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Research Article

OBSERVATION ON THE EXTENT OF GRAIN WEIGHT LOSS DUE TO THE INFESTATION OF *SITOPHILUS ORYZA* IN FIVE SELECTED RICE CULTIVARS

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ABSTRACT
To study the relative loss of weight due to the infestation of *Sitophilus oryzae* in five selected rice cultivars, a study in three replications and for three consecutive months of 2013 was carried out at Entomology Laboratory, Department of Zoology, Gour Banga University, Malda West Bengal. Maximum weight loss was noted for the local rice cultivar *kalirai* and *vadoi*, while the minimum was noted for the high yielding cultivar *Sampa mashuri*. Out of the five cultivars, high yield cultivar, *Swarna mashuri* is more resistant to the infestation of *S.oryzae* and thus good for long storage.

Keywords: *Rice Grain, Infestation of S.oryzae, Weight Loss*

INTRODUCTION

Stored product insect pests cause severe damage to food grains (Yum-Tai *et al.*, 1981). Storage losses due to insect pest infestations have been a problem of major concern especially among small-holder farmers who used to practice traditional storage structures. Inspection, sampling and monitoring of grain stores provide the baseline information that is useful in identifying and managing problems associated with grain storage, particularly insect pest infestations. In India the damage of stored grains by insect pests was estimated as 6.5 percent of the total storage amount (Raju, 1984). As damage to grain is directly related to the quality and variety of grain attention in relation to the type of the grain should be given priority.

Rice weevil (*Sitophilus oryzae* L.) has been reported as one of the severe pests of cereal grains and their products (Baloch, 1992).Rice weevil cause heavy losses of stored food grain quantitatively and qualitatively throughout the world (Arannilewa *et al.*, 2002). This pest of 'whole grain', originated in India, has spread worldwide by commerce and now has a cosmopolitan distribution. Being a ubiquitous pest of economic importance, *S. oryzae* feeds internally by boring into stored grain. The adults feed mainly on the grain endosperm thus reducing the carbohydrate content, while the larvae feed preferentially on the germ of the grain thus removing a large percentage of the proteins and vitamins **(**Belloa *et al*., 2000**)**. The female feeds on rice and lay egg inside the grain kernel in a small hole covered with a gelatinous excretion near the grain surface just about 90 micrometers deep (Estall, *et al*., 1999). Larval and pupal development takes place inside the grain. A larva of *S. oryze* consumes 0.4 mg grain/day (Giolebiowska *et al.*, 1968). While the quantity of grain consumed and the loss cumulatively is very high, the quality of the grains remains becomes very nutritionally 'poor' as the rice weevil reduces the food status of the grains (Francis *et al*., 1980).

Climatic factors, especially the micro-climate such as temperature, relative humidity, rainfall, and nature of air movements may affect the distribution, development, survival, behavior, migration, reproduction, population dynamics and outbreaks of insect pests of rice. Damage to stored grain is easier to categories by visual observation of the relative amount of damage to the grain and by measuring the amount of weight loss. Factors that usually act in a density-independent manner, influence insects to a greater or lesser extent depending on the situation and the insect species. The extent of grain loss depends on the variety under consideration. The degree of loss, so thus, can be minimized /controlled by the selection of appropriate variety with a modulation of the micro-climatic conditions of storage.

In this contemplation and to observe the relative degree of damage by *S.oryzae* to rice grains, a study for three consecutive months (July-September) of 2013 was carried out at Entomology Laboratory, Department of Zoology, Gour Banga University, Malda. Information so generated from the experiment can be useful in evaluating the relative importance of loss-causing by *S.oryzae* in relation to the room micro-climatic factors such as temperature, moisture content of grains. Further an inference can be drawn regarding the numerical presence of insect pest species and the storage facilities that may be suitable for grain storage.

MATERIALS AND METHODS

The Rice Cultivar (Table1, Figure 1):

Fresh rice grains of each of the five variety considered for the experiment were purchased from the local market and were used for this study. The grains were dried under softly sun light to prevent moldiness and stored in air tight plastic jars. Only complete and intact un-infested grains were selected for the experiments.

Table 1: List of rice variety used for this study

Sl. No.	Rice variety	Grain Type	Weight collected (Kg.)
1	*Swarna*[*]	Slender	1.5
2	*Ratna*[*]	Elongated	1.5
3	*Kalirai*[#]	Blackish and bold	1.5
4	*Vadoi*[#]	Reddish and bold	1.5
5	*Sampa Masuri*[*]	Brighter and slender	1.5

** high yielding variety; # local variety*

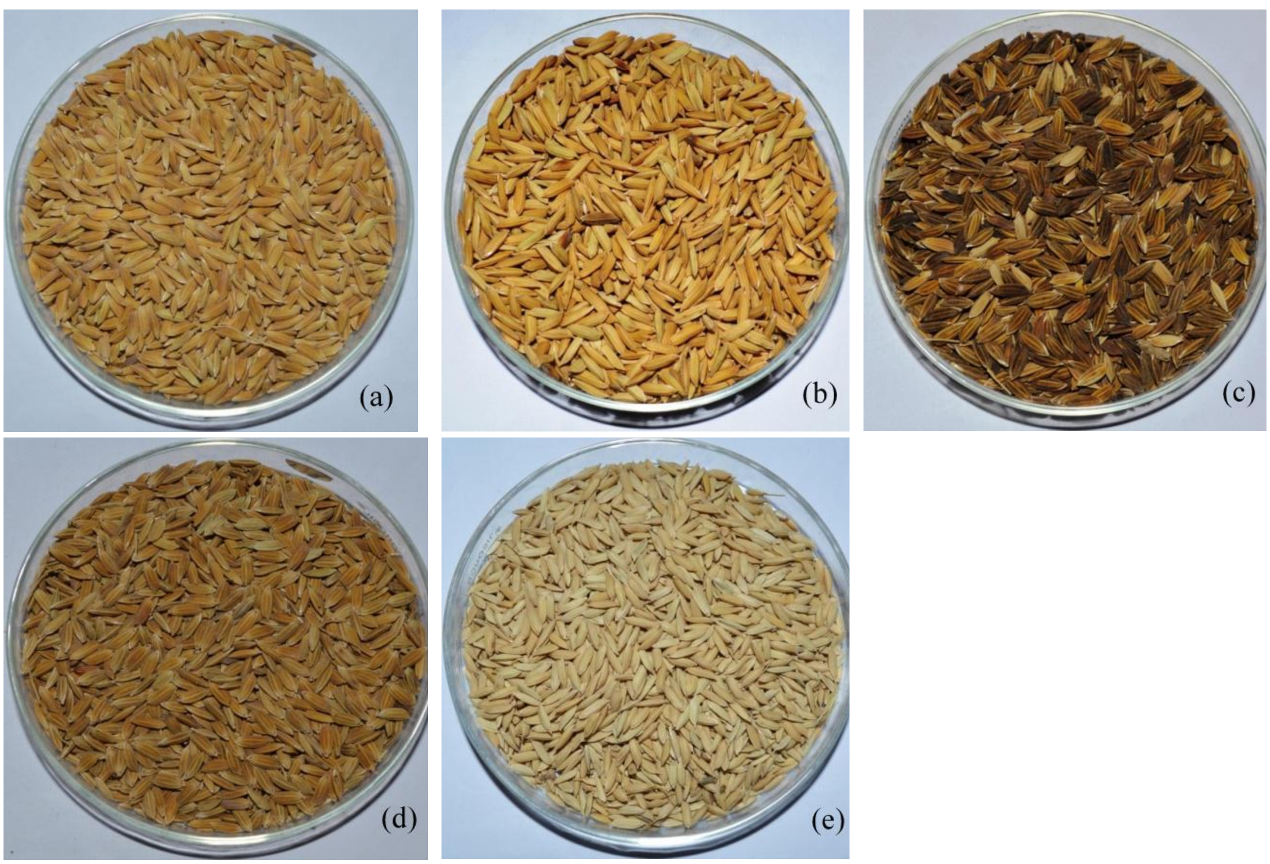


Figure 1: Different rice cultivars: (a) *Swarna* (b) *Ratna* (c) *Kalirai* (d) *Vadoi* (e) *Sampa masuri*.

***The Rice Weevil, S. Oryzae* (Figure 2):**
The rice weevil used for the experiment, is small in size and is about 1/10 inch (2 to 3 mm) in length. It is stout in appearance. It has a similarity with granary weevil in appearance. However, the rice weevil is reddish brown to black in color with four light yellow or reddish spots on the corners of the elytra (the hard protective forewings). The snout is long (1 mm), almost $^1/_3$ of the total length. The head with snout is as long as the prothorax or the elytra. The prothorax (the body region behind the head) is strongly pitted and the elytra have rows of pits within longitudinal grooves.

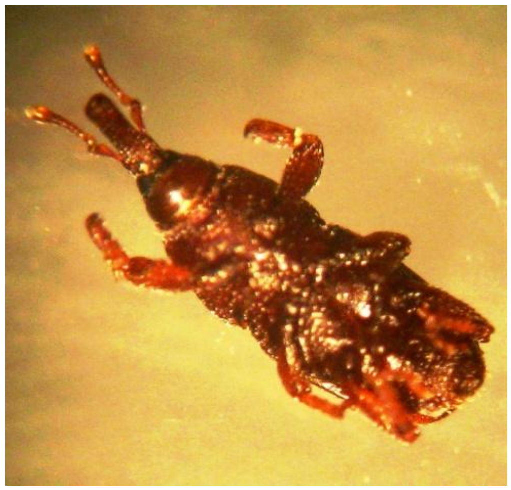


Figure 2*: Sitophilus oryzae*

***Collection and Rearing of Sitophilus sp*.:**
Rice weevils are collected from the local rice mills and were then maintained by the culture in laboratory condition. 50 rice weevils, 10 for each rice cultivar, were collected from culture and were then introduced into separate jars each of 25cm x 14 cm in size and contains 500gm of dis-infested whole rice grains of 5 different varieties (3 high yielding varieties and 2 local varieties). The top of each of the rearing jar was covered with white cloth fastened tightly with rubber bands. Continuous cultures were reared from initial cultures throughout the study period, with the aim to maintaining a steady and sufficient supply of adult weevils. The cultures were generally maintained at a temperature of 29 ± 2° C and 84±2% relative humidity.

Treatment Details
All the experiments were carried out in plastic containers (07cm diameter × 05cm height), each with about 5gm of rice variety. There were 5 separate containers for each of the 5 cultivars and 3 replications were maintained. The room environment was maintained at 29 ± 2° C and 84±2 % relative humidity. Rice of each container was infested with two-week-old 10 adult rice weevils. After each 4 days, each container was weighted and the extent of weight loss was calculated. This experiment was continued up to 20- day from the release of *S.oryzae* to each container. Daily temperature and humidity were maintained by Yoma B.O.D. incubator.

Observation and Calculation:
To estimate the grain damage by rice weevil, percent of grain damage and percent of grain weight loss was considered. Average weight loss was calculated for each container separately. After completion of the experiment, percent of grain weight loss was calculated from the difference of un-infested grain weight and the weight of the grain following the infestation of *S.oryzae*. Percent grain damage was assessed using the following formula:

Weight loss (%) = (weight loss of grains / total weight taken of grains) × 100

Spoiled grains from each of the container were separated manually from undamaged grains using a magnifying glass. Damaged and undamaged grains were independently weighed by electronic balance machine. Weighing was recorded at 4, 8, 12, 16, and 20 days from the treatment, i.e, the release of *S.oryzae*, in each container.

Data Analysis

Primary data from observations of all experiments were recorded and calculated using Microsoft Office Excel®. Final graphs and tables were also prepared using Microsoft Office Excel®.

RESULTS AND DISCUSSION

The relative loss of weight due to the infestation of *Sitophilus oryzae* in five selected rice cultivars, a study in three replications and for three consecutive months of 2013 was carried out at Entomology Laboratory, Department of Zoology, Gour Banga University, Malda West Bengal. The results are delineated below:

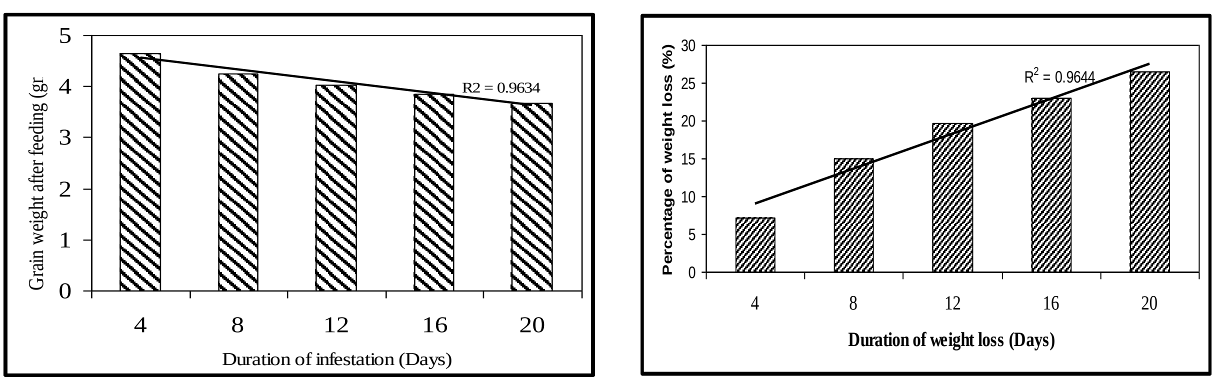
Assessment of Grain Weight Loss

To estimate the percentage weight loss in different types of rice using a conventional weight method, five rice cultivars (3 high yielding varieties and 2 local varieties) were assessed to determine the percentage of weight loss for infestation of *S.oryzae.* A variable result was noted for all the cultivars. The local cultivars experiences comparatively more loss than the high yielding cultivar. Grain weight decreases differed significantly among the various selected rice cutlivers. Grain weight loss, after 20 days of treatment, was found to be the maximum in *Vadoi* (29.27%) rice cultivar while the least was recorded for *Sampa Masuri* (20%).

Percent grain damage was assessed at 4, 8, 12, 16 and 20 days intervals. The extent of grain damage was comparatively higher in 2 local varieties *kalirai* (29.2 %) and *Vadoi* (29.27 %) and low in 3 high yielding varieties *Swarna* (26.47%), *Ratna* (22 %), *Sampa masuri* (20 %). The percentage of weight loss of different variety shown in different charts and different graphs (Figure 3, 4, 5, 6,7 and 8).

In *Swarna* the extent of was at 4, 8, 12, 16 and 20 days interval was 7.20%, 14.93%, 19.67%, 23.00%, and 26.47% respectively (Table 2).In *Ratna* the extent of was at 4, 8, 12, 16 and 20 days interval was 5.47%, 9.60%, 13.33%, 18.40%, and 22.00% respectively(Table 3).In *Kalirai* the extent of was at 4, 8, 12, 16 and 20 days interval was 7.07%, 14.20%, 20.00%, 25.73%, and 29.20% respectively(Table 4). In *Vadoi* the extent of was at 4, 8, 12, 16 and 20 days interval was 4.53%, 10.53%, 18.80%, 23.73%, and 29.27% respectively(Table 5). In *Sampa mashuri* the extent of was at 4, 8, 12, 16 and 20 days interval was 4.40%, 8.67%, 13.20%, 17.40%, and 20.00% respectively (Table 6).

Percentages of weight loss shows that rice weevil prefer more local varieties than the high yielding varieties. Local cultivar may probably is more palatable to the *S.oryzae.* The extent of damage was low in high yielding variety. So high yielding cultivar is good for long storage than local cultivar. The presence of fiber matrix is probably more in high yielding cultivar which ensures a barrier for the boring to the rice weevil.



(a) (b)

Figure 3: Graph showing (a) Weight loss; (b) Percentage of weight loss of rice cultivar *Swarna*.

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Table 2: Extent of weight loss by *S.oryzae* due to feeding on rice cultivar *Swarna*

DAYS	Weight of grain (gm.) Provide	After feeding	Weight loss (gm)	% of weight loss
	5	**4.65**	**0.35**	**7.00**
4	5	4.59	0.41	8.20
	5	4.68	0.32	6.40
Average	**5**	**4.64**	**0.36**	**7.20**
	5	4.24	0.76	15.20
8	5	4.31	0.69	13.80
	5	4.21	0.79	15.8
Average	**5**	**4.25**	**0.75**	**14.93**
	5	4.01	0.99	19.8
12	5	4.06	0.94	18.8
	5	3.98	1.02	20.4
Average	**5**	**4.02**	**0.98**	**19.67**
	5	3.85	1.15	23
16	5	3.89	1.11	22.2
	5	3.81	1.19	23.8
Average	**5**	**3.85**	**1.15**	**23.00**
	5	3.71	1.29	25.8
20	5	3.69	1.31	26.2
	5	3.63	1.37	27.4
Average	**5**	**3.68**	**1.32**	**26.47**

Table 3: Extent of weight loss by *S.oryzae* due to feeding on rice cultivar *Ratna*

DAYS	Weight of grain (gm.) Provide	After feeding	Weight loss(gm)	% of weight loss
	5	4.78	0.22	4.40
4	5	4.68	0.32	6.40
	5	4.72	0.28	5.60
Average	**5**	**4.73**	**0.27**	**5.47**
	5	4.59	0.41	8.20
8	5	4.53	0.47	9.40
	5	4.44	0.56	11.20
Average	**5**	**4.52**	**0.48**	**9.60**
	5	4.33	0.67	13.40
12	5	4.38	0.62	12.40
	5	4.29	0.71	14.20
Average	**5**	**4.33**	**0.67**	**13.33**
	5	4.13	0.87	17.40
16	5	4.09	0.91	18.20
	5	4.02	0.98	19.60
Average	**5**	**4.08**	**0.92**	**18.40**
	5	3.95	1.05	21.00
20	5	3.88	1.12	22.40
	5	3.87	1.13	22.60
Average	**5**	**3.90**	**1.10**	**22.00**

Present observation was inconsonance with the finding by Banerjee *et al*. (1985), where the maximum single kernel weight decrease attributable to an individual larva was 57 percent in rice. A similar result

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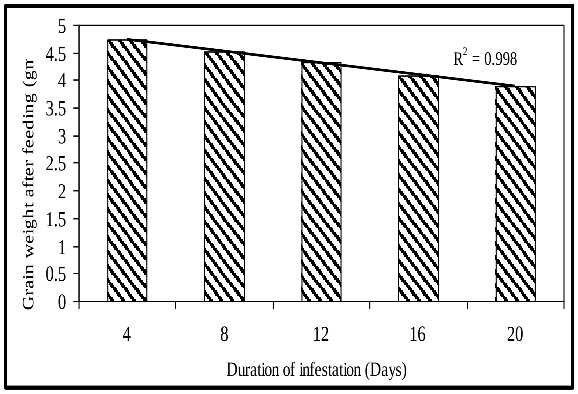
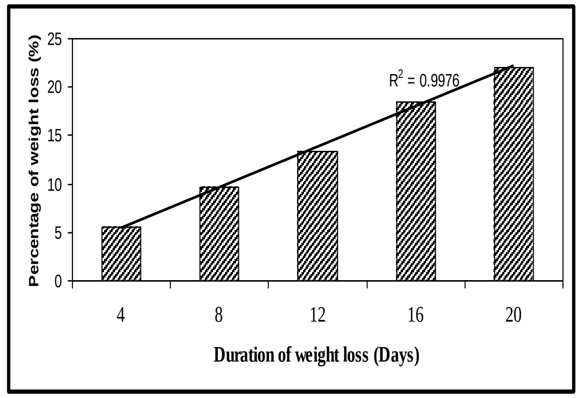
was also reported by Ansari. (2003). An individual *S. oryzae* can consume 0.49 mg of grain daily and produce 11-12 mg of waste products (Shivakoti *et al*. 2000).

From the present study, it was thus evicted that proper attention should be given for local cultivar to avoid the infestation of *Sitophilus* sp. But for high yielding variety the management attention will be comparatively low. It is also shown that losses of the rice grain increases following the increase of storing duration for all the cultivar.



(a)



(b)

Figure 4: Graph showing (a) Weight loss; (b) Percentage of weight loss of rice cultivar *Ratna*.

Table 4: Extent of weight loss by *S.oryzae* due to feeding on rice cultivar *Kalirai*.

DAYS	Weight of grain (gm.)		Weight loss(gm)	% of weight loss
	Provide	After feeding		
	5	4.68	0.32	6.40
4	5	4.65	0.35	7.00
	5	4.61	0.39	7.80
Average	**5**	**4.65**	**0.35**	**7.07**
	5	4.26	0.74	14.80
8	5	4.29	0.71	14.20
	5	4.32	0.68	13.60
Average	**5**	**4.29**	**0.71**	**14.20**
	5	4.01	0.99	19.80
12	5	3.96	1.04	20.80
	5	4.03	0.97	19.40
Average	**5**	**4.00**	**1.00**	**20.00**
	5	3.74	1.26	25.20
16	5	3.68	1.32	26.40
	5	3.72	1.28	25.60
Average	**5**	**3.71**	**1.29**	**25.73**
	5	3.53	1.47	29.40
20	5	3.51	1.49	29.80
	5	3.58	1.42	28.40
Average	**5**	**3.54**	**1.46**	**29.20**

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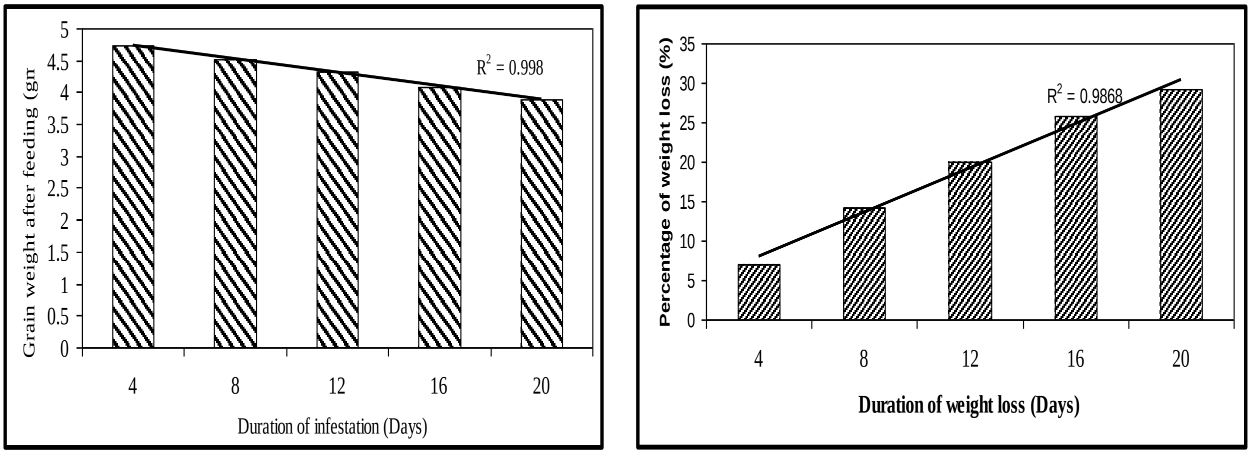
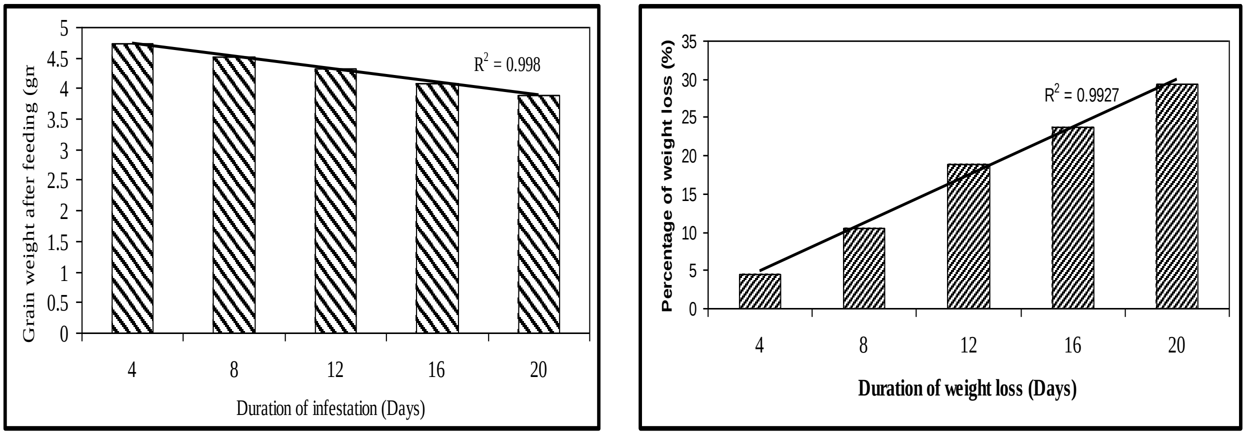


(a) (b)

Figure 5: Graph showing (a) Weight loss; (b) Percentage of weight loss of rice cultivar *Kalirai*.

Table 5: Extent of weight loss by *S.oryzae* due to feeding on rice cultivar *Vadoi.*

DAYS	Weight of grain (gm)		Weight loss (gm)	% of weight loss
	Provide	After feeding		
	5	4.65	0.35	7.00
4	5	4.85	0.15	3.00
	5	4.82	0.18	3.60
Average	**5**	**4.77**	**0.23**	**4.53**
	5	4.41	0.59	11.80
8	5	4.33	0.67	13.40
	5	4.68	0.32	6.40
Average	**5**	**4.47**	**0.53**	**10.53**
	5	4.04	0.96	19.20
12	5	3.97	1.03	20.60
	5	4.17	0.83	16.60
Average	**5**	**4.06**	**0.94**	**18.80**
	5	3.81	1.19	23.80
16	5	3.74	1.26	25.20
	5	3.89	1.11	22.20
Average	**5**	**3.81**	**1.19**	**23.73**
	5	3.51	1.49	29.80
20	5	3.44	1.56	31.20
	5	3.66	1.34	26.80
Average	**5**	**3.54**	**1.46**	**29.27**

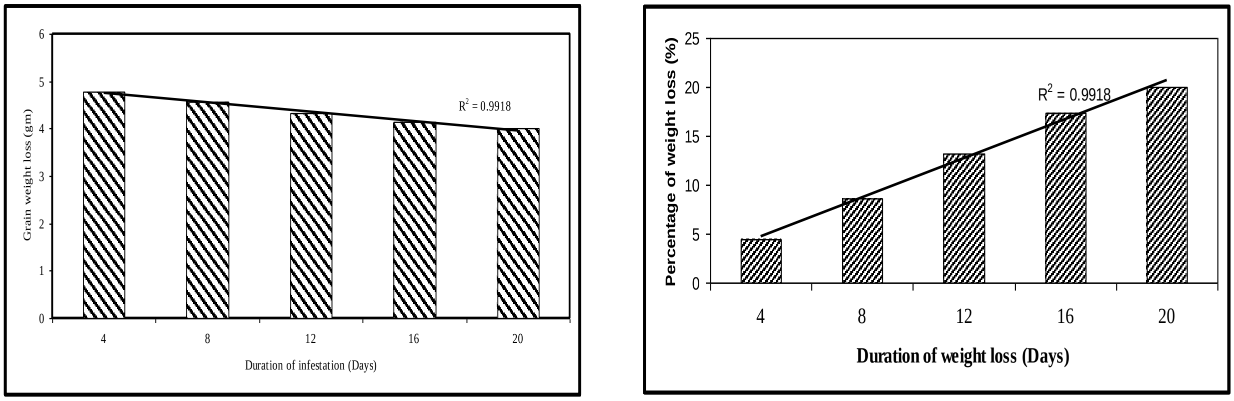


(a) (b)

Figure 6: Graph showing (a) Weight loss; (b) Percentage of weight loss of rice cultivar *Vadoi*.

Table 6: Extent of weight loss by *S.oryzae* due to feeding on rice cultivar *Sampa masuri.*

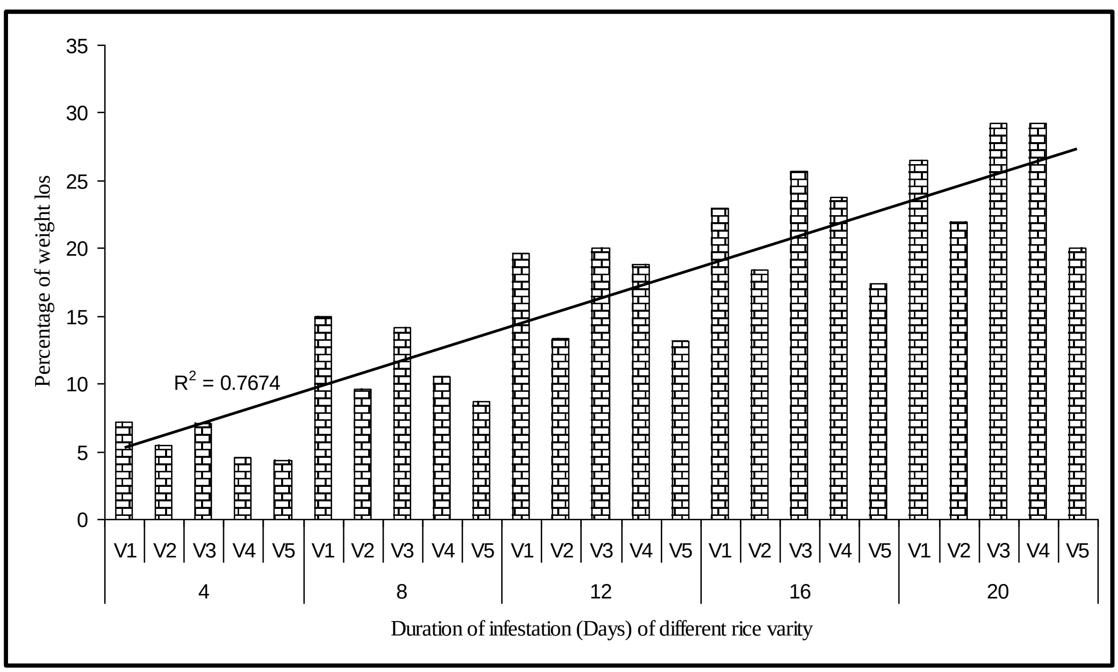
DAYS	Weight of grain (gm)		Weight loss	% of weight loss
	Provide	after feeding		
	5	4.75	0.25	5.00
4	5	4.81	0.19	3.80
	5	4.78	0.22	4.40
Average	**5**	**4.78**	**0.22**	**4.40**
	5	4.48	0.52	10.40
8	5	4.61	0.39	7.80
	5	4.61	0.39	7.80
Average	**5**	**4.57**	**0.43**	**8.67**
	5	4.29	0.71	14.20
12	5	4.38	0.62	12.40
	5	4.35	0.65	13.00
Average	**5**	**4.34**	**0.66**	**13.20**
	5	4.09	0.91	18.20
16	5	4.13	0.87	17.40
	5	4.17	0.83	16.60
Average	**5**	**4.13**	**0.87**	**17.40**
	5	3.97	1.03	20.60
20	5	4.02	0.98	19.60
	5	4.01	0.99	19.80
Average	**5**	**4.00**	**1.00**	**20.00**



(a) (b)

Figure 7: Graph showing (a) Weight loss; (b) Percentage of weight loss of rice cultivar *Sampa masuri*.

Percentage of weight loss is calcutaled of different variety (3 high yeilding varity and 2 local variety) and presented through the graph:



V1- *Swarna* rice V2- *Ratna* rice V3- *Kalirai* rice V4- *Vadoi* rice V5- *Sampa* masuri

Figure 8: Percentage of weight loss of 5 different rice cutlivers (3 high yeilding varity and 2 local variety)

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