

RESISTANCE MECHANISM STUDIES IN SELECTED RICE GENOTYPES AGAINST BROWN PLANTHOPPER, *NILAPARVATA LUGENS* (STAL)

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ABSTRACT

Twelve identified rice genotypes along with susceptible check (TN 1) and resistant check (PTB 33) were investigated for resistance against BPH during rabi 2021-22 at Regional Agricultural Research Station, Maruteru, Andhra Pradesh. Preference/non-preference mechanism was assessed through honeydew excretion studies and tolerance was measured through number of days to wilt. Brown planthopper fed on these genotypes excreted significantly lower quantity of honeydew than the susceptible TN 1 (529.33 mm²). Among the genotypes, PTB 18 and HWR-21-IR 71033-121-15-B recorded minimum honeydew excreted area of 91.00 mm² and were equivalent with the resistant check (78.67 mm²). The number of days taken by the genotypes to wilt ranged from 21.33 to 34.67 days. The susceptible check TN 1 and resistant check PTB 33 took 21.33 and 34.67 days to wilt respectively. Among the genotypes, MTU 2837-31-1-1-1 took longer (32.33 days) to wilt followed by PTB 18 which took 30.33 days.

Keywords: BPH, Honeydew, Non-preference, Preference, Tolerance

INTRODUCTION

Rice, *Oryza sativa* (Linnaeus) is one of the major cereal crops, being the staple food for more than 65 per cent of the global population (Mathur *et al.*, 1999). The rice crop is subjected to attack by beyond 100 insect species; Out of them, 20 species can cause economic damage by infesting the plant at all growth stages and a few can transmit viral diseases (Pathak and Khan, 1994). Among various biotic constraints of rice production, the Brown Planthopper (BPH), *Nilaparvata lugens* (Stal) is the leading destructive pest. Indiscriminate use of insecticides for the control

of BPH leads to the disruption of ecological balance leading to development of multiple insecticide resistance and causes pest resurgence. Hence, cultivation of BPH resistant varieties is a key pest management strategy and environmentally sound.

Plants establish resistance mechanisms to protect from nature's damage in three different ways *viz.*, antixenosis, antibiosis and tolerance. (Alam and Cohen, 1998). Antixenosis mechanism avoids insect pest damage through repelling the insects, thereby reducing pest colonization and oviposition. Antibiosis mostly affects the insect behavior like survival,

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feeding. Tolerance mechanism is a peculiar type in which plants can produce good quality crop with little or no decrease in fitness despite being attacked. (Strauss and Agarwal, 1999). Understanding different mechanisms of resistance *viz.*, antixenosis, antibiosis and tolerance is important for evolving resistant varieties. By considering all, studies on preference/non preference and tolerance mechanisms were undertaken in the identified genotypes.

MATERIAL AND METHODS

Investigations were conducted to study the resistance mechanisms in different rice genotypes against BPH at ANGRAU-RARS, Maruteru during *rabi* 2021-22. Twelve genotypes which were moderately resistant to BPH were used in the study along with susceptible check, TN 1 and resistant check, PTB 33. Selected rice genotypes seeds were sown in pots containing puddled alluvial soil. Ten days aged seedlings of each genotype were transplanted @ 3 seedlings pot⁻¹. Each entry consisted of three pots, each pot serving as a replication. The potted seedlings were kept in the polyhouse, where there is ample sunlight and they were protected from arthropod pests and predators.

Honeydew Excretion: The relative preference of BPH among the selected genotypes along with susceptible and resistant check was evaluated by estimating the amount of honey dew excreted as an indication of the feeding rate (feeding index) by the adult planthoppers following the technique developed by Pathak and Heinrichs (1980).

Thirty days aged plants were used to study honeydew excretion which were replicated thrice. Tillers of each plant were thinned out and only one tiller was retained in each pot. The culm was inserted through a hole in the middle of cardboard sheet. A polythene sheet was kept on the cardboard to prevent

moisture absorption by the filter paper. Whatman No.1 filter paper of 9.0 cm diameter were taken with a small hole in the center and a longitudinal cut from the margin to the center. These filter paper circles were dipped in bromocresol green solution (2 mg bromocresol green powder/1 ml of ethanol) and were dried for one hour. The filter papers were dipped repeatedly till they turned to yellowish orange. The treated filter paper was kept over polythene sheet and cardboard present below the potted plant. Plastic cup containing a hole in the middle was kept in an inverted position over the single potted plant (Figure 1). Five newly hatched female hoppers, pre-starved for two hours were released into the cup through the hole and plugged the hole with non-absorbent cotton to prevent escape of the insects. The hoppers were allowed to feed at the base of the stem for 24 hours. The honey dew droplets excreted by the adults, when get in touch with the filter paper turned into blue spots. The filter paper was removed 24 hours after the commencement of feeding and the total area of the blue spots appeared on each filter paper was measured by graph paper method. The honeydew spot areas were marked on a tracing paper and calculated the areas of each spot by counting the number of squares on graph paper. The area thus obtained in each replication was treated as the feeding index and expressed in terms of area (mm²) of honeydew excretion per 5 females.

Days to wilting: To observe the level of tolerance, 30-days aged seedlings of each genotype were wrapped with a mylar cage which is provided with nylon cloth and kept in a room with well-ventilated windows (Figure 2). A total of twenty-five nymphs (2nd to 3rd instar) of brown planthopper were introduced onto each plant. When plants began to wilt, planthoppers were removed and number of days taken to wilt by the plant were documented.

Table 1. Honeydew excretion by BPH adults and days to wilt of rice genotypes

S.No.	Genotypes	Area of honeydew excreted in mm ² *	Days to wilt*
1	Cul M4	171.00(13.05) ^c	27.67 (5.35) ^{bcd}
2	PTB 18	91.00(9.48) ^a	30.33(5.60) ^{ed}
3	HWR-21-IR 71033-121-15-B	91.00(9.51) ^a	28.67(5.44) ^{ed}
4	MCM 125	213.33(14.59) ^d	28.33(5.41) ^{cde}
5	MTU2889-12-1-1	166.00(12.88) ^c	27.00(5.29) ^{bcd}
6	MTU2837-31-1-1-1	167.67(12.89) ^c	32.33(5.77) ^{ef}
7	MTU2837-56-1-1-1	132.67(11.40) ^b	24.00(5.00) ^{ab}
8	MTU2842-36-1-1-1	241.67(15.52) ^{de}	28.00(5.39) ^{cd}
9	MTU2843-52-1-1-1	178.33(13.30) ^c	26.67(5.25) ^{bcd}
10	MTU2843-239-1-2-1	273.67(16.53) ^e	24.67(5.07) ^{abc}
11	MTU2846-21-4-1-1	121.00(10.99) ^b	27.00(5.28) ^{bcd}
12	MTU2846-58-1-1-1	139.33(11.62) ^b	29.00(5.47) ^{de}
13	TN 1	529.33(22.99) ^f	21.33(4.72) ^f
14	PTB 33	78.67(8.86) ^a	34.67(5.98) ^a
	Sem +	0.73	0.13
	CD (0.05)	2.13	0.37
	CV (%)	9.73	4.15

*Mean of three replications; Figures in parentheses are square root transformed values
In a column, means followed by common letter are not significantly different by DMRT at 5% level

**Fig. 1. Arrangement of different genotypes for honeydew test**



Fig. 2. Experimental setup for studying days to wilting on selected genotypes

Statistical analysis: Observations on different parameters recorded were analyzed after suitably transforming (square root transformations) the original values. ANOVA technique (Gomez and Gomez, 1984) was employed for data analysis in completely randomized design (CRD) and comparing the means by using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

Honeydew excretion: The quantity of honeydew excreted by planthoppers which is a sign of feeding preference was estimated in the selected rice genotypes. The quantity of honeydew excreted by BPH is directly related to intake of the plant sap. The average honey

dew excretion values varied from 78.67 to 529.33 mm² among the fourteen rice genotypes. All the genotypes showed significantly lower quantity of honeydew compared to the susceptible check TN 1 (529.33 mm²). The genotypes; PTB 18 and HWR-21-IR 71033-121-15-B recorded minimum honeydew excreted area of 91.00 mm² and were significantly equivalent with the resistant check, PTB 33 (78.67 mm²). The genotypes viz., MTU 2846-21-4-1-1 (121.00 mm²), MTU 2837-56-1-1-1 (132.67 mm²), MTU 2846-58-1-1-1 (139.33 mm²), MTU 2889-12-1-1 (166.00 mm²), MTU 2837-31-1-1-1 (167.67 mm²), Cul M4 (171.00 mm²) and MTU 2843-52-1-1-1 (178.33 mm²) recorded moderate honeydew excreted area and MCM 125

(213.33 mm²), MTU2842-36-1-1-1 (241.67 mm²), MTU2843-239-1-2-1 (273.67 mm²) recorded highest honeydew area among the genotypes tested. (Table 1).

Alagar *et al.* (2007) stated that the quantity of food intake is directly proportional to the quantity of honeydew excreted by BPH. Mollah *et al.* (2011) reported the lowest amount of excreted honeydew on resistant cultivars T27A, IR64, ARC10550 and Swarnalata and indicated that the female fed less and excreted less honeydew on resistant rice cultivars. Sarao and Bentur (2018) indicated the area of honeydew excretion was greater when the insects fed on susceptible varieties than on resistant varieties.

Days to wilting: The number of days required to wilt by different rice genotypes were significantly varied from 21.33 to 34.67 days. The susceptible check TN 1 and resistant check PTB 33 took 21.33 and 34.67 days to wilt respectively. Among the genotypes, MTU 2837-31-1-1-1 took longer (32.33 days) to wilt followed by PTB 18 which took 30.33 days. The other genotypes *viz.*, MTU 2846-58-1-1-1, HWR-21-IR 71033-121-15-B, MCM 125, MTU 2846-36-4-1-1, Cul M4, MTU 2889-12-1-1, MTU 2846-21-4-1-1, MTU 2843-52-1-1-1, MTU 2843-239-1-2-1 and MTU 2837-56-1-1-1 took 29.00, 28.67, 28.33, 28.00, 27.67, 27.00, 27.00, 26.67, 24.67 and 24.00 days, respectively to wilt. (Table 1).

Bhanu *et al.* (2014) revealed that the number of days required to wilt was significantly high in highly resistant, resistant and moderately resistant rice varieties than susceptible check, TN 1. BPH feeding was minimum on resistant entries, therefore the plants could withstand wilting compared to the susceptible check, TN1 and moderately resistant entries. (Reddy *et al.*, 2016).

CONCLUSION

The genotypes; PTB 18 and HWR-21-IR71033-121-15-B showed minimum honeydew excreted area of 91.00 mm² and were significantly equivalent to resistant check, PTB 33. The genotypes MTU2837-31-1-1-1 took longer days (32.33) to wilt followed by PTB 18 which took 30.33 days to wilt. The identified genotypes can be further studied for gene sequencing. Based on the sequencing, these rice genotypes can be utilized as donors in the future crossing programme to develop varieties resistant to BPH.

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