INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 3, No. 12, p. 50-54, 2013

RESEARCH PAPER OPEN ACCESS

Growth regulatory potential of five indigenous plant extracts against *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae)

Muhammad Sagheer[1], Mansoor-ul-Hasan[1], Habib ur Rehman[1], Fawad Zafar Ahmad Khan[1*], Hafiza Tahira Gul[2], Shireen Raza Haidri[1], Syed Arslan Bukhari[2], Muhammad Aftab[1], Jahanzeb Ali[3], Tauseef Amjad[1], Yasir Saeed Bajwa[1]

[1]*Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan*
[2]*Department of Entomology, Bahauddin Zakariya University, Multan, Pakistan*
[3]*Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan*

Key words: *Tribolium castaneum*, medicinal plants, growth disruptive effects, larval inhibition, pupal inhibition, adult inhibition.

doi: http://dx.doi.org/10.12692/ijb/3.12.50-54 Article published on December 06, 2013

Abstract

Plant based insecticides are effective control agents against the stored grain insect pests especially for *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). The red flour beetle, *Tribolium castaneum* (Herbst) is one of the severe pests of stored grain commodities The botanicals are have no toxic effects on our surrounding but the bioactivities of these plant extracts may induce certain detrimental effects on the biology of the certain insects causing infestation in stored grains The toxic and growth disruptive effects extracts from five medicinal plants viz; *Azadirachta indica, Murraya exotica, Eucalyptus comeldulensis, Trachspermum ammi* and *Teminalia chebula* were evaluated at a rate of 5, 10 and 15 % concentrations against the *Tribolium castaneum*. Highest larval inhibition was observed in case of *E. comeldulensis* (72.32%), followed by *A. indica* (63.96%), *T. ammi* (62.90%), *M. exotica* (58.93%) and *T. chebula* (54.96%). Maximum pupal inhibition was observed in case of *E. comeldulensis* (70.21%), followed by *A. indica* (62.26%), *M. exotica* (55.19%), *T. ammi* and *T. chebula* were both equally effective (54.82%). Highest adults' inhibition was observed in case of *E. comeldulensis* (66.67%), followed by *A. indica* (58.82%), *M. exotica* (54.90%), *T. ammi* (52.08%) and *T. chebula* (50.00%). These experiments will lead to the development of effective and natural growth regulators for control of insect pests attacking stored commodities.

* **Corresponding Author:** Fawad Zafar Ahmad Khan ✉ fawaduca@gmail.com

Introduction

The red flour beetle, *Tribolium castaneum* (Herbst) (Coleloptera: Tenebrionidae) is one of the most severe secondary insect pests that forages on a widespread range of long-lasting stored grain products including cereals and products cereals and other high value produce such as dried fruits cocoa and beans (Lee *et al.*, 2002). Management of this insect pest and other insect pests of stored grain products mainly depends on the use of residual insecticides and gaseous fumigants (Mondal and Khalequzzaman 2006; Lee *et al.*, 2010). Fumigation is the important way for control of stored grain insect pests. At present, most frequently used fumigants are methyl bromide and phosphine. But their use is restricted due to their toxic effects on environment. An alternative method for control of insect pests of stored commodities is the use of plant oils as fumigents (Tayoub *et al.*, 2012).

Plant extracts are best substitute methods for control of stored commodities insect pests. These plant extracts are safe to our environment. These botanical extracts can also be use in coordination with other control measures (Hasan *et al.*, 2012). Natural extracts can be used as alternative compounds which can control insect pests. These compounds are naturally found in many plants and these are used for the defense and are rich of secondary metabolites (Paranagama *et al.*, 2003). Over the past 15 years, interest in botanical insecticides has increased as a result of environmental concerns and insect populations becoming resistant to conventional chemicals. Botanical insecticides are naturally occurring insecticides that are derived from plants. There is an urgent need to develop safe alternatives that have the potential to replace the toxic fumigants, yet are effective, economical and convenient to use (Lee, 2004). Plant based insecticides are effective control agents against the stored grain insect pests especially for *T. castaneum* (Herbst) (Coleoptera: Tenebrionidae). Locally available botanicals have growth inhibition action on the *Tribolium castaneum* (Herbst) and cause significantly reduced growth rate. (Haq *et al.* 2005).Essential oils from different plant species possess ovicidal, larvicidal, and repellent properties against various insect species and are regarded as environmentally compatible pesticides (Lee *et al.* 2002). Keeping in view of previous experiments, present studies were planned to target the growth regulating potential of plant extracts against the larval, pupal and adult stage of the *T. castaneum*.

Materials and methods

The current studies were performed in the Grain Research, Training and Storage Management Cell of the Department of Agri. Entomology, University of Agriculture, Faisalabad during the year 2012-2013.

Insects collection

Tribolium castaneum, was collected from grain market and godowns, located in Faisalabad and Layyah, Punjab, Pakistan.

Insects rearing

Insect culture was developed on sterrilized wheat flour in sterilized jars which was kept in the incubator at temperature 30±2°C and 70±5% relative humidity to get the homogeneous population. Thirty insects were released in each jar containing 250gm flour. The jars were covered with muslin cloths to avoid insect escape. After three days adults were sieved out from the flour and the flour containing eggs were kept again in the incubator to get another generation. The flour containing adults were transferred again into jar to get homogenous population.

Collection of plant material

Leaves of *Azadirachta indica, Murraya exotica, Eucalyptus comeldulensis,* and seeds of *Trachspermum ammi,* and *Teminalia chebula* were collected from the different places.

Preparation of extracts

The plant materials were washed in water and then after drying in shade were ground to bring these in form of powder. The extracts were prepared using rotary shaker by shaking 1:2 ratio, following the

procedure which is being pronounced by Hasan *et al.* 2012. The plant extract which is obtained thus put in clean bottles and stored in refrigerator at 4°C.

Bioassay for growth inhibitory effects of plant extracts

The growth inhibitory effects of the plant extracts were evaluated in small plastic vials. Different concentrations were applied on wheat flour and then the flour was allowed to dry. Thirty adults were introduced in each vial. Data were collected for (%) larval, pupal and adult emergence in F_1 progeny were recorded after two day interval, till the F_1 adult emergence. The collected data was subjected to Abbott's formula to calculate corrected mortality and data so obtained were analyzed by Analysis for Variance using STATISTICA 7.0 software. Tuckey-HSD test was used comparison of means of significant treatments.

Results

The present study was conducted to determine the growth disrupting effects of different concentrations of extracts of *Azadirachta indica, Murraya exotica, Eucalyptus comeldulensis, Trachspermum ammi* and *Teminalia chebula* against the growth stages of *Tribolium Castaneum*. Vrious concentrations viz; 5, 10 and 15% were applied.The data was subjected to ANOVA and Tuckey-HSD test and α 5% to work out the effect of different concentrations of extracts of *Azadirachta indica, Murraya exotica, Eucalyptus comeldulensis, Trachspermum ammi* and *Teminalia chebula*.

Table 1. 1. Data regarding percent larval inhibition of *Tribolium castaneum*.

	% Larval Inhibition ± SE				
Conc. (%)	*E.comeldulensis*	*M. exotica*	*T. ammi*	*T. chebula*	*A. indica*
5	27.30 ± 2.69 def	34.26 ± 3.11 cdef	22.10 ± 2.53 ef	17.06 ± 1.22 f	27.04 ± 2.67 def
10	59.18 ± 4.93 ab	43.70 ± 3.39 bcdf	50.90 ± 4.79 abc	47.22 ± 3.42bcd	49.30 ± 3.43 abcd
15	72.32 ± 6.37 a	58.93 ± 4.90 ab	62.90 ± 5.33 ab	54.96 ± 4.87 abc	63.88 ± 5.32 ab

Larval Inhibition

Relative effects of five plant extracts on percent larval inhibition in table 1.1 is summarized as the results have revealed that maximum larval inhibition was observed in case of E. *comeldulensis* (72.32%), followed by *A. indica* (63.96%), *T. ammi* (62.90%), *M. exotica* (58.93%), and *T. chebula* (54.96%).

Table 1. 2. Data regarding percent pupal inhibition of *Tribolium castaneum*.

	% Pupal Inhibition ± SE				
Conc. (%)	*E.comeldulensis*	*M. exotica*	*T. ammi*	*T. chebula*	*A. indica*
5	24.24 ± 2.77 ef	14.44 ± 1.11f	8.52 ± 0.67f	8.52 ± 0.67f	15.41± 1.20 f
10	55.76 ± 4.90abc	41.48 ± 3.33 cde	27.41± 2.68def	27.41± 2.65def	44.97± 3.39 bcd
15	70.21 ± 5.38a	55.19 ± 4.87abc	54.82 ± 4.81 abc	54.82 ± 4.81abc	62.26 ± 5.28ab

Pupal Inhibition

Relative effects of five plant extracts on percent pupal inhibition is summarized in table.1.2 as the results have revealed that maximum pupal inhibition was observed in case of E. *comeldulensis* (70.21%), followed by *A. indica* (62.26%), *M. exotica* (55.19%), *T. ammi* and *T. chebula* were both equally effective (54.82%).

Adult Inhibition

Relative effects of five plant extracts on percent adults inhibition in this is summarized in table 1.3 as the results have revealed that maximum adults

inhibition was observed in case of E. *comeldulensis* (66.67%), followed by *A. indica* (58.82%), *M. exotica* (54.90%), *T. ammi* (52.08%) and *T. chebula* (50.00%).

Discussion

My results were quite similar with the Huang *et al.* (2000) found that cardamom oil dramatically suppressed egg hatching and larval survival of *T. castaneum*, thus showing its ovicidal properties. In addition, it also prevented eggs treated with the oil from developing to the adult stage. Similar growth inhibitory effects were obtained by Das(2006) by examining the efficacy of commercial neem-based insecticide, Nimbicidine® against eggs of the red flour beetle *Tribolium castaneum* (Herbst). Abbasipour H *et al.* 2011 found similar growth inhibitory effects with *Elettaria cardamomum* against three stored–product insects. My results were somehow similar with (Kingwei and Fields, 2003) with protein-enriched pea flour against *Cryptolestes ferrugineus*, *Tribolium castaneum* (Herbst), and *Sitophlus oryzae* (L.)My results regarding growth inhibition were somehow resemble with Tripathi *et al.* (2001).Our results were similar with (Lee *et al.* 2002).

Table 1. 2. Data regarding percent adults inhibition of *Tribolium castaneum*.

% Adult Inhibition ± SE					
Conc. (%)	*E.comeldulensis*	*M. exotica*	*T. ammi*	*T. chebula*	*A. indica*
5	18.94 ± 1.44efg	9.80 ± 0.87fg	4.17± 00.00	9.80 ± 0.87fg	8.63 ± 0.68fg
10	56.06 ± 4.95ab	41.67 ± 3.33bcde	23.96 ± 2.76 defg	28.43 ±2.69 cdef	42.75 ± 3.34 bcd
15	66.67 ± 6.34a	54.90 ± 4.87 ab	52.08± 4.60 ab	50.00 ± 4.21 abc	58.82 ± 5.00 ab

The overall studies showed that maximum growth inhibition in *Tribolium castaneum* (Herbst is caused by *Azadirachta indica* as compared to *Murraya exotica, Eucalyptus comeldulensis, Trachspermum ammi,* and *Teminalia chebula*. *A. indica* based extracts significantly suppressed all the growth stages of *T.* castaneum. Azadirachin present in *A. indica* extract considerably affected the growth stages viz; egg, larvae, pupae and adults of subsequent offspring of *T. castaneum* through delayed larval, pupal and adult emergence. More Research work should be conducted on the extracts and essential oils of these plants at grain protectant against insect pest of stored commodities. These plant products can be used in integration with other bio- rational approaches.

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