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RESEARCH ARTICLE

SCREENING AND EVALUATION RICE VARIETIES /LINES FOR RESISTANCE AGAINST ROOT-KNOT NEMATODE, *MELOIDOGYNE GRAMINICOLA.*

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Abstract

Screening of some rice varieties were tested for their resistance against rice root-knot nematode *(Meloidogyne graminicola).* The investigation was conducted on 50 rice varieties along with LALAT as local check , which showed evidence of damaging potential of *Meloidogyne graminicola in* terms of plant growth parameters and disease incidence. Disease intensity grade was classified on the basis of root knot index. Out of fifty varieties,45 were moderately resistant to *Meloidogyneincognita* while 3 varieties Ciherang Sub 1,IR 64 Sub 1and PSBRC 18 were susceptible with maximum number of egg mass per galls (6) while the rest 2 varieties ,IRIOF 571 & IRIOF 602 showed resistant reactions.Possible reasons for reduction of shoot weight and root weight in infected plant may be due to improper supply of nutrients resulting from nematode infection for which it is compensated to some extent in resistant varieties.

Introduction:-

Rice (*Oryza sativa L.*) is an important staple food crop for majority of human population in the world in general and in Asia in particular. In India, rice occupies more than one-quarter of the cropped area and contribute between 40-43 % of total food grain. *Meloidogyne graminicola,* the root-knot nematode is an obligate parasite of rice, *Oryza sativa.* Yield loss up to 50% might be incurred due to severe infestation of *Meloidogyne 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). The use of resistant cultivars is a low cost and sustainable option for the control of nematodes in the long term. Which does not impose unwanted changes in traditional agronomic practices (Amoussou et al. 2004). So far, efforts to breed rice cultivars resistant to rootknot nematode have been limited. However attempts have been made to screen popular varieties (Sampath et al. ,1970: Israel & Rao, 1971: Roy, 1973) to identify those that are suitable to be cultivated in nematode infested areas.

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Rootknot nematodes (*Meloidogyne* spp.) are among the most prevalent economical crop pests worldwide (Sasser ,1989; Stirling et al.,1992;Oka et al.,2000) and they interfere with anchorage and absorption of crop plants. They are most destructive and devastating important crop pests. Root-knot nematode causes quite different morphological and anatomical responses in different plants and even in various parts of a particular plant and different species can causes different responses in the same plant (Krusberg, 1963). The morphological response of plants to nematode infection resulted in severe stunting, chlorosis, wilting and drooping of leaves, delay in flowering, fruit formation and yield, aggregation of nutrition deficiencies and retardation of growing point of shoot and root system. Though the nematicides are quite effective against nematodes but these are hazardous to health, soil and environment. Use of

resistant cultivars is an economical and eco-friendly option for the management of nematode diseases under field conditions.
The major causes of low productivity are the incidence of insects and diseases including plant parasitic nematodes. Plant parasitic nematode, *Meloidogyne graminicola* alters the metabolic processes of the host which are manifested in the form of cellular, physiological and biochemical changes occurring in the infected host. The root-knot nematodes causes measurable changes in the morphology and physiology of the host plants.(Williamson and Gleason, 2003). The infection caused by these nematode results in yellowing of leaves and poor plant growth. This nematode has a wide host range which reduces the effectiveness of crop rotation for its management. The nematode can also be managed by use of nematicides but due to high cost and unavailability makes them unsuitable for farmers in subsistence farming system. Therefore, an alternative source of ecologically sound and viable option to avoid the losses caused by the nematodes is the use of resistant cultivars / lines. In the present investigation, 50 Rice cultivars/ lines along with one local check i.e.LALAT were screened in phased manner under pot culture condition to locate the resistant source among various germplasms in screen house of the Nematology Department, College of Agriculture, OUAT,BBSR, during July 2015 up to November 2015.

Materials and methods:-

In the present study, seedlings of fifty Rice genotypes along with one local check i.e LALAT were subjected to screening for resistance against root knot nematode *Meloidogyne graminicola* during July to November 2015,in the Department of Nematology, OUAT,BBSR. Egg masses of *M. graminicola* were collected from pure culture already maintained on Rice plants. Second stage juveniles used in these experiments were obtained from egg masses raised on infected Rice plants. The experiment was carried out in screen house of the Nematology Department. Earthen pots of 15cm dia. were filled with denematised, sterlised sandy soil, FYM and sand mixture in 2:1:1 ratio @1Kg/pot. Seeds of each genotype were sown in the earthen pots containing steam sterilized soil. After germination, these were thinned to single plants in each pot with three replications in each case. One week old seedlings of Rice genotypes were inoculated with freshly hatched larvae of root knot nematode (*M. incognita*) @ $1000J_2$/ pot by exposing the roots. Forty five days after inoculation, plants were uprooted, washed, cleaned and then fixed in 4% formalin. Staining was done in lactophenol aniline blue and cleared in pure lactophenol and observations were made on the number of galls, number of seeds, plant height, fresh and dry weight of root and shoot and final nematode population of the soil for each tub. Root gall index was assessed on 0-5 scale. Rice plants were uprooted from the pots after 45 days of inoculation and screening of Rice germplasm for resistance and susceptibility against root knot nematode (*Meloidogyne graminicola*) was done by adopting 1-5 scales as Highly Resistant (1= no gall/egg mass per plant), Resistant (2=1-10 galls/ egg mass per plant), Moderately resistant (3= 11-30 galls / egg mass per plant). Susceptible (4= 31-100 galls/ egg mass per plant) and Highly Susceptible (5 = more than 100 galls/egg masses per plant) as per Root-knot Index scale given by Gaur et al.,2001.

Evaluations of resistant rice varieties against root-knot nematode, *meloidogyne incognita:-*

Seeds of rice cultures/varieties of known resistance obtained from screening process were surface sterilized by treating with 0.1 % $Hgcl_2$ solution for about four minutes followed by five risings with sterile water. For evaluation purpose inoculations and observations were followed as done before in screening process.

Results and discussion:-

Screening of Rice varieties/cultivars against root-knot nematodes:-

The Table-1 revealed that out of fifty Rice varieties/cultivars screened against root-knot nematode, 3 varieties Ciherang Sub 1,IR 64 Sub 1and PSBRC 18 were susceptible with maximum number of egg mass per galls (6) while the rest 2 varieties ,IRIOF 571 & IRIOF 602 showed resistant reactions. Possible reason for reduction of shoot weight and root weight in infected plant may be due to improper supply of nutrients resulting from nematode infection for which it is compensated to some extent in resistant varieties.

Effect of nematode infections on plant growth parameters:-

Plant height: Due to the infection of rice root-knot nematode the shoot length and root length decreases 17cm and 2.1cm of the susceptible Rice cultivar, IR64 Sub1, which was statistically different from other resistant varieties. The decrease is possibly due to improper uptake and transport of elements, nutrients and water resulted from nematode infection (Table 1).

Shoot weight and root weight:-

The infection of rice root knot nematode and formation of giant cells and galls in the roots of both resistant and susceptible varieties has shown decrease in shoot weight 0.4g and root weight 0.2g of the susceptible Rice cultivars, which was different from other resistant varieties resistant reaction. Possible reason for reduction of shoot weight and root weight in infected plant may be due to improper supply of nutrients resulting from nematode infection for which it is compensated to some extent in resistant varieties (Table 1).

The present investigation is in conformity with Gitanjali et.al. (2007) who screened 8 rice varieties, screening rice varieties for resistance against root knot nematode (*Meloidogyne graminicola).* Anil Prashar *et al.* (2004) clearly demonstrated that the severity of *Meloidogyne graminicola* to rice increases with increase of water stress, hence the important of using rice cultivars that are tolerant to water stress and resistant to the nematode. Kalita *et al.* (2004) screened twelve commonly cultivated rice cultivars against rice root knot nematode (*Meloidogyne graminicola*) in sick soil under greenhouse condition.

From the above investigation it can be suggest that resistance is one of several tools for use in an integrated approach for root knot nematode management. Two primary attributes of host resistance for nematode managementare relevant a) the value of resistance infection and b) the rotational value of resistance in cropping systems for protecting subsequent crops, based on the ability to suppress nematode population densities in soil by restricting nematode reproduction. These two attributes underpin most nematode resistance breeding and management decisions. Resistant lines will be proved useful parents for root knot nematode resistant breeding programme.

Table 1(a). Root-knot Index Scale (Gaur et al.2001)

Root-knot Index Scale	**Number of Galls/ egg masses per plant root**	**Reactions**
1	0	HR
2	1-10	R
3	11-30	MR
4	31-100	S
5	>100	HS

Table 1. Screening & Evaluation of rice varieties/cultivars/lines against root-knot nematode, *Meloidogyne graminicola* (Average of three replications).

S.I.No.	Varieties	Fresh shoot weight (g)	Fresh root weight (g)	Fresh shoot length(cm)	Fresh root length(cm)	Dry shoot weight(g)	Dry root weight (g)	No.of egg mass per galls	Final population*	Reaction**	No. of effective tillers per clumps
1	BR II	0.4	0.3	21	2.5	0.3	0.2	3	0.7	MR	1.3
2	BR II Sub 1	0.4	0.2	22	3	0.3	0.3	1	0.6	MR	2
3	Ciherang	0.5	0.3	26	3.2	0.4	0.3	4	0.8	MR	1.7
4	Ciherang Sub 1	0.5	0.4	24.5	3	0.2	0.3	6	1	S	1
5	CR 1009	0.5	0.4	18	2.7	0.3	0.2	4	0.7	MR	2.3
6	CR 1009 Sub 1	0.4	0.3	19	2.2	0.5	0.4	3	0.7	MR	1.7
7	IR 64	0.7	0.5	24.1	2.5	0.4	0.3	3	0.8	MR	1.3
8	IR64 Sub 1	0.5	0.3	17	2.9	0.3	0.2	6	0.8	S	2
9	PSBRC 18	0.7	0.4	23	2.7	0.6	0.3	5	0.7	S	2.3
10	PSBRC 18 Sub 1	0.7	0.4	24	2.5	0.2	0.1	4	0.7	MR	1.3
11	Sambamahswi	0.7	0.6	21	2.5	0.3	0.3	3	0.7	MR	1.7
12	Sambamahswi Sub 1	0.7	0.3	20	2.8	0.3	0.1	2	0.7	MR	1
13	Swarna	0.4	0.4	19.5	2.9	0.3	0.1	3	0.7	MR	1.7
14	Swarna Sub 1	0.8	0.5	17	2.7	0.5	0.3	2	0.6	MR	2
15	TDK 1	0.4	0.4	25	3.1	0.3	0.2	3	0.7	MR	1.7
16	TDK Sub 1	0.8	0.5	24.1	3.2	0.4	0.6	1	0.7	MR	1.3
17	Inpara	0.7	0.4	25	2.1	0.6	0.4	2	0.7	MR	2.3
18	IR 42	0.6	0.5	23.7	2.2	0.5	0.4	2	0.7	MR	2.3
19	IR 68	0.5	0.6	24.2	2.7	0.4	0.3	3	0.7	MR	1.3
20	IR 72	0.5	0.5	23.1	2.9	0.3	0.2	2	0.7	MR	2
21	IR 74	0.6	0.6	29.7	3.2	0.3	0.2	2	0.7	MR	1
22	IRRI 119	0.5	0.5	28.1	3.3	0.4	0.3	2	0.7	MR	1.7
23	IRRI 120	0.6	0.6	29	2.9	0.2	0.1	1.3	0.7	MR	2
24	IRRI 133	0.5	0.6	30	3.3	0.4	0.2	2	0.7	MR	2.3
25	IRRI 151	0.7	0.5	31	2.5	0.3	0.2	1.3	0.7	MR	2.7
26	OR 142-99	0.6	0.4	27.1	2.3	0.3	0.2	2	0.7	MR	1.3
27	Pratikshya	0.5	0.4	28	2.4	0.4	0.3	2.7	0.7	MR	2
28	Mahanadi	0.6	0.3	27.5	3.3	0.3	0.1	4	0.7	MR	1
29	Upahar	0.5	0.4	28.1	2.7	0.4	0.3	2.7	0.7	MR	0.7
30	Jagabandhu	0.6	0.3	27.1	3.1	0.5	0.4	4	0.7	MR	2
31	IR09F 169	0.7	0.4	19.3	2.1	0.4	0.3	3.7	0.7	MR	2.3
32	IRI0F 109	0.8	0.5	17	2.2	0.5	0.4	1.3	0.7	MR	2
33	IRI0F 119	0.7	0.4	19.1	2.5	0.6	0.5	2.7	0.7	MR	2
34	IRI0F 151	0.6	0.3	20.1	2.5	0.5	0.6	2	0.7	MR	1.7
35	IRI0F 198	0.6	0.3	28	3.1	0.3	0.2	4	0.8	MR	1

36	**IRI0F 339**	0.6	0.6	19	2.1	0.2	0.3	3.7	0.8	MR	0.7
37	**IRI0F 365**	0.7	0.7	17	2.2	0.3	0.4	1.3	0.7	MR	1.7
38	**IRI0F 559**	0.8	0.8	19.1	2.5	0.4	0.3	2.7	0.7	MR	1.7
39	**IRI0F 571**	0.7	0.7	20.1	2.4	0.3	0.2	0.7	0	R	2.3
40	**IRI0F 577**	0.6	0.6	24.1	2.5	0.4	0.2	1.3	0.7	MR	1.3
41	**IRI0F 602**	0.5	0.4	25.8	2.7	0.3	0.1	0.7	0	R	2.3
42	**IRI0F 616**	0.5	0.4	28.1	2.5	0.2	0.1	2.7	0.8	MR	2
43	**IRIIF 186**	0.4	0.3	31.1	2.7	0.4	0.1	2	0.7	MR	1.7
44	**IRIIF 190**	0.6	0.4	32	2.6	0.3	0.2	3.7	0.8	MR	1.3
45	**IRIIF 195**	0.6	0.5	32.1	2.4	0.3	0.3	2.7	0.8	MR	1
46	**IRIIF 196**	0.6	0.5	27	2.9	0.4	0.2	1.3	0.6	MR	1.7
47	**IRIIF 216**	0.5	0.4	27.1	3.1	0.5	0.1	4	0.8	MR	1.3
48	**IRIIF 239**	0.7	0.4	24	3.3	0.4	0.2	3.7	0.8	MR	1.7
49	**IRIIF 262**	0.6	0.7	32.1	2.5	0.6	0.2	2	0.8	MR	1.7
50	**IRIIF 267**	0.8	0.4	24	2.4	0.4	0.3	4.7	0.4	MR	2
51	**Lalat (CHECK)**	0.5	0.3	25	3.1	0.4	0.2	3.7	0.8	MR	2
SE(M)±		**0.094**	**0.083**	**3.524**	**0.391**	**0.221**	**0.138**	**0.831**	**0.286**	**-**	**0.394**
CD(0.05)		**0.067**	**0.059**	**2.512**	**0.279**	**0.038**	**0.023**	**0.143**	**0.049**	**-**	**0.068**

*** log transformed values**

**** R=Resistant, S=Susceptible, MR=Moderately Resistant**

Conclusion:-

Some selective changes occur in the metabolism either as a consequence of the establishment of a compatible (susceptible) host-pathogen interaction or as a result of incompatibility (resistant) between host and parasite. Shoot growth parameter like shoot length, fresh weight and dry weight of different varieties of Rice in general were reduced significantly due to the infection of root-knot nematode. Due to the infection of root-knot nematode the shoot length and root length decreases 17cm and 2.1cm of the susceptible Rice cultivar, IR64 Sub1, which was statistically different from other resistant varieties. Comparison between control and infected group of individual variety showed significant decrease in shoot length in all the cases. Root growth parameters like root length, fresh weight and dry weight of different varieties of Rice were found to be significant. Basing on nematode population root gall index and susceptibility, the effect of varietal difference on root gall numbers/root system was also observed to be significant.

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