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ORIGINAL ARTICLE

Biological Control of Pulse Beetle *Callosobruchus chinensis* Adults in Stored Chickpea Grains using Oils

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ABSTRACT

Laboratory test were conducted to evaluate insecticidal effect of commercially available oils of Azadiracta indica, Cocos nucifera and Syzygium aromaticum on days to 100 per cent mortality of C. chinensis adults in stored chickpea grains. A. indica oil was found to be most effective in comparison to other two treatments when evaluated in terms of their reducing effects on longevity of adult C. chinensis. The increasing concentration of A. indica oil (0.5, 1.0 and 2.0 ml) showed 3.3, 2.63 and 1.97 mean days to 100 per cent mortality of pulse beetle adults respectively. S. aromaticum showed intermediary effect taking 4.8, 3.5 and 2.77 days. Cocos nucifera showed weakest response where days taken for above parameter were 13.73, 10.97 and 8.67. The control showed 14.6 days to 100 per cent mortality of adult insects.

Key words: *Biological Control, Callosobruchus chinensis, Chickpea Grains*

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INTRODUCTION

Cicer arietinum is one of the most important leguminous, cool-season, food crops, cultivated prevalently in the Asian Pacific region (Sharma *et al.,* 2013). It is the third most important pulse in the world that is widely cultivated for its nutritious seeds which has been eaten by humans since around 7,000 BC (Zohary *et al.*, 2012). *Callosobruchus chinensis* (L.) is one of the most economically destructive pest of chick pea which attacks the grain in storage effecting it both qualitatively as well as quantitatively (Ahmed *et al.* 2003). Grubs make hole in the grains and consume the inner part leaving empty kernel. They severely damage the grain by causing overall weightloss, altered nutritional quality and presence of insect frass, excrement and dead insects in and on the seed, and loss of seed viability (Raja *et al.*, 2008; Patel, 2011 and Islam *et al.,* 2013; Tesfu and Emana, 2013). The present investigation was aimed at assessing and identifying certain commercially available oils that can be recommended as alternative low-cost technique of minimizing post-harvest losses of chickpea grain due to infestation of *Callosobruchus chinensis.*

MATERIAL AND METHODS

REARING THE CULTURE OF TEST INSECT:

The laboratory culture of *C. chinensis* was maintained throughout the experiment by rearing them on a diet of chickpea grains, in pre-sterilized jars at a constant temperature of 30±2^{0}C and 70±5% relative humidity. For raising the culture of *C. chinensis*, a small population of the Pulse Beetle was obtained from Department of Entomology, CSA University of Agriculture and Technology, Kanpur. They were then reared in plastic/glass

containers containing pre-sterilized chickpeas. This was done to maintain a continuous laboratory culture. During the course of investigation in order to obtain a homogenous population of test insect, 15 pairs of insects were picked up from the stock culture and transferred to glass/plastic jars. Jars were covered by a muslin cloth and secured tightly with rubber bands. After 24 hours all the adults were removed and egg laid grains were maintained at required temperature and humidity. Insects that emerged after four weeks were used. Healthy and fresh chickpea grains were obtained from the local market after ensuring that they were free from pre storage infestation and eggs. The grains were thoroughly washed and dried to avoid the effect of any pesticide/insecticides before storing them in glass/plastic containers.

TEST MATERIAL- PLANT OILS:

Commercially available oils of three plants, *Azadirachta indica* (Neem oil), *Cocos nucifera* (Coconut oil) and *Syzygium aromaticum* (Clove oil) and were studied for their insecticidal properties against *C. chinensis*. Each plant oil was applied in three concentrations 0.5, 1.0 and 2.0 ml (v/w) with the help of micro pipettes to cotton swabs. Oil treated cotton swabs were placed in plastic/glass jars that were provided with 100 gm of chickpea grains. Further, jars were thoroughly shanked to make maximum contact of oil with chickpea grains then 15 pairs of the adult test insect were released in each jar. After that mouth of the jars were covered with muslin cloths to prevent entry or exit of test insect.

All the oil treated jars along with three untreated jars (control) were placed in incubator to investigate effectiveness of oils against of test insect.

PARAMETERS STUDIED USING OILS

EFFECT ON MORTALITY OF ADULT PULSE BEETLE (DAYS TO 100% MORTALITY):

In each treated jar, days taken for cent percent mortality of released adults of pulse beetles were counted and compared with untreated jars (control) to find out the efficacy of test oils, the longevity of adult pulse beetles.

Reduction percentage in longevity of adult pulse beetle was calculated by the given formula:

$$\textbf{Percentage Reduction (in longevity of test insect)} = \left(\frac{L_c - L_t}{L_c}\right) \times 100$$

Here,

L_c = Average days taken for 100 per cent mortality of adult pulse beetle in control

L_t = Average days taken for 100 per cent mortality of adult pulse beetle in treated jars

STATISTICAL ANALYSIS:

In the present investigation three different steps for statistical analysis were undertaken *viz.,* Mean, Standard Deviation and 't' test for significance (Chandrasekharan and Parthasarthy, 1975).

RESULT

EFFECT OF OILS ON DAYS TO 100% MORTALITY OF ADULTS:

As documented in Table 1, *A. indica* (neem oil) was found most effective as compared to other two treatments, when studying the effect on days to 100% mortality. The increasing concentration of neem oil (0.5, 1.0 and 2.0 ml) showed 3.3, 2.63 and 1.97 mean days to 100 per cent mortality of released pulse beetle respectively. In *S. aromaticum* it was intermediary taking 4.8, 3.5 and 2.77 days. Weakest response was seen by *Cocos nucifera* where days taken for above parameter were 13.73, 10.97 and 8.67. The control showed 14.9 days.

Fig. 1 graphically represents percentage of reduction in longevity of released *C. chinensis* due to treatment with *A. indica, S. aromaticum* and *C. nucifera* oils. It is evident from the figure that *A. indica* was the most effective with maximum reduction in longevity 86.77 with *C. nucifera* being least effective with 41.81 per cent reduction.

Table 1: Effect of oils of *Azadirachta indica, Syzygium aromaticum* and *Cocos nucifera* on days to 100 per cent mortality of adult *Callosobruchus chinensis* L.

Plant Oils		Days to 100 per cent mortality of adult *Callosobruchus chinensis* (Mean with standard deviation)	Percentage of reduction in longevity of adult
A. indica	0.5	3.30 ±.08	77.85
	1.0	2.63 ±0.12	82.34
	2.0	1.97 ±0.16	86.77
S. aromaticum	0.5	4.80 ±0.16	67.78
	1.0	3.50 ±0.16	76.51
	2.0	2.77 ±0.12	81.40
C. nucifera	0.5	13.73 ±0.25	7.85
	1.0	10.97 ±0.12	26.37
	2.0	8.67 ±0.12	46.49
Control		14.66	

* Concentration (0.5, 1.0 and 2.0) used in ml/100 gm of chickpea grains.
- Table value of t at *df* 4 at P = 0.05 is 2.78 and at P = 0.01 is 4.60.

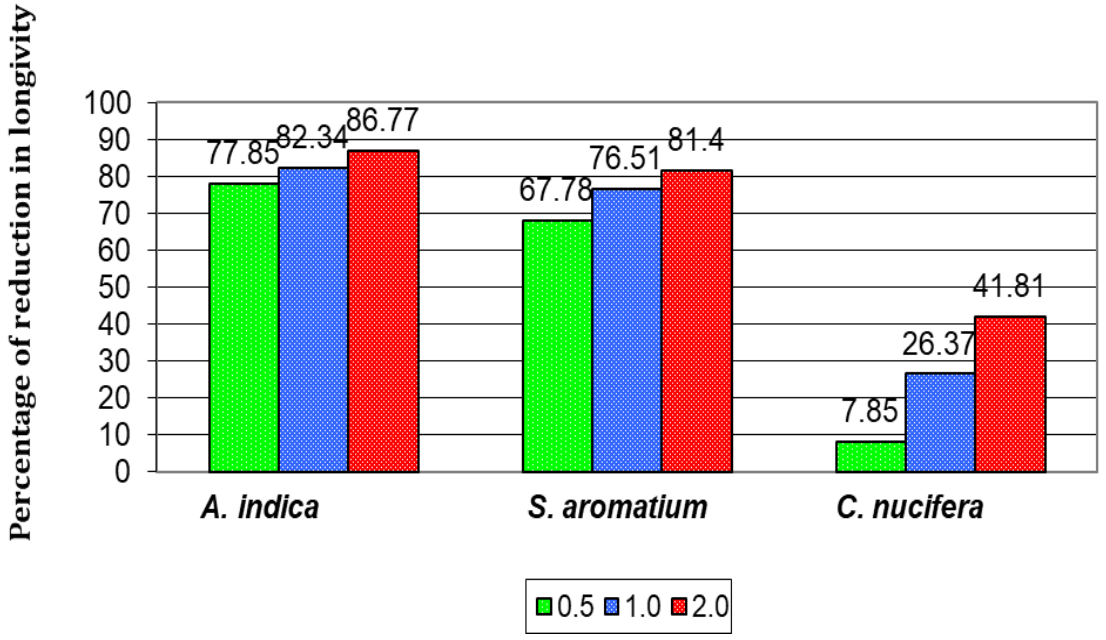

Fig. 1: Studies on the effect of oil of *A. indica, S. aromaticum* and *C. nucifera* on number of days taken for 100 percent mortality of *C. chinensis*, infesting on chickpea

DISCUSSION

In present investigation, three plant oils namely *A. indica* (neem oil), *S. aromaticum* (clove oil) and *C. nucifera* (coconut oil) were evaluated in terms of their reducing effects on longevity of adult *C. chinensis*. Results suggest that all the oils tested effectively control the test insect. *A. indica* oil, however, proved to be the best of the three treatments, producing maximum reduction (86.77%), followed by *S. aromaticum* while *C. nucifera* manifested the least reduction in longevity (41.81 per cent) of adult *C. chinensis.* The excellent

performance of neem oil over other commercial plant oils has also been reported by various investigators. Jacob and Sheila (1990) reported that the effectiveness of neem oil against *C. chinensis* on green gram which gave 60% mortality of the bruchid after 3 days of treatment. Zahid *et al.,* 2000 reported high mortality (63%) by neem oil on par with actellic and malathion. Mahfuz and Khalequzzaman (2007) tested toxicity of cardamom, cinnamon, clove, eucalyptus and neem oils against cowpea weevil, *C. maculatus* adults and found clove oil as most effective in respect of the toxicity after 24 hour and 48 hour treatment in fumigant bioassay. Abualreish (2007) tested the physical and chemical properties of the volatile oil isolated from fresh and stored clove flower buds. The active ingredient in the volatile oil was eugenol, which is capable of causing mortality of test insect. Abd-Elhady (2012) evaluated insecticidal properties of *Artemisia judaica* oil against *C. chinensis*. The results from this study indicated that the essential oil of *A. judaica* exhibited effective toxicity to *C. maculatus* in all tests (fumigation, repellency, surface film, egg hatch and adult emergence). Essential oils can affect insects in several ways, they may disrupt major metabolic pathways and cause rapid death, act as contact insecticides (Saxena *et al.,* 1992), fumigants (Shaaya *et al.,* 1997) repellents (Plarre *et al.,* 1997) and deterrents or can modify oviposition. Swella and co-worker (2007) investigated coconut oil efficacy against *Callosobruchus maculatus* on cowpea seeds. They found coconut oil as good protectant against test insect. This result is also supported by Busungu and Mushobozy (1991) who reported that coconut oil was effective in controlling *Zabrotes subfaciatus*, a Mexican bean weevil. *Ahad* (1994) showed that coconut oil, mustard oil, soybean oil protect pulse from the pulse beegtle *C. chinensis* upto 9 months.

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