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Studies on *F. oxysporum* f. sp. *cubense* - nematode interaction in banana cv. 'Monthan'

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Abstract

Inoculation of *Fusarium* wilt pathogen (*Fusarium oxysporum* f. sp. *cubense*) to soil already infested with *Pratylenchus coffeae* and *Meloidogyne incognita* resulted in the early onset and increased severity of the *Fusarium* wilt disease. In addition, *Fusarium*-nematode interaction resulted in significant reduction in plant growth and yield parameters of banana cv. Monthan.

Keywords: *Fusarium oxysporum* f.sp. *cubense*, *Meloidogyne incognita*, *Pratylenchus coffeae*, Nematode.

Introduction

Banana (*Musa* spp.) is one of the commonly cultivated fruit crops. It is otherwise called as "Apple of Paradise" and is one of the oldest and most valued fruits known to mankind. The demand for the banana is increasing due to increase in population. To meet out an estimated demand of 25 million tonnes by 2020, the productivity is to be increased (FAO, 2010) [2]. But the main hurdle in increasing the productivity is the threat posed by wilt disease caused by *Fusarium oxysporum* f.sp.*cubense* (E.F. Smith) Snyder and Hansen. Banana plant is not only attacked by fungal pathogens but also by plant parasitic nematodes. Among the different banana nematodes, *Radopholus similis*, *Pratylenchus coffeae*, *Heterodera multicaulis* and *Meloidogyne incognita* are the most widespread. Further, nematode association encouraged early development of wilt symptoms. The present study was therefore, taken up to assess the occurrence of wilt complex of banana due to the interaction of *Fusarium oxysporum* f.sp. *cubense* with nematodes.

Materials and Methods

Isolation of nematodes

The isolates of *M. incognita*, *Pratylenchus coffeae* were isolated from soil and roots collected from Eyyalore village in Cuddalore district of Tamil Nadu. Morphological characters of female, male and juveniles of nematodes was studied and confirmed with the help of descriptions outlined by Williams (1973) [10].

Extraction of nematodes from banana roots

Root lesion nematode

The root lesion nematode *Pratylenchus coffeae* from banana cv. 'Monthan' was extracted as per Baermann funnel technique (Baermann, 1971) [1]. The infected roots of banana were collected, cut and washed carefully to remove the adhering soil particles. Roots were thoroughly mixed with 50 ml of water and blended gently for two min. in blender and root sample along with water was subsequently transferred to tissue paper, placed on a wire mesh cup in a Petri dish. Sufficient water was added on Petri dish to immerse the mesh cup, tissue paper and root samples fully. After 48 h. the nematodes in the Petri dishes were collected and stored at 4°C. The number of nematodes extracted from the roots were estimated using a stereo zoom microscope and inoculated (@ 1000/ pot) around the roots of banana plants.

Root-knot nematode

The root-knot nematode, *Meloidogyne incognita* from infected roots of banana plants was cultured on tomato plants. Egg masses collected from the tomato plants were placed in Petri dishes containing distilled water in to which air was bubbled every two hours to accelerate hatching. The freshly hatched J₂ were inoculated @ 1000/ pot (Thangavelu *et al.*, 2001) [9].

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Assessment of rapidity of symptom development of wilt disease in the wilt-nematode interaction system in banana

Three months old banana suckers of uniform size obtained from disease free banana garden were pared to a depth of one cm to remove superficial infestation and treated in hot water (50-55°C) for 10 min. and planted in the pots filled with 20 kg sterilized soil. Ten days after planting, the nematodes viz., *P. coffeae* and *M. incognita* were inoculated separately @ 1000/pot. Two months after inoculation, the pathogen *F. oxysporum* f.sp. *cubense* multiplied in sand-maize medium was applied @ 10g/pot. From third month after inoculation of nematodes i.e, one month after inoculation of *F. oxysporum* f.sp. *cubense* three plants from each treatment were pulled out and observation on wilt incidence based on 1-5 scale (Ploetz *et al.*, 1999) [7] root lesion (Pinochet, 1988) [6] root-knot index based on 1-5 scale (Heald *et al.*, 1989) [3] were recorded. The nematode population of *P. coffeae* and *M. incognita* in roots were recorded up to 6th month after inoculation of nematodes. Besides, observations on the growth parameters such as plant height, pseudostem girth, number of leaves/plant, leaf area/leaf and root length were also taken. The field experiment was conducted in a randomized block design with three replications for each treatment. The treatment schedule is given below.

Treatment Schedule

T₁- *Meloidogyne incognita*

T₂- *Pratylenchus coffeae*

T₃- *F. oxysporum* f.sp. *cubense*

T₄- T₁ + T₃

T₅- T₂ + T₃

T₆-T₁+ T₂ + T₃

T₇- Control

Results and Discussion

In this study it was observed that the external symptoms of the wilt disease appeared even at one month after inoculation of *F. oxysporum* f.sp. *cubense* in the plants pre - inoculated

with either of the nematodes viz., *M. incognita* and *P. coffeae*. However, the severity of wilt incidence was the maximum (50.13%) when both the nematodes were present as compared to inoculation with *F. oxysporum* f. sp. *cubense* alone (19.52 %) or with either of the nematodes viz., *M. incognita* (29.25 %) and *P. coffeae* (21.33%). In the case of *F. oxysporum* f. sp. *cubense* alone inoculated plants, the symptoms started appearing only at two months after inoculation of the pathogen (Table 1).

In general different growth parameters such as plant height, pseudostem girth, number of leaves, leaf area and root length were significantly reduced due to nematode infestation and *F. oxysporum* f.sp. *cubense* infection. The maximum reduction of all the growth parameters viz., plant height (150.15 cm), pseudostem girth (29.06 cm), number of leaves (13.05), leaf area (1100.73 cm²) and root length (40.24 cm) was observed in the treatment with inoculation of *M. incognita*, *P. coffeae* and *F. oxysporum* f.sp. *cubense*. This was followed by the treatments with *M. incognita* plus *F. oxysporum* f.sp. *cubense* and *P. coffeae* plus-*F. oxysporum* f.sp. *cubense* (Table 2). The inoculation of either of the pathogen or the nematodes alone also showed significant reduction in the growth parameters of banana when compared to control. Our results also confirm the finding of Patel *et al.* (2000) [5] who worked on the association of fungus and root knot nematode on banana and observed the significant reduction in plant growth in all the treatments, however, maximum reduction being in plants inoculated simultaneously. Jonathan and Rajendran (1998) [4] also reported that the panama wilt disease symptoms were higher when nematode *M. incognita* was present and this complex had reduced the plant growth significantly. A significant reduction in plant growth parameters was recorded when plants were first inoculated with *P. coffeae* and *M. incognita* followed by *F. oxysporum* f.sp. *cubense* (Sundraraju and Thangavelu, 2004) [8]. Thus it is clear that the interaction of nematodes especially *M. incognita* with *F. oxysporum* f.sp. *cubense* resulted in enhanced wilt incidence and also suppressed the plant growth parameters of banana.

Table 1: Influence of nematode population on *Fusarium* wilt development in banana cv. 'Monthan'

Tr. No.	Treatments	Months after <i>F. oxysporum</i> f. sp. <i>cubense</i> inoculation								
		Root lesion Index (%)			Root knot Index (%)			Wilt incidence (%)		
		1	2	3	1	2	3	1	2	3
1	<i>Meloidogyne incognita</i>	-	-	-	25.62 (32.23)	28.45 (32.23)	29.50 (32.89)	-	-	-
2	<i>Pratylenchus coffeae</i>	28.25 (32.10)	29.00 (32.58)	29.75 (33.05)	-	-	-	-	-	-
3	<i>F.oxysporum</i> f. sp. <i>cubense</i>	-	-	-	-	-	-	-	10.23 (18.65)	19.52 (26.21)
4	T ₁ + T ₃	-	-	-	11.43 (19.76)	26.33 (30.87)	30.45 (33.49)	11.54 (19.85)	21.33 (27.50)	29.2 (32.74)
5	T ₂ + T ₃	11.30 (19.64)	24.68 (29.78)	29.32 (32.78)	-	-	-	11.50 (19.82)	19.45 (26.16)	21.33 (27.50)
6	T ₁ + T ₂ + T ₃	12.00 (20.26)	23.45 (28.96)	30.45 (33.49)	29.42 (32.84)	32.63 (34.83)	38.41 (38.41)	29.52 (32.91)	34.25 (35.81)	50.13 (45.07)
7	Untreated control	-	-	-	-	-	-	-	-	-
	SEd	0.02	0.01	0.01	0.32	0.12	0.01	0.01	0.02	0.25
	CD (p=0.05)	0.05	0.02	0.02	0.75	0.28	0.03	0.02	0.05	0.62

(-): No symptom observed

Data in parentheses indicate angular transformed values.

Table 2: Effect of nematode infestation and *F. oxysporum* f. sp. *cubense* infection on growth and development of banana cv. 'Monthan'

Tr. No.	Treatments	Growth parameters at vegetative stage				
		Plant height. (cm)	Pseudostem girth (cm)	No. of leaves/plant	Leaf area/leaf (cm ²)	Root length (cm)
1	<i>M. incognita</i>	215.25	33.02	12.72	1560.31	49.02
2	<i>P. coffeae</i>	210.33	33.32	12.02	1632.68	50.08
3	<i>F. oxysporum</i> f. sp. <i>cubense</i>	215.41	33.25	13.89	1578.52	52.47
4	T ₁ + T ₃	200.62	30.68	11.38	1438.61	36.84
5	T ₂ + T ₃	205.31	32.72	12.18	1300.98	49.90
6	T ₁ + T ₂ + T ₃	150.15	29.06	11.05	1100.73	36.24
7	Control	220.21	35.38	16.24	2203.02	65.25
	SEd	0.02	0.01	0.02	9.44	0.72
	CD (p=0.05)	0.05	0.03	0.06	11.22	1.93

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