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Efficacy of locally available plant seed oils against pulse beetle infesting blackgram

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ABSTRACT

Callosobruchus chinensis L. (Pulse beetle) is a major stored grain pest of pulse crops during storage. The research was conducted at the pulses lab of Regional Agricultural Research Station, Jashore during the period from March, 2019 to June, 2019 to study the efficacy of local market available different plant seed oil against pulse beetle (Callosobruchus chinensis L.) infesting blackgram (Vigna mungo). Different plants seed oil viz. T_1= Mustard seed oil (3ml/kg), T_2= Olive oil (3ml/kg), T_3= Coconut oil (4ml/kg), T_4= Soybean seed oil (2ml/kg), T_5= Control were included as treatments in the study. Treatments were evaluated for their effects on seed damage and weight loss in black gram at different storage intervals i.e., 30, 60, 90 and 120 days after treatment. The treatment mustard seed oil (3ml/kg) and coconut oil (4ml/kg) was found the best treatments for the lowest seed damage and weight loss i.e., 0.37, 5.07 and 0.48, 3.20 respectively, after 30 days. Similar result was found even after 120 days i.e., 2.15, 46.63 and 1.19, 10.01 respectively. The third, fourth and least effective treatments are soybean oil (2ml/kg), olive oil (3ml/kg) and control, respectively.

Key Words: *Callosobruchus chinensis L., Vigna mungo, Plant extract, seed damage and Weight loss*

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I. Introduction

Pulse crops play an important role in the daily diet of the people and in the agriculture of Bangladesh so far. Pulse crops have been assumed as poor man's meat for the low income earning people who are unable to afford proteins from animal source. *Vigna Mungo* (blackgram) is a major pulse crop among the legumes grown in Bangladesh. It contains 24% protein, 60% carbohydrate, 1.3% fat and it contains highest phosphoric acid among the pulses (Abhitej et al., 2018). In maintaining and improving soil fertility it plays important role by fixing atmospheric nitrogen in the soil. The pulse beetle, *Callosobruchus chinensis* L. is considered as the most destructive insect pest of leguminous stored grains like blackgram, chickpea, green gram, fieldpea, cowpea, pigeon pea and lentil (Aslam et al., 2002; Park et al., 2003). Pulse beetles severely damage the stored pulses (Atwal and Dhaliwal, 2005).

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It causes 40-50% losses during storage (Gosh et al., 2003). Insect pests of stored grains not only feed on the grains but also its excreta cause bad odors, fermentation, organic changes of the food grains which reduces the economic and nutritional value. Insects damaged the grains and then the damaged grains become susceptible to different microorganisms. Poisonous chemical substances like Alfa toxin is secreted from the moulds grown in the damaged stored products which is previously reported to be associated with the liver cancer of human being (Singh, 1989). Organophosphates and fumigants are the two major synthetic chemicals for controlling pulse beetle population for the protection of stored grain from the infestation. Due to the development of resistance in *Callosobruchus chinensis,* gradually these chemicals will lose their effectiveness against insects. Again residual effects of these chemicals are dangerous to human health and the environment (Isman, 2006; Rajendran and Sriranjini, 2008). So, mixing insecticides with food grain for protection against insects is not safe also (Bekele et al., 1995). Therefore, use of ash, edible oils and plant products can be alternative to synthetic chemicals and fumigants that could be easily used by farmers (Isman, 2008). Farmers and researchers often claim the successful use of plant extracts (Chiasson et al., 2004; Yankanchi and Patil, 2009) in insect pest control. Moreover, present researches revealed that different plants seed oil may have ability to act as alternative to fumigants (Tunc et al., 2000; Lee et al., 2001; Yamane, 2013). It is also reported that certain plant preparations are safer than chemical one (Weaver and Subramanyam, 2000; Yankanchi and Patil, 2009). Therefore, plant products such as seed oil should be explored to protect stored grains against insect pest. The objective of this research work was to find out potentiality of some plant materials over commercially available chemical pesticides to prevent *C. chinensis* infestation during pulse seed storage. So, the experiment was undertaken to investigate the efficacy of local market available different plant seed oils against pulse beetle (*Callosobruchus chinensis*) infesting blackgram (*Vigna mungo*).

II. Materials and Methods

The experiment was conducted at the pulse lab of Regional Agricultural Research Station, Jashore during the period from March, 2019 to June, 2019 to study the efficacy of local market available different plant seed oils against pulse beetle (*Callosobruchus chinensis)* infesting blackgram (*Vigna mungo*). The research was laid out in a randomized completely block design with three replications. Different plant seed oils viz. T_1= Mustard seed oil (3ml/kg), T_2= Olive oil (3ml/kg), T_3= Coconut oil (4ml/kg), T_4= Soybean seed oil (2ml/kg), T_5= Control were included as treatments in the study (Table 01). The five pairs of adult pulse beetle, *C. chinensis* Linn. were released in each of the plastic container bearing proposed treated blackgram grains of 500 grams. Plastic containers were then covered with their lids and preserved in room temperature (Figure 01) up to 120 days after insect release.

Table 01. Different plant seed oils used against *C. chinensis* infesting blackgram (*Vigna mungo*)

Common Name	Scientific Name	Family	Plants Parts Used	Conc. Used
Mustard oil	*Brassica napus*	Brassicaceae	Seed oil	3ml/kg
Olive oil	*Olea europea*	Oleaceae	Seed oil	3ml/kg
Coconut oil	*Cocos nucifera*	Arecaceae	Seed oil	4ml/kg
Soybean oil	*Glycine max L.*	Fabaceae	Seed oil	2ml/kg

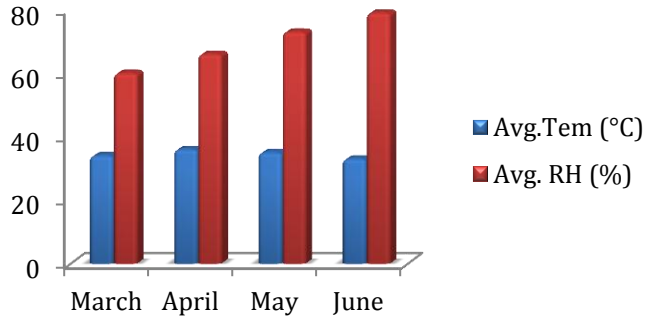

Figure 01. Average temperature and relative humidity during (March-June)-2019 in Jashore.

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Data to be recorded

Seed Damage: From the jar of each replicate ten gram seeds were taken after 30 days. From the total number of seeds taken for observation, the damaged seeds were separated. The recorded data were used for calculating the percentage of damaged seed. The same procedure was followed after 60, 90 and 120 days. The following formula was used for determination of percent seed damage as described by (Adams and Schuten, 1978).

$$\text{Percent seed damage} = \frac{Number\ of\ damaged\ seeds}{Number\ of\ seeds\ for\ observation} \times 100$$

Weight Loss: After removing the beetles from each jar the weight of seeds were taken after 30, 60, 90 and 120 days. The percent weight loss was calculated by the following formula.

$$\text{Percent weight loss} = \frac{W-f}{w} \times 100$$

Where,

w = Initial weight of seeds

f = Final weight of seeds.

Then data were analyzed using "R" statistical software (R Core Team, 2018).

III. Results and Discussion

Seed damage

The percent seed damage after 30 days in all the treatments varied from 0.37 to 10.28 percent (Table 02). The research work on the effectiveness of different plants seed oils as protectants against pulse beetle infesting mungbean indicated that after 30 days of storage, mustard seed oil, *i.e.,* 3ml/kg showing 0.37 percent damage against the pulse beetle and were significantly superior over all other treatments (Table 02). Second best effective treatment was coconut oil (4ml/kg) having 5.07 percent damage. The soybean seed oil (2ml/kg) was found the third best effective treatment showing 5.61 percent damage followed by olive oil (3ml/kg) treatment and control having 6.1 and 10.28 percent seed damage (Table 02). After 60 days of storage the order of effectiveness of the treatments in the descending order was mustard seed oil 3ml/kg > coconut oil 4ml/kg >soybean seed oil 2ml/kg > olive oil 3ml/kg >control having 0.55, 30.41, 33.03, 43.24 and 51.38 percent seed damage respectively (Table 02). Even after 90 days of storage mustard seed oil (3ml/kg) continued to be the best treatment to the mungbean showing 0.97 percent seed damage (Table 02). Coconut oil and soybean seed oil was found the second and third best effective treatment showing 42.89 and 50.30 percent damage, respectively followed by olive oil (3ml/kg) treatment and control (Table 02). After 120 days of storage mustard seed oil (3ml/kg) showed as the best treatment having 2.15 percent seed damage and rest of the treatments were statistically significant over control but showing more than or equal to 50 percent damage (Table 02). From the above findings it was revealed that among the four plants seed oil mustard seed oil (3ml/kg seed) was the best treatment against pulse beetle to reduce the percent seed damage and another report also showed that mustard oil was effective in reducing per cent seed damage which is reported by Venkatsham et al. (2014).

Table 02. Effect of different plants seed oil on percent seed damage by the pulse beetle in blackgram after 30, 60, 90, and 120 days after storage

Treatments	Percent Seed damage after			
	30 days	60 days	90 days	120 days
T_1	0.37 e	0.55 d	0.97 c	2.15 d
T_2	6.1 b	43.24 b	75.23 a	78.06 b
T_3	5.07 d	30.41 c	42.89 b	46.63 c
T_4	5.61 c	33.03 c	50.30 b	56.06 c
T_5	10.28 a	51.38 a	82.05 a	92.21 a
Lsd (.05)	0.188	5.18	7.77	9.54
CV (%)	1.82	8.67	8.21	9.81

T_1= Mustard seed oil (3ml/kg), T_2= Olive oil (3ml/kg), T_3= Coconut oil (4ml/kg), T_4= Soybean seed oil (2ml/kg), T_5= Control

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Weight Loss

The percent weight loss after 30 days in all the treatments varied from 0.48 to 6.10 percent. The research work on the effectiveness of different plants seed oils as protectants against pulse beetle infesting mungbean indicated that after 30 days of storage, mustard seed oil, *i.e.,* 3ml/kg showing 0.48 per cent weight loss and were significantly superior over all other treatments (Table 03). Second best effective treatment was coconut oil (4ml/kg) having 3.20 percent weight loss. The soybean seed oil (2ml/kg) was found the third best effective treatment showing 4.09 percent weight loss followed by olive oil (3ml/kg) treatment and control having 5.60 and 6.10 percent weight loss (Table 03). After 60 days of storage the order of effectiveness of the treatments in the descending order was mustard seed oil 3ml/kg > coconut oil 4ml/kg >soybean seed oil 2ml/kg > olive oil 3ml/kg >control showing 0.64, 6.19, 8.50, 11.55 and 14.56 percent weight loss respectively (Table 03). Even after 90 days of storage mustard seed oil (3ml/kg) continued to be the best treatment to the mungbean showing 0.89 percent weight loss (Table 03). Coconut oil and soybean seed oil was found the second and third best effective treatment showing 9.56 and 22.12 percent weight loss, respectively followed by olive oil (3ml/kg) treatment and control (Table 03). After 120 days of storage mustard seed oil (3ml/kg) showed as the best treatment having 1.19 percent weight loss and rest of the treatments were statistically significant over control (Table 03). From the above findings it was revealed that least weight loss was obtained from application of mustard seed oil @ 3ml/kg and Singh et al. (2006) recorded no weight loss on pea seeds treated with mustard oil @2ml/kg.

Percent weight loss and seed damage was found minimum when seeds treated with mustard seed oil @3ml/kg and coconut oil @4ml/kg respectively which indicates that mustard seed oil and coconut oil can inhibit the multiplication of pulse beetle that is similar with the report of Mummigatti and Raghunathan, (1997) and the report was mustard oil and groundnut oil can inhibit the multiplication of C. *chinensis.* It is concluded that, mustard seed oil @3ml/kg seed can be used for successful protection against pulse beetles in stored grains of blackgram.

Table 03. Effect of different plants seed oil on percent weight loss by the pulse beetle in blackgram after 30, 60, 90, and 120 days after storage

Treatments	Percent Weight loss after			
	30 days	60 days	90 days	120 days
T_1	0.48 e	0.64 e	0.89 e	1.19 e
T_2	5.60 b	11.55 b	33.14 b	35.05 b
T_3	3.20 d	6.19 d	9.56 d	10.01 d
T_4	4.09 c	8.50 c	22.12 c	25.01 d
T_5	6.10 a	14.56 a	49.77 a	56.61 a
Lsd (.05)	0.44	0.8	2.91	5.3
CV (%)	6.04	5.13	6.69	11.01

T_1= Mustard seed oil (3ml/kg), T_2= Olive oil (3ml/kg), T_3= Coconut oil (4ml/kg), T_4= Soybean seed oil (2ml/kg), T_5= Control

IV. Conclusion

The study revealed that among the five treatments mustard seed oil @3ml/kg was the best effective treatment to reduce the percent seed damage and weight loss. So, considering the findings of the present research work, on stored blackgram grains mustard seed oil @3ml/kg may be recommended for eco-friendly management of *Callosobruchus chinensis* Linn.

Conflict of interest

The authors declare that they have no conflict of interest

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