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Efficacy of Some Plant Extracts Against Stored-Product Pest Red Flour Beetle, *Tribolium Confusum* (Jacquelin Du Val) (Coleoptera: Tenebrionidae) Adults

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ABSTRACT: The efficacy of five plant extracts, *Lantana camara*, *Ruta chalepensis*, *Rhazya stricta*, *Heliotropium bacciferum* and *Marrubium vulgare* against *Tribolium confusum* ware investigated by admixing plant extract with wheat grains. Mortality (%) increased with increasing concentrations, exposure periods and varying from plant to plant. *L.camara* and *R. chalepensis* induced the highest percent of mortalities (95.4 and 93.8%) at 500 ppm after 6 days of exposure respectively, for *T. confusum*, followed by *Rh. Stricta*, *M. vulgare* and *H. baccifirum*. (91.4, 84.5 and 83,3%) respectively. The lowest LC50s were for *L. camara* and *R. chalepensis* (114.61 and 117.78 ppm), after 6 days from exposure respectively, followed by *Rh. Stricta*, *M. vulgare* and *H. bacciferum* (175.48, 251.99 and 309.67 ppm respectively. The rate of repellency increased with increase of dose level. *L. camara* had the lead in repellent action where repellent percentage was 100 % at 500 ppm followed by *R. chalepensis*with, 91%. The repellency rates of other plant extracts were between 50.22 -66.54 at the same concentration which had a moderate repellent action. Statistical analysis showed that all plant extracts revealed significant deference except between *H. bacciferum* and *M. vulgare*. Among all the plant extracts *L.camara* and *R. chalepensi* were generally more toxic than other plant extracts against *T. confusum*.

KEYWORDS: Efficacy, Mortality, Plant extracts, Stored food products, *Tribolium confusum*.

I. INTRODUCTION

Stored product pests cause serious damage by feeding on stored food products and endanger the public health by contamination of food, results to reduce of both in quantity and quality of stored products. Management of these insects is considered the most effective approach for the protecting of stored food products and prevention of economic losses, caused by insects. Among all of the storage-pest insects, confused flour beetle (*Tribolium. confusum*) is cosidered one of the most important pests, present worldwide on a wide varities of stored products (Christain Olsson *et al*, 2005). It is responsible for significant losses in many stored product materials especially flour and cereals in storage (Via 1999, Weston and Rattlingourd 2000). The grain industries in developing countries have been employed different strategies in order to preserve the stored grain from insect infestation. Among all of those, synthetic insecticides largely used as stored food product protestant. The problems associated with extensive use of synthetic insecticides are undesirable side effects including the insect resistance, adverse effects on non-target organisms and general environmental contamination. Also, they can have direct toxicity to user and increasing cast of application (Georghiou, 1987; Metcalfe, 1989; Lamiri *et al*., 2001). Hence, there is interest in developing alternative, and environmentally safe methods to control insect pests while retaining acceptable product quality. The use of botanical pesticides in controlling insect pests is considered to be the most viable and environmentally safe approach to offset ever increasing danger caused by synthetic pesticides (Saxena, 1982). The bio efficacy of various plants extracts against pulse beetles and *Tribolium castaneum* had been studied by various authors (Rahman and Talukder, 2006; Sagheer *et. al*., 2011; Bhalerao, 2014).

The current research reviews the use of bio synthetic insecticides as a disinfestation method of stored food grain pests. The work aimed to study the toxicity and repellency effect of plant extracts extracted from five different plans on the most abundant stored product pest (*T. confusum*) as a safe method to reduce their population without pollution.

II. MATERIAL AND METHODS

The foregoing investigation was comprised of the efficacy of five different plant extracts against *Tribolium confusum* (Jacquelin du Val) (Coleoptera: Tenebrionidae) and it was conducted in the laboratory of plant protection under the effects of four different concentration levels (200, 300, 400 and 500 ppm) of plant extracts.

A. *Samples used*

The wheat and flour of wheat variety (*Triticum vulgare*) obtained from the market, were selected for the study. The whole wheat and flour of wheat were sieved and cleaned from husks, dust or any inert materials. The conditioned samples were then stored at room temperature in sealed bags in the laboratory until used for the experiments.

B. *Tested insects*

The red flour beetle, *Tribolium confusum* Jaquelin du Val (Coleoptera: Tenebrionidae) was selected for the study. It was obtained from natural infested cereal grain, from a local market. The original stock cultures of insects were maintained in the laboratory.

C. *Rearing technique of insect*

The confused flour beetle, *Tribolium confusum* Jaquelin du Val (Coleoptera: Tenebrionidae) was obtained from the previous culture present in the laboratory. Apure culture of the confused flour beetle were prepared, growing and maintained on wheat flour under the control condition of 30±2℃, 12: 12 L: D and 70±5% R.H. New emerged adult insects (1-2 days after emergence) of *T. confusum* were used for the experiment, according to Saidana *et al*. (2007).

D. *Plant extracts*

Five plant extracts were used in this investigation. Plant extracts, scientific names of plants, used parts in extraction of plant extracts and source of plant extracts are listed in table (1).

Table 1: Scientific names of plants, used part in extraction of plant extracts and sources

Scientific Name of Plants	**Used Parts**	**Sources**
Lantana camara	Leaves	Saudi Arabia
Ruta chalepensis	″	″
Rhazya stricta	″	″
Heliotropium bacciferum	″	″
Marrubium vulgare	″	″

E. *Preparation of plant extracts*

The leaves of *Lantana camara* L., *Ruta chalepensis, Rhazya stricta*, *Heliotropium bacciferum and Marrubium vulgare* were collected from around central part of Saudi Arabia. Collected leaves were washed with distilled water and air dried for six days and macerated using domestic grinder. The powdered materials were separately subjected to acetone extraction with Soxhlet apparatus for 15-18 hrs. Crude extracts were passed through Whatman (No. 1) filter paper and concentrated by a rotatory evaporator under low pressure. Dark-green residue obtained were stored in glass vials and maintained in a refrigerator (4℃) until further use.

F. *Bioassay of extract against T. confusum*

Four concentration (200, 300, 400 and 500 ppm) were made in analytical grade acetone for assay. The extracts were mixed for about five minutes with wheat grains (1 ml/50 gm wheat) and air dried for 10 minutes. 1-2 days old adults of *T. confusum* were released into plant extracts, treated wheat containing bottles (21×10 cm) covered with perforated lid. Three replications were maintained for each concentration of the individual plant extract. Same volume of acetone treated grains were served as control. Mortalities were recorded on 2, 4 and 6 days after the treatment.

G. *Repellency experiments*

Small plastic vials (capacity 100 ml) were used to test the extracts. The vials used for the experiment were disinfested with 80% alcohol 24 hours before inoculation. A control containing no extracts was allotted to each treatment. There was one set of two

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vials joined by clear plastic pipe of 1 cm diameter at an angle of 180 degrees for each replication. One vial of each set was provided with 20g of wheat grains, and fixed at the position A, while the other vial was kept empty, and given the name B or fixed at the position B. Before filling with grains, vials (B) were not treated. Ten adults of *T. confusum* of the same age were released in vials A.

H. Statistical analysis

All obtained data were statistically analyzed using Finney (1971) software. Comparisons among the means of the various treatments were performed, using the revised least significant different (L. S. D) at < 0.05 level. Angular transformation was done for the percentage values.

III. RESULTS

A. Insecticidal activity of five plant extracts on adult insects of T. confusum

The results presented in Table 2 show the percentage of adult mortality endured due to the five plant extracts against *T. confusum*. The data showed that both concentrations of *L.camara* and *R. chalepensis* induced 90.0 and 89.3 % mortality with 500 ppm after 4 days of exposure, respectively for *T. confusum*. The highest percent of mortalities achieved were 95.4 and 93.8 % for both of plant extracts after 6 days from exposure with 500 ppm concentration (Table 2). The mortality percentage increased after 6 days of exposure for all plant extracts. After 6 days of exposure, *Rh. stricta*, *H. bacciferum* and *M. vulgare* gave (91.4, 83.3 and 84.4 %) with 500 ppm, respectively. The lowest mortalities were 83.3 % for *H. baccifirum*. Mortality of control was less than 5% along the exposure periods. LC50s and 95 % confidence limits for each plant extract are shown in Table 3. Data were analyzed using the probit analysis, and the effectiveness was expressed as LC50 values. The lowest LC50s were for *L. camara* and *R. chalepensis* after 6 days from exposure which it was 114.61 and 117.78 ppm, for *T. confusum*, respectively. The respective values of LC 50s of the other plant extracts after the same period of exposure were (175.48, 309.67 and 251.99 ppm for *Rh. stricta*, *H. bacciferum* and *M. vulgare*, respectively. The obtained results showed that the plant extracts of *L.camara* and *R. chalepensi* were generally more toxic than other plant extracts and they possess lower LC50s.

Table 2: Percentage mortality of *Tribolium confusum* (L.) adult treated with extracts of five plants

Plant extracts	Concentration (ppm)	Mortality %		
		2d	4d	6d
Lantana camara	200	45.3	65.5	70.0
	300	55.5	68.3	77.2
	400	64.5	80.0	86.3
	500	87.7	90.0	95.4
Ruta chalepensis	200	51.1	61.7	68.3
	300	54.1	66.7	73.6
	400	63.8	76.3	81.8
	500	82.3	89.3	93.8
Rhazya stricta	200	44.4	46.6	57.7
	300	51.1	63.7	69.7
	400	61.5	71.6	79.6
	500	78.1	87.7	91.4
Heliotropium bacciferum	200	36.6	37.7	38.8
	300	45.5	46.7	52.2
	400	58.8	65.5	70.0
	500	72.2	78.8	83.3
Marrubium vulgare	200	42.2	43.3	46.6
	300	46.7	50.0	55.5
	400	61.1	71.1	77.7
	500	77.7	82.2	84.5
	Cont.	00.0	00.0	2.2

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Table 3: LC50 values and 95% confidence limits for *T. confusum* (L.) adult reared in media containing acetonic extracts from five plants materials

Plant extracts	Assay times (days)	Slope	LC50 (95%CL)
Lantana camara	2	0.92	203.97 (176.23- 284.30)
	4	1.37	127.37 (120.11- 221.22)
	6	1.79	114.61 (096.42- 179.44)
Ruta chalepensis	2	0.83	244.25 (205.71- 339.14)
	4	1.41	130.37 (098.00- 207.78)
	6	1.58	117.78 (077.21- 179.29)
Rhazya stricta	2	1.02	290.58 (226.00- 373.30)
	4	1.49	229.30 (178.32- 294.57)
	6	1.55	175.48 (130.24- 236.13)
Heliotropium bacciferum	2	1.09	386.73 (312.37- 478.64)
	4	1.68	344.53 (284.69- 416.79)
	6	1.88	309.67 (256.62- 373.52)
Marrubium vulgare	2	0.51	331.16 (260.85-420.16)
	4	1.78	291.87 (234.00- 363.80)
	6	1.97	251.99 (197.69- 320.95)

B. *Repellency experiments*

The results and statistical analysis of the repellency rate of tested plant extracts are presented in Table 4. Data demonstrated that *L. camara* had the lead in repellent action where repellent percentage was 100 % at 500 ppm concentration followed by *R. chalepensis* with 91% for the same concentration. The repellency rates of other plant extracts were between 50.22 -66.54 at the same concentration which had a moderate repellent action. Statistical analysis showed significant difference between *L. camara* and other plant extracts. Also, numerically the repellency rate of all plant extracts revealed significant deference except between *H. bacciferum* and *M. vulgare*. Finding revealed that the rate of repellency increased with increase of dose level. At 500 ppm concentration all plants showed the highest repellency rate.

Table 4: Repellency of plant extracts to *T. confusum* (L.)

Plant extracts	Repellency at concentrations (%)				Means
	200	300	400	500	
Lantana camara	77.21	84.22	94.3	100.00	88.93a
Ruta chalepensis	71.03	76.98	88.41	91.08	81.88b
Rhazya stricta	55.65	49.33	44.61	66.54	54.03c
Heliotropium bacciferum	37.61	39.99	42.54	50.22	42.59d
Marrubium vulgare	40.26	41.33	43.27	54.36	44.81d

*Means followed by the same letter are not significantly differ at 5 % level of probability

IV. DISCUSSION

In the present study, chemical safe control (use of some plant extracts) of the stored product pest (*T. confusum*) were investigated. Plant-derived materials have been found to be highly effective, more readily biodegradable, less likely to contaminate the environment and to have lower potential to produce resistance, making them viable alternatives to synthetic pesticides (Talukder and Howse, 1995; Shaaya *et al*., 1997; Talukder and Miyata, 2002; Khan and Gumbs, 2003; Park *et al.*, 2003). There are a lot of studies that shows the important of different plant extracts in order to control different stored products insects (Schmutterer, 1990; Xie *et al*., 1995; Singal and Chauhan, 1997; Golob *et al*., 1999; Weaver and Subramanyam, 2000; Schmutterer and Singh, 2002).

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Regard to the effect of plant extracts in this research almost all used plant extracts were superior whereas, the *L.camara* and *R. chalepensi* were generally more toxic than other plant extracts and they possess highest mortality rate and lower LC50s. parallel response to the level of concentration and exposure time. This result revealed that all used plant extracts showed toxicity against *T. comfusum*, but some plant extract was more effective than others. This is in agreement with finding of Aslan *et al.* (2004) that hey reported *Tetranychus urticae* and *Bemisia tabaci* could be controlled by the essential oil vapors of *Satureja hortensis*, *Ocimum basilicum* and *Thymus vulgaris*. From their experiments, it was revealed that though essential oil of the three plants can act as a control agent against *T. urticae* and *B. tabaci*, it was found that *Satureja hortensis* was more powerful than the others two. Ali and Mohammed (2013), studied the toxicity effect of the methanol extracts of *Anethum graveolens, Eucalyptus glauca, Apium graveolens, Malva parviflora, Z. officinale* and *Mentha longifolia* against *T. confusum*.

Our results demonstrated that *L. camara* showed the highest repellency rate against *T. confusum* followed by *R. chalepensis,* whereas, other plant extracts hade moderate repellent action at the same concentration (500ppm). Similarly demonstrated by Padin *et al*. (2013), that they studied 9 medicinal plants for their insecticidal and repellent activities against *T. castaneum*. The significant mortality of *T. castaneum* was noticed by the researchers in *Viola arvensis* on grain, followed by *Matricaria chamomilla*, *Brassica campestris* and *Jacaranda mimosifolia.* Similary, the significant repellent activity was detected in the *Jacaranda mimosifolia, Matricaria chamomilla* and *Tagetes minuta.*

However, action mode of plant extracts remains to be determined. Plant extracts, a plant type based on natural plant compound, are expected to be become the possible application, representing selective, efficacious and toxicologically safe products.

IV. CONCLUSION

Result of the study show that almost all the used plant extracts showed superior toxicity against *T. comfusum*, but the *L.camara* and *R. chalepensi* were generally more toxic than other plant extracts. Mortality was increased with increase of concentration and exposure time. all applied plant extracts significantly repelled the *T. confusum* adults compared with control. Therefore, plant extracts can play an important role in stored food products protection and they can become an interesting alternative to conventional chemical control strategies. Further investigation for improving the effectiveness of plant-based products as pesticides will provide an advantage to the agricultural industry of developing counties

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