

# A STUDY OF EGG PREDATORS OF ELDANA SACCHARINA WALKER (LEPIDOPTERA : PYRALIDAE)

By G. W. LESLIE

South African Sugar Association Experiment Station, Mount Edgecombe 4300

## Abstract

The insecticide exclusion technique and a serological technique called cross-over electrophoresis were used in a study of the egg predators of the sugarcane borer *Eldana saccharina* Walker. Results of the insecticide exclusion trial showed that, in untreated plots, approximately 60% of eggs artificially positioned on sugarcane stalks were destroyed. Ants belonging to the genera *Paratrechina* and *Solenopsis* were associated with damaged eggs as were a species of mite and a species of thrips. The serological technique was used to examine the stomach contents of 4 373 arthropods for the presence of eldana egg protein. The arthropods tested were collected from sugarcane in two areas: one where eldana numbers were high, and one where numbers were low. The results showed that predation was greatest where eldana numbers were high and that mites, cockroaches and ants were the more frequent egg predators. Overall the level of predation was low. Only 1% of all arthropods tested gave positive results. This discrepancy between the results of the insecticide exclusion trial and those of the serological tests may be attributed to the ease with which predators located the eggs in the insecticide exclusion trial.

## Introduction

Predation can be an important factor in regulating numbers of a pest. The life cycle of the borer *Eldana saccharina* Walker includes egg and early larval stages which are exposed and therefore more vulnerable to predation than are the subsequent larval and pupal stages, which are well protected by the plant tissue and by the pupal case. The work reported here concerns predators of eldana eggs only. Larval predators have been investigated and reported by Leslie and Boreham<sup>7</sup>. Two techniques were used in this study: insecticide exclusion, and a serological technique called cross-over electrophoresis. The former was first employed by De Bach<sup>2</sup> and relies on insecticides to exclude predators from treated areas. The response of the pest to predator removal is then monitored. Such a technique provides a general idea of how the arthropod community may influence a pest population. Cross-over electrophoresis was first developed for predator/prey studies by Healy and Cross<sup>5</sup> and Sergeeva<sup>8</sup>.

This type of serological test relies on the mobility of proteins in an electric field. The antigen protein, usually the stomach contents of a suspected predator, migrates to the anode because of its negative charge. The antibody protein, being positively charged, migrates to the cathode. Thus in an electric field and under appropriate conditions, these two components of a serological reaction migrate towards one another. If the predator under test has consumed eldana protein, an antigen/antibody precipitate is formed, which does not happen if no eldana protein is present. The antibodies used in such tests are produced by inoculating rabbits with prey protein.

## Methods

### Insecticide exclusion trial

This trial comprised four blocks, each of which was divided into a treated and an untreated plot approximately 10 m<sup>2</sup>. Each experimental plot was surrounded by guard plots of equal area. Two insecticides were used: malathion and dieldrin applied at 21 kg/ha and 4 kg/ha respectively. Dieldrin was

applied to the ground and lower parts of the stools, while malathion was applied to the cane stalks only. The treatment was repeated one week after the first application.

Counted cohorts of eldana eggs were placed behind dead leaf sheaths of six cane stalks in each plot. The eggs were recovered three days later and examined for evidence of predation, an exercise which was repeated five times.

### Cross-over electrophoresis

Eldana eggs were crushed in a large volume of saline, refrigerated at 4°C for 24 hours and centrifuged at 5 000 rpm for ten minutes. The supernatant was freeze-dried and subsequently dialysed against several changes of 0,85% saline. The volume was adjusted to give a protein concentration of 30 mg protein/ml. Rabbits were inoculated with this antigen solution following the method of Boreham and Gill.<sup>1</sup> An anti-serum which gave a high homologous titer\* was obtained.

Suspected predators were collected from areas where eldana damage to sugarcane was heavy and where it was slight. Surveys showed that in these two regions (called A and B) numbers of eldana larvae per 100 stalks were between 50-60 and 1-5 respectively. It was assumed that the abundance of eggs was related to the abundance of larvae.

## Results

### Insecticide exclusion trial

The results of five experiments are shown in Table 1. From untreated plots an average of 39,8% of eggs placed out were recovered. From treated plots an average of 81,0% were recovered.

### Serological testing of arthropod stomach contents

(a) *Testing the antiserum.* The antiserum obtained against eldana eggs was tested for cross-reactions to various stages of this insect as well as to stages of other Lepidoptera associated with sugarcane. Results are shown in Table 2. All cross-reactions were either reduced to acceptable levels or eliminated by diluting the antiserum 1:7 with 0,85% saline. Such a dilution did not reduce the homologous titer.

(b) *Results of tests for eldana egg predators.* The results of tests for eldana egg protein conducted on stomach contents of 4 373 arthropods are shown in Table 3. Of these, 2 351 were collected from Region A and 2 022 from Region B.

TABLE 1  
Recovery of eggs from insecticide exclusion trial

Experiment number	1	2	3	4	5
% Eggs recovered from treated plots	87,9	72,9	77,9	78,9	87,6
% Eggs recovered from untreated plots	37,9	23,7	43,3	62,2	31,9
Difference	50,0	49,2	34,6	16,7	55,7
LSD at 0,05% level	42,9	9,8	33,1	16,8	10,9

\* The titer of an antiserum is the highest dilution of it which gives a positive reaction.

**TABLE 2**  
Cross reaction tests of undiluted *E. saccharina* egg antiserum

Reacting antigen	Antigen dilution											
	1/10	1/20	1/40	1/80	1/160	1/320	1/640	1/1280	1/2560	1/5120	1/10240	1/20480
<i>E. saccharina</i> egg	+	+	+	+	+	+	+	+	+	+	+	+
<i>E. saccharina</i> larvae	+	+	+	+	+	+	+	+	+	+	+	+
<i>E. saccharina</i> adult	+	+	+	+	+	+	+	+	+	+	+	+
<i>S. calamistis</i> egg	+	+	+	+	+	NOT TESTED FURTHER						
<i>S. calamistis</i> larvae	+	+	+	+	+	+	+	+	+	+	+	+
<i>Chilo</i> sp. larvae	+	+	+	+	+	+	+	+	+	+	+	+
<i>Mythimna</i> sp. larvae	+	+	+	+	+	+	+	+	+	+	+	+
Oenophilid larvae	+	+	+	+	+	+	+	+	+	+	+	+

**Cross reactions of diluted *E. saccharina* egg antiserum**

Reacting antigen	Antigen dilution											
	1/10	1/20	1/40	1/80	1/160	1/320	1/640	1/1280	1/2560	1/5120	1/10240	1/20480
<i>E. saccharina</i> egg	+	+	+	+	+	+	+	+	+	+	+	+
<i>E. saccharina</i> larvae	+	+	+	+	+	+	+	+	+	+	+	+
<i>E. saccharina</i> adult	+	+	+	+	+	+	+	+	+	+	+	+
<i>S. calamistis</i> egg	+	+	+	+	+	+	+	+	+	+	+	+
<i>S. calamistis</i> larvae	+	+	+	+	+	+	+	+	+	+	+	+
<i>Chilo</i> sp. larvae	+	+	+	+	+	+	+	+	+	+	+	+
<i>Mythimna</i> sp. larvae	+	+	+	+	+	+	+	+	+	+	+	+
Oenophilid larvae	+	+	+	+	+	+	+	+	+	+	+	+

**TABLE 3**  
Results of tests to detect *E. saccharina* egg predators

Arthropod type	Region A				Region B			
	No. -ve	No. +ve	Total	% +ve	No. -ve	No. +ve	Total	% +ve
Coleoptera larvae	21	0	21	0	3	0	3	0
Coleoptera adults	201	2	203	1,0	88	1	89	1,1
Blattaria								
Type 1	37	1	38	2,6	0	0	0	0,0
Type 2	6	0	6	0,0	3	0	3	0,0
Type 3	20	1	21	4,8	1	0	1	0,0
Heteroptera	44	0	44	0	26	0	26	0
Homoptera	89	0	89	0	38	0	38	0
Acarina								
Type 1	115	1	116	0,9	76	0	76	0,0
Type 2	133	10	143	7,0	189	6	195	3,1
Type 3	40	1	41	2,4	0	0	0	0,0
Saltatoria								
Type 1	20	0	20	0	32	0	32	0
Type 2	32	0	32	0	1	0	1	0
Type 3	12	0	12	0	12	0	12	0
Type 4	4	0	4	0	0	0	0	0
Formicidae								
<i>Pheidole</i> sp.	630	2	632	0,3	582	1	583	0,2
<i>Paratrechina</i> sp.	12	0	12	0	482	7	489	1,4
<i>Solenopsis</i> sp.	109	1	110	0,9	0	0	0	0
<i>Dorylus</i> sp.	219	0	219	0	0	0	0	0
<i>Polyrhachis</i> sp.	4	0	4	0	0	0	0	0
<i>Plagiolepis</i> sp.	3	0	3	0	6	0	6	0
<i>Crematogaster</i> sp.	56	0	56	0	1	0	1	0
<i>Acantholepis</i> sp.	36	0	36	0	58	0	58	0
<i>Aenictus</i> sp.	29	6	35	17,1	0	0	0	0
<i>Campanotus</i> sp.	0	0	0	0	184	0	184	0
Araneida	251	0	251	0	158	0	158	0
Chelonethida	18	0	18	0	41	0	41	0
Scorpionida	0	0	0	0	5	0	5	0
Chilopoda	3	0	3	0	6	0	6	0
Isopoda	20	1	21	4,8	0	0	0	0
Collembola	152	4	156	2,6	0	0	0	0
Dermaptera	0	0	0	0	2	0	2	0
Diptera	5	0	5	0	2	0	2	0
Pscoptera	0	0	0	0	11	0	11	0
<b>Totals</b>	<b>2 321</b>	<b>30</b>	<b>2 351</b>	<b>1,3</b>	<b>2 007</b>	<b>15</b>	<b>2 022</b>	<b>0,7</b>

### Discussion

The results from the insecticide exclusion trial show that in four of the five trials significantly more eggs were recovered from the treated plots, and it is assumed that this reflects the effect of the insecticide treatment. Which arthropods were most severely affected could not be ascertained, but it is likely that they would have been ground-dwelling foragers. Flying arthropods would have been least affected.

In the process of recovering egg samples two species of ant, *Paratrechina* sp. and *Solenopsis* sp., as well as a species of mite and a species of thrips were observed feeding on the egg masses in untreated plots. The association of ants with destroyed eggs is important. Because of the large numbers of ants in sugarcane fields their impact as egg predators could be considerable.

The serological method is considered one of the more reliable tests for predator identification, its main advantage being that the predator locates and eats the prey in its natural environment.

The results of testing arthropods collected from Region A show that mites, cockroaches and collembolans were the more frequent predators. The percent positive tests recorded were 4,0; 3,1 and 2,6 respectively. The very abundant ant genera *Pheidole* and *Paratrechina* showed 0,3 and zero percent of those tested to be positive. The ant genus *Solenopsis* showed 0,9% of those tested to be positive confirming the identification in the exclusion trial of this type of ant as an egg predator. It is interesting to note that six positive tests were recorded from a small sample of 17 individuals of the ant genus *Aenictus*. Another member of this group (known as the driver ants) was recorded by Leslie and Boreham<sup>7</sup> as a frequent larval predator.

In Region B positive tests were recorded from mites and from the ant genera *Paratrechina* and *Pheidole* (2,2; 1,4 and 0,2 respectively).

Predation on eldana eggs was greatest where host numbers were high, but the overall level of predation was low. The number of positive tests recorded from Region A was only 1,3% of the total number conducted, and the level in Region B was lower. Only 0,7% of those arthropods tested proved positive. Data from Leslie and Boreham<sup>7</sup> on predation of eldana larvae showed that the level of predation reflected larval abundance. The percentages of positive results obtained were 11,8 and 2,9 from high density areas and low density areas respectively.

Thus the level of predation on both eldana eggs and larvae seems to depend on the density of the pest. Because the serological data cannot be quantified, percent positive or negative results must be interpreted with caution. There is as yet no way of showing that a strong positive reaction to egg antiserum for example, represents a fresh feed on one egg or an old feed of several eggs. However, fewer positive results were recorded for egg predators than for larval predators, which implies lower predation on eldana eggs.

The insecticide exclusion trial showed that over a three day period as many as 60% of eggs were removed by predators.

However, the serological results show that egg predation as determined by the number of positive tests, is low. This difference may be explained by the fact that the egg batches in the exclusion trial were positioned artificially. Despite efforts to conceal the eggs in the same manner as the moth does, they may have been located by predators with relative ease. Previous studies of eldana predators do suggest that naturally concealed eggs are less likely to be attacked by predators. Dick<sup>3</sup> observed that under artificial conditions predation of all stages of eldana by a species of ant occurred. Girling<sup>4</sup> noted heavy predation of artificially-placed eldana eggs on maize plants. However, he stated that some naturally laid eggs may escape detection by predators.

Overall the results show that mites, cockroaches, ants and collembolans are the more frequent predators of eldana eggs.

In a review Hinton<sup>6</sup> includes in a list of egg predators 21 species of mites, nine species of ants and two species of collembolans. No record is cited of egg predation by cockroaches. However, laboratory observations on eldana eggs which were exposed to cockroaches have shown that they will eat them. The single positive result obtained from the isopods tested reflects an accidental feed. This was probably brought about because the egg laying sites chosen by eldana moths form part of the habitat frequented by these arthropods. No positive results were recorded from the spiders tested, which is to be expected since spiders usually attack mobile prey.

### Conclusions

Arthropods that are associated with sugarcane have been shown to eat both artificially positioned eldana eggs and those which have been laid naturally. The level of egg predation shown in the insecticide exclusion trial was probably artificially high because of the ease with which the eggs were detected by predators. The more important predators of eldana eggs include mites, cockroaches, ants and collembolans.

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