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EFFECT OF HUMIDITY AND TEMEPRATURE ON THE LIFE STAGES OF *TRIBOLIUM CASTANEUM* ON STORED RICE IN QUETTA

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Abstract

Red flour beetles (Tribolium castaneum) are a main pest of stored products, causing economic harm to stored rice through physical destruction to the rice, causing decreases in grain quality. This study evaluated the effect of temperature and relative humidity on the developmental stages of the red flour beetle (Tribolium castaneum) on stored rice in Quetta, Pakistan. Laboratory experiments were conducted using rice varieties (basmati, milled, and medium-long grain rice) under varying temperatures (25–55°C) and humidity levels (40–80%). Maximum development occurred at 35°C and 60–65% RH, with significantly lower development at 25°C and 80% RH. Findings indicate that environmental factors significantly influence pest population dynamics and can inform better grain storage practices.

Keywords: *Life stages, Red flour beetles, Stored rice, Tribolium castaneum*

INTRODUCTION

Rice (*Oryza sativa* L.) is the major food crop of the South Asian region. Due to different factors, the productivity of the rice is decreasing. It is the second production of the world next to wheat and different countries of the world used rice, mostly 90% of the South Asian countries used rice (1). "Despite being a major rice producer, Pakistan faces post-harvest losses due to inadequate storage conditions, particularly in arid zones like Quetta where climatic variation affects pest development. However, limited data exist on how temperature and humidity influence the life cycle of *T. castaneum* in stored rice in this region." Pakistan is the 13th-largest rice producer in the world. Pakistan produced 7.79 million tons of rice annually on average between 2001 and 2011, making up over 8.5% of the world's total rice exports. Millions of farmers in Pakistan's Punjab and Sindh Provinces rely on the production of rice as their primary source of income, and this is where the majority of rice types are farmed. Pakistan is one of the world's top producers of basmati rice, a popular variety of rice valued for both its scent and quality (2). Due to prolonged storage of rice pest, the valuable income is more at risk of losses from a variety of sources, including pest infestations. Pests of stored grains are the global source of the most measurable and qualitative losses to stored crops, with losses that range from 10 to 40 percent (3). The rust-red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera: *Tenebrionidae*), is mostly responsible for rice damage, resulting in a 40% reduction in grain quantity (4). The growth and developmental stages of *Tribolium castaneum* (red flour beetle) in stored rice are strongly influenced by both temperature and humidity. The beetle exhibits the highest population increase under moderately high temperatures ranging from 30°C to 35°C coupled with elevated humidity levels. The aim of the study was to find the impact of humidity and temperature of rice pest.

METHODOLOGY

VARIETY OF RICE/SAMPLE SIZE

A total 2-3 kg different varieties of rice like (Basmati, Milled rice, and Medium-long grain rice (non-basmati rice) were collected in different silos of Quetta. Milled rice is collected form area A. basmati rice are collected from area B and medium long rice are collected form area c.

INSECT COLLECTION

The rice pest was collected by random selection of different silos from grain markets of Quetta district of Balochistan. Approximately 60 samples of rice pest were collected from different areas of Quetta, and later on pest samples were shifted to laboratory for further experimentation.

LABORATORY EXAMINATION OF RICE PEST

A controlled climate chamber was utilized to regulate the relative humidity and temperature of the laboratory environment. Rice samples collected from various locations were individually sealed in sterile petri dishes (15.5 × 9 cm) and placed in the rearing area for experimental use. To prevent insect escape while ensuring proper ventilation, each petri dish was covered with a fine mesh screen (5). The samples were maintained under these laboratory conditions for a total of 48 days. At 14-day intervals (i.e., on days 14, 28, and 48), each rice sample was weighed, and the developmental stages of Tribolium castaneum (red flour beetle) were assessed by recording the mean number of larvae, pupae, and adult insects.

DATA ANALYSIS

The collected data were transferred to statistical package for the SPSS version 20 and analysis outcomes variables were done by using two-way analysis of variance (ANOVA) and software excel used for tables and graphs.

RESULTS

Number of larvae of red flour beetle (*Tribolium castaneum*) on different rice varieties (milled rice, basmati rice and medium long grain rice) after different days under different temperature (T) (T_1=25, T_2=30, T_3=35 and T_4= 55C˚) and different relative humidities (H) (H_1= 40, H_2=60, H_3=70 and H_4=80) have been shown in Table I. A p-value less than 0.05 is typically considered to be statistically significant. Statistical analysis showed that, there is significant association of larvae emergence on different varieties of rice with temperature and humidity.

Table I. Mean larval emergence of *Tribolium castaneum* on different rice varieties under varying temperature and humidity conditions after 30 days

Treatment	**Larvae emergence on different rice varieties**			
Temperature (C˚) Humidity(Average)	**Milled rice** (*Oryza sativa*)	**Medium long grain rice** (*Oryza sativa*)	**Basmati rice** (*Oryza sativa*)	**Std .Error of mean**
T_1H_1	18	16	10	Milled rice (*Oryza sativa*) 2.36197
T_1H_1	15	12	9	
T_2H_2	22	19	14	Medium long grain rice (*Oryza sativa*) 1.78139
T_2H_2	20	18	12	
T_2H_2	24	20	14	
T_3H_3	28	22	13	Basmati rice (*Oryza sativa*) 1.27758
T_3H_3	26	21	14	
T_3H_3	28	20	16	
T_4H_4	9	6	5	
T_4H_4	7	8	4	
Mean	19.7000	16.2000	11.1000	
Sample size (N) 60				
ANOVA	F= 36.253 P= 0.00	F= 55.885 P= 0.00	F= 54.859 P= 0.00	

Number of pupae of red flour beetles (*Tribolium castaneum*) on different rice varieties (milled rice, basmati rice and medium long grain rice) after different days under different temperature (T) (T_1=25, T_2=30, T_3=35 and T_4= 55C˚) and different relative humidities (H)(H_1= 40, H_2=60, H_3=70 and H_4=80) have been shown in Table II. A p-value less than 0.05 is typically considered to be statistically significant. Statistical analysis

showed that, there is significant association of pupae emergence on different varieties of rice with temperature and humidity.

Table II. Mean pupal emergence of *Tribolium castaneum* on different rice varieties under varying temperature and humidity conditions after 38 days

Treatment	**Pupae emergence on different rice varieties**			
Temperature (C°) Humidity(Average)	**Milled rice** (*Oryza sativa*)	**Medium long grain rice** (*Oryza sativa*)	**Basmati rice** (*Oryza sativa*)	**Std .Error of mean**
T_1H_1	12	10	6	Milled rice
T_1H_1	14	9	5	(*Oryza sativa*)
T_2H_2	20	15	12	2.18174
T_2H_2	18	17	10	Medium long
T_2H_2	20	18	13	grain
T_3H_3	24	19	12	rice
T_3H_3	22	17	10	(*Oryza sativa*)
T_3H_3	23	18	9	1.69444
T_4H_4	7	5	4	Basmati rice
T_4H_4	4	6	3	(*Oryza sativa*)
Mean	16.4000	13.4000	8.400	1.14698
Sample size (N) 60				
ANOVA	P= 0.00	P = 0.00	P= 0.001	
	F = 68.054	F= 114.437	F= 19.880	

Number of adult of red flour beetles (*Tribolium castaneum*) on different rice varieties (milled rice, basmati rice and medium long grain rice) after different days under different temperature (T) (T_1=25, T_2=30, T_3=35 and T_4= 55C˚) and different relative humidities (H) (H_1= 40, H_2=60, H_3=70 and H_4=80) have been shown in Table III. A p-value less than 0.05 is typically considered to be statistically significant. Statistical analysis showed that, there is significant association of adult emergence on different varieties of rice with temperature and humidity.

Table III. Mean adult emergence of *Tribolium castaneum* on different rice varieties under varying temperature and humidity conditions after 48 days

Treatment	**Adult emergence on different rice varieties**			
Temperature (C°) Humidity(Average)	**Milled rice** (*Oryza sativa*)	**Medium long grain rice** (*Oryza sativa*)	**Basmati rice** (*Oryza sativa*)	**Std .Error of mean**
T_1H_1	10	9	4	Milled rice
T_1H_1	13	9	3	(*Oryza*
T_2H_2	15	15	10	*sativa*)1.96667
T_2H_2	17	15	11	
T_3H_3	20	16	10	Medium long
T_3H_3	17	17	8	grain rice
T_3H_3	20	16	7	(*Oryza sativa*)
T_4H_4	5	4	4	1.62070
T_4H_4	2	3	2	Basmati rice
T_3H_3	20	16	7	(*Oryza sativa*)
Mean	13.7000	11.6000	6.9000	1.06927
Sample size (N) 60				
ANOVA	P= 0.00	P= 0.00	P=0.05	
	F= 49.975	F= 75.074	F=12.803	

MEAN NO. OF LARVAE, PUPAE, AND ADULT STAGES OF RED FLOUR BEETLES (*TRIBOLIUM CASTANEUM*) ON DIFFERENT RICE VARIETIES

Mean number of larvae, pupae, and adult stages of red flour beetles (*Tribolium castaneum*) on different rice varieties (milled rice, basmati rice and medium long grain rice) after different days under different temperature (T) (T_1=25, T_2=30, T_3=35 and T_4= 55C˚) and different relative humidities (H) (H_1= 40, H_2=60, H_3=70 and H_4=80).

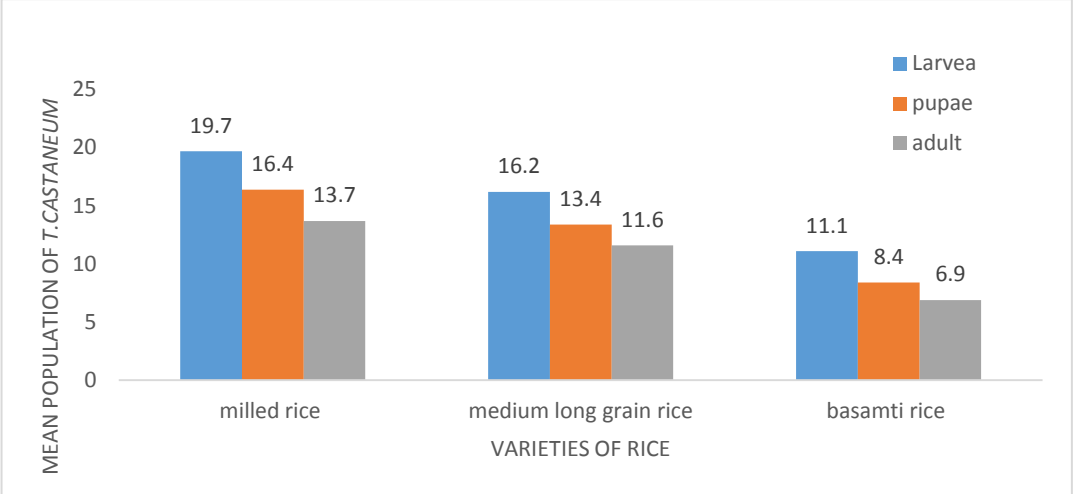

Fig. 1. Mean number of larvae, pupae, and adult stages of red flour beetle (*T. castaneum*) on different rice varieties

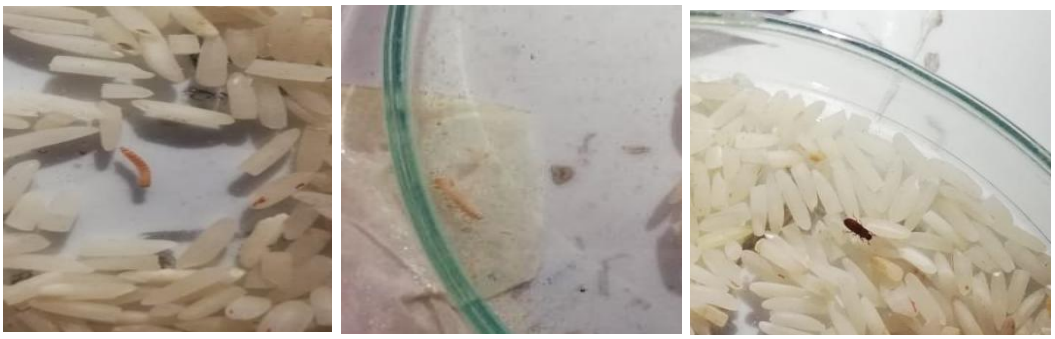

Fig. 2. Larva, pupa and adult of *Tribolium castenum*

DISCUSSION

This study examined the effects of temperature and moisture on the three stages of development: (larva, pupa, and adult) of rice pest *Tribolium castaneum*, Although the temperature (35 °C) showed a very high rate of development for all red flour beetle (*Tribolium castaneum*) life periods, the lowest temperature (25 °C) and highest temperature (55 °C) in this study exhibited red flour beetle (*Tribolium castaneum*) slow ratio of growth. Thus, the results demonstrated that temperature has a significant impact on the life span of red flour beetles (*Tribolium castaneum*) (6). Hassan *et al.*, 2023 obtained the relevant data from their study on the impact of temperature and moisture on the *rhyzopertha Dominica* population on grind rice (7). It has been suggested that grain seed be harmed by insects during high infestation stages. When the quantity of damaged grains, which can be identified by their holes, is not counted, the percentage of grain destruction that results in dryness and, ultimately, the amount of weight loss, are determined (8).

The results of this study from the Quetta districts demonstrated how the environment's temperature and relative humidity affect larval development in a research laboratory. One can observe that in (Table I). The average larvae emergence on milled rice were 19.700, medium long grain rice were 16.200 and basmati rice were 11.100 after 30 days. In case of larvae development, the findings showed that the speed of larvae growth of red flour beetle (*Tribolium castaneum*) was affected by the food nature. Astuti et al., 2013 obtained the relevant data from their study on the impact of temperature and moisture on the *Rhyzopertha dominica* population on grind rice (9).

In the current research the findings for larvae development displayed that on basmati rice the red flour beetles (*T. castaneum)* had slower growth than milled rice and medium long grain rice in the presence of temperature and humidity, the important influence of temperature and relative moisture on the life of the silos pest has also been proved by another study (10).

The results of the pupae development showed that the mean pupae time on stored rice was after 38 days (Table II) The average pupae emergence on milled rice were 16.400, medium long grain rice were 13.400 and basmati rice were 8.400 after 38 days.. In the existing research the results for pupae development exhibited that on basmati rice the red flour beetle (*T. castaneum)* had slower development than milled rice

and medium long grain rice in the presence of temperature and moisture. In this investigation it was noted that a rise in the temperature up to 30℃ normally favor the growth of red flour beetle (*Tribolium castaneum)* but more rises from 40℃ has an adverse influence. Likewise, a rise in the relative humidity levels typically advantage for the development of *Tribolium castaneum*. This important influence of temperature and moisture on the pest development has been noted in previous research (11).

In the present study the adult growth of red flour beetles (*T. castaneum)* outcomes exposed that rice pest under laboratory condition at (25, 30, 35, 40 and 55°C) and with mean relative humidity (40, 60, 70 and 80%) was provided to the stored rice. The adult appearance similarly required longer to emerge at low temperatures and humidity, but it also took less time to develop when the temperature increased to between 30 and 35 °C and high relative humidity levels of 60 and 70%, as reported by Che Muhamed *et al.,* 2016 (12). *Trogoderma granarium* studies revealed that the maximum rate of oviposition occurred at 30 or 35 degrees Celsius, while it decreased at 20 or 40 degrees Celsius.

CONCLUSION

The present study concludes that the red flour beetle (*Tribolium castaneum*) is a predominant pest affecting various rice varieties and follows a complete metamorphosis involving three main developmental stages: larva, pupa, and adult. The findings indicate that optimal population growth of T. castaneum occurs at temperatures between 30°C and 35°C with relative humidity ranging from 60% to 70%. In contrast, environmental conditions below 25°C with 40% humidity and above 45°C with 80% humidity were found to be unfavorable for its development. These results demonstrate that both temperature and humidity play critical roles in influencing the life cycle and population dynamics of T. castaneum.

Based on these observations, it is recommended that grain storage facilities, particularly in arid regions such as Quetta, maintain ambient conditions below 30°C and relative humidity under 60% to effectively inhibit the growth and proliferation of *T. castaneum*.

References:

1. Bekele BG. Review on integrated pest management of important disease and insect pest of rice (Oryzae sativa L.). World Sci News. 2018;100.
2. Abdullah M, Li J, Ghazanfar S, Ahmed J, Khan I, Ishaq MN. Where Pakistan stands among top rice exporting countries, an analysis of competitiveness. J Northeast Agric Univ (Engl Ed). 2015;22(2):80-6.
3. Iqbal S. Insect, pest and disease management in rice. Austin Publication, Irving, TX. 2020;85.
4. Pathania M, Thakur AK. Biology and Management of Pulse Beetle on Black Gram (Doctoral dissertation, Department of Entomology).
5. Praveena SM, Omar NA. Heavy metal exposure from cooked rice grain ingestion and its potential health risks to humans from total and bioavailable forms analysis. Food Chem. 2017;235:203–211.
6. Ahmad F, Iqbal N, Zaka SM, Qureshi MK, Saeed Q, Khan KA, et al. Comparative insecticidal activity of different plant materials from six common plant species against Tribolium castaneum (Herbst)(Coleoptera: Tenebrionidae). Saudi J Biol Sci. 2019;26(7):1804-8.
7. Hassan MW, Hashmi MA, Sarwar G, Mehmood Z, Saleem W, Farooqi MA. Damage assessment of stored grain pests against rice grains types and wheat. Int J Trop Insect Sci. 2023;43(1):35–41.
8. Geremew M, Molla A, Gabbiye N, Harvey J, Mahroof R, Abay F. Effects of threshing and storage conditions on post-harvest insect infestation and physical characteristics of maize grain. J Stored Prod Res. 2023;103:102131.
9. Shafique M, Ahmad M, Chaudry MA. Feeding preference and development of Tribolium castaneum (Herbst.) in wheat products. Pak J Zool. 2006;38(1):27.
10. Issrani RK, Shaikh AM, Larik SA, Kanwal R, Soomro F, Soomro FA, Panhwar WA. Biology of red flour beetle, Tribolium castaneum (Herbst, 1797), in two flour media under laboratory conditions. J Wildl Biodivers. 2024;8(3):340–347.

11. Carvalho MO, Geirinhas H, Duarte S, Graça C, de Sousa I. Impact of red flour beetle infestations in wheat flour and their effects on dough and bread physical, chemical, and color properties. J Stored Prod Res. 2023;102:102095.
12. Che Muhamed AM, Atkins K, Stannard SR, Mündel T, Thompson MW. The effects of a systematic increase in relative humidity on thermoregulatory and circulatory responses during prolonged running exercise in the heat. Temperature. 2016;3(3):455–464.