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Susceptibility of wheat, *Triticum vulgare* (Linn.) genotypes to the lesser grain bore, *Rhizopertha dominica* Fabricius (Coleoptera, Bostrichidae) larvae

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Abstract
The lesser grain borer, *Rhyzopertha dominica* Fabricius (Coleoptera: Bostrichidae) is a primary pest of stored wheat. Many authors studied its development on this cereal like (e.g. wheat, rice, sorghum, oats, pearl, millet, malt, barley chickpeas, peanuts and beans etc. The aim of performed laboratory experiments was to assess the feeding preferences for the different varieties of wheat viz; HI 7747, HD 1982, K 65, Kalyan Sona, TL 174 and UPT 72294 and to evaluate their susceptibility/resistance to progeny production of *R. dominica* particularly larvae. The experiments were conducted at 28°C and 60 ± 5% of relative humidity. The mean survival rate of R. dominica larval and dockage in various wheat were determined. The influence of the wheat genotypes on the larval development of *R. dominica* was significant. 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 1982.

Keywords: *Rhyzopertha dominica*, susceptibility, UPT 72294, TL 174 and HD 1982

1. Introduction
The lesser grain borer, *Rhyzopertha dominica* Fabricius, (Coleoptera: Bostrichidae) is a cosmopolitan pest of a wide variety of food grannies mainly cereals but also include grains from families Poeaceae (e.g. rice, wheat, sorghum, oats, pearl, millet, malt, barley) and Fabaceae (e.g. chickpeas, peanuts, beans) (Edde, 2012) [1]. The lesser grain borer is one of the great economic importances in the Indian sub-region of oriental region and many other zoogeographical regions of the world (Bashir 2002) [2]. The economically most important beetles infesting cereal grains on a worldwide scale, and its feeding can reduce kernels to the pericarp (Campbell and Sinha 1976) [3]. Stored product *R. dominica* beetles are resistant to many grain protestants (Parkin 1965 and Pandey and Singh, 1974) [4, 5].
The mean survival rate of *R. dominica* larvae and adults, progeny emergence and amounts of insect-damaged grains and dockage in various wheat grain varieties were determined (Astuti *et al*. 2013) [6]. Also, influence of lesser grain borer feeding on chemical properties was found out. The influence of the grain species on the development of *R. dominica* was significant. Females lay eggs on the surface and newly born larvae drill into the kernels, preferring breaks or the germ area where the covering testa is loose (Chanbang *et al*. 2008a) [7]. On damaged kernels, first instars larval mortality decreases (Mebarkia *et al.* 2009) [8] and progeny production increases (Surtees 1964) [9], while hardness of kernels has no effect on *R. dominica* reproduction (Bhatia and Gupta 1969; Sinha *et al.* 1988; Towes *et al*. 2000) [10-12].
Rhyzopertha dominica females lay eggs on the surface and newly born larvae bore into the kernels, preferring breaks or the germ area where the covering testa is loose (Singh and Pande, 1977) [13]. On damaged kernels, first instar larvae mortality decreases (Metwaly *et al.* 2015) [14]. and progeny production increases, while hardness of kernels has no effect on *R. dominica* reproduction (Arthur *et al.*2012, Ozkaya *et al.* 2009) [15, 16]. A lot of research was conducted which dealt with the influence of the species and variety of the plant on the development of R. dominica and occurrence of the progeny (Storey *et al.*1983 and Amos *et*

al. 1986) [17, 18]. The objectives of this study are to assess the larval feeding preferences for the varieties of wheat and to evaluate their susceptibility/resistance to *R. dominica* Fabr.

2. Materials and Methods

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 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 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. The whole amount of all varieties will keep in the above incubator for 12 hours for disinfections

3. Experimental Protocol

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) [17].

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 and) [18, 19]. 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. The data obtained are recorded in table -1 and table-2

4. Statistical analysis

Results of examination were expressed in percent of larval survival (%) with computed standard error (SE). The ratio of these estimated variances in known as the variance ratio or 'F'. This observed value of 'F' is compared with the theoretical value of 'F' given by Finney, (1952) [19]. for testing the significance. The standard error of mean (S.Em.) is calculate ed as /2VE. It is a measure of their variation in the means due to sampling errors and gives an indication of the comparative reliability of the estimated mean. The critical difference (C.D.) is the product of (S.E.) Diff. X t 5%, which is the minimum value required in order to make differences between any two means, may be considered significant. The C.D. at 5.0 per cent level for the results of each investigation are given under the respective table.

Table 1: Varietal food preference of *R. dominica* larvae on wheat releasing 100 larvae

Treatments	Number of larvae presence 0n each Replication			Total Number of larvae / Mean Percentage of larvae	
Varieties	Repication-1	Repication-2	Repication-3	Total Number of larvae	Mean % Larvae
HI 7747	2	1	1	4	1.33
HD 1982	4	8	5	17	5.66
K 65	2	1	1	4	1.33
Kalyan Sona	6	7	1	14	4.66
TL 174	15	8	7	30	10.00
UPT 72294	25	18	26	69	23.00

Analysis of variance

Source of variation	DF.	S.S.	M.S.	Variable Ratio	'F'	At
					5%	1%
Treatment	5	1001.33	200.27	22.52	3.11	5.06
Error	12	106.67	8.87			

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

SE. ± 2.43

C.D. at 5% 5.29

Treatment	UPT 72294	TL 174	*HD 1982*	Kalyan Sona	K 65	HI 7747
	23.00	10.00	5.66	4.66	1.33	1.33

The highest number of *Rhyzopertha 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 1982.

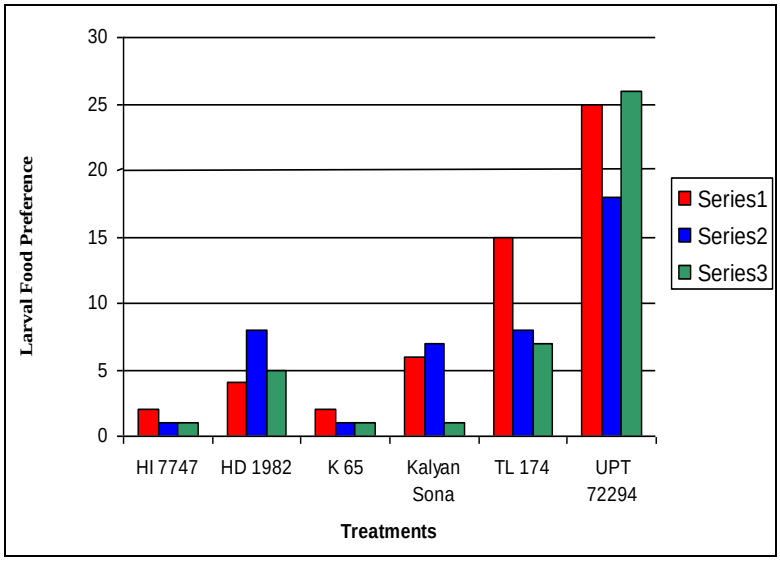

Fig 1A: Varietal food preference of *Rhyzopertha dominica* larvae on wheat irrespective of replications.

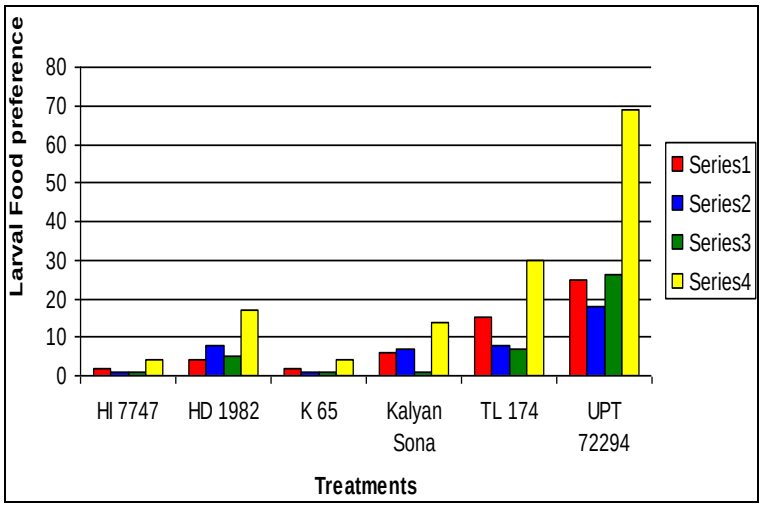

Fig 1b: Varietal food preference of *R. dominica* larvae on wheat irrespective of replication and their number

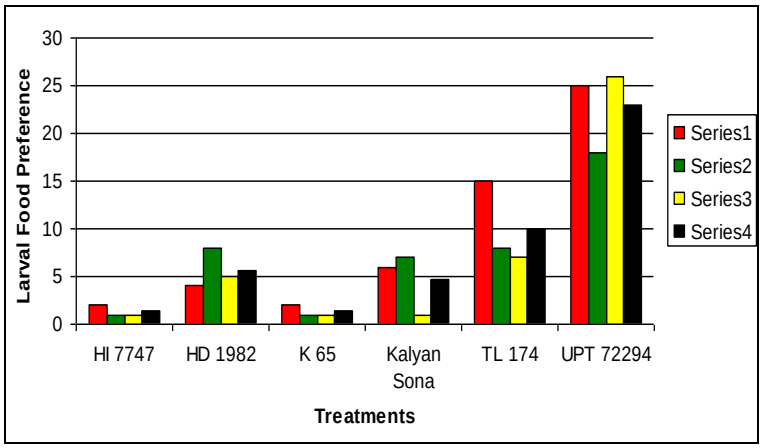

Fig 1C: Varietal food preference of *R. dominica* larvae irrespective of replications irrespective of replications, Number and mean larval %

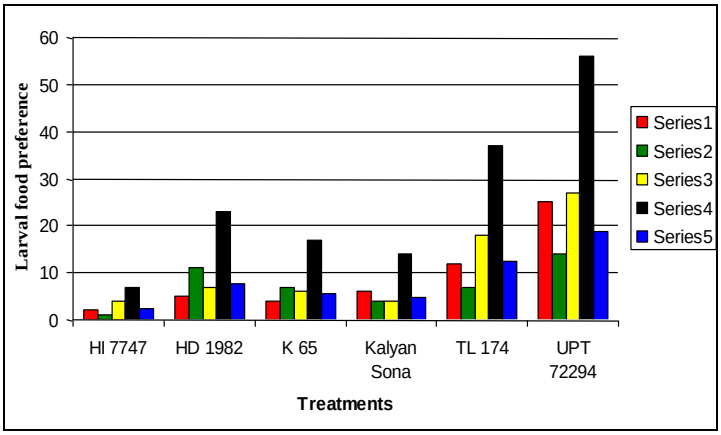

Fig 1d: Varietal food preference of R. dominica irrespective of replications, Number, average and mean %

Table 2: Varietal food preference of *Rhyzopertha dominica* Fabr. larvae on wheat by putting 100 larvae centre in varieties

Treatments	Number of larvae presence 0n each Replication			Total Number of larvae / Mean Percentage of larvae	
Varieties	Repication-1	Repication-2	Repication-3	Total Number of larvae	Mean % Larvae
HI 7747	2	1	4	7	2.33
HD 1982	5	11	7	23	7.66
K 65	4	7	6	17	5.66
Kalyan Sona	6	4	4	14	4.66
TL 174	12	7	18	37	12.33
UPT 72294	25	14	27	56	18.66

Analysis of variance

Source of variation	DF.	S.S.	M.S.	Variable Ratio	'F'	At
					5%	1%
Treatment	5	538.45	107.69	8.28	3.11	5.06
Error	12	156.00	13.00			

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

SE. ± 2.94

C.D. at 5% 6.406

Treatment	UPT 72294	TL 174	*HD 1982*	Kalyan Sona	K 65	HI 7747
	18.66	12.33	7.66	5.66	4.66	2.33

The 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-1

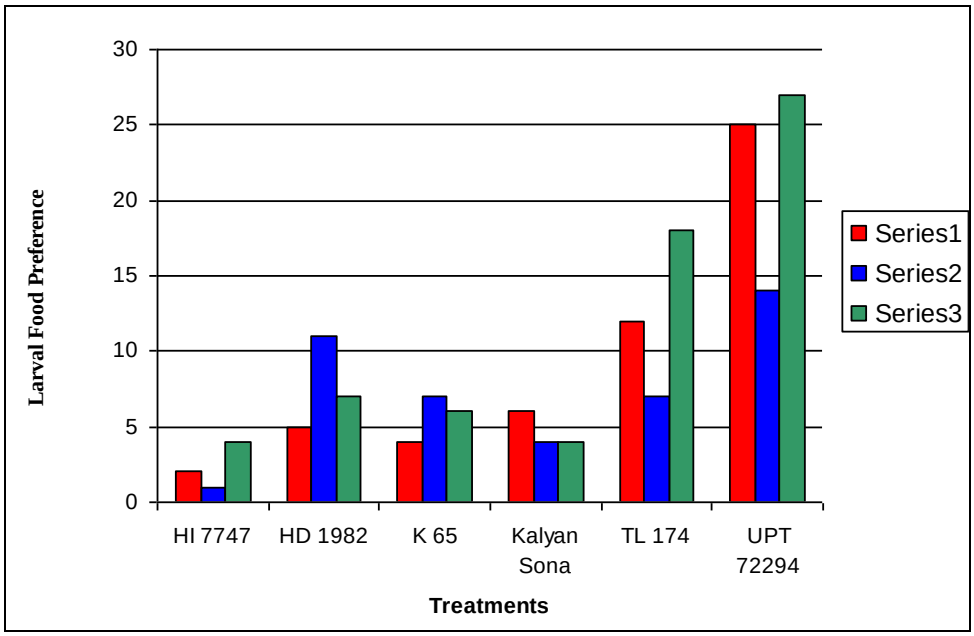

Fig 2a: Varietal food preferences of *Rhyzopertha dominica* larvae on wheat irrespective of replications

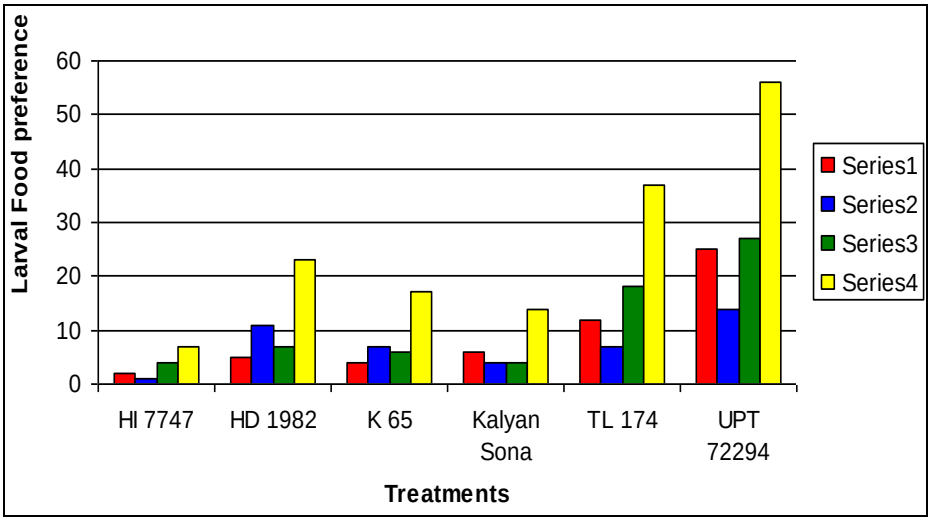

Fig 2b: Varietal food preference of *R. dominica* larvae on wheat irrespective of replication and their number

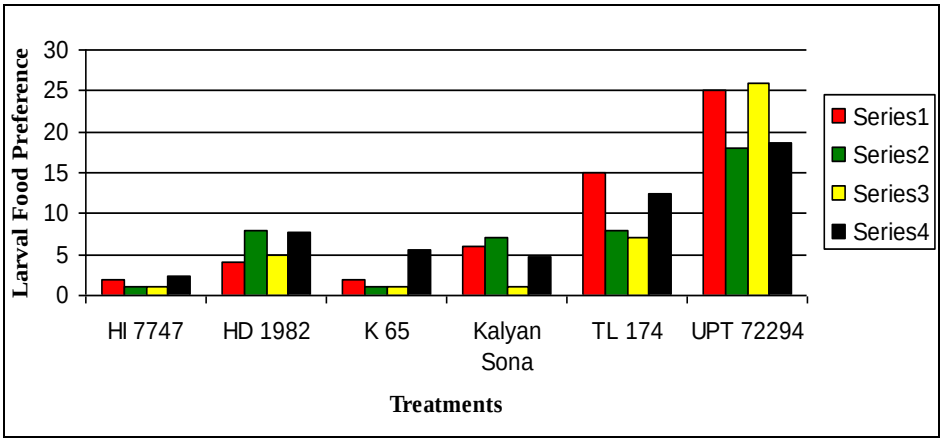

Fig 2c: Varietal food preference of *R. dominica* larvae irrespective of replications irrespective of replicatoins, Numbers and mean larval %

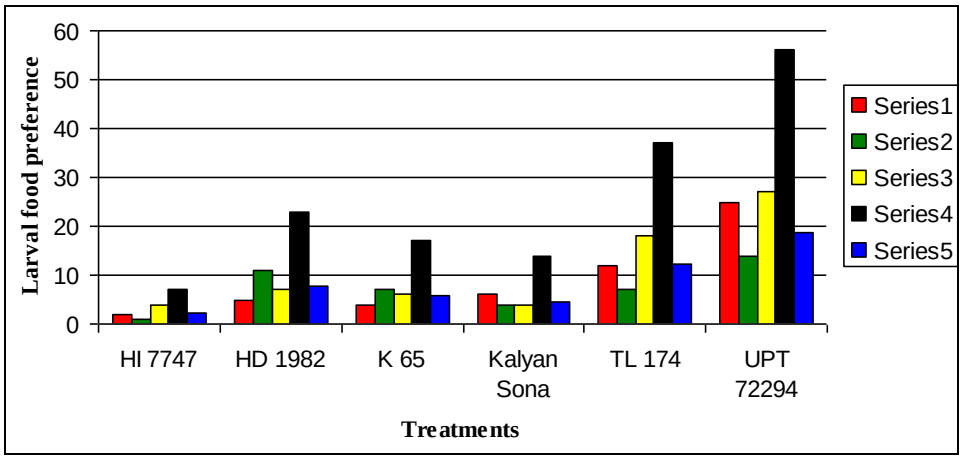

Fig 2d: Varietal food preference of *R. dominica* irrespective of replications, Number, average and mean %

5. Result and Discussion

The data depicted from Table 1 and figure 1a, 1b, 1c and 1d that the highest number of *Rhyzopertha 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 1982 Similarly, 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.

In the conformity of the present finding with these of entomologist who works on food preference and susceptibility of *Rhyzopertha dominica* for different stages of their development particularly larvae and adults as:- 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 temperature 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 30 ºC and 75.0 per cent relative humidity was the best for oviposition and development [20]. Bhatia *et al.* 1975 conducted a laboratory experiments for testing the different varieties of barley for their resistance and found that indigenous barley grain varieties are much resistant to lesser grain borer than the rice weevil under storage conditions [21]. Mookherjee, *et al.* (1969) made some observations on the damage potential of *C. cautella* and recorded that the shelled groundnuts severely damaged as the feeding occurred in every part. In other grains, except, rough rice (paddy) where there was practically no damage, feeding always began at germ point and the initial damage to the part was very high in rice and wheat, moderate in soybean, *jowar* and least in linseed or *til*. In the last four grains, feeding was continued beyond the germ point. There was hardly any insect development on wheat, sorghum, rice and *til* in the absence of germ point [22].

Pingale (1967 and 1984) mentioned that *C. chinensis* starts its infestation from the field on ripening pods of legumes and infestation continues in the storage. The beetle laid eggs on the surface of grain. The larvae after hatching, penetrate into the grain and start feeding. The insect completes its larval and pupal stages inside the grain. The beetles do not attack the crushed legumes [26, 27]. Mukherjee *et al.* (1968) revealed that *S. oryzae* infesting maize and jowar, *T. granarium* and *R. dominica* infesting wheat and *C. maculatus* infesting mung, pea and gram, can be killed in all stages by resorting to heating for varying periods of temperatures at 45 ºC to 55 ºC [28].

Beside above some workers reported the varietal response of certain stored grains susceptibility to their food materials as (Teotia and Pandey, 1968, Teotia and Singh, 1968, Simwat and Chahal, 1969, Singh *et al.*1972, Rout, *et al.* 1976, Qi and Burkholder, 1981, Sharma *et al.*1976, Sudhakar and Pandey,1982, Zaz *et al.*1982, Srivastava and Pant 1989, Stamopoulos,1991, Singh *et al.* 1993,,Singh and Sharma, 1996, Sharma *et al.*2001, Tewari and Sharma 2002 [29-43]. Uttam, *et al.* 2002, tested 16 varieties of 7 species of grain legume for the resistance to the infestation by bruchid *C. chinensis*. The greatest damage was observed on *moong* bean and least on lentil, broad bean, cowpea and one variety of gram, pigeonpea, adzupi bean and most of chick pea varieties were intermediate. Ovipositional antixenosis in the resistant of chickpea variety was due to the rough almost spiny pericap. Antibiosis was expressed in lentil, broad bean and cowpea [44].

6. Acknowledgement

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