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N Gopi
Department of Entomology, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

KH Ibohal Singh
Department of Entomology, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Corresponding Author:
N Gopi
Department of Entomology, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Biology and varietal preference of pulse beetle, *Callosobruchus chinensis* L. on stored green gram

N Gopi and KH Ibohal Singh

Abstract
The experiment was conducted to study the biology and varietal preference of pulse beetle, *Callosobruchus chinensis* L. The biology of pulse beetle was studied on the green gram variety "DGGS 4". The egg laying period, incubation period, larval period, pupal period, total developmental period, total life cycle, adult longevity of both male and female, percent egg hatchability were studied. Six green gram varieties *viz.*, Pant M-6, PUSA 0672, KM 2241, DGGS 4, IPM 2-3 and IPM 02-14 were used to evaluate the varietal preference of *C. chinensis.* Among these varieties studied, variety KM 2241 showed maximum percent seed damage and weight loss to pulse beetle which indicating high degree of susceptibility. Variety DGGS 4 showed minimum percent seed damage and weight loss to pulse beetle which indicating comparatively high degree of resistance.

Keywords: Biology, *Callosobruchus chinensis* L., green gram, seed damage, weight loss

Introduction
Pulses are the important sources of proteins, vitamins, minerals, etc. Pulses significantly contribute to the nutritional security of the country. They play a crucial role in human diets, sustainable food production and food security. They are hearty plant species that have existed in millions of years ago, a sort of wonder plant that can grow in any condition and climate. Pulses can easily grow in the drought conditions, will enhance the nutrient content of the soil through biological nitrogen fixation (Singh *et al*., 2015) [11].

India is the largest producer and consumer of pulses in the world. India contributes 29% area and 19% production of pulses in the world (Singh *et al.*, 2015) [11]. Pulses contribute 20% area and 7-10% production among all the food grains cultivated in India. Total pulses production in India is about approximately 24 million tonnes during 2018- 19 (Anonymous, 2019) [1]. Major pulse crops which have been cultivated in India are bengal gram, pigeon pea, green gram, black gram, rajma, lentil, etc. These pulses contain 20 to 25% protein by weight which is double the protein content of wheat and three times that of rice.

Green gram (*Vigna radiata* L.) which is the most important pulse crop cultivated in all parts of the country. It is otherwise known as mung bean, moosh and moong. Green gram is a warm season annual legume, grown almost as relay crop after rice and wheat cultivation. The grains or seeds are green or brown in colour and globose shaped with flat hilum. It grows well even under drought conditions in the tropical and subtropical areas. Green gram is the richest source of nutrients especially protein (14.6-33.3 g/100 g) and iron (5.6-7.9 mg/100 g) (Dahiya *et al.*, 2015) [4].

C. chinensis is a cosmopolitan pest in the tropical and subtropical regions. It is commonly called as oriental cowpea bruchid or cowpea weevil. The name *chinensis* given to this species because of it was first described from china in 1758. It is the major pest of green gram, lentil, chickpea, cowpea, pigeon pea and other pea species. Among all pulses, green gram is the most preferred host by *C. chinensis* (Patel *et al.*, 2005) [9].

The better understanding of biology of pulse beetle will be helpful in making efficient management techniques to reduce the infestation of pulse beetle. Development of resistant variety is very tedious and time consuming process. So, varietal screening from available green gram varieties will help to find comparatively resistant variety that can be cultivated and stored and can be used in the next season.

Materials and Methods

Biology: The experiment was conducted in the laboratory of Department of Entomology, College of Agriculture, Central Agricultural University, Imphal, Manipur, India. Biology of *C. chinensis* was studied on seeds of green gram variety DGGS 4 at the room temperature of 22-29 ^{0}C and relative humidity of 74-84%. 25g of green gram seeds were kept in the five plastic containers. 1 pair of same age of newly emerged adult beetles were released in each container. Mouth of the containers were closed with muslin cloth and tightened with rubber bands. After egg laying, eggs were individually kept in the plastic vials for further observations. The old adult beetles were removed from the containers after death. Total egg laying period, incubation period, total number of eggs laid by a single female, total number of eggs hatched, percent egg hatchability, larval period, pupal period, adult longevity of both male and female, total developmental period and total life cycle were recorded.

Varietal preference: Six different green gram varieties *viz*., Pant M-6, PUSA 0672, KM 2241, DGGS 4, IPM 2-3 and IPM 02-14 were used to study the varietal preference of *C. chinensis*. 50g of seeds of each variety were taken separately in plastic containers. Treatments were replicated for four times and the design used was CRD. Ten (10) pairs of same age of newly emerged adult beetles were released in each plastic container. Mouth of the containers were covered with muslin cloth and tightened with rubber bands. After 60 days of the experiment, all dusts, adult beetles and their stages were removed from the containers.

At the end of the experiment (after 60 days), percent seed damage was determined by counting the number of damaged and undamaged seeds.

$$\text{Percent seed damage} = \frac{\text{Number of seeds damaged}}{\text{Total Number of seeds used}} \times 100$$

Final weight of the seeds was recorded for calculating percent weight loss. Percent weight loss was calculated by using following formula:

$$\text{Percent weight loss} = \frac{\text{UNd} - \text{DNu}}{\text{U(Nd} + \text{Nu)}} \times 100$$

U – Weight of undamaged seeds
Nu – Number of undamaged seeds
D – Weight of damaged seeds
Nd – Number of damaged seeds

Results and Discussion

Biological study of *C. chinensis* was conducted in seeds of green gram variety "DGGS 4" presented in Table 1 revealed that mean egg laying period was 5.80±0.84 days which ranged from 5 to 7 days. It is partial conformity with the findings of Chakraborty *et al.* (2015) [3] who reported that egg laying period of *C. chienensis* was ranged between 3 and 8 days. The incubation period was ranged from 4 to 7 days with the mean of 5.40±1.14 days which is similar to the findings of Chakraborty *et al.* (2015) [3] who reported that the incubation period was ranged from 6 to 8 days with the mean of 7.03±0.54 days. The total number of eggs laid by a single female ranged from 79 to 106 with the average of 92.20±9.96 number of eggs. It is almost similar with the findings of Thakur and Pathania (2013) [12] who mentioned average number of eggs laid by single female during July-August was 99.00. The average number of eggs hatched from single female was 78.60±8.62 ranged from 75 to 92 eggs. The mean egg hatchability was 85.27±1.90% with the limit of 82.61 to 87.34%. Chakraborty *et al.* (2015) [3] also found more or less similar results. The average larval period was 10.80±0.84 days which ranged from 10 to 12 days. The present findings were almost similar to the results of Hosamani *et al.* (2018) [5]. The pupal period was ranged between 6 and 8 days with the mean of 7.00±0.71 days. It is corroborated with the findings of Thakur and Pathania (2013) [12] who reported that pupal period was ranged from 7 to 9.33 days with the average of 8.11 days in different generations. The adult longevity of male and female was ranged between 10 to 14 days and 8 to 10 days, respectively. Similarly, Augustine and Balikai (2019) [2] who reported the adult longevity of male and female was ranged from 7 to 11 days and 8 to 12 days, respectively. The total developmental period was ranged 21 to 23 days with the average of 22.00±1.00 days. It also corroborates with the findings of Augustine and Balikai (2019) [2]. The mean duration of total life cycle of *C. chinensis* was 32.80±2.28 days which ranged between 30 to 35 days. Similarly, Hosamani *et al.* (2018) [2] reported that mean total life cycle of *C. chinensis* in green gram was 32±1.50 with the range of 29 to 32 days. Patel *et al.* (2005) [9] reported that life of *C. chinensis* in green gram was ranged 28-38 days.

Table 1: Biology of *C. chinensis* on seeds of green gram variety 'DGGS 4'

Parameters	Mean±SD (n=5)
Egg laying period (Days)	5.80±0.84 (5.00-7.00)
Incubation period (Days)	5.40±1.14 (4.00-7.00)
Total No. of eggs laid/female	92.20±9.96 (79.00-106.00)
No. of eggs hatched	78.60±8.62 (69.00-92.00)
Percent egg Hatchability	85.27±1.90 (82.61-87.34)
Larval period (Days)	10.80±0.84 (10.00-12.00)
Pupal period (Days)	7.00±0.71 (6.00-8.00)
Adult Longevity of male (Days)	12.20±1.48 (10.00-14.00)
Adult longevity of female (Days)	8.80±0.84 (8.00-10.00)
Total Developmental Period (Days)	22.00±1.00 (21.00-23.00)
Total life cycle (Days)	32.80±2.28 (30.00-35.00)

SD- Standard deviation, n- Sample size
Figures in the parentheses indicated that range based on five samples

The mean data on mean percent seed damage is presented in Table 2 and illustrated in Fig. 1 revealed that all the green gram varieties showed significant variability in seed damage due to the morphological character seed hardness over 60 days of storage period. Among the varieties evaluated, the variety KM 2241 recorded as highest mean seed damage of 88.30% which was statistically at par with IPM 02-14 which showed mean seed damage of 86.11%. It corroborates with the findings of Meena (2015) [7] who reported that seed damage of green gram was 90.68% after 90 days of storage. The lowest percent seed damage was recorded in variety

DGGS 4 with the mean seed damage of 76.07% which was less preferred by the pulse beetle. Next to DGGS 4, the less preferred varieties were Pant M-6, IPM 2-3 and Pusa 0672 with the mean seed damage of 81.28%, 84.20% and 85.06%, respectively. It shows partial conformity with the findings of Sadozai *et al.* (2003) [10] who reported that mean seed damage of green mung was 79.55%. It is also partial conformity with the findings of Chakraborty *et al.* (2015) [3] who reported that mean seed damage of green gram was 38.42%.

The mean data on seed weight loss presented in Table 2 and illustrated in Fig. 1 exhibited that atleast one variety showed significant variability in causing weight loss over 60 days storage period. The variety KM 2241 showed highest mean weight loss of 52.51% which was significantly varied from rest of the varieties. The minimum weight loss was recorded in the variety DGGS 4 which showed significant weight loss of 32.47%. It is almost similar with the findings of Nagaraja (2006) [8] who reported that in the chick pea genotype ICPL 8863 recorded mean weight loss of 33.42%. Next to DGGS 4, variety IPM 2-3 significantly exhibited the mean seed weight loss of 43.82%. The remaining green gram varieties, Pant M-6, IPM 02-14 and Pusa 0672 showed average weight losses of 43.95%, 45.13% and 45.54%, respectively which were not significantly different from each other. Sadozoi *et al.* (2003) [10] revealed that mean weight loss of green gram was 36.64% which corroborates with the present findings. Similarly, Kavitha *et al.* (2018) [6] reported that green gram genotype WGG-42 showed mean weight loss of 29.21%.

Table 2: Food Preference of *C. chinensis* on some varieties of Green gram Seeds

Variety	Percent seed damage	Percent weight loss
T1=Pant M-6	81.28 (9.02)	43.95
T2=Pusa 0672	86.11 (9.28)	45.54
T3=KM 2241	88.30 (9.40)	52.51
T4=DGGS 4	76.07 (8.72)	32.47
T5=IPM 2-3	84.20 (9.18)	43.82
T6=IPM 02-14	86.11 (9.28)	45.13
SE(m)±	0.04	1.35
CD (p=0.05)	0.13	4.02

Figures in the parentheses are square root transformed values
Data presented in the table are mean of four replications

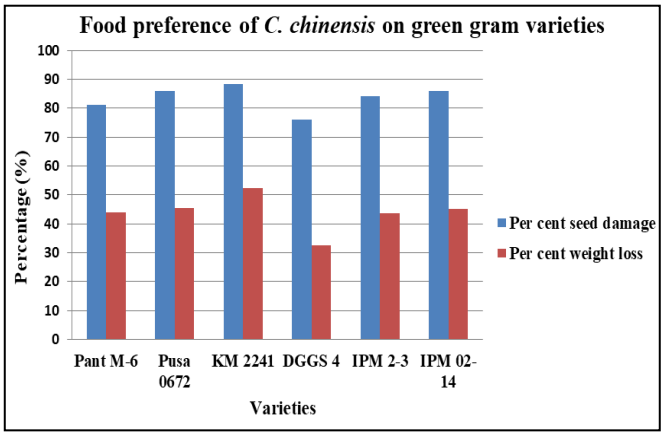

Fig 1: Graphical representation of food preference of *C. chinensis* on some green gram varieties

Conclusion

From the present findings, *C. chinensis* has completed its life cycle in 30 to 35 days. Among the six green gram varieties, KM 2241 was most preferred variety by pulse beetle. Variety DGGS 4 was less preferred by *C. chinensis* indicating high degree of resistance. So, this variety can be used for cultivation and can be stored.

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