the effect of insecticides, chemosterilants or parasites. The value of the program has been demonstrated with lygus bugs and cabbage loopers. Preliminary programs have also been run for pink bollworm, bollworm, and other insects.

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BIOCLIMATOLOGY AND INSECT DEVELOPMENT

R.E. Fye

Objectives

To develop bodies of bioclimatological and biological data that may be used to predict the course of biological control of cotton insects.

Summary of Progress

Temperatures in the various plant parts of cotton planted in one m rows and in two rows on a 0.52 m bed were monitored for 5-24 hour periods during the growing season. Future analysis will compare the temperatures within the canopies of the cotton in the standard row and the narrow-spaced cotton.

Leaf temperatures ($\hat{y}$) on the upper side of cotton leaves may be estimated from air temperature (at in °F) with the regression equation: $\hat{y} = 12.6 + 0.892(at)$, and for the underside with the regression equation: $\hat{y} = 3.7 + .916(at)$. In the regression study introducing the height of the leaf in the plant as an additional independent variable had little effect upon the estimates by the regression equations. Though the modification of temperatures by the leaves is but a few degrees the leaves provide a sphere of activity where insects can function during periods of high temperatures.

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