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Susceptibility of Three Local Sorghum Varieties to *Sitophilus zeamais* Motschulsky [Coleoptera: Curculionidae]

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ABSTRACT

Investigations were carried out to determine the most susceptible variety among three local sorghum cultivars, namely Fara-fara, Kaura and Lale, to Sitophilus zeamais Motsch. Physical parameters (length, width and moisture content) of each of the sorghum varieties were determined before introduction of the adult weevils for the susceptibility test. Adult emergence and grain damage were also evaluated. Results of this study showed that Lale had the highest (0.75cm) grain length while Fara-fara had the least (0.63cm). Statistically, there was no significant (p<0.05) difference between the grain length of the three local sorghum varieties. It was found that Lale had the highest (1.10cm) mean grain width, while the least (0.73cm) was recorded from Kaura. The results show that there was a significant (p<0.05) difference between the grain width of the three local sorghum varieties. Lale variety had the highest (7.4%) moisture content, while Fara-fara had the lowest (7.1%). highest (268.25) adult emergence was obtained from Fara-fara variety, while the least (113.50) was from Kaura local variety. highest (15.71%) grain damage was observed in Fara-fara, while the least (8.47%) was from Kaura. The sorghum grain damage caused by S. zeamais on the three different was significantly (P<0.05) different. The findings of this study have shown that all the three sorghum local varieties were susceptible to S. zeamais, and Fara-fara was the most susceptible variety to S. zeamais among the tested varieties. Susceptibility test of the three sorghum local varieties against other insect pests of storage is hereby recommended.

Key words: Grain damage, Emergence, Local sorghum varieties, *Sitophilus zeamais*, Susceptibility,

INTRODUCTION

Sorghum is the world's 5th most important cereal in terms of both production and area planted. Roughly 90% of the world's sorghum lie in the developing countries mainly in Africa and Asia. Sorghum is widely grown for food and as a feed grain, sorghum constitutes major source of calories and protein for millions of people in Africa and Asia [1].

Storage is an important act which enhances marketing efficiency by providing utility [2]. Storage is particularly important in agricultural commodities are more evenly spread throughout the year.Nigeria is losing about 2.4 billion tons yearly to poor harvest and storage facilities [3]. The losses were mainly in maize, sorghum, millet, rice, cowpea, groundnut, soya beans, yam and cassava.One of the major problems associated with the utilization and storage of sorghum is the attack by insect pests especially the maize weevils, *Sitophilus zeamais* Motschusky.

S. zeamais is a cosmopolitan pest of sound and whole grains in the tropics and temperate regions of the world. It is a primary pest that attacks other corps such as maize, rice groundnut, cowpea, millet, dry yam products, dry cassava, cocoyam, etc, in Nigeria [4]. Adults of this weevil live from several months to one year. The maize weevil is a small beetle which varies in size with characteristic rostrum which serves as part of the mouthparts. It varies from dull red-brown to nearly black and is usually marked on the back with four light reddish or yellowish spots. The maize weevil has fully developed wings beneath its wing covers and can fly readily. The thorax is densely pitted with somewhat irregularly shaped punctures, except for a smooth narrow strip extending down the middle of the dorsal side [5].

The insect damages are ranging from 5 – 30% of the world's total agricultural production [6]. Infestation by *S. zeamais* often starts a few weeks before crop harvest in the field and may spread to storage facilities [7].It is not yet possible to give accurate figures of the losses either in weight or quality caused by insects during storage. In sorghum, the losses incurred through insect damage in store, is estimated to be in the region of 35% of total production [8]. During storage, apart from the percentage losses incurred by the insect pests, they also render large quantities of grains useless by contaminating them with their droppings, webs and odours [9, 10]. Significant losses in grain, both quantitative and qualitative occur during storage. These include loss in weight of 4.03 – 65.77% [11], nutritional, organoleptic, and aesthetic quality of the stored grains [12]. The losses may also be biological [13], with loss as high as 10 – 46.67% have been reported as germination loss [11].

MATERIALS AND METHODS

Mass Rearing of *S. zeamais*
Infested maize grains with *S. zeamais* were obtained from Katsina Central Market. Adults of *S. zeamais* were sieved out from the infested maize grains using a 2 mm stainless steel laboratory sieve and the culture was established on a known weevil susceptible local sorghum variety (*Doguwa*). To each of five 50 cm^3 plastic rearing bottles, 250 g of *Doguwa* sorghum grains was placed and then 50 pairs of adult *S. zeamais* were introduced. The bottles were covered with muslin cloth and held in place with rubber band and kept in the laboratory for two weeks to allow oviposition. The adult weevils were later sieved out and allowed the sorghum grains to stay under laboratory conditions until the emergence of adult weevils which were used for the experiment.

Determination of Physical Parameters of the Grain
Length and width: The length and width of 10 randomly selected from each sorghum variety were individually measured using a Vernier caliper.

Moisture content: Moisture content of each sorghum variety was determined by weighing 10 g from each variety and drying in an oven at 120ºC for 2 hours, after which they were removed and re-weighed, this continued until a constant value was obtained and expressed mathematically as:

$$MC = \frac{Y - Z}{Y} \times 100$$

Where: Y = Initial Weight
Z = Final Weight
MC = % Moisture Content on Wet Basis

Determination of Adult Emergence
Four replicates of 50 g of grains of each sorghum variety were placed in separate transparent plastic containers covered with muslin cloth. 50 pairs of newly emerged adults of *S. zeamais* were introduced into each of the 50 g of sorghum variety, and arranged in a completely randomized design (CRD). The weevils were allowed to oviposit for 2 weeks after which they were removed. The experimental containers were left undisturbed on the laboratory table until the emergence of the F1 Generation. The emerged adult weevils were allowed to feed from the sorghum grain for another 1 week, after which the emerged adults from each plastic bottle were counted and recorded.

Assessment of Grain Damage
The level of damage caused by *S. zeamais* on the three sorghum cultivars was evaluated from the same set-up. The adult weevils from each of the containers were sieved out and the grain was weighed again and recorded. The grain damage was determined by using the formula:

$$\% \text{ Grain Damage} = \frac{\text{Initial Grain Weight} - \text{Final Grain Weight}}{\text{Initial Grain Weight}} \times 100$$

Statistical Analysis

The data were subjected to analysis of variance (ANOVA) and means were separated using LSD at 5% level of significance (p<0.05).

RESULTS

The grain length of the three different sorghum varieties is shown in Table 1. The Table indicates that *Lale* had the highest (0.75 cm) grain length while *Fara-fara* had the least (0.63 cm). The mean grain length of *Kaura* was found to be 0.75cm. Statistically, there was no significant (p<0.05) difference between the grain length of the three local sorghum varieties.

Table 1 also shows the mean grain width of the three local sorghum varieties. It was found that *Lale* had the highest (1.10 cm) mean grain width, while the least (0.73 cm) was recorded from *Kaura*. *Fara-fara* had a mean grain width of 0.83 cm. The results show that there was a significant (p<0.05) difference between the grain width of the three local sorghum varieties.

Table 1: Sorghum Grain Physical Parameters

Sorghum Variety	Grain Length (cm) ± S.E	Grain Width (cm) ± S.E	Grain Moisture Content (Per cent) ± S.E
Fara-fara	0.63 ± 0.09	0.83 ± 0.09	7.10 ± 0.05
Kaura	0.73 ± 0.04	0.73 ± 0.09	7.20 ± 0.05
Lale	0.75 ± 0.05	1.10 ± 0.20	7.40 ± 0.05
CV (%)	4.74	6.51	0.39
LSD (5%)	ns	0.27	ns

ns = non significance

The grain moisture content is presented in Table 1. The Table indicates that *Lale* variety had the highest (7.4%) moisture content, while *Fara-fara* had the lowest (7.1%). The results also show that the moisture content was not significantly (p<0.05) different between the three sorghum varieties.

Table 2 shows adult emergence of *S. zeamais* from three different sorghum varieties. The Table indicates that the highest (268.25) adult emergence was obtained from *Fara-fara* variety, while the least (113.50) was from *Kaura* local variety. Adult emergence of 170.75 was recorded from *Lale* variety. The results also reveal that the adult emergence of *S. zeamais* from the three local varieties of sorghum was significantly (P<0.05) different.

The mean grain damage of the three sorghum varieties caused by *S. zeamais* is presented in Table 3. The table shows that the highest (15.71%) grain damage was observed in *Fara-fara*, while the least (8.47%) was from *Kaura.* Grain damage of 9.55% was recorded from *Lale.* The sorghum grain damage caused by *S. zeamais* on the three different was significantly (P<0.05) different.

Table 2: Adult Emergence of *S. zeamais* from Three Local Sorghum Varieties

Sorghum Variety	Amount of Grain Used (g/50 g)	Number of Weevils Introduced	Mean Number of Emerged Adults ± S.E.
Fara-fara	50	20	268.25 ± 3.25
Kaura	50	20	113. 50 ± 2.75
Lale	50	20	170.75 ± 1.75
CV (%)	_	_	0.60
LSD (5%)	_	_	4.50

Table 3: Grain Damage of Three Local Sorghum Varieties Caused by *S. zeamais*

Sorghum Variety	Amount of Grain Used (g/50 g)	Number of Weevils Introduced	Mean Grain Damage (Per cent) ± S.E.
Fara-fara	50	20	15.71 ± 2.06
Kaura	50	20	8.47 ± 0.90
Lale	50	20	9.55 ± 1.02
CV (%)	_	_	5.80
LSD (5%)	_	_	2.54

DISCUSSION

The present study shows that there was variation in response of *S. zeamais* to the three sorghum varieties. This could be due to the fact that the grain physical parameters were found to be different among the sorghum varieties. The findings indicated that *Lale* had the highest grain length, width and moisture content, while *Fara-fara* had the least grain length and moisture content. The physical parameters had great impact in response of *S. zeamais* to the grain varieties particularly on oviposition and/or egg hatch as suggested by [14]. These physical factors among others are most likely to be the contributory factors that affected the differences in the adult emergence of *S. zeamais* and grain damage that might be caused by the weevil in *Kaura* and *Lale*. However, *Fara-fara* had less grain length and moisture and supported more adult *S. zeamais* progeny while *Kaura* which had more grain length and moisture than *Fara-fara* supported less adult *S. zeamais* progeny. This confirms the findings of [4] who observed that there was no clear effect of physical characteristics of 15 maize varieties as an index of determining susceptibility or resistance to *S. zeamais* activity.

The findings of this study revealed that all the three local sorghum varieties were susceptible to *S. zeamais* infestation. This is because there was considerable emergence of adult *S. zeamais*. Mean number of F1 progenies emerged from the different sorghum varieties were considerably variable. The highest emergence of *S. zeamais* adults was recorded in *Fara-fara*, while the least adult emergence was observed in *Kaura*. This agrees with the findings of [15] who reported emergence of more adult *S. zeamais* from susceptible varieties, Fendisha-5(155) and Murya-1(138), while the least emergence was in WB-(20).

The grain damage caused by *S. zeamais* to the three local sorghum varieties was significantly ($p<0.05$) different. The higher grain damage observed in *Fara-fara* 42 days after introduction of the weevils could be attributed to the higher number of adult progeny that developed in this variety, thus indicating a greater preference of such variety by *S. zeamais* as suitable substrate for development. This is in agreement with findings of [16] who reported higher weight loss in local maize varieties than the improved varieties after a period of 35 days of the experiment. Similarly, [15] reported higher (24.33) sorghum grain damage in Fendisha-5 which had higher (155) F1 progeny emergence of *S. zeamais*. Findings of this study also indicated that increase in moisture did not increase grain damage. This is not in accordance to the findings of [17] who reported that high moisture content increases activities of biotic agents, thus increasing loss in storage. Similarly, [4] reported that the highest percentage moisture content was recorded on Oba super-1 which supported significantly more adult *S. zeamais* progeny and highest weight loss.

CONCLUSION

The findings of this study have shown that all the three sorghum local varieties were susceptible to *S. zeamais.* However, *Kaura* was less susceptible as it gave less adult emergence of *S. zeamais* as well as less grain damage than *Fara-fara* and *Lale* six weeks after introduction. It has also been observed that more adults of *S. zeamais* emerged from *Fara-fara,* and also there was more damage to the variety than the other two. Therefore, *Fara-fara* was the most susceptible variety to *S. zeamais* among the tested varieties.

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