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## Evaluation of certain botanicals against pulse beetle, *Callosobruchus chinensis* (L.) on cowpea

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### Abstract

The different plant products viz., neem oil, castor oil, mustard oil, groundnut oil, karanj oil (0.1 & 0.5 ml or g / 100 g of seeds) and neem leaf powder, karanj leaf powder, aak leaf powder and datura leaf powder (1.0 and 2.5 g/ 100 g seeds) when admixed with cowpea grains proved to be causing adverse effect on adult emergence of *C. chinensis* and reduces grain damage and weight loss by this pest. The neem oil was the best treatment to enhance the developmental period and reducing the adult emergence and ovipositional potential, while datura leaf powder was least effective treatment. The per cent grain damage and weight loss were minimum in neem oil and maximum in datura leaf powder. No adverse effect of tested plant products was observed on the germination of cowpea seeds up to 90 days of treatment.

**Keywords:** Pulse beetle, cowpea, *Callosobruchus chinensis*, management, plant product

### Introduction

Pulses the “wonderful gift of nature” play an important role in Indian economy and are a rich source of supplementary protein to daily diets based on cereals and starchy food for a predominantly vegetarian population and for those who cannot afford expensive animal protein. Pulses are therefore often regarded as poor man’s meat. In India 17 species of bruchids belonging to 11 genera have been recorded infesting different pulses (Arora, 1977) [1]. The members of genus *Callosobruchus* (Coleoptera, Bruchidae) is a cosmopolitan field-to-store pest ranked as the principal post-harvest pest all over the world, but in India, *C. maculatus* (Fab.), *C. analis* (Fab.) and *C. chinensis* (Linn.) are the predominate pest species of the genera (Dias, 1986) [7]. Bruchids causes substantial quantitative and qualitative losses manifested by seed perforation, reduction in weight, market value and germ inability of seeds. The insects spend its entire immature stage in individual legume seeds.

### Materials and Methods

The bio-efficacy of different plant products were evaluated against *C. chinensis* in complete randomized design. The treatments were replicated three times. The details of different plant products were use in the experiment are given in table 1. The fine powders of different plant products were prepared by drying them in shade and then grinded in electric grinder. The powders were sieved through 60 mesh sieve and mixed with seeds @ 1.0 and 2.5 g/100 g seeds. For mixing the powder with seeds, 100 g seeds were placed in glass vial and desired doses of powder were added to each vial. The powders were mixed thoroughly with seeds by shaking the vials. Samples of seed from each treatment were transferred to specimen tubes. A control (untreated) was also kept simultaneously. The observations (ovipositional potential, developmental period, adult emergence, grain damage, and weight loss and germination test) were recorded.

### Results and Discussion

#### Effect on ovipositional potential (Table 1)

The significant difference existed between the doses of plant product in reducing the ovipositional potential of test insect in comparison to control. The ovipositional potential of test insect got progressively decreased with the increase in dose level of each treatment. The mean number of eggs laid per female at different dose levels ranged from 27.89 to 29.52. Comparing the results obtained in different plant product, the neem oil was found to be most

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effective in which minimum mean number of eggs was laid (24.67 eggs) by the female and significantly superior to rest of the treatments. It was followed by castor oil, mustard oil, neem leaf powder, groundnut oil, karanj oil, karanj leaf powder, aak leaf powder and datura leaf powder with 27.50, 27.83, 28.17, 28.83, 29.17, 29.83, 30.67 and 31.67 eggs/female, respectively, however, no significance difference among the treatments of castor oil, mustard oil, neem leaf

powder, groundnut oil, karanj oil and karanj leaf powder; karanj oil, karanj leaf powder, aak leaf powder and datura leaf powder. The present results get fully support from the study of Bhargava (1997), Bhatnagar *et al.* (2001), Bhargava and Meena (2002) and Singh and Sharma (2002) [3, 4, 5] who found that different plant product mixed with pulses was found effective for minimizing the ovipositional potential of *Callosobruchus* spp.

**Table 1:** Effect of different plant products (oils/leaf powders) on ovipositional potential of *C. chinensis*

Dose	Ovipositional potential (eggs/female)*									Mean
	Plant oils and leaf powders									
	Neem oil	Karanj oil	Castor oil	Mustard oil	Groundnut oil	Datura leaf powder	Neem leaf powder	Karanj leaf powder	Aak leaf powder	
C <sub>1</sub>	25.33	30.00	28.66	29.00	29.66	32.00	29.00	30.66	31.33	29.52
C <sub>2</sub>	24.00	28.33	26.33	26.66	28.00	31.33	27.33	29.00	30.00	27.89
Mean	24.67	29.17	27.50	27.83	28.83	31.67	28.17	29.83	30.67	-
Control	51.33									
		S.Em+	C.D. at 5%							
Treatment		0.87	2.65							
Dose		0.59	1.81							
Treatment X Dose		1.99	6.02							

Used treatment  
 1. Plant oils (ml / 100 g seeds)  
 2. Plant leaf powders (g / 100 g seeds)  
 \* Data based on 120 individuals (three replications of 40 in each).

Used dose  
 C<sub>1</sub> 0.10  
 C<sub>2</sub> 0.50  
 1.00 2.50

**Effect on developmental period (Table 2)**

When the newly hatched larvae fed with grains admixed with different plant products, all the doses were found to be significantly better in increasing the developmental period when compared with control. The mean duration of development ranged from 27.26 to 32.92 days at different dose levels of plant product, while it was 25.33 days in the control. Considering the results observed in different treatments, the mean duration of developmental period ranged from 28.67 to 32.33 days, being minimum in grains treated

with datura leaf powder (28.67 days), at par with aak leaf powder (29.00 days), karanj oil (29.17 days) and karanj leaf powder (29.33 days). The maximum developmental period was recorded in neem oil (32.33 days), which was at par with castor oil (31.50 days). These findings are in accordance with the results obtained by Naik and Dumber (1984), Singh *et al.* (1993), Bhargava and Meena (2002) and Bajjiya (2010) [12, 16, 5, 2] who have also observed to prolonged the developmental period of *Callosobruchus* spp. by treatment with different plant products.

**Table 2:** Effect of different plant products (oils/leaf powders) on total developmental period of *C. chinensis*

Dose	Total developmental period (days)*									Mean
	Plant oils and leaf powders									
	Neem oil	Karanj oil	Castor oil	Mustard oil	Groundnut oil	Datura leaf powder	Neem leaf powder	Karanj leaf powder	Aak leaf powder	
C <sub>1</sub>	29.00	26.33	28.33	28.00	27.33	26.00	27.33	26.66	26.33	27.26
C <sub>2</sub>	35.66	32.00	34.66	33.33	32.66	31.33	33.00	32.00	31.66	32.92
Mean	32.33	29.17	31.50	30.67	30.00	28.67	30.17	29.33	29.00	-
Control	25.33									
		S.Em+	C.D. at 5%							
Treatment		0.37	1.15							
Dose		0.34	1.07							
Treatment X Dose		1.38	4.20							

Used treatment  
 1. Plant oils (ml / 100 g seeds)  
 2. Plant leaf powders (g / 100 g seeds)  
 \* Data based on 120 individuals (three replications of 40 in each).

Used dose  
 C<sub>1</sub> 0.10  
 C<sub>2</sub> 0.50  
 1.00 2.50

**Effect on adult emergence (Table 3)**

The adult emergence of *C. chinensis* from grain treated with different plant products showed significant difference as compared to control. The per cent adult emergence decreased with increase in dose levels of the test compounds. The adult emergence at different dose levels varied from 26.91 to 32.54 per cent as against 77.33 per cent in control. In neem oil the

adult emergence was 28.66 per cent at lowest dose level which decreased to 23.16 per cent at highest dose level, whereas, in control it was 77.33 per cent. Similar trend of adult emergence was recorded in other treatments. Comparing the results obtained in various plant products, it was found that neem oil was most effective in which minimum percentage of adult emergence (25.91%) occurred

and significantly superior to rest of the treatments. The next effective treatment was castor oil (26.92 days) followed by neem leaf powder (27.50 days), mustard oil (27.58 days) and groundnut oil (32.74 days), however no significant difference was observed among them. The maximum adult emergence was recorded in the treatment of dathura leaf powder (34.00%), which was statistically comparable with aak leaf

powder (33.17%). The present findings are conformity with Singh and Sharma (2002), Haghtalab *et al.* (2009), Bajiya (2010) and Ratnasekera and Rajapakse (2012) [15, 9, 2, 14] who tested different plant products against *C. chinensis* and found that mixing of plant products *viz.*, neem, castor, mustard with different pulses seed which causing inhibitory effect on adult emergence.

**Table 3:** Effect of different plant products (oils/leaf powders) on adult emergence of *C. chinensis*

Dose	Adult emergence (%)*									Mean
	Plant oils and leaf powders									
	Neem oil	Karanj oil	Castor oil	Mustard oil	Groundnut oil	Datura leaf powder	Neem leaf powder	Karanj leaf powder	Aak leaf powder	
C <sub>1</sub>	28.66 (32.37)	34.60 (36.03)	29.00 (32.58)	30.16 (33.31)	32.33 (34.65)	36.66 (37.26)	30.00 (33.21)	35.10 (36.33)	36.33 (37.07)	32.54 (34.78)
C <sub>2</sub>	23.16 (28.77)	27.81 (31.83)	24.83 (29.89)	25.00 (30.00)	26.16 (30.76)	31.33 (34.04)	24.60 (29.73)	29.33 (32.79)	30.00 (33.21)	26.91 (31.25)
Mean	25.91 (30.60)	31.21 (33.96)	26.92 (31.25)	27.58 (31.68)	29.25 (32.74)	34.00 (35.67)	27.30 (31.50)	32.22 (34.58)	33.17 (35.16)	-
Control	77.33 (61.57)									
		S.Em+	C.D. at 5%							
Treatment		0.36	1.12							
Dose		0.19	0.54							
Treatment X Dose		1.30	3.92							

Used treatment used dose  
 C<sub>1</sub> C<sub>2</sub>  
 1. Plant oils (ml / 100 g seeds) 0.10 0.50  
 2. Plant leaf powders (g / 100 g seeds) 1.00 2.50  
 \* Data based on 120 individuals (three replications of 40 in each).  
 \*\*Figures in parentheses are the angular transformation values

**Effect on grain damage (Table 4)**

The per cent of damaged grains in all the doses of different treatments were significantly less than the per cent of damaged grains in control. in neem oil, the grain damage was 30.80 per cent at the initial dose level, which reduced to 24.00 per cent at highest dose. Similar trends were recorded in other treatments. The mean grain damage at different dose levels ranged from 27.66 to 33.83 per cent. While, assessing the

results obtained in different plant product, the average grain damage ranged from 27.40 to 33.90 per cent, being minimum in neem oil (27.40%) and maximum in datura leaf powder (33.90%). However, no significant difference was observed among the treatments of neem oil, castor oil and mustard oil; mustard oil, neem leaf powder, groundnut oil and karanj oil and karanj leaf powder, aak leaf powder and datura leaf powder.

**Table 4:** Effect of different plant products (oils/leaf powders) on grain damage of *C. chinensis*

Dose	Grain damage (%)*									Mean
	Plant oils and leaf powders									
	Neem oil	Karanj oil	Castor oil	Mustard oil	Groundnut oil	Datura leaf powder	Neem leaf powder	Karanj leaf powder	Aak leaf powder	
C <sub>1</sub>	30.80 (33.71)	34.10 (35.73)	31.53 (34.16)	32.33 (34.65)	33.70 (35.49)	36.70 (37.29)	33.80 (35.55)	35.00 (36.27)	36.50 (37.17)	33.83 (35.56)
C <sub>2</sub>	24.00 (29.33)	28.30 (32.14)	25.10 (30.07)	26.66 (31.09)	27.20 (31.44)	31.10 (33.90)	27.50 (31.63)	29.10 (32.65)	30.00 (33.21)	27.66 (31.73)
Mean	27.40 (31.56)	31.20 (33.96)	28.32 (32.15)	29.50 (32.89)	30.45 (33.49)	33.90 (35.61)	30.65 (33.62)	32.05 (34.48)	33.25 (35.21)	-
Control	41.20 (39.93)									
		S.Em+	C.D. at 5%							
Treatment		0.44	1.35							
Dose		0.21	0.61							
Treatment X Dose		0.81	2.46							

Used treatment used dose  
 C<sub>1</sub> C<sub>2</sub>  
 1. Plant oils (ml / 100 g seeds) 0.10 0.50  
 2. Plant leaf powders (g / 100 g seeds) 1.00 2.50  
 \* Data based on 120 individuals (three replications of 40 in each).  
 \*\*Figures in parentheses are the angular transformation values

**Effect on weight loss (Table 5)**

The relative efficacy of different treatments in per cent

reduction in net weight of cowpea grains were found significant. The mean per cent weight loss at different dose

levels ranged from 8.85 to 9.65 per cent, as against 13.10 per cent in control. A significant difference was observed between dose levels. Considering the results observed in different treatments, the minimum per cent weight loss (7.64%) was recorded in neem oil, at par with castor oil (8.37%) and mustard oil (8.89%). Maximum per cent weight loss (10.85%) was observed in datura leaf powder, followed by aak leaf powder (10.16%), karanj leaf powder (9.77%), karanj oil (9.55%) and these were at par with each other. However, no significant difference was also recorded between

the treatments of mustard oil, neem leaf powder, groundnut oil, karanj oil, karanj leaf powder and aak leaf powder. The present findings are corroborate with the findings of Kumari *et al.* (1990), Choudhary (1990), Sundria *et al.* (2001), Raghavani and Kapadia (2003), Singh and Sharma (2002), Khalequzzaman *et al.* (2007) and Bajiya (2010) [11, 6, 17, 13, 15, 10] who observed that different oils tested against *C. chinensis* proved effective for the reduction in percentage damaged grains by number as well as by weight.

**Table 5:** Effect of different plant products (oils/leaf powders) on weight loss of *C. chinensis*

Dose	Weight loss (%)*									Mean
	Plant oils and leaf powders									
	Neem oil	Karanj oil	Castor oil	Mustard oil	Groundnut oil	Datura leaf powder	Neem leaf powder	Karanj leaf powder	Aak leaf powder	
C <sub>1</sub>	8.06 (16.49)	10.00 (18.43)	8.90 (17.36)	9.30 (17.76)	9.50 (17.95)	11.18 (19.53)	9.31 (17.77)	10.20 (18.63)	10.44 (18.85)	9.65 (18.10)
C <sub>2</sub>	7.21 (15.58)	9.10 (17.56)	7.84 (16.26)	8.47 (16.92)	8.80 (17.26)	10.51 (18.92)	8.50 (16.95)	9.33 (17.79)	9.87 (18.31)	8.85 (17.30)
Mean	7.64 (16.04)	9.55 (18.00)	8.37 (16.82)	8.89 (17.34)	9.15 (17.61)	10.85 (19.23)	8.91 (17.36)	9.77 (18.21)	10.16 (18.58)	-
Control	13.10 (21.20)									
		S.Em+	C.D. at 5%							
Treatment		0.44	1.34							
Dose		0.20	0.59							
Treatment X Dose		0.79	2.40							

Used treatment

used dose

	C <sub>1</sub>	C <sub>2</sub>
1. Plant oils (ml / 100 g seeds)	0.10	0.50
2. Plant leaf powders (g / 100 g seeds)	1.00	2.50

\* Data based on 120 individuals (three replications of 40 in each).

\*\*Figures in parentheses are the angular transformation values

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