

CONTROL OF POTATO TUBER MOTH, *PHTHORIMAEA OPERCULELLA* (LEPIDOPTERA: GELICHIIDAE) IN RUSTIC FARM STORAGE AND FIELD BY MEANS BIOLOGICAL AND CULTURAL PRACTICES.

GABER, NEVIEN M., K. A. HASSAN and NAHLA A. EZZ

Plant Protection Research Institute, ARC, Giza, Egypt

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Abstract

The present work was conducted in Qalubia Governorate during 2010 to control the potato tuber moth, *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelichiidae) in rustic farm storage and potato fields. Results showed that, double release of the parasitoid, *Trichogramma evanescens* Westwood and the predators, *Chrysoperla carnea* (Stephens) and *Orius albidipennis* (Reuter) were effective as biological agents against *P. operculella* under straw-cover heaps. The highest reduction percentage occurred with application of both *T. evanescens* and *C. carnea*, they reduced the infestation to 75.56% whereas application of both *T. evanescens* and *O. albidipennis* reduced the infestation to 56%. Application of *O. albidipennis* alone gave poor reduction percentage (5.1%). One release of *O. albidipennis* reduced the infestation to 21% in the field. However, application the agronomic cultural practices reduced rate of infestation to 45% at the trail end in the storage.

INTRODUCTION

Potato tuber moth (PTM), *Phthorimaea operculella* (Zeller) is the single most significant insect pest of potato in North Africa and the Middle East (Fuglie *et. al.*, 1992). It is a noxious pest of potato in both field and store causing serious economic damage. The greatest damage occurs in storage where the larval mining of tubers causes rotting and renders the tubers and become unmarketable (Kroschel & Koch 1994). In Egypt, a common method of tubers storage is to pile potatoes in straw-covered heaps under field conditions. According to (Von Arx *et. al.*, 1987) PTM infestations may destroy the entire crop within 2–4 months in rustic stores.

The parasitoid, *Trichogramma evanescens* Westwood is a potential natural enemy of potato tuberworm as well as the predator, *Chrysoperla carnea* (Stephens) (Zaki, 1986 and Mandour *et. al.*, 2008). Also, members of the genus *Orius* are a generalist predators of small arthropods associated with a wide range of natural and agricultural habitats (Vacante *et. al.*, 1997). Furthermore, *Orius albidipennis* (Reuter) has tremendous potential as a biological control agent, especially in its native range around the Mediterranean Basin (Sobhy *et. al.*, 2010).

Cultural control in potato crop are equally important as the biological control (Horne & Page, 2008). It can reduce *P. operculella* infestation in the field (Shelton and Wyman, 1979 c.a. Susannah *et. al.*, 2009). The present work was carried out to control the potato tuber moth in both field and traditional storage, with application of biological agent and cultural practices.

MATERIALS AND METHODS

Trichogramma evanescens

The local egg parasitoid, *T. evanescens* was reared on Angoumois grain moth, *Sitotroga cerealella* (Oliv.) eggs according to Abd El-Hafez (1994). Releases of *T. evanescens* were made using thick paper cards (Duplex paper, 250 weight) containing parasitized *S. cerealella* eggs. Each card contained 3 cohorts with parasitoids (500/each), thus, the total number of parasitoids/ card was about 1500 parasitoids.

Chrysoperla carnea

The predator maintained from laboratory rearing at 27±1°C and a photoperiod of 16:8 h (L:D). The adults were placed in plastic boxes (22x13x10 cm) covered with black muslin for deposited eggs and changed every 2 days. Semi artificial diet (2g yeast extract, 1g fractoze and 1cm distilled water) drops were provided on tape stacked on the muslin. The deposited eggs were collected daily and kept in glass jars until hatching. The hatch larvae were supplied by eggs of *S. cerealella* as food source. The eggs used for rearing recycling were allowed to be deposited on black muslin, whereas the release, eggs were on black canson paper, subsequently cut in cylinder bands displaying 250 eggs/ each.

Orius albidipennis

O. albidipennis were reared at laboratory conditions of 28±2°C, 75±10 % RH and 16:18 h L.D. photoperiod. The adults were placed in plexiglass cylinders (9cm high x 4cm diameter) covered with fine cotton gauze. Frozen eggs of *Ephestia kuehniella* Zeller (obtained from the stock culture of "Chrysoperla carnea Mass Rearing Unite" Faculty of Agriculture, Cairo Univ. Giza, Egypt) were used as a food source. Middle veins of lettuce were used as oviposition substrates. Veins of lettuce with *Orius* eggs were removed from the adult unites three times per week and placed in boxes (15x33x10 cm). To prevent cannibalism some strips of paper were added to each box and water was supplied by adding moist cotton. The 3rd nymphal instar was employed.

Sitotroga cerealella

Eggs of grain moth *S. cerealella* were collected from the *S. cerealella* mass production units of bollworm department, Plant Protection Research Institute, Agricultural Research Center according to the method of Hassan (1995).

Agronomics approach

Recent study was conducted at Qalubya governorate on potato from 2010 summer season crop and stored at piles in straw-covered heaps and in potato fields under field conditions. The experiments were performed under rustic farm store conditions, while the agronomic approach trial was followed out under recommended culture practices. The additional pre and post-harvesting practices in this trial were:

- Removing the potato vines and destroyed it before harvesting is an essential step in potato production.
- Removing of tubers with vascular discoloration as attackable source.
- Careful check for damaged and infected tubers and discard it (first check).
- Clean rice straw covering is significant factor when placing potatoes in storage.
- Impermeable check 15 days after storage (second check) for discarding the blighted tubers.

Total 450 plants from nine replicates (50 plants each/ 2 carats) were sampled from pre-harvesting potatoes twice a week intervals. Post-harvesting trial had five potato straw-covered heaps (one cubic meter in diameter/ each) and 100 potato tubers were randomly sampled from each cubic meter repeatedly till the crop selling. Check control was access as likely as experiment trial.

Release

Storage trials contain five potatoes straw-covered heaps (one cubic meter in diameter/ each). One of card *T. evanescens*, one of *C. carnea* cylinder band or 500 nymphs of *O. albidipennis* was hand placed on each heap under straw covers. The releasing agents were transported to the field in a cooling box. Two releases of beneficial species were followed out in each treatment. The stored tubers while received the two releases during the crop checkout to removing infested and diseased tubers 2 weeks intervals. Additional five heaps were set up as check control. One hundred potato tubers randomly sampled from each cubic meter (500 tubers/ treatment), repeatedly till the crop selling. One disperse (500 nymphs/ replicate) of *O. albidipennis* was carried out in potato fields at the end of April. Nine replicates (2 carats/ each) were installed in both treated and untreated potato fields. A total of 450 plants were examined for infestation status in both treated and untreated replicates.

Tuber infestation percentages were recorded and reduction percentages were calculated according to Henderson and Tilton (1955) equation.

RESULTS AND DESCUSSION

Results in table 1 showed relative rates of tuber damage due to *P. operculella* ranked between (3.00-29.00 %). The highest infestation rates of this pest were recorded last season at the same locality, it being 4.00% (Ezz & Hassan, 2010).

Double releases of the parasitoid, *T. evanescens* and the predators *C. carnea* and *O. albidipennis* were employed for tuberworm suppression in straw-covered heaps. Compared with check control, the most effective utilization of biological control agents was observed with *T. evanescens* and *C. carnea* integrated. The pest infestation reduced, reached to 74.71% after first release and 75.56% at the end of experiment (Table 1).

As shown in Table 1, reduction percentage at attempting end was 56.00% in *T. evanescens* and *O. albidipennis* combined use. Dramatically regression in reduction percentages were demonstrated till it reached 5.10% with *O. albidipennis* solo assigning. Through the field dispersal, this percentage was approximately 21.00% after a single release of *O. albidipennis* (Table 2).

Exact cultural practice treatments recorded 45.00% reduction in the PTM infestation rates at the trail end (Table 1).

From aforementioned results, combined utilization of *T. evanescens* and *C. carnea* resulted height reduction in *P. operculella* population. Ezz and Hassan (2010) recorded reduction rates 41.41 and 53.13% in tuberworm populations with single application of both *C. carnea* and *T. evanescens*, respectively. It has become common practice to apply several biocontrol agents simultaneously however against just one pest species (Madadi, *et. al.*, 2008). In the combined use of natural enemy species, additive predation effects may explain the efficacy of natural enemy communities in suppression of herbivore populations (Rosenheim, 2005). We assumed that, if the previous two beneficial species are used simultaneously for *P. operculella* biological control it would contribute to suppress the tubers infestation under storage in straw-covered heaps.

The rostrum of our observation that, revealed *T. evanescens* may be an efficient apparatus to the tuberworm, whereas *O. albidipennis* showed weak preying behavior under rustic store trial. The predatory bug has tremendous potential as a biological control agent, especially in its native range around the Mediterranean basin. Nevertheless, little is known for the effect of the different preys on development of *O. albidipennis* compared with other species of *Orius* (Sobhy *et. al.*, 2010). Predominantly, polyphagous integrated used could participate to reducing preys.

Table 1. Reduction percentages of *Phthorimaea operculella* infestation under release three beneficial species in storage and cultural control compared with check control.

Sampling	Treatment infestation %					Reduction %			
	<i>T. evanescens</i> + <i>Ch. carnea</i>	<i>T. evanescens</i> + <i>O. albidipennis</i>	<i>O.</i> <i>albidipennis</i>	Culture practice	Check control	<i>T. evanescens</i> + <i>Ch. carnea</i>	<i>T.</i> <i>evanescens</i> + <i>O.</i> <i>albidipennis</i>	<i>O.</i> <i>albidipennis</i>	Cultural control
Sample 1 (1 st release)	12.00	20.00	17.00	8.00	22.00				
Sample 2 (week after release)	4.00	11.00	5.00	7.00	29.00	74.71	58.28	77.69	33.62
Sample 3 (2 nd release)	4.00	8.00	8.00	15.00	26.00	51.11	66.15	60.18	0.00
Sample 4 (before crop selling)	2.00	6.00	11.00	3.00	15.00	75.56	56.00	5.10	45.00

Table 2. Reduction percentages of *Phthorimaea operculella* infestation under release of *O. albidipennis* in the field compared with check control.

Sampling	Treatment infestation %			Reduction %	
	<i>O. albidipennis</i>	Cultural control	Check control	<i>O. albidipennis</i>	Cultural control
Sample 1 (release)	4.22	2.00	3.33		
Sample 2	3.33	0.67	3.33	21.05	0.00

Santi & Maini (2006) mentioned that, if *O. laevigatus* and *C. carnea* are used for biological control simultaneous in greenhouses, they will only contribute.

Recent study conducted suppression in the *P. operculella* damage mainly to controlled agronomic cultural practices. In our case, we assume decline the infestation rates referable to strict agronomic practices especially narrowly tubers checkout period and removing the infested tubers after harvesting and under storage. Many cultural practices which used by farmers to improve the yield and quality of potato can also limit the infestation of PTM and minimize damage to tubers (Fuglie *et. al.*, 1992 and Hanafi, 1999). However, further research needs to be done on dispersing the examined beneficial insects in cultural practices treatments to complement information on their successful application against potato tuberworm under storage.

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**مكافحة فراشة درنات البطاطس *PHTHORIMAEA OPERCULELLA*
(LEPIDOPTERA: GELICHIIDAE) تحت ظروف التخزين التقليدية و الحقل باستخدام
وسائل مكافحة حيوية وزراعية**

نفين محمود جابر، كارم أبو زيد حسن ، نهلة عبد العزيز عز

معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الدقي- الجيزة- مصر

أجريت الدراسة الحالية في محافظة القليوبية لمكافحة فراشة درنات البطاطس (*Phthorimaea operculella* (Zeller) باستخدام طرق حيوية وزراعية تحت ظروف التخزين التقليدية للبطاطس و في الحقل. و كانت إطلاقتان من طفيل البيض *Trichogramma evanescens* Westwood و المفترسان (*Chrysoperla carnea* (Stephens) و (*Orius albidipennis* (Reuter) قد اطلقتا ضد الآفة تحت ظروف تخزين درنات البطاطس علي هيئة أكوام مغطاة بقش الأرز. أظهرت الدراسة أن الاستخدام المتزامن للطفيل *T. evanescens* و المفترس *C. carnea* أعطي أفضل النتائج، حيث بلغت نسب الخفض في تعداد الآفة 75.56% بنهاية فترة الاختبار قبل بيع المحصول مباشرة. وأدي الإطلاق المتزامن للطفيل *T. evanescens* و المفترس *O. albidipennis* إلي خفض نسب الإصابة إلي 56.00%، بينما وجد أن الإطلاق المنفرد للمفترس *O. albidipennis* أعطي نسب خفض منخفضة (5.51%). كما أدت إطلاقه واحدة في الحقل للمفترس *O. albidipennis* الي خفض تعداد الآفة بلغت 21.00%. واتضح من الدراسة ان استخدام الوسائل الزراعية بمفردها ادي الي خفض تعداد فراشة درنات البطاطس تحت ظروف التخزين بنسبة بلغت 45.00% في نهاية فترة التجربة .