J. Agric. Sci. Mansoura Univ., 28(5): 4067 - 4075, 2003

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

Abdel-Aziz, Sahar Y.
Deptemartment of Economic Entomology and Pesticides, Fac. of Agric., Cairo Univ.

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. nubilalis* 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 carnea* (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 nubilalis* 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 wire-gauze 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 x 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* egg-masses 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:

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.

Table (2): Effect of parasitism with`` *Trichogramma evanescens* and predation on *Ostrinia nubilalis* eggs placed on maize plants in 2001 season.

Collecting Date	No. of placed		Total number and percentage of collected							
			Parasited eggs		preyed eggs	died eggs	Lost eggs	hatched eggs		Emergence holes
	masses	eggs	no.	%				no.	%	
Treated plots										
Jul-23	48	901	324	35.96	180	66	20	311	34.52	242
Jul-24	45	878	398	45.33	140	98	100	142	16.17	289
Jul-25	48	904	361	39.93	120	77	20	326	36.06	294
Jul-26	48	925	499	53.95	160	115	20	131	14.16	327
Jul-27	48	934	569	60.92	180	85	40	60	6.42	445
Jul-28	48	904	598	66.15	200	37	0	69	7.63	678
Jul-29	48	963	631	65.52	180	45	0	107	11.11	494
Jul-30	48	948	553	58.33	240	22	20	113	11.92	429
Jul-31	48	982	687	69.96	220	19	0	56	5.70	532
Aug-01	48	886	483	54.51	240	57	0	106	11.96	368
Aug-02	48	952	647	67.96	180	21	20	84	8.82	539
Aug-03	48	967	625	64.63	280	13	0	49	5.07	478
Aug-04	48	937	684	73.00	220	10	0	23	2.45	536
Aug-05	48	923	664	71.94	200	0	0	59	6.39	531
Total	669	13004	7723		2740	665	240	1636		6182
%				59.39	21.07	5.11	1.84	12.58		80.09
Untreated plots										
Jul-23	12	198	10	5.05	40	26	0	122	61.62	7
Jul-24	12	227	0	-	60	16	0	151	66.52	-
Jul-25	12	209	17	8.13	40	15	20	117	55.98	13
Jul-26	12	248	23	9.27	20	24	0	181	72.98	21
Jul-27	12	222	25	11.26	100	9	0	88	39.64	18
Jul-28	12	251	18	7.17	60	22	0	151	60.16	17
Jul-29	12	239	33	13.81	80	8	20	98	41.00	28
Jul-30	12	238	15	6.30	60	11	0	152	63.87	13
Jul-31	12	190	50	26.32	60	5	0	75	39.47	40
Aug-01	12	235	54	22.98	20	6	0	155	65.96	43
Aug-02	12	242	34	14.05	20	10	0	178	73.55	30
Aug-03	12	234	69	29.49	60	8	20	77	32.91	55
Aug-04	12	236	63	26.69	40	8	0	125	52.97	53
Aug-05	12	238	71	29.83	40	9	0	118	49.58	47
Total	168	3207	482		700	177	60	1788		385
%			15.03		21.83	5.52	1.87	55.75		79.88

Table (1): Effect of parasitism with *Trichogramma evanescens* and predation on *Ostrinia nubilalis* eggs placed on maize plants in 2000 season.

Collecting date	No. of placed		Total numbers and percentages of collected							
			Parasited eggs		preyed eggs	died eggs	Lost eggs	hatched eggs		emergence holes
	masses	Eggs	no.	%				no.	%	
Treated plots										
Jun-26	42	841	252	29.96	120	94	20	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	60	334	37.24	206
Jun-29	48	957	315	32.92	160	96	100	286	29.89	209
Jun-30	48	936	369	39.42	140	108	60	259	27.67	276
Jul-01	48	925	358	38.70	120	87	20	340	36.76	295
Jul-02	48	977	392	40.12	180	73	40	292	29.89	302
Jul-03	45	884	291	40.12	200	68	20	299	29.89	211
Jul-04	48	1058	407	38.47	220	59	60	312	29.49	302
Jul-05	48	972	383	39.40	200	60	20	309	31.79	267
Jul-06	48	935	441	47.17	260	38	40	156	16.68	381
Jul-07	48	919	463	50.38	180	59	0	217	23.61	334
Jul-08	48	978	478	48.88	220	44	0	236	24.13	378
Jul-09	48	895	511	57.09	200	53	20	111	12.40	421
Mean	660	13109	5268		2440	1040	540	3821		3995
%			40.19		18.61	7.93	4.12	29.15		75.84
Untreated plots										
Jun-26	12	215	0	-	20	24	20	151	70.23	-
Jun-27	12	208	0	-	40	26	40	102	49.04	-
Jun-28	12	240	0	-	20	19	0	201	83.75	-
Jun-29	12	210	12	5.71	20	20	20	138	65.71	7
Jun-30	12	213	0	-	80	20	0	113	53.05	-
Jul-01	12	240	0	-	40	18	0	182	75.83	-
Jul-02	12	225	10	4.44	40	17	0	158	70.22	9
Jul-03	12	240	0	-	60	13	20	147	61.25	-
Jul-04	12	245	20	8.16	80	9	0	136	55.51	15
Jul-05	12	240	0	-	20	11	20	189	78.75	-
Jul-06	12	236	35	14.83	40	7	0	154	65.25	24
Jul-07	12	234	0	-	100	12	0	122	52.14	-
Jul-08	12	240	10	4.17	20	8	0	202	84.17	8
Jul-09	12	240	6	2.50	60	10	20	144	60.00	4
Total	168	3226	93		640	214	140	2139		67
%			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 *Coccinella 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.

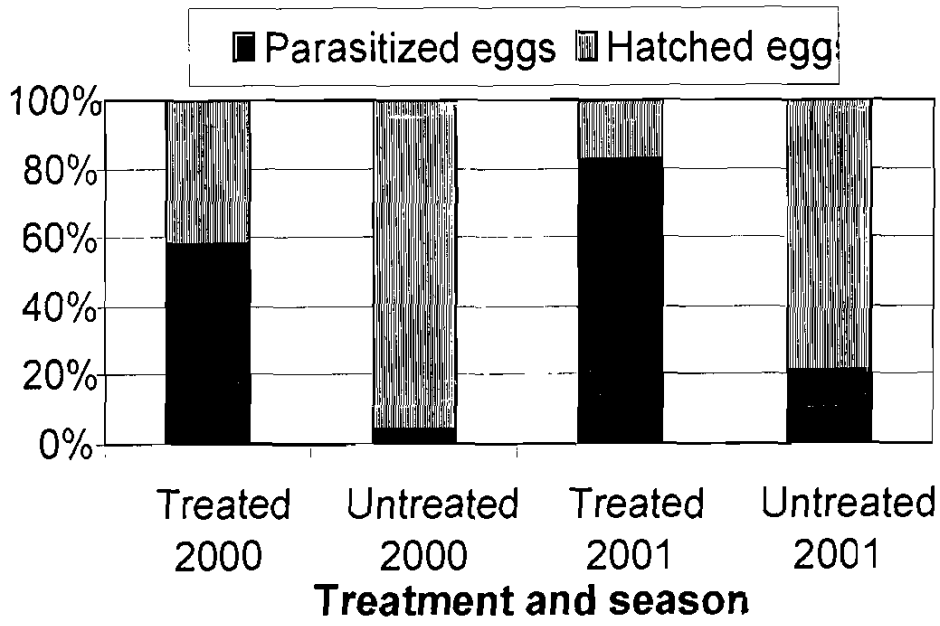

Fig (1): Percentages of hatched *Ostrinia nubilalis* eggs and those parasitized with *Trichogramma evanescens* in 2000 and 2001 seasons.

REFERENCES

Abbas, M.S.T.; A.H. El-Heneidy; S.I. El-Sherif and M.M. Embaby (1989). on utilization of *Trichogramma evanescens* to control the sugar-cane borer *Chilo agamemnon* in sugar cane fields in Egypt. I. Pilot studies Bull ent. Soc. Egypt, 17:57-62.

Abbas, M.S.T.; M.M. Embaby; A.R. Hamed and M.A. Ewaise (1990). Utilization of *Trichogramma evanescens* to control the sugar-cane borer *Chilo agamemnon* in sugar cane fields in Egypt. Release in 410 feddan Egypt. J. Appl. Sci., 5:220-224.

Abd El-Hafez, Alia (2001). The effect of egg size of the pink bollworm and some Lepidopterous insects on the quality attributes of *Trichogramma evanescens* and *Trichogrammatoidea bactrae*. Egypt. J. Biol. Pest Control, 11:1-13.

Ahmed, S.S. (2001): Ecological studies on certain insect pests infesting maize ears. M. Sc. Thesis, Fac. of Agric., Cairo Univ.

Andow, D.A. (1990). Characterization of predation on egg masses of *Ostrinia nubilalis* (Lepidoptera: Pyralidae). Ann Entomol. Soc. Am. 83: 482-486.

Berger, H. (1982). Results of European corn borer control with *Trichogramma evanescens* Westw. in Austria in 1981. Pflanzenarzt. 1982, 35: 2, 17-19.

Brower, J.H. (1993). Eggs of stored-product Lepidoptera as hosts for *Trichogramma evanescens* (Hym.: Trichogrammatidae). Entomophaga, 28: 355-362.

El-Heneidy A.H.; M.S.T. Abbas; M.M. Embaby; and M.A. Ewaise (1990). Utilization of *Trichogramma evanescens* to control the sugar-cane borer *Chilo agamemnon* in sugar cane fields in Egypt. 5-Approach towards large-scale release. In: 3rd International Symposium, San Antonio, Tx., USA. Trichogramma and other egg parasites "Les Colloques de l'INRA" 56: 187-190.

Hassan, S.A. (1993). The mass rearing and utilization of *Trichogramma* to control Lepidopterous pests: achievements and outlook. Pestic-sci. Essex: Elsevier App. Sci, 37: 387-391.

Kares, E.A.; A.A. Hafez; F.F. Shalaby and G.H. Ebaid (2002). Evaluation of *Trichogramma evanescens* (Westwood) and *Bacillus thuringiensis* as control management tools of *Ostrinia nubilalis* (Lepidoptera: Pyralidae) in corn fields at Qalubia Governorate. Egypt. J. Biol. Pest Control, 12:71-77.

Lisowicz, F. and J. Kot (1999). Effectiveness of *Trichogramma* spp. in controlling the European corn borer (*Ostrinia nubilalis* Hbn.) on maize. Progress in Plant Protection. 1999, 39: 493-495.

Neuffer , G. (1982). The use of *Trichogramma evanescens* Westw. in sweet corn fields. A contribution to the biological control of the European corn borer *Ostrinia nubilalis* Hbn. in southwest Germany. Trichogramma and other egg parasites "Les Colloques de l'INRA" 9: 231-237.

Pasko, A.K.; A.V. Barabash; A.M. Girinberg; A.F. Vorotyntseva; I.N. Boubeiryn and B.V. Pynzar (1983). Aerial distribution of *Trichogramma*. Zaschita Rastenii,7:17-23

Saleh, M.M. (1986). Ecological studies on certain corn borers in Egypt. M. Sc. Thesis, Fac. of Agric., Cairo Univ.

Semeada, A.M.; G. Fediere; M. El-Sheikh; and S.I. El-Sherif (1999). Current status of corn borers in maize fields and pilot utilization of ScGV as a biocontrol agent. J. Agric. Sci. Mansoura Univ., 24(11): 6265-6274.

Tran, L.C. ; R.Bustamante and S.A Hassan (1986). Release and recovery of *Trichogramma evanescens* on corn fields in the Philippines. Trichogramma and other egg parasites "Les Colloques de l'INRA" 43: 597-608.

Zanaty E.M. and Z. Shenishen (1989). Control of the European corn borer *Ostrinia nubilalis* Hubner, by utilization of sterilized moths and the egg parasitoid *Trichogramma evanescens* (Westwood.) Bull ent. Soc. Egypt, 17:29-36.

J. Agric. Sci. Mansoura Univ., 28(5), May, 2003

كفاءة طفيل البيض *Trichogramma evanescens* (Westwood.) فـــى مكافحـــة دودة الذرة الأوربية فى حقول الذرة الشامية

سحر ياسين عبد العزيز
قسم الحشرات الاقتصادية والمبيدات - كلية الزراعة - جامعة القاهرة - الجيزة

درست كفاءة الإطلاقات الحقلية بطفيل البيض *T. evanescens* فى مكافحة الإصابة بدودة الذرة الأوربية على نباتات الذرة الشامية فى منطقة الجيزة خلال موسمى ٢٠٠٠، و٢٠٠١. وقد تم الإطلاق بمعدل ٦٠ ألف طفيل/فدان موزعة على ٥ إطلاقات بفارق زمنى ٣ أيام بين كـــل منهما على بيض الحشرة المربى معمليا والذى أجريت عدوى النباتات به يوميا لمدة أسبوعين.

و فى السنة الأولى أدى الإطلاق إلى رفع نسبة التطفل من ٢,٨٨ إلى ٤٠,١٦%. وكانت نسبة البيض الميت والبيض المفقود ٧,٩ و٤,١% فى مساحة الإطلاق بالمقارنة بـــ ٦.٦ و ٤,٣% فى المساحة غير المعاملة. بينما بلغت نسبة فقس بيض الحشرة ٢٩,٢ و٦٦,٣% فى كلا المساحتين على الترتيب.

و فى السنة الثانية وصلت نسبة التطفل أقصاها ٧٣% فـــى منطقـــة الإطـــلاق مقـــابل ٢٩,٨٣% تطفل طبيعى فى منطقة المقارنة، وكان متوسط هذه النسبة ٥٩,٣٩ و١٥,٠٣% فى كـــلا المنطقتين على التوالى. وكانت نسبة البيض الميت والمفقود ٥,١ و١,٨% فى مســـاحة الإطـــلاق مقارنة بـــ ٥.٥ و ١,٩% فى المساحة غير المعاملة. بينما بلغت نسبة الفقس ١٢,٦ و٥٥,٨% فـــى كلا المساحتين على الترتيب.

وتراوحت نسبة خروج الأفراد الكاملة للطفيل من بيض دودة الذرة الأوربية الموضـــوع على النباتات بين ٧٢ و٨٠%، ومن بيض فراشة الحبوب المربى عليه الطفيل بيـــن ٧٧,١ و٨٥,٦ %. كذلك سجلت الدراسة تواجد العديد من المفترسات على النباتات والتى تسببت فى خفض تعداد بيض دودة الذرة الأوربية بنسب تراوحت من ١٨,٦١ إلى ٢١,٨%.