

Screening of plant extract for insecticidal biopotency against *Callosobruchus chinensis* L. (Coleoptera:Bruchidae) on chickpea, *Cicer aritenum* L.

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Abstract

Laboratory experiments were conducted to evaluate the preliminary screening efficiency of ten plant materials against the pulse beetle, *Callosobruchus chinensis* L. (Coleoptera : Bruchidae), which infests stored chickpea seeds. All the crude extract of the collected plant material were tested by dry-film technique against the early emerged adults of *C. chinensis* L. under storage conditions. The spraying of the extract was done in glass petridishes (10cm diameter) by potters spray tower, using 1.0 ml. of solution per petridish. The crude extracts were tested in three treatments and each treatment with three replications, along with control (Benzene + emulsified water). Ten early emerged adult beetles were released inside each pair of petridishes and allow to remain there for two hours. After which, they were transferred to the fresh petridishes containing chickpea seeds for feeding under control conditions ($25 \pm 1^\circ\text{C}$ temp. $75 \pm 5\%$ relative humidity). Amongst the crude extracts, seeds of *A. indica* (1.0 ml/100g seed) was found to be more effective causing highest (87.95%) mortality to th beetles followed by rhizome extract of *A. galanga* (79.26%) and unripe fruits of *A. squamosa* (78.35 %) mortality), respectively. The mean mortality percentage of remaining treatments was arranged in the following descending order on the basis of their respective mortality percentage as *A. vasica* (66.27) > *C. tora* (55.21) > *C. rotundus* (28.77) > *A. aspera* (21.14) > *G. pentaphylla* (17.81) > *C. domesticus* (12.39) > Control (6.14) percent, respectively. However, the beetle mortality was not significantly different among all treated beetle compared to the control. Hence, these crude extractives may be suggested as admixtures in the integrated management of beetle infestation of pulse seeds during storage.

Keywords: crude extract, *Callosobruchus chinensis*, neem, galangal, sweetflage and chickpea

1. Introduction

The pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) has been reported in the oriental zoogeographical region particularly in India, Indonesia, China and Japan [1, 2]. The pulse beetle, is the most widespread and destructive major insect pest of stored legumes [3, 4]. Pulse beetle are commonly occurring and most serious insect pest of stored pulses viz. black, green, red and Bengal gram, peas, beans, cowpea and soybean [5, 6]. The bruchids attack the leguminous pods in the field wherefrom they are carried to store godowns also [7, 8]. They destroy completely the endospermic portion of seed leaving only the seed coat. The seed thus losses completely its viability and the pulses are rendered unfit for human use as Dal or for conversion into flour [9, 10]. This pest not only cause economic loss but are also responsible for 10% loss of world's cereal production. Insecticides of plant origin compared to synthetic ones, are safer for the environment are generally less expensive, easily processed and used by farmers and small industries. These natural indigenous plant products are often active against a limited number of species and are often biodegradable, nontoxic products and are potentially suitable for use in integrated pest management (IPM), they could lead to the development of new classes of safer insect control agents [11, 12].

In oriental region, farmers have inherited knowledge of mixing leaves, barks, seeds, roots and oils of some traditional

plants with the stored grains for protection against insect pests during storage as neem [13, 14, 15], sweetflag [16, 17, 18], greater galanga [19, 20, 21, 22] and *Annona squamosa* [23, 24, 25, 26]. Farmers and researchers often claim the successful use of natural products in insect pest management [27] vegetable oils [28] and plant and botanical powders [29, 30]. Research reveals that powder and extracts prepared from plants have a variety of properties including insecticidal activity, repellency to pests, antifeedant effects, insect growth regulator and other agricultural pests. Indigenous plant extracts has shown promise as grain protectants against the pulse beetle and the other stored grain insect-pests plant extracts [31, 32, 33, 34]. It has been reported that certain plant preparations and traditional methods are much safer than chemical insecticides [35, 36].

However, the use of synthetic insecticides for controlling stored product insects have been or may be banned globally due to problems such as their persistent toxicity in food grains, the subsequent development of resistance in insect populations, effects on non-target organisms and other adverse environmental impacts. In short, global ecology is facing severe threat from the use of pesticides so the search for ecologically safe methods to control insect pest of stored food products is an awe inspiring field of research. Keeping in view of the above, the selected plant materials should be explored to protect stored products against *Callosobruchus chinensis* infestation a major insect pest of stored grains.

2. Materials and Methods

2.1 Procurement of raw plant materials

The investigations on the screening of various available indigenous naturally occurring plant materials viz; aerial parts of *Achyranthes aspera* Linn., *Adhatoda vasica* Nees., *Cassia tora* Linn., *Cyperus rotundus* Linn., leaves of *Annona squamosa* Linn., seeds of *Azadirachta indica* A.Juss,

Gynendropsis pentaphylla L., rhizomes of *Acorus calamus* Linn, *Alpinia galanga* (Linn) Willd., *Curcuma domesticus* Val. were collected from different places of Kanpur. Crude extract of each plant was selected for the preliminary study. Untreated seeds of a common chickpea cultivars Ver. K-805 of U.P. were used for different bioassay(Table-1).

Table 1: List of plants and their parts used for preparing crude extract

Scientific Name	English Name	Common Name	Family	Part Used
<i>Achyranthes aspera</i> Linn.	Prickly chaff flower	Latzeera	Amaranthaceae	aerial parts
<i>Acorus calamus</i> Linn.	Horse tail	sweet flag	Acoraceae	Rhizomes
<i>Adhatoda vasica</i> Nees.	Malabar nut	adulsa	Acanthaceae	aerial parts
<i>Alpinia galanga</i> (Linn) Willd.	Galangal	Thai ginger	Zingiberaceae	aromatic rhizome
<i>Annona squamosa</i>	Sugar-apples	sharifa	Annonaceae	Unripe fruite
<i>Azadirachta indica</i> A.Juss	Neem	Neem	Maliacea	Seed kernel
<i>Curcuma domesticus</i> Linn.	Turmeric	Haldi	Zingiberaceae	
<i>Cassia tora</i> Linn.	Night-flowering Jasmine	Parijat	Oleaceae	Ripe fruits
<i>Cyperus rotundus</i> Linn.	Coco-grass	Nagar motha	Cyperaceae	Rhizomes
<i>Gynendropsis pentaphylla</i> L	Gynendra	Hulhul	Caparedacea	Seeds

2.2 Insect’s culture

The laboratory culture of *Callosobruchus chinensis* was initiated from the eggs collected from laboratory. Adults of *C. chinensis* were drawn from laboratory mass cultures reared in glass jars at temperature 25±1°C without controlling conditions. The early emerged adult beetle, *Callosobruchus chinensis* were used for experiment and fed on chickpea, *Cecер aritenum* ver. K-805. The collected eggs were placed in a well ventilated plastic container and chickpea seeds were provided to newly hatched larvae. The laboratory reared early emerged adults were used for the present investigation to assess their insecticidal efficacy.

2.3 Apparatus used for experiment

Small plastic jars (capacity 50 ml) were used for the experiment; there was one set of two jars joined by clear plastic pipe of 1cm diameter at an angle of 180 degree for each replication. One jar of each set was provided with 10 g of grains given the name ‘A’ while the other jar was kept empty and given the name ‘B’. In jar ‘A’, the grains treated with extracts were placed, while the jar B remained empty. The jars used for experiment were disinfected with alcohol.

2.4 Experimental Bioassays

The crude extract of each selected plant was topically applied at doses of 10ml /100gm of grains. Ten adults of *C. chinensis* were released in the treated grain jars A. The jars used for experiment were covered with pieces of muslin cloth size of jars with rubber band. For control no extract was applied on grains, only water was applied on the grains. There were three replicates for each treatment and one control. The data on mortality of the test insect were recorded after 6hr., 12 hr. and 24 hours after their release. The observed data were computed for their insecticidal activity.

2.5 Statistical analysis

The data were arranged in tabulated form and graph formats. The mortality (%) was corrected by

Abbotts’s formula:

$$Pr = \frac{Po - Pc}{100 - Pc} \times 100$$

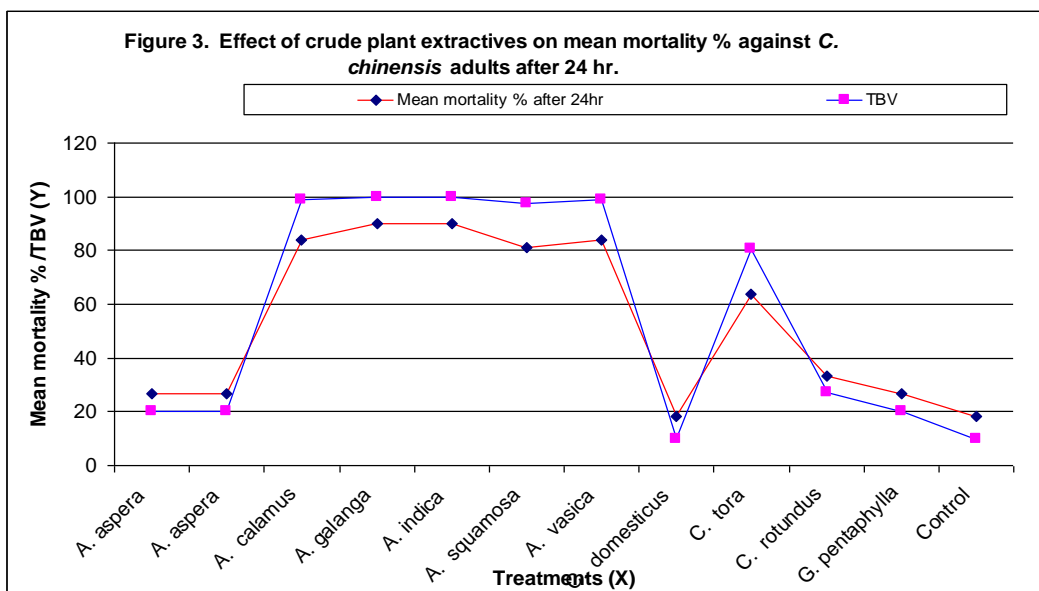
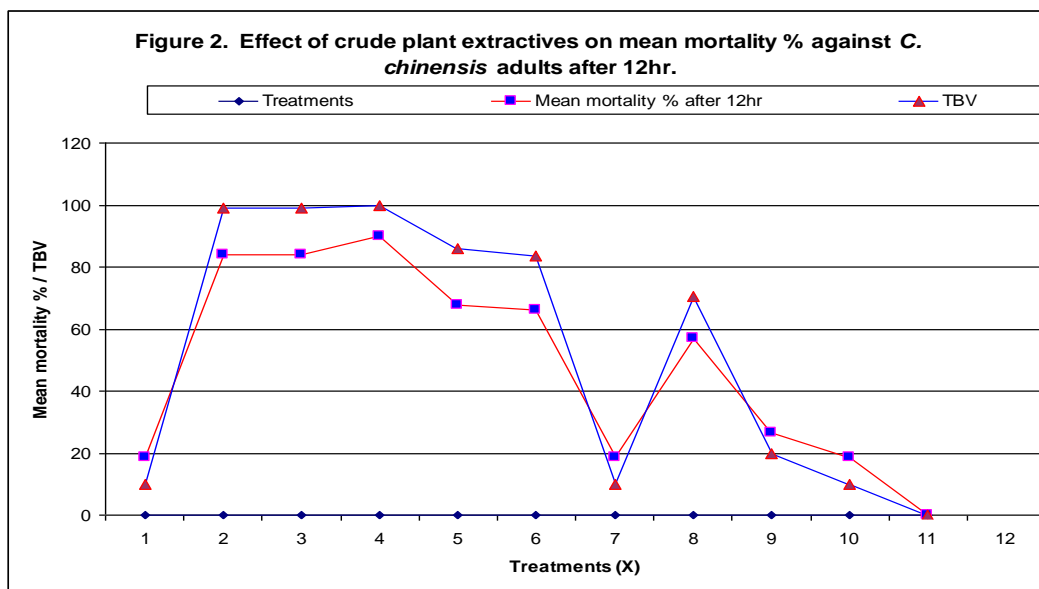
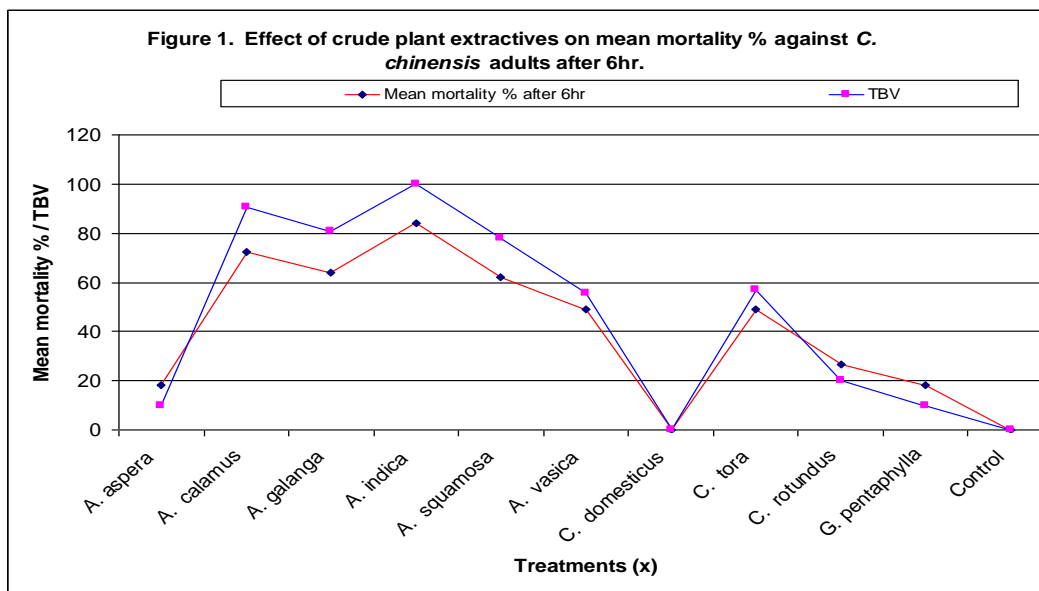
where, Po = Observed mortality, Pc = Control mortality. The data was analysed using (ANOVA) test.

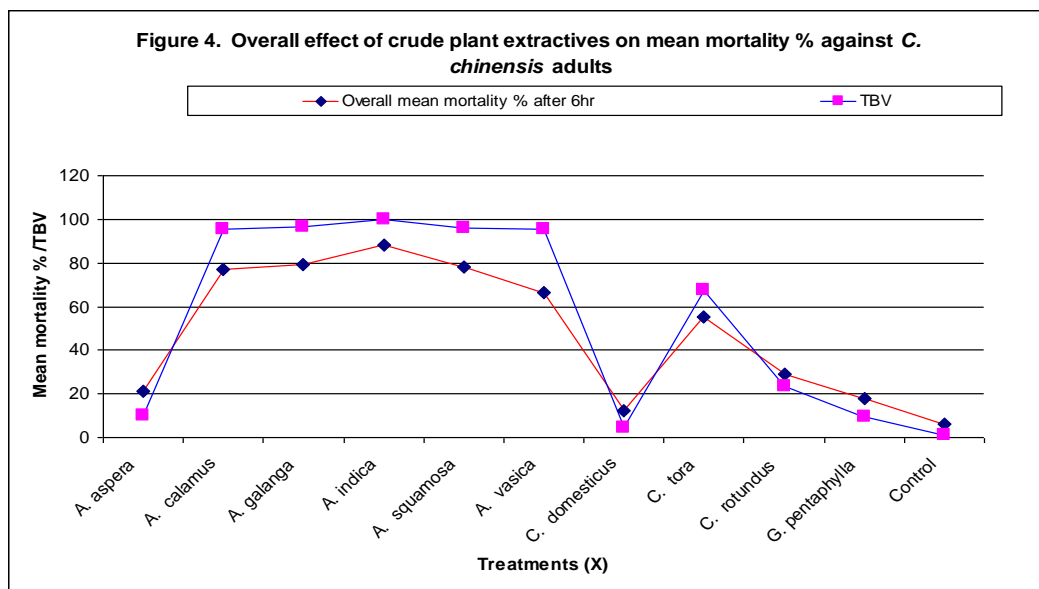
Table 2: Effect of crude non asteraceous plant material on mean mortality % against emerging *C. chinensis* adults

Treatments Herbal products (100%)	Mean mortality % after			Mean Mortality %IR
	6h.	12h.	24h.	
<i>A. aspera</i>	18.44(10.0)	18.44(10.0)	26.56(20.0)	21.14(10.1)
<i>A. calamus</i>	72.29(90.7)	83.85(98.9)	83.85(98.9)	77.21(95.5)
<i>A. galanga</i>	63.93(80.7)	83.85(98.9)	90.00(100.0)	79.26 (96.5)
<i>A. indica</i>	83.85(99.9)	90.00(100.0)	90.00(100.0)	87.95 (99.9)
<i>A. squamosa</i>	61.92(77.8)	67.86(85.8)	81.14(97.6)	78.35 (95.9)
<i>A. vasica</i>	48.84(55.5)	66.14(83.6)	83.85(98.9)	66.27 (95.5)
<i>C. domesticus</i>	0.00(00.0)	18.44(10.0)	18.44(10.0)	12.29(04.5)
<i>C. tora</i>	48.93(56.9)	57.00(70.3)	63.93(80.7)	55.21(67.5)
<i>C. rotundus</i>	26.56(20.0)	26.56(20.0)	33.21(27.0)	28.77(23.2)
<i>G. pentaphylla</i>	18.44(10.0)	18.44(10.0)	26.56(20.0)	17.81(09.4)
Control	0.00	0.00	18.44	06.14(1.1)

(Figure within parenthesis represent mean percentage transformed back value)

- C.D. for treatment x period means = 0.0764
- C.D. for treatment means(plant extract) = 0.046
- C.D. for treatment means (control) = 0.19





3. Results

The data depicted in the Table-2 and figure 1-4 indicated that seed extract of neem, *A.indica*, *A. galangal*, *A. squamosa* and *A. calamus* were significantly effective with respect to early emerged adult beetle mortality of *C. chinensis*. Seed crude extract of neem *A.indica* was found to be more effective (87.95%) followed by *A. galanga* (79.26%) and *A. squamosa* (78.35%) mortality of the bruchids. Remaining extract were arranged based on their mean mortality percentage in the following descending order as: *A. calamus* (77.21 %) > *A. vasica* (66.27%) > *C. tora* (55.21%) > *C. rotundus* (28.77%) > *A. aspera* (21.14%) > *G. pentaphylla* (17.81 %) > *C. domesticus* (12.39%) > Control (6.14 %), respectively. The results unambiguously demonstrated the efficacy of neem, alpinia sweetflag crude extract in reducing infestation of *C. chinensis*. Insecticidal activity of plant extract were observed to decrease beetle production of *C. chinensis* on stored chickpea seeds [36, 37]. The aromatic nature of the plant leaf powders suggests that it contains volatile constituents, which are highly effective against insects.

4. Discussion

In support of above findings seeds of *Azadirachta indica* were reported to show insecticidal activity against a variety of insect species and, azadirachtin, the active principle, exhibited insect antifeedant, moult inhibiting and anti-gonadotropic effects in insects [38, 39]. The rhizomes of *Acorus calamus* and the active ingredient (β -asarone) were investigated for their insecticidal properties [40]. However, its bitter taste and lack of contact toxicity restricts its use and unsuited on stored products meant for human consumption.

5. Conclusion

The findings of the present investigation based on laboratory experiments, therefore recommended the potential exploitation of *A. indica*, *A. galanga*, *A. squamosa* and *A. calamus* as admixtures in pest management strategies, especially by small scale farmers, who store small amounts of pulses for consumption and planting. The research findings

can be used by both scientific community and common rural people for bio-discovery of these natural resources sustainably. The plants are easily biodegradable, low-priced and sophisticated and may warrant further investigation to determine the exact mode of action of active ingredients and their effect on non-target organisms.

6. Acknowledgements

Thanks are due to U.P., Council of Science and Technology, Lucknow for financial assistance and DR. R.K.Singh, Principal, D.B.S.College, Kanpur for providing the necessary laboratory facilities to carry out the Project. I have great pleasure in expressing my profound gratitude to Dr. N.D Pandey, former Professor and Head, Division of Entomology, C.S.Azad University of Agriculture and Technology, Kanpur for his constant encouragement throughout my studies.

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