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Varietal resistance of certain indigenous wheat, *Triticum aestvum* (Linn.) for the larval development of lesser grain borer, *Rhyzopertha dominica* Fabrecios (Coleoptera: Bostrichidae)

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Abstract
A laboratory experiment was carried out to test the larval development of lesser grain borer. *Rhyzopertha dominica* Fabrecios on different varieties of wheat *Triticum aestvum* Linn was evaluated at Department of Zoology, D.B.S. College, Kanpur, India during 2004 to 2005 in protected and unprotected condition. The data revealed significant differences among six wheat varieties namely TL 174, K 65, HI 774, UPT 72294, Kalyan Sona and HD 1982 for larval development of *R. dominica.* The data revealed significant differences among various wheat varieties for larval development *of R. dominica*. The lowest larval period 27.50 days was found in HI 7747 followed by HD 1982 and Kalyan Sona having the larval period 27.76 and 29.20 days respectively. These do not differ significantly to each other. In HI 7747 one larva could not complete its development even up to 48 days and it was dead before population. The highest larval period (33.44 days) was observed in UPT-72294 followed by K 65 and TL 174 having the larval period 32.42 and 31.54 days respectively. These three varieties do not differ significantly each other but differ significantly from the others.

Keywords: *Triticum aestvum, Rhyzopertha dominica,* HI 7747 and Kalyan Sona

Introduction
The lesser grain borer, *Rhyzopertha dominica* (F is one of the most important beetles, infesting of stored grain worldwide (Edde, 2012, Mazzi and Dorn, 2012) [1, 2]. It belongs to the order Coleoptera in the family Bostrichidae infesting cereal kernels (Potter, 1935, Surtees, 1963, Stinner *et al.* 1972, Rao *et al.* 1972) [3, 4, 5, 6]. *Rhyzopertha dominica* Fabrecios is a major pest of wheat (Flinn *et al.,* 2004) [7] and rice (Chanbang *et al*., 2008 a, b) [8, 90]. Both larvae and adult produce frass and cause weight losses by feeding on grains. *R. dominica* infestation can reduce rice to dust (Cuperus et al., 1990 [10].
There are three aspects of the impact of *R. dominica* infestation: loss in the quantity of stored grain, loss in quality of stored seeds (Sánchez-Mariñez *et al*., 1997) [11] and the cost to prevent or control infestations (Anonymous, 1998) [12].
On wheat and rice, larvae consume both germ and endosperm during their development in grain and thus produce more frass than *Cryptolestes ferrugineus* and *Sitophilus granarius* (Campbell and Sinha, 1976) [13]. *R. dominica* is also capable of damaging grain, causing weight losses of up to 40%, compared to 19%, 14% and 10% for *S. oryzae*, *Tribolium castaneum* and *Ephestia cautella*, respectively. Weight loss from individual kernels has also been reported with different varieties of triticale, a wheat-rye hybrid (Baker *et al.*, 1991) [14], and in rice infested with *R. dominica* (Nigam *et al*., 1977) [15]. *R. dominica* feeding on seed germ reduces germination rates and vigour of the grains and may be followed by secondary pests and fungi (Bashir, 2002) [16].
Adults and larvae of *R. dominica* feed primarily on stored cereal seed including wheat, maize, rice, oats, barley, sorghum and millet. They are also found on a wide variety of foodstuffs including beans, dried chillies, turmeric, coriander, ginger, cassava chips, biscuits and wheat flour. There are several reports of the lesser grain borer being found in or attacking wood as is typical of other Bostrichidae. *R. dominica* has been reported to produce progeny on the seeds of some trees and shrubs (acorns, hackberry [Celtis occidentalis] and buckbrush [Symphoricarpos orbiculatus]) (Wright *et al*., 1990) [17].

The objectives of this study were to conduct an experiments to compare successful *R. dominica* first instar larval development on six wheat varieties namely TL 174, K 65 HI 774, UPT 72294, Kalyan Sona and HD 1982 for larval development of *R. dominica.* Lastly, we sought to determine the role of short-term feeding by *R. dominica* larvae on the successful infestation and their development of first instars on deferent varieties of wheat.

Materials and Methods

Mass rearing of *Rhyzopertha dominica*

Examination of the influence of different wheat grain varieties ie; (x) on the emergence of the progeny of *R. dominica*, on stored wheat grains, as well as effect of their presence on chemical properties of grains were conducted in bio-pesticide and toxicological laboratory, Department of Zoology, D.B.S, College, Kanpur which *is* located in between latitudes 25.26º and 26.58º North and longitudes 19.31º and 84.34º East, Kanpur is situated at an elevation of about 127.117º metres above the mean sea level and has a semi-arid subtropical zone during, 2004-2005.

2.1 Tested insect and their rearing

The lesser grain borer, *Rhyzopertha dominica* Fabricius collected from the naturally infested wheat grains from the local market of kanpur and and was mass reared in the laboratory at ambient room temperature in glass jars. *R. dominica* reared on wheat kernels 450 g, and 100 adults were put in a glass jar (13 cm Diameter x 47 cm height) with the bottom covered with black as per Tripathi *et al.* 2017 [21]. Adults of *R. dominica* of both sexes and 2-4-weeksold were used during the experiment with temperature (T) 29±1 °C and relative humidity (RH) 70±5% and a photoperiod of 16:8 (light/dark). Adults were allowed to oviposit for three days and were then removed in the bio-pesticide and toxicological laboratory, Department of Zoology, D.B.S, College, Kanpur. Mixed wheat kernels, The lid of glass jar provided with a hole (3 cm Diameter) closed by a stainless steel wire mesh to allow gaseous exchange and checked daily. After three days of eggs hatches into larvae. The first instar larvae characterized by a terminal median spine.

2.2 Tested Wheat Genotypes

The test wheat grain varieties were used for *R.dominica* food preference of larval susceptible or resistance. The wheat grain varieties viz; HI 7747, HD 1982, K 65, Kalyan Sona, TL 174 and UPT 72294 were treated with *R.dominica* larvae. Before conducting the experiments each wheat grain was thoroughly examine for the presence of mites or damage by the insects and presence of their eggs etc. only healthy sound and free from injury grains will take for study. Maintaining the incubator at 36oC disinfected all the varieties of wheat (Shukla *et al.* 2020) [22]. The whole amount of all varieties will keep in the above incubator for 12 hours for disinfections

3. Experimental Protocol

The lesser grain borer, *Rhyzopertha dominica* (F.), females lay eggs loosely outside of wheat kernels. Larvae hatching from eggs enter wheat kernels to complete immature development. Four laboratory experiments were conducted to understand the wheat kernel infestation by first instars of *R. dominica* at 28 °C and 65% r.h The tests were carried out by placing 40 wheat kernels in glass containers (35 mm ∅; height 20 mm) with 20 first instars larvae, 0–24 h old. Such containers, closed with a net (120 mesh) to provide ventilation, were placed in an incubator at 29 ± 1 °C, 70 ± 5% R.H. and 16 h of light alternating with 8 h of darkness. For each of the six wheat genotypes, tests were carried out with 40 entire kernels and with 40 longitudinally sectioned kernels. Three replicates were carried out for each test (Amos *et al.* 1986) [23].

This experiment was carried out to test the possibilities for the presence of any attractant responsible for larvae attraction towards a particular varieties viz; HI 7747, HD 1982, K 65, Kalyan Sona, TL 174 and UPT 72294 For this, the method described earlier was followed (Storey, 1983) [14], observation for the presence of larvae in each variety was recorded after 20 days of release. This long exposure period was given. So the established properly into the preferred variety. There were two experiments. In the first, 100 larvae were released in the centre of the varieties while in the second 100 eggs were kept on a watch glass instead of larvae. Thus the larvae were given an equal chance to enter in any variety (Finney, 1952) [24]. The data obtained are recorded in table -1 and figure - 1 to 5

Table 1: Showing the larval period of *R. dominica* in different varieties of wheat

Treat-ment.	Name of the variety	Symbol of the variety	Larval R_1	Period R_2	in R_3	Days R_4	Total	Average
1.	HI 7747	V_1	28.00	30.00	26.00	26.00	110.00	27.50
2.	K 65	V_2	32.00	36.33	31.00	30.33	129.66	32.42
3.	TL 174	V_3	31.50	31.00	34.00	29.66	126.16	31.54
4.	UPT 72294	V_4	36.30	34.20	31.40	31.87	133.77	33.44
5.	HD1982	V_5	26.50	26.25	29.50	28.80	111.05	26.16
6.	Kalyan Sona	V_6	26.50	29.00	30.25	31.00	116.75	29.20

Analysis of variance

Source of variation	DF.	S.S.	M.S.	Variable Ratio	'F' 5%	At 1%
Treatment	5	125.61	25.12	5.81	2.77	4.25
Error	12	77.76	4.32			
Total	23	203.37				

Highly significant at 5% and 1% level of significance.

SE. ± 1.47

C.D. at 5% 3.09

Treatment- V_1 V_2 V_3 V_4 V_5 V_6

27.50 27.76 29.20 31.54 32.42 33.44

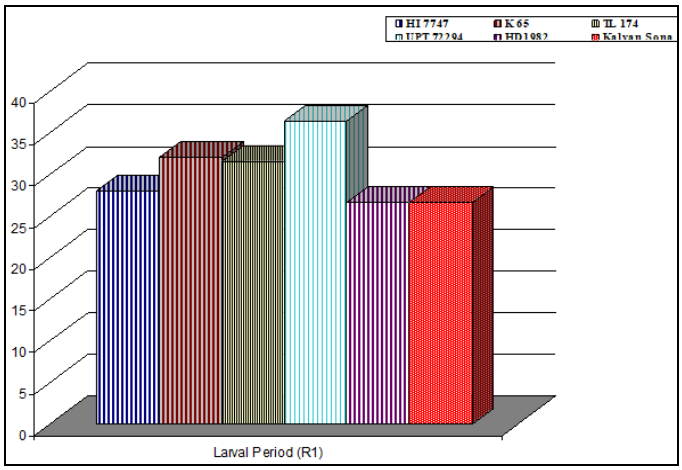

Table 1: Showing the larval period of *R. dominica* in different varieties of wheat

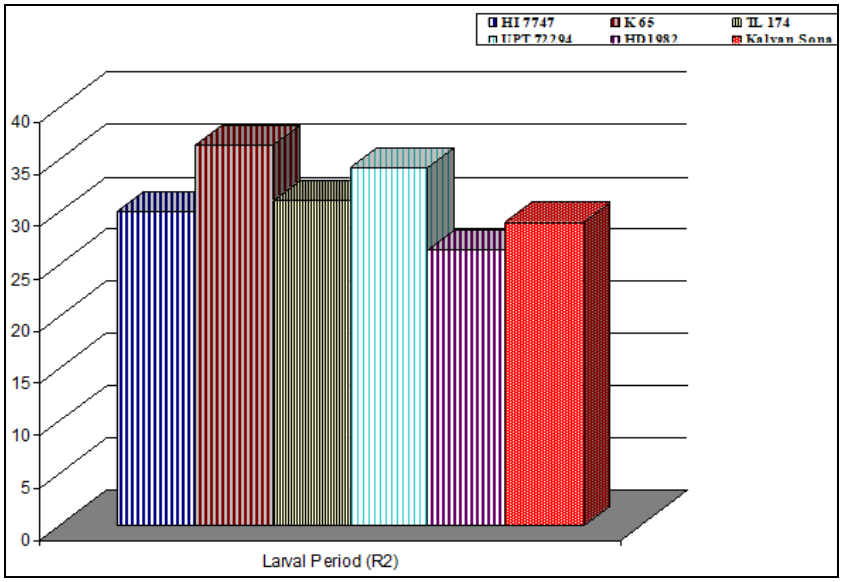

Table 2: Showing the larval period of *R. dominica* in different varieties of wheat

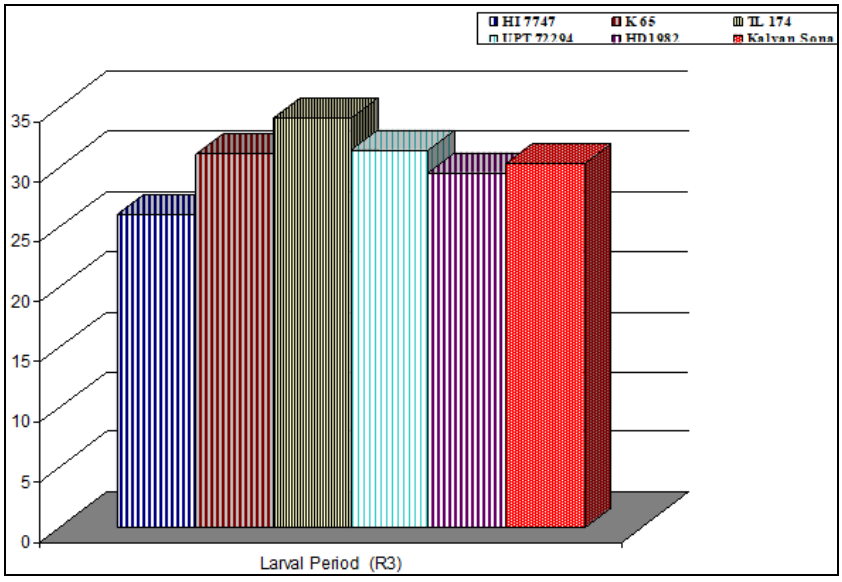

Table 3: Showing the larval period of *R. dominica* in different varieties of wheat

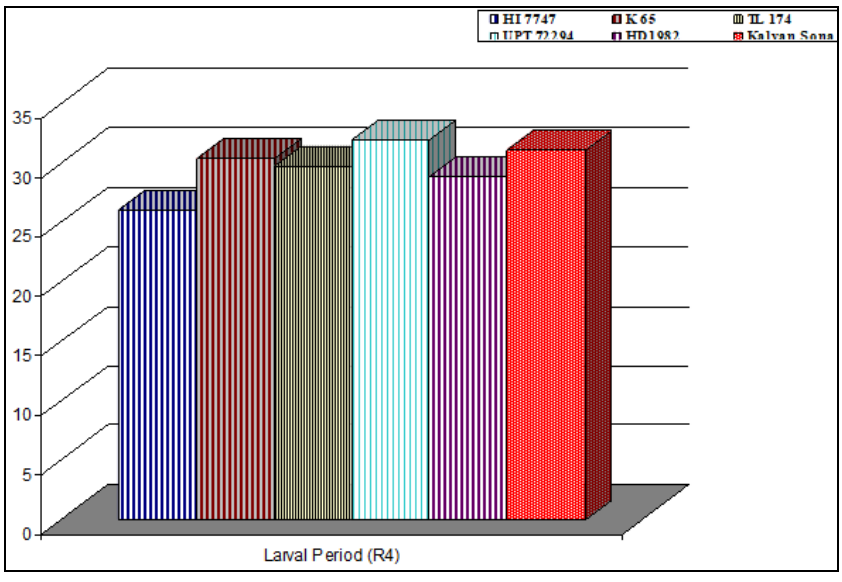

Table 4: Showing the larval period of *R. dominica* in different varieties of wheat

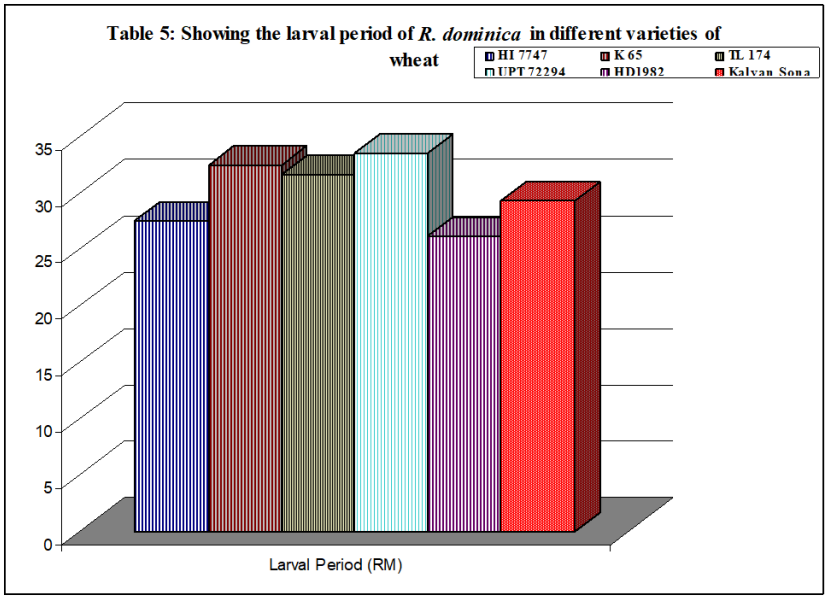

Table 5: Showing the larval period of *R. dominica* in different varieties of wheat

The lowest larval period 27.50 days was found in V_1 (HI 7747) followed by V_5 (HD 1982) and V_6 (Kalyansona) having the larval period 27.76 and 29.20 days respectively. These do not differ significantly to each other. In V_1 (HI 7747) one larva could not complete its development even upto 48 days and it was dead before population. The highest larval period (33.44 days) was observed in V_4 (UPT-72294) followed by V_2 (K 65) and V_3 (TL 174) having the larval period 32.42 and 31.54 days respectively. These three varieties do not differ significantly each other but differ significantly from the others.

4. Data analysis: The number of adults emerged and the development period on flour and on pasta debris were submitted to one-way analysis of variance (ANOVA), two-way ANOVA with diet and thickness as fixed factors while data on sieved flours were submitted to three-way ANOVA with diet, thickness, and particle size as fixed factors. The statistical differences among means were evaluated using the least significant difference (LSD) test at $\alpha = 0.05$ (SPSS22).

5. Result

The data depicted from Table 1 and figure 1a, 1b, 1c and 1dthat the highest number of *Rhizopertha dominica* larvae 23.00 were present in UPT 72294 which is observed the most preferred variety. This variety differs significantly from the others. The next variety in order to preference for food is TL 174 having 10 larvae followed by H.D. 1982 having 5.66 larvae, which do not differ significantly to each other but differ significantly from the rest of the varieties. The least preferred varieties are HI 7747 and K65 having only 1.33 larvae and these do not differ from Kalyan Sona and HD 1982Similarly, the data depicted from Table 2 and figure 2a,b,c,d that the he highest number of *R. dominica* larvae was observed in UPT 72294 having 18.66 which differs significantly from the others. This clearly indicated that UPT 72294 is the most preferred variety for the larval establishment. This also confirms the previous observations of Table-2 and figure 2a, 2b, 2c and 2d, respectively.

6. Discussion

In this study, the development of *R. dominica* was observed on different six wheat varieties namely TL 174, K 65, HI 774, UPT 72294, Kalyan Sona and HD 1982. In the conformity of the present finding with the of entomologist who works on food preference and susceptibility of *rhyzopertha dominica* for different stages of their development particularly larvae and adults as:-Howe, 1950reportedthat chestnut flour and semolina permitted the development of larvae in a period of time similar to that observed in cereal kernels [25]. Edde and Phillips, 2006b was observed that chickpea flour and wheat flour were a less appropriate food, and in fact, only 25% of larvae completed development to adult. In the case of corn meal, rice flour, and wheat bran, only 5% of adults emerged larvae were unable to develop on corn starch and potato starch while reproduction on small pieces of dried potatoes [26]. The behaviour on seeds is different according to the plant species; for example, *R. dominica* can develop and reproduce on walnut seeds and acorn (Jia *et al*., 2008) [27]. Although *R. dominica* is a well-known pest of wheat grains and pasta, debris was less suitable for the development of larvae, as few adults emerged and a longer development time was observed (Locatelli *et al*., 2008) [28].

Some workers like Singh *et al.* (1972) were also studied the oviositional preference of *Sitophilus oryzae* on major wheat varieties and their suitability for its subsequent larval development, was studied at 30 $\pm$ 1 ºC temperature and 70.0 per cent RH. The for oviositional preference as determined by the average number of eggs laid on different varieties [24]. Baker *et al.* (1991a) evaluated 30 Eastern soft wheat cultivars by allowing 5 female S. *oryzae* to oviposit for 3 days on 25-gram samples of each cultivar. Under these conditions, progeny production was 7.2 weevils per female per day, a near optimum response [25].

The literature is being compiled onvarietal susceptibility and mechanism of resistance for oviposition reducing or multiplication of lesser grain borer, *Rhizopertha dominica* Fabr. and other stored grains pests are described by various workers yearwise (Teotia and Singh. 1968, Bhatiaand Gupta,1969, Singh *et al.* 1974, K, 33, 34, 35, 36 During the observation, it was found that the highest number of *Rhizopertha dominica*_larvae 23.00 were present in UPT 72294 which is observed the most preferred variety. This variety differs significantly from the others. The next variety

in order to preference for food is TL 174 having 10 larvae followed by H.D. 1982 having 5.66 larvae, which do not differ significantly to each other but differ significantly from the rest of the varieties.

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