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RESEARCH ARTICLE

STUDIES ON THE BIOLOGY OF PULSE BEETLE (*CALLOSOBRUCHUS CHINENSIS* LINN.) INFESTING COWPEA

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ABSTRACT

Pulses (grain legumes) are the second most important group of crops worldwide. Globally, 840 million people are under nourished mainly on account of inadequate intake of proteins, vitamins and minerals in their diets. Under stored conditions , pulses suffer maximum grain loss due to dreaded stored grain bruchid pests. Studies on the biology of pulse beetle *Callosobruchus chinensis* (Linn) (*Coleoptera: Bruchidae*) on the stored cowpea revealed that the insect completed six generations from April to October. The total developmental period of bruchid was 33 days during July- August while it was 37.3 days during April- May. On average duration of incubation period was 7.13±0.34 and 6.04±0.78 while larval + pupal period was 28.51± 2.06 and 28.12±2.08days in two successive generations. The adult life span for male was 4.76±0.64 days and 6.01±0.13 where as for female 8.36±0.12 and 9.13±0.09 days. The total life span of male and female was 34.24±2.16 days in average. The pre- oviposition, oviposition and post- oviposition periods were 6.36±0.36 hours, 4.21±0.16 days and 4.15±0.42 days, respectively in first generation while these parameters recorded as 5.36±0.16 hours, 5.75±0.64 days and 4.69±0.57 days, respectively in second generation. The average eggs laid by female was 96.4 and 102 while hatchability of eggs recorded as 92% and 95.5% and sex ratio of male and female was 1: 1.04 and 1:1.12 in two successive generations.

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INTRODUCTION

Pulses are excellent sources of proteins (20-40%), carbohydrates (50-60%) and are fairly good sources of thiamin, niacin, calcium and iron. Cowpea is good source of dietary protein and nutritionally supplement to low-protein cereal foods that is essential for developmental processes to human (Murdock *et al*., 2008; Timko *et al*., 2007). It is also consumed by non human animals and insects as it is a vital source of protein which is then indirectly consumed by humans through the diet. Thus protection of stored pulses is of great importance to meet nutritional demand (Graham *et al*., 2007). Cowpea is one of the major sources of income for farmers and traders in Africa due to its ability to thrive in the semi-arid tropics on relatively poor soils and even in low rainfall (Anonymous, 2007). It is thus a reliable source of income and food to peasants and subsistent farmers in Africa (Roncoli *et al.*, 2001 and Singh *et al*., 2003). Despite the role played by cowpea in agricultural sector, post harvest infestation is a main challenge encountered toward achieving development goals as it causes massive losses in storage (Adedire *et al*., 2011). Pulses are important source of dietary protein, and have unique property of maintaining and restoring soil fertility and improving physical properties of soil by virtue of their leaf fall. Among, all the pests of stored grain products, the insects are the major cause of food grain damage (Negamo *et al*., 2007). The most common insects which attack the stored products are belong to the order Coleoptera and Lepidoptera (Bekele *et al*., 1997). These are the largest orders which contain most prominent stored pests (Girma, 2006). Pulse beetle, *Callosobruchus chinensis* is a serious damage, pest of the world; it attacks mainly on the pulses, cereals and different types of grains. The damage due to this pest affects the germinative ability and nutritive value of the seed (Sharma, 1984). Mukherjee *et al*. (1970) observed that pulse beetle caused 32-64% infestation in leguminous seeds than cucurbitaceous and solanaceous vegetable seeds as well as oil seeds (3%). Pulse beetle infestation to the tune of 50-60% was found in stored pulse grains after 6 months of traditional storage (Caswell, 1973). Many workers have studied the life cycle of pulse beetle on various stored pulses in different parts of the country and abroad. *C. chinensis* is one of the primary

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and most destructive pest of stored pulses found abundant in this area. Infestation starts right from the field and continues up to storing. Maximum damage is caused in the months of July to October. Pulse beetle causes not only quantitative but also qualitative losses like nutritive loss, germination loss and make the pulse grain unfit for marketing as well as for human consumption. The present studies were carried out to study the biology of the pest insect in cow pea.

MATERIALS AND METHODS

The biology of pulse beetle *C. chinensis* was carried out under laboratory condition on local variety of cow pea (*Vigna radiata* Walp.) during the months between April – October, 2010. Two successive generations were studied. To raise the culture in laboratory, the adults of *C. chinensis* were collected from the local grain market and species of *C. chinensis* was carefully separated by using stereoscope binocular microscope on the basis of morphological characters i.e. presence of frons with three pairs of setae and conical labrum in adult and then maintained on 100gm disinfected cow pea seeds.

For conducting studies on the insect, three plastic containers (5 x 5 cm) containing 100gm seeds were taken in with freshly emerged five pairs of one day old adults of *C. chinensis* which was released in each of the three containers. Mouth of the containers was covered by muslin cloth and secured with rubber bands and later maintained in ambient laboratory conditions. Adults were removed from these containers after death and total number of eggs laid was counted and released. In order to facilitate the observation, one egg was kept on each grain, while others were removed with the help of needle. Such 100 grains were kept individually in plastic vials under laboratory condition at fluctuating room temperature 28.62 ± 2.46°C and relative humidity 82.61 ± 3.96%.

The eggs were observed daily until the eggs hatched. After hatching larva bore down in the seed making egg shell empty and pass its larval and pupal stages in the seeds. The indication of pupal stage was a net on the surface of the seed but it is hard enough to record the exact larval and pupal period for the season that it was inside the seed. The data on developmental stages and sex ratio of the test species in seeds tested was recorded. The adult stage was observed and recorded. Sex ratio was confirmed on the basis of distinguished characters. Duration of the total life cycle was also recorded.

RESULTS AND DISCUSSION

As the incubation period varies depending upon the ambient condition in different months, the mean incubation period was 7.13 ± 0.34 days in the first generation and 6.04±0.78 in the second generation. The ranges of incubation period was 5-8 days in both generations which was quite similar to the result as found by (Qazi, 2007). The mean larval + pupal period was 28.51 ± 2.06 days in the first generation while in the subsequent generation it becomes to 28.12 ±2.08 which was quite close to the range noticed by (Patel *et al*., 2005). In the first and second generations the larval + pupal duration was ranged from 23- 32 days and 24- 33 days respectively. Similar results were also found by (Patel *et al*., 2005). Whereas (Radha and Susheela, 2014) observed 19 days larval + pupal period of pulse beetle at 30.02°C temperature and 70% relative humidity on different pulses. The mean adult duration was 6.16 ± 1.06 in the first and that becomes 7.36±0.04 in second generation. The adult duration was ranged from 4 – 11 days and 5-12 days respectively. Thus, the insect become quite habituated with its host so the incensement of the duration of adult longevity takes place. The adult female longevity was somewhat greater than the males.

Table 1. Duration of different stages, pre- oviposition, oviposition, post oviposition period and adult longevity of *C. chinensis* in two successive generations

Stage	Number of individual observed	Duration in days			
		Range (1st generation)	Average ± S.D. (1st generation)	Range (2nd generation)	Average ± S.D. (2nd generation)
Egg	100	5 – 8	7.13 ± 0.34	5 – 8	6.04 ± 0.78
Larval + Pupal period	90	23– 32	28.51 ± 2.06	24 – 33	28.12 ± 2.08
Adult	50	6 – 10	8.31 ± 0.98	7 – 10	8.36 ± 0.82
Total developmental period	90	22 – 38	30.25 ± 1.06	23 – 39	31.45± 0.35
Pre- oviposition period (hours)	25	3 – 7	6.36 ± 0.36	3 – 6	5.36 ± 0.16
Oviposition period	25	3 – 6	4.21 ± 0.16	4 – 6	5.75 ± 0.64
Post oviposition period	25	2 – 6	4.15 ± 0.42	2 – 7	4.69± 0.57
Adult longevity of Male	25	4 – 7	3.76 ± 0.64	5– 7	6.01 ± 0.13
Adult longevity of Female	25	6 – 11	8.36 ± 0.12	6 – 12	9.13 ± 0.09

Table 2. Hatchability of eggs, egg laying capacity and sex ratio of *C. chinensis* on cow pea in two successive generations

Parameters		1st Generation		2nd Generation	
Egg laying capacity	Number of female observed 5	Number of eggs laid by 5 females 482	Average eggs laid by female 96.4	Number of eggs laid by 5 females 510	Average eggs laid by female 102
Hatchability	Number of eggs observed 200	Number of eggs hatched 184	Percent hatchability 92	Number of eggs hatched 191	Percent hatchability 95.5
Sex ratio of male and female	Adult observed	Sex development percentage	Sex ratio	Sex development percentage	Sex ratio
	100	Male : 49%	1: 1.04	Male : 47%	1: 1.12
		Female : 51%		Female : 53%	

These results were in agreement with the study done by (Borikar and Pawar, 1994; Kiran Kumari *et al*., 2005) . Such differences in adult longevity may be due to differences in temperature and relative humidity. The average eggs laid by female of *C. chinensis* on cowpea were 99.20. Radha and Susheela (2014) recorded a single female laid as many eggs as 135.5 eggs during its life span in *C. maculatus.* The result indicates dissimilar trends in the result because egg laying capacity may vary depending upon species.

In addition (Qazi, 2007) recorded a single female laid as many as 91 eggs. The pre- oviposition, oviposition and post-oviposition periods were 6.36±0.36 hours, 4.21±0.16 days and 4.15±0.42 days , respectively in first generation (Table 1) while these parameters recorded as 5.36 ±0.16 hours, 5.75 ±0.64 days and 4.69 ±0.57 days, respectively in second generation (Table 1). Butani *et al.* (2001) recorded average duration of pre-oviposition, oviposition and post oviposition period as 5.10 hours, 4.5 days and 0.66 days, respectively. These differences may be due to differences in food as well as environmental conditions. The adult life span for male was 4.76± 0.64 days and 6.01±0.13 where as for female 8.36±0.12 and 9.13±0.09 days (Table 1). The total life span of male and female was 34.24±2.16 days in average. Qazi (2007) reported that the average life span was 22 days. Such difference in adult longevity may be due to differences in temperature and relative humidity.

The hatching of eggs laid *C. chinensis* was 92% and 95.5% in two successive generations (Table 2). The increment of the egg laying percentage shows that cowpea is preferable host for deposition of more eggs. Radha and Susheela (2014) also found hatchability of about 98% is quite close to the results presently found. The sex development of male was 48 % and female was 52% in average as found in the two generations. Sex ratio of male and female was 1: 1.04 in first generation and 1: 1.12 in the second generation (Table 2). The result revealed the fact that the number of female was slightly higher than the male which is contrary as revealed from the studies done by (Patel *et al*., 2005).

Conclusion

The results of the study show that the developmental period of the egg to adult was around a month or more than that. During optimum period of growth the total developmental period is less than a month thus causing huge damage to seeds. Ovipositional period, post oviposition period and male-female longevity is increased during the subsequent generation and that indicates about the adaptability of the beetle with the pulse crop. During unfavorable conditions depending on the food supply, temperature and humidity duration of developmental period may increase or decrease. Data pertaining from the experiments shows that the percent hatchability become increased during second generation and that indicates that the capability of the insect to exploit the resource getting increased generation after generation. The current research paves the way to provide awareness to the farmers about the nature and extent of damage caused by the beetle in storage.

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