

The effect of insecticides on the survival of heliothis egg parasitoids.

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Abstract

The residual action of nine insecticides commonly used in cotton were assessed on the survival of the native egg parasitoid *Trichogramma funiculatum* by exposing adult wasps to sprayed cotton leaves 1, 3, 5, 7, 10 and 14 days after treatment (DAT). Es-fenvelerate (.025% a.i.), beta-cyfluthrin (.02% a.i.), methomyl (.045% a.i.) and thiodicarb (.075% a.i.) were highly toxic to the wasps, while endosulfan (.07% a.i) and profenofos (.075% a.i.) were not significantly toxic from DAT 3 onwards. *Bacillus thuringiensis* (30 ml/L), chlorfluazuron (.02% a.i.) and omethoate (.02% a.i.) had no significant adverse affects on wasp survival.

Introduction

Wasp egg parasitoids of the genus *Trichogramma* (and relatives) are commonly used as inundative biological control agents of lepidopteran pests throughout the world. These wasps are currently being produced commercially by three insectaries in eastern Australia and have potential as biocontrol agents of heliothis (*Helicoverpa* spp.). An understanding of the effects of insecticides on the survival of *Trichogramma* is essential to fully utilise them in integrated pest management programs. This report presents information on the effects of common cotton insecticides on the survival of the native egg parasitoid *Trichogramma funiculatum*.

Materials and Methods

Parasitoids

A laboratory culture of the native wasp egg parasitoid *T. funiculatum* was commenced in 1992, and maintained on eggs of the cotton bollworm, *H. armigera*. The parental stock were collected on the Darling Downs from *H. armigera* eggs in sorghum.

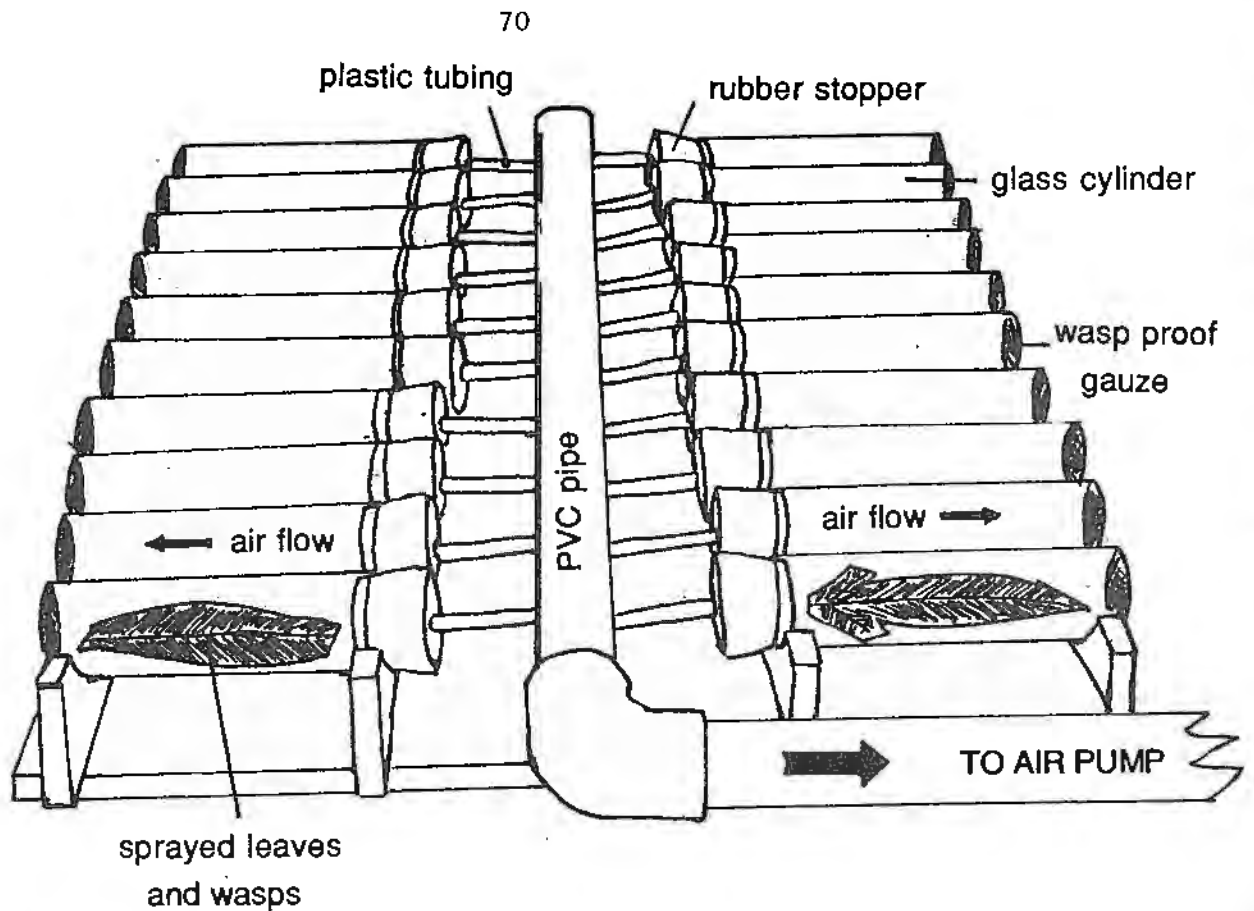


FIGURE 1: Bioassay chambers used to study wasp survival on sprayed cotton leaves.

Bioassay-Chambers

An apparatus for testing parasitoid survival in 60 bioassay chambers was constructed (Fig. 1). Each chamber consisted of a glass cylinder 150 mm long and 40 mm in diameter with flamed ends. Wasp proof stainless steel gauze (47 strands/cm, 0.125 mm aperture and 0.08 mm wire diameter) was glued to one end of each chamber. Sprayed cotton leaves and parasitoids were introduced via the open end which was then sealed with a single-hole rubber stopper. A 6 mm diameter plastic tube through the rubber stopper linked each chamber to a 25 mm diameter PVC pipe that was connected to an air pump. An airflow of 38 ± 2 cm/sec was pumped through all chambers to remove any possible fumigant action of the insecticides being tested. Wasp proof gauze was also melted onto the end of the plastic tube that opened into each chamber. This ensured that parasitoids were contained within each chamber.

Insecticides

The effects of insecticides commonly used in cotton were evaluated against *T. funiculatum*. Potted cotton plants (Siokra 1-4) in a glasshouse were sprayed to runoff using 1 L plastic hand sprayers. The insecticides and concentrations applied are shown in Table 1. The concentrations tested were equivalent to recommended volumes mixed in 1000 L of water, and were comparable to concentrations used in horticultural crops.

Procedure

Cotton leaves were removed from sprayed plants 1, 3, 5, 7, 10 and 14 days after treatment (DAT) and placed in bioassay chambers (Fig. 1). Ten newly emerged, fed adult *T. funiculatum* were then released into each aerated chamber. All wasps were removed after two hours and the numbers dead/alive were recorded to determine survivorship. There were five replicates for each treatment and survivorship data were arcsine transformed and analysed by analysis of variance.

Results

Wasp survival on leaves sprayed with *Bacillus thuringiensis* (Dipel ES™), chlorfluazuron (Helix™) and omethoate were not significantly different from survival on leaves sprayed with water (Table 1). Survival against all other chemicals tested was significantly reduced DAT 1. Larvicidal methomyl was particularly toxic one DAT 1 with no survival recorded. The synthetic pyrethroids (es-fenvelerate and beta-cyfluthrin) had the greatest effect on wasp survival which was significantly reduced up to DAT 10.

Survival on leaves sprayed with methomyl improved greatly DAT 3 with the ovicidal rate and DAT 10 with the larvicidal rate. There were no significant differences between survival on leaves sprayed with ovicidal or larvicidal thiodicarb. Although survival on leaves sprayed with profenofos was very poor DAT 1, it improved greatly from DAT 3 onwards, and was not significantly different from leaves sprayed with water. Survival on leaves sprayed with endosulfan was high from DAT 3 onwards.

TABLE 1

The residual action of insecticides applied to cotton leaves on the percentage survival of *Trichogramma funiculatum*.

TREATMENT	concentration (% a.i.)	DAYS AFTER TREATMENT					
		DAY 1	DAY 3	DAY 5	DAY 7	DAY 10	DAY 14
control (water)		93.8 ± 2.5 a	94.2 ± 2.7 a	95.0 ± 3.1 a	86.1 ± 1.7 ab	88.5 ± 5.1 ab	92.0 ± 3.7 ab
<i>Bacillus thuringiensis</i>	30 ml/L	88.1 ± 6.9 a	93.5 ± 2.9 a	92.5 ± 3.1 ab	85.1 ± 4.9 ab	94.3 ± 5.7 a	83.9 ± 2.3 bc
Chlorfluazuron (helix)	0.02	91.6 ± 2.3 a	93.7 ± 2.8 a	87.2 ± 2.6 abcd	91.1 ± 5.4 a	86.5 ± 3.4 abc	97.5 ± 2.5 a
omethoate	0.0225	90.9 ± 4.3 a	85.2 ± 7.9 a	86.9 ± 0.8 abcd	77.6 ± 3.0 bcde	78.7 ± 3.4 bcd	91.0 ± 4.4 ab
endosulfan	0.0735	63.2 ± 4.1 b	90.8 ± 4.6 a	77.5 ± 8.7 bcd	82.0 ± 7.4 abc	84.8 ± 4.0 abc	98.2 ± 1.8 a
es-fenvelerate	0.025	54.5 ± 10.7 b	62.4 ± 5.4 bc	76.8 ± 4.8 cd	66.3 ± 4.8 cde	59.1 ± 15.0 cd	73.6 ± 9.4 bc
profenofos	0.075	20.2 ± 8.2 c	86.9 ± 7.7 a	87.7 ± 4.3 abc	90.3 ± 5.0 a	77.1 ± 5.8 bc	90.0 ± 3.3 ab
beta-cyfluthrin	0.0175	30.6 ± 8.3 c	28.4 ± 8.2 d	47.8 ± 12.9 e	88.7 ± 5.6 ab	51.7 ± 7.3 d	60.7 ± 11.1 c
thiodicarb - ovicidal	0.01875	63.9 ± 9.5 b	82.5 ± 6.9 ab	76.1 ± 6.6 bcd	84.0 ± 3.8 abcd	81.0 ± 5.0 abc	85.4 ± 7.0 ab
thiodicarb - larvicidal	0.075	63.4 ± 6.3 b	72.2 ± 8.4 ab	66.5 ± 5.3 de	63.8 ± 7.1 de	73.7 ± 6.7 bcd	79.1 ± 5.2 bc
methomyl - ovicidal	0.01125	43.9 ± 7.4 bc	78.9 ± 4.5 ab	82.2 ± 3.0 bcd	78.2 ± 4.6 bcde	92.9 ± 0.02 ab	82.5 ± 4.4 bc
methomyl - larvicidal	0.045	0.0 ± 0.0 d	47.7 ± 16.2 cd	63.3 ± 9.9 de	61.0 ± 8.6 e	83.3 ± 5.6 abc	95.0 ± 5.0 a

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Data are percentage survival of wasps after exposure to treated cotton leaves for two hours in a bioassay chamber with a constant airflow of approximately 38 cm/sec.. Data were analysed by analysis of variance. Means were compared by Fisher's least significant difference technique. Values represent the mean ± standard error of five replicates. Column means followed by the same letter are not significantly different for P<0.05. Treatment means significantly different from control means are shaded.

Discussion

B. thuringiensis, chlorfluazuron and omethoate (at the tested concentration) had no significant adverse effects on wasp survival, suggesting that they could be utilised in IPM programs to conserve natural and released parasitoid populations.

The recommended use of chemicals in cotton is usually a rate per hectare, and the concentration applied varies according to the amount of water mixed with the chemical. Consequently some of the insecticide concentrations reported here are probably much lower than those applied in field cotton. Despite this, some insecticides were highly toxic to *T. funiculatum*, namely es-fenvelerate, beta-cyfluthrin (both synthetic pyrethroids), larvicidal methomyl and larvicidal thiodicarb. The results suggest that these chemicals should be avoided when attempting to conserve or enhance populations of *Trichogramma* wasps.

Survival on leaves sprayed with profenofos and endosulfan was high from DAT 3 onwards, suggesting that wasp releases may be integrated with insecticide applications if releases were correctly timed, i.e. wasps were not released within three days of a spray. However, to date there are no data on the effects of non-lethal doses of insecticides on wasp behaviour. It would be unwise to assume that the behaviour of surviving wasps is unchanged. Parasitism levels, wasp fecundity and longevity may decrease when wasps are exposed to sub-lethal insecticide doses.

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