BIOCLIMATOLOGY AND INSECT DEVELOPMENT

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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 of squares, bolls, and terminal buds of short and long staple cottons and the temperature within the squares, boll bracts, and canopy of the cotton plant were 2-5°F. less than the air temperature. The temperatures of plant parts are highly correlated with air temperatures and may be estimated from air temperature with regression equations.

Studies of shading by cotton plants indicate that canopy coverage by Deltapine Smoothleaf and Pima S-2 cottons may be estimated from the linear regression equations: $\hat{y} = 4.28 + 1.04$ (height in cm), respectively, when $\hat{y}$ = the percentage canopy coverage.

Development of the bollworm, the tobacco budworm, the beet armyworm, the cabbage looper, Trichoplusia ni (Hübner), and the salt-marsh caterpillar, Estigmene acrea (Drury), may be predicted from the proportion of development (reciprocal unit of development) that takes place in a two-hour period in mean substrate temperatures between 20° and 35°C. (The reciprocal units of development may be estimated with simple regression equations with the logarithm of temperature as the independent variable.) When mean temperatures in excess of 38°C. were included in the temperature regimens, development was slowed. Development of the pink bollworm was better predicted by an asymptotic regression equation with the logarithm of temperature as the independent variable. In all species, high temperatures lowered fecundity and reduced longevity.

In studies of egg mortality, eggs were exposed for 2, 4, 8, 16 and 24 hours daily to temperatures of 35° and 40°C. in RH's of 10, 20 and 40%. No mortality of cotton bollworm eggs resulted from the exposures at 35°C., but some mortality occurred during the second 4-hour exposure at 40°C. and 10% RH, and mortality was high in eggs exposed for longer periods. Similar results were obtained with tobacco budworm eggs except that all eggs died during the 24-hour exposures at 35°C. and 10% RH, at 40°C., the first mortality occurred during the 3rd exposure to 10% RH. Beet armyworm eggs were killed during the 1st exposure of 20 hours to 35°C. and 10% RH and by 8 hours or more at 40°C. Similar results were obtained with cabbage looper eggs, but the eggs hatched somewhat better at the high temperatures and low humidities. Salt-marsh caterpillar eggs suffered heavy mortality when they were exposed for 16 hours or more to 35°C. and for 4 hours or more to 40°C. Pink bollworm eggs sustained

heavy mortality when they were exposed twice for 16 hours or more to 35°C. and 10 and 20% RH, when they were exposed to 40°C. and 10% RH, and when they were exposed one or more times for 16 hours or more to 40°C.

Also, the effects of larval-pupal exposure and adult exposure to daily periods of 2, 4, 8 or 16 hours at temperatures of 35° and 40°C. were studied with the same insects. Generally, the developmental period decreased as the daily exposure to 35°C. was increased; fecundity, fertility and longevity were unaffected. Insects exposed 16 hours to 35°C. as larvae and pupae or as adults had reduced fecundity, fertility and longevity. Exposures of the larvae and pupae and the adults to temperatures of 40°C. did not affect development, fecundity and fertility when the exposure periods were only 2 and 4 hours. However, when the periods were increased to 8 hours at 40°C., fecundity and fertility were reduced, and the developmental period was increased. When the larvae and pupae were exposed for 16 hours daily to a temperature of 40°C., fecundity, fertility and longevity were generally reduced.