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CONTROL OF *TROGODERMA GRANARIUM* (Everts) BY AQUEOUS LEAF EXTRACTS OF *LANTANA CAMARA* AND *CLERODENDRUM INERME*

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ABSTRACT

The leaves of *Lantana camara* (L) and *Clerodendrum inerme* (L)were tested for their efficacy against the stored grain pest *Trogoderma granarium* (Everts) using aqueous leaf extracts. Three different concentrations ranging from 2.5, 5.0, and 10.0 % per 20 g wheat when applied against different larval and adult stages, produced significant mortality and thereby seed protection over controls. This suggests the insecticidal nature of these plants against one of the serious pests of wheat and their promise as alternative to chemical pesticides.

KEY WORDS: Mortality, Stored grain pest, Insecticidal, Seed protection

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INTRODUCTION

As per the records, more than 10% of the post harvest damage in warehouse and granaries occur due to pests and mites infestation and 5-10% of the stored grains in India are lost due to insect pests[1, 2] .Controlling them with chemicals is a serious concern as it leads to environmental contamination and health hazards[3]. Many plants possess chemical substances with remarkable biological activities which provide protection and resistance against pests[4]. Many alkaloids and flavanoids have also been reported in different plants with insecticidal properties[5]. Since they possess such chemicals, utilization of the plant materials in pulverised form, crude extracts or purified form should be encouraged for biopesticidal usage.

Cassia fistula (L.)*, Azadirachta indica* (A. juss) and *Calotropis procera* (Ait.) are some of the plants which are proved to be lethal to various stored grain pests and delay the developmental stages by interfering with their apolytic and molting processes[4,6]. Leaves of *Ocimum sanctum* (L.)*, Vitex negundo* (L.)*, Aegle marmelos* (L.) and *Lippia geminate* (L.) have been used for the protection of stored rice forms in rural India[7.] Similarly, leaf powders of *Annona squamosa*, *Punica granatum, Murraya koenigii* and *Eucalyptus globuli* caused high mortality in *Tribolium castaneum* (Herbst)*, Rhizopertha dominica* (Fabr.) *and C. cephalonica* (Staint.) and have shown protection against seed damage[8,9,6,10] . Laboratory and field studies in the UK and Northern Ghana with powdered leaves and hot water extracts of *Cassia sophera* (L.) against *Callosobruchus maculates* (F) and *Sitophilous oryzae* (L.) were found to be effective[11]. These traditional methods world wide are useful in protecting the grains variably for 5-12 months[12,13]. Hence in the present study commonly available plants like *L. camara* and *C.inerme* were tested for their efficacy against a serious pest of wheat, *T. granarium.*

MATERIALS AND METHODS

(i)Samples of wheat grains*:*

Local variety of wheat grains, *Triticum aestivum* L. cultivated in this region, were collected from market, washed thoroughly with water to remove any dust or other particles and dried properly before use.

(ii) Insect pest

Trogoderma granarium (Everts) is one of the most destructive pests of stored grain products and thrives well in warm and dry climates. The usual mode of spread of this pest is by commerce and trade. It is one of the hardiest insects that infest stored grains in India. It is considered to be a dirty feeder breaking and powdering more kernels than it consumes and contaminate food grains by their own body parts and setae which cause gastrointestinal irritations

(iii) Culture

The stock cultures were maintained in plastic jars 2/3 filled with a mixture of whole wheat grains, crushed grains and wheat flour in the ratio 6:2:1 at optimum conditions of 28± 1^{o}C and RH 75±2% for many generations. For the present study, larvae of different stages and adults were separated from stock cultures and used.

(iv) Plant materials

Fresh green leaves of *L. camara* and *C. inerme* which were not exposed to any pesticide were collected from the University campus, washed, drained and weighed for making aqueous extracts (½ Kg /1000mL). The aqueous extracts were prepared by grinding them well in a mixer with distilled water and sieved through two layered cheese clothes . The extracts were then aliquoted into small vials(5 mL) and stored at 4^{o}C for further use. Different concentrations of these extracts (2.5%, 5.0% and 10.0 %)

were prepared freshly by mixing with distilled water (V/V) and used for experiments.

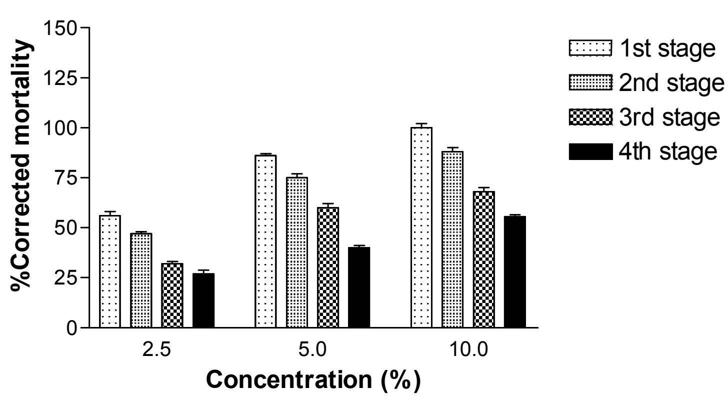
(v) Experimental design
Thirty larvae of each 1st, 2nd, 3rd and 4th instars were separated from the stock cultures. Thy were transferred to small plastic jars containing 20 g wheat treated with 2mL of 2.5, 5.0 and 10.0 % concentration of leaf extracts separately. Similarly 20 adults were separated and transferred to different jars with 20 g wheat mixed with different concentrations of leaf extracts as above. Respective controls from each stage were maintained without any leaf extract treatment.
At regular intervals of 24 h, the cultures were assessed for mortality. The number of dead insects in each set was noted and they were removed .The cultures were maintained until complete mortality was observed or for one generation. Percentage mortality and the extent of seed protection with respect to controls were determined using appropriate statistical methods. All experiments were repeated thrice.

(vi) Statistical analysis
Percentage mortality over controls in larvae, percentage mortality in adults and percentage seed damage from each set of experiment had been tabulated[14] and the mean ±SE for each triplicate was calculated. These data were then subjected to one way ANOVA using Bonferroni's multiple comparison test for the post hoc separation using the software PRISM 3.0 and the graphs were produced accordingly.

RESULTS

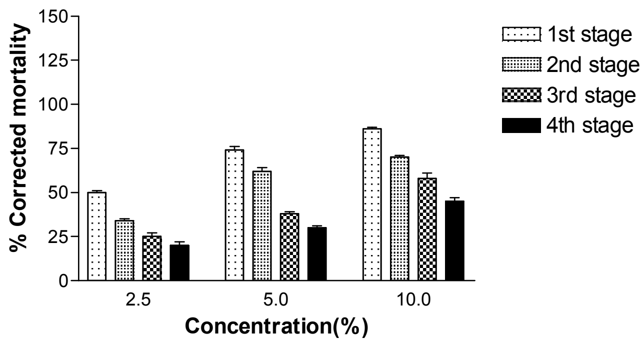
(i) Rate of mortality
The effect of aqueous leaf extracts of *L. camara* and *C. inerme* are shown in Figs.1a and 1b. When different stages of larvae were introduced to different concentrations of *L. camara* extracts, they failed to metamorphose and exhibited significant mortality over controls within a period of five days. First instars were highly sensitive and showed 100% mortality with highest concentration at day 5. The remaining concentrations of 2.5 and 5.0 % showed 56± 2% and 96± 1% mortality at the same duration. In the case of 2nd, 3rd and 4th instars the highest concentration produced 88± 2, 68± 2 and 56.6± 1% mortality respectively at day5 showing that, latter the stages of development, lesser the effect. Similarly in 2nd, 3rd and 4th instars, 5.0% concentration produced 75± 2, 60± 2 and 40± 1% mortality respectively while 2.5% concentration produced 47± 1, 32± 1 and 26.8± 2 % mortality after exposure for 5 days (Fig.1a).

Figure 1 a
% mortality over controls in different larval stages of T. granarium after exposure to L. camara leaf extracts (p < 0.001).



When larvae were exposed to different concentrations of *C. inerme,* the extent of damage was as high as that of *L. camara*. Mortality produced was about 86± 1, 701±, 58 ± 3and 45± 2% respectively with 10.0% concentration in different stages while 5,0% concentration produced 74± 1, 62± 2, 38± 1 and 30± 1% mortality. Similarly, lower concentration of 2.5% exhibited 50± 1, 34± 1, 25± 2 and 20± 2% mortality over controls in different stages of larvae (Fig.1b).

Figure 1b
% mortality over controls in different larval stages of T. granarium after exposure to C. inerme leaf extracts (p < 0.001).

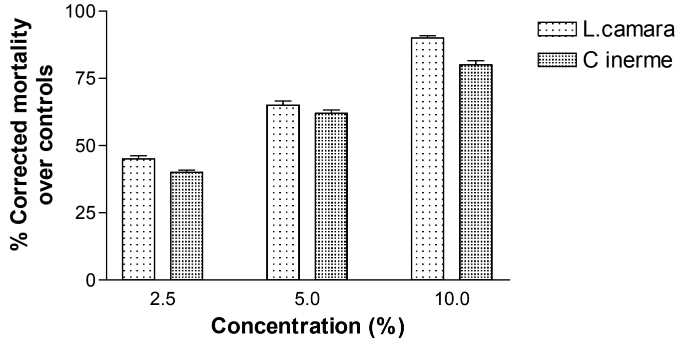


In both cases, a dose response increase in mortality was observed with an increase in concentration. The early stages of larvae were more sensitive to the aqueous extracts and died within a short period of 5 days while the late stages survived a little longer. However, complete mortality was observed within a period of 7-10 days with both herbal extracts.

When adults were introduced to different concentrations of both plant extracts, they failed to produce any progeny. Periodic observations at 24 h intervals revealed that there were no egg laying in cultures treated with 5.0 or 10.0 % leaf extracts while those with 2.5% extracts do show some egg laying after one week but the eggs failed to hatch further, suggesting an ovicidal effect. Adult mortality between 45 -90% was observed with *L. camara* and 40 - 80% in case of *C. inerme* (Fig. 2). The treated adults failed to produce any eggs with higher concentration of both plant extracts while few eggs produced in the lowest dose failed to develop further suggesting their ovicidal properties.

The cultures were however kept for another 30 days and discarded when fresh set of larvae failed to develop from it.

Figure – 2
% mortality over controls in adults of T. granarium after exposure to L. camara and C. inerme leaf extracts (p < 0.001).



(i) Seed protective effect:

To obtain an insight into the seed protective effect, the grains which were introduced at the beginning of each experiment (20 g wheat grains contain about 400 seeds) were collected after a period of two months of exposure and checked for the extent of damage. The broken seeds were separated, counted and compared with the control sets. Control cultures have shown typical pattern of seed damage with lots of debri while a significant reduction in damaged seeds were observed after treatment with *L. camara* and *C. inerme*. The percentage seed protection over controls ranged from 86.81± 2.3 to 98.250±.75% in 1st instars, 80.57± 0.65 to92.92± 1.3 % in 2nd instars 75.63± 1.2 to 85.83± 1.3% in 3rd instars and 70.25± 1 to80.39± 0.8% in 4th instars after exposure to *L. camara* (Fig.3a) while it ranged from 80.6± 1 to 90.25± 0.8% in 1st instars, 75.38± 0.65 to 85.5± 1 % in 2nd instars, 73.2± 0.8 to 80.8± 0.7% in 3rd instars and 65.8 to 75.1± 0.8% in 4th instars after treatment with *C. inerme* (Fig.3b). A dose dependant increase in seed protection was observed in both cases. However *L. camara* was more effective.

Figure 3 a
% mortality over controls in different larval stages of T. granarium after exposure to C. inerme leaf extracts (p < 0.001).

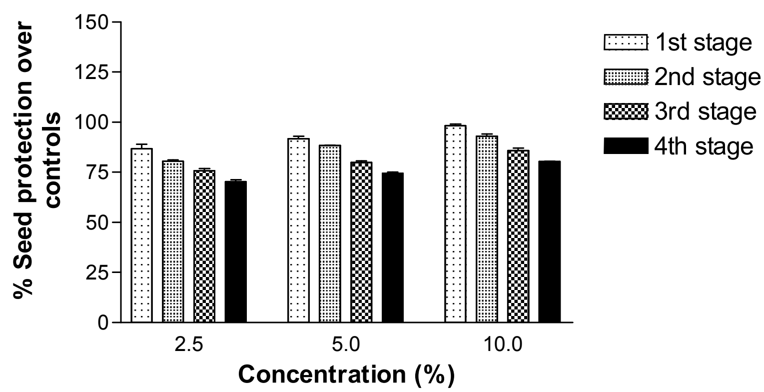
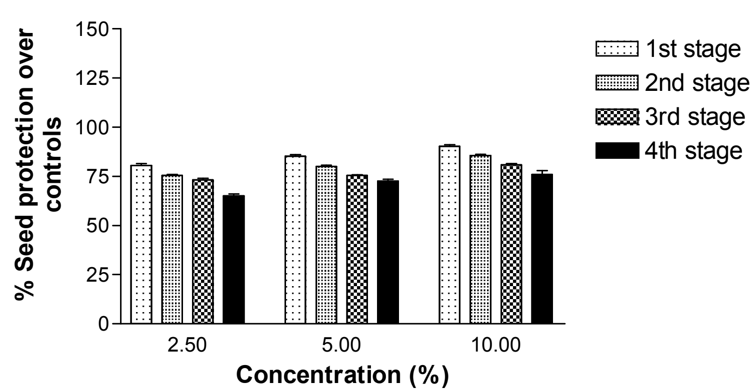


Figure 3 b
% seed protection over controls in different larval stages of T. granarium after exposure to C. inerme leaf extracts (p < 0.001)



DISCUSSION

Post harvest loss due to insects is a serious problem. Use of botanicals with insecticidal activities gaining momentum as this would be a better alternative against stored grain pests. Many plants with biopesticidal activities are shown to be promising against stored grain pests as they act as antifeedants, depressants and growth regulators or impair the immune functions of insects[4,8]. Pulverized leaves and aqueous extracts of plants like *A. squamosa*, *C. fistula*, P*. granatum, C. procera, M. koinigii, M. oleifera* and .*O. sanctum* have been used traditionally for the protection of stored grains all over the world [12,13]. Our earlier reports also enlists some of the botanicals which are effective against various stored grain pests like *T. castaneum, R. dominica*, and *C. cephalonica* [6,8,9,10]. .

With this view the analysis of the present study reveals the efficacy of aqueous extracts of *L. camara* and *C. inerme* on all developmental stages of *T. granarium*. Larval mortality increased with increase in concentrations. Early stages of larvae were more sensitive to different concentrations and showed high mortality within a short period. Adults failed to produce any eggs in most of the cases or failure of the produced eggs to develop further confirms the ovicidal property along with the direct larvicidal nature exhibited by the plant components. These results are in conformity with the earlier results shown against *C. cephalonica* [6]. These plants are also shown to delay the developmental stages by interfering with apolytic and molting processes of various insects .[4, 6]

Seed protective nature was clearly established over controls with both plant components at the selected doses. However, the use of increased concentration further boost the larvicidal property within a very short time to provide long lasting seed protection from pests [8,9,10]. Similar results were also observed against other pests like *C. cephalonica, S. oryzae, T .castaneum, R. indica* with various botanicals including *A. indica, M. koinigii, P. granatum* and *Ricinus communis (L)* and recommended such post harvest treatment for wheat, rice and groundnut[15] .

CONCLUSION

From the present study the effectiveness of *L. camara* and *C. inerme* for post harvest control is highly recommended. This is of practical significance as these can be recommended for traditional way of seed protection by farmers.

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