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A Study on Effect of Different Plant Extracts against *Callosobruchus maculatus* (Fabricius) on Stored Chickpea in Saurashtra (Gujarat)

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Abstract—*A laboratory study was conducted at the JAU, Junagadh (Gujarat) during 2013-14 on the deterrent effect of different aqueous plant extracts against pulse beetle, Callosobruchus maculatus (Fabricius) (Coleoptera: Bruchidae) in stored seeds of chickpea, Cicer arietinum (L.). Among different aqueous extracts of plants materials, the custard apple seed extract at 5% gave maximum deterrence of oviposition and sub sequential adult emergence of C. maculatus. The results revealed that all of the tested materials with some variations had deterrent and toxic effects against the pest.*

Keywords: *Callosobruchus maculatus, chickpea, plant extract*

1. INTRODUCTION

Pulses form an important part of Indian cuisine. Pulses play an important role in human nutrition in a predominantly vegetarian country like India. Pulses are grown in an area of 22-23 million hectares with an annual production of 13-18 million tons (MT). India accounts for 33% of the world area and 22% of the world production of pulses (FAOSTAT, 2012). In Gujarat, chickpea (*Cicer arietinum* L.) is widely grown in Ghed area, Bhal and Panchmahal district and cultivated in about 240000 hectare area with an annual production of 273000 metric ton with an average yield of 1138 kg per hectare (Anon., 2013).

Among the insect pests, pulse beetle, *C. maculatus* (F.) is a cosmopolitan field-to-store pest ranked as the principal post harvest pest, which lead to a reduction of commercial value and seed germination, in addition the grains become unfit for human consumption (Atwal and Dhaliwal, 2005). The reason for searching the alternative of pesticide is expensive price of pesticide, so poor farmers are unable to fumigate their godown or storages. The pest controlling efficacy of many plant derivatives has already been proved against several storage pests (Rahman and Talukder, 2006). These are also having less environmental impact in terms of insecticidal hazards and could benefit our agricultural sector. The present experiment was therefore, carried out to evaluate the effects of leaf and seed extracts of plants against pulse beetle, *C. maculatus* to protect cowpea seeds in storage.

2. MATERIALS AND METHODS

The experiment on management of pulse beetle, *C. maculatus* by using plant extracts on chickpea seeds in storage was conducted in the Storage Entomology & Packaging Research Laboratory, Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh during the year of 2013-14.

3. PREPARATION OF PLANT EXTRACTS

Fresh leaves or seeds of selected plants were collected at their respective places and brought to the laboratory. Each plant material was dried under shade and powdered by using electric grinder and pass through a 20 mesh sieve and kept in a 1 kg capacity polypropylene bag. 300 g of each powdered plant material was taken into a 2 litre capacity conical flask and 1000 ml of distilled water was added to it and it was homogenized in a homogenizer for 15 minutes and then allowed to settle it for 24 h. The extract was separated using fine muslin cloth and then filtered. The filtrate was collected in a 2 litre capacity conical flask and volume was made up to 1000 ml. This was considered as stock solution. Required concentrations were prepared from the stock solution.

4. OVIPOSITION DETERRENT ACTIVITY

For each concentration, 150 seeds of chickpea were taken in a conical flask and mixed with each concentration of aqueous extracts and seeds treated with water alone used as control. After through mixing the seeds were air dried and they were separated into three lots each having 50 seeds, stored in plastic containers (8 X 6.5 cm) and 5 pairs of newly emerged adult of *C. maculatus* were introduced in each container. The treatment control was maintained separately for each treatment. After 15 days, number of eggs laid on treated seeds (Ts) and control

seeds (Cs) were recorded and the percentage of oviposition deterrence (POD) was calculated by following formulae given by Singh and Jakhmola (2011).

$$POD = \frac{Cs - Ts}{Cs} \times 100$$

Where,

Ts = number of eggs laid on treated seeds

Cs = number of eggs laid on control seeds

5. ADULT EMERGENCE ACTIVITY

After the eggs were counted, the experimental set up was kept undisturbed till the emergence of F_1 adults from the treated and untreated seeds. The number of F_1 adults emerged from the control seeds (Ac) and treated seeds (At) were recorded. The percentage reduction in F_1 adult (PRA) emergence (F_1) was calculated by following formulae given by Singh and Jakhmola (2011).

$$PRA = \frac{Ac - At}{Ac} \times 100$$

Where,

Ac = number of F_1 adults emerged from the control seeds

At = number of F_1 adults emerged from the treated seeds

6. DATA ANALYSIS

Mean number of eggs laid on treated and control seeds and F_1 adult emergence were calculated using the above said formula. The data obtained from the experiments were subjected to two-way analysis of variance (ANOVA) and then, treatment means were compared by DNMRT test.

7. RESULTS AND DISCUSSION

Oviposition deterrence and reduction of adult emergence (%)

Oviposition deterrence %

The oviposition deterrence effect of different plant extracts on chickpea was presented in Table 1 and Fig. 1. The data revealed that maximum oviposition deterrent activity was observed in custard apple seed extract at 5 per cent (64.86%) followed by custard apple leaf extract (64.41%), neem seed extract (63.48%), mustard seed extract (61.40%), black pepper seed extract (61.37) at same dose level and the custard apple seed extract (61.35%) and neem seed extract (60.95%) at 3 per cent dose level. These treatments were not significantly different to each other. These results are in agreement of Kahare (1993) and Hossain and Haque (2010) stated that chickpea seeds treated with 1 per cent neem leaves and seed extract had the lowest egg deposition by *C. chinensis.*

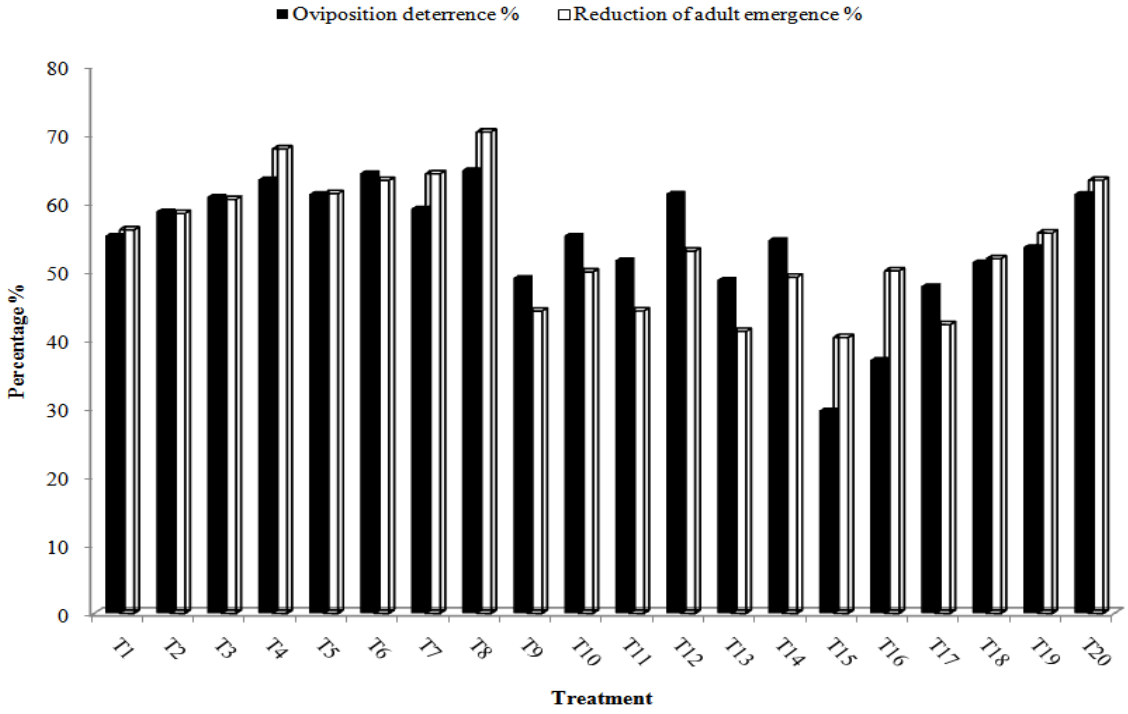

Fig. 1: Effect of plant extracts against oviposition and adult emergence of *C. maculatus* in chickpea

8. REDUCTION OF ADULT EMERGENCE %

The average per cent reduction of adult emergence is mentioned in Table 1 and depicted in Fig. 1. The experimental results revealed that the maximum per cent reduction of adult emergence of *C. maculatus* was observed in chickpea seeds treated with custard apple seed extract 5% (70.46%) followed by neem seed extract 5% (67.98%) and they were statistically at par with each other. The present results get corroborate with the findings of Raja *et al.* (1998), who exemplified that plant extract of *A. squamosa* showed oviposition deterrent effects in F_1 and F_2 generation of *C. maculatus* and also prohibited the adult emergence of *C. maculatus*. Similar findings were obtained by Hossain and Haque (2010), who found that the neem seed extract in ethanol, hexane and petroleum ether medium had the highest growth inhibition effect, on adult emergence. Zia *et al.* (2011) observed the black pepper was the most effective treatment in controlling *C. chinensis.*

9. CONCLUSION

The present findings have brought out the efficacy of different aqueous plant extracts against *C. maculatus*. It indicated that botanical derivatives might be useful as insect control agents for commercial use. Custard apple leaves and seed extracts, neem leaves and seed extracts, mustard seed extract and black pepper seed extract were effective to some degree in reducing the ovipositional preferences as well as adult emergence and increasing the inhibition rates. The effective extracts are useful in reducing the ovipositional preferences and increasing the inhibition rate as well as significantly fewer F_1 adults emergence from food treated with these extracts. It serves as a alternative to chemical pesticides. It is an inexpensive and effective technique, and its easy adaptability will give additional advantages leading to acceptances of the technology by farmers.

Table 1: Effect of different plant extracts against oviposition and adult emergence of *C. maculatus* on chickpea

Treatment	Plant extract	Dose	Oviposition deterrence %	Reduction of adult emergence %
T1	Neem leaf extract	3 %	48.02def (55.25)	48.53defghi (56.14)
T2	Neem leaf extract	5 %	50.06cde (58.79)	49.91cdefgh (58.53)
T3	Neem seed extract	3 %	51.33abc (60.95)	51.11bcdefg (60.58)
T4	Neem seed extract	5 %	52.83abc (63.48)	55.54ab (67.98)
T5	Custard apple leaf extract	3 %	50.31bcd (59.21)	51.64bcdef (61.45)
T6	Custard apple leaf extract	5 %	53.38ab (64.41)	52.81abcd (63.39)
T7	Custard apple seed extract	3 %	51.56abc (61.35)	53.40abc (64.33)
T8	Custard apple seed extract	5 %	53.65a (64.86)	57.08a (70.46)
T9	Mustard leaf extract	3 %	44.47gh (49.07)	41.69jkl (44.24)
T10	Mustard leaf extract	5 %	48.02def (55.25)	44.98ij (49.97)
T11	Mustard seed extract	3 %	45.96fgh (51.66)	41.71jkl (44.27)
T12	Mustard seed extract	5 %	51.59abc (61.40)	46.73ghi (53.01)
T13	Mint leaf extract	3 %	44.30gh (48.77)	39.97 l (41.28)
T14	Mint leaf extract	5 %	47.65def (54.62)	44.53ijk (49.19)
T15	Mahendi leaf extract	3 %	32.96j (29.67)	39.45l (40.38)
T16	Mahendi leaf extract	5 %	37.50i (37.07)	45.08ij (50.13)
T17	Jatropha leaf extract	3 %	43.78h (47.87)	40.53kl (42.26)
T18	Jatropha leaf extract	5 %	45.78fgh (51.36)	46.09hij (51.91)
T19	Black pepper seed extract	3 %	47.05efg (53.57)	48.26dfghi (55.67)
T20	Black pepper seed extract	5 %	51.58abc (61.37)	52.78abcde (63.37)

Figures in parentheses are retransformed values, those outside are Arcsine transformed values

Means in the same column showing similar alphabets are not significantly different by DNMRT (p = 0.05)

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