INSECTICIDAL ACTIVITY OF JATROPHA SEED OIL AGAINST CALLOSBRUCHUS MACULATUS (FABRICIUS) INFESTING PHASEOLUS ACONITIFOLIUS JACQ

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INTRODUCTION

The pulse beetle, *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae) is a cosmopolitan insect pest of *Phaseolus aconitifolius* Jacq. (Mataki) and cowpea, *Vigna unguiculata* Linnaeus (Walpers). The insect is a field-to-store pest as its infestation of cowpea often begins in the field as the mature pods dry (Haines, 1991). The insect multiplies very rapidly in storage where it causes very high losses. In the present investigation insecticidal activity of jatropha seed oil against *Callosobruchus maculatus* has been carried out. The eggs of *C. maculatus* were more susceptible to Jatropha oil and shows mortality to all selected dosage. Jatropha seed oil was highly toxic to the eggs of *C. maculatus* (*F* = 76.17; *p* < 0.001) at all dosage levels compared to other pre-adult stages (larvae: *F* = 65.13; *p* < 0.001, Pupae: *F* = 17.43; *p* < 0.001).

KEY WORDS
Jatropha seed oil
Callosobruchus
maculatus
Phaseolus aconitifolius

ABSTRACT
The Pulse beetle, *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae) is a cosmopolitan insect pest of *Phaseolus aconitifolius* Jacq. (Mataki) and cowpea, *Vigna unguiculata* Linnaeus (Walpers). The insect is a field-to-store pest as its infestation of cowpea often begins in the field as the mature pods dry (Haines, 1991). The insect multiplies very rapidly in storage where it causes very high losses. In the present investigation insecticidal activity of jatropha seed oil against *Callosobruchus maculatus* has been carried out. The eggs of *C. maculatus* were more susceptible to Jatropha oil and shows mortality to all selected dosage. Jatropha seed oil was highly toxic to the eggs of *C. maculatus* (*F* = 76.17; *p* < 0.001) at all dosage levels compared to other pre-adult stages (larvae: *F* = 65.13; *p* < 0.001, Pupae: *F* = 17.43; *p* < 0.001).

MATERIALS AND METHODS

Culturing of the experimental insect

The culture of pulse beetle *C. maculatus* was reared in laboratory. About 1 kg of grains were sterilised in an oven at 80°C for 24 hr, cooled and divided in 200g lots into plastic
kliner jars. About 100 adult *C. maculatus* from laboratory stock cultures were introduced onto the sterilized grains in each jars and allowed four days to lay eggs. The jars were covered with muslin cloth to facilitate ventilation and were placed on inverted Petri dishes kept in a large tray containing industrial oil to prevent any crawling insects and mites from invading and contaminating the cultures. The cultures were kept in the laboratory (32 ± 1ºC, 60 ± 5% RH. and 12hr: 12hr light: dark regime)

**Collection and extraction of Jatropha seed oil**
The seeds of *Jatropha curcas* were harvested from trees from the Akurdi and Lonavala areas. They were dried in a shade for seven days, shelled and the batches ground into a fine powder. Five hundred and fifty gram of the powder and 2.5L of petroleum ether (40ºC) were used in the extraction of the oil with a Soxhlet’s extractor for 48 hr. This yielded 250mL of clean yellow oil and the ether was recovered through a rotary evaporator. The oil was kept in the dark at 4ºC until it was needed.

**Experimental design of laboratory studies**
Four oil treatments; 0.5, 1.0, 1.5 and 2.0 mL of *Jatropha* seed oil on 100g of grains and untreated grains (control) were used in the experiments. Each treatment was replicated four times and kept for 15 / 30 days.

**Toxicity of the oil on *C. maculatus* adults in grains**
The various rates of the *Jatropha* seed oil were applied to 100g of sterilized cowpea grains in one litre kilner jars and covered with muslin cloth. Each jar was infested with 20 unsexed *C. maculatus* adults. The number of dead insect(s) in each jar was assessed after 72 hr. Insects not responding to pin probe were considered dead. Untreated grains were used as control.

**Data analysis**
Data collected on insect counts were transformed using square root (x + 1) whereas percentage data were transformed using Arcsine (x /100)1/2 transformations. Abbot’s formula was also used to adjust the data where there were deaths in control treatment.

**RESULTS AND DISCUSSION**

**Effect of oil on eggs and immature stages inside cowpea seeds**
Toxicity is one of the various effects of terrenes plant fixed oils to insects. Adebowale and Adedire (2006) found that *Jatropha* seed oil contained a high proportion of sterols and terpene alcohols responsible for insecticidal action (Duke, 1992). The current study showed *Jatropha* seed oil was highly toxic to the eggs of *C. maculatus* (F = 76.17; p< 0.001) at all dosage levels compared to other pre-adult stages (larvae: F = 65.13; p< 0.001, pupae: F = 17.43; p< 0.001). This resulted in a significantly reduced number of adults emerging from the seeds (Table 4). A limited toxicity was observed with 0.5mL/100g treatment especially on egg and larval stages. However, the oil treatments produced significantly lower adult numbers (p<0.05) compared to the untreated control. In insect development, the eggs tend to be more tolerant to chemical treatments (Giga and Smith, 1987). However, in this experiment the *Jatropha* seed oil significantly inhibited egg development as observed by Adebowale and Adedire (2006)

**Toxicity, repellency and persistence of *Jatropha* seed oil to *C. maculatus***
The percent mortality of *C. maculatus* adults in cowpea grains with different dosages of *Jatropha* seed oil is shown in Table 1. The oil was highly toxic (F = 4214.61; p<4, 15 0.001)
after 72-hour exposure at all dosage levels. The lowest dosage (0.5mL) recorded a significantly lower toxicity against C. maculatus. Paired t-test of the toxicity of the oil to insects showed the ability of the oil to repel C. maculatus was dosage dependent ([F = 145.44; p<0.001]; it increased with increase in the dosage of the oil (Table 2). The lowest dose (0.5mL) repelled 47.5% where highest dose (2.0mL) repelled 98.0%. There was no significant difference (p>0.05) between 1.5mL and 2.0mL. Persistency of the oil on the cowpea grains to cause mortality to C. maculatus at all. Treatment rates generally declined in storage from 15 to 30 days (Table 3). Within the treatment levels, the 2.0mL and 1.5mL doses caused significantly higher mortality ([F = 56.58; p< 0.001]) than the 0.5mL level after 15day of storage. The control of C. maculatus larvae and pupae inside the seeds will require higher oil concentrations. Accumulation of higher concentrations of the jatropha seed oil in the grains could affect their quality and use as human food. Jatropha seed oil has shown promise as a
stored product protectant against insect pests. However, with the closeness of stored grains to the table, the behavior of curcin, a toxic protein found in its extracts or oils should be monitored over time and establish how much of it ends up in various foods after processing the grains.

ACKNOWLEDGEMENTS

Author is grateful to Principal, Dr. Nitin Ghorpade, Dr. P. S. Tambde and Prof. Satish Ekar, Prof. Ramkrishna More College, Akurdi, Pune, for providing necessary laboratory facilities.

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