Inhibitory Effects of Medicinal Plant Extracts Against Tribolium Castaneum (Herbst.) (Coleoptera: Tenebrionidae)

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***Abstract*- Qualitative and quantitative losses of almost all the stored grain products are associated with Tribolium castaneum commonly known as red floor beetle. Since its first appearance, chemicals are vitally being used to manage the pest which encouraged evolutionary changes in the insect. Searching the alternative to the chemicals, the present study was planned to investigate the potential of different medicinal plant extracts against the test insect. Extracts of Fumeria indica, Viola odorata and Linium ustatisum at 3, 6, 9 and 12 % doses along with the untreated check were applied for their significant effects upon insect mortality and population growth rate. Extending the experiment, flour weight loss was also calculated due to insect feeding. The observations were recorded after 48, 96, and 144 hours, while population growth rate was checked after 35 days. Statistical analysis exhibited that Viola odorata extract significantly displayed higher insect mortality, lower population growth rate levels and least reduction in grain weight followed by Fumeria indica and Linium ustatisum.**

***Key words*: Fumeria indica, Viola odorata, Linium ustatisum, Medicinal Plants, Tribolium castaneum**

I. INTRODUCTION

Worldwide, Food security is considered as a vital aspect as it belongs to fulfillment of nutritional needs of human being. As wheat is a staple food of Pakistan as well as many other countries. In Pakistan it is harvested from 9.1 million hectares area yielding 25.5 Million metric tons annually [1]. Wheat crop undergo severe pre harvest and post harvest perturbations which results in exponential qualitative and quantitative losses [2]. In Pakistan, Farmers keep 75 % of their wheat production at household level for their nutritional needs and store them by traditional ways which encourage the stored grain pest attack resulting in bad quality of grains every year [3].

Stored grain losses are associated with the Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) and it is considered most common among its community [4]. The pest is generally found in grain storages, flour mills, and warehouses. In a general perception, larvae or adults could not damage any sound grain so they only feed upon damaged grains by other pests [4]. In almost all the countries, the pest is managed through synthetic pesticides [5]. But due to the usage of similar chemicals year after year, pest has gained resistance against these pesticides such as phosphine at different life stages [6,7]. Furthermore increased cost of insecticides, hazardous handling, residual effects, detrimental effects upon human beings and environment are also worth notable [8]. The scenario clarifies that efforts must be done in finding the alternatives to these chemicals. Coping this, medicinal plant extracts showing insecticidal properties attract the attentions as they are relatively cheaper, locally available and are least toxic to human beings [9,10]. Regarding this, a number of plants have been reported having bioactive metabolites showing repellent and toxic properties upon a wide range of insect pests [11-14]. Many of the plants have been reported recently which showed insecticidal potential against the Red Flour Beetle [15-20]. Keeping the view of potential of medicinal plants, the present study was planned to conduct experiments using the Fumeria indica, Viola odorata and Linium ustatisum to identify their insecticidal properties against red flour beetle.

II. MATERIALS AND METHODS

The experiments were conducted in the Department of Entomology, University of Agriculture Faisalabad in 2014-15 via using completely randomized design (CRD) in triplicate. Potential of three Medicinal plants (Fumeria indica, Viola odorata and Linium ustatisum) was explored against Tribolium castaneum.

A. Collection & rearing of insects.

Collection of insects were done from the godowns of Agriculture Food Department, Bahawalpur, Punjab and were further reared upon sterilized wheat flour in plastic Jars by librating thirty adults of each strain containing 500 g of wheat flour. Muslin cloth was used for covering the jars and moreover tying with rubber bands to avoid the escape of insects. The jars were placed in the incubator at specifying temperature of 30 ± 2°C and humidity at 70 ± 5 for developing the homogenous population of insects [21].

B. Preparation of plant extracts

Linseed (Linium ustatisum), leaves of Shahtra (Fumeria indica), and Banafsa (Viola odorata) were collected from the field and market of Bahawalpur. Plant materials were dried under shade and grinded with the help of electric grinder. Grinded contents were passed through 40-mesh sieve for obtaining fine powders. Extraction was done using acetone as solvent by adding 50g of powder and 100 ml of solvent (acetone). The samples were loaded on rotary shaker (IRMICO OS-10) at 120 rpm for 24 hours. Filtration was done with the help of whattman filter paper.

C. Mortality test

Each experiment was carried out in plastic or glass vials. Four different concentrations 3%, 6%, 9% and 12% of plant extracts of Fumeria indica, Viola odorata, Linium ustaltisum and an untreated control were applied. 20g of wheat flour in each vial (100 ml) and 20 adults were introduced in each vial and covered it. Mortality rate of adults was recorded after 48, 96 and 144 hours.

D. Population growth rate

The survived individuals from the contact toxicity were transferred into the new clean jars containing 40g of sterilized wheat flour and the data regarding reduction in population growth rate of F1 generation was recorded after 35 days.

E. Weight Loss in Flour

Small baits of treated flour at different concentrations were prepared including an untreated check, while the initial weight of each bait and one day starved adults was measured. Twenty homogenous one day starved adults were released after 3 days. The weight loss of baits was measured after six weeks and alteration in the weight of adults was compared by following formula.

$W0 = W1 – W2$

Where:- W0 = Weight difference; W1 = Initial weight of bait; W2 = Final weight of bait

F. Statistical Analysis

The data was analyzed in one-way analysis of variance (ANOVA) in Statistix 8.1 and means were separated for significance using Tukey's honestly significant difference (HSD) Test where P = 0.05.

III. RESULTS

A. *Insect Mortality*

All the plant extracts were categorized as reliable in term of insect mortality but their efficacy varied by application of concentration. Higher concentrations of all the plant extracts shown better results. For example, 12 % concentration of Viola odorata gave the most mean mortality 9.402% followed by Fumeria indica (8.365%). Linium ustatisum showed least insect mortality (7.058%). But when the applied concentration of plant extracts was reduced, the mean mortality rate of insect was also recorded lowest e.g. 3% concentration of Viola odorata recorded 5.452% mean mortality followed by Fumeria indica (3.981%) and Linium ustatisum (2.029%). No mortality (0.00%) of Insect was recorded in control treatment (Figure 1).

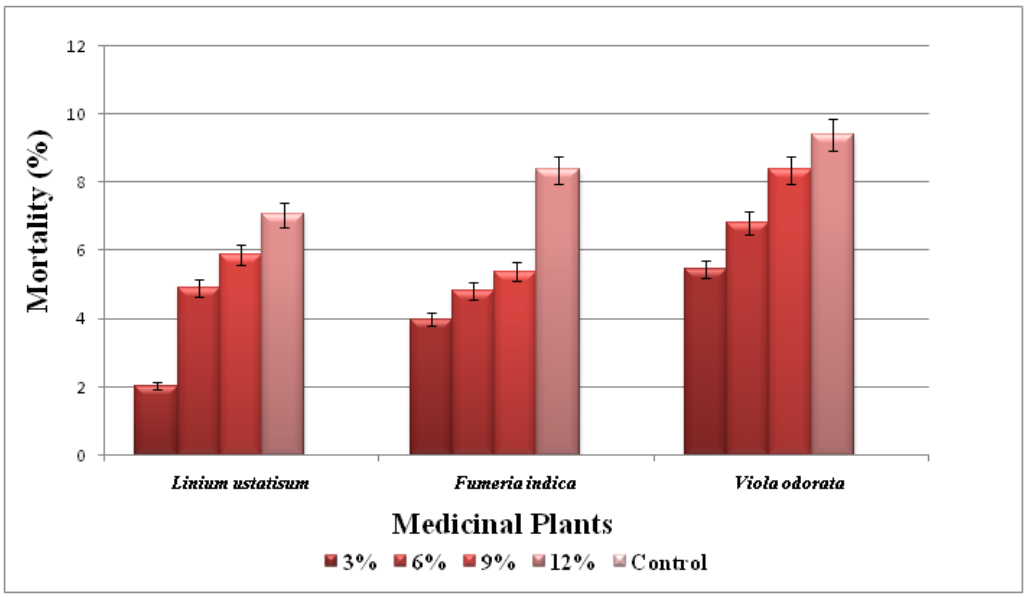

Figure 1:- Comparison of mean mortality values of Tribolium Castaneum due the interaction of different concentrations (3, 6, 9, and 12%) of Fumeria indica, Viola odorata and Linium ustatisum extracts with different time intervals (24, 48, 72 and 96 hours). Here control values are 0.00%.

B. *Population growth rate*

Figure (2) represents a significant difference between the performances of plant extracts. Viola odorata reduced mean population growth rate up-to (71.183%) at concentration of 12% followed by Fumeria indica (61.611%) and Linium ustatisum (52.342%) as compared to control (5.091%) . The reduction in the concentrations also minimized the potential of the botanical extracts as 3% concentration least reduced mean population growth rate levels (52.721%, 40.010% and 29.041 respectively).

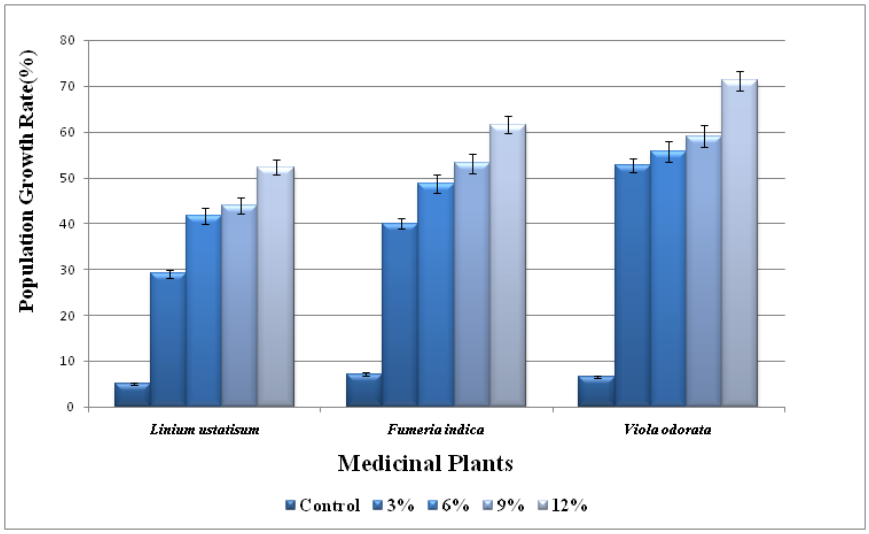

Figure 2:- Comparison of mean values of the data regarding reduction in percent population growth rate of Tribolium Castaneum due the interaction of different concentrations (3, 6, 9, and 12%) of Fumeria indica, Viola odorata and Linium ustatisum with different time intervals (24, 48, 72 and 96 hours).

C. Flour weight loss

Similar performance was recorded for this attribute also as higher doses of plant extracts were directly proportional to their insecticidal potential. Here also Viola odorata performed better followed by Fumeria indica and Linium ustatisum as 12% concentration recorded minimum grain weight loss with featuring values 3.000%, 3.500% and 4.332% respectively as compared to control i.e. 9.521%. (Figure 3) illustrates increase in grain weight loss at 3% dose levels as featuring value recorded were 4.802%, 5.161 and 6.503% respectively comparing with control (9.121%).

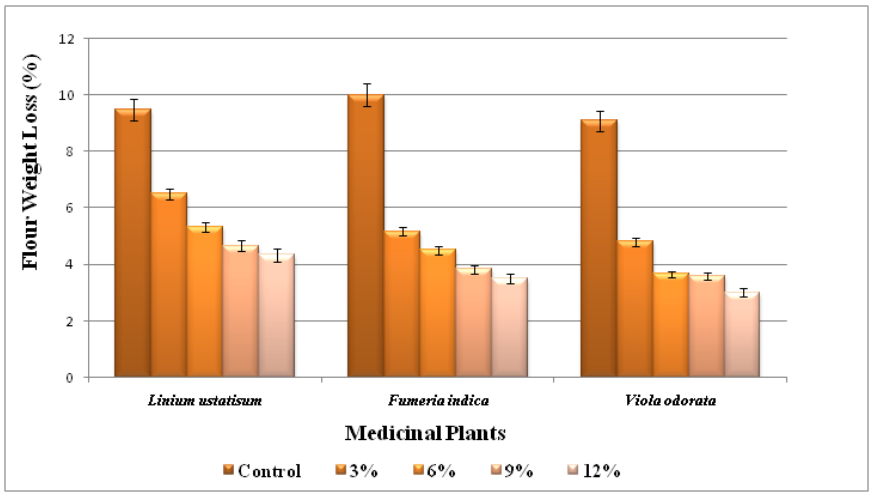

Figure 3:- Comparison of mean values of the data regarding percent weight loss in flour due to feeding of Tribolium Castaneum along with the interaction of different concentrations (3, 6, 9, and 12%) of Fumeria indica, Viola odorata and Linium ustatisum with different time intervals (24, 48, 72 and 96 hours).

IV. DISCUSSION

Rapid and repeated use of the synthetic insecticides has shifted the balance towards the finding and usage of eco-friendly pesticides [22,23]. Regarding this, plant extracts have emerged as alternatives [24,25] showing their toxic potential at various concentrations against the stored grain insect pests such as red flour beetle. In context to this, we evaluated some medicinal plant extracts at varying concentrations against T. castaneum. Our experimental findings proved theses plant extracts have suitable potential regarding insect mortality, population growth rate and weight loss in flour. We found maximum adult mortality at 12% concentration of all the plant extracts. Our findings are in line with Chaubey [26] who recorded highest adult mortality of Tribolium castaneum at similar concentration of Trachyspermum ammi, Anethum graveolens and Nigella sativa. These results further get strengthened by the findings of Padin [15], Jahromi [27], Noman [28] and Bilal [17] who also documented the success of different plant extracts against T. castaneum at higher concentrations. We further examined the effects of subjected plant extracts upon population growth rate levels and it was found that relatively higher concentrations of all plant extracts exhibited better results in keeping the population growth rate at lower levels. Our findings correlate with the efforts of Sagheer [16,29,30] who tested different indigenous plant extracts for different attributes against T. castaneum. Furthermore, we recorded the reduction in wheat flour weight loss when we applied 12% concentrations of all the extracts that mean the toxicity of extracts at higher concentration was lethal against the target insect. Recent efforts of Bibi [31] found connecting with ours as she tested Azadirechta india and Chrysenthimum extracts against mortality and wheat flour losses attributes against Tribolium castaneum in laboratory conditions and documented 42.83% mortality of insect by higher concentrations of plant extracts as well as minimum weight loss in flour by insect feeding.

V. CONCLUSIONS

We have observed that medicinal plants have greater potential in minimization of target pest and they can be used as alternatives to the synthetic chemicals for the management of stored grain pests. But we recommend that a proper layout must be followed to produce plant extracts and higher concentration of plant extracts must be applied for better management of pests.

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CONFLICTS OF INTEREST

We declare that we don't have any conflicts of interest.

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