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Short Communication

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Assessment of resistant varieties of maize against *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) in laboratory conditions

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ABSTRACT

Grains of five different maize varieties (MMRI Yellow, Pearl White, Malka-2016, YH-1898 and Sadaf) were evaluated for their comparative resistance to *Tribolium castaneum* under laboratory conditions (30+2°C and 70+5 R.H). Data of percent mortality were taken after 30, 60 and 90 days. Significantly, the maximum mortality of adults was observed in MMRI Yellow (28.57%, 33.67% and 41.61%) in sound seeds and lowest mortality was noted in Sadaf (14.88, 21.33% and 24.99%) during observation period. The seed germination was highest in MMRI Yellow which was 90% while lowest was noted in Sadaf as 50%. The highest protein contents were recorded in Malka-2016 (12.83% and 11.60%) and lowest in YH-1898 (3.90% and 2.50%) in both sound and cracked seeds. However, maximum fiber contents were observed in Malka-2106 (2.76% and 2.16%), while lowest (0.43% and 0.30%) in YH-1898 for both seed types. Consequently, MMRI Yellow variety was proved to be resistance as compared to other varieties with maximum germination. It can be concluded that resistant varieties of maize could be utilized in breeding program to reduce the post-harvest losses of grains.

KEYWORDS: Maize varieties, resistance, *Tribolium castaneum*, germination

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INTRODUCTION

In between the different cereal crops, maize is an important cereal crop which is grown in all over the world. In Pakistan, maize is the 4th largest cultivated crop after cotton, rice and wheat [1]. The chemical, physical and biochemical characteristics of maize play an important role in resistant against insect pests of stored product. The color, shape, moisture and protein contents as well as phenolic compounds in maize variety have been reported for resistance [2,3]. Differences in the amino acid profile, lipid, alkaloids and carbohydrate composition of plants are responsible for resistance or increased susceptibility to stored-product arthropods [4,5]. Various types of insect pests attacked on maize under storage conditions including *Sitophilus zeamais* and *Sitotroga cereallela*. However, population of pests can be reduce by use of resistant varieties as compared to varieties which are susceptible to store product pests [6].

Red flour beetle damage the most of the food products. Symptoms of infestation related to heated grains and become Pinkish color of food products at very high population densities [7]. The grubs attack on jute stacks which can infest the store products and 75% losses found in maize, sorghum and wheat grains, therefore crude fat, sugars, carbohydrates and proteins contents also decreased and increased moisture contents [8,9].

Increased numbers of pesticides application have developed resistance in insect pests and harmful for environment. Owing to resistance problems, alternative management strategies can be used which are environmental safety and no health concerns. The growing of resistance varieties may reduce the pest populations as well as environment safe from hazardous. Therefore, the present research was conducted to evaluate the resistant varieties of maize against *T. castaneum* under laboratory conditions and also check the nutritional losses by biochemical analysis of seeds.

MATERIALS AND METHODS

Collection and Rearing of Insects

Mixed population of *T. castaneum* was collected from different food storage departments located at various places in Muzaffargarh and from Faisalabad food grains market for rearing purpose under laboratory conditions. Three hundred adults were introduced into four (1-liter) jars with 500g of maize. The insects were allowed to oviposit for seven days after which they were sieved out. The opening on the jar lids was covered with muslin net. The F1 adults that emerged were introduced into other jars containing maize and the resulting F2 adults were then used for the various experiments. Rearing conditions were maintained at 30+2°C and 70+5 R.H in the laboratory.

Tested Varieties

Five maize varieties (MMRI Yellow, Pearl White, Malka-2016, YH-1898 and Sadaf) were used in the experiment. These varieties were collected from Maize and Millets Research Institute, Yusafwala, Sahiwal. The experiment was laid out in Completely Randomized Design (CRD) in Grain Research Training and Storage Management Cell, Department of Entomology, University of Agriculture Faisalabad.

Determination of resistance maize varieties against *T. castaneum*

Five maize genotypes seeds samples were used to determination of resistance and each genotype were kept in large mouth jars and 30 insects were released in jar for free choice feeding and oviposition [10].

Biochemical analysis of seeds to test the nutritional losses

Nutritional changes of the infested flour induced by infestation of *T. castaneum*, were studied for crude protein and crude fiber contents using ICC and AACC methods [11].

Viability of germination effect

The resistant seeds of each variety were sown in petri dishes in each replication under laboratory conditions. Germination of these seeds was checked after one week of sowing.

Statistical analysis

The percent mortality data was subjected to analysis of variance in Analytical software, "Statistix v8.1 [12]. The means of significant treatments was compared using Tukey's HSD test at $\alpha = 5$ [13].

RESULTS

The present studies were conducted to determine the resistance variety and percentage mortality of T. castaneum in five maize varieties (MMRI Yellow, Pearl White, Malka-2016, YH-1898 and Sadaf). The maximum mortality of *T. castaneum* was observed in MMRI Yellow variety as compared to other tested varieties. The maximum mortality was recorded in MMRI Yellow sound seeds (41.61%) and cracked seeds (29.13%). However, lowest insect mortality was observed in Sadaf variety (24.99% and 18.96%) in sound and cracked seeds (Table 1). Similar trends were observed in both sounds and cracked seeds after 30, 60 and 90 days intervals. Among all the maize varieties, MMRI Yellow showed resistance against the *T. castaneum* at different intervals.

Mean comparison data of protein contents in seed type show significant results in Table 2. The maximum protein contents were noted in sound seeds while the lowest protein contents were noted in cracked seeds. The maximum protein contents were shown in Malka-2016 (12.83%) in sound seeds whereas lowest protein contents were noted in YH-1898 (2.50%) in cracked seeds.

However, data of fiber contents in seed type show significant results with maximum fiber contents were noted in sound seeds, Malka-2016 (2.76%) while the lowest fiber contents was observed in YH-1898 (0.30%) for cracked seeds (Table 2).

The percent germination of maize varieties affected by *T. castaneum*, the results showed that all the main effects of variety are significant. The maximum germination (90.33%) was noted in MMRI Yellow and the lowest germination (50.00%) was found in YH-1898 while 100% germination was noted in control (Fig. 1).

DISCUSSION

The present study was conducted to check the resistance/susceptibility of five maize varieties (MMRI Yellow, Pearl White, Malka-2016, YH-1898 and Sadaf) against *T. castaneum*. In the light of present investigations, the outcomes depicted that there was great variation in mortality of tested insects and significant difference was observed in all tested varieties. Our outcomes showed that maximum mortality was observed in MMRI Yellow and YH-1898 against tested insects. While minimum mortality was observed in Pearl White and Sadaf.

However, highest mortality rate of *T. castaneum* was (31.40%) in sound seeds for MMRI Yellow variety, whereas lowest mortality was noted in Sadaf (13.89%), the insect was *T. castaneum*.

The present outcomes were also supported by Sarwar [14]. Similar results were obtained by Nisar [15] who reported that Angoumois grain moth and S. cerealella were susceptible against the different wheat varieties.

Similar findings observed by Suleiman *et al.* [16] in corn. The present study supported by Muzemu *et al.* [17] who observed that ZM421 and ZM521 varieties showed potential to *S. zeamais* progeny suppression and tolerance as evidenced by high parent weevil mortality, low weevil emergence, less grain weight loss, low grain damage and high germination percentage.

Table 1: Mean (±SE) comparison of data regarding % mortality of *T. castaneum* by the interaction of different maize varieties and seed types after 30, 60 and 90 days intervals

Variety	Mean (±SE) mortality after 30 days		Mean (±SE) mortality after 60 days		Mean (±SE) mortality after 90 days	
	Sound seeds	Cracked seeds	Sound seeds	Cracked seeds	Sound seeds	Cracked seeds
MMRI Yellow	28.57+1.40^{a}	12.17+1.43^{b}	33.67+2.11^{a}	16.40+2.01^{c}	41.61+1.49^{a}	29.13+1.32^{ab}
Pearl White	18.6+1.49^{c}	12.12+2.20^{b}	20.70+1.06^{ab}	15.93+1.21^{c}	28.28+1.27^{abc}	18.87+0.13^{e}
Malka-2016	12.08+2.09^{b}	13.38+3.96^{b}	18.23+1.79^{c}	13.53+2.95^{c}	20.78+1.68^{de}	18.37+2.32^{e}
YH-1898	16.28+2.67^{b}	19.43+1.79^{ab}	21.54+0.89^{cde}	20.35+4.82^{bc}	30.83+2.27^{ab}	26.54+1.0^{bcd}
Sadaf	14.88+1.60^{c}	12.91+1.96^{c}	21.33+0.67^{ab}	18.96+0.34^{e}	24.99+1.28^{bcde}	19.05+2.84^{ab}

Table 2: Effect of *T. castaneum* on protein contents and fiber contents in seed type of maize varieties

Variety	Protein contents		Fiber contents	
	Sound seeds	Cracked seeds	Sound seeds	Cracked seeds
MMRI Yellow	4.40+0.25^{d}	4.00+0.17^{de}	0.66+0.08^{cf}	0.36+0.08^{f}
Pearl White	8.93+0.12^{b}	7.43+0.49^{bc}	1.46+0.08^{de}	1.00+0.05^{ce}
Malka-2016	12.83+0.18^{a}	11.60+0.40^{a}	2.76+0.17^{a}	2.16+0.12^{b}
YH-1898	3.90+0.20^{de}	2.50+0.20^{e}	0.43+0.03^{f}	0.30+0.05^{f}
Sadaf	8.13+0.55^{bc}	7.10+0.20^{c}	1.90+0.11^{bd}	1.50+0.10^{de}

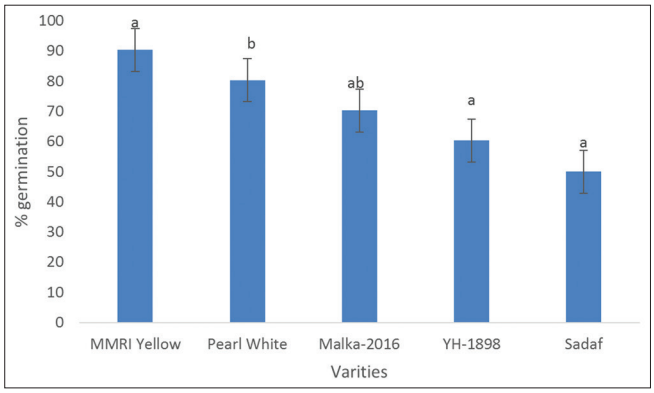

Fig 1. Germination (%) of different seeds of maize varieties

As indicated by our outcome revealed, germination was maximum in MMRI Yellow which was 90% while lowest germination was noted in Sadaf as 50%. Maximum protein contents were recorded in Malka-2016 (12.21%) and minimum in YH-1898 (3.20%). However, maximum fiber contents were observed in Malka-2106 (2.46%) and lowest (0.36%) in YH-1898.

CONCLUSION

It was concluded that maximum mortality was observed in MMRI Yellow and YH-1898 against tested insects. Mortality was noted minimum in Pearl White and Sadaf. Mortality of *T. castaneum* was maximum in sound seeds of MMRI Yellow and minimum mortality was noted in Sadaf. Therefore, present results revealed that MMRI Yellow maize variety proved to be resistant variety against the *T. castaneum*.

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