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Efficacy of different Plant Extracts and Spinetoram (Radiant) Against Red Flour Beetle (*Tribolium Castaneum* (Herbst.) (Coleoptera: *Tenebrionidae*).

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ABSTRACT

Agriculture commodities infested by insect pest are being controlled by various methodologies for countering their drastic affects. One of the earliest methods is the use of insecticide against red flour beetle (Tribolium castaneum) insects have developed resistance against these insecticides, there for in the present research we were examine the mortality effect of two plants extracts (kaniar and shahtra) and spinetoram (radiant) against red flour beetle to compare the efficacy of these insecticide. The lethal effect of kaniar, shahtra and spinetoram were be evaluated using 6 concentrations 2.5, 5, 7.5, 10, 12.5 and 15 with 3 replications. The filter paper was used for bioassay evaluating the mortality after 24, 48, 72, and 96 hours. Statistical analysis was carried out for (ANOVA) using statistics 8 software. Mean of significant treatments were compared using Tukey HSD test. Mortality analysis showed that highest mortality was observed in case of spinetoram (radiant) (97%) at 150 ppm after 96-hour exposure following the plant extract Kaniar (70%) at 15% concentration after 96-hour exposure and shahtra (57%) at 15% concentration after 96-hour exposure, high repelancy was obtained by the plant extract, Shahtra (100%) after 60 minutes exposure followed by Kaniar (93%) after 60 min exposure. The results concluded that both the plants are highly effective than the insecticide against Tribolium castaneum and they can be safely used against stored product pests in commodities to conserve the food grains for future use without residual effects and other side effects related to health and food quality.

INTRODUCTION

Red flour beetle (*Tribalium castaneum* (Herbst)) (Coleoptera: Tenebrionidae) is one of the devastating grain pest infesting stored food throughout the world. Earlier research has reported about 10-40% losses due to insect pests in stored grains (Rajkumar *et al*., 2019). In developed countries 5-6 percent losses are caused by stored grain pests and such as in developing countries 20% losses of grain are caused by insect pests. These stored insect pests destroyed lot of loses of the world production equal to one-third almost cause losses of hundred billion dollar (Said and Pashte, 2015). These insects do not just cause the quantitative, but it also causes the qualitive by producing excreta and their dead bodies which produce bed smell in grains (Singh *et al*., 2021). By the infestation of insect pests which destroy the quality and quantity of grain in stored grain as well economy has also been infected by infestation of the insect pests (Ali and Ali, 2015) it has been also reported that some insect pests secrete toxins chemical which carcinogenic effect on human's health if it is engulfed by any way to human (Lis *et al*., 2011).

Red flour beetle adults is reddish brown, and their eggs are long and white in color. The adult selected the crevices for ovi-position and their eggs are coated along the sticky substance to attach the eggs with surface of any material and small particles layer adhere to the eggs to protect from biotic and abiotic factors (Li and Arbogast, 1991). The larvae of red flour beetle are yellowish white in colour and have typically 3 pair of thoracic legs and their larval instar been 6-7 which depend on nutrition and temperature as well as their immature away from the light to enter in the food. Last stages of larval instar make a shelter on the body for pupation. Their pupae are known as exarate which is white in colour the exarate means their appendages are free but not glued to the body. Characters of the female and male can be differentiated by their external genitalia. At 25°C the development of red flour beetle completes their life cycle from eggs to adults in 41.8 days and in 35.5°C completes their life cycle in 21.7 days (Hagstrum and Subramanyam 2006). The eggs are hatched in 5 days, larval stage is completed in 12-13 days and the pupal stage almost 4 days. Males have a setiferous patch on the posterior side of the fore femur, but females do not (Li and Bousquet, 1990). To control this pest species in mills, a broad range of insecticide treatments are used, aluminium phospide is a fumigant insecticide used for the control of pests, and other alternative fumigants such as sulfuryl fluoride are substitutes to traditional fumigant, methyl bromide while comparing the use of it recent are less regularly applies in general type of structural fumigations as in past (Subramanyam and Hagstrum, 2012). The treatment by number of insecticides which are applied for aerosol and residual have become alternative for flavour, as the risk materials are reduced along with the higher utilisation due to pyrethroids, insect growth regulators (IGRs) and pyrethrin's (Arthur and Fontenot, 2012; Arthur, 2015).

Excessive use of conventional synthetic pesticide to protect stored cereals has resulted the development of insecticide resistant strains, handling hazards, insecticide residues in food, threat to human health and serious environmental issues (Benhalima *et al*., 2004). For the continuous and economical supply of food and other agriculture commodities these invaders should be controlled through a safe management strategy (Tchonkouang *et al*., 2024). To handle this damaging situation there is the need for sincere interest regarding the control of stored product pest (Copping and Menn, 2000). For the store grain the application of chemical verses insect pest and have become infective because in *T. castaneum* number of resistant strains have developed (Guedes *et al*., 1996; 1997). In storage cereals the prevention of insect pest through the world has arisen in new form by using the biopesticides (Rizvi *et al*., 2001). According to the environmentalists all over the world advises to use minimum persistent insecticides for the deleterious influence of pure compounds and extracts of plants (Hameed *et al*., 2012). Keeping in view the economic and safe importance of botanical this research study was designed to evaluate the bio-efficacy of two plant extracts (Kanair and Shahtra) against red floor beetle and also to check the insecticidal effect of spinetoram (radiant) against the mentioned insect store grain pest.

MATERIALS AND METHODS

The experiment was performed in laboratory of PARC-Arid Zone Research Centre, Dera Ismail khan, during 2023.

Equipment of Research Experiment

The equipment for performing this experiment the essential accessories were used that are wheat flour, plastic jars, rubber bands, muslin cloth, camel hair like brushes, sieves, Walter filter papers and petri dish.

Insect Population Collection and Culturing

The heterogeneous insect population of *Truibolium castaneum* were collected from AZRC Farm store. The collected population were raised in the laboratory on sterilized flour, for their growth criteria the minimum temperature 27±2°C with relative humidity of 65±5% were provided. The adults obtained from the cultured population were sieved out than after duration of 72 hours and the flours having eggs to make uniform were incubated and the F1 homogenous population was analyzed for the experiment.

Plant Materials

Fresh leaves of kanair and shahtra were collected from the local fields of Dera Ismail Khan.

Plant Extract Preparation

The collected seeds were ground to fine powder with the help of electric grinder in the laboratory. The powered materials weighted 100g transferring to conical flask by adding 300ml acetone and loaded on rotary shaker for 72 hours to make throughway the homogenous solution. The prepared extracts were shifted to vials glass after the filtration with the help of Whitman filter paper done and collected in the flask and placed on oven for 5 to 10 minutes aim to make it little bit thick by drying. Then these were put in the refrigerator at 4℃ after proper labelling.

Dosage Formulation of Extracts

The successful extracts after preparation insects were prepared and the applied the required doses against it. The aim was to measure the already prepared extracts at 5, 10 and 15ml each and added these extracts to the distilled water and measured in the flask at 85, 90 and 95ml respectively. The complete mixing of these dose at the end were applied to the filter papers which had placed in the petri dish.

Nominee Insecticides

The aim of nominee insecticides chlorpyriphos, their brand name Dursban was purchase from scientific store Faisalabad.

Dosage Formulation of Insecticides

With the help of formula, the insecticide dose was prepped.

$C1V_1=C2V2$

C1= SC of used insecticide (%)

V1= Volume of insecticides required (ml)

C2= Concentration to be prepared (ppm)

V2= volume of water to be used to prepare desire dose (ml)

The volume required of insecticide (V1) has been calculated with the help of using suspension concentration (SC) of 48% of chlorpyriphos insecticides.

Mortality Bioassay

The petri dishes having Whatman filter paper as experimental units against *Tribolium castaneum* were tr $Mc\,(\%)\frac{Mo}{100+Me} \times 100$ eated using the different levels of concentration i.e., 5%, 10% and 15% along with insecticides at the rate 1000ppm, 2000ppm and 3000ppm and used 3 replications of each dose with I control group under research. The experiment was consisting of 12 units if each treatment. In the laboratory conditions to each petri dish the 20 adults' insects of T. castaneum were released and recorded the insect rate of mortality after exposed time of 24, 48 and 72 hours respectively. Data was recoded using the formula:

$Mc(\%) = \frac{Mo}{100+Me} \times 100$ Mc= Corrected mortality rate (%)

Mo= Adults treated mortality rate (%)

Me= controlled mortality rate (%)

Repellent Activity Bioassay

The repellent activity was determined with the help of (Islam *et al*., 2009) described method 'area preference'. In this method for repellent activity diagnoses of *Tribolium castaneum* half filter discs were arranged. Each prepared filter paper discs were died for 10 minutes after treating with different doses level with acetone extracts. The half filters papers separately edge to edge were tapped by the half control disc and put-on petri dishes. The jars as experimental units with 1 control group in 3 replications applying acetone half treated discs. Then 20 insects in each petri dish were released for recording the observations after 12 and 24 hours respectively, for drawing the conclusions using the formula to record the (ANOVA) and mean comparison performance against repellence percentage as:

Percentage repellence (PR %) = $Nc\,\frac{Nc-Nt}{Nc+Nt} \times 100$

Nc= Control number of insects

Nt= Treated number of insects

Population Build up Bioassay

The build-up population from both the insecticides and extracts were tested by using the plastic jars as experimental unit. Each treatment assigned in jars respectively with 3 replications hence nine units of treated jars of a single extract from one trail while 3 used as control, in this way each extract was consisting of 12 jars respectively. Each 12 jars individually, were filled with broken grains. After mortality bioassay conduction the living insects from the petri dish we picked up with the help of camel hair color brush from the experimental units and transferred to the jars containing grains. Each plastic jar assigned accordingly to its respective treatment of insects. The jars were placed by making small holes in the lid for aeration. The jars were kept at constant temperature of 30℃ in incubator for 2 months. Data was recorded after each 30 and 60 days by observing the mortality rate of adult insects and growth of population. The aim of this was to record the growth of fecundity or new generation to check the trend population after treatment application. The observed trends were after recoding with the assist of following Abbott's formula calculated gained.

%Corrected growth inhibition= [C-T/] ×100

T= Number of emerged populations in treatment

C= Number of emerged populations in control.

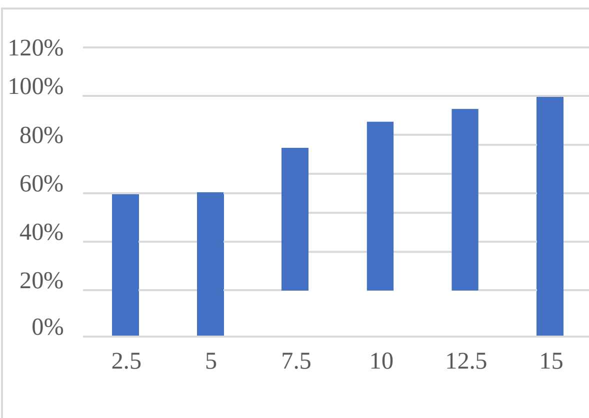
Statistical Analysis

The analysis of variance (ANOVA) and with the help of Tukey's honest significant difference (HSD) test the mean comparison by using statistics 8 software was applied using the CRD lay out.

Toxicity of Varies Concentrations of Crude Extract of Shahtra against T. Castaniume after 24 hours.

The data regarded death rate (mortality) percent of *T. castaniume* against the extracts of shahtra is given in Figure-1, which shows significant variation among different concentrations of extract. The means of mortality of *Tribolium castaniume* against different concentrations of extract after 24 hrs were computed using Tuckey HSD test, which shows that maximum mortality 97% was caused by 15% solution followed by 93, 87, 73, 63, 60 against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 60% which was observed against 2.5% concentration of the extract.

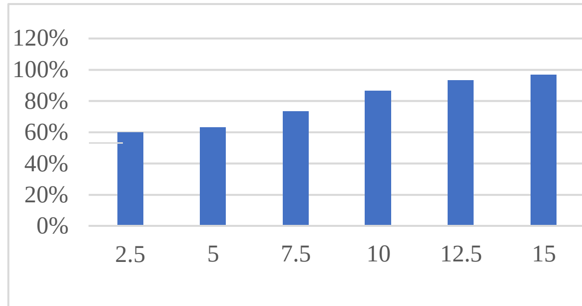
Figure 1
Mean comparison for toxicity of different concentrations of crude extracts of shahtra for their toxic effect against tribolium castaniume after 24 hours.



Toxicity of different Concentrations of Shahtra Extract against *Tribolium Castaniume* after 48 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against the extracts of shahtra is given in Figure-2, which shows significant variation among different concentrations of crude extract. The means of mortality of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tukey HSD test, which shows that maximum mortality 44.80% was caused by 15% solution followed by 39.74, 34.47, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

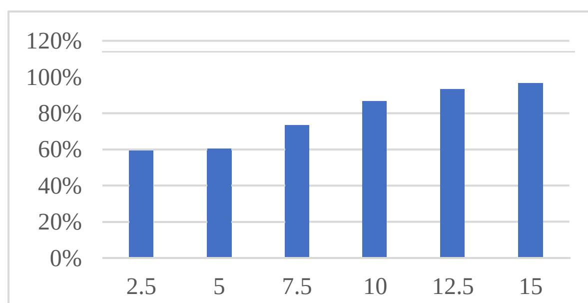
Figure 2
Mean comparison for toxicity of different concentrations of shahtra extracts against tribolium castaniume after 48 hours



Toxicity of different Concentrations of Shahtra Extract against *Tribolium castaniume* after 72 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against the extracts of shahtra is given in Figure 3, which shows significant variation among different concentrations of crude extract. The means of mortality of *Tribolium castaniume* against different concentrations of crude extract after 24 hrs were computed using Tuckey HSD test, which shows that maximum mortality 35.61% was caused by 15% solution followed by 32.28, 28.77, 25.44 and 20.44% against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 17.00% which was observed against 2.5% concentration of the extract.

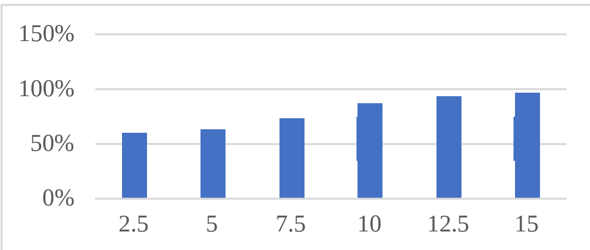
Figure 3
Mean comparison for toxicity of different concentrations of shahtra extracts against tribolium castaniume after 72 hours.



Toxicity of different Concentrations of Shahtra Extract against *Tribolium Castaniume* after 96 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against the extracts of shahtra is given in Figure 4, which shows significant variation among different concentrations of crude extract. The means of mortality of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that maximum mortality 44.80% was caused by 15% soloution followed by 39.74, 34.47, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

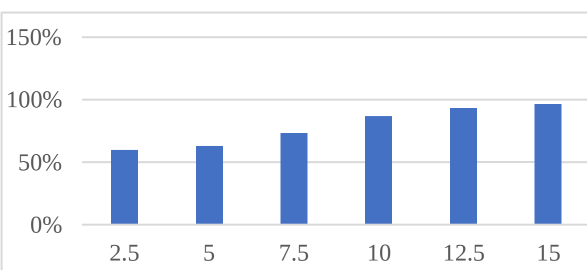
Figure 4
Mean comparison for toxicity of different concentrations of shahtra extracts against Tribolium castaniume after 96 hours.



Toxicity of different Concentrations of Kanair Extract against Tribolium Castaniume after 24 hours

The data regarded death rate (mortality) percent of *T. castaniume* against the extracts of kanair is given in Figure 5, which shows significant variation among different concentrations of crude extract. The means of mortality of *Tribolium castaniume* against different concentrations of crude extract after 24 hrs were computed using Tuckey HSD test, which shows that maximum mortality 35.61% was caused by 15% solution followed by 32.28, 28.77, 25.44 and 20.44% against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 17.00% which was observed against 2.5% concentration of the extract.

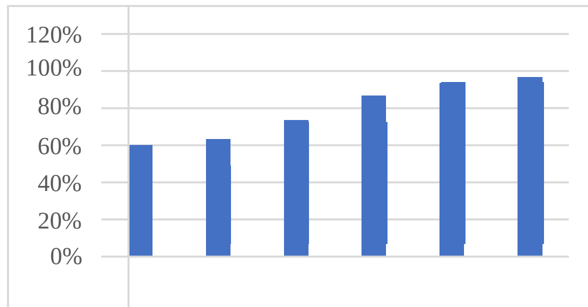
Figure 5
Mean comparison for toxicity of different concentrations of kanair extract against Tribolium castaniume after 24 hours



The data regarded death rate (mortality) percent of *T. castaniume* against the extracts of kanair in Figure-6, which shows significant variation among different concentrations of crude extract. The means of mortality of *Tribolium castaniume* against different

concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that maximum mortality 44.80% was caused by 15% soloution followed by 39.74, 34.47, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

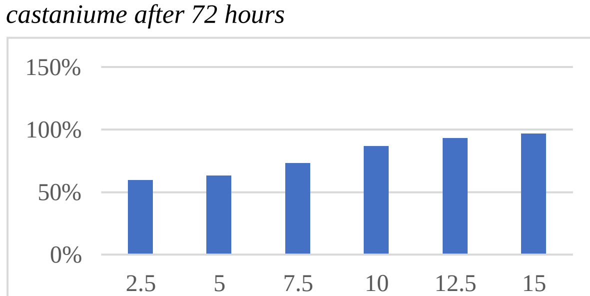
Figure 6
Mean comparison for toxicity of different concentrations of kanair extract against Tribolium castaniume after 48 hours.



Toxicity of different Concentrations of Kanair Extract against *Tribolium Castaniume* after 72 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against the extracts of kanair is given in Figure-7, which shows significant variation among different concentrations of crude extract. The means of mortality of *Tribolium castaniume* against different concentrations of crude extract after 24 hrs were computed using Tuckey HSD test, which shows that maximum mortality 35.61% was caused by 15% solution followed by 32.28, 28.77, 25.44 and 20.44% against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 17.00% which was observed against 2.5% concentration of the extract.

Figure 7
Mean comparison for toxicity of different concentrations of kanair extract against Tribolium castaniume after 72 hours

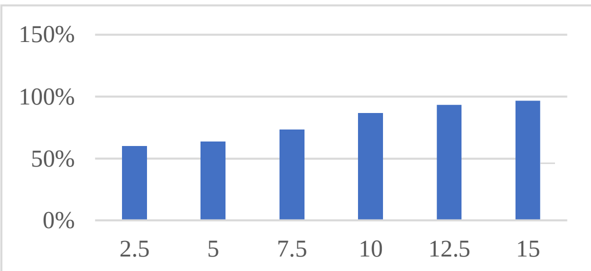


Toxicity of different Concentrations of Kanair Extract against *Tribolium Castaniume* after 96 Hours

The data regarded death rate (mortality) percent of *T.*

castaniume against the extracts of kanair is given in figure 8, which shows significant variation among different concentrations of crude extract. The means of mortality of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that maximum mortality 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum mortality of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

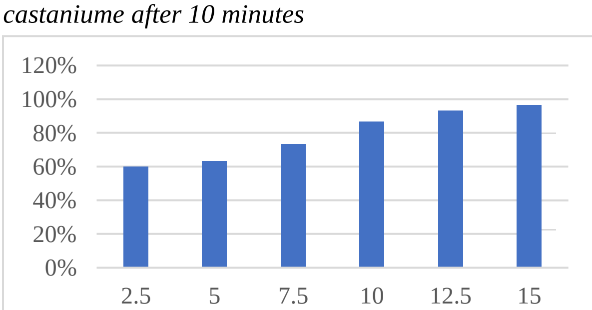
Figure 8
Mean comparison for toxicity of different concentrations of kanair extract against Tribolium castaniume after 96 hours.



Repellents effects of Varies Concentration of Shahtra Extracts against *t. Castaniume* after 10 Minutes

The data regarded repeal rate (repellency) percent of *T. castaniume* against the extracts of shahtra is given in figure-9, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that highest repellency 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

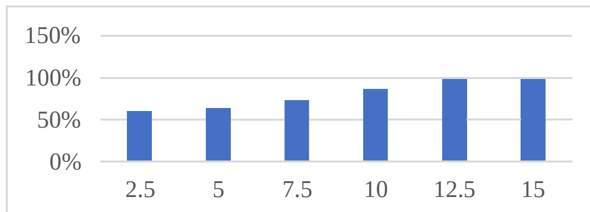
Figure 9
Mean comparison of repellency of different concentrations of shahtra extract against Tribolium castaniume after 10 minutes



Repellents effects of Varies Concentration of Shahtra Extracts against *T. Castaniume* after 20 Minutes

The data regarded repeal rate (repealancy) percent of *T. castaniume* against the extracts of shahtra is given in Figure 10, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that highest repellency 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

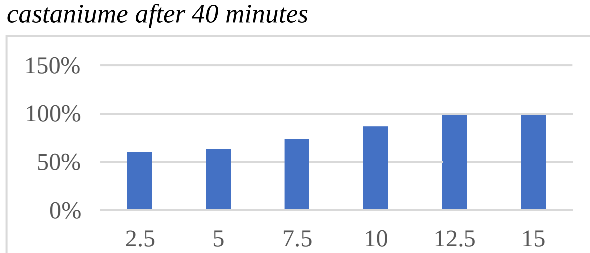
Figure 10
Mean comparison for toxicity of different concentrations of shahtra extract against Tribolium castaniume after 20 minutes



Repellents effect of Varies Concentration of Shahtra Extracts against *T. Castaniume* after 40 Minutes

ANOVA demonstration of variation of the data regarded repeal rate (repellency) percent of *T. castaniume* against the extracts of shahtra is given in Figure-11, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that highest repellency 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

Figure 11
Mean comparison for toxicity of different concentrations of shahtra extract against Tribolium castaniume after 40 minutes

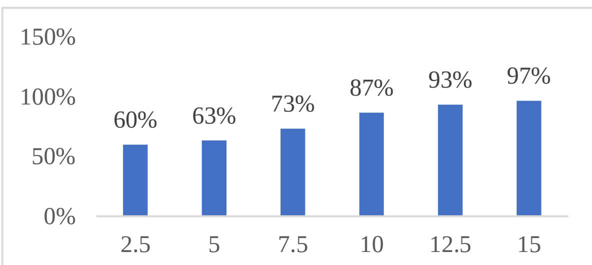


Repellents effects of Varies Concentration of Shahtra Extracts against *T. Castaniume* after 60 Minutes

The data regarded repeal rate (repealancy) percent of *T. castaniume* against the extracts of shahtra is given in Figure-12, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test are given in Fig. 4.1.2, which shows that highest repellency 44.80% was caused by 15% solution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

Figure 12

Mean comparison for toxicity of different concentrations of shahtra extract against Tribolium castaniume after 60 minutes

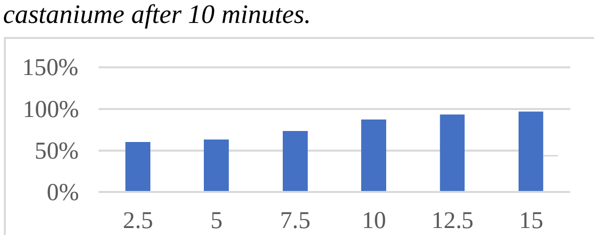


Repellents effects of Varies Concentration of Kanair Extracts against *T. Castaniume* after 10 Minutes

The data regarded repeal rate (repealancy) percent of *T. castaniume* against the extracts of kanair is given in Figure 13, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that highest repellency 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

Figure 13

Mean comparison of repellency of different concentrations of kanair extract against Tribolium castaniume after 10 minutes.

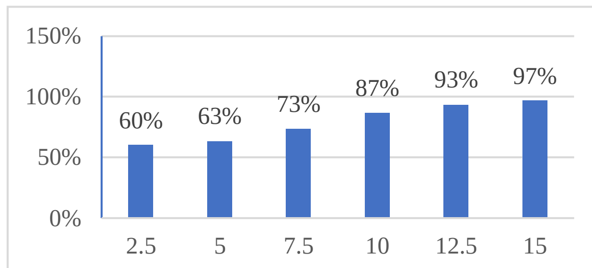


Repellents effects of Varies Concentration of Kanair Extracts against *T. Castaniume* after 20 Minutes

The data regarded repeal rate (repealancy) percent of *T. castaniume* against the extracts of kanair is given in Figure 14, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that highest repellency 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

Figure 14

Mean comparison for toxicity of different concentrations of kanair extract against Tribolium castaniume after 20 minutes

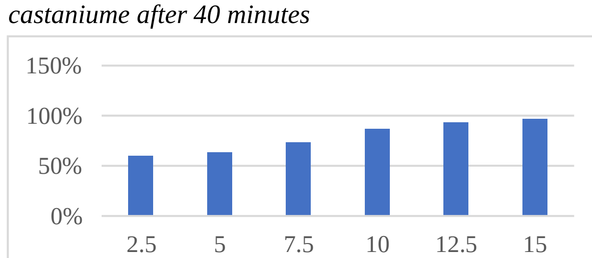


Repellents effects of Varies Concentration of Kanair Extracts against *T. Castaniume* after 40 Minutes

The data regarded repeal rate (repellency) percent of *T. castaniume* against the extracts of kanair is given in figure 15, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD test, which shows that highest repellency 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

Figure 15

Mean comparison for toxicity of different concentrations of kanair extract against Tribolium castaniume after 40 minutes

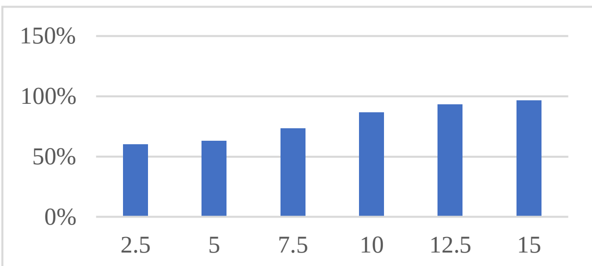


Repellents effects of Varies Concentration of Kanair Extracts against *T. Castaniume* after 60 Minutes

The data regarded repeal rate (repealancy) percent of *T. castaniume* against the extracts of kanair is given in figure 16, which shows significant variation among different concentrations of crude extract. The means of repellency of *Tribolium castaniume* against different concentrations of crude extract after 48 hrs were computed using Tuckey HSD, which shows that highest repellency 44.80% was caused by 15% soloution followed by 39.74, 3447, 30.88 and 27.54% against 12.5, 10, 7.5 and 5% respectively. Minimum repellency of *T. castaniume* was 22.46% which was observed against 2.5% concentration of the extract.

Figure 16

Mean comparison for toxicity of different concentrations of kanair extract against Tribolium castaniume after 60 minutes

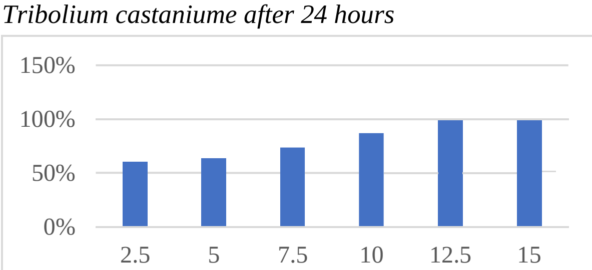


Toxicity of Spinetoram (Radiant) against *Tribolium Castaniume* after 24 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against spinetoram (radiant) is given in figure-17, which shows significant variation among different concentrations of the insecticide. The means of mortality of *T. castaniume* against different concentrations of the insecticide after 24 hrs were computed using Tuckey HSD test which shows that maximum mortality 45.61% was caused by 100 ppm followed by 33.77 and 23.26% against 75 and 50 ppm respectively. Minimum mortality of *T. castaniume* was 13.33% which was observed against 25 ppm concentration of the insecticide.

Figure 17

Toxicity of Insecticide Spinetoram (Radiant) against Tribolium castaniume after 24 hours

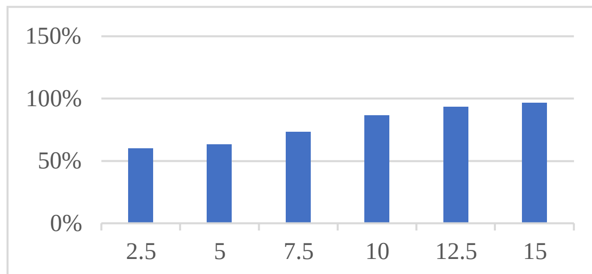


Toxicity of Insecticide Spinetoram (Radiant) against *Tribolium Castaniume* after 48 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against spinetoram (radiant) is given in figure-18, which shows significant variation among different concentrations of the insecticide. The means of mortality of *T. castaniume* against different concentrations of the insecticide after 24 hrs were computed using Tuckey HSD test which shows that maximum mortality 45.61% was caused by 100 ppm followed by 33.77 and 23.26% against 75 and 50 ppm respectively. Minimum mortality of *T. castaniume* was 13.33% which was observed against 25 ppm concentration of the insecticide.

Figure 18

Mean comparison of toxic effect of Spinetoram (Radiant) against Tribolium castaniume after 48 hours

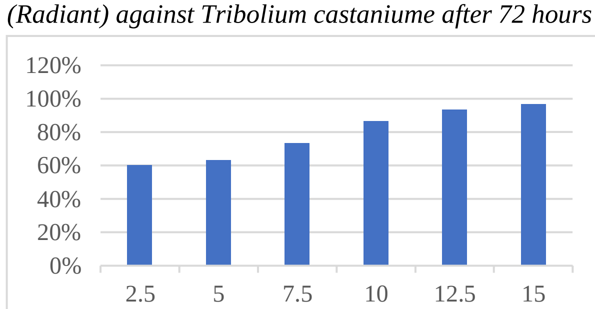


Toxicity of Insecticide Spinetoram (Radiant) against *Tribolium Castaniume* after 72 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against spinetoram (radiant) is given in figure-19, which shows significant variation among different concentrations of the insecticide. The means of mortality of *T. castaniume* against different concentrations of the insecticide after 24 hrs were computed using Tuckey HSD test which shows that maximum mortality 45.61% was caused by 100 ppm followed by 33.77 and 23.26% against 75 and 50 ppm respectively. Minimum mortality of *T. castaniume* was 13.33% which was observed against 25 ppm concentration of the insecticide.

Figure 19

Mean comparison of toxic effect of Spinetoram (Radiant) against Tribolium castaniume after 72 hours

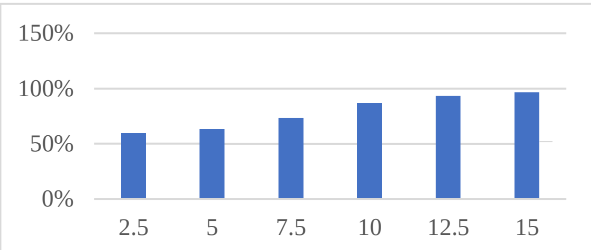


Toxicity of Insecticide Spinetoram (Radiant) against *Tribolium Castaniume* after 96 Hours

The data regarded death rate (mortality) percent of *T. castaniume* against spinetoram (radiant) is given in figure-20, which shows significant variation among different concentrations of the insecticide. The means of mortality of *T. castaniume* against different concentrations of the insecticide after 24 hrs were computed using Tuckey HSD test which shows that maximum mortality 45.61% was caused by 100 ppm followed by 33.77 and 23.26% against 75 and 50 ppm respectively. Minimum mortality of *T. castaniume* was 13.33% which was observed against 25 ppm concentration of the insecticide.

Figure 20

Mean comparison of toxic effect of Spinetoram (Radiant) against Tribolium castaniume after 96 hours



DISCUSSION

The storage of the cereals is a problem since the start of agriculture and increasing day by day as the need of the storage is increasing stored grain insect pest cause reduction in weight, texture and also quality of seed. It is studied that up to 10% losses of the stored grain occur in temperate and more than 20 % occur in tropical zone *T. castaniume* adult is red to brown their Egg are oblong and white Adult shows small preferences for crevices as egg laying site, Egg outer cover are coated along a sticky material that aid in an aching the egg to the surface and cause little particle to adhere to them (Li and Arbogast, 1991). To overcome this problem a research work was perform at Arid zone research center, Dera Ismail Khan regarding toxic and repellent effect of crude extracts of two indigenous plant and insecticide spinetoram (radiant) was checked against *T. castoreum* . Six concentrations of plant extracts and 6 concentration of insecticide spinetoram (radiant) were used.

In the present study three plant extracts (*Mentha arvenits*, *Fumaria indica* and *Astera cers*) and insecticide pyriproxyfen were evaluated against red flour beetle, *Tribalium castaneum* and Khopra beetle were used Plants have different kinds of phyto-compound that can affect the growth and metabolic activity of insects and can be used as an alternate of insecticides (Rajkumar *et al*. 2019). As these phytochemicals are better alternate for control of insects specially stored product pests due to their low mammalian toxicity and environment friendly nature (Isman, 2006). In an experiment done by researchers (Ramesha and Ramamurthy, 2012) against stored product beetles plant extract showed significant repellent effect. They observed almost 80% repellency at 10% solution of extract. Present study strongly agree with these findings as our result showed that all the three had 60-80% repellency against *Tribolium castaneum* Lower concentrations showed low repellency and higher concentration had maximum repulsive effect.

Plant extracts as well as their oils have effect on insects. They performed and experiment in which he used 57 plants oil against *Tribolium castaneum* and found that plant oils have significant effect in decreasing the pest population by repelling from infected area. Result revel as the concentration and time of exposure is increased percentage repelancy increases. Our findings also showed similar trend in results. As the percentage of extract increased from 2.5% -15% percentage repellency increased from 40% to more than 80% Contact toxicity and repellency of essential oils against *Tribolium castaneum* was assessed by (Qin *et al*. 2019). Their findings and our correlate with each other. Extracts as well as essential oils showed significant decrease in population of insect. Extracts of all three plants in the present study had almost 50-60% mortality up to 48 hrs and more than 80% repellency at 15% concentration. These results strongly disagree with (Kim *et al*. 2015) who stated 100% mortality caused in *Tribolium castaneum* by plant extracts even after 48 hrs but our findings show only 50-60% mortality in *Tribolium castaneum* by all the three plant extracts. Effect of four medicinal plants on repellency of khapra beetle by (Sagheer *et al*. 2013) by using 5-20% plant extracts. They reported that these four medicinal plants caused repellency varying between 45-55% As per our result both studies agree in terms of trend in repellency. According to our result medicinal plants cause repellency and the rate of repellency vary from plant to plants. In our results repellency caused by plant extracts varied from 40-80% against both targeted insects. Arannilewa *et al.* (2006) published his work in which the evaluated extracts of four medicinal plants against *S. zeamays* and found varying mortality in all treatments. Different extracts showed different mortalities varying from 20% to 100% after 3 days of application. Result of our study showed similarity with these findings as per results of present study all three plants showed degree of variation in toxicity against both insects (*T. granarium* and *T. castaneum*) and mortality ranged from 20-70% mortality. Results of our study also agree with (Jembere *et al* 2005) who publish his work in which they used a plant extract against insect pest. Result showed 45-60% mortality against 10-40% water extract against sorghum chaffer and 93-100% against termites within 48 hrs. In our study up to 60% or more mortality was caused by all three plant extracts against both insects (*T. granarium* and *T. castaneum)*. The present results also in line with Khan *et al*. (2024) who used different plant extracts against *P. perpusilla* (Nymphs) under laboratory conditions and recorded significant mortality. Likewise, (Haroun *et al*., 2020) used insecticide against three stored grain pests. They reported the application of 50-300ppm against these insects. Their result suggests that these insecticides can cause 100 percent mortality of the targeted insects within three days. Result of our study strongly disagree with these results as suggested by our result that such low dose of these particles cannot cause 100 percent mortality within short period of time Our results support the findings of (Ibrahim and Saleem, 2019) who found 100% mortality after the application of 250ppm insecticide. Our results also correlate at some degree with the results of (Stadler *et al*. 2012). They reported the use of insecticide at the range of 125 1000 ppm concentration and observed cent percent mortality after 15 days of application. In the present study we found almost 30-60% mortality at the concentration of 100 ppm after 2 days of application. In a research work (Gogate *et al*. 2018) studied the larvicidal effect of insecticide of periproxien from Ocimum sanction against larvae of rice moth, *Corcyra cephalonica* Larval mortality of *C. cephalonica* was found to be 80% and 83.33%. The lowest LC50 value was recorded to be 244.04 ppm after fifth day of the treatment. As the insecticide concentration and days after treatment increased, larval mortality also increased. Our results correlate with the results of these observations as the rate of mortality recorded at 100 ppm after 2 days was almost 50-60% for all treatments. And rate of mortality increased with the increase of concentration as well as exposure time.

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