# UPDATE ON RESEARCH INTO THE USE OF INSECTICIDES AGAINST THE SUGARCANE BORER *Eldana saccharina* (Lepidoptera: Pyralidae).

G.W. LESLIE

*SASA Experiment Station, P. Bag X02, Mt. Edgecombe, KwaZulu – Natal , 4300, South Africa.*

**Abstract**

The use of insecticides against the borer *Eldana saccharina* Walker is one of four research programmes against this pest. This programme comprises projects examining field insecticide trials, seedcane protection trials, insecticide persistence studies and the examination of droplet distribution and penetration in the crop.

In field trials, eldana damage was too low to show clear treatment effects. However, results from an aerial application trial, did show treatment differences and multiple applications were more effective than a single application.

Trials investigating the dipping of seedcane in insecticide solutions, showed that the synthetic pyrethroids were the most effective insecticides tested.

Studies investigating the persistence of insecticides in sugarcane show that mortality of neonate larvae exposed to synthetic pyrethroids remained high (70%) after the treatments were exposed to sunlight for up to eight weeks.

The study investigating the distribution and penetration of droplets showed that these could penetrate more than 200cm horizontally in mature cane.

## Introduction

The use of insecticides for borer control in sugarcane has been attempted in many sugar industries with some success (see for example Meagher *et al* 1993). In South Africa, investigations into the possible use of insecticides against the borer *Eldana saccharina* Walker have been periodically conducted since the early 1970's. Promising early results indicated the potential of this approach (Heathcote 1984). Consequently a revised strategy was developed, and a comprehensive insecticide research programme initiated.

The programme examines several aspects of the use of insecticides as follows:

- Field trials, based on the timing of applications to mature sugarcane in relation to peaks in eldana moth numbers.
- Seedcane protection trials, where immersion treatments for seedcane prior to planting are being examined.
- The fate of insecticides applied within the crop, where the persistence, distribution and penetration of insecticides within the standing crop are examined.

Reported here is the progress being made in these aspects of the insecticide programme against eldana. It is intended to provide a brief overview of the work being conducted.

## Methods

*Large scale field trials*

Selected fields were treated over the period of the summer eldana moth peak (usually between October and November). Treatments were as follows. Selected plots were treated every month from October to January, while others received treatments monthly for two months in various combinations as shown in Table 1.

Treatments comprised the application of the insecticide by means of knapsack sprayers to blocks of between one and two hectares. The spray was directed towards the lower half of stools to cover the region of the crop preferred by ovipositing eldana females. Treatment comprised the application of cypermethrin at a rate of 750ml/ha (200ga.i./L formulation) in 300-400L water/ha.

Treatments were applied to crops ( 9-10 months old) in October/November. Periodic surveys were conducted during the life of the trial but the most relevant surveys were the last ones conducted prior to harvest (usually in March or April). All were observation trials with no replication within a trial.

*Aerial application trial*

Treatments were also timed to coincide with moth peaks. Here, treatments were applied monthly for three months commencing in October to one block, for two months in another block and once only to a third block. The trial comprised blocks of the varieties N18 and N12 (susceptible and resistant eldana respectively). The insecticide used was alpha-cypermethrin, applied as a u.l.v. spray at a rate of 300ml insecticide/ha in 40L water.

*Seedcane treatment*

Bundles of seedcane comprising five 700mm setts, each artificially inoculated with four third instar eldana larvae were prepared. Bundles were dipped in four insecticide solutions for ten minutes. Assessment of larval mortality was made 48 hours after dipping. Rates of insecticides used were 0.08g a.i. /L, 0.15 g a.i./L and 0.30 g a.i./L (rates 1, 2 and 3 respectively in Figure 1); all were commercial formulations. Controls were water alone and water plus a wetter. (Previous trials had indicated water plus a wetter reduced larval survival in setts).

*Persistence of treatments*

In this pilot study, weighed pieces of dead sugarcane leaves (300mm long) were painted with a 0.25ml volume of a 1:2 dilution of three insecticides; cypermethrin (200g a.i./L), alpha-cypermethrin (100g a.i./L) and flufenoxuron (100g a.i./L). The dead leaf material was then exposed to the environment for periods varying from one to eight weeks. Each fortnight leaf samples were collected, milled, incorporated into an artificial diet and fed to neonate eldana larvae. Mortality was assessed after 48 hours.

*Distribution and penetration of droplets*

Preliminary examination was made of the horizontal penetration and vertical distribution of droplets, from mist blowers, in mature (2m tall) sugarcane. The spray was directed at a right angle to the direction of walking in the row. Water sensitive papers (each approximately 20mm square) were positioned at 100mm intervals vertically, on wooden stakes. The stakes were then positioned in the row being treated and the adjacent two rows. After treatment application the papers were recovered and droplet distribution assessed by counting droplets in three random fields on each paper.

## Results And Discussion

*Large scale field trials*

Results from the final survey prior to harvest, of eight trials are summarised in Table 1. While in many cases levels of damage were lower in the treated blocks than in the control blocks, differences between treatments were small and no particular combination of treatments proved more effective than any other. There was a discernible overall trend, but no consistent pattern was evident for individual treatments.

*Aerial application trial*

Results are summarised in Table 2. The second post treatment survey was conducted in March prior to harvesting the trial and this survey shows the effects of the treatments most clearly. For the variety N18, damage in the plots receiving three treatments was only 27% of the control. In the block receiving only two treatments damage was 47% of the control. By contrast for the variety N12, the blocks receiving three and two treatments were only 53% and 65% of the control respectively.

Such results indicate that aerial applications of insecticides for eldana control show promise and that repeated applications are probably necessary for the greatest effect. This trial also indicates the value of host plant resistance as a factor in reducing levels of borer damage.

*Seedcane treatment*

Results, which have not been corrected for control mortality, show that lambda-cyhalothrin and cypermethrin were the more effective insecticides tested (Figure 1). The influence of rates was seen only in the case of chlorpyrifos, indicating that rates could be reduced further for the more effective compounds. This will be examined in further trials, but these results suggest that using a 10 minute immersion period, either cypermethrin or lambda-cyhalothrin at a rate of 0.08 g a.i. /L would be effective in reducing larval survival in treated setts.

*Persistence of treatments*

Results are summarised in Figure 2. Recorded mortality, after eight weeks exposure, declined by about 30% in the case of the synthetic pyrethroids and by about 70% in the case of the insect growth regulator. Although larvae were exposed to high doses in this preliminary experiment (1-2 mg), it is encouraging

**Table 1. Levels of damage (percent internodes bored) in different treatments in the final survey of eight trials.**

| | Percent internodes bored | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Trial number** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **Means** |
| **Treatment** | | | | | | | | | |
| **ONDJ** | 3.4 | 2.8 | 1.1 | 8.5 | 1 | 2.2 | 2.8 | 2.3 | 3.0 |
| **ON** | 3.9 | 1.1 | 1.1 | 13.5 | 1.7 | 1.4 | 1.6 | | 3.5 |
| **ND** | 3 | 2.4 | 1.7 | 14.5 | 0.7 | 1.2 | 2.9 | 3.2 | 3.7 |
| **DJ** | 3.3 | 1.6 | 1.5 | 12.5 | 2.4 | 1.7 | 1.8 | | 3.5 |
| **CONTROL** | 4.5 | 2.9 | 1.5 | 14.6 | 1 | 3.5 | 2.9 | 2.6 | 4.2 |

**Table 2: Trends in eldana damage in two varieties repeatedly sprayed by air. Values are percent internodes bored.**

| | VARIETY N18 | | | | VARIETY N12 | | |
|---|---|---|---|---|---|---|---|
| **Block (treatment)** | **Surveys** | | | | **Surveys** | | |
| | **Pre-treat** | **First Post-treat** | **Second post-treat** | | **Pre-treat** | **First post-treat** | **Second post-treat** |
| **Block 1 (Control)** | 1.3 | 3.5 | 11.7 | | 1.3 | 2.3 | 4.9 |
| **Block 2 (Nov)** | 2.9 | 2.9 | 10.2 | | 3.5 | 0.7 | 4.4 |
| **Block 3 (NovDec)** | 1.6 | 0.6 | 5.5 | | 0.8 | 0.3 | 3.2 |
| **Block 4 (NovDecJan)** | 2.4 | 1.1 | 3.2 | | 1.2 | 0.1 | 2.6 |

that mortality did not decline at a greater rate. Conversely, mortality in the flufenoxuron treatment fell by 50% within the first two weeks. These results may reflect the differential stability of these compounds in sunlight. Further studies are planned and these results provide a useful initial indication of what effect exposure has on the efficacy of the insecticides tested.

*Distribution and penetration of droplets.*

An analysis of the distribution and penetration of spray droplets in the field is summarised in Figure 3. In some cases, particularly in the treated row, coverage of the water-sensitive paper was so extensive that no droplet pattern was evident. In such cases an arbitrary value of 200 droplets/ square was used; so in Figure 3, all values recorded as 200 must be read as total coverage at that position.

The vertical distribution of droplets can be seen to be narrow closest to the source of the droplets (row 1) and broadens as distance from the nozzle increases (rows 2 and 3). The nozzle was kept at a height of 100cm and in row 1 most coverage was within 20cm either side of this height. In subsequent rows coverage tended to be greater below the 100cm height.

Horizontal penetration of the droplets was shown to be up to 240 cm from the source (row width was 120 cm). This was assessed with and without the dead leaf material (trash) removed as shown in Figure 3. Surprisingly greater coverage and penetration were evident where the trash was not removed (compare row 3 with and without trash removed in Figure 3). This may possibly be explained by the fast moving droplets bouncing off trash and consequently travelling further than droplets having a clearer path where trash was removed.

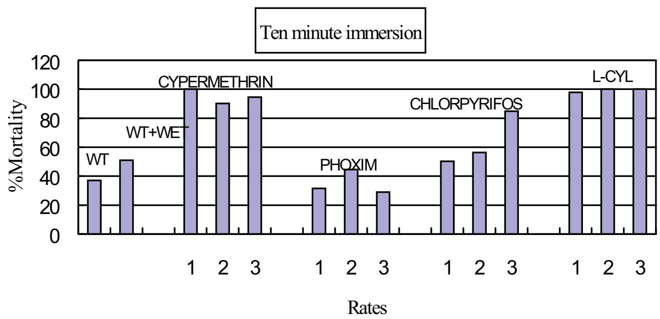


**Figure 1. Eldana larval mortality in artificially inoculated setts dipped in various insecticide treatments.**

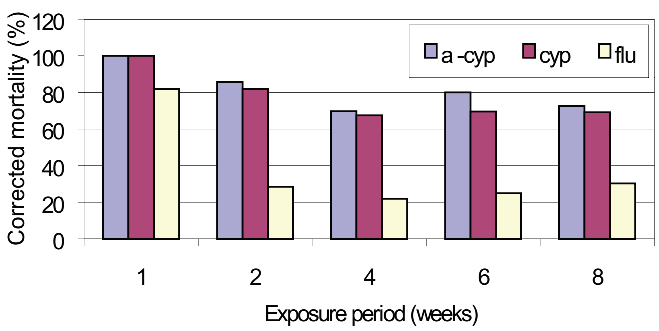


**Figure 2. The influence of exposure period of insecticide treated sugarcane leaves on neonate eldana larval mortality.**

Trash density is thought to be a great hindrance to effective coverage of tall sugarcane. However this pilot study suggests that trash may facilitate droplet penetration. Further such studies aim to corroborate these findings and examine distribution and penetration in crop of different varieties and age.

## General Discussion

Results from the large-scale field trials indicate a trend of treatments reducing damage. However with such low levels of damage it cannot be concluded that the treatments had any significant effect. With such trials, reliance is placed on natural infestations increasing as the crop ages. This has been shown to occur in eldana infestations (Leslie 1994). However the generally low population levels as a result of early harvesting crops, as well as good rains over the last few seasons have resulted in low levels of infestation making it difficult to discern any significant differences between treatments. However, timing of insecticide applications remains a viable option to influence eldana infestations in crops growing over the summer months.

The production of pest free seedcane is an important aspect of cultivating sugarcane. If such seedcane is not available, dipping setts in an insecticide solution prior to planting is a viable approach to reducing damage to the growing crop. The currently registered treatment, phoxim is not as effective as the synthetic pyrethroids tested, and these are the most likely replacements for phoxim.

The persistence of insecticides in the sugarcane habitat is of critical importance for the type of approach adopted for their field application against eldana. Ideally, the correct timing of treatment application, so as to expose the most susceptible stage to the most effective dose, would allow the use of insecticides with limited residual activity in the crop environment. Alternatively, a more persistent insecticide would allow less precision in the timing of applications. From such studies, it is hoped that those insecticides most effective for field application against eldana will be identified.

Not only is persistence of an insecticide important but also coverage and penetration of the crop. Because the current strategy requires the treatment of tall sugarcane, it is important that as much as possible of the target area (lower parts of stools) is covered. While knapsack sprayers can accomplish this for the row being treated, the force behind the droplets is not sufficient to penetrate through the stool. However the force behind droplets generated by mist blowers not only provides coverage in the row being treated but also penetration of adjacent rows, and is a method that has potential for treating tall sugarcane.

As these techniques and studies develop it is hoped that a reliable and cost effective approach to the use of insecticides against eldana will emerge. This approach, in conjunction with biological control, host plant resistance and agronomic practices, provides a balanced approach to the control of eldana in sugarcane in South Africa.

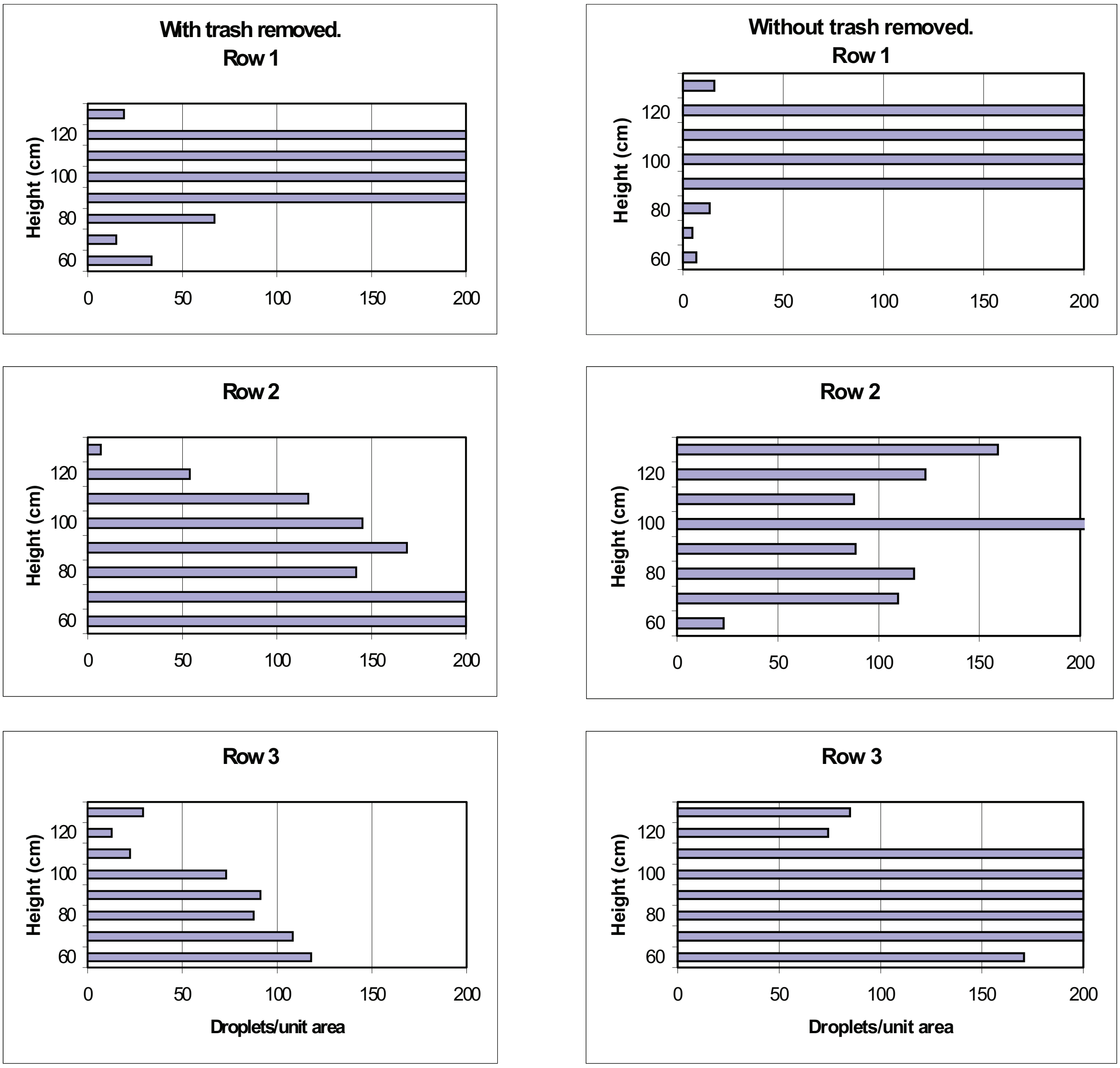


**Figure 3. Penetration of mist blower droplets in mature NCo 376, with and without trash on stalks removed. Values on the x-axis are a mean of three counts of squares 5mm on side. Values on the y-axis are the heights of the water sensitive paper.**

## REFERENCES


Heathcote, R.J.(1984) Insecticide testing against *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Proc S Afr Sug Technol Ass. 58: 154-158.

Leslie, G.W. (1994). Observations on crop damage and larval populations of the pyralid borer *Eldana saccharina* in the sugarcane varieties NCo 376 and N11. Proc S Afr Sug Technol Ass. 68: 12-14.

Meagher, R.L. Jr., Smith, J.W. Jr. & Johnson, K.J.R. Insecticidal management of *Eoreuma loftini* (Lepidoptera: Pyralidae) on Texas sugarcane: A critical review. J. Econ. Entomol. 87, (5): 1332-1344.