Journal of Entomology and Zoology Studies 2014; 2 (3): 201-205

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): 201-205

Received: 29-04-2014
Accepted: 18-05-2014

Sajjad Ali
Pest Warning and Quality Control of Pesticides, Punjab.

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

Mansoor ul Hassan
Department of Entomology, University of Agriculture, Faisalabad.

Muneer Abbas
Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad.

Faisal Hafeez
Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad.

Muhammad Farooq
Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad.

Dilbar Hussain
Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad.

Muhammad Saleem
Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad.

Abdul Ghaffar
Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad.

Correspondence:
Muneer Abbas
Entomological Research Institute, Ayub Agriculture Research Institute, Faisalabad.

Insecticidal activity of turmeric (*Curcuma longa*) and garlic (*Allium sativum*) extracts against red flour beetle, *Tribolium castaneum*: A safe alternative to insecticides in stored commodities

Sajjad Ali, Muhammad Sagheer, Mansoor ul Hassan, Muneer Abbas, Faisal Hafeez, Muhammad Farooq, Dilbar Hussain, Muhammad Saleem and Abdul Ghaffar

ABSTRACT
Study was aimed at the use of indigenous medicinal plants to check the invasion of red flour beetle, *Tribolium castaneum* (Herbst) against wheat grains. Acetone leaf extracts of turmeric (*Curcuma longa*) and garlic (*Allium sativum*) were used to evaluate their antifedant, toxicant, and growth regulatory effects against adults of *T. castaneum*. Four concentrations (5, 10, 15 and 20 %) of each extract along-with a control treatment with five replications were applied. Thirty adults of *T. castaneum* were subjected to different treatments. Results painted that percent mortality was directly proportional to increasing concentration of extracts. Both *A. sativum* and *C. long*a significantly reduced the larval, pupal and adult emergence as well as percent weight loss (at α 5%) but *A. sativum* performed better as compared to the *C. longa*. Hence it can be concluded that both the botanicals can be used as effective tool against *T. castaneum* along-with other IPM tactics.

Keywords: Toxicity, *Allium sativum*, *Curcuma longa* and *Tribolium castaneum*.

1. Introduction
Wheat (*Triticum aestivum* L) is the most vital cereal crop and staple food of Pakistan. It is consumed and stored as flour, maida, suji and grains and covers 65 % of crop area of the country [6]. During storage wheat grains are attacked by around 23 insect species in Pakistan. Among these, 10 species heavily contaminate the grains with feces, living and dead insects, egg shells, pupal cases, cocoons, noxious odor and webbing [8]. Red flour beetle, *Tribolium castaneum* is a key pest of stored products. It is estimated that 10 to 25% of global production lost occurs from insect, microbial weakening and other factors annually [9]. The adult as well as larvae of *T. castaneum* damage sound grains effecting quality and quantity of grains [12]. In case of serious infestation the grains and flour turns yellowish, stuffy and has a pungent, disagreeable smell which becomes unfit for human consumption. Efforts have been made by researchers on the use of plant products as a prospective source of bioactive chemical compounds, commercial pest control agents and viable substitute of synthetic pesticides [18].
Turmeric (*Curcuma longa*) and garlic (*Allium sativum*) are most vital spices all over the world [15]. They have been renowned a stored grain protectants against *T. castaneum*. These volatile compounds with fumigant action serve as pest control agents [7], contact insecticides [1, 3], antifeedents or repellents [3] also effecting the biological parameters such as life span, growth rate and reproduction of the target pest [14, 4].
Objective of this study was to check the toxicological effect of plant extracts against *T. castaneum* adults, estimate their effects on larval, pupal and adult emergence and to compute the percent weight loss of wheat commodity.

2. Materials and Methods
The study was conducted in the Department of Agri. Entomology, University of Agriculture Faisalabad under Completely Randomized Design (CRD). Heterogeneous sample of *T. castaneum* was collected from grain market located in Faisalabad district.

The insect culture was maintained in sterilized jars placed in the laboratory incubator at 32±2 ºC and 70% R.H to get the homogeneous population. The jars were covered with muslin cloth, tied with rubber band to avoid the escape. The culture of each was maintained in 10 different jars filled with culture medium. 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. Grinding of some indigenous medicinal plant material *viz. A. sativum* and *C. longa* 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. Plant extracts of were collected and dried. The plant extracts were tested at concentrations of 5, 10, 15, and 20%. Each treatment was replicated five times. Thirty adults of *T. castaneum* were used for bioassay study. *T. castaneum* adults were released on the treated wheat flour in vials. These vials were placed in incubator at 32±2 ºC and 65±5% R.H. Data regarding % mortality was recorded after 2, 4, 6, 8, 10 and 12 days. Moreover, data on % larvae emergence, % pupae emergence, % adult emergence and % weight loss were also recorded. Analysis of variance of the collected data was carried out using statistical software, statistix 8.1. Mean of the significant treatments was compared by Turkey-HSD test at α 5%.

3. Results and Discussion

In this experiment percent mortality caused by *A. sativum* and *C. longa* at different time and concentrations against *T. castaneum* was computed as shown in Table 1.

Maximum percent mortality caused by *A. sativum* increased with increase in concentration at a certain period after which it decreased. Maximum % mortality (12.44) was found at 20% concentration after 4 days followed by (12.34), (10.15) and (10.14) at exposure time × concentration (8 days × 20 %), (2 days × 20%) and (6 days × 20%), respectively. The minimum % mortality (1.16) observed in exposure time × concentration was (10 days × 5%). Maximum % mortality caused by *C. longa* was (11) at concentration 20% with the exposure time of 2 days followed by (10.88), (10.44) and (9.88) at exposure time × concentration (4 days × 20%), (6 days × 20%) and (8 days × 20%), respectively. The minimum % mortality (1.00) recorded at the exposure time × concentration was (12 days × 5%).

Table 1: Percent mortality caused by *A. sativum* and *C. longa*

Time (Days)	Conc. (%)	% Mortality ± S. E (*A. sativum*)	% Mortality ± S. E (*C. longa*)
2	5	2.22 ± 1.13 bc	2.11 ± 0.98 bc
2	10	4.23 ± 1.01 b	3.38 ±1.95 b
2	15	6.16 ± 1.92 b	5.55 ± 2.22 b
2	20	10.15 ± 1.82 a	11.00 ±1.95 a
4	5	2.22 ± 1.51 bc	0.00 ± 0.000 c
4	10	4.64 ±1.21 b	2.21 ± 1.09 b
4	15	6.79 ± 1.91 b	5.21 ± 1.31 b
4	20	12.44 ± 2.93 a	10.88 ± 1.11 a
6	5	1.18 ± 1.11 c	0.00 ± 0.000 c
6	10	4.94 ± 1.31 b	3.79 ± 0.56 b
6	15	6.56 ± 1.92 b	5.96 ± 1.16 b
6	20	10.14 ± 1.98 a	10.44 ± 3.33 a
8	5	1.22 ± 1.23 c	2.52 ± 1.61 c
8	10	5.55 ± 0.99 b	3.83 ± 1.95 c
8	15	5.59 ± 2.12 b	7.78 ± 1.17 b
8	20	12.34 ± 2.93 a	9.88 ± 0.925 a
10	5	1.16 ± 0.91 c	2.02 ± 1.31 c
10	10	4.91 ± 1.41 b	4.57 ± 1.92 c
10	15	6.48 ± 1.92 b	7.88 ± 1.63 ab
10	20	10.00 ± 1.95 a	9.11 ± 2.93 a
12	5	3.23 ± 0.00 b	1.00 ± 0.11 bc
12	10	5.23 ± 1.17 b	2.18 ± 0.92 b
12	15	6.67 ± 1.96 ab	4.85 ± 1.71 b
12	20	8.15 ± 2.42 a	8.11 ± 1.51 a

Table 2: Developmental effects of *A. sativum* on *T. castaneum* at different concentrations

Conc. (%)	% Larval Emergence ± S. E	% Pupal Emergence ± S. E	% Adult Emergence ± S. E
5	57.40 ± 6.37 b	22.51 ± 4.80 a	8.14 ± 1.85 b
10	39.44 ± 4.51 c	21.21 ± 3.92 a	5.18 ± 1.37 bc
15	21.85 ± 2.02 d	17.34 ± 2.41 ab	2.59 ± 0.48 cd
20	14.25 ± 1.56 e	10.44 ± 2.74 c	1.11 ± 0.55 d
Check	75.74 ± 7.66 a	31.34 ± 2.99 a	12.96 ± 2.57 a

Table 3: Developmental effects of C. *longa* on *T. castaneum* at different concentrations

Conc. (%)	% Larval Emergence ± S. E	% Pupal Emergence ± S. E	% Adult Emergence ± S. E
5	61.66 ± 9.39 b	26.49 ± 6.09 ab	12.59 ± 3.45 a
10	45.20 ± 6.12 c	26.56 ± 5.95 ab	4.81 ± 1.58 c
15	28.70 ± 3. 24 d	24.08 ± 6.01 ab	3.33 ± 1.24 c
20	25.55 ± 2.86 e	15.78 ± 5.49 c	0.74 ± 0.48 c
Check	91.11 ± 11.51 a	29.06 ± 8.13 a	18.14 ± 4.84 a

Table 2 shows percent larval, pupal and adult emergence of *T. castaneum* against different concentration of *A. sativum*. Maximum larval emergence was observed in control, (75.74%) followed by 5, 10 and 15 % concentrations, (57.40, 39.44 and 21.85%, respectively). The minimum percent larval emergence was found (14.25%) at 20 % concentration. Maximum pupal emergence was observed in control treatment (22.74%) followed by 5, 10 and 15% concentrations (22.51, 21.21 and 17.34%, respectively). The minimum percent pupal emergence (10.44%) experimented at 20 % concentration. Maximum adult emergence observed in control treatment (12.44%) followed by 5, 10 and 15% concentrations (8.14, 5.18 and 2.59%, respectively). The minimum percent adult emergence (1.11) was observed at 20 % concentration. Similarly percent larval, pupal and adult emergence of *T. castaneum* against different concentration of *C. longa* were also computed as shown in Table 3. Maximum larval emergence was observed in control treatment (91.11%) followed by the 5, 10 and 15% concentrations (61.66, 45.2 and 28.70, respectively). The minimum percent larval emergence (25.55) was observed at 20 % concentration. Maximum pupal emergence observed in control, (29.06%) while 5, 10 and 15% concentrations (26.49, 26.56 and 24.08%, respectively). The minimum percent pupal emergence (15.78%) was found at 20 % concentration. Maximum adult emergence (18.14%) was found in control treatment followed by 5, 10 and 15% concentrations (12.59, 4.81 and 3.33, respectively). The minimum percent adult emergence (0.740) was observed at 20 % concentration.

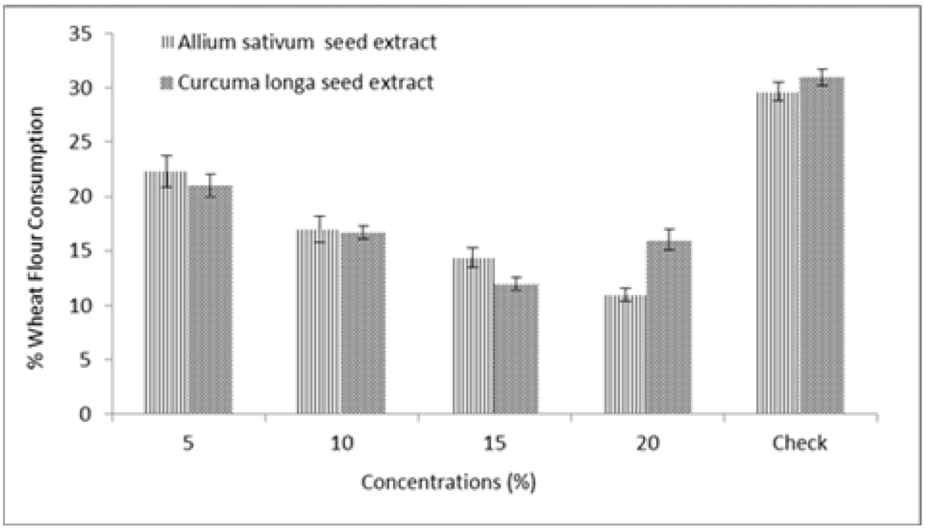

Fig 1: Percent wheat flour consumption by *T. castaneum* under different concentrations of *A. sativum* and *C. long*a seed extract

Percent weight loss in wheat flour in different concentrations of *A. sativum* seed extract was significantly different from each other. The minimum % flour consumption was (11.00) at concentration of 20% and maximum percent consumption was (29.66) in control treatment followed by 5, 10 and 15% with (22.33, 17.33 and 14.99%, respectively), respectively as shown in fig.1. Similarly, the minimum % flour consumption was (12.00) at 15 % concentration of *C. long*a seed extract. Maximum percent consumption was (31) in control treatment. *C. longa* seed extract performed well by showing maximum inhibition even at 15 % concentration as compared to the *A. sativum*.

Mortality of red flour beetle increased by increasing concentration of *A. sativum* and *C. long*a extracts. These findings relate with Mobki (2014) [10] who reported that mortality of *T. castaneum* increased with increasing garlic extract with concentration and time. The concentration of 225.8 µl/l air of the garlic extract generated 83.3% larval mortality after 48 hours. More than 95% repellency was achieved even at low concentration (2.13 $\mu l/cm^2$) of garlic extracts. Chander *et al*. (2000) [2] also supported current findings who reported that turmeric (*Curcuma long*a) extract has repellent action against *T. castaneum*, *Oryzaephilus surinamensis*, *Cryptolestes ferrugineus*, *Sitophilus oryzae*, and *Corcyra cephalonica* even after 3 months under laboratory conditions. Tripathi *et al*. (2002) [17] explored the contact and fumigant actions of essential oil of turmeric leaf extracts for toxicity studies. They investigated progeny, ovipositional and ovicidal effects of turmeric on *Rhyzopertha dominica*, *Sitophilus oryzae*, and *T. castaneum*. The adults of *R. dominica* were highly susceptible to contact action. In *T. castaneum*, the oil reduced oviposition and egg hatching by 72 and 80%, respectively. Compounds extracted from turmeric powder revealed a strong repellency action against *T. castaneum* (Su *et al*., 1982) [16]. The current findings are in partial resemblance with the results obtained by Huag (2000) [5] who tested two compounds extracted from garlic, *A. sativum* against *Sitophilus zeamais* and *T. castaneum* for contact, fumigant and antifeedant activity. The contact and fumigant toxicities of these compounds were greater against the adults. These two compounds (methyl allyl disulfide and diallyl trisulfide) of garlic were also more toxic to *T. castaneum* adults than to *S. zeamais*. Both compounds reduced the egg hatching and emergence of progeny against *T. castaneum*. Moreover, Bachrouch *et al*. (2010) [1] supported current findings and observed that as concentration of garlic increased the *egg* mortality also increase. The eggs were the most vulnerable stage, followed by adults. After 10 days garlic oil was more effective against *T. castaneum* adults than S. *zeamais*. Mona *et al.* (2009) [11] reported similar results that garlic *(A. sativum*), mint *(Mentha piperita*), basil *(Ocimum basilicum*), thyme *(Thymus vulgaris)*, sesame *(Sesamum Indicume*) and chamomile *(Chamaemelum nobile*) plant extracts showed both toxicity and repellency actions against *T. confusum*. All types of extracts were highly repellent to the adult insect as compared to the larvae with more than 70% reduction. Potential pesticides based on turmeric and garlic products not only help in the protection of stored products, but also aids in protection of high value crops and organic food production systems, where only few alternative pesticides are available. Such natural pesticides are a practical alternative for effective and defensible crop protection that would significantly reduce the environmental and human health hazards.

4. Reference

1. Bachrouch O, Jemaa MB, Chaieb J, Talou I, Marzouk T, Abderraba B. Insecticidal activity of *Pistacia lentiscus* essential oil on *Tribolium castaneum* as alternative to chemical control in storage. Tunisian J of Plant Protec 2010; 5:63-70.
2. Chander H, Ahuja DK, Nagender A, Berry SK. Repellency of different plant extracts and commercial formulations used as prophylactic sprays to protect bagged grain against *Tribolium castaneum*. J Food Sci Technol Mys 2000; 37:582-585.
3. Garcia M, Donadel OJ, Ardanaz CE, Tonn CE, Sosa ME. Toxic and repellent effects of Baccharis salicifolia essential oil on *Tribolium castaneum*. Pest Manage Sci 2005; 61:612–618.
4. Ho SH, Koh Y, Huang Y, Sim KY. The oil of garlic, *A. sativum* L. (Amaryllidae), as a potential grain protectant against *Tribolium castaneum* (Herbst) and *Sitophilus zeamais* Motsch. Postharvest Biol Technol 1996; 9:41-48.
5. Huang Y, Chen SX, Ho SH. Bioactivities of methyl allyl disulfide and diallyl trisulfide from essential oil of garlic to two species of stored-product pests, *Sitophilus zeamais* (Coleoptera: Curculionidae) and *Tribolium castaneum* (Coleoptera: Tenebrionidae). J Econ Entomol 2000; 93:537-543.
6. Khattak SU, Kama S, Amanullah K, Ahmad S, Khan AU, Jabbar A. Appraisal of rainfed wheat lines against khapra beetle, *Trogoderma granarium* (Evert.). Pakistan J Zool 2000; 32:131-134.
7. Lee BH, Annis PC, Tumaalii F, Choi WS. Fumigant toxicity of essential oils from the Myrtaceae family and 1, 8-cineole against 3 major stored grain insects. J stored Prod Res 2004; 40:553-564.
8. Lohar MK. Pest of stored grains and their control. In: Text book of applied entomology. Published by Dr. Kashif Raza under Kashif publication. Hyderabad, 2001, 99-115.
9. Matthews GA. Insecticide application in stores. In: Matthews GA, Hislop, E.C. (Eds) Application Technology for Crop Protection. CAB Int. Wallingford, UK 1993, 305-315.
10. Mobki M, Safavi SA, Safaralizadeh MH, Panahi O. Toxicity and repellency of garlic (*Allium sativum* L.) extract grown in Iran against *Tribolium castaneum* (Herbst) larvae and adults. Phytopathology and plant protection 2014; 47(1):59-58.
11. Mona F, Aziz AE, Sayed YAE. Toxicity and biochemical efficacy of six essential oils against *Tribolium confusum* (Coleoptera: Tenebrionidae). Egypt Acad J Biol Sci 2009; 2(2):1-11.
12. Mondal M, Khalequzzaman M. Toxicity of essential oils against Red flour beetle, *Tribolium*

castaneum (Herbst) (Coleoptera: Tenebrionidae). J Biosci 2006; 14:43-48.
13. Peterson CJ, Ems-Wilson J. Catnip essential oil as a barrier to subterranean termites in the laboratory. J Econ Entomol 2003; 96(4):1275-1282.
14. Rahmat A, Edrini S, Ismail P, Hin TY, Bakar MFAB. Chemical constituents, antioxidant and cytotoxic effects of essential oil from *Strobilanthes crispus* and *Lawsonia inermis*. J Biol Sci 2006; 6(6):1005-1010.
15. Ravindran PN. Turmeric: The golden spice of life. In: Ravindran PN, Nirmal Babu K, Sivaraman K (Eds) Turmeric: The Genus *Curcuma*. CRC Press, Boca Raton, FL, USA, 2007, 1-14.
16. Su HCF, Horvat R, Jilani G. Isolation, purification and characterization of insect repellents from *Curcuma longa* L. J Agr Food Chem 1982; 30:290-292.
17. Tripathi AK, Prajapati V, Verma N, Bahl JR, Bansal RP, Khanuja SPS *et al.* Bioactivities of the leaf essential oil of *Curcuma longa* (var. Ch-66) on three species of stored-product beetles (Coleoptera). J Econ Entomol 2002; 95:183-189.
18. Wheeler W. Role of research and regulation in 50 years of pest management in agriculture. J Agr Food Chem 2002; 50:4151-4155.