its physical effect upon the nymphs. The size of the spring population is also affected by the date of the last killing frost.

Temperature and rainfall thus affect the population level of lygus bugs before March 1 but, thereafter, the rate of increase appears to be the same in a number of areas and in different years until the end of May. During this period, the overwintering adults die, and the first and second generation adults are added to the population. When temperatures of 100°F occur in late May, adult survival and egg-laying are reduced, and survival of nymphs is affected so the population may decline. This sequence occurred in 1968. On June 1, 1968, there were two times more adult lygus bugs present in alfalfa than on June 1, 1967, but by early July, the 1968 populations were 3.4 times less than in 1967. Consequently, the severity of the infestation in cotton was less.

During late July and August, conditions may become more favorable, and the populations may increase. However, populations usually decline sharply during September and early October, probably because of reproductive diapause. Usually the populations increase in late October and November until a killing frost occurs and then gradually decline through the winter.

Quantitative data have been collected during the past year on the sex ratio, the percentage of females laying eggs, the numbers of eggs laid per female, and the longevity of females. Regression formulae have been calculated for the rates of development of the egg and the five nymphal stages in relation to temperature. The observed nymphal populations during 1968 fitted the calculated sequence for the predicted seven yearly generations.

Thus, the preliminary calculations reveal a potential approach to the mathematical modeling of populations of lygus bugs and the possibility of deeper insight into the factors affecting the fluctuations.

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INSECT BIOCLIMATOLOGY

R. E. Fye, Entomologist, E.R.D., A.R.S., U.S.D.A.
C. D. Bonham, Assistant Statistician, University of Arizona Agricultural Experiment Station

Objective

To develop bodies of bioclimatological data that may be used to interpret entomological data.

Summary of Progress

Linear regression equations were developed to estimate temperatures and heat flux in dry bolls, stalk debris, the soil surface, and the soil surface-stalk trash debris interface in stubbed cotton fields from air temperatures.

The contributions of such other factors as moisture to multiple linear regression were considered. Simple linear regression of the desired dependent variable on air temperature generally gave a good estimate of temperature and heat flux in the insect niches in stubbed cotton in the wintertime.

Linear regression analyses of temperatures and heat flux in pyramidal and Lumite® cages, small wooden framed screen cages, and buried cage bases indicated that crude estimates can be made from readily obtained temperature parameters. However, if a high degree of precision is required, direct measurement is not only desirable but mandatory.

Data have also been obtained for the development of regression equations to estimate temperature and heat flux (1) in the various parts of short-and long-staple cotton plants, (2) the soil surface in cotton fields in summer, and (3) at various levels below the soil surface in the wintertime. These data are currently being analyzed.

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BOLL WEEVIL INVESTIGATIONS

R. E. Fye, Entomologist, E.R.D., A.R.S., U.S.D.A.

Objective

To determine the biology and ecology of the boll weevil, *Anthonomus grandis* Boheman, in Arizona and to use this information to improve control and to predict its damage potential in the arid Southwest.

Summary of Progress

Infestations of boll weevils in Arizona in 1968 were very light, and few boll weevils were detected. Apparently, destruction of stalks and plow-under in conjunction with applications of insecticides to control the pink bollworm, *Pectinophora gossypiella* (Saunders), reduced the populations of boll weevils.

Studies of winter survival of boll weevils from Stanfield indicated that hibernation in a moist environment greatly extended longevity.

Laboratory studies showed that vertical velocities of 2.5-5.5 meters per second will suspend a passive boll weevil. Surface winds, turbulences in dust devils, and high altitude currents frequently reach this velocity in Arizona. Although velocities in excess of 31 meters per second were required to free some weevils from their foothold on cotton leaves any irregularity in the airstream enhanced the possibility that the weevil would be freed.

Developmental periods of boll weevils from cultivated cotton ranged from 88 days at 15°C to 17 days at 30°C. However, temperatures in excess of some