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Biology of Pulse Beetle *Callosobruchus chinensis* in Storage Condition in Green Gram

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Abstract: ***Pulse beetle, Callosobruchus chinensis (Coleoptera: Bruchidae) is a stored grain pest of pulses in India. Biology of pulse beetle was studied in 2010-11 in the soil science laboratory of KVK, Balasore. The fecundity of female, egg period (days), larval-pupal period (days) and longevity of adult were studied in the treatment & viz., Azadirachta indica, Lantana camera, Cymbopogon citratus, Ocimum tenuiflorum, Vitex negundo, Annona squamosa, Aegle marmelos and Pongamia pinnata leaf powder.***

Keywords: Callosobruchus chinensis, Pulse beetle, Green gram,Costal Odisha,Pulse field

1. Introduction

Pulses are important component of our daily diet as they are the cheapest source of proteins, vitamin, energy and minerals. Production of pulse has increased at a much slower rate compared to cereal, oil seeds and other crops over the last two decades. However, with the increase of population per capita availability of pulses has declined. For nutritional security and also for sustainable agriculture, pulses play a significant role *(Arya et al, 2002).* The demand of protein is increasing by about 3% annually. Pulses add atmospheric nitrogen in the soil, besides meeting their own requirement of nitrogen. Alternatively by inclusion of pulses in the existing cropping system in the form of intercropping, increase the overall productive of farm *(Arya et al., 2007)* In India pulses are grown on an area of 22 million hectares producing 13 million tones. The productivity of the crops have remained static for the last three and half decades with the increasing population and the stagnating pulse production the estimated availability of pulses has gone down from 70.1gm/day/person in 1951 to 31 gm/day/person in 2008 whereas Indian Council of Medical Research recommends 65 gm/day/person (Enabling pulses revolution in India (Ready, *et. al.,* 2012).

The pulse crops are attacked by than 150 insect pests. Among the insects which infest various pulses are *Callosobruchus chinensis* (Linn.). *C maculatus* (Fab) and *C. analis* (Fab).The genus C*allosobruchus* has been reported to be a serious pest in the middle and Far East, Africa and India. Pulse bettle *C. chinensis* is the most important and common of all the bruchid pests in India. The infestation begins in the field and continues in the store houses causing heavy losses. This peat is cosmopolitan in nature and in Odisha it occurs throughout the year infesting all types of pulses grains. They cause both qualitative and quantitative losses. They deteriorate the quality of seeds by denaturing and decreasing the solubility of proteins. Both grub and adult causes the damage. In badly damaged grains , endosperm is eaten by the grubs leaving only the thin outer covering or thin film or seed coat. Such infested grains are not only unfit for consumption but also useless as seed. The beetle is oligophagous and exhibits a high degree of specificity for its growth and development.Even with low infestation, the commercial values are completely lost. Therefore, a large percentage of stored pulses go waste each year. In an average 2.0 to 2.5 million tons of pulses are lost annually due to insect pests. At present days pest management packges have been developed for different pulse crops (*Arya et al.*,2002 and Das, 2002) and by utilizing these packages (Tripathy , 2002) different seed agencies have geared up the task of quality seed production in pulses.

The information on the biology and management of *C. chinensis* on different pulse seeds is meager under Odisha condition (Patro et al., 2001). The protein content of different pulses ranges from 17 to 28 per cent (in soybean upto 43.20%) which is more than double of the protein content of cereals (8-10%). Some of the legumes are also consumed on large scale as vegetables in green pod stage. Its fodder is rich in protein and palatable to cattle. The broken seeds and/or husk left after processing of "dal" are in variably used as concentrate feed for cattle. The pulse crops occupy 20 percent of the total area under food grain in India, but they make only14 per cent of the total production of food grains as due effort has not been made.

2. Methods

1) Study Site

The studies on biology of *Callosobruchus chinensis* in green gram were carried out during the year 2010-11 in the soil science laboratory of Krishi Vigyan Kendra (KVK), Balasore. The plant leaves were collected from the Baliapal, Basta and Jaleswar block of Balasore district. The main culture medium viz. the seeds of green gram (*Vigna radiata*) var. HUM -1 was also collected from the farmers' field of Baliapal block of Balasore district.

2) Preparation of Main Culture Medium and Plant Extract

The seeds of green gram (*Vigna radiata*) var. HUM-1 was cleaned and sieved to remove the undesired other seeds and the other foreign materials. The seeds were taken in airtight galvanized seed bin and fumigated by ethylene-di-bromide (EDB) in order to eliminate the traces of insects and mite infestation. Half kilogram of disinfested seeds was taken in glass jar (15 x 10 cm). The moisture content of grain was measured before experimentation by using OSAW digital moisture meter. For preparation of stock culture, adult beetles of *Callosobruchus chinensis* were collected from infested grains of godowns using an aspirator. A pair of adults was then released in jar containing conditioned green gram grains. The jars were kept in incubator at 27$\pm$10^{0}C temperature and 70$\pm$5 per cent relative humidity. After emergence, pairs of freshly emerged adult beetles from this uniparental culture were taken for experiment. Biological studies of *Callosobruchus chinensis* were undertaken in controlled environmental condition under BOD by taking undamaged seeds and a pair of adults in plastic jar covered with muslin cloth. Time to time observation of egg laying, hatching of eggs, larval and pupal period and adult emergence and their longevity was recorded.

The leaf powder of different plant products *viz., Azadirachta indica, Lantana camera, Cymbopogon Citratus, Ocimum tenuiflorum, Vitex negundo, Annona squamosal, Aegle marmelos* and *Pongamia pinnata* were collected from Baliapal of Balasore district of Odisha. Then the plant products were dried in shade and then they were grinded by electronic grinder to get fine powder. The powder was sieved through 60 mesh sieve. The plant products were mixed with conditioned green gram seeds @ 2 g/100 g of grains separately. Untreated check was also kept simultaneously. Sample of 100 g seeds of green gram from each treatment was transferred to the jar of 4.5 cm length and 3.5 cm diameter size. The treatments were replicated three times. Five pairs of freshly newly emerged bruchids were released in each jar. Then the jar was covered with muslin cloth and tied with rubber band and then kept in room for three months.

3) Data Analysis

Each treatment was replicated three times and data on adult emergence were subjected to statistical analysis as per Completely Randomised Block Design (CRBD). Data on the emergence of adult beetles were transformed using angular and square root values and analysed as per Gomez and Gomez (1984).

4) Results and Discussion

Eight plant products and one untreated check were tested against the stored grain pest, *Callosobruchus chinensis* in laboratory. The biological studies of the pest on treated green gram seeds were carried out during 2010-11.

Fecundity

The data obtained on the effect of plant products on the fecundity of *Callosobruchus Chinensis* are presented in the table. It is evident from the data that mean number of eggs laid by a single female on green gram was minimum (17.25 eggs) in *Azadirachta indica* leaf treated green gram which was followed by *Cymbopogon citratus* (19.32 eggs), Vitex negundo leaf powder treatment (19.64 eggs). All the above treatments were statistically at par. In the rest of the other treatments egg laying varied from 22.23 eggs in *Lantana camera* leaf powder to 25.00 eggs in Aegle marmelos leaf powder treated green gram. The egg laying on the other treatments *viz., Pongamia pinnata*, Ocimum tenuiflorum, Annona squamosa and Aegle marmelos varied from 23.00 to 25.00 eggs per female and all the above treatments were statistically at par. However, the maximum number of egg laying (114.00 eggs per female) was observed in untreated check. Statistically significant lower number of eggs were laid (17.25/female) on *Azadirachta indica* leaf powder treated seed as compared to rest of the treatments except Cymbopogon citratus powder treated seeds with which it was statistically at par. However, all the treatments recorded significantly lower number of eggs than the untreated check. Apart from this anti-ovi-positive effect of *Azadirachta indica* also appeared with Cymbopogon citratus powder. However, the least effect of *Aegle marmelos* leaf powder was noticed although it was even superior to untreated check. Present finding was different from the statement by Pandey *et al.* (1986) and Mandal, *et.al*. (2006).This difference might be observed due to the difference in formulations. Pandey and his co-workers (1986) used plant extract whereas, in present study, raw plant powders were taken. Similar results were stated by Bhaduri, *et. al.* (1985) and Ahad Md. Abdul, *et al.* (2012). The lowest numbers of eggs were observed with *Azadirachta indica* leaf powder. The maximum numbers of eggs were counted in untreated check followed by *Aegle marmelos* leaf powder, although it was statistically superior to untreated check.

Egg Period

The egg period of *Callosobruchus Chinensis* varied from 5.21 to 6.33 days in different treatments as against 5.67 days in untreated check (Table 1). The minimum time of 5.21 days were taken for hatching in Cymbopogon citratus treated green gram whereas, 6.33 days were taken on Aegle marmelos treated seeds. The longest egg period was recorded on *Aegle marmelos* leaf powder followed by *Ocimum tenuiflorum* leaf powder while the shortest egg period was on *Cymbopogon citratus* leaf powder. Borikar and Pawar (1996) and Mandal and Konar (2006) reported that the maximum duration of egg, larval and pupal period was 5, 17 and 6 days, respectively on survival of different stages of *Callosobruchus Chinensis* during development on green gram control measures.

Larval-Pupal-Period

The larvae and pupae completed their development in 22 days in untreated green gram whereas, the maximum larval-pupal period of 27.21 days was observed in *Pongamia pinnata* leaf powder treatment followed by *Azadirachta indica* (26.58 days), *Cymbopogon citratus* (26.24 days), *Vitex negundo* (25.68 days) and *Annona squamosa* leaf powder (25.48 days). These were also statistically at par with each other. Significantly more larval-pupal days of *Callosobruchus Chinensis* was noticed on *Pongamia pinnata, Azadirachta indica* leaf powder treated green gram seed as compared to *Lantana camera, Ocimum tenuiflorum, Vitex negundo, Annona squamosa* and *Aegle marmelos* leaf powder treatment. However, it was statistically at par with

Azadirachta indica leaf powder and *Cymbopogon citratus* powder treatments. Larval-pupal period in untreated check was 22.00 days, while it was the longest on *Pongamia pinnata* leaf powder (27.21days). This treatment was superior to rest of the treatments although it was closely followed by *Azadirachta indica* leaf powder 26.58 days. Borikar and Pawar (1996) reported that the maximum duration of egg and larval-pupal period were 5 and 6 days respectively.

Longevity of Adult:

The mean adult longevity of *Callosobruchus chinensis* reared on green gram as influenced by the admixing of plant products is depicted in the table. The data revealed that in *Vitex negundo* leaf powder treated green gram minimum longevity (4.32 days) of adults was observed. The maximum longevity (7.23 days) was noticed in untreated check. In other treatments the longevity of adults were 4.75, 4.86, 5.33, 5.33, 6.00 and 6.00 days recorded in *Azadirachta indica*, *Ocimum tenuiflorum*, *Lantana camera*, *Aegle marmelos*, *Annona squamosa* and *Cymbopogon citratus* leaf powder respectively. Longevity of adults were in between 4.32 days in *Vitex negundo* leaf powder to 7.23 days in untreated check. The highest longevity was observed in the untreated check (7.23 days), whereas, in case of treated seed the highest value of the same was counted in *Pongamia pinnata* leaf powder (6.38 days), followed by *Cymbopogon citratus* and *Annona squamosa* leaf powder (6.0 days). The lowest longevity was observed on the *Vitex negundo* leaf powder (4.32 days).

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Table 1: Effect of different plant leaf powder (@ 2 g/100 g of seeds on the biological parameter of Callosobruchus chinensis on green gram in storage condition

	Treatments	*Fecundity no of eggs/female*	*Egg period (Days)*	*Larval-pupal period (Days)*	*Longevity of adults (Days)*
T_1	*Azadirachta indica* leaf powder	17.25^{a}	5.86	26.58^{efgh}	4.75^{ab}
T_2	*Lantana camera* leaf powder	22.33^{bcd}	5.44	24.10^{bc}	5.31^{bcd}
T_3	*Cymbopogon citratus* leaf powder	19.32^{ab}	5.21	26.24^{efg}	6.00^{de}
T_4	*Ocimum tenuiflorum* leaf powder	23.23^{def}	5.89	23.49^{b}	4.86^{abc}
T_5	*Vitex negundo* leaf powder	19.64^{abc}	5.84	25.68^{ef}	4.32^{a}
T_6	*Annona squamosa* leaf powder	24.58^{defg}	5.64	25.58^{de}	6.00^{de}
T_7	*Aegle marmelos* leaf powder	25.00^{defgh}	6.33	24.22^{bcd}	5.33^{bcd}
T_8	*Pongamia pinnata* leaf powder	23.00^{de}	5.49	27.22^{ghi}	6.38^{ef}
T_9	Untreated check	114.00^{i}	5.67	22.00^{a}	$7.23f^{g}$
	SEM ($\pm$	1.039	0.413	0.461	0.287
	CD at 5 %	**(3.08)**	**(N.S.)**	**(1.37)**	**(0.84)**