

Studies on the Resistance of the Cross Lines and Some Varieties of Rice to Three Hoppers at IRRI in Philippines

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These experiments were conducted to learn the techniques for studying varietal resistance to the brown planthopper (*Nilaparvata lugens*), the white-backed planthopper (*Sogatella furcifera*), and the rice green leafhopper (*Nephotettix impicticeps*), during one-month's short-term study program at IRRI, 1971. The following two experiments were carried out in the greenhouse.

- (1) Screening of rice varieties to the brown planthopper.
- (2) Varietal preference study of planthoppers and leafhoppers.

I. Screening test for the brown planthoppers.

Materials and Methods:

In this mass-screening tests, the F₃ lines of IR841×(IR8×Mudgo) and of IR20×TKM-6 were used. Taichung (Native) 1 was used as a susceptible check, while Mudgo served as a resistant check.

The test materials were planted in rows about 5-cm apart in wooden plots 60×45×10cm.

The test lines and varieties were seeded directly in rows about 20cm long and obtained by partitioning the 45cm row length in the middle. Twenty-six lines were accommodated in one plot. One row of each of the susceptible and resistant varieties was interspersed at random in each plot.

Each line was tested in only two replications and each replication has twelve plots. One replication was interspersed in accordance with the test line numbers and the other replication at random for each plot. One replication was set apart from the other replication by a screen partitioning the greenhouse. The wooden plots were placed in a painted iron tray containing 3 to 4 cm of standing water.

Before insect infestation, seedlings were thinned out and the number of seedlings were reduced to about 10 in each row. The seedlings were infested with third and fourth instar nymphs of brown planthopper about 7 days after seeding (at the one-leaf stage).

The distribution of the brown planthoppers on different varieties was recorded at 24 and 48 hours after infestation (Table 2). The final reaction for plant damage was recorded at 18 days after insect infestation (Table 1). The reaction of individual plants tested in this experiment was recorded according to the following scale:

- 0=No visible damage
- 1=Partial yellowing of the first leaf
- 2=Partial yellowing of the first and second leaves
- 3=Pronounced yellowing and slight stunting
- 4=Signs of wilting and severe stunting
- 5=Dead

The reaction types recorded by above scale were grouped with the following three classes for brief interpretation of results:

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Resistant group: Reaction types 0, 1, 2

Susceptible group: Reaction types 4, 5

Intermediate group: Reaction type 3

Results:

Random F₃ populations of the crosses IR841×(IR8×Mudgo) and IR20×TKM-6 were tested for their reaction to brown planthoppers. The results obtained were as shown in Table 1.

- (1) The populations of about 64% in the crosses IR841×(IR8×Mudgo) belonged to resistant group, those of about 25% to susceptible group, and those of about 11% to intermediate group.
- (2) The populations of about 78% in the crosses IR20×TKM-6 belonged to resistant group, those of about 12% to susceptible group, and those of about 10% to intermediate group.
- (3) The segregation for resistance and susceptibility for both crosses seemed to occur.
- (4) Most of the populations of Taichung(Native) 1 was highly susceptible and Mudgo was highly resistant to brown plant-hoppers.

In this study, the population distribution for each plot and number of insects per plant were observed (Table 2).

- (1) The range of number of insects per plant was 3.0 to 8.8 at 24 hours' observation and 2.8 to 5.4 at 48 hours' observation.
- (2) Total average number of insects per plant was higher in 24 hours observation than in 48 hours' observation. This was because large number of insects died after 24 hours of infestation.

II. Varietal preference study of planthoppers and leafhoppers.

Materials and Methods:

1) Brown planthoppers.

- a) Preference of brown planthoppers to the F₃ lines of IR841×(IR8×Mudgo) and IR20×TKM-6 was made from the mass screening test mentioned above. Observation on number of insects per plant was made at 24 hours in one replication and at 48 hours in other replication after infection. In Taichung(Native) 1 and Mudgo used for check varieties for mass-screening test, same observation was also made.
- b) In another preference study of brown planthoppers, three indica varieties (Taichung (Native) 1, Mudgo and IR667) and three japonica varieties (Mankyung, Norin No. 29 and Jaekun which are grown in Korea) were used for comparison of preference with *indica* and *japonica* varieties. The methods used were almost identical to those used for former mass screening test of brown planthoppers.

The seedlings were infested with insects about 12 days after seeding (at the two-leaf stage). Third-instar nymphs were released into a wire screened cage containing two wooden plots planted with six varieties listed above. This experiment was tested in 8 replications in a randomized block design. The populations of brown planthoppers on seedlings for each variety were observed at 1, 24, and 48 hours after infestation.

2) Rice green leafhopper and white backed planthopper:

The materials and methods of preference study used for both insects were identical to those used for preference of brown planthoppers. These experiments were run in 4 replications with randomized block design. The test materials were planted in rows about 10-cm apart in wooden plot in only rice green leafhoppers. Third instar nymphs in rice green leafhopper study and a mixture of nymphs and adults in white backed planthopper study were used. The cage for rice green leafhoppers was placed on the floor of the greenhouse because the space was not available. The floor of the greenhouse was washed out by watering two to three times a day during the experiment.

Results:

Preference of the brown planthoppers for Taichung(Native) 1, Mudgo, and F₃ lines of IR841×(IR8×Mudgo)

and IR20×TKM-6 were tested (Table 3).

- 1). Large numbers of brown planthoppers were found on the Taichung(Native) 1 and low numbers of insects were recorded on the variety Mudgo.
- 2). The numbers of brown planthoppers in F₃ lines of the crosses used was higher than on Mudgo and less than on Taichung(Native) 1.
- 3). Lower numbers of insects were found in 48 hours observation than 24 hours observation.

Preference of the brown planthoppers for three *indica* and three *japonica* varieties was tested and their preference was compared (Table 4).

- 1). There was no difference in preference of brown planthoppers between *indica* and *japonica* varieties in this experiment.
- 2). Low numbers of planthoppers were recorded on the varieties Mudgo and Jaekun, while large numbers of insects were recorded on the varieties IR667, Mankyung, Norin No. 29 and Taichung (Native) 1.
- 3). It was found that the variety Mudgo was least preferred and the variety IR667 most preferred by the brown planthoppers.

Preference of the rice green leafhoppers for three *indica* and three *japonica* varieties was tested (Table 5).

- 1). There was also no difference in preference of green leafhopper between *indica* and *japonica* varieties.
- 2). Largest numbers of rice green leafhoppers was recorded on Mudgo at 48 hours after infestation but the lowest numbers were on Taichung(Native) 1 and Mankyung.
- 3). It was found that the varieties Taichung (Native) 1 and Mankyung were least preferred and the variety Mudgo most preferred by the rice green leafhoppers.

Preference of the white backed planthoppers for several *indica* and *japonica* varieties was tested (Table 6).

Although there were higher number of insects on the varieties Mudgo and IR667 and lower number of insects on the variety Taichung(Native) 1, the over-all population of the green leafhoppers was too low to determine the differences in their preference for the test varieties. Further study will be required for the interpretation of varietal preference of white backed planthoppers.

Table 1. Classification of F₃ lines of IR841×(IR8×Mudgo) and IR20×TKM-6 for reaction to the brown planthoppers. IRRI 1971.

	Number of Seedlings						Total
	Reaction type						
	0	1	2	3	4	5	
Taichung(Native) 1					24	100	124
Mudgo	12	96	19				127
IR841×(IR8×Mudgo)	126	1011	501	278	315	329	2556
IR20×TKM-6	8	150	35	24	12	17	246

Resistant group : Reaction types : 0, 1, 2

Susceptible group : Reaction types : 4, 5

Intermediate group : Reaction types : 3

Table 2. Distribution of brown planthoppers on seedlings in each plot of mass screening test at a given time after infestation, IRRI, 1971.

Plot No. Replication*						
Plot No.	I			II		
	Number of insects	Number of plants	Number of insects per plant	Number of insects	Number of plants	Number of insects per plant
1	961	271	3.5	1,191	271	4.4
2	1,131	294	3.8	1,476	272	5.4
3	905	275	3.3	1,314	295	4.4
4	1,334	308	4.3	1,074	289	3.7
5	1,053	260	4.1	865	308	2.8
6	1,256	288	4.4	903	312	2.9
7	1,851	260	7.1	1,117	265	4.2
8	793	264	3.0	906	263	3.4
9	1,261	260	4.8	1,009	271	3.7
10	1,255	244	5.1	858	274	3.1
11	1,556	260	5.9	1,423	261	5.4
12**	760	86	8.8	278	79	3.5
Total	14,116	3,067	58.1	12,414	3,160	46.9
Average			4.6			3.8

* Observation of number of insects in replication I was made on 24 hours and in replication II on 48 hours after infestation.

** Only 8 rows in the plot.

Table 3. Preference of the brown planthoppers (2nd and 3rd instar nymphs) for different test plants, IRRI, 1971.

Variety and Cross	Time observed (hrs.)*	Number of insects recovered	Number of plants observed	Number of insects per plant
Taichung(Native) 1	24	1,304	124	10.5
	48	853	128	6.7
Mudgo	24	481	129	3.7
	48	337	127	2.6
IR841×(IR8×Mudgo)	24	11,282	2,557	4.4
	48	10,661	2,637	4.0
IR20×TKM-6	24	1,359	246	5.5
	48	613	270	2.3

* Observation of number of insects in replication I was made on 24 hours and in replication II on 48 hours after infestation.

Table 4. Preference of the brown planthopper, *Nilaparvata lugens* for several indica and japonica varieties. Third instar nymphs were released into a wire screened cage containing the six varieties in the greenhouse, IRRI, 1971.

Variety	Number* of brown planthoppers/plant at a given time interval			
	1 hr.	24 hrs.	48 hrs.	Total
T(N) 1**	3.1	5.0	3.8	11.9
Mudgo**	3.5	1.1	1.4	6.0
IR667**	5.1	7.6	5.6	18.3
Mankyung***	4.1	4.4	4.2	12.7
Norin # 29***	3.3	5.0	3.9	12.2
Jaekun***	3.4	4.6	4.7	8.0

* Average number of insects from 8 replications.

** *Indica* varieties

*** *Japonica* varieties

Table 5. Preference of the rice green leafhopper, *Nephotettix impicticeps*, for several indica and japonica varieties. Third instar nymphs were released into a cage containing six varieties in the greenhouse. IRRI 1971.

Variety	Number* of rice green leafhoppers/plant at a given time of interval			
	1hr.	24 hrs.	48 hrs.	Total
T (N) 1**	7.7	7.5	3.8	19.0
Mudgo**	5.8	8.1	9.4	23.3
IR667**	7.9	8.9	5.3	22.1
Mankyung***	5.5	5.9	4.4	15.8
Norin # 29***	7.0	7.3	5.3	19.6
Jaekun***	8.9	6.5	5.1	20.5

* Average number of insects from 4 replications.

** *Indica* varieties

*** *Japonica* varieties.

Table 6. Preference of the white-backed planthopper, *Sogatella furcifera*, for several *indica* and *japonica* varieties. Adults were released into a wire-screened cage in the greenhouse containing the test varieties, IRRI, 1971.

Variety	Number* of white-backed planthoppers/plant at a given time of interval				
	2 hrs.	4 hrs.	24 hrs.	48 hrs.	Total(cm)
T(N)**	0.8	1.4	1.1	0.8	4.1
Mudgo**	0.9	2.0	1.8	1.7	6.4
IR667**	1.1	2.2	2.3	1.0	6.6
Mankyung***	0.7	1.2	1.3	1.2	4.4
Norin # 29***	1.1	1.3	1.5	1.4	5.3
Jaekun***	1.0	1.3	1.3	1.3	4.9

* Average number of insects from 4 replications.

** *indica* varieties.

*** *japonica* varieties.