TWO DEVELOPED PROGRAMS FOR CONTROLLING POTATO TUBER MOTH

MOUSTAFA, OMAYMA K.[1], MOHAMED H. BELAL[2] AND NAIROUZ R. GIRGIS[1]

1. *Central Agricultural Pesticides Laboratory, Agricultural Research Center, Dokki, Egypt.*
2. *Faculty of Agriculture, Cairo University*

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Abstract

Two programs for controlling PTM were developed, program I included the sex pheromone water traps, and two biocides, Abamectin 1.8% and Xentari 10.3% and program II included the sexphermone water traps only . Data showed that the percent reduction of infestation according Hendrson and Telton formula were 97% and 52% for program I and program II , respectively . The mean yield of program I was 21.100 ton / fed. while it was 16.50 ton / fed. for program II compared with 15.9 ton / fed. for the control . Also the results showed that the percent reduction of PTM infestation was 100% for the stored potato yield from program I after 2 months storage , while it reached to 64.81% and 61.85% after the same period of storage in the potato yield from program II when treated with Verotecto and Agerin , respectively.

INTRODUCTION

Farmers throughout the world have traditionally been encouraged by commercial, government and consumer interests to use synthetic chemical pesticides for a "fast and effective fix" to pest problems. After 30 – plus years of the use and abuse of chemical pesticides, all of these interests, as well as the farmer, now understand that chemical insecticides have a limited life and that excessive and repeated use leads to resistance, pest resurgence and environmental problems. Effective pest management requires a diversity of tools and the flexibility that these tools will bring (Inceoglu *et al.*, 2001). The bio – compounds and sex pheromones are good examples of effective tools. The potato tuber moth is considered to be a serious insect pest of potato in the field and in storag.

The present study reports developed programs for controlling this insect.

MATERIALS AND METHODS

During the 2001 season, two developed programs were conducted in El – Santa region. The experimental area of each program was one feddan and one feddan for control. The planting date was 1st February, and the usual techniques for planting, fertilizing and growing the crop were followed, without the use of pesticides. The two programs used included the use of sex pheromones. The pheromone traps were of the water pan type. The attractant (bait) was a commercially available PTM sex pheromone mixture consisting of two compounds : trans – 4 , cis – 7 tridecadiene - 1 – 01 acetate $(PTM)_1$, and trans – 4, cis – 7 – 10 tridecadiene – 1- 01 acetate $(PTM)_2$. These compounds were impregnated on rubber caps which were stored at 5 °c in a refrigerator . The experimental area for each program was divided into 3 plots each plot represented one replicate . Baited sex pheromone water traps were sited in each of the designated areas at the rate of one trap per plot (3traps per feddan) and considered as a tool of PTM control . The PTM male moth catches were recorded daily and the correlation between the mean nightly male moth catch and percentage of infestation in potato plants was determined. The program I included the sex pheromone water traps as mentioned, and two biocides. The two selected biocides were chosen because they had been the most efficient in the field tests Belal *et al* (2004). The first application on the 7th of May 2001, was the bio – compound , Abamectin 1.8% EC at the rate of 60 ml per feddan. The 2nd treatment, applied 10 days following the 1st, was Xantari 10.3% (water dispersible granule) based on *Bacillus thuringiensis* subsp. aizawai at the rate of 240 g per fed. El – Santa canal water was used for the dilution of the tested bio – compounds , Xentari and Abamectin . The program II consisted of the sex pheromone traps only .

At harvest time potato tuber were picked, at random, from the yield of each program area (2 ton / fed.) to be stored in traditional Nawwallas. The potato crop was divided into four piles (replicates) and dusted with Verotecto or Agerin. Piles were covered with dry *Lantana camara* plants in a layer 2.5cm deep and rice straw in a layer 50cm thick. One sex pheromone water trap was put outside of the Nowwalla. Four piles were used as control without any treatment. The infested tubers were recorded after 15 days. Reductions in PTM infestation were estimated according to Henderson and Telton (1955) .

RESULTS AND DISCUSSION

The results in Table 1 indicate that the recorded percentages of PTM infestation were 21.0, 14.0, 4.0 and 1.0 during program I, 18.0, 30.0, 20.0 and 15.0% during program II compared with control 20.0, 56.0, 58.0 and 35.0% before and after treatments. The reduction in PTM infestation ranged between 76.0% - 97.0% during program I, while it ranged between 40.0% - 52.0% during program II. The results indicate that treatment with program I or program II was significantly superior than the control in reducing the percentage infestation. Mean nightly male PTM moth catches in sex pheromone traps during program I and program II are set out in Table 1.Observation of the trapping of the male PTM revealed an increase of trapped males until 25th April. The mean numbers of male PTM moths were 117.33, 37.60, 0.90 and 0.80 during program I and 114.33, 94.33, 30.00 and 29.0 during program II on 25/4 before treatment, 1st period (27/4 to 6/5), 2nd period (7/5 to 16/5) and 3rd period (17/5 to 29/5), respectively. This fluctuation in catch throughout the experimental period depends mainly on the sudden changes in the temperature and other meteorological factors which affect the emission rate of the pheromone isomers (Bekheit *et al.* 1997). The yield of marketable tubers in tons / fed. are shown in Table 1. The mean yield under program I was 21.100 ton / fed. and under program II 16.50 ton / fed., while in the untreated area it was 15.900 ton / fed. In general, the first program was very effective against PTM, whereas the second program was moderately effective against PTM in the field. In conclusion, both biocides (Xentari and Abamectin) are effective compounds for PTM control. Although potato tuber moth larvae burrow in leaves and tubers, *Bt.* and sex pheromone mass trapping applications reduced their population levels considerably and reduced the percentage of infestation and yield loss in potato tubers. Recently, Avermctins, a novel class of macrocyclic lactones, were isolated from a culture of soil microorganisms (Dybas, 1983). They have extremely high potencies agricultural and household insect pests in several orders. Abamectin penetrates the leaf tissue forming an Abamectin reservoir within the leaf. This Abamectin reservoir provides residual activity since surface residues of Abamectin dissipate rapidly. As a result Vertimec has minimal impact on beneficial insects, (Dybas and Green, 1989). Isolation of sex pheromone in California by Foudu *et al.* (1975), and Bacon *et al.* (1976), concluded that two mixtures of trans – 4, cis – 7 – tridecadien – 1 – 01 – acetate (PTM) and $(PTM)_1$ + trans – 4, cis – 10 – tridecatrein – 1 – 01 acetate $(PTM)_2$ were most effective for monitoring and mass

Table 1. Percentage of infested and reduction % of potato tuber moth and mean nightly male PTM moth catch in sexpheromone traps and yield of marketable tubers in tons / feddan (2001) during program I and II

Treatment	% of PTM infestation on potato plants				% reduction of PTM infestation			mean nightly male moth catch in sexpheromone traps No. male PTM moth / trap / night				Yield of marketable tubers in ton / feddan
	Date of inspection											
	Before treatment	1st period	2nd period	3rd period	1st period	2nd period	3rd period	Before treatment	1st period	2nd period	3rd period	
Program I	21.0	14.0	4.0	1.0	76%	94%	97%	117.33	37.60	0.90	0.80	21.10
Program II	18.0	30.0	20.0	15.0	40%	62%	52%	114.33	94.33	30.0	29.0	16.50
Control	20.0	56.0	58.0	35.0								15.90

Before treatment = 25/4
1st period = 27/4 to 6/5
2nd period = 7/5 to 16/5
3rd period = 17/5 to 29/5
*Henderson and Telton equation (1955).

trapping of PTM. Doss *et al.* (1994) reported that light and pheromone traps were found promising and were simple means of reducing PTM infestation . Bekheit *et al.* (1997) studied the effectiveness of *B. thuringiensis*, Granular virus and mass trapping with sex pheromone against potato tuber moth, *P. operculella* in Egypt. They indicated that *Bt.*, GV. and mass trapping PTM using a sex pheromone with one opplication of *Bt.* reduced the infestation of PTM on potato plants. Results in Table 2, show that Verotecto and Agerin effectively protected potatoes from PTM infestation for two months of storage. The percentage reduction of PTM infestation was 100% after two months storage in program I. While the percentage reduction of PTM infestation in program II was 64.81 and 61.85 when treated with Verotecto and Agerin, respectively. Raman *et al.* (1987) in Peru, found that the dried foliage of *Eucalyptus globlulus*, *Lantana camara* and *Minthostachys* sp.,both in dried, shredded and powdered forz, was effective in controlling *P. operculella* damage to potatoes stored for 4 months. Dipel (*B. thuringiensis* var. Kurstaki) was most effective in reducing damage when applied as a dust formulation, resulting in significant reductions in numbers of holes per tuber, sprout damage and tuber rottage. Das, *et al.* (1992) used different treatments

Table 2. Efficacy of tested biocides against *P. operculella* infestation in storage potato at El – Santa, Gharbia Governorate, Egypt (year 2001)

Treatments	Mean percentage of tubers damaged by PTM							Rotted tubers
	Date of inspection					Mean %	Reduction %	
	27/5	10/6	25/6	10/7	25/7			
	I First program							
Verotecto (150 g/ton)	0.0	0.0	0.0	0.0	0.0	0.0	100	25 kg
Agerin (150 g/ton)	0.0	0.0	0.0	0.0	0.0	0.0	100	20 kg
	II Second program							
Verotecto (150 g/ton)	0.0	1.0	3.0	5.0	10.0	3.8	64.81	90kg
Agerin (150 g/ton)	0.0	2.0	2.6	4.0	12.0	4.12	61.85	105kg
control	0.0	5.0	12.0	17.0	20.0	10.8	-	200kg

to control potato tuber moth, *Phthorimaea operculella* (Zeller) for 2 and 4 months of storing potato tubers. A Granulosis virus (GV) preparation at 5 kg / ton of tubers was effective against PTM for up to 2 months of storage i.e. up to sprouting. Dusting *Bacillus thuringiensis* Berliner, Granulosis virus Gv and Fenvalerate 0.7% gave good PTM control (Doss *et al.* 1994). Das *et al.* (1998) determined that Granulosis virus and

B. thuringiensis were equally effective in reducing pest damage. After three months storage the treatments showed no significant effect on sprouting.

It may be concluded that the use of sex phermone and biocides are effective and specific for PTM, offering a great deal of promise in resolving some of the problems commonly associated with dependence on broad spectrum insecticides, In addition by offering a completely different mode of action from conventional neurotoxic chemical insecticides they can be very useful in managing resistance to those chemicals .

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استخدام برامج متطورة لمكافحة فراشة درنات البطاطس فى الحقل والمخزن

أميمة كمال مصطفى[1]، محمد حلمي بلال[2]، نيروز رزق الله جرجس[1]

١ – المعمل المركزى للمبيدات-مركز البحوث الزراعية – الدقي – جيزة – مصر.
٢ – كلية الزراعة – جامعة القاهرة- جيزة – مصر .

تعتمد فكرة هذين البرنامجين على خفض تعداد فراشة درنات البطاطس فى الحقل إلى أقل ما يمكن وحتى فترة الحصاد لتخزين الناتج خالياً من أى إصابة .

أجريت الاختبارات خلال موسم زراعة ٢٠٠١

تمت زراعة ٣ أفدنة بمنطقة السنطة محافظة الغربية أول فبراير فدان للبرنامج الأول وآخر للثانى والثالث للمقارنة .

البرنامج الأول :– قسمت المساحة المخصصة للبرنامج الأول (١ فدان) إلى ٣ قطاعات ووضع فى كل منها مصيدة فرمونية (٣ مصائد للفدان) فى الخامس والعشرين من إبريل تركت إلى الحصاد ــ فى السابع من مايو تم رش قطاعات الاختبار بالفيرتيمك ١,٨% بالجرعة الموصى بها ٦٠ مل/ فدان وفى السابع عشر من مايو تم معاملة قطاعات الاختبار الثلاثة بالزنتارى بتركيز ٢٤٠جم/ فدان .

البرنامج الثانى :– استخدمت المصائد الفرمونية بنفس المعدل المستخدم فى البرنامج الأول دون معاملة النباتات بأي من المركبات الأخرى وتركت المصائد بقطاعات الاختبار حتى فترة الحصاد .

- أثبتت النتائج انخفاض متوسط إصابة نباتات البطاطس من ٢١% إلى ١% فى حالة استخدام البرنامج الأول ومن ١٨% إلى ١٥% بالنسبة للبرنامج الثاني بينما تزايدت من ٢٠ – ٣٥% فى الكنترول وذلك منذ بداية استخدام البرامج وحتى يوم الحصاد . بينما كان متوسط عدد ذكور الفراشات يتراوح بين ١١٧,٣٣ – ٠,٨ فراشة / مصيدة / يوم خلال فترة البرنامج الأول فى حين كان متوسط عدد الفراشات يتراوح بين ١١٤,٣٣ – ٢٩ فراشة / مصيدة / يوم فى البرنامج الثاني .
- المعدلات الإنتاجية للفدان كانت ٢١،١٠ ، ١٦،٥٠ ، ١٥,٩٠٠ طن / فدان للبرنامج الأول والثاني والمقارنة على التوالي .
- بعد الحصاد تم تخزين ٢ طن درنات من إنتاج كل برنامج وطن واحد للمقارنة فى نوالة عادية كل طن قسم إلى ٤ مكررات (٤ أكوام) ثم تم تعفيرها بالفيروتيكتو بمعدل ١٥٠جم / طن والطن الآخر تم تعفيره بالأجرين بمعدل ١٥٠جم / طن ثم وضعت طبقة من نبات لانتاناكمارا ٢,٥ سم

على كل كومة وفى النهاية تم تغطيتها بطبقة من قش الأرز سمك ٥٠ سم ووضعت مصيدة أمـــام باب النوالة هذا بالنسبة للمحصول إنتاج البرنامج الأول والثانى أما المقارنة فتم تغطيتهـــا بقـــش الأرز فقط ووضعت فى نوالة أخرى عادية.

- كانت نتائج البرنامج الأول : ١٠٠% نسبة الخفض فى الإصابة بعد شهرين من التخزين فـــى حـــين وصلت نسبة الخفض إلى ٦٤،٨١% ، ٦١،٨٥% فى ناتج البرنامج الثاني لكـــل مـــن الفيروتيكتـــو والأجرين على التوالي بعد شهرين أيضاً من التحزين وكان الفقد فـــى المحصـــول ٢٥ كجـــم فـــى البرنامج الأول للمعاملة بالفيروتيكتو و ٢٠كجم بالنسبة للمعاملة بالأجرين بينما زاد فى البرنامج الثاني إلى ٩٠ كجم و١٠٥ كجم لكل من الفيروتيكتو والأجرين على التوالي.