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Preliminary insecticidal bioefficacy of certain naturally occurring ecofriendly botanicals against pulse beetle, *Callosobruchus chinensis* Linn. (Bruchidae)

[1] BS Chandel, [2] Indrani Dubey, [3] Amit Prakash Singh
[1, 2] Biopesticide and Toxicological Lab, Department of Zoology, DBS College, affiliated to CSJM University, Kanpur, Uttar Pradesh, India
[3] Department of Zoology, Narain PG College, Sikohabad affiliated to Dr. BRA University, Agra, Uttar Pradesh, India

Abstract
The present manuscript covers the preliminary screening of feeding toxicity of certain naturally occurring crude extract against chickpea bruchid, *Callosobruchus chinensis* Linn. (Coleoptera: Bruchidae) infesting on chickpea, *Cicer arietinum* L. ver. K 850 seeds. The selected plant materials viz; aerial parts of *Vitex negundo* Linn., *Withania somnifera* Dun., *Swertia chirayita* Roxb., *Tabernamontana devaricata* Linn., ripe fruites of *Jatropha curcus* Linn., *Nyctanthes arbortristis* Linn., unripe fruits of *Lantana camara* Linn., *Momordica charantia* Linn., rhizomes of *Zingiber officinale* Rosc. and *Saussurea lappa* C.B. Clarke were used for their insecticidal effectiveness against early emerging adults of pulse beetle, *C. chinensis* Linn. in laboratory trials. The crude extract of each plant was selected and tested by dry film technique for early emerging beetles of *C. chinensis* on pulse grain. The data depicted from the results that among selected bioactive crude plant extracts maximum mean mortality was observed in *L. camara* (77.0) followed by *V. negundo* (75.40) and *W. somnifera* (71.14), respectively. It can be concluded on the basis of result obtained that these plant could be use as biorational insecticide in their soxhlet extract or their biochemical farm in future for the protection of grains under storage conditions.

Keywords: screening, insecticidal, *Callosobruchus chinensis*, *Lantana camara*, *Vitex negundo*

1. Introduction

Pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) is the most serious noxious, cosmopolitan insect-pest of stored pulses and cause both qualitative and quantitative losses in legumes [1, 2, 3]. Generally, the farmers are frequently using synthetic chemical pesticides to control many insect pests infestation of storage materials and field crops. The use of synthetic insecticide is very effective for the control of insect pest but their indiscriminate and injudicious use has resulted in undesirable ill effects along with environmental pollution [3, 4]. The risks to human health and environmental side effects have forced to look for greener alternatives to chemical pesticides especially for vegetables like okra where fruits are plucked at an interval of every 2-3 days [5].

India being a major subtropical country with the great variation in climatic condition provides ample plant wealth sources. The research work on properties like insecticidal, antifeedant and repellent of various plant species has been initiated on many insect species of economic importance. In the last two decades crude and refined extracts of different plant against many crop and stored insect-pests were tested and found effective against the pests. Several commercial products of botanical origin and their derivatives are available in the market for insect pest control on various crops. The extracted material of different plants of varied effectiveness and properties against insect pests are available [5, 6]. Interest has arisen to work out the role of plant products as ecofriendly, non toxic and biodegradable in controlling the insect pest [7, 8]. The present study has been undertaken after review of available literature. The aim of this study is to workout aware of hazardous toxic effect, mankind has used botanicals to control insects since ancient times [9, 10].

2. Materials and Methods

The methodology of the present investigation is described under the following heading:

2.1 Procurement of raw plant material ten plants were selected for study

Aerial parts of *Vitex negundo* Linn., *Withania somnifera* Dun., *Swertia chirayita* Roxb., *Tabernamontana devaricata* Linn., unripe fruits of *Lantana camara* Linn., *Momordica charantia* Linn., ripe fruites of *Nyctanthes arbortristis* Linn., seeds of *Jatropha curcus* Linn., rhizomes of *Zingiber officinale* Rosc. and roots of *Saussurea lappa* C.B. Clarke were collected from different places of Kanpur, Uttar Pradesh and local market. Crude extract of each plant parts was used for the study [Table-1].

Table 1: List of the collected plant materials

Scientific Name	English Name	Common Name	Family	Part Used
Jatropha curcus Linn.	Physic nut	Hedge castor	Euphorbiceae	Seeds
Lantana camara Linn.	Wild sage	Lantana	Verbenaceae	Unripe fruits
Momordica charantia Linn.	Bitter guard	Karela	Cucurbitacea	Unripe fruits
Nyctanthes arbortristis Linn.	Night-flowering Jasmine	Parijat	Oleaceae	Ripe fruits
Swertia chirayita Roxb.	Felwort	Chirayta	Gentianaceae	Aerial parts
Saussurea lappa C.B. Clarke	Costus	Kuth	Asteraceae	Roots
Tabernaemontana devaricata Linn., R.Br.ex Roem. & Schult.	Chandani	Crape Jasmin	Apocynaceae	Aerial parts
Vitex negundo Linn.	Five-leaved chaste tree	Legundi	Verbenaceae	Aerial parts
Withania somnifera Dun.	Ashwagandha	Winter cherry	Solanaceae	Aerial parts
Zingiber officinale Rosc.	Ginger root	Adarak	Zingiberaceae	Rhizomes

2.2 Insect's culture

Adults of *Callosobruchus chinens*is were taken from laboratory mass cultures reared in glass jars at temperature 25±1°C without control conditions. The early emerged adult beetles, *C. chinensis* were used for experiment and fed on crude extract of treated stored gram, chickpea *Cicer arietinum* L. (Fabales: Fabaceae) ver. K- 805.

2.3 Preparation of crude extract

For the preparation of crude extract, the collected plant parts were washed with distilled water. Thereafter, crude extract was prepared using domestic pistle for crushing them followed by sieving through 60 mesh size sieve to obtained crude extract. Crude extracts 100.00% were kept in reagent bottle at room temperature and properly sealed to prevent quality loss.

2.4 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.

2.5 Experimental Bioassay

The emerging beetles of *C. chinensis* were used for experimental purpose. The insecticidal test of the crude plant extracts were performed by dry-film technique. One ml. of solution (selected plant extract) was sprayed per petridish. Each crude extract was tested in three treatments and each treatment with three replications. There was one control experiment in which pertidish was spryed with benzene and emulsified water. To record the mortality, the crude extract sprayed petridishes were gently shaken under an electric fan until the liquid phase evaporated, leaving behind a uniform dry film of extract on the glass surface. Inside each pair of petridish, ten emerging beetle, *C. chinensis* were released and allowed to remain there for feeding up to 48 hours. All the adults were removed from petridishes and mortality was recorded after 24 hours and percentage mortality was noted for competition of insecticidal effects. The observed mortality % of treated adult beetles, *C. chinensis* were converted into angular transformed values, which were statistically analyze to test the significance and compared with the three treatments, respectively. Each treatment with three replication of selected crude extracts and period with the control. After treatment, the number of beetles for starved beetle, *C. chinensis* remained in each replication (petridish) were recorded at an interval of 24 hrs., 48 hrs. and 72 hrs., respectively. The detail of each laboratory experiment against adult beetle, *C. chinensis* are summarized in table-1.

The data were arranged in tabular form and graph formats. The mortality (%) was corrected by Abbotts's formula [11]:

$$\mathbf{Pr = Po – Pc / 100 – Pc \times 100}$$

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

Table 2: Mean mortality percentage of selected crude plant extract against emerging *C. chinensis* adults

Treatments Herbal products (100%)	Mean mortality % after			Mean Mortality %
	6h.	12h.	24h.	
Jatropha curcus Linn.	57.00 (70.3)	61.92 (77.8)	75.00 (93.3)	64.64 (93.3)
Lantana camara Linn.	72.29 (90.7)	75.00 (93.3)	83.85 (98.9)	77.04 (93.6)
Momordica charantia Linn.	0.00 (0.0)	18.44 (10.0)	26.56 (20.0)	15.00 (06.7)
Nyctanthes arbortristis Linn.	37.22 (36.6)	48.84 (56.7)	59.00 (73.5)	44.45 (49.0)
Swertia chirayita Roxb.	54.78 (66.7)	61.92 (77.8)	75.00 (93.3)	63.86 (80.6)
Saussurea lappa C.B. Clarke	0.00 (00.0)	18.44 (10.0)	18.44 (10.0)	12.29 (01.1)
Tabernaemontana devaricata Linn.	18.44 (10.0)	18.44 (10.0)	18.44 (10.0)	18.44 (10.0)
Vitex negundo Linn.	67.86 (85.8)	72.29 (90.8)	83.85 (98.9)	75.40 (93.7)
Withania somnifera Dun.	63.44 (80.0)	75.00 (93.3)	75.00 (93.3)	71.14 (88.1)
Zingiber officinale Rosc.	46.92 (53.4)	52.77 (63.4)	59.21 (73.8)	52.23 (62.5)
Control (untreated)	0.00 (0.0)	0.00 (0.0)	18.00 (10.0)	6.14 (62.5)

(Figure within parenthesis represent mean percentage transformed back value)

C.D. for treatment x period means = 0.0554

C.D. for treatment means (plant extract) = 0.064

C.D. for treatment means (control) = 0.16

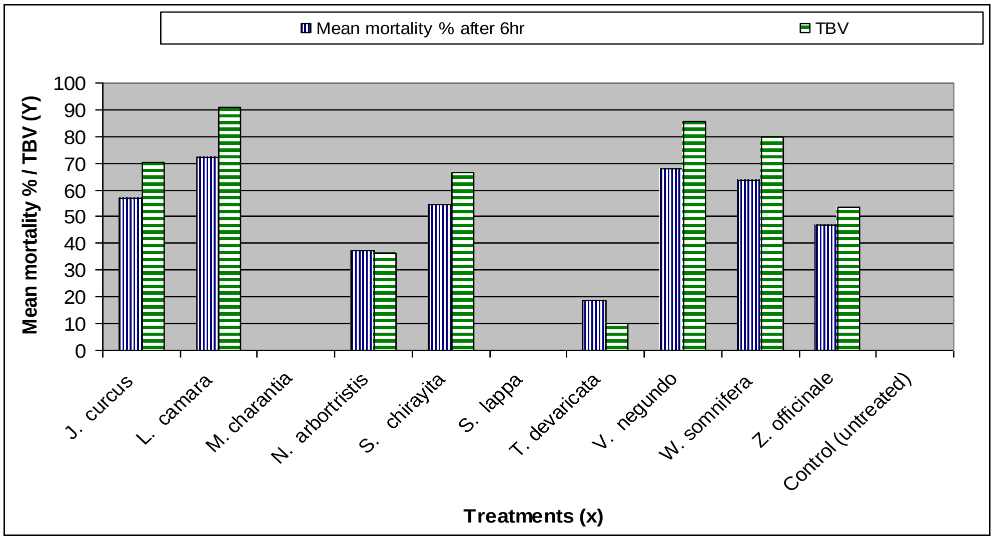

Fig 1: Effect of crude phytoextractives on mean mortality % against *C. chinens* is adults after 6hr.

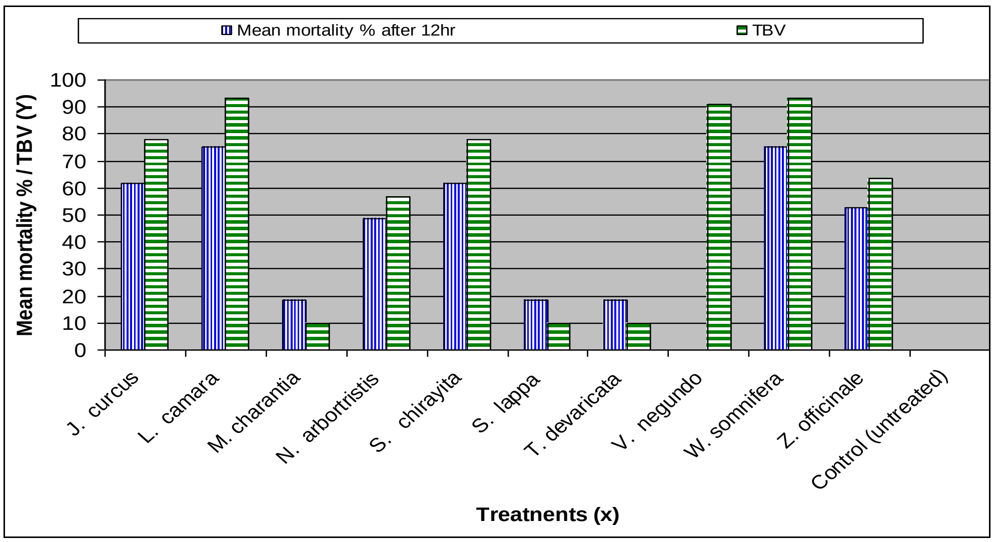

Fig 2: Effect of crude phytoextarctives on mean mortality % against *C. chinensis* adults after 12hr.

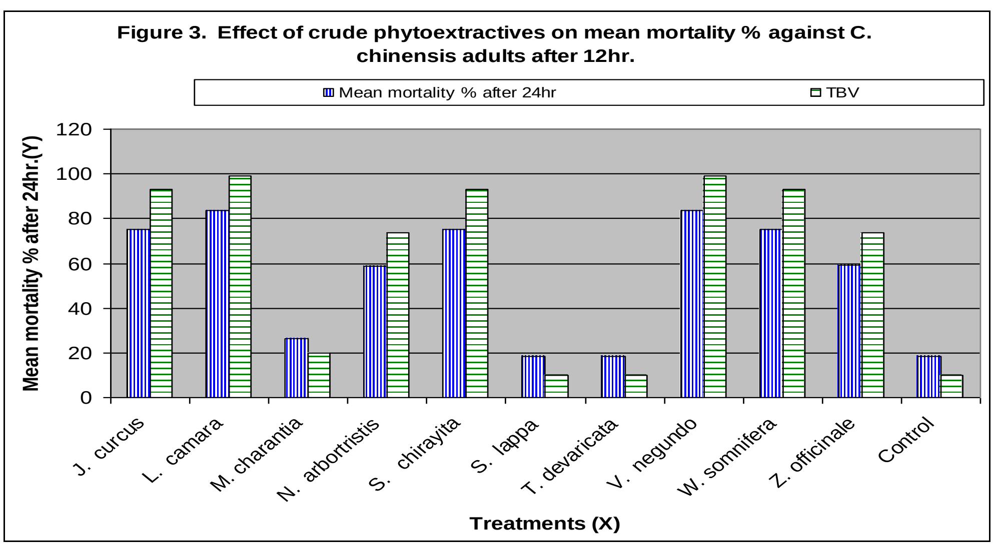

Fig 3: Effect of crude phytoextractives on mean mortality % against *C. chinensis* adults after 12hr.

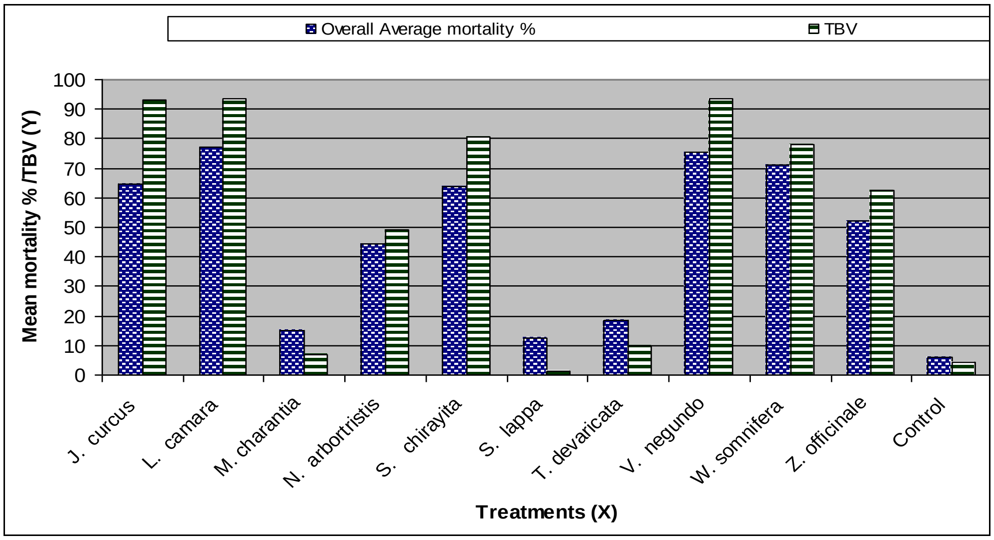

Fig 4: Overall effect of crude phytoextractives on mean mortality % against *C. chinensis* adults

3. Result

The data depicted in table 2 and figure 1,2,3,4 indicated that the plant extract of *L. camara* gave the maximum mortality. It killed 77.00 per cent beetles followed by *V. negundo* (75.40 percent) > *W. somnifera* (71.14 percent) > *J. curcus* (64.64 percent*)* > *S. chirayita* (63.86 percent) > *Z. officinale* (63.86 percent*)* > *N. arbortristis* (44.45 percent) > *T. devaricata* (18.14 percent) > *M. charantia* (15.00 percent) > *S. lappa* (12.96) > Control (6.24), respectively. The plant extract of *L. camara* differed significantly from remaining once except *V. negundo* and *W. somnifera* from which it does not differs significantly to one another.

Table 2 and figure 5 indicated that all the three periods differed significant to one and another. The mortality percentage of *C. chinensis* is maximum after 24 hrs. and minimum after 6 hrs. The period of 24 hrs. is significantly superior to period of 12 hrs. in both control and treated. The overall effect of all the treatments in killing the larvae is greater than that of control in all the three periods.

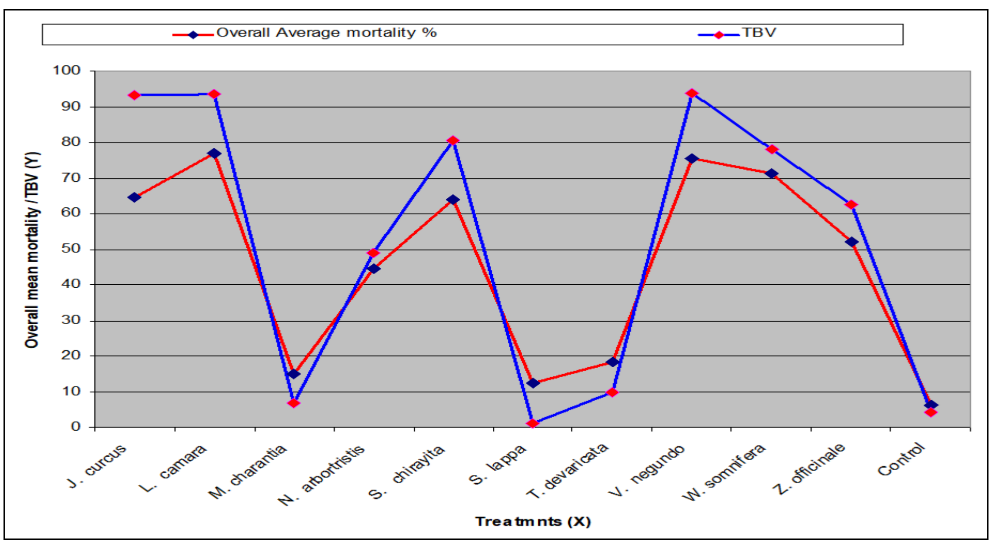

Fig 4.1: Overall effect of crude phyto-extractives on men mortality % against *C. chinensis* adults.

4. Discussion

In the support of the above findings, exploration of 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 [12, 13, 14, 15]. Insecticidal activity of *T. procumbens* and *W. somnifera* is well documented against a range of insect pests [16, 17, 18] The use of plant products to protect stored grain from insect pest depredation is an age-old practice [19]. Essential oils, extracts and the chemical ingredients have been used greatly in grain protection in many laboratory and field trials [20, 21]. These natural insecticides are used for the control of stored product insect pests because of their relatively high efficacy against all stages of insects [22, 23]. With limitations on the use of contact chemical insecticides and fumigants in stored products and increasing public demand for wholesome and pest-free food products, there is a need for developing biorational pest management technologies for stored products.

5. Conclusion

The present investigation revealed that there appears prospects in selected naturally occurring botanicals which encourage the search for ecofriendly natural herbal insecticides offering an alternative to hazourdous toxic synthetic insecticides. The crude extract of *Lantana camara* Linn., *Vitex negundo* Linn. (Verbenaceae) and *Withania somnifera* Dun. (Solanaceae) have the potential to be used as an ideal approach for the management of pulse beetle, *Callosobruchus chinensis* under storage conditions

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