BIOLOGICAL CONTROL OF TOMATO PESTS IN EGYPT

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Abstract

Biological control trial on tomato plants were carried out at Mubarak City for Scientific Research and Technology Application, New Borg El-Arab, Alexandria, Egypt during two tomato summer seasons; 2008 and 2009 compared with field treated with insecticides. The most serious insect pests in both fields were *Heliothis armigra, Spodoptera littoralis* and *S. exigua* larvae. The pests control in the biological field depended mainly on releasing of the coccinellid species and the parasitoid *Trichogramma evanescens*. The releases were timed according to the catches of the pheromone traps and the weekly survey of the insect pests. The pests, control in the traditional field depended only on insecticide treatments. In 2008 season in the biological control field, five releases of mixture of coccinellid predators; *Coccinella undecimpunctata, C. sptempunctata* and *Hypodimia trideampunctata* at ratio of to 17: 7 : 5, respectively. In the second season, six releases of *C. undecimpunctata* and one of parasitoid, *Trichogramma evanescens* were done in biological control field. In the corresponding insecticide treatment field, four insecticide applications were carried out in the first season 2008, while in the second season, three insecticide treatments were applied. The infestation rates in the first season in tomato fruits were 1.3 and 3.8% in biological control and insecticide treated fields, respectively. While in the second season, these rates were 0.2 and 2.7% in the two fields, respectively. The tomato production was estimated with 9174 and 3867 kg/fed. in biological control and insecticides treated field in 2008 season, respectively, while in the second season those were 5804 and 3812 kg/fed., respectively.

Key words: Tomato production, biological Control, Predators, *Heliothis armigra*.

INTRODUCTION

Tomato is one of the most important vegetable crops, but its production is usually subject to high risk in the markets because of drastic changes in the prices. Also, the crop suffers from infestations of insect pests and infections of diseases. Because tomato is a cash crop with usually a high value, the growers tend to use

insecticides and fungicides indiscriminately to ensure high productivity and reasonable benefits.

Pesticides are known as toxic compounds to human-beings as well as to many other non-target organisms (Poster, 1987). Non-biodegradable pesticides cause contaminate soil, water system and food chains, and constitute a major components of environmental pollution, so the chemical control has become a troubled pest management strategy (Debach and Rosen, 1991).

Since several years ago, because of limited cultivated area in Egypt, the policy of Ministry of Agriculture in has emphasized crop intensification. For this reason, heavy duties are added to responsibilities of agriculturists, especially the plant protection specialists. Thus, the difficult equation has become how to increase crop production with less, or without, pesticides. The strategy of integrated pest management (IPM) could be the solution if taken seriously. Among the means of IPM, is understanding the role of natural enemies in different agricultural ecosystems to preserve and encourage their presence and use in suppressing pest population (Tawfik and El-Husseini, 2002). To apply IPM systems, there is a need to have good knowledge on the biology and ecology of the target insect pests and associated natural enemies as well as the climatic conditions. Decisions of pest control should be based upon survey of the pests and their associated natural enemies, with limited applying of insecticides if needed (Mesbah, 2007).

The current investigation was undertaken at the experimental farm of Arid Lands Cultivation and Development Research Institute, Mubarak City for Scientific Research & Technology Applications to produce tomato without insecticide in order to produce healthy uncontaminated tomato fruits and to keep this new area away from pesticide pollutions.

MATERIALS AND METHODS

A field experiment was carried out at Mubarak City for Scientific Research and Technology Application, New Borg El-Arab City, Alexandria Governorate during two successive summer seasons; (2008 and 2009).

Tomato seedlings were sown on April 1st in 2008 season and on March 15th in 2009. The experimental field was divided into area "A" of a quarter feddan (biological control field), area "B" (traditional field) of another quarter feddan, treated with insecticides against tomato insect pests during the two experimental seasons. In the first season (2008) five predator releases were done in the biological control field on April 15th, April 26th, May 10th, June 17th and June 23rd. The predator adults were

Coccinella undecimpunctata, C. septempunctata and *Hypodimia trideampunctata* at ratio of 17: 7: 5, respectively. The numbers of released predators in the five dates were 320, 272, 384, 448 and 352 predators, respectively. These predators were collected from the weeds (Mesbah and El-Husseini, 2009). In the second season (2009), six releases of *C. undecimpunctata* were carried out on April 24th, May 19th, May 24th, June 5th, June 10th and June 27th with rates, 480, 160, 200, 440, 600 and 480 predators/fed., respectively. In addition, the parasitoid, *Trichogramma evanescens* was released on June 14th at a rate of 120 thousand wasps/fed. In the second season *C. undecimpunctata* was mass-reared under laboratory conditions on aphids. As for the insecticide treated field, four insecticide applications were carried out in 2008 season; profenofos (Selecron 72% EC), malathion (Malathion 57%) and chlorfluazuron (Atabaron 5% EC) + chlorpyrifos (Bestban 48% EC) two times. In the second season (2009), three insecticide treatments were carried out; selecron, malathion, chlorpyrifos + chlorfluazuron, respectively.

Pheromone traps:

For monitoring *Spodotpera littoralis* adults in the first and second seasons and *Heliothis armigera* male moths, baited water pheromone traps were used. The number of moths were recorded every three nights, while the pheromone was replaced every 10 days.

Mean of adult counts between different treatments were compared using "t" test.

RESULTS AND DISCUSSION

In the biological control field, the predatory releases were carried out on basis of weekly surveying of tomato insect pests and pheromone trap catches.

Major insect pests of tomatoes:

Field examination of the tomato experimental field revealed that the major insect pests were *H. armigera, Spodoptera littoralis* and *S. exigua* larvae, in addition to jassids, *Bemisia tabaci* and aphids. The most of damage was caused by lepidopterous larvae especially in the first season, larvae fed on buds and flowers of tomato plants and may also bore into the stem and preferred the fruits. Generally, the period from the third week of June until the first week of July witnessed the serious lipedopterus larval infestation. In the first season (2008) in the biological control field, *Spodoptera* moths increased suddenly on June 17 (64 moths/3 nights) (Fig. 1) and reached the highest numbers on June 23 (86 moths/3 nights). Meanwhile, the highest infestation rate of tomato fruits was recorded in the third week of June (27.2%),

followed by 6.8% in the fourth week of June (Table 1). The infestation declined during July and reached to 0.3% in the third week of July. The overall mean of the infestation rate during 2008 season was 1.3%. Five releases of coccinellid predators were carried out during 2008 season in biological control field. In the insecticide treated field, the highest infestation in tomato fruits were recorded in the third week of June and in the second one of July, (6.5 and 5.2%, respectively), while the lowest rate of infestation (1.2%) occurred in the third week of July (Table 1). The overall mean of the infestation of tomato fruits in the first season in insecticide treated field was 3.8%. In the second season (2009), generally, no infestation was recorded with *Heliothis armigra* larvae, while only one moth of *Heliothis* was recorded throughout the whole season. In the biological control field, in spite of appearance of *Spodoptera* moths early in the pheromone trap (on April 24 with a rate, 18 moths/3 nights) (Fig. 2), no infestation was recorded until the third week of June (Table 1). The lowest infestation was recorded during the first and second weeks of July. The overall mean of infestation during 2009 in the biological control field was 0.2%. During this season, six releases of *C. undecimpunctata* and only one release of the parasitoid, *Trichogramma evanescens* was done in the biological control field. In the insecticide treated field, the highest infestation of tomato fruits occurred in the fourth week of June (6.1%) followed by 2.4% in the second week of July, while the lowest infestation was recorded in the third week of July (0.5% (Table 1). The overall mean of infestation was 2.7%. In this season, three insecticide treatments were applied. The present results are in agreement with those of Neeson 2004 who found the *Heliothis punctigra* and *H. armigera* were the most common insect pests that damage tomatoes. One key to a successful organic greenhouse operation is maintaining rigorous pests management (Dodson *et al.*, 2002). The present data also revealed that in spite of the increasing of *Spodoptera* male moths numbers in the pheromone traps late in the season, there was low infestation in tomato fruits. Similar finding was recorded by Mesbah (2007) who found that in late cotton season, the male moths of *Spodoptera littoralis* were attracted to the pheromone traps, while the females laid their eggs on nearby suitable crops. The differences between insects infestation in biological control field and insecticide-treated field were insignificant in 2008 season ($t = 0.906$), while they were highly significant in the second season ($t = 27.75$) (Table 1).

Table 1. Weekly production of tomato fruits and their infestation rates with lepidopterous worms in the biological control and insecticide treated fields.

Date (weekly)	2008 season				2009 season			
	Fruits production kg/fed.		Infested fruits %		Fruits production kg/fed.		Infested fruits %	
	B	I	B	I	B	I	B	I
June								
2nd week	0	0	0	0	96	0	0	0
3rd week	18	22	27.2	6.5	432	140	0	0.7
4th week	764	150	6.8	1.7	1032	132	0.4	6.1
July								
1st week	1710	511	2.1	1.6	2048	1001	0.1	2.0
2nd week	1380	1737	0.6	5.2	1716	1812	0.1	2.4
3rd week	4668	1369	0.3	1.2	480	728	0	0.5
4th week	604	78	0.7	1.4	-	-	-	-
Total	9174	3867	1.3	3.8	5804	3812	0.2	2.7
"t" calculated	1.66		0.906		1.53		27.75**	
"t" tabulated	2.57		2.57		2.57		2.57	

B = Biological control field.

I. = Insecticide –treated field

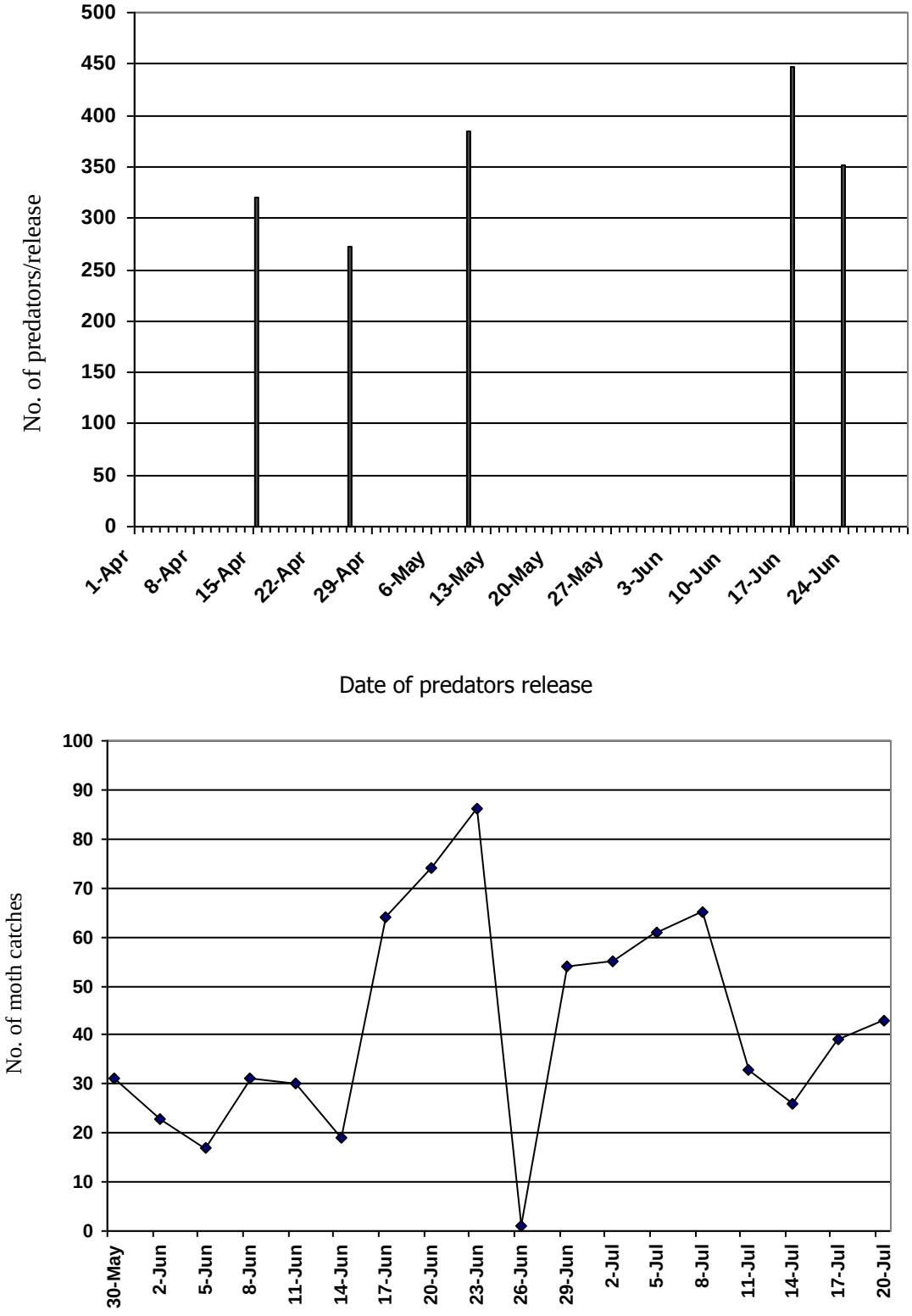

Fig. 1. Predatory releases and pheromone trap catches of *Spodoptera littoralis* male moths in 2008 season.

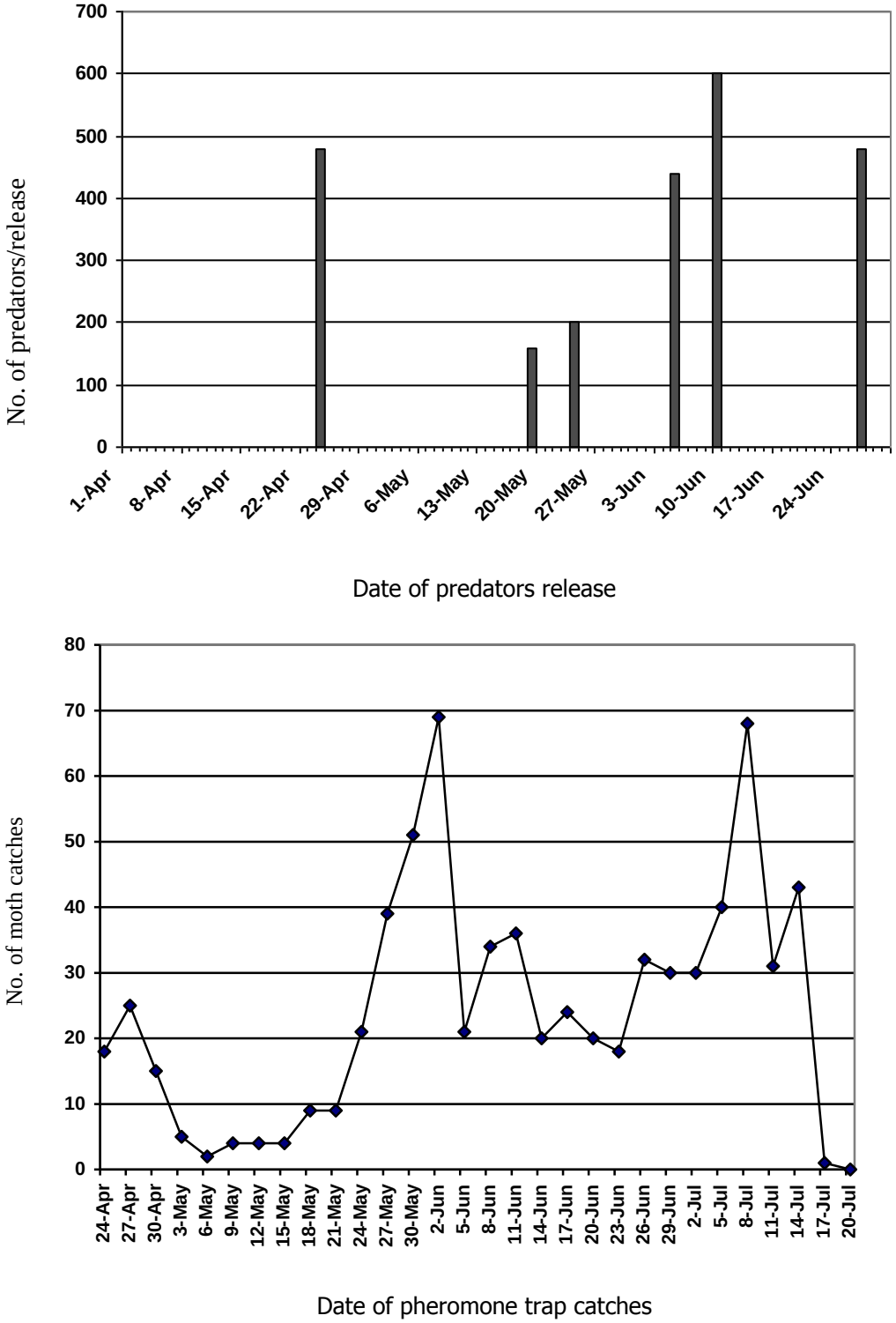

Fig. 2. Predatory releases and pheromone trap catches of *Spodoptera littoralis* male moths in 2009 season.

Tomato production:

Tomato production began in the two fields during the third week of June, 2008, (18 and 22 kg/fed., respectively, Table 1). The period from the third week of June until the third one of July was the real period of tomato production. The highest peaks of production in the biological control field during 2008 season were recorded in the first and third week of July (1740 and 4668 kg/fed., respectively). In insecticide-treated field, the major production was recorded in the second and third weeks of July, (1737 and 1369 kg/fed., respectively). The same trend was observed in the results in the second season (Table 1), where the highest production of tomato fruits in the biological control field was recorded from the third week of June (1032 kg/fed.) through the second week of July, 2048 kg/fed. and 1716 kg/fed. in the first week and the second week, respectively. Meanwhile, in insecticide treated field, they were 1001 and 1812 kg/fed., in the same period. The total production of tomato fruits in biological control field and insecticide treated one in 2009 seasons were 5804 and 3812 kg/fed., respectively. It is noteworthy that the harvest period in the second season (2009) was shorter than that of the first season due to cut off irrigation water in the experimental farm for a long time during the harvest period. However, the present results are not in line with those of Steffen *et. al.* (1995) who indicated that the yield produced under organic system is very similar to that produced by the conventional control. Differences between tomato yield in the biological control field and insecticide-treated one were insignificant in the two seasons 2008 and 2009, where calculated "t" = 1.66 and 1.53, respectively. It is noteworthy also that in spite of the increasing of tomato production in the biological control field during the two seasons as compared to the insecticide treated one, there was an increase in the infestation rates in insecticide treated field than that in biological control field during the two seasons (Table 1). On the other hand, there an increasing demand for production of insecticidal free products. Such unpolluted commodities are safe and healthy, as well as they could be sold in higher price. Besides, there is high merit in biological control system, where it keeps the environmente far from the pollution.

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المكافحة الحيوية لأفات الطماطم فى مصر

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أجريت هذه التجربة على نباتات الطماطم في مدينه مبارك للأبحاث العلمية والتطبيقات التكنولوجية بمدينه برج العرب الجديدة –الإسكندرية– مصر .خلال صيف موسمي 2008و2009وذلك مقارنة بحقل معامل بالمبيدات.

وكانت اخطر الآفات الحشرية في كلا الحقلين المكافحة الحيوية والمعامل بالمبيدات وهى دودة ثمار الطماطم الأمريكية ودودة ورق القطن الكبرى والصغرى .ولقد أعتدمدت المكافحة في حقل المكافحة الحيوية بصفه رئيسيه على إطلاق أنواع من مفترسات أبو العيد وكذلك طفيل التريكو جراما افنيسينس واعتمد إطلاق الأعداء الحيوية على تعداد الفراشات المصادة بواسطة المصائد الفرمونيه وكذلك الحصر الاسبوعى للآفات .

أما في حقل المكافحة التقليدية بالمبيدات فقد اعتمد على استخدام المبيدات الحشرية فقط.

في موسم 2008 تم إطلاق خمسه أطلاقات من مفترسات أبو العيد للأنواع أبو العيد 11 نقطه, أبو العيد 7نقط و أبو العيد 13 نقطه بنسبة 5:7:17 لكل منهم على التوالي وفى الموسم التالي تم إطلاق 6 أطلاقات من المفترس أبو العيد 11 نقطه بالإضافة إلى إطلاقه واحده من طفيل التريكوجراما افيسينيس أما في الحقل المعامل بالمبيدات قد تم معاملته بالمبيدات أربع مرات في موسم 2008وثلاثه معاملات في موسم 2009وقد كانت نسبه الإصابة في ثمار الطماطم في حقل المكافحة الحيوية في المواسم الأول 1.3% مقارنه ب3.8% في الحقل المعامل بالمبيدات و في الموسم الثاني كانت 0.2% و2.7% في حقل المكافحة الحيوية والحقل المعامل بالمبيدات على التوالي . وقد كان إنتاج الطماطم في الموسم الأول هو 9174كجم/ ف مقارنة

ب 3867كجم/ ف في حقل المكافحة الحيوية وحقل المعاملة الكيماوية على التوالي وفى الموسم الثانى (2009) 5804كج/ف و3812كج/ف فى حقل المكافحة الحيوية والحقل المعامل.