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# Deterrent effect of plant extracts against *Callosobruchus maculatus* on stored cowpea in Saurashtra (Gujarat, India)

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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 cowpea, *Vigna unguiculata* (L.). Among different aqueous extracts of plants materials, maximum percentage of oviposition deterrence was observed in custard apple seed extract (67.19%), custard apple leaf extract (65.95%), neem seed extract (65.44%), mustard seed extract (64.65%) and jatropha leaf extract (64.16%) at 5 per cent concentration. The maximum adult emergence reduction was seen in custard apple seed extract (78.45%), custard apple leaf extract (77.14%) and neem seed kernel extract (NSKE) (77.09%) at 5 per cent dose level. Minimum weight loss percentage was observed in the cowpea seeds treated with custard apple seed extract at 5% dose level, which recorded 79.20%. The results revealed that all of the tested materials with some variations had deterrent and toxic effects against the pest.

**Key words:** *Callosobruchus maculatus*, Cowpea, Plant extract

## 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, 2011). Cowpea, *Vigna unguiculata* (L.), is an important edible legume crop gaining recognition in India as a staple crop. Cowpea is a very good source of vegetable protein for millions of people. In Gujarat, cowpea (*V. unguiculata*) is grown in mid and north Gujarat area as *kharif* and *rabi* pulses with 500 to 1800 kg per hectare (Anonymous, 2012).

Among the insect pests, pulse beetle, *Callosobruchus 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 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.

## MATERIALS AND METHODS

The experiment on management of pulse beetle, *C. maculatus* by using plant extracts on cowpea 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.

**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.

**Oviposition deterrent activity:** For each concentration,

 

**Table 1.** The details of various plant extracts used for experiment against *C. maculatus* in stored cowpea.

| Treatment | Common name | Scientific name | Dose |
|---|---|---|---|
| $T_1$ | Neem leaf extract | *Azadirachta indica* (A. Juss) | 3% |
| $T_2$ | Neem leaf extract | *Azadirachta indica* (A. Juss) | 5% |
| $T_3$ | Neem seed kernel extract | *Azadirachta indica* (A. Juss) | 3% |
| $T_4$ | Neem seed kernel extract | *Azadirachta indica* (A. Juss) | 5% |
| $T_5$ | Custard apple leaf extract | *Annona squamosa* (L.) | 3% |
| $T_6$ | Custard apple leaf extract | *Annona squamosa* (L.) | 5% |
| $T_7$ | Custard apple seed extract | *Annona squamosa* (L.) | 3% |
| $T_8$ | Custard apple seed extract | *Annona squamosa* (L.) | 5% |
| $T_9$ | Mustard leaf extract | *Brassica juncea* (L.) | 3% |
| $T_{10}$ | Mustard leaf extract | *Brassica juncea* (L.) | 5% |
| $T_{11}$ | Mustard seed extract | *Brassica juncea* (L.) | 3% |
| $T_{12}$ | Mustard seed extract | *Brassica juncea* (L.) | 5% |
| $T_{13}$ | Mint leaf extract | *Mentha arvensis* (L.) | 3% |
| $T_{14}$ | Mint leaf extract | *Mentha arvensis* (L.) | 5% |
| $T_{15}$ | Mahendi leaf extract | *Lawsonia inermis* (L.) | 3% |
| $T_{16}$ | Mahendi leaf extract | *Lawsonia inermis* (L.) | 5% |
| $T_{17}$ | Jatropha leaf extract | *Jatropha curcas* (L.) | 3% |
| $T_{18}$ | Jatropha leaf extract | *Jatropha curcas* (L.) | 5% |
| $T_{19}$ | Black pepper seed extract | *Piper nigrum* (L.) | 3% |
| $T_{20}$ | Black pepper seed extract | *Piper nigrum* (L.) | 5% |

150 seeds of cowpea 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).

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

Where, Ts = number of eggs laid on treated seeds; Cs = number of eggs laid on control seeds

**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).

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

Where, Ac = number of $F_1$ adults emerged from the control seeds At = number of $F_1$ adults emerged from the treated seeds.

**Measurement of loss of weight:** After complete emergence of $F_1$ adults, the weight losses due to *C. maculatus* infestation on cowpea seeds were recorded. The weight of the treated seeds (Wt) and control seeds (Wc) were observed before and after experiment and the percentage reduction in weight loss (PRW) was calculated by following formulae given by Singh and Jakhmola (2011).

$$\mathbf{PRW} = \frac{\mathbf{Wc - Wt}}{\mathbf{Wc}} \times \mathbf{100}$$

Where,

Wc = weight of the control seeds; Wt = weight of the treated seeds

**Statistical 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 Duncan's new multiple range test (DNMRT).

## RESULTS AND DISCUSSION

**Oviposition deterrence and reduction of adult emergence (%):** The percent oviposition deterrence as well as reduction of adult emergence to *C. maculatus* after treatment with plant extracts under laboratory study recorded in stored cowpea has been presented in Table 2. The average per cent of oviposition deterrence

**Table 2.** Effect of different plant extracts against oviposition and adult emergence of *C. maculatus* on cowpea.

| Treatment | Plant extract | Dose | Oviposition deterrence % | Reduction of adult emergence % |
|---|---|---|---|---|
| $T_1$ | Neem leaf extract | 3 % | $51.22^{bcd}$ (60.76) | $56.57^{cde}$ (69.65) |
| $T_2$ | Neem leaf extract | 5 % | $50.95^{bcd}$ (60.30) | $57.69^{bcd}$ (71.38) |
| $T_3$ | Neem seed kernel extract | 3 % | $51.22^{bcd}$ (60.76) | $59.53^{abcd}$ (74.28) |
| $T_4$ | Neem seed kernel extract | 5 % | $54.02^{ab}$ (65.44) | $61.40^{ab}$ (77.09) |
| $T_5$ | Custard apple leaf extract | 3 % | $52.76^{abcd}$ (63.37) | $61.08^{ab}$ (76.58) |
| $T_6$ | Custard apple leaf extract | 5 % | $54.31^{ab}$ (65.95) | $61.44^{abc}$ (77.14) |
| $T_7$ | Custard apple seed extract | 3 % | $51.25^{bcd}$ (60.82) | $60.43^{ab}$ (75.59) |
| $T_8$ | Custard apple seed extract | 5 % | $55.07^{a}$ (67.19) | $62.35^{a}$ (78.45) |
| $T_9$ | Mustard leaf extract | 3 % | $47.17^{efg}$ (53.78) | $51.44^{fgh}$ (61.13) |
| $T_{10}$ | Mustard leaf extract | 5 % | $52.73^{abcd}$ (63.32) | $55.68^{def}$ (68.20) |
| $T_{11}$ | Mustard seed extract | 3 % | $50.22^{cde}$ (59.06) | $52.59^{efg}$ (63.09) |
| $T_{12}$ | Mustard seed extract | 5 % | $53.52^{abc}$ (64.65) | $56.52^{cde}$ (69.53) |
| $T_{13}$ | Mint leaf extract | 3 % | $45.70^{g}$ (51.22) | $45.93^{jk}$ (51.61) |
| $T_{14}$ | Mint leaf extract | 5 % | $51.48^{abcd}$ (61.20) | $47.33^{hij}$ (54.04) |
| $T_{15}$ | Mahendi leaf extract | 3 % | $38.66^{h}$ (39.08) | $40.58^{l}$ (42.37) |
| $T_{16}$ | Mahendi leaf extract | 5 % | $46.67^{fg}$ (52.90) | $42.56^{kl}$ (45.76) |
| $T_{17}$ | Jatropha leaf extract | 3 % | $46.45^{fg}$ (52.52) | $47.13^{ij}$ (53.71) |
| $T_{18}$ | Jatropha leaf extract | 5 % | $53.24^{abcd}$ (64.16) | $52.01^{fg}$ (62.05) |
| $T_{19}$ | Black pepper seed extract | 3 % | $46.48^{fg}$ (52.58) | $46.01^{jk}$ (51.76) |
| $T_{20}$ | Black pepper seed extract | 5 % | $49.71^{def}$ (58.18) | $51.16^{ghi}$ (60.66) |

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)

of test insect at different two dose levels ranged from 39.08 to 67.19 per cent. Maximum percentage of oviposition deterrence (67.19%) was observed in custard apple seed extract treatment at 5% concentration followed by custard apple leaf extract at 5%(65.95%), neem seed kernel extract at 5% (65.44%), mustard seed extract at 5% (64.65%), jatropha leaf extract at 5% (64.16%), custard apple leaf extract at 3% (63.37%), mustard leaf extract at 5% (63.32%) and mint leaf extract at 5% (61.20%). These mentioned treatments were statistically at par with each other. Whereas, the treatment of mahendi leaf extract 3%

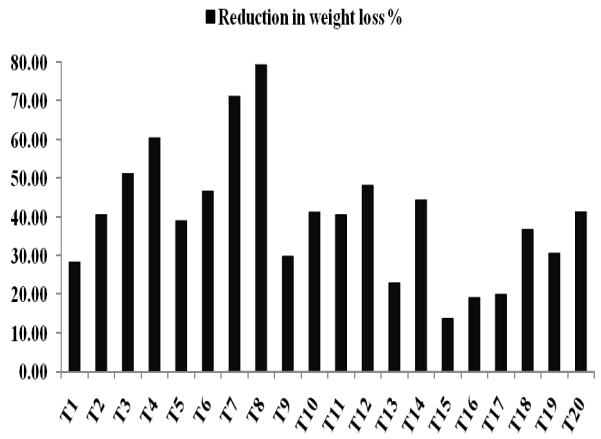


**Fig. 1.** *Percentage reduction in weight loss in stored cowpea treated with different plant extracts against Callosobruchus maculates.*

gave the least percentage of oviposition deterrent property (39.08%) among all the treatments.

In case of per cent reduction of adult emergence of *C. maculatus*, maximum reduction was observed in custard apple seed extract at 5% (78.45%) followed by custard apple leaf extract at 5% (77.14%), neem seed kernel extract at 5% (77.09%), custard apple leaf at 3% (76.58%), custard apple seed extract at 3% (75.59%) and neem seed kernel extract at 3% (74.28%). These treatments were also statically at par with each other. The reduction in adult emergence could either be due to egg mortality or larval mortality or even reduction in hatching of the eggs.

The present results are in agreement of the findings of Raja *et al.* (2000), who reported that leaf extract of *A. indica* and *Jatropha curcas* showed oviposition deterrence and antifeedant activity as well as reduction of the adult emergence of *C. maculatus*. Rao and Sharma (2007) observed the ovicidal effect of seed ethyl acetate and hexane extracts of custard apple on rice moth and revealed that these were the most effective effects in causing ova mortality. Vanmathi *et al*. (2012) reported ovipositional deterrent property of some plant against pulse beetle and concluded that the extract of *A. indica* exhibited 69.44 per cent reduction in oviposition at higher concentration on blackgram.

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*. Raja *et al.* (2001) reported that mint extract 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 into 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. Al Lawati *et al.* (2002) demonstrated that the extracts of jatropha and commercial neem in ethanol caused high mortality of *C. chinensis.* Wahedi *et al.* (2013) reported that the effect of aqueous extract of neem seed at different graded level against *C. maculatus* adult emergence in cowpea. They found that NSKE (Neem seed kernel extract) significantly suppressed adult emergence least by 3.00 ± 2.16 each at 1.5 ml.

**Reduction in weight loss %:** Weight loss indicated the quantitative loss in stored grains due to insect feeding showing a direct relationship between insect population and weight loss and in present findings, it is portrayed in Fig. 1. The results revealed that the per cent reduction of weight loss for treated grain ranged from 13.71% to 79.20%. Minimum per cent weight loss was observed in the cowpea seeds treated with custard apple seed extract at both 3% and 5% dose level, which recorded 71.06% and 79.20% reduction in weight loss, respectively. This supports the findings of Wahedi *et al.* (2013), where neem seed extract significantly prevented emergence of $F_1$ adults of *C. maculatus* and subsequent weight loss done due to pest. The results for the neem seed extract agree with Ahmed *et al.* (2014), who reported that pest repellent constituents in neem seed justify the use of neem as grain protectant.

## Conclusion

The findings of the present investigations indicate that plant parts might be useful as insect control agents for commercial use. Custard apple leaves and seed extracts as well as neem leaves and seed extracts effective to some degree in reducing the ovipositional preferences and increasing the inhibition rates. Significantly fewer $F_1$ adults emerged from food treated with extracts. To minimize the severe damage caused by insect pests, the traditional use of plant products, proved to be highly effective against stored-product insects. It is an inexpensive and effective technique, and its easy adaptability will give additional advantages leading to acceptances of the technology by farmers.

## REFERENCES

AL-Lawati, H.T., Azam, K.M. and Deadman, M.L. (2002). Insecticidal and repellent properties of subtropical plant extract against *Callosobruchus chinensis* (L.). *Sultan Qaboos University Journal Scientific Research Agriculture Science,* 7 (1): 37-45.

Ahmed; Kiyawa; Maryam; Kutama and Isah (2014). Effects of Pre-Harvest Application of Lamda Cyhalothrin and Neem Seed Extracts in the Management of Cowpea Bruchid, *Callosobruchus maculatus* Fab. (Coleoptera:Bruchidae) on Stored Cowpea. *Global Advanced Research Journal of Agricultural Science,* 3 (3): 100-105.

Anonymous (2012). Margdarshikha: district wise area, production and yield of important food and non food crops in Gujarat state, Directorate of Agriculture Gujarat state, Gandhinagar.

Atwal, A.S. and Dhaliwal, G.S.(2005). Agricultural pests of South Asia and their management. 5th edition. Kalyani Publishers, New Delhi. 390pp.

FAO STAT (2011). FAOSTAT–Statistical Database. www.faostat.fao.org

Rahman, A. and Talukder, F.A. (2006). Bioefficacy of some plant derivatives that protect grain against the pulse beetle, *Callosobruchus maculatus*. *Journal of Insect Science,* 6 (3): 1-10.

Raja, N., Albert, S., Ignacimuthu, S., Ofuya, T.I. and Dorn, S. (1998). Evaluation of some plants for use in the control of cowpea weevil *Callosobruchus maculatus* (Coleoptera: Bruchidae). *Applied Tropical Agriculture*, 3: 34-39.

Raja, N., Albert, S., Ignacimuthu, S., Ofuya, T.I. and Dorn, S. (2000). Role of botanical protectants and larval parasotoid *Dinarmus vagabundus* (Timberlake) (Hymenoptera: Pteromalidae) against *C. maculatus* (Fab.) (Coleoptera: Bruchidae) infesting cowpea seeds. *Malaysian Applied Biology*, 29 (1):255–260.

Raja, N., Albert, S., Ignacimuthu, S., Ofuya, T.I. and Dorn, S. (2001). Effect of plant volatile oils in protecting stored cowpea *Vigna unguiculata* (L.) Walpers against *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) infestation. *Journal of stored product research,* 37: 127-132.

Rao, N.S. and Sharma, K. (2007). Ovicidal effect of seed extracts of custard apple on *Corcyra cephalonica* (Stainton) and *Trogoderma granarium* (Everts). *Pesticide research Journal,* 19 (1): 4-6.

Singh, P. and Jakhmola, S.S. (2011). Efficacy of botanical extracts on biological activities of pulse beetle *Callosobruchus maculatus* (Fab.) on green gram. *Trends -in-Biosciences*, 4 (1): 25-30.

Vanmathi, J.S., Padmalatha, C., Ranjit Singh, A.J.A. and Chairman, K. (2012). Effect of chosen botanicals on the oviposition deterrence and adult emergence of *callosobruchus maculatus* (F.) (coleoptera: bruchidae). *Elixir Bio Technology International Journal*, 51 (A): 11120-11123.

Wahedi, J.A., David, L.D., Edward, A., Mshelmbula, B.P. and Bullus (2013). Efficacy of seed powder and extracts of *Azadirachta indica* Linn (Meliaceae) at graded levels on adult *Callosobruchus maculatus* (Coleoptera: Bruchidae) in mubi, north – eastern Nigeria. *International Journal of Science and Nature*. 4 (1): 138 -141