

Response of Rice Genotypes Against Rice Root-Knot Nematode, *Meloidogyne graminicola*

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ABSTRACT

The rice root-knot nematode, *Meloidogyne graminicola* is one of the major problem and cause 17-30% yield losses in rice crop due to partially filled kernels. The huge loss caused by *M. graminicola* can be reduced by using the number of management practices, but chemical method is most popular and commonly used by farmer. Due to indiscriminate use of chemical pesticides for management of *M. graminicola* enhance the problem of resistance and risk to the environment, so there is current need of the adoption of various eco-friendly management approaches among which resistant cultivars is a low cost, long term and sustainable option for the management of plant parasitic nematodes. In present investigations, 47 rice genotypes were evaluated for resistant against *M. graminicola* under screen house conditions, in the Department of Nematology, CCS HAU, Hisar during *kharif*2020-21. Seeds of each genotype were sown in

the earthen pots (1 kg soil capacity) containing steam sterilized sandy loam soil and inoculated with freshly hatched second stage juveniles of *M. graminicola* @ 2000 J2/pot. Forty-five days after inoculation, observations were recorded on number of galls and eggsmasses/plant. The result clearly revealed that all the genotypes showed varying degree of reaction against *M. graminicola*. Out of 47 rice genotypes, four genotypes (HKR 09-189, HKR 09-93, IR 95780-43-1-1-1 and NVSR 2098) showed resistant reaction and 15 genotypes (HKR 15-32, HKR 127, HKR 128, HKR 16-58, IR 14L 521, IR 99784-255-91-1-5, IR 98976-20-1-2-2, CRR 807-1, HKR 48, HKR 2018-39, HKR-126, HKR-127, HKR-128, HB-1 and HB-3) showed moderately resistant reaction against *M. graminicola*. Remaining genotypes were either susceptible or highly susceptible reaction against *M. graminicola*.

Keywords Genotypes, *Meloidogyne graminicola*, Reaction, Rice, Screening.

INTRODUCTION

Rice (*Oryza sativa* L.) is a crop that belongs to the Poaceae family. Approximately, 90 % of the world's rice is grown and consumed in Asia, which is a native for 60% of the world population. In India, it was cultivated from ancient time. India rank 1st in area and 2nd in production, after China and it accounts for 21.5% of world rice production. Annually the country produces 175.58 million tonnes of rice (FAOSTAT

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2018). The rice affected by number of abiotic and biotic factors. Among biotic factors, plant parasitic nematodes (PPNs) constitute an important component (Jain *et al.* 2012). However, *M. graminicola* has become a most important destructive pest and serious problem in major rice producing countries of the world including in India (Jain *et al.* 2012). It's become major problem in rice producing areas, particularly in nursery where flooding is intermitted and also due to higher number of plants/unit area. The major causes for high incidence of *M. graminicola* infection are attributed to presence of light textured soil, scarcity of sufficient water and transplantation of infected seedlings in main fields.

M. graminicola is making its importance felt in almost all the rice growing areas. Apart from rice crop, *M. graminicola* has been found to infect a number of crops and certain weeds which grow in the vicinity of affected rice plants. *M. graminicola* is highly damaging to upland, lowland and deep water rice and causes severe economic losses to rice crop grown in the nursery as well as in the main field (Haque *et al.* 2018). Due to PPNs on rice, annually estimated globally yield loss ranges from 10-25% (Bridge *et al.* 2005). *M. graminicola* causes 16-20% loss in lowland rainfed rice (Bangladesh) and cause 16-32% under irrigated and 11-73% under flooded conditions in India (Tian *et al.* 2018). The huge loss caused by *M. graminicola* can be reduced by using the number of management strategies, but chemical method is most popular and commonly used by farmer. Due to indiscriminate use of chemical pesticides for management of rice root-knot nematode enhance the problem of resistance and risk to the environment; efforts in the recent past have been initiated on the management of this nematode through host resistance, bio-agents and chemicals. The use of resistant cultivars against the nematode is a low cost, long term and sustainable option for the management of nematodes which does not impose unwanted changes in traditional agronomic practices in rice production (Amoussou *et al.* 2004). Sufficient amount of work has been done on various aspects of pathogen and its management against root-knot nematode in rice. So, far more studies have not been carried out on aspects of availability of resistant genotypes and an effective, eco-friendly management of root-knot nematode in

rice. Keeping this in view, present investigation was undertaken to evaluate the different rice genotypes for resistant against *M. graminicola*.

MATERIALS AND METHODS

In present investigations, 47 rice genotypes along with Pusa 1121 as standard check were evaluated for resistant against rice root-knot nematode, *M. graminicola* under screen house conditions, in the Department of Nematology, CCS HAU, Hisar during *kharif*2020-21.

Preparation of pure of rice root-knot nematode, *M. graminicola*

For the inoculation, pure culture of *M. graminicola* was maintained on rice variety Pusa 1121 (locally available susceptible) in screen house conditions of Department of Nematology, CCS HAU, Hisar, Haryana. Pure cultures were raised in screen house in 5 kg earthen pots filled with sterilized sandy loam soil. Healthy seedlings of rice (Pusa 1121) were translated in the pots. Second stage juveniles (J2) of *M. graminicola* were obtained from eggs from the pure culture which was maintained in the screen house; the seedlings of rice in pots were inoculated with these J2. The cultures were allowed to multiply for 4-5 generations and used in screening experiment for inoculation in pots under screen house conditions.

Collection of rice genotypes

Forty-seven rice genotypes, including rice variety Pusa 1121 as standard check obtained from Rice Research Station, Kaul (Haryana) for experimental purpose. Seeds of above genotypes were sown in steam sterilized sandy loam soil in 15 cm dia. earthen pots (one kg soil capacity). One week after germination, one plant was retained per pot and inoculated with 2000 freshly hatched J2 of *M. graminicola*. Forty-five days after inoculation, all the plants were uprooted carefully from the earthen pots. The roots of plants were retrieved carefully and kept under running tap water to clear it from adhering soil particles and recorded the observations such as number of galls and eggsmasses/plant. The genotypes were categorized (eggmass index) as resistant, moderately resistant,

Table 1. Root-knot scale for categorization of rice genotypes.

Eggmass index	Reaction
0-1.0	Resistant (R)
1.1-2.0	Moderately resistance (MR)
2.1-3.0	Susceptible (S)
3.1 and above	Highly susceptible (HS)

susceptible and highly susceptible for confirmation as per standard protocols by AICRP, Nematodes (Table 1).

$$\text{Eggmass index} = \frac{\text{No. of eggmasses per plant in tested variety} \times 4}{\text{No. of eggmasses per plant in standard variety (susceptible check)}}$$

RESULT AND DISCUSSION

Forty-seven rice genotypes were evaluated for resistant against *M. graminicola* under screen house conditions during 2020-21 and data is presented in Table 2. The result clearly indicated that the rice genotypes showed greater variation in response to *M. graminicola* from resistant to highly susceptible. A total of 47 genotypes of rice were screened, four genotypes (HKR 09-189, HKR 09-93, IR 95780-43-1-1-1 and NVSR 2098) showed resistant reaction and 15 genotypes (HKR 15-32, HKR 127, HKR 128, HKR 16-58, IR 14L 521, IR 99784-255-91-1-5, IR 98976-20-1-2-2, CRR 807-1, HKR 48, HKR 2018-39, HKR-126, HKR-127, HKR-128, HB-1 and HB-3)

Table 2. Reaction of rice genotypes for resistance against rice root-knot nematode, *Meloidogyne graminicola*. R- Resistant; MR- Moderately resistant; S- Susceptible; HS- Highly susceptible.

Sr. No.	Genotype number	Number of galls/plant	Number of egg-masses /plant	Eggmass index	Reaction
1	HKR 15-33	70.00	40.50	2.10	S
2	HKR 07-147	88.50	63.50	3.29	HS
3	HKR 09-189	5.75	2.25	0.12	R
4	HKR 09-104	90.50	66.00	3.42	HS
5	HKR 09-93	4.25	2.00	0.10	R
6	HKR 15-35	78.00	46.75	2.42	S
7	HKR 15-32	53.50	32.25	1.67	MR
8	HSD -1	68.00	39.75	2.06	S
9	HKR 127	49.25	28.75	1.49	MR
10	HKR 128	45.25	25.50	1.32	MR
11	HKR 16-35	75.25	42.25	2.19	S
12	HKR 16-58	48.50	28.00	1.45	MR
13	HKR 14-30	76.00	45.25	2.34	S
14	PR- 126	76.00	44.75	2.32	S
15	IR14L586	75.00	41.25	2.14	S
16	NVSR-474	74.50	45.00	2.33	S
17	IR 64	79.25	48.75	2.52	S
18	HKR 47	71.75	43.25	2.24	S
19	IR 14L 521	45.75	25.50	1.32	MR
20	IR 95780-43-1-1-1	4.00	1.50	0.08	R
21	IR 99784-255-91-1-5	52.50	31.25	1.62	MR
22	IR 98976-20-1-2-2	56.75	32.75	1.70	MR
23	PAU 7551-1-1	74.00	43.50	2.25	S
24	HKR 17-44	75.00	44.25	2.29	S
25	CRR 807-1	48.50	28.00	1.45	MR
26	NVSR 2098	3.75	1.50	0.08	R
27	HKR 2018-24	74.50	44.75	2.32	S
28	HKR 2018-39	48.50	28.25	1.46	MR
29	HKR 48	82.00	51.50	2.67	S
30	CSR-30	82.00	61.50	3.18	HS
31	Pusa-1121 (standard check)	104.75	77.25	4.00	HS
32	HKR 46	79.25	48.25	2.50	S
33	HKR 47	77.00	41.25	2.14	S
34	HKR 48	46.50	25.75	1.33	MR

Table 2. Continued

35	HKR-120	73.75	44.75	2.32	S
36	HKR IR 64	81.00	61.00	3.16	HS
37	HKR-126	52.75	30.00	1.55	MR
38	HKR-127	48.25	27.00	1.40	MR
39	HKR-128	45.25	25.50	1.32	MR
40	Bas 370	76.50	46.00	2.38	S
41	Tar-Bas-41	85.50	62.75	3.25	HS
42	PB-1	74.50	44.75	2.32	S
43	Govind	80.75	48.25	2.50	S
44	HB-1	48.50	26.75	1.39	MR
45	HB-2	76.75	45.50	2.36	S
46	HB-3	48.25	26.75	1.39	MR
47	Bas Demo Type-3	75.50	47.25	2.45	S

showed moderately resistant reaction against rice root-knot nematode. Remaining genotypes were either susceptible or highly susceptible reaction against rice root-knot nematode. Out of 26 rice cultivars, 21 cultivars were found resistance to the *M. graminicola* (Yik and Birchfield 1979). Similarly, the reaction of eight rice germplasms was observed by Gitanjali and Thakur in the year 2007, of which four were moderately resistant whereas, two were highly susceptible to this nematode and none of them was found resistant. Out of 53 rice genotypes, 13 genotypes were highly resistant towards rice root-knot nematode as reported by Simon in the year 2009. Evaluation of advanced backcross populations developed for water stress environment revealed that Teqing and the donarscvc Type 3, Zihui 100, Shwe Thwe Yin Hyv were resistant reaction against *M. graminicola* (Prasad *et al.* 2006).

Rana *et al.* (2016) also observed that out of 50 basmati rice cultivars, only Pusa 1637-18-7-6-20 showed resistance to *M. graminicola*. Similarly, Dhurwey *et al.* (2019) evaluated 19 rice cultivars against *M. graminicola*, of which 6 showed highly resistant reaction. Results were also supported by Kumar *et al.* (2020) who evaluated 79 rice genotypes against rice-root nematode under screen-house condition and reported Pusa 1121 as highly susceptible against *M. graminicola*, same observed in present study.

CONCLUSION

The finding of our study revealed that significant different among rice genotypes in their reaction toward *M. graminicola*. A total of 47 genotypes of rice

were screened, four genotypes (HKR 09-189, HKR 09-93, IR 95780-43-1-1-1 and NVSR 2098) showed resistant reaction and 15 genotypes showed moderately resistant reaction against *M. graminicola*. These genotypes suffered less damage by *M. graminicola* as compared to susceptible or highly susceptible genotypes. Furthermore, these genotypes can be used in future breeding programs for introduction of nematode resistant varieties.

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