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Screening of promising rice varieties against rice weevil (*Sitophilus oryzae*) under laboratory condition

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Abstract
The varietal screening of *S. oryzae* was studied on the rice grain and it was revealed that the minimum number of adult emergence was found in variety Swarna (3.33 adults) whereas variety MTU-1001 was found to be tolerant against *S. oryzae* with less per cent of grain damage (2.66%) and weight loss (1.00%). While the variety Dubraj Selection -1 was found highly susceptible to this pest in accordance to highest number of adult emergence (21.65 adults), maximum percent of grain damage (8.33%) and weight loss (6.66%), respectively.

Keywords: Varietal screening, rice weevil, *S. oryzae*, stored grain pest

Introduction
The problem of insect pest in rice is more serious at post-harvest stage rather than in the field. Several number of insect pests have been reported to be associated with stored rice, rice weevil (*Sitophilus oryzae*) has become the most destructive, economically damaging primary pest which damage stored food grains and their products (Baloch, 1992 and Nwaubani *et al*., 2014) [4, 13] and they causes the maximum grain damage which are stored at 25-30 °C and at low relative humidity (Batta, 2004) [6]. Rice weevil is the most ubiquitous, and the attacked grains known to be are wheat, maize, sorghum and rice (Bhatiya, 1975) [7] and this pest cause heavy losses to stored grain quantitatively and qualitatively throughout the world (Arannilewa *et al*., 2002) [2] because they have very high reproduction rate and a robust character, hence it heavely damage and contaminates the preserved stored grains (Shrestha, 2020) [15]. And adult rice weevil prefers grain endosperm and reduce the carbohydrate content, while the larvae feed prefrentially germ of the grain result they remove a large per centage of the proteins and vitamins. The female feeds and lay egg inside the rice grain kernel in about 90 micrometers deep by making a small hole and covered it with a gelatinous excretion near the grain surface (Estall and Riudavets, 1999) [10]. Larval and pupal development takes place inside the grain (Chatterji *et al*., 1977) [8]. Annual grain losses in storages due to the insect pests is approx 15 per cent (Joshi *et al*., 1991) [11], while the maximum grain loss attributed to a single weevil species reached nearly 57 per cent in rice (Banerjee and Nazimuddin,1985) [5]. The main challenge with the stored grain insect is their fast multiplication rate hence their control is always a big task because they are not only consuming the last produce but also deteriorating the quality by their excreta, bad odour and flavours (Atwal, 1986) [3].
Host resistance can play an important role in minimizing damage of stored rice by *S. oryzae* (Rashid *et al*., 2009) [14]. For this, it is necessary to know the susceptibility of the rice varieties to the infestation of insect pests. It will assist the concerned authorities to take suitable measures for storage rice. The present study was, therefore, undertaken to look into the nature of infestation of rice weevil, *S. oryzae* on fifteen rice varieties and to observe its population development on these varieties. In those countries where storage facilities are inadequate, stored grain resistance might be used either alone or along with other protective methods.

Materials and Methods
In this experiment, treatments were arranged in a completely randomized design (CRD) with three replications for each treatment of rice varieties in laboratory of Department of Entomology, College of Agriculture, IGKV, Raipur (C.G.) during, 2021-22. The initial culture of *S. oryzae* were collected from seed warehouse of Dharampura, Raipur, considered as the preliminary culture.

Rearing of the test insects two kg healthy, undamaged rice grain, variety Swarna were taken for experiment after disinfected it by deep freezing in -14 ℃ temperature for 24 hours and then after disinfected rice were used for further study. Two plastic jars were kept in laboratory, containing one kg grain in each, the collected preliminary insect which was approximately 500 adults were released for obtaining fresh weevil population and mouth of the jar was covered with muslin cloth and tightened by rubber bands. These jars were kept undisturbed for one month under room temperature at 23 ℃ to 31 ℃ and 60±5% relative humidity.

Varietal screening of rice against *Sitophilus oryzae*. The following fifteenth rice varieties *viz*., Swarna, C.G. Devbhog, Samba Masuri (BPT 5204), Basmati- 370, Zinc Rice -MS, MTU- 1010, Safri-17, Karma Masuri, Indira aerobic -1, Dubraj Selection-1, Vikram TCR, R-1919 (C.G. Dhan 1919), HMT, Kalimuch and MTU-1001 were obtained from IGKV, Raipur, for the purpose to studying the host preference of *S. oryzae* under no choice test. For this 30 g of healthy and uninfected rice grains were taken in three replications and twenty unsexes adult weevils were released and top of the bottle were kept covered with muslin cloth and tightly fixed with rubber bands. These were kept for observation up to 60 days. Insect population, per cent grain damage and per cent weight loss were recorded by using the following formula; Insect population were observed by counting the total number of adults emerged after completion of one generation. Percent grain damage was determined by using the following formula;

$$\% \text{ Grain damage} = \frac{\text{No. of damaged grains}}{\text{Total no. of grains}} \times 100$$

Per cent weight loss was recorded by weighing of grain after sieved of frass and loss was determined by using the following formula suggested by Adams and Schulten (1978) [1]; by Zinc rice - MS (17.66 adults), HMT Where, OW = Original weight on dry matter basis.

CW = Current weight on dry matter basis.

$$\% \text{ Weight loss} = \frac{OW - CW \times 100}{OW}$$

Statistical Analysis

The data obtained from different treatments were subjected to statistical analysis by using Completely Randomized Design (CRD) using OPSTAT software. The significance of treatment was tested by critical difference (C.D.) at 5 per cent level of significance for the comparison among the treatments, for which the marginal means of each treatment was considered.

Results and discussion

The fifteenth rice varieties were evaluated for varietal screening of rice against *Sitophilus oryzae*, on the basis of insect population, per cent grain damage and per cent weight loss. The results of experiment have been presented in Table (1) and Fig. (1) Showed that the most preferred variety by rice weevil.

Adult emergence

After 60 days of infestation the minimum number of adult emergences was recorded in rice variety Swarna (3.33 adults) and Safri-17 (4.66 adults) were found to be the most tolerated variety with the least number of insect emergence, followed by variety MTU-1001(5.33 adults), Vikram TCR (6.00 adults) and MTU-1010 (6.33 adults) respectively. While the maximum adult population was recorded in Dubraj (17.00 adults), Indira Aerobic-1 (16.66 adults), Kalimuch (13.33 adults) and Basmati- 370 (11.66 adults) was found maximum preferred as the average number of adults emerged.

Thus, the variety Dubraj selection-1 (21.66 adults) followed by Karma masuri (18.33 adults) were found to be the most susceptible variety. Conversely, Swarna (3.33 adults), followed by Safri-17 (4.66 adults) were found to be the most tolerated variety with the least number of insect emergence.

Percent grain damage

The present findings on screening of rice varieties against *S. oryzae* revealed that minimum grain damage of 2.66 per cent observed in rice variety MTU 1001 and Swarna (2.66%), followed by MTU-1001 (3.66%), Vikram TCR (3.66%), Safri-17 (3.66%), Basmati-370 (3.66%), Samba Masuri (3.66%), and Kalimuch (1.06%).

The highest grain damage was observed in variety Dubraj Selection -1 (8.33%) followed by Karma Masuri (6.66%), C.G. Devbhog (5.66%), Zinc rice -MS (4.33%), R-1919 (C.G Dhan 1919) (4.33%), HMT (4.66%) and Indira aerobic - 1 (4.66%) respectively.

Thus, the variety Dubraj selection -1 (8.33%) and Karma Masuri (6.66%) was found to be the most susceptible varieties. Conversely, MTU-1001 and Swarna was reported to be the more tolerant varieties with least grain damage (2.66%). Other varieties have intermediate reaction.

The present findings are in conformity with findings of Khaliq (2013) [12] who reported that the Basmati- 515 as susceptible rice variety.

Per cent weight loss

Among different varieties of rice screened against *S. oryzae* the minimum weight loss of 1.00 per cent observed in variety MTU- 1010 and Basmati- 370 (1.33%) were found to be the most resistant variety with the minimum per cent of weight loss followed by MTU-1001(1.33%), Vikram TCR (1.66%), Zinc rice -MS (1.66%), Samba Masuri (BPT 5204) (1.66%), Safri-17 (2.00%) and Swarna (2.33%) respectively. Rice variety Dubraj Selection -1 was highly preferred as it had indicated maximum weight loss of 6.66 per cent and C.G. Devbhog (3.33%) were found to be the most susceptible variety, followed by variety R-1919 (C.G Dhan 1919) (3.33%), Kalimuch (3.33%), Karma masuri (3.00%), Indira aerobic -1(2.66%) and HMT (2.66%), respectively.

Thus, the variety Dubraj Selection -1 (6.66%), C.G Devbhog (3.33%), were found to be the most susceptible variety. Conversely, MTU- 1010 (1.00%) and Basmati- 370 (1.33%) found to be the most resistant variety with the minimum per cent weight loss. Chaudhary and Chakraborty (2014) also studied the relative loss of weight due to the infestation of *S. oryzae* in five selected rice cultivars and reported that maximum weight loss was recorded in the local rice cultivar Kalirai and Vadoi, while the minimum was noted in the high yielding cultivar Samba mashuri.

Table 1: Number of adult emergences, % grain damage and % weight loss in different rice varieties at 60 DAS

S. No	Rice varieties	Grain weight (g)	Average number of adult emerged	% Grain damage in rice varieties	% Weight loss in rice varieties
1	Swarna	30	3.33 (2.07)*	2.66 (9.26)	2.33 (8.74)
2	C.G. Devbhog	30	12.33 (3.64)	5.66 (13.68)	3.33 (10.49)
3	Samba Masuri (BPT 5204)	30	10.66 (3.41)	3.66 (11.01)	1.66 (7.33)
4	Basmati- 370	30	11.66 (3.55)	3.66 (11.01)	1.33 (6.53)
5	Zinc rice -MS	30	17.66 (4.31)	4.33 (11.99)	1.66 (7.33)
6	MTU- 1010	30	6.33 (2.69)	3.33 (10.49)	1.33 (6.53)
7	Safri-17	30	4.66 (2.37)	3.66 (11.01)	2.00 (7.94)
8	Karma masuri	30	18.33 (4.39)	6.66 (14.89)	3.00 (9.87)
9	Indira Aerobic -1	30	16.66 (4.19)	4.66 (12.35)	2.66 (9.26)
10	Dubraj Selection -1	30	21.66 (4.75)	8.33 (16.76)	6.66 (14.89)
11	Vikram TCR	30	6.00 (2.64)	3.66 (11.01)	1.66 (7.14)
12	R-1919 (C.G. Dhan 1919)	30	10.33 (3.36)	4.33 (11.99)	3.33 (10.49)
13	HMT	30	17.00 (4.23)	4.66 (12.35)	2.66 (9.26)
14	Kalimuch	30	13.33 (3.78)	3.66 (11.01)	3.33 (10.49)
15	MTU-1001	30	5.33 (2.51)	2.66 (9.26)	1.00 (5.73)
	S.Em. ±		0.11	0.82	0.88
	CD @ 5%		0.33	2.39	2.57

*Figures in parentheses are square root transformed value DAS - Days after storage

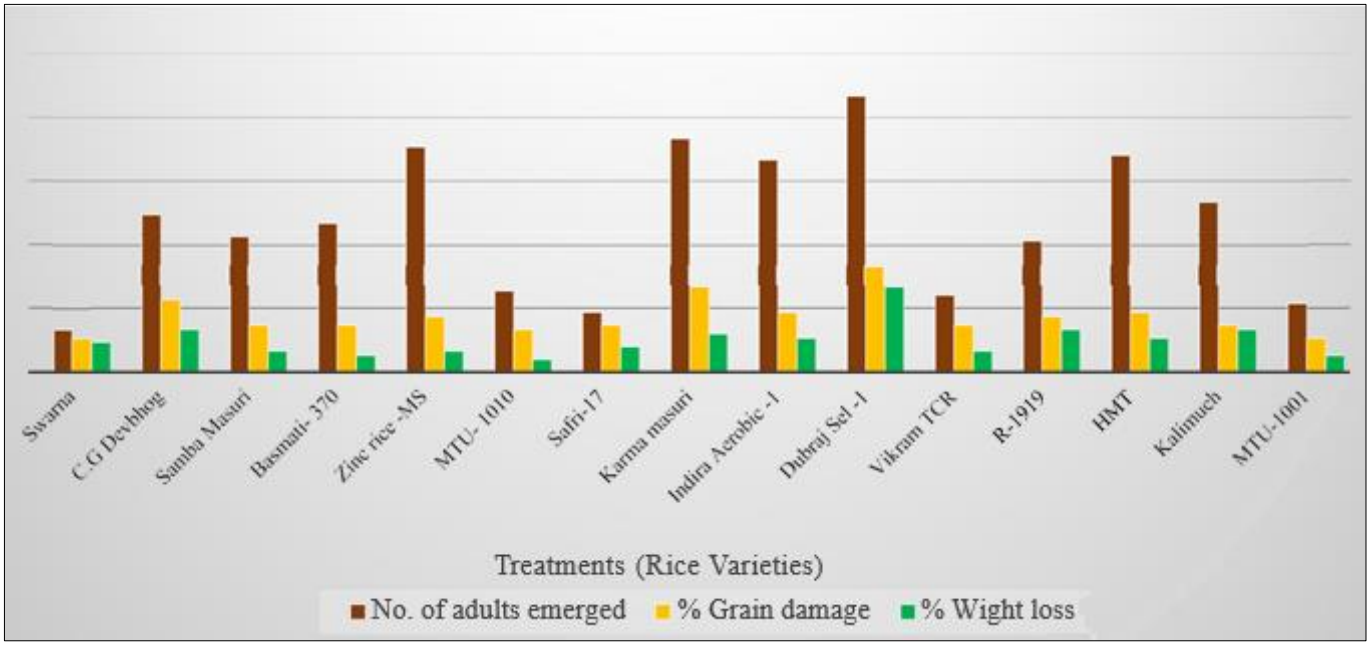

Fig 1: Number of adult emergences, % grain damage and % weight loss in different rice varieties at 60 DAS

Conclusion

The experiment consisted of conducting no choice test on different varieties of rice grains in biological parameters viz., adult emergence of weevil, per cent weight loss and per cent grains damage were assessed to determine the varietal susceptibility of *S. oryzae*. Results on no choice test showed that the rice variety MTU-1001 was significantly superior than other varieties with minimum adult emergence, minimum per cent weight loss (1.00%) and minimum per cent grain damage (2.66%). Rice variety Dubraj Selection-1 recorded maximum adult emergence (21.66 adults), maximum per cent grain damage (8.33%) and maximum per cent weight loss (6.66%).

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