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Olfactory Stimulants Mediated Egg-Laying Preference of Cowpea and Faba Bean Beetles and the Effectiveness of some Aromatic Plant Products as Protective Agents

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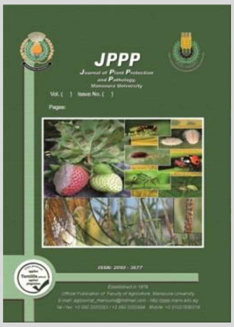

ABSTRACT

The chrysomelid beetles, *Callosobruchus maculatus* (F.), and *Bruchidius incarnatus* (Boheman) . females showed different degrees of egg-laying preference on the legume grains. *C. maculatus* females preferred cowpea over soybean and chickpea. While they significantly desired egg-laying on white bean over horse bean and chickpea. While *B. incarnatus* females showed the highest preference for laying eggs on soybean, they also preferred horse beans over white beans and chickpeas. The ovipositional preference is odor-mediated, whereas *C. maculatus* females showed greater attraction to cowpea extracts than to horse bean or chickpea. Regarding *B. incarnatus*, it exhibited the highest attraction to horse bean extract. The efficiency of the crashed plant leaves (rosemary and marjoram), and clove bud flowers in protecting cowpea and horse bean grains from *C. maculatus* and *B. incarnatus* was evaluated after 37 days of storage. The growth rates of *C. maculatus* reared on cowpea treated with marjoram and rosemary were very slow (0.050, and 0.053) in comparison with control (0.397). On the contrary, the lowest growth rate of *B. incarnatus* reared on horse beans treated with clove was 0.0478 followed by marjoram (0.052),while the growth rate was high as faster on untreated horse bean seeds (0.154). All botanical treatments significantly decreased the oviposition activities of both beetles. Marjoram, rosemary, and clove treatments significantly reduced cowpea damage by (84.1, 80.57, and 75.69%, respectively) against the attack of *C. maculatus*. While, bud flower clove proved effective against *B. incarnatus*, it led to a reduction in the rate of horse bean seed damage (57.46%).

Keywords: bruchid, rosemary, marjoram, clove.

INTRODUCTION

The Leguminosae, commonly known as the legume crops, includes several plants, including cowpea, soybean, horse bean, and chickpea which are a source of protein and food for many people (Gameel, 2014, and El-Ghamery et al., 2021). According to the Food and Agriculture Organization of the United Nations (FAO 2012), over 870 million people around the world are malnourished due to a lack of protein, vitamins, and minerals in their diets. Stored grain infestation with insects causes economic damage and deteriorates the quality of food grains and food products (Trivedi et al., 2018). *Callosobruchus maculatus* (F.) and *Bruchidius incarnatus* Boh are considered among the most important and cosmopolitan pests, seriously attacking several legumes stored grains (Kulkarni *et al.* 1985 , :Magagula and Maina,: 2012 Uddin and Adesiyun,2012,; and Osman et al.,2015). losses caused by *C. maculatus* in stored legumes are significant ranging between 10 – 50% of the total yield (Fornal et al., 2007, Upadhyay and Ahmed, 2011). Eldefrawy and Abd El-Raheem (2017) reported that under six months of natural infestation, the maximum proportion of infestation was 50% in faba bean seeds infested with *B. incarnatus*. Most of the damage caused by these insects is weight loss, lower quality and quantity attributes, and market value, as well as the capacity of the afflicted grains to germinate. Botanicals have been employed to protect stored grains from prevalent pests since the dawn of time. They act as insect development inhibitors, repellents, antifeedants, toxicants, and reproduction inhibitors (Trivedi et al., 2018). The use of medicinal and aromatic plants in stored grain pest management is a promising source of safe and cheap materials (Moawad,2003; Trivedi et al., 2018). Therefore, the present investigation deals with the ovipositional preferences of *C. maculatus* and *B. incarnatus* females among different legume seeds, and the role of olfactory stimulants of legume seeds. In addition, evaluation of the efficacy of some botanical natural products as bio-agent on insect population growth, and seed damage.

MATERIALS AND METHODS

All experiments were conducted in the laboratory of the Economic Entomology Department, Faculty of Agriculture, Mansoura University, Mansoura, Egypt.

1. Insect and grain legumes source.

laboratory cultures of *Callosobruchus maculatus* (F.) and *Bruchidius incarnatus* Boh. (Coleoptera: chrysomelidae) were established from the naturally infected cowpea and broad bean seeds and reared separately on cowpea and horse bean for several generations in an incubator maintained at 30 ± 2°C. The beetles were sexed using the keys described by Rees, 2004. Newly emerged mated females (2-day old) of *C. maculatus* and *B. incarnatus* were used for estimating their oviposition preference on different legume grains under laboratory conditions. The legume seeds (cowpea, *Vigna unguiculata*; horse bean, *Vicia faba*; soybean, *Glycine max*; white bean, *Phaseolus vulgaris* and chickpea, *Cicer*

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arietinum) used in the bioassays were purchased from grocery stores (in Mansoura, Egypt). Seeds were first oven-dried at 60ºC for 72 hours to kill all immatures of bruchids (Osman, et al.,2015).

2.Estimate the oviposition preference of cowpea and small bean beetles.

In response to cowpea, soybean, and chickpea seeds.

To estimate the oviposition preference of *C. maculatus* and *B. incarnatus* among the three tested legume seed species (cowpea, soybean, and chickpea) choice tests were conducted according to Messina and Renwick (1985). Each choice test consists of 15Petri dishes with a diameter of 12 cm as replicates for each beetle species. Each dish was divided into three equal sections by using cardboard strips. Thirty clean seeds of each legume (approximately homogeneous in size) species were placed in a section. The grains were arranged in a single layer without any overlapping. Single pairs of 2-day-old adult males and females of each species were released in the Petri dish and removed after 48 hours. Petri dishes were kept under laboratory conditions at a temperature of 30± 2° C. Number of eggs laid on seeds of each legume species was recorded after 24 and 48 hours.

In response to white bean, horse bean, and chickpea grains.

The previously mentioned choice tests were conducted to evaluate the oviposition preference of both bruchid beetles among the three legume (white bean, horse beans, and chickpeas). Twenty-five clean grains of each legume (approximately homogeneous in size) species were placed in a section. After introducing the insect pairs (male and female) to each dish, all dishes were placed under a temperature of 30 ± 2 ° C, then eggs were counted after 24 and 48 hours.

3. Influence of legume grain extracts on the behavior response of the cowpea and small bean beetles.

Grains extraction: To have a source of grain extracts, seeds of cowpea, horse bean, white bean soybean and chickpea were steeped separately (ten seeds/ 10 ml solvent) for 48 hours in acetone. The seeds were then removed from the solution. All extracts were stored at -4 ºC for laboratory bioassay.

The Y-tube bioassay: The trial Y-tube comprises three chamber arms (2.5 cm distance across x 10 cm stature) joined with an exposure plastic cylinder chamber in the experimental Y-tube (6.0 cm in width x 5.0 cm high). Each arm was shut by a dark plastic cover. Tanglefoot was used to coat the inside wall of each cover as a sticky material, and one tube cover was coated with 0.4 ml of the extract, while the other two covers were coated with an equal amount of pure solvent (as control). The beetles were placed inside the exposure chamber, which was immediately closed. Each trial was carried out four times with five female beetles per time. Counts were done in 20 min. after exposure to beetles. After each trial, the Y-tube was cleaned with ethanol and distilled water. All extracts were tested individually, and each female used in the bioassays was used only once.

4. The role of some aromatic plants as bio-agents in protecting legume grains from *C. maculatus* and *B. incarnates*:

This laboratory experiment was carried out to compare the efficiency of some natural plant products, crashed plant leaves of rosemary and marjoram, and clove bud flowers (Table, 1) on the growth rate and damage of *C. maculatus* and *B. incarnates*.

Table 1. The common and scientific names of some botanical products used in the storage of cowpea and faba bean.

Common name	Scientific name	Family
Bud flower clove	*Syzygium aromaticum*	Myrtaceae
Rosemary	*Rosmarinus officinalis*	Lamiaceae
Marjoram	*Majorana hortensis*	Lamiaceae

Insects and natural plant products sources:

*Callosobruchus maculatu*s and *B. incarnates* were obtained from the previously mentioned cultures. The natural plant products were purchased from medicinal herbal shops and were ground aromatic a powder.

Estimate the efficacy of plant powders as a protective agent against cowpea and faba bean beetles:

24 kg of cowpea as well as horse bean seeds, free of infestation and approximately equal in size, were divided into four groups (6 kg/ group). Each group/ treatment was divided into three replicates (2 kg for each replicate). In each replicate, five pairs of each bruchid beetles (males and females) were introduced into plastic cans containing 2 kg of healthy grains. After those three piles of each medical plant were distributed in the plastic cans (each pile containing 15 g of dried crushed botanical parts within a piece of gauze) and stored under laboratory conditions (31± 3.5 ºC nd 67 ± 4.2%R.H). In addition, a group of seeds was stored without treatment as a control. The abundance of egg laying became monitored every nine days to decide the start of a brand-new generation.

After 37 days of storage, the grains were examined to assess the prominent appearance of eggs produced on seeds, insect population increase (growth rate) and seed damage. The total number of eggs was counted on the treated and control seeds. To estimate the population growth rate, the numbers of insect adult males and females (alive and dead individuals) were registered for each plastic can. The growth rate (r) was estimated by using the following equation: Nt = N0.ert (where, N0 = Initial population density (no. of female), Nt = Population density (no. of newly emerged females) after time t, e = the base of natural logarithms, and t = number of generation). Seed damage was performed by counting the damaged and undamaged legume seeds. The seed damage percentage was calculated using Fosto et al, (2019) formula. Seed damage = Number of seeds damaged /Total number of seeds × 100.

-Statistical analysis was fulfilled by using one-way ANOVA.

RESULTS AND DISCUSSION

Results

1.Oviposition preference of the chrysomelid females.

In response to cowpea, soybean, and chickpea grains.

The oviposition choice tests evaluated the egg-laying preference of *C. maculatus* and *B. incarnatus* females among cowpea, soybean, and chickpea grains. From data illustrated in Fig. (1) it is apparent that there were significant differences between the mean number of eggs laid by females of *C. maculatus* and *B. incarnatus* on the different legume species. *C. maculatus* females recorded the highest number of eggs laid on cowpea grains (24.13±4.0 eggs/ female) in comparison with the other legumes grains. So, *C. maculatus* females exhibited discrimination between the legume grains, preferring cowpea (52.77%) over soybean (27.4%) and chickpea (19.83 %). On the contrary, *B. incarnatus* females laid significantly more eggs on soybean (25.2±3.5 eggs/female). Chickpeas ranked third in order of egg-laying preference for both beetles (Figure, 1). The obtained data revealed that *B. incarnatus* females showed different preferability and distributed their eggs throughout the two days within the following proportions 52.77, 27.4, and 19.83 %, on soybean, cowpea, and chickpea respectively.

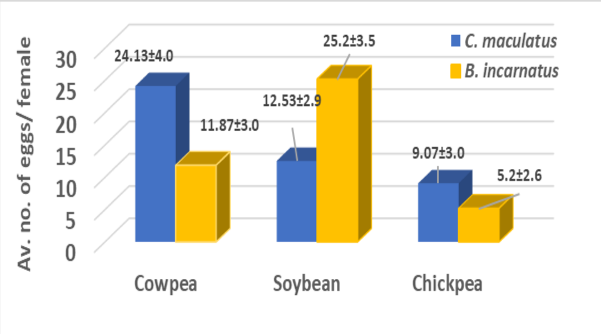

Figure 1. Average number of eggs laid per female of *Callosobruchus maculatus* and *Bruchidus incarnates* over cowpea, soybean, and chickpea grains throughout 48hr:(L.S.D. $_{P5\%}$ = 2.45 and 2.26 for *C. maculatus* and *B. incarnatus*).

In response to horse bean, white bean, and chickpea grains.

Callosobruchus maculatus and *B. incarnatus* females show different degrees of egg-laying preference on the tested legume grains. Data illustrated in Fig.(2), indicated that the highest number of eggs deposited by *C. maculatus* female on white bean was 23.73±9.8 in comparison with horse bean (14.27±4.6) or chickpea (3.87±2.4 eggs/female). While *B. incarnatus* females significantly laid more eggs on horse beans (29.4±6.2 eggs/female). Fewer eggs were set on chickpea seeds by each beetle throughout the two days. It could be concluded that *C. maculatus* females distributed their eggs throughout the 2 days on horse bean, white bean, and chickpea within the following proportions 34.08, 56.68, and 9.24%, respectively, while *B. incarnatus* females distributed their eggs consistent with the subsequent proportions of 63.28, 27.83 and 8.89%, respectively.

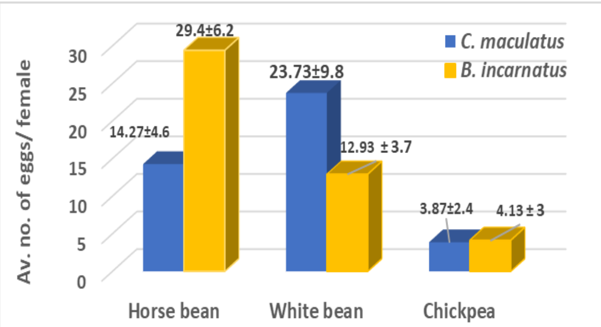

Figure 2. Average number of eggs laid per female of *Callosobruchus maculatus* and *Bruchidus incarnates* over horse bean, white bean, and chickpea grains throughout 48hr:(L.S.D. $_{P5\%}$ = **4.72 and 3.31 for *C. maculatus* and *B. incarnatus***)

2.Olfactory response of *C. maculatus* and *B. incarnates* females to grain extracts of the tested legume grains.

The experimental tube indicated that bruchid beetles exhibited different degrees of attractiveness in response to grain extracts in acetone (Table 2). Mated female *C. maculatus* significantly showed high attraction to both cowpea (85 ± 10.0 %) and white bean (80 ±16.32%) extracts. *C. maculatus* exhibited the lowest response to chickpea (55 ± 10.0%) and soybean (45± 10.0%). Regarding *B. incarnatus*, it significantly exhibited the highest response toward horse bean extract in acetone (80 ±16.32%). The olfactory responses of *C. maculatus* females coupled with the oviposition preference of the present investigations (Figures 1 and 2), whereas cowpea and white bean seeds were shown to be the most favored oviposition substrate than chickpea and soybean in choice tests.

Table 2. Percentage of attracted *Callosobruchus maculatus* and *Bruchidus incarnates* females in response to cowpea, horse bean, chickpea, white bean, and soybean extracts in acetone.

Legume grains	*C. maculatus*	*B. incarnates*
Cowpea	85 ± 10.0 a	70 ± 11.54 ab
Horse bean	70 ± 11.54 ab	80 ±16.32 a
Chickpea	55 ± 10.0 b c	65 ±10.0 ab
White been	80 ± 16.32 a	40 ±23.09 b
Soybean	45± 10.0 c	65 ±10.0 ab
L.S.D $_{p5\%}$	17.83	22.69

3.Efficacy of plant powders as a protective agent against cowpea and faba bean beetles.

On the growth rate and reproduction:

As seen in Table (3) the population growth rate of *C. maculatus* was very slow on cowpea seeds treated with marjoram (0.0.05) followed by rosemary (0.053) and clove (0.148), in comparison with those reared on untreated cowpea (0.397). With respect to *B. incarnatus*, the same tendencies were recorded, where the growth rate of *B. incarnatus* was high as faster on untreated horse bean grains (0.154) than those reared on horse bean treated with clove (0.0478), marjoram (0.052), and rosemary (0.094). Ovipositional activities were calculated to f_2 adult emergence (of *C. maculatus*) and f_1 (of *B. incarnatus*) on the different treatments as presented in table 3. As shown in Table 3, all botanical treatments affected both beetles (*C. maculatus* and *B. incarnates*) reproductive parameters, with the laying of eggs much less than controls (P = 0.05).

Table 3. Effect of crushed leaves of rosemary and marjoram; and clove on the growth rate and reproduction of *Callosobruchus maculatus* (reared on cowpea) and *Bruchidius incarnatus* (reared on horse bean) after 37 days under stored conditions (31± 3.5 °C and 67 ± 4.2%R.H.).

Treatments	*Callosobruchus maculatus*		*Bruchidus incarnates*	
	Growth rate	Av. No. of eggs to f_2 adult emergence	Growth rate	Av. No. of eggs to f_1 adult emergence
Clove	0.148	96.3±28.2 b	0.0478	158.3 ±17.7 b
Rosemary	0.053	88.3±21.3 b	0.094	355.3 ±7.1 b
Marjoram	0.050	36.3±20.3 b	0.052	370 ±24.6 b
Control	0.397	6137.7±2175.9 a	0.154	1167.8 ±123.9 a
L.S.D. (P = 0.05).		1508.1		443.9

On seed damage:

Data represented in Table (4) cleared that the lowest percentage of damaged grains caused by *C. maculatus* was observed in the cowpea treated with marjoram (5.7 ± 2.1), and the effects were statistically like those of rosemary (7.0 ±2.0), and clove (8.67 ±2.1) after 37 days of storage. The highest damage caused by cowpea beetle was recorded in the untreated grains (up to 35.67± 5.9 %). With respect to the efficacy of the tested plant products against *B. incarnatus* in stored horse bean grains, the lowest grain damage was observed in horse beans treated with clove followed by those treated with marjoram (22.67 ± 2.5) and rosemary (29.33 ± 2.1) compared to the control (44.67 ± 5.68 %). As seen in Table (4) the reduction percentages in cowpea damage caused by *C. maculatus* when treatment with the tested crushed plants, its activity may be organized in descending order as follows 84.1, 80.37, and 75.69 for marjoram, rosemary, and clove respectively. While the reduction percentages in horse bean damage caused by *B. incarnatus* were 57.46, 50.75 and 34.34 in treated with clove, rosemary, and marjoram, respectively. In general, leaf powder of marjoram and rosemary exhibited the best performance in opposition to *C. maculatus*, wherein they recorded the lowest growth rate and the best effect to defend cowpea in opposition to *C. maculatus*. In addition, the bud flower clove was proven to be effective against *B. incarnatus*, resulting in a slower growth rate and less horse bean grain damage.

Table 4. Percentage of grains damaged caused by *Callosobruchus maculatus* and *Bruchidius incarnatus* on cowpea and horse bean treated with plant product powder and stored for 37 days under stored conditions (30 ± 3.5 °C and 66 ± 4.2%R.H.).

Treatments	*C. maculatus*		*B. incarnatus*	
	% Seed damage	% Reduction of damage	% Seed damage	% Protection of damage
Clove	8.67 ±2.1 a	75.69	19.0 ± 4.0 a	57.46
Rosemary	7.0 ±2.0 a	80.37	29.33 ± 2.1 bc	34.34
Marjoram	5.67 ±2.1 a	84.1	22.67 ±2.5 b	49.75
Control	35.67 ± 5.9 b	----	44.67 ± 5.7 c	-----
L.S.D.	6.45		7.23	

- **Calculated and tabulated f was (52.43, and 4.07) in *C. maculatus* and was (26.15, and 4.07) in *B. incarnatus* treatments.**

Discussion

It is obvious from the present study that *C. maculatus* and *B. incarnatus* females showed different degrees of egg-laying preference on the tested legume grains. *C. maculatus* females strongly preferred cowpea over soybean and chickpea. While they significantly desired egg-laying on white bean over horse bean and chickpea. *B. incarnatus* females cleared that the highest preference for laying eggs on soybean over cowpea and chickpea, they also preferred horse beans over white beans and chickpeas. These results agree with previous observations from Swella and Mushobozy (2009) that *C. maculatus* females exhibited the highest number of eggs laid on cowpea and pigeon pea in comparison with chickpea seeds. Also, the present results coupled with those obtained by Ajayi et al., (2015) that *C. maculatus* females differentiated between the legume grains. Nisar et al (2021) added that red kidney bean grains contained greater egg-laying choice for *C. maculatus* (22.54%) compared to different examined legumes at the same time as desi chickpea grains (14.53%) had a lesser ovipositional choice. The present study revealed that may be chemical cues of the seed the reason for such differential choices. The results obtained showed that *C. maculatus* and *B. incarnates* females varied in their innate response to the odors of the tested grains. In the Y-tube bioassay, *C. maculatus* females exhibited a higher preference for cowpea followed by horse bean and chickpea extracts. With respect to *B. incarnates* females, they showed the highest response towards horse bean followed by cowpea, and chickpea extracts. The differences in the attraction of *C. maculatus* and *B. incarnates* females to the odors of the tested legume seeds confirm that the bruchids have varied preferences for different legume grains (Smith, 1998; Rees, 2004; De Bruyne and Baker, 2008). According to Ajayi et al.,(2015) differences in the volatile organic compounds in legume seeds may have mediated the differential attraction of bruchid females to the seeds of the tested legume species. So, it could be concluded that oviposition preference in *C. maculatus* and *B. incarnates* among seed legume species is mediated by seed volatile organic compounds. Belong to Genus *Callosobruchus*, the oviposition preference of *C. chinensis* on four different leguminous seeds was evaluated by Mainali et al., (2015), whereas cowpea seed was shown to be the most favored oviposition substrate overd white kidney bean, soybean, mung bean and azuki bean. Ignacimuthu et al., (2000) and Mainali et al., (2015) demonstrated that *C. chinensis* females employ chemical information during both host-seeking and acceptance. Also, results in the present study coupled with those by (Babu et al., 2003 Beck et al., 2012; Li et al., 2012) suggest that volatiles emitted from healthy seeds were attractive to bruchid females. It is plausible that a pest of legume crops such as *C. maculatus* and *B. incarnates* will use this compound as a host location cue.

The obtained data indicated that crushed leaves of *Majorana hortensis* and *Rosmarinus officinalis* plants (Fam. Lamiaceae) were sufficient to elicit a reduction in adult emergence of *C. maculatus* and offered the highest protection to the cowpea seeds. While crushed flowers of *Syzygium aromaticum* (Myrtaceae) exhibited the lowest reduction in adult emergence of *C. maculatus*. Abuo El-Enine et al. (2016) demonstrated that volatile oils extracted from *M. hortensis* and *R. officinalis* significantly exhibited oviposition-deterring properties against *C. maculatus* in comparison with *S. aromaticum* oil. Belong to Family Lamiaceae, leaves powder (Fotso et al. 2018) or volatile oils (Fotso et al. (2019) of *Hemizygia welwitschia* also significantly reduced the production and inhibited F1 progeny emergence of *C. maculatus*. Also, volatile oils of the Lamiaceae, *Ocimum canum* (Kosini et al, 2015) and *Plectranthus glandulosus* (Danga et.al., 2015) offer a significant reduction in seed damage activity compared with the untreated seeds. With respect to *B. incarnatus*, crushed flowers of *S. aromaticum* (Myrtaceae) exhibited the highest reduction in adult emergence of *B. incarnatus*. Fouad (2013) indicated that the essential oil of clove, *S. aromaticum* exhibited repellent properties against the bean beetle *B. incarnatus* adults. All used botanicals were shown to influence the oviposition of *C. maculatus* and *B. incarnates*. Similar conclusion was recorded by Saxena et. al (1986) and Trivedi et al. (2018). Shukla et. al (2011) demonstrated that oviposition inhibition occurs either due to the death of females before laying their eggs in contact with botanical products or due to failure during egg laying of live females.According to, Alrubeai et al. (2001) clove flower buds extract caused inhibition of egg laying by females. Danga et al. (2015) reported that crude extracts of *Callistemon rigidus* (Myrtaceae) leaves showed high mortality being the best progeny inhibitor. Also, results in the present study coupled with those by Chudasama et al. (2015), Kosini and Nukenine (2017) and Mahama et al. (2018) suggest that leaf powder extracts are highly effective in controlling bruchids infestations. Hertlein et al. (2011) and Fotso et al. (2018) demonstrated that, effective control of protectants is attributed to the mortality of adult and/or immature stages, confirmed by lack of progeny generation. According to Fotso et al. (2019) the efficacy of these botanical methods could be attributed to the presence of some bioactive compounds, including phenolic compounds, alkaloids, saponins, tannins, flavonoids, triterpenoids, and sterols. The present study revealed damage to cowpea and horse bean seeds indicating the quantitative loss in stored grains because of insect feeding displaying a direct correlation between insect population and grains damage. So, it could be recommended the potential of using crushed leaves of *R. officinalis* or *M. hortensis* to control *C. maculatus* in stored cowpea, wherein they recorded the lowest growth rate and the best effect to defend cowpea in opposition to *C. maculatus*. In addition, bud flower clove proved an effective agent against *B. incarnatus*, as it led to a high reduction in the growth rate and a reduction in horse bean seed damage.

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المنشطات الشمية توسطت في تفضيل وضع بيض خنافس اللوبيا والفول وفاعلية بعض النباتات العطرية كعوامل وقاية

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الملخص

تظهر اناث خنفساء اللوبيا وخنفساء الفول الصغيرة درجات مختلفة من تفضيل وضع البيض علي الحبوب البقولية . حيث فضلت اناث خنفساء اللوبيا حبوب اللوبيا علي حبوب فول الصويا والحمص . بينما فضلوا بشكل كبير وضع البيض علي الفاصوليا البيضاء علي الحمص والفول . بينما أظهرت اناث خنفساء الفول الصغيرة أعلي تفضيل لوضع البيض علي فول الصويا ،ايضا فضلت حبوب الفول علي الفاصوليا البيضاء والحمص . التفضيل بواسطه الرائحة أظهرت اناث خنفساء اللوبيا انجذاب أكبر لمستخلصات حبوب اللوبيا أكبر من حبوب الفول أوالحمص . بينما خنفساء الفول الصغيرة فقد أظهرت أكبر جاذبية لمستخلص حبوب الفول . تم تقييم كفاءة أوراق النباتات المطحونة (البردقوش _ اكليل الجبل _وازهار القرنفل) في حماية حبوب اللوبيا والفول من خنفساء اللوبيا والفول الصغيرة بعد 37 يوم من التخزين . كانت معدل نمو خنفساء اللوبيا المرباه علي حبوب اللوبيا المعاملة بالبردقوش واكليل الجبل بطيئه (0.050 و0.053) مقارنة بالحبوب الغير معاملة . علي العكس من ذلك كان أقل معدل نمو لخنفساء الفول الصغيرة المرباه علي الفول المعالج بالقرنفل (0.0478) ويليه البردقوش (0.052) بينما كان معدل النمو أسرع علي حبوب الفول الغير معاملة (0.154). جميع المعاملات النباتية قللت بشكل ملحوظ من وضع البيض لكتا الخنفساء .قللت معاملات البردقوش واكليل الجبل والقرنفل بشكل كبير من ضرر اللوبيا بنسبة (84.1 و80.57 و75.69 %علي التوالي) ضد خنفساء اللوبيا .بينما أظهرت براعم زهرة القرنفل فاعليه ضد خنفساء الفول الصغيرة حيث أدي الي انخفاض معدل تلف بذور الفول بنسبة 57.46%.