EVALUATION OF DIFFERENT INTEGRATED PEST MANAGEMENT CONCEPTS FOR CONTROLLING THE LEGUMES BEETLES, *CALLOSOBRUCHUS MACULATUS* (F.) AND *CALLOSOBRUCHUS CHINENSIS* (L.) ON FABA BEAN AND COW PEA SEEDS

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INTRODUCTION

The beetles of the family Bruchidae are important as primary insect pests of stored legumes. Grain legumes are often the main source of protein for people in developing countries, they suffer heavy quantitative and qualitative losses from the attack of *Callosobruchus* species during storage. Caswell (1981) reported a loss of approximately 50% of cowpeas in storage for 3 or 4 months due to infestation by *C. maculatus* (F.). The two most widespread species of *Callosobruchus* are the southern cowpea beetle *C. maculatus* (F.) and the chins pulse beetle *C. chinensis* (L.). Populations of *C. maculates* collected from different geographical locations show variations in behavior, ecology and morphology (Applebaum *et al.*, 1968 and Credland, 1986 & 1987). The word 'strain' is used here to denote populations of *C. maculates* collected from different geographical areas.

Chemicals such as malathion and sumithion can be used for control but they cause certain adverse effects on product security and the environment. Malathion is particularly valuable for the protection of stored products from mites, flour beetles, grain weevils and other pests. This may be due to the low acute toxicity to humans and other warm blooded animals. Many investigators have studied the effectiveness of organophosphorus insecticides against stored product insects e.g. Abo El-Ghar and Badawy (1961) Godavari Boi *et al.* (1964); Strong *et al.* (1969); Williame *et al.* (1978), Ahmed and Delmon (1979); Abdel-Kader *et al.* (1982); Barbara and Linda (1983) and Patoural and Joyeb (1988).

Oils give multiple effects on storage bruchids, such as increased adult mortality, lowering oviposition rate or interfering with larval development and adult

emergence (Messina and Renwick, 1983). Singh *et al.*, (1978) proposed that oil causes progeny mortality through partial or complete failure of embryonic development in the eggs rather than reduced oviposition and increased adult mortality. On the other hand, Schoonhoven (1978) found that groundnut oil reduced C. maculates oviposition, and longevity of adults (Uvah and Ishaya, 1992). The use of edible oil is the most suitable because of its commercial availability, low cost besides being non-toxic to humans, do not affect seed germination and do not create off flavors in cooked products (Abdel-Latif, 2003).

The use of bio-products, Beauveria bassiana (Bb) has been widely applied for pest management. Effective control measures for pest management in pre-harvest pests by (Bb) were found by some researches.

In late 1993 the post-harvest technology institute carried out surveys of the composition of pests in the warehouses of food grains in Vietnam and research on the use of (Bb) for pest management in post-harvest food grain (Pham Thi Thuy *et al.*, 1994).

The present work is aimed to study certain comparison responses of C. maculatus (F.) and C. chinensis (L.) to some natural plant oils, bio-products, mixture of pesticides and bio-products and pesticides that may be safe in an integrated pest management programm for combating these insect pests

MATERIAL AND METHODS

Cowpea variety balady and faba bean variety balady seeds were treated with the fumigated with fostoxin at 3 tablets for 5 days for each variety. One day old adults (uncounted) of the cowpea beetles *C. maculatus*, (F.) and chins pulse beetls, *C. chinensis*, (L.), reared under laboratory conditions at 26 ± 2°C and 60 ± 5% RH were applied to induce infestation in bags of both cowpea and faba bean seeds. Plastic bags (16 X 24 cm) were filled with 1/2 Kg of each type of seeds and kept in storage conditions; the moisture content of the seeds was approximately 14% at the beginning of the experiment. Trials were triplicated in the Qalubia and Sharkia Governorates under open-storages. The experiment was repeated in two locations (Qalubia and Sharkia Governorates). Clarify the effect of the used materials under different conditions.

Two plant oils; garlic and onion natural oils at 0.5, 1, 2%; Biover as an Entomopathogenic fungi (32000 viable spores / mg) containing the fungus *Beauvearia bassiana* (Bb) dust at 1, 1.5, 2 and 4 gm; Mixture: Biover + Malathion (3/4 : 1/4) at 1.5 gm + 3 mg and the organophosphorous compound Malathion 1%

dust at 2, 4, 8 and 16 mg were conducted at monthly intervals. 20 adults (A group of mixed male and female) *C. maculatus*, (F.) and *C. chinensis*, (L.), were released into each bag at zero and 45 days storage periods.

After 2, 3, 4, 5 and 6 months of storage, the number of alive and dead *C. maculatus*, (F.) and *C. chinensis*, (L.), inside a 1/2 kg sample of faba bean and cowpea seeds was inspected. Samples were returned back to the bags after inspection. The efficiency of the tested materials in reducing infestation and population of *C. maculatus*, (F.) and *C. chinensis*, (L.), were calculated as percentage reduction of adult population in the seed samples at the various storage periods as follows:

$$\% \text{ Reduction} = \frac{\text{Adults number in controlled} - \text{Adults number in the treatment}}{\text{Adult number in control}} \times 100$$

Percentage seeds damaged by feeding of C. *maculatus*, (F.) and *C. chinensis*, (L.), larvae were recorded after the completion adults emergence at storage periods.

After initial treatment and after 6 months storage period of faba bean and cowpea, 25 seeds were placed on absorbing cotton pad soaked with water in Petri dishes. Three replicates for each treatment were made. Germination of seeds were recorded after 7 days.

Determination of total lipids, carbohydrates and protein as major biochemical components were carried out in faba bean seeds treated with the highest concentration according to Knight *et al.*, (1972); Cromptop, & Birt (1967) and Bradford (1976)

The data was subjected to analysis of variance (ANOVA) and the means were compared by L.S.D. test at 0.05 level, using SAS program (Anonymous, 1988). In view of the wide differences in variance at month 6, the LSD values were not calculated for these means.

RESULTS AND DISCUSSION

Results concerning the toxic effect of garlic and onion natural oils at 0.5, 1 and 2%, biover at 1, 1.5, 2 and 4 gm, mixture (Biover + Malathion) at 1.5 gm: 2 mg, as well as malathion at 2, 4, 8 and 16 mg on adult population of C. *maculatus*, (F.) and *C. chinensis*, (L.), and percentage reduction for stored faba bean and cowpea seeds in Qalubia and Sharkia governorates are given in Tables (1,2,5 and 6). In addition, the Sharkia governorate recorded the higher number of population than

Qalubia governorate for both C. *maculatus*, (F.), and *C. chinensis*, (L.) to store faba bean and cowpea seeds.

Results revealed that the number of C. *maculatus*, (F.) per 1/2 Kg of faba bean and cowpea seeds were obviously reduced in the various treatment at different storage periods compared to the control. This is evident that insect population was also concentration dependent. At the highest concentrations used against C. *maculatus*, (F.) the overall means of insect population were (0.0, 0.0, 0.0, 87, 363, 1110), (0.0, 0.0, 0.0, 230, 932, 2788), (0.0, 0.0, 0.0, 110, 386, 1174) and (0.0, 0.0, 0.0, 246, 1046, 2866) per 1/2 Kgm of faba bean and cowpea seeds in Qalubia and Sharkia governorates, respectively during storage periods of 6 months for Malathion at 8 and 16 mg, garlic oil at 2%, onion oil at 2%, biover at 4 gm, mixture (Biover+ Malathion))and control, respectively. The corresponding reduction values of population were (100, 100, 100, 81.8, 74.3), (100, 100, 100, 78.9, 73.3), (100, 100, 100, 80.4, 74.2) and (100, 100, 100, 87.8, 71.3) for tested materials, respectively (Tables 1 and 2).

The effect of the treatment of the seeds into the bags with the aforementioned various materials on adult population of *C. chinensis*, (L.) and reduction percentage for stored faba bean and cowpea seeds in Qalubia and Sharkia governorates is summarized in Tables (5 and 6). Results showed that the number of *C. chinensis*, (L.) adults per 1/2 Kg of faba bean and cowpea seeds were increased with rising storage period and was also concentration dependent, but in the control after five months storage where the population of the control suffered for depletion of diet so its population went down. The overall mean population was markedly reduced in different treatments in comparison with the control exception for the 6 months storage period. At the highest concentrations used, the mean adult population was (0.0., 0.0, 0.0, 135, 527, 1320), (0.0, 0.0, 0.0, 147, 786, 2845), (0.0, 0.0, 0.0, 191, 558, 1369) and (0.0, 0.0, 0.0, 165, 876, 2908) per 1/2 Kg of faba bean and cowpea seeds in Qalubia and Sharkia governorates respectively during storage periods of 6 months for Malathion at 8 and 16 mg, garlic oil 2%, onion oil 2%, biover 4 gm, mixture (Biover + Malathion) and control respectively. The corresponding reduction values of population were (100, 100, 100, 79.7, 73.8), (100, 100, 100, 79.5, 75.3), (100, 100, 100, 78.8, 73.6) and (100, 100, 100, 79.4, 75.2) for tested materials respectively. Results indicated that malathion at 8 and 16 mg was the most effective compound in reducing insects infestation and population in the stored faba bean and cowpea seeds followed by garlic oil at 2%, onion oil 2%, biover at 4 gm and mixture (Biover + Malathion). In this respect Pham Thi Thuy *et*

al, (1994) reported that the use of chemical protectants such as malathion and sumithion, can give good control of pests. Mohamed, (1996) evaluated the malathion as grain protectants against two species C. *maculatus*, (F.) and C. *chinensis*, (L.). The results showed that malathion has high efficiency (94.4 and 93.3%, respectively).

Recently, oils have been used in the protection of stored grains. Abdel-Latif, (2003) showed that four plant oils (almond, colocynth, sesame and castor oils) at the LC_{95} give complete protection to treated seeds (cowpea and chickpea) up to 2 months. Also, after 4 months of storage treatment significantly reduced the number of progeny compared with non treated seeds. In this respect, Singh (1978), El-Sayed and Abdel –Razik (1987) and Zewar (1987) also reported similar results. The mode of action of plant oils used is partially attributed to interference with normal respiration resulting in suffocation (Gunther and Jepson, 1960). Many vegetable and mineral oils exhibit ovicidal activity at concentration rates ranging between 5 to 8 ml/Kg (Singh *et al.*1978 and Golob, and Webley1980).

Beauveria bassinana fungal pathogens infect insects by contact and do not need to be consumed by their host to cause infection. Once the fungus has killed its host, it grows back out through the softer portions of the cuticle, covering the insect with a layer of white mold which produces millions of new infective spores that are released in the environment (Groden, 1999). The present results were in harmony with that of Annop and Surakrai (1986) who reported that *C. chinensis*, (L.) died with treatment with *Beauveria bassinana*. The use of bioinsecticides such as the fungus *Beauveria bassinana* is highly effective for the control of storage pests C. *maculatus*, (F.) and *C. chinensis*, (L.) on beans (Pham Thi Thuy, *et al.*, 1994). Mansour (1999) reported the sensitivity of C. *maculatus*, (F.) towards *Beauveria bassinana* application.

The possibility of mixing *B. bassinana* and *V. lecanii* with insecticides is important in the use of the fungus in integrated pest management programs (IPM). Findings are in line with that of Hall (1981b), Sewify (1989) and Abdel-Gawad, (2000). It is also important to point out that the stability of fungal infectivity in a mixture of insecticide is particularly related to certain isolates of the fungus. This has been confirmed in the present investigation, as well as previous reports of Olmert & Kenneth (1974) and Hall (1981a). An increased efficacy of application was observed in the case of fungus combined with low concentration of insecticides (Foschi and Grassi 1985). The infection of host with fungi caused weakness of host, and chemical control was highly effective at low dose.

Table (I)

Number of *Callosobruchus maculatus* adults in Faba bean and Cowpea seeds and percent reduction at various storage periods in Qalubia governorate

Treatment	Conc.	Number of adults in half kilo gram of seeds and % reduction at indicated storage periods (months)					
		Faba bean seeds					
		2	3	4	5	6	Mean
Garlic oil	0.5%	0.0(100)	40(94.7)	120(93.1)	480(80.5)	982(0.0)	324(73.7)
	1%	0.0(100)	0.0(100)	25 (98.6)	165(93.3)	687 (0.0)	175 (78.4)
	2%	0.0(100)	0.0(100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0(100)	60 (92)	190 (89.1)	595 (75.8)	1052(0.0)	379 (71.4)
	1%	0.0(100)	0.0 (100)	55 (96.8)	235 (90.4)	853 (0.0)	229 (77.4)
	2%	0.0(100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Biover	1gm	70(65)	240(68)	595 (65.8)	1135(53.9)	1805(0.0)	769(50.5)
	1.5gm	0.0(100)	120 (84)	390 (77.6)	975 (60.4)	1960 (0.0)	689 (64.4)
	2gm	0.0 (100)	30 (96)	250 (85)	700 (71.5)	1386 (0.0)	473 (70.6)
	4gm	0.0 (100)	0.0 (100)	6.0 (99.7)	80 (96.7)	350 (12.5)	87 (81.8)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	120 (93.1)	530(78.5)	1165 (0.0)	363 (74.3)
Malathion	2mg	80 (60)	260 (65.3)	690 (60.3)	1210(50.8)	1900(0.0)	828(47.3)
	4mg	0.0 (100)	0.0 (100)	3.0 (99.8)	39 (98.4)	367 (9.0)	82 (81.4)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	200(--)	750 (--)	1740(--)	2460 (--)	400 (--)	1110(--)
LSD 1.90 at 5% level					P<0.01		
		Cowpea seeds					
Garlic oil	0.5%	0.0(100)	55(98.2)	315(95.9)	2024(29.1)	4334 (0.0)	1346(64.6)
	1%	0.0 (100)	0.0(100)	43 (99.4)	287 (89.9)	1892 (0.0)	444 (77.9)
	2%	0.0(100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0 (100)	65 (97.8)	419 (94.5)	2998(0.0)	5485(0.0)	1793(58.5)
	1%	0.0 (100)	0.0 (100)	51(99.3)	437 (84.7)	2413 (0.0)	580 (76.8)
	2%	0.0 (100)	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)	0.0 (100)
Biover	1gm	35 (90.8)	192 (93.6)	1921(74.7)	3974(0.0)	6351(0.0)	2495(51.8)
	1.5gm	0.0 (100)	90 (97)	715 (90.5)	3658(0.0)	5935 (0.0)	2080 (57.5)
	2gm	0.0 (100)	22 (99.3)	305 (96)	1451(49.2)	4534 (0.0)	1262 (68.9)
	4gm	0.0 (100)	0.0(100)	11 (99.9)	152 (94.7)	987 (0.0)	230 (78.9)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	79 (99)	932 (67.3)	3651(0.0)	932 (73.3)
Malathion	2mg	41 (89.2)	213 (92.9)	2113(72.2)	3986(0.0)	6559 (0.0)	2582(50.9)
	4mg	0.0 (100)	0.0 (100)	13 (99.8)	73 (97.4)	586 (0.0)	134 (79.4)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	380(--)	2997 (--)	7591(--)	2854(--)	120(--)	2788(--)
LSD = 2.11 at 5% level					P<0.01		
Note: Values has been transferred to log values before conducting the statistical procedures							

%Reduction in adults population in brackets ( )

Table (II)

Number of *Callosobruchus maculatus* adults in Faba bean and Cowpea seeds and percent reduction at various storage periods in Sharkia governorate

Treatment	Conc.	Number of adults in half kilo gram of seeds and % reduction at indicated storage periods (months)					
		Faba bean seeds					
		2	3	4	5	6	Mean
Garlic oil	0.5%	0.0(100)	43 (94.5)	130(92.9)	510(80.4)	1097(0.0)	356(73.6)
	1%	0.0(100)	0.0(100)	27 (98.5)	177 (93.2)	749 (0.0)	191 (78.3)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0 (100)	65 (91.7)	205 (88.7)	705 (72.9)	1168(0.0)	429 (70.7)
	1%	0.0 (100)	0.0 (100)	65 (96.4)	256 (90.2)	915 (0.0)	247 (77.3)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Biover	1gm	75 (65.9)	270(65.6)	665 (63.5)	1358(47.8)	1846(0.0)	843 (48.6)
	1.5gm	0.0(100)	130(83.4)	460 (74.7)	1056 (59.4)	2081 (0.0)	745(63.5)
	2gm	0.0 (100)	45 (94.3)	255 (86)	793 (69.5)	1408 (0.0)	500 (70)
	4gm	0.0 (100)	0.0 (100)	10 (99.5)	114(95.6)	428 (7.0)	110 (80.4)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	130(92.9)	565 (79.3)	1235(0.0)	386 (74.2)
Malathion	2mg	90 (56.1)	295 (62.4)	725 (60.2)	1275(51)	1950 (0.0)	867 (45.9)
	4mg	0.0 (100)	0.0 (100)	5.0 (99.7)	47 (98.2)	492 (0.0)	109 (79.6)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	205 (--)	784 (--)	1820(--)	2600(--)	460 (--)	1174(--)
LSD =1.94 at 5% level					P<0.01		
		Cowpea seeds					
Garlic oil	0.5%	0.0(100)	60(98)	350(95.5)	2105(27.4)	4551(0.0)	1413(64.2)
	1%	0.0 (100)	0.0(100	50 (99.4)	321 (88.9)	1924 (0.0)	459 (77.7)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0 (100)	70 (97.7)	434 (94.5)	3215(0.0)	5763(0.0)	1896 (58.4)
	1%	0.0 (100)	0.0 (100)	60 (99.2)	523(82)	2514 (0.0)	619 (76.2)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)
Biover	1gm	41 (89.8)	200(93.4)	2019(74.3)	4089(0.0)	6624(0.0)	2595(51.5)
	1.5gm	0.0 (100)	100 (96.7)	743 (90.5)	3923 (0.0)	6027 (0.0)	2159 (57.4)
	2gm	0.0 (100)	30 (99)	331 (95.8)	1754 (39.5)	4991 (0.0)	1421 (66.9)
	4gm	0.0 (100)	0.0 (100)	20(99.7)	159 (94.5)	1051 (0.0)	246 (78.8)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	91 (98.8)	1231(57.6)	3909 (0.0)	1046(71.3)
Malathion	2mg	45 (88.8)	227(92.6)	2210(71.9)	4119 (0.0)	6889 (0.0)	2698 (50.7)
	4mg	0.0 (100)	0.0 (100)	20 (99.7)	86(97)	634 (0.0)	148 (79.3)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	400(--)	3052(--)	7851(--)	2900(--)	125(--)	2866(--)
LSD = 2.15 at 5% level					P<0.01		
Note:	Values has been transferred to log values before conducting the statistical procedures						

%Reduction in adults population in brackets ( )

Table (III)

Percentage of Faba bean and Cowpea seeds damaged by feeding of *Callosobruchus maculates* adults resulted following treatments of seeds at various storage periods in Qalubia governorate

Treatment	Conc.	% Seeds damaged of Faba bean and Cowpea seeds at indicated storage periods (months)				
		Faba bean seeds				
		2	3	4	5	6
Garlic oil	0.5%	0.0	0.7	2.8	11.4	28.9
	1%	0.0	0.0	0.4	3.3	15.6
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	1.1	4.5	15.1	33.9
	1%	0.0	0.0	1.0	5.2	20.4
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	1.3	5.6	16.2	36.5	68.7
	1.5gm	0.0	2.1	9.1	26.5	61.5
	2gm	0.0	0.5	5.0	17.5	42.3
	4gm	0.0	0.0	0.1	1.5	7.8
Biover + Malathion	1.5gm+ 2mg	0.0	0.0	2.1	11.6	32.4
Malathion	2mg	1.4	6.0	18.3	39.9	73.8
	4mg	0.0	0.0	0.1	0.8	7.4
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	3.6	17	48.1	92	99.1
		Cowpea seeds				
Garlic oil	0.5%	0.0	0.4	2.6	17	47.8
	1%	0.0	0.0	0.3	2.3	15.7
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	0.5	3.5	24.8	63.7
	1%	0.0	0.0	0.4	3.5	20.6
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	0.2	1.6	15.2	43.4	88.5
	1.5gm	0.0	0.6	5.7	31.7	73.8
	2gm	0.0	0.2	2.4	12.7	44.9
	4gm	0.0	0.0	0.1	1.2	8.2
Biover + Malathion	1.5gm+ 2mg	0.0	0.0	0.6	7.2	33.1
Malathion	2mg	0.3	1.8	3.3	31.6	78.2
	4mg	0.0	0.0	0.1	0.6	4.8
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	2.7	24	77.9	98.2	99.1

Table (IV)

Percentage of Faba bean and Cowpea seeds damaged by feeding of *Callosobruchus maculates* adults resulted following treatments of seeds at various storage periods in Sharkia governorate.

Treatment	Conc.	% Seeds damaged of Faba bean *and* Cowpea seeds at indicated storage periods (months)				
		Faba bean seeds				
		2	3	4	5	6
Garlic oil	0.5%	0.0	0.7	2.9	11.5	30.1
	1%	0.0	0.0	0.5	3.5	16.2
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	2.7	6.2	18.1	37.9
	1%	0.0	0.0	1.0	5.3	20.8
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	1.3	5.9	17.2	40.2	71.5
	1.5gm	0.0	2.2	10	27.9	63.2
	2gm	0.0	0.8	5.1	18.5	42.4
	4gm	0.0	0.0	0.2	2.1	9.4
Biove + Malathion	1.5gm+ 2mg	0.0	0.0	2.2	11.8	32.7
Malathion	2mg	1.5	6.5	18.9	40.7	74
	4mg	0.0	0.0	0.1	0.9	9.2
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	3.5	16.8	47.6	91.7	99.5
		Cowpea seeds				
Garlic oil	0.5%	0.0	0.4	2.8	17.3	48.6
	1%	0.0	0.0	0.3	2.5	15.9
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	0.5	3.5	25.5	65.1
	1%	0.0	0.0	0.4	4.0	21.3
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	0.3	1.7	15.6	43.7	89.2
	1.5gm	0.0	0.7	5.8	32.8	74.2
	2gm	0.0	0.2	2.5	14.6	48.9
	4gm	0.0	0.0	0.1	1.2	8.4
Biover + Malathion	1.5gm+ 2mg	0.0	0.0	0.6	9.1	36
Malathion	2mg	0.3	1.9	3.4	31.7	79.1
	4mg	0.0	0.0	0.1	0.7	5.1
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	2.8	24.1	78.5	98.8	99.7

Results of percentages seeds damage by the feeding of C. *maculatus*, (F.) and *C. chinensis*, (L.), on faba bean and cowpea seeds after various treatments were given in Tables (3, 4, 7 and 8) which show clearly that the treatments of various materials resulted in considerable drop in seed damage compared to control. In addition, the Sharkia governorate recorded a higher number in percentages of seed damage than Qalubia governorate for both C. *maculatus*, (F.), and *C. chinensis*, (L.).

Table (V)

Number of *Callosobruchus chinensis* adults in Faba bean and Cowpea seeds and percent reduction at various storage periods in Qalubia governorate

Treatment	Conc.	Number of adults in half kilo gram of seeds and % reduction at indicated storage periods (months)					
		Faba bean seeds					
		2	3	4	5	6	Mean
Garlic oil	0.5%	0.0(100)	45(95.3)	210(89.4)	820(71.6)	1986(0.0)	612 (71.3)
	1%	0.0 (100)	0.0(100)	39 (98)	217 (92.5)	823 (0.0)	216 (78)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0 (100)	60 (93.7)	300 (84.8)	1100(61.9)	2286(0.0)	749 (68.1)
	1%	0.0 (100)	0.0(100)	53 (97.3)	405(86)	1059 (0.0)	303 (76.7)
	2%	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Biover	1gm	95 (56.8)	290(69.5)	935 (52.8)	1851(36)	2600(0.0)	1154(43)
	1.5gm	0.0 (100)	130 (86.3)	651 (67.1)	1485 (48.6)	2420 (0.0)	937 (60.4)
	2gm	0.0 (100)	40 (95.8)	318 (83.9)	935 (67.6)	2192 (0.0)	697 (69.5)
	4gm	0.0 (100)	0.0 (100)	18 (99.1)	114 (96.1)	541 (3.4)	135 (79.7)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	92(95.4)	765 (73.5)	1776(0.0)	527 (73.8)
Malathion	2mg	105(52.3)	365 (61.6)	1059(46.5)	1993(31)	2800 (0.0)	1264(38.3)
	4mg	0.0 (100)	0.0 (100)	9.0 (99.5)	54(98.1)	420 (20.8)	97 (83.7)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	220(--)	950(--)	1980(--)	2890(--)	560 (--)	1320(--)
LSD = 2 .00 at 5% level					P<0.01		
		Cowpea seeds					
Garlic oil	0.5%	0.0 (100)	50(98.2)	327(95.4)	2359(33.1)	4954(0.0)	1538(65.3)
	1%	0.0 (100)	0.0(100)	31 (99.6)	205 (94.2)	1349 (0.0)	317 (78.8)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0 (100)	55 (98)	454 (93.7)	2918(17. 2)	5453(0.0)	1776(61.8)
	1%	0.0 (100)	0.0(100)	60 (99.2)	431 (87.8)	2341 (0.0)	566 (77.4)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Biover	1gm	80 (71.9)	275 (90.2)	1389(80.6)	4042 (0.0)	6553 (0.0)	2468(48.5)
	1.5gm	0.0 (100)	117 (95.8)	642 (91)	3659(0.0)	6087 (0.0)	2101(57. 4)
	2gm	0.0 (100)	25 (99.1)	298 (95. 8)	1021 (71)	4097 (0.0)	1088 (73.2)
	4gm	0.0 (100)	0.0 (100)	10 (99.9)	91 (97.4)	635 (0.0)	147 (79.5)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	105(98.5)	773(78.1)	3051(0.0)	786 (75.3)
Malathion	2mg	95 (66.7)	397 (85.8)	2015(71.9)	3953(0.0)	6054 (0.0)	2502(44.9)
	4mg	0.0 (100)	0.0 (100)	13 (99.8)	60 (98.3)	515 (0.0)	118 (79. 6)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	285 (--)	2798(--)	7159(--)	3524(--)	460 (--)	2845(--)
LSD = 2 .07 at 5% level					P<0.01		
Note: Values has been transferred to log values before conducting the statistical procedures							

%Reduction in adults population in brackets ( )

The rate of seed damage was (0.0, 0.0, 0.0, 7.8, 32.4, 99.1), (0.0, 0.0, 0.0, 8.2, 33.1, 99.1), (0.0, 0.0, 0.0, 9.4, 32.7, 99.5), (0.0, 0.0, 0.0, 8.4, 36, 99.7), (0.0, 0.0, 0.0,10, 39.9,99.5), (0.0, 0.0, 0.0, 5.2, 27.5, 99.4), (0.0, 0.0, 0.0, 14.1, 41, 99.8) and (0.0, 0.0, 0.0, 5.7, 30, 99.9) at the highest concentrations used per 1/2 Kg of faba bean and cowpea seeds in Qalubia and Sharkia governorates, respectively during storage periods of 6 months for Malathion at 8 and 16 mg, garlic oil at 2%, onion oil at 2%, biover at 4 gm , mixture (Biover + Malathion) and control, respectively.

Meanwhile, a pronounced increase in seed damage was recorded with increasing storage period and insect population in the seeds. The obtained data revealed clearly that percentages of seed damage of both faba bean and cowpea seeds was positively related to the population density of insects in the seeds and the length of storage period. In that work the protection with different treatments for faba bean and cowpea seeds was mainly due to reduced oviposition, low adult emergence and high adult mortality, and it agrees completely with the results of the present investigation. The results were confirmed with Raja *et al.* (2001) and Abdel- Latif (2003).

Table (VI)

Number of *Callosobruchus chinensis* adults in Faba bean and Cowpea seeds and percent reduction at various storage periods in Sharkia governorate

Treatment	Conc.	Number of adults in half kilo gram of seeds and % reduction at indicated storage periods (months)					
		Faba bean seeds					
		2	3	4	5	6	Mean
Garlic oil	0.5%	0.0 (100)	53(94.7)	219(89.1)	963 (67.5)	2127(0.0)	672 (70)
	1%	0.0 (100)	0.0(100)	45 (97.8)	281(90.5)	1034 (0.0)	272 (77.7)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0 (100)	69 (93.1)	357 (82.2)	1259(57.5)	2511(0.0)	839(66.6)
	1%	0.0 (100)	0.0(100)	62 (96.9)	435(85.3)	1216(0.0)	343 (76.4)
	2%	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Biover	1gm	110(52.2)	332(67)	1221(39.3)	2079(29.8)	2655 (0.0)	1279(37.7)
	1.5gm	0.0 (100)	137 (86.4)	710(29.4)	1637 (44.8)	2524 (0.0)	1002 (52.1)
	2gm	0.0 (100)	45(95.5)	346 (82.8)	1037 (65)	2352 (0.0)	756 (68.7)
	4gm	0.0 (100)	0.0(100)	27 (98.7)	141 (95.2)	787 (0.0)	191 (78.8)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	97 (95.2)	813 (72.6)	1881(0.0)	558 (73.6)
Malathion	2mg	120(47.8)	448 (55.4)	1259(37.4)	2005(32.3)	2683 (0.0)	1303(34.6)
	4mg	0.0 (100)	0.0 (100)	13 (99.4)	73 (97.5)	635 (0.0)	144 (79.4)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0(100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	230(--)	1005(--)	2010(--)	2963(--)	635(--)	1369(--)
LSD = 2 . 05 at 5% level P<0.01							
		Cowpea seeds					
Garlic oil	0.5%	0.0 (100)	57(98)	335 (95.4)	2680 (26.2)	5047(0.0)	1624 (63.9)
	1%	0.0 (100)	0.0 (100)	40 (99.5)	215 (94.1)	1409 (0.0)	333 (78.7)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Onion oil	0.5%	0.0 (100)	63 (97.8)	460 (93.7)	3055(15.8)	5611(0.0)	1838(61.5)
	1%	0.0 (100)	0.0 (100)	70 (99)	445 (87.7)	2419 (0.0)	587 (77.3)
	2%	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Biover	1gm	90 (71)	291 (89.7)	1400(80.8)	4435(0.0)	6703(0.0)	2584(48.3)
	1.5gm	0.0 (100)	122(95.7)	675 (90.7)	3950 (0.0)	6114 (0.0)	2172 (57. 3)
	2gm	0.0 (100)	31 (98.9)	305 (95.8)	1122 (69.1)	4256 (0.0)	1143 (72.8)
	4gm	0.0 (100)	0.0 (100)	13 (99.8)	105 (97.1)	707 (0.0)	165 (79.4)
Biover + Malathion	1.5gm+ 2mg	0.0 (100)	0.0 (100)	130 (98.2)	797 (87)	3449(0.0)	876 (75.2)
Malathion	2mg	111(64.2)	405(85.7)	2030(72.2)	4205(0. 0)	6359 (0.0)	2622(44.4)
	4mg	0.0 (100)	0.0 (100)	20 (99.7)	72 (98)	713 (0.0)	161 (79.5)
	8mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
	16mg	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)	0.0 (100)
Control	--	310(--)	2831 (--)	7291(--)	3630(--)	480 (--)	2908(--)
LSD = 2 . 10 at 5% level P<0.01							
Note: Values has been transferred to log values before conducting the statistical procedures							

%Reduction in adults population in brackets ( )

Table (VII)

Percentage of Faba bean and Cowpea seeds damaged by feeding of *Callosobruchus chinensis* adults resulted following treatments of seeds at various storage periods in Qalubia governorate

Treatment	Conc.	% Seeds damaged of Faba bean and Cowpea seeds at indicated storage periods (months)				
		Faba bean seeds				
		2	3	4	5	6
Garlic oil	0.5%	0.0	0.7	3.9	16.3	46.4
	1%	0.0	0.0	0.6	3.9	16.4
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	0.9	5.4	22.1	56.7
	1%	0.0	0.0	0.8	6.9	22.9
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	1.4	5.8	20	48	87.4
	1.5gm	0.0	2.0	11.9	34.4	71.1
	2gm	0.0	0.6	5.4	19.6	52.8
	4gm	0.0	0.0	0.3	2.0	10
Biover + Malathion	1.5gm+ 2mg	0.0	0.0	1.4	91.5	39.9
Malathion	2mg	1.6	7.1	23.1	51.1	90.5
	4mg	0.0	0.0	0.1	0.9	7.3
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	3.3	17.7	47.7	91.5	99.5
		Cowpea seeds				
Garlic oil	0.5%	0.0	0.4	2.7	19.4	54.6
	1%	0.0	0.0	0.2	1.7	11.3
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	0.4	3.6	24.3	63
	1%	0.0	0.0	0.4	3.5	70.1
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	0.6	2.6	12.5	41.2	87.7
	1.5gm	0.0	0.8	5.4	31.4	74.6
	2gm	0.0	0.2	2.3	9.5	38.6
	4gm	0.0	0.0	0.1	0.7	5.2
Biover + Malathion	1.5gm+ 2mg	0.0	0.0	0.7	6.2	27.9
Malathion	2mg	0.7	3.5	17.8	45.9	88.9
	4mg	0.0	0.0	0.1	0.5	4.2
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	2.0	21.4	71.5	96.2	99.4

Table (VIII)

Percentage of Faba bean and Cowpea seeds damaged by feeding of *Callosobruchus chinensis* adults resulted following treatments of seeds at various storage periods in Sharkia governorate

Treatment	Conc.	% Seeds damaged of Faba bean and Cowpea seeds at indicated storage periods (months)				
		Faba bean seeds				
		2	3	4	5	6
Garlic oil	0.5%	0.0	0.8	4.0	18.2	49.5
	1%	0.0	0.0	0.7	4.8	20
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	1.0	6.3	24.8	61.7
	1%	0.0	0.0	0.9	7.3	25.2
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	1.6	6.5	24.5	55.1	94.1
	1.5gm	0.0	2.0	12.4	36.5	73.6
	2gm	0.0	0.7	5.8	21.1	55.7
	4gm	0.0	0.0	0.4	2.5	14.1
Biover + Malathion	1.5gm+2mg	0.0	0.0	1.4	13.4	41
Malathion	2mg	1.8	8.4	26.9	56.4	95.9
	4mg	0.0	0.0	0.2	1.3	10.6
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	3.4	18	47.3	90.5	99.8
		Cowpea seeds				
Garlic oil	0.5%	0.0	0.4	2.7	21.1	55.8
	1%	0.0	0.0	0.3	1.8	11.5
	2%	0.0	0.0	0.0	0.0	0.0
Onion oil	0.5%	0.0	0.4	3.6	24.6	63.2
	1%	0.0	0.0	0.5	3.6	20.2
	2%	0.0	0.0	0.0	0.0	0.0
Biover	1gm	0.6	2.6	12.2	42.7	88.8
	1.5gm	0.0	0.8	5.4	32.6	74.7
	2gm	0.0	0.2	2.3	10	39.3
	4gm	0.0	0.0	0.1	0.7	5.7
Biover + Malathion	1.5gm+2mg	0.0	0.0	0.8	6.3	30
Malathion	2mg	0.8	3.6	17.6	46.5	90.2
	4mg	0.0	0.0	0.1	0.5	5.4
	8mg	0.0	0.0	0.0	0.0	0.0
	16mg	0.0	0.0	0.0	0.0	0.0
Control	--	2.1	21.6	71.8	96.6	99.9

Seed germination percentage of faba bean and cowpea seeds in Qalubia and Sharkia governorates resulted from the different treatments (initially) nearly germinated normally (83-84%, 81-83%) and (92-94%, 92-95%), respectively. On the other hand, after 6 months it was (83-86%, 82-84%) and (90-94%, 91-95%), respectively. These results indicated that there was no effect of the tested materials on the percentage of seed

germination and the results were confirmed with Magdoline (1985), Mahmoud (1990), Khaire *et al.*, (1992), Pacheco *et al.* (1995) and Abdel- Latif, (2003).

Table (IX)

Effect of different treatments on major biochemical components

Treatments	Mean ± S.E	Percentage observation	
Total Lipids			
Garlic oil	1.90 ± 0.004 (c)	122.58	+ 22.58%
Onion oil	0.72 ± 0.01 (a)	174.19	+ 74.19%
Biover	2.16 ± 0.01 (b)	139.35	+ 39.35%
Biover + Malathion	2.16 ± 0.001 (b)	139.35	+ 39.35%
Malathion	2.16 ± 0.01 (b)	139.35	+ 39.35%
Control	1.55 ± 0.02 (d)	100.00	-
LSD = 0.2 at 5% level		P<0.05	
Carbohydrates			
Garlic oil	30.74 ± 9.03 (c)	73.86	- 26.14 %
Onion oil	26.55 ± 2.42 (d)	63.79	- 36.21 %
Biover	37.71 ± 2.72 (b)	90.61	- 9.39 %
Biover + Malathion	38.47 ± 1.05 (b)	92.63	- 7.37 %
Malathion	35.95 ± 1.87 (b)	86.38	-13.62 %
Control	41.62 ± 0.028 (a)	100.00	-
LSD = 3.04 at 5% level		P<0.05	
Total Proteins			
Garlic oil	21.23 ± 0.02 (c)	101.00	+ 1%
Onion oil	20.46 ± 0.18 (c)	97.34	- 2.66%
Biover	20.95 ± 0.30 (c)	97.67	- 2.33%
Biover + Malathion	22.78 ± 0.52 (b)	108.38	+ 8.38%
Malathion	24.41 ± 0.79 (a)	116.13	+ 16.13%
Control	21.02 ± 0.014 (c)	100.00	-
LSD = 1.04 at 5% level		P<0.05	
Note: Value is expressed as mg/gm body weight			

The observed results showed that constant increase of total lipids with biover, malthion and mixture (39.35%)compared with control but in case of plant oils (garlic and onion) were (22.58 and 74.19%) respectively. On the other hand, the results showed that different decrease with different treatments (26.14, 36.21, 9.39, 7.37 and 13.62%), respectively in case of carbohydrates as shown in Table (9). In case of total proteins there was an increase with malathion and mixture of malathion and biover (16.13 and 8.38%), respectively. In general the data showed that there is significant increase in total lipids seed content and reduction in carbohydrate compared with control (Table 9). Also, the results indicated that there is significant increase in total protein in seed content compared with control in malathion and mixture of malathion and biover. The results of insects feeding on seed internal contents (which mainly protein and lipids) showed a reduction in quantity per seed. Insects usually do not feed on the outer shell (which's mainly cellulose or carbohydrate). This is behavior change in relation with seed contents. Reducing the protein and lipids contents in the infested seeds will raise the ratio of carbohydrates

(as cellulose). In this respect, Jood, *et al.* (1996) showed that nutritional composition viz., fat, protein and carbohydrates of treated sorghum grains with plant products remained unaffected after one month of storage and the change after 6 months in nutritional composition was proportional to insect damage.

SUMMERY

The effect of direct treatments of faba bean and cowpea seeds with plant oils (Garlic and onion), fungus (Biover), mixture (Malathion and biover) and pesticides (Malathion) on insect population and percentage seeds damage of stored seeds due to infestation with C. *maculatus*, (F.) and *C. chinensis*, (L.) was studied.

Results showed that percentage seeds damage of both faba bean and cowpea seeds was positively correlated with insect population and storage period. Insect population and percentage seeds damage of both faba bean and cowpea seeds were significantly reduced in treated seeds during storage period extended to 6 months in comparison with untreated one. The results indicated that there was no effect of the tested materials on the percentage of the seed germination.

Data showed that there is positive and negative significance in biochemical components (total lipids, carbohydrates and total proteins) seed content compared with untreated one.

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