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RESEARCH PAPER

Assessing the food preferences of common varieties of maize by *Sitophilus zeamais*

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Abstract: A laboratory experiment was conducted to investigate the susceptibility and food preference of five commonly cultivated maize varieties namely Local Chakhao Chujak, Mizo Local Purple, LMC-19, LMC-9, and White Local under controlled laboratory storage conditions. Hundred grams of healthy grains from each variety were infested with 10 pairs of newly emerged *Sitophilus zeamais*. adults and observed for 45 days to assess per cent seed loss and weight loss. Results showed significant varietal differences in susceptibility. Chakhao Chujak recorded the highest seed loss (34.40%) and weight loss (10.43%), indicating high vulnerability, whereas Mizo Local exhibited the lowest seed loss (3.62%) and weight loss (1.17%), suggesting strong resistance. The susceptibility order was Chakhao Chujak > LMC-19 > White Local > LMC-9 > Mizo Local. These findings emphasize the role of varietal selection as a cost-effective, eco-friendly, and sustainable strategy for integrated storage pest management, reducing reliance on synthetic insecticides and preserving grain quality during storage.

Keyword: Maize varieties • *Sitophilus zeamais* • Seed loss • Weight loss • Chakhao chujak

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Introduction

Maize (*Zea mays* L.) is a widely cultivated cereal crop domesticated in Central America and globally recognized as the "Queen of cereals" for its high yield potential (Ranum *et al.*, 2014). It can be cultivated across diverse agroecologies and seasons, making it a staple food, feed and fuel source. India ranked 4th in area and 7th in production, representing around 4% of the world's maize area and 2% of total production. During 2018-19 in India, the maize area has reached to 9.2 million ha (Shekhar and Singh, 2021). In India, kharif maize accounts for 83% of the area, while rabi maize contributes 17% (Yadav *et al.*, 2023). The infestation of maize-by-maize weevil commences in the field but damage to maize grains by maize weevil is done during storage period. Such damaged grains have reduced nutritional values, lower percent germination and reduced weight and market values (Trematerra *et al.*, 2013) Post-harvest losses in maize are exacerbated by storage pests, particularly the maize weevil, *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae), which can cause 20–40% grain loss (Hared *et al.*, 2014) the maize weevil, S. *zeamais* causes severe quantitative and qualitative losses in stored maize grain (Adedire, 2001; FAO, 2002; Nwosu *et al.*, 2015a; Nwosu *et al.*, 2015b). Maize weevil is one of the most serious, internal feeding pests of maize seed and grain. *S. zeamais* is found in all tropical and sub-tropical parts of the world (Dobie, 1974). To suppress storage pests, synthetic insecticides have been applied to grains on a large scale (Rajashekar *et al.*, 2012), but their drawbacks include environmental risks, pesticide resistance, and residue concerns (Cherry *et al.*, 2005). Sustainable alternatives, such as plant-based grain protectants (Longe, 2010; Ivbijaro and Agbaje, 1986; Adedire *et al.*, 2011), are gaining attention. Nevertheless, varietal resistance remains one of the most sustainable and economical approaches to managing storage pests. Grain physical and biochemical characteristics including kernel hardness, pericarp thickness, starch composition, and phenolic content play a critical role in determining varietal susceptibility to *S. zeamais* (Tefera *et al.,* 2011). Recent studies have reported considerable variation in maize genotypes for resistance to maize weevil infestation. (Khan *et al.,* 2021) revealed that the open-pollinated varieties JALAL (white) and AZAM (white) exhibited significantly lower susceptibility to *S. zeamais* compared to ZARD LOCAL (yellow) and KASHMIRI (yellow) Similarly, research conducted in Ethiopia identified maize genotypes from the Melkasa and Bako Agricultural Research Centers that demonstrated inherent resistance traits under laboratory infestation tests (Academia.edu, 2021). Additionally, Basyal *et al.* (2022) identified Nepalese hybrids Khumal Hybrid-2 and Rampur Hybrid-4 as less susceptible based on lower grain damage and weight loss. These findings collectively highlight the potential of integrating resistant genotypes into breeding programs as a sustainable strategy for mitigating post-harvest losses caused by *S. zeamais*. Given the importance of host plant resistance in post-harvest pest management, the present study aims to evaluate the food preference and susceptibility of selected maize varieties -local chakhao chujak, mizo local purple, lmc-19, lmc-9 and white local to *S. zeamais* pests based on susceptibility index values.

Materials and methods

Rearing of Sitophilus sp. stock culture

The initial culture of *Sitophilus* sp. was started by collecting the adult moths from the infested maize grains from nearby godown. Adults were introduced in plastic bottle containing the maize grains which are uninfected by *Sitophilus sp*. at top portion of the bottle was covered with a muslin cloth and tied with rubber bands to prevent from adults escaping. These plastic bottles will be kept under non-invasive laboratory conditions in the PG laboratory Department of Entomology, CAU, Imphal. The stock culture will be maintained at room temperature and then newly emerged young adults will be used throughout the period of experimental investigation. The detail regarding materials used and the technique will be employed during the period of investigation.

Assessment of food preferences among maize varieties

Five common maize varieties using for the food preference namely Local Chakhao Chujak, Mizo Local Purple, LMC-19, LMC-9, and white local (Figure 1-3). Seeds of five varieties of maize were obtained from different sources such as those selling in local market for household purpose to get the mother culture of the insect *Sitophilus sp.* and then the insect were reared in PG laboratory of the Department of Entomology, College of Agriculture, Central Agricultural University, Imphal. The fresh seeds were placed in desiccator at 75 °C temperature and 75% relative humidity (with ± 5% tolerance) with potassium hydroxide and conditioned for 15 days. Later on, moisture content of seed was determined with the help of universal moisture meter. Hundred grams healthy grains of each variety were initially weighed and kept in jars of 1kg capacity separately.10 pairs of newly emerged male and female moths of same age were released into each jar and covered with Muslin cloth to prevent the escape of the insect. Percent seed damage by (Giga and Canhão (1993) and percent weight loss (Boxall 1986) were calculated after 45 days release of insect *Sitophilus sp*.

$$\text{Percent seed damage} = \frac{\text{Number of damaged seeds}}{\text{Total number of seeds}} \times 100$$

$$\text{Percent weight loss} = \frac{\text{Initial weight - final weight}}{\text{Initial weight}} \times 100$$

Results and discussion

Extent of seed damage

The data on mean percent seed damage revealed that all the maize varieties exhibited significant variability in susceptibility to damage by *Sitophilus* spp. over a 45-day storage period, which was maintained to allow the weevil to complete its life cycle. Mean percent damage among the evaluated varieties ranged from 3.62% to 34.40%. The variety Chakhao Chujak (T3) recorded the highest damage of 34.40%, followed by LMC-19 (T2) with 12.80%, White Local (T5) with 8.67%, and LMC-

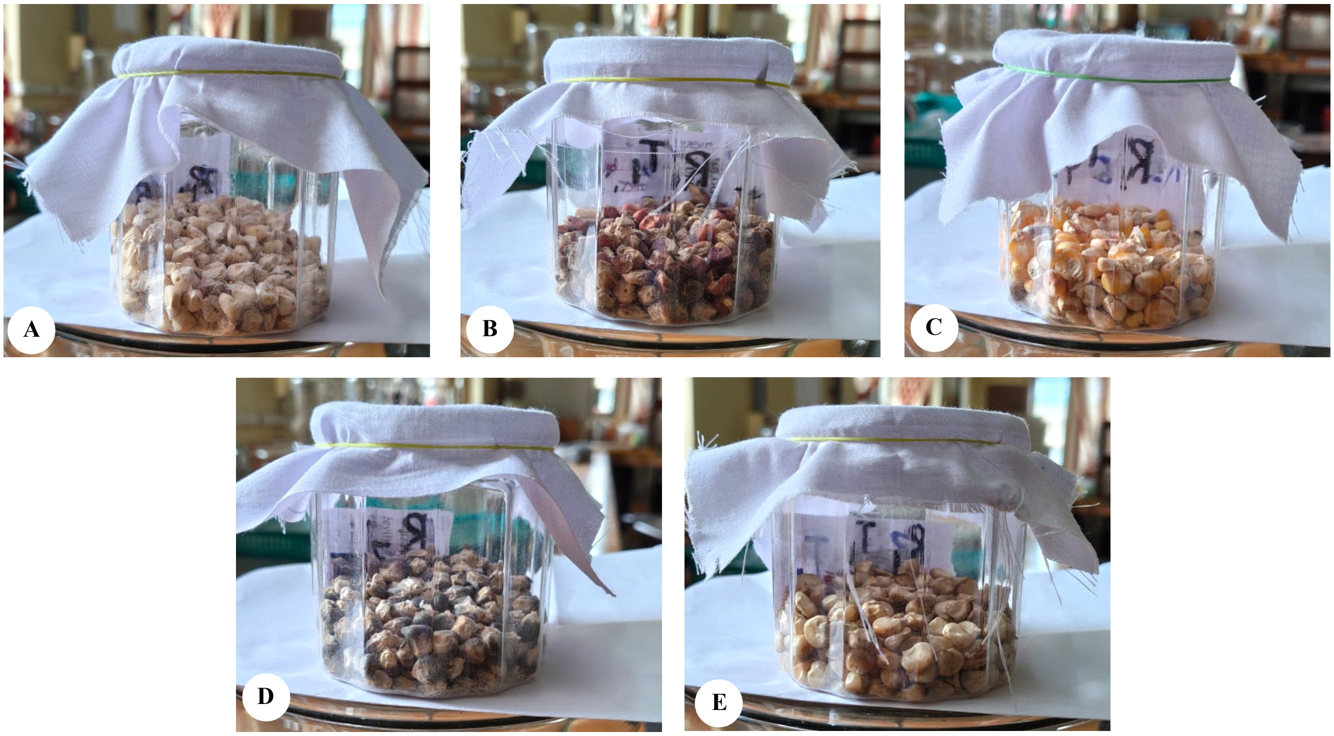

Figure 1(A-E). Food preference of common varieties of maize by *Sitophilus* spp., (A)- White Local, (B)- LMC-19, (C)- LMC-9, (D)- Chakhao Chujak, (E)- Mizo Local

Figure 2. Susceptible maize variety Chakhao chujak by *Sitophilus* spp.

Figure 3. Resistance maize variety Mizo Local by *Sitophilus* spp.

9 (T1) with 4.5%, while Mizo Local (T4) showed the lowest seed loss of 3.62%, indicating its strong resistance to the pest (Table 1. These results showed that Chakhao Chujak was found to be the most susceptible variety, whereas Mizo Local was found to be the most resistant among the varieties studied to the pest in term of loss to maize seeds among the varieties evaluated. The variations in the susceptibility of five maize genotypes given on the experiment may be due to the innate capacity of the maize variety to defend itself against *S. zeamais* attack. The findings are in close agreement with Baimaiyi *et al.* (2007) and Keba *et al.* (2020), who reported that grain hardness and kernel density are primary determinants of resistance, as these features hinder adult weevil penetration

Table 1. Food preference of common varieties of maize by *Sitophilus* spp.

Treatment	Variety/Genotype	Percent seed loss (%)	Percent weight loss (%)
T1	LMC-9	4.5 (2.13)	2.28(1.51)
T2	LMC-19	12.80(3.58)	4.47(2.11)
T3	Chakhao chujak	34.40(5.87)	10.43(3.23)
T4	Mizo local	3.62(1.90)	1.17(1.08)
T5	White local	8.67(2.95)	3.72(1.93)
SEm	1.09	0.45	
CD 5%	3.28	1.38	

Values in brackets are square root transformed values

and larval development within the grain. Similarly, Ranson (2000) noted that soft, starchy grain types are generally more prone to weevil damage than harder, flint types due to ease of boring and higher carbohydrate availability for larval nutrition. Physical factors such as pericarp thickness, grain hardness, and kernel texture play vital roles in deterring oviposition and restricting larval entry (Tefera *et al.*, 2011; García-Lara *et al.,* 2019). The hard and flint-type kernels typical of resistant varieties like Mizo Local likely provided mechanical resistance to feeding and development, resulting in reduced seed damage. In contrast, Chakhao Chujak's softer, starch-rich endosperm may have facilitated oviposition and larval tunneling, leading to higher seed damage. In addition to physical traits high protein content and lower starch concentration are associated with reduced palatability and feeding preference, as reported by Basyal *et al.* (2022) and Derera *et al.* (2001). Keba *et al.* (2020) and Girma *et al.* (2021) also found significant variation in maize genotype susceptibility, attributing resistance to a combination of grain hardness, low moisture content, and high phenolic concentration. Overall, the present study's results support these findings, indicating that varietal resistance to *Sitophilus* spp. is a multifactorial trait governed by structural integrity, kernel density, and biochemical constituents. The strong resistance of Mizo Local may therefore be due to a combination of harder kernel texture, thicker pericarp, and elevated phenolic content, whereas Chakhao Chujak's soft texture and higher carbohydrate levels may have enhanced its susceptibility.

Extent of weight loss

The percent seed weight loss caused by *Sitophilus* sp. on tested maize varieties showed that none of the varieties were completely resistant to infestation, with varying losses recorded over a 45-day storage period. The variety Chakhao Chujak (T3) recorded the highest seed weight loss of 10.43%, followed by LMC-19 (T2) with 4.47%, White Local (T5) with 3.72%, and LMC-9 (T1) with 2.28%, while Mizo Local (T4) recorded the lowest loss of 1.17%. Based on both percent seed loss and weight loss, Chakhao Chujak emerged as the most susceptible and preferred variety for *Sitophilus* sp. while Mizo Local showed the greatest resistance. The susceptibility ranking of the varieties was: Chakhao Chujak > LMC-19 > White Local > LMC-9 > Mizo Local, leading to the selection of Chakhao Chujak for further studies in the present research. These findings are consistent with those of Tiwari *et al.* (2020), who reported maximum weight loss in sweetcorn, likely due to its higher starch and sugar content, which enhances palatability and larval development of *Sitophilus zeamais*. Similar observations were made by Arnason *et al.* (2004), who noted an inverse relationship between protein concentration and susceptibility, suggesting that genotypes with higher protein and secondary metabolites are less preferred by storage weevils. Furthermore, Baimaiyi *et al.* (1999) emphasized that grain hardness and pericarp thickness are critical resistance factors, as they restrict oviposition and larval penetration, whereas other researchers have considered parameters such as grain weight, insect population, and kernel infestation to evaluate maize variety resistance to storage pests (Pareek *et al.*, 1977; Bernardo, 1972). Recent studies further support these findings where Basyal *et al.* (2022) and Jallow and Pitan (2022) observed that maize varieties with flint endosperms and elevated phenolic levels exhibited slower weevil development and reduced F_1 progeny emergence. Similarly, López-Castillo *et al.* (2023) demonstrated that Mexican maize races with dense, hard kernels and high antioxidant activity suffered significantly lower weight losses compared to softer-grained varieties. These collective results indicate that physical grain hardness, biochemical composition, and nutritional content are the principal mechanisms conferring resistance to *S. zeamais* in maize.

Thus, the resistance displayed by Mizo Local in the present study could be attributed to a combination of higher kernel hardness, thicker pericarp, and possibly elevated phenolic content, which together create unfavourable conditions for oviposition and larval development. Conversely, the greater susceptibility of

Chakhao Chujak may be associated with its softer, starch-rich endosperm, providing a more conducive substrate for *Sitophilus* infestation and growth.

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Conclusion

This study clearly demonstrates that maize variety plays a crucial role in determining susceptibility to *Sitophilus* spp. infestation during storage. Chakhao Chujak, which recorded the highest seed and weight losses, is the most susceptible, while Mizo Local exhibits strong resistance, making it a promising choice for storage in pest-prone regions. The findings highlight the importance of varietal selection as an eco-friendly, cost-effective approach to integrated pest management, reducing dependence on synthetic insecticides.

Future storage strategies should prioritize resistant varieties like Mizo Local, while susceptible ones like Chakhao Chujak may require additional protection measures such as botanical grain protectants or improved storage structures. Incorporating resistant genotypes into breeding programs can further enhance sustainable maize production and storage.

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