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PARASITISM AND BIOLOGY OF THE EGG PARASITOID, *Trichogramma evanescens* WESTW. IN RELATION TO VARIOUS HOST INSECTS AT KAFR EL-SHEIKH REGION.

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ABSTRACT

Percentages of natural parasitism by *Trichogramma evanescens* Westw. were highest in eggs of *Ostrinia nubilalis* Hub. followed by those of *Chilo agamemnon* Bles., *Sesamia cretica* Led. and *Spodoptera littoralis* Biosd. However, biological characteristics of produced parasites indicated that *S. cretica* was the most suitable host for the parasite.

Natural parasitism of *O. nubilalis* eggs was higher in maize fields than that of *C. agamemnon* in rice fields and *S. littoralis* in cotton fields. It was found that *S. littoralis* eggs was covered with fur which acted as a mechanical barrier for parasitism. Parasites reared on *S. cretica* have longer durations of longevity and longer life-cycle besides a higher sex ratio in adult emerging and oviposition and post-oviposition period. *Sitotroga cerallella* Oliv. was found to be a moderately suitable host for the parasite. The laboratory strain of the parasite came inferior to the field strain.

INTRODUCTION

The egg parasitoid, *Trichogramma evanescens* Westw. (Hymenoptera: Trichogrammatidae) is an important excellent biocontrol agent, it is very small so that large population can be reared in a small space. Its life-cycle at 25°C occupies only 10 days and it can easily and continuously reared in the laboratory Salt (1934). Observations in Kafr El-Sheikh region indicated that the egg-masses of *Ostrinia nubilalis* Hub. (Lepidoptera: Pyraustidae) and *Chilo agamemnon* Bles. (Lepidoptera: Pyralidae) were highly parasitized upon with the egg parasitoid; *T. evanescens* late in the season.

The efficiency of *T. evanescens* as a biocontrol agent against *O. nubilalis* has been demonstrated by several investigators in USSR (Shchepetil 'nikova and Murashevskaya 1979) in Germany (Hassan and Heil, 1980), in Egypt (El-Sherif H. A. F. 1979), ((Abbas *et al,* 1989) and (Metwally 2000).

The present investigation is a further step in that direction. It aimed, therefore, towards a study on biology and parasitism of *T. evanescens* on certain economically important lepidopterous pests, *Spodoptera littoralis* Biosd., *S. cretica* (Lepidoptera: Noctuidae), *C. agamemnon* (Fam. Pyralidae), *O. nubilalis* (Fam.Pyraustidae), and *Sitotroga cerealellae* Oliv (Fam. Gelechiidae). Such information are necessary in developing pest management programs for the considered pests.

MATERIALS AND METHODS

Hosts and parasite cultures:

Cultures were maintained under constant laboratory conditions of 27.5±1.5 °C and 65±5 R.H. Egg-masses of *S. littoralis, C. agamemnon, O. nubilalis* and *S. cretica* were collected from cotton, rice and maize fields at

Kafr El-Sheikh region in June 2006. *S. littoralis* larvae were then maintained on castor leaves and emerging moths were oviposited on castor branches. *C. agamemnon, O. nubilalis* and *S. cretica* were reared on maize cutting stems and resulting moths were oviposited on wax paper. *S. cereallella* was maintained on maize flour and its eggs were obtained by sieving the latter.

The parasite culture started with parasitized egg-masses of *O. nubilalis* collected from maize fields at Kafr El-Sheikh in September 2006, then maintained on *S. cerellella* egg for 15 generations until August 2007.

Assessment of natural parasitism:

A lot of about 2000 eggs of each host was collected from the field at about 15 days intervals on 22/8, 6/9, 21/9 and 6/10/2007. parasitized hosts were daily examined. It was found that unparasitized eggs hatch while parasitized ones acquire black color and were further dissected under the binocular microscope to affirm parasitism by *T. evanescens*. Percentage of parasitism were then assessed.

Field and laboratory experiments:

Eggs of the hosts were exposed to the parasite once in a maize field and another in the laboratory. For each host, 4 lots (each of 200 eggs) were used. Eggs of each lot were sticked on a card using 2% Arabian gum solution. In field experiment the cards (4 lots × 4 hosts = 16) were distributed about 20 m apart, each being attached to a maize leaf.

As for the laboratory experiment, the 16 cards were placed inside a beaker covered with gauze, in a random way, and ovipositing parasites placed with them. In both experiments, parasites were allowed to oviposit for one day, hosts were then incubated. From the 4^{th} day on, unparasitized eggs started to hatch while parasitized ones acquired black color and their parasitism was further affirmed by dissection. Both experiments (field and laboratory) were conducted on 29/9 and repeated on 4/10/2007. percentage of parasitism in each lot for each host was obtained and average percentage of parasitism was calculated.

Biology:

According to Hassan (1981) hosts, including *S. cereallella* were exposed to the parasite (Lab. strain) *S. cereallella* was further exposed to the parasite in the field (field strain) in order to compare biological capabilities of the laboratory parasite (which had been maintained in the laboratory for 15 generations) with that of field parasite. Exposure of hosts eggs to the laboratory parasite was made in a beaker covered with gauze, while exposing *S. cereallella* to field parasite was carried by attaching cards containing its eggs to maize leaves in the field. Each 4 lots (200 eggs each) of each host was exposed to the parasite for one day and then incubated. They were daily observed to register date at which parasitized eggs turn black indicating the end of larval period. Parasites emerging from each lot were daily counted, in order to determine pupal duration.

As for determining fecundity and longevity, 10 pairs of newly emerged individuals resulting from each host were chosen randomly. Each pair was confined with 200 hosts which were daily renewed, until death. Number of daily parasitized hosts, number of daily resulting progeny and their sex, longevity of both sexes, oviposition period, post oviposition period and percentage of adult emergence were all determined.

Hosts eggs were weighted in order to relate biology of *T. evanescens* on different hosts with size of the host. Four lots (200 eggs each) of each host were weighted and mean weight was calculated.

RESULTS AND DISCUSSION

Table (1): Percentage of parasitism by *T. evanescens* on different host insects infesting different host plants in the field (2007).

Date of inspection	Natural parasitism (%)			
	***O. nubilalis* on maize**	***C. agamemnon* on rice**	***S. littoralis* on cotton**	
			Without fur	**With fur**
22/8	8.2	7.2	2.3	0.00
6/9	42.6	40.5	16.8	0.00
21/9	83.4	66.7	28.7	0.00
6/10	89.6	78.6	@	@

@ no available data

Table (1) shows that percentages of natural parasitism increased with the progressive time of year from 22.8 on, to reach the highest values on 6[th] of October, value obtained for *O. nubilalis* on maize was the highest, followed by that of *C. agamemnon* on rice and then *S. littoralis* on cotton. With regard to *S. littoralis* it was found that egg masses covered tightly with dense fur were unparasitizable. Whereas, those bare or lightly covered with fur were amenable to parasitism. Dense fur seems to act as mechanical barrier and thus protects eggs from parasitism. This point was further confirmed in the laboratory by exposing covered and bare egg-masses to the parasite and the same results was obtained, thus reaching the same conclusion. Portion of *S. littoralis* eggs which were laid naturally bare was determined by collecting 100 egg-masses from the field and classifying them into egg-masses covered with fur (31), egg-masses partly covered with fur (44) and bare egg-masses (25). It was revealed that *O. nubilalis* was the most preferred host, followed by *C. agamemnon* and then *S. littoralis*.

Table (2): Parasitism by *T. evanescens* in different hosts both in the field and in the laboratory.

Host	Parasitism (%)	
	Field exp.	**Laboratory exp.**
O. nubilalis	79.2	88.0
C. agamemnon	67.4	85.5
S. cretica	52.3	69.2
S. littoralis	42.4	62.3

It was shown that *S. littoralis* eggs covered with fur which acted as a mechanical barrier for their parasitism by *T. evanescens* great portion of eggs was therefore unamenable to this mortality factor. This is probably the reason why Kamal (1951) could not obtain control of this pest by periodic colonization of this parasite, in Egypt.

Data in Table (2) indicated that eggs of *O. nubilalis* exposed artificially to the parasite in the field yielded highest rate of parasitism by *T.*

evanescens followed by those of *C. agamemnon* , *S. cretica* and then *S. littoralis*. Also, parasitism values obtained in the laboratory came in the same trend of field experiment but values were generally higher than their respective field values. These results are in agreement with Hassan and Heil (1980) who recorded that *T. evanescens* is one of the most recommended parasite species for controlling the pests since it is effective parasite on *O. nubilalis* eggs. Neuffer (1980) concluded that using *T. evanescens* for controlling *O. nubilalis* showed a clear reduction in maize infestation by the borer and gave an increase in the yield.

Table (3): Weight of eggs on different hosts.

Host	Weight of host's egg in µg	
	Mean ± S.D.	Range
S. cretica	146.5±6.2	141.6 – 128.7
S. littoralis	52.4±3.3	45.6 – 56.5
O. nubilalis	44.3±6.7	36.2 – 48.2
C. agamemnon	36.2±4.2	31.3 – 35.5
S. cereallella	32.3±4.2	28.5 – 39.2

Table (3) shows that egg of *S. cretica* came heaviest (146.5 µg) followed by that of *S. littoralis* (52.4), *O. nubilalis* (44.3), *C. agamemnon* (36.2) and then *S. cereallella* (32.3).

Data in Table (4) show that the parasite (both sexs) seem to have longer durations of immature stages, longer longevity and longer life-cycle when reared on *S. cretica* and *S. cereallella* (both parasite strains) than when produced on other tested hosts. The same Table indicates that, number of parasitized hosts per female and fecundity were significantly higher in parasites reared on *S. cretica* than in those reared on other tested hosts.

Numbers of parasites per individual host was highest in parasites reared on *S. cretica* (3.2) followed by those reared on *C. agamemnon* (1.8), *O. nubilalis* (1.3), *S. cereallella* (1.2) and *S. littoralis* (1.1). the lowest sex ratio was found in parasites raised on *S. cretrica* (1.80) followed by that of those reared on *C. agamemnon* (2.81) *O. nubilalis* (3.00), *S. cereallella* (3.25) and *S. littoralis* (3.29). Thus, as number of parasites per individual host increased sex-ratio decreased. The percentage of adult emergence was highest in parasites reared on *S. cretica* followed by those on *S. cereallella, O. nubilalis, C. agamemnon* and *S. littoralis*. Ovipostion period was less than post oviposition period in all cases.

However, all biological criteria proved that *S. cretica* seemed to be the best host for the parasite, as life-cycle duration, number of parasitized hosts, fecundity, mean number of parasites per individual host and percentage of adult emergence were all higher for parasites raised on this host than those raised on other tested hosts, the other three hosts, *i.e.*, *C. agamemnon, O. nubilalis* and *S. littoralis* could be arranged discerningly as follows, *C. agamemnon, O. nubilalis* and *S. littoralis* on bases of fecundity, mean number of parasites per individual host and percentage of adult emergence. It was shown that sex ratio of parasites (produced on *S. cretica*) decreased as emergence was delayed.

T4

It was stated that parasites in their oviposition period may choose preferred hosts on basis of their quality and size, the frequency of which decreases as time elapse, accordingly, parasites emerging late would be those which were laid as eggs in smaller, less preferred hosts than those emerging early. Since Clausen (1939), Flanders (1939) and Abd El-Rahman (1974) reported that unpreferred hosts yielded smaller parasites of a lower sex-ratio than preferred ones.

As for rearing host *S. cereallella,* it was shown to be a moderately suitable host for the parasite, despite that its egg is smaller than those of all other hosts it yielded parasites of longer life cycle and higher percentage of adult emergence than all other tested hosts excepting *S. cretica;* produced larger adult parasites than *C. agamemnon* and *O. nubilalis*. However, because of its easiness and cheapness to rear in the laboratory when compared with other studied hosts, it may be considered to be the most suitable as a rearing host for *T. evanescens*.

The biological characteristics of the laboratory strain of *T. evanescens* was compared with those of the field strain of the same host. The laboratory strain was found to be inferior to the field strain in many biological characters. It was significantly less (P = 0.05) in number of parasitized hosts and fecundity than the field strain. It was also smaller in size and slightly less in life cycle duration and percentage of adult emergence than in the field strain. Therefore, as has been suggested by Kovalenkon (1980) and Ram *et al.* (1995), *Trichogramma* spp. maintained in the laboratory must be reinforced periodically with field material to prevent loss of quality.

REFERENCES

Abbas, M. S. T.; A. H. El-Heneidy; M. M. Emnaby and M. A. Ewais (1989). Utilization of *Trichogramma evanescens* to control the lesser sugar-can borer, *Chilo agamemnon* Bles. in sugar-cane in Egypt. 3-three wave release technique, Pro. 1st Int. Conf. Econ. Ent. 11, 87.

Abd El-Rahman, I. (1974). Studies on ovipositional behavior and control of sex in *Aphytis melinus* De Bach, a parasite of California red scale, *Aonidiella aurantii* (Mask.). Aust. J. Zool. 22: 231 – 47.

Clausen, C. P. (1939). The effect of host size upon the sex-ratio of Hymenopterous parasites and its relation to methods of rearing and colonization. J. N. Y. Entomol. Soc., 47: 1 – 9.

El-Sherif, H. A. F. (1974). Biological control of the sugar cane borer *Chilo agamemnon* Bles., by field distribution of the egg parasite *Trichogramma evanescens* Westw. Ph. D. Thesis, Fac. Agric., Cairo Univ.

Flanders, S. E. (1939). Environmental control of sex in Hymenopterous insects. Ann. Entomol. Soc., Ann.32: 11 – 26.

Hassan, S. A. (1981). Mass production and utilization of *Trichgramma*: 2, 4 years successful biological control of the European corn borer. Med. Fac. Lanboww Rijks Univ. Gent., 46/2, 417 – 424.

Hassan, S. A. and M. Heil (1980). Control of the European corn borer with a single release of the egg parasite *Trichogramma evanescens* (Nachrichtenblatt des Deutschen Pflanzenschutzdiensts) 32 (7): 97 – 99.

Kamal, M. (1951). Biological control project in Egypt with a list of introduced parasites and predators. Bull Soc. Ent. Egypte, 35 No. 44: 221 – 270.

Kovalenkov, V. G. (1980). *Trichogramma* on cotton growing farms. Zashchita Rastenii. 11: 38 – 39.

Metwally, M. M. (2000). Studies on the important insect pests of maize plants and their natural enemies at Kafr El-Sheikh district. Ph. D. Thesis, Fac. Agric., Tanta Univ., Egypt.

Neuffer, G. (1980). The use of *Trichogramma evanescens* for the control of the corn borer, *Ostrinia nubilalis* Hbn. in maize grown for food. Landesantalt fur Pflanzenschuty. 405 – 406, Stuttgart Ger Fed Rep. (R.E.A) (A), 69, (5) 2664.

Ram, P.; W. B. Tshernysher; V. M. A. Fonina and S. M. Yreenberg (1995). Studies on the strain of *Trichogramma evanescens* West. collected from different hosts in Northern Moldova. J. Appl. Ent., 119 (1): 79 – 82.

Salt, G. C. (1934). Experimental studies in insect parasitism 1- Introduction and technique. 11. Super parasitism. Proc. Roy. Soc., b, Vol., 114: 450 – 476.

Shchepetil 'nikova, V. A. and Z. S. Murashevskaya (1979). *Trichogramma* in the USSR. Zashchita Rastenii 1: 26 – 27.

دراسة تطفل وبيولوجى طفيل *Trichogramma evanescens* West على بعض الآفات الاقتصادية فى منطقة كفر الشيخ

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أجرى البحث بهدف دراسة تطفل الطفيل *T. evanescens* على بعض الآفات الاقتصادية التابعة لرتبة حرشفية الأجنحة ومدى أمكانية استخدامه فى مكافحتها حيث شملت الدراسة الآفات: دودة الذرة الأوربية، دودة القصب الصغيرة، دودة القصب الكبيرة ، دودة ورق القطن وفراش الحبوب حيث تم جمع كتل بيض هذه العوائل من حقول الذرة والأرز والقطن فى يونيو 2006 وتم تربيتها فى المعمل تحت ظروف ثابتة من الحرارة 27.5°م ورطوبة 65 ٪، ربيت دودة ورق القطن ووضعت بيضها على ورق الخروع بينما ربيت دودتى القصب الصغيرة والكبيرة ودودة الذره الأوربية على قطع من سيقان الذرة ووضعت فراشتها البيض على ورق شمع فى حين ربيت فراشة الحبوب على دقيق الذرة وحصل على بيضها بنخل الدقيق وبدأت التربية المعملية للطفيل فى سبتمبر 2006 واستمرت على بيض فراشة الحبوب فى المعمل تحت نفس ظروف الحرارة والرطوبة المذكورة لمدة 15 جيل متتالية حيث بدأت التجارب فى أغسطس 2007. وقدرت نسبة التطفل فى الطبيعة على العوائل المختلفة وأيضاً فى المعمل.

كما تمت دراسة بيولوجى الطفيل على كل العوائل المختبرة وكانت النتائج كالتالى:

1- زادت نسبة التطفل تدريجياً فى الحقل بتقدم الموسم وكانت أعلى نسبة تطفل على بيض دودة الذرة الأوربية فى حقول الذرة ثم دودة القصب الصغيرة وكانت أقل نسبة للتطفل لبيض دودة ورق القطن غير المغطى بالزغب.

2- دلت التجارب أن بيض دودة القصب الكبيرة كان أفضل العوائل لتربية الطفيل ويرجع ذلك إلى كبر حجم بيض دودة القصب الكبيرة (146.5 ميكروجرام) وأن الطفيل يفضل بيض دودة الذرة الأوربية ثم دودة القصب الصغيرة وأخيراً بيض دودة ورق القطن.

3- أظهرت التجارب أن عدد الطفيليات يتناسب طردياً مع حجم بيض العائل وأن النسبة الجنسية تتناسب عكسياً على حجم بيض الطفيل.

4- وجد أن بيولوجى الطفيل يتدهور باستمرار تربيته معملياً.

Table (4): Some biological aspects of the egg-parasitoid *T. evanescens* reared on different hosts.

Stage		Duration in days ± S.D.					
		C. agamemnon	***O. nubilalis***	***S. cretica***	***S. littoralis***	***S. cereallella***	
						Lab. strain	**Field Strain**
Egg±larvae		3.0±0.00 (3-3)	3.0±0.00 (3-3)	3.0±0.00 (3-3)	3.0±0.00 (3-3)	3.0±0.00 (3-3)	3.0±0.00 (3-3)
Pupae		8.7±0.44 (8-9)	8.7±0.44 (8-9)	9.0±0.71 (8-10)	8.8±0.37 (8-9)	8.0±0.00 (8-8)	8.0±0.00 (8-8)
Adult	Female	2.9±1.52 (1-6)	3.5±0.97 (2-5)	5.2±3.05 (2-10)	2.7±1.06 (1-5)	5.0±1.05 (3-7)	5.6±1.26 (4-7)
	Male	1.5±0.53 (1-2)	1.5±0.97 (1.4)	1.8±0.42 (1-2)	1.7±0.95 (1-3)	3.6±1.28 (2-5)	3.8±1.17 (2-5)
Total life cycle	Female	14.6	15.3	17.2	14.5	16.0	16.6
	Male	13.2	13.2	13.8	13.5	14.6	14.8
No. of parasitized/host/♀		30.0±22.3 (3-70)	29.3±19.8 (8-61)	59±30.0 (15-120)	20.5±16.3 (8-55)	6.7±7.9 (1-29)	28.6±11.2 (4-40)
No. of progeny/♀		56.2±39.2 (7-132)	43.0±33.4 (12-85)	170.2±89.4 (41.350)	22.3±15.7 (9-65)	8.2±9.3 (2-35)	36.4±11.4 (6-51)
No. of parasites/host		1.8	1.3	3.2	1.1	1.2	1.2
Sex ratio ♀:♂		2.61 : 1	3.00:1	1.80:1	3.29:1	3.25:1	3.25:1
Adult emergency %		92.2	94.6	98.2	88.3	95.6	96.1
Oviposition period in days		1.3±0.7 (1-3)	1.5±0.8 (1-3)	1.8±1.0 (1-4)	1.3±0.5 (1-2)	1.8±0.7 (1-3)	1.9±0.8 (1-3)
Post oviposition period		1.6±1.1 (0-4)	2.0±1.2 (0-4)	3.4±2.5 (0-8)	1.4±1.1 (0-3)	3.2±1.5 (1-6)	3.7±1.4 (1.6)