OVICIDAL RESEARCH WITH EMAMECTIN BENZOATE AGAINST TOBACCOBUDWORM EGGS

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Introduction

Emamectin benzoate is a second generation of avermectin insecticide for crop protection being developed by Novartis Crop Protection. It is highly effective against a broad range of lepidopterous pests at very low use rates (8.4- 16.5 g ai/ha). It is most effective when ingested as a neurotoxin, but it also demonstrates contact activity. It's not systemic. However, through translaminar movement, Emamectin benzoate penetrates the plant cuticle to form a reservoir of the active ingredient. Emamectin benzoate is highly selective for Lepidopterous larvae and is not disruptive to beneficial arthropods in integrated pest management programs. The compound is being developed in the United States under the trade name Proclaim™ for vegetables.

In 1998, bioassays were conducted at Novartis Delta Research Station in Greenville, MS to study the activity of Emamectin benzoate against tobacco budworm eggs, and the effect of rate and age of eggs on the efficacy of Emamectin benzoate.

Materials and Methods

Heliothis virescens eggs were obtained from the USDA Southern Insect Management Research Unit, USDA-ARS, Stoneville, MS and were sprayed at 24 h, 48 h, and 72 h old in a laboratory spray chamber which was calibrated to deliver 160 liters/ha at 2.8 kg/cm^2 with one TeeJet 8002EVS flat fan spray tip. Emamectin benzoate 0.16EC was applied at 8.4, 11.2, and 16.8 g ai/ha with Dyne-Amic as additive at 0.5% v/v. For comparison to Emamectin benzoate, methomyl (Lannate LV 2.4 EC) at 280 g ai/ha was included in the 24 h old egg bioassay. Untreated control eggs were sprayed with water. Two hours after application treated eggs were transferred into petri dishes containing artificial diet. Each petri dish contained 10 eggs and represented one replication. Each treatment was replicated ten times. Eggs were held in the Rearing Room at ca. 24° C for mortality assessment at 4 and 6 days after application. All the treated eggs were kept to 8-9 days after treatment to make sure that there was no delay in hatching due to chemical treatment. Larvae were considered dead if they did not respond to prodding with a pointed object. Prior to statistical analysis, data were transformed using a log(X+1) normalization. Data were also corrected using Abbott's formula, and analyzed using Fisher Protected LSD.

Results and Discussion

At the end of the experiment, treated eggs either hatched or failed to hatch. Eggs that failed to hatch included white, brown, and blackhead eggs. Since the number of white and brown eggs in the Emamectin benzoate and methomyl treatments were not significantly different from the Untreated Control, they were excluded from this report. Eggs that hatched either developed normally or died during eclosion or shortly afterwards.

For this report, non-eclosed eggs in the blackhead stage were classified as mortality due to ovicidal toxicity of Emamectin benzoate, and dead larvae were classified as killed by the ovo-larvicidal activity.

When applied to 24 h old eggs no significant differences in the number of dead eggs were noted between methomyl and Emamectin benzoate treated eggs. Also no significant rate effect was observed in the Emamectin benzoate treatments. Methomyl caused low egg mortality in this experiment, only 10.4% compared to 2.1 - 7.4% in Emamectin benzoate (Fig. 1).

Fig. 1 **Ovicidal activity of Emamectin benzoate and Methomyl on 24 h old tobacco budworm eggs**

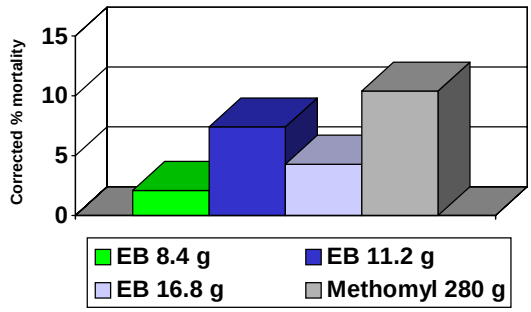

Fig. 2 shows the number of dead larvae in the Emamectin benzoate and methomyl treatments. A significant treatment effect was observed for the mortality caused to larvae as they chewed their way out of the egg chorions: Mortality in the Emamectin benzoate treatments was greater than mortality in the methomyl treatment. Emamectin benzoate at 3 rates caused the same mortality, rainging from 79 to 82% mortality, compared to 14.5% in methomyl. In the Emamectin benzoate treatments, larvae were either found dead inside the eggs after they had chewed on the treated egg chorions trying to hatch, during eclosion, or shortly afterwards. No sign of larvae feeding on the diet was observed, and no live larvae were found. Larvae in the methomyl treatment were found dead shortly after

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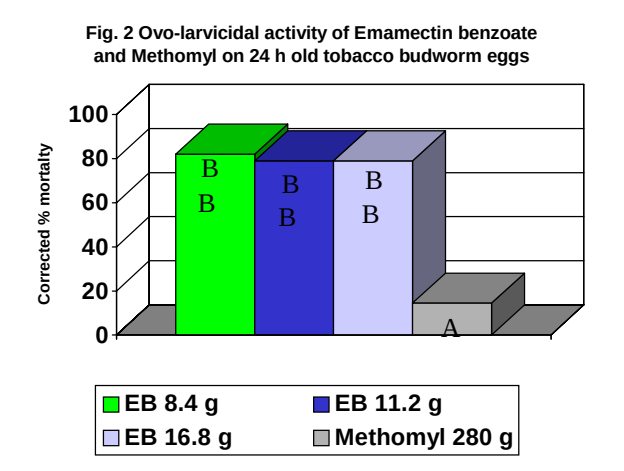
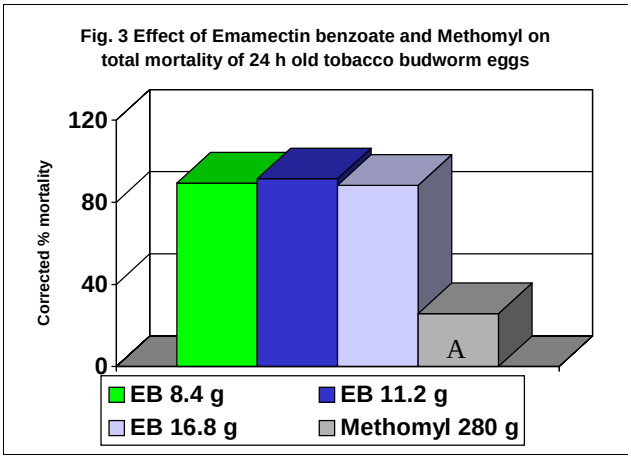
emergence, and again, no sign of feeding was observed on the substrate.



Treatment: p=0.0001

Total mortality (eggs and larvae) in Emamectin benzoate was also significantly greater than total mortality in methomyl. However, no rate response was noted among the Emamectin benzoate treatments (Fig. 3). Total mortality in the Emamectin benzoate treatments ranged from 88 to 92%, compared to 26% in the methomyl treatment.

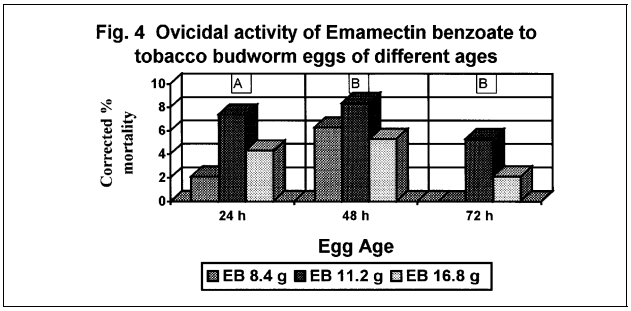


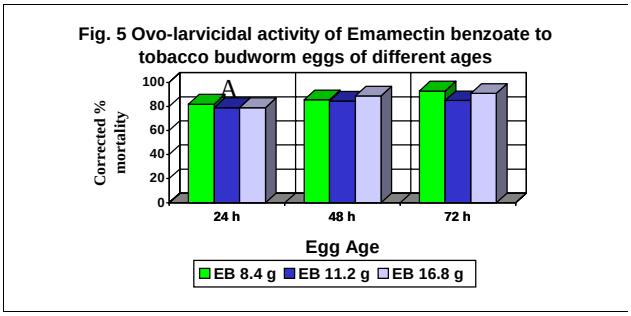
Treatment: p=0.0001

B B

When comparison was made of the effect of rate of Emamectin benzoate and age of eggs at application on egg mortality, no significant treatment or age effect at 0.05 alpha level was noted: All rates of Emamectin benzoate resulted in approximately about the same level of mortality, whether the application was made to 24 h, 48 h, or 72 h old tobacco budworm eggs (Fig. 4)

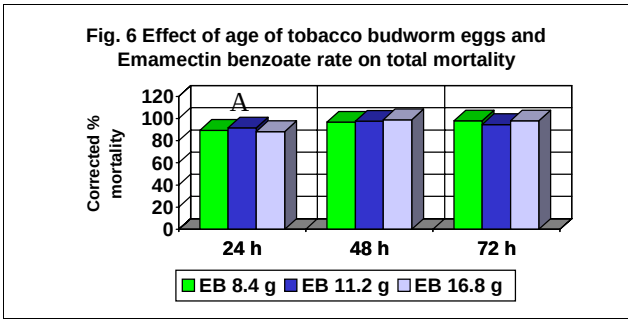
When comparison was made of the effect of rate and age of eggs on mortality of neonate larvae, a significant age effect was observed: mortality was greater for 48 h and 72 h old eggs than for 24 h old eggs. Within each age group, however, there was no significant rate response(Fig. 5).





Age: p=0.0004

Total mortality of eggs and larvae again clearly showed a significant age effect: higher mortality was observed in the 48 h and 72 h old eggs than in the 24 h old eggs. Within each egg group there was no significant rate effect (Fig. 6). Higher mortality was noted in the older eggs probably because there was more residue of Emamectin benzoate left on the treated egg shells of the 48 h and 72 h old eggs than on the 24 h old eggs.



Age: p=0.001

Conclusions

This experiment indicates that Emamectin benzoate only has very low ovicidal activity against tobacco budworm eggs. Most of the mortality results from ingestion of the treated egg chorions, and maybe from contact with Emamectin benzoate by the larvae as they emerge from egg shells. This activity, coupled with the excellent larvicidal activity, should give Emamectin benzoate an efficacy advantage over many of the currently used insecticides for control of such important pests as the Heliothine complex in cotton.

Literature Cited

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