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Effect of Food Preferences on Some Biological Aspects of the Cigarette Beetle, *Lasioderma serricorne* F.

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Abstract:
The cigarette beetle, *Lasioderma serricorne,* is one of the most important insects that attack most of the stored dry materials, especially wheat and medicinal and aromatic plants. The experiments conducted on preferred and non-preferred foodstuffs were the future objective of identifying them to find an optimal way to control them. The results obtained show that the insect preferred coriander, anise, chamomile, fennel, caraway, and cumin is the least preferred for mating, laying eggs, and larval development. The results showed that the insect is attracted to the host plants that contain sufficient protein, carbohydrates, 1.8 cineole, p- cymene and limonene to develop and preserve their offspring.
Keywords: *Lasioderma sericorne;* coriander; anise; chamomile; fennel; caraway; cumin; preferred; non–preferred.

INTRODUCTION

Lasioderma serricorne (F.) is one of the most important insects belonging to the order Coleoptera: Anobiidae, which affects most dry plants such as most medicinal, aromatic plants and grains such as wheat and its products, and infests the cigarette plants (Abdel-Hameid and Ibrahim, 2023; Arbogast *et al.*, 2002; Dimetry *et al.*, 2004; Hagstrum, 2016). This insect has become known to induce a high loss in the quality and quantity of stored plants (Abd El-Salam, 2010). The proportion of weight reduction under *L. serricorne* feeding ranged from 18.00 to 68.00 percent. In food crops, they damage crops through acute feeding, hence causing weight losses and seed losses, and the commercial value is reduced (Dodiya *et al.*, 2024; Karnavat *et al.*, 2025).

In the meantime, research is being carried out to control this destructive pest by several methods (Dimetry and Abd El-Salam, 2010; Kibar *et al.*, 2021; Ponce *et al.*, 2023). Here, finding attractive, repellent, or non-preferred substances may be a feasible way to minimize pest damage. Therefore, we wanted to do this work to know what foods are preferred and not favorable to the pest, and the results obtained may be useful in finding materials useful in reducing the number of this pest (Abd El-Salam *et al.*, 2018; Hashem *et al.*, 2017). To control and minimize these harmful effects of chemical insecticides, alternate methods of pest control like biological control, use of antifeedants, hormonal insecticides, plant extracts, etc. are being used (Ashraf *et al.*, 2024; Guo *et al.*, 2021; Iqbal and Ashraf, 2019; Khanum and Javed, 2021). In this work, several medicinal and aromatic plants were selected to conduct an experiment on which plants are preferred and not preferred by the insect target.

MATERIALS AND METHODS

Rearing the test insect

The culture of *Lasioderma serricorne* (F.) was started from a field strain obtained from dry chamomile flowers collected from Beni Suef Governorate. This field strain was reared for 10 generations on a medium consisting of 95.0% ground whole wheat flour + 5.0% dried granules yeast (Lefkovitch and Currie, 1963). This breeding medium was found suitable from the point of view of facilitating the separation of different stages for experiments. The food materials, before being used, were treated by freezing for at least 2 weeks to eliminate any possible infestation by any other insects. Fifty adults were kept in a jar containing 200 gm of food and incubated under rearing conditions until adult emergence, which were used for starting other cultures.

Laboratory conditions

The different stages of the insect were reared under constant conditions of temperature (30.0±1.0 °C) and relative humidity (65.0±5.0 % R.H.).

The plant used in the trial

Two experiments were carried out by two methods, non-choice and choice tests. Six aromatic and medicinal plants were used, namely Coriander seeds (*Coriandrum sativum* L.), Fennel seeds (*Foeniculum vulgare* Miller), Anise seeds (*Pimpinella anisum* L.), Caraway seeds (*Carum carvi* L.), Chamomile flowers (*Matricaria chamomilla* L.) and Cumin seeds (*Cuminum cyminum* L.).

Non–choice test

The above-mentioned six medicinal plants were used; 15 Pairs of newly emerged adults were placed in a Petri dish (9 cm in diameter) on 3 gm of each host plant. The number of deposited eggs was recorded (using a binocular microscope), and for up to 2 weeks, the host and eggs were left till egg hatching. The number of larvae produced in each host plant was counted and left to eat till pupation. The number of larval mortalities was recorded. Also, the pupae were counted, and the number of adults (progeny) that emerged from each host was counted. The experiment was replicated five times.

Choice test

An arena (3.0cm high x 15.5 cm diameter) divided into six equal divisions was used. Two grams of each host plant were placed inside each room. Fifty pairs of newly emerged adults were introduced in the center of the arena and covered with the arena cap. The distribution of the adults on each host plant was recorded after 1,3,5,7,9 and 11 days. After each period, the host plants were removed, and eggs were counted using a binocular microscope. Then newly host plant was placed inside each room. The experiment was replicated five times.

Statistical analysis

The data obtained were statistically analyzed using the "F" test, and the means were compared using the least significant difference statistics, L.S.D. $_{0.05}$ (ANOVA) by SPSS version 16 program.

RESULTS

Non-choice test

The different biological parameters of *L. serricorne* on the six selected medicinal and aromatic plants are shown in Table (1). The results obtained showed that the highest number of eggs was laid on coriander seeds (761.2 eggs) and the least number was for cumin (177.2 eggs), with a significant difference between the other tested plants. The host preference for deposition of *L. serricorne* can be arranged in descending order as follows: coriander, chamomile, anise, fennel, caraway and cumin. The percentage of egg hatchability differed significantly on the different host plants used (Table 1). The maximum percentage of hatched eggs was recorded on anise (96.9%), and the minimum percentage of egg hatchability was recorded on the cumin plant (60.4%). The number of hatched larvae resulting from the eggs deposited by 15 females differs according to the host used. The maximum number of larvae obtained was on chamomile (644.2 larvae), and the minimum number of larvae was on cumin (107.2larvae). There are no significant differences in the number of larvae obtained between coriander, chamomile, anise, and fennel, while significant differences were found between the previous host plants and caraway and cumin. The percentage of larval mortality was significantly affected by feeding on different hosts. When larvae were fed on caraway and cumin seeds, the mortality percentage reached 77.4 and 61.4 %, respectively, while for larvae that were fed on fennel, chamomile, and anise, the respective values were 56.2, 64.4, and 57.4%, respectively. The lowest percentage of larval mortality was recorded on coriander seeds (21.4%). Also, the results showed that the number of larvae that reached the pupal stage differed with differences in the host plant. The maximum number was achieved with the larvae that fed on chamomile, followed by coriander, anise, fennel, caraway, and the least number was cumin (Table 1). The type of host significantly affected the number of the adult stage. The highest percentage of adult emergence was (85.9%) on coriander seeds, followed by anise (56.2%), chamomile (54.05%), and fennel (53. 3%). The lowest percentage of adult emergence resulted on caraway and cumin (41.9 and 29.6 %, respectively). There are no significant differences in the number of adult emergences between chamomile, anise, and fennel, while coriander had significant differences with all tested host plants. From the above results, it could be concluded that coriander seemed to be the most suitable host for *L. serricorne* of all tested hosts, where fecundity and adult emergence were the highest, while on cumin, the tested insect showed the least fecundity, fertility and adult emergence.

Choice test

A choice test was carried out using the same hosts tested in the previous test. The results were summarized in Table (2). Fifty pairs of newly emerged adults (1-3 days old) of *L. serricorne* were released to choose between different hosts. Data indicated that coriander, cumin, and fennel seeds attracted the highest number of adults (25.8, 22.4, and 22.2 individuals, respectively), followed by anise, caraway seeds, and chamomile (10.4, 8.6, and 7.6 adults, respectively) after one day. On the

third day, the adults began to move toward the different hosts. At the same time, the adult females began to lay eggs on all tested hosts. The highest number of eggs was laid on coriander seeds and chamomile (84.0, 79.6 eggs, respectively).

Table 1. Host preference of the cigarette beetle, *Lasioderma serricorne* (non-choice test).

Host	Avg. No. ±SE		%	Avg. No. ±SE			% adult emergence
	Eggs for 2 weeks	Resulted larvae	hatchability	larval mortality	pupae	emerged adults	
Coriander	761.2±73.5a	597.4±20.9a	78.48	21.4±1.6c	576.0±67.9a	495.0±39.6a	85.9
Chamomile	700.4±18.3a	644.2±43.6ab	91.97	64.4±3.3ab	579.8±47.7a	313.4±6.7b	54.05
Anise	612.2±9.0ab	593.4±8.5ab	96.92	57.4±3.2b	536.0±20.5a	317.4±4.7b	56.2
Fennel	609.2±27.0b	535.6±15.4b	87.9	56.2±4.8b	479.4±39.0a	255.6±24.3c	53.3
Caraway	299.6±58.2c	215.2±10.3c	71.82	77.4±9.8a	137.8±23.7b	57.8±5.2d	41.9
Cumin	177.2±14.7d	107.0 ±27.2c	60.49	61.4±5.2b	35.8±2.5b	10.6±1.6d	29.6
F	32.25*	110.89*	-----	12.6*	36.8*	85.19*	-------
$LSD_{0.5}$	120.09	63.2	-----	15.62	115.66	56.9	-------

Means followed with the same letters are not significantly different.

The least number of eggs was laid on cumin (25.4 eggs). On the 5th day, the highest number of adults were attracted to caraway and fennel (22.0 and 21.6 adults, respectively), followed by coriander, anise, chamomile and cumin (19.6, 15.2, 11.2 and 10.4 adults, respectively). During this period, the highest number of eggs was recorded on coriander (472.6 eggs), followed by chamomile (390.2 eggs), anise (185.4eggs), fennel (109.6eggs), caraway (90.4 eggs), while the lowest number of eggs was recorded on cumin (55.2 eggs). On the 7th day, the orientation of the adults towards the different hosts was different from the preceding days, where the highest number of adults was recorded on chamomile, fennel and coriander (21.2, 20.0 and 18.8 adults, respectively), followed by anise, caraway and cumin (16.2, 12.2 and 11.6 adults, respectively). As regards oviposition of eggs, the same trend was recorded as on the 5th day. Coriander was found to be attractive for laying eggs in comparison to the other hosts, where the maximum number of eggs was laid (383.6 eggs).

On the other hand, caraway was the least attractive for egg laying (26.6 eggs) on average were laid. On the 9th day, the highest number of adults was recorded on fennel, chamomile, and anise (24.6, 22.0, and 20.8 adults, respectively), and the lowest number of adults was recorded on coriander, caraway, and cumin (13.0,10.4 and 9.2 adults, respectively). During this period, the highest number of eggs was recorded on chamomile (152.0 eggs), followed by coriander (122.4 eggs), and the least number of eggs was laid on cumin (12.2 eggs). On the 11th day, the highest number of adults was recorded on chamomile (27.0 adults), followed by fennel (19.6 adults), coriander (11.6 adults), caraway (14.6 adults), anise (13.8 adults), cumin (13.4 adults), and the least number was recorded on coriander (11.6 adults). During the same period, the highest number of eggs was recorded on chamomile and coriander (82.4 and 76.4 eggs, respectively), which were found to be the more favorable hosts for egg laying, and cumin was the least favorable one (9.6 eggs). The descending order of adults that were attached to different hosts was as follows: fennel (21.2 individuals), coriander (18.6 individuals), chamomile (15.5 individuals), cumin (15.1 individuals), anise (15.0 individuals), and caraway (14.6 individuals) (Table 2).

Significant differences were found in the average number of adults attracted by fennel and chamomile, anise and caraway. There are no

significant differences between fennel and coriander. The highest average number of eggs was on coriander (1148.0 eggs), followed by chamomile (1022.2 eggs), anise (516.2 eggs), fennel (306.2 eggs), caraway (181.4 eggs), and cumin (129.0 eggs). Highly significant differences were found between the average number of eggs laid on coriander, chamomile, and the other host plants. From the foregoing results, it could be concluded that fennel was highly preferable for landing of the adults and coriander was the most suitable host for oviposition.

Table 2. Attraction and oviposition of Lasioderma serricorne adults on different hosts (choice test).

Avg. No. adults attracted and egg laying/host after treatments (±SE)	Days	Stage	Host							
			Coriander	Chamomile	Anise	Fennel	Caraway	Cumin	F	$LSD_{0.5}$
	1-day	Adults	25.8±3.5b	7.6±2.2a	10.4±3.4b	22.2±4.1a	8.6±2.7b	25.4±3.3a	7.54NS	9.45
		Eggs	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	----	----
	3-days	Adults	22.4±2.5a	4.6±2.9c	13.8±1.0b	18.8±2.3ab	19.6±3.1ab	20.8±3.1ab	6.47NS	7.55
		Eggs	84.0±3.0a	79.6±7.3a	56.6±4.5b	58.0±5.4b	28.8±3.5c	25.4±5.4c	23.6*	14.85
	5-days	Adults	19.6±2.3bc	11.2±2.5ab	15.2±1.9b	21.6±1.9ab	22.0±2.7a	10.4±2.2c	5.1NS	6.63
		Eggs	472.6±40.4a	390.8±27.3b	185.4±9.0c	109.6±10.3d	90.4±8.2d	55.2±6.5d	67.35*	61.65
	7-days	Adults	18.8±1.5ab	21.2±2.3a	16.2±2.0abc	20.0±2.2a	12.2±1.6bc	11.6±3.7c	3.07NS	2.74
		Eggs	383.6±26.1a	323.4±27.0b	149.6±10.3c	80.8±4.7d	28.2±2.3e	26.6±2.1e	91.43*	46.9
	9-days	Adults	13.0±2.5ab	22.0±2.3bc	20.8±1.9b	24.6±1.9ab	10.4±2.7a	9.2±2.2c	5.1NS	6.63
		Eggs	122.4±9.0a	152.0±10.3b	88.4±5.6c	35.8±5.2d	18.8±2.1de	12.2±3.7e	74.5*	19.4
	11-days	Adults	11.6±3.7b	27.0±3.2a	13.8±5.2b	19.6±2.9ab	14.6±2.6b	13.4±5.0b	2.13NS	11.44
		Eggs	85.4±8.6a	76.4±7.9a	36.2±5.2b	22.0±2.6bc	15.2±2.5c	9.6±2.4c	33.53*	16.15
Avg. No. adults attracted			18.5	15.6	15.0	21.2	14.6	15.1	------	-----
Total Avg. No. Eggs			1148.0	1022.2	516.2	306.2	181.4	129.0	------	-----

Means followed with the same letters are not significantly different.

DISCUSSION

The results indicate that the aromatic and medicinal plants have stronger attractiveness to *L. serricorne* adults. The behavioral response of insects to the previous host plants depends on various factors, including insect species, developmental stage, volatiles from the host plants, the chemical compositions of the host plant, the physical plant, application method, and special environmental conditions, and so on. Some compounds that strongly attract insects, especially sex pheromones, have been developed as attractants for detecting and monitoring programs (Burkholder and Ma, 1985), or as attractants (Nansen and Phillips, 2004). It was found that *L. serricorne* adults reared on the diets, namely, anise, cumin, cottonseed, and whole wheat grain, showed the least fecundity and development as the protein and carbohydrate contents of these foods were very low (Ali *et al.*, 1972; Oliveira *et al.*, 2025). The

kind of diet offered to larvae of *L. serricorne* had a significant effect on the different biological aspects of the insect. Chickpeas, coriander and chamomile were the most suitable hosts. These hosts contained a fairly high percentage of crude protein (24.9, 18.9 and 18.4%, respectively) and have high carbohydrate content (51.8, 40.4 and 25.0%, respectively). However, on fennel and cumin, females showed the least fecundity and development, where the content of protein (12.0,13.2%, respectively) and carbohydrate (35.4 and 22.3%, respectively) was very low (Babarinde *et al.*, 2008; Memon *et al.*, 2017; Naveena *et al.*, 2019; Patra, 2015). A study showed that *C. camphora* blocks had stronger attractiveness to *L. serricorne* adults than *C. camphora* oil. The behavioral response values of *L. serricorne* adults to *C. camphora* blocks significantly increased with increasing doses above the dose of 0.8 g. The authors attributed this attraction to the presence of active substances in the plant, mainly including camphor, nerolidol, linalool, 1,8-cineole, safrole, or borneol (Jianhua *et al.*, 2018).

The results showed that some plants like coriander and chamomile were most attractive to the cigarette beetle for feeding and laying eggs. Others were less attractive for feeding and laying eggs, such as anise and cumin. The chemical composition and physical properties of these host plants were different. The main constituents of *Pimpinella anisum* L. fruits were trans-anethole (93.9%) and estragole (2.4%). The olfactorily valuable constituents that were found with concentrations higher than 0.06% were (E)-methyeugenol, α-cuparene, α-himachalene, β-bisabolene, p-anisaldehyde and cis-anethole (Özcan and Chalchat, 2006). The chromatographic analysis presented ten components, with the four main constituents in coriander seeds being linalool (64.4%); 2-dodecanal (5.5%); palmitic acid (5.3%); and geraniol (5.1%) (dos Santos *et al.*, 2019). Another study revealed that the main sesquiterpenes in the chamomile essential oil were Camazulene (19.9%), α-bisabolol (20.9%), A and B bisabolol-oxides (21.6% and 1.2% respectively) and β-farnesen (3.1%) were the major components. In lower concentrations were identified α- and β-caryophyllene, caryophyllene-oxide and spathulenol, and also some monoterpenes like β-phellandrene (0.8%), limonene (0.8%), β-ocymene (0.4%) and γ-terpinen (0.2%) (Costescu *et al.*, 2008). The chemical composition of the extracted cumin seed were *α*-phellandrene (0.82%), Limonene (0.5%), (E)-*β*-ocimene (9.72%), *γ*-terpenine (12%), *α*-terpinolene (3%), p-menth-2-en-1-ol (9%), Cuminldehyde (35.25%), Geraniol (0.63%), 2-caren-10-al (1.32%), *α*-Terpinyl acetate (5.32%), Tetradecene (12.25%), Manoyl oxide (0.63%) and Phynyl ethyl anthranilate-2-(4.70%) (Moawad *et al.*, 2015). Numerous studies have demonstrated the ability of *L. serricorne* to target plants with volatile substances (Hori *et al.*, 2011; Mahroof and Phillips, 2007; Phoonan *et al.*, 2014). One of the most promising substances that attracts the insect for mating or laying eggs was β-ionone, catechol, benzaldehyde, α-terpineol, linalool, *S*-perillaldehyde, *S*-limonene, β-caryophyllene, α-humulene, citronellal, and citral (Lü and Liu, 2016; Nagasawa *et al.*, 2014; Phoonan *et al.*, 2014). These substances appeared to have dual functions, i.e., they could attract or repel the beetle depending on the concentration of the compounds. The α-terpineol, linalool, and *S*-perillaldehyde strongly repelled *L. serricorne* at a dose of 1 µl but tended to attract the beetles at a very low dose (Hori, 2004). *L. serricorne* females showed more sensitivity to plant volatiles than males (Mahroof and Phillips, 2007).

A previous study has given one elucidation for this behavior, as the leading females of *L. serricorne* are attracted (attraction without pheromone) to the appropriate food by the volatile smell of food, followed by the release of the female's special pheromone to attract males for mating (Nagasawa *et al.*, 2014). The females then lay their eggs on this selected food suitable for feeding and growing their larvae. *L. serricorne* females may not be able to discriminate between suitable and less suitable host plants solely based on plant volatiles (Edde and Phillips, 2006).

Alternatively, there are potential differences in the factors that govern host choice for mating, oviposition, and larval growth in the species (Nagasawa *et al.*, 2014). A detailed

understanding of the role of plant volatiles in plant– insect interactions would be beneficial in the development of tools for the enhancement of environmentally friendly solutions for managing the pest (Chaudhari *et al.*, 2021; de Lima Carvalho *et al.*, 2018; Nagasawa *et al.*, 2014). Attractive substances are one of the most promising ways to fight both sexes of the insect, *L. serricorne* (Edde and Phillips, 2006; Mahroof and Phillips, 2007).

CONCLUSION

The cigarette beetle, *L. serricorne,* is attracted to the content of host plants that have a fairly high percentage of crude protein and have a high carbohydrate content & 1.8 cineole, p-cymene, and limonene, for mating, oviposition, and larval development. The use of attractive substances in the traps will be useful in the control of this stubborn pest.

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CONFLICT OF INTEREST

The authors hereby state that there is no conflict of interest to declare.

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