Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(6): 100-103

Received: 02-09-2020
Accepted: 06-10-2020

Navendu Nair
Department of Agriculture Entomology, College of Agriculture, Tripura, India

Dilip Nath
Department of Zoology, Holy Cross College, Tripura, India

Sahini Reang
Department of Zoology, Holy Cross College, Tripura, India

Prasenjit Pal
Department of Extension and Social Sciences, College of Fisheries, CAU, Tripura, India

Corresponding Author:
Navendu Nair
Department of Agriculture Entomology, College of Agriculture, Tripura, India

Management of pulse beetle, *Callosobruchus maculatus* (Chrysomelidae: Coleoptera) using local natural products in Tripura

Navendu Nair, Dilip Nath, Sahini Reang and Prasenjit Pal

Abstract
Pulse beetle, *Callosobruchus maculatus* F. (Chrysomelidae: Coleoptera) is a major pest of stored pulse grains in Tripura. Use of chemical insecticides in storage has several ill effects while natural products for the management of these insects are considered as safer. In this context, five locally available non chemical natural products *viz.*, Neem powder, Turmeric powder, Mustard oil, Coconut oil and Cow dung ash were used to evaluate the effectiveness against *C. maculatus*. Three sets of experiments were carried out separately on three different pulse seeds *viz.*, Field pea (*Pisum sativum*), Chick pea (*Cicer arietinum*) and Pigeon pea (*Cajanus cajan).* It is evident from the present work that out of the five treatments, mustard oil and coconut oil owing to their insecticidal and oviposition deterrent activities provided excellent protection to the seeds up to three months where not a single grain was infested by the pulse beetle. Moreover, as both of these oils are edible so these can be used very safely and efficiently in storing of pulse seeds for protection against pulse beetles without any side effects for human consumptions.

Keywords: *Cajanus cajan*, Callosobruchus maculates, Cicer arietinum, management, Pisum sativum

1. Introduction
Pulses play a significant role in the diet of the Indian people. Undoubtedly, pulses are an important protein source for the vegetarians and it is also considered as poor man's meat for the under privileged people who cannot afford animal proteins [18]. The pulse seeds suffer a great damage during storage due to insect attack [20]. Infestation of pulse beetle causes both qualitative and quantitative losses in legume seeds. The pulse beetles inflict their damage on stored pulses mainly by the feeding of inner contents of the seeds by the grubs resulting in weight loss, loss in quality/market value, reduced germination in seed material and mould development and "caking" causing severe losses. So the infestation of pulse beetles on the pulse grains badly affects the farmers by reducing the value of their stored pulse seeds for marketing, consumption or planting.

Many synthetic insecticides have been found to be effective against pulse beetle [15, 10]. However, the use of these synthetic chemical insecticides bear some associated problems like development of resistant insect strains, toxic residues in foods and humans, workers' safety and high cost of procurements [1]. Moreover, pulses stored specifically for consumption purpose should not be treated with toxic chemicals since the residues of these chemicals may pose serious risk on human health. On the other hand certain plant preparations and traditional methods are much safer than chemical insecticides [24]. Therefore, alternative methods such as the use of ash, edible oils and plant products that could be easily used by farmers need to be considered [9]. Lale (1992) [12] reported that plant materials and local traditional methods are much safer than insecticides and suggested that their use needed exploitation. Successful use of ash, plant extracts, vegetable oils and plant leaf powders in insect pest control has been reported by many workers [4, 8, 3, 6].

Agriculture is the backbone of the economics of Tripura. The warm and humid climatic condition of Tripura is favourable for the growth and development of insects and pathogens. The common people use the pulses in their regular diet in this state also. Pulse beetle, *Callosobruchus maculatus* is also considered a major pest causing severe damage to the stored pulses. Sometimes, the farmers, business persons and traders become helpless due to the infestation of *C. maculatus.* Total quantity of their stored pulse seeds get destroyed by the

ravages of this particular pest which cause a great economic loss for them. Keeping in view the importance of this pest, the present work has been envisaged on pulse seeds to find out some locally available natural non-chemical materials which can be used in successful management of this pest without any side effects on the consumers.

2. Materials and Methods

The present experiment has been done in the laboratory of the Department of Agril. Entomology at College of Agriculture, Tripura during February-May, 2018.

2.1 Stock culture of *Callosobruchus maculatus*

Infested Pigeon pea (*Cajanus cajan)* seeds along with adult pulse beetles (*C. maculatus*) were collected from AICRP on Pigeon pea, Tripura Centre. Mature seeds of Field pea (*Pisum sativum*) and Chick pea (*Cicer arietinum*) were collected from local market. In the laboratory, homogeneous laboratory culture of the beetles were maintained in plastic containers separately on Field pea, Chick pea and Pigeon pea seeds. During collection of the pulse seeds it was confirmed that the seeds were not mixed with any insecticide at the time of storage. The newly emerged pulse beetles from the stock culture of these three different seeds were utilized for the experiments with the concerned seeds.

2.2 Collection of treatment materials

A total of five (5) locally available natural materials *viz.,* (a) Mustard oil, (b) Turmeric powder, (c) Coconut oil, (d) Neem leaves and (e) Cow dung ash were used to evaluate their effects. The mustard oil, turmeric powder and coconut oil were bought from the local market. Fresh Neem leaves were collected from the local village. The leaves were dried under shed and crushed to make powder. Cow dung was collected from the village. After drying up the powder was made by burning it.

2.3 Method of observations

Observations have been done as follows**:-**

Three sets of experiments were carried out separately on three different pulse seeds *viz.,* Field pea (*P. sativum*), Chick pea (*C. arietinum*) and Pigeon pea (*C. cajan).* The seeds were used to find out the overall efficacy of locally available natural materials on those pulse seeds for the management of *C. maculatus*. Total twenty four (24) plastic containers were taken to conduct each experiment. Each container was filled by 200 nos. of pulse seeds. Regarding the study of efficacy by coconut and mustard oils, 1 ml of each product was mixed thoroughly with the seeds for individual treatment. Neem powder, Cow dung ash and Turmeric powder were taken as 1 gm of each and mixed thoroughly with the pulse seeds in the containers for individual treatment. Each treatment was replicated for four (4) times. Four containers were kept with untreated seeds for control. Fifteen (15) pairs of freshly emerged adult beetles were released in each container. Three observations were taken at monthly intervals starting from the first day of treatment. Percentage of infested seed was calculated to see the overall efficacy of the treatments. The same procedure was followed for each experiment. Data obtained were statistically analyzed in accordance with one factor Completely Randomized Design (CRD) and treatment mean values were compared by Duncan's Multiple Range Test (DMRT). All statistical analysis has been done through "SAS 9.3" package.

3. Results and Discussion

The efficacy of treatment materials against pulse beetle on field pea, chick pea & pigeon pea in terms of per cent grain infestation has been observed up to three months after the treatments (Table 1). Almost similar trend of observations was recorded for all the three experiments. The observations after one month of treatment showed significant (at 1% level of Significance) protection of grains by all the treatments over the control. Maximum protection of grains (0% infestation) was recorded in case of coconut oil and mustard oil where not a single grain was found to be infested by the pest. Both of these two treatments showed higher protection to the grains as compared to other treatments. The second best result was found in the seeds treated with Turmeric powder and infestations on different grains were: Chick pea (5.88%)> Field pea (11.50%)> Pigeon pea (13.13%). The performance by different treatments on the grains after one month was recorded as follows:

1. Field pea: Coconut = Mustard (0.000)> Turmeric (11.5000)> Neem (30.875)> Cow dung (28.500)> Control (58.500).
2. Chick pea: Coconut = Mustard (0.000)> Turmeric (5.875)> Cow dung (24.750)> Neem (26.625)> Control (45.625).
3. Pigeon pea**:** Coconut = Mustard (0.000)> Turmeric (13.125)> Cow dung (29.875)> Neem (32.625)> Control (67.750).

The above data showed that the performance of Turmeric powder treatment was comparatively superior over Neem powder and Cow dung ash to control the pulse beetle. Although Neem powder and Cow dung ash provided some degree of control but these two treatments were less effective than the oils and Turmeric powder. Maximum infestation was recorded in case of untreated seeds. The infestation level on untreated seeds of different grains was as follows: Chick pea (45.63%)> Field pea (58.50%)> Pigeon pea (67.75%). It was also observed that the insects laid eggs on the seed coats in all the treatments except in mustard oil and coconut oil treated seeds.

After two months of application the per cent infestations were again counted from all the treated samples. After one month of treatments, there was neither any live insect nor any egg on the seed coats of coconut oil and mustard oil treated seeds, so naturally after two months of treatment it was found that the seeds treated with these two edible oils were totally free from any infestation which indicated the highest performance of these two treatments to control the pulse beetle in stored grains. The seeds treated with other treatments including control were severely infested by pulse beetles ranging from 68.50 to 99% infestation. The protection performances by the treatments on different seeds were as follows after two months of application:

1. Field pea: Coconut = Mustard (0.000)> Cow dung (76.000)> Turmeric (94.000)> Neem (93.500)> Control (98.125).
2. Chick pea: Coconut = Mustard (0.000)> Cow dung (68.500)> Neem (93.125)> Turmeric (94.625)> Control (96.750).
3. Pigeon pea: Coconut = Mustard (0.000)> Cow dung (75.750)> Neem (93.750)> Turmeric (94.125)> Control (99.000).

The above data showed that, the infestation in cow dung ash

treated seeds was comparatively less as compared to the turmeric and neem treated seeds. By cow dung ash treatment, 76%, 68.5% and 75.75% seeds were infested in case of Field pea, Chick pea and Pigeon pea, respectively. But for neem and turmeric treatments 93.13% to 94.63% seeds were infested in different categories of seeds. Maximum infestation was again recorded in untreated seeds, where 98.13%, 96.75% and 99.00% seeds were infested in case of Field pea, Chick pea and Pigeon pea, respectively. Per cent infestation in untreated seeds was significantly higher as compared to all other treatments in case of Field pea and Pigeon pea but in case of Chick pea it was at par with Turmeric and Neem powder.

Observation after three months of application revealed that only coconut and musterd oil treaded seeds were protected fully but other treatments along with control showed cent percent infestation. It indicated that only coconut oil and mustard oil treated seeds could give full protection of the seeds against pulse beetles even after three months.

It is evident from the present study that mustard oil and coconut oil are excellent grain protectants against pulse beetles. Turmeric powder also provides good protection against the pest and is proved to be superior over cow dung ash and neem leaf powder but this is for only up to one month. After two months cow dung ash is proved to be superior over Turmeric powder and neem leaf powder though considerable percent of grains (68.5-76%) were also infested in this treatment too.

Pokharkar and Chauhan (2010) [17] tested different materials *viz.*, vegetable oils, powders of different plant materials and inert dust (ash) for their efficacy against *Callosobruchus chinensis* in stored chickpea. However, on contrary to the present findings they obtained better result with ash (0.00% infestation) as compared to mustard oil (7.28%) and coconut oil (7.65%). But the present findings corroborate the findings of Singh *et al.* (2006) [21] who observed no weight loss on pea seeds treated with mustard oil at 2ml/ kg against *C. chinensis*. Hossain *et al*. (2014) [7] tested edible and non-edible oils against *Callosobruchus chinensis* in stored chickpea of which mustard oil reduced the oviposition, adult emergence, seed infestation and seed weight loss at 8.0 ml/kg. Khaire *et al*. (1993) [11] also reported the effectiveness of vegetable oils against *C. chinensis* on pigeonpea. Pandey *et al*. (1981) [14], Messina & Renwick (1983) [13], Pierrard (1986) [16] and Ahmed *et al*. (1988)[2] used oils of groundnut (*Arachis hypogaea* L.), castor (*Ricinus communis* L.), coconut, palm kernel, corn, cotton, babassu (*Orbignya* sp.), mustard (*Brassica juncea* L.), olive (*Olea europea*), sesame (*Sesamum indicum* L.), sunflower (*Heliunthus annuus* L.), and rice (*Oryza sativa* L.) in their studies. Castor oil at 8 mg. kg-1 provided complete protection against *C. maculutus* (Singh *et al*., 1978) [22]. Singh *et al*., 1990 [23] reported that palm and coconut oils at 4 ml/kg are the most effective protectants of chick-pea seeds against *C. chinensis* for 3 months of storage, followed by groundnut, rapeseed and mustard oils. According to Das (1987) [5] Neem seed oil shows 100% control of *C. chinensis* for 5 months when used @ 10 ml.kg-1. But it is evident from the present study that neem leaf powder is not an efficient protectant of stored pulse seeds against pulse beetles. However, according to Rajasri and Rao (2012) [19] commercially available neem formulations are very effective against *C. chinensis* in stored bengalgram. Leaf powders of *Tridax procumbens*, *Withania somnifera*, *Pongamia pinnata* and *Gliricidia maculata* have also been reported to be very effective against the pulse beetle, *Callosobruchus chinensis* in protecting stored green gram seeds [25].

Table 1: Percent seed infestation by pulse beetle after different months of treatment

Treatments	Field Pea			Chick pea			Pigeon pea		
	1m	2m	3m	1m	2m	3m	1m	2m	3m
Neem	30.875 b	93.500 b	100.000 a	26.625 b	93.125 a	100.000 a	32.625 b	93.750 b	100.000 a
Coconut	0.000 d	0.000 d	0.000 b	0.000 d	0.000 d	0.000 b	0.000 d	0.000 d	0.000 b
Mustard	0.000 d	0.000 d	0.000 b	0.000 d	0.000 d	0.000 b	0.000 d	0.000 d	0.000 b
Cow dung	28.500 b	76.000 c	100.000 a	24.750 b	68.500 b	100.000 a	29.875 b	75.750 c	100.000 a
Turmeric	11.500 c	94.000 b	100.000 a	5.875 c	94.625 a	100.000 a	13.125 c	94.125 b	100.000 a
Control	58.500 a	98.125 a	100.000 a	45.625 a	96.750 a	100.000 a	67.750 a	99.000 a	100.000 a
Level of Significance	**	**	**	**	**	**	**	**	**
LSD 0.05	5.125	2.761	668 E-9	2.6393	3.8137	668 E-9	4.427	3.548	668 E-9

** Significant at 1% level of probability

4. Conclusion

From the present study it can be concluded that among the five treatments mustard oil and coconut oil owing to their insecticidal and oviposition deterrent activities provided excellent protection to the seeds where not a single grain was infested by the pulse beetle even after three months of treatment. Moreover, as both of these oils are edible so these can be used very safely and efficiently in storing of pulse seeds for protection against pulse beetles without any side effects to the human beings.

5. Acknowledgement

The authors are grateful to the Principal, College of Agriculture, Tripura for the liberal facilities provided for this study. The authors are also grateful to the AICRP on Pigeon pea, College of Agriculture, Tripura for providing seed materials and live insects used in this study.

5. References

1. Adedire CO. Use of nutmeg, *Myristica fragrans* (Houtt) powder and oil for the control of cowpea storage bruchids, *Callosobruchus maculatus* (F.). Journal of Plant Disease Protection. 2003; 109:193-199.
2. Ahmed K, Khalique F, Afzal M, Malik BA, Malik MR. Efficacy of vegetable oils for protection of greengram from attack of bruchid beetle. Pakistan Journal of Agricultural Research. 1988; 9:413-416.
3. Bakkali F, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils- a review. Food and Chemical Toxicology. 2008; 46:446-475.
4. Chiasson H, Vincent C, Bostanian NJ. Insecticidal properties of a Chenopodium-based botanical. Journal of Economic Entomology. 2004; 97(4):1378-1383.
5. Das GP. Efficacy of neem oil on the egg grub mortality of *Callosobruchus chinensis* Linn. (Bruchidae:

Coleoptera). Tropical Grain Legume Bulletin. 1987; 34:14-15.
6. Firake DM, Firake PD, Behere GT, Azad Thakur, NS, Nath D. Traditional Practices for the Management of Major Pests of Horticultural Crops and Stored Produce in North East India. In: Ancestral Knowledge in Agri-Allied Science *(*R. K. Saha, D. Nath and H. saha eds.). New India Publishing Agency, New Delhi, 2014, 73-83p.
7. Hossain MA, Alim MA, Ahmed KS, Haque MA. Insecticidal potentials of plant oils against *Callosobruchus chinensis* (Coleoptera: Bruchidae) in stored chickpea. Journal of Entomological Society of Iran. 2014; 34(3):47-56.
8. Isman MB, Machial CM. Pesticides based on plant essential oils from traditional practice to commercialization. In Rai, M. and M.C. Carpinella, (eds.), naturally occurring bioactive compounds. Advances in Phytomedicine. 2006; 3:29-44.
9. Isman MB. Botanical insecticides: for richer, and for poorer. Pest Management Science. 2008; 64:8-11.
10. Jolli RB, Karabhantanal SS, Jayaprakash TC. Influence of pesticides and storage methods in the management of pulse beetle (*Callosobruchus* spp.) and their effects on seed viability in moth bean. Journal of Entomological Research. 2005; 29(2):159-162.
11. Khaire VM, Kachare BV, Mote UN. Effect of different vegetable oils on ovipositional preference and egg hatching of *Callosobruchus chinensis* Linn. on pigeonpea seeds. Seed Research Journal. 1993; 21:128-130.
12. Lale NES. A laboratory study of the comparative toxicity of products from the three species of the Maize weevil. Post harvest Biological Technology. 1992; 2:612-664.
13. Messina FJ, Renwick JAA. Effectiveness of oils in protecting stored cowpea from the cowpea weevil (Coleoptera: Bruchidae). Journal of Economic Entomology. 1983; 76:634-636.
14. Pandey GP, Doharey RB, Varma BK. Efficacy of some vegetable oils for protecting greengram against the attack of *Callosobruchus maculatus* (Fabr.). Indian Journal of Agricultural Sciences. 1981; 51:910-912.
15. Patil RK, Nawale RN, Mote UN. Efficacy of synthetic pyrethroids as seed protectants of pigeonpea against pulse beetle, *Callosobruchus maculatus* (F.). Indian Journal of Entomology. 1994; 56(1):51-57.
16. Pierrard G. Control of the cowpea weevil, *Callosobruchus maculatus*, at the farmer level in Senegal. Tropical Pest Management. l986; 32:197-200.
17. Pokharkar PK, Chauhan NR. Bioefficacy of botanicals material against *Callosobruchu chinensis* (Linnaeus) in stored chickpea. International Journal of Plant Protection. 2010; 3(1):72-76.
18. Rahman MS, Ashrafuzzaman M, Sikdar SU, Zobayer N, Ahmad M. Potency of botanical extracts on management of pulse beetle (*Callosobruchus chinensis* L.). International Journal of Biosciences. 2013; 3(3):76-82.
19. Rajasri M, Rao PS. Neem formulations – safer seed protectants against pulse beetle, *Callosobruchus chinensis* for long term storage of Bengalgram. International Journal of Applied Biology and Pharmaceutical Technology. 2012; 3(3):323-328.
20. Sherma SS. Review of Literature of the losses caused by material as grain protectants against insect pests of stored *Callosobruchus* species (Bruchidea: Coleopetra) during storage of pulses. Bulletin of Grain Technology. 1989; 22:62-68.
21. Singh KM, Sureja AK, Sarma AK. Bio-efficacy of some botanicals against *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) on pea. Indian Journal of Entomology. 2006; 68:404-406.
22. Singh SR, Luse RA, Leuschrer LK, Nangju D. Groundnut oil treatment for the control of *Callosobruchus maculatus* (F.) during cowpea storage. Journal of stored Products Research. 1978; 14:77-80.
23. Singh S, Singal SK, Verma AN. Evaluation of some edible oils as protectants of chickpea seeds, *Cicer arierinum* L. against pulse beetle, *Callosobruchus chinensis* (L.) by preferential feeding method. In: Proc. 5th Intl. Working Conf. Stored Prod. Protec. (Bordeaux, France, 1990) (eds. Fleurat-Lessard, F. & Ducom, P.), 1990, 1715-1724.
24. Weaver DK, Subramanyam B. Botanicals. In Alternative to Pesticides in Stored-Product IPM (B. Sub-ramanyam and D.W. Hagstrum, eds.). Kluwer Academic Publishers, Norwell, MA, 2000, 303-320p.
25. Yankanchi SR, Lendi GS. Bioefficacy of certain plant leaf powders against pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae). Biological Forum – An International Journal. 2009; 1(1):12-17.