Vol. 40, No. 1, pp. 48-54 Indian Journal of Nematology June, 2010

Identification of Nematode Resistant Gene Sources Against Root-Lesion Nematode (*Pratylenchus coffeae*) in Banana

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ABSTRACT: An experiment was conducted in pots under green house condition during 2003-04 to evaluate for tolerance/resistance in banana varieties against root-lesion nematode. Among 72 *Musa* germplasms screened against root-lesion nematode, cvs. Singhlal, Sakkarachayna, Malai Kali, Manik Champa, Madavazhai, Kartobiumtham and Marabale were found resistant to *Pratylenchus coffeae,* whereas cvs. Chakia, ReDia, Ratisa local, Dudh Sagar, Rersian, Karibale, Kechulepa, Rajapuri India, Raidi Chinna, Wather, Chakkara Kannan, Yenagu Rontha, Kachkel, Soniyal and Ambeli were found moderately resistant to root-lesion nematode. It is interesting to note that the cultivars Kothia, Gragric Sarpara, Elavalai, Myndoli and Virupakshi though recorded high root-lesion indices and nematode populations, the reaction of plant growth parameters was minimal which proved that they posses a high degree of tolerance to *P. coffeae.* The remaining 43 varieties were found susceptible to *P. coffeae,* of which nine varieties were exhibited highly susceptible to *P. coffeae.*

Key words: Banana germplasm, *Pratylenchus coffeae,* tolerance, resistance, susceptible

The root-lesion nematode, *Pratylenchus coffeae* considered to be the economically important nematode pests of banana is widely distributed in South India (Sundararaju, 1996). Crop losses caused by nematodes to banana are very high, with an average annual yield losses estimated at about 20% worldwide (Sasser & Freckman, 1987). Crop losses caused due to *P.coffeae* in cv.Nendran was reported as 44.4% (Sundararaju & Cannayane, 2003). These nematodes can be controlled with the chemicals, but they may have adverse environmental effects and the use of nematicides is too expensive dangerous for subsistence farmers. Breeding for host plant resistance is a promising strategy for controlling nematodes (Speijer & De Waele, 1997). Since the root-lesion nematode has been well documented to cause considerable yield losses to banana, the present study was undertaken to evaluate 72 banana germplasms in pots under greenhouse conditions for locating the resistant/tolerant reaction to root-lesion nematode.

MATERIALS AND METHODS

Seventy two banana germplasms including two reference cultivars were tested in pots under greenhouse conditions at National Research Centre for Banana, Podavur, Tiruchirapalli during 2004-2005. Healthy uniform suckers of banana cultivars were planted in individual pots (40 x 25 cm) containing 5 kg sterilized loamy soil. The pots were arranged in a randomized manner under the greenhouse condition maintained at a temperature range of 25-30°C with a minimum photo period of 12 h daily. After one month, the plants were inoculated with 5000 active nematodes of *P. coffeae* in each plant. The root-lesion nematode, *P. coffeae* was extracted from axenic culture maintained on carrot discs in 1% bacto-agar medium. Five replications were maintained for each cultivar. A known resistant cultivar Yankambi KM 5 and susceptible cultivar Nendran were chosen as a reference culivars with respect to *P. coffeae*.

Six months after inoculation, the plants were carefully depotted and washed to remove the adhering soil particles. At the time of termination of the experiment, biometric observations like plant height and weight, pseudostem girth and no. of leaves were recorded from all the 72 germplasm in order to assess the damage caused by the nematodes (a measure for the tolerance/sensitivity of the accessions) and the reproduction of the nematodes (a measure for the resistance/susceptibility of the accessions). Root mass, root vigour, no. of healthy and

infested roots, root length and visual observation on root-lesion indices were recorded based on 1 to 5 scales as described by Pinochet (1988). After indexing, complete roots were removed from banana, mixed thoroughly and three aliquots of 10 g each were collected from each seedling. The collected roots were cut into 1 cm pieces and macerated in a kitchen blender for 45 seconds. The suspension was passed through 250, 106 and 40 µm pore sieves, rinsed with tap water and the nematodes were collected from the 40 µm pore sieve and estimated by using stereoscopic microscope.

Statistical analysis

The results of the experiment on the reaction of different varieties against root-lesion and root-knot nematodes were analyzed as a factorial randomized block design.

RESULTS AND DISCUSSION

The data on biometric observations recorded from 72 *Musa* germplasm evaluated in pots under greenhouse conditions are presented in Table 1 and 2.

Biometric observation

It is seen from Table 1 that significant increase in plant growth, shoot weight, pseudostem girth and number of leaves was recorded in cvs. Singhlal, Malaikali, Karpooravalli, Boddida Bukisa, Manik champa, Gragric Sarpara, Baidi Chinna, Elavazhai, Karthobiumtham, Virupakshi, Rajthali, Marabale and Kalyan Bale. The remaining varieties are on par with each other but the plant growth, plant weight, pseudostem girth and no. of leaves were differed between the varieties.

Root damage assessment

It was observed from Table 2 that significant increase in root characters like no. of roots, no. of infested/healthy roots, length and weight of the roots were noticed in varieties viz., Singhlal, Beula, Malaikali, Karpooravalli, Boddida Bukisa, Manik Champa, Bhurkal, Karibole, Kechulepa, Gragric Sarpara, Yanugu bontha and Ambeli. About 80% of the roots were infested with the nematodes in varieties viz., Kothia, Pisang Raja, Battisa Piro, Enna Benian, Cuba, Bersain, Kehulepa, Nendranpadathi, Manohar, Bacharia Malbhog, Kechulepa, Kullan, Jawari Bale, Pacha and Kachkel (Table 2). Among the 72 varieties screened, seven varieties namely Singhlal, Sakkarachayna, Malai Kali, Manik Champa, Gragric Sarpara, Karpooravalli and Boddida Bukkisa have shown significance increase in both shoot and root characters (Table 1 & 2).

Nematode reproduction

The perusal of the data shown in Table 3, indicated that minimum nematode population coinciding with negligible root-lesion index was noticed in varieties *viz.* Singhlal, Sakkarachayna, Malai Kali, Manik Champa, Madavazhai, Kartobium tham, Gragric Sarpara, Yanugu Bontha and Ambeli.

Plant response

Based on the shoot characters, root characters like root mass, root vigour, no. of healthy roots, no. of infested roots, root-lesion index and nematode population, the following seven out of 72 varieties namely Singhlal, Sakkarachayna, Malai Kali, Manik Champa, Madavazhai, Kartobiumtham and Marabale were found resistant to root-lesion nematode (Table1 & 2). Whereas, the cultivars Chakia, Beula, Batisa local, Dudh Sagar, Bersian, Karibale, Kechulepa, Rajapuri India, Baidi Chinna, Wather, Chakkara Kannan, Yenagu Bontha, Kachkel, Soniyal and Ambeli were found moderately resistant to root- lesion nematode. It is interesting to note that the cultivars Kothia, Gragric Sarpara, Elavalai, Myndoli and Virupakshi though recorded high root-lesion indices and nematode populations, the reaction of plant growth parameters was minimal which proved that they posses a high degree of tolerance to *P. coffeae.* The remaining 43 varieties were found susceptible to *P. coffeae,* of which nine varieties were exhibited highly susceptible to *P. coffeae* (Table 2).

Breeding for nematode resistance mainly involves in identification of sources of resistance and hybridization with susceptible cultivars which otherwise have favorable attributes. Therefore initial screening of germplasm has been suggested to identify suitable cultivars for resistance and tolerance to nematodes, which would further enable

Table 1. Reaction of banana accessions to root-lesion nematode, *Pratylenchus coffeae*

a) Plant growth parameters **(Mean of five replications)**

Variety	Genomic group	Plant height (cm)	Pseudostem girth (cm)	No. of leaves	Plant weight (kg)	Root length (cm)	Root weight (g)
Bersain	ABB	55 bcd	17 abcd	8 cdefg	1 bc	35 def	300 i
Kothia	ABB	85 hij	22 defg	7 bcde	1 bc	25 bc	300 i
Chakia	ABB	70 efg	20 bcdefg	7 bcde	2 def	25 bc	400 k
Beula	ABB	70 efg	21 cdefg	7 bcde	2.5 g	35 def	450 l
Singhlal	ABB	95 jkl	24 fg	10 gh	2 ef	35 def	450 l
Batisa local	ABB	80 ghi	24 fg	10 gh	1.5 bcd	20 ab	350 j
Pidimonthan	ABB	65 def	20 bcdefg	6 abc	1.8 cde	35 def	400 k
Lamby	ABB	85 hij	21 cdefg	8 cdefg	2 def	30 cde	400 k
Poombidiyan	ABB	80 hi	22 defg	6 abc	2 def	35 def	400 k
Vellapalayankodan	ABB	85 hij	23 efg	6 abc	1.5 bc	40 gf	200 h
Kalibow	AAB	65 def	13 a	7 bcde	1.8 cde	40 gf	300 i
Pisang Raja	AAB	65 def	21 cdefg	6 abc	1.3 ab	30 cde	350 j
Sakkarachayna	AAB	60 cde	18 abcde	6 abc	1.5 bc	40 gf	300 i
Matti Kali	AAB	90 ijk	23 efg	6 abc	2.5 g	45 gf	450 l
Batisa Piro	ABB	75 fgh	17 abcd	7 bcde	2 def	25 bc	350 j
Ennai Benian	ABB	55 bcd	22 defg	8 cdefg	1.8 cde	60 h	350 j
Shani Kela	ABB	85 cd	20 bcdefg	8 cdefg	2.3 fg	25 bc	450 l
Kanpooravalli	ABB	115 m	25 g	8 cdefg	2 def	30 cde	400 k
Boodda Bukkisa	ABB	95 jkl	31 h	10 gh	2.5 efg	35 def	400 k
Bhurkeli	ABB	85 hij	22 defg	7 bcde	2.5 g	40 fg	450 l
Hoobale	AAB	70 efg	15 ab	8 cdefg	1.3 ab	30 cde	100 e
Gragric Sarpara	AB	100 kl	20 bcdefg	9 ef	1.5 bc	30 cde	100 e
Manik Champa	AAB	80 ghi	20 bcdefg	9 efg	2 def	25 bc	400 k
Sabri	AAB	65 def	15 ab	6 abc	2.5 g	35 def	400 k
Padathi	AAB	75 fgh	20 bcdefg	7 bcde	1.5 bc	25 bc	100 e
Dudh Sagar	AAB	65 def	20 bcdef	6 abc	1.5 bc	20 ab	55 bc
Cuba	ABB	60 cde	20 bcdefg	7 bcde	1.8 cde	25 bc	100 e
Bersain	ABB	65 def	20 bcdefg	4 a	1.8 cde	20 ab	100 c
Peyan	ABB	70 efg	20 bcdefg	5 ab	2 def	15 a	50 bc
Koombidiyan	ABB	45 ab	15 bcdefg	7 bcde	1 a	15 a	30 A
Vennutmannan	ABB	75 fgh	20 ab	7 bcde	2 def	25 bc	50 Bc
Alukhel	ABB	70 efg	20 bcdef	8 cdefg	1.5 bc	30 cde	40 Ab
Karibale	ABB	65 def	20 bcdefg	5 ab	2 def	20 ab	100 c
Nendran	ABB	75 fgh	20 bcdefg	5 ab	2.5 g	40 fg	75 d
Madavazhai	ABB	65 def	20 bcdefg	5 ab	1.5 bc	35 efg	65 bcd
Kullar Kunnai	ABB	75 fgh	20 bcdefg	6 abc	1 a	20 ab	50 c
Mutheli	ABB	65 def	15 ab	4 a	1.3 ab	40 fg	65 cd

Variety	Genomic group	Plant height (cm)	Pseudostem girth (cm)	No. of leaves	Plant weight (kg)	Root length (cm)	Root weight (g)
Kehulepa	BB	80 ghi	20 bcdefg	9 efg	2 def	45 g	75 d
Nendrapadathi	BB	80 ghi	20 bcdefg	7 bcde	2 def	25 bc	75
Manohar	BB	85 hij	20 bcdefg	8 cdefg	1.8 cde	30 cde	50 bcd
Elavalai	BB	95 jkl	20 bcdefg	8 cdefg	2 def	25 bc	60 cd
Bacharia Malbhog	BB	75 fgh	20 bcdefg	7 bcde	2 def	35 def	55 bc
Kechulepa	ABB	80 ghi	20 bcdefg	6 abc	2.3 fg	35 efg	125 f
Kartobiumtham	AAB	85 hij	20 bcdefg	6 abc	2.3 fg	40 fg	150 g
Rajapuri India	AAB	85 hij	20 bcdefg	6 abc	2 def	40 fg	100 e
Attu Nendran	AAB	70 efg	20 bcdefg	6 abc	1 a	20 ab	75 d
Myndoli	AAB	80 ghi	20 bcdefg	8 cdefg	1 a	30 cde	75 d
Poovan	AAB	80 ghi	20 bcdefg	7 bcde	1.5 bc	40 efg	100 e
Digjowa	AAB	80 ghi	20 bcdefg	6 abc	2 def	40 fg	100 e
Kullan	AAB	65 def	20 bcdefg	7 bcde	1 a	25 bc	75 d
Baidi Chinna	AAB	100 kl	20 bcdefg	8 cdefg	1.5 bc	25 bc	75 d
Jawari Bale	AAB	65 def	20 bcdefg	10 gh	2 def	20 ab	50 bc
Virupakshi	AAB	115 m	25 g	8 cdefg	1.8 cde	25 bc	50 bc
Kadli	AAB	85 hij	20 bcdef	8 cdefg	1.8 cde	30 cde	75 d
Rajthali	AAB	105 lm	25 g	10 gh	2 def	40 bcd	150 g
Marabale	AAB	105 lm	20 bcdefg	8 cdefg	1.5 bc	25 bc	50 bc
Padaga	AAB	85 hij	20 bcdefg	8 cdefg	2 def	40 fg	75 d
Karpuram Bale	AB	115 m	25 g	12 h	1.5 bc	20 ab	75 d
Sanna Chenkadali	AA	50 abc	15 ab	8 cde	1.5 bc	20 ab	75 d
Wather	AAB	45 ab	18 abcde	7 abc	1.5 bc	20 ab	60 cd
Chakkarakannan	AAB	55 bcd	16 abc	8 cdef	1.5 bc	20 ab	55 bc
Pey kunnan	ABB	45 abc	18 abcde	8 defg	1.8 cd	20 ab	60 cd
Yenagu Bontha	ABB	55 bd	17 abcd	9 fg	1.8 cd	30 cde	75 d
Kallu Monthan	ABB	50 abc	16 abc	7 bcd	2 def	40 fg	150 g
Mas	ABB	45 ab	16 abc	9 defg	2 def	35 def	125 f
Gouria	ABB	40 ab	18 abcde	8 cde	1.5 bbc	35 def	100 e
Kachkel	ABB	55 bcd	15 ab	8 cde	2 def	45 g	75 d
Soniyal	AAB	55 bcd	15 ab	10 gh	2 def	35 def	120 f
Ambeli	AAB	50 abc	16 abc	10 efg	1 def	20 ab	75 d
Chandrabale	AAB	50 abc	15 ab	9 efg	2 def	35 def	100 e
Pisang Lilin[1]	AA	75 fgh	16 abc	8 cde	2 def	35 def	300 i
Robusta[2]	AAA	65 def	15 ab	6 abc	1.3 ab	30 cde	400 k

[1]Reference cultivar (nematode resistant variety)
[2]Reference cultivar (nematode susceptible variety)
Means in the same column followed by the same letter do not differ significantly according to Duncan Multiple Range Test for P<0.05%

Table 2. Reaction of banana accessions to root-knot nematode, *Pratylenchus coffeae*

b) Nematode reproduction and host infestation **(Mean of five replications)**

Variety	Genomic Group	No. of roots	Infected roots	Root (10g)	RLI*	Host reaction**
Bersain	ABB	75 ij	50 (66.7) f	190 z	4	HS
Kothia	ABB	100 lm	80 (80.0) k	96 st	3	S
Chakia	ABB	75 ij	55 (73.3) fg	40 fg	2	MR
Beula	ABB	140 o	40 (38.5) l	52 kl	2	MR
Singlal	ABB	150 p	50 (33.3) l	22 ghi	1	R
Batisa local	ABB	100 lm	45 (45.0) jk	74 op	2	MR
Pidimonthan	ABB	100 lm	75 (75.0) jk	210 z	4	HS
Lamby	ABB	95 kl	70 (73.7) ij	70 no	3	S
Poombidiyan	ABB	80 j	50 (62.5) f	65 mn	3	S
Vellapalayankodan	ABB	55 gh	40 (72.7) e	148 z	4	HS
Kalibow	AAB	90 k	70 (77.8) ij	130 x	3	S
Pisang Raja	AAB	100 lm	80 (80.0) k	146 z	4	HS
Sakkarachayna	AAB	90 k	30 (33.3) k	23 cd	1	R
Malai Kali	AAB	110 n	30 (27.3) k	24 mn	1	R
Battisa Piro	ABB	80 j	65 (81.3) hi	168 z	5	HS
Enna Benian	ABB	70 i	60 (85.7) gh	96 st	3	S
Shahil Kela	ABB	100 lm	70 (70.0) ij	160 z	4	HS
Karpuravalli	ABB	95 kl	15 (15.8) k	51 z	2	MR
Boddida Bukkisa	ABB	100 lm	30 (30.0) ij	55 wx	2	MR
Bhurkel	ABB	105 mn	40 (38) k	70 r	2	S
Hoobale	AAB	40 de	25 (62.5) bc	121 w	3	S
Gragric Sarpara	AB	50 fg	15 (30.0) de	52 rst	2	MR
Manik Champa	AAB	100 lm	25 (25.0) jk	21 gh	1	R
Sabri	AAB	110 n	80 (72.7) k	156 y	4	HS
Padathi	AAB	40 de	30 (75.0) cd	99 u	3	S
Dudh Sagar	AAB	35 cd	10 (28.5) ab	37 defg	2	MR
Cuba	ABB	50 fg	40 (80.0) e	82 ghi	3	S
Bersain	ABB	50 fg	30 (40.0) e	45 mn	2	MR
Peyan	ABB	30 be	10 (33.33) ab	52 q	2	MR
Koombidiyan	ABB	20 a	15 (75.0) a	95 rst	3	S
Vennutmanna	ABB	40 de	30 (75.0) cd	78 mn	3	S
Alukhel	ABB	20 a	15 (75.0) a	87 ijk	3	S
Karibale	ABB	30 bc	15 (52.0)	32 cd	2	MR
Nendran	ABB	40 de	30 (75.0) cd	254 z	5	HS
Madavazhai	ABB	45 ef	25 (56.0) ab	82 ghi	3	S
Kullar Kunnai	ABB	30 bc	20 (67.0) ab	84 m	3	S
Mutheli	ABB	45 ef	35 (77.8) de	78 pq	3	S

Variety	Genomic Group	No. of roots	Infected roots	Root (10g)	RLI*	Host reaction**
Kehulpa	BB	50 fg	40 (80.0) e	96 st	3	S
Nendrapadathi	BB	40 de	35 (87.5) de	156 z	4	HS
Manohar	BB	30 bc	25 (83.8) bc	95 mn	3	S
Elavalai	BB	40 de	10 (25.0) cd	851	3	S
Bacharia Malbhog	BB	45 ef	40 (88.9) e	150 x	4	HS
Kechulepa	ABB	50 fg	15 (30.0) e	19 b	1	R
Kartobiutham	AAB	60 h	20 (33.3) e	22 b	1	R
Rajapuri India	AAB	50 fg	30 (60.0) cd	90 b	3	S
Attu Nendran	AAB	35 cd	20 (57.1) ab	156 b	4	HS
Myndoli	AAB	35 cd	25 (71.4) bc	112 z	3	S
Poovan	AAB	40 de	30 (75.0) cd	120 ghi	3	S
Digjowa	AAB	50 fg	35 (70.0) de	121 b	4	S
Kullan	AAB	35 cd	30 (85.7) cd	90 b	3	S
Baidi Chinna	AAB	35 cd	25 (71.4) bc	82 c	3	S
Jawari Bale	AAB	25 ab	20 (80.0) ab	120 cd	3	S
Virupakshi	AAB	25 ab	10 (40.0) a	77 b	3	S
Kaali	AAB	40 de	25 (62.5) bc	82 b	3	S
Rajthali	AAB	50 fg	25 (50.0) bc	85 ghi	3	S
Marabale	AAB	20 a	10(50.0) a	2 fg	2	R
Pacha	AAB	30 bc	25 (83.3) bc	81 a	3	S
Kalyan Bale	AB	30 bc	15 (50.) ab	90 c	3	S
Sanna Chenkadali	AA	40 de	10 (75.0) cd	175 b	5	HS
Wather	AAB	40 de	20 (50.0) ab	35 v	2	MR
Chakkarakannan	AAB	40 de	15 (37.5) cd	38 cdef	2	MR
Pey kunnan	ABB	35 cd	25 (71.4) bc	76 efg	3	S
Yenagu Bontha	ABB	40 de	15 (37.5) bc	34 hij	1	R
Kallu Monthan	ABB	50 fg	25 (50) bc	102 cde	3	S
Mas	ABB	60 h	40 (66.6) e	285 u	5	HS
Gouria	ABB	40 de	30 (75.0) cd	78 z	3	S
Kachkel	ABB	50 gf	20 (40.0) e	30 jk	2	MR
Soniyal	AAB	60 h	35 (58.3) de	30 c	3	S
Ambeli	AAB	35 dc	20 (57.1) ab	78 c	3	S
Chandrabale	AAB	50 gf	35 (70.0) de	82 q	3	S
Yankambi KM5[1]	AAA	150 p	30 (20.0) 1	12 c	1	R
Nendran[2]	AAB	100 lm	80 (80.0) k	225 z	5	HS

[1]Reference cultivar (nematode resistant variety)

[2]Reference cultivar (nematode susceptible variety)

* RLI : 1 =No infection; 2 = 1-10 lesions; 3 = 11-15 lesions; 4 = 16-20 lesions; 5 = above 20 lesions

** Host Reaction: R = Resistant; MR = Moderately Resistant; S = Susceptible; HS = Highly Susceptible

the breeder to synthesize male breeding stocks that can be used in the *Musa* breeding programmes.

In the present study, seven *Musa* genotypes viz. Singhlal, Sakkarachayna, Malai Kali, Manik Champa, Madavazhai, Kartobiumtham and Marabale showed resistant reaction to *P. coffeae.* The results are in agreement with the earlier workers tested on different banana germplasm. Vadivelu *et al.,* 1987 reported that the following banana cultivars/hybrids *viz*., Kunnan, Vennettukunnan and hybrid-74 (Matti x Pisang lilin) were found tolerant/resistant to *P. co.ffeae.* Collingbom and Gowen, 1997 reported that the genotypes Calcutta -4, Yangambi Km 5, Paka (AA) and Kunnan (AB) have been shown to have significant resistance to *P. coffeae.* Sundararaju and Uma in 1998 reported that cultivars Calcutta -4, Burrow Cemsa and hybrid E.A.O322, FHIA-01 in Rome group showed the resistant reaction to *P. coffeae*.

ACKNOWLDEGEMENT

Authors are thankful to Dr. M.M. Mustaffa, Director, National Research Centre for Banana, Trichy, Tamil Nadu for providing necessary facilities and encouragement during the conduct of this study. Thanks are also due to Mr. T. Sekar, Technician for his technical assistance rendered in carrying out the work.

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Accepted for publication : May, 2010