Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 7 [12] November 2018: 141-145

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

Effect of grain protectants on biology of pulse beetle (*Callosobruchus chinensis* L.) in black gram

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ABSTRACT
A laboratory study was carried out in Department of Entomology, C.S.A.U.A &T., Kanpur, during 2014-15., to evaluate effect of grain protectants on biology of pulse beetle in black gram. Among different grain protectants such as neem oil, clove oil, camphor, aonla fruit powder, Lantana camera leaf powder and neem leaf extract, the maximum mortality percent (100.0%), minimum number of egg laying (1.66 eggs/adult), and lowest adult emergence of pulse beetle (1.0%) in black gram was observed on the seed treated with higher dose of neem oil (5ml/kg seed) followed by clove oil (5ml/kg seed) was proved most effective. However, neem oil proved to be the best in managing pulse beetle infestation to lower levels followed clove oil.
Key words: Callosobruchus Chinensis, neem oil, clove oil and black gram.

Received 11.08.2018 Revised 21.09.2018 Accepted 23.10.2018

INTRODUCTION

India is the world producer as well as consumer of black gram. It produces about 1.5-1.9 million tones of black gram annually which occupies the area about 3.5 million hectare with an average productivity of 500 kg/ha [5]. Black gram is member of Asiatic *Vigna* crop group. It is an annual pulse grown mostly as a fallow crop in rotation with rice. Similar to other pulses black gram being a legume which enriched with soil nitrogen content and has relatively short about to 90-100 days maturity. It is attacked by several insect pests including pulse beetle (PB), *Callosobruchus chinensis* L., as its destructive and major pest in storage [1]. Gujar and Yadav [10] reported 55-60 per cent loss in seed weight and 45.50-66.30 per cent loss in protein content due to its damage and pulse seeds became unfit for human consumption as well as for planting. At present, pest control measures in storage rely on the use of synthetic insecticides and fumigants, which is the quickest and surest method of pest control but it is also not advised to mix the insecticides with food grains. Their indiscriminate use in the storage, however, has led to a number of problems including insect resistance, toxic residues in food grains [9], environmental pollution and increasing costs of application. In view of these problems together with the upcoming WTO regulations, there is a need to restrict their use globally and implement safe alternatives of conventional insecticides and fumigants to protect stored grains from insect infestations [23].

In recent year attention has been paid to find out safer and specific chemicals to control insects and creating the harmful residues in environment. There are certain natural substances from plants which can damage the peculiar Arthropod's vital system [14], use of oils as grain protectant is the ancient practice to save the grains in storage, from the attack of insects the whole/splinted .The edible oils are mixed with splinted pigeon pea and legumes before storage @about 1-2 ml./kg. As a rule, an adult beetles are the only source of primary infestation and therefore, best and safest method would be inhibited the oviposition of beetle on the grain with the use of edible oils which may have the advantage such as low cost, easy availability and have no toxic hazard to human being and animals. Encouraging results have been reported against the beetle infesting different pulses [13, 19-22]. The present studies were, carried out not only to study the biology of the pest insect on black gram seeds

but also to evaluate the efficacy of some indigenous plant products against *C. chinensis* infesting black gram.

MATERIALS AND METHODS

The insect *Callosobruchus chinensis* (L.) belong to the Order-Coleoptera, family -Bruchidae known as pulse beetle.

Rearing of the insect: The adult of pulse beetle were collected from local granaries and bought to the laboratory, Department of Entomology, C. S. Azad University of Agriculture and Technology, Kanpur, U. P. to start the culture. The test culture was obtained from separate culture raised from a single pair of *C. chinensis*. About 5 kg seed of black gram variety T-9 was obtained from E.B. Legume, C.S. Azad University of Agriculture and Technology, Kanpur. For conducting studies on biology of the *C. chinensis*, three plastic containers (5x5 cm) containing 100 gm seeds were taken in with freshly emerged single pair of *C. chinensis* which was released in each of the three containers. Identification of the sexes was made by employing the method of Raina [16]. Mouth of the containers was covered by muslin cloth and secured with rubber bands and later maintained in ambient laboratory conditions.

Adults were removed from these containers after death and total number of eggs laid by a single female on host grains was recorded. Eggs laid each day were kept in separate containers covered with muslin cloth and observations were recorded on incubation, developmental (larval and pupal) and total developmental period. Observations on incubation, larval and pupal period inside the grain were recorded by breaking the whole grain with the help of needle and observing the stage of insect with the help of magnifying glass. The rearing of the beetles was continued till the completion of six generation. Data thus obtained were analyzed statistically in completely randomized design.

Collection of newly emerged adults: For obtaining adults large number of grains having eggs of *C. chinensis* were placed in fresh jar. The jars were examined daily for the emergence of adult beetles and all emerging adults on a particular date were collected.

Apparatus used: Following apparatus were used: glass jars, muslin cloth, specimen tube, rubber band, weighing balance, weighing box and magnifying lens.

Grain protectants used: Neem oil (3ml/kg seed), clove oil (3ml/kg seed), camphor (1gm/kg seed), aonla fruit powder (10gm/kg seed), *Lantana camera* leaf powder (5gm/kg seed) and neem leaf extract (5ml/kg seed).

Biological aspects of the pest:

Mortality test: For the mortality test, seeds treated with different oils, powder and non-toxic materials were kept in plastic tube (7.5x3.5cm. size). Number of grains in each tube was also counted. Five pairs of old adults for 24 hours were released in each tube from the pure culture raised in laboratory. The tube was tied with muslin cloth and rubber band to the escape of insects. These tubes were properly labeled. These treated samples were kept under constant observation in the room maintained at temperature 27 ±1^{o}C and relative humidity 70±5 per cent. Mortality count was made regularly. The data on percentage mortality counts were statistically analyzed, after subjecting the values to angular transformation.

Egg lying: The beetles generally mate soon after emergence. The copulation period was very short in this time (4-8 minutes). Under laboratory condition the laying continued during the day and night. Before ovipositing on egg, small quantity of clear viscous fluid is secreted and eggs are laid in this fluid firmly glues eggs on the surface of the grain. The eggs are oval, Plano convex and translucent. The eggs are whitish which turned yellow with age [17]**.** The observations on number of eggs laid were recorded after 10 days of the release of adult in each tube. The number of eggs laid per female was also recorded on the basis of total number of eggs laid by female.

Adults emergence: Adults emerged out by cutting open the window in the seed. Complete development from egg to adult was recorded by noting the total number of adults emerged out from commencement of 27 th day after setting the experiment, the freshly emerged beetles were counted and removed daily for another 12 days so as to avoid the chances their recounting and to confirm that the total emergence is over. The per cent adult emergence was recorded on the basis of total number of eggs laid/sample and the total number of adult emerged.

RESULT AND DISCUSSION

Two doses of each protectants were tested and the different observations were taken at various intervals for recording the effect of various treatments on some important stages of black gram.

Effect of protectants on the mortality of pulse beetle:

The mortality of adult beetles was being presented in table-1, it is evident that at higher doses the maximum adults were found killed on the seeds treated with neem oil @ 5ml/kg seed (100.0%) followed by Clove oil at lower dose @ 3ml/kg seed (89.33 %) whereas in other treatments at lower dose *viz.,*

castor oil (82.33%) and Camphor (73.66%), neem leaf extract (65.33%), *L. camera* leaf powder (57.66%) and aonla fruit powder (49.33%).

As regard the seed treatment with higher dose i.e. 5 ml/kg seeds and 10g, 15g/kg seed & non- toxic materials gave almost similar trend as in case of 1g, 3ml, 5ml /kg & 5g and10g/kg powder and non-toxic materials but slightly, increase mortality was recorded from lower doses. All the treatments were found superior over control.

Table-: Per cent mortality of pulse beetle after 3 days on black gram seeds treated with different seed protectant.

Sl. No.	Treatments	(Lower) Dose/kg Seed	% mortality	(Higher) Dose/kg Seed	% mortality
1	Neem oil	3ml.	91.00 (72.54)	5ml.	100.00 (90.0)
2	Castor oil	3ml.	82.33(65.14)	5ml.	86.33 (68.30)
3	Clove oil	3ml.	89.33(70.93)	5ml.	97.33 (80.59)
4	Camphor	1g.	73.66(59.12)	2g.	76.00 (60.66)
5	Aonla fruit powder	10g	49.33(44.61)	15g	54.33 (47.48)
6	*L. camera* leaf powder	5g	57.66(49.40)	10g	60.33 (50.96)
7	Neem leaf Extract	5ml	65.33(53.92)	10ml	79.33 (62.59)
8	Control	-		-	
	S.E.(d)+		0.25		2.06
	C. D.		0.53		4.36

3.2. Effect on egg laying: It is apparent from the Table-2 that the minimum number of eggs observed in seeds treated with higher dose of neem oil (1.66), clove oil (2.00), camphor (3.33), castor oil (4.33), aonla fruit powder (7.00), Neem leaf extract (9.00) and *L. camara* leaf powder(12.33). Whereas in lower doses maximum egg laying (3.33) were observed on neem oil treated seeds, which was at par with clove oil (4.33) and Caster oil (6.33) and Camphor (7.33) these were significantly superior to aonla fruit powder (10.33), Lantana camera leaf powder (15.33) and neem leaf extract (12.66) eggs. All the treatments were found significantly superior to control. Lantana camera leaf powder found less effective but were superior over control.

Table-2: Total average number of eggs laid by *C. chinensis* L. on black gram seed treated with different seed protectant.

Sl. No.	Treatments	(Lower) Dose/kg Seed	% mortality	(Higher) Dose/kg Seed	% mortality
1	Neem oil	3ml.	3.33 (10.51)	5ml.	1.66 (7.40)
2	Castor oil	3ml.	6.33 (14.57)	5ml.	4.33 (12.01)
3	Clove oil	3ml.	4.33 (12.01)	5ml.	2.00 (8.13)
4	Camphor	1g.	7.33 (15.70)	2g.	3.33 (10.51)
5	Aonla fruit powder	10g	10.33 (18.74)	15g	7.00 (15.34)
6	*L. camera* leaf powder	5g	15.33 (23.05)	10g	12.33 (20.55)
7	Neem leaf Extract	5ml	12.66 (20.84)	10ml	9.00 (17.45)
8	Control	-	24.33 (29.55)	-	23.33 (28.88)
	S.E.(d)+		1.43		1.46
	C. D.		3.03		3.09

3.3. **Effect of treatments on the emergence of adults**:

As Table 3 showed that lowest per cent of adult emergence (1.66%), was found in seed treated with higher dose of neem oil @ 5ml/kg seed, followed by clove oil (2.0%) @ 5ml/kg seed, Camphor (3.0%) 2g/kg seed, Castor oil (4.3%) @ 5ml/kg seed and they were significantly different from other treatments such as aonla fruit powder (6.0%) 10 gm/kg seed, *L. camera* leaf powder (8.33%) @ 5gm/kg seed and neem leaf extract (9.3%) @ 5ml/kg seed. All the treatments was found significant to untreated control. The higher dose (5ml and 10g, 15g/kg seeds) of these oils, powder and non-toxic materials was quite effective in checking the adult emergence.

Table-3:Adult emergence of *Callosobruchus chinensis* Linn. in black gram seed treated with different seed protectants.

Sl. No.	Treatments	(Lower) Dose/kg Seed	% mortality	(Higher) Dose/kg Seed	% mortality
1	Neem oil	3ml.	1.66 (7.40)	5ml.	1.00 (5.73)
2	Castor oil	3ml.	4.33 (12.01)	5ml.	2.00 (8.13)
3	Clove oil	3ml.	2.00 (8.13)	5ml.	1.33 (6.62)
4	Camphor	1g.	3.00 (9.97)	2g.	2.00 (8.13)
5	Aonla fruit powder	10g	6.00 (14.17)	15g	4.33 (12.01)
6	*L. camera* leaf powder	5g	8.33 (16.77)	10g	6.33 (14.57)
7	Neem leaf Extract	5ml	9.33 (17.78)	10ml	7.33 (15.70)
8	Control	-	38.00 (38.05)	-	45.00 (42.13)
	S.E.(d)+		1.12		1.01
	C. D.		2.37		2.14

DISCUSSION

The results revealed that the maximum percent of mortality was observed on the seed treated with higher dose of neem oil (100.0%), which is differ from the seed treated with clove oil (97.3%), castor oil (86.3%) and camphor (76.0%). These were found to be significantly better in increasing adult mortality than the neem leaf extract, *L. camera* leaf powder (50.9%) and (79.3%). aonla fruit powder (54.3%). These finding are similar to Ali *et al*. (1983) who reported that lower dose of neem oil and mustard oil i.e. 0.5 ml/100g seed is less effective than higher dose (1.0ml/100g seed). Higher dose was proved to be more effective in increasing mortality (100%). Das [6] observed castor oil treatment resulted in the mortality of adult weevils and the eggs, which were failed to hatch. Kachare *et al*. [11] found that 0.5, 0.75 and 1.0 per cent oil as seed protectants gave good results in insect mortality These results are also in agreement with the finding of Thakur and Pathania [24] who reported that neem oil caused 100% mortality of pulse beetle (*C. chinensis*) infesting black gram.

The minimum number of eggs was observed (1.66 eggs/adult) in seeds treated with higher dose of neem oil followed by clove oil (2.0), camphor (3.33) and castor oil (4.33). Similar to these findings Kavadia [12] observed that coating of mustard and neem oil can provide complete protection of egg lying. Perira [15] reported that neem oil protected the egg laying *C. maculatus.* Singh and Verma [20] evaluated the vegetable oil for checking the oviposition. Doharey *et. al*. [8] also concluded that all the edible oils provided complete protection in egg laying.

The lowest emergence of the adult beetle was found in seeds treated with higher doses. It was minimum (1.0%) on seed treated with neem oil followed by clove oil (1.3%), camphor and castor oil (2.0%), (4.3%) in aonla fruit powder, *L. camera* leaf powder (6.3%) and neem leaf Extract (7.3%). It may be concluded that oils, proved to be more effective in reducing the adult emergence. Yadav [25] applied neem seed oil, which completely checked the adult emergence. Doharey *et al* [7], observed that the edible oils prevented the emergence of adult beetles (*C. chinensis*). Ahmed *et al.* [1] observed that the neem seed powder completely prevented the adult emergence.

CONCLUSION

The data on biology of pulse beetle indicated that among the all treatments, neem oil @ 5ml/kg seed found to be superior over rest of treatments which recorded highest per cent mortality, lowest egg laying and adult emergences when seed treated with high dose of chemicals.

ACKNOWLEDGEMENT

The authors are thankful to Department of Agricultural Entomology, C.S.A. University of Agriculture and Technology-Kanpur for their support and for providing the facilities.

REFERENCES

1. Ahmed, K. S., T. Itino and T. Ichikawa, (2003). Duration of developmental stages of *Callosobruchus chinensis* (Coleoptera: Bruchidae) on azuki bean and the effects of neem and sesame oils at different stages of their development. *Pak. J. Biol. Sci.,* **6**(10): 932-335.
2. Ahmed, K., Feeroza, K., Mohammad, A., Bashir, A. M., and Malik, M., Riza, (1988). Efficacy of vegetable oil for protection of green gram from attack of bruchid beetles. *Pakistan Journal of Agricultural Research.*
3. **9** (3):413-416.
4. Ali, S. I., Singh, O. P. and Mishra, U. S. (1983). Effectiveness of plant Oils against pulse beetle, (*Callosobruchus Cinensis)*. *Indian Journal of Entomology* 45 (1): 6-9.
5. Anonymous, (2015). All India Coordinated research Project on field pea, IIPR-Kanpur, pp. 57-60.

6. Das (1986). Eco- toxicological studies on pulse beetle infesting green gram. 4 Effect of edible oil treatment on the germination of green gram (*Vigna radiata*) Wilczek seeds. *Indian Journal of Entomology*. **45** (4): 414-419.
7. Doharey, R. B. Katiyar, R. N. Singh, K. M. 1988. Effect of edible oil in protection of green gram 4 (*Vigna Radiata*) seed from Pulse beetle (*Callosobruchus chinensis*). *Indian Journal of Agricultural Science* 58 (2): 151-151.
8. Doharey, R. B. Katiyar, R. N. and Singh, K. M. (1990). Eco-toxicological studies on pulse beetles infesting Green gram. Four comparative efficacies of some edible oils for the protection of green gram (*V. radiate* L.) Wilezek against pulse beetle *Callosobruchus chinensis* & *Callosobruchus maculatus* F.). *Bull. Grain Technology* 28: (116-119).
9. Fishwick, F. B. (1988). Pesticide residues in grain arising from post harvest treatments. *Aspects of Applied Biol.,* **17**: 37-46.
10. Gujar, G. T. and T. D. Yadav, (1978). Feeding of *Callosobruchus maculatus* (Fab.) and *Calloso-bruchus chinensis* L. in green gram. *Indian J. Entomol.,* **40**: 108-112.
11. Kachare, B. V., Kharire V. M. Mote, U. N. (1994). Efficiency of Different vegetable oils as seed treatment in increasing Storage ability of pigeon pea seeds against pulse beetle, (*Callosobruchus Chinensis* L.). *Indian Journal of Entomology.* **56** (1): 58-62.
12. Kavadia, V. S. (1974). Summary of investigations of taxo-logical Problems associated with the use of fumigants and protectants in storage grains in Rajasthan. *Indian J. Ent.,* **27** (2): 160-164.
13. Mishra, H. P. (2000). Effectiveness of indigenous plant product against the pulse beetle *Callosobruchus chinensis* (L.) on mothbean (*Vigna unguiculata*). *Indian Journal of Entomology.* 67 (2).
14. Osmani, Z. and Singhamony, S. (1980). Effect of citrus oils on mortality and metamorphosis of *Aedes egypti*. *PestcideS.* **14** (9): 15-16.
15. Pereira, John.1983. The effectiveness of six vegetable oil protectant of cow pea (Vigna unguiculata) and Bambara Groundnuts (*Vigna subterranean*) against infestation by *C. maculatus*.
16. Raina, A. K. (1970). *Callobruchus* species infesting stored pulses (Grain legume) in India and their comparative biology. *Indian J. Ent.,* **32** (4): 303 -310.
17. Rajak, R. L. and Pandey, N. D. 1965. A life history of pulse beetle, (Callosobruchus chinensis L.). *J. Sci. and Tech*. **3**:119-123.
18. Rajak, R. L. and Pandey, N. D. (1965). A life history of pulse beetle*, (C. chinensis* L.). Coleoptera: bruchidal, Labdev. *J. Sci. and Tech*. **11** (9): 15-16.
19. Satyalseen, Narayan and Krishna, S. S. (2008). The effect of some Common oil seed and spp. serving as an adult food on the reproduction potential of *T. Castaneum*. *Entomon.*, **5** (3): 160-162.
20. Singh and Verma (1985). Oviposition composition and population dynamic in storage insects. *Proc IV th International conference on stores Prod. Protection Tel Aviv Israel*, pp. 426-433.
21. Singh, P. K. (2003). Effect of some oils against pulse beetle, (*Callosobruchus chinensis*) infesting stored pulses in India. Indian Journal of Entomology. **62** (4): 319-322.
22. Singh, S. C. (2005). Effect of neem bark powder as protectant against *Callosobruchus chinensis* L. on stored chickpea and lentil. *Indian Journal of Entomology.* **63** (3): 203-205.
23. Subramanyam, B. and Hagstrum, D. W. (1995). Integrated management of insects in stored products. Marcel Dekker Inc., New York. pp. 426.
24. Thakur, A. K. and Pathamia, M. (2013). Biology of Pulse beetle (*Callosobruchus chinensis)* and its management through plant products on black gram (Vigna mungo). *Sci. Technol. Arts. Res. J.,* **2** (1):18-21.
25. Yadav, T. D. (1985). Anti oviposition and ovicidal toxicity of neem Oil against three species of *Callosobruchus. Neem news Letter.* **2** (1):5-6.

CITATION OF THIS ARTICLE

Sachin Kumar, Sathish B N, Sanjeev Kumar, Veer Vikram Singh and Krishan Pal. Effect of grain protectants on biology of pulse beetle (*Callosobruchus chinensis* L.) in black gram. Bull. Env. Pharmacol. Life Sci., Vol 7 [12] November 2018 : 141-145