EVALUATION AND AUGMENTATION OF BIOLOGICAL CONTROL AGENTS TO REPLACE OR SUPPLEMENT THE USE OF PESTICIDES

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Objectives

A. To assess the influence of environmental factors, both natural and artificial on the effectiveness of parasites, predators, and pathogens in suppressing pests.

B. To determine the potential of various biological control agents.

Summary of Progress

Heliothis Virus Study:

The first phase of a *Heliothis* virus study was concerned with degree of persistence which various formulations exhibited in the field. Preliminary studies in 1968 indicated that the virus was rendered ineffective within a few hours after application.

A small-plot replicated experiment was initiated at Tucson on September 18, 1969, to compare the residual properties of four virus formulations. All were applied at the rate of 40 larval equivalents per acre. Leaf samples were pulled at 0, 24, 72 and 144 hours after the plots were sprayed and returned to the laboratory for bioassy. Six-day old *Heliothis zea* larvae were placed individually on 50 leaves from each plot and allowed to feed for 24 hours before being transferred to individual media cups. Each treatment was replicated three times, resulting in 150 larvae per treatment at each sample date. Mortality counts were made at 7 days and periodically thereafter until pupation began.

Results: Most of the mortality obtained from the various treatments occurred within the 7-10 post-inoculation period. The little that occurred thereafter appeared to be insignificant. Three of the virus formulations were fairly effective when larvae were fed on the treated leaves immediately after the plants were sprayed. However, the effectiveness of all but one dropped off rapidly as the period of exposure to environmental conditions increased. These data are presented in Table 1.

Table 1

Residual effectiveness of four Heliothis virus formulations using 6-day old Heliothis zea larvae for bioassy.

	Per Cent Viral Mortality[1/]			
	Post-Treatment Leaf Samples Collected at:			
Treatments	0-hour	24-hour	72-hour	144-hour
Control	2.8	2.2	2.1	5.0
VHZ 690	6.9	1.4	2.8	--
VHZ 691	88.2	30.8	16.8	--
VHZ 69 M	67.9	31.4	22.9	--
VHZ 69 C	92.4	66.2	53.8	49.0

1/ Per cent mortality is based on 12-13 day post-inoculation counts.

Effects of Biotrol BTB 183 on the Pink Bollworm:

Laboratory tests showed that first-instar pink bollworm larvae are susceptible to Biotrol BTB 183, a commercial preparation of Bacillus thuringiensis, when fed this material incorporated in artificial medium. Some mortality was obtained by placing first-instar larvae on the leaf surface of treated cotton plants for short periods of time and then returning them to artificial medium. In field tests, several application rates of both wettable powder and dust formulations of Biotrol BTB 183 failed to suppress pink bollworm populations.

Predation of Pink Bollworm Eggs:

Field studies demonstrated that a majority of the pink bollworm eggs laid on cotton plants during early and mid-season are placed in exposed areas which are accessible to commonly-occurring predators. Tests were conducted by artificially placing eggs under cotton boll bracts to substantiate the importance of predation as a natural control factor. After exposure periods of 24 and 48 hours in the field, 33.5 and 72.2 per cent, respectively, of the eggs had been destroyed by predation. A detailed laboratory study was conducted with the minute pirate bug, Orius spp., to determine its potential as an egg predator of the pink bollworm. The consumptive capacity of the five nymphal instars was 5.6, 7.2, 8.4, 10.8,

and 14.7 pink bollworm eggs, respectively. Additionally, the adult, during its five-day preoviposition period, consumed an average of 31.4 eggs. Other predators, especially larvae of Chrysopa spp., were observed, under field conditions, to be preying upon pink bollworm eggs.

Suitability of the pink bollworm egg as a host for Trichogramma sp:

The biology and population increase of the hymenopterous parasite Trichogramma sp. developing in the eggs of the pink bollworm, Pectinophora gossypiella (Saunders) and the cabbage looper, Trichoplusia ni (Hübner) under various constant temperatures, were studied in the laboratory.

The intrinsic rate of increase (r_m), net reproduction rate (R_o), mean generation time (T) and finite rate of increase (λ) were the basic parameters utilized in assessing temperature and host-egg influence on the biology and population growth of the parasite.

The population of the parasite increased more rapidly in the eggs of T. ni than in the eggs P. gossypiella at all temperatures. The developmental period, total fecundity and age-specific fecundity were also affected by the host egg.

Temperature influenced population growth by affecting adult longevity and fecundity. Considerable differences in the intrinsic rates of increase among the various constant temperatures occurred. The maximum increase occurred at 83°F, in both host eggs.

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