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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 nematode pest and cause 17-30% yield losses in rice crop. 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, 15 rice genotypes were evaluated for resistant against *M. graminicola* under screen house conditions, in the Department of Nematology, CCS HAU, Hisar during *Kharif* 2023. Seeds of each genotype were sown in the earthen pots (2 kg soil capacity) containing steam sterilized sandy loam soil and inoculated with freshly hatched second stage juveniles of *M. graminicola* @ 3000 J2/pot. Forty-five days after inoculation, observations were recorded on number of galls and eggs masses/plant. The result clearly revealed that all the genotypes showed varying degree of reaction against *M. graminicola.* Out of fifteen rice genotypes, three genotypes (CSR-90, HKR 16-1 and PR-106) showed moderately resistant reaction against rice root-knot nematode. 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 (Anonymous 2000). Annually the country produces 135.75 million tonnes of rice (Anonymous 2023). 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 & Kumar 2015) [8, 11]. 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) [8]. 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 (Kumar 2021) [9].

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 (Kumar *et al.*, 2021) [9]. *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) [7]. Due to PPNs on rice, annually estimated globally yield loss ranges from 10-25% (Bridge *et al.* 2005) [4]. *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) [18]. 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) [1]. 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, 15 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* 2023.

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

For the inoculation, pure culture of *M. graminicola* was maintained on rice varieties Pusa 1121 and TN1 (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 and TN1) 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

Fifteen rice genotypes (7 scented and 8 non-scented), 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 earthen pots (two kg soil capacity). One week after germination, one plant was retained per pot and inoculated with 3000 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 (gall index) as highly resistant, resistant, moderately resistant, susceptible and highly susceptible for confirmation as per standard protocols by AICRP, Nematodes (Table 1).

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

Galls per plant	Gall index	Reaction
0 galls	1	Highly Resistant (HR)
1-10 galls	2	Resistant (R)
11-30 galls	3	Moderately resistance (MR)
31-100 galls	4	Susceptible (S)
>100 galls	5	Highly susceptible (HS)

Statistical analysis

The data obtained in the experiment was analyzed by Complete Randomized Design (CRD).

Results and Discussion

Fifteen rice genotypes were evaluated for resistant against *M. graminicola* under screen house conditions during kharif season 2023and 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 15 genotypes of rice were screened, three genotypes (CSR-90, HKR 16-1 and PR-106) 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) [19]. 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) [14].

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) [5] evaluated 19 rice cultivars against *M. graminicola*, of which 6 showed highly resistant reaction. Results were also supported by Kumar *et al.* (2020) [12] 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. Similarly, Kumar *et al.*, (2022) [10] assessed 47 rice genotypes and reported four genotypes (HKR 09-189, HKR 09-93, IR 95780-43-1-1-1 and NVSR 2098) showed resistant reaction against *M. graminicola*.

Table 2: Reaction of rice genotypes for resistance against rice root-knot nematode, *Meloidogyne graminicola*

Sr. No.	Genotype number	Number of galls/plant	Number of egg-masses /plant	Reaction
1	CSR-30	45.00	34.50	S
2	PB-7	88.50	63.50	HS
3	CSR-89	35.00	27.00	S
4	CSR-90	27.50	18.00	MR
5	PB-1121 (standard check)	104.75	77.25	HS
6	PB 1509	102.00	74.75	HS
7	PB-1847	53.50	32.25	S
8	PR-114	41.00	33.25	S
9	HKR 127	55.25	28.75	S
10	HKR 128	45.25	27.50	S
11	HKR 16-1	15.25	11.25	MR
12	PR-113	78.50	38.00	S
13	PR-129	86.00	47.25	S
14	PR-126	76.00	44.75	S
15	PR-106	14.00	7.25	MR

HR-Highly Resistant, R-Resistant, MR-Moderately Resistant, S-Susceptible, HS-Highly Susceptible

Conclusion

The finding of our study revealed that significant different among rice genotypes in their reaction toward *M. graminicola.* A total of 15 genotypes of rice were screened, three genotypes (CSR-90, HKR 16-1 and PR-106) 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 programmes for introduction of nematode resistant varieties.

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