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Screening of Legume and Cereal seeds against *Callosobruchus maculatus* on the Basis of Fecundity and Longevity

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Abstract: The fecundity and development of *Callosobruchus maculatus* on legumes and cereals was studied at College of Agricultural Dera Ghazi Khan. Temperature and relative humidity during the investigation were 30.2-34°C and 46-61%.The data was taken at 24 hours interval. Cereals and legumes seeds were examined and found that eggs were occasionally laid on wheat, maize and red cow-pea but larva did not survive on these grains, while on rice there was no egg laying .Moreover *C. maculatus* did not develop on lentil seeds. The highest frequency of *C. maculatus* i.e., 81.0 eggs was recorded on gram seeds, while the lowest frequency i.e., 23.0 eggs were recorded on wheat. Adult female life was ranged between 6.6-80 days, where the highest age was observed on white gram seeds and the lowest on rice seeds. Adult male life was observed between 6.0-7.2, where longest age on black gram seeds and the shortest on rice. Similarly the shortest egg to adult period (19 days) was recorded on powder of black and white gram seeds and the longest 65 days on the mung bean seeds. Moreover the highest adult emergence (95%) was recorded on white whole gram and the lowest (11.7%) on crushed black gram in the same way the highest male to female ratio was recorded on mung bean which was 2:1 and the lowest on white cow-pea here number of female are greater than male (1:2.67).Further the highest average weight of individuals of *C. maculatus* was recorded when feed on white cow-pea which was 7.5mg and the lowest 5.0mg when feed on whole black gram seeds.

Key words: Legumes pest, *Callosobruchus maculatus*, fecundity and longevity, stored grain pests**.**

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1. Introduction

Cereals are crops of the family Gramineae planted primarily for their edible seeds for human consumption and as a fodder for animals feeding. They provide about 60% of the calories and 50% of the protein to human race (Wittwer 1980).The economics of Pakistan and many other agricultural countries depend directly upon cereals and indirectly the prosperity of all nations depends upon increased production of cereals. Besides a major source of food for human being the cereals are used as feed for livestock and as industrial raw material for products of many food and non-food production. Cereal crops are cultivated upon an area of 13099500 million hectares with an average production of 34302500 million tons in Pakistan, while areas under cultivation and production in Punjab remained 9605300 million hectares and 2578500 million tons respectively (Agricultural statistics of Pakistan 2010-2011).

Similar to cereal the pulses are also a good source of food nutrients (proteins, carbohydrates, lipids, vitamins and minerals) and food energy (Tajamal 1985) and comprise the major portion of Pakistani food (diet).They are cultivated upon an area of 1328800 million hectares in Pakistan with an average production of 656000 tones while the area under pulses cultivation and production in Punjab is 1127600 hectares and 522000 million tons respectively (Agricultural statistics of Pakistan 2010-2011).

Both the cereal and pulses are infested by a large number of insect species in fields but due to some management and control measure the pests are controlled and the damage is not recovered. After harvest the crop produce is stored as grains for future consumption, even at this stage the commodities are not safe. In stores the grains and pulses are attacked by a number of storage pests. The storage pests cause colossal damage to the commodity which reduces not only the quantity but also the quality of seeds. Of these, the spotted bean weevil, *Callosobruchus maculatus* (Coleoptera: Bruchidae) is the most notorious storage pests of the common legumes (Mung bean, Mash, Gram, Lentil, Garden pea, Cow-pea, whole black gram and soya-bean), which is widely spread in Asia, Africa, Central and South America.

Body length of the *C. maculatus* adults' ranges from 2.5 to 3mm, the color of elytra is reddish brown and whitish hairs on elytra are arranged like a letter "X", female of four spotted bean weevil laid up-to 100 eggs. Hatched larva enters the seed where

it completes its development. Before pupation the larvae reach the periphery of grain, pierce its surface to make a round hole for the exit of adult beetle and then pupate. The entire life cycle takes 40-178 days. It can produce several generations in a year (Zakladonio and Ratanova, 1987).

Keeping in view the importance of crops and storage of the produce on one hand and their deterioration due to the pulse beetle on the other hand, a research project designed to screen the legumes and cereals.

2. Material and Methods

The experiment was conducted at College of agriculture Dera Ghazi Khan during 2012-2013. The culture of the test insect was raised in control laboratory conditions on various kinds of legumes seeds in storage research laboratory of Entomology section. The materials other than the insects include food commodities (pulse and cereals); containers, mason jars, plastic bags, chemicals and muslin cloth etc. were purchased from the local market.

Before start of the experimentation legume seeds and powder (White whole gram, white crushed gram, mung bean beans, lentil, red cow-pea, white cow-pea and black whole gram) and cereal seeds (wheat, maize and rice) were conditioned at 4±1°C for 10 days to make sure that the commodities are free of any infestation.

2.1 Reproductive potential of *Callosobruchus maculatus*

In order to study reproductive potential of *Callosobruchus maculatus* one pair of one day old adults was released in 10grams of the legume and cereal grains contained in Mason jar. There were 10 treatments consist of seven legume and three cereal seeds. Experiment was conducted five times. The seven types of leguminous grains include mung bean (*Vigna radiata*), black gram (*Cicer arietinum*), white cowpea (*Vigna unguiculata*), red cow-pea and lentil (*Lens culinaris*). Three types of cereal grains include wheat grains (*Triticum aestivum*) maize (*Zea mays*) and rice (*Oryza sativa*) grains. In each replicate the food commodity was changed daily to facilitate the data recording and rectify any error in eggs counting that may happen otherwise. Eggs counting were done in each replication at the interval of 24hours until the female insect dies away. Daily record of laboratory temperature and humidity was maintained throughout the experimental period.

2.2 Development and life cycle

Another experiment was conducted to determine the development and effects of food commodities on life cycle of *Callosobruchus maculatus* in legumes and cereals. For this experiment one pair of adult beetle was released in each commodity. Observations on egg laying were being made every day. The grains containing eggs on them were separated and preserved for future studies. Keeping the record of egg laying and onward observations was helpful in determination of number of egg lying by the female and viability of eggs i.e. number of eggs hatched out of the total number. Similarly larval and pupal periods was calculated through the recorded information .The data was converted into percentage in order to facilitate the description of results. On completion of experiment the data was statistically analyzed and results were evaluated after proper tabulation of the observations.

3. Results

3.1 Fecundity

The results on fecundity of *Callosobruchus maculatus* on three cereals (wheat, rice and maize) and seven legumes (White whole gram, white crushed gram, lentil, red cow-pea, mung bean, white cow-pea and whole black gram) are depicted in Table.1.

The data indicates that the highest fecundity of *C. maculatus* on the first day of observation was recorded on whole gram there were 19.0 eggs counted on this commodity followed by mung bean, red cow-pea black gram, lentil, white cow-pea and white crushed gram giving 18.6, 9.2, 7.0, 6.6 and 4.8 respectively. The lowest fecundity was recorded on maize where the number of eggs was enumerated as 0.8 while no egg laying was noticed in wheat and rice during the observation period.

The statistical analysis of the data showed that white whole gram and mung bean were although significantly similar to each other but were proved different from rest of the treatments. Similarly red cow-pea was found significantly different from the remaining treatments. Lentil, white cow-pea gram and whole black gram were found equally responsive and did not show significant difference from one another but were found different from the white crushed gram and maize that had the lowest number of eggs of the test insect. Zero fecundity (no egg) was observed in wheat and rice grains.

Table 1. Fecundity of *Callosobruchus maculatus* on different commodities.

Treatments	Mean no. of eggs laid after						
	Day 1	Day2	Day3	Day4	Day5	Day6	Total
Wheat	0.0E*	0.60E	12.0E	11.0ABC	1.8D	0.0D	25.4D
Rice	0.0E	0.0F	0.0E	0.0D	0.0D	0.0D	0.0D
Maize	0.80E	3.0E	6.8T	7.2C	4.0D	1.2C	23.0D
whole white gram	19.0A	23.4A	17.2AB	11.60ABC	8.4A	2.2BC	81.0A
Crushed white	4.8D	8.2D	14.4BC	14.4A	6.06AB	2.6B	51.0C
Lentil	6.8C	14.4BC	16.0ABC	7.4BC	4.4C	2.0BC	50.60C
Red cow-pea	9.2B	13.6C	14.6BC	11.60ABC	8.0A	4.2A	61.20B
Mung bean	18.6A	14.0C	14.0BC	11.20ABC	5.4BC	2.4B	65.6B
White cow-pea	6.6C	16.6B	21.0A	11.80ABC	7.4AB	2.4B	65.0B
Whole black gram	7.0C	13.2C	18.80A	11.80ABC	6.4AB	2.2BC	60.40B

*Values sharing different letters are statistically different at 5% probability.

On the second day of observation the highest egg laying was recorded in white whole gram which was enumerated as 23.40 followed by white cow-pea, lentil, mung bean, red cow-pea, crushed white gram and maize where fecundity was 16.6,14.4,14.0,13.6,13.2,8.2, and 3.0 respectively. The lowest fecundity was recorded on wheat which was 0.60 while it was 0.0 on rice.

The analyzed data shows that response of white whole gram was significantly different from that of the other treatments. Similarly white cow-pea and lentil were statistically non-significant to each other but were different from rest of the treatments. Lentil, red cow-pea, mung bean and whole black gram were statistically similar to each other but significantly different from the other treatments. Moreover significant differences were found between maize and white crushed gram which were also different from rest of the treatments. Since rice had zero egg laying no comparison could be made with the other treatments.

On the third day of observation the highest fecundity was recorded on white cow-pea which was 21.0 followed by black gram, lentil, red cow-pea, white crushed gram, mung bean and wheat where numbers of eggs were counted as 19.80, 17.20, 16.00, 14.60, 14.00, and 12.00 respectively. The lowest fecundity was recorded on maize which was 6.8 while similar to that of previous record no egg laying was recorded in rice grains.

The statistical analysis of the data indicated that whole gram, lentil, white cow-pea and whole black gram had no significant difference among them but were significantly different from the other treatments. Similarly whole gram, white crushed gram, lentil red cow-pea and mung bean were non-significant to each other while significantly different from rest of the treatments .On the other hand wheat, white crushed gram, lentil red cow-pea and mung bean were statistically similar to each other but different from the other treatments .Maize showed the lowest fecundity and was significantly different from all the tested commodities. Since no egg lying was observed in rice, it cannot be compared with any of the treatments.

On the fourth day the highest fecundity was recorded on white crushed gram followed by white cow-pea, black gram, whole-gram, red cow-pea, mung bean, wheat and lentil where the respectively fecundity was obtained as 11.80, 11.80, 11.6, 11.6, 11.20, 11.0 and 7.4.The lowest fecundity of the tested insect was recorded on maize which enumerated as 7.2 eggs while no egg lying was recorded in rice.

The analyzed data showed that the most of the treatments i.e. wheat, whole gram, similar to each other but different from the remaining treatments .Similar responses were given by wheat, whole gram, lentil, red cow-pea, mung bean, white cow-pea and black gram.

On the fifth day the highest fecundity of 8.4 was on white whole gram followed by red cow-pea, white cow-pea, white crushed gram, black gram, mung bean, lentil and maize giving 8.0, 7.4, 6.6, 6.4, 5.4, 4.0 and 4.0 eggs respectively. The lowest fecundity was 1.8 recorded on wheat while no egg lying was done on rice.

The results of statistical analysis indicated that whole gram, white crushed gram, red cow-pea and whole black gram were non-significantly different from one another but significantly different from the remaining treatments. Similarly, white crushed gram, mung bean, white cow-pea and whole black gram were non significantly different from each other while significantly different from rest of the treatments the lowest fecundity was shown by maize but it was found statistically similar to lentil and mung bean and different from rest of the treatments. In case of rice no egg lying was recorded as was noticed in the previous days of observation.

On the sixth day the highest fecundity was recorded on red cow-pea which was 4.2 eggs followed by white crushed gram, mung bean, white cow-pea, black gram, white whole gram and lentil where the respectively number of eggs were obtained as 2.6, 2.4, 2.2, 2.2 and 2.0.The lowest fecundity was recorded on maize where the number of eggs were found 1.2 while no egg laying was recorded on rice during this observation.

The statistical analysis of the data indicated that red cowpea was significantly different from all other treatments. Mung bean, white cow-pea, black gram, lentil, white crushed gram and white whole gram were statistically similar to each other but different from the remaining treatments. Similarly maize was significantly different from the all treatments except whole gram, lentil and black gram.

On the seventh day of the observation female was found dead and no eggs were recorded in any of the treatments.

The average number of eggs laid by a female of *C. maculatus* in her life span were the highest in white whole gram which were 81.80 followed by mung bean, white cow-pea, red cow-pea, whole black gram, white crushed gram, lentil and wheat showing the number of eggs as 65.60, 65.60, 61.20, 60.40, 51.0, 50.60 and 25.40.The lowest number of eggs was 23 which was recorded on maize while no egg laying was recorded on rice during whole life of the female.

It was clear from the statistical analysis of the data that white whole gram reflected significant differences from all tested treatments. Mung bean, white cow-pea, red cow-pea and whole black gram were non-significantly different from the remaining treatments. Similarly white crushed gram and lentil were non-significant to each other but significantly different from the other treatment. Maize showed the lowest fecundity and was significantly different from all other treatments except wheat.

3.2 Adult life:

The data about life span of adult male female *C. maculatus* are depicted in table (2.). the observation show that the highest life period of the female gender was recorded on maize, whole gram, white crushed gram, lentil, red cow-pea and white cow-pea which was 8 days followed by black gram, wheat and rice where the female life was 7.8, 7.4 and 6.6 days respectively.

Table 2: Mean longevity *Callosobruchus maculatus* on different commodities

Treatment	Longevity(days)	
	Female	Male
Wheat	7.40B*	6.6
Rice	6.6C	6.0
Maize	8.0A	6.4
White whole gram	8.0A	6.8
White crushed gram	8.0A	7.0
Lentil	8.0A	7.0
Red cow-pea	8.0A	7.0
Mung bean	8.0A	7.0
White cow-pea	8.0A	7.0
Whole black gram	7.8AB	7.2

*Values sharing different letters are statistically different

Male life is non-significant different at 5% level of significance. Female life is significantly different at 5% level of significance.

Statistical analysis of the data show that rice had minimum life period of the female adults which was statistically different from all other treatments followed in ascending order by wheat and whole black gram which were also statistically different from rest of the treatments. Similarly the longest age of male gender was recorded on black gram which 7.2 days and the shortest on rice were showing 6.0 days. Statistically all the treatments are similar.

Table 3: Life cycle of *C. maculatus* on different commodities

Treatments	Duration of different life stages(days)			
	Egg	Larval	Pupal	Egg-Adult
Wheat	9	___	___	___
Rice	__	___	___	___
Maize				
White whole gram	5	9	2	16
White crushed gram	6	10	3	19
Lentil	6	___	___	___
Red cowpea	6	___	___	___
Mung bean	5	7	3	15
White cowpea	5	9	3	17
Whole black gram	6	8	2	16

3.3 Life cycle

The life cycle of *C. maculatus* was studied on the same commodities i.e. three cereals (wheat, rice and maize) and seven legumes (whole gram, white crushed gram, lentil, red cow-pea, mung bean, white cow-pea and black gram).

The data (table 3) shows that the longest egg period was recorded in wheat which was 9 days followed by maize(8 days),white crushed gram, lentil and red cow-pea (6days) while the shortest egg period was recorded in whole gram, mung bean and white cow-pea (5 days) in each treatment. It was observed that the larvae hatched from the eggs without breaking the eggs shells and tried to penetrate down and started feeding inside the grains. The larvae failed to further develop into pupal stage in wheat, maize, lentil and red cow-pea. The investigations indicated that after initial feeding, the larvae in all treatments died away.

The longest larval period was recorded in white crushed gram which was 10 days followed by white whole gram (9 days), white cow-pea (9days) and whole black gram (8 days) and the shortest larval period was recorded in mung bean which was 7 days. It was observed that the further development of the larvae continued in these treatments so the larvae transformed into pupal form. The pupation took place inside the grains.

The maximum pupal period was recorded in white crushed gram, mung bean and white cow-pea which was 3 days and the minimum pupal period was found in white whole gram and whole black gram which was 2 days in both the treatments. The whole life cycle was recorded in mung bean which was 15 days.

3.4 Emergence Rate

To find out the emergence rate of on three cereals and seven legumes some grains with known number of eggs were separated and kept under observation for further development. It was clear from the data (table 4) that all the eggs were hatched into larvae. However this study was not possible on rice because no eggs were deposited on this commodity.

In further studies it was found that the transformation of pupae from the larvae did not occurred in wheat, maize, lentil and red cow-pea. In the remaining five treatments (whole gram, crushed gram, mung bean, white cow-pea and black gram) the development up-to emergence of the adults were observed accordingly.

But again the difference did occur within these last mentioned five treatments .The maximum emergence was recorded on white whole gram which was 95% followed by white crushed gram, mung bean and white cow-pea where the adult emergence was obtained as 78.57,69.23 and 54.71 percent respectively in descending order. The minimum emergence (11.76%) was recorded in whole black gram where only two larvae developed into pupal and adult stages.

3.5 Sex ratio and body weight

Number of male and female adults was recorded separately in each treatment to find the sex ratio. Additionally the body weights of newly emerged adults were also recorded to estimate the amount of food preferably consumed by the individual on the tested commodities.

The highest male to female ratio was recorded in mung bean which was 2:1 followed by white crushed gram and whole was 1.75:1 and 1.38:1 and in whole black gram the number of male and female is greater than the male adults which gave male to female ratio of 1:2.67 Table 5.

Table 4 Percent emergence of *Callosobruchus maculatus* on different commodities

crops	Egg	Larvae	Pupae	Adult	% emergence
Wheat	15	15	___	___	___
Rice	___	___	___	___	___
Maize	17	17	___	___	___
White whole gram	20	20	19	19	95.00
White crushed gram	14	14	11	11	78.57
Lentil	20	20	__	___	___
Red cow-pea	18	18	__	___	---
Mung bean	13	13	9	9	69.23
White cow-pea	17	17	11	11	64.71
Whole black gram	17	17	2	2	11.76

Table-5 Comparison of sex ratios and mean body weight of the adults produced by a pair of *Callosobruchus maculatus* on different commodities.

Treatments	Eggs	Means adults emergence			Sex ratio	Body weight/individual(mg)		
		Male	Female	Total		Male	Female	Average
Wheat	15	---	---	---	---	---	---	---
Rice	----	---	---	---	---	---	---	---
Maize	17	---	---	---	---	---	---	---
White whole gram	20	11	8	19	1.38:1	4.0	7.0	5.5
White crushed gram	14	7	4	11	1.75:1	5.0	7.0	6.0
Lentil	20	---	---	---	---	---	---	---
Red cow-pea	18	---	---	---	---	---	---	---
Mung bean	13	6	3	9	2:1	5.0	6.0	7.5
White cow-pea	17	3	8	11	1:2.67	7.0	8.0	7.5
Whole black gram	17	1	1	2	1:1	4.0	6.0	5.0

Regarding the recorded bodyweight, the body weight of male and female sexes of *C. maculatus* were recorded separately. The highest body weight per individual adults was found in white cow-pea which average to 7.5 mg where weight of the males was 7.0mg and of the females 8.0mg followed by white crushed gram, white whole gram and mung bean where the average weight per male insect was recorded as 6.0,5.5 and 5.5mg respectively. The separately recorded by weight of male and female sexes was 5.0, 4.0, 5.0, 7.0, 7.0 per adults respectively. In whole black gram the body weight of the adult was the lowest one. The obtained body weight per male adult was 4mg and per female adult was 6.0mg and the average weight per one adult was 5mg.

4. Discussion

The present research was conducted in a partially controlled lab conditions. The studies were consisted of investigation on fecundity and development of *C. maculatus* on cereals and legumes. The temperature and humidity were maintained as 30.2-34.9°C and 46-61% conducted by some previous scientists and is discussed below.

4.1 Fecundity

The fecundity of *C. maculatus* was studies on different food grain species of two groups i.e. cereals (wheat, rice, maize) and pulses (white whole gram, white crushed gram, lentil, red cow-pea, mung bean, white cow-pea and whole black gram). The comparative preference of egg laying by the bruchids was observed on the tested food grains. However, the damage could have been noticed on rice which may have been because of the fact that the surface of rice grains is polished, slippery and hard. The size of the grain may not be sufficient to provide adequate space for larval and pupal development. The moisture content of the rice grains may be less than that of the other grains hence; the female did not prefer this commodity for egg depositing. These results are in agreement with those reported by Xu-weigen and Xu (1990) who stated that it was not found infesting cereal grains, however, egg laying was occasionally recorded these results partially conform the present investigation.

Among pulses the highest fecundity was recorded on white whole gram where the average numbers of the eggs were counted as (81.0) followed by mung bean, white cow-pea, red cow-pea, whole black gram, and white crushed gram having the number of eggs as 65,65,61,40 and 51.0 and the lowest number was 50.60 recorded on lentil. These results indicate that the number if eggs varied from 50.60 to 81.0.These results are also finding partially agreement with those reported by El-Halfawy et al.(1972) who conducted the research on biology of *C. maculatus* on six types of legume seeds and found that number of eggs laid per female averaged from 62.4-93.1.Some support to these findings come from Sharmila-Roy (1994) who studied on oviposition and development of *C. maculatus* on legume seeds on common storage conditions resulted that bruchids preferred the Bengal gram, cowpea, lentil and red gram.

4.2 Egg period

The highest egg period was recorded on cereals. It maybe because of unsuitable host and period ranged from 8-9 days while in legumes it was recorded as non-significant and ranged from 5-6 days.

4.3 Larval period

In case of cereals it was observed that eggs were laid occasionally. After hatching initial feeding was done by the larvae but could not survive and died away shortly. These findings are in accordance with those obtained by Xu-weigen and Xu (1991) who reported that eggs occasionally laid on stored cereals but larvae did not survive.

Among legumes the larvae did not survive on red cow-pea and lentil. Here also the larvae died away after feeding on the grains for a short time. This may be due to hard and slippery seed coat of red cow-pea

and small size of the lentil grains as compared to that of *C. maculatus* and cluster bean for *Callosobruchus* spp. In the remaining treatments the highest larval period was recorded on white crushed gram which was 10 days followed by white whole gram, white cow pea and whole black gram which was 9, 9 and 8 days respectively and the lowest period of 7-days was recorded on mung bean so the larval period varied from 7 to 10 days on the tested food commodities. These findings are in conformity with those obtained by Chokouhian (1993) who reported in a study on biology of *C.* maculatus on legumes that larval stage lasted 8-10 days on the tested legumes.

4.4 Pupal period

Since the larvae could not survive on tested cereals and two of tested legumes i.e. lentil and red cow-pea no further development of bruchid was obtained so the results on pupal development could not be reported. In the remaining treatments pupal period was recorded from 2 to 3 days and was observed that no difference occurred in pupal periods on the tested leguminous grains. These results are partially in agreement with the results reported by Pandey and Singh (1997) who concluded that the combine larval and pupal period of *C. maculatus* as 10 to 13 days.

4.5 Adult life

Adult life for the both genders (males and females) was recorded separately. For males of *C. maculatus* the adult age remained non-significant (6-7days) among all the treatments including cereals and legumes. However the minimum adult age was observed on cereals. In case of age of adult females significant differences were found among the treatments. Minimum adult age of the female was observed on cereals (wheat and rice) which may be due to the fact that the test insect is not pest of cereals so died sooner than the adults in other commodities. The highest adult age was observed on legumes and ages were found statistically similar to each other. These ages were in the range of 6-8 days. The results of the present studies are somewhat supported by Xu-weigen and Xu (1999) who concluded that the life span of adults was temperature dependent and were in range of 5-10 days at 31.37°C and 10-27 days at 24°C.

4.5 Life cycle

The total egg to adult period was recorded on five legumes while the complete life cycle could not be observed on the tested three cereals and two legumes (red cow-pea and lentil) because the development did not occur on these grains. On those where further development took place the longest egg to adult period was observed on white crushed grams which was 19 days followed by white cow-pea, whole black gram and white whole gram which was 17,16 and 16 days respectively while the shortest egg to adult period was (15 days) on mung bean. Egg to adult period was in the range of 15-19 days. These results are partially in accordance to those obtained by Xu-weigen and Xu (1999) who reported that the egg to adult period was 20-21 days at a temperature of 20°C.A small variation does occur which is negligible, however it may be due to differences in environmental and laboratory conditions, varieties of the commodities utilized and culture of the pest.

4.6 Adult emergence

Adult emergence and sex ratio was recorded only on the said legumes because as mentioned previously no further development was observed on three cereals and two leguminous grains. On other pulses the highest emergence rate was recorded in white whole gram which was 95% followed by white crushed gram mung bean and white cow-pea which was 78.57,69.23 and 64.71% while the lowest emergence rate was on whole black gram which was 11.76 %. Wijerate (1998) conducted similar studies and reported that among the three host species cow-pea was the most suitable food substrate for adult bruchid development while Yaddav and Pant (1978) reported that black gram is unsuitable for the bruchid *C. maculatus*.

4.7 Sex ratio

Number of male and female adults were calculated separately in each treatment to find sex ratio so the highest male to female ratio was recorded in mung bean which was 2:1 followed by white crushed gram 1.75:1, white whole gram 1.38:1, whole black gram 1:1 while in white cow-pea the number of female is greater than the male adult so the ratio was 1:2.67.Such findings could not be traced out in the available literature.

4.8 **Adult weight**

The body weight of newly emerged adults was also recorded to estimate the amount of food preferably consumed by the individual bruchids on the tested commodities. The highest combined average weight was calculated in white cow-pea which was 7.5mg where weight of males was 7.0mg and of the females 8.0mg followed by white crushed gram, white whole gram and mung bean where average weight per insect was 6.0, 5.5, and 5.5mg respectively. The separately recorded body weight of

male and female sexes was 5.0, 4.0, 5.0mg and 7.0, 7.0 and 6.0mg respectively.

These findings partially agree with those of Wijeratne (1998) who reported that cow-pea was the most suitable food substrate for adult production and females emerging from adzuki beans were smaller than from those emerging from cowpea and green gram suggesting that Adzuki bean (*Phaseolus angularis*) was inferior as food substrate so the reason for differences in weight on different commodities may be food quality and preference.

5. Conclusion

According to our results it is concluded that the pest only lay egg and pollute the cereals (all types) and among legumes Lentil and red cow-pea while on other hand mung bean is its favorite diet where there is the shortest life cycle with high development rate.

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Competing Interests

Authors declare that they have no competing interests.

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