International Journal of Biology Sciences

ISSN Print: 2664-9926
ISSN Online: 2664-9934
Impact Factor: RJIF 5.45
IJBS 2022; 4(1): 140-143
www.biologyjournal.net
Received: 07-04-2022
Accepted: 09-05-2022

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Effect of botanicals on number of egg laid by *Callosobruchus chinensis* in stored chickpea

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DOI: https://doi.org/10.33545/26649926.2022.v4.i1b.102

Abstract
An experiment was conducted to test the efficacy of botanicals against pulse beetle in stored chickpea. Eight treatment including untreated control comprising of Cinnamon powder (3 g/kg), Clove powder(3 g/kg), Black pepper seed powder(3 g/kg), Turmeric rhizome powder(5 g/kg), *Acorus calamus* rhizome (Vekhand) powder (2 g/kg), *Acorus calamus* rhizome (Vekhand) powder(4 g/kg), *Acorus calamus* rhizome (Vekhand) powder (8 g/kg) were used against adult pulse beetle, Callosobruchus chinensis on chickpea grains. All botanicals recorded minimum eggs laid by the pulse beetles on the grain treated with than the untreated control. *Acorus calamus* rhizome (Vekhand) powder (8 g/kg) and *Acorus calamus* rhizome (Vekhand) powder (4 g/kg) were found most effective in inhibiting egg laying even up to 6 month of storage after release of insect.

Keywords: Pulse beetle, botanicals, stored chickpea

Introduction

In India, Maharashtra is the largest producer of chickpea accounting 14.00% of the total production followed by Madhya Pradesh (39%). Chickpea is the most important pulse crops after dry bean and peas (Anonymous 2017) [2]. Heavy qualitative and quantitative losses occur due to the attack of pulse beetle (*Callosobruchus chinensis*) L. In the stored chickpea grains and other stored grains such as beans, gram and lentil seeds in the developing countries. Invasion of this insect causes reduction in germination of grains, weight loss and lower market value (Raja and William, 2008; Patel, 2011; Sagheer *et al*., 2013; Islam *et al*., 2013 and Tesfu and Emana, 2013) [14, 12, 18, 8, 21]. Numerous control methods have been used for the control of *C. Chinensis* including the use of larval parasitoids as biological control agent, changes in the temperature of storage house and microwave energy use.

India has achieved a record of chickpea with area, production, productivity of 3.55 million ha, and 7.17 million tones respectively (Anonymous 2017) [2]. In India there are about 200 species of pest insects which cause damage to stored grains and grains products in storage. *Callosobruchus chinensis* is a major, economically important pest of all pulses and cause 40-50% losses of pulses in storage (Gosh *et al*., 2003) [6]. However India imports pulses to feed the ever increasing population. Marginal increase in production in the last 4 decades and astronomical losses during post-harvest storage, attributable to the pulse beetle (PB) *Callosobruchus chinensis* (L.) (Coleoptera: Bruchidae) (Mendki *et al*., 1999) [11], are other possible reasons for importing pulses.

Success achieved so far in making the stored products free from pests has been largely dependent on pesticides alone. Pesticides are the most powerful tool available for pest control. Despite these credentials, the long and indiscriminate use of pesticides has been found ecologically unsound. Insecticides were found to cause toxic effects on the produce intended for consumption, which forced a processor to look towards plants and plant products as protectants for stored products as an alternative to the highly persistent synthetic chemicals. Global warming has cautioned us and the adverse consequences (Priyanka *et al*., 2014) [13]. Insecticide use are always alarming and also inducing pest out break because of pest resistance. In this condition, alternative methods of insect control utilizing botanical products are being used in many countries.

There is a need to find some alternative procedure for the control of *C. chinensis*. These methods should be cheaper, safe to environment and human health and highly effective in

use an alternative method found is the use of plant part and their products as repellent and deterrents such as essential latex and powders of some parts of plants (Sagheer *et al*., 2013; Khan *et al*., 2014 and Hasan *et al*., 2014) [18, 9, 7]. Plant-derived materials are more readily biodegradable, relatively specific in the mode of action and easy to use (Das, 1986) [5]; they are environmentally safe, less hazardous, less expensive and readily available. These grain protectants are environmentally safe, less hazardous, less expensive and readily available. Keeping these view in mind, the present experiment is designed to investigate the efficacy of herbal powders against pulse beetle in stored chickpea.

Material and Method

A Laboratory experiment was conducted on "Efficacy of herbal powder against pulse beetle (*Callosobruchus* spp.) in stored chickpea" at the laboratory of AICRP on PHET and Seed Technology Research Unit (STRU), Dr. P.D.K.V. Akola (M.S) under laboratory conditions lasting for a period of 180 days during year 2017-18.

Rearing of test Insect in the laboratory: To obtain adequate culture of *Callosobruchus chinensis* the adults were collected from the Pulses Research Unit, Dr. PDKV, Akola along with pulses chickpea on which eggs were laid by pulse beetle and released into plastic container contains healthy chickpea grains. The top was covered with muslin cloth secured firmly by rubber band. After emergence of new adults, the beetles were introduced in to chickpea variety JAKI-9218. Some adults were transferred into another set of containers containing fresh chickpea grain and such procedure was repeated to maintain the culture throughout the period of research. These cultures were grown in laboratory under ambient conditions. Mass culture of *C. chinensis* was maintained in the laboratory for experimental purpose. One kg of freshly harvested certified grain with very high percentage of germination and low moisture content (<10%) was taken for each replication of all the treatments. This one kg of grain were treated with the botanical powder as per dose given in table number 1. From this 1 kg of already treated grain 100 g was taken out in the plastic container of 250 ml capacity and in which five pairs of adult bruchids (newly emerged) were released to record the observation every month. The observation were recorded at monthly interval on number of egg laying. After 14 days of release of insects, the plastic container of 250 ml capacity were observed and eggs laid on grains were recorded.

Result and Discussion

Effect of botanicals on the number of egg laid by *Callosobruchus chinensis* after 14 days of release

The data shown in table 1 indicated significant difference in respect of number of eggs/100 g seed in all the storage periods after treatment. Numbers of eggs laid/100g seed by the pulse beetles were recorded and data were statistically analysed.

In 1st month

All the treatments were found statistically superior over control and proved effective in bringing about significantly lower egg laying of pulse beetle as compared to untreated control (266.67 eggs/100 g grain). Significantly minimum number of eggs were laid by the beetles in the grains treated with *Acorus calamus* rhizome powder @ 8 g/kg grain (14.00 eggs/100 g grain), which was found to be statistically superior over the rest of treatments. The next best treatment in respect of decreasing efficacy were *Acorus calamus* rhizome powder @ 4 g/kg grain (18.67 eggs/100 g grain) and *Acorus calamus* rhizome powder @ 2 g/kg grain (20.67 eggs/100g grain). Significantly which were found at par with other. The next effective treatment in respect of minimum egg laying was black pepper seed powder 3 g/kg grain (26.33 eggs/100 g grain), clove powder @ 3 g/kg grain (26.67 eggs/100 g grain), cinnamon powder @ 3 g/kg grain (30.33 eggs/100 g grain) and turmeric rhizome powder @ 5 g/kg grain (34.00 eggs/100g grain). However, these treatments found at par with each other.

In 2nd month

All the treatments were found to be effective in inhibiting the egg laying of pulse beetle on the chickpea grains. Significantly least number of eggs/100 g grain was recorded on the grains treated with *Acorus calamus* rhizome powder @ 8 g/kg grain (18.00 eggs/100 g grain), which was found superior over the next best treatment, *Acorus calamus* rhizome powder @ 4 g/kg grain (22.67 eggs/100 g grain). The effective treatments in respect of inhibiting the eggs was *Acorus calamus* rhizome powder @ 2 g/kg grain (28.00 eggs/100g grain) and black pepper seed powder @ 3 g/kg grain (33.00 eggs/100 g grain), which were found at par with other. Black pepper powder found at par with next best treatment clove powder @ 3g/kg grain (38.00 eggs/100g grain) followed by cinnamon powder @ 3 g/kg grain (46.67 eggs/100 g grain) and turmeric rhizome powder @ 5 g/kg grain (47.33 eggs/100 g grain). Significantly maximum number of egg were laid in untreated control (281.67 eggs/100 g grain).

In 3rd month

The result presented in table 1 indicated that significantly minimum eggs laying were recorded in *Acorus calamus* rhizome powder @ 8 g/kg grain (25.67 eggs/100 g grain), which was found significantly superior over the rest of treatments. The next effective treatments in respect of inhibiting eggs was *Acorus calamus* rhizome powder @ 4 g/kg grain (31.67 eggs/100 g grain) and *Acorus calamus* rhizome powder @ 8 g/kg grain (37 eggs/100 g grain), which were found statistically at par with the next treatment black pepper seed powder @ 3 g/kg grain (45.67), which was also found at par with next best treatment clove powder @ 3 g/kg grain (47.33 eggs/100g grain) and followed by cinnamon powder @3 g/kg grain (58.67 eggs/100 g grain) and turmeric rhizome powder @ 5 g/kg grain (59.33). Significantly maximum number of eggs was laid in untreated control (308.33 eggs/100 g grain).

In 4th month

All treatments were found effective in inhibiting the egg laying of pulse beetles on the stored chickpea grain. Significantly minimum eggs laid by the pulse beetles on the grain treated with *Acorus calamus* rhizome powder @ 8 g/kg grain (29.33 eggs/100 g grain), which was found significantly superior over the rest of treatment and followed by *Acorus calamus* rhizome powder @ 4 g/kg grain (35.67 eggs/100 g grain) and *Acorus calamus* rhizome powder @ 2 g/kg grain (44 eggs/100 g grain). The next best treatment in respect of egg inhibiting was black pepper powder @ 3 g/kg

grain (55.67 eggs/100 g grain). Black pepper seed powder was found at par with next best treatment clove powder @ 3 g/kg seed (58.33 eggs/100 g seed). Clove powder was also found at par with next best treatment cinnamon powder @ 3 g/kg grain (65.33 eggs/100 g grain) followed by turmeric rhizome powder @ 5 g/kg grain (72.33 eggs/100 g grain). Significantly maximum number of eggs was laid in untreated control (333.67 eggs/100 g grain).

In 5th month

At fifth month after treatment, all the treatments were found statistically superior over untreated control (356.00 eggs/100 g grain) in respect of minimizing eggs laying of pulse beetle. Significantly least number of eggs was recorded on the grains treated with *Acorus calamus* rhizome powder @ 8 g/kg grain (41.00 eggs/100 g grain) followed by *Acorus calamus* rhizome powder @ 4 g/kg grain (49.00 eggs/100 g grain) and *Acorus calamus* rhizome powder @ 2 g/kg grain (56.33 eggs/100g grain). The next effective treatments were black pepper seed powder 3 g/kg grain (68.67 eggs/100 g grain) and clove powder @ 3 g/kg grain (72.33 eggs/100 g grain), which were found at par with each other. Clove powder treatment also found at par with next best treatment cinnamon powder @ 3 g/kg grain (79.67 eggs/100 g grain) and turmeric rhizome powder @ 5 g/kg grain (86.67 eggs/100 g grain). These two treatments which were found at par with each other.

In 6th month

The result showed in Table 1 indicated that all treatments were found significantly superior over untreated control in minimizing the number of eggs laying by pulse beetle. Statistically minimum egg laying was observed on the seeds treated with *Acorus calamus* rhizome powder @ 8 g/kg grain (45.00 eggs/100 g grain). The next best treatment was *Acorus calamus* rhizome powder @ 4 g/kg grain (56.00 eggs/100 g grain) followed by *Acorus calamus* rhizome powder @ 2 g/kg grain (64.33 eggs/100g grain) and black pepper seed powder 3 g/kg grain (70.33 eggs/100 g grain). The remaining treatment in order of decreasing efficacy in terms of minimizing egg laying of pulse beetle were clove powder @ 3 g/kg grain (75.67 eggs/100 g grain), cinnamon powder @ 3 g/kg grain (81.67 eggs/100 g grain) and turmeric rhizome powder @ 5 g/kg grain (88.33 eggs/100 g grain). Significantly maximum number of eggs was laid in untreated control (380.67 eggs/100 g grain).

Table 1: Effect of botanicals on egg laying of *Callosobruchus chinensis* (L.) on stored Chickpea Grains

Sr. No.	Treatments	Doses g/kg seed	Average no. of egg laid after 14 days of beetles release/ 100 gm grains						
			In 1st month	In 2ndmonth	In 3rd month	In 4th month	In 5th month	In 6th Month	Cumulative mean
1.	Cinnamon powder	3g	26.33 (1.42)	38.00 (1.58)	45.67 (1.66)	58.33(1.77)	79.67(1.90)	81.67(1.91)	54.94(1.70)
2.	Clove powder	3g	30.33(1.48)	46.67(1.67)	58.67(1.77)	65.33(1.81)	72.33(1.86)	75.67(1.88)	58.16(1.74)
3.	Black pepper seed powder	3g	26.67(1.43)	33.00(1.52)	47.33(1.67)	56.67(1.75)	68.67(1.84)	70.33(1.85)	50.44(1.67)
4.	Turmeric rhizome powder	5g	34.00(1.53)	47.33(1.67)	59.33(1.77)	72.33(1.86)	86.67(1.94)	88.33(1.95)	64.66(1.78)
5.	*Acorus calamus* rhizome powder	2g	20.67(1.31)	28.00(1.44)	37.00(1.57)	44.00(1.64)	56.33(1.75)	64.33(1.81)	41.72(1.58)
6.	*Acorus calamus* rhizome powder	4g	18.67(1.27)	22.67(1.35)	31.67(1.50)	35.67(1.55)	49.00(1.69)	56.00(1.75)	35.61(1.51)
7.	*Acorus calamus* rhizome powder	8g	14.00(1.14)	18.00(1.25)	25.67(1.41)	29.33(1.47)	41.00(1.61)	45.00(1.65)	28.83(1.42)
8.	Untreated/control	-	266.67(2.42)	281.67(2.45)	308.33(2.49)	333.67(2.52)	356.00(2.55)	380.67(2.58)	321.66(2.50)
	F' test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	
	SE(m) ±		0.03	0.03	0.03	0.02	0.02	0.01	
	CD at 5 %		0.10	0.09	0.08	0.05	0.05	0.03	
	CV		3.99	3.24	2.57	1.66	1.48	0.80	

Figures in parenthesis are corresponding logarithmic transformation value

Discussion

From the experimental finding, it was noticed that the average number of eggs laid / 100 g seed recorded after 14 days after introduction of adult beetles, varied significantly in all the storage periods after botanicals treatments.

Significantly minimum number of eggs were laid by the beetles in the grains treated with *Acorus calamus* rhizome powder @ 8 g/kg grain(14.00 eggs/100 g grain) followed by *Acorus calamus* rhizome powder @ 4 g/kg grain (18.67 eggs/100 g grain), *Acorus calamus* rhizome powder @ 2 g/kg grain (20.67 eggs/100g grain), black pepper seed powder 3 g/kg grain (26.33 eggs/100 g grain), clove powder @ 3 g/kg grain (26.67 eggs/100 g grain), cinnamon powder @ 3 g/kg grain (30.33 eggs/100 g grain) and turmeric rhizome powder @ 5 g/kg grain (34.00 eggs/100 g grain) and in untreated control (266.67 eggs/100 g grain) in first month. While after 6 months, cumulative mean of average no. of egg laid (of entire six months data) was derived and it was found that similar order of effectiveness of botanicals on average no. of egg laid by pulse beetle even after six months.

These findings derive support from Shivanna *et al.* (1994) [17] who reported effectiveness of sweet flag at all dosage levels (0.5, 1.5, 2.5 g/50g of grain) reduced the egg laying considerably. The average fecundity in sweet flag treated seed ranged from 5-8 eggs and tulsi treated seed at all 3 dosage levels (0.5, 1.5, 2.5 g/50g seed) has recorded maximum number of eggs (200) which were on par with untreated check.

Meghwal *et al.* (2012) [10] also reported minimum (6 to 8 eggs/100 g seed) egg laying of pulse beetle due to *Acorus calamus* rhizome powder @ 10 g/kg seed was most effective in respect of inhibiting the eggs laying.

Saiful *et al.* (2013) [15] who also found that black pepper powder @ 5 g/kg seed were found most effective in checking egg laying.

Conclusion

Acorus calamus rhizome powder @ 8 g/kg grain and *Acorus calamus* rhizome powder @ 4 g/kg grain recorded most effective in respect of inhibiting the eggs laying of pulse beetle and can used for successful protection of chickpea grain up to six months of storage.

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