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Field screening of improved rice genotypes against the Asian rice gall midge (*Orseolia oryzae* Wood-Mason)

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ABSTRACT

Asian rice gall midge (Orseolia oryzae Wood-Mason) is a serious pest in most of the rice growing areas in India particularly when high dose of nitrogen is used. In order to know the reaction of popular high yielding varieties (HYVs) and few improved genotypes to gall midge 87 genotypes were screened under natural field condition at 50-62 days after transplanting at zero and 120 kg N ha^{-1} based on appearance of silver shoot. Few genotypes from early group like Ananga, Annada, Kharavela and Shaktiman showed highly resistant reaction at both the level of nitrogen with 0% silver shoot. Cultivar Jajati and Suraksha showed moderately resistant reaction in mid group and Chaitanya in late group. Other cultivars/genotypes showed high infestation of gall midge as observed from the incidence of silver shoots and are classified as either susceptible or highly susceptible at 120 kg N ha^{-1} level. Under high N level invariably there was high incidence of gall midge in most of the genotypes than the zero N level.

Key words: *Asian rice gall midge, field screening,nitrogen level*

Asian rice gall midge is a major pest in India and many parts of Asia and accounted for 3-70 % yield losses (Chatterjee *et al* 1976). It is widespread in occurrence and found in most of the rice growing states like Andhra Pradesh, Assam, Bihar, Chattisgarh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharastra, Manipur, parts of Uttar Pradesh and West Bengal. As per the intensity and regularity of occurrence, few areas have been identified as hot spots. These are coastal and northern Telangana regions of Andhra Pradesh, Ranchi areas of Jharkhand, entire Chattisgarh, coastal and Sambalpur areas of Orissa and Tamil Nadu (Mathur and Krishnaiah, 2004). Host plant resistance is a preferred strategy for management of Asian Rice Gall midge (*Orselia oryzae)*. But the variation in biotypes across locations and/or existence of more than one biotype in a region makes it more difficult for breeding cultivar against the pest. The problem is more serious in intensive rice growing conditions where more of nitrogenous fertilizer is used to realize a higher yield in popular high yielding varieties (HYVs) that are not bred for resistant against the pest. In the present scenario high dose of nitrogen application is indispensable to obtain higher yield but there are reports that incidence of gall midge is more in plots receiving increased level of nitrogen (Narayanan *et al*, 1973; Israel *et al*., 1968).

Thus the present study was undertaken to know the reaction of genotypes to gall midge(GM) at zero and 120 kg N ha^{-1} level *vis a vis* identify donor(s) from presently grown popular improved genotypes that could be utilized for development of resistant cultivars by minimizing the transfer of undesirable traits which is not the case in traditional donor cultivars.

MATERIALS AND METHODS

The study was conducted during wet seasons of 2007 and 2008 at Central Rice Research Institute, Cuttack where the biotypes has been identified as '2'. Screening under natural field conditions of 87 HYVs /improved genotypes of early (up to 125 days), medium (126-135 days) and late duration (> 136 days) at 0 and 120 kg of applied nitrogen $hectare^{-1}$ keeping the (P_2O_5) phosphorous and (K_2O) potassium at 60 kg $hectare^{-1}$ each. These cultivars were sown during 1st week of July and planted after 30 days in an augmented block design with 30 entries per block as per their duration

with Jaya as susceptible check and Shaktiman, Daya, IR 36, Lalat and Samalei as resistant checks (Prasad *et al*, 2004). Except control blocks where no nitrogen was applied, 50% of N was applied as basal and rest N in two equal splits, one at 30 days after transplanting i.e. at maximum tillering and other at booting stage which varied from 25-40 days from maximum tillering stage as per the duration. The maximum temperatures during (i.e. 2nd September to 4th October, 2007) were 28-32 ^{0}C and relative humidity were 75-90 % when maximum incidence of silvers hoots were observed. No plant protection chemicals were applied to the crop. The natural incidence of gall midge was observed in the trial and their reaction to the genotypes taken at both level of N i.e. N_0 and N_{120} in all three maturity duration group were recorded by taking five random plants from the mid rows of 6 rows plot of 6.5m length during last week of September to 1st week of October (22nd September to 4th October, 2007) at 50 to 62 days from the date of transplanting. Based on the percentage of silver shoot the genotypes were ranked as highly resistant, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible as per the Standard Evaluation System of IRRI, 1996.

RESULTS AND DISCUSSION

The high percent of silver shoots were observed invariably in almost all the genotypes in 120 kg N ha^{-1} level than in zero level except a few resistant cultivars that suggest that strong correlation exist between gall midge infestation and high N fertilization. This was also reported by Israel *et al* (1961), Chelliah *et al* (1972) and Narayan *et al*, (1973).

At zero level of applied N the early maturing cultivar Saket 4, Daya, Shaktiman, IR 50, Radhi, Ratna,IR 64, Lalat, Ananga, Annada,Kharavela,Bhoi, Satabdhi, Sasyasree, Bhavani and Prasad were not at all infested by gall midge as there was no silver shoot observed where as at 120 kg N ha^{-1} level only Shaktiman, Ananga, Annada, Kharavela showed such reactions. Therefore, these genotypes posses true resistance and are classified as strongly resistant against the pest. This needs further confirmation under artificial epiphytotic conditions in net house. Cultivar IR 50 and Satabdi showed resistant reaction at 120 kg N ha^{-1} level and cultivar Khitish and Divya showed moderately resistant reaction at zero N level. All other genotypes of this maturity group showed susceptible reaction where as Daya, Ratna, Pusa 44,Bhoi, and Bhavani, showed highly susceptible reaction under 120 kg N ha^{-1} level, though Daya Ratna & Bhavani were reported to be resistant.The details of the reaction of each genotype from each maturity duration group are presented in Table 1.

In mid duration group, genotype IR 8, Suraksha, Jajati, Birupa CR 2340-3, CR 2463-15, CR

Table1. Reaction of transplanted rice genotypes to gall midge in wet season 2007 at CRRI, Cuttack under zero and 120 Kg N ha^{-1} Nitrogen level

		NPK 0:60:60 kg ha^{-1}			NPK 120:60:60 kg ha^{-1}	
Variety (Up to 125 days duration)	% of Silver shoot	Score	Grain yield (t ha^{-1})	% of Silver shoot	Score	Grain yield (t ha^{-1})
Saket 4	0	0	3.1	22.2	7	3.8
Daya	0	0	2.9	35.4	9	4.2
Shaktiman	0	0	3.2	0	0	4.3
IR 50	0	0	2.6	1.7	3	4.4
Pusa 44	19.2	7	3.5	24.5	7	4.6
Gajapati	20.7	7	3.9	19.6	7	4.8
Radhi	0	0	3.0	20	7	3.9
Vijetha	18.8	7	4	19.4	7	5.6
Ratna	0	0	2.4	27.9	9	3.6
IR 64	0	0	3.9	17.3	7	4.9
Lalat	0	0	2.5	21.3	7	4.6
Sravani	20.7	7	3.4	17.5	7	5.3

		NPK 0:60:60 kg ha^{-1}			NPK 120:60:60 kg ha^{-1}	
Variety (Up to 125 days duration)	% of Silver shoot	Score	Grain yield (t ha^{-1})	% of Silver shoot	Score	Grain yield (t ha^{-1})
Ananga	0	0	3	0	0	3.9
Annada	0	0	3.2	0	0	4.1
Narendra 2	10	0	2	20	7	3.9
Kharavela	0	0	3.4	0	0	5.0
Konark	20.9	7	2.2	22.4	7	4.2
Bhoi	0	0	2.8	28.3	9	4.6
IR 72	18.1	7	2.2	20.3	7	4.5
Satabdi	0	0	3.1	1.6	3	4
Naveen	22.8	0	3.2	21.5	7	4.3
Khitish	3.3	3	3	18.7	7	4.2
Divya	5.3	3	2.4	21.3	7	3.7
Sasyasree	0	0	3.4	19.4	7	5
Bhavani	0	0	3.6	27.7	9	4.7
Prasad	0	0	4.1	17.1	7	5.5
PR 111	17.9	7	2.6	16.4	7	3.8
BK 190	28	9	2.7	26.0	9	3.2
Variety (126-135) days duration						
Jaya	17.4	7	3.0	18.9	7	3.9
Surendra	17.5	7	3.6	18.9	7	5.4
IR 8	0	0	4.0	13.3	7	5.4
Pusa Basmati 1	22.4	7	2.8	26.6	9	3.1
Indira	30.5	9	3.6	22.7	7	4.1
Tapaswini	2.8	3	4.4	14.1	7	5.4
Suraksha	0	0	4.0	1.6	3	4.4
Sonasali	1.7	3	4.8	14.3	7	6.3
Jajati	0	0	3.8	1.8	3	4.0
Vikramarya	23.6	7	5.2	25.8	9	5.9
Birupa	0	0	3.2	32.7	9	7.1
Gouri	20.0	7	4.2	14.3	7	5.8
Kshira	24.5	7	3.2	36.4	9	5.2
Meher	4.2	3	2.2	19.4	7	3.6
CR 2463-16	2.5	3	3.0	27.1	9	3.7
Swarna	21.3	7	4.7	26.0	9	6.4
CR 2340-3	0	0	2.6	24.0	7	3.0
CR 2340-1	1.4	3	2.4	28.8	7	3.6
CR 2461-9	12.7	7	2.8	24.2	7	3.2
CR 2462-8	20.0	7	3.0	23.5	7	3.6
Dubraj	18.8	7	3.2	27.6	9	4.0
CR2364-25	13.0	7	2.1	28.6	9	3.1
CR 2463-15	0	0	2.2	22.8	7	3.7
CR 2340-7	13.0	7	2.4	22.2	7	3.0
CR 2464-12	0	0	2.5	25.7	9	3.9

Variety (126-135 days duration)	NPK 0:60:60 kg ha^{-1}			NPK 120:60:60 kg ha^{-1}		
	% of Silver shoot	Score	Grain yield (t ha^{-1})	% of Silver shoot	Score	Grain yield (t ha^{-1})
IR 36	18.9	7	3.1	25.8	9	4.6
Mahsuri	14.2	7	3.4	19.0	7	5.8
Phalguna	0	0	3.2	26.4	9	4.8
Urbashi	21.7	7	3.1	19.7	7	5.2
Variety >136 days duration						
Sabita	2.5	3	3.4	26.5	9	4.8
Salivahana	3.8	3	3.4	16.4	7	5.8
Dharitri	25	7	3.5	20.3	7	6.3
Samalei	2.6	3	4.3	23.6	7	4.9
Moti	5.4	3	3.1	19.3	7	5.2
Gayatri	2.3	3	3.6	36.0	9	6.9
Samba Mahsuri	22.9	7	3.1	31.8	9	4.2
Rajshree	0	0	3.9	30.1	9	6.1
Nagarjuna	23.9	7	3.0	24.6	7	3.2
Vibhava	2.2	3	4.0	32.2	9	5.2
MTU 1071	0	0	4.4	26.6	9	6.6
Lunisree	23.0	7	3.4	26.5	9	4.4
Bhanja	0	0	3.0	30.2	9	5.2
Manika	15.9	7	4.1	32.7	9	5.8
Vasistha	30	9	3.6	16.2	7	5.3
KrishnaHamsa	27.2	9	4.8	23.5	7	5.5
Savitri	18.1	7	3.3	36.3	9	7.4
Pooja	14.8	7	3.8	28.3	9	6.4
Sashi	18.4	7	2.4	31.9	9	4.0
MDU 3	15.8	7	2.6	19.4	7	3.9
Jaisree	16.3	7	2.8	21.6	7	4.0
Sesu	4.2	3	4.8	30.6	9	5.4
Pratibha	23.9	7	3.0	29.4	9	4.6
Pratikshya	16.6	7	3.8	19.7	7	6.8
Chaitanya	0	0	3.1	2.0	3	4.9
Deepa	18.4	7	2.8	31.9	9	3.1
Samanta	1.8	3	3.6	24.2	7	5.0
Indrabati	15.3	7	4.2	25.8	9	5.0
Mahanadi	19.7	7	3.2	33.3	9	4.8
Ranjit	21.3	7	3.4	24.0	7	7.2

0-Highly resistant ; 1-Resistant; 3 Moderately resistant; 5 Moderately susceptible; 7-Susceptible; 9-Highly susceptible

2464-12 and Phalguna had showed highly resistant reaction at zero N but none were consistent at 120 kg N ha^{-1} level except Jajati and Suraksha showing moderately resistant reaction. Genotype Tapaswini, Sonasali, Meher, CR 2463-16 and CR 2340-1 were moderately resistant at zero N level but all other genotypes besides Jajati and Suraksha were either susceptible or highly susceptible to gall midge at high N level. Pusa Basmati 1,Vikramarya, Birupa, Kshira, CR2463-16, Swarna, CR 2340-1, Dubraj, CR 2464-25, CR2464-12, IR 36 and Phalguna showed highly susceptible reaction at higher N level.

Among late maturity group, Rajshree, MTU 1071, Bhanja and Chaitanya showed highly resistant reaction at zero N but under high N application, only Chaitanya showed moderately resistant reaction. Although Sabita, Salivahana, Samalei, Gayatri, Vibhava, Moti, Sesu, and Samanta had resistant reaction they failed to show such reaction under high N fertilization, rather they showed susceptible or highly susceptible reaction. From earlier study Samalei was found resistant and Ratna was susceptible based on silver shoot percentage (Khandalkar *et al* 1991) also gave similar results in the present study. Like wise Ratna and Mahsuri that was reported highly susceptible by Kaushik *et al* (1979) also showed similar reaction. Present study indicated that the early cultivars are less prone to gall midge infestation with less number of silver shoot than medium and late duration cultivars. This is in conformity with the results observed by Kaushik *et al* (1979).

This study suggested that genotype Annada, Ananga, Kharavela, Shaktiman in early duration were highly resistant and Jajati and Suraksha in mid duration and Sesu in late duration group were resistant against gall midge even at 120 kg N ha^{-1} level. These genotypes could be grown commercially to avoid severe gall midge infestation in endemic areas and also used as donors for development of gallmidge resistant varieties. Applications of more of nitrogenous fertilizer invite more of gall midge incidence in susceptible cultivars.

The highly resistant cultivars were again screened during wet season, 2008 and the result was confirmed showing highly resistant reaction in comparison to the susceptible check Jaya having 18.5 and 26.8%silver shoots at zero and 120 kg N ha^{-1} level, respectively.

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