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Pathogenicity of *Meloidogyne incognita* infecting Mungbean

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Abstract
Pathogenicity trial of *Meloidogyne incognita* was conducted consecutively for two different seasons on mungbean (C.V.Dhauli) under net house conditions. With increase in the initial inoculums density of *M. incognita,* there was progressive decrease in various growth parameters and increase in nematode population in soil as well as in plant roots during both the seasons under investigation. The maximum reduction in plant growth parameters was observed at an inoculums level of 10,000 J_2/kg soil. Pooled analysis of data also indicated a similar trend. Thus the estimated damaging threshold level of *M. incognita* in mungbean (CV.Dhauli) was 100J_2 /kg soil.

Keywords: *Meloidogyne incognita,* mungbean, pathogenicity

Introduction
Mungbean (*Vigna radiata*) is an important pulse crop which provides nutritional security to the millions of peoples across India. This crop is rich in dietary protein (22.1%) which is a chief source of protein to millions of poor Indians. In our country more than a dozen of pulses are grown along with mungbean. This crop is adapted to multiple cropping systems because of its short duration nature as well as its ability to tolerate moisture stress condition. One of the major limitations of mungbean production is the association of plant parasitic nematodes resulting in serious threat to its cultivation. Root knot nematode, *Meloidogyne incognita* was for the first time reported from mungbean in India causing appreciable loss in growth and yield by Singh, 1972. Considering the importance of this crop and its vulnerability to *M. incognita,* efforts were made to determine the pathogenic potential of this important plant parasitic nematode through green house experiments.

Materials and Methods
A set of 15cm diameter earthen pots comprising of twenty numbers were used to test the pathogenicity of *M. incognita* in mungbean (c.v. Dhauli). The pots were filled with sterilized soil and compost mixture (1kg/pot) and sown with surface sterilized mungbean seeds@ 3 seeds /pot. Seven days after germination one healthy plant/pot was retained and the rest were removed. The pots along with the plants were arranged into five rows each with four pots. *M. incognita* J_2 obtained from single egg mass culture on mungbean plants were inoculated in the rhizosphere of mungbean plants in the pots in successive rows @ 0,10,100,1000 and 10,000 J_2/kg soil. Thus the experiment comprised of five treatments each with four replications which was conducted for two seasons during 2011-13.Pots were watered till harvest. Plants were carefully uprooted fifty days after inoculation and observations on different growth parameters viz; shoot length, root length, number of floral bunches/plant, number of pods/plant, shoot dry weight, root dry weight, number of nodules/plant including number of galls/g of root, population of nematodes/kg soil and population of nematodes in 1g of root were recorded. Soil population was estimated by following modified sieving- Baermann funnel technique. The population of nematodes in root sample was determined by staining the roots in sodium hypochlorite-acid fuchsin, followed by pressing between two slides for observation and enumeration under stereo binocular microscopes.

Results and Discussion
Plants inoculated with 100 J_2/kg soil and above exhibited stunting, yellowing and marginal leaf necrosis and galling of roots to varying degrees. Kumar *et al*., 2011 [2] and Mohanta and

Swain. 2014 [3] have reported symptoms of *M. incognita* inoculated in cowpea and turmeric respectively similar to the present study. Perusal of data indicated a progressive decrease in various growth parameters with increase in the initial inoculums density of *M. incognita* in both the seasons as well as irrespective of seasons. Significant reduction in shoot length, number of floral bunches /plant, number of pods/plant, (Table 1) root dry weight and number of nodules/g of root (Table 3) was recorded at 100 J_2/kg soil. Singh *et al.*, 2012 reported significant reduction in plant growth of okra inoculated with 500, 1000 and 2000J_2 *M. incognita* with progressive increase of total nematode population. Osunlola and Fawole, 2015 [4] have reported progressive decrease of plant growth and increase in population of *M. incognita* with increase in the initial inoculums density from 0-90000 eggs in sweet potato. However, such significant reduction in shoot dry weight and root length (Table 2) was recorded at 1000J_2/kg soil. Further, the number of galls/ plant (table-3), number of nematodes/kg soil and number of nematodes/g of root (Table-4) increased with increase initial inoculums density of *M. incognita* which was also progressive in both the seasons as well as irrespective of the seasons. However, significant difference among the treatments was recorded in nematode population/ kg soil and nematode population/g of root. Tsai, 2010 [7] has reported increase in the number of galls with increase in the initial inoculums density similar to the present study in mungbean. Even at the lowest inoculums density of *M. incognita* (10J_2/kg) significant increase in population of nematodes in soil as well as root were recorded. Although significant differences in the number of galls/g of root could be recorded among the treatments in season I and season II respectively, the treatments of the pooled mean were not significant. Khan *et al.*, 2012 and Sumita, 2014 [1, 6] reported similar reduction in plant growth, increase of *M. incognita* population in mungbean similar to the present study with 1000J_2 and100J_2 respectively as the damaging threshold level. The damaging threshold level of *M. incognita* in the present study was estimated to be 100J_2/kg soil. Mohanta and Swain, 2014 [3] also reported pathogenic variability of *M. incognita* in turmeric with the damaging threshold level of 100J_2/kg soil which is in corroboration with the present study.

Table 1: Effect of initial inoculums level of *M. incognita* on plant growth parameters of mungbean

	Shoot Length(cm)			Number of floral bunches /plant			Number of pods/plant		
Treatments (J2/kg soil)	**Season- 1**	**Season-2**	**Pooled Mean**	**Season- 1**	**Season- 2**	**Pooled Mean**	**Season-1**	**Season-2**	**Pooled Mean**
0	52.63	37.08	44.85	4.75	10.00	7.37	10.00	6.75	8.37
10	52.58	32.95	42.76	4.25	8.50	6.37	9.25	5.75	7.5
100	47.01	31.38	39.19	3.75	6.25	5	7.50	4.75	6.12
1000	44.08	31.33	37.70	3.25	5.75	4.5	5.25	4.75	5
10000	41.45	26.08	33.76	3.00	5.50	4.25	5.00	2.50	3.75
Mean	47.55	31.76	39.65	3.80	7.20	5.5	7.40	4.90	6.15
CV	1.48	13.33	9.71	11.77	27.66	26.24	23.28	38.00	28.95
SE(m) T	1.762	2.12	1.36	0.224	0.99	0.51	0.86	0.931	0.63
S	-	-	0.86	-	-	0.32	-	-	0.39
T*S	-	-	NS	-	-	0.72	-	-	NS
CD(0.05) T	6.93	8.33	3.91	0.88	3.91	1.47	3.39	3.66	1.81
S	-	-	2.47	-	-	0.93	-	-	1.15
T*S	-	-	NS	-	-	2.08	-	-	NS

Table 2: Effect of initial inoculums level of *M. incognita* on plant growth parameters of mungbean

	Shoot dry weight(g)			Root length(cm)			Root dry weight (g)		
Treatments (J2/kg soil)	**Season-1**	**Season-2**	**Pooled Mean**	**Season-1**	**Season-2**	**Pooled Mean**	**Season-1**	**Season-2**	**Pooled Mean**
0	4.65	2.78	3.71	28.63	17.55	23.08	1.53	2.29	1.91
10	4.58	2.30	3.43	27.38	17.00	22.18	0.91	1.95	1.43
100	4.38	2.20	3.28	23.25	16.25	19.75	0.80	1.62	1.21
1000	4.20	2.18	3.18	22.88	13.50	18.18	0.77	1.34	1.05
10000	3.00	1.40	2.2	15.73	12.00	13.86	0.52	1.18	0.85
Mean	4.16	2.17	3.17	23.57	15.26	19.42	0.90	1.68	1.29
CV	9.97	24.31	14.64	13.83	16.83	15.11	44.05	8.91	5.72
SE(m) T	0.21	0.26	0.54	1.630	1.284	1.04	0.19	0.07	0.10
S	-	-	1.08	-	-	0.65	-	-	0.06
T*S	-	-	NS	-	-	1.47	-	-	NS
CD(0.05) T	0.82	1.04	0.4716	6.41	5.05	2.99	0.75	0.38	0.53
S	-	-	0.29	-	-	1.89	-	-	0.19
T*S	-	-	NS	-	-	4.23	-	-	NS

Table 3: Effect of initial inoculums level of *M. incognita* on root nodulation and galling of mungbean

	Number of nodules/g root*			Number of galls/g root**		
Treatments (J2/kg soil)	**Season-1**	**Season-2**	**Pooled Mean**	**Season-1**	**Season-2**	**Pooled Mean**
0	38 (1.58)	18 (1.45)	32 (1.51)	1 (1.00)	1 (1.00)	0.25 (0.50)
10	19 (1.27)	17 (1.24)	18 (1.25)	13 (3.72)	11 (3.39)	2 (1.69)
100	15 (1.18)	15 (1.20)	15 (1.18)	17 (4.23)	49 (7.00)	12 (3.50)
1000	9 (0.96)	12 (1.11)	10 (1.04)	41 (6.43)	69 (8.33)	17 (4.16)
10000	5 (0.76)	12 (1.09)	8 (0.92)	43 (6.56)	70 (8.39)	17 (4.19)
Mean	14 (1.15)	16 (1.22)	15 (1.18)	19 (4.39)	31 (5.62)	7 (2.81)
CV	33.74	7.48	23.87	20.04	38.15	33.50

SE(m) T	(0.14)	(0.07)	(0.1)	(0.44)	(1.16)	NS
S	-	-	NS	-	-	NS
T*S	-	-	NS	-	-	0.876
CD(0.05) T	(0.58)	(0.28)	(0.29)	(1.73)	(4.55)	NS
S	-	-	NS	-	-	NS
T*S	-	-	NS	-	-	(2.53)

*Figures in parentheses are log values ** Figures in parentheses are √ values

Table 4: Effect of initial inoculums level of *M. incognita* on soil and root population of mungbean

	Nematode population/kg soil*			**Nematode population/g root***		
Treatments (J2/kg soil)	**Season-1**	**Season-2**	**Pooled mean**	**Season-1**	**Season-2**	**Pooled mean**
0	0 (1.00)	0 (1.00)	0 (1.00)	0 (1.00)	0 (1.00)	0 (1.00)
10	549 (2.74)	5623 (3.75)	1778 (3.25)	60 (1.78)	28 (1.45)	41 (1.61)
100	758 (2.88)	7762 (3.89)	2398 (3.38)	155 (2.19)	63 (1.80)	97 (1.99)
1000	6165 (3.79)	10232 (4.01)	7943 (3.90)	229 (2.36)	100 (2.00)	147 (2.18)
10000	22908 (4.36)	21379 (4.33)	22387 (4.35)	282 (2.45)	132 (2.12)	190 (2.28)
Mean	562 (2.75)	1584 (3.20)	954 (2.98)	56 (1.75)	30 (1.47)	41 (1.61)
CV	115.56	2.73	17.90	3.41	12.45	2.11
SE (m) T	NS	(0.04)	(0.75)	(0.03)	(0.09)	(0.048)
S	-	-	NS	-	-	(0.03)
T*S	-	-	NS	-	-	(0.07)
CD (0.05) T	NS	(0.17)	(2.17)	(0.12)	(0.36)	(0.14)
S	-	-	NS	-	-	(0.09)
T*S	-	-	NS	-	-	(0.19)

* Figures in parentheses are log values

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