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Repellency evaluation of indigenous plant extracts against *tribolium castaneum (coleoptera; tenebrionidae*)

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Abstract
Five indigenous plants viza *viz. Mentha longifolia* (Mint), *Momordica charantia* (Bitter Guard), *Luffa aegytiaca* (Sponge Guard), *Carum copticum* (Ajwain) and *Curcuma longa* (Turmeric) were tested at different concentrations of 0, 25, 50 and 75% as crude extract to check its repellency effect against *Tribolium castaneum* after exposure for 10 days. *Mentha longifolia* exhibited maximum repellency (96.67%) at 75% dosage followed by (86.67 *Momordica charantia* %), *Luffa aegytiaca* (76.67%) and *Carum copticum* (73.33%). Minimum repellency was shown by *Curcuma longa* (63.33%). The natural plant extracts can prove the best alternatives to chemical repellents.

Keywords: *Tribolium castaneum*, repellents, indigenous plant extracts, red flour beetle

Introduction
Insects are always a problem in stored commodities worldwide because, they reduce the quantity and affect the quality of grains (Pugazhvendan *et al.*, 2012) [25]. Red flour beetle, *Tribolium castaneum* (Herbst) causes serious damage to stored commodities like grain, flour, peas, beans, nuts, dried fruits and spices **(**Pugazhvendan *et al.*, 2009**)** [24]. The damage is characterized both in quality deterioration and loss in quantity. In case of serious infestation, the flour turns yellowish and mouldy with pungent odour and ultimately becomes unfit for human consumption (Atwal, 1976) [5]**.** Presently, synthetic insecticides are used for the control of this pest **(**Hassan and Reichmuth. 2004) [13]. Globally, about 2.5 million tons pesticides are used annually for the control of insect pests and the losses caused by pesticides reached about $100 billion each year **(**Wali and Dhaliwal., 2008) [17]. In liquid insecticides Deltamethrin while in fumigants, Aluminum phosphid and Magnesium phosphid are commonly used for the control of this insect pests (Islam *et al*., 2009,) [14] Naphthalene /phenyl tablets are also commonly used for this purpose (Latif *et al.*, 2004**)** [19]**.** But these synthetic compounds pose significant adverse effects like soil and water contamination, toxicity to non-target organisms and resistance issues (Ukeh *et al*., 2010) [28]. Therefore, there is an immediate need to develop such crop protectants which are environmentally safe, convenient and friendly to non-target species.

Indigenous plant extracts are considered to be less toxic, easily degradable and non-pollutable (Cetin *et al*., 2004, Nadra, 2006**)** [7, 23]. Many of the plant extracts have shown broad spectrum of repellent, insecticidal, anti-feeding, ovipositional deterrence, growth inhibition, sterility, ovicial, larvicidal and anti-vector effects on insect pests and plant and several pathogenic fungi (Joy *et al*., 2001; Kim *et al*., 2003**;** Cetin *et al*., 2004) [15, 16, 7]. Most of the plants materials are good source of bioactive components (Lahlou *et al*., 2001) [18].

Bioactivities of plant extracts such as repellency, antifeedent, larvicidal, ovicidal and sterility have been reported by several researchers using different plant species and insect pests (Cetin *et al*., 2004) [7]. *Mentha longifolia* and *Mormodica charantia* have been reported as effective repellents against *Tribolium castaneum* (Moreira *et al.*, 2007 and Bhuwan, 2011; Adesina 2013) [20, 6, 1]. Turmeric (*Curcama longa*) has been reported as an excellent repulsive and growth inhibitor against adults of *Tribolium castaneum* **(**Saljoqi *et al*., 2006) [27]. Keeping in view the scope of testing new plant species, the present work was carried out to evaluate the repellent effects of five indigenous plant extracts i.e., *Mentha longifolia* (Mint), *Momordica charantia* (Better Guard), *Luffa aegytiaca* (Sponge Guard), *Carum copticum* (Ajwain) and *Curcuma longa* (Turmeric) on *Tribolium castaneum*.

Materials and methods
Collection and extraction of plant material
Five indigenous plants (Table 1) *viz. Mentha longifolia* (Mint), *Momordica charantia* (Better Guard), *Luffa aegytiaca* (Sponge Guard) *Carum copticum* (Ajwain) and *Curcuma longa* (Turmeric) were collected from the local market/area. These plant materials were properly washed and dried at controlled temperature and relative humidity i.e., 27±2°C and 75 ± 5% respectively. After proper drying, these plant materials were grinded by used electric blender. These extracts were then filtered through Whatmann No. 1 filter paper (Saxena *et al*., 1980) and kept in refrigerator as stock solution. Serial dilutions were made as necessary. Each plant extract was then evaluated for its repellent effect against the adult stage of *T. castaneum* Repellency of insects exposed to various doses and exposure time was tested. The whole experiment was conducted in a temperature control laboratory (30±2 ºC, 65±5 RH) at the Nuclear Institute for Food & Agriculture (NIFA), Tarnab Peshawar.

Table 1: List of indigenous plant extracts used as repellent materials against *T. castaneum*

Plants	Family	Part used
Menthe longifolia	Lamiaceae	Leaves
Momordica charantia	Cucurbitaceae	Mature fruit
Luffa aegytiaca	Cucurbitaceae	Mature fruit
Carum copticum	*Umbelliferae*	Seed
Curcamin Longa	*Zingiberaceae*	Root

Culture of *Tribolium castaneum*

T. castaneum was collected from the warehouses having infested grains in Nowshera and Peshawar districts and were cultured on the wheat flour plus yeast (@ 9:1). The stock culture was maintained in the laboratory in dark atmosphere at 28 ± 2 °C temperature and 70 ± 5% relative humidity. The eggs were collected on the white filter papers by placing *T. castaneum* adults on the filter papers for 48 hours. After emergence, the larvae were transferred to other glass jars for further development to adult stage. Repellency test was conducted with fifty beetles of 7 days old *T. castinum* adults that were confined in glass Petri dishes.

Repellence Bioassay

A-pencil line was drawn in the middle of the Whatmann No. 1 filter paper (6 cm diameter). One half side of the filter paper was treated with the required concentration (i.e., 25, 50 and 75%) of plant extract while the other half was not treated. After treatment, the filter paper was first air dried for few minutes before transferring the insects. The control was treated with distilled water only. The fifty number of 7 days old beetles were released in the middle of treated Petri dishes with the help of clean hair brush. All adults were observed for 10 days to check the repellency over time. Each tested concentration was tested with five replicates. Percent repellence (PR) values were computed using the method by (Hassanali *et al.*, 1990) [12];

$$PR = N_C - N_T / N_C + N_T \times 100,$$

Where Nc was the number of insects on the control half and N_T was the number of insects on the treated half.

Statistical Analysis

Data on percent repellency was statistically analyzed using computer program MSTAT-C. The Least significant difference (LSD) at 5% level of significance was used to compare the treatment means (Waller and Duncan, 1969).

Results and discussion

Results on the repellent effect of plant extract are given in Table 2. *Mentha longifolia* exhibited good repellent effect with 66.67% efficiency followed by *Momordica charantia* (60%), *Luffa aegytiaca* (54%), *Carum copticum* (50%) and *Curcuma longa (*43%*)* at 25% dosage. Increase in repellency was observed when the dose increased from 25% to 50% and 75%. Maximum repellency (96.67%) was recorded with *Mentha longifolia* at 75% dosage followed by *Momordica charantia, Luffa aegytiaca Carum copticum* and *Curcuma longa* as 86.67, 76.67, 73.33 and 63.33% respectively (Fig. 1). Our results showed that *Mentha longifolia* is most effective among the tested plant extracts which is in accordance with the findings of Akrami (2008) [2] who reported that *Mehtha longifolia* essential oil caused 93.3% repellency against *T. castaneum.* Present results are in line with the findings by Gunarathna, (2009) [11] who reported *Mentha longifolia* with 89% repellency level. Al-Jabr (2006) [3] found that *M. longifolia* exhibited high repellency with 84.73% at 1% concentration against *T. castaneum.* These findings are further supported by Saeidi and Moharramipour (2013) [26] who reported the significant repellency effect of *M. longifolia* against *T. confusum* as compared to *Artemisia khorassanica* and *Rosmaria officinalis*. These finding are also supported by Mahmoodavand and Shakarami (2014) who found *M. longifolia* with 86.7% repellency against *T. castaneum.* Bhuwan (2011) [6] found that *Mentha longifolia* strongly repelled *T. castaneum* and *S. oryzae* at low concentrations. Similarly, *Momordica charantia* was a most effective extract against *T. castaneum* after *M. longifolia.* Similar results with *Momordica charantia* were also registered by Dwivedi and Shekhawat (2004) [8] who reported that *Momordica charantia* showed 74.87% repellency against *Trogoderma granarium* (Everts). Our findings are supported by the findings of Mohiuddin *et al*., (1987) [22] who observed 75% repellency with *Momordica charantia* against *T. castaneum*. *Curcuma longa* was found most effective extract against *T. castaneum*. The results of the present investigations are in agreement with the results of Asawalam and lgwe (2012) [4] who reported that the use of *Curcuma longa* is recommended for the control of *T. granarium* in stored grains. Damalas (2011) [9] recommended *Curcuma longa* as an effective repellent against insect pests of stored grains. Thus the percentage repellency of different plant extracts in descending order can be summarized as follows: *Mentha longifolia* > *Momordica charantia* > *Luffa aegytiaca*> *Carum copticum* > *Curcuma longa*. Hence, it is concluded that *Mentha longifolia* exhibited more effective repelling action followed by *Momordica charantia, Luffa aegytiaca, Carum copticum* and *Curcuma longa* against *T. castaneum*

Table 2: Repellency effect of various plant extracts on *Tribolium castaneum*

Doses (%)	Plant extract-wise repellency (%)					Overall mean
	Mint	Bitter gourd	Sponge gourd	Ajwain	Turmeric	
0 (control)	0.0 k	0.0 k	0.0 k	0.0 k	0.0 k	0.0 d
25	66.67 def	60.00 fgh	53.33 hi	50.00 ij	43.33 j	54.67 c
50	73.33 cd	70.00 cde	66.67 def	63.33 efg	56.67 ghi	66.00 b
75	96.67 a	86.67 b	76.67 c	73.33 cd	63.33 efg	79.33 a
Overall Mean	59.17 a	54.17 b	49.17 c	46.67 c	40.83 d	-

LSD value at 0.05% for doses = 3.69 LSD value at 0.05% for extracts = 4.13 LSD value at 0.05% for interaction = 8.25 Means in columns/rows followed by similar letters are not significantly different at 0.05% level of probability (DMR test).

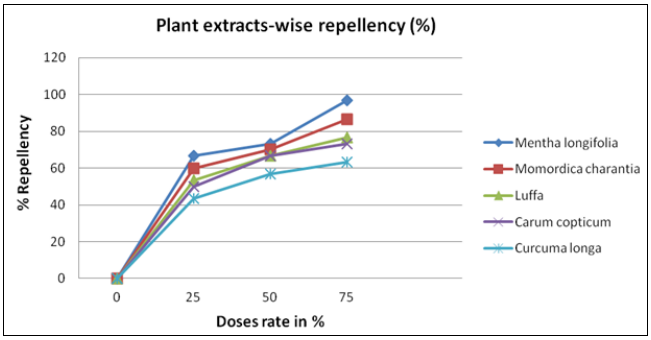

Fig 1: Repellency effect of five plant extracts on adults of *Tribolium castaneum.*

Conclusion and recommendations

It was concluded that indigenous plant extracts has high potential to replace the chemical pesticides in protecting stored commodities against *T. castaneum*. Further research work is needed to explore the potential of above plant extracts as a bio-pesticide which can prove as useful alternative to chemical insecticides. It is also imperative to check the detrimental effects of these products on animals and environment if any.

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References

1. Adesina JM. Insecticidal potential of *Momordica charantia* (L.) leaves powder against maize weevil *Sitophilus zeamais* (Mots.) infestation. International. J. Bio sci. 2013; 3(1):28-34.
2. Akrami H. Insecticidal effect of essential oils from *Thymus kotschyanus* and *Mentha longifolia* on some stored product Insects. M.Sc. Thesis of Entomology, Islamic Azad Uni, Science and Reserch Branch, Iran, 2008, 97.
3. Al-Jabr AM. Toxicity and repellency of seven plant essential oils to *Oryzaephilus surinamensis and Tribolium castaneum*. Scientific. J. King Faisal Univ. (Basic & Appl. Sci.). 2006; 7(1):14-27.
4. Asawalam EF, U Igwe. Insecticidal potentials of *curcuma longa* l. rhizomes and *cymbopogon citratus* leaves extracts against the khapra beetle (trogoderma granarium) on stored groundnut. Agri Sci. Research J. 2012; 2(9):534-538.
5. Atwal AS. Insect pests of stored grain and other products. In: *Agricultural pests of India and South-East Asia*. Kalyani Publisher, New Delhi, India, 1976, 389-415.
6. Bhuwan BM, SP Tripathi. Repellent Activity of Plant Derived Essential Oils against *Sitophilous oryzae* (Linnaeus) and *Tribolium castaneum* (Herbst). Sing. J. Sci. Res. 2011; 1:173-178
7. Cetin HF, Erler A, Yanikoglu. Larvicidal activity of a botanical natural product, Akse Bio, against *Culexpipiens. Fitot*. 2004; 11(75):724-728.
8. Dwivedi SC, Shekhawat NB. Repellent Effect of Some Indigenous Plant Extracts Against *Trogoderma granarium* Asian J. Exp. Sci., 2004; 18(2):47-51.
9. Damalas. Potential uses of turmeric (Curcuma longa) products as alternative means of pest management in crop production. POJ. 2011; 4(3):136-141.
10. Dwivedi, Shekhawat. Repellent Effect of Some Indigenous Plant Extracts against Trogoderma granarium (Everts). Asian J. Exp. Sci. 2004; 18(1&2):47-51
11. Gunarathnae TVNM, Karunaratne MMSC. Laboratory evaluation of some Sri Lankan plants as post-harvest grain protectants for the control of rice weevil Sitophilus oryzae Vidyodaya J of Sci. 2009; 14(2):69-83.
12. Hassanali A, Lwande W, Ole-Sitayo N, Moreka L, Nokoe S, Chapya A, *et al*. Weevil repellent constituents of Ocimum suave leaves and Eugenia caryophyllata cloves as grain protectants in parts of Eastern Africa. Discovery Innov. 1990; 2:91-95.
13. Hasan MM, Reichmuth C. Relative toxicity of phosphine against the bean bruchid Acanthoscelides obtectus (Say) (Col., Bruchidae). J of Applied Ento. 2004; 128:332-336.
14. Islam MS, Hasan MM, Xiong W, Zhang SC, Lei CL. Fumigant and repellent Essential oils against stored pests J. Biopest. 2009; 5(2):120.
15. Joy PP, Thomas J, Mathew S, Skaria BP. Medicinal Plants. In: Trop. Hort., 2 Ed: TK Bose, J. Kabir and PP Joy, 2001, 449-632.
16. Kim SI, Roh JY, Kim DH, Lee HS, Ahn YJ. Insecticidal activities of aromatic plant extracts and essential oils against Sitophilus oryzae and Callosobruchus chinesis. J. Stor Prod. Res. 2003; 39(3):293-303.
17. Koul O, Walia S, Dhaliwal GS. essential oils as green pesticides: potential and constraints. Biopestic. int. 2008; 4(1):63-84.
18. Lahlou M, Berrada R, Hmamouchi M, Lyagoubi M. Effect of some Moroccan medicinal plants on mosquito larvae, Thérap. 2001; 56:193-196.
19. Latif MA, Rahman MM, Alam MZ. Efficacy of camphor in protecting rice grains infested by rice weevil (Sitophilus oryzae Linn.) in storage. J. Agric. Edu. Tech. 2004; 7:75-78.
20. Moreira MD, Picanco MC, Barbosa LC, Gudes CNR, Campos MR, Silva GA, *et al.* Plant compounds insecticide activity against Coleoptera pests of stored products. Pesq. agropec. Bras, 2007, 42.
21. Mahmoodvand S, 2012. Effects of essential oil and powder four plant species on Tribolium castaneum (Herbst) and Tribolium confusum. MS Thesis, Islamic Azas Uni, Arak Branch.
22. Mohiuddin S, Qureshi RA, Khan MA, Nasir MKA, Khatri LM, Qureshi SA. Laboratory investigations on the repellency of some plant oils to red flour beetle. Tribolium castenum, 1987.
23. Nadra HAM. Use of Sesbania sesban (L.) Merr seed extracts for the protection of wheat grain against the granary weevil, Sitophilus granarius. Scientific J of King Faisal Uni (Basic and Applied Sciences). 2006; 7:121-135.
24. Pugazhvendan SR, Elumalai K, Ronald Ross P, Soundarajan M. Repellent activity of chosen plant species against Tribolium castaneum. Wolrd J. Zool. 2009; 4(3): 188-190
25. Pugazhvendan SR, Ronald Ross, Elumalai P,

Insecticidal K. repellant activities of plants oil against stored grain pest, Tribolium castaneum. Asian Pacific J of Tropical Disease, 2012, 412-415.
26. Saeidi M, Moharramipour S. Insecticidal and repellent activities of Artemisia khorassanica, Rosmarinus officinalis and Mentha longifolia essential oils on Tribolium confusum. J. Crop Prot. 2013; 2(1):23-31.
27. Saljoqi AUR, Afridi MK, Khan SA, Rehman S. Effects of six plant extracts on rice weevil Sitophilus oryzae L. in the stored wheat grains. J. Agric. And Biol. Sci. 2006; 1(4):61-65.
28. Ukeh DA, Birkett MA, Bruce TJA, Allan EJ, Pickett JA, Mordue (Luntz) AJ, *et al*. Behavioural responses of the maize weevil, Sitophilus zeamais, to Host (maize grain) and non-host plant volatiles. Pest Manag. Sci. 2010; 66:44e50.