Egypt. J. Agric. Res., 79 (1), 2001.

ACCEPTANCE AND PREFERENCE OF PINK BOLLWORM AND SOME LEPIDOPTEROUS EGGS FOR PARASITISM BY *TRICHOGRAMMA*

ALIA ABD EL-HAFEZ[1], E.F.EL-KHAYAT[2], F.F. SHALABY[2]
AND MANAL A.A. EL-SHARKAWY[1]

1 Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza, Egypt.

2 Plant Protection Despartment, Faculty of Agriculture, Moshtohor, Benha.

(Manuscript received November 1999)

Abstract

Two sets were designed to determine the acceptance and preference of some lepidopterous hosts to be parasitized by *Trichogramma evanescens* and *Trichogrammatoidea bactrae* females which had been maintained on angoumois grain moth, *Sitotroga cerealella* eggs (original culture) for more than 10 generations, In the first set, *Trichogramma* female was offered the choice between *S.cerealella* eggs (the original host) and those of each of the other five hosts i.e.; pink bollworm *Pectinophora gossypiella* Saunders, spiny bollworm *Earias insulana* Boised, black cutworm *Agrotis ipsilon* Hufn, rice bran moth *Corcyra cephalonica* and Mediterranean flour moth *Ephestia kuehniella.* Data revealed that females of the two parasitoids accepted to parasitize eggs of the six lepidopterous species with different levels of preference, i.e., 2.0-2.9 contacts & 10.75-21.79 parasitized eggs by *T.evanescens* and 1.2-3.0 contacts & 6.04-32.46 parasitized eggs by *T.bactrae* . The two parasitoid females didn't prefer *S.cerealella* more than either of the remaining five hostes. In the second set, eggs of the six host species were exposed to *Trichogramma* females, Eggs of the six host species were also accepted for parasitism with different levels of preference. The acceptance and preference behavior between the two parasitoids were insignificnt. While, *P.gossypiella* eggs were the most preferred by females of the two species over those of the remaining five hosts.

Key words: *Trichogramma evanescens Trichogrammatoidea bactrae,* lepidopterous eggs, Parasitism.

INTRODUCTION

The hymenopterous egg parasitoid of Trichogramma are practically used in suppressing populations of many insect pests in many parts of the world (Famoso & Alba, 1990; Hassan & Guo, 1991; Wuehrer & Hassan, 1993; Gomez *et al.*, 1995). This wide use of Trichogramma is mostly due to the easy mass production techniques of these parasitoids on factitious hosts which are mainly stored product lepidopterous insects such as *Ephestia kuehniella, Plodia interpunctella* and *Sitotroga cerealella* that are easy to be reared all the year round and produce large numbers of eggs. This laboratory study was carried out to investigate the preferences of *Trichogramma evanescens* (the native parasitoid) and *Trichogrammatoidea bactrae* (imported from USA in 1992) to parasitize eggs of different lepidopterous field crops and stored product pest species, It is hoped if these laboratory studies may add a beam of light to gain further knowledge about the differences in parasitization as a result of preferences shown by the parasitoids.

MATERIALS AND METHODS

Host Rearing: Eggs of six lepidopterous species *i.e.;* pink bollworm *Pectinophora gossypiella (*Saund.), spiny bollworm *Earias insulana* (Boisd.), black cutworm *Agrotis ipsilon* Hufn, angoumois grain moth *Sitotroga cerealella,* rice bran moth *Corycera cephalonica* and Mediterranean flour moth, *Ephstia kuehniella* were used in this study. These insect species were reared in the Integrated Pest Management laboratory, Bollworms Department, Plant Protection Research Institute for several generations. Pink and spiny bollworms were reared on modified artificial diet as described by Abd El-Hafez, Alia *et al.,* (1982). While black cutworm larvae were reared on castor-bean leaves using the same technique as described by Fahmy *et al.,* (1973).

Rice bran moth, angoumois grain moth and Mediterranean flour moth, were reared in glass breeding jars (1-liter capacity) containing nutrition source (rice bran, soft wheat and wheat flour, respectively) to be used as food and pupation site. The rearing materials were firstly sterilized at 60°C for 1-2 hours, scattered in a fine layer upon trays covered with muslin and kept under laboratory conditions (25-28°C and 60-70 R.H.) until use. Eggs of each host were added to the suitable food material in breeding jars covered with cloth wrapped cotton kept in position by rubber band and kept until pupation. After pupation, jars were examined daily until moth's emergence. Freshly emerged adults were confined and allowed to mate and oviposit in glass chimney oviposition cages.

Parasitoid Rearing: The two parasitoid species: *T. evanescens* and *T. bactrae* were reared on pink and spiny bollworm eggs at the formerly mentioned laboratory. For efficient mass rearing of each parasitoid, host egg sheets (2000-2500 eggs) were exposed to 200-250 adult females into 0.4-liter glass jars provided with 10% sucrose solution for nutrition and covered with cloth-wrapped cotton kept in position by rubber band. Host eggs were replaced every 24 hrs to avoid superparasitism and the parasitized eggs were kept in clean glass vials (4 x 8.5cm).

Experimental Techniques: *Trichogramma* species used in the present study were cultured on *S.cerealella* eggs for more than 10 generations, however, two sets were conducted for studying their host preference. In the first set, females of each parasitoid were offered the choice between eggs of the original host eggs (angoumois grain moth) and those of each of the 5 other pests *i.e.,* pink bollworm, spiny bollworm, black cutworm, rice bran and Mediterranean flour moth. A single freshly emerged mated trichogramma female was released in a glass vial (4 x 8.5cm) together with 100 eggs (2 sheets each contained 50 eggs) of the target pest (pink bollworm) and another l00 eggs (2 sheets each contain 50 eggs) of the commercial host angoumois grain moth. The four egg sheets were glued near the four corners of a larger piece of paper (4 x 4 cm) and a droplet of bee honey was added in the center (Hassan and Guo 1991). In the same way, the same experiment was done using eggs of the other 4 target pests (spiny bollworm, black cutworm, rice bran, and Mediterranean flour). The vials were checked 6 times during the first 3 hrs of the experiment (every $^{1}/_{2}$ hr) and the location of the parasitoid to the target or the angoumois grain moth eggs was recorded. Five days after parasitism, the number of parasitized eggs per female was counted. The test was repeated at least 20 times for each combination of the two Trichogramma and host eggs.

The second set was conducted by offering females of each of the two parasitoids the choice between eggs of the six hosts. Five freshly emerged mated females were released in a 0.4 liter glass jar with 6 different host egg cards (each card contained 80 eggs from each host species glued randomly on a piece of 10 cm. (diameter) paper. A droplet of bee honey was added on the paper center for nutrition and jars were covered with pieces of cloth-wrapped cotton kept in position by rubber band. Five days after starting the experiment, the parasitized eggs, belong to each host species, were counted. The same test was replicated 20 times for each ofthe two parasitoids.

All the experiments were conducted at 27 (26-28)°C and 80 (75-85) % RH. While, analyses of variance were done on all data (ANOVA) and Duncan's multiple range test was used to separate the means (Snedecor & Cochran 1980).

RESULTS AND DISCUSSION

Data of the first set, Table 1 show that the two parasitoids accepted to parasitize eggs of the six lepidopterous species with different levels of preference. When eggs of *P.gossypiella* and *S.cerealella* were offered to *T.evanescens* females reared from *S.cerealella* eggs, *P.gossypiella* eggs were more preferred than those of

S.cerealella. The mean number of contacts by female (mean number of observations in which the female was seen on an egg through the first 3 hrs of exposure) on *P.gossypiella* (2.6/ female) was slightly higher than on *S.cerealella* (2.4/ female), while the number of parasitized *P.gossypiella* eggs per female was about twice (21.25 parasitized eggs/female) of *S.cerealella* (10.75 eggs/female).

When either *E.insulana* or *A. ipsilon* eggs were used in combination with the original host *S.cerealella* eggs, *T.evanescens* females significantly spent more time on eggs of the two former hosts, but the number of parasitized eggs per female didn't differ significantly between *S.cerealella* and each of the two hosts. The number of contacts per female through the first 3 hrs averaged 2.9 & 2.8/ female on the two hosts compared to 2.1 & 2.3/female on *S.cerealella* eggs, while the number of parasitized eggs averaged 16.13 & 16.42/ female for the two hosts and 15.35&15.79/female for *S.cerealella* eggs. When *C.cephalonica* and *S.cerealella* eggs were offered, *Trichoramma evanescens* female significantly spent more time on *S.cerealella* eggs (2.contacts) than on *C.cephalonica* (1.3 contacts), although the number of parasitized eggs (16.71 and 21.79/female, respectively) didn't differ significantly between the two hosts. However, female of *T.evanescens* spent an equal time (2.3 contacts) and parasitized about equal number of eggs (18.57 & 19.3 eggs/female, respectively) when offered *S.cerealella* and *E. kuehniella.*

As for T. bactrae, data in Table 1 clearly show that this parasitoid spent more time and showed significantly strong preference to eggs of the two bollworms *P.gossypiella* & *E. insulana* and *E. kuehniella* than *S.cerealella* eggs. The number of contacts through 3hrs exposure averaged 1.8 & 3.0 on *S.cerealella* & *P. gossypiella, 1.2 & 2.5 on S.cerealella* & *E.insulana* and 1.5 & 2.8 contacts/female on *S. cerealella* & *E.kuehniella,* respectively. The number of parasitized eggs of each of the three hosts per a *T.bactrae* female averaged almost 3 times of those obtained for *S.cerealella* i.e.; 10.92 & 32.46 for *S.cerealella* & *P.gossypiella,* 6.04 & 22.96 for *S.cerealella* & *E.insulana* and 8.38 & 22.58 parasitized eggs/female for *S.cerealella* & E.kuehniella, respectively.

On the other hand, no marked preference was clear when *T.bactrae* females were offered the choice between eggs of *S.cerealella* and either of *A.ipsilon* or *C.cephalonica* eggs although those females significantly spend more time on the two latter hosts. The number of contacts averaged 1.8 & 2.8 on *S.cerealella & A.ipsilon,* whereas those averaged 2.2 & 3.0 on *S.cerealella & C.cephalonica,* respectively. While mean numbers of parasitized eggs were 14.75 & 15.7/*S.cerealella* female opposed to 11.25 and 19.13 eggs/*A.ipsilon* and *C.cephalonica* female, respectively.

In the second set, in which the eggs of the six host species were offered to *Trichogramma* females, the six groups of eggs were accepted for parasitism, but with different levels of preference. The acceptance and preference behavior between the two parasitoid species took the same trend, where the statistical analysis of data was insignificant. The results in Table 2 indicated that P.gossypiella eggs were the most preferred by females of the two parasitoid species over those of the other five hosts. This preference was according to either the number of parasitized eggs per 5 females of *T.evanescens* or *T.bactrae* (30.3±1.98 & 50.1±11.68) or the percentage of parasitized eggs (24.5±2.12&35.16±4.82%). The lowest numbers of parasitized eggs (10.7 & 10.3 per 5 females) and percentages of parasitism (8.65 & 7.23 %) were recorded in *S. cerealella* eggs. The number of *E.insulana*, *E. kuehniella*, *C.cephalonica* and *A.ipsilon* parasitized eggs by *T.evanescens* averaged 23.7, 22.5, 20.2, and 16.3 per 5 females, respectively, however, the percentages of parasitism were 19.16, 18.19, 16.33 and 13.17%, respectively. On the otber hand, *T.bactrae* parasitized different numbers eggs of these hosts reached 21.6, 17.5, 15.6, and 27.4 parasitized eggs/5 females, respectively, Table 2, whereas the percentages of parasitism reached 15.16, 12.28, 10.95, and 19.23%, respectively.

In relation to the present study, the preference of *Trichogramma* to hosts rather than that from which they emerged (*S.cerealella* eggs) was pointed out by many authors. Salt (1940) found that a pure strain of *T.evanescens* remained to prefer eggs of *Ephestia* or *Agrotis* than those of *Sitotroga,* although the parasitoid was reared for more than 260 generations on *S.cerealella* only. Taylor and Stern (1971) found various preference levels for the eggs of 7 species of Lepidoptera by *T.semifumatum*. The preference of some hosts by *T.bactrae* over the eggs of *S.cerealella was* similar to those recorded by Wuherer and Hassan (1993) who found that 47 strains of *Trichogramma* and 2 strains of *Trichogrammatoidea* accepted eggs of the diamondback moth. The ratio of parasitized *Plutella to Sitotroga eggs* was 34.4 to 6.1 and that of contacts with the two host species was 2.6 to 0.2.

In contrary to the present results, Pavlik (1993) indicated that some *Trichogramma* strains did not lose their acceptance of their natural host and successfully developed in this host despite their being reared on eggs of the factitious host *Ephestia kuehniella* for several years. However, Gomez *et al.,* (1995) mentioned that *T.pretiosum* females preferred the factitious host eggs over the natural one when offered *D.saccharalis* and *S.cerealella* .eggs, however they found an opposite result when *D. indigenella* and *S.cerealella* eggs were used.

Table 1. Preference behavior (number of contacts) and mean number parasitized eggs/ *T.evanescens* & *T.bactrae* females when offered the choice between *Sitotroga* and each of five lepidopterous host eggs.

Lepidopterous Hosts	*T. evanescens*		*T. bactrae*	
	No. contacts ± SE (range)	No. parasitized eggs/ female ± SE (range)	No. contacts ± SE (range)	No. parasitized eggs/ female ± SE (range)
S.cerealella	2.4^{a} ±0.51 (0-6)	10.75^{b}±1.76 (0-26)	1.8^{b}±0.37 (0-5)	10.92^{b}±2.46 (0-38)
P. gossypiella	2.6^{a}±0.48 (0-6)	21.25^{a}±3.67 (0-54)	3.0^{a}±0.35 (0-6)	32.46^{a}±3.20 (0-55)
S.cerealella	2.1^{b}±0.21 (0-4)	13.25^{a}±1.36 (0-36)	1.2^{b}±0.20 (0-3)	6.04^{b}±1.38 (0-24)
E. insulana	2.9^{a}±0.22 (1-5)	16.13^{a}±2.43 (0-41)	2.5^{a}±0.35 (0-6)	22.96^{a}±1.71 (0-38)
S.cerealella	2.3^{b}±0.39 (0-6)	15.79^{a}±2.20 (0-36)	1.8^{b}±0.31 (0-5)	14.75^{a}±2.18 (0-25)
A. ipsilon	2.8^{a}±0.36 (0-6)	16.42^{a}±0.05 (0-49)	2.8^{a}±0.33 (0-5)	11.25^{a}±1.72 (0-28)
S.cerealella	2.0^{a}±0.23 (0-4)	16.71^{a}±3.39 (0.42)	2.2^{b}±0.33 (0-6)	15.70^{a}±2.10 (0-35)
C.cephalonica	1.3^{b}±0.27 (0-6)	21.79^{a}±2.72 (0-48)	3.0^{a}±0.31 (0-6)	19.13^{a}±3.13 (0-58)
S.cerealella	2.3^{a}±0.32 (0-6)	18.57^{a}±2.82 (0-47)	1.5^{b}±0.34 (0-5)	8.38^{b}±2.10 (0-33)
E.kuehniella	2.3^{a}±0.34 (0-6)	19.30^{a}±2.95 (0-50)	2.8^{a}±0.34 (0-6)	22.58^{a}±2.93 (0-43)

Means followed by the same letter at the same column for *Sitotroga* and each host are not significantly different (P<0.05).

Table 2. Mean number and percentage of prasitized eggs by *T.evanescens* & *T.bactrae* females (reared from *S.crealella* eggs) when offered the choice between eggs of six lepidopterous species.

Lepidopterous Hosts	*T. evanescens*		*T. bactrae*	
	No. parasitized eggs/ 5 females ± SE (range)	% Of parasitized eggs ± SE (range)	No. parasitized eggs/ 5 females ± SE (range)	% Of parasitized eggs ± SE (range)
P. gossypiella	30.3^{a} ±1.98 (20-42)	24.50^{a}±2.12 (13.07-36.59)	50.1^{a}±11.68 (10-110)	35.16^{a}±4.82 (10.99-49.43)
E. insulana	23.7^{ab}±2.88 (10-36)	19.16^{b}±2.01 (10.42-29.75)	21.6^{b}±2.82 (12.-37)	15.16^{b}±3.36 (5.61-39)
A. ipsilon	16.3^{bc}±1.67 (6-26)	13.17^{b}±5.91 (4.03-24.39)	27.4^{b}±4.88 (8-56)	19.23^{b}±2.29 (7.84-28.95)
S.cerealella	10.7^{c}±4.26 (0-40)	8.65^{c}±2.65 (0-26.14)	10.3^{b}±4.08 (0-32)	7.23^{c}±2.73 (0-23.26)
C.cephalonica	20.2^{b}±3.28 (10-35)	16.33^{b}±2.02 (8.33-23.73)	15.6^{b}±2.60 (10-31)	10.95^{bc}±2.41 (7.7-30.77)
E.kuehniella	22.5^{b}±4.16 (10-51)	18.19^{b}±2.65 (11.02-35.42)	17.5^{b}±4.53 (10-53)	12.28^{bc}±5.80 5.14-21.71
Total	123.7 (0-51)	100 (0-36.59)	142.5 (0-110)	100 (0-49.43)
LSD 0.05	8.592	6.14	15.994	3.38

Means followed by the same letter at the same column are not significantly different (P<0.05).

ANOVA yielded no significant difference between the two *Trichogramma* species (P<0.05).

REFERENCES

1. Abd El-Hafez, Alia, A. G. Metwally and M. R. A. Saleh. 1982. Rearing pink bollworm *Pectinophora gossypiella* (Saund.) on Kidney bean diet in Egypt (Lepidoptera - Gelechiidae). Res. Bull., Fac. of Agric., Zagazig Univ., April, No. 576, 10 pp.

2. Fahmy, H. S. M., A. H. Zaazou, A. A. M. Kamel and A. H. El Hemaesy. 1973. Effect of temperature and humidity on the immature stages of the greasy cutworm *Agrotis ipsilon* (Hufn.) (Lepidoptera: Noctudae). Bull. Soc. Ent. Egypt, Econ., 57: 153-164.

3. Famoso, R. B. and M. C. Alba.1990. Effective rate of *Trichogramma chilonis* Ishii against *Helicoverpa armigera* Hubner on cotton. Cotton-Research-Journal (Philippines), 3(2): 90-98.

4. Gomez, L. L. A., A. E. Diaz and L. A. Lastra. 1995. Selection of strains of *Trichogramma exiguum* for controlling sugarcane borers (*Diatraea spp*) in the Cauca valley, Colombia. *Trichogramma* and other egg parasitoids: 4th International Symposium, Cairo (Egypt) October 4-7, 1994, (75-78).

5. Hassan, S. A and M. F. Guo. 1991. Selection of effective strains of egg parasites of the genus *Trichogramma* (*Hymenoptera: Trichogrammatidae*)to control the European corn borer *Ostrinia nubilalis* Hb.(*Lepidoptera: Pyralidae*). J. App. Entomol., 111 (4): 335-241.

6. Pavlik J. 1993. Variability in the lost acceptance of European corn borer, *Ostrinia nubilalis* Hbn. (Lepidoptera: Pyralidae) in strains of the egg parasitoid *Trichogramma* spp (Hym, Trichogrammatidae). J. APP. ENT., 115(1): 77-84.

7. Salt, G.1940. Experimental studies in insect parasitism. VII the effects of different hosts on the parasite *Trichogramma evanescens*. Proceedings ofthe Royal Society, London, 15(A): 81-95.

8. Snedecor, G. W. and W. G. Cochran. 1980. Statistical methods, 2nd Ed. The Iowa State University Press, Ames, Iowa, pp. 318.

9. Taylor, T.A. and V. M. Stem. 1971. Host-Preference studies with the egg parasite *Trichogramma semifumatum* (Hymenoptera: Trichogrammatidae). Ann. Ent. Soc. Am., 64 (6): 1381-1390.

10. Wuehrer, B. and S. A. Hassan. 1993. Selection of effective species/strains of *Trichogramma* (Hymenoptera: Trichogrammatidae) to control the diamondback moth *Plutella xylostella* (Lepidoptera: Plutellidae). J. App. Entomol. (Germany), 116(1): 80-89.

تقبل وتفضيل بيض دودة اللوز القرنفلية وبعض حشرات حرشفية الأجنحة للتطفل عليه بواسطة الترايكوجراما

علية عبد الحافظ [1]، عزت الخياط [2] ، فوزي شلبي [2]، منال عبد المحسن الشرقاوي [1]

١ معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - جيزة.
٢ قسم وقاية النبات - كلية الزراعة - جامعة الزقازيق - فرع بنها - مشتهر.

تم تصميم تجربتين لقياس مدى تقبل وتفضيل بيض بعض الحشرات من حرشفية الأجنحة للتطفل عليه بواسطة إناث كل من *Trichoramma evanescens* و *Trichogrammatoidea bactrae* التي تم تربيتها لأكثر من ١٠ أجيال على بيض فراشة الحبوب (العائل التجاري لتربية الترايكوجراما).

في التجربة الأولى - أعطيت الفرصة لإناث كل من الطفيليين للاختيار بين بيض فراشة الحبوب وبيض كل من خمسة عوائل أخرى وهي : فراشة دودة اللوز القرنفلية، فراشة دود اللوز الشوكية، فراشة الدودة القارضة، فراشة الأرز وفراشة دقيق البحر الأبيض المتوسط، وقد أوضحت النتائج أن إناث كل من النوعين تقبلت بيض كل من العوائل الست بمستويات مختلفة من التطفل، ففي حالة إناث *T.evanescens* تراوح عدد مرات الملامسة لبيض العائل ما بين ٢ و٢,٩ مرة وعدد البيض المتطفل عليه ما بين ١٠,٧٥ و ٢١,٧٩ بيضة في المتوسط، أما في حالة إناث *T.bactrae* فقد كان عدد مرات الملامسة لبيض العائل ما بين ١,٢ و٣ مرة وعدد البيض المتطفل عليه ما بين ٦,٠٤ و٣٢,٤٦ بيضة في المتوسط، هذا ولم تفضل إناث الطفيليين بيض فراشة الحبوب على بيض أي من العوائل الخمس الأخرى.

في التجربة الثانية - تم تعريض بيض العوائل الست المذكورة معاً لإناث الترايكوجراما. وقد تقبلت الإناث بيض العوائل الست، ولكن بمستويات مختلفة من التفضيل أيضاً، ولم يختلف سلوك التقبل والتفضيل بين نوعي الطفيل معنوياً، بينما كان بيض فراشة دودة اللوز القرنفلية هو الأكثر تفضيلاً عن بيض باقي العوائل الأخرى.