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Effect of carbofuran and fenamiphos on three nematodes infesting banana

(Kesan karbofuran dan fenamifos pada tiga nematod yang menyerang tanaman pisang)

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Key words: nematodes, banana

Abstrak

Dua racun nematod, karbofuran dan fenamifos, telah diuji untuk kawalan tiga nematod parasit tumbuhan yang menyerang tanaman pisang kultivar Mas Raub. Populasi *Rotylenchulus reniformis, Meloidogyne incognita* dan *Helicotylenchus* spp. yang endemik tidak mengurangkan hasil pisang secara ketara walaupun rawatan fenamifos dan karbofuran mengurangkan populasi *M. incognita* dan *Helicotylenchus* spp. di dalam akar. Populasi *R. reniformis* di dalam tanah dan akar tidak dikurangkan secara ketara dengan penggunaan racun nematod tersebut.

Abstract

Two nematicides, carbofuran and fenamiphos, were tested for the control of three plant-parasitic nematodes infesting banana cv. Mas Raub. With an endemic populations of *Rotylenchulus reniformis, Meloidogyne incognita* and *Helicotylenchus* spp., the yield of banana was not significantly reduced although the treatments of fenamiphos and carbofuran lowered the population of *M. incognita* and *Helicotylenchus* spp. in the roots. The population of *R. reniformis* in soil and plant roots was not significantly reduced by the nematicides.

Introduction

Banana is grown in many parts of Malaysia since the crop provides substantial income for small and large-scale farmers. The success of banana cultivation is attributed to the use of suitable cultivars for various markets and needs, and proper agronomic practices. With the encouragement given by the Ministry of Agriculture to increase fruit production (Alwi 1986), the acreage of banana crops has increased. The estimated area under banana cv. Rastali, Berangan, Embun and Mas in Peninsular Malaysia is 9 508 ha which are mainly located in the states of Perak, Johor and Pahang (Anon. 1989).

Little information is available on the effect of nematodes on local banana production (Ramlah and Rukayah 1990) although many nematodes are associated with the crop. For instance, as early as 1939, several undescribed nematode species were found on banana (Thompson 1939). Control of the two well-known nematode genera affecting banana production, *Radopholus* and *Pratylenchus* spp., was considered important in ensuring the success of a crop diversification programme involving banana in Malaysian agriculture (Graham 1969). Currently, 14 species and 2 genera of plant parasitic nematodes, namely *Basirolaimus seinhorsti, Helicotylenchus dihystera, H.*

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erythrinae, H. multicinctus, H. pasohi, Macroposthonia denoudeni, M. ornata, Pratylenchus brachyurus, P. coffeae, Radopholus similis, Rotylenchulus reniformis, Tylenchorhynchus martini, Xiphinema orthotenum, X. radicicola, Hemicriconemoides sp. and *Meloidogyne* sp. have been recorded on banana (Raden Winoto and Sauer 1982; Abdul Karim and Mohamad Zaidun 1983). The most common genera among them are *Helicotylenchus, Pratylenchus, Radopholus, Meloidogyne* and *Rotylenchulus.* This study attempts to determine the effect of carbofuran and fenamiphos on three of the nematodes, namely *Rotylenchulus reniformis, Meloidogyne incognita* and *Helicotylenchu*s spp. *(dishytera* and *multicinctus),* infesting banana. The results will provide information on nematode damage on banana.

Materials and methods

The experiment was carried out on banana cv. Mas Raub in an experimental plot at MARDI station in Serdang. The plot was divided into 16 (9 m x 9 m) plots designated for the experimental treatment. A soil sample, consisting of 10 soil probes, was taken from each plot by using a 2.5 cm diameter soil auger for nematode population assessment before the experiment. Nematodes from a 200 mL sub-sample from each sample were extracted by Oostenbrink elutriator (Flegg and Hooper 1970). The initial nematode counts per 200 mL soil were *R. reniformis* 629, *Helicotylenchus* spp. 60, and *M. incognita* 2. Since the level of *R. reniformis* was the highest, the nematodes were extracted and cultured on banana seedlings grown on nematode-free soil in a glasshouse. The nematodes were extracted and then inoculated on the seedlings for the experiment at 30 000 nematodes/seedling in polybag to ensure the presence of a sufficiently high nematode population that could depress growth and yield of banana.

Meristem-cultured plants of banana cv. Mas Raub (Hamidah et al. 1987) were transplanted into black polybags containing nematode-free sand and kept in the glasshouse before field planting.

The experiment consisted of four treatments i.e.

A) naturally occurring nematodes,
B) naturally occurring nematodes + *R. reniformis* culture,
C) B + 3 % carbofuran (90 g *Furadan*/plant 1 month and 2 months after planting, and then every 4 months) and
D) B + 10 % fenamiphos (15 g *Nemacur*/banana before planting, and then every 4 months).

There were four plants in each treatment which was replicated four times in a randomized complete block design. Each replication was separated from the other by a guard row. The banana plants were manured with i) 60 g NPK (15:15:15)/plant 2 months after planting, ii) 120 g NPK (15:15:15)/plant 2 months later, iii) 300 g NPK (15:15:15)/plant 4 months later, iv) 300 g NPK (12:6:22)/plant 1 month later, v) 250 g NPK (12:6:22) and 50 g of muriate of potash/plant every 6 consecutive months.

Nematode populations in soil and roots were monitored every 2 months for a period of 2 years. At least 2 kg of composite soil and 50 g root samples were collected from each treatment replicate. Nematodes in soil (one 200 mL sub-sample) were extracted by Oostenbrink method (Flegg and Hooper 1970), while those in roots were assessed from acid fuchsin-stained roots (one 5 g sub-sample) and blended roots (one 5 g sub-sample).

Before harvesting, the circumference of the pseudostem was measured as an indication of plant growth. Mature fruit were harvested and the bunch length, bunch weight, number of combs per bunch, average weight of comb, average number of fruit per comb, average fruit length and average diameter of fruit were recorded.

Data of nematode population at the end of the experiment and the accumulated yield were subjected to the analysis of variance and Duncan's Multiple Range Test.

Results and discussion

The results showed that the application of fenamiphos and carbofuran did not significantly affect growth and yield of banana. The differences in parameters of growth and yield between treatments were not statistically significant ($p > 0.05$, *Table 1*).

The results also showed that fenamiphos and carbofuran had no significant effects on the populations of all the three nematode genera in the soil *(Table 2)*. However, in the roots, fenamiphos reduced the number of *H. dihystera* and *M. incognita* significantly ($p < 0.05$, *Table 2*).

The number of *R. reniformis* was the highest among the three nematodes. However, the nematode did not cause significant effect on plant damage and yield, and the number was not reduced by the nematicides.

Many researchers reported that the nematode caused various forms of damage to banana roots. The adult females fed on feeder roots of banana near the vascular cylinder causing distinct lesion near head region while the posterior remained outside the root and enlarged (Edmunds 1971). The reniform nematode caused endodermal cell wall thickening and breakdown around infected site with endodermal, pericycle and vascular parenchymal cells fusing into a syncytium (Li et al. 1984). However, the biological damage in the root tissues was

Table 1. Effects of nematicide treatments on banana yield at MARDI, Serdang

Treatment	Stem circum. (cm)	Total bunch no.	Bunch length (cm)	Bunch weight (kg)	No. combs/ bunch	Comb weight (kg)	No. fruit/ comb	Fruit length (cm)	Fruit diam. (cm)
A. Naturally occurring nematodes	43.89	10	28.30	1.78	5	0.72	16	8.29	3.36
B. Naturally occurring nematodes + *R. reniformis* culture	39.77	8	21.49	1.75	4	0.76	17	8.32	3.32
C. B + 3% carbofuran	39.72	9	21.67	2.03	5	0.76	16	8.33	3.29
D. B + 10% fenamiphos	40.95	12	21.23	1.74	5	0.73	16	8.39	3.32
S.E.	2.11	1.63	1.39	0.02	0.19	0.05	0.43	0.22	0.03

Table 2. Number of nematodes in soil and banana roots at the end of experiment at MARDI, Serdang

Treatment	No. of nematodes in 200 mL soil			No. of nematodes in 5 g banana root		
	Rot	Hel	Mel	Rot	Hel	Mel
A. Naturally occurring nematodes	12 800	58	8	220	8a	108b
B. Naturally occurring nematodes + *R. reniformis* culture	10 700	324	42	238	475b	12a
C. B + 3% carbofuran	28 600	300	16	104	167ab	15a
D. B + 10% fenamiphos	11 000	83	8	318	17a	8a
S.E.	163	66	24	91	99	20
	ns	ns	ns	ns	*	*

Rot = *Rotylenchulus reniformis*
Hel = *Helicotylenchus* spp.
Mel = *Meloidogyne incognita*

ns = not significant ($p > 0.05$)
* = significant ($p \leq 0.05$)
Mean values within each column with the same letters are not statistically significant ($p > 0.05$)

apparently not serious enough to affect aboveground growth and yield of banana even at a population level of more than 20 000 nematodes/200 mL soil in this experiment. If the nematode parasitism on banana roots in this study is similar to that of cowpea, the non-significant reduction in growth and yield of banana could partly be explained. In cowpea, although the nematode caused cellular modification such as thickening of cell wall, dense and granular cytoplasm (Rahman Razak and Evans 1976), yield was sustained at a very high nematode infestation (Razak 1975).

The other two nematodes, *M. incognita* and *Helicotylenchus*, were too small in numbers to affect the growth and yield of banana. Therefore, although there was a significant reduction of the nematode populations in the roots, no improvement of yield was observed.

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References

Abd. Karim, S. and Mohd. Zaidun, B. M. (1983). Nematod parasit tumbuhan utama pada tanaman pisang, *Musa sapientum*, di Semenanjung Malaysia. *MARDI Report No.* ***85*** Serdang: MARDI

Alwi, J. (1986). Dasar dan strategi pembangunan buah-buahan. *Prosid. Simp. Buah-buahan Keb. 1986* m.s. 12–32. Serdang: MARDI

Anon. (1989). *Area of Miscellaneous Crops Semenanjung Malaysia*, Kuala Lumpur: Ministry of Agriculture

Edmunds, J. E. (1971). Association of *Rotylenchulus reniformis* with 'Robusta' banana and *Commelina* sp. roots in the Windward islands. *Trop. Agric.* ***48(1):*** 55–61

Flegg, J. J. M. and Hooper, D. J. (1970). Extraction of free living stages from soil. In *Laboratory methods for work with plant and soil nematodes* 5th ed. (Southey, J. F., ed.) p. 5–22. London: HMSO

Graham, K. M. (1969). Pests and diseases of intercropped banana in West Malaysia. Paper presented at the Malaysian Crop Diversification Conf., 1969, 8 p.

Hamidah, G., Mohd. Shaib, J. and Mohd. Senawi, M. T. (1987). Pembiakan pisang Mas secara *in vitro*. *Teknol. Buah-buahan, MARDI* ***3:*** 7–11

Hooper, D. J. (1970). Extraction of nematodes from plant materials, p. 34–8. *See* Flegg and Hopper (1970)

Li, S. M., Xu, K. L., Li, C. S. and Fon, G. (1984). A study on the reniform nematod disease of dwarf banana in Guangdong Province of China. *Journal of South China Agricultural University* ***8 (4):*** 9–14

Rahman Razak, A. and Evans, A. A. F. (1976). An intracellular tube associated with feeding by *Rotylenchulus reniformis* on cowpea root. *Nematologica* ***22:*** 182–9

Ramlah, M. and Rokayah, A., ed. (1990). *Panduan penanaman pisang Mas* MARDI: Serdang

Razak, A. R. (1975). Host-parasite relationships of *Rotylenchulus reniformis* on cowpea and cotton. Ph. D Thesis, University of London

Raden Winoto, S. and Sauer, M. R. (1982). Plant parasitic nematodes associated with cultivated plants in Peninsular Malaysia. *Malaysian Applied Biology* ***11:*** 5–17

Thompson, A. (1939). Notes on plant diseases in 1937–1938. *Malayan Agricultural Journal* ***27:*** 86–98

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