SHORT COMMUNICATION

ESTIMATING THE ECONOMIC INJURY LEVEL AND THE ECONOMIC THRESHOLD FOR THE USE OF FASTAC® AGAINST *ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE)

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Abstract

Five years of results from insecticide trials assessing the value of using α–cypermethrin (Fastac®) against *Eldana saccharina* Walker (Lepidoptera: Pyralidae) were used to estimate the Economic Injury Level (EIL) and the Economic Threshold (ET) for this pest. The analysis was based on estimates of borer damage and larval numbers, and the impact of these on estimated recoverable sugar (ERC%).

Results showed that the EIL, based on percentage internodes bored (% IB) was more reliable than estimates based on larval numbers, and was estimated to be 5.8% IB (±1.33) or 7.2% IB (±1.75), at treatment efficacy levels of 50% and 40% respectively. Least reliable were estimates based on assessments of larval numbers. This was attributed to the poor association between larval populations and intensity of damage over time.

Based on estimates of the rate of damage accumulation over time the ET, based on % IB and ERC%, was estimated to be approximately 3% IB, assuming a 40% treatment efficacy. Such estimates provide useful measures that can aid in deciding whether or not the use of an insecticide is justified.

Keywords: Eldana saccharina, sugarcane, stalk borer, economic injury level, economic threshold

Introduction

Eldana saccharina Walker (Lepidoptera: Pyralidae) is the most serious pest of sugarcane in South Africa, and several control strategies against this insect have been developed around an Integrated Pest Management (IPM) approach. This has resulted in recommendations based on resistant varieties, agronomic control measures and chemical control (Anon, 2005).

Although there have been studies conducted on the economic impact of Eldana (e.g. King, 1989), none has estimated the economic injury level (EIL) and the economic threshold (ET) for carry-over crops. Reported here is the use of results from five years of insecticide trials, to estimate an EIL and ET and so to contribute to a more effective decision making process for the use of Fastac in sugarcane cultivation.

Materials and Methods

Insecticide trials

Details of these trials are given in Leslie (2006). The trials comprised field-scale blocks of insecticide-treated and untreated sugarcane seven to eight months old in August. Treatments comprised six to eight applications of Fastac applied at three or two-weekly intervals, respectively. The product was applied at a rate of 200 ml formulation/ha/application. An estimate of yield was made at the time of the last survey, which was just before the crop was harvested.

Estimating the EIL and ET

Results from surveys of damage conducted just before harvest were used. Reduction in ERC% was plotted against damage for each of 23 field trials conducted from 2002 to 2006. Equations from linear regression plots provided estimates of parameters b and m (y=mx+b) used in the equation to estimate the EIL (estimated as % IB). The equation used is given below and was based on that developed by Pedigo et al. (1986) and modified by Goebel (1999).

$$\% \text{ IB} = (C/VK - b)/m$$

C = the cost of treatment (application plus product).
V = price of product (sucrose) (Rands/ton).
K = reduction in damage caused by treatment.
b and m = linear regression equation parameters.

The value of C was estimated to be R864/ha, based on estimates of current labour costs/ha and insecticide costs. The value V was the commercial price of sucrose (R1608/ton). Efficacy of the treatment (K) was obtained by assessing the percentage reduction in damage in treated blocks of trials compared to the controls, as assessed in the final survey of all trials and expressed as a decimal.

Results and Discussion

Shown in Tables 1 and 2 are the values used in estimating the EIL and the calculated EIL for each year's data, based on % IB and E/100. In all analyses the calculations were conducted using estimates for treatment efficacy of 40% and 50%.

Estimating the EIL

Based on % IB average EIL's of 5.8%IB (±1.33) and 7.2% IB (±1.65) were calculated, depending on the level of treatment efficacy selected (Table 1). Using E/100 showed that the estimated EIL was 32.3 (± 8.76) and 40.2 (± 10.99) E/100 for 50% and 40% efficacy levels respectively (Table 2). A feature of these estimates was the number of low r^2 values obtained. Unlike borings, which accumulate through time, larval numbers fluctuate as generations cycle over the life of the crop and can result in poor associations between damage (and therefore loss) and larval numbers.

To obtain estimates of the EIL, treatment efficacies of 40% and 50% were assumed. A clearer idea of the range of the EIL was obtained by estimating how effective each trial was in suppressing damage and *E. saccharina* numbers. Efficacy in damage reduction ranged between 32.7% and 65.3% (average 44.0%). Reduction in larval numbers ranged between 41.2% and 78.2% (average 53%). Thus, reduction in damage and larval numbers of about 40% and 50% respectively could reasonably be expected.

Based on these estimates, and examining the values given in Tables 1 and 2, a reasonable value for the EIL, using ERC% and based on % IB, would be approximately 7% IB, assuming a 40% efficacy of the insecticide treatment. Using larval numbers, the range would be approximately 30 E/100.

Table 1. Estimates of the EIL (as % IB) based on ERC% from five years' insecticide trial data, assuming differing levels of treatment efficacy against the stem borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Shown are the factors used in the equation to estimate the EIL.

Year of trial	Cost of treatment (Rands) (C)	Price of sugar (Rands) (V)	Regression equation parameters (m)	(b)	r^2 p=0.05	EIL (% IB)	Estimated treatment efficacy (K)	No. of trials
2006	864	1608	0.1098	0.0132	0.2489	9.7	0.5	5
2005	864	1608	0.3449	0.0022	0.5494	3.1	0.5	6
2004	864	1608	0.3329	0.0003	0.5276	3.2	0.5	3
2003	864	1608	0.2173	-0.0011	0.7745	5.0	0.5	4
2002	864	1608	0.1345	-0.0165	0.3545	8.1	0.5	5
				Mean		5.8		
				SD		2.97		
				SEM		1.33		
2006	864	1608	0.1098	0.0132	0.2489	12.1	0.4	5
2005	864	1608	0.3449	0.0022	0.5494	3.9	0.4	6
2004	864	1608	0.3329	0.0003	0.5276	4.0	0.4	3
2003	864	1608	0.2173	-0.0011	0.7745	6.2	0.4	4
2002	864	1608	0.1345	-0.0165	0.3545	10.1	0.4	5
				Mean		7.2		
				SD		3.69		
				SEM		1.65		

Table 2. Estimates of the EIL (as E/100) based on ERC% from five years' insecticide trial data, assuming differing levels of treatment efficacy against the stalk borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Shown are the factors used in the equation to estimate the EIL.

Year of trial	Cost of treatment (Rands) (C)	Price of sugar (Rands) (V)	Regression equation parameters (m)	(b)	r^2 p=0.05	EIL (E/100)	Estimated treatment efficacy (K)	No. of trials
2006	864	1608	0.0316	0.0049	0.1788	33.9	0.5	5
2005	864	1608	0.062	0.0051	0.4046	17.3	0.5	6
2004	864	1608	0.0161	-0.0008	0.0056	66.8	0.5	3
2003	864	1608	0.0491	-0.111	0.7302	24.1	0.5	4
2002	864	1608	0.0557	0.0041	0.6080	19.2	0.5	5
				Mean		32.3		
				SD		19.58		
				SEM		8.76		
2006	864	1608	0.0316	0.0049	0.1788	42.4	0.4	5
2005	864	1608	0.062	0.0051	0.4046	21.6	0.4	6
2004	864	1608	0.0161	-0.0008	0.0056	83.5	0.4	3
2003	864	1608	0.0491	-0.111	0.7302	29.6	0.4	4
2002	864	1608	0.0557	0.0041	0.6080	24.0	0.4	5
				Mean		40.2		
				SD		24.58		
				SEM		10.99		

Estimating the ET

The EIL provides an estimate of what levels of damage will cover the costs of treatment application. Equally useful is an indication of the level of damage at which treatment needs to be considered to prevent the EIL being reached, i.e. the Economic Threshold (ET). To estimate this, the trends in damage over time (August to April) in the control plots of the insecticide trials were plotted, and linear regressions calculated for each of the five years' trial data. High r^2 values (mean 0.91 ± 0.06) indicate the reliability of the trend for damage to increase with time.

A similar, but more variable estimate was shown based on larval numbers (mean r^2 0.64 ± 0.14). These trends can be used to indicate the probable economic threshold for these two measures. From the trend in damage and larval numbers over time it can be calculated that the final (April) level of damage is 2.96 times the level recorded in August. This is the critical time (spring) for deciding whether or not to spray Fastac. If the estimates of % IB given in Table 1 for 40% efficacy of insecticide treatment are taken to be the maximum acceptable levels in a crop prior to harvest (i.e. the EIL in April), then the August levels of damage and larval population can be estimated. Where the April estimate is set at 7% IB, the initial estimate would be approximately 2.4% IB (7/2.96). The same calculation can be performed for E/100 estimates. If the April estimate was set at 40 E/100, the population in August would be estimated to be 12.6 E/100 (32.3/2.57).

General discussion

While estimates of the EIL and ET are based on several season's data, a number of the components of the equation can change. These are the price of sugar, the cost of application and the efficacy of the treatment. While further trials on different cultivars can refine the efficacy value, growers can obtain seasonally adjusted values for the price of sugar and the costs of application. This would provide more reliable season-specific values for the EIL and ET.

However, the use of an insecticide in conjunction with other control practices provides the most viable approach to *E. saccharina* control. When considering the use of Fastac, cognisance must be taken of variety cultivated, soil type, level of applied N and infestation history of the field. All these factors have been shown to influence *E. saccharina* infestations and its development in a crop.

Conclusions

The EIL for the use of Fastac is estimated to be 7% IB or 30 E/100, and the ET is estimated to be 3% IB or 13 E/100.

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