Integrated pest management strategies adopted by sugarcane growers in the midlands of Kwazulu-Natal to counter an incursion of the African Sugarcane Borer (Eldana saccharina: Walker)

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Abstract. The African sugarcane borer (*Eldana saccharina: Walker*) has been a pest of sugarcane in the South African sugar industry since 1939. Overall, the pest causes losses to the industry of approximately US$70 m per annum. The low-altitude coastal belt regions have been the most seriously affected. Eldana was first identified in the higher-altitude coastal Midlands South region in 1989. From 2013 it became apparent that pest populations were rising and posing a serious threat to the economic viability of farmers in the region. This paper outlines the strategies adopted by growers in this region to contain the spread of the pest. The rise in the pest population necessitated an awareness programme amongst growers, together with a co-ordinated approach focused on Integrated Pest Management (IPM) strategies. Farmers agreed to levy themselves to finance the costs of spraying. As a result of these efforts growers have been able to maintain their two-year cropping cycle and thereby maintain economic viability.

Keywords: sugarcane, *Eldana*, insecticides, Integrated Pest Management (IPM), economic viability

Introduction

The South African sugar industry is approximately 380,000 hectares in extent, situated between 29 and 30 degrees south latitude. Sugarcane is grown in three broad but distinct homogenous climate zones: a northern hot semi-arid irrigated region, a sub-tropical coastal rainfed region (0-500 metres above sea level) and a region at higher altitude (500 – 1,000 m above sea level). Harvesting cycles vary by region, from twelve months where cane is grown under irrigation, to 12 to 18 months in the coastal areas and a longer 24 month harvesting cycle in the cooler, high altitude areas.

Sugarcane in South Africa is affected by a wide range of indigenous and exotic pests and diseases, most of which occur across all the cane growing regions in the country. However, local climatic conditions have an influence on the degree to which each of these pests and diseases proliferate.

The African sugarcane borer (*Eldana saccharina: Walker*) has been a pest of sugarcane in the South African sugar industry since 1939. An indigenous species, Eldana has established itself since this time as the most serious pest affecting sugarcane. A lepidopteran stem borer, Eldana causes damage to the internal tissues of the cane stalk, resulting in a loss of sucrose. Populations of the pest increase within fields as the crop increases in age. The consequent increase in the amount of damage as populations increase can have a devastating effect on final sucrose yields.

Overall, across the industry, Eldana causes damage of approximately US$70 m per annum. With the exception of the cooler, higher altitude cane growing regions, levels of the pest increased dramatically since the 1980s with the low-altitude coastal regions being the most seriously affected. Control has been difficult. Until 2004 there were no effective insecticides available to effect some degree of control of the pest and growers had to resort to premature harvesting to keep pest populations in check. This has resulted in considerable losses in farm revenue. Eldana damage is worse in drier seasons or where the crop undergoes any form of stress.

The Midlands South cane-growing area is a part of the cooler higher altitude cane-growing regions. The area is situated about 90km inland from the coastal city of Durban. Approximately 35,000 hectares in extent, cane in this particular region is grown at an altitude of between 600 – 1,020 metres above sea level and the average annual rainfall is approximately 740 mm per annum.

Eldana was first identified in parts of the Midlands South region in 1989, and although sporadic outbreaks have occurred since then, pest populations remained at manageable levels. It was thought that Eldana in this region would never amount to a serious threat due to the lower minimum temperatures and their effect on the pest's mating threshold. (Atkinson 1980; Way 1994) However, from 2013 it became apparent that pest populations were rising (see Table 1) and posing a serious threat to the economic viability of growers in the region, who mostly

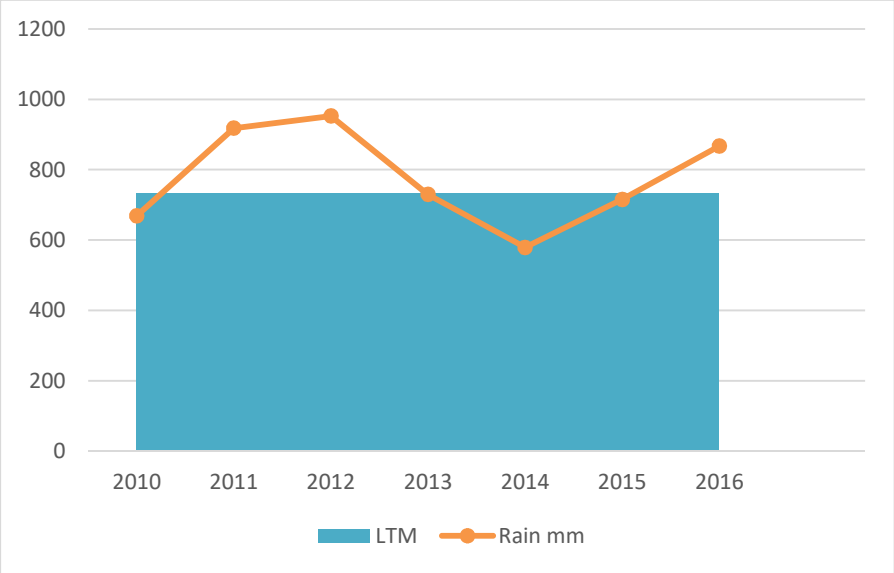
harvest on a 24 month cycle and therefore premature harvesting to control the pest, was not an option.

Table 1. Annual mean Eldana (e/100) recovered in stalk samples by mill region, 1999 to 2016

Year	ML	PG	UF	FX	AK	EN	MS	GH	DL	MS	NB	SZ	UK	IND
99/00	1.2	5.3	1	-	6.4	4.2	13.3	10.1	3.5	0.1	-	9	2.2	5.1
00/01	1	8	2	5	7	5	19	12	6	0	0	6	3	5.7
01/02	0.6	11.2	2	2.5	4.5	4.7	14	7.8	5.3	0	0.5	6.1	3.5	4.8
02/03	1.8	7.6	3.5	3.1	5.2	7.9	14.5	11.3	8.6	0	0	5.8	2	5.5
03/04	1.4	6.8	3.3	4.1	7.6	6.4	11.7	9.8	8.6	0	0.3	11.4	4.1	5.8
04/05	2.2	7	1	2.3	6.1	6.7	5.7	8.6	7.5	0.1	0.1	6.8	3.2	4.4
05/06	1.4	3.9	1.1	5.3	5.8	6	5.3	5.3	8.5	0.4	0.5	7.5	3.6	4.2
06/07	1.8	3.1	0.2	1.3	3.5	1.3	4.7	5.1	4.6	0.3	0.1	4.3	1.2	2.4
07/08	1.3	-	0.3	2.8	1	3.6	4.2	6.7	6.8	0.3	0.1	4.9	0.7	2.7
08/09	4.1	5.3	0.8	3	2.8	1.3	4.4	5.6	4.2	0.6	0.3	2.2	1	2.7
09/10	0.9	-	0.7	2.7	2.9	1.4	4.6	3.6	2.7	0.7	0.1	3.9	2.6	2.2
10/11	0.9	1.1	1.7	5.2	4.8	2.9	10.1	5.9	5.5	0.9	0.3	9.9	8.7	4.5
11/12	1	1	0.7	4.2	5.2	1.1	8	5.6	5.6	1	0.3	6.5	7.5	3.7
12/13	1.3	0.9	1.2	5.6	4.5	3.3	7.7	5.2	4.4	0.8	0.2	4.8	3.1	3.3
13/14	0.7	1.1	1.2	3.4	2.2	2.1	4.7	5.4	4.0	0.5	0.3	3.0	2.6	2.4
14/15	0.8	1.1	0.9	4.5	2.8	2.3	4.7	5.5	4.1	1.6	0.3	6.9	3.6	3.0
15/16	0.9	1.1	1.1	2.9	2.4	1.5	3.6	4.1	5.0	1.8	0.1	6.7	3.9	2.7
Mean	1.4	4.3	1.3	3.6	4.4	3.6	8.3	6.9	5.6	0.5	0.2	6.2	3.3	3.8

After a relatively wet year in 2012 the rainfall in 2013 and 2014 was poorly distributed and below long term mean (see Figure 1). This resulted in the crop being frequently water stressed during this period and led to a sudden increase in levels of Eldana, beginning in August 2013.

Figure 1. Annual rainfall (mm) vs Long Term Mean (LTM)



When the mill started crushing in March 2014 it was apparent that Eldana damage was at significant levels and was affecting the quality of cane being delivered. There was therefore an

urgent need for remedial measures to ensure that the situation did not deteriorate. With the populations of the pest increasing, and it not being possible to harvest large areas prematurely in order to contain the pest, alternative strategies were urgently required in order to maintain the economic viability of growers.

Method

The function of biosecurity in the South African sugar industry is carried out through Local Pest Disease and Variety Control Committees (LPD&VCCs). These committees are established and empowered by legislation through the Sugar Act, 1978. Representatives of growers and millers make up the official members, supported by extension and biosecurity staff from the South African Sugarcane Research Institute (SASRI) who carry out inspections of farms and collect data relating to pest and disease levels present in individual fields. This data is then presented to the Committee who then may order any action required in accordance with pre-determined hazard levels for each pest or disease.

The LPD&VCC therefore constitutes an appropriate body to guide and enforce any action required of growers in the event of an incursion as well as the management of long-standing biosecurity problems.

As such, in August 2014 the LPD&VCC together with other grower leaders, and the SASRI Extension Specialist called for an emergency meeting of growers to put measures in place to attempt to contain the spread and intensification of levels of Eldana in the area (The Link, September 2015).

At the time the dry seasons had also affected most of the South African sugar industry and as a result Eldana was on the increase over a wide area. This led to the need to obtain emergency registration of additional insecticides in an attempt to counter the threat. The active ingredients, chlorantranilliprole and indoxacarb, had proved successful in controlling Eldana in trials and these, together with a synthetic pyrethroid, alpha-cypermethrin, which was already registered, added to the battery of available chemical control options.

It was acknowledged that widespread application of insecticide could provide temporary relief from the problem, but that other longer term strategies such as the planting of more Eldana resistant varieties and the introduction of biological control methods would provide effective long-lasting management of the pest. With this in mind a number of short-term strategies were agreed upon which began with a district-wide scouting programme to determine the extent of the infestation across the area. Growers were required to complete this survey within one month.

At the same time training was arranged for growers and their farm staff to enable them to scout correctly and accurately identify the pest. This was to ensure that all scouting was done in the same manner.

Once the area-wide scouting figures were available, a further meeting was called. These figures showed that an area of approximately 3,000 ha of the following season's (2015/2016) harvest was infested with Eldana. Scouting was carried out in the following year's cane to protect this crop as the then current 2014/2015 crop was to be harvested over the next few months.

As explained above, LPD&VCCs set hazard levels for pests and diseases. In this instance the Local Rules were changed to require the compulsory spraying of infested fields in the event of and presence of Eldana being found. However, above a certain level it was required that the grower harvest the field as it had been found that above this level it would not be possible to effectively contain the pest and that premature harvesting was the only fully effective option to contain the spread of the pest. In the event of a field being sprayed, it had to be shown that the spraying had been effective before permission was granted to keep the field until its planned harvest age.

It was acknowledged that the problem was area-wide and that all growers were affected. A decision was then taken to impose a levy on all growers of an amount of R2.50/tonne of cane delivered to the mill. These funds could then assist growers in treating the infested cane with insecticide.

A spraying program was compiled by SASRI scientists and the local extension specialist where two treatments would be funded by this levy. The two sprays were to target the moth peak periods of Eldana and this would therefore limit the spread and infestation of the pest.

Over the following 4 months the programmes outlined were implemented and through continuous surveys of fields the effectiveness of the measures was evaluated.

Results and discussion

The interventions imposed by the LPD&VCCs led to containment of Eldana across the district as evidenced in Table 2.

Table 2. Hectares requiring spraying interventions

Sep 2014	Dec 2014	Jun 2015	Dec 2015	Aug 2016	Dec 2016	Mar 2017
2634	3120	1500	1200	800	800	780

As a result of careful scouting and appropriate and timely applications of insecticide, Eldana populations were significantly reduced over the time period from September 2014 to March 2017. Growers who for various reasons were unable to treat their cane suffered poor quality and yields. Of the factors that led to the overall success of this programme, the most important was that it was agreed and co-ordinated at area level. The presence of the SASRI extension specialist in the region, a central office and the opportunity for co-ordination this provided was of significant benefit to growers. Access to advice from the extension and subject specialists at SASRI also greatly assisted growers to achieve the success that they did.

Another area of attention during the programme was the removal of all residue from fields which could contain the pest and enable re-infestation to occur. This residue in heavily infested fields was removed and burned or raked and burned in the fields.

In addition, more long-term IPM control strategies, such as habitat management and the planting of resistant varieties were promoted (SASRI 1995).

Growers were encouraged to improve biodiversity and the presence of natural predators of Eldana through planting Eldana attracting or "pull" vegetation on their farms such as *Cyprus dives* and *Cyperus papyrus*. This practice has been shown to reduce Eldana damage in sugarcane.

Currently there are a number of Eldana-susceptible varieties grown in the area, as a result of low pest pressure in the past enabling these varieties to be planted. This possibly contributed to increasing the severity of the recent outbreak of Eldana. As a result of this new threat SASRI has begun to focus on releasing more Eldana-resistant varieties for this particular area with a view to encouraging a more balanced variety disposition across the area.

Summary and conclusions

In summary, the effectiveness of scouting for pests cannot be over emphasised. Effective scouting in this instance enabled growers to make appropiate and timely decisions and provided a very useful early warning of the possible development of problems within fields.

The area-wide approach to pest and disease control used in this programme which involved all growers and support services proved invaluable and contributed significantly to the overall success of the programme. Growers were involved in collective decision-making under the guidance of the LPD&VCC, who together with the SASRI extension specialist provided an effective control centre for the programme.

The decision by growers to levy themselves to fund a spray programme was unprecedented in the South African sugar industry and provided a useful model to other areas to follow in similar circumstances should they require.

With the correct management and effort, this programme showed that a pest incursion can be effectively controlled. In so doing, growers have been able to maintain their 24 month cropping cycle and thereby maintain their economic viability.

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