Mansoura University
Faculty of Agriculture
Department of Pesticides

Efficacy of Some Insecticides against Cotton Mealybug *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae)

By

LINA HASSAN-ELRADY ALI SAAD

Research Assistant, Plant Protection Research Institute (PPRI), Dokki, Giza.

THESIS

Submitted for Partial Fulfillment of

the Requirements for the degree of

Ph.D. Degree

In

Agricultural Sciences

(Pesticides)

2021

CONTENTS

INTRODUCTION			**1**
REVIEW OF LITERATURE			**6**
I. Cotton mealybug *Phenacoccus solenopsis* (CMB)			**6**
II. Toxicological studies on cotton mealybug			**9**
	- Commercial compounds efficacy		**9**
	- Phytochemical efficacy		**24**
III. Biochemical studies on Cotton Mealybug			**40**
IV. Biological studies on Cotton Mealybug			**42**
V. Determination of essential oils components			**50**
MATERIALS AND METHODS			**53**
I. Tested compounds			**53**
	A. Organophosphate insecticides		**53**
		1. Malation	**53**
		2. Profenofos	**53**
	B. Insecticide Growth Regulator (IGR)		**54**
		1. Hexaflumuron	**54**
		2. Flufenoxuron	**54**
	C. Pyrethroid insecticide		**55**
		Lambda-cyhalothrin	**55**
	D. Miniral oil		**55**
		Diver® oil	**55**
	E. Phytochemicals		**55**
		1. Natural unorganized drugs	**55**
		2. Essential oils	**56**
II. Tested insect			**57**

Collection of insect			**57**
Mealybug rearing			**57**
III. Toxicological studies on cotton mealybug			**61**
	A. Culture of *Phenacoccus solenopsis* Tinsley		**61**
	B. Essential oils extraction technique		**61**
	C. Gas Chromatography-Mass Spectrometer/ analysis of essential oils		**62**
	D. Bioassay tests		**62**
IV. Biochemical studies			**64**
	A. Preparation of samples for enzyme assay		**64**
	B. Determination of enzyme activities		**64**
		1. Determination of transaminase enzymes activities	**64**
		2. Determination of alkaline phosphatase enzyme activity	**65**
V. Biological studies			**65**
Data collection for biological studies			**66**
VI. Statistical analysis			**67**
RESULTS AND DISCUSSION			**68**
I. Toxicological studies on the cotton mealybug *Phenacoccus solenopsis* Tinsley			**68**
	1. Susceptibility of 3rd instar nymph of CMB after one and three days of synthetic conventional compounds application		**68**
	2. Susceptibility of 3rd instar nymph of CMB after three and seven days of oils and plant extracts application		**74**
II. Gas Chromatography-Mass Spectrometer/ analysis of essential oils			**82**

III. Biochemical studies			**89**
	1. Effect of tested compounds on transaminases GPT (ALT) and GOT (AST) enzymes activities		**90**
	2. Determination of Alkaline phosphatase (ALP) activity		**97**
IV. Biological studies			**100**
	1. Developmental durations after treatment with the LC_{50} of the synthetic compounds		**100**
		Egg incubation period	**100**
		Immature stages	**100**
		Mature female stage	**101**
	2. Developmental durations after treatment with the LC_{50} of certain phytochemicals		**102**
		Egg incubation period	**102**
		Immature stages	**102**
		Mature female stage	**103**
	3. Number of females of *P. solenopsis* laying eggs after treatment with the tested compounds		**104**
SUMMARY AND CONCLUSION			**113**
I. Toxicological studies on the cotton mealybug *Phenacoccus solenopsis* Tinsley			**115**
	1. Susceptibility of 3rd instar nymph of CMB 1st and 3rd day after synthetic compounds application		**115**
	2. Susceptibility of 3rd instar nymph of CMB 3rd and 7th day after oils and plant extracts application		**116**
II. Gas Chromatography-Mass Spectrometer/ analysis of essential oils			**116**
III. Biochemical studies			**117**

	1. Determination of transaminases activity GPT (ALT) and GOT (AST)	**117**
	2. Determination of Alkaline phosphatase (ALP) activity	**118**
IV. Biological studies		**118**
	1. Developmental durations after treatment with the LC_{50} of the synthetic compounds	**118**
	Egg incubation period	**118**
	Immature stages	**119**
	Mature female stage	**119**
	2. Developmental durations after treatment with the LC_{50} of certain phytochemical	**120**
	Egg incubation period	**120**
	Immature stages	**120**
	Mature female stage	**121**
	3. Number of females of *P. solenopsis* laying eggs after treatment with the tested compounds	**121**
CONCLUTION		**122**
REFERENCES		**124**
ARABIC SUMMARY		**١**

List of Abbreviations

No.	List of Abbreviations	Means
1	CMB	Cotton mealybug
2	EO	Essential oil
3	IGR	Insect growth regulator insecticide
4	GC/MS	Gas Chromatography-Mass Spectrometer
5	ppm	Part per milion
6	AChE	Acetyl choline enzyme
7	GPT (ALT)	Glutamine pyruvic transaminase
8	GOT (AST)	Glutamic oxaloacetic transaminase
9	LDP line	Logarithm of dose with probability

Table	List of Tables	Page
1	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after one day of synthetic compounds application.	**70**
2	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after three days of synthetic compounds application.	**72**
3	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after three days of oils and plant extracts application.	**75**
4	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after seven days of oils and plant extracts application.	**77**
5	Chemical constituents of the active essential oils identified by GC/MS technique.	**86:88**
6	GPT activity (U/L) in the supernatant of the 3rd instar nymph of *P. solenopsis* Tinsley treated with the most effective $LC_{50's}$ compounds.	**93**
7	GOT activity (U/L) in the supernatant of the 3rd instar nymph of *P. solenopsis* Tinsley treated with the most effective $LC_{50's}$ compounds.	**95**
8	Alk-phosphatase activity (U/L) in the supernatant of the 3rd instar nymph of *P. solenopsis* Tinsley treated with the most effective $LC_{50's}$ compounds.	**98**
9	Developmental durations (Mean±SE) in days of CMB *P. solenopsis* Tinsley stages under laboratory conditions after treatment with the LC_{50} of the synthetic compounds.	**105**

10	Developmental durations (Mean±SE) in days of CMB *P. solenopsis* Tinsley stages under laboratory conditions after treatment with the LC_{50} of certain phytochemicals.	**106**

Fig.	List of Figures	Page
1	Morphological differences between female and male of CMB – the ovisac full of eggs and crawlers is obvious under the adult female.	**58**
2	Cotton Mealybug *Phenacoccus solenopsis* Tinsley infection in several areas of the cotton plant.	**59**
3	Life cycle of Cotton Mealybug *P. solenopsis* Tinsley.	**60**
4	Cleavenger apparatus hydro distillation	**61**
5	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after one day of synthetic compounds application.	**71**
6	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after three days of synthetic compounds application.	**73**
7	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after three days of oils and plant extracts application.	**76**
8	Susceptibility of 3rd instar nymphs of cotton mealybug *P. solenopsis* Tinsley after seven days of oils and plant extracts application.	**78**
9	GC chromatogram of Lemon grass *Cymbopogon citratus*	**83**
10	GC chromatogram of Rosemary *Salvia rosmarinus*	**84**
11	GC chromatogram of Camphor *Eucalyptus melliodora*	**85**
12	GPT activity (U/L) in the supernatant of the 3rd instar nymph of *P. solenopsis* Tinsley treated with the most effective $LC_{50's}$ compounds.	**94**
13	GOT activity (U/L) in the supernatant of the 3rd instar	**96**

	nymph of *P. solenopsis* Tinsley treated with the most effective $LC_{50's}$ compounds.	
14	Alk-phosphatase activity (U/L) in the supernatant of the 3rd instar nymph of *P. solenopsis* treated Tinsley with the most effective $LC_{50's}$ compounds.	**99**
15	First, second and third instar nymph durations (Mean±SE) in days of CMB *P. solenopsis* Tinsley under laboratory conditions after treatment with the LC_{50} of the tested compounds.	**107**
16	Pre-oviposition, oviposition and post-oviposition period durations (Mean±SE) in days of CMB *P. solenopsis* Tinsley under laboratory conditions after treatment with the LC_{50} of the tested compounds.	**108**
17	Longevity and life cycle durations (Mean±SE) in days of CMB *P. solenopsis* Tinsley under laboratory conditions after treatment with the LC_{50} of the tested compounds.	**109**
18	Female's fecundity (Mean±SE) of CMB *P. solenopsis* Tinsley under laboratory conditions after treatment with the LC50 of the tested compounds.	**109**
19	Number of females laying eggs (Mean±SE) of CMB *P. solenopsis* Tinsley under laboratory conditions after treatment with the LC_{50} of the tested compounds.	**110**

SUMMARY AND CONCLUSION

"Efficacy of Some Insecticides against Cotton Mealybug *Phenacoccus Solenopsis* Tinsley (Hemiptera: Pseudococcidae)"

The cotton plant (*Gossypium hirsutum* L.) is listed in the top ten crops commercialized daily. It is one of the most important cash crops and also called silver fiber and plays a pivotal role in the economy of the country. In Egypt, cotton is infested by several pests during its different growth stages.

Mealybugs "hard to kill pests" commonly known as Pseudococcids are ubiquitous groups of sap-sucking plant insects. Cotton Mealybug (CMB) is a major sucking pest that attacks different varieties of cotton. It is a highly polyphagous insect pest; it attacks more than 154 plant species including field crops, vegetables, ornamentals, weeds, bushes, and trees belonging to the families: Malvaceae, Solanaceae, Asteraceae, Fabaceae, Euphorbiaceae, Amaranthaceae and Cucurbitaceae. It causes economic damage mainly to cotton, brinjal, okra, tomato, sesame, sunflower, and China rose.

As a result of excessive use of synthetic insecticides, some problems such as reduction of beneficial organisms, environmental pollution, hazards to humans, building up of pest resistance and upsetting the natural balance were appeared. So, many studies have determined the importance of using natural alternatives in Integrated Pest Management (IPM) programs.

From this point of view, this investigation aimed to

First: Evaluate the toxic effects of some synthetic conventional pesticides; Malathion 57% EC, Profenofos 72% EC, Hexaflumuron 10% EC, Flufenoxuron 10% EC, Lambda-cyhalothrin 5% EC and Diver® oil 97% on the 3rd instar nymph of cotton mealybug (CMB), *Phenacoccus solenopsis* Tinsley under laboratory conditions.

Second: Evaluating the toxic effects of some phytochemicals; plant extracts of Olibanum *Boswellia carterii* and House pine *Araucaria heterophylla* and the leaves essential oils of Camphor *Eucalyptus melliodora*, Rosemary *Salvia rosmarinus* and Lemon grass *Cymbopogon citratus* on the 3rd instar nymph of CMB under laboratory conditions.

Third: Phytochemical investigation of the leaves essential oils of (*S. rosmarinus*, *C. citratus* and *E. melliodora*) using GC/MS to identify their chemical constituents and find out the most effective components in the promising toxic essential oils against CMB.

Fourth: Estimate the effect of sublethal concentrations in both synthetic pesticides and botanicals on the activity of Alkaline phosphatase (ALP) and transaminases (GOT and GPT) enzymes in the supernatant (homogenize) of CMB under laboratory conditions.

Fifth: Biological studies on the developmental durations (egg incubation period, immature stages and mature female stage) after treatment with the LC_{50} of synthetic compounds and certain phytochemicals.

I. Toxicological studies on the cotton mealybug *Phenacoccus solenopsis* Tinsley:

1- Susceptibility of the 3rd instar nymph of CMB after one and three days after synthetic compounds application

Results showed that Profenofos exhibited a high degree of efficiency as insecticide after one day of initial application followed by Lambda-cyhalothrin, Malathion, Flufenoxuron and Hexaflumuron showing the $LC_{50's}$ of (1.488, 10.091, 154.596, 217.095 and 225.292) ppm, respectively and $LC_{90's}$ of (4.563, 250.154, 347.164, 893.447 and 969.407) ppm, respectively. Based on Profenofos (100), the slopes of the toxicity lines were calculated to be fluctuated and increased from 0.919 in Lambda-cyhalothrin to 3.648 in Malathion. The other toxicants lines came between these two synthetic conventional compounds.

The toxicity index of the LC_{50} values could be showed that Profenofos (100 %) was the most effective toxicant followed by Lambda-cyhalothrin (14.747 %), Malathion (0.963 %), Flufenoxuron (0.685 %) and finally Hexaflumuron (0.660 %).

However Lambda-cyhalothrin proved a high degree of efficiency as insecticides after three days of application followed by Profenofos, Hexaflumuron, Flufenoxuron and Malathion showing the $LC_{50's}$ of (0.369, 1.065, 46.522, 53.634 and 75.513) ppm, respectively and $LC_{90's}$ of (4.216, 22.141, 182.795, 232.833 and 253.571) ppm for Profenofos, Lambda-cyhalothrin, Malathion, Hexaflumuron and Flufenoxuron, respectively. Based on Lambda-cyhalothrin (100), on the basis of the toxicity index, it is clear that Lambda-cyhalothrin was the most toxic to the 3rd instar nymphs of CMB followed by Profenofos (34.554 %), Hexaflumuron

(0.791 %), Flufenoxuron (0.686 %) and the least one Malathion (0.487 %).

2- Susceptibility of the 3rd instar nymph of CMB after three and seven days after oils and plant extracts application

Data showed that Rosemary exhibited a high degree of efficiency as insecticide after three days of initial application followed by Lemon grass, Camphor, Olibanum, House pine and Diver® oil showing the $LC_{50's}$ of (3102.591, 3323.293, 4966.815, 8470.625, 9797.514 and 15080.433) ppm, respectively and $LC_{90's}$ of (13226.041, 17074.043, 22656.729, 57847.187, 66936.244 and 95566.056) ppm, respectively. Based on Rosemary (100), the toxicity index being (20.574, 31.667, 36.628, 62.466 and 93.359) % for Diver® oil, House pine, Olibanum, Camphor and Lemon grass, respectively.

However Lemon grass proved a high degree of efficiency as insecticides after seven days of application followed by Rosemary, Olibanum, Diver® oil, Camphor and House pine showing the $LC_{50's}$ of (680.073, 740.591, 1299.897, 1381.831, 2483.432 and 3852.178) ppm, respectively and $LC_{90's}$ of (4020.773, 4226.784, 8974.716, 13385.587, 21616.766 and 29999.605) ppm for Lemon grass, Rosemary, Diver® oil, Camphor, Olibanum and House pine, respectively. Based on Lemon grass (100), the toxicity index being (17.654, 27.384, 49.215, 52.317 and 91.828) % for House pine, Camphor, Diver® oil, Olibanum and Rosemary, respectively.

II. <u>Gas Chromatography-Mass Spectrometer/ analysis of essential oils:</u>

The qualitative and quantitative compositions of the essential oils were analyzed and the most abundant constituents of *E. melliodora* were

found to be (z)-tagetenone (20.56%), *p*-cymene (16.62%) and (-)-spathulenol (14.60%). The *S. rosmarinus* essential oil mainly consisted of 1,8-cineol (18.37%), (-)-spathulenol (5.79%), and (+)-limonen (3.17%), while the major constituents of *C. citratus* essential oil were ɤ-citral (70.44%) and γ-dodecalactone (9.22%). *S. rosmarinus* and *C. citratus* essential oil showed a significant relative percentage of monoterpenes (90.87% and 89.06%), respectively than *E. melliodora* (77.2%), indicating that their presence and percentages may responsible for the highly insecticidal properties against *P.solenopsis* 3rd instar nymph.

III. <u>Biochemical studies:</u>

1- Determination of transaminases activity GPT (ALT) and GOT (AST)

Data indicated that all tested compounds caused fluctuation in GPT and GOT activities during experimental periods. Lambda-cyhalothrin (pyrethroid insecticide) caused a significant decrease in GPT enzyme activity to reach (-74.53 and -35.84) % at 1st and 3rd day after treatment, respectively then changed to significant increase in enzyme activity to reach (135.32 %) 5th day post treatment. While a significant increase was obvious in GOT enzyme activity to reach (31.51 and 85.01) % in 1st and 5th day post treatment, respectively with no significant changes found in the 3rd day post treatment.

Lemon grass *Cymbopogon citratus* essential oil caused a significant increase in GPT enzyme activity to reach (51.81 %) 1st day after treatment with no significant changes found in the 3rd and 5th day post treatment. While a significant increase was obvious in GOT enzyme activity to reach (54.50, 22.94 and 10.64) % in 1st, 3rd and 5th day post treatment, respectively.

Olibanum *Boswellia carterii* natural unorganized drug caused a significant increase in GPT and GOT enzymes activity to reach (14.52, 97.16 and 177.05) % and (398.37, 58.18 and 52.54) % in 1st, 3rd and 5th day post treatment, respectively, while a significant increase appeared on the GPT enzyme activity to reach (15.46 %) in the 5th day post treatment.

The miniral oil, Diver® caused a significant decrease in GPT and GOT enzymes activity to reach (-38.22 and -41.33) % in the 1st and 3rd day after treatment and (-26.61, -46.92 and -22.54) % in 1st, 3rd and 5th day post treatment, respectively.

2- Determination of Alkaline phosphatase (ALP) activity

Data demonstrated the effect of the $LC_{50's}$ of the tested compounds on ALP activity of the 3rd instar nymph of *P. solenopsis* to confirm their insecticidal potency. All treatments exhibited significant inhibition of ALP activity along the experimental period except in case of lemon grass after one day from treatment. The Diver® miniral oil caused the greatest inhibition of ALP activity followed by Lambda-cyhalothrin then, Lemon grass EO and Olibanum natural unorganized drug with inhibition percentages values -97.14, -97.15, -89.49 and -32.15 % below the control level in the 5th day post treatment, respectively.

IV. <u>Biological studies:</u>

1. Developmental durations after treatment with the LC_{50} of the synthetic compounds

- **Egg incubation period**

Data about the control experiment showed that the mean egg incubation periods of females ranged from 80 to 150 min with an average of 106.66 ± 26.66 min. The egg incubation period when treated with

Lambda-cyhalothrin ranged from 90 to 150 min with an average 120.00 ± 20.00 min and with Diver® oil it ranged from 80 to 140 min with an average 109.00 ± 18.14 min, all that with no difference from control.

- **Immature stages**

Data showed that the LC_{50} of Lambda-cyhalothrin caused an increase in the duration of newly hatched nymph's first instar (crawlers); it lasted for 16 to 22 days with an average of 19.88 ± 2.03 days. The second nymphal instar duration ranged from 4 to 13 days with an average of 7.63 ± 2.72 days. Decrease appearance in the third nymphal instar duration, ranged from 0 to 5 days with an average of 1.62 ± 2.26 days compared to control.

After using the LC_{50} of Diver® oil with young adult females an increase observed with the durations of crawlers and second nymphal instars which lasted for 14 to 19 and 2 to 20 days with an average of 16.90 ± 1.59 and 12.00 ± 5.27 days, respectively but a highly decrease was found in the third nymphal instar duration which ranged from 0 to 3 days with an average of 0.30 ± 0.95 days compared to control.

- **Mature female stage:**

Data showed that when treated with LC_{50} of Lambda-cyhalothrin the pre-oviposition and oviposition periods of *P. solenopsis* increased and it varied from 2 to 23 and 23 to 55 days with an average of 14.75 ± 7.93 and 40.62 ± 11.32 days, respectively. While, a high decrease appeared with the post-oviposition period and ranged from 0 to 4 days with an average of 0.50 ± 1.32 days. Female's longevity ranged from 46 to 69 days with an average of 55.87 ± 6.95 days. Total life cycle highly decreased and lasted for 21 to 39 days with an average of 28.12 ± 5.50 days compared to control. Increase observation on data reported that the

number of eggs laid by a single female (fecundity) during its entire life period ranged from 150 to 790 eggs with an average of 550.62 ± 203.75 eggs compared to control.

Results showed that when treated with LC_{50} of Diver® oil pre-oviposition and oviposition periods of *P. solenopsis* increased and it varied from 16 to 27 and 14 to 47 days with an average of 19.90 ± 2.91 and 31.10 ± 9.69 days, respectively. While, a high decrease appeared with the post-oviposition period and ranged from 0 to 6 days with an average of 2.10 ± 2.62 days. Female's longevity ranged from 40 to 65 days with an average of 53.10 ± 9.79 days. Total life cycle highly decreased and lasted for 18 to 39 days with an average of 29.10 ± 6.00 days compared to control. Data reported that fecundity during its entire life period highly increased and ranged from 74 to 901 eggs with an average of 365.70 ± 238.12 eggs compared to control.

2. Developmental durations after treatment with the LC_{50} of the phytochemical compounds

- **Egg incubation period**

Data indicated that the egg incubation period when treated with Lemon grass was 110 min and when treated with Olibanum ranged from 90 to 140 min with an average 112.50 ± 19.20 min; with no difference from control.

- **Immature stages**

Data showed that the LC_{50} of Lemon grass caused an increase in the duration of crawlers; it lasted for 17 days. The second nymphal instar duration was 11 days. Highly decrease appearance in the third nymphal instar duration compared to control.

After using the LC_{50} of Olibanum with young adult females a decrease observed with the duration of crawlers which lasted for 8 to 13 days with an average of 11.50 ± 2.30 days and also the second nymphal instar duration increased, ranged from 10 to 18 days with an average of 12.50 ± 3.41 days but the a highly decrease was found in the third nymphal instar duration which ranged from 0 to 15 days with an average of 3.75 ± 7.50 days compared to control.

- **Mature female stage:**

Data showed that no differences happened in the pre-oviposition and oviposition periods of *P. solenopsis* when treated with the LC_{50} of Lemon grass, they were 10 and 20 days, respectively. While, a highly decrease appeared on the post-oviposition period. A highly decrease in female longevity and total life cycle happened; they were 30 and 28 days, respectively compared to control. Data reported that there were a highly decrease in the number of eggs laid by a single female (fecundity) during its entire life period was 261 egg compared to control.

Results showed a decrease on pre-oviposition, oviposition and post-oviposition periods of *P. solenopsis* when treated with LC_{50} of Olibanum, it varied from 3 to 26, 12 to 37 and 0 to 20 days with an average of 11.25 ± 9.01, 23.25 ± 9.04 and 9.00 ± 9.11 days, respectively. A highly decrease is obvious in female longevity and total life cycle; they were ranged from 38 to 50 and 22 to 64 days with an average of 43.25 ± 4.66 and 36.00 ± 19.02 days, respectively compared to control. Data reported that fecundity decreased and ranged from 83 to 968 eggs with an average of 370.75 ± 356.58 eggs compared to control.

3. Number of females of *P. solenopsis* Tinsley laying eggs after treatment with the tested compounds

Our results revealed that the number of females of *P. solenopsis* laying eggs after treatment was not affected when treated with the studied synthetic compounds, but we found a highly significant decrease when treated with the Lemon grass essential oil (N=1) followed by Olibanum the natural unorganized drug (N=4), compared to control, consequently, a decrease in the pest population and a decrease in the rate of infestation of preferred economic field crops.

CONCLUSION

The insecticidal activity of different compounds against *Phenacoccus solenopsis* Tinsley was studied. The most active synthetic compounds after one and three days of treatment were Profenofos (Organophosphate) and Lambda-cyhalothrin (Pyrethroid) and the most active phytochemical compounds after three and seven days of treatment were Rosemary *Salvia rosmarinus* and Lemon grass *Cymbopogon citratus* EOs. The major volatile components of the tested essential oils were characterized by GC/MS technique. Also, the impact of the most effective compounds on transaminases and alkaline phosphatase of *P. solenopsis* were studied. It was found that all tested compounds caused dramatic declination of both transaminases and alkaline phosphatase. This suggested the high potency of the phytochemical compounds such as Rosemary and Lemon grass EOs as environmentally friendly alternatives of traditional insecticides.

Also, the biological studies obtained that Lambda-cyhalothrin caused an increase in the duration of crawlers, decrease the 3rd instar nymph duration, highly decreased the life cycle duration and increase the pre-oviposition and oviposition periods. Diver® oil cause an increase in

crawlers and 2nd instar nymph durations, decrease in 3rd instar nymph duration, highly decreased in total life cycle and post-oviposition period and highly increased the female fecundity. The lemon grass EO proved to be more effective as it caused a highly decrease in the 3rd instar nymph duration, female fecundity and longevity, post-oviposition period and total life cycle. Similarly, Olibanum plant extract induced a highly decrease in 3rd instar nymph duration, female fecundity and longevity and total life cycle. The number of females of *P. solenopsis* laying eggs after treatment was not affected when treated with the studied synthetic compounds, but we found a highly significant decrease when treated with the Lemon grass essential oil followed by Olibanum the natural unorganized drug, compared to control.

Through this study, it can be concluded that one of the most important points has to be studied well is how to apply these phytochemical compounds in the integrated management programs for the cotton mealybug pest to achieve the decrease in the pest population and the rate of infestation of preferred economic field crops.