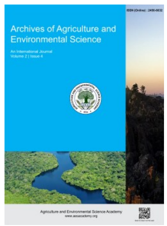
Archives of Agriculture and Environmental Science 11(1): 14-21 (2026)
https://doi.org/10.26832/24566632.2026.110103

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes



ORIGINAL RESEARCH ARTICLE

Host preference dynamics of rice weevil (*Sitophilus oryzae* L.) in stored cereals

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ARTICLE HISTORY

Received: 01 December 2025
Revised received: 19 February 2026
Accepted: 26 February 2026

Keywords

Grain damage
Free choice
No choice
Sitophilus oryzae
Storage pest

ABSTRACT

The study aimed to evaluate the host preference of rice weevil (*Sitophilus oryzae* L.) among six different cereals viz., rice, maize, wheat, barley, sorghum, and oats and assess their resistance to infestation. The experiment was conducted at the Entomology laboratory of Rampur Campus, Chitwan, from May to August 2025 under both free-choice and no-choice conditions using completely randomized design (CRD) with four replications. Each treatment consists of one hundred grains with fifteen pairs of newly emerged rice weevils from the stock culture, introduced under no-choice conditions and fifty pairs per replication under free-choice conditions. The assessed parameters were grain damage percentage, weight loss percentage, and germination percentage before and after the treatment. Under free-choice conditions, wheat recorded the highest grain damage (28.25%) and weight loss (20.01%), whereas oats showed the lowest damage (3.25%) and weight loss (1.52%); greatest reduction in germination was also in wheat (20%) and the smallest in oats (3%). Under no-choice conditions, wheat again had the highest grain damage (14.50%) and weight loss (17.44%), both significantly greater at the 0.1% level, while oats had the lowest damage (4.75%) and weight loss (2.21%); correspondingly, the highest reduction in germination occurred in wheat (18%) and the lowest in oats (3%). This study suggests that wheat is a highly preferred host, while oats exhibit higher resistance against rice weevils. It also suggests that integrating resistant grains and targeted pest management strategies can reduce post-harvest loss.

Citation of this article: Gyawali, A., Neupane, A., Gaire, A., & Kafle, K. (2026). Host preference dynamics of rice weevil (*Sitophilus oryzae* L.) in stored cereals. *Archives of Agriculture and Environmental Science*, *11*(1), 14-21, https://dx.doi.org/10.26832/24566632.2026.110103

INTRODUCTION

Cereal crops significantly contribute to food and nutrition security in Nepal, as the dietary fulfillment of Nepalese people is primarily centered on these crops. Cereals provide 65% of total energy and 60% of total protein intake of the Nepalese population (Dahal *et al*., 2022). Cereal crops are very important for food security, but they are also very easy for different storage pests to get into. Insect infestations cause the loss of almost a quarter to a third of stored grain every year around the world (Emery & Cousins, 2019). In tropical areas, where damage is between 20% and 30%, these losses are worse than in temperate areas, where damage is between 5% and 10% (Talukder, 2017; Rajendran & Sriranjini, 2008). Different insects, including rice/maize weevil (*Sitophilus* spp.*)*, Angoumois grain moth (*Sitotroga cerealella*, Oliver), Indian meal moth (*Ploida interpunctella*, Hübner), Lesser grain borer (*Rhyzopertha dominica* F.), Khapra beetle (*Trogoderma granarium*, Everts), red rust flour beetle (*Tribolium castaneum*, Herbst), and legume weevil (*Callosobruchus* spp.). Among these, the rice weevil (*Sitophilus oryzae* L.) is a cosmopolitan insect that infects various cereals, including maize, rice, wheat, barley, and sorghum (USDA, 2016). The rice weevil, *Sitophilus oryzae* L (Coleoptera: Curculionidae), is a significant pest of stored grains, including maize, rice, wheat, and other cereals, leading to substantial global post-harvest losses (Doherty *et al*., 2023; Majd-Marani *et al*., 2023). Rice weevils undergo four developmental stages: egg, larva, pupa, and adult. The development of each stage typically requires approximately 30 ± 4 days, during which the female deposits around 400 eggs (Ahmad *et al.*, 2022; Arafah *et al.*, 2023). The duration may fluctuate based on the environment. Damage is caused by both the larval and adult stages. Larvae reside within the kernel, feeding on the germ and internal tissues of the grain. This removes proteins and vitamins. Adults, on the other hand typically consume the endosperm located directly beneath the husk. This reduces the carbohydrate content in the grains (Gvozdénac *et al.*, 2020; Khanal *et al.*, 2021). Generally, both sexes are similar; however, the male's rostrum is shorter and larger. Adult weevils are proficient fliers, traveling between granaries and grain fields for direct infestation (Ahmad *et al.*, 2022). The extent of damages is often accelerated when moisture content (> 12%), relative humidity (> 70%), and temperature (> 27˚C) promote the growth and development of the weevil (Khanal *et al.*, 2021). Once the grains become infested, they become increasingly susceptible to secondary infestations, which further intensify storage losses (Doherty *et al.*, 2023).

In Nepal, cereals are usually stored in traditional containers such as bhakari (rolled bamboo or straw mat), wooden baskets, earthen clay pots, and bamboo baskets, which provide inadequate protection against *S. oryzae* infection (Kandel, 2021). Farmers in rural regions lack the appropriate technology and knowledge to store grains for longer periods. This increases the susceptibility of grains to pests such as rice weevils. Farmers in Nepal prioritize increasing crop yields over minimizing the post-harvest losses, particularly during storage. Despite efforts to enhance grain production, inadequate storage and uncontrolled infestations continue to result in significant losses, particularly among rural smallholder farmers who rely on traditional storage systems. Despite efforts to enhance grain production, inadequate storage and uncontrolled infestations continue to result in significant losses, particularly among rural smallholder farmers who rely on traditional storage systems. This study will investigate the behavior of *S. oryzae* across various grain types, contrasting with prior research that predominantly concentrated on individual grain types, thereby filling a significant gap in the comprehension of its pest dynamics within conventional storage systems. Previous research primarily focused on varietal screening to identify crops resistant to pests. However, there is a significant research gap in understanding how the infestations of *S. oryzae* affect post-infestation germination, seed damage, and weight loss. A significant research gap exists concerning the behavior of *S. oryzae* under no-choice conditions, which closely simulate actual storage environments where typically only a single grain is available. This study aims to bridge this gap by examining the oviposition behavior of the pest in specific storage conditions and the impact of variables such as grain hardness, moisture, and texture on the egg-laying preferences of *S. oryzae.* The findings are expected to provide practical insights for farmers, offering cost-effective methods and sustainable and targeted pest management strategies, improving grain storage methods, and enhancing seed quality, thereby contributing to the reduction of post-harvest losses.

MATERIALS AND METHODS

Description of study area

The study was conducted in the Entomology laboratory of Rampur Campus located at Khairahani-5, Chitwan, from May to August 2025, at 27° 36' 17" N latitude, 84° 33' 12" E longitude, and 213 m above sea level.

Identification of *S. oryzae*

Insects were morphologically identified as follows: rice weevil: smaller, dull reddish, with four brown spots on the elytra (Koehler, 2021); maize weevil: slightly larger, dark brown to black with reddish stains on the elytra (Mason & McDonough, 2012).

Mass rearing

Mass rearing of *S. oryzae* was carried out using six plastic jars (16.6 × 7.7 cm), each with 500 g capacity. Wheat grains were cleaned, sterilized at 60°C for 4 hours in a hot air oven, shade dried, and frozen at -20 °C for 24 hours to eliminate any infestation at any insect stage (Yadav *et al.*, 2018). Adults of *S. oryzae* were collected from the infested grains and introduced into the jars, with fifteen pairs of rice weevils released into each jar. The jar was covered with a fine mesh for aeration. Parent weevils were removed after 7 days of inoculation to prevent overlapping generations and uncontrolled populations. The females laid eggs inside the grains, where the larvae developed internally, feeding until pupation. After 4–6 weeks, newly emerged adults (pure culture) were collected.

Treatment details

The host preference of *S. oryzae* was studied under both no-choice and free-choice storage conditions at the laboratory in a Completely Randomized Design (CRD) with six treatments, viz., T_1= Rice (*Oryzae sativa*), variety: Sawa Mansuli sub-1, T_2= Maize (*Zea mays*), variety: Arun-2, T_3= Wheat (*Triticum aestivum*), variety: Gautam, T_4= Barley (*Hordeum vulgare*), variety: Local, T_5= Sorghum (*Sorghum bicolor*), variety: Local, and T_6= Oats (*Avena sativa)*, variety: Local replicated four times.

Experimental setup

Free-choice setup

In the free-choice setup, 100 grains from each cereal were placed in separate petri plates. These plates were arranged horizontally in a circular manner at equal distances from the center within a plastic basin measuring 45 cm × 15 cm, divided into six equal compartments to accommodate all treatments. Fifty pairs of newly emerged *S. oryzae* were released at the center of the basin, providing the adults with a free choice of grains (Gvozdénac *et al.*, 2020). The basin was then covered with a nylon net to allow proper aeration while preventing insect escape. The experiment was conducted under controlled conditions, with a temperature of 30 ± 5°C and relative humidity of 60%.

No-choice setup

In the no-choice test, 100 grains from each of the six treatments were placed in cylindrical jars (16.6×7.7 cm). These jars were replicated four times in a Completely Randomized Design (CRD). Fifteen pairs of newly emerged rice weevils (*Sitophilus oryzae*) were released into each jar. The jars were then covered with a nylon net to allow proper aeration while preventing insect escape (Pal *et al*., 2021). The experiment was conducted under controlled conditions, with a temperature of 30 ± 5°C and relative humidity of 60 ± 10%. This setup allowed for the observation and recording of rice weevil host preference among different cereal grains.

Observations

Data were recorded on the 15^{th} day and collected for a 60-day period to ensure enough time for significant results. Continuous monitoring was essential for tracking the development of grain damage, weight loss and germination.

Grain damage

For assessing grain damage, we considered emergence holes, oviposition punctures, and broken grains with frass at every 15-day interval and grain damage percentage was calculated by following the formula (Law-Ogbomo & Enobakhare, 2006):

$$\text{Damage \%} = \frac{\text{Nd}}{\text{Tn}} \times 100$$

Where, Nd = No. of damaged grains; Tn = Total number of grains.

Weight loss

To assess the extent of seed damage caused by insect infestation, weight loss was calculated as an indicator of quantitative deterioration. The reduction in seed weight results from the weevils' consumption of seed contents, leaving behind damaged or hollow grains. The percentage of weight loss was determined using the following the formula (Odeyemi & Daramola, 2000):

$$\text{Weight loss \%} = \left(\frac{\text{W1} - \text{W2}}{\text{W1}}\right) \times 100$$

Where, W_1 = Initial weight of seed before infestation; W_2 = Final weight of damaged seed.

Germination percentage

The germination percentage was assessed before and at the end of the research using the petri plate method. Prior to the experiment, 100 randomly selected seeds from each cereal were placed in petri plate dishes (99 mm × 20 mm) on moist filter paper and maintained at room temperature. At the end of the experiment, 25 grains from each replication (a total of 100 grains per treatment) were tested in the same way. The number of germinated grains was recorded, and the percentage of germinated grains was calculated using the following the formula (ISTA, 2023):

$$\text{Germination \%} = \frac{\text{NG}}{\text{TG}} \times 100$$

Where, NG = number of seeds germinated; TG = total number of seeds tested.

Statistical analysis

Data was recorded and entered in Microsoft Excel (2023). The mean values of different parameters obtained from the study were recorded and subjected to statistical analysis by using the analysis of variance (ANOVA) technique using the R Studio software (Version 2025.05.1). Treatment means were compared using Duncan's multiple range test (DMRT) at 5 % probability level and significant differences among the means were separated by using least significant difference (LSD) at 5% level.

RESULTS AND DISCUSSION

Free-choice test

Grain damage: Significant differences in damage percentage were observed at all-time points ($p<0.001$). The percentage of grain damage was highest in wheat at 15 days, 30 days,45 days and 60 days with 7.25%, 13.50%, 22.00% and 28.25%, respectively. While oats had the least number of grain damage i.e. 1.00%, 2.00%, 3.00% and 3.25% at 15, 30, 45 and 60 days, respectively. The ascending order of grain damage at the end of the experiment was oats<rice<barley<maize<sorghum<wheat where the rest of the treatment differed significantly but barley and rice did not differ significantly with each other at the 5% level of significance by LSD test. Sorghum, maize, barley and rice had 16.00%,13.50%, 8.00% and 7.50% of grain damage, respectively at the end of the experiment (Table 1). In line with the findings of Awadallah *et al.* (2024), our research confirms that cereal grains show varying levels of damage from *Sitophilus oryzae* during storage. Wheat was the most affected, suffering the highest grain at the end of the experiment and oats the least preferred. None of the cereals showed immunity to the weevil (Bhargude *et al*., 2021). The strong preference for wheat can be explained by its higher content of attractive volatiles, such as 2-ethylhexanol, piperitone, and (+)-Δ-cadiene, which act as chemical cues that stimulate weevil migration and oviposition, ultimately leading to greater infestation and grain damage (Lu *et al*., 2024). This shows wheat is a prime target for the rice weevil, likely due to its nutrients and structure, which make it easy for the pest to infest. In contrast, oats were the least affected, supporting their lower vulnerability and fewer instances of grain damage (Awadalla *et al*., 2021). The reason behind this difference is the presence of natural defense compounds like avenacosides, phenolics, and fatty acids, which function as feeding deterrents, lower palatability and hinder larval development, thereby providing oats with a degree of resistance against storage pests (Manjhu *et al*., 2022). Oats and many barleys are "covered" cereals; the lemma and palea remain tightly adherent to the caryopsis after threshing, creating a dense, lignocellulosic

hull (hydroxycinnamic acids). This husk is a physical barrier to oviposition and can reduce kernel palatability to internal feeders like *S. oryzae* (Kärkönen *et al.*, 2022).

Weight loss: Significant differences in weight loss were observed among the treatments (p<0.001) during the experiments. Wheat (T_3) exhibited the highest weight loss of 20.01%, significantly greater than all other treatments. Sorghum (T_5) followed with 16.01% weight loss, statistically distinguishable from maize (T_2) at 13.01%. Rice (T_1) recorded 9.99% weight loss, followed by barley (T_4) at 7.03%. Oats (T_6) showed the lowest weight loss at 1.52%, significantly lower than all other treatments (Table 2). Subedi *et al.* (2009) confirmed higher weight loss percentages in wheat and polished rice under free-choice conditions, indicating wheat's suitability for weevil feeding and reproduction. Awadallah *et al.* (2024) supported this, noting that wheat attracted the maximum number of weevils, resulting in the highest weight loss percentage. The preference for wheat is likely due to its nutritional content, presence of volatiles and lack of physical barriers, making it more accessible for feeding and oviposition. In contrast, oats were the least preferred grain, and similar findings were found in study conducted by Manju *et al.* (2022).

Germination percentage: Significant differences were observed among treatments for both pre and post-infestation germination percentages (p<0.001). Before infestation, sorghum (T_5) and rice (T_1) exhibited the highest germination percentages at 96% and 94% respectively, which were statistically similar to each other but significantly higher than those of other treatments. Maize (T_2) followed with 93%, statistically indistinguishable from wheat (T_3) at 90%. Barley (T_4) recorded 86%, and oats (T_6) had the lowest germination at 82%, significantly lower than those of other treatments. After infestation, sorghum (T_5) maintained the highest germination percentage at 89%, significantly higher than other treatments. Rice (T_1), maize (T_2), barley (T_4), and oats (T_6) recorded 84%, 82%, 81%, and 79%, respectively, with no significant differences among them. Wheat (T_3) showed the lowest germination at 70%, significantly lower than all other treatments. The highest difference in germination percentage was obtained in wheat at 20% and lowest in the oats, at 3%. The results of this study, showing significant germination percentage reduction in wheat due to *Sitophilus oryzae* infestation, are consistent with past research by Mehta *et al.* (2021), who reported substantial germination declines in wheat due to severe embryo injury caused by rice weevil larvae, as supported by Lu *et al.* (2024), who noted that germination losses primarily arise from larval feeding on the embryo. The embryo, being critical for seed viability, when damaged by larvae, directly reduces germination potential, explaining wheat's high susceptibility. On the other hand, oats exhibited the least germination reduction, aligning with Manjhu *et al.* (2022), who said that oats are resistance to protective compounds like avenacosides that stop larval embryo damage. Sorghum, despite higher grain damage compared to maize, showed a similar reduction, likely because *S. oryzae* primarily caused endosperm damage in sorghum, which affects grain weight more than the embryo critical for germination.

Table 1. Grain damage percentage caused by *S. oryzae* at different time frames under free choice conditions.

Treatments	Grain damage %			
	15th day	30th day	45th day	60th day
T_1 (Rice)	2.25 ±0.25^d	3.50±0.29^d	7.25±0.48^d	7.50 ±0.29^d
T_2 (Maize)	3.50±0.29^c	7.00±0.41^c	12.50±0.29^c	13.50 ±0.29^c
T_3 (Wheat)	7.25±0.25^a	13.50 ±0.29^a	22.00±0.41^a	28.25±0.48^a
T_4 (Barley)	2.0 ±0.00^d	5.50 ±0.00^d	6.50±0.29^d	8.00±0.00^d
T_5 (Sorghum)	4.75±0.25^b	9.25 ±0.25^b	13.50±0.29^b	16.00±0.41^b
T_6 (Oats)	1.0±0.00^e	2.0±0.00^e	3.00±0.00^e	3.25±0.25^e
Grand Mean	3.45	6.37	10.79	12.75
SEm±	0.21	0.25	0.32	0.32
LSD	0.63	0.76	0.94	0.95
CV%	12.28	8.05	6.08	5.06
F Test	***	***	***	***

Note: CV: Coefficient of Variation; LSD: Least significant difference; SEm±: Standard error of mean; ***: Significant at 0.001 level of significance; Values with the same letters in a column are not significantly different at 5% level of significance by LSD test.

Table 2. Weight loss percentage caused by *S. oryzae* at day 60 under free choice conditions.

Treatments	Weight loss (%)
T_1 (Rice)	9.99±0.08^d
T_2 (Maize)	13.01±0.26^c
T_3 (Wheat)	20.01±0.10^a
T_4 (Barley)	7.03±0.08^e
T_5 (Sorghum)	16.01±0.25^b
T_6 (Oats)	1.52±0.09^f
Grand Mean	11.26
SEm±	2.91
LSD	0.16
CV%	2.91
F Test	***

Note: CV: Coefficient of Variation; LSD: Least significant difference; SEm±: Standard error of mean; ***: Significant at 0.001 level of significance; Values with the same letters in a column are not significantly different at 5% level of significance by LSD test.

No- choice test

Grain damage: Significant differences in the grain damage were observed across the treatments in the percentage of grain damage caused by *S. oryzae* on the 15th day ($p<0.01$), 30th day ($p<0.001$), 45th day ($p<0.001$), and 60th day ($p<0.001$). During the experiment, on the 15th day, the highest number of damaged grains was observed in sorghum (5.75%), which was statistically distinguishable from maize (3.50%), barley (3.50%) and oats (3.0%) and the grain damage percentage in rice (5.25%) and in wheat (5.50%) was not significantly different from each other (Table 3). On day 30, the highest percentage of grain damage was found in rice (9.0%), followed by maize (7.5%), wheat (6.5%), sorghum (6.0%), barley (4.0%), and oats (3.0%). Damage caused by *S. oryzae* on day 45 was lowest in oats (4.0%), and highest in rice (10.25%), followed by maize (9.75%), wheat (9.0%), sorghum (8%), and barley (4.50%). Similarly, on day 60, Wheat (14.50%) recorded the highest grain damage caused by *S. oryzae*, followed by rice (13.0%), maize (12.25%), sorghum (9.50%), barley (6.0%), and the lowest damage was found in oats (4.75%) which was statistically similar to that of barley (Table 3). The ascending order of grain damage at the end of the experiment was: oats < barley < sorghum < maize < rice < wheat. This trend is consistent with the findings of Bhargude *et al.* (2021), who also found that wheat was the most vulnerable to *S. oryzae* infestations. However, these findings contradict the observations of Subedi *et al.* (2009), who reported that polished rice (14%) was the most susceptible grain under no-choice conditions. Polishing rice (i.e., removing bran and pericarp layers) increases its susceptibility to *S. oryzae* infestation (Lucas & Riudavets, 2002). Wheat, maize, rice release high amounts of semiochemicals (aldehyde and ketones from lipid/carbohydrate metabolism), and weevil use these volatiles as a signal to locate their host (Germinara *et al.*, 2008). Behavioral assays with single cereal volatiles have shown clear attraction responses in weevils reinforcing the role of cereal odor chemistry in host finding (Germinara *et al.*, 2008). Oats and many barleys are "covered" cereals; the lemma and palea remain tightly adherent to the caryopsis after threshing, creating a dense, lignocellulosic hull (hydroxycinnamic acids). This husk is a physical barrier to oviposition and reduces kernel palatability to internal feeders like *S. oryzae* (Kärkönen *et al.*, 2022). Previous studies on oat and barley hulls have document their lignocellulosic toughness, consistent with this barrier hypothesis (Rosentrater & Bucklin, 2022). Lignin concentration of the hulls is negatively correlated with digestibility (Raffrenato *et al.*, 2017). Phenolics and proanthocyanidins found on hulls of oats and barley have are widely reported to reduce palatability or deter feeding in phytophagous insects (Varga *et al.*, 2018).

Weight loss: The data recorded on weight loss due to *S. oryzae* infestation in different cereals are presented in Table 5. Based on the weight loss percentage, wheat (17.44%) was most preferred host for *S. oryzae*, which was significantly greater ($p<0.001$) than all observed values of other treatments, aligning with the findings of Subedi *et al.* (2009) and Awadallah *et al.* (2024). The lowest weight loss was observed in oats (2.21%). Rice (13.22%), maize (9.01%), barley (7.63%), and sorghum (4.27%) also differed significantly from each other in the weight loss assessment (Table 4). Wheat's headspace contains higher amounts of key attractants- 2-ethylhexanol, piperitone, and (+)-Δ-cadiene than the other cereals. These compounds are present in both maize and wheat but they are abundant in wheat, so the odor field from wheat more often exceeds *S. oryzae*'s olfactory response threshold; consequently, more adults arrive and settle, oviposition increases and cumulative weight loss is greater in wheat. While oats and barley emit weaker/different blends of these cues, causing lower weight losses (Lu *et al.*, 2024). The results of this study are consistent with NHPI (Natal Hypothesis Preference Induction) but don't prove the natal experience effects. The NHPI hypothesis predicts that females prefer to lay their eggs on the same host species on which they developed as larvae (Davis & Stamps, 2004). Beyond the NHPI, innate olfactory biases, along with cereal-specific volatile compounds of the host (Trematerra *et al.*, 2013).

Table 3. Grain damage percentage caused by *S. oryzae* at different time frames under no-choice conditions.

Treatments	Grain damage%			
	15th day	30th day	45th day	60th day
T_1 (Rice)	5.25±0.85^a	9.00±0.40^a	10.25±0.25^a	13.00±0.40^a
T_2 (Maize)	3.50±0.50^b	7.5±0.28^b	9.75±0.47^{ab}	12.25±1.31^a
T_3 (Wheat)	5.50±0.28^a	6.5±0.28^{bc}	9.0±0.40^{bc}	14.50±0.86^a
T_4 (Barley)	3.50±0.64^b	4.0±0.40^d	4.50±0.28^d	6.00±0.40^c
T_5 (Sorghum)	5.75±0.25^a	6.0±0.40^c	8.0±0.48^c	9.50±0.64^b
T_6 (Oats)	3.00±0.00^b	3.0±0.40^d	4.0±0.00^d	4.75±0.25^c
Grand Mean	4.41	6.00	7.58	10
SEm±	0.5	0.37	0.34	0.74
LSD	1.50	1.10	1.02	2.20
CV %	22.95	12.42	9.06	2.20
F Test	**	***	***	***

Note: CV: Coefficient of Variation; LSD: Least significant difference; SEm±: Standard error of mean; **: Significant at 0.01 level of significance; ***: Significant at 0.001 level of significance; Values with the same letters in a column are not significantly different at 5% level of significance by LSD test.

Table 4. Weight loss percentage caused by *S. oryzae* infestation in different host crops under no-choice conditions.

Treatments	Weight loss (%)
T_1 (Rice)	13.22±0.32[b]
T_2 (Maize)	9.01±0.22[c]
T_3 (Wheat)	17.44±0.24[a]
T_4 (Barley)	7.63±0.46[d]
T_5 (Sorghum)	4.27±0.41[e]
T_6 (Oats)	2.21±0.26[f]
Grand Mean	8.96
SEm±	0.33
LSD	0.99
CV %	7.43
F Test	***

Note: CV: Coefficient of Variation; LSD: Least significant difference; SEm±: Standard error of mean; ***: Significant at 0.001 level of significance; Values with the same letters in a column are not significantly different at 5% level of significance by LSD test.

Table 5. Germination percentage of different grains before and after the infestation by *S. oryzae* under no-choice conditions.

Treatments	Germination %	
	Before	After
T_1 (Rice)	94±1.11[a]	81±1.00[b]
T_2 (Maize)	93±1.00[ab]	83±1.00[b]
T_3 (Wheat)	90±1.15[b]	72±1.63[c]
T_4 (Barley)	86±1.15[c]	81±1.00[b]
T_5 (Sorghum)	96±1.63[a]	88±1.63[a]
T_6 (Oats)	82±1.15[d]	79±1.00[b]
Grand Mean	90.16	80.66
SEm±	1.2	1.2
LSD	3.6	3.7
CV %	2.71	3.09
F Test	***	***

Note: CV: Coefficient of Variation; LSD: Least significant difference; SEm±: Standard error of mean; ***: Significant at 0.001 level of significance; Values with the same letters in a column are not significantly different at 5% level of significance by LSD test.

Germination percentage: There were significant differences among the treatments in germination percentage before the infestation ($p<0.001$) of *S. oryzae* and after the infestation ($p<0.001$). The results obtained on the effect of *S. oryzae* infestation on the germination percentage of different selected grains are presented in Table 5. Before the infestation, highest germination percentage was observed in sorghum (96%), which was on par with rice (94%) and maize (93%). Oats exhibited the lowest germination percentage (82%), while wheat (90%) and barley (85%) were intermediate and statistically different from extremes. After the infestation by *S. oryzae*, sorghum maintained the highest germination percentage (88%), statistically higher than that of all other cereals. Germination percentage of maize (83%), rice (81%), barley (81%), oats (79%) was statistically significant (Table 5). The highest absolute reduction in germination percentage was observed in wheat (18%), significantly greater than that of other cereals ($p<0.001$). It was followed by rice (13%) and maize (10%), which didn't differ significantly from each other but were significantly different from other treatments. The reduction in germination percentage in sorghum was 8%, barley 5%, and the lowest was found in oats 3%, where barley and oats were at significantly par ($p<0.001$). As wheat recorded the highest weight loss, the pattern matches *S. oryzae* biology: adults feed on the endosperm, while larvae consume the germ, damaging the embryo and reducing viability (Mehta *et al.*, 2021). The primary reason grains lose weight is damage to endosperm (Saeed & Laing, 2023), while the reduction in germination percentage is caused by embryo damage (Chandaragi *et al.*, 2022). Infestation creates a hot and humid environment inside the seed, promoting mold growth, which eventually lowers the seed viability (FAO, 2013). Avenacocides concentrated in the husk prevent grain damage and weight loss, resulting in the lowest reduction in germination percentage (Pecio *et al.*, 2013).

Comparison between no-choice and free-choice conditions

Grain damage: Grain damage at 60 days was greater in wheat under free-choice (28.50%) compared to no- choice conditions (14.50%). The lowest grain damage was observed in oats under free-choice conditions (3.75%), which was slightly higher under no-choice conditions (4.75%) as shown in the Figure 1.

Weight loss: Figure 2 illustrates the percentage of weight loss in different grains caused by *S. oryzae* after 60 days under no-choice and free-choice conditions. The highest weight loss was observed in wheat under both no-choice (17.44%) and free-choice (20.1%). Lowest weight loss was observed in oats under free-choice (1.52%) and 2.21% under no-choice conditions, suggests a strong level of resistance or non-preference by the weevil.

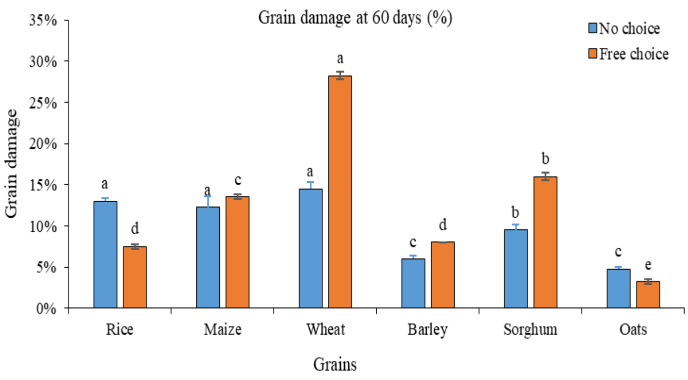

Figure 1. *Grain damage due to S. oryzae on different host.*

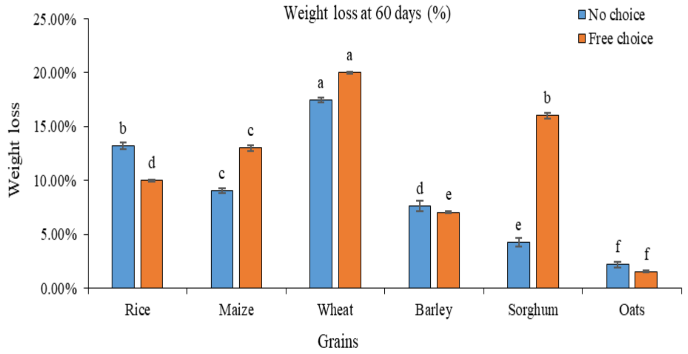

Figure 2. *Weight loss caused by S. oryzae on different host.*

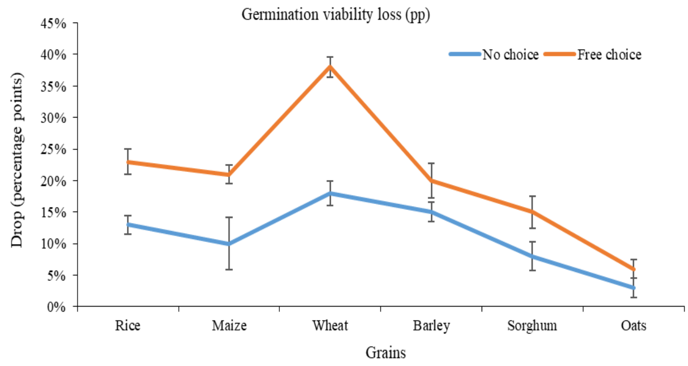

Figure 3. *Germination percentage drop by S. oryzae on different host.*

Germination percentage: Figure 3 shows the reduction in germination viability in percentage points (pp) of different grains caused by *S. oryzae*. Overall, the decline in germination percentage varied among the grains. Wheat experienced the highest percentage drop (20%) under free-choice and 17% under no-choice conditions. The lowest percentage drop was observed in oats (3%) under both free-choice and no-choice conditions.

Conclusion

This study found that the host grain significantly influences the infestation dynamics of *S. oryzae*, affecting grain damage, weight loss and germination percentage under both free-choice and no-choice conditions. Wheat consistently showed the highest susceptibility, with the greatest grain damage (14.50% in no-choice; 28.25% at 60 days in free-choice), the most weight loss (17.44% in no-choice and 20.01% in free-choice) and the largest reduction in germination (18% in no-choice and 20% in free-choice), whereas oats were the least preferred, showing the lowest grain damage (4.75% in no-choice; 3.25% at 60 days in free-choice), minimal weight loss (1.52–2.21%), and only a 3% germination reduction likely due to the protective effect of the husk. The results suggest that husked grains such as oats and barley are more suitable for longer storage, while unhusked grains like wheat are more vulnerable and require stricter protection and regular inspections. These findings highlight the importance of selecting appropriate storage grains to minimize the post-harvest losses caused by *S. oryzae*. To enhance robustness and external validity, future work should include multi-year trials with larger sample sizes, validation under farmers' storage conditions, and investigating the biochemical studies to identify host volatiles influencing *S. oryzae* behavior.

ACKNOWLEDGEMENTS

We sincerely acknowledge IAAS Rampur Campus for generously providing the research materials and offering invaluable guidance throughout the study. Our deepest gratitude extends to our parents and friends for their steadfast support, both physical and emotional, which has been instrumental throughout this research journey.

DECLARATIONS

Author contribution Statement: Conceptualization: A. G.[1], A. N.; Methodology: A. G.[1] & A. N.; Software and validation: A. G.[1] and A. N.; Formal analysis: A. G.[1]; Investigation: A. G.[1] and A. N.; Resources: K. K.; Data curation: A. G.[1]; Writing—original draft preparation: A. G.[1]; Writing—review and editing: A. G.;[2] Visualization: A. G.[1]; Supervision: K.K. & A. G.[2]; Project administration: K. K. The final manuscript was reviewed and approved by all authors.

Conflicts of interest: The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Ethics approval: This study did not involve any animal or human participant and thus ethical approval was not applicable.

Consent for publication: All authors gave their consent to publish this paper in AAES.

Data availability: The data that supports the findings of this study are available on request from the corresponding author.

Supplementary data: No supplementary data is available for the paper.

Funding statement: No external funding is received for this study.

Additional information: No additional information is available for this paper.

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