EVALUATION OF FIVE INSECTICIDES AGAINST THE BLACK LEAFHOPPER (*Ricania speculum* Walker) ATTACKING PATOLA [*Luffa cylindrica* (L.) Roem]

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ABSTRACT

In the small plot trial; diazinon, permethrin, malathion, methyl parathion and endosulfan at the manufacturers' recommended rates and sprayed 4 times starting at flowering significantly controlled the nymphs of the black leafhopper. Highest yield and net return were obtained in malathion-treated plants. Diazinon gave the lowest yield and net return but these were still higher than those of the unsprayed control.

The results of the preliminary screening tests were confirmed in the large plot trial. Except for carbofuran, all other insecticides provided immediate control of the black leafhopper nymphs. Under non-shaded condition, yield was highest on endosulfan-treated plants while the methyl parathion-treated plants gave the highest net income/ha under shaded condition. These insecticides also seemed to have no deleterious effect on predatory spiders.

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KEY WORDS: Black leafhopper (*Ricania speculum* Walker). Chemical control. Patola [*Luffa cylindrica* (L.) Roem]. Yield. Net return.

INTRODUCTION

The black leafhopper, *Ricania speculum* Walker, is a serious insect pest of patola *[Luffa cylindrica* (L.) Roem*]*. It starts to attack patola at the flowering stage. From then on, the pest maintains a high population even after the last harvesting period.

The nymphs and adults of the black leafhopper suck the sap of the plants causing the infested leaves to turn yellow or brown as though scorched by fire or drought, dry prematurely and eventually die. The pest also feeds on developing fruits preventing them from reaching harvestable size (Matarong, 1983). It also secretes honeydew in abundance which encourages growth of sooty mold and makes the leaf surface black. This eventually affects the photosynthetic activity of the plant.

The life cycle, seasonal abundance and natural enemies of the black leafhopper were previously studied (Esguerra and Gabriel, 1969; Esguerra and Oben, 1984) and information from these was used as basis in the formulation of an efficient pest control strategy.

The use of chemicals is the most common and popular method accepted by farmers in controlling this pest as well as other insect pests attacking patola. For example, farmers apply malathion to control pests and ensure successful patola production.

The black leafhopper remains a serious insect pest of patola. Thus, continuous screening of locally available insecticides must be done so that effective pesticides will always be available for farmers' use whenever the currently used insecticides become ineffective.

MATERIALS AND METHODS

Evaluation of Five Insecticides Against **R. speculum**

Seeds of the smooth-skin variety of patola were planted in 1 x 5 m plots at a distance of 100 cm between hills and 100 cm between treatments. A randomized complete block design (RCBD) with six treatments was used. Each treatment was replicated 3 times with five plants per replication. The treatments were diazinon [0, 0-diethyl-0-(2-isopropyl-4-methyl-6-pyrimidinyl)-phosphorothioate], permethrin [3-phenoxybenzyl-3-(2, 2,-dichlorovinyl) - 2, 2 - dimethyl-cyclopropanecarboxylate], methyl parathion [0,0-dimethyl-0-4-nitrophenyl phosphorothioate], malathion [0,0-dimethyl-S-(1,2-dicarboethoxy ethyl) phosphorodithioate], endosulfan [6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6, 9 - methano-2, 4, 3-benzodioxathiepen-3-oxide] and the unsprayed control. The insecticides were applied using the manufacturers' recommended rates at a spray volume of 400 liters per hectare. Each insecticide was initially applied at flowering when the black leafhopper population began to appear. Succeeding spray applications were done every 2 weeks and stopped 2 months after the initial flowering. All the approved cultural practices for growing patola were followed.

Counts of black leafhoppers at various stages of development were taken at flowering before the first spray, while subsequent counts were done every 2 weeks before each spray. The total number of leaves on each plant as well as the number of leaves that showed yellowing and with characteristic black spots resulting from feeding punctures made by the black leafhopper were counted.

Patola fruits were harvested from each treatment as soon as the fruits reached marketable size. The number and weight of fruits were recorded.

Cost and return analysis of each control measure was done to determine which among the treatments gave the highest net profit.

Large Plot Trial

The results of the small plot trial indicate that endosulfan, malathion, methyl parathion and permethrin are promising insecticides in terms of effectivity against the black leafhopper and other insect pests of patola. These insecticides and another locally available granular insecticide, carbofuran (2,3-dihydro-2,2-dimethyl-7-benzofuranyl methyl carbonate), were evaluated under shaded condition where serious infection was usually observed.

Seeds of the smooth-skin variety of patola were planted in 1 x 10 m plots. Each treatment consisted of 10 plants and was replicated 3 times in a randomized complete block design. Border plants were provided between treatments and between rows of patola to prevent spray deposits from reaching other treatments. The same cultural practices, procedure of data gathering, frequency of spraying (except for carbofuran which was applied twice at flowering) and rate of spray as in the small plot trial were followed.

Profitability of the control measures used was determined in the same manner as in the small plot trial.

To verify whether similar results as in patola planted under shaded condition would be obtained, studies were conducted in an open field. The same procedure was followed as in the trial conducted under shaded condition.

Counts of leaf-feeding caterpillars, *Diaphania indica* Saunders, were also made when this insect pest was observed to attack patola under shaded condition. This was done to find out whether the insecticides used were also effective against the said pest.

RESULTS AND DISCUSSION

Evaluation of Five Insecticides Against **R. speculum**

Small Plot Trial

All insecticides (diazinon, permethrin, malathion, methyl parathion and endosulfan) applied at the manufacturers' recommended rates significantly controlled the nymphal population of the black leafhopper (Table 1). There was also a correspondingly low population of adult black leafhoppers on the treated plants. This could probably be attributed to the ability of the insects to avoid insecticidal sprays by transferring to nearby unsprayed plants during the scheduled spraying.

Plants sprayed with any of the five insecticides had significantly less infested leaves than the control plants (Table 2). Malathion-sprayed plants exhibited the least number of infested leaves among the treatments but this did not significantly differ from that of the other treatments. Severe infestation was observed in the control plants.

Table 1. Mean number of nymphs and adults of *Ricania speculum* on patola plants treated with various insecticides.[1]

Treatment[2]	Pre-Treatment Count		Post-Treatment Count	
	Nymphs	Adults	Nymphs	Adults
Diazinon	62.9	16.1 ab	0.7 b	4.3
Permethrin	55.6	11.4 bc	0.5 b	3.5
Methyl Parathion	60.0	9.0 bc	0.3 b	3.9
Malathion	57.5	8.5 bc	0.1 b	5.6
Endosulfan	61.7	6.9 c	0.5 b	5.0
Unsprayed Control	59.3	20.6 a	59.5 a	5.2

[1] Means within a column followed by a common letter or without any letter are not significantly different at 5% level, DMRT.

[2] Insecticides sprayed once every 2 weeks using the manufacturers' recommended rates.

Table 2. Percent infested leaves of patola plants treated with various insecticides.[1]

Treatment[2]	Pre-Treatment Count	Post-Treatment Count
Diazinon	49.2	36.1 b
Permethrin	37.8	28.7 b
Methyl Parathion	41.5	31.0 b
Malathion	36.2	26.9 b
Endosulfan	42.6	32.3 b
Unsprayed Control	39.7	90.2 a

[1] Treatment means within a column followed by common letter or without any letter are not significantly different at 5% level, DMRT.

[2] Insecticides sprayed once every 2 weeks using the manufacturers' recommended rates.

Plants sprayed with malathion produced more marketable fruits and consequently gave higher fruit weight than the rest of the treatments (Table 3). Permethrin-treated plants ranked next, followed by methyl parathion and endosulfan. Plants sprayed with diazinon gave the least number of marketable fruits among the insecticidal treatments, thus giving the lowest fruit weight. Nevertheless, these values

Table 3. Yield and cost and return analysis of patola grown in small plots and treated with various insecticides.

Treatment[1]	Yield[2]		Yield	Yield Value[3]	Input Cost/Ha[4]	Net Income/Ha
	No.	Wt (kg)	(kg/ha)	(₱)	(₱)	(₱)
Diazinon	51	4.60 c	9200	18400	3275.81	15124.19
Permethrin	80	7.05 a	14100	28200	6005.81	22194.19
Methyl Parathion	73	6.45 ab	12900	25800	3575.81	22224.19
Malathion	83	7.20 a	14400	28800	3955.81	24844.19
Endosulfan	76	5.85 b	11700	23400	3583.81	19816.19
Unsprayed Control	25	1.45 d	2900	5800	2475.81	3324.19

[1] Based on the manufacturers' recommended rates.

[2] Mean marketable yield of five plants/treatment replicated 3 times.

[3] Patola price = ₱2.00/kilo (1983)

[4] Inputs/ha (₱)

Farm operations = ₱1361.00

Fertilizers

Urea 98 kg x ₱2.80/kg = ₱274.00

Complete 30 kg x ₱2.70/kg = ₱ 81.00

Fungicide

Maneb 13.33 kg x ₱57.00/kg = ₱759.81

Insecticides

Diazinon	(12 li) - ₱ 4.00/0.06 li	= ₱ 800.00
Permethrin	(12 li) - ₱17.65/0.06 li	= ₱3530.00
Methyl Parathion	(12 li) - ₱ 5.50/0.06 li	= ₱1100.00
Endosulfan	(12 li) - ₱ 7.40/0.06 li	= ₱1480.00
Malathion	(12 li) - ₱ 5.40/0.06 li	= ₱1108.00

were still higher than those obtained in the control plants.

All insecticide treatments gave higher net returns than the unsprayed control (Table 3). Plants sprayed with malathion gave the highest net income followed by those sprayed with methyl parathion and permethrin which had almost similar net returns. Diazinon-treated plants showed the lowest net income although the amount was still much higher than that obtained from the control plants. There was a considerable economic loss when the black leafhopper infestation was left uncontrolled.

Large Plot Trial

Under shaded condition. The performance of the four sprayable insecticides (methyl parathion, endosulfan, permethrin and malathion) and the granular insecticide (carbofuran) under shaded condition is shown in Table 4. All insecticidal treatments except carbofuran provided an immediate control of the black leafhopper nymphs. Figure 1 shows nymph-free malathion-sprayed patola plants and nymph-infested unsprayed ones. The adult population of the black leafhopper was likewise reduced by the treatments. However, these data could not be used as a measure of the effectiveness of the insecticides since the adult black leafhopper is very mobile and some of them might have transferred to nearby unsprayed plants when they were disturbed during spraying.

Severe infestation was observed in carbofuran-treated plants but this was still less severe than that in the unsprayed control plants. The control plants died before the fourth spraying due to severity of the damage caused by the feeding of the black leafhopper.

The caterpillars of *Diaphania indica* were observed to attack patola infested with *R. speculum.* Table 4 shows that methyl parathion and permethrin were effective in reducing the population of *D. indica*.

Highest yield (weight basis) of patola fruits per hectare was obtained from endosulfan-treated plants (Table 5). Plants treated with

Table 4. Mean number of *Ricania speculum* nymphs and adults and *Diaphania indica* larvae per patola plant under shaded condition when sprayed with various insecticides.[1]

Treatment [2]	Pre-Treatment Count			Post-Treatment Count		
	Ricania speculum		*Diaphania indica*	*Ricania speculum*		*Diaphania indica*
	Nymphs	Adults	Larvae	Nymphs	Adults	Larvae
Methyl Parathion	69.0	3.1	4.2	1.3	4.9	0.1
Endosulfan	40.0	2.4	4.7	2.4	9.5	0.6
Permethrin	58.0	3.4	3.6	2.2	3.8	0.1
Carbofuran	67.0	2.6	3.8	123.9	15.3	3.9
Malathion	48.8	1.8	3.4	2.7	5.0	11.8
Unsprayed Control [3]	72.8	2.7	5.8	167.7	16.7	5.0

[1] Average of three replications per treatment with 10 plants per replication.

[2] Insecticides sprayed once every 2 weeks.

[3] Plants died before the fourth spraying.

Table 5. Yield and cost and return analysis of patola planted under shaded condition and treated with various insecticides.

Treatment[1]	Yield[2]		Yield	Yield Value[3]	Input Cost/Ha[4]	Net Income/Ha
	No.	Wt. (kg)	(kg/ha)	(₱)	(₱)	(₱)
Methyl Parathion	13	2.02	1010	3030.00	2064.32	965.68
Endosulfan	13	2.28	1140	3420.00	2585.16	834.84
Permethrin	11	1.39	695	2085.00	2315.00	-230.00
Carbofuran	16	1.65	825	2475.00	4228.67	-1753.67
Malathion	10	1.82	910	2730.00	2165.46	564.54
Untreated Control	3	0.54	270	810.00	1887.40	-1077.40

[1] Applied using the manufacturers' recommended rates.

[2] Total yield from 20 plants planted at a distance of 100 x 100 cm.

[3] Patola price = ₱3.00/kilo (October, 1984).

[4] Inputs/ha (₱)

Farm operations = ₱1361.00

Fertilizers

Urea 98 kg x ₱2.80/kg = ₱274.40

Complete 30 kg x ₱2.70/kg = ₱ 81.00

Fungicide

Maneb 3 kg x ₱57.00/kg = ₱171.00

Insecticides

Methyl Parathion 50% EC ₱27.00/500 ml RR = 473.68 ml/400 li/ha = ₱176.92

Endosulfan 35% EC ₱ 7.40/60 ml RR = 1263.16 ml/400 li/ha = ₱697.76

Permethrin 10% EC ₱17.65/60 ml RR = 300 ml/400 li/ha ₱427.60

Carbofuran 3% G ₱17.00/kg RR = 2 kg a.i./ha = ₱2341.27

Malathion 57% EC ₱21.50/500 ml RR = 1.25 qts./ha = ₱278.06

methyl parathion ranked second, followed by malathion and carbofuran. Permethrin-treated plants gave the lowest yield but this was still much higher than that in untreated ones.

Table 5 shows that methyl parathion gave the highest net return, followed by endosulfan and malathion. Losses were incurred in plants treated with carbofuran and permethrin as well as those which were untreated.

Under non-shaded condition. The effectiveness of the five insecticides used in controlling *R. speculum* under non-shaded condition is shown in Table 6. All insecticides used except carbofuran, were effective against the black leafhopper. Although carbofuran was not as effective as the sprayable insecticides, it maintained the leafhopper population at a lower level than that in the unsprayed check. The population of the adult black leafhoppers on plants treated with the sprayable insecticides was low and this could again be attributed to the ability of the adults to transfer to nearby unsprayed patola plants when disturbed during spraying.

Table 7 shows that endosulfan gave the highest number and weight of marketable patola fruits among the treatments. Malathion ranked second, followed by methyl parathion and permethrin. Carbofuran-treated plants produced the lowest number and weight of marketable fruits among the treated plants but this was still much higher than that in the untreated control plants.

Table 7 reveals that endosulfan-treated plants had the highest net income/ha followed by those treated with malathion, methyl parathion, permethrin, carbofuran and the control in decreasing order. Except for carbofuran, all the four insecticidal treatments realized more than 4 times as much peso return as the untreated ones.

The spider population was not determined before initial spraying because spiders could hardly be observed at flowering when the leafhopper population was starting to build up. However, the data presented in Table 8 suggest that the insecticidal treatments did not affect

Table 6. Mean number of nymphs and adults of *Ricania speculum* per patola plant under non-shaded condition when sprayed with various insecticides.[1]

Treatment[2]	Pre-Treatment Count		Post-Treatment Count	
	Nymphs	Adults	Nymphs	Adults
Methyl Parathion	53.3	4.3	3.3	2.4
Endosulfan	36.3	5.2	10.5	5.6
Permethrin	47.7	3.2	13.4	2.8
Carbofuran	50.0	6.4	66.2	4.6
Malathion	48.7	4.8	10.9	3.8
Unsprayed Control	49.0	5.6	120.8	14.4

[1] Average of three replications per treatment with 10 plants per replication.

[2] Insecticides sprayed once every 2 weeks using the manufacturers' recommended rates.

Table 7. Yield and cost and return analysis of patola grown in large plots under non-shaded condition.

Treatment [1]	Yield [2]		Yield	Yield Value [3]	Input Cost/Ha [4]	Net Income/Ha
	No.	Wt (kg)	(kg/ha)	(₱)	(₱)	(₱)
Methyl Parathion	31.00	8.49	8490	25470	7978.50	17491.50
Endosulfan	36.67	9.35	9350	28050	8364.90	19685.10
Permethrin	29.33	7.78	7780	23340	8162.25	15177.75
Carbofuran	21.67	5.87	5870	17610	9036.50	8573.50
Malathion	33.33	8.75	8750	26250	8050.00	18200.00
Unsprayed Control	19.33	3.77	3770	11310	7897.50	3412.50

[1] Applied using the manufacturers' recommended rates.

[2] Mean marketable yield of 10 plants/treatment replicated 3 times.

[3] Patola price = ₱3.00/kilo (October, 1984)

[4] Inputs/ha (₱)

Farm Operation	=	₱2700.00
Weeding	=	1500.00
Spraying	=	90.00
Fertilizing	=	180.00
Wire	=	961.50
Guod (bamboo)	=	2466.00
		₱7897.50
Insecticides		
Methyl Parathion	=	₱ 81.00
Endosulfan	=	467.40
Permethrin	=	264.75
Carbofuran	=	1139.00
Malathion	=	152.50

the number of predatory spiders. No significant variation in the number of predatory spiders was noted between the treated and untreated plants after the chemical application.

Based on these results; methyl parathion, malathion, endosulfan and permethrin can be recommended for the control of key pests of patola and other cucurbits. In commercial fields where unsprayed control plots are not provided, the number of insecticidal sprays of either of the four recommended insecticides can further be reduced so as to decrease the cost of production.

Table 8. Number of predatory spiders per treatment taken after the chemical application.[1]

Treatment[2]	**Number of Spiders**
Methyl Parathion	0.33
Endosulfan	0.67
Permethrin	0.33
Malathion	0.67
Unsprayed Control	0.33

[1] Each treatment consisted of 10 plants replicated 3 times.

[2] Applied using the manufacturers' recommended rates.

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