

Study of Biology and Bio-efficacy of Botanicals on Pulse Beetle (*Callosobruchus chinensis* L.) of Stored chickpea Seeds

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ABSTRACT: Botanicals are basically broad spectrum insecticides; botanicals are not very selective because of their wide range as they target broad range of insect and pest. In this study the major challenge and tremendous efforts have been made in control and authenticity of the botanicals its wider role in pest management their adoption and utilization for sustainable pest and crop management also its assessment against the major pest i.e., pulse beetle (*Callosobruchus chinensis* L.). The present research work also present the insect biology and efficacy to management of pulse beetle (*Callosobruchus chinensis* L.) on chickpea seeds under stored condition. Assessment of different botanicals for study their carried out during February to April year 2022 at Department of Entomology, Institute of Agriculture Sciences, Bundelkhand university Jhansi, based on different parameters related to pulse viz., adult egg laying, adult emergence, mortality, percentage of damage and weight loss. Significant variation observed and different hyphenated techniques among the botanicals with respect to damage of seeds by pulse beetle. Among all botanicals treatment neem leaf powder @ 5gm/ kg of seed was superior over the all other botanicals followed by the turmeric powder@ 5gm /kg of seed and lantana camara leaf powder @5 gm/kg of seeds observed effective to management of pulse beetle for minimizing their egg laying, adult emergence weight loss and damage percentage. All the treatments were showed effective over untreated control. These contributions of assessment of botanicals aims to provide a brief overview of the latest development in efficacy of all botanicals treatments which may be used for storage condition of chickpea because they are sustainable, safe for human being and environment also.

Keywords: Botanicals, *Callosobruchus chinensis* L., Chickpea, *Lantana camara* and Neem leaf powder.

INTRODUCTION

Chickpea (*Cicer arietinum*) belongs to the family leguminacea, also known as bengal gram and grow all over the world, it is a most important pulse crop and attain first position to production and area. It is good sources of vitamin and minerals which are important in human diet. The uses of different botanicals treatment is aimed to awareness about the hazardous effect and reduce of synthetic chemicals pesticide which is used for protect the stored seeds which release the toxic effects and unsafe for environment and animals (Ogh *et al.*, 2020). The botanicals seed protectants can minimize the damage, insect incidence and also the unsafe effects of synthetic pesticide. Infestation of stored insect pest causing different type of losses viz., seed damage, weight loss, germination percentage and deterioration of market quality of seed (Pandey and Singh 1997). The bruchids causing severe damage in

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stored pulses they start their infestation from field and also from old storage materials, the larvae and adult both causing infestation and continuous breeding and increase population by laying egg on neighboring seeds by which emerged larvae causing damage by many generation on seeds under storage house (Ramzan *et al.*, 1990).

The most important bruchids which causing severe damage on chickpea are *Callosobruchus chinensis* (Linn.) and *C. maculatus* (Fabricius). Both insects belong to Family-Bruchidae and order-Coleoptera. *Callosobruchus chinensis* L. is most destructive which causing severe both qualitative and quantitative losses, the larva of insects feeding on seed cotyledons by their voracious nature (Ali *et al.*, 2004).

METHOD AND MATERIAL

The experiment was conducted in completely randomized design (CRD) with using 9 treatments and

3 replications using JG-14 variety of chickpea (Desi) to study the bio-efficacy of botanicals against pulse beetle during February to April year 2023 at Agricultural Entomology Laboratory, Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (Uttar Pradesh). The treatments were used in experiments are T₁ Dhatura leaf powder @ 5gm/kg seed, T₂ Turmeric powder @ 5gm/kg seed, T₃ Neem leaf powder @ 5gm/kg seed, T₄ Cow dung ash @ 5gm/kg seed, T₅ Clove @ 5gm/kg seed, T₆ Black pepper powder @ 5gm/kg seed, T₇ Lantana leaf powder @ 5gm/kg seed, T₈ Custard apple leaf powder @ 5gm/kg seed, T₉ Untreated control.

Preparation of Treatment Material. All the botanicals using in experiments were used as powdered form where the leaves of Neem (*Azadiracta indica*), Dhatura (*Dhatura metal*), Lantana (*Lantana camera*), Custard apple (*Annona squamosa*), were collected from nearby area and shed dry for completely moisture reduction then grinded to make powder, whereas the turmeric clove and black pepper purchased from market then powdered them, and cow dung ash is take from village area where cow dung cake used as fuel.

External identification of male and female bruchids. This species exhibits some sexual dimorphism where Males possess deeply emarginated or indented eyes and prominently pectinate antennae, while in female these characters are not distinctly marked. In females tip of abdomen is exposed while in males it is covered by elytra, females are having two dark patches, one on each side of the line. Generally female is larger than male.

Procedure. The experiment conducted with 500 gram of chickpea seeds filled in 1 kg capacity plastic jars and 20 pair of insects (male & female) was released in the plastic jars and cover the opening of jars with muslin or mark in cotton cloth and tied the cloth with rubber bands. The procedure was repeated for each jar (27 jars) and these plastic jars kept in ambient temperature condition in laboratory.

The observation was taken on various parameters viz. egg laying, adult emergence, adult mortality, damage percentage and weight loss percentage etc. observation were recorded at various days after treatment according to parameters are given below;

Per cent Adult Mortality. The data for adult mortality was conducted at 1, 4, 8 and 12 days after treatment, firstly dead and live beetle were counted in each different plastic jars and for mortality percent was count with this formula;

Mortality per cent- (Total dead beetles/Total released beetles) *100

Number of Eggs Laid by Pulse Beetle. The average number of egg laid on grain or seed by pulse beetle was observed for check the efficacy of treatment to minimizing the fecundity of beetle, to calculate the average egg laying 100 grain randomly selected from each treatment and counted them at 3, 6, 9 days after of adult release. Then data was calculated to find out average of egg laying.

Number of adult emergence. The number of adult emergence was counted 1, 2, 3 months after release of

insect, to find out that adult emergence both dead and live beetles were counted and removed them and by using this formula total adult emergence was calculated:

Adult emergence (%) - (total adult emerged/ total egg laying)* 100

Per cent seed infestation. To count seed infestation percentage, after 3 month of storage randomly 100 grains was taken from each replication and then count total damaged grain the by using this formula total per cent seed damage was calculated:

Grain/seed damage per cent- (No of damaged seed/total seeds)*100

Per cent seed weight loss. Weight loss was calculated by taken initial weight of undamaged seed at starting of experiment and taken final damaged seeds at end of experiment then by using given formula:

Per cent seed weight loss-

{(Initial weight of seeds- final weight of seed)/Initial weight of seed}*100

RESULT AND DISCUSSION

Mortality percentage. The result of observation with respect to mortality percentage of *Callosobruchus chinensis* (L.) at 1, 3, 6, and 9 days after treatment under various botanicals or plant products viz. neem leaf powder, turmeric powder, dhatura leaf powder, lantana leaf powder, custard apple leaf powder, clove, black pepper, cow dung ash. Among these treatment the highest mortality found was recorded in neem leaf powder @ 5gm/kg seed that is (24.33 per cent, 28.67 per cent, 32.33 per cent, 34.33 percent) per cent mortality at 1, 3, 6, and 9 days after treatment (Varma and Anandhi 2010), and followed by turmeric powder @ 5gm/kg seed (21.33 per cent, 24.00 per cent, 26.00 per cent, 30.33 per cent) and Dhatura leaf powder @ 5gm/kg seed (19.00 per cent, 20.00 per cent, 23.33 per cent, 27.33 per cent) at 1, 3, 6, and 9 days after treatment respectively. The minimum adult percent mortality was recorded in untreated control and other remain botanicals show more effective to untreated control. The investigation also similarly with Kour *et al.* (2014) who reported the neem leaf powder effective to per cent mortality of pulse beetle infesting pea seed. Similar investigation also done by Kumar *et al.* (2016) that observed Neem leaf power highly effective among some botanical used.

Fecundity or egg laying of pulse beetle. The mean egg laying or fecundity of pulse beetle on grains of chickpea mean egg laid was found 47.33 to 80 eggs/ 100 seeds. The minimum egg laying was found in Neem leaf powder @ 5gm/kg seed treatment or highest effective to reduce the fecundity followed by turmeric powder @ 5gm/kg seed and custard apple powder @ 5gm/kg seed. Similarly, by Dar *et al.* (2014) observed that the neem leaf highly effective to minimize fecundity of pulse beetle and Jatav *et al.* (2022) also observed custard apple leaf powder effective to reduce fecundity of pulse beetle also supported by Misra (2000); Malaikozhundan and Vinodhini (2018).

Table 1: Effect of treatment on adult mortality of pulse beetles on chickpea seeds.

Sr. No.	Treatment	Mortality %			
		1 DAT	4 DAT	8 DAT	12 DAT
T ₁	Dhatura leaf powder @ 5gm/kg	19.00	20.00	23.33	27.33
T ₂	Turmeric powder @ 5gm/kg	21.33	24.00	26.00	30.33
T ₃	Neem leaf powder @ 5gm/kg	24.33	28.67	32.33	34.33
T ₄	Cow dung ash @ 5gm/kg	6.67	7.00	8.00	8.00
T ₅	Clove @ 5gm/kg	13.67	15.33	16.33	13.00
T ₆	Black pepper powder @ 5gm/kg	7.00	7.00	8.67	8.67
T ₇	Lantana leaf powder @ 5gm/kg	17.00	18.33	19.33	20.67
T ₈	Custard apple powder @ 5gm/kg	20.67	21.33	22.67	24.00
T ₉	Control	0.82	1.33	0.33	0.00

Table 2: Effect of treatment on fecundity of pulse beetles on chickpea seeds.

Sr. No.	Treatment	Mean egg laid /100 seed		
		3 DAT	6 DAT	9 DAT
T ₁	Dhatura leaf powder @ 5gm/kg	25.33	30.67	40.67
T ₂	Turmeric powder @ 5gm/kg	21.33	30.00	32.33
T ₃	Neem leaf powder @ 5gm/kg	18.33	24.67	30.33
T ₄	Cow dung ash @ 5gm/kg	31.00	33.00	33.67
T ₅	Clove @ 5gm/kg	39.67	46.33	47.33
T ₆	Black pepper powder @ 5gm/kg	23.33	45.67	46.33
T ₇	Lantana leaf powder @ 5gm/kg	31.33	43.00	43.67
T ₈	Custard apple powder @ 5gm/kg	25.33	30.67	38.67
T ₉	Control	72.30	75.33	79.67

Table 3: Effect of botanical treatment on adult emergence of pulse beetle.

Sr. No.	Treatment	Adult emergence		
		1 Month	2 Month	3 Month
T ₁	Dhatura leaf powder @ 5gm/kg	22.33	24.33	31.33
T ₂	Turmeric powder @ 5gm/kg	14.67	17.67	23.33
T ₃	Neem leaf powder @ 5gm/kg	11.33	15.33	19.00
T ₄	Cow dung ash @ 5gm/kg	20.67	31.33	30.67
T ₅	Clove @ 5gm/kg	25.00	29.67	38.00
T ₆	Black pepper powder @ 5gm/kg	29.67	30.67	35.33
T ₇	Lantana leaf powder @ 5gm/kg	24.33	28.33	32.33
T ₈	Custard apple powder @ 5gm/kg	18.67	21.67	28.33
T ₉	Control	39.00	50.67	69.67

Adult emergence percentage. Per cent of adult emergence of pulse beetle at 1 month, 2 month and month after treatment revealed at (Table 3) and the result found significantly the Neem leaf powder @ 5gm/kg seed was highly effective to minimize adult emergence i.e. (11.33 per cent, 15.33 per cent, 19.00 per cent) followed by turmeric powder @ 5gm/kg seed (14.67 per cent, 17.67 per cent, 23.33 per cent) and custard apple leaf powder. All remain botanicals treatment superior to untreated control. Similarly, the observation carried out by Khinchi *et al.* (2017) and Kaur *et al.* (2019) found Neem leaf effective to minimize emergence of pulse beetle.

Percent seed damage. The data revealed in Table 4 described that the minimum seed damage percentage was found in neem leaf powder @ 5 gm/kg seed showed 9.00 percent damage followed by turmeric powder @ 5gm/kg seed resulted 10.60 per cent seed damage and custard apple leaf powder showed 13.50 per cent grain damage in experiment. However, the highest damage percentage of seed found in untreated control (73.00 per cent) and all remain botanicals superior to untreated control, that result observed at 3 month after treatment application also that investigation result supported by Khan *et al.* (2015); Nishad *et al.* (2020) and Mounika *et al.* (2021).

Table 4: Effect of treatment on percent weight loss and per cent seed damage.

Sr. No.	Treatment	Dose	Grain/seed damage %at90 days after release	Weight loss % of seed at 90 days after release
T ₁	Dhatura leaf powder	5 gm /kg	15.90	8
T ₂	Turmeric powder	5 gm /kg	10.60	5.3
T ₃	Neem leaf powder	5 gm /kg	9.00	3
T ₄	Cow dung ash	5 gm /kg	30.83	14.3
T ₅	Clove	5 gm /kg	27.00	10.4
T ₆	Black pepper powder	5 gm /kg	19.40	12
T ₇	Lantana leaf powder	5 gm /kg	21.66	9.8
T ₈	Custard apple leaf powder	5 gm /kg	13.50	7.1
T ₉	Control	-	73.00	25.3

Per cent weight loss of seed/grain. The data of per cent weight loss was observed (Table 4) at 3 month and significantly neem leaf powder @ 5gm/ kg seed was found highly effective to minimize per cent weight loss i.e. (3.00 per cent) of chickpea seeds followed by turmeric powder @5 gm/kg seed (5.3 per cent) and custard apple leaf powder @ 5gm/kg seed show 7.1 per cent weight loss of grain. The maximum seed weight loss percentage found in untreated control and all other botanicals viz., dhatura leaf powder, cow dung ash, clove, black pepper, and lantana leaf powder superior with respect to untreated control. Similarly, investigation supported by Jahan *et al.* (2022); Kumari *et al.* (2022) showed minimum weight loss per cent of seed by Neem leaf powder.

CONCLUSIONS

The plant based botanical seed protectant viz., Neem leaf powder, Dhatura leaf powder, Turmeric leaf powder, clove, Black pepper, Custard apple leaf powder, Lantana leaf powder and cow dung ash was used to management of pulse beetle was found effective to control their damage on stored chickpea seed and among these neem leaf powder was highly effective to high adult mortality, reducing fecundity, damage percent, minimum adult emergence and minimized weight loss per cent, these eco-friendly and have no hazardous effect on environment and human hence these can be used instead of synthetic pesticides.

FUTURE SCOPE

The promising plant based botanical identified in this study can be further exploited commercially for management of pulse beetle and safeguard the severe impact on both the environment and human health.

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Conflict of Interest. None.

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