

Toxicity power of some arid zone plants against the stored grain insect pest, *Callosobruchus spp.*

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Abstract

Mung bean is major cereal of Rajasthan. During its storage several insect pest spoiled it by their various activities thus reducing the cost value of mung beans, so in present study an experiment was performed to evaluate some botanicals and their combination in the form of pellet for their toxicity power against the important stored grain pest *Callosobruchus spp.* These botanicals were *Azadirachta Indica*, *Eucalyptus globulus*, *Fagonia cretica* and *Balanites aegyptiaca* and applied @ 0.5gm, 1gm. and 2gm per 20 gms of stored mung beans seeds. All the botanicals showed their toxicity power against the test insect, *Callosobruchus spp.* in comparison to the control experiment. Pellet made by *Azadirachta Indica* @2gm showed maximum toxicity with 83.33% mortality of test insect followed by the combination of *Azadirachta Indica* and *Eucalyptus globulus* with 80% mortality.

Keywords: *Callosobruchus*, Pulse beetle, Botanicals, Contact toxicity, Adult mortality

Introduction

Infestation of pests of stored products is a serious problem all over the world. These insect pests lower the quantitative and qualitative properties of the grains, (Aryani and Auamchareon, 2016) [1]. Damage caused by stored grain insect pests is about 5-10% and 20-30% in temperate and tropical regions respectively, (Talukder, 2006 [19]; Rajendran and Sriranjini, 2008 [18]; Aryani, 2016) [1]. Presence of insect pest in storage products results in the form of contamination and economic losses due to the damage caused and decrease in nutritional value, (Wilbur and Mills, 1985 [22]; Burkholder and Faustini, 1991) [2]. Several beetles are known as pests of field as well as storage products, *Callosobruchus maculatus* belongs to the above category whose larvae cause damage to seeds during field and storage conditions, (Musa, 2013) [15]. *Callosobruchus* is a primary pest of pulses and its infestation shows a negative impact on seed quality and their market value, (Caswell, 1980 [3]; Kosar and Srivastava, 2016) [11].

All over the world, these grain pests are controlled by using synthetic insecticides which associate with many serious problems like resistance of pest against pesticides, residual problems in grains, environmental pollution (Ishii et al. 2010) [9], resurgence of pests and harmful to non-target organisms, (Kumar et al. 2007 [12]; Islam et al. 2017) [10]. Alternative to chemical insecticides are botanicals which are plant-derived natural insecticides, are cheaper, easily available and safer for both the environment and human being, (Waqas et al. 2019) [21], target specific and have no adverse impact on beneficial insects, (Trivedi et al., 2018 [20]; Gehlot et al. 2021) [13].

Materials and methods

The experiment was conducted at the entomology lab, Department of Zoology, Jai Narain Vyas University, Jodhpur, Rajasthan to evaluate some botanicals viz. *Azadirachta indica*, *Eucalyptus globulus*, *Fagonia cretica*, *Balanites aegyptiaca* for their toxicity against stored grain insect pest, *Callosobruchus spp.*, for this ten newly emerged adults were introduced in culture tubes containing twenty grams of seeds of mung bean, now a plant pellet placed in

between the grains and the top of culture tubes were covered with muslin cloth and tied with rubber bands. The tubes were placed in an incubator at 28±2°C and 70±5 percent relative humidity. The mortality of adult insects was observed after two days of treatment till the mortality of all insects. The pellet made up by botanicals was applied at three concentrations, 0.5, 1 and 2gm/20gm seeds of mung beans. Each experiment was replicated three times.

Preparation of plant pellet

For the preparation of plant pellets, required dose of plant powder was mixed with 2% solution of edible gum and stirred with the help of a glass rod for proper mixing then allowed the pellet to dry for 24 hrs. at room temperature.

For the combination of two plants, the most effective *Azadirachta* powder was mixed with *Eucalyptus* and *Fagonia* powder in the ratio of 1:1 at the required doses.

Results and discussion

In the present investigation, the adult mortality percentage of *Callosobruchus spp.* ranges from 23.33 to 83.33% (Table-1). Results of this study showed that all the botanical pellets at their three concentrations (weight) had a significant effect over the untreated control. Percentage mortality of adult insects increased with an increase in the weight of botanical pellet. Maximum and minimum adult mortality were recorded in seeds treated with 2gm pellet of *Azadirachta indica* (83.33%) and 0.5gm pellet of *Balanites aegyptiaca* (23.33%) respectively. Seeds treated with 2gm pellets of various botanicals, following order of mortality percentage was recorded, *Azadirachta indica* + *Eucalyptus globulus* (80.00%), *Eucalyptus globulus* (73.33%), *Azadirachta indica* + *Fagonia cretica* (70.00%), *Fagonia cretica* (56.67%), *Balanites aegyptiaca* (53.33%). Seeds treated with 1gm pellets, again *Azadirachta indica* (60.00%) showed a superior result in comparison to other botanical pellets (1gm) and over untreated control. Analysis of variance ascertained that toxicity powers of all plant species at the same concentration as well as at different concentrations are significantly different. (Table 2)

The results confirmed the toxicity of botanicals on adult pulse beetle. The conclusion is supported by the observation of various scientists who also reported insecticidal property of botanicals to control stored grain insect pests. Derbalahand Ahmed (2011) [4] tested powder and oil of spearmint (*Mentha viridis*) against *Sitophilus oryzae* infesting wheat grains, result revealed that both treatments found effective against the mortality of adult insects. Nenaah (2014) [16] evaluated the insecticidal property of *Ageratum conyzoides*, *Achillea biebersteinii* and *A. fragrantissima* in the form of oil and powder against adult mortality of *Sitophilus oryzae*, *Tribolium castaneum* and *Rhyzopertha dominica*, oil of *A. dbiebersteinii* was found most effective. Ileke and Bulus (2012) [8] evaluated *Azadiracta indica*, *Piper guineense*, thonn and *Anacardium occidentale* seeds powder for their fumigant and contact toxicity against *Callosobruchus maculatus*, *Azadiracta indica* and *Piper guineense* showed effective result with 100% mortality within seven days of experiment. Ekeh *et.al.* (2013) [6] used powder of various plants such as *Capsicum nigrum*, *Aframomum melegueta*, *Ocimum gratissium*, *Azadiracta indica*, *Zingiber officinale* and *Allium sativum*, to control *Callosobruchus maculatus* infesting stored legumes, among all tested plants *Ocimum gratissium* was found most effective against mortality of *C. maculatus*. Similar investigations were revealed by Mkenda *et.al* (2015) [14] by using the powder of leaves of *Dysphania ambrosioides*, *Tephrosia vogelii*, *Lippia javanica*, *Vernonia amygdalina* and *Tithonia diversifolia* against *Callosobruchus*

maculatus infesting cowpea storage and they reported that these biopesticides are effective and less hazardous to control bruchids. Dayaram and Khan (2016) [5] tested the oil of *Salvia officinalis*, *Coriandrum sativum* and *Rosmarinus officinalis* against pulse beetle and found that all plant oil had toxic effective in causing mortality of test insect. Fouad *et.al* (2020) [7] also showed the promising results with plant products.

Nisar *et al.* 2022 [17] assessed mortality strength of four edible oils, each in 04 different concentrations against *Callosobruchus maculatus* damaging cowpea seeds during storage. Neem oil showed highest mortality, while poppy, mustard and pumpkin oils also gave effective results against *C. maculatus*.

Conclusion

During the present research, it is concluded that all the arid zone plant applied in the form of pellet at various concentration showed promising results to control the test insect, *Callosobruchus spp* infesting mung beans during storage condition. These plant pellets are non-toxic and environment friendly so can be use in eco-friendly control of test insect.

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Table 1: Toxicity power of arid zone plants against adults of *Callosobruchus spp.*

Plant Species	Doses (gm/20g seeds)	Adult Mortality (%)	Plant Species	Doses (gm/20g seeds)	Adult Mortality (%)
<i>Azadirachta indica</i>	0.5	50.00	<i>Balanites aegyptiaca</i>	0.5	23.33
	1	60.00		1	43.33
	2	83.33		2	53.33
<i>Eucalyptus globulus</i>	0.5	36.67	<i>Azadirachta indica</i> + <i>Eucalyptus globulus</i>	0.5	46.67
	1	53.33		1	50.00
	2	73.33		2	80.00
<i>Fagonia cretica</i>	0.5	30.00	<i>Azadirachta indica</i> + <i>Fagonia cretica</i>	0.5	43.33
	1	46.67		1	56.67
	2	56.67		2	70.00
Control			3.33		

Table 2: Analysis of Variance for the toxicity power of arid zone plants against *Callosobruchus spp.*

Source	Df	Total ss	Means	Comp. F
Doses	2	29.21283	14.6064	75.381
Plant species	5	12.7077	2.5415	13.05676
Error	10	1.9465	0.1946533	
Total	17	43.86707		

CD at 5% = 0.8026024

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