



Department of Plant Protection  
Faculty of Agriculture  
University of Damanshur



**ECOLOGICAL AND BIOLOGICAL  
STUDIES ON CERTAIN POTATO PESTS AND  
THEIR CONTROL**

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By

**Asmaa Anwer Abdel-Maksoud Khalaf Allah**  
B.Sc. (Plant Protection)  
Faculty of Agriculture, Damanshur University

Department of Plant Protection  
Faculty of Agriculture  
Damanshur University

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## ENGLISH SUMMARY

Potato is a highly nutritious food which provides us with carbohydrates, proteins, minerals, vitamins (C & B) and high quality of dietary fibers. Potato is the fifth most economically important crop in the world. Egypt produces 2.6 million metric tons of potatoes and exports 411.000 metric tons to Europe and some Arab countries. Potato crop is subjected to be attacked with many insect-pest species, in particular the potato tuber moth *Phthorimaea operculella* (Zeller), Aphids *Myzus persicae*, whiteflies *Bemisia tabaci*, thrips *Thrips tabaci*, Aphid lion *Chrysoperla carnea*, *Coccinella undecimpunctata*.

In the present field trials were conducted to survey the main prevailing insect-pests and /or beneficial ones on potato plants at Etey- El- Baroud, district, El-Behiera Governorate, Egypt during the elapsing period from November 2015 up to May 2017.

**Therefore, the main objectives of the present conducted study are the following:**

- 1- Survey the main insect pests of potato plant leaves and tubers throughout the elapsed period from December 2015 up to 2017.
- 2- Studying the biological parameters of potato tuber moth *Phthorimaea operculella*
- 3- Studying the impact and effectiveness of certain chemical-and bio-pesticides against the common abundant insect- pests on potato plants.

**The obtained results can be summarized as follows:**

### **1-Survey of the prevailing insects on the growing Potato Plants *Solanum tuberosum* L. (*Solanaceae*)**

It was found that Potato plants are mainly attacked by a large number of insect pests such as potato tuber moth *Phthorimaea operculella* (Zeller), Aphids *Myzus persicae*, whiteflies *Bemisia tabaci*, thrips *Thrips tabaci*, Aphid lion *Chrysoperla carnea*, *Coccinella undecimpunctata*.

#### **1.1- The first winter season, of 2015-2016:**

The mean calculated number of the counted individuals of *Phthorimaea Operculella* /trap/feddan of Cara variety in 1<sup>st</sup> winter was gradually increased from the 1<sup>st</sup> of November (168.00) up to the 2<sup>nd</sup> inspection date (177.75). The mean calculated number of the counted individuals of *Ph.Operculella* /trap/feddan of

Spunta variety in first winter was gradually increased from the 1<sup>st</sup> of November (101.00) up to the 2<sup>nd</sup> inspection date (110.00). The mean calculated number of the counted individuals of *Ph. Operculella* /trap/feddan of Rosetta variety in first winter was gradually increased from the 1<sup>st</sup> of November (53.00). The mean calculated number of the counted individuals of *Myzus Persicae* ( Sulzer) / 15 plants of Cara variety in first winter was gradually increased from the 1<sup>st</sup> of November (11.50) up to the 4<sup>th</sup> inspection date (24.50). The mean calculated number of the counted individuals of *Myzus Persicae* ( Sulzer) / 15 plants of Spunta variety in first winter was gradually increased from the 1<sup>st</sup> of November (7.80) up to the 4<sup>th</sup> inspection date (22.00). The mean calculated number of the counted individuals of *Myzus Persicae* ( Sulzer) / 15 plants of Rosetta variety in first winter was increased from the 1<sup>st</sup> of November (13.50) up to the 3<sup>rd</sup> inspection date (20.30). The maximum number of *Bemisia tabaci* / 15 plants of Cara variety in the first winter were recorded on 15<sup>th</sup> of November and 6<sup>th</sup> of December (32.5). The maximum number of *Bemisia tabaci* / 15 plants of Spunta variety in the first winter were recorded on 22<sup>nd</sup> of November (37.3). The number of *Bemisia tabaci* / 15 plants of Rosetta variety in the first winter were increased on 8<sup>th</sup> and 2<sup>9th</sup> of November (32.3). The calculated mean number of *Chrysoperla carnea* / 15 plants of Cara variety in the 1<sup>st</sup> winter season was rather low or absent all over the inspection periods of winter growing season. The mean number of the inspected individuals of *Chrysoperla carnea* / 15 plants of Spunta variety in the 1<sup>st</sup> winter season was obviously low during November then increased to (1.0) in December. The mean number of the inspected individuals of *Chrysoperla carnea* / 15 plants of Rosetta variety in the 1<sup>st</sup> winter season was rather low all over the inspection periods of winter growing season. The mean calculated number of the counted individuals of *Coccinella undecimpunctata* / 15 plants of Cara and Spunta variety in the first winter season was negligible or absent all over the winter growing season. The mean number of the inspected individuals of *Coccinella undecimpunctata* / 15 plants of Rosetta variety in the first winter season was ratherly low all over the inspection periods of winter growing season.

### **1-2- The first summer season, of 2016:**

The mean calculated number of the counted individuals of *Phthorimaea operculella* /trap/feddan of Cara variety increased from the 13<sup>th</sup> of November (75.75) up to the 10<sup>th</sup> of April (419.5). The mean calculated number of the counted

individuals of *Phthorimaea operculella* /trap/feddan of Spunta variety in the first summer season was noticed on first inspection date of February (21.5). The maximum number of *Phthorimaea* /trap/feddan of Rosetta variety in the first summer season were recorded on the 10<sup>th</sup> and 17<sup>th</sup> on April (272.00 and 258.8) respectively. The mean number of inspected individuals of *Myzus persicae* / 15 plants of Cara variety was obviously high during the period from February to April. The calculated mean number of *Myzus persicae* / 15 plants of Spunta variety was gradually increased from (29.80) to (31.30) on the 21 and 28<sup>th</sup> of February respectively. The calculated mean number of *Myzus persicae* / 15 plants of Rosetta variety in 1<sup>st</sup> summer season were increased on 21<sup>st</sup> and 13<sup>th</sup> of February and March that were (28) and (28.3) respectively. The maximum number of *Bemisia tabaci* / 15 plants of Cara variety in the first summer were recorded on 28<sup>th</sup> of February and 13<sup>th</sup> of March (52.3). The maximum number of *Bemisia tabaci* / 15 plants of Spunta variety in the first summer were recorded on 21<sup>st</sup> of February and 13<sup>th</sup> of March (53.5). The maximum number of *Bemisia tabaci* / 15 plants of Rosetta variety in the first summer were recorded on 28<sup>th</sup> of February and 27<sup>th</sup> of March (54.5). The calculated number of *Thrips tabaci* / 15 plants of Cara variety in first summer season was increased on 28<sup>th</sup> and 13<sup>th</sup> of February and March (50.3 and 49.8) respectively. The calculated mean number of *Thrips tabaci* / 15 plants of Spunta variety in first summer season were found gradually increased from 3<sup>rd</sup> week up to the end 2<sup>nd</sup> week of March (35.00, 40.8, 45.00, 49.3, and 49.3). The maximum number of *Thrips tabaci* / 15 plants of Rosetta variety in the first summer season were recorded on 27<sup>th</sup> of March and 3<sup>rd</sup> of April (45.0 and 45.8) respectively. The mean number of *Chrysoperla carnea* / 15 plants of Cara variety in the 1<sup>st</sup> summer season were rather low or absent all over the inspection periods. The mean number of *Chrysoperla carnea* / 15 plants of Spunta variety in the 1<sup>st</sup> summer season were rather low or absent all over the inspection periods. The maximum number of *Chrysoperla carnea* / 15 plants of Rosetta variety in the 1<sup>st</sup> summer season were recorded on 13<sup>th</sup> of March (1.5) to the 24<sup>th</sup> of April (0.5). the mean number of counted individuals of *Coccinella undecimpunctata* / 15 plants of Cara variety in the 1<sup>st</sup> summer season was noticed on the 1<sup>st</sup> inspection date of February (0.25). The maximum number of *Coccinella undecimpunctata* / 15 plants of Spunta variety in the 1<sup>st</sup> summer season were recorded on 14<sup>th</sup> and 28<sup>th</sup> of February and also on 13<sup>th</sup> of March and 3<sup>rd</sup> of April (0.75). The maximum number of

*Coccinella undecimpunctata* / 15 plants of Rosetta variety in the 1<sup>st</sup> summer season were recorded on 28<sup>th</sup> of February and 13<sup>th</sup> of March (1.00).

### **1-3 The second winter season, of 2016-2017:**

The maximum number of *Ph. operculella* /trap/feddan of Cara variety in the second winter season were recorded in the second inspection period of November (165.5). The maximum number of *Ph. operculella* /trap/feddan of Spunta variety in the second winter season were recorded in the second inspection period of November (107.5). The calculated number of *Ph. operculella* /trap/feddan of Rosetta variety in the second winter were found gradually decreased from the 2<sup>nd</sup> week up to the 3<sup>rd</sup> inspection period of January (64.3, 55.0, 45.0, 33.5, 22, 13.5, 8.30 and 3.30). The mean calculated number of the counted individuals of *Myzus persicae* (Sulzer) / 15 plants of Cara variety in the second winter season increased from the first of November (7.5) up to the 6<sup>th</sup> inspection date (24.5). The mean calculated number of the counted individuals of *Myzus persicae* (Sulzer) / 15 plants of Spunta variety in the second winter season increased from the second inspection period of November (7.5) up to the 13<sup>th</sup> in date of December (24.75). The mean calculated number of the counted individuals of *Myzus persicae* (Sulzer) / 15 plants of Rosetta variety in the second winter season increased from the second inspection period of November (9.5) up to the 22<sup>th</sup> in date of November (17.5). The maximum number of *Bemisia tabaci* / 15 plants of Cara variety in the 2<sup>nd</sup> winter season were recorded on 22<sup>nd</sup> of November and 6<sup>th</sup> of December (36.3). The maximum number of *Bemisia tabaci* / 15 plants of Spunta variety in the 2<sup>nd</sup> winter season were recorded on 22<sup>nd</sup> of November and 13<sup>th</sup> of December (45.0). The maximum number of *Bemisia tabaci* / 15 plants of Rosetta variety in the 2<sup>nd</sup> winter season were recorded on the 2<sup>nd</sup> and 4<sup>th</sup> inspection period of November (37.5). The maximum number of *Chrysoperla carnea* / 15 plants of Cara variety in the 2<sup>nd</sup> winter season was noticed on 13<sup>th</sup> December (0.75). The maximum number of *Chrysoperla carnea* / 15 plants of Spunta variety in the 2<sup>nd</sup> winter season were recorded on 6<sup>th</sup> of December (1.25). The maximum number of *Chrysoperla carnea* / 15 plants of Rosetta variety in the 2<sup>nd</sup> winter season were recorded on 20<sup>th</sup> of December (1.00). The mean calculated number of the counted individuals of *Coccinella undecimpunctata* / 15 plants of Cara, Spunta and Rosetta variety in the 2<sup>nd</sup> winter season was negligible or absent all over the winter growing season.

#### 1-4 - The second summer season, of 2017:

the mean calculated number of the counted individuals of *phthorimaea operculella* /trap/feddan of Cara variety in the 2<sup>nd</sup> summer was increased from the 7<sup>th</sup> of February (33.3) up to the 17<sup>th</sup> of April (446.75). The mean calculated number of the counted individuals of *phthorimaea operculella* /trap/feddan of Spunta variety in the 2<sup>nd</sup> summer season was noticed on 1<sup>st</sup> inspection date of February (26.3). The maximum number of *phthorimaea operculella* /trap/feddan of Rosetta variety in the 2<sup>nd</sup> summer season were recorded on 17<sup>th</sup> of April. The maximum number of *Myzus persicae* / 15 plants of Cara variety in 2<sup>nd</sup> summer season was recorded on 27<sup>th</sup> of March (47.0). The number of *Myzus persicae* / 15 plants of Spunta variety in 2<sup>nd</sup> summer season were increased on 28<sup>th</sup> of February and 13<sup>th</sup> of March (37.8 and 37.5) respectively. The number of *Myzus persicae*/ 15 plants of Rosetta variety in 2<sup>nd</sup> summer season were increased on 27<sup>th</sup> of March and 3<sup>rd</sup> of April (32.0). The maximum number of *Bemisia tabaci* / 15 plants of Cara variety in 2<sup>nd</sup> summer season was gradually increased from the 1<sup>st</sup> inspection period of February to the 1<sup>st</sup> inspection period of March (35.5 to 53.3) respectively. The mean calculated number of the counted individuals of *Bemisia tabaci* / 15 plants of Spunta variety in the 2<sup>nd</sup> summer season was gradually increased from the 1<sup>st</sup> inspection period of February to the 2<sup>nd</sup> inspection period of March (16.3 to 62.5) respectively. The maximum number of *Bemisia tabaci* / 15 plants of Rosetta variety in the 2<sup>nd</sup> summer season was recorded on 21<sup>st</sup> of February and 13<sup>th</sup> of March (55.0). The calculated number of *Thrips tabaci* / 15 plants of Cara variety in the 2<sup>nd</sup> summer season was increased on 27<sup>th</sup> of March and 3<sup>rd</sup> of April (43.8 and 42.5) respectively. The calculated mean number of *Thrips tabaci*/ 15 plants of Spunta variety in the 2<sup>nd</sup> summer season were found gradually increased from 1<sup>st</sup> week of February up to 13<sup>th</sup> of March (17.8, 24.8, 28.3, 34.8, 35.5 and 40.3). The mean calculated number of counted individuals of *Thrips tabaci*/ 15 plants of Rosetta variety in the 2<sup>nd</sup> summer season were gradually increased from 7<sup>th</sup> of February (19.8) up to the 1<sup>st</sup> inspection period (52.5). The mean number of *Chrysoperla carnea* / 15 plants of Cara variety in the 2<sup>nd</sup> summer season were low or absent all over the winter growing season. The maximum number of *Chrysoperla carnea* / 15 plants of Spunta variety in the 2<sup>nd</sup> summer season was recorded on 13<sup>th</sup> of March (2.00). The maximum number of *Chrysoperla carnea* / 15 plants of Rosetta variety in the 2<sup>nd</sup> summer season were recorded on 28<sup>th</sup> of February (2.25). The maximum number of *Coccinella undecimpunctata* / 15 plants of Cara variety in the

2<sup>nd</sup> summer season were recorded on 6<sup>th</sup> and 20<sup>th</sup> of March (0.75). The maximum number of *Coccinella undecimpunctata* / 15 plants of Spunta variety in the 2<sup>nd</sup> summer season were recorded on 13<sup>th</sup> of March (1.25). The mean number of *Coccinella undecimpunctata* / 15 plants of Rosetta variety in the 2<sup>nd</sup> summer season were low all over the inspection periods.

## **2- Studying the biological parameters of potato tuber moth *Phthorimaea operculella*:**

### **2-1 The biological parameters of *Ph. operculella* on three potato varieties:**

There were significant different between the average of the incubation period of egg obtained from adults reared on potato variety, Rosetta and those reared on the potato varieties Cara and Spunta. The averages were 5.50, 4.02 and 4.72 for Rosetta, Cara and Spunta respectively, whereas no significant difference were observed in the incubation period of egg between the two varieties Cara and Spunta. The highest value hatchability percentage was 85% which obtained when larvae fed on Kara and Spunta varieties followed by Rosetta variety with a value of 86%. Feeding on both Cara and Spunta significantly reduced larval duration with averages of (14.04 and 14.02) comparing with feeding on Rosetta variety which recorded an average of (18.07). There were significant different in pupal duration which reared on the potato varieties Cara, Spunta and Rosetta with averages of 9.22, 10.68 and 12.23' respectively. There were significant different in the averages of emergence percentage of adults which reared as larvae on the potato varieties Cara, Spunta and Rosetta with an averages of 81, 78 and 80%, respectively. There are no significant difference in the number of males (♂) between three varieties of potato Cara, Spunta and Rosetta, while there are significant different in the number of females (♀) obtained from larvae reared on potato variety, Spunta and those reared on the potato varieties Cara and Rosetta with averages of 3.50, 3.80 and 3.80, respectively. Female fecundity of female was affected by the different potato varieties, thus, female fecundity decreased from 113.30 eggs on Cara variety to 94.40 eggs on Spunta variety, and to 82.95 eggs on Rosetta varieties, respectively. The obtained results showed that feeding on Cara variety prolonged the longevity period of mated female (22.30 days) comparing with Spunta and Rosetta varieties with an averages of 18.10 and 18.40 days respectively.

## **2-2 The life table parameters of *Phthorimaea operculella* on three potato varieties:**

The potato variety Cara demonstrated the highest net reproductive rate ( $R_0$ ) (37.7 eggs/female) followed by Spunta variety (22.7 eggs/female) and Rosetta variety (16 eggs/female). The average generation duration ( $G_t$ ) was obviously the longest (40.9 days) for the larvae of PTM fed on Spunta variety. The shortest generation duration (35.9 days) was obtained when larvae were fed on Cara variety. Meanwhile, generation duration was (37.8 days) when larvae were fed on Rosetta variety. Population intrinsic rates ( $r_m$ ) decreased from 0.46, to 0.18 individuals/female/day when larvae were fed on Cara, and Rosetta varieties, while a moderate value of intrinsic rate of increase (0.24 individuals/ female/day) was obtained when the larvae were reared on Spunta variety. The aforementioned results confirmed that Cara variety demonstrated the highest degree of variety suitability and was verified by  $R_0$ ,  $G_t$  and  $r_m$  values. Cara variety is the most preferred variety for PTM when population– doubling time was considered. Female fecundity ( $M_x$ ) recorded 7.8, 6.2 and 5.6 for Cara, Rosetta and Spunta, respectively. The highest finite rate of increase ( $\lambda$ ) of PTM was obtained for Cara variety with a value of 1.58 individuals/ female/day and accordingly considered as the most preferred feeding source. The lowest preferred host plant in this respect was Rosetta variety. In general, the calculated biological parameters viz.  $R_0$ ,  $G_t$ ,  $r_m$ ,  $\lambda$  and  $D_t$  indicate that Cara variety appeared to be the quite favorable for achieving the highest developmental and multiplication rates of *Ph. operculella*, followed by Spunta and Rosetta which were the least favorable in this respect. The natural mortality data figures for larvae reared on Cara variety were 23.14, 19.67 and 2.4%, respectively, the natural mortality data figures for larvae reared on Spunta variety were 25, 21 and 2.39 for AM, RM and log population, respectively. The natural mortality data figures for larvae reared on Rosetta variety were 19.9, 16.33 and 2.39 for AM, RM and log population, respectively. For pupae similar natural mortality trends were observed when *Ph. operculella* larvae were fed on Cara, Spunta varieties with values of 17.35, 11.33 and 2.29, 10.6, 6.7 and 2.27%, respectively, while the corresponding values of 19.3, 12.66 and 2.29% were obtained for Rosetta variety.



**2- Studying the impact and effectiveness of certain chemical- and bio-pesticides against the common abundant insect- pests on potato plants.**

**3-1- Chemical applications in the growing season of 2018 and 2019 for controlling potato tuber moth after 1<sup>st</sup> and 2<sup>nd</sup> sprays:-**

In our present investigation, different compounds belonging to different groups were choice to be involved in the IPM program for controlling potato tuber moth *Phthorimaea operculella*. The efficacy of each of the following insecticides: Emamectin benzoate ( Ematox 2%), Spinosad (Tracer 24%), Bacillus thuringiensis (BT) (Dipel 6.4% DF) and Methomyl (Methomax 90% SP) were evaluated on potato plants under field conditions.

**3-1-1-Efficacy of tested insecticides during summer cultivation of season 2018 against the potato tuber moth *Phthorimaea operculella*:-**

The superior efficient toxic effect of tested chemical compounds was revealed for Methamox after 1<sup>st</sup> and 2<sup>nd</sup> sprays resembled by a general mean of reduction (73.5%) and (70.48%) respectively. Ematox, Tracer and Dipel indicated less efficient control against the insect after 1<sup>st</sup> spray with a general means of reduction comprised (51.98%, 41.22% and 39.28%) respectively, compared to that calculated general means of reduction after 2<sup>nd</sup> spray (54.69%, 59.34% and 55.3%) respectively.

**3-1-2-Efficacy of tested insecticides during summer cultivation of season 2019 against the potato tuber moth *Phthorimaea operculella*:-**

The superior efficient toxic effect of tested chemical compounds was revealed for Methamox after both of the performed 1<sup>st</sup> and 2<sup>nd</sup> sprays; resembled by general means of reduction amounted to 70.41% and 80.67% respectively. Ematox indicated more efficient control against the insect after 1<sup>st</sup> spray with a general mean of reduction comprised (60.59%) compared to that calculated general mean of reduction after 2<sup>nd</sup> spray (53.60%). Tracer and Dipel indicated less efficient control against the insect after 1<sup>st</sup> spray with general means of reduction comprised (35.62% and 52.22%)

respectively compared to that calculated general mean of reduction after 2<sup>nd</sup> spray (49.05% and 54.15%) respectively

### **3-2-Chemical applications in the growing season of 2017 for controlling Aphids and Whitefly:-**

#### **3-2-1-Efficacy of tested insecticides during summer cultivation of season 2017 against the Aphids *Myzus persicae* after the 1<sup>st</sup> and 2<sup>nd</sup> sprays by using three different concentrations of Ematox pesticide:-**

The superior efficient toxic effect of tested concentration was revealed for concentration 12cm<sup>3</sup> after 1<sup>st</sup> and 2<sup>nd</sup> sprays; resembled by a general means of reduction comprising 81.15% and 81.90% respectively. Concentration 3cm<sup>3</sup> indicated more efficient control against the insect after the 1<sup>st</sup> spray with a general mean of reduction comprised (67.61%) compared to that calculated general mean of reduction after the 2<sup>nd</sup> one (63.56%). concentration 6cm<sup>3</sup> showed a less toxic effect in reduction the infestation of assigned insect-pest, after the 1<sup>st</sup> spray with a general mean of reduction comprised (65.43%) compared to that calculated general mean of reduction after the 2<sup>nd</sup> one (68.11%).

#### **3-2-2-Efficacy of tested insecticides during summer cultivation of season 2017 against the Aphids *Myzus persicae* after the 1<sup>st</sup> and 2<sup>nd</sup> sprays by using three different concentrations of Tracer pesticide:-**

The superior efficient toxic effect of tested chemical concentrations were revealed for concentration 12cm<sup>3</sup> after both of the performed 1<sup>st</sup> and 2<sup>nd</sup> sprays; resembled by general means of reduction amounted to 64.97% and 69.59% respectively. It was followed by the 2<sup>nd</sup> ranked concentration 6cm<sup>3</sup> 45.61% and 54.59% respectively and concentration 3cm<sup>3</sup> came in the 3<sup>rd</sup> order with reduction percentage 32.92% and 47.86% respectively.

#### **3-2-3-Efficacy of tested insecticides during summer cultivation of season 2017 against the Whitefly *Bemisia Tabaci* after the 1<sup>st</sup> and 2<sup>nd</sup> sprays by using three different concentrations of Ematox pesticide:-**

The superior efficient toxic effect of tested chemical concentrations was revealed for concentration 12cm<sup>3</sup> after 1<sup>st</sup> and 2<sup>nd</sup> sprays; resembled by a general means of reduction comprising 76.1% and 80.47% respectively, followed by the 2<sup>nd</sup> ranked concentration 6cm<sup>3</sup> (67.7% and 72.39%) respectively, then the 3<sup>rd</sup> ranked concentration 3cm<sup>3</sup> (63.99% and 65.91%) respectively.

**3-2-4-Efficacy of tested insecticides during summer cultivation of season 2017 against the Whitefly *Bemisia Tabaci* after the 1<sup>st</sup> and 2<sup>nd</sup> sprays by using three different concentrations of Tracer pesticide:-**

The superior efficient toxic effect of tested chemical concentrations were revealed for concentration 12cm<sup>3</sup> after both of the performed 1<sup>st</sup> and 2<sup>nd</sup> sprays; resembled by general means of reduction amounted to (63.56% and 68.89%) respectively. It was followed by the 2<sup>nd</sup> ranked concentration 6cm<sup>3</sup> (61.48% and 64.81%) respectively, and concentration 3cm<sup>3</sup> came in the 3<sup>rd</sup> order with reduction percentage (46.25% and 60.61%) respectively.