BIOLOGICAL CONTROL INVESTIGATIONS

D. E. Bryan
R. E. Fye
G. D. Butler Jr.
Adair Stoner
C. G. Jackson
E. G. Neemann
A. L. Wardecker

Objectives:

To determine the feasibility of using native and introduced parasites and predators to control insects damaging cotton.

Summary of Progress:

Field cage tests with Eucelatoria sp. and Palexorista laxa (Curran) showed these tachinid parasites to be potentially effective for control of the bollworm, Heliothis zea (Boddie), and the tobacco budworm, Heliothis virescens (Fabricius). Fourth and fifth stage host larvae were placed on plants in 6 feet x 12 feet x 24 feet plastic screen cages at a density of one to every two plants and allowed one day to become established before the parasites were introduced. The adult flies were allowed to search and parasitize for two days; then the host larvae were retrieved and held in the laboratory for evidence of parasitism. In 16 replications, an average of 57% of the recovered host larvae were parasitized in the two-day period by Eucelatoria sp. when they were released at a rate of 20 females per cage (approximately 2,500 per acre). At the same conditions, an average 51% control was obtained in five replicates with Palexorista laxa.

A culture of the exotic parasite Exorista segregata (Rondani) has been established in the laboratory where it is maintained on 5th-stage tobacco budworms. However, we have not been able to rear the parasite in the numbers required for biological control studies. A majority of the host larvae exposed to the flies have eggs deposited on them, but only 20-25% produce fly puparia. In a study made to find out what happens to these parasites between oviposition and pupation, the percentage hatch and the length of the egg stage were determined at constant temperatures of 68°, 77°, 86°, 90° and 95°F. At all temperatures, at least 90% of the eggs hatched. Also, the time required for egg hatch was shorter than the length of the 5th-stage of the tobacco budworm. For example, the eggs hatched in 2-3 days at 77° and 96°F.; the 5th stage of the host lasted an average 5-6 days.

Laboratory studies of Archytas marmoratus (Townsend), a larval-pupal parasite of 5th- and 6th-stage bollworms and tobacco budworms, showed that larviposition could be stimulated by the presence of host blood, fresh frass, or regurgitated material. The chemical substance that stimulates larviposition was identified tentatively as a water-soluble protein. Daily dissections of parasitized host larvae showed that the parasite has three larval instars and that their total duration was about nine days at 82°F. The end of the first larval instar of the parasite coincided with the pupation of the host. Pupal development outside the host required another 12-13 days.
The braconid parasite *Bracon kirkpatricki* (Wilkinson) was studied in the laboratory to determine whether it is a feasible biological control agent against the pink bollworm, *Pectinophora gossypiella* (Saunders). The total development time on this host varied from $22.4 \pm 1.2$ days at $68^\circ F$ to $7.9 \pm 0.4$ days at $95^\circ F$. Mass rearing techniques were developed with the beet armyworm, *Spodoptera exigua* (Hübner), as host. With these techniques, the cost of the labor necessary to rear 1,000 adult parasites is about 58 cents. The other large item, the host larvae, amounts to $3/1,000$ beet armyworms. However, an average yield of 10 adult parasites/host is obtained. Studies in 6 feet x 12 feet x 24 feet plastic screen cages showed that 75-80% control may be possible if the parasite is released at the rate of $10,000$/acre/week early in the season from the time of first appearance of the host larvae until the end of the first generation of host larvae.

Adult *Leiophron* spp., a braconid parasite of *Lygus* nymphs, were received from Moorestown, N. J. where they had been received from Poland. Field-collected *Lygus* nymphs were parasitized and held in the laboratory until parasites were about to emerge and then some of these nymphs were placed in field cages at four locations in southern Arizona. Additional parasites were held in the laboratory and spun cocoons. These cocoons are being held at 35-40°F. and will be brought out early in 1971 to produce additional parasites. The univoltine habit of this insect makes its increase slow.

A colony of *Polistes exclamans arizonensis* (Snelling) has been propagated successfully in the confines of a small cage. The results indicate that this voracious predator may lend itself to manipulation and movement into the vicinity of fields requiring predatory activity. These predators have the advantage of leaving a field for the night and may be readily confined until necessary production practices may be accomplished.

Early season grain sorghum serves as a host of greenbugs, *Schizaphis graminum* (Rondani), and corn leaf aphids, *Rhopalosiphum maidis* (Fitch), which are utilized as prey by a lady beetle *Hippodamia convergens* Guérin-Méneville, *Chrysopa* spp., *Collops* spp.,*Geocoris* spp., *Nabis* spp. and various other minor predators. Also, populations of the lady beetles, *Collops* spp., and *Chrysopa* spp. reach high levels and overflow into adjacent cotton where they prey on several pests. Intercultivations of sorghum and cotton may greatly facilitate this interchange and increase the predatory activity in the cotton.

Adult *Nabis alternatus* (Parshley) and *N. americoferas* (Carayon) in a continuing diapause and parasite study were collected weekly in the field and dissected to inspect fat and egg status for diapause condition and also for parasites. From January 15, 1970, when the study began until November 17, 1970, totals of dissected nabids were: *N. alternatus* - females 1,424, males 1,207; and *N. americoferas* - females 480, males 452. *Weisia pendula* (Foerster), a hymenopterous parasite, was found nearly exclusively in male nabids. Present data indicate a possibility of a partial diapause October 13 through November 17 for *N. alternatus* and October 20 through November 17 for *N. americoferas*.

*Nabis alternatus*, *N. americoferas*, *N. capsiformis* (German), *Podisus acutissimus* (Stål), *Arrachus cinereus wygodzinskyi* (Elkins), *Sinea complexa* (Caudell), *S. confusa* (Caudell), *Zelus renardii* (Kolenati), and *Z. socius* (Uhler) were studied to determine their ability to utilize plant food. All except *P. acutissimus* showed only increased longevity when they fed on some
plant foods; *P. acutissimus* showed greater longevity and also advanced as far as the 5th stage.

During June and July 1970, a total of 91,000 net sweeps were made in six alfalfa fields, two sorghum fields, three safflower fields, and 12 cotton fields to determine the fluctuations in population of 12 insect predators. In addition, the sex ratio of several species, the species of *Nabis* and *Geocoris*, and the presence of fecund adults was determined. Detailed reports on each predaceous species are being prepared.

Cotton fields are subject to a continuous influx of harmful and beneficial insects. It is well known that moths are most active at night, but it is not generally known when some predator insects fly. Insects in flight were collected in traps mounted on a truck driven at different times of the day and night. Predators such as *Collops vittatus* (Say) and *Geocoris* spp. flew mostly from 9:30 p.m. to 1:00 a.m. *Hippodamia convergens* flew at midday. *Nabis* spp. flew from 8 to 9 p.m. in early summer and then both earlier and longer (from 2 to 3 a.m.) as the days shortened. *Notoxus calcaratus* (Horn) flew from 8 to 9 p.m., was slightly active through the night and sometimes had increased activity from 4 to 5 a.m.