

Research Article



Population Fluctuation and Weight Losses Caused by Khapra Beetle, *Trogoderma granarium* Everts on Different Wheat Varieties

Shereen Zulfikar¹, Zulfikar Ahmed Maher², Attaullah Khan Pathan⁴, Imran Ali Rajput^{3*}, Din Muhammad Soomro¹, Muhammad Akbar Lashari¹, Arsalan Memon³, Sibghatullah⁵ and Mir Zehri Khan⁵

¹Department of Entomology, FCPT, SAU Tandojam, Pakistan; ²Information Technology Centre, SAU Tandojam, Pakistan; ³PARC-Arid Zone Research Institute, Umerkot, Pakistan; ⁴PARC-Southern Zone Agricultural Research Center, Karachi, Pakistan; ⁵Horticulture Research Institute, (BARDC) Pakistan Agricultural Research Council, Khuzdar, Balochistan, Pakistan.

Abstract | Khapra beetle, *Trogoderma granarium* is considered as a major threat to stored wheat and other products in all over the world. Their attack is not only limited to wheat grains but also reduces the various products made from it. The losses are defined as a measurable decrease of the food quantity and quality and can be avoided through proper control measures and selection of resistant varieties. During the present study, the different wheat varieties were screened against *T. granarium*. The initial weight of healthy grains of each variety was recorded properly. The losses caused by pests were categorized on the basis of grain weight loss (%), powder weight (mg) and population of pests emerged. In results, it was observed that the attack of *T. granarium* was present more or less on all wheat varieties. However, the performance of Marvi and Mehran varieties was found to be resistant against *T. granarium* and thus recommended for future plantations. The present study will be useful to provide the information for controlling *T. granarium* on wheat.

Received | May 28, 2020; **Accepted** | August 21, 2020; **Published** | October 06, 2020

***Correspondence** | Imran Ali Rajput, PARC-Arid Zone Research Institute, Umerkot, Pakistan; **Email:** ranaimran234@gmail.com

Citation | Zulfikar, S., Z.A. Mahar, A.K. Pathan, I.A. Rajput, D.M. Soomro, M.A. Lashari, A. Memon, Sibghatullah and M.Z. Khan. 2020. Population fluctuation and weight losses caused by khapra beetle, *Trogoderma granarium* everts on different wheat varieties. *Pakistan Journal of Agricultural Research*, 33(4): 744-747.

DOI | <http://dx.doi.org/10.17582/journal.pjar/2020/33.4.744.747>

Keywords | Wheat, *Trogoderma granarium*, Varietal preference, Grain, Storage losses

Introduction

Wheat *Triticum aestivum* L. is one the major source of human diet. In Pakistan, it is generally estimated that approximately 65-75% of total wheat production is stored at the farms. During storage, grains face the serious attack of various stored grain insect pests. They do not only attack the grains but also on their by-products and cause reduce the grain weight and their quality (Abro, 1996). In insect pests, the *Trogoderma granarium* is one of the world's most dangerous pest of wheat products and seeds. It belongs to order Coleoptera and probably originated from various regions including Pakistan, India, and Bangladesh. Although, it is a cosmopolitan insect

pest but mostly founds in the warm and dry regions. Except wheat, it is also primary pest of maize, sorghum, gram pulses and dried fruits (Arivudainambi and Singh, 2003). The larvae of khapra beetle have much tolerance to survive in adverse conditions i.e. up to 44 °C and 2% moisture and may survive for several months without food and due to this behavior, *T. granarium* is difficult to eradicate (Khattak et al., 1995; Chaudhary and Mahla, 2010; Jha, 2013). However, adults may live for short time period about 1-3 weeks. Unlike other beetles, its adult is harmless and only larvae damage grains. This species is considered a dirty feeder, breaking or powdering more kernels that it consumes. The attack is generally at the embryonic point but later when infestation becomes severe, other

parts of the grains are also badly damaged.

In USA barley about 300 tones, in southeastern Turkey 30 tones grains and in Turkey average 20-30% grain losses are reported due to *T. granarium*, Mahla (2001). The economic importance and infestation by Khapra beetle in stored grains also reported from the Asian and European countries (Malathi and Singh, 2001). Keeping of above points in view, an experiment was conducted on population fluctuation and damage caused by *T. granarium* in various varieties of wheat under laboratory conditions. It is expected that the results of the present study will be helpful to screening the wheat varieties against this noxious store grain pest.

Materials and Methods

The culture of *T. granarium* was obtained from Grain Storage Research Laboratory, Tropical Agriculture Research Institute, Karachi University. Eight different varieties of *Triticum aestivum* L. were evaluated for susceptibility to *T. granarium* at Department of Entomology, Sindh Agriculture University, Tando Jam during 15th July to 25th Nov. 2019. At preparatory stage of the experiment, the healthy grains of each variety were weighed. The samples of these wheat varieties were obtained from two different institutes i.e. Wheat Research Institute Sakrand and Nuclear Institute of Agriculture (NIA) Tandojam. The obtained varieties were Mehran, TJ-83, Bhitai, Sarsabz, Inqlab, Abadgar, Marvi and Kiran and the standard weight of sample of each variety used in the experiment was 100 g and kept in 500 g (capacity) plastic jars covered with muslin cloth and banded with rubber strips. In each plastic jar ten couple of adult *T. granarium* beetles with same age were shifted. Observations regarding pest population fluctuations were recorded regularly from the beginning of experiment on fortnightly basis by counting their numbers. Furthermore, other parameters to know relative susceptibility of wheat varieties to pest infestation i.e. (a) % grain infestation (b) weight of powder and (c) adult and grub population were recorded at the execution of experimental period. The experiment was laid out in a Randomized Complete Design (CRD) with four replications. The collected data were statistically analyzed through statistical software STAT. 0.8.

Results and Discussion

The results in Table 1 showed that all the selected

varieties infested significantly different ($p < 0.05$). All the trialed varieties were varied in their total number of grains present in 100 g of the sample. Maximum numbers of grains (1936) were counted in Mehran variety and the minimum (1136) in Marvi variety. The numbers of the maximum healthy grains 1619 were counted in Mehran variety and the minimum (1032) in Marvi variety. In this regard, the lowest numbers of damaged grains 104.3 were recorded in Marvi and the highest 407.7 were in Sarsabz variety. The results of percent infestation showed significantly difference ($P < 0.05$) between all wheat varieties and maximum percent infestation was recorded in Sarsabz (24.67%) followed by Bhitai (23.07%), and maximum powder material was recorded in variety Sarsabz with 0.648g followed by Bhitai 0.584 g. The lowest amount of powder was recorded in Marvi as compared to other wheat varieties. These results showed that Marvi and Mehran were the most resistance varieties than other wheat varieties.

Table 1: Comparisons of different parameters due to infestation by *T. granarium* on different wheat varieties.

| Varie-ties | Total number of grains | No. of healthy grains | No. of damaged grains | Percent infesta-tion | Powder weight |
|------------|------------------------|-----------------------|-----------------------|----------------------|---------------|
| Marvi | 1136 d | 1032 e | 104.3 c | 9.18 e | 0.1173 e |
| Mehran | 1936 a | 1619 a | 313.0 bc | 16.16 d | 0.4034 b |
| Sarsabz | 1652 b | 1245 bc | 407.7 a | 24.67 a | 0.6480 a |
| Abadgar | 1434 bc | 1118 cd | 316.3 bc | 22.04 b | 0.5343 c |
| Bhitai | 1547 c | 1190 cd | 357.3 b | 23.07 ab | 0.5843 c |
| Kiran | 1347 bc | 1068 de | 279.3 c | 20.71 c | 0.4907 d |
| TJ-83 | 1420 c | 1361 b | 259.7 c | 18.24 cd | 0.4410 e |
| Inqlab | 1627 b | 1265 c | 362.7 b | 22.29 ab | 0.5349 d |
| LSD | 234.3 | 189.7 | 174.3 | 8.335 | 0.0676 |

Table 2: Mean population of grubs and adults *T. granarium* in different wheat varieties.

| Varieties | Total number of grubs | Total number of adults | Pooled Mean |
|-----------|-----------------------|------------------------|-------------|
| Marvi | 31.01±0.16e | 3.89±0.07c | 17.44 |
| Mehran | 35.61±0.45e | 4.15±0.15c | 19.87 |
| Sarsabz | 116.41±1.87a | 11.65±0.83a | 64.02 |
| Abadgar | 63.62±1.21cd | 7.75±0.15b | 35.67 |
| Bhitai | 86.13±1.10b | 7.56±0.23b | 46.83 |
| Kiran | 44.71±0.34d | 3.88±0.07c | 24.29 |
| TJ-83 | 38.21±0.12de | 4.48±0.19c | 21.34 |
| Inqlab | 68.12±0.84c | 6.2±0.05bc | 37.15 |
| Mean±S.E | 60.47±0.77a | 6.19±0.30b | |

The least population of *T. granarium* was recorded in Marvi variety with 17.44, Mehran 19.87 and TJ-83 21.34. The lowest population emergence of grubs was recorded 31.01 ± 0.16 in Marvi and maximum 116.41 ± 1.87 in Sarsabz. A lowest number of adults were recorded in Kiran with 3.88 ± 0.07 and the highest were in Sarsabz with 11.65 ± 0.83 . The number of grubs was recorded higher than adults (Table 2).

The present findings showed that all the varieties of wheat expressed more or less resistance against *T. granarium*. The difference among the cultivars for different parameters is also supported with previous finding by Simwat and Chahal (1982). Randolph *et al.* (2005) conducted an experiment in laboratory to categorize resistance in the wheat cultivars and found similar response of different response of wheat cultivars against *T. granarium*. Sharma (2002) studied the response of different wheat varieties against *T. granarium* and found some wheat varieties showed susceptible and found some immune varieties. The present results revealed that the maximum numbers of healthy grains were counted in Mehran and the minimum in Marvi variety. The results of percent infestation showed that the highest grain percent of infestation and powder material were recorded in Sarsabz and the lowest in Marvi variety as compared to other wheat varieties. This is proved that Marvi and Mehran varieties are most resistant than other wheat varieties. The results are in agreement of various researchers such as Mahela and Ameeta (2001) who investigated the infestation and weight loss in store grains by *T. granarium*. Abundance of pest population is recorded at most of places as Mordkovich *et al.* (2000) reported that of Khapra beetle, *T. granarium* was recorded in grains, grain products, parcels with seeds, commercial products, packaging materials and warehouses. Similarly, Khattak *et al.* (2000) reported that the attack of pest reduces the protein, ash, fiber and fats from the stored grains. Various experiments concerning performance of wheat genotypes has been conducted in Pakistan by Saima and Muhammad (2000), Ali *et al.* (2009) and Sarwar *et al.* (2012, 2013) observed that variability in various wheat varieties which turned out to be resistant or vulnerable against store grain pests. Mebarkia *et al.* (2010) reported that lower resistance genotypes to various stored grain pests to grain pest attacks may be recognized low and high content of carbohydrate and protein.

Conclusions and Recommendations

It is concluded that wheat varieties Sarsabz and Bhattai were observed as most vulnerable varieties which could be infested heavily by *T. granarium* however Marvi and Mehran varieties were observed as resistant varieties. It is suggested that resistant varieties could be encouraged for further multiplication and storage.

Novelty Statement

The performance of Marvi and Mehran wheat varieties are found to be resistant against *T. granarium* and thus recommended for future plantations.

Author's Contribution

S. Zulfikar and Z.A. Mahar conceived the idea data collection and overall management of the article, A.K. Pathan provided the culture of Khapra beetle, I.A. Rajput data analysis and wrote paper, D.M. Soomro Technical support during study, M.A. Lashari Plegiarism and revised manuscript, A. Memon, Sibghatullah and M.Z. Khan Manuscript setting.

Conflict of interest

The authors have declared no conflict of interest.

References

- Abro, G.H., 1996. Relative resistance of commercially grown varieties of different cereals to *Tribolium castaneum* (Herbst) attack. Pak. J. Zool., 28: 39-44.
- Ali, A., M. Sarwar, S. Khanzada and G.H. Abro. 2009. Reaction of certain wheat varieties to the action of red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera) under insectary conditions. Pak. J. Zool., 41(1): 51-56.
- Arivudainambi, N.M. and R.P. Singh. 2003. Fumigant toxicity of neem (*Azadirachta indica*, A. Juss) seed oil volatiles against Khapra beetle, *Trogoderma granarium*. Annals. Plant Prot. Sci., 11(2): 207-211.
- Chaudhary, S.D. and J.C. Mahla. 2001. Insect-pests infesting stored wheat in different climatic regions of Haryana. Crop. Res. Hisar., 21(2): 384-386.
- Jha, A.N., 2003. Feeding propensity of *Ephestia cautella* and *Trogoderma granarium* to eighteen cultivars of wheat. Ind. J. Entomol., 65(2): 228-

232.

- Khattak, S.U., H. Mohammad, S. Abdul and A.U. Khan. 1995. Screening of new wheat genotypes against Khapra beetle, *Trogoderma granarium* Everts. Proc. Pak. Cong. Zool., 15: 87-93.
- Khattak, K., S. Kamal, Karimullah, S. Ahmad, A. Khan and A. Jabbar. 2000. Appraisal of rainfed wheat lines against Khapra beetle, *Trogoderma granarium* Everts. Pak. J. Zool., 32(2): 131-134.
- Mahla, J.C., 2001. Population dynamics of storage pests and their incidence in wheat grain under different climatic zones of Haryana. Annals. Agric. Biol. Res., 6(2): 151-154.
- Mahla, M.K. and O.P. Ameta. 2001. Grain infestation in stored wheat in arid zone of Rajasthan. Insect. Environ., 7(3): 127-128.
- Malathi, S. and V.S. Singh. 2001. Combining ability of certain wheat varieties for resistance to khapra beetle, *Trogoderma granarium*. Ind. J. Entomol., 63(3): 317-321.
- Mebarkia, A., A. Guechi, S. Mekhalif and M. Makhlof. 2010. Biochemical composition effect of some cereal species on the behaviour of *Sitophilus granarius* L. and *Rhyzopertha dominica* F. species in semi-arid zone of Setif, Algeria. J. Agron., 4: 1-7. <https://doi.org/10.3923/ja.2009.60.66>
- Mordkovich., B. Ya and E.A. Sokolov. 2000. Detection of Khapra beetle in warehouses. Zashchit. Karantin Rastenii., 12: 26-27.
- Randolph, T.L., F.B. Peairs, K. MichaeL, C.B. Walker, J.R. Stubbs, J.S. Quick and S.D. Haley. 2005. Yield response and categories of resistance to Russian wheat aphid in four Dn4 hard red winter wheat cultivars. J. Econ. Ent., 98: 588-594. <https://doi.org/10.1093/jee/98.2.588>
- Saima, J. and A. Muhammad. 2000. Screening of different wheat cultivars (flour) against the attack of *Tribolium castaneum* Herbst (Coleoptera: Tenebrionidae) under laboratory Conditions. Pak. J. Biol. Sci., 3(12): 2256-2259. <https://doi.org/10.3923/pjbs.2000.2256.2259>
- Sarwar, M., M. Ashfaq and M.A.M. Randhawa. 2013. Assessing the potential of assorted plant powders on survival of grain mite wheat grain. Int. J. Agric. Sci. Biores. Eng. Res., 2(1): 1-6.
- Sarwar, M., N. Ahmad, M. Bux and M. Tofique. 2012. Potential of plant materials for the management of cowpea *Callosobruchus analis* (Coleoptera: Bruchidae) in gram during Storage. Nuclear, 49 (1): 61-64.
- Sharma, V.K., 2002. Susceptibility of wheat germplasms to stored grain pests. Ind. J. Entomol., 15: 1-11.
- Simwat, K.S. and B.S. Chahal. 1982. Effect of different levels of initial infestation of *Sitophilus oryzae* (L), *Trogoderma granarium* (Everst) and *Tribolium castaneum* (Herbst) on their population build up and resultant loss to wheat. Ind. J. Ecol., 8: 74-81.