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Screening of available germplasm lines of bitter gourd against root-knot nematode

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Abstract
Among the germplasm lines, IC-44410, IC-44415, IC-44417, IC-44426, IC-45341 and IC-45346 were found to be susceptible to root-knot nematode. Remaining all germplasm lines were found to be highly susceptible to root-knot nematode. The number of root galls/egg masses recorded in highly susceptible lines ranged from 116.00 to 181.00 /plant. The gall index recorded in these lines was 5.00/plant. The number of root galls/egg masses recorded in susceptible lines ranged from 72.00 (IC-44415) to 82.33 (IC-45341)/plant. The gall index recorded in these lines was 4.00/plant. It could also be seen from the data presented in Table 2 that the initial root-knot nematode population in soil was 1000 J2 /pot and six weeks after inoculation, the nematode population of susceptible lines was lower than the highly susceptible lines. The susceptible germplasm lines, IC-44410, IC-44415, IC-44417, IC-44426, IC-45341 and IC-45346 recorded the multiplication factor of 2.08, 2.18, 2.64, 2.40, 2.30 and 2.35 respectively.

Keywords: Germplasm, inoculation, susceptible, root-knot nematode, bitter gourd etc.

Introduction
The root-knot nematodes, Meloidogyne spp. are one of the major constraints in vegetable production. It causes an annual monetary loss to the tune of Rs. 547.50 million in cucurbits (Jain *et al*., 2007) [1]. The host range of root-knot nematodes is extensive and more than two thousand plant species have been reported as hosts for this nematode. (Sasser, 1980) [2]. Four common Meloidogyne spp. (*M. incognita, M. javanica, M. hapla and M. arenaria*) comprise up to 95 per cent of all root-knot nematode species. Among these, M. incognita is the most common species and infects almost all cultivated plants, which makes it most damaging pathogen. This nematode is sedentary parasite and produce disease symptoms both on above and below ground parts. The symptoms are often mistaken for macro or micro nutrient deficiency or moisture stress. Foliar symptoms include stunting, premature wilting, leaf chlorosis and below ground symptoms included root galls or knots on the roots, which affect nutrient uptake by plant. The root-knot nematodes causes severe damage thus leads to dramatic yield losses up to 24 per cent (Sikora and Fernandez, 2005) [3].

The management of root-knot nematodes is more difficult than that of other pests because root-knot nematodes mostly inhibit into the soil and usually attack the underground parts of plants. Moreover, nematodes in addition to their own pathogenic effects may also play a role with other disease-causing agencies like fungi, bacteria and viruses acting as incitants or vectors thus helping other organisms to be more effective in causing diseases. Nematodes themselves are also capable of breaking disease resistance.

Screening of seventeen germplasm lines of bitter gourd against root-knot nematode, M. incognita was done in glasshouse with a view to search for the source of resistance for recommendation to the farmers for cultivation and or to the breeders for incorporating the resistance in high yielding but susceptible varieties/lines and ultimately to release it to farmers for cultivation in fields infested with *M. incognita*. The information on various aspects of nematode management is scanty, scattered as there is no systematic work on damage potential of root-knot nematode on bitter gourd. Therefore, the investigation was undertaken with the screening of available germplasm lines of bitter gourd against root-knot nematode.

Materials and Methods
A statistically designed experiment for screening of different germplasm lines of bitter gourd against root-knot nematode was conducted during summer season of the year 2019 in the glasshouse of AICRP on Nematodes, Department of Agril. Entomology, M.P.K.V., Rahuri. The seeds of seventeen germplasm lines of bitter gourd as listed in Table 1 were obtained from Senior Vegetable Breeder, AICRP on Vegetable Improvement Scheme M.P.K.V. Rahuri. All the germplasm lines of bitter gourd were sown in 15 cm diameter earthen pots containing 1 kg

mixture of autoclaved soil and FYM in 3:1 proportion. Thinning was done after germination so as to maintain only one healthy seedling in each pot. Each germplasm line was inoculated with 1000 freshly hatched larvae (2nd stage juveniles) of root-knot nematode. For inoculation stock culture of root-knot nematode was maintained on brinjal in the earthen pots as well as in the field. Inoculation was done by pouring the freshly hatched nematode suspension obtained from the egg masses of stock culture in three holes prepared around the plants and on roots exposed by removing the top layer of the soil, which were later on covered by the moist autoclaved soil.

Before inoculation nematode count per ml of suspension was taken under microscope and required quantity of the suspension poured in to the pots. Also, the germplasm lines without inoculation of nematodes were maintained. The plants were watered as and when required. The details of the experiment are given below.

Details of experiment

Design	: Randomized Block Design
Replications	: Three
Treatments	: Seventeen
Date of sowing	: 26/02/2019
Date of inoculation	: 27/02/2019
Date of termination	: 04/04/2019

Table 1: List of germplasm lines of bitter gourd screened against root-knot nematode, *M. incognita*

Sr. No.	Germplasm line	Sr.No.	Germplasm line
1	IC 33227	10	IC 44425
2	IC 33275	11	IC 44426
3	IC 44410	12	IC 44428
4	IC 44413	13	IC 45341
5	IC 44415	14	IC 45346
6	IC 44417	15	IC 50527
7	IC 44419	16	IC 85603
8	IC 44423	17	IC 68238
9	IC 44424		

Method of recording observations

Six weeks after inoculation, each germplasm line of bitter gourd was uprooted carefully and the adhering soil was washed properly under clean tap water. The plants were then cut at the base and observations like number of root galls and egg masses present on roots were counted. The observations on shoot and root lengths were recorded in centimeter. While the fresh and dry weights were recorded up to two decimals of gram on top pan balance. To count egg masses, staining of egg masses was done by dipping the roots in 1 per cent solution of trypan blue for two minutes. After dipping, roots were washed two to three times under tap water to remove the stain of the roots. The gall index 1 to 5 scale was worked out by considering the number of root galls and eggs masses/plant. On the basis of gall index the lines were categorized in different reactions as below in Table 2

Table 2: Gall index categories

Gall index	No. of root galls/egg masses/plant	Reaction
1	0	Highly resistant (HR)
2.	1 to 10	Resistant (R)
3.	11 to 30	Moderately resistant (MR)
4.	31 to 100	Susceptible (S)
5.	> 101	Highly susceptible (HS)

Analysis of the experimental data

In order to find out the significant difference in the different germplasm lines of bitter gourd, all the experimental data were statistically analysed by standard statistical procedures. The significance of different lines was assessed at 5 per cent level.

Result and Discussion:

Screening of seventeen germplasm lines of bitter gourd against root-knot nematode, M. incognita was done in glasshouse with a view to search for the source of resistance for recommendation to the farmers for cultivation and or to the breeders for incorporating the resistance in high yielding but susceptible varieties/lines and ultimately to release it to farmers for cultivation in fields infested with M. incognita.

The observations on root galls/egg masses recorded six to eight weeks after inoculation are presented in Table 3

It could be seen from the Table 3 and 4 that out of seventeen germplasm lines of bitter gourd screened against root-knot nematode, none was found to be resistant to the pest. However, six and eleven lines were susceptible and highly susceptible to root-knot nematode, respectively. The number of root galls/egg masses recorded in these lines ranged from 72.00 (IC-44415) to 181.00 (IC-50527) / plant. The gall index recorded in these lines ranged from 4.00 to 5.00 / plant. In contrast, Sable and Darekar (1986) screened 20 varieties of bitter gourd against M. incognita which were found susceptible with root knot index ranging from 4.0 to 5.0. Among the germplasm lines, IC-44410, IC-44415, IC-44417, IC-44426, IC-45341 and IC-45346 were found to be susceptible to root-knot nematode. Remaining all germplasm lines were found to be highly susceptible to root-knot nematode. The number of root galls/egg masses recorded in highly susceptible lines ranged from 116.00 to 181.00 /plant. The gall index recorded in these lines was 5.00/plant. The number of root galls/egg masses recorded in susceptible lines ranged from 72.00 (IC-44415) to 82.33 (IC-45341)/plant. The gall index recorded in these lines was 4.00/plant.

Table 3: Effect of different germplasm lines of bitter gourd on root-knot nematode, *M. incognita* population

Sr. No.	Germplam lines	Initial root-knot nematode population (J_2)/plot	Root-knot nematode population (J_2)/plot at termination				Multiplication factor
			R1	R2	R3	Mean	
1.	IC 33227	1000	3600	3620	3480	3566.67	3.56
2.	IC 33275	1000	3680	3440	3480	3533.33	3.53
3.	IC 44410	1000	2240	2080	1920	2080	2.08
4.	IC 44413	1000	3800	3720	3840	3786.67	3.78
5.	IC 44415	1000	2280	2360	1920	2186.67	2.18
6.	IC 44417	1000	2720	2520	2620	2640	2.64
7.	IC 44419	1000	2720	2760	2800	2760	2.76
8.	IC 44423	1000	2820	2880	2800	2833.33	2.83
9.	IC 44424	1000	3480	3360	3600	3480	3.48
10.	IC 44425	1000	3480	3600	3460	3513.33	3.51
11.	IC 44426	1000	2520	2260	2440	2406.67	2.40
12.	IC 44428	1000	3520	3560	3320	3466.67	3.46
13.	IC 45341	1000	2240	2440	2260	2306.67	2.30
14.	IC 45346	1000	2340	2480	2240	2353.33	2.35
15.	IC 50527	1000	3480	3500	3600	3526.67	3.52
16.	IC 85603	1000	3520	3600	3640	3586.67	3.58
17.	IC 68238	1000	3700	3680	3740	3706.67	3.70
	SE ±					81.12	
	CD @5%					233.13	

It could also be seen from the data presented in Table 3 that the initial root-knot nematode population in soil was 1000 J_2 /pot and six weeks after inoculation, the nematode population of susceptible lines was lower than the highly susceptible lines. The susceptible germplasm lines, IC-44410, IC-44415, IC-44417, IC-44426, IC-45341 and IC-45346 recorded the multiplication factor of 2.08, 2.18, 2.64, 2.40, 2.30 and 2.35 respectively.

Table 4: Reaction of different germplasm lines of bitter gourd to root-knot nematode, *M. incognita* as evidenced by gall index/plant

Sr. No	Variety	No. of root gall/egg masses per plant			Mean number of gall/egg masses/plant
		R1	R2	R3	
1.	IC 33227	151	168	162	160.33
2.	IC 33275	124	127	123	124.67
3.	IC 44410	74	87	77	79.33
4.	IC 44413	151	166	163	160.00
5.	IC 44415	70	74	72	72.00
6.	IC 44417	79	83	81	81.00
7.	IC 44419	116	117	122	118.33
8.	IC 44423	174	187	177	179.33
9.	IC 44424	138	143	144	141.67
10.	IC 44425	153	154	157	154.67
11.	IC 44426	77	75	81	77.66
12.	IC 44428	142	147	139	142.67
13.	IC 45341	79	83	85	82.33
14.	IC 45346	85	79	81	81.66
15.	IC 50527	179	183	181	181.00
16.	IC 85603	157	167	164	162.67
17.	IC 68238	116	118	114	116.00
	SE				3.20
	CD at 5%				9.19

Sr. No	Treatment	Gall index per plant			Mean gall index	Reaction
		R1	R2	R3		
1.	IC 33227	5	5	5	5	HS
2.	IC 33275	5	5	5	5	HS
3.	IC 44410	4	4	4	4	S
4.	IC 44413	5	5	5	5	HS
5.	IC 44415	4	4	4	4	S
6.	IC 44417	4	4	4	4	S
7.	IC 44419	5	5	5	5	HS
8.	IC 44423	5	5	5	5	HS
9.	IC 44424	5	5	5	5	HS
10.	IC 44425	5	5	5	5	HS
11.	IC 44426	4	4	4	4	S
12.	IC 44428	5	5	5	5	HS
13.	IC 45341	4	4	4	4	S
14.	IC 45346	4	4	4	4	S

15.	IC 50527	5	5	5	5	HS
16.	IC 85603	5	5	5	5	HS
17.	IC 68238	5	5	5	5	HS
	SE				0.06	
	CD at 5%				0.17	

Conclusion

The experiment on screening of different germplasm lines of bitter gourd against root-knot nematode, *M. incognita* was conducted in the glasshouse. The soil in the pots was inoculated with 1,000 freshly hatched juveniles (J_2) of root-knot nematode after germination in the pots. The experiment was terminated at 6 weeks after inoculation. The results revealed that, none of seventeen germplasm lines tested was found to be resistant to root knot nematode. However, germplasm lines *viz*., IC-44410, IC-44415, IC-44417, IC-44426, IC-45341 and IC-45346 were found to be susceptible to root-knot nematode. Remaining all germplasm lines were found to be highly susceptible to root-knot nematode.

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