Sampling consisted of moving into each plot at least 25 yards and pulling 10 leaves at random for determining degree of cotton leaf perforator infestation to include leaves showing mines, fourth and fifth stage larvae and the horseshoe stage. Ten half-grown bolls were pulled in each plot and examined for presence of pink bollworm larvae.

Results and Discussion: Results of this experiment indicated that the cotton leaf perforator can be controlled with Lannate at 0.5 lb/acre with an application interval of at least 11 days.

The pink bollworm was not controlled in this plot of cotton and at the time the test was initiated 100% of the bolls were infested. This test indicated that under severe population pressure, the pink bollworm cannot be controlled at the longer application interval. However, at the 5.5 day interval, the data indicated that adequate control was being achieved. Observations of the long-interval sample collected on September 15 where 90% of the bolls were infested revealed the probable reason for lack of any apparent control in this treatment. Most of the larvae found in the bolls were first instar, indicating an application interval slightly in excess of that required to give good control.

Because no attempt was made during the earlier part of the growing season to control the pink bollworm, severe damage had occurred by the time this test was initiated. Therefore, yield data were not taken in this test.

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BIOLOGICAL CONTROL INVESTIGATIONS

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Objectives

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

Summary of Progress

In February 1971 CIRB made funds available for a 112-acre pink bollworm, Pectinophora gossypiella (Saunders), control test with Bracon kirkpatricki (Wilkinson) and Chelonus blackburni (Cameron). In the ensuing months weekly production of both species was scaled up to about 250,000 of the former and 50,000 of the latter with the intent of keeping constant pressure on the pink bollworm population from first cotton bloom until the end of August. Beginning June 10 and continuing to September 2 a total of 2,019,000 B. kirkpatricki and 283,000 C. blackburni were released on a semiweekly basis. During this period the release fields received one insecticide treatment for lygus bugs on July 27 and one treatment for pink bollworm control on 75 acres in the parasite release area on September 5. In the non-release area (200 acres) four insecticide applications were made for pink bollworm control and one application for

bollworm, Heliothis zea (Boddie), control. B. kirkpatricki performed well in suppressing the pink bollworm infestation in the blooms. C. blackburni did not maintain control in the mid- and late-season infestations because the numbers released were but 20% of the intended 2500/acre/week to be released at peak production before September. The production technique has been perfected since that time.

Palexorista laxa (Curran), a tachinid parasitic only on Heliothis spp., was acquired from the Commonwealth Institute of Biological Control in Bangalore, India. Laboratory studies of survival and reproduction at constant temperatures showed that the number of larvae parasitized and the number of resultant puparia was greatest at 25°C and declined steadily with increasing temperatures. For all females tested, a mean number of 56.6 larvae was parasitized and a mean total of 72.2 puparia was produced at 25°C. However, the percentage of the total number of larvae offered that was parasitized was greatest at 32.2°C when 30.8% produced one or more puparia. Corresponding percentages for 30°C and 25°C were 24.4% and 23.4%, respectively. All females tested parasitized an average of 36.2 larvae and produced 49 puparia in a 12-day oviposition period. As expected, longevity was inversely related to temperature, ranging from a mean of 46.1 days at 20°C to 12.9 days at 35°C for females and 32.1 days at 20°C to 16.0 days at 35°C for males.

Eucelatoria sp., a tachinid which is virtually specific to Heliothis spp., is indigenous to Arizona. In constant temperature tests the total production of progeny by a single female of the tachinid Eucelatoria sp., when Heliothis spp. were used as hosts, ranged from 144 at 20°C to 198 at 30°C and declined at temperatures above 30°C. The mean number/female rose from 68.2 at 20°C to 112.9 at 30°C and then dropped to 52.4 at 32.2°C and to 2.0 at 35°C. Mean female longevity declined from 61.8 days at 20°C to 17.9 days at 35°C. Males were 7-10 days shorter lived over the same temperature range.

Polistes exclamans arizonensis (Snelling), an indigenous vespid predator in Arizona cotton fields was successfully overwintered in stacks of cardboard with interspersed spacers. When the wasps emerged in the spring they readily nested in a 1.2 m x 1.8 m x 1.2 m shelter with screen on three sides. The wasps were fed fourth to sixth stage larvae of the tobacco budworm, Heliothis virescens (Fabricius), and provided torn kraft paper for nesting material. A mean total of 5.3 budworm larvae was required for the nutrition of each wasp.

Adult Leiophron spp., braconid parasites of lygus bug nymphs imported from Turkey and France, were received from the Morristown, N.J., parasite introduction station. Some shipments were released in alfalfa at Tucson, others were utilized for rearing in the laboratory. Lygus nymphs collected in mid-September 1971 in the release area were 10-20% parasitized. Both species are multivoltine and therefore potentially more valuable than the Polish univoltine species imported in 1970.

Adult N. alternatus (Parshley) and N. americoferus (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 1/15/70 when the study began until 10/26/71 totals of dissected nabids were N. alternatus females 2675, males 2349; and N. americoferus females 1201, males 1243. Wesmaelia pendula (Foerster), a braconid parasite, has been found almost exclusively in male nabids. Present data show at least partial diapause beginning in October and lasting well into December.

Zelus socius (Uhler) and Nabis capsiformis (Germar) have been studied to determine their ability to utilize plant food and both show only increases in longevity by feeding on some plant foods.

O. tristicolor (White) has been reared successfully in the laboratory on a small scale using Indian meal moth, Plodia interpunctella (Hbn.), or pink bollworm eggs stuck to filter paper.

The duration of the egg, larval, prepupal, and pupal stages of the convergent ladybeetle, Hippodamia convergens (Guérin-Méneville), was determined at different constant temperatures. The egg stage varied in length from 4.5 days at 20°C to 1.8 days at 31.1°C. The larval stage was 17.2 days at 20°C and 7.4 days at 37.2°C. Prepupal development required 1.7 days at 20°C and 1.0 days above 28.9°C. The pupal stage varied from 11.9 days at 15°C to 2.6 days at 33.9°C .

In an interplanting of cotton and sorghum many predators from populations feeding in the sorghum on biotype C of the greenbug, Schizaphis graminum (Rondani), moved across the cotton (about 161.5 m wide) when the sorghum matured. Convergent ladybird beetles moved the least readily. The sorghum matured late (early September harvest) therefore, the predators were not forced from the sorghum early enough to control a bollworm outbreak in late August. To be successful in Arizona the sorghum apparently must be planted no later than the cotton.

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REARING INVESTIGATIONS

Raymond Patana and W.C. McAda

Objectives

To improve rearing techniques and develop methods of mass producing insects infesting cotton that can be used in the laboratory and in field releases of parasites and predators.

Summary of Progress

Laboratory cultures of bollworms, beet armyworms, pink bollworms, saltmarsh caterpillars, and tobacco budworms are maintained at the laboratory in Tucson. These cultures are used for studies of parasites and predators oriented toward biological control and for resupply for other individuals and/or laboratories in the United States and Canada.

During 1971 production of beet armyworms and pink bollworms was increased to provide hosts for parasite rearing for field releases. Through June and mid-July approximately 100,000 larvae per week were produced for rearing Bracon kirkpatricki. For a five-week period from the last week of July through August an average of 59,000 pink bollworm pupae per week were produced for the parent culture. During this same period an estimated 1.5 million pink bollworm eggs per week were produced for rearing Chelonus blackburni. Various techniques are being evaluated to increase return and to cut down the cost of the pink bollworm rearing program.