ENVIRONMENTAL IMPROVEMENT THROUGH BIOLOGICAL CONTROL AND PEST MANAGEMENT

T. F. Watson
P. V. Perkins
D. T. Langston
R. J. Rakickas
D. G. Fullerton

Objectives:

A. To develop a pest management program to prevent lygus damage in cotton

B. To determine the potential of selected predators, parasites and pathogens as control agents of important cotton pests

Summary of Progress:

A. Pest management

(1) Safford (Eastern Arizona)

Strips of alfalfa were interspersed in cotton at the rate of 12% of the acreage. High populations of lygus developed in the alfalfa during the season. The peak of nymphal activity occurred on July 18, a critical period of heavy fruit-set in cotton. Populations of both adults and nymphs started to decline in the alfalfa on August 11, with a subsequent rise in the population level in cotton. The peak nymphal population in cotton occurred on August 19 and then declined rapidly. Observations indicated that the poor condition of the alfalfa at this time probably was the reason for the reversals in the population trends. In general, lygus in the cotton remained below 10 per 100 net sweeps. However, on August 19 and 24 both adults and nymphs were found in the cotton at a level of 10 to 20 per 100 sweeps.

(2) La Palma (Central Arizona)

Two adjacent blocks of cotton (approximately 25 acres each) were utilized in an alfalfa strip-plant test. The two fields differed only in the percentage of the land area seeded with alfalfa; one field had four-row alfalfa strips alternating with 48-row strips of cotton (approximately 8% alfalfa) and the other contained half the above amount of alfalfa or two-row strips bordered by 48 rows of cotton (4% alfalfa).

This area has a perennial lygus problem and generally much chemical control is applied. Results were not as outstanding as those in the Safford experiment. Several factors are apparently involved, one of which relates to the condition of the alfalfa strips. The stand of alfalfa was not particularly good and was stressed for water several times during the season. In spite of this, high populations of lygus developed in the alfalfa in contrast to the cotton.

A comparison of lygus populations in the cotton and alfalfa strips reveals several interesting points. Adult and nymphal populations in the two blocks of cotton were almost identical. However, adult and nymphal populations in the alfalfa strips showed a 2 to 1 ratio in the 4% alfalfa strips as compared to the 8% strips. This indicates that the same numbers of lygus were present in both fields and the same number was locating and staying in the alfalfa strips, but since the alfalfa acreage was approximately one half the amount in one field as compared to the other the lygus population density was twice as great. The importance of the alfalfa strips in holding the lygus is illustrated when comparisons are made between comparable sample units in the cotton and alfalfa strips. In the 8% - alfalfa field, the ratio of lygus adults was 1 to 12 - cotton to alfalfa. In the 4% - alfalfa field, the ratio was 1 to 26 - cotton to alfalfa.

Conclusions which can be drawn from this experiment are: (1) that control of lygus in the cotton was not totally satisfactory; (2) that the two-row alfalfa strips were comparable to the four-row strips in holding lygus; and, (3) that large predator populations were developed in the alfalfa strips and were present throughout the test period.

B. Biological control

(1) Nabis alternatus as a predator of Lygus hesperus

A detailed laboratory study has been completed to determine the consumptive capacity of Nabis alternatus on Lygus hesperus. Survival of all nabid instars was poor when provided with no food other than a plant source. Survival and development were good, however, when lygus bugs were provided as the food source. In order to complete the five nymphal instars, Nabis alternatus requires 158.1 1st instar, 91.5 2nd instar, 56.4 3rd instar, 28.8 4th instar, or 11.2 5th instar lygus. Each successive nabid instar requires a proportionately greater number of each lygus instar to complete development. This illustrates the potential of this predator as a biological control agent of lygus.

(2) Predation of pink bollworm eggs

Several preliminary trials were conducted to determine the amount of predation and/or parasitism on pink bollworm eggs in the Safford area. Small egg batches were placed under bracts near squares or under the calyx of bolls. After periods of 12, 24 or 48 hours the egg batches were collected, returned to the laboratory for microscopic examination and held for possible parasite development.

In general, it appears that considerably greater predation occurs at night than during the day. More predation occurred when egg batches were placed on squares than on bolls. However, in one trial 91% of 433 eggs placed on bolls were destroyed. Observations and sweep net samples indicated the presence of commonly-occurring predaceous species such as Orius sp., Chrysopa sp., Geocoris sp., Collops sp. and Nabis sp. All of these species have been shown to be

voracious feeders on pink bollworm eggs in the laboratory. No parasites were recovered from the eggs during these trials.

(3) Parasitism of the bollworm, Heliothis zea

A survey was initiated to determine the seasonal incidence of parasitism of the bollworm on sorghum, cotton, and alfalfa in various areas of Arizona. The initial effort indicates that several parasite species are involved and that parasitism is more prevalent on H. zea on sorghum than either of the other crops.

(4) Effects of certain microbial agents on the bollworm and cabbage looper

Laboratory studies with several new strains of Bacillus thuringiensis (provided by Nutrilite Products, Inc.) indicate that one of the new strains is considerably more toxic to both the bollworm and cabbage looper than is the standard strain which is commercially available. The development of this or similar strains for commercial purposes would greatly enhance microbial control efforts.

Field studies were conducted with several pathogens for effectiveness against the bollworm. In most cases, effectiveness was determined by returning treated cotton or alfalfa foliage to the laboratory for bioassy. Materials tested included Bacillus thuringiensis (formulations from both Nutrilite Products, Inc. and International Minerals Corp.) and three formulations of the Heliothis virus.

Results indicated that high mortality can be obtained with both formulations of Bacillus and with two of the virus formulations. Research with these materials will continue.