The ovicidal activity of Tracer* Naturalyte* Insect Control on *Helicoverpa* spp.

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Abstract

The ovicidal and larvicidal activity of Tracer* Naturalyte* Insect Control and conventional ovicidal standards was investigated on *Helicoverpa* spp. under Australian conditions. Two trials were carried out; the first used laboratory reared *Helicoverpa armigera* eggs, and the second used *Helicoverpa* spp. eggs naturally laid on field cotton. The results showed that Tracer killed 10-30% of eggs and 20-80% of hatching neonates. The ovicidal activity of Tracer was slightly less than conventional ovicidal standards (Larvin®, Ovasyn® and Lannate®), however, the combined ovicidal and larvicidal action was generally equivalent to, or greater than the standards. These data show that Tracer should be applied at the brown egg stage to utilise both the ovicidal and larvicidal action of this product.

Introduction

Tracer Naturalyte Insect Control (480g/L spinosad) was registered for use against *Helicoverpa* spp. in Australian cotton in 1997. Field and laboratory studies from the USA on *Heliothis virescens* and *Helicoverpa zea* have shown that Tracer is an effective ovicide (equivalent to standards) and superior to standards as a larvicide against hatchling neonates (Peterson *et al.*, 1998). Circumstantial evidence from use in Australia has indicated that Tracer has ovicidal activity against *H. armigera* and *H. punctigera.* (George Saville, Dow AgroSciences, *pers. com.*).

It is critical to time insecticide applications to target newly hatched (neonate) larvae before they become entrenched in flowers or fruit. If Tracer demonstrates significant ovicidal activity, there would be greater flexability in application timing targeting both brown eggs and neonates. The aim of this study was to determine the ovicidal and larvicidal activity of Tracer on newly hatched *Helicoverpa* spp. neonates and *Helicoverpa* spp. eggs relative to conventional ovicidal standards.

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Materials and Methods

Two trials were carried out on the Darling Downs. The first was a laboratory/field trial using eggs produced from a laboratory colony and the second was a field/laboratory trial using naturally laid eggs.

Trial 1

The first trial was carried out on the 5 November 1999 at "Cowan" (Graham Clapham). Laboratory moths were allowed to lay eggs onto paper towel *ad libitum* (Teakle, 1995). Half of the eggs were placed at 25°C and allowed to develop to the "brown egg" stage and the other half were stored at 12°C, so that they stayed at the "white egg" stage. Egg cards were made by cutting paper towel with the eggs on into strips (ca. 40 mm x 15 mm) and stapling them to a strip of plain paper. Each egg card contained ca. 10 eggs (range= 1-40, average= 10.9).

Eggs were transferred to the field and the trial was carried out as a small plot non-replicated trial. Plots were 2 rows x 40 m per treatment with a buffer row on each side of the plot. Forty egg cards (20 containing brown eggs and 20 containing white eggs) were stapled to the upper canopy of a chickpea crop at random locations throughout the plot. This resulted in approximately 200 brown and white eggs for each treatment. Plots were sprayed with each treatment (see **Table 1**) and allowed to dry. Insecticides were applied with an Azo precision sprayer at a water volume of 100 L/ha, using 200 kPa pressure, and flat fan nozzles. The egg cards were collected one hour after spraying and transferred to a controlled temperature room (25°C, 60-70% RH, 14:10 L:D). The number of eggs on each egg card were counted and each egg card was placed individually into a 28 mL Solo™ plastic cup. Egg development was recorded daily for five days. The following data were recorded: number of dead eggs, number of hatched eggs, number of dead neonates, and number of surviving neonates. For this study a dead egg was an egg that had a fully formed neonate within however it failed to hatch.

Trial 2

Trial 2 was carried out on the 4 December 2000 at "Wamarrow" (Stewart Armitage), approximately 10 km east of Cecil plains. The trial consisted of small (2 rows x 80 m) unreplicated field plots of cotton, and was conducted immediately following a significant *Helicoverpa* spp. egg-lay. The plots were sprayed once with insecticides (see **Table 1**), or untreated. The insecticides were applied using an Azo precision sprayer at a water volume of 100 L/ha, using 300 kPa pressure and hollow cone nozzles. Approximately 200 naturally laid *Helicoverpa* spp. eggs (ca. 100 white and 100 brown eggs) were collected from each treatment one hour after spraying, The collected eggs were placed individually into the cells of plastic tissue culture trays (96 cells per tray). Eggs were transferred to controlled temperature conditions, as in Trial 1, and egg hatch and larval mortality were recorded daily for five days.

Table 1. Treatments and rates used in trial 1 and trial 2.

					Trial 1 – "Cowan"	Trial 2 – "Wamarrow"
No.	**Treatment**	**Active Ingredient**	**Conc. (g/L)**	**Form. Type**	**Rate of Product (mL/ha)**	**Rate of Product (mL/ha)**
1	Untreated				-	-
2	Tracer Naturalyte	spinosad	480	SC	25	25
3	Tracer Naturalyte	spinosad	480	SC	50	50

4	Tracer Naturalyte	spinosad	480	SC	100	100
5	Tracer Naturalyte	spinosad	480	SC	200	200
6	Larvin®[1] 375	thiodicarb	375	SC	1000	1000
7	Ovasyn®[1] EC	amitraz	200	EC	2000	2000
8	Lannate®[2] L	methomyl	225	SL	1000	1000
9	Predator®[3] 300	chlorpyrifos	300	EC	n/a	5000

[1] Registered Trademark of Aventis CropScience Pty Ltd.
[2] Registered Trademark of DuPont.
[3] Registered Trademark of Dow AgroSciences

Results

Trial 1

Eggs were scored as hatched, dead or infertile. When determining the percentage eggs hatched, infertile eggs were excluded from the sample leaving only dead (ovicidal activity) and hatched eggs. Neonates that died within 24 hours of hatching were counted as having died from larvicidal activity. Unfortunately the egg sheet used in the "brown egg" study were predominantly infertile and no meaningful data were produced.

Figure 1 clearly shows that Tracer at 100 and 200 mL/ha displayed significant ovicidal activity (ca. 30%), and was slightly less ovicidal than Larvin® @ 1 L/ha (ca. 50%), Ovasyn® @ 2 L/ha (ca. 55%) and Lannate-L® @ 1L/ha (67%). These data shows that there was significant larvicidal activity on hatchling neonates in all treatments. Larvicidal mortality in the Tracer treatments (72-80%), were higher than the standard ovicidal products (Larvin® = 50%, Ovasyn® = 25%, Lannate-L® = 27%). The neonates that hatched from the Tracer treatments showed symptoms of paralysis with their mandibles moving uncontrollably (flaccid paralysis). Combined ovicidal and larvicidal activity of Tracer treatments at rates above 25 mL/ha resulted in approximately 100% mortality. This was equivalent to, or greater than, the standard ovicidal products (Larvin®= 98%, Ovasyn®= 81%, and Lannate-L®= 95%).

Trial 2

Results from trial 2 are displayed on **Figure 2** (white eggs), **Figure 3** (brown eggs), and **Figure 4** (total eggs). The larvicidal activity of products was scored slightly differently compared to trial 1. Only neonates that didn't hatch successfully were scored in this group. This was due to high mortality in the control group within 24 hours of hatching, due possibly to suffocation. This rating gave an indication of the knockdown of hatchling neonates. Predator 300 insecticide was included as a larvicide with known low ovicidal activity.

The ovicidal activity of Tracer on white eggs (20-28%) was comparable to that of Larvin® (29%) and Ovasyn® (26%), but lower than Lannate-L® (48%) (**Figure 2**). The larvicidal knockdown of Tracer (13-28%) was equivalent to or greater than the standards (Larvin®= 26%, Ovasyn®= 14% and Lannate-L®= 19%). Predator gave very low ovicidal and ovi-larvicidal control of white eggs and was only slightly greater than the control. Lannate® gave the greatest total mortality of white eggs. Tracer at 50 mL/ha and above was approximately equivalent to the other standards.

The ovicidal activity of Tracer on brown eggs (22-35%) was slightly lower than the conventional standards (Larvin®= 42%, Ovasyn®=50% and Lannate-L®= 64%), but the larvicidal knockdown of Tracer on hatchling neonates (15-36%) was superior to the standards (Larvin®= 15%, Ovasyn®= 10% and Lannate-L®= 9%). Predator gave 22% ovicidal and 15% larvicidal control of hatchlings, this was lower than the other standards and was equivalent to Tracer at 25 mL/ha. Overall, Lannate-L® gave the greatest total mortality of brown eggs. Tracer at the three highest rates was equivalent to, or greater than the other standards.

The ovicidal and larvicidal mortality of hatchlings combined for both white and brown eggs are shown in **Figure 4**. Lannate-L® caused the greatest mortality; followed by the three highest rates of Tracer, Larvin® and Ovasyn® (which were equivalent). The combined ovicidal and larvicidal action of Tracer is generally equivalent to that of the conventional standards.

Discussion

There was no recorded incidence of egg parasitism in any of the treatments. This was probably because synthetic pyrethroids, which are highly toxic to egg parasitoids, were used extensively in the trial area.

Data from the two trials shows that Tracer displayed ovicidal activity against *Helicoverpa* spp., killing 10-30% of eggs. This activity was slightly lower than the conventional standards. Tracer showed significant knockdown of hatchling neonates (20-80%) when applied to white or brown eggs. This larvicidal activity was either equivalent to, or greater than the conventional standards. Total kill of eggs, i.e. combined ovicidal and larvicidal activity on hatchlings of Tracer was generally equivalent to, or greater than standards.

The high mortality of hatchling neonates indicates that the larvae consumed a lethal dose of Tracer from the egg chorion as they chew out of the egg. The rapid knockdown of hatchlings by Tracer seen in Trial 2, demonstrates the rapid speed of action of Tracer against neonates.

The findings presented here for Tracer are similar to those reported against *H. virescens* and *H. zea* in the U.S.A. Both field and laboratory studies in the U.S.A. showed that Tracer had equivalent ovicidal activity to Ovasyn®, Larvin® and Lannate-L®, and was superior in ovi-larvicidal activity of hatchling neonates (Peterson *et al.*, 1998).

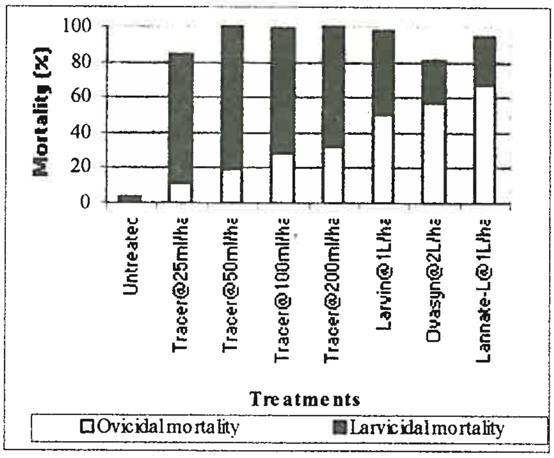

Figure 1. Trial 1: The ovicidal and larvicidal action of Tracer and conventional standards on **white** *H. armigera* eggs.

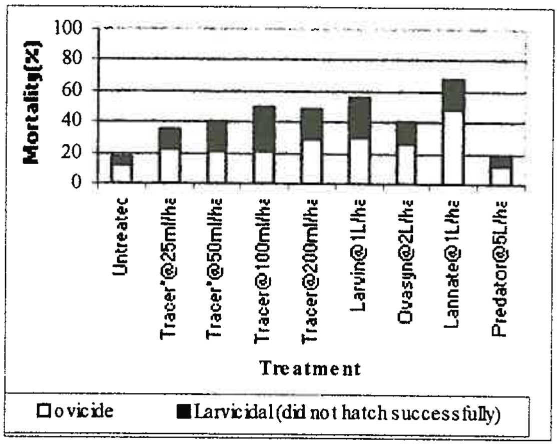

Figure 2. Trial 2: The ovicidal and larvicidal action of Tracer and conventional standards on **brown** *Helicoverpa* spp. eggs.

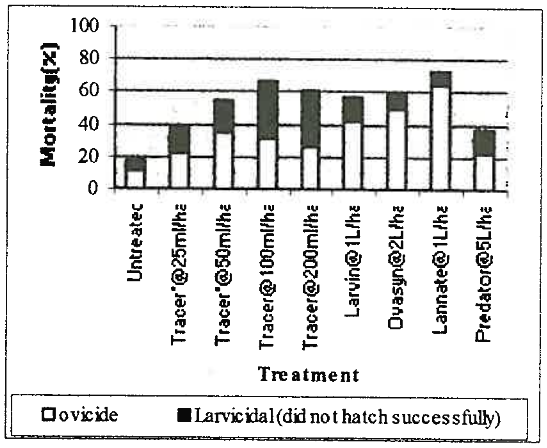

Figure 3. Trial 2: The ovicidal and larvicidal action of Tracer and conventional standards on **White** *Helicoverpa* spp. eggs.

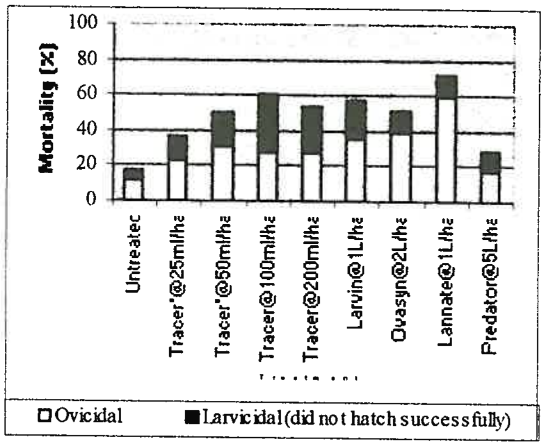

Figure 4. Trial 2: The ovicidal and larvicidal action of Tracer and conventional standards on *Helicoverpa* spp. eggs. **Total** *Helicoverpa* spp. eggs.

Tracer applications can be safely targeted at late white to brown eggs to best utilise the ovicidal and larvicidal knockdown action. These data also show that the addition of an ovicide to Tracer may be unnecessary, this is an interesting avenue for future research. This study shows that the recommended label rates of Tracer (150 and 200 mL/ha) gave the best overall results.

Conclusions

- Tracer killed between 10 and 30 % of eggs and between 20 and 80% of hatching neonates.
- The ovicidal activity of Tracer was slightly less than conventional ovicidal standards, however, combined ovi-larvicidal action was generally equivalent to, or greater than standards.
- The ovicidal property of Tracer may eliminate the necessity to tank-mix an ovicidal product with Tracer; this is an interesting topic for future research.

- These data show that Tracer can be applied at the brown egg stage to best utilise the ovicidal and larvicidal action of this product.

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