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Impact of certain indigenous varieties of wheat, *Triticum aestivum* Linn. (Poacea) for the development of pupae and adult emergence of lesser grain borer under laboratory trials

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Abstract
Prevention of food losses during postharvest storage is of paramount economic importance. An experiment was conducted to assess the pupal development of lesser grain borer, *Rhyzopertha dominica* Fabr. on wheat varieties ie; HI 7747, K 65, TL 174, UPT 72294, HD 1982 and Kalyan sona were used under storage condition at the Department of Botany, D.B.S. College, CSJM University, Kanpur. All the experiments were conducted in incubator at 32° C under laboratory condition. It was found that largest pupal period (10.02 days) was observed in K. Sona followed by TL 174 and K 65 having the pupal period 10.74 and 11.10 days respectively whereas the highest pupal period was observed in HI 7747 having the period 14.12 days and differs significantly from the other. The intermediate varieties were K 65, UPT 72294 and HD1982 in which pupal period 10.10 days, 10.50 days and 12.40 days were observed respectively which do not differ significantly. The highest period was recorded in UPT 72294 having 44.96 days, which differs significantly from to each other. The highest percentage of adult emergence were noticed in UPT 72294 followed by TL 174. Whereas lowest emergence were in HI 7747 in which the last emergence were found.

Keywords: *Triticum aestivum*, indigenous, adult emergence and poacea

1. Introduction
The major occupation of most of the all over the world is agriculture and more than 70% of Indian population depends on agriculture for their livelihood (Teotia and Singh, 1968, Rao and Wilbur,1972, Campbell and Sinha,1976) [1, 2, 3]. Food grain losses due to insect infestation during storage are a serious problem, particularly in the developing countries (Talukder *et al*. 1993 and Jeeva *et al*. 2006) [4, 5] Seventy per cent grain losses due to insect infestation are the most serious problem in storage, particularly in villages and towns of developing countries like India (Jacobson,2004) [6]. It has been estimated that about 15-20% of the world agricultural production is lost every year due to insect infestation (Weaver and Subramanyam. 2006) [7]. In India losses caused by insects accounted for 6.5% of stored grain (Dubey *et al*. 2008) [8]. Their attacks reduce both the quantity and quality of stored seed. *Rhyzopertha dominica* Fab. (Coleptera: Bostrichidae) is the most common and injurious to stored grains having an important position among the storage pests (Jacobson, 2004, Kiruba *et al.* 2006) [9, 10]. The test insect lesser grain borer, *Rhyzopertha dominica* Fabricius is a cosmopolitan pest of a wide variety of food granries mainly cereals but also include grains from families Poeaceae particularly rice, wheat, sorghum, oats, pearl, millet, malt, barley and Fabaceae like chickpeas, peanuts, beans (Loganathan *et al*.2003, Huang and Subramanyam, 2005, Udo, 2011, Singh and Chandel, 2019) [11, 12, 13, 14]. The objectives of the present study are to assess the Pupal development and adults emergence of lesser grain borer, *R. dominica* Fabr. on different wheat varieties.

2. Materials and Methods
Material and methods Examination of the influence of different wheat grain varieties ie; HI 7747, K 65, TL 174, UPT 72294, HD 1982 and Kalyan sona 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 Chandel *et al*.2011 [15]. The experiments were conducted in bio-pesticide and toxicological laboratory, Department of Botany, 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

Nagar, Uttar Pradesh, India is situated at an elevation of about 127.117o metres above the mean sea level and has a semi-arid subtropical zone.

2.1: Tested insect and their rearing

The lesser grain borer, *Rhyzopertha dominica* Fabricius was reared on wheat kernels 450 g, and 100 adults were put in a glass jar (13 cm Diameter x 20 cm height) with the bottom covered with black. Adults of *R. dominica* of both sexes and 2-4-weeks old 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 laboratory, Department of Botany, D.B.S, College, affiliated to C.S.J.M. University, Kanpur Nagar, U.P. India

2.2: Collection of wheat grains:

Only healthy sound and free from injury wheat grains will take for study. Healthy wheat grains, *Triticum aestivum* (L.) were purchased from the local market of Kanpur Nagar, cleaned thoroughly and sun dried. The grains were cooled at 8-10% moisture level and stored at room temperature in air tight plastic bag for experimental use.

2.3:Tools Used: The tools like egg laying apparatus, glass jars petri-dish a 100 mesh sieve, plastic jars with perforated top, Camel hair brush, muslin cloth, chemical balance, complete with weight box magnifying hand lens and a binocular microscope etc. was used in the present investigation.

2.4: Obtaining Eggs: for Different Experiments The newly emerged male and female of *R. dominica* (Fabr.) distinguished by observing a number of characters mentioned above, was keep into a special egg laying apparatus. It is a special device, consisting of glass chimney at the top, tied with muslin top, kept on the ordinary sieve netting. The sieve and chimney kept over petridish will keep above another petridish, which is just reverse in their position as above petridish. The whole device kept on large petridish filled with water Adults will provide 0.5 per cent glucose solution with the help of soaked cotton wool and hanged in the center of the top muslin cloth of the chimney. Just emergence, the adults are sluggish and less active but after a few times they become more active, males are more active than the females. 0-2 and hours old eggs removed from the petri-dish regularly and kept into the specimen tubes labeled with date-wise to find the known aged eggs.

1. **Experimental Protocol:** The tests were carried out by placing 40 wheat kernels in glass containers (35 mm ∅; height 20 mm) with 10 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. Pupal test was conducted according to (Singh and Chandel,2014) [16]. with minor modifications. The extracted materials were weighed and dissolved in petroleum for making different concentration (0.5, 1.0 and 2.0% along with control). Pilot experiments were done to obtain the appropriate concentrations of each extractive (0.5, 1.0 and 2.0%). Before applying extracts to the thorax of the insect, 10 minutes chilling were done with 4 0C in refrigerator. Then 1 µl of prepared solution was applied to the dorsal surface of each insect using a micropipette (volume digital micropipets, bio-rad, India). The response of different wheat varieties was assessed as by observing the *R. dominica* pupal development and percentage of adult emergence. The methods described earlier were followed. The data are recorded in Table and figure 1 to 3, respectively.

2. **Experimental Findings:** In order to ascertain the relative pupal development and their adult emergence of different indigenous wheat varieties to *Rhyzopertha dominica* (Fabr.), the following experiments were conducted: -

Table 1: Showing the average pupal period of *R. dominica* with in different varieties of wheat

Sr. No.	Wheat Varieties	Larval Period in Days					
		R_1	R_2	R_3	R_4	Total	Average
1.	HI 7747	14.00	14.50	14.00	14.00	56.50	14.12
2.	K 65	10.33	10.33	12.75	11.33	44.41	11.10
3.	TL 174	11.00	11.25	9.37	11.34	42.96	10.74
4.	UPT 72294	12.70	12.13	11.25	10.00	46.03	11.50
5.	HD1982	12.50	12.00	12.50	12.60	49.60	12.40
6.	Kalyan Sona	10.50	10.00	8.25	11.33	40.08	10.02

Analysis of variance

Source of variation	DF.	S.S.	M.S.	Variable Ratio	'F' 5%	At 1%
Treatment	5	41.97	8.39	9.02	2.77	4.25
Error	18	16.79	0.93			
Total	23	58.76				

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

SE. I 0.68

C.D. at 5% 1.43

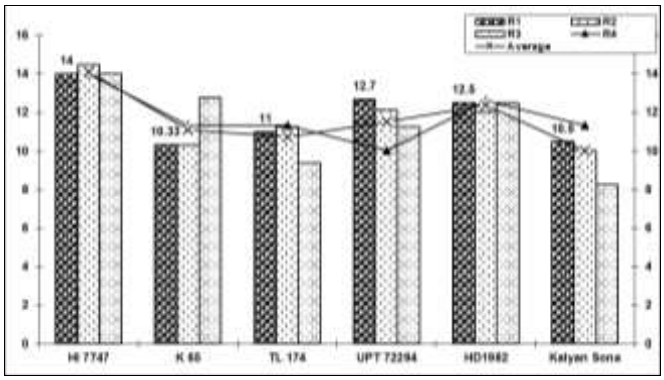

Fig 1: Showing the average pu al period of *R. dominica* with in different varieties of wheat

It was found table-1 and figure-1 that different varieties of wheat can be grouped into certain categories in regards of their pupal period of *R. dominica*. The largest pupal period (10.02 days) was observed in K. Sona followed by TL 174 and K 65 having the pupal period 10.74 and 11.10 days respectively. These are not significantly different. The highest pupal period was observed in HI 7747 having the period 14.12 days and differs significantly from the other. The intermediate varieties were K 65 and others. The intermediate varieties were K 65, UPT 72294 and HD1982 in which pupal period 10.10 days, 10.50 days and 12.40 days were observed respectively which do not differ significantly.

Table 2: Showing the mean pupal period of *R. dominica* F. in different indigenous varieties of wheat,*Triticum aestivum* Linn.

Treatment	Wheat Varieties	Mean develop R_1	Period ment R_2	For R_3	Compleat R_4	Total	Average
1.	HI 7747	42.00	44.50	40.00	40.00	166.50	41.62
2.	K 65	42.00	46.66	43.75	41.66	174.07	43.52
3.	TL 174	42.50	42.25	43.37	41.00	169.12	44.96
4.	UPT 72294	49.00	46.33	42.66	41.87	179.86	44.96
5.	HD1982	39.00	38.25	42.00	41.40	160.65	40.16
6.	Kalyan Sona	37.00	39.00	38.00	42.33	156.83	39.21

Analysis of variance

Source of variation	DF.	S.S.	M.S.	Variable Ratio	'F' 5%	At 1%
Treatment	5	89.91	17.98	3.581	2.77	4.25
Error	18	90.36	5.02			
Total	23					

Highly significant at 5% and 1% level of significance.
SE. I 1.58
C.D. at 5% 3.32

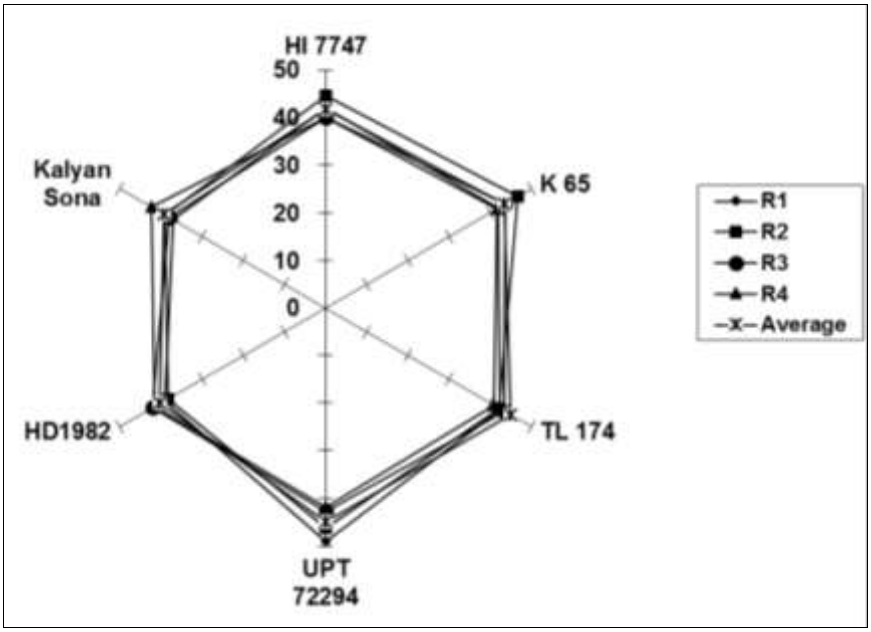

Fig 2: Showing the average complete development period of *R. dominica* with in different varieties of wheat

From the table-2 and figure-2, it is clear that lowest period for complete development period was 39.21 days in Kalyan sona followed by HD1982, HI 7747 and TL 174 having 40.16, 41.62 and 42.88 days, respectively, which do not differ significantly to each other. The highest period was recorded in UPT 72294 having 44.96 days, which differs significantly from to each other. The highest period was recorded in UPT 72294 the adults emerged were very vigorous and healthy in both the sexes and in HD1982 the females were vigorous while males were normal. In TL 174 female were very short and males were normal. In the case of Kalyan sona, it was observed that female were vigorous and males were stout and normal while in case of K 65 and HI 7747 the male were normal and females not seemed vigorous.

Table 3: Showing the average pupal period of *R. dominica* F. in different indigenous varieties of wheat, *Triticum aestivum* Linn.

Treatment.	Wheat Varieties	Larval Period in Days				Total	Average
		R_1	R_2	R_3	R_4		
1.	HI 7747	14.00	14.50	14.00	14.00	56.50	14.12
2.	K 65	10.33	10.33	12.75	11.33	44.41	11.10
3.	TL 174	11.00	11.25	9.37	11.34	42.96	10.74
4.	UPT 72294	12.70	12.13	11.25	10.00	46.03	11.50
5.	HD1982	12.50	12.00	12.50	12.60	49.60	12.40
6.	Kalyan Sona	10.50	10.00	8.25	11.33	40.08	10.02

Table 4: Showing the percentage emergence of *R. dominica* in different Wheat Varieties

Treatment	Wheat varieties	% Age	Adult	Emerged	R_4	Total	Average
		R_1	R_2	R_3			
1.	HI 7747	10	20	10	10	50	12.50
2.	K 65	10	30	40	30	120	27.50
3.	TL 174	40	40	80	30	190	47.50
4.	UPT 72294	70	60	50	80	260	65.00
5.	HD1982	20	40	40	60	150	37.50
6.	Kalyan Sona	20	20	40	30	110	27.50

Transformed data (Angular Transformation)

Treatment	Wheat Varieties	Symbol of the variety	% Age	Adult	Emergence	R_4	Total	Average
			R_1	R_2	R_3			
1.	HI 7747	V_1	18.44	26.56	18.44	18.44	81.88	20.47
2.	K 65	V_2	18.44	33.21	39.33	33.21	124.09	31.02
3.	TL 174	V_3	39.23	39.23	63.44	33.21	175.11	43.78
4.	UPT 72294	V_4	56.79	50.77	45.00	63.44	216.00	54.00
5.	HD1982	V_5	26.56	39.23	39.23	45.00	150.02	37.50
6.	Kalyan Sona	V_6	25.56	26.55	29.23	33.21	125.56	31.39

Analysis of variance

Source of variation	DF.	S.S.	M.S.	Variable Ratio	'F'	At
					5%	1%
Treatment	5	2692.72	538.55	7.42	2.77	4.25
Error	18	1306.04	72.55			
Total	23	3998.76				

** Significant at 5% and 1% level of significance.

SE. I 6.02

C.D. at 5% 12.65

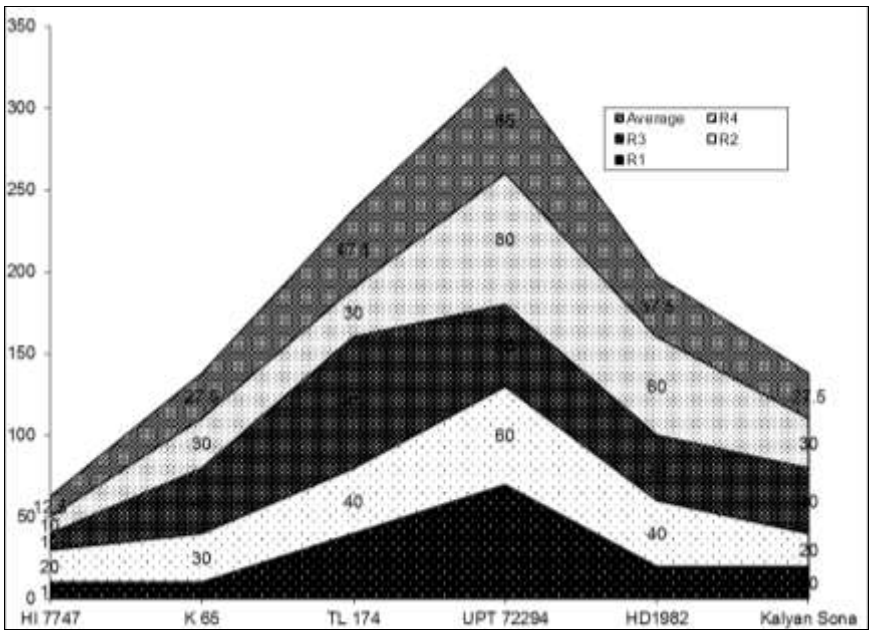

Fig 4: Showing the percentage emergence of *R. dominica* F in different indigenous varieties of wheat, *Triticum aestivum* Linn.

From the above table and also represented symbolically it is clear that the highest percentage of adult emergence were in UPT 72294 followed by TL 174. It was observed in this observation that the lowest emergence were in HI 7747 in which the last emergence were found. The variety HI 7747, K 65 and Kalyan Sona are not significantly different from each other. The variety HD1982 and TL 174 stood intermediate in position.

4. Discussion

In the support of above findings various varieties of stored grain were suitable for survival of their test insects by many scientist as Koura *et al.* 1971, Gokhale 1973, Bhatia *et al.*1975, Bhattacharya *et al.* 1975, Mullen and Arbogast, 1977, Satyavir, 1982a, Banerjee and Nazimuddin, 1983, Katiyar and Khare 1983, Khattak, *et al.*1987, Ram Chunni and Singh, 1996 [17, 18, 19, 20, 21, 22, 23, 24, 25, 26]. According to Malathi *et al.* 2001, Elhag 2002 and Loganathan, *et al.*2003 also reported similar findings in support of present investigation [27, 28, 29, 30, 31]. Beside above findings Birch and Snowball (1945) observed that eggs of *Rhizopertha dominica* (Fabr.) are developed at constant temperature [32]. Srivastava

and Pant (1989) made the study on the effect of host species on the development of *C. chinensis* and concluded that beetles lay more eggs on smooth seed with well-defined seed coat than those with depressed, wrinkled or rough surface. It was also observed that more eggs were laid on bigger seeds [33]. Pant and Dang (1969) described that *Tribolium castaneum* Herbst was developed in the appropriate food value of several stored commodities [34].

Boldt (1974) observed the fecundity of *S. cerealella* in stored wheat to be greatest at the temperatures 20-30 ºC. Development of pupae was shortest at 30-32 ºC, and differences due to relative humidity were not significant. The optimum conditions for development, attainment of adult weight and percentage emergence were 30-32 ºC and 65-80.0 per cent relative humidity [35].

Pandey and Singh (1974) conducted an experiment to test the relative resistance of certain main varieties *viz* Vijay, Son, Ganga-2, Kisan, EH 486, Ganga-5 and Johnpuri against *R. dominica* and found that Ganga-2, Vijay and EH 486 were relatively much resistant than remaining varieties [36]. Singh *et al.* (1974) made studies on the oviposition and development of *S. oryzae* in high yielding varieties of wheat at all combinations of three temperatures 19, 25 and 90.0 per cent. Oviposition and development were best in the varieties with highest moisture content at any level of relative humidity or 15-15.5 per cent moisture content. A combination of 30ºC and 75.0 per cent relative humidity was the best for oviposition and development [37].

Singh and Pandey (1975) conducted an experiment regarding co-relative studies between *R. dominica* and *S. cerealella* on 11 maize variety between insect population and percentage of damage, percentage damage and loss in weight and insect population and loss in weight against both the pests separately. The value were 0.94, 0.85 and 0.94 in case of *R. dominica* and 0.58, 0.60 and 0.96 in case of *S. cerealella*, respectively. These values are highly significant and positive, which indicate clearly that increase in one factor will effect other, means if one increases, the other will certainly increase and vice-versa [38].

5. Conclusion

In the present fings the largest pupal period (10.02 days) was observed in K. Sona followed by TL 174 and K 65 having the pupal period 10.74 and 11.10 days respectively. These are not significantly different. The highest pupal period was observed in HI 7747 having the period 14.12 days and differs significantly from the other, while in complete development is 39.21 days in Kalyan sona followed by HD1982, HI 7747 and TL 174 having 40.16, 41.62 and 42.88 days, respectively, While the highest percentage of adult emergence were in UPT 72294 followed by TL 174. It was observed in this observation that the lowest emergence were in HI 7747 in which the last emergence were found. The variety HI 7747, K 65 and Kalyan Sona are not significantly different from each other. The variety HD1982 and TL 174 stood intermediate in position.

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