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Assessment of infectivity against root knot nematode, *Meloidyne incognita* and lesion nematode, *Pratylenchus zeae* in sugarcane genotypes

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Abstract
A greenhouse experiment was conducted to screen against root knot nematode, *Meloidogyne incognita* with chip bud seedling 27 numbers of clones. Among them 19 clones were found to be moderately resistant, two resistance and six clones were susceptible. Another greenhouse experiment was conducted to screen against lesion nematode, *Pratylenchus zeae* using chip bud seedling same 27 clones. Among them 20 clones were found to be tolerant, one clone was moderately resistant and six clones were found to be susceptible. A separate field experiment was conducted to screen twelve clones against root knot nematode, *Meloidogyne incognita* and lesion nematode, *Pratylenchus zeae.* Among them seven clones were found to be moderately resistant and three clones were susceptible to root knot nematode. The check varieties, CoC 24 and CoC25 were found to be resistant. For lesion nematode eight clones were found to be tolerant and three clones were found to be susceptible. The check variety CoC 25 were found to be moderately resistant. A field experiment was conducted to screening of 33 sugarcane varieties/ clones against root knot nematode, *Meloidogyne incognita.* Among them seventeen clones were found to be moderately resistant, fourteen clones were susceptible. The two varieties (CoC 24 and CoC 25) were found to be resistant. A field experiment was conducted to screening of 33 sugarcane varieties/clones against lesion nematode, *Pratylenchus zeae.* Among them thirty clones were found to be tolerant and three clones were found to be moderately resistant C 15157, C 15499 and CoC 25.

Keywords: Root knot nematode and lesion nematode, sugarcane clones, screening

Introduction

In India nematodes are reported to cause about 10-40% yield loss in sugarcane (Sasser and Freckman, 1987) [17] whereas Dinardo-Miranda and Menegatti (2003) [7] estimated that the loss due to nematodes was up to 20% cane production. Five genera *viz*., Pratylenchus, Meloidogyne, Hoplolaimus, Tylenchorhynchus and Helicotylenchus are widely prevalent in sugarcane ecosystem. In Tamil Nadu, the association of all give genera of nematodes with sugarcane crop was documented by (Mehta, 1992) [12]. Certain genera particularly, Pratylenchus (20 species), Helicotylenchus (3 species) and Tylenchorhynchus (36 species) are widely distributed in sugarcane. Several others are common locally eg. Meloidogyne (7 spp), Xiphinema (52 spp), Hoplolaimus (11 spp.). Sugarcane is generally grown as a continuous monoculture crop with usually no more than a few months break between removing the old ratoon and replanting. Thus conditions tend to favour for the development of relatively large populations of nematodes. The nematodes associated with sugarcane rarely occur alone in the soil but are present in communities comprising a number of species. Surveys from several parts of Tamil Nadu showed that the number of genera present in a single soil sample ranges from one to 12 genera/species. Among these *Pratylenchus zeae*, *Meloidogyne incognita* and *Meloidogyne javanica* were reported as highly pathogenic nematodes (Stirling and Blair, 2007) [19]. Attention has so far focused on species of Pratylenchus and Meloidogyne as they are wide spread on sugarcane and generally considered the most damaging plant parasitic nematodes. Root lesion and root knot nematodes are obligate parasites of plants and their reproductive capacity is limited by the availability of roots. If a clone has smaller root system, the lower number of nematodes could be due to the limitations in the root biomass available as a food source. In introgression populations, it is even harder to have uniform root biomass because of the significant variation of the root and shoot biomass among test clones. Considering the above facts an attempt was made to screening the available clones against root knot and lesion nematode in sugarcane in both glasshouse and field conditions.

Materials and Methods

1. Greenhouse screening of sugarcane clones against root knot nematode, *Meloidogyne incognita*

To assess the level of resistance against root knot nematode, Meloidogyne incognita under glasshouse condition, a trial was performed with 27 sugarcane clones in the glass house located in Sugarcane Research Station, Tamil Nadu Agricultural University, Cuddalore, India. A completely randomized block design was used with three replications each for inoculated and uninoculated treatments were maintained for each clone. Single budded sets of 27 sugarcane clones were planted in 5 kg capacity of pots mixed with soil and maintained in glasshouse. One month after planting inoculate with freshly hatched second stage M. incognita juveniles at 5000J2/ pot. The top of soil was removed and pour nematode suspension and cover with soil. After 90 days of inoculation and gall index in plants was assessed with 1-5 scale.

2. Greenhouse screening of sugarcane clones against lesion nematode, *Pratylenchus zeae*

Single budded sets of 27 sugarcane clones were planted in 5 kg capacity pots containing sterilized soil and maintained in glasshouse. One month after planting inoculate with *P. zeae* at 5000 juveniles/pot. Three replications each for inoculated and inoculated control were maintained. Three months after inoculation observations on nematode multiplication in soil and root population were recorded. Each plants were carefully uprooted and cut the root system and were washed free of soil. Roots were processed by root maceration technique and soil samples were processed by Cobb’s wet-sieving and sedimentation technique. The nematodes were extracted by Modified Baermann method and the soil population of plant parasitic nematodes were assessed. The lesion index of the root was estimated by measuring the length of roots with lesioned tissue and is expressed in percentage.

3. Field experiment on screening of sugarcane clones against root knot nematode and lesion nematode

A field experiments were conducted with a total of twelve clones were screened against root knot nematode, M. incognita in nematode sick field at Sugarcane Research Station, Tamil Nadu Agricultural University, Cuddalore, Tamil Nadu, India. The double budded sugarcane clones were planted with 90 cm spacing between the rows in plots of 20m2. Nematodes were extracted from soil samples by Cobbs decanting and sieving method (Cobb, 1918) [3] followed by modified Baermann’s funnel method (Schindler, 1961) [18] for extraction of vermiform stages of males and second stage juveniles. The plants were removed after ten months and gall index the plants was assessed on 1-5 scale for root knot nematode. For lesion nematode damage assessment, lesion index of the root was estimated by measuring the length of roots with lesioned tissue and is expressed in percentage.

Similar methodology was followed in the second year field experiments with 33 sugarcane clones and screened against root knot and lesion nematodes. The data on damage was recorded with 1-5 scale for root knot nematode and lesion index as expressed in percentage.

Results and Discussion

1. Glass house screening of sugarcane clones against root knot nematode, *M. incognita* and lesion nematode, *P. zeae*

A total of 27 clones were screened against root knot nematode, *M. incognita*. Among them 19 clones were found to be moderately resistant and six clones were susceptible. Two clones were found to be resistant. In the lesion nematode screening 20 clones were found to be tolerant, and six clones were found to be susceptible. The clone C 260628 were found to be moderately resistant (Table 1).

Table 1: Screening of sugarcane clones against root knot nematode, *Meloidogyne incognita* and lesion nematode, *Pratylenchus zeae*

Sl. No.	Clone/Variety	Gall index	No. of galls/Plant	Reaction	Root lesion index (%)	Level of resistance
1	C 33004	3	25	MR	15	T
2	C 33005	3	13	MR	16	T
3	C 33008	3	16	MR	11	T
4	C 33018	3	16	MR	13	T
5	C 33024	3	35	S	23	S
6	C 33025	3	21	MR	15	T
7	C 33028	3	17	MR	14	T
8	C 33032	3	38	S	26	S
9	C 33035	3	19	MR	12	T
10	C 33042	3	15	MR	17	T
11	C 33046	3	40	S	21	S
12	C 33049	3	17	MR	16	T
13	C 33050	3	15	MR	14	T
14	C 33051	3	16	MR	12	T
15	C 33056	3	20	MR	10	T
16	C 33060	3	14	MR	18	T
17	C 33062	3	18	MR	17	T
18	C 33064	3	33	S	28	S
19	C 33074	3	22	MR	14	T
20	C 33075	3	15	MR	12	T
21	C 33082	3	36	S	30	S
22	C 33105	3	18	MR	13	T
23	C 33108	3	39	S	27	S
24	C 33114	3	14	MR	12	T
25	C 33122	3	17	MR	16	T
26	C 260628	2	7	R	9	MR
27	CoC 24	2	9	R	11	T

MR – Moderately resistant, S – Susceptible, R – Resistant, T-Tolerant

Field experiment

2. Field screening of sugarcane clones against root knot nematode, *M. incognita* and lesion nematode, *P. zeae*

A total of twelve clones were screened against root knot nematode, M. incognita. Among them seven clones were found to be moderately resistant and three clones were susceptible. The two check varieties (CoC 24 and CoC25) were found to be resistant. In lesion nematode screening eight clones were found to be tolerant and three clones were found to be susceptible. The variety CoC 25 were found to be moderately resistant (Table 2).

Table 2: Screening of sugarcane clones against root knot nematode, *Meloidogyne incognita* and lesion nematode, *Pratylenchus zeae*

Sl. No.	Clone/Variety	Gall index	No. of galls/Plant	Reaction	Lesion index in root (%)	Level of resistance
1	C 33004	3	25	MR	15	T
2	C 33005	3	13	MR	16	T
3	C 33008	3	16	MR	11	T
4	C 33064	3	33	S	15	T
5	C 33025	3	21	MR	26	S
6	C 33032	3	38	S	16	T
7	C 33049	3	17	MR	14	T
8	C 33050	3	15	MR	28	S
9	C 33024	3	35	S	30	S
10	Co 86032	3	17	MR	16	T
11	Coc 25	2	7	R	9	MR
12	CoC 24	2	9	R	11	T

MR – Moderately resistant, S – Susceptible, R – Resistant, T-Tolerant

In the second year, at nematode sick plot a total of 33 clones were screened against root knot nematode and lesion nematode. Among them seventeen clones were found to be moderately resistant and fourteen clones were susceptible. The two varieties were found to be resistant. Visual ratings for root knot nematode (RKN) were highly correlated with reproductive factor (RF) value and nematode eggs per g of roots. This is in agreement with our previous work where visual ratings were correlated with extracted nematodes and eggs from the test clones (Bhuiyan *et al*., 2014) [1]. Visual rating has been used to screen other crops against root knot nematodes such as peanuts and Psidium species (Dong *et al*., 2008; [8] Milan 2007 [14]. However, Matsuo *et al*., (2012) [11] opposed the exclusive use of root galling to assess resistance, as it can cause errors in selecting for nematode resistance. They indicated that some genotypes do not produce galls in response to RKN infection even though nematode reproduction in those genotypes may be high. However, we favour the use of visual rating as an assessment method when screening clones for resistance to RKN because of the short time (less than a minute) to assess a nematode-infested root. This study found that basic *S. spontaneum*, and *E. arundinaceus*; and some backcross progenies derived from these wild canes, and commercial hybrids are resistant to moderately resistant to RKN. This is in agreement with earlier studies (Stirling *et al*., 2011; [20] Bhuiyan *et al*., 2014; [1] Croft *et al*., 2015) [5]. One *S. spontaneum* clone (Glagah-1286) was resistant to both types of nematodes. In general, the wild relative of sugarcane, *S. spontaneum*, is relatively easy to cross with sugarcane hybrids, and in fact, modern sugarcane varieties are the product of successful crosses between *S. officinarum* and *S. spontaneum* (Cox *et al*., 2000) [4]. These crosses provided modern sugarcane with resistance to a range of diseases and abiotic stresses, as well as greater ratoonability (Bonnett and Henry 2011) [2]. Testing of more *S. spontaneum* clones for nematode resistance and targeted crossing with commercial hybrid should be continued to produce nematode-resistant sugarcane varieties. This is in agreement with earlier studies a pot culture experiments were conducted under glasshouse conditions to evaluate their resistance reaction against root knot and lesion in 27 sugarcane clones (Jayakumar, *et al*., 2020) [9].

In the second year against lesion nematode thirty clones were found to be tolerant and three clones were found to be moderately resistant (Table 3). Studies on resistance to *P. zeae* sugarcane clones Co 88020, Co 89009 and Co 89034 were found to be resistant to *P. zeae* (Mehta *et al*., 1994) [13]. Novaretti (1988) [15] reported that sugarcane clone, NA 56-79 was tolerant to *P. zeae*. In Brazil, sugarcane clone cv. sp 70-1143 was found to be resistant to both *P. zeae* and *Meloidogyne javanica* (Novaretti, 1992) [16] while the clone IAC 77-52 was found to be tolerant to *P. zeae* (Dinardo *et al*., 1996) [6]. Wild relatives of sugarcane were also reported to be highly resistant to Pachymetra root rot (Magarey and Croft 1996; [10] Croft *et al*., 2015) [5]. Thus, introgression of resistant genes of these wild species and other close relatives of sugarcane has the potential to provide the industry with improved varieties that could help manage many difficult-to-control soil pathogens.

Table 3: Screening of sugarcane clones against root knot nematode, *Meloidogyne incognita* and lesion nematode, *Pratylenchu zeae* under field conditions.

Sl. No.	Clone/Variety	Gall index	No. of galls/Plant	Reaction	Lesion index in root (%)	Level of resistance
1	C 15081	3	22	MR	11	T
2	C 15079	3	15	MR	15	T
3	C 15011	3	32	S	12	T
4	C 15021	3	34	S	16	T
5	C 15004	3	17	MR	13	T
6	C 15006	3	31	S	11	T
7	C 15157	3	33	S	9	MR
8	C 15086	3	35	S	14	T
9	C 15181	3	22	MR	12	T

10	C 15151	3	18	MR	11	T
11	C 15192	3	20	MR	15	T
12	C 15195	3	32	S	14	T
13	C 15088	3	14	MR	12	T
14	C 15176	3	17	MR	16	T
15	C 15210	3	20	MR	14	T
16	C 15095	3	22	MR	13	T
17	C 15175	3	20	MR	12	T
18	C 15645	3	30	S	16	T
19	C 15827	3	16	MR	15	T
20	C 15499	3	13	MR	8	MR
21	C 15632	3	35	S	14	T
22	C 15639	3	37	S	11	T
23	C 15642	3	18	MR	16	T
24	C 15810	3	14	MR	12	T
25	C 15607	3	30	S	14	T
26	C 15683	3	35	S	11	T
27	C 15603	3	18	MR	13	T
28	C 15559	3	36	S	15	T
29	C 15708	3	31	S	13	T
30	C 15525	3	37	S	12	T
31	Co 86032	3	19	MR	16	T
32	CoC 24	2	7	R	11	T
33	CoC 25	2	8	R	9	MR

T-Tolerant, S-Susceptible, MR-Moderately resistant, R - Resistant

Conclusion

The relative susceptibility and resistance of sugarcane clones was determined both under controlled glass house and field conditions. In the present experiment, seven clones were found to be moderately resistant and three clones were susceptible and two varieties (CoC 24 and CoC25) were found to be resistant to M. incognita. Similarly eight clones were found to be tolerant, three clones were found to be susceptible and the variety CoC 25 was found to be moderately resistant to *P. zeae* under field conditions.

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