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Survival and Population Buildup of Brown Planthopper *Nilaparvata lugens* (Stal) on Selected Rice Genotypes

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ABSTRACT

Studies on survival and population buildup of *Nilaparvata lugens* on some selected rice genotypes was carried out in glasshouse. On 40 day old plants, BPH population recorded at 40 days after infestation ranged from 0 to 141 insects/plant on selected genotypes whereas TN1 recorded the highest population of 312 insects/plant. Among all selected genotypes, PHSS17 recorded lowest nymphal survival (38%), highest period of nymphal development (19.35) days and lowest growth index (1.96). On 60 day old plants, BPH had lower nymphal survival, longer development period, lower growth index and lower population buildup as compared to 40 day old plants. All selected rice genotypes showed strong antibiosis mechanism of resistance and the resistance appeared to be enhanced in 60 day old plants than in 40 day old plants.

Key words *Oryza sativa, Nilaparvata lugens, antibiosis, survival, population buildup.*

The brown planthopper (BPH) [Nilaparvata lugens (Sta°l) (Hemiptera: Delphacidae)] is a typical piercing–sucking insect pest of rice (*Oryza sativa* L.; Poaceae), which feeds on phloem sap and thus affects the growth of rice and results in 'hopperburn' in rice fields (Watanabe and Kitagawa, 2000). chemical control of BPH by using insecticides has remained futile approach. Management and policy changes in the 1980s and 1990s emphasized non-insecticidal tactics to avert BPH outbreaks (Bottrell and Schoenly, 2012) Host plant resistance which is relatively stable, cheap environmentally friendly and generally compatible with other methods of pest management has been considered as a major control strategies against this pest. Three mechanisms of plant resistance *viz.*, antixenosis, antibiosis and tolerance are generally recognized. Pest survival and population buildup is one of the major and reliable parameter in antibiosis mechanism to evaluate the degree of resistance (IRRI, 1980 and Panda and Heinrichs, 1983) of a variety or genotypes. Hence, present study on survival and population buildup of BPH on some resistant genotypes was carried out.

MATERIAL AND METHODS

Experiments were conducted in glasshouse. The average temperature, relative humidity and day and light during the study period were 25 to 30oC, 70 to 80% and 12:12 h, respectively. Fifteen day old seedlings of each test genotypes were planted in 12 cm diameter clay pots. When plants became 40 and 60 day old, they were covered with cylindrical mylar film cage (90 cm height x 10 cm diameter) and kept in galvanized iron trays filled with water and infested with 10 first instar nymphs per plant keeping five replications for each genotype. Insects were observed daily. Number of nymphs that became adults were recorded and converted into percentage and the days required to grow into adult was recorded for individual surviving insect. Growth index of BPH on each genotype was computed by using the data obtained from the experiments on nymphal survival and nymphal developmental period as follows:

Growth index = nymphal survival (%) / Nymphal developmental period (days)

To study the population buildup of BPH, three pairs of freshly emerged males and females were released on 40 and 60 day old potted rice plants of test genotypes confined within polyester film cages. PTB 33 and TN1 were used as resistant and susceptible checks respectively. Nymphs and adults were counted at 20 and 40 days after infestation and the experiment was conducted with four replications. The data obtained from the experiments was statistically analyzed and different parameters observed in the experiments were subjected to Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984)

RESULTS AND DISCUSSION

Survival of BPH nymphs ranged from 38.0 to 94.0% and 34.0 to 86.0% on 40 and 60 day old plants respectively (Table 1). Among genotypes tested, PHSS 17 reported significantly the lowest survival of 38.0% followed by PHSS 11(46.0%), PHSS 16 (66.0%) which were on par with resistant check PTB 33(44.0%). This was followed by PHSS 6 and PHSS 12 (72%).

Table 1. Nymphal survival, developmental period and growth index

Genotypes	Plant Age(days)					
	40			60		
	NSP (%)*	NDP(days)**	GI*	NSP (%)*	NDP(days)**	GI*
PHSS 6	72.00[b] (58.05)	11.12[c] (3.33)	6.47[b] (14.73)	66.00[b] (54.33)	11.45[c] (3.38)	5.76[b] (13.89)
PHSS 11	46.00[cd] (42.70)	16.97[a] (4.12)	2.71[d] (9.48)	42.00[c] (40.39)	17.80[a] (4.21)	2.36[d] (8.84)
PHSS 12	72.00[b] (58.05)	12.03[bc] (3.47)	5.99[b] (14.17)	64.00[b] (53.13)	13.12[bc] (3.62)	4.88[c] (12.76)
PHSS 16	66.00[bc] (54.33)	13.33[b] (3.65)	4.95[c] (12.86)	62.00[b] (51.94)	14.20[b] (3.77)	4.37[c] (12.07)
PHSS 17	38.00[d] (38.05)	19.35[a] (4.39)	1.96[e] (8.05)	34.00[c] (35.67)	19.70[a] (4.44)	1.73[e] (7.56)
TN 1	94.00[a] (75.82)	7.80[d] (2.79)	12.05[a] (20.31)	86.00[a] (68.03)	8.96[d] (2.99)	9.60[a] (18.05)
PTB 33	44.00[cd] (41.55)	18.21[a] (4.27)	2.42[de] (8.94)	42.00[c] (40.39)	18.83[a] (4.34)	2.23[d] (8.59)
SEd	6.0555	0.1384	0.4958	2.9778	0.1433	0.4595
CD(0.05)	12.9893	0.2969	1.0634	6.3875	0.3074	0.9856

*, ** Mean of five replications. *Figures in parenthesis are arc-sine transformed values. ** Figures in parenthesis are square root transformed values. In a column, means followed by same letter are not significantly different by DMRT at 5% level.

NSP- Nymphal Survivrl Percentage. NDP- Nymphal Developmental Period. GI- Growth Index.

On 60 day old plants, the lowest nymphal survival was recorded on PHSS 17 (34.0%) which was 2.53 fold lower than susceptible check TN1 (86.0%). This was followed by PHSS 11 (42%), PHSS 16 (62.0%), PHSS 12 (64.0%) and PHSS 6 (66.0%).

Current study reported reduction in survival rate of BPH on resiststant plants. This fits well with the study of Kalode and Krishna, 1979, Maheshwari, *et al*., 2006a. Mortality was high immediately before the adult stage was reached or shortly thereafter (Kalode, *et al.*, 1975).This might be due to the presence of antibiosis factors *i.e.* presence of feeding deterrent such as soluble silicic acid, malic acid and benzoic acid in the resistant genotypes as reported by Soundararajan, *et al*., 2002. When plants grew older, generally there was a tendency in reduction of survival rate of nymphs on all the resistant genotypes.

Nymphal developmental period of BPH on 40 and 60 day old plants ranged from 7.80 to 19.35 and 8.96 to 19.70 days respectively (Table 1). Among genotypes tested at 40 days age, PHSS 17 showed significantly highest nymphal developmental duration of 19.35 days followed by PHSS 11 (16.97 days), PHSS 16 (13.13 days), PHSS 12 (12.03 days) and PHSS 6 (11.12 days). At 60 days age, nymphal duration was longer than that on 40 day old plants on all genotypes including susceptible check. Prolonged nymphal developmental period on resistant varieties was also reported by Maheshwari, *et al.,* 2006b and Mishra, *et al.,* 2001. Alagar and Suresh, 2007 suggested the nutrition of the insects surviving on the resistant genotypes might be inadequate, unsuitable due to presence of high total sugars and non-reducing sugars. They attributed to both olfactory and gustatory stimuli of the insect.

Lower growth index value indicates the unsuitability of the entry for growth and development of BPH. Growth index of BPH on 40 day old plants of selected entries (Table 1) ranged from 1.96 to 6.47 which was significantly lower than that on TN1 (12.05). On 60 day old plants, selected genotypes showed the growth index of BPH ranging from 1.73 to 5.76 whereas TN1 recorded 9.60. Growth index on PHSS 17 was lowest (1.73) which was 1.29 fold lower than PTB 33 (2.23). This was followed by PHSS 11 (2.36), PHSS 16 (4.37), PHSS 12 (4.88) and PHSS 6 (5.76). Vanitha, *et al.,* 2011 and Kumar, *et al.,* 2012 reported the reduced growth index of BPH on resistant rice lines than susceptible ones. The growth index takes into account both survival and the developmental period. It is considered more reliable parameters for comparing the suitability of the test genotypes [Mishra, *et al*., 2001].

Population buildup of BPH (Table 2) on selected genotypes varied from 6.25 to 78.50 and 0.00 to 141.00

Table 2. Population buildup of *N. lugens* on selected genotypes

Genotypes	Population buildup (No.)*					
	Plant age					
	40 DAS			60 DAS		
	20 DAI**	40 DAI***	mean	20 DAI**	40 DAI***	Mean
Swarnalatha	59.00[b] (7.68)	141.00[b] (2.15)	100.00	53.25[b] (7.30)	139.00[b] (2.15)	96.13
IR 64	8.50[e] (2.92)	0.25[e] (0.09)	4.38	6.75[e] (2.60)	0.50[e] (0.18)	3.63
IR 65482-7-217-1-2-B	46.75[c] (6.84)	122.50[c] (2.09)	84.63	39.25[c] (6.26)	118.00[c] (2.08)	78.63
OM 4498	35.00[d] (5.92)	68.25[d] (1.83)	51.63	32.50[d] (5.70)	60.75d (1.79)	46.63
RP-2068-18-3-5	6.25[f] (2.50)	0.00[f] (0.00)	3.13	6.00[e] (2.45)	0.00[f] (0.00)	3.00
TN1	167.50[a] (12.94)	312.00[a] (2.49)	239.75	156.25[a] (12.50)	298.75[a] (2.48)	227.50
PTB 33	6.00[f] (2.45)	0.25[e] (0.09)	3.13	5.50[e] (2.35)	0.00[f] (0.00)	2.75
SEd	0.2816	0.0246		0.2397	0.0248	
CD(0.05)	0.6040	0.0528		0.5142	0.0531	

*Mean of four replications

Figures in parenthesis are square-root transformed values. * Figures in parenthesis are log (x+1) transformed values.

In a column, means followed by same letter are not significantly different by DMRT at 5% level

on 40 day old plants at 20 and 40 days after infestation respectively. Population buildup was minimum on PHSS 17 (6.25) followed by PHSS 11 at 20 days after infestation and at 40 days after infestation it reduced to 0.00 and 0.25 respectively. The population buildup was lower on 60 day old plants than on 40 day old plants. All selected genotypes showed significantly less buildup than TN1. This indicated very strong antibiosis in these genotypes. Interestingly, at 40 days after infestation, population on all genotypes was slightly increased than 20 days after infestation except in PHSS 11, PHSS 17 and resistant check PTB 33 which recorded decrease or no further buildup at all. This confirms the very high level of antibiosis in these genotypes. These results are in confirmation with the findings of Alagar and Suresh, 2007 and Vanitha, *et al.*, 2011 who reported low population buildup in resistant rice accessions.

Current study reported lower survival, slower growth and development and population buildup in some selected genotypes. These genotypes with strong antibiosis resistance mechanism can be used to develop resistant cultivars.

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