EFFICACY OF THE EGG PARASITOID Trichogramma evanescens WESTW. FOR CONTROLLING THE EUROPEAN CORN BORER Ostrinia nubilalis HBN. ON MAIZE PLANTATION

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ABSTRACT

The efficacy of field releases of the egg parasitoid, Trichogramma evanescens Westw. against Ostrinia nubilalis Hbn. on maize plantation were investigated at Giza region in 2000 and 2001 seasons. Five releases were made in 3 days intervals with a total release density of 60000 parasitoids/feddan to control an artificially placed egg masses of O. nubilalis. In 2000 season, the mean percentage of parasitism was 40.19% in the treated area and 2.88% in the untreated one. The died and lost eggs averaged 7.9% and 4.1% in the treated plots in comparison with 6.6% and 4.3% in control. The hatched eggs of O. nubilalis were 29.2 and 66.3% in the treated and untreated areas, respectively. For 2001 season, the highest percentage of parasitism occurred by the end of the release period with 73% in the released area and 29.83% natural parasitism in the unreleased one. The mean percentage of parasitism was 59.39% and 15.03%, in both areas, respectively. The percentage of died and lost eggs were 5.1% and 1.8% in the treated plots in comparison with 5.5% and 1.9% in untreated ones, in arrangement. The hatchability % of O. nubitalis eggs was 12.6 in the treated area and 55.8 in untreated one. The percentage of parasitoid emergence hole from O. nubilalis eggs ranged 72 to 80%.

The role of predation with the natural predators on suppressing *O. nubilalis* egg population were also determined. Direct observation of the predators on maize plants showed the presence of *Coccinella undecimpunctata* L., *Paederus alfierii* Kock., *Lapidura riparia* Pall., *Chrysoperla camea* (Steph.), *Syrphus corrollae* F., and *Scymnus subvillosus* The percentage of predation ranged 18.61 to 21.8% during both seasons.

INTRODUCTION

The European corn borer, Ostrinia nubitalis Hbn. is a serious pest threatening maize plants causing economic yield losses to them (Semeada et al., 1999). Recently this pest cause a damage to the new introduced sugar beet plants. The use of chemical insecticides is, still, a common practice for combating the pest in Egypt. It could be fairly stated that Trichogramma spp. are absolutely the most commonly used egg-parasitoids for insect pests control in many parts of the world (Abd El-Hafez 2001). Although several researchers have reported successes using the egg parasitoid Trichogramma evanescens. Westwood (Hymenoptera: Trichogrammatidae) against O. nubilalis on maize plants in other countries (Berger 1982, Neuffer 1982, Pasko et al. 1983, Tran et al. 1986 Hassan 1993, and Lisowicz & Kot 1999) and against Chilo agamemnon Bles. on sugar cane plants in Egypt (Abbas, et al. 1989, Abbas, et al. 1990 and El-Heneidy et al. 1990) while very little has been published on O. nubilalis in Egypt (Zanaty & Shenishen 1989 and Kares et al. 2002).

This paper is a contribution to the investigations on the efficacy of field releases of *T. evanescens* against *O. nubilalis* on maize plants as a further step towards the trails for augmentation of field applications of such parasitoid. However, role of predation with the natural predators on suppressing *O. nubilalis* egg population were determined.

MATERIALS AND METHODS

1. Experimental design:

This experiment was conducted at the Agricultural Experimental Farm of The Faculty of Agriculture, Cairo University, Giza in two successive seasons. Plots were seeded with the maize variety "Giza 2" on May 11, 2000 and June, 8, 2001 and received regular agricultural treatments but no chemical insecticides were applied. Each replicate consisted of two plots, each measuring 20x20 m. with about 120 and 90 m. apart between plots in 2000 and 2001 seasons, respectively. Each experiment containing 3 replicates (6 plots). Each plot consisted of 24 rows containing five release points for T. evanescens equally spaced in a x-shaped pattern. To avoid parasitoid drift by wind the experimental southern plots were allocated for the parasitoid release trials while the northern ones were left as control. Release cards were placed in the field release sites late in the afternoon to reduce mortality due to heat shock. The release card was hanged to a plant inside a carton tube covered tightly with 1.5 mm screen mesh lid on top and bottom to prevent predation by other insects and allow escaping of the emerging parasitoids. A week after each release the cards were collected and rate of parasitoid emergence was estimated.

2. Artificial infestation with O. nubilalis egg masses:

In each of the treated and untreated plots four and one blocks were determined, respectively. Each block consisted of 56 plants divided into four groups of 14 plants each. Each group received laboratory reared egg masses placed randomly at a rate of one egg mass on one of 14 plants per day for 14 days to represent an infestation of 100% of the group plants by the end of the 14 days. The laboratory reared egg masses were less than 12 hrs old and pinned near the midrib at the base of the leaf blade on the underside of leaf nearest the silking ear (Andow 1990). Those laboratory reared egg masses were removed after 24 hrs of exposure and reared in the laboratory.

3. Rearing technique:

To obtain the host (*O. nubilalis*) egg masses, a large number of hibernating larvae were collected from maize fields during October and November. Healthy ones were kept in plastic containers provided with cotton and refrigerated at 7±2 °C until next May. As required, the larvae were removed from refrigeration and exposed to laboratory condition until pupation then adults emergence. Pairs of adults were confined for oviposition into wiregauze cages covered daily with new wax paper to receive egg masses. The middle masses (about 20 eggs) were selected and prepared for field artificial infestation.

The parasite was maintained from parasitized egg masses of O. nubilalis collected from maize fields in Giza and reared at the laboratory on

Sitotroga. cerealella (Oliver) egg masses as described by Brower (1993) with an exception that the release card was 2×5 cm and containing about 230 parasitized eggs each.

4. Number and dates of releases:

To establish a continuous supply of the parasitoid, *S. cerealella* eggmasses were subjected to the parasitoid under laboratory condition throughout 3-4 days period. This facilitated the release of the parasitoid throughout a relatively longer period. Five releases, at a rate of about 12000 parasitoids/feddan each, were made in 3 days intervals starting from June 25, 2000 and July 22, 2001 thus making the total release density of about 60000 parasitoids /feddan.

5. Evaluation of release efficacy:

The laboratory reared *O. nubilalis* egg masses were exposed to the released parasitoid adults in the field for 24 hrs then removed and reared in the laboratory to calculate the number and percentage of parasitized, preyed, lost, died, and hatched eggs, as well as to determine the species and number of parasite emergence holes.

RESULTS

1. Efficacy of the parasitoid:

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Table (1) indicates that for the first season, the parasitism percentage with T. evanescens on O. nubilalis eggs in the release area ranged 27.96-40.12% one week after the 1st release (i.e. one day after the 3rd release) compared with 0.0-5.71% in untreated area. The rate of parasitism increased to 47.17% and ranged 0.0-14.83% in the release and control areas. respectively after the 4th release. Two weeks after the 1st release, parasitism rate reached its maximum 57.09% in the release area versus 2.5% in control area. Irrespective of sampling dates, the mean percentage of parasitism was 40.19% in the treated area against 2.88% in the untreated one. The died and lost eggs averaged 7.9% and 4.1% in the treated plots in comparison with 6.6% and 4.3% in control, respectively. The hatchability percentages of O. nubilalis eggs in the plots that received parasitoids ranged 33.1-42.2% after the 1st release then decreased to about 30% after the 3rd release then reached its minimum 12.4% by the end of collecting dates. By neglecting the collecting dates, average of hatchability was 29.2 and 66.3% in the treated and untreated areas, respectively. The percentage of emergence hole of the parasitoid from O. nubilalis eggs ranged 72.04 to 75.84%. Such percentage from the cards holding the rearing host eggs (S. cerealella) was 77.1%.

As for the second season (Table 2), the first release of *T. evanescens* increased the rate of parasitism on the artificially placed egg masses of *O. nubilalis* from 0.0-8.13% in unreleased area to 35.96-45.33% in the released one. Such rate increased after the second release to 66.15% in the release area versus 11.26% in control area. The highest percentage of parasitism occurred by the end of the second weeks with 73% in the treated area against 29.83% in the untreated one. Average parasitism of placed egg masses over the different sampling dates was 59.39% and 15.03%, in the release and control areas, respectively.

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Table (1): Effect maiz	و م و م	f parasitism with <i>Trichogramma evanescens</i> and plants in 2000 season.	ith <i>Trich</i> c season.	gramma	evanescer		predation on <i>Ostrinia nubilalis</i> eggs placed on	strinia nub	ilalis egg	s placed on
100100	Ž	No. of			Total numbers	s and percent	ages of collecte	P.		
ing	ğ	placed	Pa.	Parasited eqqs	preyed	died	died Lost	hatched eggs	l eggs	emergence holes
gale	masses	Eggs	ē	%				no.	%	
				Treated plo	ts) (
Jun-26	42	841	252	29.96	120	96	70	355	42.21	196
Jun-27	48	935	334	35.72	100	112	80	309	33.05	217
Jun-28	45	897	274	30.55	140	89	99	334	37.24	506
Jun-29	48	957	315	32.92	160	96	100	286	29.89	508
Jun-30	48	936	369	39.42	140	108	9	259	27.67	276
Jul-01	48	925	358	38.70	120	87	70	340	36.76	562
Jul-02	48	526	392	40.12	180	73	4	292	29.89	302
Jul-03	45	884	291	40.12	200	99	20	299	29.89	211
Jul-04	48	1058	407	38.47	220	29	09	312	29.49	302
Jul-05	48	972	383	39.40	200	90	20	309	31.79	267
90-Inf	48	935	441	47.17	260	38	40	156	16.68	381
Jul-07	48	919	463	50.38	180	29	0	217	23.61	334
Jul-08	48	978	478	48.88	220	44	0	236	24.13	378
60-In	48	895	511	57.09	200	53	50	111	12.40	421
Mean	099	13109	5268		2440	1040	540	3821		3995
%			40.19	•	18.61	7.93	4.12	29.15		75.84
		}			Untreated p	lots				
Jun-26	12	215	0		20	24	20	151	70.23	,
Jun-27	12	208	0		40	56	40	102	49.04	•
Jun-28	12	240	0		20	19	0	201	83 75	•
Jun-29	12	210	12		20	70	20	138	65.71	7
Jun-30	12	213	0	•	80	20	0	113	53.05	•
Jul-01	12	240	0	í	40	18	0	182	75.83	•
Jul-02	12	225	5	4.44	40	17	0	158	70.22	თ
Jul-03	12	240	0	,	09	13	50	147	61.25	•
Jul-04	12	245	50	8.16	8	6	0	136	55.51	15
Jul-05	12	240	0	,	20	==	50	189	78.75	•
30-lnc	12	236	32	14.83	40	7	0	154	65.25	24
Jul-07	12	234	0	,	9	12	0	122	52.14	•
3 n -08	12	240	9	4.17	20	æ	0	202	84.17	80
90-lnC	12	240	ဖ	2.50	9	9	8	144	00 09	4
Total	168	3226	93		640	214	140	2139		29
%			2.88		19.84	6.63	4.34	66.31		72.04

The percentage of emergence hole was about 80% in both areas. The same table explains that the emergence rate of the cards holding the rearing host eggs (S. cerealella) was 85.6%. The percentage of died and lost eggs were 5.1% and 1.8% in the plots that received parasitoids compared to 5.5% and 1.9% in untreated ones, respectively. The hatchability percentages of O. nubilalis eggs ranged 16.1-36.1% after the 1st release then decreased to 5.7% after the 3rd release then reached the least percentage 2.45 by the end of collecting dates. Over the different collecting dates hatchability was 12.6 and 55.8% in the treated and untreated areas, respectively.

2. Role of the natural predators:

In 2000 season, (Table 1) represents the percentage of predation of O. nubilalis eggs by the natural predators. Direct observation of the egg predators on maize plants showed the presence of Coccinelia undecimpunctata L., Paederus alfierii Kock., Lapidura riparia Pall., Chrysoperla carnea (Steph.), Syrphus corrollae F., and Scymnus subvillosus at the experimental region. The percentage of predation averaged 18.61% in the release area and 19.84% in control. In 2000 season, the natural predators preyed 21.1% of O. nubilalis eggs in the release area and 21.8% in the unreleased one (Table 1).

DISCUSSION

The relatively low rate of parasitism during the first season may be due to the lack of natural parasitism (2.88%) and low the parasitoid emergence rate from the cards holding its host eggs (77.1%). Saleh (1986) at Alexandria and Kares et al. (2002) at Qalubia reported 17-37% and 19-54% natural parasitism with *T. evanescens* on *O. nubilalis* in maize fields in Aug. and Sept. The percentage of parasitism increased by the end of the experimental period, possibly due to the establishment of a new generation of the parasite built up from the released individuals. Zanaty & Shenishen (1989) mentioned that the generation period of *T. evanescens* was about 12 days.

By excluding died, lost, and preyed eggs, Fig (1) illustrate that in 2000 season, the percentages of parasitized and hatched eggs were about 58 and 42% for treated plots against 4 and 96% for untreated one in arrangement. The corresponding percentages in 2001 season were about 82.5, 17.5, for treated plots against 21 and 79% for untreated one in arrangement. The percentages of parasitism obtained abroad by Neuffer (1982), Pasko et al. (1983), Tran et al. (1986), Hassan (1993), and Lisowicz & Kot (1999) go in line with these results. In Egypt, Kares et al. (2002) obtained 70-75% parasitism by releasing 66000 wasps/feddan.

Although several researchers (e.g., Ahmed 2001) surveyed the predators on maize plants at Giza reggion, The current study determined the percentages of predation on the *O. nubilalis* egg masses by the natural predators.

Such considerable rates of parasitism that obtained during both seasons through lights on *T. evanescens* as a satisfactory biocontrol agent for regulating O. *nubilalis* populations in maize fields in Egypt.

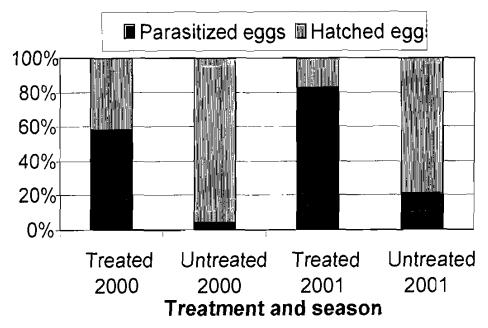


Fig (1): Percentages of hatched Ostrinia nubilalis eggs and those parasitized with Trichogramma evanescens in 2000 and 2001 seasons.

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كفاءة طفيل البيض (Trichogramma evanescens (Westwood فـــى مكافحــة دودة الذرة الأوربية في حقول الذرة الشامية

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درست كفاءة الإطلاقات الحقلية بطفيل البيض T. evanescens في مكافحة الإصابية بدودة الذرة الأوربية على نباتات الذرة الشامية في منطقة الجيزة خلال موسمي ٢٠٠٠، و ٢٠٠١. وقد تم الإطلاق بمعدل ٦٠ ألف طفيل/فدان موزعة على ٥ إطلاقات بفارق زمني ٣ أيام بين كل منهما على بيض الحشرة المربى معمليا والذي أجريت عدوى النباتات به يوميا لمدة أسبوعين.

و فى السنة الأولى أدى الإطلاق إلى رفع نسبة التطفل من ٢,٨٨ إلى ٢,٨٦ وكانت نسبة البيض الميت والبيض المفقود ٧,٩ و ٤,١ فى مساحة الإطلاق بالمقارنة بـــ ٢٠٦ و ٣,٤ فى المساحة غير المعاملة. بينما بلغت نسبة فقس بيض الحشرة ٢٩,٢ و ٢٩,٣ فى كلا المساحتين على الترتيب.

و فى السنة الثانية وصلت نسبة التطفل أقصاها ٧٧% في منطقة الإطلاق مقابل 7٩,٨٣ تطفل طبيعى فى منطقة المقارنة، وكان متوسط هذه النسبة ٥٩,٣٩ و ٥٩,٠٣ فى كلا المنطقتين على التوالى. وكانت نسبة البيض الميت والمفقود ٥٩ و ١٠,٨% فى مساحة الإطلاق مقارنة بـ ٥٠٠ و ١٢,٦ و ١٢,٦ و ٥,٠٥% في كلا المساحة غير المعاملة. بينما بلغت نسبة الفقس ٢٦٦١ و ٥,٠٥% في كلا المساحتين على الترتيب.

وتراوحت نسبة خروج الأفراد الكاملة للطفيل من بيض دودة الذرة الأوربية الموضــوع على النباتات بين ٧٢ و ٨٠٪، ومن بيض فراشة الحبوب المربى عليه الطفيل بيــن ٧٧،١ و ٨٥،٦ %. كذلك سجلت الدراسة تواجد العديد من المفترسات على النباتات والتي تسببت في خفض تعداد بيض دودة الذرة الأوربية بنسب تراوحت من ١٨,٦١ إلى ٢١,٨ ٢٪.