

LATENT EFFECTS OF SOME PESTICIDES AND PLANT GROWTH REGULATOR ON COWPEA APHID, *Aphis craccivora* KOCH (HOMOPTERA: APHIDIDAE)

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ABSTRACT

The latent toxicity of chemical insecticide; malathion, bioinsecticide; *Beauveria bassiana* and a plant growth regulator (PGR) Extratone were studied on some biological parameters of adult *Aphis craccivora* under laboratory conditions. The obtained results revealed that the two sub-lethal concentration 0.01 and 0.1 ppm sub LC₅₀ (0.73 ppm) of malathion decreased each of the mean longevity of adult (one day old), mean offspring in addition to pre-parturition, parturition and post-parturition periods in comparison to the control. Eventually, both concentrations reduced the mean numbers of offspring of adult per day. *B. bassiana* at concentrations (200ppm) at (100ppm) decreased each of the mean longevity of adult, number of offspring, pre-parturition and parturition but increased post-parturition periods in comparison to the control. Both concentrations of *B. bassiana* treatment reduced the mean number of offspring of *A. craccivora* (one day old) during longevity per day. Extratone at recommended concentration decreased the duration of *A. craccivora*, increased the pre-parturition period and decreased the parturition period, Post-parturition period, the mean longevity of *A. craccivora* and the mean number of offspring of each *A. craccivora* adult female.

Keywords: *Aphis craccivora*, malathion, *Beauveria bassiana*, plant growth regulator (PGR), Extratone, pre-parturition, parturition, post-parturition periods

INTRODUCTION

The cowpea aphid, *Aphis craccivora* is one of the major insect pest attacking leguminous crops in Egypt. Malathion is the most effective insecticide in controlling this pest as it posses a highly toxic effect against *A. craccivora* (Nasser *et al.*, 2000). Entomopathogenic fungi are currently used in controlling several insect pests as an alternative way or complementary to chemical insecticides. Improvements in virulence and speed of killing can be achieved by understanding the mechanisms of fungal pathogenesis and using genetically modifying targeted genes, thus improving the commercial efficacy of these biocontrol agents. Entomopathogenic fungi are considered as the best candidate for biological control of aphid (Latge and Papierok, 1988; Van *et al.*, 2007). Plant growth regulators proved to have different effects on *A. craccivora*. The aim of the present work is determining the latent effect of some pesticides of different types on cowpea aphid.

MATERIALS AND METHODS

Tested compounds:

Chemical insecticide:

- Trade name: Malathion57% (EC).
- Chemical name: o,o-dimethyl-s-(1,2(di-carbethoxy ethyl phosphoro dithioate)).
- Recommended rate: 1.250 L/Feddan.

Entomopathogenic fungus:

- Trade name: Biovar.
- Scientific name: *Beauveria bassiana*.
- Recommended rate: 200g/100L at concentration of 2.3×10^7 spores per gm.

Plant growth regulator:

- Trade name: Extratone.
- Chemical composition: It consists of
 - Naphylacetic acid.....2.5%
 - Moisture.....5.0%
 - Inert.....92.5%
- Recommended rate: 60cm/100L.

Rearing technique of *A. craccivora*:

A. craccivora were reared on faba bean plants under laboratory conditions at 20-25°C, 70± 5% R.H. and under a photoperiod of 16:18 hours according to El-Arnaouty (1991).

Biochemical assays:

Treatments:

Malathion 57% E.C.:

The two concentrations of aqueous solution were prepared at (0.01 and 0.1ppm), respectively under LC₅₀ (0.73ppm) after determination it and five replicates were used for each concentration, each replicate have 20 individuals of *A. craccivora*.

Beauveria bassiana:

The two concentrations of aqueous solution were prepared (100 and 200ppm), respectively and five replicates were used for each concentration, each replicate have 20 individuals of *A. craccivora*.

Plant growth regulator (PGR), Extratone treatments:

Five replicates were prepared at recommended concentration (60 ml/100L), each replicate have 20 individuals of *A. craccivora*.

Application technique:

Leaf dipping technique:

The serial concentrations of aqueous solution were prepared for each tested insecticides. Leaves of faba bean were dipped in the insecticides solutions for 10 second then left to dry at room temperature. Treated leaves were put separately in five Petri dishes for each concentration and untreated leaves put in five Petri dish as control then 20 individuals of *A. craccivora* were put in each replicate and counted individuals after 24, 48, 72 hr. post treatments under laboratory conditions (25-28°C and 70-75R.H%) (Ghatwary, 2000) and followed them daily, then latent effect was determined as mean longevity of adult, pre-parturition, parturition, Post-parturition, the mean number of nymphs/female and the mean number of offspring of adult stage.

RESULTS AND DISCUSSION

Latent effect of malathion 57% EC at different sub lethal concentrations (LC50s) on biological aspects of adult stage of *Aphis craccivora* (one day old):

Data represented in Table (1) show that, the two sub-lethal concentrations LC_{50s} of malathion decreased the mean longevity of adult as compared with the control. The mean longevity of adult ranged between 8.23±0.62 and 8.47±0.63 days and control was 11.91±0.64 days. The obtained data also show decrease in mean offspring at 0.1 ppm gave 14.46±1.5 nymphs and at 0.01ppm gave 21.46±1.61 nymphs while control gave 35.25±1.83 nymphs. Also, pre-parturition, parturition and post-parturition periods changed compared with control.

The pre-parturition periods which the adult don't able to give offspring increased than control for the two concentrations as follow at 0.1ppm and 0.01ppm showed 1.38±0.14, 1.2±0.11day, respectively and control was 1.10±0.03 day. The parturition periods of *A. craccivora* at 0.1ppm, 0.01ppm concentration of malathion decreased than control which were 6.07±0.62, 6.00±0.55 and 10.60±0.61days, respectively. The mean post-parturition periods were 0.77±0.3, 1.27±0.21 and 0.28±0.08 days at 0.1ppm,0.01ppm and control, respectively. The increase in the mean post-parturition period which the adult still alive and don't able give progenies was observed.

The results indicated highly latent effects of malathion These results are in harmony with these results recorded by (Islam *et al.*, 1990) who stated that malathion 57% EC was most effective causing a 99.26% reduction of aphids. (Chang and Chen, 1993) who found that controlled of *A. craccivora* effectively by malathion 50% EC.

Table (1): Latent effect of malathion 57% EC. at different sub lethal concentrations LC₅₀) on biological aspects of adult stage of *A.craccivora* under laboratory conditions.

Concentrations ppm	Longivety Mean±S.E. (Day)	Pre-parturition Mean±S.E. (Day)	Parturition Mean±S.E. (Day)	Post-Parturition Mean±S.E. (Day)	No. of nymphs/ female Mean±S.E. (Day)
0.01	8.47±0.63 (5-11)	1.2±0.11 (1-2)	6.00±0.55 (3-8)	1.27±0.21 (0-2)	21.46±1.61 (12-33)
0.1	8.22±0.62 (6-11)	1.38±0.14 (1-2)	6.07±0.62 (3-10)	0.77±0.30 (0-3)	14.46±1.5 (7-23)
Control	11.91±0.64 (4-24)	1.10±0.03 (1-2)	10.60±0.61 (3-23)	0.28±0.08 (0-3)	35.25±1.83 (5-65)

Effect of malathion on number of offspring of adult stage of *Aphis craccivora* ne day old during longevity at different sub-lethal concentrations under laboratory conditions:

Data presented in Table (2) show the daily mean number of offspring of *A. craccivora* per female for two sub lethal concentrations of malathion.

The obtained data show that, in the first, second, third, fourth, fifth, sixth, seventh, eighth and ninth day the mean number of nymphs were (1.25±0.16, 3.60±0.43, 4.27±0.29, 3.85±0.22, 3.13±0.44, 2.44±0.18, 2.71±0.29, 2.60±0.81 & 1.00±0.00) at 0.01 ppm, (1.00±0.00, 3.31±0.31, 3.07±0.28, 3.62±0.25, 1.91±0.21, 1.00±0.00, 1.00±0.00, 1.4±0.24 & zero) at 0.1 ppm and recorded in control (4.15±0.45, 4.67±0.26, 5.06±0.58, 6.13±0.32, 3.81±0.19, 3.56±0.17, 3.16±0.20, 3.67±0.16 & 2.6±0.18)nymphs, respectively.

On the tenth day the mean numbers of nymphs were zero, zero and 2.17±0.31 nymphs at 0.01ppm, 0.1ppm and control, respectively. Finally on the eleventh day the mean numbers of nymphs were zero, zero and 2.20±0.34 nymphs at 0.01ppm, 0.1ppm and control, respectively. Generally, all the two sub lethal concentrations of malathion treatment reduced the mean numbers of progenies of apterous as compared to control.

Table (2): Effect of malathion on number of offspring of adult stage of *A. craccivora* ne day old during longevity at different sub-lethal concentrations under laboratory conditions.

Days	Concentrations		
	0.01ppm Mean±S.E.	0.1ppm Mean±S.E.	Control Mean±S.E.
1 st	1.25±0.16 (1-2)	1.00±0.00 (1-1)	4.15±0.45 (1-9)
2 nd	3.60±0.43 (1-5)	3.31±0.31 (2-5)	4.67±0.26 (2-7)
3 rd	4.27±0.29 (2-7)	3.07±0.28 (2-4)	5.06±0.58 (2-8)
4 th	3.85±0.22 (3-5)	3.62±0.25 (2-6)	6.13±0.32 (5-8)
5 th	3.13±0.44 (1-4)	1.91±0.21 (1-3)	3.81±0.19 (2-6)
6 th	2.44±0.18 (2-3)	1.00±0.00 (1-1)	3.56±0.17 (2-5)
7 th	2.71±0.29 (2-4)	1.00±0.00 (1-1)	3.16±0.20 (2-5)
8 th	2.60±0.81 (2-4)	1.4±0.24 (1-2)	3.67±0.16 (2-5)
9 th	1.00±0.00 (1-1)	0.00±0.00 (0-0)	2.6±0.18 (1-4)
10 th	0.00±0.00 (1-1)	0.00±0.00 (0-0)	2.17±0.31 (1-5)
11 th	0.00±0.00 (0-0)	0.00±0.00 (0-0)	2.20±0.34 (1-4)

Latent effect of *Beauveria bassiana* (Biovar) at sub recommended concentration on biological aspects of adult stage of *Aphis craccivora* (one day old):

Entomopathogenic fungi, *B. bassiana*, penetrate the insect cuticle utilizing a plethora of hydrolytic enzymes, including chitinases, which are important virulence factors. Two chitinases (Bbchit 1 and Bbchit 2) have

previously been characterized in *B. bassiana*, neither of which possesses chitin-binding domains.

The obtained data in Table (3) reveal that (200ppm) and (100ppm) decreased the mean longevity of apterous , number of offspring and three division periods of duration of *A. craccivora* adult as compared to control, respectively.

The data show decrease in the longevity, offspring of apterous adult of *A. craccivora*, decrease in pre- parturition and parturition periods than control and this will resulted in a decrease of the injury the aphids caused to faba bean. Also the increase in post-parturition periods than control was observed.

The obtained data proved that *B. bassiana* can serve successfully as a biocontrol agent against *A. craccivora*. These results are in harmony with these results obtained by (Zaki, 1998) who revealed that, *B. bassiana* was effective in controlling *A. craccivora*, the period of reproduction of *A. craccivora* was significantly decreased after applying. The total duration was decreased by increasing the dose of the compound.

Baverstock *et al.* 2006 stated that the infection by *B. bassiana* reduced the number of nymphs produced of *A. pisum* within 24 h of inoculation and over the entire infection period compared to uninfected aphids. Kim, 2007 revealed that, a significant dose of *V. lecanii* affect on reduction of life span, reproductive period and fecundity in 1st and 3rd instars after spore application. Reproduction period was also significantly shortened with increasing spore concentration. It was the isolate which able to affect populations of cotton aphid by reducing life span and total fecundity.

Table (3): Latent effect of *B. bassiana* (Biovar) at two concentrations 100 and 200 ppm on biological aspects of adult stage of *A. craccivora* (one day old) under laboratory conditions.

Concentrations Ppm	Longevity/day Period Mean±S.E.	Pre-parturition Period Mean±S.E.	Parturition Period Mean±S.E.	Post-Parturition Period Mean±S.E.	No of nymphs/ female Mean±S.E.
100	9.91±1.31 (5-18)	1.00±0.00 (1-1)	7.91±0.93 (4-11)	1.00±0.55 (0-6)	31.55±2.36 (16-41)
200	8.33±0.66 (4-15)	1.00±0.00 (1-1)	6.57±0.49 (1-10)	0.76±0.28 (0-4)	27.43±1.62 (14-39)
Control	11.91±0.64 (4-24)	1.10±0.03 (1-2)	10.60±0.61 (3-23)	0.28±0.08 (0-3)	35.25±1.83 (5-65)

Effect of *Beauveria bassiana* (Biovar) on number of offspring of adult stages of *Aphis craccivora* (one day old) during longevity at two concentrations under laboratory conditions:

The data presented in Table (4) show the mean number of progenies (nymphs) of *A. craccivora* during longevity per female daily at two tested concentration of *B. bassiana* (100ppm) and (200ppm). Data show that female gave mean on first day zero nymphs at 100ppm and 200ppm while gave 4.15±0.45 nymphs at control. On the second day female gave 5.6±0.15, 4.67±0.26 and 6.45±.64 nymphs at 100 ppm, 200 ppm and control respectively. On the third day female gave 4.55±0.43, 4.27±0.29 and 5.00±0.23 nymphs at 100ppm, 200ppm and control, respectively.

Table (4): Effect of *Beauveria bassiana* Balsamo on number of offspring of dult stages of *Aphis craccivora* (one day old) during longevity at two tested concentrations 100 and 200 ppm under laboratory conditions:

Days	Concentrations		
	100ppm Mean±S.E. (Ranges)	200ppm Mean±S.E. (Ranges)	Control Mean±S.E. (Ranges)
1 st	0.00±0.00 (0-0)	0.00±0.00 (0-0)	4.15±0.45 (1-9)
2 nd	5.60±0.15 (5-7)	4.67±0.26 (2-7)	6.45±0.64 (4-9)
3 rd	4.55±0.43 (3-6)	4.27±0.29 (2-7)	5.00±0.23 (3-6)
4 th	4.82±0.54 (3-7)	3.62±0.25 (2-6)	6.10±0.21 (5-7)
5 th	3.81±0.19 (2-6)	2.78±0.10 (2-3)	4.91±0.10 (4-5)
6 th	3.56±0.17 (2-5)	3.20±0.12 (2-4)	3.89±0.45 (3-5)
7 th	3.16±0.20 (2-5)	2.50±0.19 (2-3)	3.64±0.13 (3-5)
8 th	3.10±0.16 (2-4)	2.69±0.13 (2-3)	4.17±0.54 (2-5)
9 th	2.6±0.18 (1-4)	1.80±0.20 (1-2)	3.00±0.55 (1-4)
10 th	2.40±0.24 (2-3)	1.40±0.24 (1-2)	3.20±0.34 (1-5)
11 th	2.00±0.00 (2-2)	1.25±0.25 (1-2)	2.17±0.31 (1-5)
12 th	0.00±0.00 (0-0)	1114 0.00±0.00 (0-0)	2.43±0.17 (1-3)

On the fourth day female gave 4.82 ± 0.54 , 3.62 ± 0.25 and 6.10 ± 0.21 nymphs, on the fifth day female gave 3.81 ± 0.19 , 2.78 ± 0.10 and 4.91 ± 0.10 nymphs, on sixth day female gave 3.56 ± 0.17 , 3.20 ± 0.12 and 3.89 ± 0.45 nymphs, on seventh day female gave 3.16 ± 0.20 , 2.5 ± 0.19 and 3.64 ± 0.13 nymphs, on eighth day female gave 3.10 ± 0.16 , 2.69 ± 0.13 and 4.17 ± 0.54 nymphs, on ninth day female gave 2.6 ± 0.18 , 1.80 ± 0.20 and 3.00 ± 0.55 nymphs, On tenth day female gave 2.40 ± 0.24 , 1.40 ± 0.24 and 3.20 ± 0.34 nymphs, on eleventh day female give 2.00 ± 0.00 , 1.25 ± 0.25 and 2.17 ± 0.31 nymphs and on twelfth day female gave zero, zero and 2.43 ± 0.17 nymphs at 100ppm, 200ppm and control, respectively.

Generally, both concentrations of *B. bassiana* reduced the mean number of progenies of apterous compared with control. These results are in agreement with (Zaki, 1998) who revealed that, *B. bassiana* was effective in controlling *A. craccivora* and the fecundity was reduced markedly from 95.7 young in the control to 3.4 young at 0.05 mg. ml⁻¹. But (Kim, 2007) investigated that the daily fecundity of individual aphids, *A. gossypii* was not affected by spore dose of *V. lecanii* CS625.

Effect of Extratone as a plant growth regulator on biological aspects of *Aphis craccivora* at recommended concentration:

The obtained data in Table (5) show that the recommended concentration of Extratone affected the duration of *A. craccivora* by increasing the pre-parturition period. The pre-parturition period was 1.25 ± 0.16 day for Extratone, while control was 1.10 ± 0.03 day.

Table (5): Comparison between effects of treatments with malathion at LC₅₀ (0.73ppm), *B. bassiana* and Extratone at recommended concentration on biological aspects of *A. craccivora* adults under laboratory conditions:

Periods Treatments	Longevity/day Period Mean±SE)	Pre- parturition Period Mean±SE	Parturition Period Mean±SE	Post- Parturition Period Mean±SE	No. of nymphs/ female Mean±SE
Control	11.91 ± 0.64 (4-24)	1.10 ± 0.03 (1-2)	10.60 ± 0.61 (3-23)	0.20 ± 0.08 (0-3)	35.25 ± 1.83 (5-65)
Extratone	7.13 ± 0.67 (5-18)	1.25 ± 0.16 (1-2)	5.88 ± 0.72 (3-9)	0.00 ± 0.00 (0-0)	12.50 ± 2.05 (5-21)
Malathion	5.88 ± 0.69 (4-9)	1.00 ± 0.00 (1-1)	4.25 ± 0.49 (3-6)	0.63 ± 0.26 (0-2)	13.38 ± 1.63 (4-20)
<i>Beauvaria bassiana</i>	8.33 ± 0.66 (4-15)	1.00 ± 0.00 (1-1)	6.57 ± 0.49 (1-10)	0.76 ± 0.28 (0-4)	27.43 ± 1.62 (14-39)

Extratone decreased the parturition period (5.88 ± 0.72) days while control (10.60 ± 0.61) days. Post-parturition period was zero for Extratone, recorded 0.20 ± 0.08 days in case of control. Also, the obtained data show decrease in the mean longevity of *A. craccivora*, (7.13 ± 0.67) days after applying Extratone at recommended concentration, while it was (11.91 ± 0.64) days in control. Just as the data show decrease in the mean number of offspring of each mother of *A. craccivora* when treated with Extratone at

recommended concentration (12.50±2.05) nymphs while the control was 35.25±1.83 nymphs.

This result indicated that Extratone used to improve faba bean growth and also control *A. craccivora*. The results represented in Table (5) also indicated highly efficiency of malathion than other treatments.

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التأثيرات المتأخرة لبعض المبيدات و منظمات النمو النباتية علي حشرة من اللوبيا

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تمت دراسة سمية الملاثيون 57% كمبيد كيميائي وفطر البوفاريا كفطر ممرض للحشرة و إكسترا تون كمنظم نمو نباتي علي بعض السمات البيولوجية للطور البالغ لحشرة من اللوبيا/فيس كراسيفورا تحت الظروف المعملية أوضحت النتائج أن الملاثيون 57% بتركيزين مختلفين تحت التركيز النصف مميت قلل طول عمر الطور البالغ وفترات التوالد وعدد الخلفات لكل أنثي و خفض عدد الخلفات لكل أنثي علي طول فترة عمرها يوميا مقارنة بالكنترول . تم دراسة التأثير المتبقي لفطر البوفاريا عند تركيزين 100 و 200 جزء في المليون علي المظاهر البيولوجية للطور البالغ لحشرة/فيس كراسيفورا . و أوضحت النتائج أن فطر البوفاريا قلل من طول عمر الطور البالغ وعدد الخلفات لكل أنثي وفترة ما قبل التوالد مقارنة بالكنترول ولكن زاد فترة ما بعد التوالد و خفض عدد الخلفات لكل أنثي علي طول فترة عمرها يوميا مقارنة بالكنترول. الإكستراتون عند التركيز الموصي به أثر علي حشرة من اللوبيا بزيادة فترة ما قبل التوالد وتخفيض فترة التوالد وما بعد التوالد وطول عمرها و متوسط عدد الخلفات لكل حشرة كاملة.

قام بتحكيم البحث

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