NOTES ON SUGARCANE TRASH CATERPILLARS (NOCTUIDAE) AND EFFECTS OF DEFOLIATION ON THE CROP

By A.J.M. CARNEGIE and J. DICK
South African Sugar Association Experiment Station

Abstract

At least 7 species of Noctuid moths have been reared from caterpillars collected beneath trash in cane fields, and some at least feed at night on leaves of young ratooning sugarcane, the chief offender being *Mythimna phaea* Hamps. Feeding appeared to be initiated by onset of darkness, but a reduction in numbers feeding occurred before dawn. Natural enemies included 6 Tachinid flies, an Ichneumonid wasp, a species of *Entomophthora* and what appeared to be a polyhedral virus. Insecticide trials showed that, despite the trash blanket's protective covering, a measure of control was achieved with the following insecticides:- Endosulfan, DDT, carbaryl, *Bacillus thuringiensis*. The moths have been caught in light traps, which may have some practical application as indicators of forthcoming infestations Artificial defoliation could cause a reduction in yield of 18,6 tons cane per hectare, accompanied by reduction in size of internodes.

Introduction

The term trash caterpillar is applied to the larval stage of various Noctuid moths, which have been associated with partial or complete defoliation of young ratooning sugarcane.

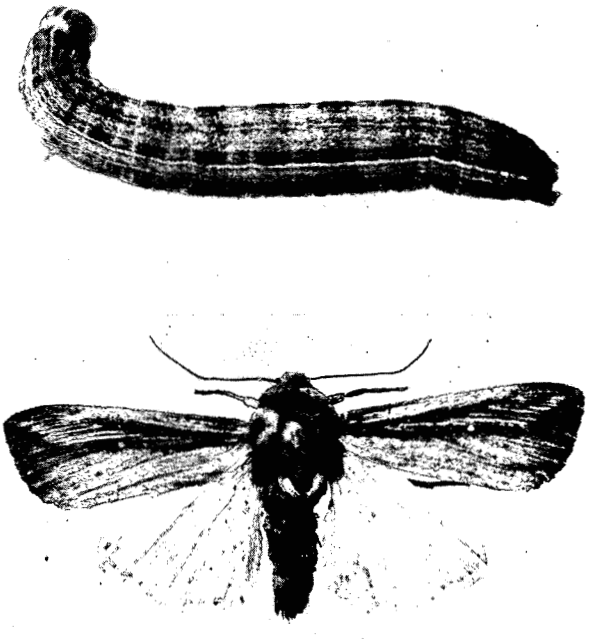


Fig. 1 Trash caterpillar *(Mythimna sp.)* and adult moth.

Fig. 2 Young ratoons damaged by trash caterpillars.

The problem is restricted almost entirely to areas where trashing rather than burning has been practised; i.e. after cutting, the trash is removed unburnt from the crop and spread as a blanket or placed along the interrows as a surface mulch. This affords cover under which the caterpillars, which are nocturnal in habit, may shelter during the day, emerging at night to feed. The trash blanket shelters the caterpillars and pupae from many natural enemies, adverse climatic conditions, and from insecticides. Susceptible fields are mainly in non-irrigated coastal areas of Natal, although outbreaks have been recorded in Swaziland and in the eastern Transvaal, when the presence of incompletely burnt trash and cane tops afforded sufficient shelter for the caterpillars.

Trash caterpillars are indigenous grass-inhabiting insects, and attack sugarcane only between May and late November, during which period cutting is in progress and young ratooning cane is available. Ratoons are attacked only during the first few months of growth. With the advent of early summer rains and warm weather there is an increase in natural control and outbreaks cease.

The adult moths, which are probably capable of flying considerable distances, oviposit on the trash or on leaves of young ratooning cane. Approximately 500 eggs may be laid by one female, and these hatch within about 10 days to produce the first stage caterpillars. The larval stage, which includes 6 instars, lasts about 4 weeks and the mature caterpillar pupates just below the soil surface, where the pupa remains for about 2 weeks before the adult moth emerges.

During the past few years, interest in trash caterpillars has increased, and investigation of their bionomics has been undertaken. In reporting on this work it was considered appropriate to include a section dealing with earlier work on the effects of defoliation.

Species Involved

The taxonomy of this group requires clarification, and in recent years several name changes have occurred. Until recently it was thought that one, or possibly two species were involved. However, during the past two seasons, field-collected caterpillars have been reared to the adult stage in the insectary and it appears that at least 7 species are involved. The following species have been identified by the British Museum: *Mythimna phaea* Hamps., *M. polyrabda* Hamps., *Borolia longirostris* Berio, *Proxenus xantholopha* Hamps., *Simplicia extinctalis* Zell., *Aethetis ignava* Gn. and *Elydna* sp. Further identifications are awaited, and it is probable that one or two additional species are involved.

The chief offender appears to be *Mythimna phaea* (referred to also as *Cirphis, Leucania* and *Pseudaletia*), and in field infestations and insectary cultures this caterpillar has proved to be the most damaging. *Mythimna* spp. and *Borolia* spp. feed on the living cane leaves, but the other species appear to feed mainly among the decaying trash.

It is not possible, at this stage, to separate the different species conclusively by larval features alone. There are 3 obviously different groups of caterpillars, although within these groups more than one species may occur. For insectary cultures, field-collected caterpillars were separated into "trash caterpillars" and "other species", the former group including most species which actually eat the growing leaves and consisting mainly of the species *Mythimna phaea.*

Feeding Behaviour

Observations both in the field and in the insectary suggest that, unless the caterpillars are parasitised or diseased, feeding above the trash blanket does not occur during daylight hours. If the trash blanket is parted, in a field where feeding has occurred, the dormant and curled-up caterpillars may be found at the bases of the cane plants, and some may enter cracks in the ground. When thus exposed to daylight, the caterpillars remain immobile for a varying period, then set off hastily for the nearest cover.

If disturbed while feeding at night, either manually or by bright artificial light, they will drop from the plants into the trash.

Insectary observations were made on field-collected caterpillars which were caged on growing cane plants. The cane grew in plastic trays let into the floors of glass-sided cages (150 x 75 x 40cm) which were covered with gauze on the top. A thick layer of trash was distributed over the cage floors. Numbers feeding were noted at intervals during the night and light intensity was estimated by means of a photographic light meter. Moon phase was between new moon and first quarter, and moonlight was negligible.

Initiation of feeding appeared to be dependent on the onset of darkness, for it was found that, in darkened insectary cultures, caterpillars would feed during the day. However, nocturnal observations suggested that curtailment of feeding could occur independently of light conditions, for numbers feeding at night decreased before the onset of daylight as shown in Table 1.

With *Mythimna* sp. (probably *M. phaea)* feeding began shortly after dark, and highest numbers were recorded during the very early morning. Numbers feeding began to decrease before any change in light conditions was noted. By the time the first signs of dawn were visible, a definite downward movement into the trash cover was apparent, although the insectary was in complete darkness. By the time there was sufficient light to register on a photographic light meter, very few caterpillars were still feeding. From one caterpillar which remained on the cane at sunrise, a Tachinid parasite was reared. This suggested that those caterpillars remaining after dawn were probably behaving abnormally.

Very few caterpillars, other than those believed to be *M. phaea,* were seen feeding at any time.

Of the caterpillars placed in Cage 1 no more than 50% were ever seen feeding together. It is

Table 1

Numbers of caterpillars feeding during the night in insectary cultures

Date	Time	Numbers feeding			Light conditions (approx).
		Cage 1 Mainly *M. phaea* 120 insects	Cage 2 Other spp. 20 insects	Cage 3 Other spp 40 insects	
26/8/71	17:55	2	0	0	(sunset 17:36)
	18:25	34	1	0	almost dark, light reading 0
	20:05	46	2	0	dark
	21:25	45	1	0	dark
27/8/71	04:15	56	1	0	dark
	05:40	22	0	0	dark, but distant dawn glow visible
	05:55	9	0	0	light enough to count; light reading nil
	06:03	4	0	0	light reading 5 ft.c.
	06:10	2	0	0	light reading 42 ft.c.
	06:12	1	0	0	light reading 110 ft.c.
	06:19	0	0	0	sunrise 06:20
		Mainly *M. phaea* 100 insects	other spp. 70 insects		
21/10/71	16:40	0	0		dull overcast afternoon
	18:35	11	0		too dark to read (sunset 18:09)
	21:40	41	0		dark
22/10/71	00:15	46	2		dark
	02:05	47	2		dark
	04:05	38	2		dark, no sign of dawn (sunrise 05:12)

possible that different individuals began and ceased feeding at different times during the night, so that more than 50% did in fact feed; but their positions on the leaves suggested otherwise. Individuals were not marked in any way, but it was apparent that the same caterpillars were seen repeatedly on the same leaf. It is considered more likely that failure to feed was caused by state of maturity, parasitism or disease.

Caterpillars feed on the leaf laminae from the outer margins towards the midribs, which, excepting for the leaf tips, usually remain undamaged. However, where infestations are very heavy most of the midrib also may be consumed.

Effects of Defoliation

During the period from 1952 to 1959 sugarcane crop losses which might be attributed to feeding by insects were investigated. As part of this programme, attention was paid to the type of damage caused by the various leaf-eating insects which sometimes defoliate sugarcane fields. Since ensuring the presence of these insects in an experimental field would have been impossible, and confining them to particular plots would have presented considerable difficulty, it was decided to undertake artificial defoliation, imitating as closely as possible the effects of feeding by the insects themselves.

The validity of such artificial treatment is supported by the fact that, unlike many sap-sucking insects, leaf-eating species are not generally known to transmit plant diseases. Any yield reduction following their feeding is therefore largely due to decreased photosynthesis resulting from reduced leaf area, the removal of tissue, and possibly other traumatic effects. As far as these effects are concerned, artificial injury should not differ significantly from natural feeding.

Three field trials involving artificial defoliation were undertaken and their results were summarised in Annual Reports of the Experiment Station of the South African Sugar Association between 1953 and 1959.

Material and Methods

Since trash caterpillars are more likely to attack ratoon cane, young first ratoons were used in all experiments. Leaf material was removed by means of a large, rather blunt scalpel the action of which was between cutting and tearing. This appeared to imitate the effect of natural feeding more closely than did the clean cut caused by a sharp blade. The aim in each experiment was to simulate the effect of a severe trash caterpillar attack in which practically all leaf lamina material was removed, but in which the growing point was not damaged.

At the time when the first experiment was carried out the occurrence in Natal of ratoon stunting disease had not yet been confirmed and no precautions were taken to prevent the spread of this disease on the scalpel blade. In subsequent experiments the scalpel was disinfected by dipping in alcohol and flaming, between treatments but not between individual plots. This was, perhaps, insufficient protection against infection but the results do not suggest that stunting disease played a significant part in subsequent yield losses.

First experiment

This was conducted at Shakaskraal in a field of young ratoon cane of the variety NCo 310, which had been planted to test the effect of using different types of sett and consisted of twenty plots, each being six rows 7,3m long. The plant cane, harvested in July 1951, had shown no significant differences due to treatments and the field was therefore thought to be suitable for further experimentation but, in order to minimise any residual effects, the new treatments were superimposed on replications of the previous treatments.

Treatments: First experiment

1. A single defoliation in October, three months after harvest.
2. Defoliation twice at an interval of four weeks.
3. Root pruning by means of a pickaxe, to test the effect of such damage as might be caused by cultivation.
4. A combination of defoliation and root pruning.
5. A set of control plots left untreated.

The cane from this field was harvested in August 1953. The results indicated no significant differences between treatments although the mean yield for the plots defoliated twice was 20 tons per hectare less than that for the control. In the light of the highly significant results obtained in subsequent experiments it is suggested that the lack of significant response in this experiment was due to variability of the field and the age (25 months) of the cane at harvest.

Second Experiment

It was decided to continue this investigation by carrying out a trial at Mount Edgecombe and to include treatments simulating the type of damage caused by locusts which do not always confine their attacks to fields at an early stage of growth, and often return to feed on fields which are recovering from previous attacks.

In October 1952 sugarcane of the variety Co 331 was planted in 48 small plots, each with an area of 1/350 hectare. When this was harvested in October 1953 differences between plots were slight and the site was considered suitable for experimentation. Each treatment was replicated 6 times.

Treatments: second experiment

0 : Control

1 : Defoliated once

2 : Defoliated twice

3 : Defoliated three times

4 : Defoliated four times

5 : Defoliated five times

The first defoliation took place in November, 1953, one month after harvest, subsequent defoliations being carried out at intervals of three weeks.

L1 : Defoliated once, in February 1954, four months after harvest.

L2 : Defoliated twice, at four months and eleven months after harvest

Effect on development of leaves

At first it appeared as though the immediate effect of defoliation was stimulation of leaf development, since new growth was rapid and the spindle lengthened by as much as ten inches per week. Three weeks after the first defoliation the shoots had acquired a complete new set of leaves. However, the leaves became less robust, particularly after repeated defoliation. All foliage removed in this experiment was weighed, and the results are summarised in Table 2.

Since defoliation of series L1 coincided with the final treatment in series 5, it was possible to compare, for cane of the same age, the total weight of leaf produced in four months by damaged and undamaged cane. In series L1, a total of 174 kilograms of leaves was removed in a single defoliation, while a total of only 82 kilograms was removed from series 5 in five defoliations.

Effect on numbers of sticks

The shoots present in all plots were counted before the first treatment and no significant difference between plots was found. Subsequent counts indicated a tendency for more shoots to develop in defoliated plots, and after 6 months, plots defoliated three times had significantly the greatest number of shoots. However, at 20 months, when the cane was harvested, many of the shoots in defoliated plots had died out and final counts indicated that more sticks were present in the control plots with a definite downward trend as the number of defoliations increased. Figures for this final count are summarised in Table 2.

Effect on length of internodes and total length of sticks

Measurement of the internodes in a sample of cane from each plot indicated that, in defoliated cane, the joints that were being produced at the time of defoliation were considerably shorter than those in undamaged cane. This was not particularly noticeable in cane defoliated once or twice at an early stage because the growing-point was still below the soil surface at the time of treatment, but the effect was noticed as a reduction in

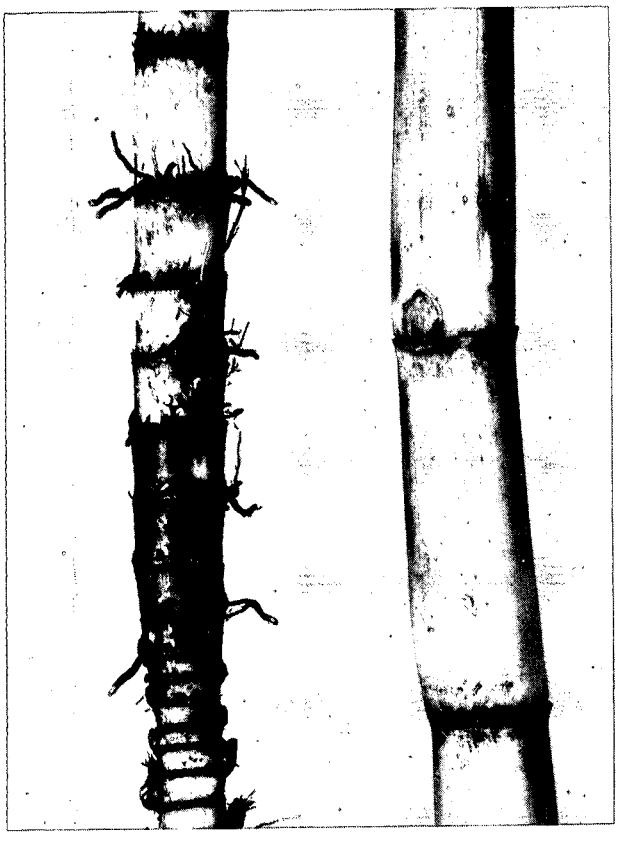
Table 2

Results of second defoliation experiment

Treatment	Weight of leaves kg (totals)	Number of sticks at harvest (totals)	Height to base of lowest green leaf cm (means)	Yield tc/ha 1st ratoon	Analysis of samples				Yield tc/ha 2nd ratoon
					Sucrose % cane	Purity	Reducing sugar ratio	Fibre % cane	
Control	—	2201	216	116	14,2	93,1	1,2	15,7	132
1	13	2071	206	98	13,6	91,9	1,4	16,2	121
2	30	1994	183	87	13,5	91,1	1,7	15,4	125
3	46	1922	163	73	13,1	91,2	1,7	15,9	123
4	70	1661	150	59	12,6	90,4	2,3	16,6	111
5	82	1323	111	37	13,0	89,9	1,9	14,8	93
L1	174	2230	189	91	13,3	91,7	1,4	16,4	130
L2	318	1933	166	62	13,1	90,7	1,6	16,6	127
LSD									
5%	16	275	15	14	0,5	1,3	0,5	1,0	19
1%	21	369	20	20	0,6	1,7	0,7	1,3	24

the number of joints above the surface. In cane which had been repeatedly defoliated, the base of each stick consisted of a succession of very short joints, produced during the period when defoliation was taking place, followed by joints more normal in length, produced after the final treatment (Fig. 3). In cane which had been defoliated at a later stage there was a group of five or six short joints, associated with the bases of the leaves which had been damaged (Fig. 4).

The total length of each stick in treated plots decreased by an amount corresponding to the difference between the short internodes produced at the time of defoliation and normal internodes such as were produced by the control series at the same stage of growth (Table 2). Joints produced after the cane had developed a new set of leaves were not significantly shortened but became progressively thinner as the number of treatments increased.



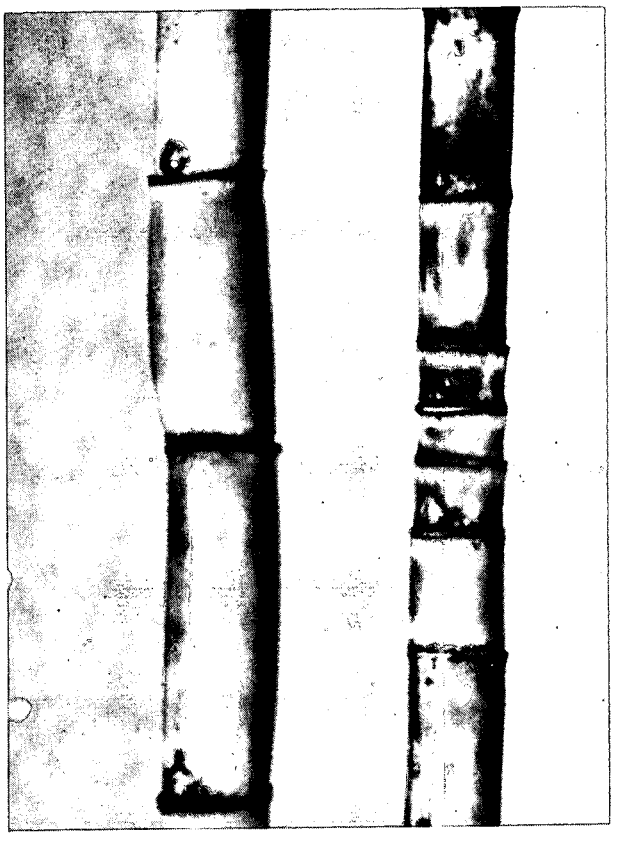


Fig. 3 Effect of repeated defoliation shown by cane on the left. Undamaged cane on right.
Fig. 4 Effect of a single late defoliation shown by cane on the right. Undamaged cane on left.

Effect on weight of crop

The cane in this experiment was harvested at 20 months of age in June 1955. The results (Table 2) show that there was a significant reduction in yield, even in plots subjected to a single defoliation, with a significant linear trend in a downward direction as the number of defoliations increased. Plots defoliated once, at four months, were intermediate between those defoliated once and twice at an early stage, and those defoliated at four and again at eleven months were intermediate between those defoliated three and four times. Since a considerably greater weight of leaf tissue had been removed from the plots subjected to late defoliation than from the most severe of the earlier treatments, a greater loss of yield had been expected from the former.

Effects on composition

Samples of cane from each plot were analysed and means for the various treatments were calculated (Table 2).

For sucrose and purity there was a downward trend as the numbers of defoliations increased, the two late treatments again being intermediate. The reducing sugar ratio was somewhat erratic but higher for all treatments than for the control. Fibre per cent cane was high for the plots subjected to late defoliation. The low figures obtained for the plots defoliated five times may have been due to the fact that much of the original cane had died out and had been replaced by younger shoots which developed after the treatments were completed.

Second ratoon results

In order to discover any residual effect of defoliation the cane in this field, without further treatment, was allowed to ratoon again and was harvested, at 24 months, in June 1957 (Table 2). The results demonstrate that, at least in the most severely damaged plots, defoliation of young first ratoons significantly affected the second ratoon crop.

Third experiment

Repeated defoliation is unlikely to be caused by trash caterpillars which normally disappear after one generation. Further evidence on the effect of a single defoliation was therefore sought in a third experiment, carried out at Mount Edgecombe. Replicated plots were planted with sugarcane of the varieties Co 331 and NCo 376 in 1956. No treatment was applied to the plant cane which was harvested as a uniformity trial in August 1957. About two months later the young first ratoon plants were artificially defoliated to simulate the effect of feeding by trash caterpillars.

In December 1958, the cane was harvested as 16 month first ratoons and the yield for both varieties was found to have been reduced by about 16 tons per hectare (Table 3).

Discussion of defoliation experiments

In spite of the anomalous result of the first defoliation experiment it has been shown that a single defoliation may cause a significant reduction in yield. This reduction, representing 18 tons cane per hectare in the second experiment and 16 tons per hectare in the third, would be of sufficient economic importance to justify expenditure on control measures. By aggravating the effect, the more severe treatments in the second experiment made the results more easily discernible. These results were confirmed by the anatomical changes, particularly in the size of internodes, which consistently followed defoliation.

Table 3

Yield of 1st ratoon crop of third defoliation experiment in tons cane per hectare

Treatment	Variety	
	Co 331	NCo 376
Untreated	106	138
Defoliated	89	122
Difference	17	16
L.S.D.		
5%	10	
1%	14	

Control of Trash Caterpillars

Natural enemies

Insect parasites, especially Tachinid flies, may be noted in abundance in any field where caterpillar damage is conspicuous. Table 4 concerns field-collected caterpillars which were placed on growing sugarcane in insectary cages at Mount Edgecombe. The caterpillars were separated as far as possible into different species, and records were kept of adult moths and parasitic flies obtained from them. Nearly as many parasites as adult moths were obtained, and total mortality among the moths was very high (approximately 86%).

Table 4

Fate of field-collected caterpillars cultured in the insectary

Species	Numbers per batch	Adult moths reared	Tachinid flies reared
Mythimna sp.	131	8	19
	120	30	26
	100	8	11
Proxenus sp.	38	1	0
	70	10	5
Simplicia sp.	20	7	2
Proxenus sp. and *Simplicia* sp. mixed	40	9	2
Total	519	73	65

Insect parasites so far recorded are listed, in approximate order of importance, in Table 5. The Ichneumonid *Netelia* sp. is the only wasp parasite encountered so far.

Table 5

Natural enemies recorded from trash caterpillars

	Parasite	Host caterpillar
Diptera (Tachinidae)	*Linnaemya angulicornis* Speiser	*Athetis ignava* Gn, *Mythimna* sp.
	Cuphocera argyrocephala Macq.	*Athetis ignava* Gn. *Mythimna* sp.
	Cuphocera ruficornis Macq.	*Athetis ignava* Gn. *Mythimna* sp.
	Pseudogonia rufifrons Wied.	*Athetis ignava* Gn. *Mythimna* sp. *Simplicia extinctalis* Zell.
	Pales sp.	*Mythimna* sp.
	? Aplomya sp.	*Mythimna* sp.
Hymenoptera (Ichneumonidae)	*Netelia* sp.	*Mythimna* sp.
Fungus	*Entomophthora* sp.	*Mythimna* sp.
Virus	Nuclear polyhedrosis?	Various species

The seasonal effects of what appears to be a polyhedral virus are also very important. Identification of the pathogen concerned awaits confirmation, but its effects resemble very closely those described for the virus infection of armyworm (Brown and Swaine, 1965). Affected caterpillars become inactive and watery, and after death they remain hanging on the leaves from which they were feeding, gradually shrivelling up. At the watery stage, fluid may leave the body and flow over the leaf surface, where the pathogen may be ingested by other caterpillars, which then become infected. Such an infection may destroy numerous caterpillars almost overnight, but incidence depends apparently on optimum conditions, infection occurring most frequently towards the end of the trash caterpillar season, i.e. in October and November. No accurate assessment of the proportion of caterpillars so destroyed has yet been made. However, in the course of an insecticide trial it was noted that increasingly large numbers of watery corpses were occurring daily on the cane leaves, and their numbers were counted in 10 control plots to compare with the numbers of healthy caterpillars in the same plots. It was estimated that about 26% died in this way, which was considerably fewer than appearances would have suggested.

A fungus (*Entomophthora* sp.) has been identified from dead caterpillars collected in the field, and it may be this, rather than a virus which causes the mortality just described.

Insecticide

Two field trials aimed at the caterpillar stage have been conducted.

Material and methods

In both experiments the design was a randomised block with 10 replications. Each plot included a number of cane rows of standard length, with adequate guard rows between plots.

With one exception, treatments were applied along the rows with knapsack sprayers. The exception concerned a dust formulation, which was applied with a portable motorised blower.

Treatments : Trial 1

1. Control
2. Endosulfan 50% wettable powder at 0,6kg active ingredient/hectare.
3. Carbaryl 85% wettable powder at 0,6kg active ingredient/hectare
4. DDT 50% wettable powder at 1,7kg active ingredient/hectare.
5. DDT 25% emulsion at 1,7kg active ingredient/hectare.

Treatments : Trial 2

1. Control
2. Endosulfan 50% wettable powder at 1,0kg active ingredient/hectare.
3. Endosulfan 5% dust at 2,0kg active ingredient/hectare.
4. *Bacillus thuringiensis* suspension at 2,5 l per 50 l water/ha.

Assessment of results

In the second trial a pre-treatment count was made by stripping one row in each plot of its trash blanket and counting the numbers of caterpillars present. In the first trial no pre-treatment count was done, which made a full analysis of results impossible. Following treatments, rows were similarly stripped at varying intervals, and surviving caterpillars counted.

Classification of caterpillars into healthy, sick and dead proved to be impossible, and results were assessed entirely on numbers of survivors. In the second trial, these were divided into *Mythimna* and other species.

Results Trial 1

Decreases in numbers following the first post-treatment count are shown in Table 6. The percentage decrease after 2 days was higher in all treated plots than in control plots.

Trial 2

Results are summarised in Table 7. Pretreatment counts were of little use in the statistical analysis, but are included in the table. Although a larger drop in numbers was evident for treated plots than for controls, statistical analysis showed significant differences only at the second post-treatment count, and then only for the two endosulfan formulations.

Table 6 Decrease in caterpillar numbers following first post-treatment count in insecticide trial 1

Treatment	% decrease after:-	
	2 days	7 days
Control	10,8	12,3
Endosulfan 50% w.p.	35,7	36,0
Carbaryl 85% w.p.	39,2	28,2
DDT 50% w.p.	39,0	32,5
DDT 25% e.c.	19,0	0,4 (increase)

Table 7 **Pre-treatment and survivor counts in insecticide trial 2**

Treatment	Numbers of living caterpillars							
	Pre-treatment 25-10-71		Post-treatment 1 27-10-71		Post-treatment 2 29-10-71		Post treatment 3 1-11-71	
	Mythimna spp.	Others	*Mythimna* spp.	Others	*Mythimna*	Others	*Mythimna* spp.	Others
Control	158	61	110	42	52	38	21	106
Endosulfan 50% w.p.	138	128	41	40	11**	65	8	27
Endosulfan 5% dust	182	101	59	46	17**	52	6	18
B. thuringiensis	194	119	92	35	61	45	15	37

Discussion of insecticide trial results

From the first insecticide trial it was apparent that, although the decrease in caterpillar numbers was greater in all treated plots than in control plots, no insecticide gave a good immediate kill, and it was concluded that this was because the blanket of trash protected the caterpillars from contact with the insecticide. Even 10 days after treatment, large numbers of healthy caterpillars were still present, and were apparently feeding either on the dead trash or on the ratooning cane below the trash blanket.

For this reason, the second trial included the application of a dust formulation under pressure, which was intended to contact caterpillars sheltering beneath the trash blanket. However, no dramatic response resulted even from this application method.

Endosulfan wettable powder was probably the most successful treatment. Although, at the final count, it lagged slightly behind the dust formulation, the quantity of active ingredient was lower, and it is an easier formulation to apply.

The inclusion of *Bacillus thuringiensis* was prompted by the fact that in the insectary, caterpillars which fed upon foliage treated with this material died, whereas caterpillars of the same batch which fed on untreated foliage did not. In the field it may have been more effective than the results suggest, for it causes cessation of feeding which results in starvation, so that affected caterpillars may have been included among survivors although they were no longer causing damage. This treatment has the advantage of being ineffective against the many natural enemies of trash caterpillars.

In both trials, counts in the control plots showed that caterpillar numbers were decreasing, regardless of treatment. This was due partly to normal metamorphosis and partly to the effects of natural enemies.

General Discussion

Defoliation of the sort produced by trash caterpillar infestations can evidently result in crop loss. Once trash caterpillar damage is noticed the worst of it is usually over, and the infestation is waning. Furthermore, trash caterpillar infestations are accompanied by a powerful complex of natural enemies, many of which are adversely affected by insecticides. Also, insecticides are not entirely effective against the caterpillars because, during the day, they shelter beneath the trash blanket. It might be possible to treat harvested fields with an insecticide in anticipation of any invading moths, but since infestations are sporadic and patchy and are worse in some years than in others, the economics of such a policy are questionable.

These considerations all indicate the need for some early warning system so that an outbreak may be anticipated. Detection of eggs or first-stage caterpillars would require an intensity of field inspection which is probably impracticable. There is some hope, however, that it may be possible to determine current numbers of adult moths by the use of light traps, and that such numbers may relate to subsequent caterpillar outbreaks in the vicinity.

In East Africa, using a network of light traps, much work has been done on the movements and migration of the armyworm moth, *Spodoptera exempta* (Wlk.), which is a related species (e.g. Brown, 1970).

During the last year at Mount Edgecombe, moth records have been obtained from Robinson-type light traps (Robinson and Robinson, 1950). Moths of trash caterpillars have been caught, although in smaller numbers than might have been expected. The prospects of any practical application of this, or other trapping methods are being investigated.

Acknowledgements

Insecticide trials were conducted on Tongaat Sugar Estates, whose co-operation is appreciated. Help with identifications was received from The Commonwealth Institute of Entomology, Mr. E.S. Brown of the Armyworm Research Unit, and Drs. Y. Tanada and G. Thomas of the University of California.

REFERENCES

1. **Brown E.S.** 1970. Control of the African armyworm *Spodoptera exempta* (Wlk.) — an appreciation of the problem. E. Afr. Agric. For. J. 35 No. 3 pp 237-245.
2. **Brown E.S. and Swaine G.** 1965. Virus disease of the African armyworm *Spodoptera exempta* (Wlk.) Bull. ent. Res. 56 pp 95-115.
3. **Robinson H.S. and Robinson P.J.M.** 1950. Some notes on the observed behaviour of Lepidoptera in flight in the vicinity of light-sources together with a description of a light-trap designed to take entomological samples. Ent. Gaz. 1 pp 3-20.