CURRENT RESEARCH PROGRAMME AGAINST *ELDANA SACCHARINA* WALKER (LEPIDOPTERA : PYRALIDAE)

By A. J. M. CARNEGIE

South African Sugar Association Experiment Station, Mount Edgecombe 4300

Abstract

The current research programme to combat the borer *Eldana saccharina* Walker (Lepidoptera : Pyralidae) is discussed. Topics include aspects of crop management and chemical application, moth behaviour, effects of predators and the field release of egg parasitoids.

Introduction

This paper summarises the current research programme against the pyralid moth borer *Eldana saccharina* Walker, and follows similar papers of recent years (Carnegie[4]).

Management Practices

Research into various aspects of crop management continued because it has been found that certain cultural practices affect eldana numbers (Carnegie[4]).

Pre-trashing

Field trials for studying the effects on eldana of stripping maturing cane of its lower leaves were continued, and the results are presented in a separate paper for this Congress (Carnegie and Smaill[6]). It was found that eldana populations were markedly reduced (approx 30%) and that damage levels also were lowered without yield losses. The thoroughness of the operation made little difference to effects, and there was not much advantage in repeating the operation more than once. A quick removal and dropping of the trash was sufficient to result in a worthwhile reduction in the numbers of borers subsequently recorded.

Nitrogen

A further series of trials was completed on three different soils, in which eldana numbers were assessed in ratoon crops which had received various rates of nitrogen. The three soil forms included are listed in Table 1 together with the results of the trial. Eldana numbers were generally much lower than in the trial reported last year, and trends for an increase in numbers and in damage levels with increasing nitrogen were generally absent. Two of the soil forms (Mayo; Tambankulu) have melanic A horizons and a capacity for high nitrogen mineralization, while the Valsrivier soil form has an orthic A horizon and its nitrogen mineralizing capacity is low. In the latter soil there were clear growth responses up to 180 kg N/ha, and this was accompanied by increases in eldana populations and in damage levels which were not statistically significant.

The analysis of samples of cane grown under different conditions and of wild host plants is continuing. This started as a co-operative project with Natal University, but we are now sending samples for nitrogen and amino acid analysis to Cape Town University and to CSIR in Pretoria.

The objective is to determine to what extent eldana numbers are influenced by the physiological conditions of the host plant.

Varieties

Every opportunity is taken to assess eldana numbers and damage levels from variety trials in affected areas and considerable information is accumulating. A comparison of varietal susceptibility is shown in Table 2, where the num-

TABLE 1

Numbers of *Eldana saccharina* and damage levels under different conditions of nitrogen application and on different soil types

kg N	(4 *R 16 months)		(3 R 18 months)		(4 R 17 months)	
	eldana/100 stalks	% stalks damaged	eldana/100 stalks	% stalks damaged	eldana/100 stalks	% stalks damaged
0	4,9	39,7	6,6	72,3	0,4	40,0
60	2,6	43,1	8,0	74,1	0,9	40,2
120	4,3	44,5	8,9	83,3	1,0	44,6
180	3,6	48,3	11,3	84,2	0,4	38,2
240	6,2	46,6	10,9	83,9	1,1	52,2
300	5,1	50,3	10,3	85,5	1,2	32,6
Soil characteristics						
System	Umzinto coastal lowlands		Umzinto coastal lowlands		Umzinto coastal lowlands	
Parent Material	dolerite		Lower ecca		Lower ecca	
Form	Mayo		Valsrivier		Tambankulu	
Series	Msinsini		<55% Arniston or Chalumna >55% clay		Tambankulu	
A horizon	melanic		orthic		melanic	

* R = ratoon

TABLE 2

Varietal susceptibility to eldana borer, the number of larvae present being expressed as percentage of the number found in variety NCo 376, which is taken as 100

Variety	Measurements as % of NCo 376 eldana
N53/216	38
N8	45
N51/168	58
N7	60
N14	69
CB36/14	84
N6	84
NCo 382	84
N55/805	92
N12	95
NCo 376	100
NCo 310	106
N13	120
NCo 334	120
NCo 339	133
N52/219	225
J59/3	236
N11	236

ber of larvae present in each variety is expressed as a percentage of the number found in variety NCo 376 which is taken as 100.

In addition a project has been started in which choice of variety by the moth and subsequent survival of the larvae will be investigated. Under simulated field conditions eldana moths will be presented with a number of cane varieties on which to ovipost, and any "preferences" will be recorded. Also, in a number of varieties larval survival and infestation effects on their host plant will be studied.

Ripeners

The preference of eldana for older, riper cane has long been appreciated (Girling[7], Carnegie and Smaill[5]) and it is predictable that borer numbers might increase in artificially ripened cane. Such cane is usually treated between six and eight weeks of harvest, a period too short for the completion of a full generation of the borer, but in 1979 it had been observed in a variety trial that eldana numbers increased considerably in a cane row which was treated with ripener (Roundup) and further investigation was considered to be justified.

Preliminary results for a trial to assess effects of two ripeners on eldana populations are shown in Table 3. Results after four weeks showed no noticeable differences between treatments, but in the Polado-treated plots increases in borer numbers and in damage levels occurred as the cane ripened. No marked effects were produced by Ethrel. Eight weeks after treatment an application of 825 g/ha of Polado (a higher rate than the 500-550 normally recommended) produced an increase in eldana numbers significant at the 1% level.

Herbicides

It has been suggested over the years that eldana incidence may be affected by herbicide use. For example herbicides could suppress eldana predators, or could alter the physiology of the cane plant in such a way that it becomes more attractive or more nutritious to the insect, which would then multiply more rapidly. Figures obtained from extensive surveys (Carnegie[4]; Paxton[9]) have proved inconclusive, and it was decided to conduct replicated trials with various herbicides applied to ratooning cane in eldana areas. Of the two trials initiated one had to be abandoned because of drought. In the other, which was completed satisfactorily, the following treatments were applied: hand-weeding at an inefficient level; very efficient hand-weeding; diuron and Actril DS; paraquat + Lasso + atrazine; diuron + Sencor; Velpar + diuron. The site was in the Emoyeni area, treatments were conducted as normally practiced, and eldana populations (which were considerable) were assessed at harvest. There were only small non-significant differences between treatments, with highest numbers being recorded in the inefficiently hand-weeded plots and lowest numbers where a mixture of diuron and sencor had been used.

Further herbicide trials are at present in progress.

Population Monitoring

Light trapping

The use of light traps as a means of monitoring eldana moth populations is included in a separate paper for this Congress (Atkinson[3]). During the last twelve months the existing light trap grid was extended and it now comprises 21 light traps. Most are in Natal but the grid includes traps in the Transvaal, Swaziland and Malawi. Although such projects are long-term, there are already strong indications of seasonal peaks, which correspond with the larval peaks discernible from mill and field summary data.

Pheromones

Studies of eldana mating behaviour (Atkinson[1]) led to the conclusion that the secretion of a pheromone is involved,

TABLE 3

Effects of two ripeners on numbers of *Eldana saccharina* and on damage levels, six and eight weeks after treatment in November (Variety NCo 376 treated at 14 months)

Treatment	6 weeks			8 weeks		
	% stalks damaged	eldana per 100 stalks	% joints bored	% stalks damaged	eldana per 100 stalks	% joints bored
Control	31,8	12,3	3,4	35,2	8,5	3,6
Polado 400 g/ha	39,0	16,0	4,2	42,0	16,8	4,4
Polado 550 g/ha	36,7	15,3	3,9	41,0	13,8	4,5
Polado 825 g/ha	38,3	18,2	3,9	42,2	20,2	4,9
Ethrel 1,5 ℓ/ha	34,7	12,0	3,2	37,3	11,2	3,1
L.S.D. (0,05)	12,8	8,4	1,96	7,98	7,72	1,4

something which has provoked investigations by workers elsewhere (Zagatti[10]). At Mount Edgecombe two small rooms were modified so that illumination and climatic conditions within them could be controlled. One room was lined with gauze onto which moths could climb and in the other a wind tunnel was installed. These rooms were used to test various substances extracted from eldana moths by biochemists of Stellenbosch University, with whom a co-operative project is in progress and to whom we send material. The lack of response by moths to these substances has been disappointing and puzzling, but the co-operative project has been extended for a further year.

Similar eldana extracts received from workers in London were tested in Natal in field cages of various designs, but again there were no encouraging responses. A tentative conclusion is that the sexes meet when walking rather than flying, and that any pheromones produced by eldana do not operate over long distances. Further tests are planned with baited cages which the moth may approach by walking rather than by flying. The cages will be fixed to the upper end of a pole up which the moths may walk, as they might ascend the stalk of a host plant.

A study of the histology of the secretory glands which produce these presumed pheromones has been completed (Atkinson[2]). It was found that the male moth has a ducted gland at the base of each forewing, and secretory tissue with prominent hair pencils on the 8th abdominal segment. Cells which may have a secretory function are located also on the 7th abdominal segment of the female.

Biological Control

During the year experimental field releases were started of *Trichogramma australicum* Girault (Trichogrammatidae) and of *Telenomus* sp. (Scelionidae). The trichogrammatid was mass-reared in the biocontrol unit at the Experiment Station at Mount Edgecombe from a culture brought from Taiwan and with *Sitotroga cerealella* Olivier as a laboratory host. The scelionid was from West African stock and was reared in the biocontrol unit on eggs of eldana. *T. australicum* was released in three heavily infested fields in the Shakaskraal area between August 1981 and January 1982, when the fields were cut. The parasites were usually released twice weekly at average rates of 300 000, 240 000 and 180 000 per week respectively for the three fields. Altogether 11,3 million *T. australicum* were released. *Telenomus* was released in one field at Mtunzini. Far fewer parasites of this species were available because in the laboratory *Telenomus* must be reared on eldana eggs, which are far less copiously produced than are those of *Sitotroga*. *Telenomus* has been released on six occasions, and so far 24 000 parasites have been placed in the field.

Initially both species were released in protective cages which covered growing cane in the field, but subsequently *T. australicum* was released in the open. Four *Telenomus* field cages are still used, and are of a type of gauze through which the parasites may pass but which will contain the eldana moths which are placed in the cages to oviposit.

The success of the operation cannot be assessed by recovering the parasites in feral eggs because these are almost impossible to find. Instead, eldana eggs which are laid in the laboratory on cane trash are deliberately placed in the vicinity of the release sites, and subsequently collected and examined for parasitization. So far very few recoveries have been made, but it is still too early in the programme to pass judgement on the success or otherwise of the operation, which may well require several years to prove itself.

Very recently experimental releases of a West African *Trichogramma* species have been started in the Tongaat area, and this programme follows the methods used for *T. australicum*. A further West African egg parasite (*Trichogrammatoidea eldanae*) will be field tested when numbers become sufficient.

The supporting culture of *Sitotroga cerealella* received a severe set-back when it was invaded by the parasitic pteromalid wasp *Habrocytus* sp. A separate uncontaminated culture has now been started, and the culture of an alternative laboratory host *Ephestia kuehniella* Zell has been expanded.

A small stock of the West African fly *Descampsina sesamiae* Mesnil has been received from which it is hoped to establish a strong laboratory culture with a view to field releasing.

The identification of eldana predators, including the use of serological techniques continues, and forms the subject of a paper for this Congress (Leslie[8]).

Chemical Control

Work on insecticidal control has centred on attempts to reduce eldana damage in young ratooning cane, insecticide application methods in mature cane, and in laboratory bioassay techniques.

It was noted that during periods of drought, possibly as a result of premature ripening, comparatively young cane became severely damaged by eldana. In the course of two series of trials the following chemicals were tested against eldana in young ratooning cane: chlorpyrifos; parathion; gamma BHC; oxamyl; carbofuran; aldicarb; chlormefos; terbufos; endosulfan; monocrotophos; azinphos-ethyl; phoxim; fenamiphos; isofenphos. Results were assessed in terms of borer numbers and damage levels. None of the chemicals gave a satisfactory level of control. The systemic nematicide oxamyl was tried also on mature and on young cane, again without effect.

These results confirm previous findings that eldana borer is not easily controlled with chemicals once it has entered the cane stalk. The stages of the life cycle which are exposed are the adult, egg and first larval instar, and further attention is now being paid to their chemical control. However dusts rather than liquid formulations are being used, and are aimed at the lower parts of the cane plants. The best application method appears to be the use of a motorized mistblower adapted for dusting.

The design and construction of suitable laboratory bioassay equipment has received considerable attention, and a programme of quick and precise insecticide screening is now in progress.

Conclusion

No single factor can be identified as having a critical effect on eldana numbers, but investigatory work is showing that eldana populations may be influenced by a number of factors, some of which may be controllable. The practice of pre-trashing can reduce the size of eldana populations. Some cane varieties tend to support larger numbers of eldana than do others, although all our commonly grown varieties are susceptible. Numbers of eldana have been shown to increase following application of ripeners. The

direct or indirect effects of nitrogen on eldana numbers are receiving further attention.

Light traps for monitoring eldana populations and the testing of various presumed pheromones are showing progress, and the programme is being developed further.

The biological control programme progresses satisfactorily and there are several candidate parasites which show some promise.

Insecticide application methods and laboratory bioassay deserve further investigation.

REFERENCES

1. Atkinson, P. R. (1981). Mating behaviour and activity patterns of *Eldana saccharina* Walker: (Lepidoptera: Pyralidae) *J ent Soc sth Afr* 44, **2**: 265–280.
2. Atkinson, P. R. (1982). Structure of the presumed pheromone glands of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). *J ent Soc sth Afr* 45, **1**:
3. Atkinson, P. R. (1982). Phenology of *Eldana saccharina* Walker in Natal and the use of light traps to monitor the distribution and abundance of the insect. (In press).
4. Carnegie, A. J. M. (1981). Combating *Eldana saccharina* Walker: a progress report. *SASTA Proc* **55**: 116–119.
5. Carnegie, A. J. M. and Smaill, R. J. (1980). The incidence of moth borers in South African sugarcane during the 1979/80 season: *SASTA Proc* **54**: 154–157.
6. Carnegie, A. J. M. and Smaill, R. J. (1982). Pre-trashing as a means of combating the borer *Eldana saccharina* Walker. (In press).
7. Girling, D. J. (1971). *Eldana saccharina* Walker (Lepidoptera: Pyralidae), a pest of sugarcane in East Africa. *ISSCT Proc* **14**: 429–434.
8. Leslie, G. W. (1982). A study of egg predators of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). (In press).
9. Paxton, R. H. (1982). Eldana borer (*Eldana saccharina*): the results of mill and field history surveys. *SASTA Proc* **56**: (In press).
10. Zagatti, P. (1981). Comportement sexuel de la pyrale de la canne à sucre *Eldana saccharina* (Wlk) lié à deux phéromones émises par le male. Behaviour 78: 88 pp 81–97.