detected in the F_1 male larvae obtained when irradiated insects of either sex mated with unirradiated or irradiated insects. Data are now being accumulated to measure the proportion of F_1 insects carrying these chromosomal aberrations after doses ranging from 5000 to 25000 rad of gamma irradiation or after timed exposures to fast neutrons.

Effects of irradiated on pink bollworms. If male pink bollworms are given 20000 rad of gamma irradiation and then allowed to mate with normal females, the egg production of the females is reduced to 25% of the control. In studies to determine the cause of this reduction, it has so far been shown that the irradiated males mate as often as the normal males (as determined by spermatophore counts in single pair matings) and that the longevity of males irradiated at 20 k rad is equal to that of untreated males. Subjective determinations of sperm showed more variation in irradiated males than in unirradiated males, but sperm were found in the spermatheca of females allowed to mate with treated males as often as in females allowed to mate with untreated males. Thus, a physiological (chemical) factor is apparently responsible for the decrease in production of eggs.

Pink bollworm mutant isolated. A stock of pink bollworms has been established in which all larvae have black heads compared with the brown heads in the wild-type stocks. The inheritance of this trait is not completely determined.

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THE BIOLOGY AND ECOLOGY OF LYGUS SPP. ON COTTON AND ASSOCIATED CROPS

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Objective

To determine the biology and ecology of the several species of *Lygus* in Arizona and to use this information to improve the control of *Lygus* spp. in cotton.

Summary of Progress

After the first frost in the fall, populations of lygus bugs in alfalfa are predominantly adults. On warm winter days, these adults become active and lay eggs. Because the egg has a threshold developmental temperature of about 46.5°F, the stage is greatly prolonged at low temperatures. Mortality of eggs is probably high during this time because the tender plant tissues in which the eggs are laid are subjected to periodic frosts. When the frozen tissues dry, the eggs of the lygus bug are destroyed. The appearance of nymphs is therefore dependent on minimum temperatures. During warm winters, nymphs may be present in January; in colder years, none will be found. Rainfall during December and January reduces spring populations, possibly because of 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

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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.