TREATMENT OF SUGARCANE SETTS FOR SUPPRESSION OF THE PYRALID BORER *ELDANA SACCHARINA*

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Abstract

Trials were conducted in which commercial formulations of the insecticides cypermethrin, λ-cyhalothrin, chlorpyrifos and phoxim were tested for their efficacy as insecticidal dips against *Eldana saccharina* Walker larvae in sugarcane setts. Insecticides were tested at three rates: 0,08g, 0,15g and 0,38g active ingredient/L. Setts were immersed in the solutions for five or 10 minutes and larval mortality assessed 48 hours later.

The synthetic pyrethroids (cypermethrin and λ–cyhalothrin) were the more effective insecticides tested, with larval mortalities of over 90% recorded at the highest rate. The least effective insecticide was phoxim where larval mortality was most frequently below 30%, irrespective of rate. Previous trials had shown that water with a wetter alone could be effective as a sett dip and results showed that average mortality of 23% (s.d. 17.6) was recorded from such a treatment. Where setts were dipped in water only, an average mortality of 19,0% (s.d. 10,7) was obtained (values corrected for control mortality).

No significant effect of immersion period on mortality could be shown for all insecticides and rates.

While it is recommended that uninfested sugarcane stalks be used for seedcane, this study shows that when this is not possible, the use of synthetic pyrethroids in a sett dip could reduce the survival of eldana larvae in treated setts.

Key words: Eldana, insecticides, sett dipping, sugarcane, seedcane

Introduction

Because of the high cost of establishing sugarcane fields, seedcane must be of a high quality. While the best practice is to use pest-free sugarcane as seedcane, this is not always possible. Suppression of *Eldana saccharina* Walker (Lepidoptera: Pyralidae) in seedcane can be achieved by treating the cane in hot water at 50°C for 20 minutes, or by dipping the cane in a solution of phoxim at a rate of 2ml formulation/L for 15 minutes (Anon, 2001). Fumigation for four hours at 32g/m^3 with methyl bromide has proved effective without influencing subsequent germination (Leslie, 2000). However, use of methyl bromide requires special conditions to make its use effective and safe. Similarly, hot water treatment requires access to a suitable treatment plant and there have been concerns about the availability and efficacy of phoxim. For these reasons tests were conducted to identify alternative treatments that could be used to treat seedcane for eldana infestations.

Immersing setts in an insecticide solution as a pre-plant dip is simple and effective and a preliminary series of trials was conducted by this method (Anon 1995, 1996). In these, the insecticides cypermethrin, chlorpyrifos and phoxim were used at three rates with immersion periods of five, 10 and 15 minutes. High larval mortality (over 70%) was recorded at all rates of cypermethrin and chlorpyrifos used. Phoxim was the least effective insecticide tested. Despite the high mortalities obtained, the data were highly variable, making the interpretation of the results difficult (standard deviation as a percent of the mean ranged between 3% and 119%). This was partly attributed to the variable level of larval infestations in setts cut from sugarcane naturally infested in the field. Consequently, a method for producing artificially infested setts was developed and used in these trials.

Materials and Methods

Treatments

Four insecticides were used in the trials: cypermethrin, λ–cyhalothrin, chlorpyrifos and phoxim. The initial series of trials tested rates of 0,25g, 0,50g and 0,75g a.i./L. The trials reported here tested rates of 0.08g, 0,15g and 0,38g active ingredient/L. Included was a water only treatment and a water plus wetter only treatment (Bladwet at a rate of 1,3ml/L). The latter treatment was included to assess the value of using a wetter alone, because it had shown some promise in earlier trials (Heathcote 1984). Setts not dipped at all were the untreated controls.

Setts

Because of the difficulties associated with using naturally infested sugarcane, a method of preparing artificially inoculated setts was developed. Setts, 700mm long (with trash removed) were manually inoculated with four large (third to fourth instar) eldana larvae obtained from a laboratory culture. They were placed in holes previously drilled into the setts at an angle (and not penetrating through to the other side). The ends of the setts were sealed with wax and tests were done with tape being placed or not placed over the holes after larvae had been inserted. The results are summarised in Table 1 and show that this method for developing artificially infested setts was effective. Setts without tape over the holes were used three days after their preparation.

Table 1. Larval survival in artificially inoculated setts after seven days.

Test number	With tape over holes			Without tape over holes		
	No. of setts	Number of larvae		No. of setts	Number of larvae	
		Placed in setts	Recoverd from setts		Placed in setts	Recovered from setts
			No. alive (%)			No. alive (%)
1	12	47	43 (91)	12	48	46 (96)
2	13	52	38 (73)	13	52	42 (87)

Trial design

The trials were analysed as a 4x3x2 factorial design, in order to investigate the effects of insecticide, application rate and period of immersion simultaneously. This procedure made it possible to identify which factors are important, whether each factor exerts its effect independently of other factors and to suggest likely response relations between the factors.

A treatment comprised an insecticide rate (one of three) and one of two immersion periods, five and 10 minutes. For each treatment five setts were used. These were placed in a gauze bag to capture larvae that left borings. The mesh was sufficient to prevent larvae escaping but it allowed the solution to move freely. After immersion in the test solution for the prescribed time, the bag containing the setts was removed and set aside. After 48 hours the setts were removed from the bag and split longitudinally. Dead and live larvae were recorded.

Each treatment was replicated three times, giving a total of 15 setts per insecticide rate, per immersion period. A greater number of controls were conducted and a total of 30 setts were used for the water only control, and 60 for the no-immersion control. The entire trial design itself was replicated three times over three years.

Results

Mortality for all treatments was corrected for control mortality using Abbot's formula (Busvine 1971) with inoculated setts that received no treatment at all used as the control.

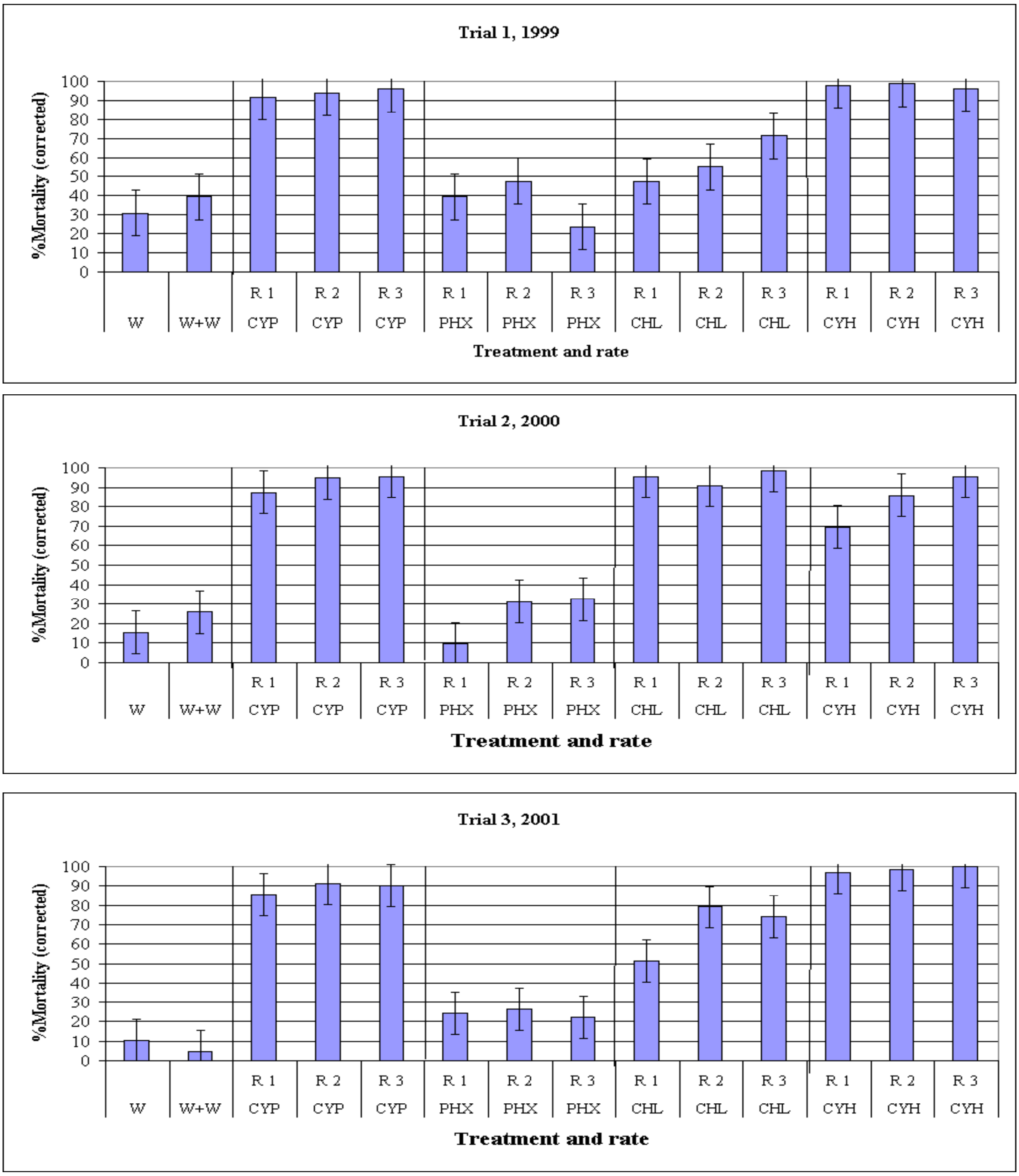

Figure 1. The influence on insecticide rate on the mortality of *Eldana saccharina* larvae in sugarcane setts in three trials. Rates (R1-R3) are given in the text. Error bars represent ± one standard error. Treatment codes are: W = water, W+W = water plus wetter, CYP=cypermethrin, PHX= phoxim, CHL= chlorpyrifos, CYH= λ–cyhalothrin.

Shown in Figure 1 are the plots of treatment and rate against corrected mortality for the three sets of trials. In all trials mortality from using water alone fluctuated between 10% and 30%. There was no significant advantage in using a wetter at the rate used, with mortality from this treatment ranging between 5% and 40 %. Mortality of over 80% at all rates was recorded in all trials with cypermethrin. Phoxim was the least effective insecticide tested with recorded mortality never exceeding 50% and most frequently was below 30%. Results from chlorpyrifos were variable. In two of the three trials there was a significant response to rate, with the highest rate causing between 71% and 74% mortality and the lowest rate between 47,5% and 51,4% mortality. In one trial mortality was above 90% at all rates. In trials with λ–cyhalothrin there was no response to rate in two trials (trials 1 and 3) and mortality in these was above 90%. In the one trial where there was a significant response to rate, the lowest and highest recorded mortality was 73% and 96% respectively.

Summarised in Table 2 are the results showing the influence of immersion period on mortality. Periods of five minutes and 10 minutes were tested. In all trials, for all treatments and both time periods, no significant effect of immersion period on mortality could be shown, except in one case. In trial three, chlorpyrifos showed significantly greater mortality (85%) after 10 minutes immersion than after five minutes (50%). In trial one, there was a similar trend, but this was not significant.

Table 2. The effect of immersion period on larval mortality in setts dipped in four insecticides and two water treatments.

Treatment	Immersion period (minutes)	Number of samples	Year		
			Trial 1: 1999	Trial 2: 2000	Trial 3: 2001
			Percent mortality	Percent mortality	Percent mortality
LSD 0,05			**22.30**	**19.39**	**17.26**
Water	5	6	30.26	28.89	27.70
Water	10	6	40.38	21.34	28.66
Water&Wetter	5	6	34.80	36.93	21.17
Water&Wetter	10	6	51.73	31.75	25.71
Cypermethrin	5	9	92.75	91.90	91.90
Cypermethrin	10	9	95.69	95.01	90.42
Phoxim	5	9	42.50	30.68	40.68
Phoxim	10	9	39.38	35.34	38.12
Chlorpyrifos	5	9	51.90	96.64	*61.16
Chlorpyrifos	10	9	69.43	94.72	*87.89
λ–cyhalothrin	5	9	96.94	87.57	97.50
λ–cyhalothrin	10	9	98.69	83.57	100.00
Control		12	6.35	11.39	19.79

* Values significantly different from each other at the 5% level of significance.

Discussion

The use of artificially infested setts improved the reliability of the trials but it could be argued that, because of this, the results need to be interpreted cautiously. In addition, the setts used had all trash removed, probably making penetration of the borings by the insecticide solutions easier, which further improved their efficacy. Nevertheless these results do provide a clear indication of the efficacy of the various treatments.

The synthetic pyrethroids (cypermethrin and λ–cyhalothrin) were the more effective insecticides tested. In all trials and at all rates the recorded mortality from the cypermethrin treatments was never lower than 85%. A similar pattern was shown for λ–cyhalothrin, and either of these insecticides could be used as a sett dip. Tomlin (2000) notes that both insecticides have similar properties, for example they are stable to light, and breakdown quickly in soil (DT_{50} 1-2 months). Currently λ–cyhalothrin is the more expensive product (R295/L) so, based on price, cypermethrin (at R75/L) would be the preferred treatment.

While chlorpyrifos was effective, the results were variable. In only one trial was mortality above 90%. In the other trials mortality, at the highest rate, was 71% and 74%. In addition chlorpyrifos tends to be unstable when exposed to light (Tomlin 2000). Therefore the pyrethroids remain the better choice.

The currently recommended treatment of phoxim was the least effective insecticide tested with mortality not rising above 50% in any trial. However this may be related to the rate selected and immersion period. The current recommendation requires phoxim to be used at a rate of 2ml formulation/L. The highest rate used in these trials was 0,6ml formulation/L. In addition, the recommendation requires an immersion period of 15 minutes. This time period was not included in these trials; however, it was included in preliminary trials. At this immersion period and at a rate of 1,5ml phoxim/L, larval mortality of 81,3% (s.d. 12,2) was obtained. It is therefore probable that the poor performance of phoxim in these trials can be related to the rate and immersion periods used.

Insecticide rates included the lowest range found to be effective in the preliminary trials, and two rates lower than that. High mortality was recorded at the lowest rate tested, which suggests that even lower rates may be effective. However, approximately 85% mortality was recorded at the lowest rate of cypermethrin, and this is probably the lowest level that could be acceptable. In one trial, λ–cyhalothrin showed a clear rate - mortality response, with the lowest rate recording 70% mortality. Therefore it would be prudent not to use rates lower than those used in these trials. Although it could be argued that any mortality could be beneficial, mortalities of at least 90% should be required for treating seedcane.

No effect of immersion period could be shown; rates used were effective at all immersion periods, suggesting that immersion for less than five minutes could be effective. However it is probable that periods of less than five minutes would be difficult to implement in practice. Because the purpose is to provide maximum effectiveness, immersion periods should be at least five minutes and probably ten minutes.

Current recommendations for the control of eldana in seedcane are hot water treatment or the use of phoxim. Methyl bromide is a useful tool, but supervision and other requirements limit its value. These trials have shown that synthetic pyrethroids can be effective in reducing larval survival in setts. Even though mortality at the rates and immersion periods used were high, they are unlikely to be totally effective in eliminating eldana from treated seedcane. Because of this, it is important to select seedcane carefully, ensuring as far as possible that it is eldana-free before use. Where this is not possible, the measures reported above can be used to reduce the impact of eldana in infested seedcane.

Conclusions

The synthetic pyrethroids cypermethrin and λ–cyhalothrin were the more effective insecticides.

A rate of 0,08g ai/L for cypermethrin and a rate of 0,15g ai/L for λ–cyhalothrin were the lowest effective rates. Both immersion periods tested were equally effective.

The currently recommended insecticide, phoxim, was the least effective which is attributed to the rate and immersion periods used.

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