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Response of brinjal (*Solanum melongena* L.) varieties for resistance against root-knot nematode, *Meloidogyne incognita* race-1

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ABSTRACT

Thirty brinjal varieties were screened for their resistance / susceptibility to root-knot nematode (*Meloidogyne incognita* race-1) infestation. Out of 30 brinjal varieties, eighteen varieties viz., Black Beauty, Brinjal 1 hybrid, Brinjal No.38, Chamak, Govinda, Green round, Nagina, Nav Kiran, Neel Kamal, Nishant, P.K-123, Prabha Kiran, Prasad, Sukhda, Surya Kiran, i9Utkal, VNR-51 and VNR-60 were highly susceptible, seven varieties (Brinjal Advance, Brinjal BSS1013, Green long, Harshit, Prapti, Shamli and Ujjwal) were susceptible, two varieties (Mahy 112 and Mahy Ruby) were tolerant, two varieties (Hybrid green and JK Kajal) were moderately resistant and only one variety Mahy 80 was resistant against *Meloidogyne incognita* race-1. To the best of our knowledge, Mahy 80 variety was ported to be resistant against root-knot nematode, *M. incognita* race-1 for the first time.

Keywords: *Meloidogyne incognita*, *Solanum melongena*, Resistant, Screening, Root-knot nematode.

INTRODUCTION

Vegetables constitute important component of human nutrition and have been part of the human diet for millions of people all over the world. Vegetable crops are usually the most susceptible and worst affected host of *Meloidogyne Goeldi,* (1887) species [7, 21]. Brinjal or eggplant (*Solanum melongena* L.) is foremost grown vegetable crops in India and was grown in an area of 9.57 lakh ha during 2015-16 [17]. It has both nutritive and medicinal values. In Haryana, 27.3% loss in brinjal was estimated due to root-knot nematode, *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949 at initial population density of 2,800-3460J_2/kg soil [10]. The yield loss in brinjal due to *M. incognita* race-3 in Maharashtra was reported as 32.73% [13]. Similarly, the estimated yield loss caused by *M. incognita* to brinjal has also been recorded as 16.67% in India [18] and 28.0% in West Bengal alone [4]. As a result of root-knot nematode infection, the roots get severely damaged which in turn hinders the water absorbing capacity of the plant and ultimately the plants show stunted and poor growth [14]. Out of various management strategies for plant parasitic nematodes, chemical control has proved generally effective but it is highly expensive as well as toxic to plants, soil micro-flora and ecological security [8]. Therefore, the development and implementation of alternative control strategies for eco- safe sustainable food production are needed. The most environmental friendly and cost effective ways to control plant disease caused by bacteria, fungi, and plant parasitic nematodes is through growing resistant plant varieties which decrease yield losses, increase profit and result in more sustainable production of food and fibre. Hence, the objective of this study was to screen thirty varieties of brinjal against their reaction to root-knot nematode, *M. incognita* race-1.

MATERIAL AND METHODS

The surface sterilized seeds of each tested brinjal varieties viz., Black Beauty, Brinjal 1 hybrid, Brinjal Advance, Brinjal BSS 1013, Brinjal Green long, Brinjal No- 38, Chamak, Govinda, Green Round, Harshit, Hybrid Green, JK Kajal, Mahy 112, Mahy 80, Mahy Ruby, Nagina, Nav Kiran, Neel kamal, Nishant, P.K-123, Prabha Kiran, Prapti, Prasad, Shamli, Sukhda, Surya kiran, Ujjwal, Utkal, VNR-51 and VNR-60 were sown in 12"inches autoclaved pots containing sterilized soil + farm yard manure (3:1) mixture. The race-1 of *Meloidogyne incognita* was identified using according to Taylor and Sasser [24] and its pure culture was maintained in green house. Three weeks old (21 days) healthy seedlings of each variety were transplanted into 12″ earthen pots containing 4 kg sterilized soil. Five days after transplantation, the rhizosphere soil was carefully removed to expose the roots. The roots were inoculated with freshly hatched second stage juvenile (J_2) of *M. incognita* race-1 @ 1000 J_2 per kg soil.

Thereafter, exposed roots were properly covered with soil. Each treatment was replicated three times and pots were placed in green house condition at temperature 25±2 °C. The experiment was completely randomized block design. The pots were irrigated as and when required. Uninoculated plants were served as control

After 90 days of inoculation of juvenile (J_2), plants of each variety were removed from pots and plant growth parameters such as plant length (cm), plant fresh and dry weight (g), percentage reduction in growth parameters over control were calculated. Number of galls per root system, nematode population per pot and nematode reproduction factor (*RF = Pf/ Pi*) where, Pf = Final population Pi = Initial population) were calculated. Nematode from the soil of each pot were isolated according to Cobb's sieving and decanting method followed by modified Baermann's funnel method [22]. For the estimation of nematode population in roots, 1.0g root from each replicate was macerated with a sufficient amount of water in warring blender for 30 seconds and various developmental stages of nematode in the roots were counted. The SPSS software version 16.0 was employed to the sampled data to analysis one-way analysis of variance and Least Significant Difference was calculated at p = 0.05 and p =0.01 level of probability.

Hussain's resistance–susceptibility index [16] given below was used with minor modification to determine the degree of resistance and susceptibility of different brinjal varieties against root-knot nematode, *M. incognita* race-1.

1. 1-10 galls/root system, reproduction factor < 1.00, no significant reduction in plant dry weight =Resistant (R)
2. 11-20 galls/root system, reproduction factor 1.01-2.00 no significant reduction in plant dry weight = Moderately resistant (MR)
3. 21-30 galls/root system, reproduction factor 2.01- 3.00, < 10.00 % significant reduction in plant dry weight =Tolerant (T)
4. 31-100 galls/root system, reproduction factor 3.01- 5.00, 10.01 - 25.00 % significant reduction in plant dry weight = Susceptible (S).
5. >100 galls/root system, reproduction factor >5, >25.01 % significant reduction in plant dry weight = Highly Susceptible (HS)

RESULTS AND DISCUSSION

The results indicated in Table-1 and 2 revealed that the different brinjal varieties showed differently resistance–susceptibility to the infection of *M.incognita* race-1. Although, no variety was completely immune to *M.incognita* race-1 Out of the thirty varieties of brinjal screened, the highest plant dry weight reduction, root galling and reproduction factor ware recorded in the variety Nishant, whereas, the lowest plant growth reduction, root galling, reproduction factor and reduction in dry weight of plant were recorded in the variety Mahy 80. Out of thirty brinjal varieties, eighteen varieties *viz.*, Black Beauty, Brinjal 1 hybrid, Brinjal No.38, Chamak, Govinda, Green round, Nagina, Nav Kiran, Neel kamal, Nishant, P.K-123, Prabha Kiran, Prasad, Sukhda, Surya kiran, Utkal, VNR-51 and VNR-60 exhibited high susceptibility on the basis of percentage reduction in dry weight against their respective control, nematode reproduction factor, and number of galls per root system. The seven varieties *viz.*, Brinjal Advance, Brinjal BSS1013, Green long, Harshit, Prapti, Shamli and Ujjwal showed susceptible reaction on the basis of number of galls per root system, nematode reproduction factor and percentage reduction in dry weight over control. The varieties Mahy 112 and Mahy Ruby were recorded as tolerant when their numbers of galls per root system, percentage reduction in dry weight, reproduction factor were collectively considered as the parameters for resistance- susceptible index. Moreover, two varieties Hybrid green and JK Kajal showed moderately resistant response to *M. incognita* race-1 when percentage reduction in dry weight, reproduction factor and number of galls were compared for the rating. However, on the other hand, only one brinjal variety Mahy 80 exhibited resistant reaction on the basis of number of galls per root system, reproduction factor and percentage reduction in dry weight over control.

Previously, the different varieties of brinjal had also been screened or evaluated by various researcher against *M. incognita* and *M. javanica* [11, 1, 25, 23, 6, 19, 20]. They also reported that different brinjal varieties/lines responded differently to the infection of *Meloidogyne* spp. The brinjal varieties/lines *viz.*, Annamalai, KS-224, Vijay and 71-19 were reported as resistant against *Meloidogyne incognita* [15, 3]. Whereas, the moderately resistant response was recorded in the varieties Rajendra Baigan, Rajendra Annapurna, Utkal Jyoti and Uttora against *M. incognita* [3, 9]. Recently 85 genotype of brinjal were evaluated, out of which only five (BR-123-3, G1abiColl.-11-6-1, S-324-329-1-2, SR-301, 2016/BRRVAR-4) were moderately resistant against *M. incognita* [19].

To the best of our knowledge, brinjal variety Mahy 80 was reported resistant against root-knot nematode, *M. incognita* race-1 for the first time. It can be concluded from the above results that the brinjal varieties exhibited resistant (Mahy 80) and moderately resistant (Hybrid green and JK Kajal) response against *M.incognita* race-1. Therefore, these varieties may be used as key component of integrated management programme for the eco-sustainable management of *M.incognita* race-1 infecting brinjal.

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Table 1: Response of brinjal varieties to *Meloidogyne incognita* on plant growth parameters.

Variety	Treatment	Plant length (cm)			Percentage reduction over control	Plant fresh weight(g)			Percentage reduction over control	Plant dry weight(g)			Percentage reduction over control
		Shoot	Root	Total		Shoot	Root	Total		Shoot	Root	Total	
Black Beauty	Control	44.37	22.90	67.27		74.90	28.33	103.23		25.33	18.40	43.73	
	Inoculated	37.97	15.80	53.77	20.07	57.37	20.87	78.24	24.21	18.73	10.33	29.06	33.55
	C.D.(P=0.05)			5.234				6.445				3.532	
	C.D.(P=0.01)			6.478				8.334				5.723	
Brinjal 1 Hybrid	Control	33.45	13.67	47.12		77.25	24.25	101.5		30.35	18.35	48.70	
	Inoculated	26.03	10.78	36.81	21.88	55.40	15.67	71.07	29.98	24.30	11.48	35.78	26.53
	C.D.(P=0.05)			5.334				6.893				3.239	
	C.D.(P=0.01)			7.449				9.201				5.495	
Brinjal Advance	Control	36.27	12.45	48.72		62.67	19.50	82.17		25.27	16.63	41.90	
	Inoculated	28.90	9.10	38.00	22.00	48.67	14.35	63.02	23.31	21.77	10.97	32.74	21.86
	C.D.(P=0.05)			3.239				6.343				3.293	
	C.D.(P=0.01)			4.563				8.209				5.321	
Brinjal BSS 1013	Control	44.83	13.55	58.38		66.9	29.03	95.93		23.35	15.25	38.60	
	Inoculated	36.47	10.67	47.14	19.25	55.33	24.45	79.78	16.84	18.45	11.35	29.80	22.80
	C.D.(P=0.05)			4.741				6.225				3.326	
	C.D.(P=0.01)			6.478				8.334				4.746	
Brinjal Green long	Control	44.37	13.69	58.06		72.30	19.45	91.75		30.20	17.33	47.53	
	Inoculated	36.08	9.37	45.45	21.72	62.70	12.80	75.50	17.71	24.33	14.55	38.88	18.20
	C.D.(P=0.05)			4.343				5.394				3.456	
	C.D.(P=0.01)			6.21				7.445				4.767	

Brinjal No- 38	Control	35.33	16.33	51.66		59.97	24.67	84.64		27.90	16.67	44.57	
	Inoculated	23.40	12.40	35.80	30.70	42.37	17.80	60.17	28.91	20.67	10.33	31.00	30.45
	C.D.(P=0.05)			4.212				6.672				3.451	
	C.D.(P=0.01)			5.792				8.325				4.675	
Chamak	Control	33.73	12.40	46.13		45.80	18.67	64.47		23.90	14.90	38.80	
	Inoculated	22.67	8.82	31.49	31.74	38.80	10.22	49.02	23.96	16.52	9.62	26.14	32.63
	C.D.(P=0.05)			4.741				6.225				3.326	
	C.D.(P=0.01)			6.478				8.334				4.746	
Govinda	Control	42.68	13.42	56.10		76.20	16.68	92.88		25.90	13.67	39.57	
	Inoculated	25.90	10.25	36.15	35.56	56.12	12.35	68.47	26.28	18.05	9.20	27.25	31.13
	C.D.(P=0.05)			5.382				6.232				1.792	
	C.D.(P=0.01)			6.564				8.534				2.461	
Green Round	Control	42.90	12.80	55.70		69.90	24.67	94.57		23.67	15.45	39.12	
	Inoculated	36.98	9.47	46.45	16.61	54.20	20.10	74.3	21.43	16.40	10.20	26.60	32.00
	C.D.(P=0.05)			4.443				5.922				3.236	
	C.D.(P=0.01)			5.676				8.346				4.362	
Harshit	Control	37.50	16.30	53.80		67.90	21.90	89.80		20.40	14.40	34.80	
	Inoculated	30.97	13.20	44.17	17.90	50.40	17.49	67.89	24.40	16.50	10.37	26.87	22.79
	C.D.(P=0.05)			4.741				6.225				3.326	
	C.D.(P=0.01)			6.478				8.334				4.746	
Hybrid green	Control	43.20	13.35	56.55		58.25	23.50	81.75		26.90	16.20	43.10	
	Inoculated	39.67	11.50	51.17	9.51	50.25	20.35	70.6	13.64	24.20	15.10	39.30	8.82
	C.D.(P=0.05)			4.577				6.742				4.230	
	C.D.(P=0.01)			6.337				8.323				5.856	

JK Kajal	Control	35.30	14.67	49.97		65.45	19.40	84.85		25.45	15.67	41.12	
	Inoculated	28.38	11.95	40.33	19.29	53.15	14.66	67.81	20.08	22.85	14.33	37.18	9.58
	C.D.(P=0.05)			3.623				6.424				4.403	
	C.D.(P=0.01)			5.386				8.208				5.620	
Mahy 112	Control	30.35	11.47	41.82		48.52	15.43	63.95		22.73	11.20	33.93	
	Inoculated	27.17	9.42	36.59	12.51	40.67	14.67	55.34	13.46	20.45	10.20	30.65	9.67
	C.D.(P=0.05)			3.437				6.103				2.453	
	C.D.(P=0.01)			4.288				7.687				3.902	
Mahy 80	Control	31.57	9.43	41.00		68.20	15.48	83.68		14.63	11.20	25.83	
	Inoculated	29.20	8.47	37.67	8.12	63.20	14.13	77.33	7.59	13.65	10.10	23.75	8.05
	C.D.(P=0.05)			3.656				7.512				2.832	
	C.D.(P=0.01)			5.192				10.381				3.965	
Mahy Ruby	Control	40.25	12.35	52.60		58.35	18.20	76.55		25.45	14.05	39.50	
	Inoculated	36.67	11.45	48.12	8.52	54.90	16.47	71.37	6.77	24.15	12.45	36.60	7.34
	C.D.(P=0.05)			4.874				6.474				2.455	
	C.D.(P=0.01)			6.297				8.293				3.874	
Nagina	Control	44.83	11.07	55.90		68.30	28.10	96.40		22.35	14.85	37.20	
	Inoculated	38.47	8.62	47.09	15.76	54.48	21.65	76.13	21.03	15.65	10.20	25.85	30.51
	C.D.(P=0.05)			4.355				6.632				3.274	
	C.D.(P=0.01)			5.896				8.408				4.490	
Nav Kiran	Control	48.33	15.45	63.78		74.30	16.10	90.40		33.94	12.67	46.61	
	Inoculated	33.75	10.30	44.05	30.93	53.07	10.25	63.32	29.96	23.67	8.45	32.12	31.09
	C.D.(P=0.05)			5.492				6.234				3.242	
	C.D.(P=0.01)			6.476				8.356				5.154	

Neel kamal	Control	38.15	13.25	51.40		77.03	20.10	97.13		24.67	13.25	37.92	
	Inoculated	31.90	9.67	41.57	19.12	49.50	14.90	64.40	33.70	15.35	10.25	25.60	32.49
	C.D.(P=0.05)			5.254				6.641				3.443	
	C.D.(P=0.01)			6.594				8.293				4.343	
Nishant	Control	44.83	15.90	60.73		73.03	25.9	98.93		23.56	15.45	39.01	
	Inoculated	34.47	10.30	44.77	26.28	54.48	21.65	76.13	23.05	15.10	9.33	24.43	37.38
	C.D.(P=0.05)			4.741				6.225				3.326	
	C.D.(P=0.01)			6.478				8.334				4.746	
P.K-123	Control	33.73	11.30	45.03		53.50	17.67	71.17		24.45	13.67	38.12	
	Inoculated	22.67	8.82	31.49	30.07	40.25	10.22	50.47	29.09	17.45	10.15	27.60	27.60
	C.D.(P=0.05)			4.146				6.191				3.641	
	C.D.(P=0.01)			5.985				8.204				4.322	
Prabha Kiran	Control	37.45	14.37	51.82		71.35	24.22	95.57		37.23	21.10	58.33	
	Inoculated	29.73	11.10	40.83	21.21	53.30	18.67	71.97	24.69	25.30	14.65	39.95	31.51
	C.D.(P=0.05)			4.293				6.934				4.303	
	C.D.(P=0.01)			5.336				7.904				5.987	
Prapti	Control	34.67	14.67	49.34		80.67	23.1	103.77		27.90	15.53	43.43	
	Inoculated	26.50	12.45	38.95	21.06	60.33	15.45	75.78	26.97	21.45	12.33	33.78	22.22
	C.D.(P=0.05)			5.365				7.123				3.923	
	C.D.(P=0.01)			6.487				9.201				4.497	
Prasad	Control	42.30	16.45	58.75		61.33	22.45	83.78		28.35	15.40	43.75	
	Inoculated	32.67	10.45	43.12	26.60	52.67	15.17	67.84	19.03	20.33	10.39	30.63	29.99
	C.D.(P=0.05)			5.755				6.992				3.763	
	C.D.(P=0.01)			7.198				8.974				4.234	

Shamli	Control	25.30	15.20	40.50		45.25	20.40	65.65		27.30	16.47	43.77	
	Inoculated	18.90	10.17	29.07	28.22	33.48	16.67	50.15	23.61	21.35	14.30	35.65	18.55
	C.D.(P=0.05)			3.394				6.382				3.604	
	C.D.(P=0.01)			4.597				8.34				4.495	
Sukhda	Control	22.33	12.93	35.26		42.43	21.67	64.10		25.13	16.47	41.60	
	Inoculated	18.90	10.17	29.07	17.56	33.48	16.67	50.15	21.76	18.62	11.67	30.29	27.19
	C.D.(P=0.05)			5.273				5.155				3.962	
	C.D.(P=0.01)			6.569				7.002				5.134	
Surya kiran	Control	40.73	13.05	53.78		78.7	17.67	96.37		22.25	13.55	35.80	
	Inoculated	32.48	9.95	42.43	21.10	59.1	14.42	73.52	23.71	16.73	9.45	26.18	26.87
	C.D.(P=0.05)			4.514				6.324				3.145	
	C.D.(P=0.01)			6.687				8.304				4.202	
Ujjwal	Control	38.45	14.35	52.80		67.30	19.45	86.75		22.27	15.77	38.04	
	Inoculated	27.45	10.30	37.75	28.50	46.50	14.50	61.00	29.68	15.07	13.72	28.79	24.32
	C.D.(P=0.05)			4.946				6.845				2.293	
	C.D.(P=0.01)			6.53				8.263				4.132	
Utkal	Control	42.37	18.23	60.60		73.25	23.67	96.92		22.50	15.20	37.70	
	Inoculated	35.97	15.80	51.77	14.57	56.67	19.35	76.02	21.56	16.67	10.20	26.87	28.73
	C.D.(P=0.05)			4.731				6.331				3.201	
	C.D.(P=0.01)			6.878				8.47				4.672	
VNR-51	Control	43.43	14.50	57.93		72.93	20.10	93.03		24.10	15.87	39.97	
	Inoculated	36.97	10.75	47.72	17.62	55.48	15.80	71.28	23.38	20.67	7.67	28.34	29.10
	C.D.(P=0.05)			5.574				8.951				3.203	
	C.D.(P=0.01)			7.192				10.456				4.453	

VNR-60	Control	32.50	12.80	45.3		72.50	19.67	91.17		29.78	16.15	45.93	
	Inoculated	26.17	9.62	35.79	20.99	57.47	15.33	72.8	21.02	20.90	13.17	34.07	25.83
	C.D.(P=0.05)			4.092				7.482				3.315	
	C.D.(P=0.01)			5.374				9.255				4.494	

Table 2: Response of brinjal varieties to *Meloidogyne incognita* on the nematode Population and Reproduction factor.

		Population of Root-knot Nematode				
Variety	**No. of galls/root system**	**J2+J3+J4+ Male+ Female/root system**	**J2+Male/kg soil**	**Total**	**Reproduction factor (*Rf=pf/pi*)**	**Response of variety**
Black Beauty	120	259	14205	14464	14.46	HS
Brinjal 1 hybrid	107	221	12655	12876	12.88	HS
Brinjal Advance	92	165	4380	4545	4.55	S
Brinjal BSS 1013	74	123	3845	3968	3.97	S
Brinjal Green long	67	120	4290	4410	4.41	S
Brinjal No- 38	124	275	14320	14678	14.68	HS
Chamak	130	310	14570	14910	14.91	HS
Govinda	123	235	15470	15705	15.71	HS
Green Round	124	245	14564	14809	14.81	HS
Harshit	83	145	4520	4665	4.67	S
Hybrid Green	15	29	1470	1499	1.50	MR
JK Kajal	19	38	1893	1931	1.93	MR
Mahy 112	23	57	2853	2910	2.91	T
Mahy 80	8	15	649	664	0.66	R
Mahy Ruby	27	63	2224	2287	2.29	T

Nagina	107	176	10357	10533	10.53	HS
Nav Kiran	130	245	14880	15125	15.13	HS
Neel kamal	128	216	14905	15121	15.12	HS
Nishant	163	423	16539	16906	16.91	HS
P.K-123	132	218	14561	14779	14.78	HS
Prabha Kiran	113	205	16535	16740	16.74	HS
Prapti	46	107	4562	4669	4.67	S
Prasad	107	183	9333	9516	9.52	HS
Shamli	74	128	3897	4025	4.03	S
Sukhda	137	218	12452	12670	12.67	HS
Surya kiran	139	204	12844	13048	13.05	HS
Ujjwal	72	178	4647	4825	4.83	S
Utkal	102	289	11820	12109	12.11	HS
VNR-51	126	195	12594	12789	12.79	HS
VNR-60	148	248	12805	13053	13.05	HS