PROGRESS IN THE USE OF AERIALLY APPLIED FASTAC® (ALPHA-CYPERMETHRIN) FOR THE CONTROL OF THE SUGARCANE BORER *ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE.), AND AN ASSESSMENT OF ITS COMMERCIAL IMPACT

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Abstract

Four field-scale aerial application trials for *E. saccharina* control were conducted with Fastac applied six times (once every two weeks) and eight times (once every three weeks) to carry-over crops from September to December. The insecticide was applied at a rate of 200 ml product/ha by means of a microlight aircraft fitted with CDA spray heads

Results showed that damage was significantly lower in the treated than the untreated cane, estimates being 73% and 67% of control estimate (six applications and eight applications respectively) in the final survey. Similarly, *E. saccharina* numbers were significantly lower in the treated cane, estimates being 79% and 76% of the control estimate (six applications and eight applications respectively), based on transformed data.

Estimates of ERC% at harvest showed that this was significantly higher in treated cane in two of the four trials conducted, but there were no differences in ERC% estimates between the two insecticide treatments.

In the region of the industry where the trials were conducted, this approach to *E. saccharina* control is being used commercially. Evidence is presented which shows that this approach has had an impact on *E. saccharina* levels in commercial carry-over crops, so improving farm economics.

It is concluded that aerial application of Fastac can suppress *E. saccharina* infestations and the commercial use of this approach shows promise.

Keywords: Eldana saccharina, insecticides, Fastac, aerial application, commercial use, sugarcane

Introduction

Research in to the control of the sugarcane borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae) follows an Integrated Pest Management approach, with biological control, ecological control and insecticidal control options being investigated. Recent studies on the use of an insecticide to reduce the impact of this pest have focused on ground application of an insecticide (Leslie 2003). While such studies showed that this approach can be effective, aerial application is considered to be a viable alternative. An important advantage of aerially applied insecticide is the ease of application, as there is no requirement for the training of agricultural staff in specialist ground application skills, or the need to purchase application and safety equipment. In addition, there is often high demand for staff for normal farming operations over the period when insecticides should be applied (August to November), causing increased pressure on available resources.

Aerial application of insecticides to crops has been practised for many years and this approach has also been used elsewhere for the control of sugarcane borers (Meagher *et al*, 1994).

The trials reported here were conducted to address the question of whether *E. saccharina* damage and numbers in carry-over cane could be suppressed by the application of an aerially applied insecticide. Contemporaneously with the field trials, growers in one part of the industry (Maidstone LPD&VCC area, Group 4) applied Fastac to carry-over sugarcane on a commercial scale. Because of cooler growing conditions at altitudes of 310-610 m, growers in this group need to carry over at least 33% of the area under cane for an economic return. Currently less than 15% is carried over. In such situations, the use of Fastac can help increase the area carried over. Preliminary findings on the commercial use of Fastac are reported.

Materials and Methods

Insecticide application and trial layout

While the main objective of the trials was to show that aerially applied insecticide could reduce the impact of *E. saccharina* on carry-over cane, application frequency was investigated as well. In the trials the treatment was applied eight times (standard) and six times to carry-over crops over the period August to December.

The insecticide was applied by a microlight using six Micron X15 controlled droplet applicator (CDA) spray heads. The heads were adjusted to provide droplets in the size range 90 to 150 microns.

The insecticide, Fastac EC (alpha-cypermethrin), was applied at a rate of 200 ml formulation/ha in 5 L water per application. Molasses was included in the mix (10% by volume) to reduce droplet drift. Fastac was applied either eight or six times (at fortnightly or three-weekly intervals, respectively) commencing in August and ending in December.

In conjunction with Extension staff, a number of fields were examined for suitability for the trials. Criteria for selection included age (8-9 months old in August), variety (avoiding resistant varieties), topography (avoiding steep sloping land) and size (area at least 3 ha). Four co-operators were selected, providing one field each. In each field, a trial comprised three blocks of cane, one control block and two treated blocks, one receiving eight applications and the other six. Although the size of the blocks varied, most were between one and two hectares in area. The boundaries of the blocks were flagged with different colours to indicate to the pilot the blocks to be sprayed. Details of the trials are summarised in Table 1.

Table 1. Details of fields used for *Eldana saccharina* Walker (Lepidoptera: Pyralidae) aerial insecticide application trials.

Trial number	Area of field (ha)	Sugarcane variety	Age* (months)
1	5.4	N16	8
2	3.4	N16	8
3	5.8	NCo376	9
4	3.9	N12	9

*at commencement of the trial

Field surveys

A pre-treatment and four post-treatment samples were taken from each block (each at approximately two-monthly intervals). The first survey was conducted just before the first application of the treatments, and the final survey was conducted just prior to harvest, eight months later. In all surveys, 100 stalks were sampled from each block. Estimates were made of *E. Saccharina* damage and numbers on each occasion. Each stalk was split vertically and total internodes, internodes bored and larval numbers present, were recorded. Yield estimates were taken at harvest.

Survey data were combined from all four trials for anlaysis and the data transformed using the $\log_{10}$ (x+1) transformation. Data were analysed using repeated measures analysis of variance and Dunnet's t statistic was used to specifically allow comparison between the treatments and control values only.

Yield estimates were taken just before the crop was harvested. Estimates comprised the collection of 10 bundles of 12 stalks from each block of each trial. Samples were processed and assessed for ERC% and data analysed using REML analysis.

The commercial impact of Fastac was assessed by monitoring, where possible, the levels of *E. saccharina* larvae in carry-over fields that had been treated with Fastac. *E. saccharina* surveys are carried out in commercial fields between May and July by Local Pest Disease and Variety Control Committee (LPD&VCC) survey teams, to identify potential carry-over fields and to determine whether or not the *E. Saccharina* levels warrant the use of an insecticide. The current local regulations state that potential carry-over fields having between 10-20 *E. saccharina* larvae/100 (E/100) stalks must either be sprayed or harvested before the end of the current milling season. Where used, the insecticide was applied by air six times, at three weekly intervals, at a rate of 200 ml product/ha, commencing in August.

Monitoring arthropods

The impact of the treatments on epigael arthropods was monitored by means of pitfall traps in two trials. In both trials, traps were placed in each of three blocks. The exact number of traps varied because of the differing size of the blocks but ranged between 6 and 10 per block, the aim being to provide coverage of the whole block. Each trap comprised a glass (60 mm wide and 165 mm deep) dug into the selected interrows of the block and contained 40 ml of a 70:30 alcohol/glycerol mix. The traps were placed out for three days and then retrieved. They were again placed out three weeks later for three days and so on throughout the life of the trial, following the method of Draper and Conlong (2000). Arthropods collected were identified as far as major groupings (ants, spiders, beetles), as well as morphospecies within these groups.

Results

E. saccharina *damage (% internodes bored)*

The results are summarised in Table 2. Damage (percentage internodes bored) increased in the control and both treatments over the period of the trials. Damage in untreated cane increased by 30.7%, while after six and eight applications of insecticide, damage increased by 40.5% and 6.9% respectively (using transformed values). The high value for the six application treatments is a result of the initial damage level being low – the lowest of all treatments. The first survey after treatment application showed no significant differences in damage between the treatments and the control. However, in all subsequent surveys, the insecticide treatments showed significantly lower levels of damage. In the final survey, damage in the treated crops was 47% and 56% lower after six and eight applications respectively, based on untransformed values of internodes bored in the control, six and eight treatment applications of 6.07%, 3.17% and 2.84% respectively.

Trends in the differences in damage levels between the insecticide treatments are also shown in Table 2. Over the sampling period the analysis showed that, periodically, damage levels were significantly different between the two application rates. However, the trend over the period of the trials was for damage to be lower in the eight applications treatment. In the final survey, four months after the last insecticide application, damage in the eight applications treatment was significantly lower than that of the six applications treatment.

Table 2. Trends in *E. saccharina* Walker (Lepidoptera: Pyralidae) damage (% internodes bored) in crops treated six and eight times with Fastac.

Survey	Control	Six applications	Treatment-control difference	Eight applications	Treatment-control difference	Six - eight applications difference
Pre-treatment	0.6499***(3.47)	0.4418 (1.76)	-0.2081*	0.5283 (2.37)	-0.1216*	-0.0865**
1st Post-treatment	0.5567 (2.60)	0.5366 (2.44)	-0.0201	0.5320 (2.40)	-0.0247	0.0046
2nd Post-treatment	0.8047 (5.38)	0.5844 (2.84)	-0.2203*	0.5106 (2.24)	-0.2941*	0.0738**
3rd Post-treatment	0.8957 (6.87)	0.5439 (2.50)	-0.3518*	0.5740 (2.75)	-0.3217*	-0.0301
Final	0.8493 (6.07)	0.6205 (3.17)	-0.2288*	0.5650 (2.84)	-0.2843*	0.0555**

LSD for comparison between treatments = 0.0450
LSD for treatment comparisons with control only using Dunnet's t statistic = 0.0357
* significantly different from control
** significant differences between treatments
*** All values are $\log_{10}$ (x+1) transformed
(Untransformed data)

E. saccharina *numbers (E/100 stalks)*

Estimates of *E. saccharina* numbers in the surveys conducted are summarised in Table 3. In all surveys but one, *E. saccharina* numbers were significantly lower in the treated than in the untreated crops. Over the period of the surveys *E. saccharina* larval numbers rose 43.7% (using untransformed values) in the untreated crop. Over the same period, in the crop treated six times, numbers rose 47.4%, and in the crop treated eight times numbers declined -6.2%. In the final survey of the crop treated six times, the estimate showed that larval numbers were 46.3% of the control assessment, while those treated eight times were 41.8% of the control assessment (all figures based on untransformed values). Despite this difference in efficacy of the two insecticide treatments, in no survey could it be shown that eight applications were more effective than six (Table 3).

Yield estimates (ERC%)

Estimates of ERC% were taken just prior to harvest and the results for each trial were combined for analysis. Data were analysed using Fisher's Unprotected Least Significant Difference test. Estimated ERC% for six applications, eight applications and the untreated crop were 9.48, 9.20 and 7.52 respectively. While estimated ERC% for the crop treated six times was greater than that of the crop treated eight times, the difference was not significant (0.28 ERC% ± 0.242 s.e.). However, the ERC% of both treatments was significantly greater than the control ($p<0.05$). Differences were, for six and eight applications, 1.96 and 1.68 respectively (± 0.242 s.e).

Table 3. Trends of *Eldana saccharina* Walker (Lepidoptera: Pyralidae) numbers in crops treated six and eight times with Fastac.

Survey	Control	Six applications	Treatment-control difference	Eight applications	Treatment-control difference	Six - eight applications difference
Pre treatment	1.376** (22.77)	1.052(10.27)	-0.324*	1.193 (14.60)	-0.183	-0.141
1st Post treatment	0.792 (5.19)	0.401 (1.52)	-0.391*	0.301 (1.00)	-0.491*	0.1
2nd Post treatment	1.019 (9.44)	0.648 (3.45)	-0.371*	0.54 (2.46)	-0.479*	0.108
3rd Post treatment	1.317 (19.75)	0.809 (5.44)	-0.508*	0.858 (6.21)	-0.459*	-0.049
Final	1.528 (32.73)	1.208 (15.14)	-0.32*	1.167 (13.69)	-0.361*	0.041

LSD for comparison between treatments = 0.293
LSD for treatment comparisons with control only using Dunnet's t statistic = 0.270
* significantly different from control
** All values are $\log_{10}(x+1)$ transformed
(Untransformed data)

Treatment impact on ants

Pitfall trap catches of epigeal arthropods were conducted in two of the four trials. While a large number of arthropod groups were collected, only catches of ants are reported here. These are the most abundant macro-arthropod in sugarcane, and are considered to be important predators of *E. Saccharina* (Leslie, 1986).

Trends in the catches of ants in are shown in Figure 1. These plots show that, over the period of treatment application - August to December - numbers of ants were lower where insecticide treatments were applied. This was more noticeable in Trial 1 than in Trial 2. However, after treatment application stopped (early December), numbers of ants in the treated crops in both trials recovered and the final assessments in February showed that ant numbers where the insecticide had been applied were similar to that recorded in the untreated sugarcane.

Ant numbers varied between the insecticide treatments, with most assessments showing no significant differences (based on calculated mean numbers per trap and associated standard errors). In the final survey in Trial 1 there were significantly more ants in the six applications treatment than either the eight applications treatment or the control. However, the converse was so in the second trial. Such differences probably reflect local population fluctuations rather than any impact of the insecticidal treatments.

Commercial use of Fastac

Shown in Figure 2 is the area of surveyed carry-over cane in the Maidstone LPD&VCC area Group 4 for the past five seasons. Included are the levels of *E. saccharina* in this cane as determined by LPD&VCC surveys. During the period 2001 to 2003, the area of carry-over cane decreased due to high levels of *E. saccharina*. In the 2003/2004 season, Fastac was applied by air to a small area (232 ha) of commercial carry-over cane. The results showed that E/100 stalks were reduced from an estimated average of 24 E/100 in 2003 to 15 E/100 in 2004 (see Figure 2). This success encouraged growers to treat larger areas (755 ha) of carry-over cane the following season and the average E/100 stalks decreased even further to an estimated 5 E/100.

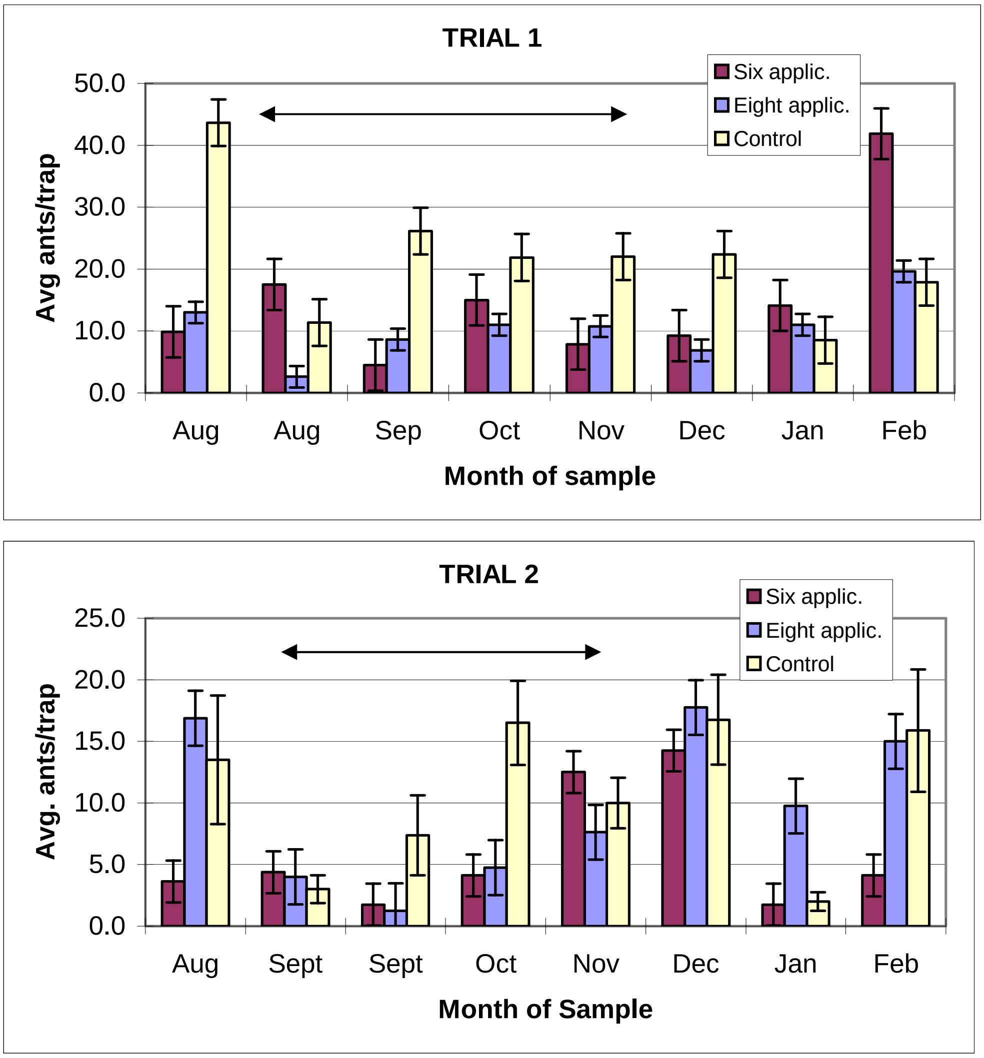

Figure 1. Trends in the numbers of ants collected from two trials where Fastac had been applied six and eight times by air. Horizontal arrow indicates the period over which the insecticide was applied. Vertical bars represent the mean number of ants/trap ± one standard error.

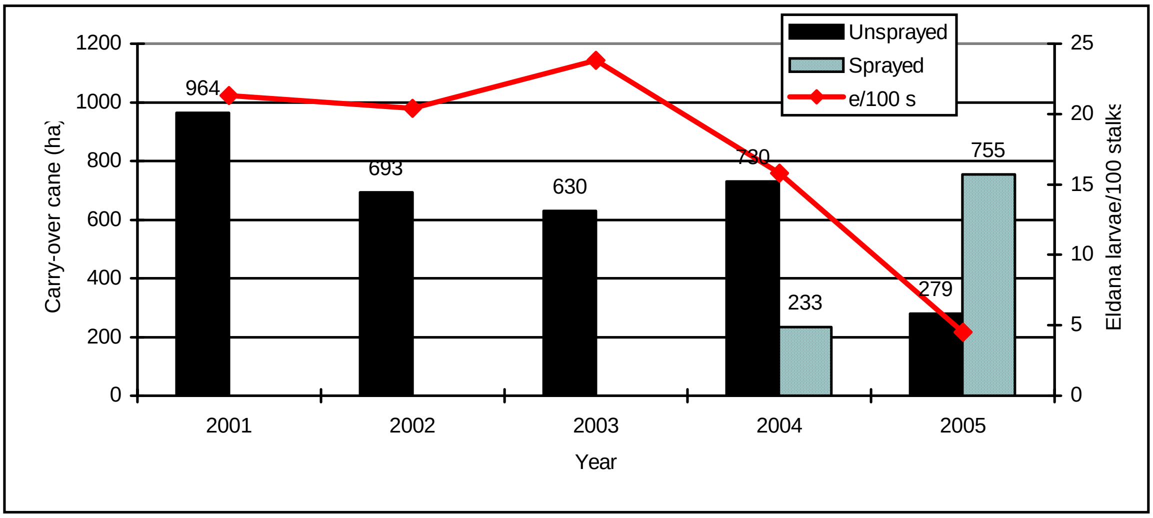

Figure 2. Trends in area of surveyed carry-over cane, *E. saccharina* Walker (Lepidoptera: Pyralidae) larvae numbers in such cane and area treated with Fastac in the Maidstone LPD&VCC Group 4.

A more detailed example from two farms is summarised in Table 4. Here two growers took the decision to spray the four fields detailed in Table 4. The decision was based on the *E. Saccharina* levels in the fields being in the range where the local LPD&VCC regulations require the crop to be harvested or, if carried over, to be treated with Fastac (*E. Saccharina* within the range of 10-20 E/100 stalks in July). On the same farms, a comparable set of fields did not have high enough levels of *E. Saccharina* and so were carried over without being treated.

Table 4. Yield estimates from fields sprayed and comparable unsprayed fields on two farms in the Maidstone Group 4 LPD&VCC area.

FARM 1							
Field	Variety	Age at harvest	Ratoon	Total cost/ha to spray (excl.Vat)	RV%	Tons RV/ha	Tons cane/ha
Fields sprayed with Fastac							
18 Gr	N16	20	3	R864	12.78	12.01	94
19 Gr	N16	20	3	R864	13.18	11.99	91
				Average	12.98	12.0	92.5
Fields not sprayed with Fastac							
162 Gr	N16	19	3	0	9.00	7.74	86
161 Gr	N16	19	3	0	8.8	7.48	85
				Average	8.9	7.61	85.5

FARM 2							
Field	Variety	Age at harvest	Ratoon	Total cost/ha to spray (excl. Vat)	RV%	Tons RV/ha	Tons cane/ha
Fields sprayed with Fastac							
20 Co	NCo376	19	3	R864	11.47	10.94	95.4
36 Co	NCo376	19	5	R864	12.58	8.96	71.2
				Average	12.03	9.95	83.3
Fields not sprayed with Fastac							
3 Co	NCo376	19	5	0	10.35	6.32	61.1
23a Co	NCo376	19	3	0	11.78	10.21	86.7
				Average	11.07	8.27	73.9

On Farm 1, the sprayed crops had an average RV% of 12.98, and 12 tons RV/ha, while equivalent unsprayed crops had an average RV% of 8.9 and 7.61 tons RV/ha – a difference of 4.08 RV% and 4.39 tons RV/ha. This was an estimated increase in income of R6080.15, based on an RV price of R1385 per ton. In the second example, Farm 2, the difference in RV% was 0.96 and 1.68 tons RV/ha. This translated into an increased income of R2326.80. The net benefit on Farm 1 was R5216.15/ha and on Farm 2 R1462.80/ha.

Discussion

The results from this study show that repeated application of an insecticide by air can significantly reduce the impact of *E. saccharina* in carry-over cane. In ground application trials with Fastac, on carry-over cane, Leslie (2003) showed that, after eight applications, damage was reduced by 75% in the final survey. However, efficacy was generally lower in the current study, with damage reduced to between 40% and 60%.

E. saccharina numbers were similarly affected, with both treatments significantly reducing larval numbers, compared with the control. It was estimated that *E. saccharina* levels were reduced by 54% and 58% after six and eight applications respectively, but the difference between the two insecticide treatments was not significant.

A similar comparison to that made with the damage recorded in Leslie (2003) can be made with *E. saccharina* numbers. Leslie (2003) recorded a 73% reduction in *E. saccharina* numbers in the final survey. This compares less favourably with the results in this study where numbers were reduced by between 54% and 58% only.

It is difficult to make reliable comparisons across seasons and trials such as these, as environmental factors and pest pressure can differ between seasons. This is shown by the highest level of damage recorded in the current study (6.07% internodes bored.) compared to that of Leslie (2003), (20% internodes bored) It is probable that in periods of low pest pressure the impact of a treatment would be reduced.

Yield estimates conducted prior to harvest showed that the treatments did increase ERC%. However, there was no significant difference in ERC% values between the two insecticide treatments. Thus, in two of three measures (*E. saccharina* numbers and ERC%)there were no significant differentiations between six and eight applications. Because of this, it should not be concluded that eight applications are more effective than six.

The cost of aerially applying Fastac was estimated to be R954/ha for six and R1272/ha for eight applications. Leslie (2003) estimated ground application costs to be R700/ha, excluding equipment and water costs. Aerial application is thus a more expensive option, but can be considered more convenient. However, it is probable that results from aerial application may be more variable than those obtained from ground application. Aerial application is particularly sensitive to wind, which may interrupt the spray schedule and increase the risk of drift.

The increasing commercial use of Fastac in the Maidstone area can be seen to have had an impact on levels of *E. saccharina* in carry-over crops. This is encouraging, as not only does it allow an increase in carry-over area, but also contributes to a reduction of *E. saccharina* in the area. The example provided of the impact of treating carry-over on RV% and other parameters on selected farms also shows the potential economic value of this *E. Saccharina* management tool. Although results from only two farms were analysed, as the use of Fastac increases, further evidence of the value of this approach will become available.

As part of the studies conducted on the use of insecticides, assessments are made of the arthropods associated with the treated crops. Results from these trials confirm the findings of a previous study (Leslie, 2003) that numbers of ants declined in the treated crops over the period of treatment application, but recovered after application stopped. However, it is interesting that aerially applied insecticide would influence ant numbers at all. Although a definitive study has yet to be conducted, observations in sugarcane, of the age treated in these trials, showed that aerially applied droplets penetrated below the canopy. Most were intercepted in the first metre of the crop, but a few reached ground level. This indicates the openness of the crop canopy, and ants may encounter droplets in parts of the crop other than the canopy.

Conclusions

- Aerially applied insecticides can reduce *E. saccharina* damage and numbers in carry-over crops.
- Six applications of Fastac are as effective as eight in reducing *E. saccharina* numbers and damage.
- Aerial application is more expensive than ground application.
- The insecticide treatments suppressed ant numbers over the period of treatment application only.
- The commercial use of Fastac has been shown to increase the RV% in treated crops.

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REFERENCES

Draper C and Conlong DE (2000). *Eldana saccharina* (Lepidoptera: Pyralidae) and arthropod predator populations in small and commercial grower sugarcane fields. *Proc S Afr Sug Technol Ass* 74: 228.

Leslie GW (1986). The arthropod predators of *Eldana saccharina* Walker (Lepidoptera: Pyralidae), their identification and relative importance. MSc Thesis, University of Natal, Pietermaritzburg, South Africa.

Leslie GW (2003). Impact of repeated applications of alpha-cypermethrin on *Eldana saccharina* (Lepidoptera:Pyralidae) and on arthropods associated with sugarcane. *Proc S Afr Sug Technol Ass* 78: 104-113

Meagher RL Jr, Smith JW Jr and Johnson KJR (1994). Insecticidal management of *Eoreuma loftini* (Lepidoptera: Pyralidae) on Texas sugarcane: A critical review. *J Econ Ent* 87(5): 1332-1344.