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Effect of chosen botanicals on the oviposition deterrence and adult emergence of *callosobruchus maculatus* (f) (coleoptera: bruchidae)

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ABSTRACT

The pulse beetle, *C.maculatus* is a major storage pest of stored grains. Different botanicals were evaluated for their bioefficacy against this pest. The present study was undertaken to study the effect of *A. indica* (L), *C. gigantea* (L.), *O.tenuiflorum* (L), *P. amarus* (linn) and *T. purpurea* ((L.) Pers.). Oviposition deterrence and adult emergence activity were carried out at three different concentrations (4%, 8% and 12%) on blackgram, *Vigna mungo* (L.) against *C. maculatus*. Maximum oviposition deterrence activity was observed in *T. purpurea* (70.09%) followed by *A. indica* (69.44%), *P.amarus*(56.21%), *O.tenuiflorum* (50.32%) and *C.gigantea* (39.39%) at higher concentration. Reduction in adult emergence was higher in *C. gigantea* and *O.tenuiflorum* (87.85%) treated seeds. The other plant powders also exhibited their higher potential against *C. maculatus.*

Introduction

The pulse beetle, *C.maculatus* Fab. (Coleoptera: Bruchidae), is a major pest of economically important Leguminous grains, such as cowpeas, Lentils, green gram, and black gram. The larvae of *C. maculatus* bore into the pulse grain which becomes unsuitable for human consumption, viability for replanting, or for the production of sprouts. They are important pests of pulse crop in Asia and Africa under storage conditions (Ogunwolu and Idowu, 1994; Okonkwo and Okoye, 1996).

India has an annual production potential of 15.04 million tonnes of pulses recorded in year 2004-05. However, nearly 8.5 % of total annual production is lost during post harvest handling and storage. Pulses play an important role in Indian diet and are the major source of protein. Pulses are rich in proteins, vitamins and minerals for the predominately vegetarian population in India and qualitative and quantitative losses to an extent of 8.5 percent are due to poor post storage handling and attack by the beetles (Bruchidae –Coleoptera).

Losses due to insect infestation are the most serious problem in grain storage particularly in the developing countries, where poor sanitation and use of in appropriate storage facilities all encourage insect attack (Talukder *et al.*, 2004; Talukder, 2005), In the tropical countries, grain harvested at high ambient temperatures and delivered in the storage loses heat slowly and hence provides ideal conditions for a rapid buildup of many grain insects (Wallbank and Greening, 1976). But synthetic insecticides possess a serious threat to man and environment by leaving residues (Matusumura, 1980) causing insect resistance, (Braltesten *et al.*, 1986) and killing beneficial insects.

Chemical pesticides are used in solving pest problems. However, their constant use has reduced the effectiveness of the pesticides because of the development of resistance by many pest organisms. Also, their long-term use has increased the level of soil and environmental pollution (FAO, 1981) affecting human lives, animals and beneficial insect species. Recent trends in environmental and health consciousness have led us to replace synthetic chemical insecticides with natural compounds of plant or animal origin. Plant constitutes one of the major components of "Green pesticides".

Various plant powders and their extracts have been reported to possess insecticidal and repellant activity against the bruchids (Agarwal *et al.*, 1988; Babu *et al.*, 1999).Use of plant bio-products became an alternative and are being effectively tried to protect nature from pesticides pollution. In recent years there has been a rapid increase in the interest of evaluating botanical insecticides in view of their eco-friendly nature. With this background the present study was undertaken to investigate bio-efficacy of herbal powder as seed protectants against bruchids in blackgram. The use of botanical materials had been found effective and successful over a number of pests. *Vitex negundo* was observed to control weevils (Morallo Rejesus, 1996), while *Azadiracta indica* was found effective against plant hoppers. Ogunwolu and Idowu (1994) showed that 2.5% powdered seed of *A. Indica* were toxic to *C. maculatus* .

The screening of previous work on the use of botanicals to control the stored grain pest, *C.maculatus* has given good information. However the previous workers have not tested the following plant derivatives viz., *A. indica* , *C. gigantea* , *O.tenuiflorum* , *P. amarus*, and *T. purpurea*. So the present study was undertaken to evaluate the effect of the powders of the above mentioned plants on the oviposition and adult emergence of *C.maculatus* and to identify the most potent botanical that can be very effective.

Materials And Methods

Collection of plant materials:

The different plant powders used in this investigation was

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taken from the leaves of *A. indica*, C. *gigantea*, *O.tenuiflorum*, *P. amarus* and *T. purpurea*. The leaves of different plants were washed with distilled water to remove dust particles and shade dried. The leaves were then pulverized with the help of an electric grinder to obtain fine powder.

Insect Culture

Black gram seeds infested by the *C. maculatus* were collected from the grocery shop and brought to the laboratory. The infested seeds were set aside in a plastic container and covered with muslin cloth till the emergence of adult. Healthy adults emerged from the container were shifted to another plastic container (6.5 x 8 cm) and provided cleaned black gram seed and the container was undisturbed until the emergence of adults. Freshly emerged subsequent generations were used for further experiments.

Collection and rearing of test Insects:

A total quantity of 25 g of sterilized black gram (*Vigna mungo*) seeds were mixed with different concentrations like 4%, 8%, 12% of respective plant powders and five pairs of freshly emerged pulse beetle, *Callosobruchus maculatus* were introduced into each plastic container under ambient conditions of 28 ± 2°C and 65 ± 5% RH. The plastic containers (6.5 x 8 cm) were covered with muslin cloth. A control set was also maintained without any treatment powder. Three replications were maintained for each treatment and control. Observations were recorded on egg laying (%) and adult emergence (%) of *C. maculatus*.

Oviposition deterrence activity:

Laboratory tests for oviposition inhibition effects were conducted by the following method of Talukder and Howse (1994) with some modifications.

Five pairs of *C. maculatus* were released in each plastic container and covered with a lid. They were allowed to remain in the container for 7 days till they lay eggs. One week after oviposition the number of eggs laid were counted using hand lens. The number of eggs laid on treated seeds (ET) and control seeds (Ec) were recorded and the percentage of oviposition deterrence (POD) was calculated by the following formula.

$$\text{Egg laying (\%) - POD} = \frac{(Ec - Et)}{Ec} \times 100$$

POD = Percentage of oviposition deterrence
Ec = control seeds
Et = treated seeds

Adult emergence activity

Starting from 20th day after oviposition, the number of adult emerged at alternative days were counted. Total number of adult emerged in each treatment was counted after 25 days of release. The number of adult emerged from the control seeds and the treated seeds were recorded .The percentage and reduction of adult emerged was calculated by the following method of Jayakumar (2010) with some modifications.

$$\text{Adult emergence (\%)} = \frac{Ac - At}{Ac} \times 100$$

Ac = control seeds
At = treated seeds

Results and Discussion

In the present study the effect of the plant powders of *A. indica*, C. *gigantea*, *O.tenuiflorum* , *P. amarus*, and *T. purpurea* on the oviposition and adult emergence of stored grain pest (*C. maculatus*) were studied. The number of eggs laid was minimum in the higher concentrations of plant powders (ie) 12 % concentration. 12% of *T. purpurea* was found to be very effective and in this concentration the egg laying capacity of *C.maculatus* was reduced to 61.00± 3.05 and the percentage of change over control was (70.09%). This was followed by *A. indica* (62.33±0.33), *P.amarus* (89.33 ±3.84), *O. tenuiflorum* (101.33±7.83) and *C. gigantea* (123.66 ±2.40). The highest reduction percentage was observed in *A. indica* (69.44%) followed by *P.amarus* (56.21%), *O. tenuiflorum* (*50.32*%) and *C. gigantea* (39.38%). The insecticidal activity of *Azardirchta* has been demonstrated against numerous insect pests and its various modes of activity include distruption of feeding, reproduction or development (Walter, 1999).Lale and Mustapha (2000) found no siginificant difference in the efficacy of neem seed oil in reducing oviposition of *C. maculatus*, adult emergence or seed damage rates in treated cowpeas. The findings of the present investigation are in accordance with those of other workers who have previously reported that plant powders reduce life span and oviposition of bruchids.

The data shown in Table 1.2 revealed the effect of plant powders on adult emergence of *C. maculatus*. A significant reduction was seen in all treatments. Further it is also clear that the efficacy of these selected plants was much stronger against F_1 generation. In the higher concentration (12%), the adult emergence reduction percentage was noticed in *C.*gigantea (7.00±0.57) with change over control (87.85%) was on par with *O. tenuiflorum* (7.00±1.00), *A.indica* (26.00 ±0.57) with a change over control (54.90%), *T. purpurea* (53.17%) and *P.amarus* (35.33 ± 5.78) with a change in control (38.72%).

Annie Bright et al. (2001) and Raja *et al.* (2001) reported that botanicals inhibited adult emergence in *C. maculatus* in cowpea. They further stated that when the eggs lay on treated seeds, the toxic substance present in the extract may enter in to the egg through chorion and suppressed further embryonic development. It is in agreement with the present study that adult emergence was greatly reduced in treated seeds than control seeds. It was reported that *C. sophera* leaf powder mixed with different commodities at 1% and 5% concentrations significantly reduced F_1 emergence of *S. zeamais, C. maculatus* and *R. dominica* in laboratory experiments. (Christina kestenholz *et al*,2005). In addition, in the same experiment, a significant increase in F_1 adult mortality was only recorded for *C. maculatus* and *R. dominica* with the 5% concentration, (Belmain *et al.,* 2001). Khanna (1995) who reported *P.guieneense* seedpowder at low concentration reduced oviposition and adult emergence of *C.maculatus.*The present study indicated that the effective reduction in the adult emergence of *C.maculatus* by the powders of the selected plants.

The present investigation has brought out the efficacy of *A. indica, C. gigantea* , *O.tenuiflorum* , *P. amarus*, and *T. purpurea* against *C.maculatus.* From the results it is evident that the extracts of *A.indica, T.purpurea, M.pubescens* are very effective in killing the pest *C. maculatus* and they can be used as biocontrol agents for the stored pest. Further the preparation of these plant powders and application on the seeds are so easy and cheaper. Hence effectual plant powders can be used as one of the component in integrated pest management especially in small godowns or shop retailer for short term storage. In addition, if applied at the right dosage and time it would certainly be an alternative to chemical pesticides at the field level.

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Table 1. Plants used for insecticidal activity

S.No.	Common Name	Botanical Name	Family	Parts used
1	Neem	Azadirachta indica	Meliaceae	Leaves
2	Eruku	Calotropis gigantea	Ascelpiadaceae	Leaves
3	Tulsi	Ocimum tenuiflorum	Labiatae	Leaves
4	Keelanelli	Phyllanthus amarus	Euphorbiaceae	Leaves
5	Kolinji	Tephrosia purpurea	Fabaceae	Leaves

Table. 2

Effect of Plant powders on oviposition of the pulse beetle, *Callosobruchus maculatus*

Treatment	Total No. of eggs laid		
	Conc % w/w		
	4%	8%	12%
Azadirachta indica	138.66±3.17 (32.02)	118.33±3.28 (41.99)	62.33±.0.33 (69.44)
Calotropis gigantea	155.33±5.87 (23.85)	135.66±6.33 (33.50)	123.66±2.40 (39.38)
Ocimum tenuiflorum	122.33±8.96 (40.03)	113.00±13.05 (44.60)	101.33±7.83 (50.32)
Phyllanthus amarus	111.33±5.48 (45.42)	100.33±5.04 (50.81)	89.33±3.84 (56.21)
Tephrosia purpurea	146.33±2.02 (28.26)	122.66±6.98 (39.87)	61.00±3.05 (70.09)
Control	204.00±14.04		

Table values represents the mean and SEM Statistical significance of difference among groups at p <0 .05; Control versus experiment; 4%, 8% and 12%. Percentage change over control is given in parenthesis.

Table .3
Effect of Plant powders on adult emergence of the pulse beetle, *C. maculatus*

Treatment	No. of Adults emerged Conc % (w/w)		
	4%	8%	12%
Azadirachta indica	38.66±2.18 (32.95)	32.33±1.85 (43.92)	26.00±0.57 (54.90)
Calotropis gigantea	19.00±1.15 (67.04)	13.00±1.15 (77.45)	7.00±0.57 (87.85)
Ocimum tenuiflorum	20.66±0.88 (64.16)	14.66±0. 66 (74.57)	7.00±1.00 (87.85)
Phyllanthus amarus	45.00±3.21 (21.95)	42.00±2.51 (27.15)	35.33±5.78 (38.72)
Tephrosia purpurea	46.00±0.57 (20.22)	34.33±0.33 (40.46)	27.00±1.15 (53.17)
Control	57.66±2.90		

Table values represents the mean and SEM. Statistical significance of difference among groups at p <0 .05; Control versus experiment; 4%, 8% and 12%. Percentage change over control is given in parenthesis.