TWO BREEDING LINES OF RICE RESISTANT TO THE RICE ROOT-KNOT NEMATODE

M. Jena, S.K. Mohanty, R.S. Panda, L.K. Bose, L. Behera and S.C. Sahu[1]

Central Rice Research Institute, Cuttack, Odisha, India 753006

Re-submitted: 18 June 2012; Accepted: 23August 2012.

Summary. The rice root knot nematode, *Meloidogyne graminicola*, is the major nematode pest in uplands and direct sown medium land paddies. Control of the pest by crop rotation is difficult as the pest is highly polyphagous. The most feasible control option is the use of resistant cultivars. True resistance is lacking in the cultivated rice genome, therefore there is the need to identify good sources of resistance for incorporation into high yielding but otherwise susceptible rice cultivars. Two F_9 recombinant inbred lines (RILs) viz. Accession No. CR3003-11-186 and CR3003-184, derived from crosses of Annapurna × Ramakrishna, were found highly resistant to the nematode and can be used as donors in breeding programmes for resistance to it.

Key words: *Meloidogyne graminicola, Oryza sativa*.

The rice root knot nematode (RRKN), *Meloidogyne graminicola* Golden and Birchfield (1965) is the major nematode pest in uplands and direct sown medium land paddies, causing as much as 70% yield loss under rainfed conditions (Prot *et al.,* 1994). The control of the nematode by application of pesticides is costly and cannot be afforded by poor rice farmers. Control of the pest by crop rotation is not very effective as the pest is highly polyphagous. The most feasible option would be the use of resistant cultivars. Unfortunately, true resistance is lacking in the cultivated rice genome. Therefore, there is the need to identify sources of resistance for incorporation into high yielding but otherwise susceptible cultivars.

Previously, we had identified two highly resistant F_9 recombinant inbred lines (RILs), accession No. CR3003-11-186 and accession No. CR3003-184, obtained by crossing the cultivars Annapurna × Ramakrishna. These lines had shown resistance in F_2, F_8 and F_9 population.

In this study we compared the reaction to *M. graminicola* of the cvs Ramakrishna (a derivative of TKM6), TKM6, Annapurna and TN1 and accession Nos CR3003-11-186 and CR-3003-184. The RRKN population used in the study was collected from the experimental farm of the Central Rice Research Institute, Cuttack, India, and maintained on the susceptible cultivar Annapurna in a screen-house at 25-30 °C. A single plant of each cultivar was grown in plastic pots containing 800 g of a 1:1 mixture of autoclaved sand and soil. The pots were arranged according to a completely randomized design with nine replicates. When 10 days old, each seedling was inoculated with 1000 freshly hatched second stage juveniles (J2) of the nematode by exposing the roots. Freshly hatched J2 were obtained by placing blended galled roots on the tissue paper supported over a wire mesh (Schindler, 1961) for 96 hours. The hatched J2 were collected in water and used for inoculation.

Forty-five days after inoculation, the plants were uprooted and the roots washed free of soil (Sahu and Chawla, 1986). The number of galls produced on each root system was counted under a binocular microscope. The roots were then stained with lacto-phenol-acid fuchsin (Southey, 1986) and the number of females in them was counted. The average numbers of galls and females/plant were used to score resistance/susceptibility of the cultivars to RRKN. Analysis of variance (ANOVA) was done using SAS PROCGLM version 9.1 (SAS institute, 1990) and means compared with Duncan's multiple range test.

There were significant differences ($P<0.01$) in the numbers of galls and females between cultivars. The susceptible parent Annapurna, used in the crossing programme as control, was significantly different from other cultivars with regard to the two traits studied, with TN1 showing significantly higher susceptibility than Annapurna (Table I and Fig. 1). The accessions CR-3003-11-186 and CR-3003-184 showed significantly fewer galls and females on the roots than all other varieties (11.7 and 16.8% of the number of galls on the susceptible cv. Annapurna, respectively), thus confirming their resistance to the nematode. The numbers of galls and females did not differ significantly between cv. Ramakrishna and its parent TKM6. TKM6 is an *indica* land race known to possess resistance to rice yellow

[1] Contact author e-mail: scsahu_crri@yahoo.co.in

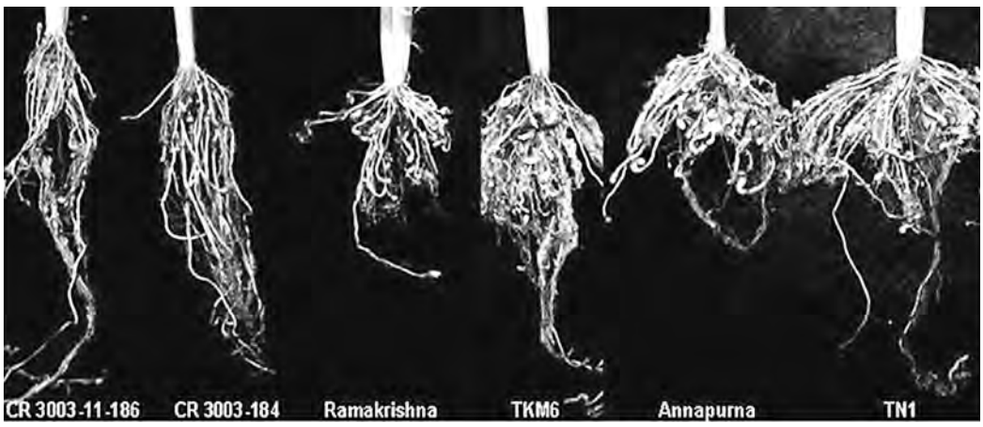

Fig. 1. Different degree of galling produced by the rice root-knot nematode, *Meloidogyne graminicola*, on the roots of the resistant rice accessions CR3003-11-186, CR3003-184, and on the cultivars Ramakrishna, TKM6, Annapurna and TN1.

Table I. Reaction of rice cultivars to the rice root-knot nematode *Meloidogyne graminicola*.

Breeding lines/Cultivars	Parentage	Galls per root		Females per root	
		Mean	% compared to Annapurna	Mean	% compared to Annapurna
Acc. no. CR 3003-11-186	Annapurna × Ramakrishna	20.2 a	16.8	26.8 a	11.8
Acc. no. CR 3003-184	Annapurna × Ramakrishna	14 a	11.7	32.9 a	14.5
Ramakrishna	IR8 × TKM6	42.7 b	35.5	99 b	43.6
TKM6	*indica* landrace	49.4 b	41.2	110.7 b	48.8
TN1	Dwarf Chow-Wu-gen × Tsai-Yuan-Chunj	158.4 d	132.0	304.1 d	134.0
Annapurna (Susceptible control)	PTB-10 × TN1	120 c	100	226.9 c	100
CV%		13.24		16.66	
CD (at 1%, 8 d.f.)		11.39		28.33	

Means in the same column having a common letter are not significantly different according to Duncan's multiple range test at P = 0.01.

stem borer, blast and bacterial leaf blight (Singh and Singh, 2003). The susceptible parent cv. Annapurna is a derivative of the cross PTB10 × TN1. PTB10 is resistant to the Asian rice gall midge insect. The increased level of resistance in both accessions may be due to transgressive segregation of the resistance from both parents, Ramakrishna and Annapurna.

Lately, RRKN has become a severe nematode pest of rice. The nematode appeared endemic in the Kaveri Delta of Mandya district of Karnataka state and Mahanadi Delta of Cuttack district of Odisha State, India, in the late nineties and early 2000, forcing the farmers to destroy the severely affected field crops. Increasing importance is now being given to the cultivation of aerobic rice due to the expected water shortage in the near future. In aerobic rice cultivation, RRKN is expected to become a very destructive pest (Kreye *et al.,* 2009). As varietal resistance is the best feasible option to manage a recalcitrant pest such as RRKN, the two resistant breeding lines identified in this study could successfully be used in breeding programmes for resistance to the nematode.

LITERATURE CITED

Kreye C., Bouman B.A.M., Castañeda A.R., Lampayan R.M., Faronilo J.E., Lactaoen A.T. and Fernandez L., 2009. Possible causes of yield failure in tropical aerobic rice. *Field Crops Research*, *111*: 197-206.

Prot J.C., Sorianoo I.R.S. and Matias D., 1994. Major root-parasitic nematodes associated with irrigated rice in the Philippines. *Fundamental and Applied Nematology, 17*: 75-78.

Sahu S.C. and Chawla M.L., 1986. Resistance of rice cultivar to root knot nematode, *Meloidogyne graminicola*. *Oryza, 25*: 62-64.

Schindler A.F., 1961. A simple substitute for a Baermann funnel. *Plant Dis. Reptr*, 45:747-748

Singh A.M. and Singh S.P., 2003. Indian rice genetic resources and their contribution to world rice improvement. *Agricultural Reviews, 24*: 292-297.

Southey J.F., 1986. *Laboratory methods for work with plant and soil nematodes*. Reference Book No. 402, Ministry of Agriculture, Fisheries and Food, HMSO, London, UK, 202 pp.

SAS PROCGLM., 1990. *SAS user's guide*. Version 9.1. 4th edn. SAS Institute, Cary, NC, USA.