An evaluation of the toxicity of two paraffin oils (Biopest® and Canopy®) on *Trichogramma pretiosum.*

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Key Findings

- The development of immature *Trichogramma* in parasitised eggs was adversely affected by dipping parasitised eggs in paraffin oils. However, survival was not significantly affected by spraying parasitised eggs with paraffin oils. This suggests that coverage is an important factor when considering the impact of paraffin oils on immature *Trichogramma.*
- The survival of adult *Trichogramma* on filter paper and cotton leaves dipped in paraffin oils was significantly lower than that in water alone, but was not significantly different when the wasps were exposed to sprayed cotton leaves. The assessment technique – dipping vs. spraying – gave contrasting results.
- The survival of adult *Trichogramma* in sprayed wire cages was not significantly affected by paraffin oils.
- Paraffin oils are likely to be reasonably safe on *Trichogramma pretiosum* at the recommended cotton rates and volumes.

Introduction

Trichogramma pretiosum Riley is an important parasitoid of heliothis (*Helicoverpa* spp.) eggs throughout the Darling Downs. In the past heliothis have been managed using broad-spectrum insecticides such as pyrethroids and organophosphates. These insecticides usually cause high mortality of *Trichogramma* and other beneficial insects. Increasingly farmers and consultants are looking for soft chemistry to control pests without killing the beneficial arthropods in the farming system. Paraffin oils are now being explored as an option to control heliothis in cotton without causing high mortality of beneficial arthropods. *Trichogramma* are particularly sensitive to chemical insecticides and can act as bioindicators of the toxicity of insecticidal products. If an insecticide does not impact on *Trichogramma* it is likely that it will be conducive to most of the beneficial fauna in the farm ecosystem.

This report documents the impact of two paraffin oils (Biopest® and Canopy®) on *Trichogramma pretiosum* during larval, pupal and adult stages of development.

Methods

Egg card bioassay

The effects of dipping parasitised heliothis eggs in paraffin oils (Biopest® and Canopy®) on *Trichogramma pretiosum* larvae was studied during different stages of immature *Trichogramma* development. *Helicoverpa armigera* eggs laid onto sheets of paper towelling (Teakle and Jensen 1985) were parasitised by *T. pretiosum* for two hours in the laboratory. The sheet of parasitised eggs was cut into 1 x 3 cm strips and each strip was stapled onto a piece of standard white paper, measuring ca. 1.5 x 7 cm, to make handling and dipping the eggs easier.

Ten randomly selected egg cards were dipped into each treatment (Table 1) for one second on days 1, 2, 4, 5 and 9 after oviposition. These developmental stages corresponded approximately to *Trichogramma* eggs (d1), larvae (d2), pre-pupae (d4), early pupae (d5) and late pupae (d9). Dipped egg cards were hung on a string-using fold back clips to dry at ambient temperature in the treatment room. Once dry, each egg card was placed in a small glass vial and held in a constant temperature room at 25°C and 60% R.H. until all healthy parasitoids had emerged.

Table 1. Treatment details.

Treatment	Insecticide Formulation	Active constituent	Oils (% volume)
Water	Control	Nil	Nil
Canopy	Paraffin Oil	815 g/l	2%
Biopest	Paraffin Oil	792 g/l	2%

Dipped surface residue bioassays

The effect of paraffin oil residues on the survival of adult *Trichogramma pretiosum* was studied in ventilated glass bioassay chambers measuring 15 cm long and 4 cm in diameter (Scholz 1994). Whatmans filter paper was saturated in a solution of each treatment (Table 1). The filter paper was then hung on a string with fold back clips and allowed to dry. The treated filter paper was used to line the inside of the glass bioassay tubes.

The same technique was also used to test residues on cotton leaves.

Approximately 20 newly emerged *T. pretiosum* wasps were placed into each bioassay tube and exposed to the treated filter paper/cotton leaves for four hours. After exposure the numbers of dead and live wasps were recorded.

Direct contact bioassays (adults)

The contact impact of paraffin oils on adult *T. pretiosum* was evaluated by spraying wasps held in fine gauze cages (Scholz and Zalucki 2000). The cages were 5 x 10 cm cylinders constructed from very fine *Trichogramma* proof stainless steel mesh (47 strands/cm; 0.125 mm aperture; 0.08 mm diameter wire), with a removable lid at each end. A 4 cm hole was cut in each lid and covered with the same wasp proof stainless steel mesh.

Approximately 20 newly emerged *T. pretiosum* wasps were transferred to each cage. The cages were hung on string then sprayed with each treatment from a distance of 30cm using a hand held atomiser.

The cages were left to dry for 20 minutes before the numbers of dead and live wasps were counted. Water sensitive paper was placed in some cages to monitor the amount of spray penetrating the walls of the cages. Good spray penetration was achieved.

Boom-sprayed bioassays

To better simulate a field application of insecticide, additional experiments were carried out using a hand held boom sprayer.

Biopest®, Canopy® and water were applied through a boom spray onto parasitised heliothis eggs to see if the treatments had an effect on *Trichogramma* emergence. Two day old parasitised egg cards were prepared, as previously described, and temporarily stuck to a cement path with sticky tape over a length of ten metres.

The path was sprayed with a 2 m wide hand held boom sprayer. DG Tee Jet 110015 nozzles were used giving a flow rate of 101L/ha at 3 bar and a speed of 7 km hr. The boom was held 0.5 metres above the cement and applied over the egg cards. A 2% v/v oil concentration was used for the Biopest® and Canopy® treatments. Once dry, each egg card was placed in a small glass vial and held in a constant temperature room at 25°C and 60% R.H. until all healthy parasitoids had emerged.

The boom sprayer was also used to treat cotton leaves for a bioassay. Three series of potted cotton plants were placed on a 10m strip of grass, and sprayed with the different treatments (Table 1). The treated leaves were allowed to dry, and ten leaves were randomly selected and placed into ventilated glass bioassay chambers (as described above). Approximately 20 newly emerged *T. pretiosum* wasps were placed into each bioassay tube and exposed to the treated leaves for four hours. After exposure the numbers of dead and live wasps were recorded.

The impact of the direct contact of boom-spray droplets on *T. pretiosum* adults was also assessed during the same application. Eight fine gauze cages containing ca. 20 adult *Trichogramma* were hung on sticks randomly over each 10 m strip and sprayed at the same time as the leaves. The cages were left to dry for 20 minutes before the numbers of dead and live wasps were counted.

Results

The effect of treatments on immature development

Trichogramma emergence was significantly reduced following dipping parasitised *Helicoverpa armigera* eggs into solutions of Canopy® and Biopest® at all stages of immature development. Emergence from eggs treated with Canopy® was significantly higher than Biopest® one and five days after *Trichogramma* oviposition. At two, four and nine days after *Trichogramma* oviposition there was no significant difference in emergence of eggs treated with Canopy® and Biopest® (Figure 1). There was also no significant difference in the emergence of parasitoids when parasitised heliothis eggs were sprayed by boom (Figure 2).

The effect of surface residues on adult survival

The mortality of *Trichogramma* adults exposed to oil on dipped filter paper and dipped cotton leaves was significantly higher the than that in the control (Figure 3). There was no significant difference in mortality between treatments when *Trichogramma* adults were exposed to cotton leaves treated by boom spray (Figure 4).

The effect of direct contact on adult survival

There was no significant difference between mortality of *Trichogramma* adults directly sprayed by treatments in cages (Figure 5).

Discussion

The results highlighted differences between the dipping and spraying assessments used to assess the impact of paraffin oils on developing *Trichogramma*, and the impact of oil residues on adult wasp survival.

Dipping parasitised eggs and leaves had a greater impact on parasitoid survival than spraying (Figure 1 vs. 2; Figure 3 vs. 4). This suggests that the oils can 'smother' *Trichogramma* during development when coverage is complete (Figures 1 and 3). Survival was not adversely affected when coverage was incomplete, i.e. following a spray (Figures 2 and 4).

The survival of adult *Trichogramma* on dipped cotton leaves decreased from 94% in the control to 50% and 58% on the Canopy® and Biopest® treated leaves respectively (Figure 3). The paraffin oils did not dry well on cotton leaves. Small pools of oil were left over the leaf surface. These pools trapped *Trichogramma* that came into contact with them, i.e. they drowned. Consequently some of the mortality that was recorded was a result of this drowning, as opposed to the action of a residual toxin.

The findings suggest that sprayed paraffin oils are reasonably safe on *Trichogramma* at the rates and volumes likely to be used in cotton. However, paraffin oils can cause considerable mortality of developing *Trichogramma* when parasitised eggs are immersed in oil solutions or are directly sprayed in the field. This may be an issue in high volume spray applications, e.g. horticulture where 500-800 L/ha spray volumes are used.

Acknowledgements

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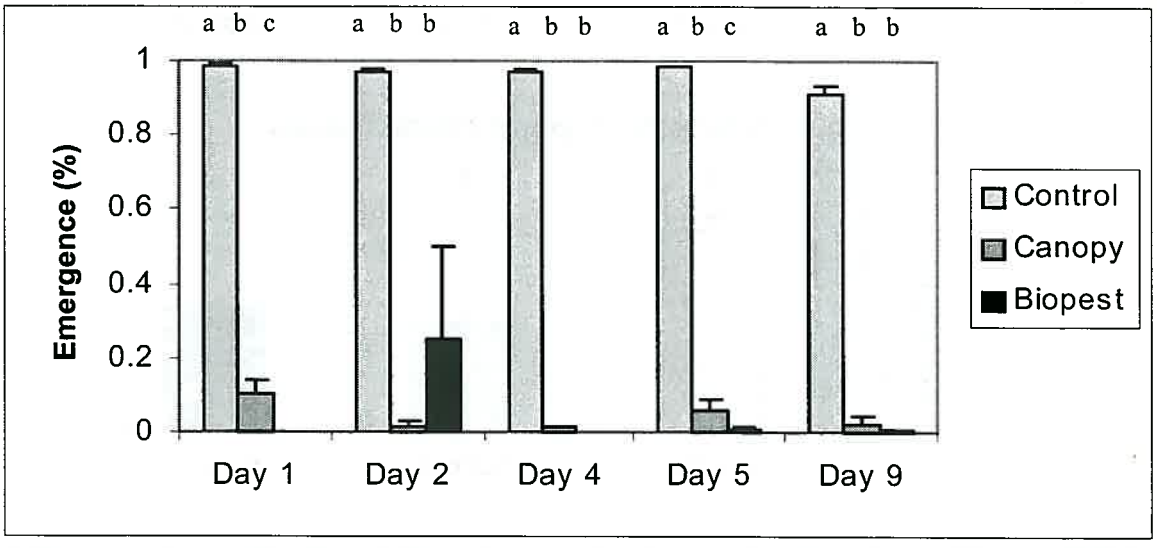

Figure 1: The emergence of *Trichogramma pretiosum* wasps after **dipping** parasitised *H. armigera* eggs in paraffin oils (Biopest® and Canopy®). The age of the parasitised eggs ranged from 1 to 9 days. Values are the mean ± standard error of 10 replicates, and were arcsine transformed for analyses. Means for a given day followed by the same letter are not significantly different (P=0.05, ANOVA, Fisher's LSD comparison).

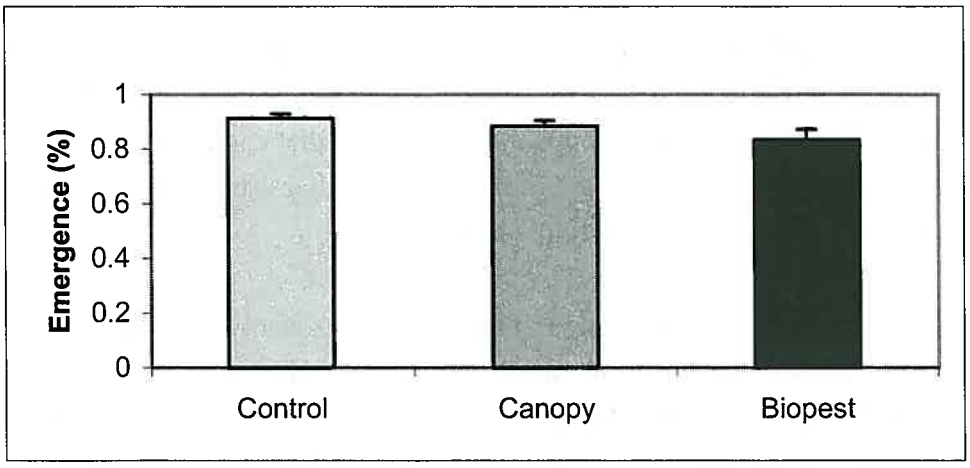

Figure 2: The emergence of *Trichogramma pretiosum* wasps after **spraying** 2-day old parasitised *H. armigera* eggs with paraffin oils (Biopest® and Canopy®). Values are the mean ± standard error of 10 replicates, and were arcsine transformed for analyses. There was no significant difference in survival (P=0.05, ANOVA).

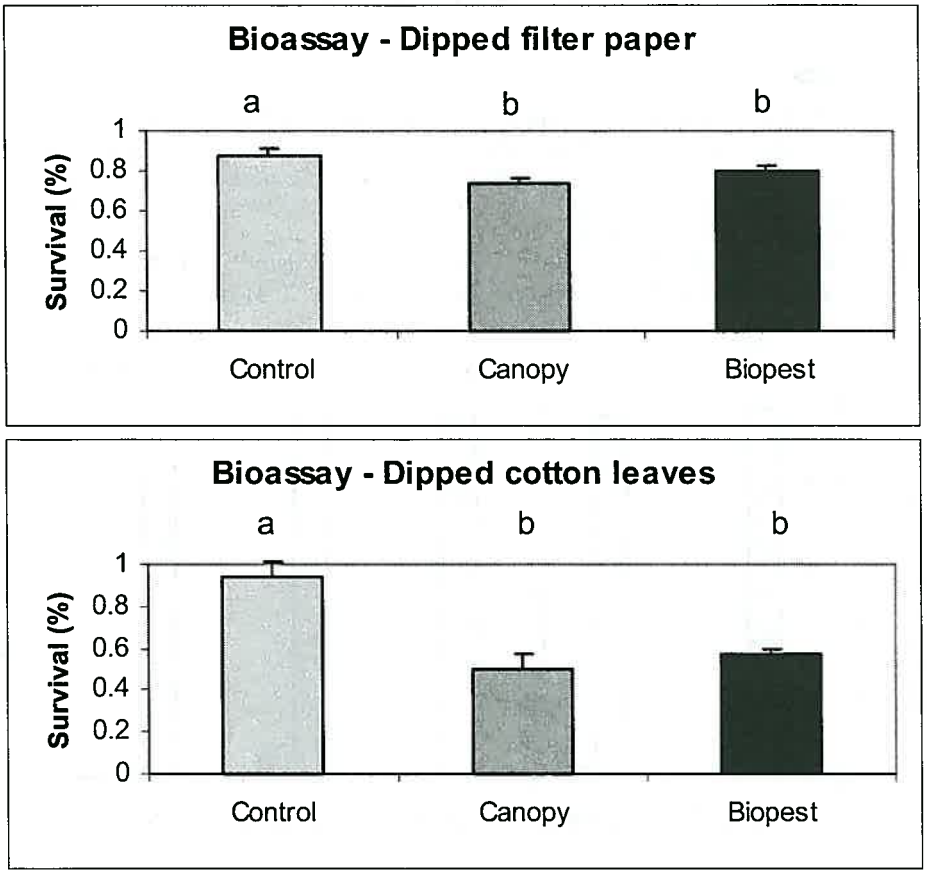

Figure 3: The survival of adult *Trichogramma pretiosum* wasps after 4 hours exposure to paraffin oil residues on **dipped** filter paper or **dipped** cotton leaves. Values are the mean ± standard error of 10 replicates, and were arcsine transformed for analyses. Means followed by the same letter are not significantly different (P=0.05, ANOVA, Fisher's LSD comparison).

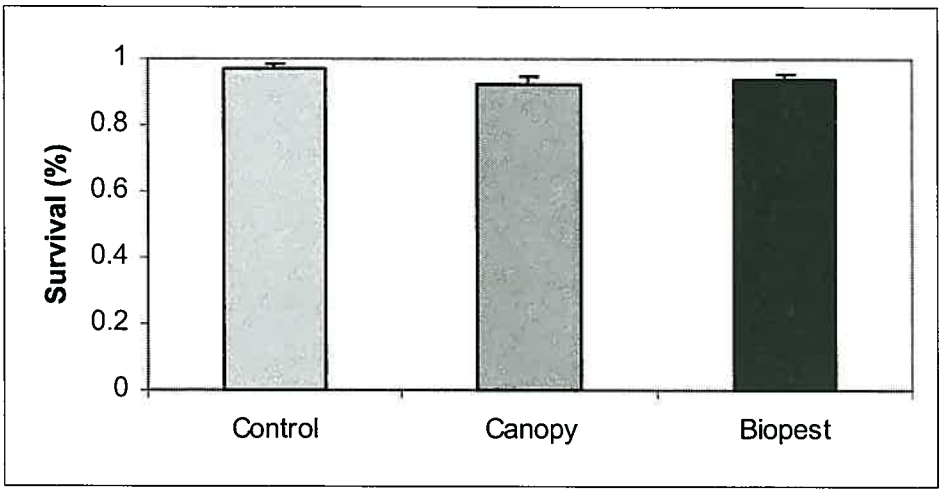

Figure 4: The survival of adult *Trichogramma pretiosum* wasps after 4 hours exposure to paraffin oil residues on **sprayed** cotton leaves. Values are the mean ± standard error of 10 replicates, and were arcsine transformed for analyses. There was no significant difference in survival (P=0.05, ANOVA).

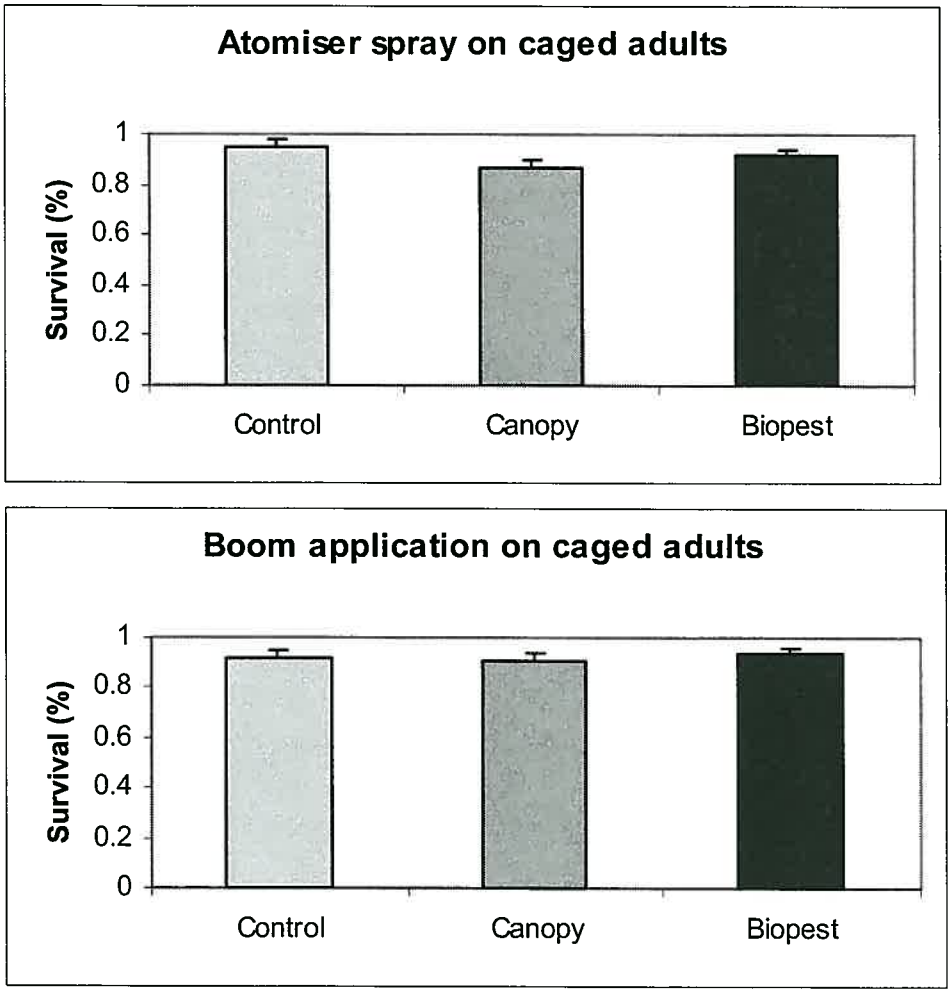

Figure 5: The survival of adult *Trichogramma pretiosum* wasps after exposure to paraffin oil residues in **sprayed** wire cages. Values are the mean ± standard error of 8 replicates, and were arcsine transformed for analyses. There was no significant difference in survival for either mode of spraying (P=0.05, ANOVA).