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RESEARCH ARTICLE

EVALUATION OF RICE GENOTYPE AGAINST LEAF FOLDER, CASE WORM AND GRASSHOPPER DESECRATION UNDER FIELD CONDITION

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ABSTRACT

The research on varietal screening of rice against leaf folder, caseworm and grasshopper damage was conducted during 2019 in Rampur, Chitwan to study the host plant resistant of different varieties of rice under field condition. The experiment was laid out in RCBD with three replications and seven treatments namely i) Makawanpur -1 ii) Mansuli iii) Radha-4 iv) Ramdhan v) Sabitri vi) Sama Mansuli sub-1 and vii) sukkha-3. The experiment revealed that lowest population of leaf folder, caseworm and grasshopper was recorded in variety Radha-4 followed by Ramdhan. The experiment showed the yield loss was significantly lower in Radha-4 followed by Sabitri and Ramdhan due to leaf folder, caseworm and grasshopper. So Radha-4 and sabitri would be good option in rice production for reducing insect pest damage.

KEYWORDS

Evaluation, rice, leaf folder, case worm, grasshopper.

1. INTRODUCTION

Rice is the major cereal crop of Nepal. Out of the total cultivated area (3.09 million ha) of the country, rice cultivation occupies 1.4 million ha and productivity is 2.56-3.2 mt/ha. Rice hold a vital role in national economy, as the share of rice in AGDP is 20% and provide 50% of the total calorie requirement of Nepalese people. Rice is the most important food in Nepalese diet and plays a significant role in the economy of farmer. In Nepalese diet, cereal contributes about 90% of the total calorie intake and 50% of this come from rice (Government of Nepal, 1992). Rice is indigenous to humid area of tropical and sub-tropical region. Rice having wider physiological adaptability is being grown successfully in tropical, sub-tropical and temperate region; from below the sea level to 2000 meters above the sea level.

Erratic rainfall, lack of irrigation, unavailability of quality seed, lack of fertilizer and incidence of insect pest are the causes of yield loss in Nepal. The rice crop is subjected to the persistent pressure of more than 100 different insect species and 20 of them are of major economic significance (Pathak, 1969; Kapur, 1967). In Asia pest alone reduce about 30% of rice production (Heinrichs et al., 1978). Leaf folder (*Cnaphalocrocismedinalis*Guenee) is major pest of rice and are sporadic in nature. The larvae of leaf folder are the damaging stage. It scrapes the green tissue of the leaves and the leaves are folded over themselves to form rolls within which the larvae remain to pupate. In the case of severe infestation, leaf margin and tips are dried up entirely and the crop gives a whitish appearance. Infestation by leaf folder was also higher in high yielding rice variety with broader and dark green foliage than in tall indica rice (Kulshrestha et al., 1970).

Caseworm (*Nymphuladepunctalis*) is a sporadic pest of rice and found where water remain stagnant. Case worm is important insect pest of rice which occurs in Australia, Africa, South America and many tropical countries. The freshly hatched larva feed on the surface of the tender leaves, but later instars feed from within the case or on the surface of even the older leaves. Damage is caused by larva feeding and cutting of the leaves tips for making leave cases. The young larvae feed on the epidermis of leaves. Infested plants present a frayed appearance. A group researcher reported severe infestation by the caseworm of rice in variety "Taichung-65" in west Bengal (Datta et al., 1967).

Grasshopper (*Hieroglyphus banians U.Biol*) is found in most of the rice tracts where the soil is loamy or sandy loam and less rainfall. Grasshopper is important insect pest of rice which occurs in almost all type of habitat including the tropics, temperate grassland, rain forest, desert and mountains. Various species of grasshopper are widely distributed in Nepal. They are polyphagous and feed on leaves of rice, maize, millets, sugarcane, grasses etc. The adult are 40-50 mm long and are shining greenish yellow, having 3 black lines running across the pronotum. Nymphs are yellowish with many reddish-brown spots in the early stages but become greenish as they grow older. It is known to cause, on an average 20% loss. Both adult and nymph of grasshopper feed on the leaves which appear to be partially eaten up. They chew angular holes in the leaves causing an injury similar to that caused by armyworm.

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2. MATERIALS AND METHODOLOGY

The study was conducted at Agronomy farm of Institute of Agriculture and Animal science from June 2019 to November 2019. Chitwan district is popular for agricultural production including cereal crops. The district is situated in middle part of Nepal covering 2118 km^2 area. Geographically, it is located at 27^0 37' N latitude and 84^0 25' E longitudes with an elevation of 198 m above sea level. Basically, this farm is meant for cereal crop production in which wheat, barley was grown six months prior to our field research. At first nursery bed was prepared by ploughing the area of 8 m^2. The field was ploughed 2 times with tractor making soil finer. The application of chemical fertilizer @ 100:50:50 kg NPK/ha from Urea, DAP and MOP and FYM @ 12.5 ton/ha. Seed @ 100 gm for each variety was sown in nursery bed by line sowing.

The seed was brought from National Wheat Research Centre, Bhairahawa and were sown in nursery 22 June 2015. The main experimental field was thoroughly ploughed 3 times with tractor. The experimental field was laid out in randomized complete design (RCBD) with seven treatments and three replications. The total number of plots was 21 and each plot were of 2.5*2.5 m^2. Spacing between the replication was 100 cm and that between the treatments was 50 cm. Total size of whole plot was 376.25 m^2 and plant to plant distance and row to row distance of 25 cm * 25 cm each with 3-5 tillers per hill. The total number of seedlings required per hill, per plot, and whole experiment were 3,300,6300 respectively. Seedlings of 30 days were transplanted in main field.

Treatment
The treatments (T) included in this study were:

T1: Makawanpur-1 T5: Sabitri
T2: Mansuli T6: Sama mansuli sub-1
T3: Radha-4 T7: Sukkha-3
T4: Ramdhan

The field was thoroughly ploughed three times. At first plough, all the previous crop and grasses were removed. At second plough, soil was made fine. At third plough, puddling was done using tractor for better growth of rice crop. Different varieties stated above were sown in nearby nursery field @80 kg/ha. At the time of nursery bed preparation, 12.5 ton/ha FYM, chemical fertilizer @100:50:50 kg NPK/ha from Urea, DAP and MOP were applied. Half dose of urea with full dose of DAP and MOP was applied at the time of field preparation and remaining half dose of urea was applied 15 days after transplanting. So, for each plot of 6.2 m^2 67.93 gm DAP, 52.083gm MOP, 44gm urea were applied.

Weeding was done at 15, 45 days after transplanting. After completion of layout, 7 treatments were allocated randomly within each block. Other agronomy practices recommended for this region were followed by raising crop. Ten plants per plot were randomly selected and tagged for observation of the insect pest damage. Damage was recorded on leaves and stem of sample plant. Data on damage pattern of insect were scored on leaves and used for analysis. On the basis of insect damage intensity on rice, damage scoring was done. The first scoring was done at 35 DAT when the insect damage started to appear. Insects occurrence and its infestation was assessed by using 0-9 scale separately for different insects. Data were taken for different insects at 15 days interval. Ten sample plants were selected randomly from each plot. Damage was assessed taking into consideration the area covered by each insect damage. The scale of the assessment is as follows:

- 0: No damage
- 1: 25% damage on 25% leaves
- 3: 50% damage on 25% leaves
- 5: 50% damage on 50% leaves
- 7: 75% damage on 50% leaves
- 9: 75% damage on 75% leaves

Grain from 1 m^2 was harvested using quadrant in each plot and the harvested grains were weighed separately for each treatment. Yield loss percentage was calculated using potential yield and obtained yield. Formula for its calculation was:

Yield loss (%) = Potential yield – Obtained yield/ Potential yield * 100

Microsoft excel was used for tabulation of data and for simple calculation. The collected data were statistically analyzed using R-stat software package. Means of separation was done by DMRT at 5% level of significance.

3. RESULT

The result so obtained are assessed and interpreted with the available supporting evidences.

Table 1: Average leaf folder and case worm damage score in different rice varieties under field condition in Chitwan, Nepal, 2019

Treatment	Leaf folder and		Caseworm damage		Total leaf folder damage
	30 DAT	45 DAT	60 DAT	75 DAT	
Makwanpur-1	0.90^{d} ±0.15	2.33^{b} ±0.35	2.30^{b} ±0.26	0.73^{b} ±0.15	1.57^{b}±0.213
Mansuli	0.78^{d} ±0.10	1.17^{c} ±0.30	1.27^{de} ±0.15	0.23^{c} ±0.32	0.86^{c}±0.168
Radha-4	0.75^{d} ±0.05	2.20^{b} ±0.26	2.23^{b} ±0.25	0.47^{bc} ±0.57	0.41^{b}±0.174
Ramdhan	1.18^{bc} ±0.10	2.50^{b} ±0.26	1.73^{c} ±0.21	0.60^{bc} ±0.17	1.51^{b}±0.062
Sabitri	1.72^{a} ±0.20	3.83^{a} ±0.05	1.67^{cd} ±0.25	0.50^{bc}±0.20	1.92^{a}±0.044
Sama Mansuli	1.33^{b} ±0.14	3.37^{a} ±0.35	2.83^{a} ±0.21	1.20^{a} ±0.30	2.18^{a}±0.156
Sukkha-3	0.95^{cd} ±0.26	2.40^{b} ±0.40	0.97^{c} ±0.21	0.77^{b} ±0.25	1.27^{b}±0.254
P value	***	***	***	**	***
LSD	0.26	0.54	0.40	0.41	0.278
CV%	13.86	11.97	12.24	35.95	10.21

DAT: Days After Transplanting, CV: Coefficient of Variation, LSD: Least Significant Difference. Value with the same letter in column is not significantly different at 5% by DMRT and figures after ± indicate standard error, **indicate significant, ***indicate highly significant at 0.001.

Analysis of variance (ANOVA) showed there is significant difference on leaf folder damage in 30 DAT, 45 DAT, 60 DAT and 75 DAT. At first reading, leaf folder and case worm damage is highly significant in Sabitri variety (1.72^{a} ± 0.20) which is followed by Sama Mansuli sub-1 (1.33^{b} ± 0.14), Ramdhan (1.1833^{bc} ± 0.10), Sukkha-3 (0.95^{cd} ± 0.26) respectively. Leaf folder and case worm damage is least significant in Radha-4 (0.750^{d} ± 0.05) which is statistically at par with Makawanpur-1 (0.90^{d} ± 0.1) and Mansuli (0.78^{d} ± 0.10).

At second reading, leaf folder and case worm damage is highly significant in Sabitri variety (3.83^{a} ± 0.05) which is at par with Sama Mansuli aub-1 (3.37^{a} ± 0.35) and is followed by Ramdhan (2.50^{b} ± 0.26) which is at par

with Sukkha-3 (2.40^{b} ± 0.40), Makawanpur-1 (2.33^{b} ± 0.35) and Radha-4 (2.20^{b} ± 0.26). Leaf folder and case worm damage is least significant in Mansuli (1.17^{c} ± 0.30).

At third reading, leaf folder and case worm damage is highly significant in Sama Mansuli sub-1 (2.83^{a} ± 0.21) which is followed by Makawanpur-1 (2.30^{b} ± 0.26) and which is at par with Radha-4 (2.23^{b} ± 0.25) and is again followed by Ramdhan (1.73^{c} ± 0.21), Sabitri (1.67^{cd} ± 0.25), Mansuli (1.27^{de} ± 0.15) respectively. Leaf folder and case worm damage is least significant in Sukkha-3 (0.97^{c} ± 0.21).

At last reading, leaf folder and case worm damage is highly significant in Sama Mansuli sub-1 (1.20^{a} ± 0.30) which is followed by Sukkha-3 (0.77^{b} ± 0.25) and which is at par with Makawanpur-1 (0.73^{b} ± 0.15), which is again followed by Ramdhan (0.60^{bc} ± 0.17) and is at par with Sabitri (0.50^{bc} ± 0.20) and Radha-4 (0.47^{bc} ± 0.57). Leaf folder and case worm damage is least significant in Mansuli (0.23^{c} ± 0.320).

In total, leaf folder damage and case worm is highly significant in Sama Mansuli sun-1 (2.183^{a} ± 0.156) which is at par with Sabitri (1.929^{a} ± 0.044) and is followed by Makawanpur-1 (1.5667^{b} ±0.213) which is at par with Ramdhan (1.504^{b} ± 0.062), Radha-4 (1.412^{b} ± 0.174) and Sukkha-3 (1.270^{b} ± 0.254). Leaf folder and case worm is least significant in Mansuli (0.863^{c} ± 0.168).

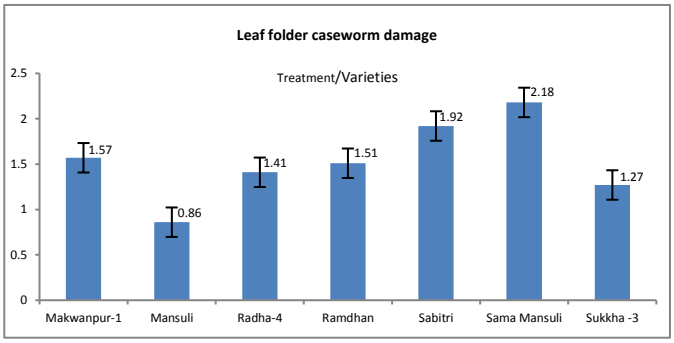

Figure 1: Average leaf folder and caseworm damage in different rice varieties.

Table 2: Average grasshopper damage score in different rice varieties under field condition in Chitwan, Nepal, 2019

Treatment	Grasshopper		damage		Total damage
	30 DAT	45 DAT	60 DAT	75 DAT	
Makwanpur-1	1.26^{bc}±0.11	1.43^{b} ±0.15	2.06^{a} ±0.25	1.20^{a} ±0.17	1.49^{a}±0.09
Mansuli	1.03^{d} ±0.11	1.33^{b}±0.15	0.86^{cd} ±0.16	0.63^{b} ±0.15	0.96^{c} ±0.28
Radha-4	1.43^{b} ±0.11	0.90^{c}±0.20	0.73^{d} ±0.15	0.56^{b} ±0.15	0.90^{c}±0.08
Ramdhan	1.06^{cd} ±0.05	2.46^{a}±0.21	1.66^{ab} ±0.46	0.53^{b} ±0.15	1.43^{a}±0.15
Sabitri	2.23^{a} ±0.15	2.23^{a} ±0.16	0.80^{d} ±0.10	0.56^{b}±0.25	1.46^{a} ±0.08
Sama Mansuli	0.30^{e} ±0.14	1.50^{b}±0.26	1.46^{b} ±0.21	1.46^{b} ±0.15	0.93^{c}±0.08
Sukkha-3	1.10^{cd} ±0.10	1.70^{b} ±0.17	1.26^{bc} ±0.31	0.60^{b} ±0.35	1.16^{b} ±0.04
P value	***	***	***	*	***
LSD	0.197	0.361	0.433	0.377	0.158
CV%	9.17	12.28	19.20	32.54	7.44

DAT: Days After Transplanting, CV: Coefficient of Variation, LSD: Least Significant Difference. Value with the same letter in column is not significantly different at 5% by DMRT and figures after ± indicate standard error, **indicate significant, ***indicate highly significant at 0.05.

Analysis of variance (ANOVA) showed that there is significant difference on grasshopper damage in 30 DAT, 45 DAT, 60 DAT and 75 DAT. At first reading, grasshopper damage was seen highly significant in Sabitri (2.233^{a}±0.152) which is followed by Radha-4 (1.433^{b}±0.115), Makawanpur-1 (1.266^{bc}±0.115), Ramdhan (1.066^{cd}±0.057), which is at par with Sukkha-3 (1.100^{cd}±0.100) and is again followed by Mansuli (1.033^{d}±0.115). Grasshopper damage is least significant in Sama Mansuli sub-1 (0.300^{e}±0.100). At second reading, grasshopper damage is highly significant in Ramdhan (2.466^{a}±0.208) which is at par with Sabitri (2.233^{a}±0.157), and followed by Sukkha-3 (1.700^{b}±0.173) which is at par with Sama Mansuli (1.500^{b}±0.264), Makawanpur-1 (1.433^{b}±0.153) and Mansuli (1.333^{b}±0.153). Grasshopper damage is least significant in Radha-4 (0.900^{c}±0.200).

At third reading, grasshopper damage is highly significant in Makawanpur-1 (2.067^{a}±0.252) which is followed by Ramdhan (1.66^{ab}±0.462), Sama Mansuli sub-1 (1.467^{b}±0.208), Sukkha-3 (1.267^{bc}±0.306), Mansuli (0.867^{cd}±0.156). Grasshopper damage is least significant in Radha-4 (0.73^{d}±0.15) which is at par with Sabitri (0.800^{d}±0.100). At fourth reading, grasshopper damage is highly significant in Makawanpur-1 (1.200^{a}±0.173). Grasshopper damage is least significant in Sama Mansuli (0.46^{b}±0.15) which is at par with Ramdhan (0.533^{b}±0.153), Radha-4 (0.566^{b}±0.153), Sabitri (0.56^{b}±0.25), Sukkha-3(0.600^{b}±0.346) and Mansuli (0.633^{b}±0.153).

At total reading, grasshopper damage is highly significant in Makawanpur-1 (1.492^{a}±0.094) which is at par with Ramdhan (1.433^{a}±0.153) and Sabitri (1.458^{a}±0.076) which are followed by Sukkha-3 (1.166^{b}±0.038). Grasshopper damage is least significant in Radha-4 (0.908^{c}±0.076) which is at par with Sama Mansuli sub-1 (0.933^{c}±0.076) and Mansuli (0.966^{c}±0.288).

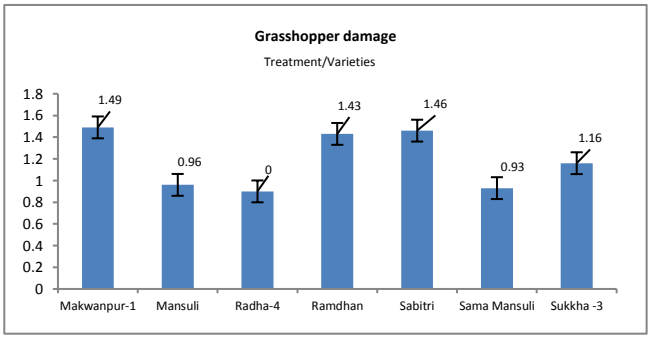

Figure 2: Average grasshopper damage in different rice varieties.

4. Discussion

Among seven treatments, the lowest incidence of leaf folder, caseworm and grasshopper was found in Radha-4 followed by Ramdhan, Mansuli, Sukkha-3, Sabitri and Sama Mansuli sub-1 respectively. The experiment showed that the yield loss was significantly lower in Radha-4 followed by Sabitri, Ramdhan, Mansuli, Makawanpur-1, Sukkha-3 and Sama Mansuli sub-1 respectively. Leaf folder infestation appeared after 4 weeks of transplanting and reached to peak during maximum tillering stage while after flowering it again appeared to be low and similar trend was also reported (Kraker et al., 1999). Leaf folder attack was low in early, drought

resistant variety Sukkha-3 in our study. In Nepal, Rice leaf folder has been noticed as minor pest for a long time but became serious since 1978 in rice throughout the Terai (Mallick, 1982) as higher incidence of leaf folder occurs in our research.

5. Summary

The study was conducted to screen different varieties of rice against leaf folder, caseworm and grasshopper damage and to study host plant resistance of different varieties of rice namely Makawanpur-1, Mansuli, Radha-4, Ramdhan, Sabitri, Sama Mansuli sub-1 and Sukkha-3. The treatments were replicated thrice and study was laid in RCBD design in Rampur, Chitwan condition. In the field experiment, grasshopper, leaf folder and case worm damage was found to be highly significant in Sabitri variety followed by Makawanpur-1 and Sama Mansuli sub-1. Moderately affected rice varieties were Ramdhan, Mansuli and least significant damage was obtained in Radha-4 and Sukkha-3.

- In Sama Mansuli sub-1 with high insect preference, yield loss was maximum (36%).
- In sukkah-3 with moderate insect preference, yield loss was maximum (32.43%).
- In Makawanpur-1 in spite of high insect preference, yield loss was moderate (24.3%).
- In Mansuli with moderate insect preference, yield loss was moderate (21.14%).
- In Ramdhan with less insect preference, yield loss was minimum (4.02%).
- In Sabitri, in spite of high insect preference, yield loss was minimum (1.87%).
- In Radha-4 with less insect preference, yield loss was minimum (0.937%).

6. Conclusion

Even though, insect preference was high in Sabitri, the yield loss was found to be minimum so it was concluded to be comparatively tolerant variety. Similarly, yield loss was minimum and less preferred by insect pest in Radha-4 and Ramdhan was also found comparatively resistant variety so these varieties could be the good option in rice production. Sama Mansuli was found to be highly susceptible followed by Sukkha-3, Makawanpur-1 and Mansuli to grasshopper, leaf folder and caseworm. One season field research could be inadequate to draw conclusion about host plant resistance of different rice varieties which must be evaluated under different climatic condition and different ecological zones over the years for recommendation.

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