



BIOLOGY OF KHAPRA BEETLE *TROGODERMA GRANARIUM* ON WHEAT VARIETIES

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ABSTRACT

Khapra beetle *Trogoderma granarium* is a destructive and voracious feeder of several stored products such as wheat, maize and rice, and it is a quarantine pest for wheat producing countries like Pakistan. The present study evaluated its biological and morphological parameters on different wheat varieties. The results revealed that its incubation period was varied from 7.01-8.91 days, being longest on the variety Faisalabad-08, and shortest on Sehar-06. Its total developmental period from egg-adult varied from 48.44- 64.16 days, respectively; male and female longevity was 19.14, and 17.02 days on Sehar-06. The weight of 6th instar larvae ranged from 6.21 to 7.11 mg, while the survival was maximum and minimum on Sehar-06 and Faisalabad-08, respectively. The minimum and maximum weight losses were observed in Faisalabad-08 and Sehar-06, respectively. Thus, Sehar-06 was observed to be the most susceptible variety giving maximum fertility and fecundity.

Key words: *Triticum aestivum*, *Trogoderma granarium*, Dermestidae, varietal variations, biology, lifetable, hatchability, fecundity, survival

Wheat (*Triticum aestivum* L.) is the most significant staple food and it is cultivated at large scale in Pakistan. There are many biotic and abiotic factors which affect wheat and the major issue is the post-harvest losses caused by stored grain pests. Of these, the khapra beetle *Trogoderma granarium* is a serious pest. There are 115 species of *Trogoderma*, 12 of which are pests of stored grains (Singh et al., 2017; Seifi et al., 2015). In fact, *T. granarium* has been designated as an A2 quarantine pest and was named one of the 100 worst invasive species (Yadav and Srivastava, 2017). The larval stage is the most harmful, as it significantly reduces the value of stored grains (Ahmad et al., 2022; Honey et al., 2017; Shahbazi et al., 2022). The larvae consume the seed embryo before the entire kernel or seed, leaving behind only the husk; and it can significantly reduce the quality and quantity of stored goods and infests a wide range of raw grains and processed grain products. It has been described as a danger to world food security (Athanassiou et al., 2016; Kulkarni et al., 2015; Gourgouta et al., 2020). Since the protein and carbohydrate content in the stored grains are reduced as a result of larval feeding, there is a significant loss in quality also (Musa and Dike, 2009; Kavallieratos et al., 2017). According to estimates, post-harvest losses

caused by insects range from 9 to 20%, along with reduced germination and contamination. These beetles can eat dried goods that have as little as 2% moisture (Masolkar et al., 2018; Usman et al., 2018). The main technique of preventing pests like *T. granarium* has been to use chemical pesticides (Borzoui et al., 2015; Majd-Marani et al., 2017; Rajput et al., 2015), but it has its own drawbacks and it is necessary to use other methods. Employing host plant resistance is one such alternative. This study evaluates the biology of *T. granarium* on few wheat varieties from Pakistan.

MATERIALS AND METHODS

Larvae of *T. granarium* were collected from household wheat in July 2019, and these with infested wheat were shifted into 1 l plastic containers in the laboratory (25± 1°C, 60± 5%RH, 14:10- L:D). Newly emerged adults were shifted to new containers with 1 g of wheat kept individually in each. The wheat varieties evaluated include- Sehar-06, Shafaq-06, Lasani-08 and Faisalabad-08. Containers were examined daily to observe the egg, larval and pupal periods, adult longevity and their survival. Full size 6th instar larvae, pupae, and adults (male and female) were selected

individually from each variety for weighing. To determine the fertility and fecundity, one pair of adult (both male and female) was shifted individually into adult rearing cage containing each variety. The number of eggs laid by female was screened and put into petri dishes for hatching to check their fertility. The weight loss was assessed by keeping 5 g of each variety in a container and leaving five pairs of insects into it. Data was recorded for one month to check the weight loss. Borzoui et al. (2015) and Hassan et al. (2018) were followed to rear the pest, and survival % was calculated using the formula- Survival (%) = No. of live beetles/ No. of beetles released x 100; while weight loss % was calculated using the formula- Weight loss (%) = (initial weight- final weight/ initial weight) x 100. Data recorded on daily basis were arranged in MS-Excel sheet and analyzed using Statistix software (Version 8.1.), and means were compared (LSD, p=0.05).

RESULTS AND DISCUSSION

Being a polyphagous stored pest, the biological and morphological parameters of *T. granarium* can be highly affected by the hosts (Athanasios et al., 2016; Kavallieratos et al., 2019). It has been investigated by Athanasios et al. (2016) that *T. granarium* had maximum growth and development on wheat as compared to other hosts such as barley, sorghum, maize and rice etc. In the present study, four varieties of wheat were evaluated for the biology of *T. granarium*. The

white translucent and cylindrical eggs were laid by females on the grains singly or in clusters of 2-5 eggs. It was recorded that single female can lay 60-70 eggs in groups in her life period, with 1-20 eggs in a day. These results are similar to those of earlier workers (Deshwal et al., 2020). The incubation period was 7.01, 7.22, 8.02 and 8.91 days on Sehar-06, Shafaq-06, Lasani-08 and Faisalabad-08, respectively; and it was longest on Faisalabad-08, while shortest was on Sehar-06. Sehar-06 was the most preferred with maximum growth and development; developmental period of 1st, 2nd, 3rd, 4th, 5th, and 6th larval instar on Sehar-06 was 5.12, 7.31, 7.38, 7.95, 8.49, and 8.94 days, respectively. The corresponding values were 7.20, 9.29, 8.89, 8.64, 9.27, and 10.56 days on Faisalabad-08. Maximum larval infestation was also recorded on the grains of Sehar-06, while Faisalabad-08 was the least infested. The mean total developmental period from egg-adult on Sehar-06, Shafaq-06, Lasani-08 and Faisalabad-08 was 48.44, 51.11, 59.28, and 64.16 days, respectively (Table 1, Fig. 1). Naseri and Borzoui (2016) determined the life parameters of *T. granarium* on varieties of wheat. In their study 6th instar larvae were recorded only on cultivars Parsi and Morvarid, while in the current study 6th larval instar was observed on all the varieties. In the present study, longest pupal period was on Faisalabad-08, while Naseri and Borzoui (2016) observed it on Morvarid. The male and female longevity was 19.14 and 17.02 days on Sehar-06, respectively, while it was 13.87 and 8.23

Table 1. Biology of *T. granarium* fed on varieties of wheat

| Stage | Varieties | | | |
|------------------------------------|---------------|----------------|----------------|---------------|
| | Sehar-06 | Shafaq-06 | Lasani-08 | Faisalabad-08 |
| Eggs | 7.01± 0.03c | 7.22± 0.14a | 8.02± 0.10c | 8.91± 0.24a |
| 1 st instar | 5.12± 0.11a | 5.24± 0.20a | 6.51± 0.41a | 7.20± 0.11a |
| 2 nd instar | 7.31± 0.13b | 8.22± 0.19b | 8.73± 0.51ab | 9.29± 0.18b |
| 3 rd instar | 7.38± 0.10bc | 7.48± 0.15c | 8.68± 0.10ab | 8.89± 0.22bc |
| 4 th instar | 7.95± 0.05bc | 8.01± 0.09c | 8.33± 0.34abc | 8.64± 0.39c |
| 5 th instar | 8.49± 0.05c | 8.55± 0.20bc | 8.99± 0.46ab | 9.27± 0.77c |
| 6 th instar | 8.94± 0.10a | 8.98± 0.08a | 10.33± 0.10a | 10.56± 0.03a |
| 6 th instar weight (mg) | 7.11± 0.09a | 7.08± 0.05e | 6.84± 0.25b | 6.21± 0.09e |
| Larval period | 35.10± 0.11bc | 39.44± 0.66a | 42.79± 0.91bc | 46.01± 1.39b |
| Pupal period | 4.04± 0.07c | 4.95± 0.13a | 5.97± 1.65bc | 6.17± 0.15a |
| Pupal weight (mg) | 4.27± 0.01a | 4.13± 0.13d | 3.95± 0.06b | 3.90± 0.02e |
| Adult male weight (mg) | 4.42± 0.07a | 4.26± 0.09d | 3.33± 0.06b | 3.10± 0.11d |
| Adult female weight (mg) | 4.91± 0.14e | 4.75± 0.10b | 3.86± 0.08b | 3.70± 0.01d |
| Egg-adult period | 48.44± 0.15d | 51.11± 0.25a | 59.28± 0.19c | 64.16± 0.33a |
| Male longevity | 19.14± 0.20a | 15.89± 0.15 b | 13.87± 0.12b | 12.33± 0.21c |
| Female longevity | 17.02± 0.10a | 12.07± 0.15d | 8.23± 0.21e | 10.19± 0.22b |
| No. of grains lost | 183.10± 3.52a | 161.01± 3.51ab | 168.00± 2.39bc | 153.77± 4.29c |
| Survival (%) | 29.33± 5.49 | 21.09± 4.16 | 13.31± 2.87 | 10.65± 1.91 |
| Weight loss (%) | 2.11± 1.17 | 2.31± 1.22 | 1.12± 0.77 | 1.26± 0.35 |

Means followed by different letters in the same row significantly different (LSD, p < 0.05).

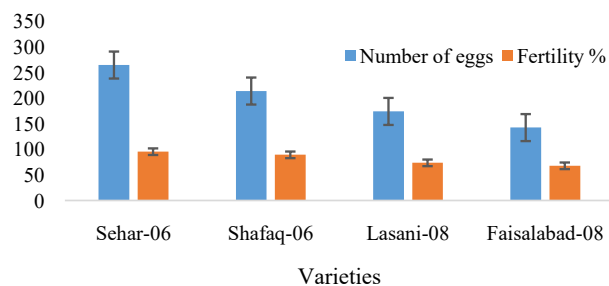


Fig. 1. Fecundity and fertility of *T. granarium* on wheat varieties

days on Lasani-08, respectively; the weight of 6th instar larvae was 7.11, 7.08, 6.84, and 6.21 mg on Sehar-06, Shafaq-06, Lasani-08 and Faisalabad-08, respectively, while maximum pupal weight was recorded on Sehar-06 and the least was on Faisalabad-08 (Table 1). Arain et al. (2006), Riaz et al. (2014) and Srivastava and Subramanian (2016) reported similar variations with varieties. The survival % was maximum on Sehar-06 and minimum on Faisalabad-08; while minimum weight loss of grain was observed with Faisalabad-08 and maximum on Sehar-06. Thus, Sehar-06 was observed to be the most susceptible variety.

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