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# EFFECTIVENESS OF POWDERED PLANT PRODUCTS AGAINST PULSE BEETLE *CALLOSOBRUCHUS CHINENSIS* L.

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## ABSTRACT

A laboratory experiment was conducted on the management of pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) through powdered plant products at Post Harvest Technology Scheme, College of Technology and Engineering, Udaipur during July to December 2011. Among the powdered plant products custard apple seed powder showed the maximum (83.67%) mortality. The minimum (23.0%) mortality was observed in grains treated with curry leaf powder (1.0%). The lowest number of eggs (1.00 egg/seed) was recorded on grain treated with custard apple seed powder (20 g/kg). The minimum adults (5.10) were emerged in seeds treated with custard apple seed powder (20 g/kg). The leaf powders of custard apple exhibited maximum number of (6.10) adults. Pulse beetle made fewest holes (0.10/seed) in grains treated with custard apple seed powder. The minimum weight loss of 3.29 per cent was recorded in custard apple seed powder treated grains. Cowpea seeds treated with custard apple seed powder at 20g/kg exhibited the maximum (66.88%) inhibition followed by neem seed kernel powder (66.62%). The minimum 60.39 per cent adult inhibitions were exhibited by custard apple leaf powder. No adverse effect on the germination of cowpea seeds was observed when treated with different doses of plant powders used as grain protectants at 0, 30, 60, 90 and 120 days after treatment.

**Key words:** Pulse beetle, *Callosobruchus chinensis* L., plant powders

## INTRODUCTION

Pulses play an important role both in Indian economy and diet. In India where the population is predominantly vegetarian, pulses are important as they are rich source of protein, amino acids, energy, minerals and certain vitamins. Among the Indian states, Rajasthan stands at first position in pulse production. The total area in Rajasthan under pulses was 3.50 million ha with the annual production of 0.71 million tones (Anonymous, 2010). The assessment of losses at storage has been an intricate problem since long. Among the bruchids, pulse beetle, C. *chinensis* causes serious damage and are cosmopolitan in distribution. These are known to breed on different pulses (Shivanna *et al,*. 2011). The insects spends its entire immature stage in individual legume seeds, where they cause weight loss, decrease in germination potential and diminish the market as well as nutritional value of the commodity. In India Gujar and Yadav (1978) recorded 32.2 to 55.7 per cent loss in seed weight and 17.0 to 53.5 per cent loss in protein content. At present, pest control measures in storage rely on the use of synthetic insecticides and fumigants. Their indiscriminate use in the storage, however, has led to a number of problems including insect resistance, toxic residues in food grains (Fishwick, 1988), environment pollution (WMO, 1995) and increasing cost of application. Plant material based insecticides are target specific, non–toxic to human being and beneficial organisms, less prone to insect resistance and resurgence, biodegradable and less expensive and are promising grain protectants. The present investigation was therefore carried out with a view to manage of pulse beetle *Callosobruchus chinensis* L. through plant products.

## MATERIALS AND METHODS

Cow pea was used for the evaluation of plant products against pulse beetle. The pulse beetle culture for all the studies were maintained in the incubator at constant temperature of 30 ± 2°C and 70 ± 5 % relative humidity in the Post Harvest Biology Laboratory, Post harvest Technology Scheme, Department of Processing and Food Engineering, College of Technology and Engineering, Udaipur. The plant materials (Table–1) were collected and shade dried until they became crisp dry. The powders of these materials were obtained by grinding their dried form separately in a mechanical grinder and by sieving through a mesh size of 50. The resulting powder was used directly as admixture to the grains at application rates of 10 and 20g/kg of seeds. Each plastic jar was provided with 100 g sieved grain of cowpea which was obtained from market and was subjected to fumigation prior to their use in the

experiments by using phostoxin for two weeks so as to kill any pest already existing. Each plant powder was put in separate jar in three replication, which were placed on a mechanical rotary shaker for 10 minutes to mix plant powder /grain mixture thoroughly with grains and then 10 pairs of 1–3 day old adult of pulse beetle taken from the 'pulse beetle rearing cell' were released in every jar. The mouth of jar was covered with muslin cloth and secured by rim of lid so as to disallow the entry or exit of any insect. The jars were placed in the incubator at temperature of 30 ± 2°C and 70 ± 5 per cent relative humidity. Three jars were also placed in the incubator as the control, having grains and pulse beetle adult as in above treatments but without any plant material.

The insecticidal potency of the plant powders against pulse beetle were studied with the following parameters:

i. Mortality of pulse beetle at different time intervals

ii. Numbers of eggs/seed

iii. Numbers of holes/seed

iv. Number of adults emerged

v. Mean inhibition rate (%)

vi. Weight loss (%) of grains

vii. Effect on germination

**(i) Mortality of pulse beetle at different time intervals.** To assess the efficacy of the plant products, the bruchid adults were released in jars containing seeds of cowpea. The jars were filled with treated cowpea and left for 24h and then five pairs of 48 h old bruchids were introduced into each jar. The jars were covered with muslin cloth for proper ventilation. The numbers of dead bruchids in each jar were counted after 24, 48 and 72 h.

**(ii) Numbers of eggs/seed.** Average number of eggs per grain laid by pulse beetle was calculated to check the effect of treatments on its oviposition/fecundity. Ten grains were randomly selected from each replication and eggs laid on those grains were counted. At the end, their average was calculated to determine number of eggs / grain in each jar.

**(iii) Number of holes/seed.** Average number of holes per grain was calculated by counting the number of holes made by pulse beetle. For this, ten grains were randomly selected in each jar and number of holes on those grains was counted. Then average was taken to determine number of holes/ grain in each replication.

**(iv) Number of adult emerged.** Number of (fresh emerged) adults in each jar were calculated to see the inhibition of pulse beetle emergence by different treatments.

**(v) Mean inhibition rate (%).** Per cent reduction in emergence of adults or inhibition rate was calculated by using the following formula:

$$IR\ (\%) = \frac{(CN - TN)}{CN} \times 100$$

CN = No. of larvae in control

TN = Number of larvae in treatment

**(vi) Weight loss (%) of grains:** The per cent weight loss was calculated at the end of experiment by using the following formula:

$$\text{Weight loss (\%)} = \frac{\text{(Initial weight – Weight of sound and damaged grains)}}{\text{Initial weight}} \times 100$$

Data were recorded on weekly basis up to 100 % mortality of $F_1$ generation.

**(vii) Effect on Germination:** The effect of plant powders were observed on the germination of cowpea seeds at 0, 30, 60, 90 and 120 days interval. The seeds were treated with powders (10 and 20 g/kg) and replicated thrice and stored in jars. The germination tests were carried out according to International Rules of Seed Testing (Anonymous, 1976). Hundred seeds from each replication were placed in a petri dish (diameter 15 cm) having blotting paper moistened with distilled water. The petri dishes were kept at a temperature of 28 ± 2 °C. The number of germinated seeds was counted and the percentage was calculated.

## RESULTS AND DISCUSSION

**(i) Mortality of pulse beetle at different time interval.** It could be seen in Table 2 that plant powders at all the application rates and time interval significantly caused pulse beetle mortality as compared to control. Custard apple seed powder showed the maximum (83.67%) mortality. The minimum (23.00%) mortality was observed in seeds treated with curry leaf powder (1%). The application of powders at different rates exerted marked effect on the mortality, but at higher rates caused rapid mortality. However, more effective powders like custard apple seed powder and custard apple leaf powder at their higher application rates (2%) caused higher mortalities as compared to many others even at their higher rates. Juneja and Patel (1994) reported that the seed powders of custard apple at 5 parts per 100 parts of green gram (w/w) resulted in 100 per cent adult mortality.

**(ii) Number of eggs/seed.** All the plant powders at their application rates of 10 and 20 g significantly reduced the number of eggs laid by pulse beetle when compared with the control, which provided the maximum of 4.13 eggs/ seed (Table 3). The lowest number of eggs (1.00 egg/seed) was recorded on grain treated with custard apple seed powder (20 g/kg). The curry leaf powder was least effective

**Table 1. Effect of plant products on the mortality of pulse beetle at different time intervals**

| Treatments | Doses (g/kg) | Per cent mortality at different time intervals | | |
|---|---|---|---|---|
| | | 24 h | 48 h | 72 h |
| Custard apple leaf powder | 10 | 46.67 (43.09) | 55.00 (47.87) | 66.33 (54.54)* |
| Custard apple leaf powder | 20 | 56.67 (48.83) | 70.33 (57.02) | 67.67 (55.37) |
| Custard apple seed powder | 10 | 41.00 (39.81) | 70.67 (57.22) | 76.67 (61.17) |
| Custard apple seed powder | 20 | 68.00 (55.56) | 77.00 (61.36) | 83.67 (66.23) |
| Neem leaf powder | 10 | 33.33 (35.26) | 40.33 (39.42) | 50.33 (45.19) |
| Neem leaf powder | 20 | 43.00 (40.97) | 42.33 (40.59) | 53.00 (46.72) |
| Neem seed kernel powder | 10 | 39.33 (38.84) | 44.33 (41.74) | 72.33 (58.30) |
| Neem seed kernel powder | 20 | 42.00 (40.39) | 52.00 (46.15) | 80.33 (63.82) |
| Curry leaf powder | 10 | 15.67 (23.24) | 20.33 (26.78) | 23.00 (28.63) |
| Curry leaf powder | 20 | 17.33 (24.55) | 24.00 (29.22) | 34.67 (36.03) |
| Control | – | 1.67 (7.33) | 1.67 (7.33) | 1.67 (7.33) |
| S. Em ± | | 0.77 | 1.04 | 1.23 |
| C.D. ($P = 0.05$) | | 2.24 | 3.05 | 3.61 |

* Figures in the parenthesis are angular transformed values

(1.40 eggs/seed) at the dose level of 20 g/kg. The table also showed that powders of fruit parts (neem and custard apple) were more effective in reducing fecundity of pulse beetle compared to those prepared from leaves. Juneja and Patel (1994) reported that no eggs were laid by pulse beetle on the green gram treated with custard apple seed powder up to 60 days, support the present results.

**(iii) Number of holes/seed.** Table 3 shows that all the plant powders at both the application rates significantly reduced number of holes made by pulse beetle as compared to the control. Pulse beetle made fewest holes (0.10/seed) in grains treated with custard apple seed powder. The seed powder of custard apple and neem exhibited significantly higher insecticidal potency even at their lower application rates when compared to other plant powders applied at higher rates. The work on the effect of custard apple seed powder on number of holes/seed is not available, hence, the present results could not be compared.

**(iv) Number of adult emergence.** As per Table 3 all the plant powders even at their lowest application rate significantly reduced the emergence of adults when compared with control, where the maximum adults (15.40) emerged. The minimum adults (5.10) emerged in jars treated with custard apple seed powder (20 g/kg). The leaf powders of custard apple exhibited maximum number of (6.10) adults. Fruits parts (neem and custard apple) again showed better insecticidal potency than the leaf powders (Table 3). Similar results were also reported by Shivanna *et al.* (1994).

**(v) Mean inhibition rate (%).** All the treatments were effective in inhhaberting the adult's emergence. The higher doses (20 g/kg) were found more effective as compared to lower doses (10g/kg). Cowpea seeds treated with custard apple seed powder at 20g/kg exhibited the maximum (66.88%) inhibition followed by neem seed kernel powder (66.62%). The minimum 60.39 per cent adult inhibition was exhibited by custard apple leaf powder (Table 3). The work on the effect of custard apple seed powder on per cent adult inhibition is not available; hence, the present results could not be compared.

**(vi) Weight loss (%) of grain.** The effect of plant powders on grain weight loss caused by pulse beetle showed that all the plant powders at both application rates significantly reduced the weight loss caused by pulse beetle when compared with the control (Table 3). The minimum weight loss

**Table 2. Effect of plant products on the pulse beetle**

| Treatments | Doses (g/kg) | No. of eggs/seed | No. of adult emergence | Per cent inhibition rate | No. of holes/ grain | Weight loss of grain (%) |
|---|---|---|---|---|---|---|
| Custard apple leaf powder | 10 | 1.72 (1.31)* | 6.10 (2.47)* | 60.39 | 0.48 (0.69)* | 16.80 (24.19)** |
| Custard apple leaf powder | 20 | 1.48 (1.22) | 5.80 (2.41) | 62.34 | 0.44 (0.66) | 15.43 (23.12) |
| Custard apple seed powder | 10 | 1.11 (1.05) | 5.18 (2.28) | 66.36 | 0.12 (0.35) | 4.13 (11.69) |
| Custard apple seed powder | 20 | 1.00 (1.00) | 5.10 (2.26) | 66.88 | 0.10 (0.32) | 3.29 (10.39) |
| Neem leaf powder | 10 | 1.27 (1.12) | 5.73 (2.39) | 62.79 | 0.27 (0.52) | 15.33 (23.03) |
| Neem leaf powder | 20 | 1.21 (1.10) | 5.40 (2.32) | 64.93 | 0.24 (0.49) | 13.47 (21.50) |
| Neem seed kernel powder | 10 | 1.21 (1.10) | 5.28 (2.30) | 65.71 | 0.16 (0.40) | 6.28 (14.48) |
| Neem seed kernel powder | 20 | 1.15 (1.07) | 5.14 (2.27) | 66.62 | 0.14 (0.37) | 5.24 (13.20) |
| Curry leaf powder | 10 | 1.46 (1.21) | 5.53 (2.35) | 64.09 | 0.20 (0.45) | 21.30 (27.44) |
| Curry leaf powder | 20 | 1.40 (1.18) | 5.20 (2.28) | 66.23 | 0.18 (0.42) | 19.05 (25.87) |
| Control | – | 4.13 (2.03) | 15.40 (3.92) | – | 1.21 (1.10) | 45.50 (42.42) |
| S. Em ± | | 0.03 | 0.03 | | 0.01 | 0.73 |
| C.D. ($P$ = 0.05) | | 0.08 | 0.08 | | 0.04 | 2.15 |

* Figures in the parenthesis are square root transformed values; ** Figures in the parenthesis are angular transformed values

of 3.29 per cent was recorded in custard apple seed powder treated seeds. The maximum weight loss of 45.50 per cent was recorded in the control. However, curry leaf powder was least effective in protecting grains from the damage of pulse beetle. The present findings are in conformity with that of Misra (2000) and Juneja and Patel (2002) who reported negligible weight losses in seed weight treated with 1% of either powdered custard apple or black pepper seeds. Similarly, Laxmi and Venugopal (2007) reported minimum weight loss in greengram treated with custard apple seed powder.

**(vii) Effect on Germination.** No adverse effect on the germination of cowpea seeds was observed when treated with different doses of plant powders used as grain protectants at 0, 30, 60, 90 and 120 days after treatment. The data presented in Table 4 revealed that at zero day intervals, the germination percentage in all the test compounds ranged between 91.50 to 93.33 as compared to 93.67 in control that was non significant among the treatments. After 30 days of treatment, there was no significant difference on the germination of cowpea seeds. However the germination ranged from 91.00 to 92.33 per cent in different treatments as compared to 92.67 per cent in control. (Table 4). The germination of cowpea seeds ranged from 90.00 to 92.00 per cent after 60 days in different treatment as compared to 92.33 per cent in control (Table 4). After 90 days intervals, the germination percentage in the treatments ranged from 88.00 to 90.67 as compared to 91.00 per cent in control (Table 4). Similarly, the germination percentage in all the treatment ranged from 87.33 to 89.33 after 120 days as compared to 89.33 percent in control. However, there was no significant difference among them (Table 4). No adverse effect on seed viability of green gram by seed and leaf powders of custard apple at 3.0 per cent (Saxena *et al.,* 1976, Yadav and Bhatnagar, 1987, Gundannavar and Deshpande, 2006 and Lakshmi and Venugopal, 2007) and on pigeon pea (Sharma *et al.,* 2010) up to 180 days of treatments was observed that corroborate the present findings.

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