

Research Article

In vitro repellency evaluation of selected botanical extracts against cigarette beetle, *Lasioderma serricorne*

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Abstract

To investigate the percent repellent outcomes of the chosen botanical extracts against adults cigarette beetle (*Lasioderma serricorne* Anobiidae: Coleoptera) an experiment was carried out at the Entomology Section, Department of Agricultural Sciences, University of Haripur, in 2015. Two native botanical extractions obtained from *Mentha longifolia* (Mint) Lamiaceae and *Momordica charantia* (Bitter Gourd) Cucurbitaceae were tested for finding the repellent outcomes against *Lasioderma serricorne* while exposing them for ten days. The concentrations of botanical materials were 25, 50 and 75%. Each treatment was replicated three times with completely randomized design (CRD). Outcomes confirmed that highest repellency was observed at tenth day of exposure by *M. longifolia* i.e. 86.667% at 75% concentration versus *L. serricorne*, followed by *M. charantia* at the same dose (75%) where the percent repellency was 76.67. The experiment further confirmed that as the exposure time and the concentrations increased the percent repellent outcomes of the *L. serricorne* also increased.

Keywords: Concentration; *Lasioderma serricorne*; Plant extracts; Repellency; Time exposure

Introduction

Tobacco is mainly cultivated in Khyber Pakhtunkhwa (KP) Pakistan. The main growing areas include viz., Buner, Charsadda, Swabi, Swat, Mardan and Manshera. *Nicotiana tabacum* L and *N. rustica* L are the main species which are cultivated in these areas [1]. At national level it attributes Rs. 34 billion to GDP along foreign earning of Rs. 587 million by the cigarette manufactures. It generates six times

more excise duty than cotton yarn [2]. Globally, stored product pests cause significant losses to storage commodities. In Pakistan, these losses are varied from 10 to 25% [3, 4]. The cigarette beetle, *Lasioderma serricorne* is a serious pest of stored products and causes considerable losses and has been regularly reported in most of the tropical and sub-tropical regions while feeding on all types of tobaccos like flue cured, rustica, burley and oriental tobaccos [5]. Similarly,

the preferred way of controlling *L. serricornis* is by using insecticides. Pyrethroids are used for crawling and flying populations while Aluminum phosphide is used against all stages in the form of fumigants. But the research showed that consistent uses of synthetic insecticides are causing negative effects on the environment and also on non-targeted organisms. Similarly, insecticides create problems of resistance in the target pests. [6]. So it is necessary to find safe crop protecting agents for their control [7, 8]. Some plant extracts have been reported with numerous negative effects on insects [7, 9, 10]. Botanical extracts are highly selective, simple to decompose, offer no residual effects, and trigger no contamination or risks to man and environment [11, 12]. In previous studies, the bioactivities of a large number of botanical oils have been also assessed versus number of insects found in stores [13, 14]. Based on the significance of plant extracts nature, this research was conducted to check the efficacy of various plant materials viz., *Momordica charantia* and *Mentha longifolia* against *L. serricornis* adults to investigate the percent repellent effects of chosen botanical extracts against *L. serricornis* adults in laboratory settings and to find out the effects of different concentrations of the chosen botanical extracts at different times of exposure.

Materials and methods

The experiment was carried out at the Department of Agricultural Sciences Entomology section, University of Haripur during 2015 to investigate the percent repellent outcomes of the chosen botanical extracts versus adult *Lasioderma serricornis*.

Test materials

Botanical materials utilized in the experiment were *Mentha longifolia* (T1) and *Momordica charantia* (T2). The above botanical materials were purchased from local market in District Haripur and then rinsed followed by drying at controlled temperature and

relative humidity i.e., $27 \pm 2^\circ\text{C}$ & $75 \pm 5\%$. Plant materials were extracted via the acetone solvent for extraction (100g of each sample in 75 ml of ethyl alcohol). The extracts were properly dried and stored in sealed glass vials in refrigerator. These botanical extracts then assessed for their repellency versus the adults of *L. serricornis* to determine the effective plant extract, percent concentration and exposure period.

Rearing & maintenance of insects culture

The checked insects were taken from laboratory cultures kept in incubators at $30 \pm 2^\circ\text{C}$ & $73 \pm 5\%$ relative humidity (RH). Wheat flour with Baker's yeasts (20:2 w/w) was the food source for insects at 12- 12.5% humidity. Collection of eggs was done by keeping the adults on filter papers for 45 hours. When eggs were hatched, then the larvae were shifted to other cages for maturity. Seven days older beetles were taken in petri dishes (10 adults per petri dish) and the botanical extracts were applied on them for finding their repellency. Poly tetrafluoro ethylene (Fluon) coating was done to avoid escaping of insects from the petri dishes.

Repellency

From the stock solution, various concentrations (25, 50 & 75%) of each plant extract were prepared by using acetone as a diluting solvent. The concentrations of test materials were obtained by taking 25, 50 and 75ml of each extract in 100ml of acetone to make 100 percent solution. The test solution was applied to each half of a filter paper disk. The control half was treated with acetone only. Filter papers were allowed to dry in open air for 10 minutes to evaporate the acetone. The diluted concentrations were used for subsequent experiments. Thirty mature beetles (seven days older) were released at the center of petri dish. In order to avoid the death of insects due to unavailability of food, a small quantity of diet was kept at the either side of the petri dishes.

Percentage repellency was determined by calculating the numbers of adults in treated & untreated areas repeatedly over the period of ten days. Each treatment was replicated thrice. Percentage repellency (PR) values were found out via the approach showed by [15].

$$\text{PR (\%)} = [(N^*_c - N^*_t) / (N^*_c + N^*_t)] \times 100$$

So as N^*_c shows number of beetles at untreated area and N^*_t shows beetles numbers at treated area.

Data analyses

The experiment was laid out in completely randomized design (CR, design) with four replications. Collected data were statistically analyzed using computer statistix ® 8.1 software. The least significant difference (LSD) at 5% level of significance was exploited to compare the treatments means [16].

Results and discussion

Percent repellency at 1st day of exposure

Lasioderma serricornis was exposed to botanical extracts viz. *Mentha longifolia* and *Momordica charantia* to the concentrations of 25%, 50% and 75% and 0% (control) so to find out their repellent outcomes. Amongst the tested botanical extracts *M. longifolia* showed repellent results of 26.67% at the concentration of 25% (Table 1) after 24 hours (1day) while *M. charantia* showed 20% (Table 2) repellent results. The percent repellent results observed on 50% concentration were 33.33 by *M. longifolia* and 30 by *M. charantia* as shown in (Table 1 & 2). At 75% concentration *M. longifolia* proved repellency of 56.67% which was similar with the findings of [17] who found that *M. longifolia* is most effective versus pests in stores at 75% concentration while *M. charantia* gave 46.67% repellent values respectively. The data further indicates that at control (0%) no repellency had been observed.

Percent repellency at 2nd day of exposure

At the second day of exposure *M. longifolia* triggered percent repellent value of 30 % at 25% concentration while *M. charantia* showed repellent value of 23% at the same concentration. At 50% concentration *M. longifolia* caused repellency of 36.67% and *M. Charantia* caused 33.33%. At the concentration of 75% repellency of 60% had been provided by *M. longifolia* while *M. charantia* showed 50% as shown in (Table 1 & 2) respectively. Our results are in accordance with the findings of [18] and who confirmed that *M. longifolia* has significant ability to repel *L. serricornis* and *S. oryzae* in minimum intensity.

Percent repellency at 3rd day of exposure

At the third day of exposure *M. longifolia* showed repellent value of 33.33% at 25% concentration while *M. charantia* caused repellency of 26.67% at the same concentration. At 50% concentration *M. longifolia* caused repellency of 40% and *M. charantia* caused 36.667% as shown in (Table 1 & 2) and these values are supported by [19]. At the concentration of 75% repellency of 63.33% was provided by *M. longifolia* and *M. Charantia* showed 53.33%, respectively. At control (0%) no repellent outcomes were observed.

Percent repellency at 4th day of exposure

The percent repellency results of the tested botanical extracts versus *L. serricornis* over exposure period of ninety-six hours (4 days) showed that *M. longifolia* caused maximum repellency of 36.67% at 25% concentration followed by *M. charantia* which caused 30% repellency (Table 1 & 2) respectively and these results are matched with the results of [18] who found *M. longifolia* is effective in low concentration against pest in stores. At 50% concentration *M. longifolia* caused repellency of 43.33% while *M. charantia* caused 40.00% correspondingly. Likewise, at the concentration of 75% repellency of 66.67% provided by *M. longifolia* while *M.*

charantia caused 56.67% repellency. At control (0%) no repellent outcomes were observed.

Percent repellency at 5th day of exposure

Percent repellent outcomes of the tested botanical extracts against *L. serricornis* over exposure period of one hundred-twenty hours (5 days) showed that at control (0%) no repellent outcomes were observed. Maximum repellent values of 40% at 25% concentration was observed by *M. longifolia* while *M. charantia* gave the repellent values of 33.33% respectively. By applying 50% concentration *M. longifolia* caused repellency of 46.67% and *M. charantia* showed repellent values of 43.33% as shown in (Table 1 & 2) At the concentration of 75% repellency of 70% proved by *M. longifolia* while *M. charantia* gave 60% repellency. These results are in close accordance with the results of [20] who found the above botanical extracts effective versus pests in stores in the tested concentrations.

Percent repellency at 6th day of exposure

Percent repellent results of plant extracts versus *L. serricornis* at the exposure period of one hundred forty-four hours (6 days) indicates that at control (0%) no repellency had been observed. *M. longifolia* gave the outmost repellent values of 43.33% at 25% concentration while *M. charantia* gave repellent values of 36.67% (Table 1 & 2). These results are supported by the findings of [21] who reported that *M. longifolia* showed repellency against stored pests in low concentration compared to other tested botanical extracts. Applying concentration of 50% *M. longifolia* caused repellency of 50% as compared with *M. charantia* whose repellent values was 46.67%. At the concentration of 75% repellency of 73.33% provided by *M. longifolia* while *M. Charantia* showed 63.33% repellency. Our results are comparable with the findings of [22] who found *M. longifolia* as a strong

agent of repellency versus store product pests at the same concentration (75%).

Percent repellency at 7th day of exposure

Percent repellency of plant extracts versus *L. serricornis* at the exposure period of one hundred sixty-eight hours (7 days) showed that *M. longifolia* triggered repellent value of 46.67 % at 25% concentration while *M. charantia* showed repellent values of 40%. At 50% concentration *M. longifolia* caused repellency of 53.33% and *M. charantia* caused 50% as provided in (Table 1 & 2) correspondingly and these findings are accordance with the results of [23] who reported *M. longifolia* a best botanical extract which repel insects in stores at medium concentration (50%). At the concentration of 75% repellency of 76.67% has been showed by *M. longifolia* while *M. charantia* showed 70% of the repellent values. At control (0%) no repellent outcomes were observed.

Percent repellency at 8th day of exposure

Percent repellent outcomes of the tested botanical extracts against *L. serricornis* over for the exposed period of one hundred ninety-two hours (8 days) applied at the concentration of 25%, 50% and 75%. *M. longifolia* gave high repellent values of 50% at 25% concentration followed by *M. charantia* with the repellent values of 43.33% correspondingly. Applying concentration of 50% *M. longifolia* caused maximum repellency of 56.67 % as compared with *M. charantia* where the repellent value was 53.33% respectively. At the 75% concentration repellency of 80% was observed by *M. longifolia* while *M. charantia* caused 70% repellency as shown in (Table 1, 2) and these results are accordance with the findings of [18] who observed that *M. charantia* provided repellent outcomes of more than 60%. At control (0%) no repellency was observed.

Percent repellency at 9th day of exposure

Percent repellent effects of the tested plant extracts on *L. serricornis* after exposure

period of two hundred sixteen hours (9 days) showed that at control (0%) no repellent outcomes were observed. *M. longifolia* caused repellent value of 53.33% at 25% concentration followed by *M. charantia* which caused repellency of 46%. At 50% concentration *M. longifolia* showed repellency of 60% while *M. Charantia* caused 56.67% repellency. When the concentration was applied @ 75%, repellency of *M. longifolia* was 83.33% whilst *M. charantia* showed 73.33% repellency (Table 1 & 2). These results are in accordance with the outcomes of [10] they find out high repellency of *M. longifolia* versus insects in stores.

Percent repellency at 10th day of exposure
 Percent repellent outcomes of the tested botanical extracts against *L. serricornis* for

exposure period of two hundred forty hours (10 days) showed that at control (0%) no repellency had been observed. *M. longifolia* gave repellent value of 56.67% at 25% concentration while *M. charantia* caused 50% repellency. At 50% concentration *M. longifolia* showed repellency of 63.33% while by *M. charantia* caused 60% repellency. At the concentration of 75% repellency of 86.67 % was provided by *M. longifolia* and *M. charantia* caused 76.67% repellency (Table 1 & 2) and these results strongly matched with the results [18] they declared that *M. longifolia* has the significant ability to repel *L. serricornis* and *S. oryzae* at low concentration. Likewise, *M. charantia* proved to be high efficient botanical extract versus *L. serricornis* after *M. longifolia*.

Table 1. Percent repellency of *Mentha longifolia* over exposure time of ten days

Concentration (%)	Percent repellency of <i>Mentha longifolia</i> over exposure time of ten days									
	1 st day	2 nd day	3 rd day	4 th day	5 th day	6 th day	7 th day	8 th day	9 th day	10 th day
0%	0.00 k	0.00	0.00 i	0.00 k	0.00 k	0.00 k	0.00 j	0.00 j	0.00 i	0.00 k
25%	26.66 def	30.00 ef	33.33 ef	36.67 def	40.00 def	43.33 def	46.67 cde	50.00 cdef	53.33 ef	56.67 def
50%	33.33 cd	36.66 cd	40.00 cd	43.33 cd	46.67 cd	50.00 cd	53.33 bc	56.67 cd	60.00 cd	63.33 cd
75%	56.66 a	60.00 a	63.33 a	66.67 a	70.00 a	73.33 a	76.67 a	80.00 a	83.33 a	86.67 a

Means in column followed by different letters showed significance at 5% level of probability

Table 2. Percent repellency of *Momordica charantia* over exposure time of ten days

Concentration (%)	Percent repellency of <i>Momordica charantia</i> over exposure time of ten days									
	1 st day	2 nd day	3 rd day	4 th day	5 th day	6 th day	7 th day	8 th day	9 th day	10 th day
0%	0.00 k	0.00	0.00 i	0.00 k	0.00 k	0.00 k	0.00 j	0.00 j	0.00 i	0.00 k
25%	20.00 fgh	23.33 gh	26.66 gh	30.00 fgh	33.33 fgh	36.67 fgh	40.00 efg	40.00 efg	46.67 gh	50.00 fgh
50%	30.00 cde	33.33 de	36.66 de	40.00 de	43.33 de	46.67 de	50.00 bcd	50.00 bcd	56.67 de	60.00 cde
75%	46.67 b	50.00 b	53.33 b	56.67 b	60.00 b	63.33 b	70.00 c	70.00 c	73.33 b	76.67 b

Means in column followed by different letters showed significance at 5% level of probability

Conclusions and recommendations

It is concluded that tested botanical extracts possess repellent abilities and repel insects in stores such as *Lasioderma serricornis*. As the

concentration (%) of the botanical extracts and exposure period (days) of the adult beetles to the tested extracts increased the percent repellency also increased. *Mentha*

longifolia proved to be high successful botanical extract against *L. serricorne* at the dosage rate of 75% during the tenth day of the exposure period. The other applied botanical extract i.e *Momordica charantia* (Bitter Gourd) has also the ability to show maximum repellent outcomes to the tested insect at the dosage rate of 75% at the tenth day of exposure. The tested botanical extracts showed their efficacy for controlling targeted insects in stores and could be served as an alternative repellent material for stored product insects. It could be desirable to examine the efficacy of such botanical materials on non-targeted living organisms while applying in IPM programs. Further research is necessary to probe the effectiveness of the tested botanical extracts (natural insecticide) as a substitute to the artificial chemical pesticides.

Authors' contributions

Conceived and designed the experiments: S Ahmad & M Saeed, Performed the experiments: W Kamal, Analyzed the data: H Zada, Contributed materials/ analysis/ tools: T Khan & S Ullah, Wrote the paper: A Rehman & A Latif.

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