THE INFLUENCE OF DEAD LEAF MATERIAL ON THE OVIPOSITION BEHAVIOUR OF *ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE) IN SUGARCANE

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Abstract

Choice of oviposition sites by *Eldana saccharina* Walker was examined by releasing moths, labelled with ^{32}p, into large field cages. In each of several cages the dead leaf material of the enclosed sugarcane had been manipulated in different ways. Treatments, which occurred in pairs, comprised the following: pre-trashed and nonpre-trashed sugarcane; nonpre-trashed sugarcane with and without litter; pre-trashed sugarcane with the litter shifted to the nonpre-trashed half of the cage; and finally the removal of dead shoots from half of the cage. Oviposition preference was determined by searching for egg batches with portable Geiger counters. Ovipositing females tended to select those treatments having the greatest abundance of dead leaf material. Within such treatments the litter was frequently the most favoured oviposition site. A possible role for the manipulation of dead leaf material as a control measure is considered.

Introduction

Eldana saccharina moths preferentially select dead leaf material as an oviposition substrate (Leslie[3]). Moreover, recovered batches are associated with the lower third of stools where such material is most abundant. It has not been clear however, where the preferred oviposition site would be if females were given a choice. To examine this, the abundance and type of dead leaf material was experimentally manipulated.

E. saccharina females labelled with ^{32}p were released into field cages. The cages enclosed sugarcane that was treated in different ways, in order to offer simultaneously two choices of oviposition substrate. Notes were made also on egg predation in the cages.

Materials and Methods

Experimental procedure comprised three stages: obtaining females labelled with ^{32}p; the field release of labelled females; and the sampling of field cages.

Obtaining labelled females

The details of this procedure have been given in Leslie.[3] Briefly, larvae were fed individually on 10 ml volumes of an artificial diet containing 1 μCi/mℓ of ^{32}p. Resultant moths were mated in the laboratory before being released into the field cages.

Field releases

Shade cloth cages (6 x 6 x 3m, 40% shade) were placed in a field of 10-month-old sugarcane, six rows per cage. Each cage enclosed two treatments, which were repeated up to three times and were as follows:

Pre-trashed versus sugarcane that was not pre-trashed (nonpre-trashed); nonpre-trashed sugarcane with litter placed in half of the cage; half the sugarcane pre-trashed but with the litter removed from this half and placed in the nonpre-trashed half of the cage; and lastly the removal of dead shoots from nonpre-trashed sugarcane, but retaining them in the pre-trashed half of the cage. Twelve cages were prepared and approximately 30 mated females were released in the centre of each cage. Moths were released over a period of two days and sometimes three days.

Sampling in cages

Sampling in cages commenced four days after the last release of labelled females. The contents of the cages were systematically scanned for egg batches and moths with portable Geiger counters. When detected, the position and height of a batch or moth was recorded and the specimen collected. The amount of predation on eggs was assessed in the laboratory.

Results

Recovered egg batches were recorded as being in one of three positions: in the litter, in or behind leaf blades or sheaths attached to stalks, or on dead shoots. Moths were most frequently recovered from the litter or towards the base of stalks.

The number and position of batches recovered in the various experiments are given in Table 1. In the first experiment comparing pretrashed and nonpre-trashed sugarcane, 62% of the recovered batches came from the pre-trashed half of the cages. Of those from the pre-trashed half, 60% were recovered from the litter. Where the sugarcane was not pre-trashed 48% of batches were recovered from dead shoots and only 15% from the small quantity of litter present; the field having been burnt at the previous harvest.

In the second experiment, where litter was added to half the interrows of nonpre-trashed sugarcane, 60% of all batches recovered were from those halves of cages where litter was present. The percentage recoveries from litter, leaves attached to stalks and dead shoots were 31%; 41% and 28% respectively. Where no litter had been placed in the interrows, 56% of batches were recovered from behind leaves attached to stalks; 31% of batches were located on dead shoots while 13% were found on what litter was present.

In experiment 3, substantial quantities of dead leaf material were contrasted with very little. Here 74% of batches were recovered from those treatments with more abundant dead leaves. In these halves of the cages, 60% of batches were located in the litter, 25% on dead shoots and only 15% on leaves attached to stalks. In those halves of the cages where little dead leaf material was available, most of the few recovered batches (68%) were found on what litter was available.

The final experiment comprised an attempt to examine the role of dead shoots in the selection of oviposition sites; the shoots were removed from nonpre-trashed sugarcane but retained in pre-trashed sugarcane. Females displayed little

Table 1

The number, (percentage) and position of egg batches recovered in the four experiments

Experiment Type	Trial Number	Number of Mated ♀♀ Released	Treatment	Position of Recovered Batches: Dead Shoots	Dead Leaves on Stalks	Litter	Totals Means and S.E.	Treatment	Position of Recovered Batches: Dead Shoots	Dead Leaves on Stalks	Litter	Totals Means and S.E.
(1) Half the sugarcane pre-trashed (PT) and half not pre-trashed (NPT)	1	38	PT	0 (0)	12 (17)	25 (35)	37	NPT	11 (16)	8 (11)	5 (7)	24
	2	30		2 (2)	23 (21)	39 (36)	64		20 (19)	19 (18)	5 (5)	44
	3	30		0 (0)	19 (33)	20 (35)	39		10 (18)	5 (9)	3 (5)	18
			Totals: Grand Total	2 140	54	84	x̄: 46,7 se: 8,7	Totals: Grand Total	41 86	32	13	x̄: 28,6 se: 7,9
(2) Sugarcane not pre-trashed (NPT) and litter (L) placed in half the interrows	1	30	NPT+L	17 (16)	20 (19)	15 (14)	52	NPT−L	24 (22)	27 (25)	5 (5)	56
	2	30		15 (20)	24 (31)	11 (14)	50		11 (14)	13 (17)	3 (4)	27
	3	39		5 (5)	29 (26)	24 (22)	58		8 (7)	35 (32)	10 (9)	53
	4	38		44 (32)	34 (25)	24 (17)	102		11 (8)	21 (15)	4 (3)	36
			Totals: Grand Total	81 262	107	74	x̄: 65,5 se: 12,3	Totals: Grand Total	54 172	96	22	x̄: 43,0 se: 6,9
(3) Half the sugarcane pre-trashed but the litter removed (PT−L) and placed in the non pre-trashed section (NPT+L)	1	25	NPT+L	13 (18)	12 (16)	27 (37)	52	PT−L	0 (0)	0 (0)	21 (29)	21
	2	24		4 (9)	5 (11)	20 (43)	29		0 (0)	3 (6)	15 (32)	18
	3	30		25 (23)	8 (8)	53 (50)	86		0 (0)	16 (15)	5 (5)	21
			Totals: Grand Total	42 167	25	100	x̄: 55,7 se: 16,6	Totals: Grand Total	0 60	19	41	x̄: 20,0 se: 1,0
(4) Pre-trashed sugarcane with dead shoots intact (PT+S) and unpre-trashed sugarcane with dead shoots removed (NPT−S)	1	30	PT+S	17 (18)	10 (11)	24 (25)	51	NPT−S	2 (2)	37 (39)	5 (5)	44
	2	23		13 (14)	11 (12)	22 (23)	46		0 (0)	32 (33)	18 (19)	50
			Totals: Grand Total	30 98	21	46	x̄: 48,5 se: 2,5	Totals: Grand Total	2 94	69	23	x̄: 47,0 se: 3,0

Table 2

The total number and (percentage) of egg batches attacked by predators in different positions and the average percentage of eggs eaten in four experiments

Experiment Number	Number of Trials	Treatment	Total Number of Batches Attacked on:- Dead Shoots	Leaves Attached to Stalks	Litter	Total	Average Percentage of Eggs Eaten x̄	SE	Treatment	Total Number of Batches Attacked on:- Dead Shoots	Leaves Attached to Stalks	Litter	Total	Average Percentage of Eggs Eaten x̄	SE
1	3	PT	1 (1)*	20 (23)	29 (33)	50 (58)	7.0	1.6	NPT	17 (20)	14 (16)	6 (7)	37 (42)	5.3	0.7
2	4	NPT+L	14 (13)	28 (26)	13 (12)	55 (51)	3.5	1.0	NPT−L	8 (8)	39 (37)	6 (6)	52 (49)	2.8	1.1
3	3	NPT+L	9 (14)	14 (21)	26 (39)	49 (74)	6.0	1.0	PT−L	0 (0)	6 (9)	11 (17)	17 (26)	6.7	4.7
4	2	PT+S	8 (13)	5 (8)	13 (21)	26 (42)	6.0	3.0	NPT−S	0 (0)	27 (44)	9 (15)	36 (58)	9.5	2.5

* Values are calculated from the number of attacked batches recovered from various positions expressed as a percentage of the total number of batches attacked.

preference for one or other of the treatments. Differences within treatments largely followed the availability of one or other of the oviposition substrates. For example where few dead shoots were available, leaves on stalks or litter were selected; in pre-trashed sugarcane where few leaves remained attached to stalks, litter or dead shoots were commonly selected.

Routine observations were made on egg predation. Table 2 shows the number and percentage of batches attacked in the various treatments of the four experiments. The position of batches which were attacked varied between treatments with no consistent pattern. Where litter was present and dead leaf material was more abundant, the number of batches attacked was greater. However the percentage of eggs eaten varied little between treatments (Table 2).

Discussion

The results show that when given a choice females will select the treatment having the greater quantity of dead leaf material. This is clearly shown in experiment 3 where abundant dead leaf material was contrasted with very little. Here 74% of recovered batches were located where dead leaf material was most common. Litter itself seems to be attractive to ovipositing females. In both experiments one and two, more batches were recovered from those treatments where litter was present. This is shown most clearly in experiment 1 where the distribution, not the abundance, of dead leaf material differed between treatments. Here litter was frequently selected as an oviposition site.

Although in these experiments females selected a range of oviposition sites, there were two consistent features of all such sites. Batches were concealed between two surfaces and only dead plant material was selected. This is in contrast with the findings of Sampson and Kumar.[4] Their study of *E. saccharina* in southern Ghana showed that, in a field cage, 77% of recovered batches were associated with green sugarcane leaves while only 20% of batches were recovered from dead leaves. Because they used young sugarcane plants (of unspecified age) it is likely that there was proportionately little dead leaf material available for the females to select. Possibly in situations where green leaf material is more abundant, females may use it more frequently as an oviposition substrate.

It is not clear why ovipositing females should select the treatments having greater quantities of dead leaf material. Possibly there is an initial response to kairomones and subsequent oviposition is mediated by thigmotactic and textural stimuli. Interestingly a preliminary laboratory study showed that ovipositing females tended to select unwashed dead leaf material in preference to similar water washed material suggesting that kairomones may be involved.

Egg predation varied between treatments and no pattern was evident. However there was an indication that where dead leaf material was more abundant, a greater percentage of batches were attacked. This may indicate the propensity of egg predators to frequent treatments where dead leaf material is more abundant. Such results are however, difficult to interpret, since little is known about the foraging behaviour of predators in sugarcane, and how this is influenced by the manipulation of dead leaf material.

Since the attraction of various types of dead leaf material to ovipositing females has been demonstrated, consideration might be given to manipulating it in such a way as to increase the mortality of *E. saccharina*. Litter could be left in the interrow and around the base of stalks as in pre-trashed sugarcane, or it could be piled up at strategic points in fields, or it could be windrowed.

Pre-trashing, is an effective practice in reducing infestations of *E. saccharina* (Carnegie and Smaill[1]) and populations of this pest may be reduced by as much as 37% by pre-trashing. Strategic piles of litter in fields could be useful in acting as a trapping material. Piles could be periodically destroyed and replaced to enhance their effectiveness or could be sprayed at intervals with an insecticide. Windrowing litter could be as effective as the previously mentioned practices. However there would be a risk of the crop growing through or near the windrows being severely damaged by the pest or by trash caterpillars.

Dead leaves on stalks were frequently selected as oviposition sites. Even when most of such material was removed by pre-trashing, the remaining residue was often used by ovipositing females. Self trashing varieties may be useful in that the number of such oviposition sites (behind closely fitting dead leaf sheaths) would be reduced. This may encourage moths to select alternative less suitable sites. Cochereau[2] found that the self-trashing variety Ragnar was less severely attacked by *E. saccharina* than other varieties grown in the Ivory Coast.

It is probably not possible to manipulate the abundance of dead shoots effectively. Reducing their number may encourage the moth to select alternative sites. If such sites were on stalks, there could be increased survival of eldana larvae.

Conclusion

Because *E. saccharina* moths preferentially select dead leaf material as oviposition sites, there are options which, either separately or in suitable combinations, could enable dead leaf material to be manipulated to such an extent that increased mortality of eggs or young larvae could be expected. The experience with pre-trashing has demonstrated the effect this type of manipulation can have on *E. saccharina*.

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