*Minufiya J. Agric. Res. Vol.38 No. 1(2): 189 -198 (2013)* "http://www.mujar.net"

# EFFICIENCY OF RELEASING THE PREDATOR *COCCINELLA SEPTEMPUNCTATA* (LINNAEUS) AND THE FUNGUS, *VERTICILLIUM LECANII* (ZIMM.) ON SUPPRESSING *APHIS CRACCIVORA* KOCH (HOMOPTERA: APHIDIDAE) ON THE SNAP BEAN *PHASIOLUS VULGARIS* (L.).

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**(Received: Nov. 6 , 2012)**

**ABSTRACT:** *Laboratory and field trials were conducted to evaluate the efficiency of the predator Coccinella septempunctata (L.), the pathogen Verticillium lecanii. and the insecticide selecron against Aphis craccivora Koch. on the snap bean plants. The predator was released at the rate of one, two and three predators / plant for one, three and five days. Higher mortality was achieved (95.8%) with the treatment of three predators / plant after five days compared to the control (0.0%). V. lecanii achieved (77.5%) mortality at the concentration of $10^8$ spores / ml. after five days compared to (0.0) mortality in the control. Higher percent of mortality (98.2) was recorded with combination of the predator and the entomopathogen, and (91.4) with selecron treatment after five days compared to (0.0 %) in the control.*
*Under field conditions, both the predatisim ratio and the pathogenicity achieved higher mortality and ranged from 25% to 98% at the rate of 2, 4 and 6 releases each has 10 predators per bed during the 2nd of March to the 18th of June while the mortality ratio to the insecticide selecron ranged from 63% to 97%*

***Key words:*** *Predator, entomopathogenic, Aphis, snap bean, selecron, Aphid.*

## INTRODUCTION

Snap bean, *Phasiolus vulgaris* (L.), is cultivated in large scale areas at Fyoum Governorate, In, Egypt either for export or local consumption. The cowpea aphid species, *Aphis craccivora* Koch, is one of the most important pests attacking snap bean causing severe damage to either plants or fruits.

*A. craccivora* sucks sap from tender leaves, flower stalks and pods and has also developed resistance to some commonly used insecticides and it causes substantial damage to other legume crops such as chickpea. This aphid is also capable of transmitting a number of viral diseases to chickpea.

The national income from exportation in the coming years is expected to be increased and this requires to obtain healthy clean fruits without chemical pesticide treatments. Among biological control agents of *A. craccivora*, the predator lady bird beetle, *Coccinella septempunctata* and pathogen *V.lecanii* have been given much attention (Valerio *et al* 2007).

In Egypt, growers still depend on chemical control of this noxious pest, yet in some other countries. The present work was conducted to estimate the effect of releasing the predator, *C. septempunctata* and *V. lecanii* as biological control agent of *A. craccivora* in snap bean fields in combination with the entomopathogenic fungus *V. lecanii*.

## MATERIALS AND METHODS

### I -Laboratory studies :

#### I-1: Stuck cultures:

Adults of *A. craccivora* were collected from infested crops of snap bean plants at Fyoum Governorate. Infested leaves were placed in paper bags, and transferred to the laboratory and applied on healthy plants (Salikutty and Peter 2007). The aphid was reared for three generations on snap bean plants of 30 days old under laboratory conditions at 27 ± 1°C and 65 ± 5 RH%. Adults of *C. septempunctata* were collected

from the field by a camel hair brush in Petri dishes, transferred to the laboratory and released on the infested snap bean plants Katsarou *et al* 2005.

## I-2:Efficiency of *C. septempunctata*:

Hundred adults of *A. craccivora* were exposed to 1*C. septempunctata* for one day, and other hundred was exposed for 3 days and the last hundred were exposed for five days. The same technique was followed with 2 and 3 predators for 1, 3 and 5 days.

## I-3: Pathogenicity of *V. lecanii*:

The entomopathogenic fungus *Verticillium lecanii* was isolated from natural collected dead adults of *A. craccivora*, (Nirmala *et al*., 2006). Serial dilutions of the entomopathogenic fungus was prepared at the concentrations of $10^6$, $10^7$ and $10^8$ spores /ml. Each was supplied by 1 ml tween 40, and 1 ml glycerin and tested. 100 adults *of A. craccivora* were exposed to the spore's suspension of *V. lecanii* at the concentrations of $10^6$, $10^7$ and $10^8$ spores /ml. alone for 5, 7 and 10 days. Four replicates were prepared for each concentration, and the control treatment was sprayed with water.

## I-4:Pathogenicity of *C. septempunctata* and *V. lecanii*.

100 adults were sprayed by the spores suspension and exposed to one *C. sepetempunctata,* for 5,7 and 10 days, other hundred of *A. craccivora* were exposed to two and three predators for 5,7 and 10 days. Results were recorded after 5, 7 and 10 days. Four replicates were prepared for each concentration, and the control treatment was sprayed with water.

## I-5: Toxicity of selecron insecticide:

100 adults per treatment of *A. craccivora* were exposed to selecron. and was applied at the concentrations of 0.75, 1 and 1.25 ml / l. four replicates as control were prepared per treatment against *A. craccivora* adults for 1, 5 and 7 days and $LC_{50}$ were also estimated.

Effects of sub lethal concentration ($LC_{50}$) of the entomopathogens by (EPA) Probit Analysis Program used for calculating LC/EC values Version 1.5 on a number of *A. craccivora* fitness parameters were calculated.

## II- Field trials:

## II-1: Efficiency of *C. septempunctata*:

Three plots of about one Kirate (175 $m^2$) each, transplanted with commercial snap bean (Bronco variety) at Fayoum district, Fayoum Governorate on during 20$^{th}$ of December 2011. The experiment was left without any pesticide treatments, each was divided into three replicates, each had four rows distributed randomly. All replicates were covered by shade netting of 250 mish under net covered condition in the field. Release of the predator started on Mar. 2, 2012,at a rate of one Petri dish / bed. The first treatment received two releases, while the second and third received four and six releases, respectively. Three treatments were practiced, the first treatment was ten predator individuals, placed in a Petri dish and released twice, the second was four Petri dishes released weekly and the third was six Petri dishes, released weekly.

## II-2:Efficiency of *C. septempunctata* and *V. lecanii*:

The second treatment was the plants that treated with *V. lecanii* at the concentration of $10^6$ spores / ml. early morning and released the predator *C. septempunctata* at the rate of two, four and six releases. The same technique was followed by treated plants with the spores suspension at the concentrations of 107 and 108 spores / ml.

## II-3: Efficiency of selecron:

The third treatment, uncovered infested snap bean plants were sprayed by selecron insecticide, at a double concentrations that were applied in the laboratory, 2 x 0.75, 2 x 1 and 2 x 1.25 l / ml.

Randomized samples of 15 leaves/ replicate were collected, before every release, the first sample was considered as the pre-count and the second one as the

first post-count and so on with the subsequent samples.

## III- Statistical analysis:

Data were subjected to analysis of variance (ANOVA) and the means were compared by L.S.D. test, at 0.05 level, using SAS program (SAS Institute, 1988). $LC_{50}$ were calculated by using Probit analysis (Finny, 1952) for the tested entomopathogen. Statistical equation of Henderson and Telton 1955 was applied to calculate the reduction in the black aphid of *A. craccivora* infestation.

## RESULTS AND DISCUSSION

## (1): Laboratory efficiency tests:

### (A): Efficiency of *C. septempunctata*:

As presented in table (1). higher percentage reduction in *A. craccivora* on snap bean plants in the laboratory was recorded after fifth day of *C. septempunctata* release, followed by the third day of release, and one day of release in the treatments of 1predator, 2 predators and 5 predators / plants. Obtained data in the fifth day of the predator release were 48.2, 77.5 and 95.8 and 0.0% in the check treatment respectively. Omkar, *et al* 2003 reported that *A. craccivora* was a suitable prey for C. *septempunctata* and the present information can be utilized for the mass rearing of *C. septempunctata*.

### (B):Efficiency of *V. lecanii*:

On the other hand, higher percentage of reduction was obtained after applying *V. lecanii* spores suspension at the concentrations of $10^6$, $10^7$ and $10^8$, after the 10 days, followed by the 7 days, and lastly by 5 days of treatment. Higher percentages of reduction after 10 days of treatment were 33.4, 61.4 and 77.5% and 0.0% in the check treatment, respectively.

### (C):Efficiency of *C. septempunctata* and *V. lecanii*:

Moreover, by treated snap bean plants by *V. lecanii* spore suspensions and the predator releases, higher percentages of reduction were obtained on the 10 days of treatment and the predator releases, followed by the seventh day, and fifth days of treatment of the predator releases, were 65.2, 74.5 and 98.2, and45.5, 60.4 and 89.7, and 30.5, 48.2 and 80.4 and 0.0% in the check treatment.

### (D):Efficiency of selecron:

In the treatment of selecron insecticide, higher percentages of reduction were recorded on the fives day of spraying at the concentrations of 0.75, 1.0 and 1.25 ml / l, followed by the third day and lastly the first day of treatment as were 45.8, 65.4 and 91.4%, respectively while it was 0.0% in the control. (Table1). respectively.

Calculated $LC_{50s}$ of the entomopathogen after first, third and the fifth days of spraying were 3 $x10^7$, 2 x $10^7$ and 1.4 x $10^6$ spores / ml., while they were 0.995, 0.877 and 0.802 ml. / l in the selecron respectively.

Statistical analysis of the obtained data showed significant differences in suppressing *A. crccivora* infested snap bean plants after the third, the seventh and the tenth of the treatment.

## (2): Field application effects:

### (A): Efficiency of *C. seotempunctata:*

Percentage of infestation of *A. craccivora* just before the first release of the predator, *C. septempunctata* ranged between 83 and 95 %, with a population of 222 and 455 / 15 leaves. These values amounted 95 % leaves infestation and 455 per 15 leaves in the control, (Table 2). After the release of first predator release on Mar. 2nd 2012, population of *A. craccivora* slightly increased on both release and non– release plants. High Aphid populations were observed after the second and the third predator releases on March 2nd and 17th, with a comparatively high population on untreated plants. The initial high density of *A. craccivora* before releasing the predator individuals might be the reason of this high population. These findings agree with those obtained by Biswas *et al*., 2008. Then the population of *A. craccivora* decreased noticeably in the release treatment from 17th March for the treatments of 2 releases, 4 releases and 6 releases until the end of the experiment, while increased in the control.

Table 1

**Table 2. Efficiency of *Coccinella sepetmpunctata* on snap bean plants for controlling *Aphis craccivora* under field conditions.**

| Sampling date | Treatments | No of *A. craccivora*/ replicate | Leaves infestation % | Reduction of *A. craccivora* % | No of *C. punctata* / replicate |
|---|---|---|---|---|---|
| Feb. 15, 2012* | A(2releases) | 222 | 88 | - | - |
| | B (4releases) | 288 | 83 | - | - |
| | C (6releases) | 305 | 90 | - | - |
| | D (no releases) | 455 | 95 | - | - |
| Mar. 2, 2012** | A(2releases) | 229 | 86 | 20 | 12 |
| | B (4releases) | 290 | 83 | 22 | 16 |
| | C (6releases) | 301 | 87 | 23 | 20 |
| | D (no releases) | 590 | 97 | - | 0 |
| Mar. 17, 2012 | A(2releases) | 200 | 97 | 39 | 22 |
| | B (4releases) | 260 | 99 | 39 | 29 |
| | C (6releases) | 250 | 100 | 45 | 32 |
| | D (no releases) | 672 | 100 | - | 0 |
| Apr. 2, 2012 | A(2releases) | 200 | 100 | 50 | 45 |
| | B (4releases) | 230 | 100 | 55 | 55 |
| | C (6releases) | 212 | 100 | 61 | 72 |
| | D (no releases) | 812 | 100 | - | 0 |
| Apr. 17, 2012 | A(2releases) | 196 | 100 | 68 | 47 |
| | B (4releases) | 222 | 100 | 72 | 62 |
| | C (6releases) | 192 | 100 | 77 | 72 |
| | D (no releases) | 1250 | 100 | - | 0 |
| May. 3, 2012 | A(2releases) | 195 | 100 | 69 | 51 |
| | B (4releases) | 220 | 100 | 73 | 64 |
| | C (6releases) | 190 | 100 | 78 | 75 |
| | D (no releases) | 1305 | 100 | - | 3 |
| May. 18, 2012 | A(2releases) | 190 | 55 | 71 | 10 |
| | B (4releases) | 210 | 52 | 78 | 11 |
| | C (6releases) | 184 | 45 | 80 | 14 |
| | D (no releases) | 1355 | 100 | - | 4 |
| Jun. 3, 2012 | A(2releases) | 105 | 37 | 77 | 12 |
| | B (4releases) | 95 | 32 | 84 | 13 |
| | C (6releases) | 82 | 27 | 87 | 15 |
| | D (no releases) | 955 | 100 | - | 4 |
| Jun. 18, 2012 | A(2releases) | 84 | 27 | 82 | 12 |
| | B (4releases) | 66 | 20 | 89 | 14 |
| | C (6releases) | 59 | 16 | 91 | 17 |
| | D (no releases) | 950 | 92 | - | 5 |

* Data of the first predator release and represents pre- count.
**Data of second predator release and represents first post- count.

Percentage of infested leaves with *A. craccivora* increased after the second and the third predator releases to reach 100% in both release and non-release (control). Then, infestation gradually declined in the treated plants to reach 16 - 27% on June 18th, and continued at 100% in the control.

Data in table (2). indicated that all the predator release rates affected *A. craccivora.* After the first release on March 2nd 2012, reduction of the *A. craccivora* population was 20, 22 and 23%, then increased after the second release to reach 39, 39 and 45% in the treatments A, B and C, respectively. It appeared that the predator individuals were taking comparatively. too long time to achieve control. These findings agree with those obtained by Kalushkov and Hodek 2004. Also, reduction increase continued from March to the end of the experiment in June to reach 82, 89 and 91% reduction in the treatments A, B and C, in 18th of June, respectively.

Population of *C. septempunctata* was 12, 16 and 20 / replicate after the first release in treatments A, B and C, respectively. The highest predator increase was observed after the fifth release to be 51, 64 and 75 predator per replicate, respectively.

## (B): Efficiency of *C. septepunctata* and *V. lecanii*:

On the other hand, percentage of infestation with *A. craccivora* before applying of *V. lecanii* spores suspension on the first release of the predator, *C. septempunctata* ranged between 80 and 93 % , with Aphid population of 201, and 490 / 15 leaves. (Table 2). These values amounted 93 % leaves infestation and 490 per 15 leaves in the control treatment. After the first predator release, on Mar. 2nd , 2012, population of *A. craccivora* slightly increased on both release and non– release plants. High Aphid populations were observed after the first release on March 2nd with a comparatively high population on untreated plants, (Table 3).

The initial high density of *A. craccivora* before releasing the predator individuals with *V. lecanii* might be the reason of this high population. Obtained data were in agreement with the findings of Sahayaraj and Namachivayam 2007 and 2011 who reported that *V. lecanii* at the concentration of $10^8$ spores / ml.suppressed 62% of *A. craccivora* population mortality increased when fungal spore concentration and exposure time increased. *V. lecanii* was most virulent to *A. craccivora..* Singh and Meghwal 2010 evaluated the efficacy of *C. septempunctata* 5, 000 beetles/ha and *V. lecanii* spores suspension at $10^8$ spores per ml and recorded a reduction of 86.60% aphid population after 10 days of release, followed by *V. lecanii* (74.23%).

Saranya and Ushakumari (2011) also reported that *V. lecanii* achieved 90% mortality at the concentration of $10^8$ spores/ ml.

Percentage of infested leaves with *A. craccivora* increased after the first predator release to reach 100% in both release and non-release (control). Then, infestation gradually declined in the treated plants to reach 8- 15% on June 18th and while continued at the level of 100% in the control.

Obtained data in table (3). shows that all treated snap bean plants with *V. lecanii* and the predator release rates affected *A. craccivora.* after the first release on March 2nd 2012, reduction of the *A. craccivora* population was 25, 25 and 35% and increased after the second release to reach 52, 54 and 65% in the treatments A, B and C, respectively. The reduction percentages increased from March to the end of the experiment on June to reach 87, 92 and 98% in the treatments A, B and C, respectively.

## (C):Efficiency of selecron:

Meanwhile, selecron insecticide was recommended against sucking insect pests, data in table (4). shows that the percentage of infestation of *A. craccivora* just before treatment, and the percent of leaves infestation ranged between 85 and 94 %, an Aphid population of 226 and 477 / 15 compound leave plants. These values amounted 94 % leaves infestation and 477 per 15 compound leaves in the check treatment, table (4). After the first treatment on Mar. 2nd , 2012, population of *A. craccivora* were decreased in the treatment to reach 135, 123 and 125 and 877 in the check. The reduction percentages decreased till the end of the treatment on 15th of June to reach 22, 20 and 12 in the treatments A, B and C, respectively.

**Table 3. Efficiency of *Coccinella septempunctata* and *Verticillium lecanii* on snap bean plants against *Aphis craccivora* under field conditions.**

| Sampling date | Treatments | No of *A. craccivora*/ replicate | Leaves infestation % | Reduction of *A. craccivora* % | No of *C. punctata* / replicate |
|---|---|---|---|---|---|
| Feb. 15, 2012* | A(2releases) +2x0.75x $10^6$ | 201 | 84 | - | - |
| | B (4releases) +2x $10^7$ | 210 | 80 | - | - |
| | C (6releases)+ 2x1.25x$10^8$ | 309 | 92 | - | - |
| | D (no releases) (control) | 490 | 93 | - | - |
| Mar. 2, 2012** | A(2releases)+2x0.75x $10^6$ | 209 | 87 | 25 | 8 |
| | B (4releases) + 2x $10^7$ | 222 | 85 | 25 | 12 |
| | C (6releases)+2x1.25x$10^8$ | 280 | 88 | 35 | 14 |
| | D (no releases) (control) | 690 | 98 | - | 0 |
| Mar. 17, 2012 | A(2releases)+ 2x0.75x $10^6$ | 178 | 95 | 52 | 13 |
| | B (4releases) + 2x $10^7$ | 175 | 99 | 54 | 16 |
| | C (6releases)+ 2x1.25x$10^8$ | 199 | 100 | 65 | 19 |
| | D (no releases) (control) | 895 | 100 | - | 0 |
| Apr. 2, 2012 | A(2releases)+ 2x0.75x $10^6$ | 165 | 100 | 60 | 14 |
| | B (4releases) + 2x $10^7$ | 154 | 100 | 64 | 17 |
| | C (6releases)+ 2x1.25x$10^8$ | 168 | 100 | 73 | 22 |
| | D (no releases) (control) | 999 | 100 | - | 5 |
| Apr. 17, 2012 | A(2releases)+ 2x0.75x $10^6$ | 154 | 82 | 67 | 15 |
| | B (4releases) + 2x $10^7$ | 133 | 65 | 72 | 19 |
| | C (6releases)+ 2x1.25x$10^8$ | 125 | 60 | 82 | 22 |
| | D (no releases) (control) | 1130 | 100 | - | 8 |
| May. 3, 2012 | A(2releases)+ 2x0.75x $10^6$ | 131 | 65 | 72 | 5 |
| | B (4releases) + 2x $10^7$ | 122 | 54 | 75 | 8 |
| | C (6releases)+ 2x1.25x$10^8$ | 111 | 50 | 85 | 10 |
| | D (no releases) (control) | 1175 | 100 | - | 5 |
| May. 18, 2012 | A(2releases)+ 2x0.75x $10^6$ | 102 | 60 | 77 | 11 |
| | B (4releases) + 2x $10^7$ | 98 | 52 | 79 | 11 |
| | C (6releases)+ 2x1.25x$10^8$ | 88 | 45 | 87 | 12 |
| | D (no releases) (control) | 1100 | 100 | - | 5 |
| Jun. 3, 2012 | A(2releases)+ 2x0.75x $10^6$ | 75 | 37 | 81 | 7 |
| | B (4releases) + 2x $10^7$ | 65 | 32 | 84 | 9 |
| | C (6releases)+ 2x1.25x$10^8$ | 53 | 27 | 91 | 10 |
| | D (no releases) (control) | 955 | 100 | - | 5 |
| Jun. 18, 2012 | A(2releases)+ 2x0.75x $10^6$ | 44 | 15 | 87 | 8 |
| | B (4releases) + 2x $10^7$ | 32 | 10 | 92 | 9 |
| | C (6releases)+ 2x1.25x$10^8$ | 10 | 8 | 98 | 14 |
| | D (no releases) (control) | 895 | 92 | - | 7 |

* Data of the first predator release and represents pre- count.

**Data of second predator release and represents first post- count.

**Table 4. Efficiency of slecron insecticide against *Aphis craccivora* infesting snap bean plants under field conditions.**

| Sampling date | Treatments | No of *A. craccivora*/ replicate | Leaves infestation % | Reduction of *A. craccivora* % | No of *C. punctata* / replicate |
|---|---|---|---|---|---|
| Feb. 15, 2012* | A(2 x 0.75 L) | 235 | 87 | - | - |
| | B (2 x 1 L.) | 277 | 85 | - | - |
| | C (2 x 1.25 L.) | 226 | 91 | - | - |
| | D (control) | 577 | 94 | - | - |
| Mar. 2, 2012** | A(2 x 0.75 L) | 135 | 88 | 63 | 3 |
| | B (2 x 1 L.) | 123 | 84 | 64 | 3 |
| | C (2 x 1.25 L.) | 125 | 88 | 64 | 6 |
| | D (control) | 887 | 97 | - | 0 |
| Mar. 17, 2012 | A(2 x 0.75 L) | 120 | 97 | 68 | 4 |
| | B (2 x 1 L.) | 103 | 99 | 71 | 5 |
| | C (2 x 1.25 L.) | 98 | 100 | 72 | 6 |
| | D (control) | 910 | 100 | - | 0 |
| Apr. 2, 2012 | A(2 x 0.75 L) | 93 | 100 | 75 | 7 |
| | B (2 x 1 L.) | 85 | 100 | 77 | 7 |
| | C (2 x 1.25 L.) | 70 | 100 | 81 | 9 |
| | D (control) | 925 | 100 | - | 0 |
| Apr. 17, 2012 | A(2 x 0.75 L) | 80 | 100 | 79 | 7 |
| | B (2 x 1 L.) | 66 | 100 | 82 | 8 |
| | C (2 x 1.25 L.) | 55 | 100 | 85 | 14 |
| | D (control) | 945 | 100 | - | 3 |
| May. 3, 2012 | A(2 x 0.75 L) | 70 | 100 | 81 | 8 |
| | B (2 x 1 L.) | 55 | 100 | 85 | 6 |
| | C (2 x 1.25 L.) | 50 | 100 | 86 | 11 |
| | D (control) | 950 | 100 | - | 3 |
| May. 18, 2012 | A(2 x 0.75 L) | 58 | 55 | 85 | 8 |
| | B (2 x 1 L.) | 41 | 52 | 89 | 7 |
| | C (2 x 1.25 L.) | 35 | 45 | 91 | 6 |
| | D (control) | 956 | 100 | - | 5 |
| Jun. 3, 2012 | A(2 x 0.75 L) | 32 | 37 | 89 | 10 |
| | B (2 x 1 L.) | 95 | 32 | 92 | 10 |
| | C (2 x 1.25 L.) | 25 | 27 | 93 | 8 |
| | D (control) | 966 | 100 | - | 9 |
| Jun. 18, 2012 | A(2 x 0.75 L) | 22 | 27 | 94 | 4 |
| | B (2 x 1 L.) | 20 | 20 | 95 | 9 |
| | C (2 x 1.25 L.) | 12 | 16 | 97 | 8 |
| | D (control) | 970 | 92 | - | 6 |

* Data of the first predator release and represents pre- count.
**Data of second predator release and represents first post- count.

Reduction percentages in *A. craccivora* were 63, 64 and 64% after the first application on March 2nd, 2012 and decreases after every application to reach 94, 95 and 97% on June 18th.

The present results proved that both the predator, *C. septempunctata* and *V. lecanii* achieved higher mortality of *A. craccivora* on commercial snap bean production.

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# تأثير إطلاق المفترس *Coccinella septempunctata* والممرض الحشري *Verticillium lecanii* كوسيلة لخفض تعداد المن *Aphis craccivora* في زراعات الفاصوليا

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معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الجيزة – دقي

## الملخص العربي

في تجربة معملية تم إطلاق المفترس *Coccinella septempunctata* بمعدل مفترس واثنان وثلاثة لكل نبات مصاب بحشرة المن *Aphis craccivora* علي حدة لمدة يوم ويومان وثلاثة أيام. دلت النتائج علي أن النسبة المئوية للإفتراس في اليوم الخامس كانت أعلي عند إطلاق ثلاثة مفترسات لكل نبات من مثيلاتها في اليوم الخامس عند إطلاق مفترسان أو مفترس لكل نبات حيث كانت النسبة المئوية للإفتراس ٩٥.٨ و٧٧.٥ و٤٨.٢% علي الترتيب. كما أن معاملة المن بفطر *Verticillium lecanii* عند تركيز $10^{8}$ جراثيم / مل كانت النسبة المؤية للتطفل في اليوم الخامس أعلي من مثيلاتها عند تركيز $10^{7}$ و $10^{6}$ جراثيم / مل حيث كانت ٧٧.٥ و٦١.٤ ٣٣.٤ %. وفي معاملة المن بفطر *V. lecanii* عند تركيز $10^{8}$ جراثيم / مل مع إطلاق عدد خمس مفترسات / نبات بعد مرور خمسة أيام كانت النسبة المؤية للتطفل والإفتراس أعلي من مثيلاتها عند تركيز $10^{7}$ جراثيم / مل + ٥ مفترسات و $10^{6}$ جراثيم / مل + ٥ مفترسات حيث كانت النسبة المؤية للتطفل والإفتراس هي ٩٨.٢ و ٧٤.٥ و ٦٥.٢ %. وفي معاملة المبيد الكيماوي سليكرون كانت النسة المؤية للموت هي ٩١.٤ و ٦٥.٤ و٤٥.٨ % بعد مرور خمسة أيام مقارنة بالكونترول.

في التجربة الحقلية دلت النتائج علي أن إطلاق المفترس ستة إطلاقات بمعدل ١٠ مفترس للإطلاقة الواحدة / ١٥ يوما تراوحت النسبة المئوية للإفتراس من ٢٠% إلي ٩١ % في الفترة من ٢ مارس إلي ١٨ يونيو ٢٠١٢ . بينما كانت النسبة المئوية للموت باستخدام المبيد سليكرون هي ٦٣ – ٩٧ %.

**Table (1): Efficiency of *Coccinella septempunctata*, *Verticillium lecanii* and selecron insecticide against *Aphis craccivora* on snap bean plants under laboratory conditions.**

| Con. / Pest | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Aphis craccivora* | *C. septempunctata* | | | | | | | | | | | | | | | |
| | 1Predator / plant | | | | 2 / plant | | | 3 / plant | | | Control | | | L C $_{50}$ / 95% | | |
| | Exposure period | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 |
| | % predatism | 20.4 | 31.5 | 48.2 | 41.2 | 63.2 | 77.5 | 55.7 | 80.8 | 95.8 | 0.0 | 0.0 | 0.0 | - | - | - |
| | *V. lecanii* | | | | | | | | | | | | | | | |
| | $10^6$ | | | | $10^7$ | | | $10^8$ | | | control | | | $LC_{50}$ | | |
| | Exposure period | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 |
| | Death rate | 15.4 | 22.5 | 33.4 | 20.2 | 30.8 | 61.4 | 25.6 | 35.6 | 77.5 | 0.0 | 0.0 | 0.0 | $3x10^7$ | $2x10^7$ | $1.4x10_6$ |
| | *C. septempunctata* + *V. lecanii* | | | | | | | | | | | | | | | |
| | *C. septempunctata* + *V. lecanii* $10^6$ | | | | *C. septempunctata* + *V. lecanii* $10^7$ | | | *C. septempunctata* + *V. lecanii* $10^8$ | | | control | | | $Lc_{50}$ | | |
| | Exposure period | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 |
| | Death rate | 30.5 | 45.5 | 65.2 | 48.2 | 60.4 | 74.5 | 80.4 | 89.7 | 98.2 | 0.0 | 0.0 | 0.0 | - | - | - |
| | selecron | | | | | | | | | | | | | | | |
| | 0.75 L. | | | | 1 L. | | | 1.25 L. | | | Control | | | $LC_{50}$ | | |
| | Exposure period | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 | 1 | 3 | 5 |
| | Death rate | 25.6 | 35.2 | 45.8 | 45.8 | 59.5 | 65.4 | 74.2 | 86.6 | 91.4 | 0.0 | 0.0 | 0.0 | 0.995 | 0.877 | 0.802 |
| | L.S.D. 5% | 1.54 | 1.41 | 0.92 | 0.63 | 1.52 | 0.79 | 1.78 | 2.51 | 0.96 | - | - | - | - | - | - |

**N.B:** 100 individuals of *C. craccivora* per plant were exposed.