SCREENING OF DIFFERENT PLANT EXTRACTS AGAINST *TRIBOLIUM CASTANEUM* (HERBST.) UNDER LABORATORY CONDITIONS

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ABSTRACT: *Red flour beetle, Tribolium castaneum, is an important pest of different stored grains. The present study was planned to evaluate the effect of seven different plant powders against T. castaneum under laboratory conditions. Four doses in five replications for each of the plant powder were prepared by mixing them with flour inside plastic jars. Twenty five pairs of adult beetles were placed inside each jar and mortality was recorded after 7 days. The mortality was increased as dose increased. Significant differences were observed among different doses of plant extracts in causing mortality of adults T. castaneum. At dose 1, maximum mortality was recorded in neem seed (25±4.01%) and peppermint (24.02±4.07%) mixed flour. While at dose 2, 3 and four, black pepper and neem seed powders caused the highest mortalities ranging from 44.4-65.2% and 40.4-69.4%, respectively. Eucalyptus (7.8%), lemon grass (24.6% and 29.4%) caused the lowest mortalities at dose 1, 2 and 3, respectively. However, at dose 4, minimum mortality was recorded in peppermint treated flour (35.2%). The use of neem seed and black pepper powders in stored grains can be very effective for the control of T.castaneum and other stored grain insect pests. The results could be helpful in designing an effective management plan for the control of T.castaneum.*

Keywords: *Tribolium castaneum*, neem seed, black pepper, mortality

INTRODUCTION

Safe storage of grains and food products is a major problem to avoid damage by insect pests [1]. About 9% of the world's grain production is lost by insect pests and mites under favorable climatic and storage conditions [2, 3, 4]. The red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae), is one of the major stored grain pests reported to cause damage to a wide range of commodities such as grain, flour, peas, beans, cacao, nuts, dried fruits, and spices, but milled grain products such as flour appear to be their preferred food [5]. Larvae and adults generally feed on the grains only which had already been damaged by other pests [6].

Preventive and curative control measures are in practice to control stored grains pests. Among these, highly toxic synthetic chemicals have been used for many years. However, these chemicals have some serious drawbacks on public health and the environment, and insecticide resistance (7) Therefore, it is necessary to look for other sources which are readily available, affordable, less toxic to mammals and safe to the environment [8].

The use of plant material as traditional protectors of the stored products is an ancient practice used everywhere in the world [9]. The protection of stored products usually involves mixing of the grains with herbal mixture [10]. In many countries, efforts are made to minimize the use of harmful insecticides through the use of native plant products, implementation of integrated pest management approaches and use of biodegradable products to protect stored grains [11]. Management of stored grain pests using materials of natural origin today is the topic that has received a lot of attention. Plants like *Azadirachta indica* L., *Cassia fistula*, *Calotropis procera*, *Lantana camara*and *Chrysanthemum coronarium* have shown insecticidal, anti-feedant, repellant and growth regulating properties to insects [12, 13, 14]. Such botanical products have numbers of advantages over the synthetic insecticides such as environmental safety, less hazardous, economic and easily available. Therefore, the present experiment was conducted to study the effect of different botanical powder: black pepper, castor bean, eucalyptus, lemon grass, neem seed, peppermint and red chilli. The results could be helpful in devising environment friendly management practices for the control of *T.castaneum*.

MATERIALS AND METHODS

The trials were conducted at the Eco-Toxicology Laboratory, Department of Entomology, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan.

Plant Materials

Black pepper, castor bean seed, eucalyptus leaf, lemon grass, neem seed, peppermint and red chili powders were used in this study. After drying, the seeds were ground to fine powder with an electric grinder. Green leaves of eucalyptus and peppermint were obtained from the eucalyptus trees and peppermint plants respectively, and dried in the laboratory. The dried leaves were ground and sieved to get the powder. Dried leaves of lemon grass were ground to make the powder. All the plant parts were purchased from the local market.

Bioassays

Four doses were prepared in glass jars (500 ml) for all the botanical powders (Table 1). Each dose was repeated five times with a total of 20 glass jars for each treatment and 20 glass jars containing wheat flour only as control. The dose was mixed in the 60 grams of wheat flour. Twenty five pairs of adult *T. castaneum* (5 day old approximately) were released in each jar. The jars were covered with muslin cloth and tightened with a rubber band. During the experiment, the temperature and relative humidity were maintained at about 25 ± 5°C and 70 ± 5% respectively. The adult mortality in each jar was recorded after 7 days.

Table 1. Plant extracts and their doses (g) used against *Tribolium castaneum*

English Name	Botanical Name	Dose 1 (g)	Dose 2 (g)	Dose 3 (g)	Dose 4 (g)
Black pepper	*Piper nigrum* L.	0.30	0.60	0.90	1.5
Castor bean	*Ricinus communis* L.	0.18	0.36	0.54	0.90
River red gum	*Eucalyptus camaldulensis* L.	0.18	0.36	0.54	0.90
Lemon grass	*Cymbopogon citratus* Staph.	0.15	0.30	0.45	0.75
Neem seeds	*Azadirachta indica* A. Juss	0.18	0.36	0.54	0.90
Peppermint	*Mentha piperita* L.	0.15	0.30	0.45	0.75
Red chilli	*Capsicum annuum* L.	0.30	0.60	0.90	1.50

Statistical analysis

Data were subjected to analysis of variance (ANOVA) using statistical software Statistix 8.1. Treatment means were separated by Tukey's HSD test at 0.05 level of significance for all statistical tests.

RESULTS AND DISCUSSION

At dose 1, the treatments were significantly different in causing mortality of adults of *T. castaneum* (df =6, 28, F = 2.99, P = 0.021) with the highest mortality caused by neem seed (25±4.01%) and peppermint (24.02±4.07%) while the least by eucalyptus (7.8.2±1.06) (Fig. 1). The adult mortality caused by different treatments at dose 2 showed non-significant differences among the treatments (df =6, 28, F = 1.45, P = 0.23). Maximum mortality was recorded in black pepper treated flour (44.4±7.42%) while lemon grass powders were least effective in terms of mortality (24.6±3.96%) (Fig. 2). However at dose 3, treatments were significantly different (df = 6, 28, F = 2.61, P = 0.03). Black pepper (57.2 ± 6.23%), and neem (53.4 ± 5.52%) showed higher mortalities of adult *T. castaneum* compared to other treatments. The mortalities caused by different treatments at dose 4 are given in figure 4 with significant differences observed among treatments (df =6, 28, F = 5.53, P = 0.000). The maximum mortality was caused by neem seed (69.4±8%) while minimal mortality was recorded in eucalyptus (38.8±5.35%) and peppermint (35.2±4.36%) (Fig. 4).

Stored grain losses always become a threat to the food security for the mankind. Among many of the factors of storage losses, insect pests are the main factor. Chemicals have been used for the control of these pests but due to indiscriminate use, the pests are developing resistance against these chemicals. Therefore, it is the need of the hour to find out an alternative which is safe and acceptable by the local people. The research indicates that the botanicals have potential to control the pest population in stored grains. All of the botanicals proved to have tendency to cause mortality of *T. castaneum*.

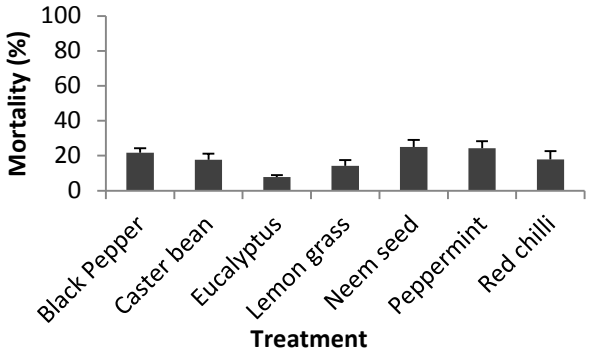

Figure 1. Mortality (%) of *T. castaneum* by different plant extracts at dose 1

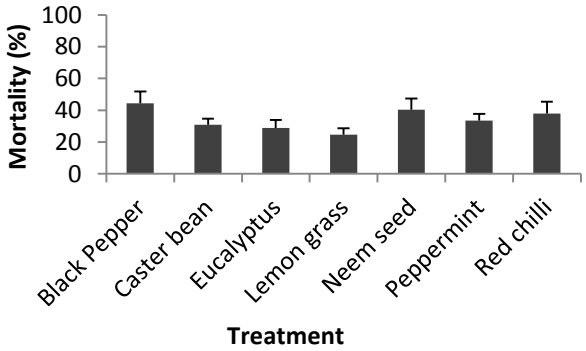

Figure 2. Mortality (%) of *T. castaneum* by different plant extracts at dose 2

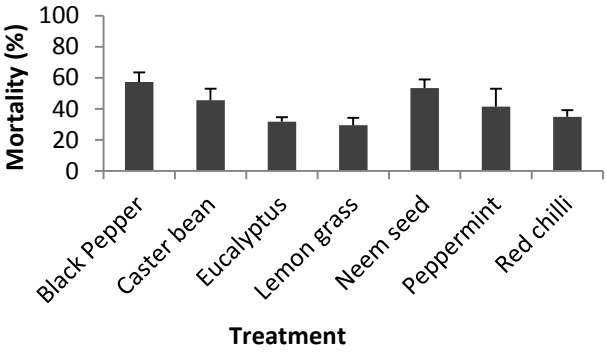

Figure 3. Mortality (%) of *T. castaneum* by different plant extracts at dose 3

The results depicted that at least one dose of every botanical has a significant effect on adult population. The mortality was increased with the increase in dose of all botanicals. Lower doses of neem showed even higher mortalities. This could be due to the fact that neem contains azadirachtin as active ingredient which is very effective in killing insects [15]. Ahmed *et al.* [16] reported greater efficacy of neem even compared to cypermethrin. The black pepper also provided maximum mortalities at all doses. Previous findings of Shayesteh and Ashouri [17] also supported these findings.

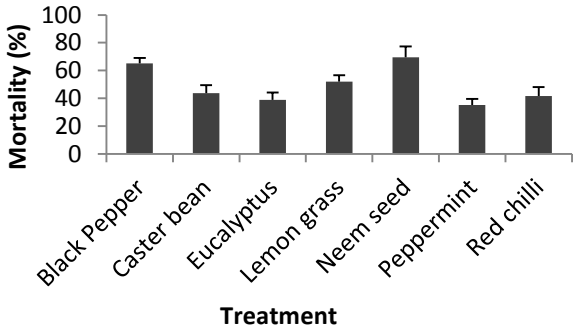

Figure 4. Mortality (%) of *T. castaneum* by different plant extracts at dose 4

He studied the effect of four powdered spices viz, black pepper, chili pepper, cinnamon and turmeric as repellents against adults of *R. dominica* F., *S. granariu*s (L.) and *T. castaneum* (Herbst) and found all of these plant species to be most effective at the highest dose (2.5%) and after interval (24 hours).

CONCLUSION

The results of the present study revealed that neem seed and black pepper powder could be a good alternative to conventional and synthetic insecticides. Keeping in view the potential hazards of synthetic insecticides, the neem powder can be used as bio-pesticide to control the insect pests of stored grains as they are also inexpensive, biodegradable and safe to human health and environment.

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