

Assessment of Dispersal and Parasitism of the Laboratory Reared *Trichogramma evanescens* West. Under Field Conditions.

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ABSTRACT

Trials were conducted in a cotton field at Qaha Research Station, Qalubia governorate, Egypt, to evaluate the dispersal ability and parasitism rate by the egg parasitoid *Trichogramma evanescens* West. (Hymenoptera: Trichogrammatidae), as well, to estimate the effect of parasitoid density from the releasing site on parasitism rate. Obtained data showed a limited dispersal ability for the parasitoid. The parasitism rates at 0, 50, 100, 150 and 200 cm. differed statistically from each other, being highest in the *S. cerealella* eggs placed at the shortest distance (43.03, 18.12, 10.92, 8.77 and 5.6%, respectively). The effect of releasing point and density on parasitism rate were also estimated. Increasing parasitoid density raised the rate of parasitism. When 2000, 3000 and 4000 parasitoids were released from the release point, the parasitism rates (mean percent ages for the whole 5 distances), were 33.21, 38.13 and 42.65%, respectively.

Keywords: *Trichogramma evanescens*, Dispersal ability, parasitism.

INTRODUCTION

Trichogramma species (Hymenoptera: Trichogrammatidae) are widely used egg parasitoids for biological control of insect pest species on different crops through augmentation and release. It is a natural enemy of many harmful lepidopteran insect pest species on crops and vegetables (Jalali and Singh, 1993). *Trichogramma* has been used against the lepidopteran pests of cotton, cabbage, apple and tomato (Smith, 1996).

Dispersal ability and parasitization rate of parasitoid wasps under field conditions are desired characteristics for success of biological control programs. Determining the dispersal ability of *Trichogramma evanescens* West. in the field is important for developing effective releasing techniques and for predicting the efficiency of such releases. Dispersal ability not only ensures that insects become uniformly distributed within the releasing areas, but can also reduce the number of release points per unit area, (Wright *et al.* 2001).

One of the factors which has a clear influence on the efficiency of bio-control release systems is the dispersal and host-location behavior of the released wasps (e.g. Bigler, 1994). From the behavior factors; walking or flying, is most important for dispersal of *Trichogramma*, is still a matter of controversy (Flanders, 1937; Smits, 1982; Pak *et al.*, 1985). After mating at the site of emergence, which is the first priority for arrhenothokous, *Trichogramma*, the female starts searching for hosts. If suitable hosts are not present in the immediate vicinity, the parasitoid has to move away from the place of emergence in order to locate a host patch. After the females have mated and left, the males will also have to disperse if they are to mate again (Keller *et al.*, 1985).

Many factors influence the speed of *Trichogramma* dispersal, such as wind speed, crop type and total leaf area of the crop (Bigler, 1983).

The distance from the release point at which a sufficient level of parasitism is found varies from 5 to 50 m, depending on the *Trichogramma* species and the crop (Franz and Voegelé, 1974).

The present study aimed to estimate the *T. evanescens* dispersal under field conditions, as indicator of searching capacity. As well, the rates of parasitism were compared with at various densities from release points.

MATERIALS AND METHODS

1. Rearing of the parasitoid and hosts:

The eggs of Angoumois grain moth *Sitotroga cerealella* (Oliver), used as a rearing host for *Trichogramma*, were obtained from its rearing laboratory in the Plant Protection Research Institute, Agricultural Research Center, Giza, Egypt. The parasitoid *T. evanescens* was reared on *S. cerealella* eggs (<24 hrs. age); eggs were glued on cardboard stripes and then offered for *Trichogramma* adults at the ratio of one parasitoid card to three host egg cards in glass jars (2-liter capacity). Egg cards were renewed daily to avoid super-parasitism.

A preliminary experiment was carried out in a cotton field of about 1/2 a feddan located at Qaha Agricultural Research station, Qalubia governorate in order to determine the flying distance of *Trichogramma* adults. Within this area, a total of 60 replicates of about 4x4m. each were chosen for receiving the desired treatments (15 for dispersal) of *Trichogramma* adults and 45 for studying the effect of density of released adults. Generally, no parasitism was observed to occur at 300 cm. distance from releasing center.

2. Dispersal ability of *Trichogramma* on cotton plants:

The center of each plot was the site of starting release. At this site, a card containing 1000 parasitised blackish eggs just before emergence or of few adults emerged was stapled to plant leaves at 50 cm. height from the ground. A card containing 500 unparasitised *S. cerealella* eggs was stapled to cotton leaves (at 50 cm. height from the ground at any of the experimented distances (0, 50, 100, 150 and 200 cm. from the releasing center. Another 9 cards were stapled around the releasing point at the same distance (Fig. 1).

After 24 h of release, *S. cerealella* cards were collected and incubated at 25 °C. Parasitism was assessed by checking for the presence of blackened eggs, and the number of parasitized eggs was counted on each egg card.

3. Effect of density of parasitoid at the releasing point on parasitism percent :

In the second experiment, the parasitized eggs card of the desired density (2000, 3000 or 4000 eggs just before adults emergence or of few adults emerged) were stapled, each eggs density at the same mentioned distances.

Analysis of variance was done on all data (one and two ways ANOVA) and Duncan's multiple range test was used to separate the means (Snedecor & Cochran 1980).

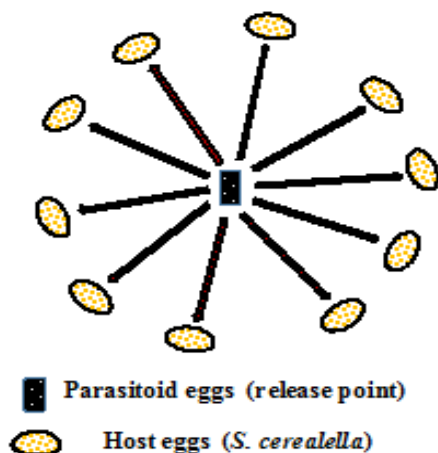


Fig. 1. Diagram showing the release point (Parasitoid egg cards) surrounded by the host eggs.

RESULTS AND DISCUSSIONS

a. Dispersal ability of *Trichogramma* on cotton plants:

Data given in Table 1(1), indicated that the parasitism rate by *Trichogramma* in *S. cerealella* eggs decreased as the pest eggs were farther from the parasitoid releasing sites. The parasitism rates at 0, 50 100, 150 and 200 cm from releasing site differed statistically from each other, being highest in the *S. cerealella* eggs placed at the shortest distance (43.03, 18.12, 10.92, 8.77 and 5.6%, respectively). The distance at which the emerging parasitoid adults can disperse from a release point is one of the most important factors in a *Trichogramma* program, (McDougall *et al.* 1997). Decreases in the parasitization rate by *Trichogramma* were reported to be dependent on the distance from release points in crop fields, fruit orchards, and forest stands (Bigler *et al.* 1988; Smith 1988; Castaneda 1990 and Wang and Ship 2004). In the present study, decreases in parasitism rates were also recorded on cotton plants as the distance from the release points was longer. The results in this trial showed that the parasitism rate for all designed distances during the 1st day after release was 25.9%, while in the 2nd day it was 16.2% and finally during the 3rd day it was 9.4%.

Table 1. Parasitization of *Trichogramma evanescens* at different distances from the release points during 3 days in the cotton field.

Distance from release point (Cm)	N	Days after release						Mean of total parasitized eggs	% of total parasitism
		1 st day		2 nd day		3 rd day			
		M. Number of parasitized eggs	% parasitism	M. Number of parasitized eggs	% parasitism	M. Number of parasitized eggs	% parasitism		
Zero (0)	500	344.4±35.9 ^a	68.9	203.4 ± 5.1 ^a	40.68	97.6 ± 7.1 ^a	19.52	645.4	43.03
50	500	116.0 ± 5.7 ^b	23.2	93.6 ± 5.3 ^b	18.72	62.2 ± 8.2 ^b	12.44	271.8	18.12
100	500	74.0 ± 6.4 ^c	14.8	46.4 ± 6.2 ^c	9.28	34.0 ± 4.2 ^c	6.8	154.4	10.29
150	500	64.0 ± 4.9 ^c	12.8	38.0 ± 3.8 ^d	7.6	29.6 ± 3.9 ^c	5.92	131.6	8.77
200	500	49.8 ± 4.8 ^c	9.96	22.6 ± 3.4 ^c	4.52	11.6 ± 2.2 ^c	2.32	84.0	5.6
300	500	0	0	0	0	0	0	0	0
Mean% parasitism			25.9		16.2		9.4		
L.S.D		22.17		6.41		7.30			

Means followed by the same small litter at the same column are not significantly different

Many studies have shown that parasitism by *T. evanescens* decreased with a distance of (4-50 m) from the release point in field crops, fruit orchards, or forest stands (Yu *et al.*, 1984; Bigler *et al.*, 1988; Smith, 1988). Wang *et al.* (1996) found that most *Trichogramma ostrinae* dispersed only 2 m from the release point in greenhouses, which is similar to the results from the present study for *T. evanescens*. The limited ability of dispersal in the current study was unexpected as the trial was conducted in open cotton field with fully developed plant canopy, the plant canopy was continuous from plant to another (i.e., plants touch each other), also, the released species was *T. evanescens* which is the Egyptian local strain known to be used in the Egyptian cotton plantations. The limited ability of dispersal for *T. evanescens* in the present work may be attributed to its rearing for decades in the laboratory, so more research studies should be implemented upon other crop host plants as well in fruit orchards to determine the reason and to design other trials to improve the parasitoid dispersal capacity.

b. Effect of release point density:

Data presented in Table 2, confirmed that increased parasitoid density caused an increase in the rate of parasitism in *S. cerealella* eggs.

Means followed by the same small litter at the same row are not significantly different. Data showed that when 2000, 3000 and 4000 parasitoids were released from the release point, the parasitism rates (mean percentages for the overall mean of 5 distances), were 33.21, 38.13 and 42.65%, respectively. The results confirmed that the highest rate of parasitism (87.76%) was recorded at zero distance when the parasitoid density was 4000. On the other hand, the lowest percentage of parasitism (14.64%) occurred at 200 cm distance when the parasitoid density was 2000. Slight (nonsignificant) changes were observed for parasitism rates between the two distances 100 and 150 cm with the same parasitoid density, those were (20.88 and 19.44%), (25.08 and 24.6) and (31.04 and 28.2%) for the parasitoid densities 2000, 3000, and 4000 respectively for the two mentioned distances 100 and 150 cm., respectively.

Table 2. Parasitism rate with *T. evanescens* according to parasitoid density at different distances from the release point in cotton plantations

Distance from release point (cm.)	Number of parasitized eggs at different parasitoid densities			
	2000	3000	4000	L.S.D
Zero (0)	399.8±8.35 ^c	421.2±7.19 ^b	438.8±4.21 ^a	9.38
% Parasitization	79.96	84.24	87.76	
50	155.6±5.41 ^c	192.6±5.13 ^b	223.4±12.42 ^a	11.53
% Parasitization	31.12	38.52	44.68	
100	104.4±4.98 ^c	125.4±7.96 ^b	155.2±8.26 ^a	9.95
% Parasitization	20.88	25.08	31.04	
150	97.2±5.40 ^c	123.0±6.86 ^b	141.0±8.32 ^a	9.59
% Parasitization	19.44	24.6	28.2	
200	73.2±6.38 ^c	91.0±7.01 ^b	107.8±5.40 ^a	8.98
% Parasitization	14.64	18.2	21.56	
Total No. of host eggs	2500	2500	2500	
Overall%Parasitization	33.21	38.13	42.65	

CONCLUSION

It could be concluded that the local strain of the laboratory reared *T. evanescens* showed a limited ability of dispersal in cotton plantations. Also, results showed a low parasitism rate that slightly increased in case of increasing the parasitoid density. Furthermore, other research projects should be conducted for improving both dispersal ability and parasitism rate by introducing naturally occurring parasitoid individuals to be involved in laboratory rearing. Moreover, cytogenetic studies have to be conducted to search for the best methods of improving the dispersal ability and parasitism rate by *T. evanescens* parasitoids, in order to be recommended.

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قياس قدرة الانتشار والتطفل تحت الظروف الحقلية لطفيال الترايوجراما *Trichogramma evanescens* West. المربي معليا .

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اجريت التجارب على محصول القطن في محطة بحوث قها محافظة القليوبية لتقييم قدرة الانتشار ومعدل التطفل لطفيال البيض الترايوجراما وكذلك لتقييم زيادة كثافة الطفيليات من مكان الاطلاق على معدل التطفل . وقد اظهرت النتائج المتحصل عليها قدرة محدودة للطفيل على الانتشار وكذلك اختلفت معدلات التطفل عند مسافات الاطلاق صفر ١٥٠٠، ١٠٠٠، ٥٠٠، ٢٠٠ سم ، حيث كانت اعلى نسبة تطفل على بيض فراش الحبوب عندما وُضع على اقل مسافة (٤٣،٠٣ ، ١٢ ، ١٨ ، ٩٢ ، ١٠٠ ، ٧٧ ، ٨ ، ٥ ، ٦ % على التوالي) . تمت ايضا دراسة تأثير زيادة كثافة الطفيل عند نقطة الاطلاق على معدل التطفل وأدت زيادة الطفيليات من نقطة الاطلاق الى زيادة معدل التطفل عندما تم الاطلاق بكثافات ٢٠٠٠ ، ٣٠٠٠ و ٤٠٠٠ طفيل وكانت معدلات التطفل بالنسبة للمسافات الخمسة (متوسط النسبة المئوية للمسافات الخمسة كلها) ٣٣،٢١ ، ٣٨،١٣ و ٤٢،٦٥ % على التوالي.