MARDI Res. J. 23(1) (1995): 47–54

Distribution of phytoparasitic nematodes on anthurium in Peninsular Malaysia

(Taburan nematod fitoparasit pada anturium di Semenanjung Malaysia)

P. M. Yuen* and P. Y. Yau**

Key words: anthurium, parasitic nematodes

Abstrak

Pensampelan dari 22 kebun anturium di tanah rendah dan tinggi di Semenanjung Malaysia menunjukkan bahawa nematod fitoparasit yang berkaitan dengan anturium ialah *Radopholus similis, Pratylenchus coffeae, Helicotylenchus dihystera, Meloidogyne, Rotylenchulus reniformis, Criconemella, Paratylenchus* dan *Tylenchorhynchus*. Perosak utama ialah nematod pengorek akar *(R. similis)* dan nematod lesion *(P. coffeae)*. Kedua-dua nematod ini boleh merosakkan sistem akar dan seterusnya menyebabkan daun menjadi kuning dan pokok bantut. Serangan nematod tidak nyata kerana nematod ini menyerang satu-satu pokok sahaja ataupun pada kelompok kecil yang berselerak. Biasanya, petani tidak tahu bahawa serangan nematod berlaku. Oleh itu, tiada tindakan pencegahan diambil. Bagi mengelakkan serangan nematod, langkah pencegahan yang perlu diambil termasuk menggunakan racun nematod sebagai rawatan sebelum menanam, mendapatkan sulur yang sihat, menempatkan batas jauh dari tanaman yang diserangi nematod, melapikkan batas dengan lapisan politena dan membersihkan peralatan ladang.

Abstract

Sampling of 22 anthurium farms in the lowland and highland regions of Peninsular Malaysia showed that the phytoparasitic nematodes associated with the crop are *Radopholus similis, Pratylenchus coffeae, Helicotylenchus dihystera, Meloidogyne, Rotylenchulus reniformis, Criconemella, Paratylenchus* and *Tylenchorhynchus*. The important pests are the burrowing *(R. similis)* and lesion nematodes *(P. coffeae)*, both of which damage the root system and are responsible for the yellow foliage and stunting of affected plants. Nematode infestation is not conspicuous because infested plants occur singly or in small scattered patches. Farmers are generally unaware of the problem and subsequently, no prophylactic measures are taken. To avoid nematode infestations, precautions to observe include using nematicides as preplant treatment, obtaining healthy suckers, siting beds away from infected crops, lining beds with polythene sheets as well as keeping farm implements clean.

*Basic Research Division, Headquarters Station, MARDI Serdang, P.O. Box 12301, 50774 Kuala Lumpur, Malaysia
**Division of Horticulture, Headquarters Station, MARDI Serdang, P.O. Box 12301, 50774 Kuala Lumpur, Malaysia
Authors' full names: Yuen Pak Mun and Yau Peng Yam

Introduction

Anthurium (*Anthurium andraeanum* Lind. & Andre) or flamingo flower is one of the spectacular flowering plants cultivated in Malaysia and is mainly grown for cut-flowers or as potted plants. Its colourful spadix and long-lasting heart-shaped spathe borne on a long stalk makes an impressive floral display. With its glossy green leaves, it is a glamorous subject for indoor planting. Traditionally, cultivations of anthurium, especially the introduced varieties and hybrids, are mainly confined to the highlands as the growers believe that these varieties adapt well to the cooler climate of high altitudes. However, due to land scarcity in the highlands and the overwhelming popularity of the flower, plantings have rapidly expanded to the lowlands. In the highlands, anthurium is mostly grown under black shade-nettings or beneath plastic rainshelters while various planting systems have been adopted by growers in the lowlands. The latter include cultivating anthurium beneath artificial shelter or under the natural shade of mature oil palms and rubber trees. These diverse planting systems and cultural practices result in disparities in yield and flower quality. The common insect pests are thrips and mosquito bugs while the diseases are crown rot and spadix rot (Syed and Safruddin 1989). Besides these, phytoparasitic nematodes have been identified as potential pests of anthurium (Yuen and Yau 1993). Infested plants usually exhibit poor growth and produce smaller leaves and blooms than healthy ones of similar age. To determine the incidence and distribution of these nematodes under different planting systems, a survey was conducted in various anthurium-growing areas of Peninsular Malaysia.

Materials and methods

In the survey, farms were randomly selected from the main anthurium-growing regions of Peninsular Malaysia, which are mainly concentrated in the states of Johor, Pahang and Perak. Ten soil samples (and root samples wherever possible) were obtained from each farm. Samples were taken from anthurium plants which were stunted or showed signs of yellowing foliage as these were indications of possible nematode infestation. Soil was sampled with a trowel to a depth of 15 cm around the root region of the selected plant. Each sample consisted of approximately 1 L soil and 200 g roots. Root samples were taken only when there was no objection as farmers were generally not keen on root-sampling of their imported anthurium varieties. Nematode extraction from samples was carried out in the Nematology Laboratory at MARDI, Serdang. The contents of each soil sample were thoroughly mixed and two 200 mL sub-samples were obtained for nematode extraction using the Oostenbrink elutriator (Flegg and Hooper 1970). Similarly, endoparasites in roots were extracted through maceration and filtration of two 5 g root sub-samples from each sampling bag (Hooper 1970). Thus from each farm, 20 sub-samples of soil and 20 sub-samples of roots were processed.

Results and discussion

Anthurium cultivation

A total of 22 farms were sampled, including 10 from the highlands. The area planted with anthurium in each farm ranged from 0.1 ha to 24.0 ha, with most of the farms about 1.2–2.0 ha *(Table 1)*. The farms sampled represented an area of 34.3 ha in the lowlands, 5.1 ha in the Cameron Highlands and 2.0 ha in Fraser's Hill. The total area planted with anthurium in the Cameron Highlands is estimated to be 12.0 ha (Ahmad et al. 1993). Thus, a significant portion of the anthurium farms in the Cameron Highlands was covered in the survey. Figures are not available on the hectarage of anthurium farms in the lowlands.

In the current survey, it was noted that anthuriums were mainly grown under netting, giving usually some 85% shade to the crop *(Table 1)*. Some were planted under

Table 1. Nematode counts in 200 mL soil and 5 g roots of anthurium in Johor, Perak and Pahang

Locality	Farm size (ha)	Shade	Variety (No. samples)		Range of nematode counts (median in brackets)							
					Rado	Prat	Heli	Melo	Roty	Crico	Para	Tyle
Johor												
Bindu, Batu Pahat	1.2	Net	Hawaii (10)	S	0–133 (17)							
				R	100–2 062 (134)							
Parit Sikom, Pontian	0.8	Oil palm	Java (10)	S	0–550 (267)	0–133 (0)	0–250 (50)				0–283 (0)	
				R	0–467 (17)	0–2 167 (134)	0–33 (0)				0–12 867 (17)	
Kempas, Skudai, Johor Bahru	1.6	Net	Java (10)	S	0–100 (17)	0–50 (0)				0–1 400 (34)		
				R	0–367 (67)	0–233 (17)						
Paloh New Village, Kluang	0.2	Net	Hawaii (10)	S	0							
				R	0							
Nyior, Kluang	0.1	Rubber	Java (6)	S		0–650 (250)					0–100 (0)	
Ulu Tiram, Johor Bahru	24.0	Oil palm	Lunatte (2)	S					0–33 (17)			
				R	0							
			Mickey Mouse (2)	S	0–33 (17)							
				R	0–200 (100)							
			Cuba (2)	S	0							
				R	0–433 (217)		0–33 (17)					
			Far Orange (2)	S	67–100 (84)							
				R	100–567 (332)							
			Hajrija (2)	S	0							
				R	0–100 (50)							
Perak												
Sg. Gading, Tapah	2.0	Net	Java (10)	S		0–110 (159)		0–67 (0)				
Chenderiang, Jln. Tapah Lama	0.4	Net	Java (10)	S		0–1 417 (117)		0–50 (0)		0–1 050 (0)		
Kg. Woh, Jln. Pahang, Tapah	0.8	Net	Tropical (5)	S	0–33 (0)							
			Lunatte (5)	S	0–950 (50)							

(cont.)

Table 1. *(Cont.)*

Locality	Farm size (ha)	Shade	Variety (No. samples)		Range of nematode counts (median in brackets)							
					Rado	Prat	Heli	Melo	Roty	Crico	Para	Tyle
Batu 4.5, Jln. Pahang, Tapah	0.4	Net	Cuba (4)	S				0–33 (0)	0–133 (33)			
				R	0							
			Obaki Pink (3)	S	0–133 (0)							
				R	0							
			Tropical (3)	S			0–17 (0)	0–17 (0)				
				R				0–200 (0)				
Batu 7, Jln. Pahang, Tapah	0.8	Shade & rain-shelter	Cuba (5)	S	0							
				R	0–33 (0)	0–67 (0)						
			Tigon (2)	S	0							
				R	0					0–33 (0)		
			Avanti (2)	S	0							
				R	0							
			Paradiso (2)	S	0							
				R	0							
Pahang												
Muadzam Shah	2.0	Oil palm	Avo Nette (5)	S			17–383 (267)					
			Southern Blush (5)	S			0–1 100 (117)					0–17 (0)
Fraser's Hill	2.0	Forest	Java (10)	S		0–50 (17)	0–100 (9)	0–317 (67)	0–617 (75)	0–250 (0)		
				R		0–1 167 (33)		0–233 (0)				
Blue Valley, Cameron Highlands	1.2	Rain-shelter & net	Cuba (5)	S	0							
			Lunatte (5)	S	0							
				R	0–100 (0)							
Kuala Terla A, Cameron Highlands	0.3	Net	Avo Nette (9)	S	0–67 (0)	0–233 (0)	0–33 (0)					
				R	0–33 (0)	0–33 (0)						
Kuala Terla B, Cameron Highlands	0.4	Rain-shelter & net	Linda der Mont (3)	S					0–33 (0)			
			Tropical (4)	S	0							
Ulu Ringlet, Cameron Highlands	0.4	Net	Lunatte (10)	S	0–300 (33)	0–367 (0)		0–667 (0)		0–33 (0)		
				R	0–367 (67)							

(cont.)

Table 1. *(Cont.)*

Locality	Farm size (ha)	Shade	Variety (No. samples)		Range of nematode counts (median in brackets)							
					Rado	Prat	Heli	Melo	Roty	Crico	Para	Tyle
Bertam Valley A, Cameron Highlands	0.8	Net	Unknown (orange) (10)	S	0–100 (0)	0–33 (0)						
				R	0–400 (0)	0–767 (33)						
Bertam Valley B, C. Highlands	0.1	Net	Hawaii (10)	S			0–700 (84)	0–200 (0)	0–3 800 (1 400)			
Bertam Valley C, C. Highlands	1.2	Net	Nitta (10)	S			0–33 (0)		0–100 (0)			
Bertam Valley D, C. Highlands	0.3	Net	Nitta (10)	S				0–33 (0)				
Bertam Valley E, C. Highlands	0.4	Net	Java (5)	S	0–33 (0)		0–133 (33)	0–167 (0)	20–1 700 (233)			
			Lunatte (3)	S			67–300 (133)		300–700 (400)			
			Nitta (2)	S			233–300 (267)		767–1 067 (912)			

Rado = *Radopholus similis* Roty = *Rotylenchulus reniformis* S = soil samples
Prat = *Pratylenchus coffeae* Heli = *Helicotylenchus dihystera* R = root samples (taken with farmer's consent)
Para = *Paratylenchus* sp. Crico = *Criconemella* sp.
Melo = *Meloidogyne* sp. Tyle = *Tylenchorhynchus* sp.

the natural shade of oil palm or rubber; with one instance in Fraser's Hill where the crop was grown beneath the canopy of jungle trees.

The main variety of anthurium grown in Peninsular Malaysia is the local variety (Java) which is grown mainly under natural shade. Other popular varieties planted are Avo Nette, Hawaii, Lunatte and Nitta. Less common are Avanti, Avo Jose, Cuba, Far Orange, Hajrija, Linda der Mont, Mickey Mouse, Obaki Pink, Paradiso, Southern Blush, Tigon, Tropical and Uranus. Most of the introduced varieties/hybrids are grown beneath artificial shade (black netting and plastic rainshelter). As most of the imported anthurium varieties are from temperate countries, it is natural that the majority of them are grown in the cooler environment of higher altitudes. On the other hand, the local variety Java is mainly grown in the lowlands. In the lower altitudes, many of the anthurium farms are located in the state of Johor which is in proximity to the export market of Singapore. There is, however, a conglomeration of farms at the foothills of Cameron Highlands, namely the Tapah district. This has come about because of the scarcity and high cost of land in the Cameron Highlands. Most of these farms are in fact managed by highland growers.

Nematodes associated with anthuriums

The survey data do not reveal any obvious trends in nematode infestation under different shelters i.e. natural shade or artificial structures. With few exceptions, nematode infestation of anthuriums is usually by more than one genus while the same species can be found at both high and low altitudes *(Table 1)*. It is not possible in this study to state which anthurium variety

is more susceptible, suffice to say that almost every variety sampled harboured nematode parasites. Plant parasitic nematodes recovered from anthurium beds and listed in descending order of frequency of occurrence were *Radopholus similis, Pratylenchus coffeae, Helicotylenchus dihystera, Meloidogyne* sp., *Rotylenchulus reniformis, Criconemella* sp., *Paratylenchus* sp. and *Tylenchorhynchus* sp. *(Table 2)*. The stunt nematode, *Tylenchorhynchus*, is rare on anthuriums and was detected on only one occasion at Muadzam Shah in Pahang. The most commonly encountered nematode was *R. similis* which was found in more than half of the sampled farms. This was followed closely by *P. coffeae* and *H. dihystera* which were recorded on 45% and 41% of the farms, respectively. *Meloidogyne* and *R. reniformis* were present in a third of the localities. The maximum nematode numbers recorded in soil and roots are also shown in *Table 2*. However, these figures do not necessarily reflect the severity of infestation on the crop. A better interpretation can be obtained through the median records. These data show that among the genera, *Rotylenchulus* had the highest median with 1 400 larvae/200 mL soil. However, no information is available on the pathogenicity of this nematode on anthuriums. More than 200 nematodes/200 mL soil (median) were recorded for *Radopholus, Pratylenchus* and *Helicotylenchus*. The high infestation levels of these nematodes are also reflected in their corresponding median records of root populations. This is an indication of the severity of attack by these parasites.

It should be noted that the two most commonly encountered nematodes, *R. similis* (burrowing nematode) and *P. coffeae* (lesion nematode), are root endoparasites. These two species are easily dispersed through planting material when suckers from infested parents are transplanted to new beds. Infective stages of the parasites within the roots soon colonise the newly established root system, causing dark brown lesions and necrotic roots (Aragaki et al. 1984). *R. similis* is a major pest of anthuriums in Hawaii and can cause as much as 50% loss in floral production (Aragaki et al. 1984) and is a major limiting factor in production and flower size (Hara et al. 1988). In Malaysia, *P. coffeae* has been found to cause root damage and severe stunting of anthurium plants with small-sized blooms, thus reducing marketability (Yuen and Yau 1993). Both nematodes damage root cortical tissues and the lesions may coalesce to completely sever a root. Injury to the roots also provides entry points for other pathogens such as bacteria and fungi, thus exacerbating the damage.

Table 2. Prevalence of various nematode genera in anthurium farms

Nematode genus	Soil (per 200 mL)			Roots (per 5 g)	
	Occurrence in 22 farms (%)	Maximum nematode no. recorded	Highest median recorded	Maximum nematode no. recorded	Highest median recorded
Radopholus	54	950	267	2 062	333
Pratylenchus	45	1 417	250	2 167	134
Helicotylenchus	41	1 100	267	33	17
Meloidogyne	36	667	67	233	0
Rotylenchulus	32	3 800	1 400	*	*
Criconemella	18	1 050	0	33	0
Paratylenchus	14	1 400	34	12 867	17
Tylenchorhynchus	4	17	0	0	0

*Roots not taken in samples in which *Rotylenchulus* larvae were isolated.

The status of the other nematodes as serious pests of anthuriums is not established. The pin nematode, *Paratylenchus*, although recovered from 14% of the anthurium farms sampled, is not common in other Malaysian crops. In Sri Lanka, it is one of the most common nematodes isolated in large numbers from the root zone of young and mature tea, but there is no evidence of pathogenicity (Campos et al. 1990). More than 14 species of *Helicotylenchus* have been detected on vegetable crops but none has been shown of economic importance (Netscher and Sikora 1990). Information on the pathogenicity of *Criconemella* on anthuriums is lacking while no work has been done locally on the effect of the root-knot nematode, *Meloidogyne*, on anthuriums.

This survey indicates that symptoms of nematode damage on anthuriums are not manifested evenly within a plot. Nematode-infested plants are stunted, bear small inflorescences with yellow tinges in the mature foliage (chlorosis), and are irregularly distributed. Nematode infestation is, therefore, not conspicuous. Thus, it is not surprising that the majority of farmers interviewed in this survey were not aware of any potential nematode problem on their crops. In no instance was nematicide applied to anthuriums in any of the farms visited.

Prophylaxis

Nematodes of proven pathogenicity that local anthurium farmers should be cautious of are *R. similis* and *P. coffeae.* Judging from the results of this survey, these two nematodes form a potential threat to anthurium plantings and proper measures should be taken to keep the pests in check or prevent and evade fresh infestations. To avoid the transfer of these endoparasitic nematodes to new plantings, precautions taken should include cutting off all roots from transplants that are to be used to establish a new bed. The lower portion of the stem from a source plant that has been in contact with soil should also be trimmed off. As an additional prophylactic measure, new planting beds may also be treated with fumigant or some other suitable nematicide to eradicate any phytoparasitic nematodes that may be present in the soil. Fumigation has the added advantage of effectively exterminating other pests as well. It is recommended that the phytotoxicity effects of a nematicide be determined on a few plants before treating a large area.

When constructing new planting beds, care should be taken to avoid taking soil from areas where a crop which is susceptible to these nematodes is grown e.g. banana and pepper. As the oil palm, *Elaeis guineensis*, has been listed as a host to *R. similis* albeit without reports of economic damage (Griffith and Koshy 1990), anthurium growers siting beds beneath mature palms must take special care when selecting a source of soil for filling the planting beds to avoid inadvertent transfer of nematodes should they be present. Lining an anthurium bed with a root barrier such as polythene sheets can retard contamination from adjacent infested plots. To limit nematode dispersal, implements used to till beds suspected of harbouring nematodes should be washed clean of adhering soil before being used in 'clean' beds. Propagating stock should be nematode-free.

Acknowledgements

The authors would like to thank Ms Nik Azah Nik Abdullah and Mr Shamsulkamal Safar for technical assistance, and also express their gratitude to the staff from various stations of the Department of Agriculture and MARDI who kindly helped in locating the anthurium farms.

References

Ahmad, A., Syed, A. R. and Yau, P. Y. (1993). Production of temperate flowers. In *Souvenir Programme Book Seminar Industri Bunga-bungaan* 18 Sept. 1993, Penang, p. 71–6

Aragaki, M., Apt, W. J., Kunimoto, R. K., Ko, W. H. and Uchida, J. Y. (1984). Nature and control of anthurium decline. *Plant Disease* ***68:*** 509–11

Campos, V. P., Sivapalan, P. and Gnanapragasam, N. C. (1990). Nematode parasites of coffee, cocoa and tea. In *Plant parasitic nematodes in subtropical and tropical agriculture* (Luc, M., Sikora, R. A. and Bridge, J., ed.) p. 387–430. United Kingdom: CAB International, Inst. Parasitology

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* (Southey J. F., ed.) (Tech. Bull. 2) p. 5–22. London: Min. Agric., Fish. & Food, HMSO

Griffith, R. and Koshy, P. K. (1990). Nematode parasites of coconut and other palms, p. 363–86. *See* Campos et al. (1990)

Hara, A. H., Nishijima, W. T. and Sato, D. M. (1988). Impact on *Anthurium* production of controlling an orchid thrip (Thysanoptera: Thripidae), an *Anthurium* whitefly (Homoptera: Aleyrodidae), and a burrowing nematode (Tylenchida: Tylenchidae) with certain insecticide-nematicides. *J. Econ. Entomol.* ***81(2):*** 582–5

Hooper, D. J. (1970). Extraction of nematodes from plant material, p. 55–8. *See* Flegg and Hooper (1970)

Netscher, C. and Sikora, R. A. (1990). Nematode parasites of vegetables, p. 237–83. *See* Campos et al. (1990)

Syed, A. R. and Safruddin, H. (1989). Major pests and diseases of highland cut flowers. Paper presented at the Seminar Bunga-bungaan: Perosak dan penyakit, Cameron Highlands, Pahang, 30 Sept.–1 Oct. 1989, 14 p. Organizer: MARDI

Yuen, P. M. and Yau, P. Y. (1993). Incidence and control of nematode pests of anthurium. *Teknol. Pelbagai Tanaman, MARDI* ***9:*** 27–30

Accepted for publication on 15 March 1995