Oviposition Deterrent Activity of Some Indigenous Plant Extracts against Pulse Beetle, *Callosobruchus chinensis* L. Infesting Pea in Storage

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Abstract

Oviposition deterrent effect of six aqueous plant extracts from leaves of worm's wood *(Artemisia roxburghii* L and *A. annua* L.), mint *(Mentha longifolia* L. and *M. spicata* L.), marigold (*Tagetus erecta* L.) and seed kernels of *dharek* (*Melia azedarach* L.) was studied against the pulse beetle, *Callosobruchus chinensis* L. at four different concentrations (1%, 2% 4% and 6%) on pea, *Pisum sativum* under laboratory conditions. The results revealed that all the tested extracts with some variations had oviposition deterrent effect against the pulse beetle as compared to untreated check. It was also observed that reduction in oviposition was increased with the increase in concentration in each treatment. Maximum oviposition deterrent activity was observed in *M. azedarach* seed kernel extract (62.78%) followed by *A. annua* (57.23%), *T. erecta* (51.64%), *A. roxburghii* (49.41%) , *M. spicata* (38.90%) and *M. longifolia* (34.59%) at the highest (6%) concentration and was at par with the deterrent activity observed in *A. annua* leaves extract but was significantly higher as compared to other extracts indicating thereby that the aqueous extract of both these plant species were equally effective in preventing the oviposition of the pulse beetle on treated pea seeds.

1. Introduction

The pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) is a common and major pest of stored legumes. The insect is a field-to-store pest as its infestation often begins in the field as the mature pods dry and when such seeds are harvested and stored, it multiplies rapidly and causes total destruction within a short duration of 3-4 months (Sathyaseelan et al., 2008). Damage is caused by adult females due to laying of eggs on the seeds and the emerging larvae bore into the pulse grains and destroy the endosperm completely and leave the seed coat only. The seeds become unsuitable for human consumption, loose viability for replanting or for the production of sprouts. Injudicious use of synthetic pesticides for post harvest pest management leads to the development of insect resistance, pest resurgence and also causes health and environmental hazards, due to their non-degradable nature (Talukder and Howse, 2000; Isman, 2006). Therefore, efforts should be made to explore some eco-friendly management techniques against agriculturally important insect-pests. Plant derived materials are more readily biodegradable, safer to mammals and environment (Isman, 2008; Kshirsagar, 2010). Besides, they may be easily and cheaply produced by farmers and small-scale industries as crude, or partially purified extracts. Keeping this in view, the present study was conducted to determine the oviposition deterrent activity of some indigenous plant aqueous extracts against *C. chinensis* infesting pea seeds in storage.

2. Materials and Methods

2.1. Insect culture and maintenance

Culture of *C. chinensis* was reared on pea seeds. Freshly harvested pea seeds were sterilized as per method of Mookherjee et al. (1968) and were kept in half kg capacity plastic jars. 10 pairs of newly emerged adults of *C. chinensis* from the laboratory stock were released in these jars. The jars were covered with pieces of muslin cloth fastened with rubber bands to prevent the contamination and escape of insects and were kept in BOD incubator maintained at 27 ± 1^0C temperature and 70 ± 5% relative humidity for their further multiplication. The subsequent progenies of the beetles were used for the experiment.

2.2. Preparations of plant extracts

Fresh plant leaves of worm s wood *(Artemisia roxburghii* and *A. annua* L.), mint *(Mentha longifolia* L. and *M. spicata* L.), marigold (*Tagetus erecta* L.) and drupes (ripened fruits) of *dharek* (*Melia azedarach* L.) were collected from the university campus and neighbouring areas during summer and rainy seasons (May-September). Drupes of *M. azedarach* were de-pulped and the seeds were washed with water and shade dried for 2-3 days. *M. azedarach* seed kernels were obtained after de-cortication. Plant parts of other selected species were washed, air dried in shade and ground to a fine powder by grinding approximately 500 g of leaves of worm's wood, mint, marigold and seed kernels of *dharek* using electric mixer-grinder. Aqueous extracts were prepared as per the method of Gahukar (1996).

2.3. Oviposition deterrent activity

Each plant extract was evaluated at four different concentrations (1, 2, 4 and 6%) in separate plastic containers of 250 cc capacity @ 2 ml $100g^{-1}$ of sterilized pea seeds with five replicates and an untreated check for each treatment. Contents were thoroughly mixed by vigorous shaking and air dried. Five pairs of freshly emerged adults of *C. chinensis* were released in each container. The containers were closed by muslin cloth tightly secured by rubber band. After 15 days, number of eggs laid on treated seeds (Et) and control seeds (Ec) were recorded and oviposition deterrency (%) was calculated as: OD=(Ec-Et)÷Ec)×100.

2.4. Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) after transformations using SPSS computer programme.

3. Results and Discussion

Data recorded on the effect of plant aqueous extracts on oviposition of *C. chinensis* on pea seeds revealed (Table 1) that after 15 days of release of adult beetles, the overall minimum egg laying of 126.35 eggs per five females was recorded in pea seeds treated with *M. azedarach* extract. It was followed by *A. annua* (148.55 eggs), *T. erecta* (154.45 eggs), *M. spicata* (164.10 eggs), *M. longifolia* (176.05 eggs) and *A. roxburghii* (184.50 eggs). Untreated control seeds recorded an egg laying of 266.60 eggs. Minimum oviposition of 94.20 eggs was observed in *M. azedarach* extract at 6% concentration. *M. azedarach* extract proved to be significantly superior to all other treatments.

Studies on deterrent effect of aqueous extracts revealed (Table 2) that, all these extracts with some variations had oviposition deterrent effect against the pulse beetle as compared to untreated check. Maximum oviposition deterrent activity was observed in *M. azedarach* seed kernel extract (62.78%) followed by leaf extracts of *A. annua* (57.23%), *T. erecta* (51.64%), *A.*

Table 1: Effect of aqueous extract on oviposition by *C. chinensis* on pea seeds treated with plant products

Treatment	Mean no. of eggs laid per 5 pairs of beetles in the indicated concentrations*				
	6%	4%	2%	1%	Mean
Artemesia annua	107.80 (10.40)	143.80 (12.01)	153.80 (12.42)	188.80 (13.75)	148.55 (12.15)
Artemesia roxburghii	127.80 (11.33)	171.20 (13.08)	215.80 (14.71)	223.20 (14.95)	184.50 (13.52)
Melia azedarach	94.20 (9.73)	119.40 (10.95)	138.40 (11.78)	153.40 (12.40)	126.35 (11.22)
Mentha longifolia	164.40 (12.84)	174.00 (13.21)	177.00 (13.32)	188.80 (13.76)	176.05 (13.28)
Mentha spicata	154.60 (12.45)	179.6 (13.42)	156.60 (12.53)	165.60 (12.88)	164.10 (12.82)
Tagetes erecta	121.20 (11.03)	143.8 (12.01)	159.00 (12.63)	193.80 (13.94)	154.45 (12.40)
Control	255.80 (15.99)	273.00 (16.51)	264.00 (16.25)	273.60 (16.54)	266.60 (16.32)
Mean	146.54 (11.97)	172.11 (13.03)	180.66 (13.38)	198.17 (14.03)	

*Mean of five replications; Figures in parenthesis are √x+ 0.5 transformed values

CD (p=0.05) Treatment: 0.17; Concentration: 0.13; Treatment×Concentration: 0.34

Table 2: Oviposition deterrent activity of some plant aqueous extracts against the pulse beetle, *C. chinensis*

Treatment	Oviposition deterrency at indicated Concentrations (%)*				Mean Oviposition deterrency
	6%	4%	2%	1%	
Artemesia annua	57.23 (49.20)	46.71 (43.09)	41.41 (40.02)	29.99 (32.65)	43.83 (91.24)
Artemesia roxburghii	49.41 (44.67)	36.84 (37.26)	13.50 (20.86)	17.51 (22.15)	29.32 (31.32)
Melia azedarach	62.78 (52.42)	55.75 (48.32)	47.32 (43.46)	43.27 (41.17)	52.28 (46.34)
Mentha longifolia	34.59 (35.93)	35.31 (36.26)	32.68 (34.83)	30.35 (31.69)	33.23 (34.68)
Mentha spicata	38.90 (38.50)	33.55 (35.28)	40.37 (39.43)	38.56 (38.18)	37.85 (37.85)
Tagetes erecta	51.64 (45.95)	46.76 (49.13)	39.54 (38.95)	28.57 (32.17)	41.63 (41.55)
Mean	49.09 (44.45)	42.49 (41.56)	35.80 (36.26)	31.38 (33.00)	39.69 (38.82)

*Mean of five replications; Figures in parentheses are arc sine transformed value

CD (p=0.05) Concentration: 2.50; Treatment: 3.07; Treatment×Concentration: 6.13

roxburghii (49.41%), *M. spicata* (38.90%) and *M. longifolia* (34.59%) at the highest (6%) concentration tested. It was also observed that reduction in oviposition was increased with the increase in concentration in all treatments. Earlier, Olaifa and Erhun (1998) found that higher concentration of powder of *Piper guineense* reduced the oviposition of the pulse beetle. Jayakumar (2010) also reported that aqueous extracts of *Cassia siamia* and *Citrus aurantium* peel were effective in preventing the oviposition of pulse beetle, *C. maculatus*. Pandey et al. (1986) reported that petroleum ether extracts of neem and four other plants proved to be potent oviposition-inhibitor against *C. chinensis* on green gram seeds. Talukder and Howse (1994) showed that the mixture of food with pithraj leaf, bark and seed powder reduced the oviposition rates of the pulse beetle, *C. chinensis*. Elhag (2000) tested crude extracts from nine plant materials as oviposition deterrents against *C. maculatus* and found that pulse treated with *Rhazya stricta* leaves, neem seeds, *Heliotropium bacciferum* aerial parts and citrus peels acted as the highly ovipositional deterrents. Rahman and Talukder (2006) reported the highest oviposition inhibition rate in black gram seeds treated with nishida (*Vitex negundo* L), followed by eucalyptus (*Eucalyptus globules* Labill) and bankalmi (*Ipomoea sepiaria* K) at 3% concentration. Govindan and Nelson (2008) tested powders from ten plants and found that rhizome powder of sweet flag, *A. calamus* when mixed with black gram seeds @ 2%, effectively checked the oviposition and adult development of pulse beetle. These results are in general agreement with our findings.

4. Conclusion

The present studies revealed that aqueous extracts of leaves of *A. roxburghii*, *A. annua*, *M. longifolia*, *M. spicata*, *T. erecta* and seed kernels of *M. azedarach* have been found quite effective in reducing oviposition of *C. chinensis*. The overall effect of these extracts would thus be a reduction in seed damage and weight loss of stored product via reduction in progeny development or adult emergence. Thus, these can be used as one of the components in Integrated Stored Pest management especially in small godowns for short term storage.

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