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## Repellent impact of botanicals against store grain pests pulse beetle (*Callosobruchus chinensis*)

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### Abstract

Pulse beetle (*Callosobruchus chinensis*) is most serious pest of stored grains. It affects variety of food grains by causing deterioration and loss in quality. This study aimed to evaluate the repellent activity of three botanicals sweet flag (*Acorus calamus*), black pepper (*Piper nigrum*) and clove (*Syzygium aromaticum*) against adult of store grain pests pulse beetle with three replications in Completely Randomized Design (CRD) through filter paper assay. Repellency was recorded after 12 h, 24 h, 48 h and 72 h of post-treatment. The result revealed that rhizome extract of sweet flag shows significantly maximum repellency 90.07% than black pepper 83.51% and clove 80.13%. Utilization of sweet flag extract for its potential repellent effect can be effectively used for controlling store grain pests.

**Keywords:** *Callosobruchus chinensis*, *Acorus calamus*, repellency, black pepper, clove

### 1. Introduction

Grain storage, which is a component of the post-harvest system through which food moves from the field to the consumer, is crucial to agriculture's efforts to ensure the future security of food supply. The loss of grain quality, quantity, weight loss, and nutritional value brought by insect damage is one of the most significant and fundamental problems with the storage process, due to inappropriate handling and storage, one-third of the entire amount of grains produced was lost each year.

Pulse beetle (*Callosobruchus chinensis*) (Coleoptera: Bruchidae) is a significant grain pest found throughout tropical and subtropical regions of the world. It is particularly devastating legumes and serves as the primary store grain pest (Kamal *et al.* 2019) [1]. The interior endosperms of grains are consumed by pulse beetle larvae by entering and destroying. In a severe infestation, it can completely destroy entire grains causing 100% damage (Aslam 2004) [3]. Additionally, it impairs a seed's ability to germinate and its nutritional value (Roy *et al.* 2014) [10]. Synthetic insecticides can be used to manage stored grain pests, but improper application puts the environmental and people health at risk and is linked to the development of insect resistance. A safe and environmentally friendly method of pest control is use of botanicals (Gopala Swamy and Wesley 2017) [5] due to the presence of secondary metabolites that provide efficacy, biodegradability, low toxicity, and various modes of action that increase the usefulness of botanical pesticides, the rhizomes of sweet flag (*Acorus calamus*), black pepper (*Piper nigrum*), and clove (*Syzygium aromaticum*) are well known to have insecticidal properties (Ahmed *et al.* 2021) [2]. The goal of the current study is to investigate the pulse beetle-repelling properties to botanicals, which will be beneficial for creating pest management plans for stored grains.

### 2. Materials and Methods

The study was conducted in biocontrol laboratory of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola Maharashtra in year 2020-2021. Culture of pulse beetle (*C. chinensis*) was obtained from warehouse and botanicals were procured from local market.

#### 2.1 Rearing of pulse beetle

Rearing of pulse beetle was done on green gram grains in plastic containers which having size 1000 ml, with 500 g seeds in it. Released pairs of adults and covered the container by using muslin cloth tightly with rubber band.

Culture was maintained throughout the experiment at  $27 \pm 2$  °C and relative humidity of  $70 \pm 5\%$ .

## 2.2 Preparation of extract form botanicals

The botanicals was thoroughly washed and dried under sun to remove dust particles and grinded to fine powder. In 100 ml of deionised water, 10 g of botanicals powder was added and stir for 15 min. After proper mixing, boil it at 65 °C then incubated for 25 min. Filtration was done by using filter paper (Whatman No.1.) then store the extract at 4 °C in refrigerator separately. The prepared extracts solutions were used for conducting experiment (Usha *et al.* 2017) [11].

## 2.3 Repellent assay

Repellency assay of pulse beetle was conducted by using filter paper. Insects were kept in captivity in petri dishes (9 cm in diameter) throughout the experiment. A nine cm diameter filter paper was divided in two half's. The other half (control) was treated with water while one half was treated with botanical extracts consistently as possible. The treated half as well as the control half was air-dried. Attach the tested half to the control half; a full disc was carefully reconstructed. The attachment was carefully designed to permit unrestricted movement of insects from one side to the other while maintaining enough space between the filter papers to prevent seepage of tested material from one half to the other. Twenty insects have been released in the center and count the number of insect present on each strip of paper after 12 h, 24 h, and 48 h and 72 h of treatment (Ramsha *et al.* 2019) [8]. Repellency was calculated by using formula.

$$\text{Repellency (\%)} = \frac{(N_c - N_t)}{(N_c + N_t)} \times 100$$

Where,

$N_c$  = number of insects on the control (untreated) area;

$N_t$  = number of insects on the treated area.

## 2.4 Analysis of data

The recorded data were analyzed in completely randomized design with three treatments and three replications at 5% level of significance by using Web Based Agricultural Statistical Package (WASP) developed by ICAR Research Complex for Goa, India.

## 3. Result and Discussion

The result of study presented in table no.1 revealed that botanicals extract show significant repellent effect among store grain pest. Filter paper assay demonstrated the insect's behavior when exposed to botanicals extract. Percent repellency was calculated by using above mentioned formula. Maximum repellency was observed in sweet flag extract @ 0.5% followed by black pepper @ 0.3% and clove @ 0.3% which recorded 90.07%, 83.51% and 80.13% respectively after 48 hours of exposure. In first 12 hours of exposure botanical extracts evoke repellency of adults of pulse beetle recorded 34.44%, 32.00% 26.00% and less repellency effect was observed after 72 hours of exposure of adults recorded 31.36%, 27.00% and 21.00% to extract of sweet flag, black pepper and clove respectively. It was noted that extract treatment of botanical shows the increasing repellency as the time of exposure increases form 12 hour to 48 hours and then it declined gradually after 72 hours. This study shows that

repellent activity of three botanicals is dependent on time of exposure and nature of beetles released. Among the all treatments, sweet flag have the higher effect to keep the beetle away. It can be concluded that botanicals extract might have significant amount of active substance that alter the behavior of the insects and provide repellency to the tested beetle. Some previous reports also displayed that presence of beta-sarone, flavonoids and pinostrobin compounds in *Acorus calamus* provides repellency effect to the insects (Wiwattanawanichakun *et al.* 2022) [12]. Black pepper and clove also contains piperine and eugenol of 72-90% (Abo-El-Saad *et al.* 2011) [1]. This study in accordance with Hemantha piris *et al.* (2021) [6] who reported highly significant repellency 96.91% and 98.99% of dried leaf and seed kernel extract of *C. thevetia* and *O. tenuiflorum* against red flour beetle after 24 hour of exposure which indicates that botanicals have high repellency properties. Likewise Gitahi *et al.* (2021) [4] observed leaf extracts of *T. diversifolia* and *V. lasiopus* posses high repellency effect against *Sitophilus zeamais* recorded 96% and 91%. *Acorus calamus* extract showed effective repellency and oviposition deterrent effect against peach fruit fly (Rehman *et al.* 2009) [9].

**Table 1:** Repellency effect of botanicals on pulse beetle

Botanical extract	Repellency (%)			
	After 12 hrs	After 24 hrs	After 48 hrs	After 72 hrs
Sweet flag @ 0.5%	34.44 (35.93)	62.34 (52.14)	90.07 (71.65)	31.36 (34.05)
Black pepper @ 0.3%	32.00 (34.45)	54.00 (47.29)	83.51 (66.05)	27.00 (31.30)
Clove @ 0.3%	26.00 (30.65)	49.04 (44.45)	80.13 (63.53)	21.00 (27.27)
SE(m)±	0.36	0.40	0.58	0.45
CD@5%	1.08	1.21	1.75	1.37

Figures in parenthesis are corresponding Arc sine transformed values

## 4. Conclusion

This study concludes that sweet flag have significant potential to cause repellent effect in store grains pest pulse beetles which can be used as better alternative against synthetic chemical insecticides as a non-toxic eco-friendly method of pest control.

## 5. Acknowledgement

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