Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

JEZS Journal of Entomology and Zoology Studies

ISSN 2320-7078
JEZS 2014; 2 (3): 107-110

Received: 19-04-2014
Accepted: 09-05-2014

Muhammad Sagheer
Department of Entomology, University of Agriculture, Faisalabad, Pakistan

Mansoor-ul-Hasan
Department of Entomology, University of Agriculture, Faisalabad, Pakistan.

Malik Najam-ul-Hassan
Department of Pest Warning and Quality Control of Pesticides, Punjab, Pakistan.

Muhammad Farhan
Department of Pest Warning and Quality Control of Pesticides, Punjab, Pakistan

Fawad Zafar Ahmad Khan
Department of Entomology, University of Agriculture, Faisalabad, Pakistan.

Abdul Rahman
Department of Entomology, University of Agriculture, Faisalabad, Pakistan

Correspondence:
Fawad Zafar Ahmad Khan
Department of Entomology, University of Agriculture, Faisalabad, Pakistan.

Repellent effects of selected medicinal plant extracts against Rust-Red Flour Beetle, *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae)

Muhammad Sagheer, Mansoor-ul-Hasan, Malik Najam-ul-Hassan, Muhammad Farhan, Fawad Zafar Ahmad Khan, Abdul Rahman

ABSTRACT
Acetone based plant extracts of *Nigella sativa*, *Syzygium aromaticum* and *Trachyspermum ammi* was assessed against the stored pest of processed commodities, *Tribolium castaneum*. Periodic analysis for the repellence, by impregnating half-filter paper disc and at various concentrations (5, 10, 15%), was done. Trials showed significant repellent effects as *T. ammi* (76.67%) followed by *S. aromaticum* (76.54%) and *N. sativa* (64.32%). Overall, the *T. ammi* extracts were proved to be more repellent followed by *S. aromaticum* and *N. sativa*. Results suggest a safer potential of these natural extracts toward disturbing the biology and invasion of stored product pest, *T. castaneum*. Results also indicate a definite potential of these extracts towards incorporation of these extracts in pest management programs and towards optimizing food security through utilizing them as bio-pesticides.

Keywords: *Nigella sativa*, *Syzygium aromaticum*, *Trachyspermum ammi*, *Tribolium castaneum,* bioactivities, contact toxicity, repellency.

1. Introduction

Tribolium castaneum is a very important insect pest of food grains and stored grain products. These stored commodities are vulnerable to insects attack and the quality of food is deteriorated. It is necessary to conserve the stored food grains reserves so that the supply food remain continuous and the prices of food grains and derived products remain stable (Talukder, 2006; Ukeh *et al.*, 2012; Nadeem *et al.*, 2012; Jahromi *et al.*, 2014) [20, 9, 5]. Loss in weight and germination ability of grains is a severe problem, especially due to pitiable sanitation along with poor storage facilities that encourage stored pests attack, disease causing organisms and increase in temperature and humidity of the stored products (Phillips & Throne, 2010; Upadhyay and Ahmad, 2011; Semeao *et al.,* 2012; Padin *et al.*, 2013; Keskin & Ozkaya, 2013) [13, 21, 17, 11, 6]. Management of these insect pests is severely dependent upon the use of synthetic insecticides. However, application of these synthetic commercial insecticides has led to several serious problems such as environmental deterioration due to chemical residues, insect resistance against these repeatedly used chemicals, deterioration of food grains due to residues and harmfulness of synthetic chemicals to the non-target organisms in the surroundings (Zapata *et al.*, 2010; Perez *et al.*, 2010; Grünwald *et al.*, 2014) [22, 12, 2]. Serious health impacts on humans and ecological changes has forced the researchers to find the new ways of stored grains insect pests management and diverting their attention towards the natural products use as insecticides such as the use of plant extracts as repellents (Rajendran & Sriranjini, 2008) [14]. Production of these repellents from plants is less expensive and easy as compared to synthetic chemicals (Shadia, 2011) [18]. These chemicals are safe to use for human beings and have minimum effects on the ecosystem. Many plant extracts are used in different forms such as essential oils and powders and they are proved to be used as stored products repellents that are economically important (Stancic *et al.*, 2011; Sagheer *et al.*, 2011; Khan *et al.*, 2013; Nazeefullah *et al.*, 2014; Mondal *et al.*, 2014) [19, 15, 16, 10, 8].

2. Materials and Methods

Experiments were performed at Department of Entomology, University of Agriculture, Faisalabad, during the year 2013-14.

2.1 Insect Collection
Collection of test insect was made from District Faisalabad, Punjab, Pakistan. Collection team visited the godowns and grain shops for this purpose. The collection was made after on the spot sieving of infested commodities.

2.2 Insect Rearing
Insects were reared on the sterilized flour kept in 300 ml plastic jars. Incubator (SANYO incubator MIR-254) was used to maintain uniform conditions. Temperature of 27±3 °C and humidity of 70±5% was consistently maintained. Adult beetles were released for egg laying and after 5 days removed from the flour through sieving. The eggs were allowed to hatch and develop under uniform conditions. The homogenous population was achieved after 28-35 days as given by Islam and Talukder (2005) [4].

2.3 Plant Material
Plant material included seeds of *N. sativa* and *T. ammi* and flower buds of *S. aromaticum*. These were obtained in dried form from Faisalabad, Punjab, Pakistan.

2.4 Extract Preparation
Grinding of plant material was done in electric grinder. A total of 50 g fine power was allowed to mix with 100 ml of acetone. The Rotary Shaker (IRMICO OS-10), adjusted at 120 rpm was used to shake all the ingredients for 24 hours. After this period, the initial filtrate was obtained by using filter paper. Concentrated stock solution was obtained by subjecting the filtrate to rotary evaporator, as devised by Hasan *et al.* (2005) and Sagheer *et al.* (2013) [3, 7] .

Table 1: Repellent effect of three extracts at three concentrations (5, 10 and 15%) against *T. castaneum*.

	Repellency % ± Standard Error		
Concentrations (%)	***N. sativa***	***S. aromaticum***	***T. ammi***
5	60.00 ± 3.19ab	79.25 ± 3.59c	70.37 ± 4.82c
10	57.03 ± 5.75a	75.55 ± 3.68c	77.41 ± 3.41c
15	75.92 ± 2.76c	74.81 ± 3.70bc	82.22 ± 4.19c

Table 2 gives an overview of the time effect on repellent action. Highest repellency was observed after 24 hours and then after 72 hours, the repellent effects were slightly lower as indicated by the statistics. Highest re

Table 2: Repellent effect of three extracts at various exposure periods (24, 48 and 72h) against *T. castaneum*.

	Repellency % ± Standard Error		
Time (h)	***N. sativa***	***S. aromaticum***	***T. ammi***
24	73.33 ± 4.19b	85.55 ± 2.00cd	88.89 ± 2.15d
48	65.55 ± 2.60ab	78.52 ± 2.36cd	75.55 ± 3.84bc
72	54.07 ± 5.37a	65.55 ± 2.48ab	65.56 ± 2.77ab

Table 3 showed the mean comparison of data regarding percent repellency of test insect by the interaction of time factor and concentration. It was found that *T. ammi* showed greater repellence of 93.33% at 15% concentration and after 24 hours while lowest trend was observed in case of *N. sativa* (38.89%) at 5% concentration and during the period of 72 hours (3 days).

Table 3: Mean comparison of the data regarding percent repellency of *T. castaneum* by the interaction of time interval and concentration of plant extracts.

Time (h)	Concentration (%)	*N. sativa* (% Repellency)	*S. aromaticum* (% Repellency)	*T. ammi* (% Repellency)
24	**5**	63.33 ± 7.96	86.66 ± 1.92	85.55 ± 6.18
24	**10**	72.22 ± 5.87	84.44 ± 6.18	87.78 ± 1.11
24	**15**	84.44 ± 2.23	85.55 ± 2.23	93.33 ± 1.11
48	**5**	63.33 ± 1.92	84.44 ± 2.22	65.55 ± 5.87
48	**10**	60.00 ± 5.09	76.67 ± 5.09	75.55 ± 6.18
48	**15**	73.33 ± 1.92	74.44 ± 2.93	85.55 ± 2.22
72	**5**	38.89 ± 7.28	66.67 ± 5.09	60.00 ± 5.09
72	**10**	53.33 ± 5.09	65.55 ± 2.93	68.89 ± 2.93
72	**15**	70.00 ± 5.09	64.44 ± 6.18	67.78 ± 5.87

2.5 Experiment for percent repellency
Different concentrations (5, 10 and 15%) were made by diluting the concentrated stock with acetone. Area preference method was used as filter paper was cut into two halves-and-half of paper was treated with the dilution. The treated paper was allowed to dry for 60 minutes and then pasted with the untreated half through scotch tape. Thirty adults (15 days old) were released in the junction of treated and untreated parts. After that, the plate was covered to avoid the escape of insects. Small amount of insect diet (wheat flour) was also introduced on both the sides to reduce the chances

of death due to starvation factor. Data was taken at 24, 48 and 72 and percentage repellency was calculated by counting the insects in untreated half. Experiment was replicated three times and Completely Randomized Design (Factorial) was followed. Statistical analysis was done by using Statistica 7.0.

3. Results

Rigorous testing was performed to evaluate the deterrent effects. As indicated in Table 1, the concentration tend to affect the repellency as highest was noted in case of *T. ammi* (82.22%) while the lowest was recorded for *N. sativa* (60.00%). The concentrations have a definite impact on repellent action because of increase in active metabolites present in extracts.

4. Discussion

Our experiments proved a significant impact of plant extracts on the test insect that cause damage to processed and stored commodities. Gracia *et al.* (2005) obtained similar results when he exposed the beetles to the plant extracts of *Baccharis salicifolia*. The terpenes present in the essential oil were responsible for the repellent as well as toxicological action. Symptoms of neurotoxicity were shown by insects. Jahromi *et al.* (2014) [5] also worked towards the repellent effects of the natural garlic emulsion on the percent repellency. Serial concentrations were made and maximum percent repellency was shown at highest concentrations. Our experiment also supports that the potential of the plant extracts to cause repellency increases with concentration. But, the results are different for the time factor because in their experiment there is no significant effect of time. It may be contributed towards the method used for experiments. They utilized the olfactometer method while in our case; the area preference method was used, which showed a progressive decrease in repellency over the time factor. Chaubey (2007) [1] determined the repellent impact of the *N. sativa* and *T. ammi* and found a significant impact of these extracts. Similar results were concluded by Sagheer *et al.* (2011, 2013) [15, 16] while working on the effects of different repellent plant extracts towards the repellent action. Future research should be focused on field application of these extracts and ways to increase the repellent action of these extracts. Application method should also be depicted in this regard to promote the sustainable practice towards managing stored product pest.

5. References

1. Chaubey MK. Insecticidal activity of *Trachyspermum ammi* (Umbelliferae), A*nethum graveolens* (Umbelliferae) and *Nigella sativa* (Ranunculaceae) essential oils against stored product beetle *Tribolium castaneum* Herbst (Coleoptera: Tenebrionidae). African Journal of Agricultural Research 2007; 2(11):596–600.
2. Grünwald S, Fast A, Mülle K, Boll M, Kler A, Bonnländer B. Feeding a grape seed extract extends the survival of the red flour beetle *Tribolium castaneum* under heat-stress depending on nrf-2, jnk-1, and foxo-1 homologous genes but independent of catechin monomers. Nutrition and Medicine 2014; 2(1):415-422
3. Hasan M, Siddique MA, Sagheer M, Aleem M. Comparative efficacy of ethanol leaf extracts of *Amaranthus viridis*, *Salsola baryosma* and Cypermethrin against *Trogoderma granarium* (Everts). Pakistan Journal Agricultural Sciences 2005; 42:61-63.
4. Islam MS, Talukder FA. Toxic and residual effects of *Azadirachta indica*, *Tagetes erecta* and *Cynodon dactylon* seed extracts and leaf powders towards *Tribolium castaneum*. Journal of Plant Diseases and Protection 2005; 112:594-601.
5. Jahromi MG, Pourmirza AA, Safaralizadeh MH. Repellent effect of sirinol (garlic emulsion) against *Lasioderma serricorne* (Coleoptera: Anobiidae) and *Tribolium castaneum* (Coleoptera: Tenebrionidae) by three laboratory methods. African Journal of Biotechnology 2014; 11(2):280-288.
6. Keskin S, Ozkaya H. Effect of Storage and Insect Infestation on the Mineral and Vitamin Contents of Wheat Grain and Flour. Journal of Economic Entomology 2013; 106:1058-1063.
7. Khan FZA, Sagheer M, Hasan M, Saeed S, Ali K, Gul HT *et al.* Toxicological and repellent potential of some plant extracts against stored product insect pest, *Tribolium castaneum* (Herbst.) (Coleoptera: Tenebrionidae). International Journal of Biosciences 2013; 3(9):280-286.
8. Mondal OA, Haque J, Haque E, Khan AR. Repellent activity of Abroma augusta extracts against *Tribolium castaneum* (Herbst) adults. Journal of Bio-Science 2014; 20:49-55.
9. Nadeem M, Iqbal J, Khattak MK, Shahzad MA. Management of *Tribolium castaneum* (Hbst.) (Coleoptera: Tenebrionidae) Using Neem (*Azadirachta indica* A. Juss) and Tumha (*Citrullus colocynthis*) (L.). Pakistan Journal of Zoology 2012; 44:325-1331.
10. Nazeefullah S, Dastagir G, Ahmad B. Effect of cold water extracts of *Acacia modesta* Wall. and *Glycyrrhiza glabra* Linn. on *Tribolium castaneum* and *Lemna minor*. Pakistan Journal of Pharmaceutical Sciences 2014; 27(2):217-222.
11. Padin SB, Fuse C, Urrutia MI, Bello GMD. Toxicity and repellency of nine medicinal plants against *Tribolium castaneum* in stored wheat. Bulletin of Insectology 2013; 66:45-49.
12. Perez SG, Lopez MAR, Sanchez MAZ, Ortega NCC. Activity of essential oils as a bio-rational alternative to control coleopteran insects in stored grains. Journal of Medicinal Plant Research 2010; 4:2827-2835.
13. Phillips TW, Throne JE. Bio-rational Approaches to Managing Stored Product. Annual Review of Entomology 2010; 55:375-397.
14. Rajendran S, Sriranjini V. Plant products as fumigants for stored product insect control. J Stored Prod Res 2008; 44:126-135.
15. Sagheer M, Hasan M, Latif MA, Iqbal J. Evaluation of some Indigenous medicinal plants as a source of toxicant, repellent and growth inhibitors against *Tribolium castaneum* (Coleoptera: Tenebrionidae). Pakistan Entomologist 2011; 33:87-91.
16. Sagheer M, Hasan M, Rehman H, Khan FZA, Gul HT, Haidri SR *et al.* Growth Regulatory Potential of Five Indigenous Plant Extracts against *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). International Journal of Biosciences 2013; 3(12):50-54.
17. Semeao AA, Campbell JF, Whitworth RJ, Sloderbeck PE. Influence of Environmental and Physical Factors on Capture of *Tribolium castaneum* (Coleoptera: Tenebrionidae) in a Flour Mill. Journal of Economic Entomology 2012; 105:686-702.
18. Shadia EAEA. Control Strategies of Stored Product Pests. Journal of Entomol 2011; 8:101-122.

19. Stancic MR, Coprean D, Sava D, Dobrinas S, Miron L, Schiopu S. Use of Garlic, Absinthium and Celandine extract as natural repellents. Environmental Engineering and Management Journal 2011; 10:445-449.
20. Talukder FA. Plant products as potential stored-product insect management agents-A mini review. Journal of Agricultural Sciences 2006; 18(1):17-32.
21. Upadhyay RK, Ahmad S. Management strategies for Control of Stored Grain Insect Pests in Farmer Stores and Public Ware Houses. World Journal of Agricultural Sciences 2011; 7:527-549.
22. Zapata N, Smagghe G. Repellency and toxicity of essential oils from the leaves and bark of *Laurelia sempervirens* and *Drimys winteri* against *Tribolium castaneum*. Industrial Crops and products 2010; 32(3):405-410.