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Effect of Monocrotophos on the Leaf Eating Caterpillar, *Opisina arenosella* Walk, when Injected into the Trunk of the Coconut Palm.

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ABSTRACT

Monocrotophos injected into the trunk of tall coconut palms (15 to 20 m) at 3.0 and 6.0g a.i. per palm, was translocated and accumulated in the leaves in quantities sufficient to kill the leaf eating caterpillar, *Opisina arenosella.* Monocrotophos was injected, as an undiluted 60% W S C, into freshly made holes, 15 cm. deep and 2 cm in diameter, made at a point 1m above the ground. Only one hole per palm was used for this treatment.

Bioassays in the laboratory and assessments of the natural population of caterpillars on the experimental palms indicated that the insecticidal effect persisted in the leaves for about four to six months. This treatment would therefore be adequate to control a succession of larvae hatching out of eggs laid over a period of time.

Although the injection technique obviates the risks of spray contamination of the environment, the question of pesticide residues in edible tissues arises and this aspect needs further study.

INTRODUCTION

The black-headed leaf eating caterpillar, *Opisina arenosella* Walk (= *Nephantis serinopa* Meyr.) is one of the serious pests of coconut in Sri Lanka. Infestations are common in the Eastern, Western, North Western and Southern Provinces. In severe outbreaks hundreds of palms have nearly all of their mature leaves reduced to dead brown tissue with only a few young leaves remaining green. Vast tracts could be affected in a locality.

Indigenous parasites are active, but the degree of effectiveness varies greatly and is not always satisfactory. Introduced parasites too have not adequately established themselves in the field. The low efficacy of these biocontrol agents may be because they are not host specific and also due to the presence of hyperparasites.

As the biological control methods presently available are inadequate, it often becomes necessary to resort to the use of insecticides and other measures. However, spraying insecticides to the crowns of tall coconut palms is difficult and is harmful to the natural enemies of the pest. Therefore, there is a need to develop techniques that would enable the simultaneous use of biological and chemical control methods. Appropriate chemical control measures can reduce pest populations while sparing natural enemies, thereby lowering the chances of subsequent resurgence of the pest.

Systemic insecticides, being effective only on the pest caterpillars that directly feed on the palm tissues, would not affect adult parasites but only parasitic larvae feeding on the caterpillars. Systemic insecticides, applied as an injection into the trunks of palms, including coconut, was found to be effective in controlling a number of insect pests. Kirthisinghe (1961) reported that 'Systox' controlled the red weevil, *Rhynchophorus ferrugineus* when injected into the trunk of the coconut palm. Stelzer (1970) demonstrated that the coconut stick insect, *Graeffea crouanii* could be controlled by trunk injection of systemic insecticides. Rai (1973) reported that 6 ml of 60% monocrotophos as emulsifiable concentrate per palm applied as an injection gave complete kill of the coconut caterpillar, *Brassolis sophorae* L. Ooi *et al.* (1975) found the trunk injection of monocrotophos may be employed to assist the tachinid parasite, *Bessa remota* to control the coconut caterpillar, *Artona catoxantha.*

Kanagaratnam (1976) reported that 6 ml of 60 per cent monocrotophos ('Azodrin 60') when diluted with water and injected using a tin funnel into the trunks of 3m tall coconut palms was effective in killing larvae of *Opisina arenosella* Walk. (= *Nephantis serinopa* Meyr.). These preliminary findings were further tested with many tall palms using undiluted insecticide for injection directly into a freshly drilled hole in the trunk.

MATERIALS AND METHODS

Two experiments were carried out on palms of different heights at two sites:

Experiment 1

Nine caterpillar infested palms, about 15m in height were selected at Horakelle Estate in the North Western Province. Three palms were injected with 5ml per palm (3.0g. ai /palm) of undiluted 60 per cent water soluble concentrate of monocrotophos and three other palms with 10ml per palm, (6.0g. ai /palm). The insecticide was applied into a hole, 15cm deep, drilled with an auger at an angle of 45° to the horizontal, at a height of one metre from the ground level. Three untreated palms were used as a control.

Pre-treatment assessment of the population of live caterpillars and pupae was done by examining a sample of 30 pest infested leaflets from each palm, including the control. Post-treatment assessments were also done as above at approximately weekly intervals.

In addition from each palm a sample of leaflets was collected at regular intervals and fed to 20 to 30 healthy caterpillars, collected from the field. Upto 85 days after injection, a total of 60 caterpillars per treatment and thereafter 90 caterpillars per treatment were utilized for each assay.

Experiment 2

This experiment was carried out on six uninfested palms about 20m in height at Bandirippuwa Estate, Lunuwila. Two palms were treated with 5ml per palm and two other palms with 10ml each as described in Experiment 1. Two untreated palms were used as a control. Before injection leaflets were cut from all the palms and fed to 30 healthy caterpillars per sample per palm in the laboratory. Post-treatment observations were also taken as above and the mortality of the caterpillars recorded 3 days after they were

introduced. The samples were assayed at approximately weekly intervals upto 178 days after injection.

RESULTS AND DISCUSSION

Experiment 1

The average number of live caterpillars and pupae of *O. arenosella* which occurred naturally upto 238 days after injection, on leaf samples, are given in Table 1.

On untreated palms, the pest population was higher than on the treated palms, in most of the observations taken from 11 to 238 days after injection. In the samples from treated palms the pest was found in small numbers until about one month after injection. This suggests that the insecticide was translocated slowly from the injection hole to the leaves. From 36 to 85 days after injection there were no live caterpillars and pupae in the samples from palms treated with 3.0g ai and 6.0g ai per palm. A few caterpillars were seen in the samples from the treated palms from 93 to 113 days after injection. These were newly hatched first instar caterpillars which may not have consumed a fatal dose of toxin at the time of assay. Thereafter there were no live pests in the samples from treated palms until 176 days after injection. However, in the samples from the untreated palms the number of live caterpillars and pupae were high throughout upto 176 days after injection, indicating that in the treated palms the insecticide was effective in killing the pest.

A lethal concentration of the insecticide appears to have persisted in the leaves of treated palms for about six months. As the pest population on the untreated palms was not high after six months, the maximum duration of persistence cannot be established from this set of observations.

The results of the bioassay carried out in the laboratory with the leaf samples collected from these palms are given in Table 2. The mortality of caterpillars fed on samples from untreated palms was very low in all the observations. In most of the observations the mortality in the samples from tretaed palms was higher than in the control. Both treatments caused very high mortality of caterpillars from 23 to 74 days after treatment, indicating that even the lower level of 3.0g ai per palm was sufficient to kill most of the caterpillars in the crown of 15m tall palms.

It appears from Table 2 that toxic concentrations of monocrotophos persist in the leaves for about six months.

Experiment 2

The results of the bioassay of leaves from 20m tall palms are presented in Table 3. The mortality of caterpillars fed on samples drawn from the untreated palms was very low in all the observations. In the samples from the treated palms the mortality was always higher than in the control upto 136 days after injection.

The insecticidal effect appears to have persisted for about four months in palms treated with 3.0g ai /palm and about six months when injected with 6.0g ai/palm.

In this experiment only one observation was taken in each assay three days after the caterpillars were introduced to the sample. It is likely that higher levels of mortality would have been recorded if the observations were continued for a longer duration. In

Table 1. *Number of live caterpillars and pupae of* Opisina arenosella *Walk, which occurred naturally on leaf samples from palms in Expt.* 1 *at Horakelle Estate.*

Days after treatment+	*Number of live caterpillars and pupae**		
	Treatments		
	Control	3.0*g ai/palm*	6.0*g ai/palm*
0	41	48	45
4	16	18	8
11	10	7	4
18	37	12	12
23	24	6	10
29	40	8	5
36	58	0	0
44	43	0	0
52	68	0	0
58	73	0	0
65	40	0	0
74	33	0	0
85	26	0	0
93	13	2	1
100	28	3	2
107	95	8	2
113	70	1	0
122	44	0	0
128	26	0	0
136	29	0	0
154	21	0	0
161	19	0	0
176	16	0	0
185	7	4	3
191	20	2	0
197	9	1	2
203	5	2	2
211	4	3	4
217	3	0	0
224	3	0	0
231	0	0	0
238	0	0	4

+Treated on 83–11–07 *Average of 3 samples from 3 palms

Table.2. *Mortality of caterpillars fed in the laboratory with leaf samples from palms in Expt. 1 at Horakelle Estate.*

Days after injection[+]	*Percent Mortality*		
	Treatments		
	Control	*3.0g ai/palm*	*6.0g ai/palm*
23	0·1	72·6	80·0
29	0	75.8	90
36	1.7	73.3	91.7
45	0	98.3	100
52	1.7	100	100
58	0	100	100
65	0	81.7	100
74	0	75	91.7
85	0	43.3	51.1
93	0	52.2	64.4
100	0	51.1	63.3
107	2.2	52.2	63.3
113	2.2	25.6	42.2
120	0	27.8	42.2
126	3.3	35.6	54.4
134	1.1	63.3	87.8
152	1.1	20	38.9
159	2.2	17.8	34.4
174	6.7	5.6	20
183	0	26.7	16.7
188	0	1.4	8.9
195	1.1	4·4	10.0
201	1.1	6.7	8.9
209	1.1	6.7	8.9

[+]Treated on 83–11–07.

the field the caterpillars feed on the leaves for about 5 to 8 weeks and would therefore consume larger amounts of the insecticide. Thus levels below 3.0g ai per palm may be adequate to control an infestation in the field.

The application of systemic insecticides by trunk injection in coconut has many advantages over other methods of insecticide treatment. With trunk injection there will be no contamination of pastures and edible crops grown under coconut. The parasites attacking eggs and pupae of the pest are not affected; only those parasites which attack the caterpillars feeding on treated palms will be affected. It is therefore an ideal method to rapidly control a fresh outbreak or to reduce the pest population before releasing parasites. The prevalent practise of lopping fronds to acheive these objectives could thus be advantageously replaced by trunk injection of systemics. Another major advantage is that timing of insecticide application is much less important than when spraying because the monocroptophos persists long enough to kill overlapping generations of the caterpillar. This method does not involve expensive power sprayers, repeated applications and is

Table 3. *Mortality of caterpillars fed in the laboratory with leaves from palms in Expt. 2 at Bandirippuwa Estate.*

*Days after injection**	*Percent Mortality*		
	Treatments		
	Control	*3.0g ai/palm*	*6.0g ai/palm*
0	5.0	0	0
4	3.3	30.0	41.7
8	6.7	91.7	78.3
12	0	90.0	75.0
18	0	75.0	58.3
21	0	48.3	58.3
25	0	63.3	53.3
32	0	58.3	78.3
40	0	100	100
47	0	100	100
53	0	75.0	100
60	1.7	36.7	75.0
65	0	51.7	70.0
75	0	33.3	46.7
88	0	33.3	20.0
103	0	23.3	4.5
115	0	18.3	55.0
122	0	23.3	21.7
136	0	13.3	16.7
178	0	0	21.7

*Treated on 83–11–27.

not labour intensive. It is also applicable where the terrain or the height of palms preclude the use of sprayers. The quantity of insecticide required is low for trunk injection, whereas for soil application or for spraying the leaves, much more insecticide would be necessary. Most of the chemical sprayed or applied in the soil is wasted if rain follows the application whereas the insecticide in the injection hole can be protected from getting washed by sealing the injection hole.

The occurrence of residues of monocrotophos in the milk and meat of mature and immature nuts when monocrotophos was injected at the rate of 3.6 g ai per coconut palm, was studied by Rai. He reported that residues were less than 0.01 ppm upto 70 days after injection, (Rai, 1973).

In Malaysia when 15 year old coconut palms were treated with 6g ai/palm of monocrotophos as water soluble concentrate the residues in the water and meat of immature and mature nuts, upto 8 weeks after treatment, was less than 0.02 ppm (Ooi et.al., 1975).

Swift (Personal communication) reports that in studies carried out in 1982 in Malaysia, the residues tend to be below the limit of detection (0.02ppm) when Azodrin was applied once to coconut palms at the rate of 0.006 kg/ha. The samples of milk, immature meat and mature meat were analysed upto days 56 after treatment.

In the present studies, it appears that the concentration of insecticide in the leaves was high upto about two months after treatment. Although the edible parts of coconut are likely to contain a lower concentration of insecticide than the leaves, it is necessary to carry out further pesticide residue studies before monocrotophos is used on a large scale for caterpillar control.

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REFERENCES

Kanagaratnam, P. (1976), Report of the Crop Protection Division 1975. Ceylon Coconut Q. 27. 36–41.

Kirthisinghe, J. K. F. (1961). The present situation (1961) of the pests and diseases of coconut palm and their control in Ceylon. 1st meeting FAO Tech. Wkg. Pty. Coco. Prod. Prot. and Processg., Trivandram, India.

Ooi, P. A. C., Yunus, A., Goh, K. G. and Balasubramanium, A. (1975). Control of the coconut leaf moth, *Artona catoxantha* Hamps: Trunk injection technique. Malaysian Agric. J. 50, 159–168.

Rai, B. K. (1973). *Brassolis sophorae* and *Castnia daedalus;* chemical control of these major pests of coconut in Guyana. J. econ. Ent. 66, 177–180.

Stelzer, M. J. (1970). Preliminary studies on the control of the coconut stick insect, *Graeffea crouanii* (Le Guillou) with systemic insecticides. Bull. ent. Res. 60, 49–51.