International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 25-01-2024, Accepted: 18-02-2024, Published: 13-03-2024
Volume 9, Issue 3, 2024, Page No. 41-43

Bionomics and population growth of *Tribolium castaneum* (Herbst) on three major cereal grains in storage

Amita Srivastava[1], Ratnanjali[2*]
[1] Assistant Professor, Department of Zoology, Dayanand Girls P.G. College, Kanpur, Uttar Pradesh, India
[2] Research Scholar, Department of Zoology, Dayanand Girls P.G. College, Kanpur, Uttar Pradesh, India

Abstract
Tribolium castaneum is a major storage insect pest that infests a variety of food commodities, including cereals and dry fruits. The present study aimed to determine its preferences among three major cereal grains: wheat (*Triticum aestivum*), maize (*Zea mays*) and rice (*Oryza sativa*). The experiments were conducted under ambient laboratory conditions (30.5±3°C and 65±5 RH) and beetles were allowed to complete their bionomics among different cereal grains. The population growth index of the insect was also measured among cereal grains. Results revealed that wheat grains were significantly preferred by the insect, exhibiting the shortest duration of the development period (29.85 days) and the highest growth index (2.329). Rice grains occupied the second position with a development period of 31.82 days and a growth index of 2.026. However, maize grains were found to be the least preferred compared to wheat and rice, having a development period of 33.52 days and a growth index of 1.845, respectively.

Keywords: *Tribolium castaneum*, bionomics, cereal grains, growth index

Introduction
Insects constitute a diverse class of invertebrates within the phylum Arthropoda and are widely found organisms on Earth. They possess a direct or indirect influence on human life. Based on their activities, insects have been classified into beneficial and harmful categories. Ecologically, insects are integral components of the environment, playing crucial roles in pollination, nutrient cycling and biodiversity. But on the other hand, they can have detrimental effects on agricultural crops and household products, infrequently act as vectors for diseases and transmit pathogens to both humans and livestock. The most deleterious impact of insects is seen in the field of agriculture. Agricultural products hold substantial economic and nutritional value, and in India, farming comprises a wide variety of crops on a large scale. Insects pose a significant challenge to agriculture, with the constant threat of their attacks persisting from the sowing of crops to the post-harvest period. During cultivation, numerous insects, including aphids, caterpillars, mites, whiteflies and thrips inflict severe damage on premature crops. This challenge extends beyond the farms, as certain crops, referred to as cereals, undergo post-harvest storage and are consumed over a prolonged period of time. Cereals serve as a staple food and provide sustenance to a significant portion of mankind. During storage, a variety of enemies such as beetles, weevils, rodents, and molds primarily contribute to losses in cereal grains. India annually produces approximately 315.7 million metric tonnes of cereals, with around 14 million metric tonnes of food grains lost during storage. In these losses, insects play a significant role, contributing approximately 2.1 to 4.3 percent of the total loss (Anonymous, 2012) [4]. Various insect pests infest stored cereal grains, with notable species namely *Tribolium castaneum, Sitophilus oryzae, Callosobruchus maculatus, Sitotroga cerealella, Trogoderma granarium,* and *Rhyzopertha dominica* (Chitra and Subramanian, 2016) [6]. Among these, *Tribolium castaneum* is recognized as a prominent storage insect pest, causing infestation not only in cereal grains but also in a variety of dry fruits (Rajput *et al*., 2016) [11]. *Tribolium castaneum*, commonly known as the red flour beetle, is a small, reddish-brown insect belonging to the Tenebrionidae family. It is a cosmopolitan insect but predominantly occupied in tropical countries including India. It is found not only in the large warehouses but also occurs as a household insect pest. It can survive in adverse climatic conditions; however, during the warmer season, its activity and infestation reach their peak (Skourti *et al*., 2019; Mariadoss and Umamaheswari, 2020) [13, 8]. It induces both qualitative and quantitative losses in food products, leading to a decline in the market value of the products and resulting in significant economic losses for the country (Srivastava and Ratnanjali, 2023) [3]. Various cereal grains, encompassing wheat, maize, rice, barley and sorghum are susceptible to its infestation during storage (Ajayi and Rahman, 2006; Turaki *et al*., 2007) [2, 15]. Hence, the present study focuses on the bionomics and development of *Tribolium castaneum* on three major cereal grains *viz*., wheat (*Triticum aestivum*), maize (*Zea mays*) and rice (*Oryza sativa*) with the aim of assessing the insect's preferences.

Material and Methods
The experiments were conducted under laboratory conditions at the Department of Zoology, Dayanand Girls P. G. College, Kanpur, Uttar Pradesh. The completely randomized design (CRD) was applied with three replications.

Rearing of the insect
Tribolium castaneum was reared under laboratory conditions. For this purpose, numerous adults were sourced from a stock of infested wheat grains from the local market in Kanpur. The adults were identified and placed in a plastic container with cleaned and sterilized wheat grains as food. The mouth of the container was covered with muslin cloth

and secured with rubber bands to prevent the escape of beetles. After a week of egg-laying, the adult beetles were removed from the container and newly emerged beetles were selected for subsequent studies.

Bionomics and population growth of the insect

The bionomics and population growth of *T. castaneum* were investigated across three cereal grains: wheat, maize and rice. The experiment was initiated by taking five pairs of newly emerged adults from the rearing container and introducing them in separate plastic containers containing 50 g sterilized grains of each cereal. The mouths of the containers were covered with muslin cloth, using rubber bands and kept under laboratory conditions with 30.5±3°C temperature and 65±5 R.H. After a week, the entire released adult population was removed and the eggs laid during that period were counted and retained for hatching. Regular observations were made on the incubation period, larval period and pupal period of the insect among different cereal grains. The number of newly emerged adults was also recorded until the emergence was stopped to calculate the percentage of emergence. The percent adult emergence was determined as per the formula (Ahmed *et al*., 2016) [1].

Percent adult emergence = (Number of adults emerged/ Total number of eggs laid) × 100

Population Growth Index

The data collected on bionomics were analyzed to determine the population growth of *T. castaneum* among different cereal grains. The growth index was calculated using the following formula outlined by (Pant and Dang, 1969) [10].

$$\text{Growth Index} = \frac{\text{Percentage adult emergence (\%)}}{\text{Average period of complete development (Days)}}$$

Statistical analysis of the data

The data recorded during the investigation underwent statistical analysis using analysis of variance (ANOVA). The critical differences (C.D.) were computed at a 5% level of significance and Microsoft Excel was employed to depict the data in tables and graphs.

Results and Discussion

It is apparent from Table 1 that the development period of *Tribolium castaneum* (Herbst) varies among different cereal grains. The incubation period was observed to be 3.86, 3.96 and 3.93 in wheat grains, maize grains and rice grains, respectively. The larval period was longest in maize grains (21.33), followed by rice grains (19.86) and shortest in wheat grains (18.13). Similarly, the pupal period ranged from 7.86 to 8.23 days, with specific durations recorded as 7.86 days in wheat grains, 8.03 days in rice grains and 8.23 days in maize grains. The complete development period (egg to adult) of *T. castaneum* was significantly different among cereal grains. The longest development period of 33.52 days was recorded in maize grains, which was followed by 31.82 days on rice grains, while the minimum development period of 29.85 days was observed in wheat grains, respectively. Similar findings were documented by Sattigi *et al*., 1995; Naik *et al*., 2016, revealing that *T. castaneum* demonstrates a significant preference for wheat during its development. Awadalla *et al*., 2023 also found that *T. castaneum* favors wheat as its primary choice over rice and maize.

Table 1: Bionomics of *Tribolium castaneum* (Herbst) on different cereal grains

Cereal Name	Incubation Period	Larval Period	Pupal Period	Complete Development Period
Wheat	3.86	18.13	7.86	29.85
Maize	3.96	21.33	8.23	33.52
Rice	3.93	19.86	8.03	31.82
S. E.	0.015	0.054	0.037	-
C.D. at 5%	0.036	0.132	0.090	-

*The data depicted in the table is the mean of three replications

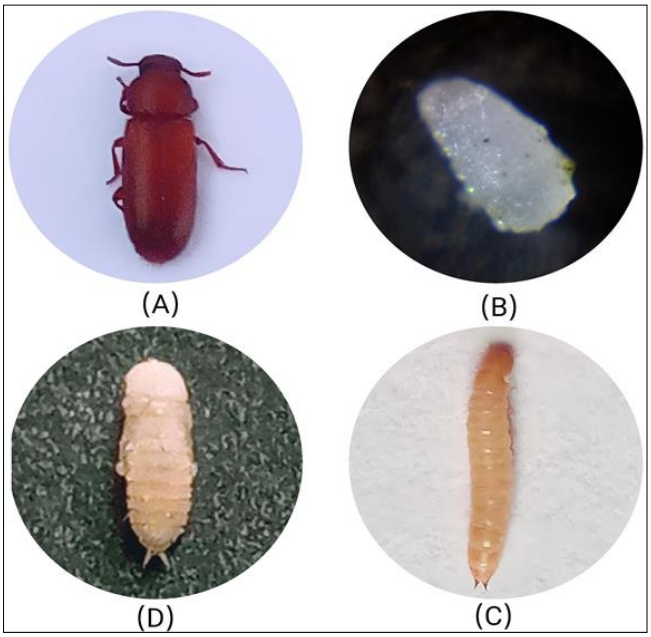

Fig 1: Life stages of *T. castaneum*: (A) Adult, (B) Egg, (C) Larva, (D) Pupa

The data concerning the population growth of *T. castaneum* in different cereal grains is presented in Table 2. It discloses the susceptibility of each cereal grain to the population growth of *T. castaneum*. However, the growth index was found to be highest in wheat grains, followed by rice grains, while it was lower in maize grains. The current findings are supported by Wong and Lee, 2011 [16]; Kayode *et al*., 2014 [7]; Skourti *et al*., 2020 [14], who reported that wheat grains are highly conductive to the growth and development of *T. castaneum*, while rice grains are considered a secondary preference.

Table 2: Population Growth Index of *Tribolium castaneum* (Herbst) on different cereal grains

Cereal Name	Percentage Adult Emergence (E)	Average Period of Complete Development (D)	Growth Index (E/D)
Wheat	69.55	29.85	2.329
Maize	61.86	33.52	1.845
Rice	64.49	31.82	2.026

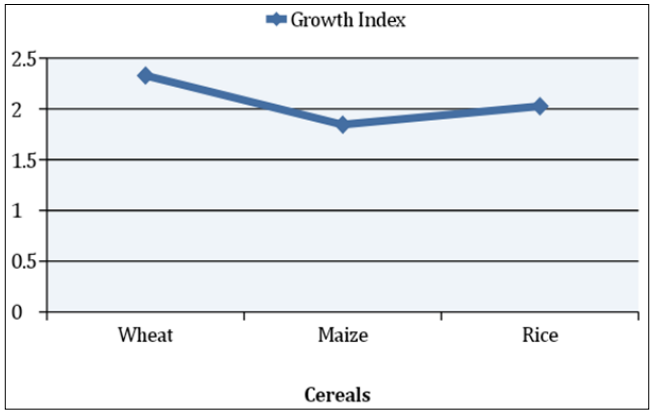

Fig 2: Growth Index of *T. castaneum* on cereal grains

Conclusion

On the basis of the present investigation, it is concluded that different cereal grains influence the growth and development of *Tribolium castaneum* (Herbst). Among them, wheat grains were identified as the most preferable and dominant over other cereal grains that facilitate the development of *T. castaneum*, thereby causing significant damage to grains during storage.

References

1. Ahmed J, Maleque M, Islam M, Bhuiyan M. Evaluation of indigenous plant powder against pulse beetle. Journal of the Sylhet Agricultural University,2016:3(2):215–221.
2. Ajayi FA, Rahman SA. Susceptibility of some staple processed meals to red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). Pakistan Journal of Biological Sciences,2006:9(9):1744–1748.
3. Srivastava A, Ratnanjali. A comparative assessment of neem derivatives for repelling the stored grain pest *Tribolium castaneum* (Herbst) in a sustainable manner. International Journal of Entomology Research,2023:8(12):77–80.
4. Anonymous. (Fide, 2012. http://agritech.tnau.ac.in/crop_protection/crop_prot_crop_insect%20 storage importance.html).
5. Awadalla SS, Hashem AS, Abdel Hady AA, Elsayed ES. Stored Grain Preference of the Red Flour Beetle, *Tribolium castaneum* (Tenebrionidae: Coleoptera). Journal of Plant Protection and Pathology,2023:14(8):243–248.
6. Chitra S, Subramanian S. Storage insect pests and their damage symptoms: an overview. Indian Journal of Entomology,2016:78(2):53–58.
7. Kayode OY, Adedire CO, Akinkurolere RO. Influence of four cereal flours on the growth of *Tribolium castaneum*, Herbst (Coleoptera: Tenebrionidae). Ife Journal of Science,2014:16(3):505–516.
8. Mariadoss A, Umamaheswari S. Seasonal abundance of red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) in food grains stored in a large warehouse. Journal of Experimental Zoology India,2020:23(2):1361–1367.
9. Naik RH, Mohankumar S, Naik SO, Pallavi MS, Srinivasan MR, Chandrasekaran S. Influence of food sources on the developmental period of *Rhyzopertha dominica*, *Tribolium castaneum* and *Sitophilus oryzae*. Indian Journal of Plant Protection,2016:44(1):63–68.
10. Pant NC, Dang K. Food values of several stored commodities in the development of *Tribolium castaneum* (Herbst). Indian Journal of Entomology,1969:31(2):147–151.
11. Rajput LB, Gilal AA, Bukero A, Magsi FH, Mastoi MI, Din IM. Population fluctuation and damage potential of red flour beetle on different dry fruits under laboratory conditions. Journal of Basic & Applied Sciences,2016:12:202–204.
12. Sattigi HN, Kulkarni KA, Lingappa S. Biology of red flour beetle, *Tribolium castaneum* Herbst on different cereal flours under laboratory Conditions. Karnataka Journal of Agricultural Sciences,1995:8(1):86-89.
13. Skourti A, Kavallieratos NG, Papanikolaou NE. Laboratory evaluation of development and survival of *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) under constant temperatures. Journal of Stored Products Research,2019:83:305–310.
14. Skourti A, Kavallieratos NG, Papanikolaou NE. Suitability of Semolina, Cracked Wheat and Cracked Maize as Feeding Commodities for *Tribolium castaneum* (Herbst; Coleoptera: Tenebrionidae). Insects,2020:11(2):99.
15. Turaki JM, Sastawa BM, Kabir BGJ, Lale NES. Susceptibility of flours derived from various cereal grains to infestation by the rust red flour beetle (*Tribolium castaneum*, Herbst) (Coleoptera: Tenebrionidae) in different seasons. Journal of Plant Protection Research,2007:47(3):279–288.
16. Wong N, Lee C. Relationship Between Population Growth of the Red Flour Beetle *Tribolium castaneum* and Protein and Carbohydrate Content in Flour and Starch. Journal of economic entomology,2011:104(6):2087–2094.