

## OCCURRENCE OF INSECT PESTS AND NATURAL ENEMIES OF POTATO PLANTS CULTIVATED AT OLD AND NEW RECLAIMED LANDS WITH SPECIAL REFERENCE TO ITS CONTROL AT MENOUIFYA GOVERNORATE

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**ABSTRACT:** *In the present study, an intensive survey of insects associated with potato plants at Menoufiya Governorate in both new reclaimed and old village land was carried out during two successive summer seasons, 2010-2011, as well as , three insecticides were applied to control potato tuber moth and aphid insects infecting potato plantation. The obtained results indicated that 22 insect species belonging to 15 families were recorded at potato plantations during the two successive years, 2010 & 2011. These species including harmful, visiting, and beneficial insects. Regarding to harmful, and visiting insects there were 15 species belonging to 9 families and 7 orders. Hemiptera, Lepidoptera Coleoptera, Hymenoptera, Thysanoptera, and Orthoptera along the two seasons. Potato tuber moth, *Phthorimaea operculella* (Zeller), and the green peach aphid *Myzus persicae* Sulzer were the most abundant insects during the survey. Moreover, 7 species of beneficial parasites and predators were recorded from potato plants. The recorded species were belong to 6 families and three orders, Hemiptera, Coleoptera and Hymenoptera. It be concluded that the potato tuber worm made sever damage to potato yield at harvest in new reclaimed lands and on the other hand the green peach aphid made a large damage through the growing plant in old village lands. Control results indicated that the grand mean of reduction percentages of *Ph. operculella* stages infesting potato plants during 2010 season was approximately equal recording 76.36 %, 74.39 %, 74.90 % for Hostathion , Protecto , and Virosecto treatments , respectively. In addition, the grand mean of reduction percentages of *Myzus persicae* stages infesting potato plants during 2010 season was approximately equal recording 90.57 %, 91.5 %, 92.37 % for Hostathion , Protecto , and Virosecto treatments , respectively. The grand mean of reduction percentages of *Ph. operculella* stages infesting potato plants during 2010 season was approximately equal recording 79.38 %, 77.86 %, 82.47 % for Hostathion , Protecto , and Virosecto treatments , respectively. In addition, the grand mean of reduction percentages of *Myzus persicae* stages infesting potato plants during 2010 season was approximately equal recording 89.70 %, 90.76 %, 86.18 % for Hostathion, Protecto, and Virosecto treatments , respectively.*

**Key words:** *Potato, Tuber moth, Aphid, *Phthorimaea operculella*, *Myzus persicae*, Control.*

### INTRODUCTION

Potato (*Solanum tuberosum* L.) is the most important vegetable crop in Egypt with 107,953 cultivated hectares, and a total production of 2,760,164 tons in 2007 (Ministry of Agriculture of Egypt, 2008). Under field conditions, potato plants are under attack by a large number of insect pests such as aphids, leafhoppers, and Lepidopterous pests. The potato tuber moth (PTM), *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae) is the most destructive pest. In addition to potato, *P. operculella* also attacks other solanaceous

plants such as tomato, tobacco, eggplant and pepper in tropical and subtropical countries, but potato is still the preferred host plant (Shelton and Wayman 1979; Mandour 1997; Keasar and Sadeh 2007).

In potato fields, the female *P. operculella* lays its eggs on the underside of the potato leaves or on the exposed tubers mainly after irrigation where potatoes are cultivated under the flooding irrigation system (Mandour 1997). PTM larvae mine the foliage, stems, and tubers (Islam *et al.* 1990; Mandour 1997). The larvae of *P. operculella* also form blotches in leaves and fold leaves

over for shelter during feeding and for pupation (Mandour 1997). The new mines are always present in the upper part of the potato canopy. The old blotches, harboring the older larvae of PTM, are likely to be found the lower parts of the potato canopy particularly near the soil surface. Larvae may also bore into potato stem and petioles (Mandour 1997). There is usually a 10% rate of tuber infestation by *P. operculella*, but when control measures are not used, the infestation rate may reach 100% (Shelton and Wayman 1979; Mandour 1997; Sileshi and Teriessa 2001). Until the last 2 decades, the control of *P. operculella* has relied upon the use of the traditional insecticides (Sarhan 2004; Keasar and Sadeh 2007). Recently, biological control of *P. operculella* using bio-insecticides and natural insect enemies has become the backbone in potato protection, either in the field (Agamy 2003) or in potato storage (Farrag 1998; Moawad *et al.* 1998; Sarhan 2004; Keasar and Sadeh 2007; Mandour *et al.* 2009), and has gained more credibility for controlling this pest. Increased research efforts have been taking place for integration using natural enemies (parasitoids, predators and entomopathogens, Mandour *et al.*, 2008). In addition, the use of beneficial insects along crop field borders increased the population of beneficial insects (Bug, 1993; Grez and Prado, 2000).

*Trichogramma evanescens* West. (Hymenoptera: Trichogrammatidae) is a native egg-egg parasitoid in Egypt. It is used worldwide against several lepidopteran pests including *P. operculella* (Agamy 2003; Sarhan 2004; Mandour *et al.* 2008). *T. evanescens* kills the hosts before they reach the plant-feeding or tuber-mining stage. In earlier studies, although there was significant reduction in PTM populations in natural-enemy treatments as compared to the control ones, *P. operculella* still inflicted heavy damage to stored potatoes (Sarhan 2004; Keasar and Sadeh 2007; Mandour *et al.* 2009). In this case, integration between an egg parasitoid such as *T. evanescens* and bioinsecticides may result in satisfactory control of *P. operculella* inside potato stores (Mandour *et al.* 2008).

The objective of this survey was to identify pests of potato to guide extension programs in addressing their most critical needs and develop solutions to major problems facing potato production in Egypt, as well as to test the efficacy of bio-insecticides against potato pests under field conditions.

## MATERIALS AND METHODS

### Survey studies:

This study was carried out at two private farms under open field conditions at Menoufiya Governorate, the first was located at Elsadat as new reclaimed soil and the second was located at Elshohada locality as ordinary old soil during two successive seasons 2010 & 2011, to monitor the occurrence and status of major pests and their associated natural enemies in potato plantation.

Thirty five days after planting potato tubers (Spunta), composite weekly samples of 120 leaves were picked, at random, from the plants of each replicate, collected in paper bags and transferred to the laboratory for examinations. Samples were continued for 12 weeks and the weekly infestation average was counted for each district.

### Control studies:

An area of about one feddan at four sites at Menoufiya Governorate in both new reclaimed and old lands was selected, planted and cultivated with potato plants variety Spunta. The experimental area was divided into sixteen plots. There was four treatments, Hostathion 40 EC, Protecto (BT), Virotocto, in addition to control. Each treatment was replicated four times. Experiment was designed as completely randomized plots. Normal agriculture practices were undertaken. There were no chemical treatments applied at all.

### Used pesticides:

- Hostathion 40 EC Bayer was applied as spray treatment at the rate of 600 ml/feddan. Active Ingredient: Triazophos Foliar Insecticide. Mode of Action Contact and stomach insecticide with translaminar action; Acetylcholine esterase inhibitor.

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- Protecto (BT) an commercial product of the bacterium *Bacillus thuringiensis* and applied as spray treatment at the rate 1 gram per liter water.

-Virotocto (Post-translational modifications PTM virus), an commercial product and applied as spray treatment at the rate of 1.5 gram per liter water

**Statistical analysis**

Data were analyzed by the computer using the CoStat 6.400 Statistical CoHort Software program , Copyright © 1998- 2008 CoHort Software 798 Lighthouse Ave. PMB 320 Monterey CA , 93940 USA, using ANOVA test with LSD at 5% level (SAS Institute. 2003). SAS/STAT Version 8.2. SAS Institute, Cary, NC. USA.

The percentage of reduction in the population of tuber worms and green aphid counts were estimated according to Henderson and Tilton formula (1955), as follows:

$\% \text{ Reduction} = 1 - [(PTA \times PCB) / (PTB \times PCA)] \times 100$ , Whereas: PTA= population of the treated plots after application, PCB= population of the check plots before application, PTB= population of the treated plots before application and PCA= population of the check plots after application.

**RESULTS AND DISCUSSION**

**Occurrence of different pests and natural enemies at potato plantations:**

Data in Tables (1 & 2) listed 19 beneficial and harmful insect species belonging to 14 families and 7 orders from potato plants during two successive seasons ( 2010 and 2011years ) at cultivated under old and new reclaimed lands.

Results (Table 1) indicated the presence of six insect natural enemies (parasites and predators) belong to 6 families and three orders: Hemiptera, Coleoptera, and Hymenoptera.

Regarding to harmful insect species (Table 2) collected from potato plants, results recorded 13 species belonging to eight families and five orders, Hemiptera, Homoptera, Thysanoptera , Lepidoptera , and Orthoptera were estimated during two seasons. The most abundant species were aphids, thrips, leafhopper and potato tuber worms.

Data in Table (3) reveal that the main pest of potato in new reclaimed area during 2010 season was the potato tuber worm *Phthorimaea operculella* (Zeller) which cause a severe damage attributed to high potato tuber infestation at harvest could be attributed to the suitable environment conditions, hence a large storm winds through March every year which remove the cover of soil making potato tuber more available to infestation with the pest.

**Table (1): Parasites and predators associated with potato plants at new reclaimed and old lands in Elmenoufiya Governorate at 2010-2011 summer plantations.**

Order	Family	Scientific name
Hymenoptera	Braconidae	<i>Apanteles litae</i> Nixon
	Braconidae	<i>Bracon instabilis</i> Marsh.
	Ichneumonidae	<i>Diadegma molliplum</i> Hlmgrn
	Trichogrammatidae	<i>Trichogramma evanescens</i> Westwood
Coleoptera	Coccinellidae	<i>Coccinella undecimpunctata</i> Reiche
Hemiptera	Anthocoridae	<i>Orius laevigatus</i> Fieber

**Shedeed**

**Table (2): Economic insects infested potato plants at new reclaimed and old lands in Elmenoufiya Governorate at 2010-2011 summer plantations.**

Order	Family	Scientific name of insects
Hemiptera	Aphididae	<i>Myzus persicae</i> Sulzer
		<i>Aphis gossypii</i> Glover
		<i>Aphis craccivora</i> Koch
	Pentatomidae	<i>Nezara viridula</i> Linnaeus
Homoptera	Cicadellidae	<i>Empoasca decipiens</i> Paoli
		<i>Empoasca distiguenda</i> Paoli
Thysanoptera	Thripidae	<i>Thrips tabaci</i> Lindeman
Lepidoptera	Noctuidae	<i>Agrotis ipsilon</i> Hufnagel
		<i>Spodoptera littoralis</i> Boisduval
		<i>Spodoptera exigua</i> Hubner
	Glechiidae	<i>Phthorimaea operculella</i> Zeller
	Pyralidae	<i>Euzophera osseatella</i> Treit
Orthoptera	Gryllidae	<i>Gryllus domestique</i> Linnaeus

**Table (3): Weekly population of the *Phthorimaea operculella* and *Myzus persicae* on the leaves of potato plants cultivated at old and new reclaimed soils of Elmenoufiya during summer plantation of 2010.**

Sampling dates	Ordinary lands		New reclaimed lands	
	Number of individuals/ 120 leaf			
	<i>Ph.operculella</i>	<i>M. persicae</i>	<i>Ph.operculella</i>	<i>M. persicae</i>
14-Feb.	0 e	0 j	0 f	0 g
21-Feb.	0 e	0 j	0 f	0 g
28-Feb.	2 e	5 i	8 e	34 e
7-March	8 d	13 h	13 d	51 c
14-March	12 c	55 f	18 c	118 a
21-March	14 bc	184 a	33 b	58 b
28-March	18 a	72 c	45 a	41 d
4-April	16 ab	67 d	44 a	118 a
11-April	18 a	136 b	46 a	54 c
18-April	16 ab	62 e	45 a	32 e
25-April	17 a	49 g	46 a	15 f
Total	121	643	288	579
LSD 5 %	3.9	4.7	4.0	3.7

t at 0.01 for potato tuber moth between the two soil types = 4.28 \*\*

t at 0.01 for green aphid between the two soil types = 4.33 \*\*

Planting time 15 January

Means in each column followed by the same letter (s) are not significantly different

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Damage to the foliage occurs throughout the two successive seasons 2010-2011 in old soils was characterized with a high level of infestation by the green peach aphid *Myzus persicae* Sulzer. The relative of high infestation by the green peach aphid due to the presence of many sources of infestation of weeds which considered as a good hosts , where the adult stage of insects was overwintered on these hosts or on cultivated solanaceae plants in the area.

Results in Table (4) indicate that the average numbers of surveyed insects along 2011 season were similar to that of 2010 season , it was noticed that the numbers of potato tuber moth was greater in new reclaimed soils in comparison with that of ordinary soils , in contrast, the average numbers of green aphid insects was high in ordinary soils in comparison with that at new reclaimed soils .

Statistical analysis of the data in Tables (3 & 4) indicated that there were significant

differences in the numbers of both of potato tuber moth and green aphid, among the sampling dates. In addition, the difference of the infestation with potato tuber moth was highly significant between ordinary lands and new reclaimed lands at both tested seasons.

At ordinary lands , the highest infestation by the potato tuber moth and green aphid were recorded along March and April months at 2010 and 2011 seasons , while at new reclaimed lands the highest numbers of potato tuber moth was recorded along April month at 2010 and 2011 seasons.

As for the green aphid numbers, the highest population was recorded at both old soils and new reclaimed one during March and April months of 2010 and 2011 seasons , in addition , there were no individuals of potato tuber worm and green aphid during February month of 2010 and 2011 seasons.

**Table (4): Weekly population of the *Phthorimaea operculella* and *Myzus persicae* on the leaves of potato plants cultivated at old and new reclaimed soils of Elmenoufiya Governorate during summer plantation of 2011.**

Sampling dates	Ordinary lands		New reclaimed lands	
	Number of individuals/ 120 leaf			
	<i>Ph.operculella</i>	<i>M. persicae</i>	<i>Ph.operculella</i>	<i>M. persicae</i>
14- Feb.	0 d	0 h	0 f	0 g
21- Feb.	0 d	5 g	0 f	3 fg
28- Feb.	9 c	14 fg	7 e	9 f
7- March	9 c	57 e	13 d	38 d
14- March	8 c	189 a	19 c	122 a
21- March	9 c	74 d	30 b	56 c
28- March	11 bc	22 f	41 a	73 b
4- April	14 ab	113 c	43 a	26 e
11- April	16 a	157 b	45 a	115 a
18- April	17 a	85 d	44 a	68 b
25- April	17 a	53 e	45 a	39 d
Total	110	769	287	575
LSD 5%	3.1	15.8	4.9	8.8

t at 0.01 for potato tuber moth between the two soil types = 4.22 \*\*

t at 0.01 for green aphid between the two soil types = 4.16 \*\*

Planting time 15 January

Means in each column followed by the same letter (s) are not significantly different

## Shedeed

Data in Tables (5, 6) show the effect of the application of three insecticides against *Myzus persicae* and *Phthorimaea operculella* infested potato plants during the summer plantation of both of 2010 and 2011 seasons.

Regarding to the control results of 2010 season (Table 5) , the grand mean of reduction percentages of *Ph. operculella* stages infesting potato plants during 2010 season was approximately equal recording 76.36 % , 74.39 % , 74.90 % for Hostathion , Protecto , and Virotecto treatments , respectively. In addition, the grand mean of reduction percentages of *Myzus persicae* stages infesting potato plants during 2010 season was approximately equal recording 90.57 % , 91.5 % , 92.37 % for Hostathion , Protecto , and Virotecto treatments , respectively.

As for the control results of 2011 season (Table 6) the grand mean of reduction percentages of *Ph. operculella* stages infesting potato plants during 2010 season

was approximately equal recording 79.38 % , 77.86 % , 82.47 % for Hostathion , Protecto , and Virotecto treatments , respectively. In addition, the grand mean of reduction percentages of *Myzus persicae* stages infesting potato plants during 2010 season was approximately equal recording 89.70 % , 90.76 % , 86.18 % for Hostathion , Protecto , and Virotecto treatments , respectively.

Finally , it could be concluded that Hostathion, Protecto and Virotecto could be used for protecting the potato foliage, against *Myzus persicae* . Protecto and Virotecto have efficient values in protecting potatoes in addition to have no deleterious effects on the Bio-elements environment. It was generally concluded that Protecto and Virotecto are the most appropriate, economically, and thus should be strongly recommended. Thus we should conscious that potato control system at new reclaimed areas differ than the potato control system at ordinary lands.

**Table (5): Efficacy of three insecticides against potato tuber moth and green aphid peach infesting potato summer 2010 plantations at Menoufiya Governorate.**

Treatments	Pre treatment	Number of individuals/ 120 leaves days after application							R % (Grand mean)
		3 day	5 day	7 day	10 day	15 day	Total	Mean	
<i>Ph. operculella</i>									
Hostathion	13	8	5	3	2	3	21	4.2	76.36
Protecto	12	7	4	3	3	4	21	4.2	74.39
Virotecto	14	9	6	4	2	3	24	4.8	74.90
Control	12	14	15	17	18	18	82	16.4	
<i>Myzus persicae</i>									
Hostathion	57	9	5	7	9	13	43	8.6	90.57
Protecto	56	11	4	5	7	11	38	7.6	91.50
Virotecto	59	8	3	5	8	12	36	7.2	92.37
Control	55	78	123	86	82	71	440	88	

Sample size = 120 leaves R = Reduction %

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**Table (6): Efficacy of three insecticides against potato tuber moth and green aphid peach infesting potato summer 2010 plantations at Menoufiya Governorate .**

Treatment	Pre treatment	Number of individuals/ 120 leaves days after application							R % (Grand mean)
		3 day	5 day	7 day	10 day	15 day	Total	Mean	
<i>Ph. operculella</i>									
Hostathion	17	7	4	3	2	4	20	4	79.38
Protecto	19	8	5	3	3	5	24	4.8	77.86
Virotecto	18	7	3	2	2	4	18	3.6	82.47
Control	17	19	18	20	19	21	97	19.4	
<i>Myzus persicae</i>									
Hostathion	38	4	3	3	4	6	20	4	89.70
Protecto	36	3	2	4	3	5	17	3.4	90.76
Virotecto	34	4	2	4	4	6	24	4.8	86.18
Control	36	35	39	37	35	38	184	36.8	

Sample size = 120 leaves R = Reduction %

The obtained results are in harmony with those obtained by Mandour *et al.*, (2012) who studied the efficacy of the egg-egg parasitoid *Trichogramma evanescens* (Hymenoptera: Trichogrammatidae) and certain bioinsecticides (e.g., Neemix, Virotecto, Agerin, Dipel 2x and Spinosad) for controlling the potato tuber moth (PTM), *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae) under storage conditions was studied. Single and combined treatments of *T. evanescens* and the bioinsecticides were tested. Neemix and spinosad were evaluated as spray treatments. Virotecto, Agerin and Dipel 2x were evaluated as dust and spray treatments. Data were recorded in terms of rate of infestation, reduction of infestation, number of *P. operculella* pupae, and number of mines per 20 tubers as well as percentage of edible parts. Data revealed that the percentage of infestation in the control treatment was as high as in the Neemix treatment being 96.67 and 90% after one and two months of storage, respectively. Obviously, Spinosad and Dipel 2x were the most effective bio-insecticides in reducing tuber infestation and number of *P. operculella* recovered pupae. Virotecto and Agerin reduced rate of infestation and

number of recovered *P. operculella* pupae over that of the control, but their effect was significantly lower than that of Spinosad or Dipel 2x.

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## الآفات الحشرية والأعداء الطبيعية المتواجدة على نباتات البطاطس في الأراضي القديمة و الأراضي الجديدة المستصلحة مع الاشارة الى مكافحتها فى محافظة المنوفية

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### الملخص العربي

تم إجراء هذا الحصر في مناطق الشهداء والسادات على فترات دورية أسبوعية وأوضحت نتائج الحصر للحشرات المتواجدة على البطاطس في الأراضي الجديدة المستصلحة والأراضي القديمة خلال موسمي الزراعة الصيفية في محافظة المنوفية خلال الموسمين ٢٠١٠-٢٠١١ عن وجود ٢٢ نوعاً متضمنة الآفات الضارة والحشرات الزائرة والنافعة.

بالنسبة للحشرات الضارة والزائرة للبطاطس تم حصر خمسة عشر نوعاً تنتمي إلى تسعة عائلات وست رتب بينما سجلت سبعة أنواع من الحشرات النافعة ( المفترسات والطفيليات ) تنتمي إلى ست عائلات وثلاث رتب . وأوضحت الدراسة أن أهم الآفات الحشرية الضارة لمحصول البطاطس في الأراضي الجديدة المستصلحة هي دودة درنات البطاطس وأن أهم الآفات الحشرية الضارة لمحصول البطاطس في الأراضي القديمة هي حشرة من الخوخ الأخضر ، كما وجد فروق معنوية جداً في أعداد الحشرات تحت الدراسة بين كل من الأراضي القديمة والأراضي المستصلحة حديثاً في كل من موسمي الدراسة.

وأوضح من الدراسة التي أجريت لمكافحة كل من الخوخ الأخضر وفراشة درنات البطاطس إن كل من المبيد الحيوي الفيروتيكتو والمبيد الحيوي بروتينكتو اعطى نتائج مماثلة في الموسم الأول (٢٠١٠) والثاني (٢٠١١) . وبهذا يوصى البحث بإمكانية استخدامهما في مكافحة كل من فراشة درنات البطاطس ومن الخوخ الأخضر التي تصيب محصول البطاطس في كل من الأراضي القديمة والحديثة.