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BIO - EFFICACY OF CUSTARD APPLE (*ANNONA SQUAMOSA* (L.) AGAINST PULSE BEETLE, *CALLOSOBRUCHUS MACULATUS* L.

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ABSTRACT

Insecticidal activity of custard apple (*Annona squamosa* (L.) plant derivatives *viz.,* leaf powder, seed powder, cake power and oil was studied against the pulse beetle (*Callosobruchus maculatus* L.) for adult mortality, oviposition inhibition and ovicidal effects. It was revealed that the maximum mortality (9.67) was observed in custard apple oil treatment followed by custard apple seed powder (8.67) and custard apple leaf powder (8.0) out of 10 up to 72 h. The maximum hatching inhibition was recorded in custard apple oil treatment (91.67%) followed by custard apple seed powder (71.76%) and custard apple leaf powder (37.87%) while minimum in custard apple cake powder (16.67%). The deterrency per cent increased with the increase in the dose of plant derivatives. The maximum deterrency (72.67%) was recorded in oil treatment followed by seed powder (52.67%) and leaf powder (30.0%) at highest dose (1.0 g or ml/100g). The minimum larvae (0.6 larvae/seed) emerged in the oil treatment followed by leaf powder (1.0 larvae/seed) and seed powder (1.6 larvae/seed) while maximum in cake powder (2.8 larvae/seed). This indicates that the plant derivatives had ovicidal activity.The plant derivatives had no harmful effect on the germination of pigeon pea seeds up to 180 days of storage.

Keywords: *Annona squamosa*, mortality, egg inhibition, ovicidal, deterrency, germination, *Callosobruchus maculatus*

INTRODUCTION

One of the eco-friendly and economic approaches to keep the stored food grains free from insect attack would be using the plant products as grain protectants. Among stored grain pests, extracts of custard apple was tested on *Callosobruchus chinensis* Linn. (Tripathy *et al*. 2001, Kotkar *et al*. 2002, Misra 2000); *C. analis* (Juneja and Patel 1994); *C. maculatus* (Dharmasena *et al*. 2001); *Rhizopertha dominica* (Patel and Valand 1994) and *Sitophilus oryzae* (Mishra *et al*. 1992).

Little information is available from literature regarding the efficacy of custard apple plant derivatives on pigeon pea against pulse beetle, *C. maculatus*,. Therefore, the plant products have been evaluated to find out their effectiveness against this pest. This study will be of help for better storage of pulses, specially pigeon pea, in tribal areas where custard apple is wildly available.

MATERIALS AND METHODS

Preparation of the plant material : The custard plant parts (leaves, fruit peel and seed powder) were prepared by drying under shade and then grinding to get fine powder. The oil and deoiled seed mass was obtained through hexane (60-80°C) method. The deoiled seed mass (cake) was left after oil extraction. The powder was sieved through 50 mesh sieve. The powdered plant derivatives were stored in PET jars at room temperature for six months. Powder/oil of all the plant derivatives was mixed with seeds at the rate of 0.5 and 1.0 g per 100 g of grains (w/w). For mixing the powder with seeds, 500 g grains were taken in a PET jar (1 lit. capacity) and desired calculated amount of powder was added to it with each treatment replicated thrice. The jars were then held from both the ends and shaken horizontally for 5 minutes to ensure thorough mixing. Untreated grains were used as control. Ten adults of the pulse beetle were released in each PET jar containing treated grains. The observations recorded were adult mortality, oviposition inhibition, ovicidal effect and effect on germination of pigeon pea seeds.

The test insect *C. maculatus* was cultured on seeds of pigeon pea (*Cajanus cajan*) Cv. GT-101. The culture was maintained at 30 ± 1ºC and 70% relative humidity and the experiments were conducted at ambient room temperature conditions.

Effect on adult mortality : To assess the efficacy of the plant products, the bruchid adults were released in jars containing seeds of pigeon pea. The jars were filled

with treated pigeon pea and left for 24h and then five pairs of 48 h old bruchids were introduced into each jar. The jars were closed with muslin cloth for proper ventilation. The numbers of dead bruchids in each jar were counted after 24, 48 and 72h.

Oviposition inhibition effect : Laboratory tests for oviposition inhibition effect were conducted. The 5 gram of treated pigeon pea seed were placed singly in Petri dish (90 mm diameter). Five pairs of pulse beetles were released in each Perti dish which was covered for the next 7 days allowing them to lay eggs. The inhibition rates (IR) and deterrency were calculated as follows.

Effect of plant derivatives on eggs: Two hundred pigeon pea seeds and a colony of 100 bruchids were placed together in a petri dish for 24h. The bruchids were removed and seeds bearing four or five eggs were selected for the experiments. Twenty five such seeds were placed in a petri dish and 0.2g/ml (1%) of each plant derivatives was mixed to the seeds. Each set of seeds was divided into five groups of five seeds and each group was placed in a fresh petri dish. As embryonic development takes about 4 to 5 days, and the larvae can be seen within the egg after the 5th day, therefore, the 24 and 48 hr old eggs were used for evaluating the ovicidal effects of plant derivatives.

Effect of plant derivatives on seed germination: The effect of plant derivatives as seed protectants was observed on germination of pigeon pea (*Cajanus cajan* L.) variety GT-101 at 30, 60, 90,120, 150 and 180 days interval. The germination tests were carried out according to International Rules of Seed Testing. Hundred seeds from each replication were placed in a Petri dish (diameter 150 mm) having blotting paper moistened with distilled water.

RESULTS AND DISCUSSION

All the plant products from both fresh and stored leaves caused adult mortality, which increased along with the duration of exposure to the plant products. The maximum mortality was observed in custard apple seed oil (1.0 %) followed by custard apple seed powder (1.0 %) and custard apple leaf powder (1.0 %). The plant derivatives at higher concentration (10g/kg seed) were more effective than it lower concentration (5g/kg) (Table 1).

All the doses of plant products were found effective in preventing the oviposition by pulse beetle as compared to control. This indicates that the plant products had oviposition inhibition activity. The deterrency per cent increased with the increase in the dose of plant derivatives. The maximum deterrency (72.67 %) was recorded in custard apple oil followed by custard apple seed powder (52.67 %) and custard apple leaf powder (30.0 %) at 1.0 per cent dose. The maximum hatching inhibition was recorded in custard apple oil (91.67 %) followed by custard apple seed powder (71.76 %) and custard apple leaf powder (37.87 %) at 1.0 % dose, while minimum in custard apple cake powder (16.67 %) at 0.5 per cent dose as presented in Table 2.

Table 1. Effect of plant derivatives of *A. squamosa* on the adult mortality (dead out of ten)

S. No.	Treatments	Dose (g or ml / kg of grain)	Mortality (Mean ± SEm) 24 h	48 h	72 h
1.	Custard apple leaf powder	5	4.67 ± 0.32	7.0 ± 0.57	7.33 ± 0.57
2.	Custard apple leaf powder	10	5.67 ± 0.88	7.67 ± 1.15	8.00 ± 0.88
3.	Custard apple peel powder	5	3.33 ± 0.33	4.0 ± 0.57	5.0 ± 0.58
4.	Custard apple peel powder	10	4.33 ± 0.88	4.67 ± 0.88	6.0 ± 1.15
5.	Custard apple seed powder	5	4..0 ± 0.57	5.33 ± 0.33	7.67 ± 0.33
6.	Custard apple seed powder	10	6.33 ± 0.33	7.0 ± 0.57	8.67 ± 1.88
7.	Custard apple cake powder	5	2.67 ± 1.20	3.0 ± 0.57	3.67 ± 0.57
8.	Custard apple cake powder	10	3.33 ± 0.33	3.67 ± 0.88	4.33 ± 0.88
9.	Custard apple oil	5	5.67 ± 0.33	7.66 ± 0.33	9.0 ± 1.15
10.	Custard apple oil	10	8.0 ± 0.58	9.33 ± 0.33	9.67 ± 0.88
11.	Control	--	1.33 ± 0.33	1.33 ± 0.88	1.33 ± 0.33

The potency and mode of action varied with plant products. Both the fresh and stored plant derivatives were effective in preventing the development of eggs into larvae as compared to control. The minimum number of larvae (0.6 larvae/seed) was in the oil treatment followed by that in leaf powder (1.0 larvae/seed) and seed powder (1.6 larvae/seed), while maximum was in cake powder (2.8 larvae/seed) (Table 2).

Table 2. Effect of plant derivatives on oviposition of pulse beetle

S. No.	Treatments	Total no. of eggs laid		Deterrency (%)		No. of larvae hatched		Hatching inhibition (%)	
		Doses (g or ml/kg)							
		5	10	5	10	5	10	5	10
1.	Custard apple leaf powder	110	105	26.67	30.00	90	82	31.81	37.87
2.	Custard apple peel powder	117	111	22.00	26.00	110	105	16.67	20.45
3.	Custard apple seed powder	92	71	38.67	52.67	41	37	68.93	71.76
4.	Custard apple cake powder	140	135	6.67	10.00	112	110	15.15	16.67
5.	Custard apple oil	48	41	68.00	72.67	18	11	86.36	91.67
6.	Control	150	150	–	–	132	132	–	–
	SEm ±	14.95	16.49			18.25	19.00	14.43	14.72

Table 3. Effect of plant derivatives of *A. squamosa* on the germination of pigeon pea seeds

S. No.	Treatments	Dose (g or ml / kg of grain)	Germination (%)			
			0 DAT	60 DAT	120 DAT	180 DAT
1	Custard apple leaf powder	5	93.33 (75.03)	89.34 (70.94)	89.52 (71.11)	89.34 (70.94)*
2	Custard apple leaf powder	10	93.01 (74.66)	90.67 (72.21)	89.75 (71.32)	89.00 (70.63)
3	Custard apple peel powder	5	92.75 (74.34)	89.65 (71.23)	90.01 (71.57)	89.50 (71.09)
4	Custard apple peel powder	10	92.34 (73.93)	89 (70.63)	89.33 (70.93)	88.63 (70.29)
5	Custard apple seed powder	5	92.00 (73.57)	88.63 (70.29)	89.67 (71.25)	88.03 (69.75)
6	Custard apple seed powder	10	92.68 (74.30)	88.63 (70.29)	89.33 (70.93)	88.00 (69.73)
7	Custard apple cake powder	5	92. 68 (74.30)	89.65 (71.23)	89.73 (71.30)	87.67 (69.44)
8	Custard apple cake powder	10	93.01 (74.66)	88.00 (69.73)	89.67 (71.25)	87.33 (69.14)
9	Custard apple oil	5	93.00 (74.65)	87.00 (68.86)	90.01 (71.57)	88.32 (70.01)
10	Custard apple oil	10	93.01 (74.66)	87.67 (69.44)	90.66 (72.20)	88.67 (70.33)
11	Control	- -	93.33 (75.03)	91.01 (72.55)	91.01 (71.57)	89.34 (70.94)
	S.Em ±		0.77	0.72	1.82	0.69
	C.D. (P = 0.05)		NS	NS	NS	NS

DAT-Days after treatment, NS-Non significant,
* Figures in parenthesis are angular transformed values

No adverse effect of plant derivatives on germination of pigeon pea seeds was observed after 0, 60, 120, and 180 days of treatment. Data furnished in Table 3 show that the germination was not affected due to the treatments and it varied from 87.33 to 89.50 per cent, which was at par with control (90%) .

Similar results were obtained by Dharmasena *et al*. (2001) who found acetone extracts of fresh and stored leaves to be toxic to adult *C. maculatus*, whereas the ethanol extracts were not active. Kotkar *et al*. 2002 found that the flavonoids isolated from aqueous extracts showed antimicrobial activity against all the common microbial contaminants of pulses and 80 per cent insecticidal activity against *C. chinensis* at a concentration of 0.07 mg ml^{-1}. The present study conforms with the work of Lawrence *et al.* (1998) where 27, 33 and 67 per cent mortality of adult *T. castaneum* was caused by ethanol extract of sugar apple leaves at 1, 3 and 5 days after exposure, respectively.

Lakshmi and Venugopal (2007) reported that the seed powder of *A. squamosa* and rhizome powder of *Acorus calamus* showed minimum egg hatching of *Callosobruchus maculatus*. It has already been reported that the seeds of *A. squamosa* contain glycerides of hydroxylated unsaturated acid which are toxic to insects. Further, the seed kernel powder at one and two percent was effective against *C. chinensis* (Ali *et al.,* 1981). Adults of *T. castaneum* were repelled by contact with food medium treated with 2 and 5 g custard apple leaf dust/10 g flour.

No adverse effect of plant products have been reported on the germination of pigeon pea. Similar results have been observed by Saxena *et al.* (1976) and Yadav and Bhatnagar (1987) which confirm the present findings.

REFERENCES

Ali, S.I., Rawat, R.R. and Singh, O.P. (1981). Effectiveness of various forms of custard apple seed powder as seed protectant against the pulse beetle, *Callosobruchus chinensis* (Linn.). *Bulletin of Grain Technology*, **19**:53-56.

Dharmasena C. M .D, Blaney W M and Simmonds M. S. J. (2001). Effect of storage on the efficacy of powdered leaves of *Annona squamosa* for the control of *Callosobruchus maculatus* on cowpeas (*Vigna unguiculata*). *Phytoparasitica,* **29**:191-196.

Juneja, R.P. and Patel, J. R. (1994). Botanical materials as protectants of green gram, *Vigna radiata* (L.) Wilczek against pulse beetle, *Callosobruchus analis* Fabricus. *Gujrat Agriculture University Research Journal,* **20**:84-87.

Kotkar, H.M., Mendki, P.S., Sadan, S.V.G.S., Jha, S.R., Upasani, S.M. and Maheshwari, V.L. (2002). Antimicrobial and pesticidal activity of partially purified flavonoids of *Annona squamosa*. *Pest Management Science*, **58**:33-37.

Lakshmi, L. Geetha,Venugopal, M.S. (2007). Effectiveness of powdered plant products as grain protectants against the pulse beetle, *Callosobruchus maculatus* (F.). *Journal of Entomology Research,* **31**:75-78.

Lawrence, E.W. (1998). Biological Activity of Sorghum Tannin Extracts on the Stored Grain Pests *Sitophilus oryzae* (L.), *Sitotroga cerealella* (Olivier) and *Tribolium castanuem* (Herbst). *Insect Science Application*, **18**:1 17-23.

Mishra, B.K., Mishra, P.R. and Mohapatra, H.K. (1992). Studies on some plant product mixtures against *Sitophilus oryzae* (L.) infesting wheat seeds. *Indian Journal of Plant Protection,* **20**:178-182.

Misra, H.P. (2000). Effectiveness of indigenous plant products against the pulse beetle, *Callosobruchus chinensis* on stored black gram. *Indian Journal of Entomology*, **62**:218-220.

Patel, K.P. and Valand, V.M. (1994). Bio- efficacy of plant materials against *Rhizopertha dominica* fab. Infesting stored wheat *Triticum aestivum* L.*Gujarat Agriculture University Research Journal*, **20**:180-182.

Saxena, B.P., Koul, O. and Tikku, K. (1976). Non-toxic grain protectants against the stored grain insects. *Bulletin of Grain Technology*, **14**:190.

Tripathy, M.K., Sahoo, P., Das, B.C. and Mohanty, S. (2001). Efficacy of botanical oils, plant powders and extracts against *Callosobruchus chinensis* Linn. attacking black gram (Cv. T 9). *Legume Research*, **24**:82-86.

Yadav, S.R.S. and Bhatnagar, K.N. (1987). A preliminary study on the protection of stored cowpea grains against pulse beetle by indigenous plant products. *Pesticides,* **21**:25-28.