Joint symposium on maize and peanut. Held in Suriname on behalf of the 75th Anniversary of The Agricultural Experiment Station of Paramaribo.

November 13 – 18, 1978

Proceedings of the Caribbean Food Crops Society. Vol. XV, 1978

CURRENT STATUS OF BANANA PEST CONTROL RESEARCH IN JAMAICA

K. Ittyeipe;
Research and Development Department
Banana Board, Kingston Jamaica W.I.

SUMMARY

Plant parasitic nematodes, banana borer weevils and various peel-scarring pests together cause an estimated 40% reduction in the yield of bananas in Jamaica. Current research has shown that both nematodes and borers may be adequately controlled by using Mocap. Primicid and Nemacur may be used in the specific control of borers and nematodes respectively. Among the unregistered, candidate pesticides screened, Miral was found to be effective against both borers and nematodes whereas Tokuthion was found to be as effective as Primicid in the control of borers. Of the various pesticides screened in the laboratory, Primicid, Miral and Mocap were found to be more lethal to banana borers than other chemicals.

Of the peel-scarring pests, crickets, grasshoppers, trash worms, *Platynota,* caterpillars and slugs may be adequately controlled by sleeving. Locally manufactured, non-insecticidal sleeves were found to be satisfactory substitutes for the imported, insecticidal sleeves. Sleeving also improved bunch weight and fruit quality.

Though both Phosvel and Malathion reduced percentage of thrips damage, the use of the former is now considered unsafe while the latter is uneconomical. However the removal of up to two distal hands from two to three week-old bunches reduced the percentage of thrips-damaged fingers without significant reduction in bunch weight.

Slug baits were found to be more effective when placed in the 'throat' of 'shooting' plants than when placed on the ground.

Both laboratory and field investigations on eight cultivars have shown that Valery was the least preferred whereas the tetraploids T 3405-1 and T 168-12 were the more preferred as borer hosts. On the other hand, Valery suffered most damage from flower thrips while tetraploid cultivars suffered the least.

INTRODUCTION

The world market demand for high-quality, blemish-free bananas together with strict governmental restrictions on pesticide use has increased the importance of banana pest research. Plant parasitic nematodes, banana borer weevils and peel-scarring pests together reduce the marketable yield of bananas in Jamaica by about 40%. This paper summarizes the current pest control research work carried out by the Research and Development Department of the Banana Board in Jamaica.

CONTROL

Dual control of nematodes and borers

Radopholus similis Cobb and *Helicotylenchus spp.* are the major species of nematodes affecting bananas in Jamaica. Until recently they were being adequately controlled by D.B.C.P.

(= Nemagon, Shell) injection. However, Nemagon has been withdrawn from the market in 1977 as it has been found harmful to humans.

Since 1972 the insecticide kepone (= chlordecone, A.C.C.) has been used widely in Jamaica for the control of banana borer weevils (*Cosmopolites sordidus* Germar). This product also has been found hazardous to humans and due to adverse press reports and public concern its use is no longer recommended.

Consequently, priority was given to the search for chemicals that could replace both Nemagon and Kepone and a completely randomized block design experiment was carried out to see whether both the nematodes and the borers could be controlled by the use of a single chemical.

The compounds tested were: Furadan (= carbofuran, Shell), Mocap (= ethoprop, Mobil), Nemacur (= phenamiphos, Bayer) and Vydate (= oxamyl, DuPont). In addition, Kepone and Nemagon were included for comparison of efficiency. 50g of Furadan 5G, 30g of Miral 10G, 40g of Mocap 10G, 30g of Nemacur 10G and 30g of Vydate 10G were sprinkled around the mat in approximately 18" (46 cm) radius every 4 months. 40g of Kepone 5D were placed immediately around the corm every 9 months and 8 ml Nemagon 75 EC diluted to a 20% aqueous solution was injected around the mat every six months.

The pre and post-treatment borer population indices in the various treatments and control are given in table 1. The indices are the mean number of borers/trap caught during the pre and posttreatment trappings (Harris, 1947; Hord and Flippin, 1956). The percentage change in the post-treatment borer population indices in the various treatments from the pre-treatment and control means are also given in table 1.

The number of nematodes recovered from 100 5-root samples in each treatment and the observed change from the mean number of nematodes in the control and in the various treatments are given in table 2.

Results indicate that the mean number of borers trapped in plots treated with Furadan, Miral, Mocap, Kepone and Vydate were significantly lower than the pre-treatment means (table 1). A comparison of the various post-treatment means with the control means indicates that the borer populations were significantly reduced in plots treated with Furadan ($P < 0.05$) and Kepone ($P < 0.002$).

Expressing the population change as a percentage of the pre-treatment level, the greatest decrease was in treatment with Kepone (77.7%) closely followed by treatments with Mocap (68.4%) and Furadan (68.0%) (table 1).

Table 1. Change in borer population indices, expressed as mean number of borers/trap in the various treatments and control

Treatments	Pre-treatment borer population indices	Post-treatment borer population indices	% change in post-treatment population indices when compared to pre-treatment indices	Significance of the change in borer population indices	% change in population indices in various treatments when compared to the control	Significance of the change in treatments compared to control
Control	1.83	1.73	− 5.46	$P > 0.10$	–	–
Furadan	2.44	0.78	− 68.0	$P < 0.01$	− 54.9	$P < 0.05$
Kepone	2.06	0.46	− 77.7	$P < 0.002$	− 73.4	$P < 0.002$
Miral	2.39	0.82	− 65.7	$P < 0.01$	− 52.6	$P < 0.10$ $P > 0.05$
Mocap	2.56	0.81	− 68.4	$P < 0.002$	− 53.2	$P < 0.05$
Nemacur	1.78	1.04	− 41.6	$P < 0.10$	− 39.9	$P > 0.10$
Nemagon	1.83	1.84	+ 0.5	$P > 0.10$	+ 6.4	$P > 0.10$
Vydate	2.83	1.07	− 62.2	$P < 0.01$	− 38.2	$P > 0.10$

Table 2. Mean number of nematodes recovered from 100g roots and the observed change from control mean as a result of treatment

Sampling Occasion	Control	Furadan	Kepone	Miral	Nemacur	Mocap	Nemagon	Vydate
Pre-treatment	1050	1400	1933	333	233	400	433	1933
Post-treatment samples								
1	2500	100	766	66	833	500	833	233
2	1350	100	366	66	366	233	66	400
3	5100	666	866	133	–	233	933	1400
4	2000	3466	2133	33	166	–	666	4433
5	5000	1966	6266	1133	2666	3200	2666	3433
6	550	1233	2500	966	900	1700	900	433
7	4100	6166	3633	3033	–	3700	–	3400
Total	18600	13697	16530	5430	4931	9566	6064	13732
Post-treatment mean	2655	1957	2362	776	986	1594	1011	1962
Observed change from control	–	– 696	– 293	– 1879	– 1669	– 1061	– 1644	– 693

From the data presented (table 2) it can be seen that Miral, Mocap and Nomacur gave better nematode control than Nemagon. As a suitable alternative Miral would be best but it is still in its experimental stage and cannot be recommended. Nemacur is a suitable nematicidal alternative but because of its low insecticidal activity, Mocap is a more suitable nematicidal/ insecticidal treatment for both nematode and borer control.

Specific control of banana borers

In a completely randomized block design experiment, the efficiency of Belt (= chlordane, Velsicol), Heptachlor (= Hoptagran, Volsicol); Primicid (= pirimiphos – ethyl, I.C.I.), Surecide (= cyanofenphos, Sumitomo) and Tokuthion (Bayer) in controlling banana borer weevils were compared with that of Kepone. Rates of application were 40g each of Primicid 10G, Tokuthion 5G, Belt 50 and Kepone 50, 60g of Heptachlor 2.5D and 80g of Surecide 1.5D per mat placed immediately around the corm. Primicid 50 EC, at the rato of 2.5 litres/acre diluted with water to make 20 gallons (91 litres) was applied as a spray close to the base of the pseudostem to give 3 ml/mat.

The pre and post-treatment borer population indices for the various treatments and control are given in table 3. The indices are the mean number of borers/trap caught during the pre and post-treatment trappings. The percentage change of the post-treatment indices in the various treatments from the pre-treatment and control means are also given in table 3.

Results presented in table 3 indicate that there was a general decline in the post-treatment number of borers caught/trap in all the treatments including control, when compared to the pre-treatment numbers. This could be due to the effect of chemicals being leached into the control plots during periods of excessive rain. The post-treatment number of borers/trap was significantly less than the pre-treatment means in all except control, Chlordane and Surecide treatments. However, the decrease in numbers was highly significant in plots treated with Primicid (both 10G and 50 EC, $P < 0.001$ and $P < 0.002$ respectively) followed by treatments with Kepone ($P < 0.02$) and Tokuthion ($P < 0.05$ table 3).

Duncan's Multiple Range analysis of the post-treatment borer population indices indicated that control was most effective in Primicid (both 10G and 50 EC), and Tokuthion treatments, all three performing at a level not significantly different from Kepone. However, Tokuthion is not yet registered for use in bananas and therefore cannot be recommended.

Sensitivity of banana borers to various chemicals under laboratory conditions.

As there is no accurate means of assessing the borer population density in the field, the absolute effectiveness of a chemical in terms of percentage mortality cannot be measured. Hence a number of chemicals were screened in the laboratory for their efficiency in killing borers.

The chemicals tested included the technical materials of Basudin (=diazinon, Ciba – Geigy), Chlordane, Heptachlor, Lannate (=methomyl, DuPont), Lindane (=gammexane, Chevron), Miral, Mocap; Nemacur, Nemagon, Phosvel (=leptophos, Velsicol), Primicid and Thiodan (=endosulfan, Hoechst).

Table 3. Post-treatment banana borer population indices expressed as mean number of borers/trap in the various treatments and control compared to one another and with the pre-treatment means

Treatments	Pre-treatment borer population indices (Mean No. of borers per trap)	Post-treatment borer population indices (Mean No of borers per trap [1])	% change in post-treatment population indices	Significance of the change in borer population indices [2]
Control	1.39	0.96 ab [3]	– 30.9	$P > 0.10$
Chlordane	3.59	1.40 a	– 61.0	$P < 0.05$
Heptachlor	3.33	1.02 ab	– 69.4	$P < 0.05$
Kepone	3.05	0.71 bc	– 76.2	$P < 0.02$
Primicid 50 EC	4.89	0.45 c	– 90.8	$P < 0.002$
Primicid 10 G	3.00	0.26 c	– 91.3	$P < 0.001$
Surecide	1.55	1.07 ab	– 31.0	$P > 0.10$
Tokuthion	1.33	0.39 c	– 70.7	$P < 0.05$

[1] Means of monthly assessments

[2] $P > 0.10$ means difference not significant at 10% level
$P < 0.05$ means significance at 5% level
$P < 0.001$ means significance at 0.1% level

[3] Mean figures followed by the same letter are not significantly different at 5% level.

Duncan's Multiple Range Test.

Five percent solutions of each chemical were applied topically using a hand micro-applicator (Arnold, 1967) and a droplet (size 5) of the chemical solution was administered to each individual borer. The percentage mortality of borers in the various treatments was corrected, for control mortality by using Abbott's formula (Finney, 1947):

$$P = \frac{pi - c}{100 - c} \times 100$$

Where P = corrected percentage mortality
pi = observed mortality
c = control mortality
Results presented in table 4 indicate that Primicid, Miral and Mocap caused mortalities not significantly different from each other ($P > 0.10$) in each case) and were also more effective than all other chemicals tested. Heptachlor, Lannate and Lindane also caused mortalities equal to or higher than 50%.

Table 4. Comparison of percentage mortality caused by the topical application of 5% solutions of different insecticidal compounds on banana borer weevils

Insecticides	Corrected % mortality at 2 days	
Basudin	48.5	de[1]
Chlordane	36.0	c
Heptachlor	55.1	ef
Lannate	55.0	ef
Lindane	50.0	de
Miral	63.0	fg
Mocap	59.0	fg
Nemacur	38.5	c
Nemagon	2.0	a
Phosvel	43.5	cd
Primicid	65.0	g
Thiodan	14.0	b

[1] Figures followed by the same letter are not significantly different from each other at 5% level (Duncan's Multiple Range Test)

Table 5. Comparison of maturation period, bunch weight and peel scarring in 60 each of sleeved and unsleeved bunches

Treatments	Mean time to maturity (in days)	Mean bunch wt. (lb)	Percentage of fingers scarred by Leaves	Slugs	Grass-hoppers	Crickets	Rats	Total % of scarred fingers
Sleeved	120.5	37.23	1.532	1.445	0.557	0.035	0.156	3.725
Unsleeved (control)	128.2	33.25	3.576	4.514	3.131	0.190	0.756	12.167
Significance[1] of difference	$P > 0.10$	$P < 0.01$	$P < 0.01$	$P < 0.05$	$P < 0.001$	$P < 0.05$	$P < 0.05$	$P < 0.01$

[1] $P < 0.05$, $P < 0.01$ and $P < 0.001$ indicate significant difference between treatments at 5, 1 and 0.1% respectively.

Control of peel-scarring pests by sleeving

Based on a field trial carried out in Jamaica (Bond, 1974) and on reports from elsewhere (Berrill, 1956; Kuhne and Kritzinger, 1964; Cann, 1965; Perumal and Adam, 1968; Phillips 1971 and Turner and Rippon, 1973), the Research and Development Department of the Banana Board had recommended the use of 3% blue tinted, 1% dursban – impregnated 0.05 mm thick polyethylene sleeves for the improvement of bunch weight and fruit quality of bananas (Ostmark and Whyte, 1975).

The results of an experiment carried out to study the effect of bunch sleeving on improving the external appearance, bunch weight and maturation period of bananas are given in table 5.

It was found that when bunches were covered with blue, dursban-impregnated polyethylene sleeves, there was a significant increase in bunch weight ($P < 0.01$) and less peel-scarring by insects (crickets, grasshoppers, trashworms and *Platynota)* ($P < 0.001$); slugs ($P < 0.01$); rats ($P < 0.05$); and leaf rubbing ($P < 0.01$) than when unsleeved. However the decrease in maturation period of the sleeved bunches was not significant.

The results of another experiment carried out to compare the efficiency of locally manufactured, non-insecticidal bunch sleeves with the imported, dursban-impregnated ones, is given in table 6.

It was found that the local sleeves were satisfactory substitutes, except that more of them split under field conditions. Although the insecticidal sleeves offered better protection from peel scarring pests than the non-insecticidal ones ($P < 0.001$ for percentage scarring), there was no significant difference between them in mean bunch weight, mean time to maturity and percentage of fingers scorched by sun. The thicker sleeves reduced the incidence of leaf scarring ($P < 0.001$) and when untinted they also increased the bunch weight significantly ($P < 0.001$).

Control of banana flower thrips

Flower thrips *(Frankliniella parvula Hood)* enters the inflorescence just before it emerges or possibly even before and damages the peel of the young fruit by oviposition.

The comparative efficiency of single applications of 0.15% Malathion (=carbophos, American Cyanamid), Phosvel and Sevin (carbaryl, Union Carbide) to the 'throat' of banana plants at flowering was evaluated. Results presented in table 7 indicate that treatments with both Phosvel and Malathion reduced thrips damage significantly, Phosvel being more effective than

Table 6. The effect of covering bunches with six different types of sleeves compared with unsleeved bunches

Parameters Measured	Unsleeved control	Imported insecticidal		Locally manufactured, non insecticidal			
		0.05 mm blue	0.05 mm untinted	0.05 mm blue	0.05 mm untinted	0.075 mm blue	0.075 mm untinted
Mean bunch weight (in lb)	31.9	40.3	40.4	37.2	39.5	38.6	44.6
Maturation period (in days)	95.6	92.3	97.3	97.9	92.4	93.0	94.9
% of fingers scarred by insects	18.63	2.70	2.03	4.27	5.03	3.63	4.07
% of fingers scarred by leaf rubbing	1.27	0.77	0.57	0.73	0.87	0.39	0.33
% of fingers sporched	0.13	0.19	0.00	0.00	0.07	0.00	0.00
% of sleeves split	Not Applicable	1.87	0.97	12.50	27.45	11.83	25.04

Table 7. Percentage of fingers scarred by thrips in the three treatments, control and in the pre-treatment sample

Parameters measured	Pre-treatment[1]	Control	Treatments per 60 plants		
			Malathion	Phosvel	Sevin
Total no. of fingers	3,234	7,140	6,886	6,465	6,389
No. of fingers scarred by thrips	346	684	559	341	565
% of fingers scarred	10.41	9.58	8.12	5.36	8.90
Significance[2] of difference between control and other treatments	$P > 0.10$	–	$P < 0.05$	$P < 0.001$	$P > 0.10$

[1]Pre-treatment assessment was done on 30 plants only

[2]$P < 0.05$ and $P < 0.01$ indicate significant difference at 5 and 1% respectively

Malathion. However, the use of Phosvel has since then been suspended in Jamaica by health authorities and treatment with Malathion was not economical. Sevin was found to be ineffective against thrips.

However, the result of another experiment given in table 8 shows that the removal of up to two distal hands from two to three week-old bunches reduced the percentage of thrips damaged fingers without significant reduction in bunch weight. This is because thrips damage is more prevalent in the distal hands of the bunch. This operation also resulted in an increase of mean length and girth of fingers.

Table 8. Effect of removing distal hands of bunches after emergence of the last hand, on bunch weight finger length and girth and thrips scarring

No of hands on bunch at emergence	No. of hands removed	Mean bunch weight (in lb)	Mean finger length (in inches)	Mean caliper girth 1 inch = 32 units	% of fingers scarred by thrips
	0	28.5	7.4	35	14.1
	1	27.8	7.6	37	11.5
6	2	26.2	7.9	38	10.2
	3	22.4	8.1	40	12.4
	0	33.4	7.5	37	12.3
	1	34.3	7.6	39	8.4
7	2	32.8	7.9	41	8.7
	3	29.2	8.3	43	2.6
	0	39.9	7.8	38	17.1
	1	38.5	8.1	41	11.5
8	2	35.8	8.2	42	14.7
	3	30.1	8.3	44	11.2
	0	46.4	7.8	40	20.2
	1	47.3	8.0	44	14.7
9	2	43.6	8.3	43	12.6
	3	39.5	8.5	45	10.3
	0	51.3	8.0	40	18.9
	1	50.1	8.3	42	15.8
10	2	50.6	8.6	44	13.8
	3	42.2	8.9	46	8.0
	0	57.8	8.1	44	22.8
	1	56.1	8.5	45	14.1
11	2	55.3	8.9	47	16.3
	3	46.7	9.3	48	6.5

Table 9. Percentage of fingers scarred by slugs in the various molluscicidal treatments and control

Parameters measured	Treatments per 30 plants				
	Metaldehyde-coir dust bait at base	Metaldehyde – coir dust bait in 'throat'	Mesurol at base	Mesurol in 'throat'	Control
Total no. of fingers on bunches	2,537	2,699	2,586	3,056	2,844
No. of fingers scarred by slugs	739	189	853	303	910
Percentage of slug scarring	29.13	7.00	32.98	9.91	31.99
Significance[1] of difference from Control	$P > 0.10$	$P < 0.001$	$P > 0.10$	$P < 0.001$	–

[1] $P < 0.001$ indicates significant difference at 0.1%
$P > 0.10$ is not significant

Control of slugs

Two species of slugs – *Vaginulus* sp. and *Veronicella* sp. damage bananas by feeding on the pool. The traditional metaldehyde bait placed around the pseudostem base does not satisfactority control slugs unless applied repeatedly and over the entire field.

The efficiency of 5% metaldehyde – coir dust mixture and 4% methiocarb (mesurol, Bayer) pellets in the control of slugs when placed in the 'throat of plants with newly emerged bunches was compared with that of same baits placed around the pseudostem base.

Results presented in table 9 show that both 'throat' treatments were significantly more effective than the ground treatments ($P < 0.001$ in both cases). Metaldehyde bait en the 'throat' was found to be more effective and economical than the other treatments and therefore may be recommended.

CONCLUSION

The decline of the Banana Industry in Jamaica has been attributed to a number of causes of which drought, labour shortage and poor management are the ones often mentioned. These are no doubt legitimate contributory factors but the low yield in Jamaica (3.5 tonnes per acre) is in a large messure due to lack of proper pest management efforts. Pests pose a serious problem to banana production in Jamaica. The problem will continue unless the growers take a more active part in pest management. Efforts will continue towards finding safer and more economical methods of pest control in bananas.

REFERENCES

Arnold, A.J. 1967. Arnold Hand-operated applicator. Lab. Practice 16 (1): 56-57

Berrill, F.W. 1956. Bunch covers for bananas. Qd. Agric. J. 82: 435-440

Bond, W.B. 1974. Bunch sleeving trial. Ann. Rep. Banana Board, Jamaica 53-62.

Cann, H.J. 1965. Banana growing plantation practices. Agric. Gaz. N.S.W. 76: 672-678

Finney, D.J. 1947. Probit analysis. A statistical treatment of sigmoid response curves. Cambridge Univ. Press 389 pp.

Harris, W.V. 1947. The banana borer. E. Afr. Agric. J. 13: 15-18

Hord, H.H.V. and Flippin, R.S. 1956. Studies of banana weevils in Honduras. J. Econ. Ent. 493: 296-300.

Kuhne, F.A. and Kritzinger, H. 1964. Polyehtylene sleeves for banana bunches. Farming S. Afr. 40: 37-52

Ostmark, H.E. and Whyte, E.B. 1975. Banana peel-scarring pests. Bulletin No. 8, Research Dept., Banana Board, Jamaica.

Perumal, A. and Adam, A.V. 1968. Bagging of Giant Cavendish banana stems in Honduras. Trop. Agric. (Trin.) 45: 109-112

Phillips, C.A. 1971. The effect of polyethylene bunch cover on growth and quality of Robusta bananas. Proc. 2nd. Ann. Conf. ACORBAT, 80-88.

Turner, D.W. and Rippon, L.E. 1973. Effect of bunch covers on fruit growth and maturity in bananas. Trop. Agric. (Trin.) 50: 235-240.

NAME OF PAPER: Current status of Banana pest control research in Jamaica.
(K. Ittyeipe)

Questions by: R. Segeren-v.d. Oever
Country: Suriname

QUESTIONS:

1. Can you give us some more information on the chemical product Miral?

2. Did you ever observe Mocap is more easily leached than other nematicides? Of course this depends on soil type too.

ANSWERS:

1. Miral is an Organo phosphate insecticide/nematicide from CIBA-GEIGY. It is experimentally used in many crops including bananas. It is very effective against soil insects and nematodes. Please refer to Thompson (1977), Agricultural chemicals, Volume III on insecticides — a CIBA-GEIGY product manual for details of LD_{50}, formula — uses precautions.

2. Mocap is less soluble than Vydate but is more soluble than Nemacur. Mocap appears to move vertically in soil than horizontally, exept where there is soil wash and erosian as on hill slopes. The vertical movement maybe greater in Sandy Soil. Usual vertical movement is not more than 10 inches (25 cm in loamy soil.