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# EFFECT OF SOME BOTANICALS ON BIOLOGICAL PARAMETERS OF PULSE BEETLE (*CALLOSOBRUCHUS CHINENSIS* L.) IN PEA (*PISUM SATIVUM* L.)

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**ABSTRACT**
Six ethanolic extracts viz. neem leaf, rhizome of ginger, garlic and turmeric, eucalyptus leaf and leaf of *Lantana camera* were evaluated to find out their effect on biological parameters of pulse beetle (*Callosobruchus chinensis* L.) in pea during 2009-2010. It was observed that all the botanicals were superior over control to suppress some biological parameters such as egg laid/seed, egg laid/day, oviposition period, hatchability per cent, adult formation and adult survivorship while prolonged some developmental stage such as incubation period and larval-pupal period. Among the botanicals, garlic was found to be very effective against larval development of pulse beetle thereby no adult emergence (0.00%) followed by neem and turmeric with 4.76 and 6.67% adult emergence, respectively.

## INTRODUCTION

Pulses are considered as the most nutritious and play an important role in fulfilling the protein deficiency in the daily diet of the people and also they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in sustainable agriculture (Kannaiyan, 1999). India has an annual production potential of 17.21 million tonnes of pulses recorded in year 2011-12 (Anonymous, 2012). Pea (*Pisum sativum* L.) belonging to the family leguminosae is among the four important cultivated legumes next to soybean, groundnut and beans (Hulse, 1994). Peas are excellent source of vitamin A, vitamin C, vitamins B and lutein. Protein and sugar content is about one-quarter of dry weight. Peas are also an excellent source of crude protein and crude fiber up to 23% and 5.5% respectively (Hickling, 2003). One of the major constraints in production of pulses are the insect pests which inflict severe losses both in the field and storage. Agrawal *et al.* (1988) reported that about 8.5 % of total annual pulse production is lost during post harvest handling and storage. In India, over 200 species of insects have been recorded infesting various pulses (CABI, 2007). Among bruchids, *Callosobruchus chinensis* is a major cosmopolitan pest that causes serious damage to pulses in storage condition. Gugar and Yadav (1978) reported that 55-69% weight loss and 45.6 - 66.3% protein loss by infestation of pulse beetle on chickpea. Though some synthetic pesticides have been proved quite effective for controlling this pest in storage but it again arise the residue problem in food stuff. However, use of pesticdes leads to the development of insect resistance and environmental pollution has forced the researchers to look for some non-toxic pulse protectants. Various locally available plant products have been tried recently with good degree of success as protectants against a number of stored grain insect pests (Gill and Lewis, 1971; Dulia *et al.*, 1999; Varma and Dubey, 1999; Swain and Baral, 2004; Salam *et al.*, 2005). Keeping all these views in mind, the present study was conducted to evaluate the effectiveness of ethanolic extract of some botanicals on various developmental stages of pulse beetle for their eco-friendly management.

## MATERIALS AND METHODS

The experiment was conducted at Department of Plant Protection, Palli Siksha Bhavana, (Institute of Agriculture), Visva-Bharati, Sriniketan - 731 236, Birbhum, West Bengal during the year 2009- 2010 to evaluate the effectiveness of ethanolic extract of some botanicals on various developmental stages of pulse beetle. The experiment was carried under laboratory condition where room temperature and RH were 27 ± 5°C and 70 ± 5 %, respectively. Healthy and fresh seeds were used to avoid any pre-storage infection or egg laying of bruchids. These were then examined and sound grains were used for use in the studies after they were kept in insect proof container. In the experiment six ethanolic extracts *viz*. neem, turmeric, garlic, ginger, eucalyptus and *Lantana camera*

(leaves/rhizome/bulb etc.) at 10% dilution were prepared by drying the leaves/rhizome/bulb under shed condition. After drying all botanicals were ground and soaked overnight in cent percent ethanol and then filter through filter paper and applied all extracts @ 5ml/kg of seed with three replications for each treatment. One pair of newly emerged male and female insect obtained from the laboratory culture of *C. chinensis* was released in plastic container having 5 treated grains in each container and kept whole experimental set up under laboratory condition following completely randomized design (CRD). After every 24 hours the paired insects were transferred to the new sets of containers containing treated grains till the adult died. Daily observation on egg laying per female, ovipositional period, incubation period, hatchability, larval-pupal period, adult survivorship, adult mortality were recorded. Adult emergence and adult mortality per cent with respect to control were computed by using the following formula:

$$\text{Adult emergence (\%)} = \frac{\text{No. of adults emerged}}{\text{No. of eggs hatched}} \times 100$$

$$\text{Adult mortality (\%)} = \frac{\text{Adult emergence in control} - \text{Adult emergence in treatment}}{\text{Adult emergence in control}} \times 100$$

The number of adults that emerged in each replication was converted in to proportion of the total number of eggs laid and proportion of the hatchability and expressed as percentage. Percentage data were transformed to arcsine value i.e. $\text{Sin}^{-1}\sqrt{(X/100)}$ and analysis of variances between means were determined with the help of a statistical package MSTATC, other growth parameters were root transformed i.e. $\sqrt{(X + 0.5)}$ following the principles of Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### Egg lay

The lowest number of egg lying (egg/seed and eggs/day) was recorded on garlic treated seed (0.47 and 2.33) followed by turmeric (0.68 and 3.42), neem (0.84 and 4.55), *Lantana camera* (0.97 and 4.83), ginger (1.00 and 5.00) and eucalyptus (1.01 and 5.07), whereas in untreated check it was (8.57 and 1.71) respectively. Some of the findings of present investigation are in conformity with the results of Kumari and Singh (1998) who reported that neem leaf dust was effective in respect of number of eggs laid against pulse beetle (*Callosobruchus chinensis* L.). Results are disagreed with the findings of Sharma *et al*. (2013) who reported that on the basis of number of eggs laid, adult emergence and seed damage except neem seed kernel powder and turmeric powder all treatments (neem oil, mustard oil, groundnut oil, turmeric powder mixture with mustard oil and groundnut oil) were considered as most effective against *C. chinensis*. Sharanabasappa *et al*. (2008) reported that *C. chinensis* produced the lowest number of eggs when grown on neem oil.

### Oviposition period

The data presented in the table showed significant variation with a range of 2.67 to 4.67 days. The lowest ovipositional period was recorded in garlic treated seeds (2.67 days)

**Table 1: Effect of some botanicals on biological parameters of pulse beetle (*Callosobruchus chinensis* L.) infesting pea**

| Treatments | Dose (mL/kg seed) | *Egg laid/ day(number) | *Egg laid/ seed(number) | *Oviposition period (days) | *Incubition period (days) | **Hatchability (%) | *Larval-pupal period (days) | **Adult emergence (%) | *Adult survivorship (days) | **Adult mortality over control(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Neem (10%) | 5 | 4.55(2.25) | 0.84(1.16) | 3.33(1.95) | 6.18(2.58) | 43.76(41.40) | 31.67(4.85) | 4.76(7.40) | 1.33(1.29) | 90.88(79.49) |
| Ginger (10%) | 5 | 5.00(2.34) | 1.00(1.22) | 4.00(2.12) | 5.70(2.49) | 44.86(42.05) | 41.94(6.51) | 18.61(21.26) | 2.94(1.85) | 72.66(63.53) |
| Garlic (10%) | 5 | 2.33(1.68) | 0.47(0.98) | 2.67(1.77) | 6.67(2.68) | 26.19(30.77) | 0.00(0.71) | 0.00(0.00) | 0.00(0.71) | 100.00(90.00) |
| Turmeric (10%) | 5 | 3.42(1.96) | 0.68(1.08) | 3.33(1.95) | 6.69(2.68) | 37.03(37.44) | 46.33(6.84) | 6.67(8.86) | 0.67(0.99) | 93.96(81.60) |
| Eucalyptus (10%) | 5 | 5.07(2.36) | 1.01(1.23) | 4.67(2.27) | 6.01(2.55) | 44.32(41.73) | 34.92(5.95) | 28.79(32.29) | 3.97(2.11) | 58.51(50.03) |
| *Lantana camera* (10%) | 5 | 4.83(2.30) | 0.97(1.21) | 4.00(2.12) | 5.98(2.55) | 41.16(39.91) | 45.50(6.78) | 21.14(27.22) | 2.67(1.78) | 72.01(58.17) |
| Control | - | 8.57(3.01) | 1.71(1.49) | 4.67(2.27) | 5.32(2.41) | 50.68(45.39) | 21.92(4.73) | 61.76(51.80) | 4.83(2.31) | - |
| SEm ± | | 0.13 | 0.05 | 0.07 | 0.03 | 1.76 | 1.12 | 6.12 | 0.16 | - |
| CD (0.05) | | 0.38 | 0.15 | 0.21 | 0.10 | 5.34 | 3.39 | 18.57 | 0.49 | - |

*Figures in the parenthesis indicate the root transformed $[\sqrt{(x+0.5)}]$ values
**Figures in the parenthesis indicate the angular transformed $[\sin^{-1}\sqrt{(x/100)}]$ values

followed by neem (3.33 days) and turmeric (3.33 days) whereas; in control it was 4.67 days. Present finding are comparable with Kalita *et al*. (2002) who reported that neem act as strong ovipositional deterrent against pulse beetle in storage. Khaire *et al*. (1993) reported that neem oil had an adverse ovipositional effect of *Callosobruchus chinensis* Linn. on pigeonpea seeds.

**Incubation period**

The incubation period varied significantly and ranged from 5.23- 6.69 days. Longest period was observed on turmeric treated seeds (6.69 days) which was at par with garlic (6.67 days) followed by neem (6.18 days), eucalyptus (6.01 days) and *Lantana camera* (5.98 days) while shortest period being observed on untreated grains (5.23 days). Kumar *et al*. (2007) showed that some botanicals enhanced the incubation period of *Sitophilus oryzae* as compared to untreated control.

**Hatchability**

The hatchability of *C. chinensis* significantly reduced in various grain protestants and ranged from 26.19 to 50.68 per cent. Lowest hatchability was observed on garlic (26.19%) followed by turmeric extract (37.03%) and lantana leaf extract (41.16%) and highest hatchability was observed in untreated control (50.68 %). Findings are in close conformity with Zia *et al*. (2011) who reported that garlic reduced hatchability significantly against *C. chinensis* on chickpea. Kar *et al*. (2012) reported that neem leaf powder treated seeds were found to be significantly effective against the hatchability of *C. maculates* on chickpea.

**Larval-pupal period**

The larval-pupal period cannot be worked out as no adult has been formed in garlic treated seeds, otherwise maximum increase has been recorded in turmeric extract (46.33 days) followed by *Lantana camera* (45.50 days). However, shortest period was observed from untreated grains (21.92 days). Reports regarding the effect of tested botanicals on larval-pupal period of *C. chinensis* is very scanty, therefore, results may be compared with other similar works. Kumar *et al*. (2007) reported that the larval and pupal period of *Sitophilus oryzae* was increased by using various botanicals while Chaubey (2007) reported that the developmental period was significantly increased by using essential oil from dried fruits of different botanicals (*Trachyspermum ammi*, *Anethum graveolens* and *Nigella sativa*) against *Tribolium castaneum*.

**Adult emergence**

The ultimate emergence of adult was also influenced by these botanicals. No adult emergence has been observed in garlic treated seed however, the other botanicals showed significant decrease in adult emergence. Lowest percentage of adult was emerged in the treatment neem (4.76%) followed by turmeric (6.67%), ginger (18.61%), *Lantana* (21.14%) and least effect was recorded in eucalyptus (28.79%). Khalequzzaman and Goni (2009) who observed that seed treated with neem leaf powder gave significant reduction of adult emergence of *C. chinensis* which corroborate the present findings. Rahman *et al*. (2013) also reported the effectiveness of neem and garlic against *C. chinensis*.

**Adult survivorship**

The Adult survivorship cannot be worked out as no adult has been formed in garlic treated seeds, otherwise minimum days of survival was recorded in turmeric extract (0.67 days) followed by neem (1.33 days), *Lantana camera* (2.67 days) whereas in untreated check it was 4.83 days. Brisibe *et al*. (2011) reported that some botanicals including neem reduced adult survival of bruchids (*Callosobruchus maculatus*) significantly on cow pea grains that may be supported the present findings.

**Adult mortality**

The effect of garlic extract was found most promising as 100% adult mortality achieved in this treatment followed by turmeric (93.96%), neem (90.88%), ginger (72.66%) and *Lantana camera* (72.01%). Khalequzzaman and Goni (2009) again reported that 100 % mortality of *Callosobruchus chinensis* was recorded when the cowpea seeds were treated with neem leaf powder @ 2g/50g of seed. Present findings are similar with the study of Varma and Anandhi (2010) who reported that neem leaf powder and lantana leaf powder provided significant mortality of pulse beetle.

With a view to eco-friendly management of this bruchid beetle, efficacy of the three plant extracts garlic, turmeric and neem were found very promising. Therefore, from the above study it may be concluded that the plant extracts can be effectively used as grain protectants and thereby reduce the load of toxic chemicals in our food stuff as well as in the environment.

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