

## Evaluation of Common Nepalese Rice Cultivars Against Rice Root Knot Nematode

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### ABSTRACT

Twelve commonly cultivated rice cultivars viz. Radha-7, Ghaiya-2, Rampur Masuli, Bindeshwari, Makawanpur-1, Sabitri, Janaki, Chaite-2, Radha-9, Radha-4, Chaite-6 and Masuli were tested against rice root knot nematode (*Meloidogyne graminicola*) in sick soil under greenhouse condition. Resistance screening of the cultivars was done based on the reproducibility of *M. graminicola* to IR-29 susceptible check and disease intensity grade was classified on the basis of root knot index. All the cultivars were susceptible to *M. graminicola* except Masuli and Chaite-6, which were moderately resistant. Ghaiya-2 and Janaki were even more susceptible than IR-29 and these cultivars can be used as susceptible check instead of IR-29. Since the common cultivars were susceptible to *M. graminicola*, it is necessary to screen more rice cultivars to explore resistant sources against root knot nematode of rice.

**Key words:** *Meloidogyne graminicola*, *Oryza sativa*, resistant sources

### INTRODUCTION

Rice root knot nematode (*Meloidogyne graminicola* Golden and Birchfield) is an important pathogen of rice *Oryza sativa* L. (Plowright and Bridge 1990). It could cause economic loss in upland, lowland, deepwater rice (Prasad et al 1987, Bridge et al 1990) and nurseries (Bridge et al 1990). Yield loss up to 50% might be incurred due to severe infestation of *M. graminicola* in upland, rainfed and direct-seeded rice (Lorenzana et al 1998) under field condition. In pot experiment, reduction in grain yield was reported up to 98% (Plowright and Bridge 1990). This nematode was also reported in rice based cropping systems of Nepal and yield reduction up to 40% in farmers' field (Sharma-Poudyal et al 2002, Sharma et al 2001). All the varieties observed by Sharma-Poudyal et al (2002) were infected by *M. graminicola*. These indicate the presence of potential nematode pest attacking on rice varieties in Nepal. Detailed information about the common cultivars response to *M. graminicola* is still inadequate in Nepal.

Research conducted in many countries revealed that the most of rice cultivars were susceptible to

*M. graminicola* (Bridge et al 1990) however, limited number of rice cultivars and breeding lines has been recorded as resistant to *M. graminicola* (Jena and Rao 1976, Kalita and Phukan 1990, Tandingan et al 1996, Soriano et al 1998). Nematicides like Fensulfthion, Oxamyl, Phorate (Prasad and Rao 1976a, 1976b, 1977a, 1977b) and Carbofuran (Prasad and Rao 1976a) were effective to control *M. graminicola*. However, most of the farmers are not using the nematicide due to lack of information about the disease, lack of technical know-how, unavailability and high cost of the chemicals. Besides, nematicides are more hazardous to the environment. Therefore, rice root knot management through deployment of resistance varieties is paramount and therefore screening of common rice cultivars cultivated in Nepal was tested against *M. graminicola*.

### MATERIALS AND METHODS

Twelve commonly grown rice cultivars in Nepal viz. Radha-7, Ghaiya-2, Rampur Masuli, Bindeshwari, Makawanpur-1, Sabitri, Janaki, Chaite-2, Radha-9, Radha-4, Chaite-6, and

Masuli and two check cultivars IR-29 (susceptible) and IR-72 (resistant) (Tandingan et al 1996) were grown in plastic pots (19 cm diameter) in greenhouse, Department of Plant Pathology, Institute of Agriculture and Animal Sciences at Rampur, Chitwan. Three kg of soil (sandy loam) infested with *M. graminicola* was used as source of inoculum per pot. Pre sprouted 5 seeds of each cultivars were seeded in each pot. Cultivars were replicated six times in complete randomized block design. FYM @ 10 t ha<sup>-1</sup> and N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O @ 50:30:30 kg ha<sup>-1</sup> was incorporated in soil as basal application. Rice seedlings were grown in stimulated upland soil condition. Nematode population and diseases parameters were observed on 50 day old seedlings (Weerapat and Chongkid 1990). Soil temperature was recorded at 5 cm depth from the time of seeding to disease observation.

*M. graminicola* second stage juvenile (J2) from root and soil was extracted by blender cum modified Baermann tray method and sieving cum modified Baermann funnel method, respectively (Hopper 1970). J2 were extracted from 100 g soil and 2 g root sample from each pot. Eggs were extracted from 1 g of root sample as suggested by Hussey and Barker (1973). Final J2 and eggs population were counted as described by Bridge et al (2000). Root galling was indexed from 0 to 10 scale (Zeck 1971), (0 = complete and healthy root system, no infestation, 1 = very few small galls can only be detected upon close examination, 2 = small galls as in '1' but more numerous and easy to detect, 3 = numerous small galls, some grown together, function of roots non seriously affected, 4 = numerous small galls some big galls, majority of roots still functioning, 5 = 25% of root systems severely galled and root functioning, 6 = 50% of root system severely galled and root not functioning, 7 = 75% of root system severely galled and lost for production, 8 = no healthy roots, nourishment of plant interrupted, plant still green, 9 = the completely galled root system is rooting, plant is dying and 10 = plant is dead).

Classification of resistance and susceptibility of rice cultivars was done based on reproducibility percentage nematode population in susceptible

check cultivar ie IR-29 (Taylor 1967). Normal reproduction of *M. graminicola* ie 100% was considered in susceptible check (IR-29). Reproducibility percentage of J2, egg and final (J2 + egg) on test cultivar was calculated as Nematode Population in Test Cultivar × 100/ Nematode Population in Susceptible Cultivar. Susceptibility and resistance was classified as follows (Taylor 1967):

- Susceptible: Plants, in which nematode reproduction is normal (susceptible check),
- Slightly resistant: Plants, in which reproduction is about 26 - 50% that of susceptible plants,
- Moderately resistant: Plants in which reproduction is about 11 - 25% that of susceptible plants,
- Very resistant: Plants in which reproduction is about 1 - 10% that of susceptible plant,
- Highly resistant: Plants in which reproduction is less than 1% that of the susceptible plants, and
- Immune: Plant in which no reproduction of the nematode occurs.

Root knot disease was graded as given below to find out the more consistent result (Taylor and Sasser 1978).

Disease scale	Disease intensity
0	Disease free
1-2	Very mild
3	Mild
4-5	Moderate
6-8	Severe
9-10	Very severe

## RESULTS AND DISCUSSION

Initial population of the *M. graminicola* second stage juvenile (J2) ranged from 0.4 - 4.4 g<sup>-1</sup> soil in the experimental pots. Covariance analysis revealed that there was no effect of initial J2 population on observed *M. graminicola* population and disease parameter. Soil temperature at seeding to disease observation was ranged from 23 to 27 °C.

Among the tested cultivars based on the J2 reproducibility in root, moderately resistance cultivar was only Masuli (24%) and Masuli was found similar to resistant check ie IR-72 in resistant reaction. Slightly resistant cultivars were Rampur Masuli (49%), Chaite-2 (32%), Radha-9 (48%), Radha-4 (39%) and Chaite-6 (32%) and other cultivars were found to be susceptible. However based on the egg reproducibility (%) in root besides Chaite-6 (22%) and Masuli (25%) were found as the moderately resistant. Both cultivars Radha-7 (46%) and resistant check i.e. IR-72 were found as slightly resistant and other cultivars were found susceptible (Table 1). Final nematode population was considered as the sum of J2 and egg of root. Based on final population, Masuli (24%) and Chaite-6 (24%) were found moderately resistant. Other cultivars were found susceptible. Final reproducibility of nematode was found higher in Ghaiya-2 and Janaki than susceptible check ie IR-29. Similarly, Masuli and Chaite-6 had less reproducibility than resistant check ie IR-72. The lowest root knot intensity grade was mild in Chaite-6 (3). Janaki (6) and Radha-4 (6) had the highest disease intensity grade ie severe (Table 1).

Resistance and susceptibility level of rice cultivar was differed with the basis of classification ie reproducibility of J2, egg, final population and root knot disease intensity. Jena and Rao (1976) also observed the similar inconsistent result. However, Sahu et al (1994) screened on the basis of root knot index. Jena and Rao (1976) suggested the best criteria for evaluation of rice cultivars against *M. graminicola* is based on the reproduction of egg. Present study indicates the inconsistent result on resistant class between the egg reproducibility and final nematode reproducibility. Since, *M. graminicola* is endoparasite of root and its progeny has different form in root, it would be better to include sum of progenies while considering the population and reproduction. Therefore, final population ie sum of its progenies would represent the total number of J2 and egg in root than single population parameter J2 or egg. Masuli and Chaite-6 was moderately resistant based on the final nematode reproducibility (%) while others were susceptible. However, yield reduction due to *M.*

*graminicola* in Masuli was reported about 40% in farmers' field (Sharma-Poudyal et al 2002). Therefore there might be serious yield loss, where the susceptible cultivars are being cultivated in infested field. Higher nematode multiplication was observed in Ghaiya-2 and Janaki than susceptible check ie IR-29 indicates the higher susceptibility of these cultivars to *M. graminicola*. These cultivars can be used as a susceptible check in screening of Nepalese rice cultivars. Difference in resistance reaction of IR-72 observed in this study and as reported by Tandingan et al (1996) might be due to difference in the water management. Tandingan et al (1996) reported IR-72 as resistant cultivars in permanent flooded condition and present study was carried out in simulated upland water condition. Environmental factors affect the resistance to *M. graminicola* (Plowright and Bridge 1990, Wallace 1987).

Generally most of the cultivars of *O. sativa* were susceptible and only a limited number of rice cultivars were resistant (Bridge et al 1990). Since, most of the commonly grown Nepalese rice cultivars were also found susceptible to *M. graminicola*, more cultivars including local landraces should be screened against the nematode to identify resistance sources. This study indicate that the chances of getting sources of genetic resistance against *M. graminicola* seems to be poor in Nepalese rice cultivars. Thus we need to develop an alternative integrated management practices to keep the damage below the economic threshold level.

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#### REFERENCES

- Bridge J, L Michel and RA Plowright. 1990. Nematode parasites of rice. *In: Plant parasitic nematodes in subtropical and tropical*

- agriculture (M Lue, RA Sikora and J Bridge, eds). UK, CAB International. Pp. 69-108.
- Hopper DJ. 1970. Extraction of nematodes from plant materials. *In: Laboratory methods for working with plant parasitic nematodes* (JF Southy ed). Stationary Road, London. *Mist. Agric. Fish and Food Tech. Bull.* Pp. 34-38.
- Hussey RS and KR Barker. 1973. A comparison of methods of collecting inocula of *Meloidogyne* spp. including a new technique. *Plant Dis. Repr.* 57:1025-1028.
- Jena RN and YS Rao. 1976. Nature of root knot nematode (*Meloidogyne graminicola*) resistance in rice (*Oryza sativa* L.) I. Isolation of resistant varieties. *In: Proceedings of the Indian Academy of Sciences* 83B:177-184.
- Kalita M and PN Phukan. 1990. Reactions of some rice cultivars to *Meloidogyne graminicola*. *Indian J. Nematol.* 20:215-216.
- Lorenzana OJ, PP Matamis, CB Mallinin, OL Jose and DS De-leon. 1998. Cultural management practices to control rice root knot nematode. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines). *PCARRD Highlights' 98: Summary of the Proceedings of the 1998 Regional Research and Development Symposia.* Los Banos, Laguna (Philippines). 120p.
- Plowright R and J Bridge. 1990. Effects of *Meloidogyne graminicola* (NEMATODA) on the establishment; growth and yield of rice cv IR36. *Nematologica* 36:81-89.
- Prasad JS, MS Panwar and YS Rao. 1987. Nematode problems of rice in India. *Tropical pest management* 33:127-136.
- Prasad SK and YS Rao. 1976a. Chemotherapy of the root knot nematodes (*Meloidogyne graminicola*) in rice. II. Evaluation of pesticides as soil drench. *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz* 83:730-735.
- Prasad SK and YS Rao. 1976b. Chemotherapy of the root knot nematodes (*Meloidogyne graminicola*) in rice. II. Effects of root dip treatment with nematicides on invasion and development of the nematode. *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz* 83:739-741.
- Prasad SK and YS Rao. 1977a. Soil drench pesticide treatment to control the root knot nematode *Meloidogyne graminicola*. *International Rice Research Newsletter* 2:20.
- Prasad KS and YS Rao. 1977b. Subsequently infectivity of treatment *Meloidogyne* larvae in chemicals. *International rice research Newsletter* 2(5):19-21.
- Sahu SC, LK Bose, J Pani, RN Misra and CD Misra. 1994. Genetic evaluation of the wild *Oryza* species for resistance against the rice root knot nematode, *Meloidogyne graminicola* Golden and Birchfield. *Annals of Plant Protection Sciences* 2:90-91.
- Sharma-Poudyal D, RR Pokharel, SM Shrestha and GB Khatri-Chhetri. 2002. Population and effect of rice root knot nematode in diseased and healthy looking rice plants and their distribution in rice field. *J. Inst. Agric. Anim. Sci.* 23:9-14.
- Sharma SB, S Pande, M Saha, KK Kaushal, M Lal, M Singh, K Singh, R Pokharel, RP Upreti and K Singh. 2001. Plant parasitic nematodes associated with rice and wheat based cropping systems in Nepal. *International Journal of Nematology* 11:35-38.
- Soriano IR, MJ Espiritu, V Schmit, D Brar and G Reversat. 1998. Resistance to rice root knot nematode *Meloidogyne graminicola* in *Oryza longistaminata* and *Oryza glaberrima*. *Philippine J. Crop Sci.* 23:89.
- Tandingan IC, JC Prot and GD Rowulo. 1996. Influence of water management on tolerance of rice cultivars for *Meloidogyne graminicola*. *Fundamental Appl. Nematol.* 19:189-192.
- Taylor AL. 1967. Introduction to research on plant nematology, FAO, Rome. 133p.
- Taylor AL and JN Sasser. 1978. *Biology, identification and control of root knot nematodes (Meloidogyne graminicola)*. Cooperative publication, Department of Plant Pathology, NCSU, Raleigh, North Carolina. 111p.
- Wallace HR. 1987. A perception of tolerance. *Nematologica* 33:419-432.
- Weerapat P and B Chongkid. 1990. Wild rice, *Oryza rufipogon*, a source of resistance to root knot nematode in rice. *Thai Agricultural Research Journal* 8:90-94.
- Zeck WM. 1971. A rating scheme for field evaluation of root knot nematode infestations. *Pflanzenschutz-Nachrichten.* Bayer AG. 24:141-144.