J. Agric. Sci. Mansoura Univ., 33 (2): 1487 - 1498, 2008

DOS CONTINUOUS REARING OF *Trichogrammatoidea bactrae* NAGARAJA (TRICHOGRAMMATIDAE: HYMENOPTERA) ON THE SAME HOST FOR SEVERAL GENERATIONS AFFECTED PARASITOID EFFICIENCY?

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ABSTRACT

Laboratory study was conducted on *Trichogrammatoidea bactrae* Nagaraja, the specific parasitoid of *Pectinophora gossypiella* (Saunders) eggs. This study aimed to identify whether the wasp quality deteriorated after rearing for several generations on the factitious host *Sitotroga cerealella* Olive eggs and whether the rearing of parasitoids on this factitious host for several generations would influence the acceptance of the target host (*P. gossypiella* eggs). For this purpose, four different rearing lines were established. These lines were started with parasitoids from two laboratory stock cultures reared separately for several generations on *P. gossypiella* and *Sitotroga cerealella* eggs, respectively. Comparing with laboratory stock culture, there is no deterioration in females' fecundity by continuous rearing on the two hosts. On the other hand, the continuous rearing of the parasitoid on the factitious host *S. cerealella* eggs did not loss the parasitoid acceptance to the target host, *P. gossypiella* eggs. Meanwhile, enhancement in females' quality occurred by adding pink bollworm eggs to *S. cerealella* culture every six generations.

INTRODUCTION

The parasitoid *Trichogrammatoidea bactrae* was described by Nagaraja (1978). Hutchison *et al.*, 1990) stated that *T. bactrae* imported from Australia into United States as a specific parasitoid of pink bollworm *Pectinophora gossypiella* (Saunders). Meanwhile it was imported to Egypt from USA at 1992. In Egypt, Abd El-Hafez 1994 and 1995 reared this parasitoid on pink and spiny bollworms eggs and made comparable studies between this parasitoid and the local one (*Trichogramma evanescens* Westwood). Also, Abd El-Hafez and Nada (2000) carried out studies to estimate the fundamental bases needed for handling the aforementioned parasitoid against pink bollworm under Egyptian field conditions. They found that this parasitoid was effective in reducing pink bollworm infestation either when introduced in the IPM program of controlling cotton pests or when used in combination with insecticides. Thus it could be used safely in the IPM program. Abd El-Hafez *et al* (2001) studied the acceptance and preference of pink bollworm and some lepidopterous eggs (*Earias insulana, Agrotis ipsilon, Sitotroga cerealella, Ephestia kuehniella* and *C. cephalonica)* for parasitism by *T. evanescens* and *T. bactrae*. They found that, the acceptance and preference behavior between the two parasitoids were insignificant. While, *P. gossypiella* eggs were the most preferred host by females of the two species over the remaining five hosts. Also, El- Sharkawy (2002) conducted field studies to determine the efficiency of releasing *T. bactrae* in suppressing the population of pink bollworm during two successive cotton seasons (2000 and 2001) in Moshtohor region, Qalubyia governorate, and it was found that *Trichogramma* wasps are effective in controlling bollworms as it reduced percentages of losses from 58.9 in control to 11.9% in *T. bactrae* release area.

Recently, trichogrammatid species are mass reared at lower and Upper Egypt on the factitious host, *S. cerealella* eggs and used against some lepidopterous pests in many crops such as; cotton, sugarcane, maize, rice, vegetables and fruits. This host and other factitious hosts are used to reduce the cost and to increase the mass production of parasitoids. Characteristics such as host egg volume, chorion thickness, nutritional content, age, and egg distribution can affect quality of parasitoids reared from eggs of these hosts (Greenberg *et. al.*, 1998 and Abd El- Hafez 2001). In addition to the direct suitability of a factitious host, there is also the potential for an evolutionary response by the parasitoid to being reared for many generations on an alternate host. Physiological, morphological, or behavioral characteristics of parasitoids that are adaptive when the factitious host is used may cause parasitoids to perform less well on the target host (Hopper *et al.*, 1993). Because parasitoid performance is related to host quality (Schmidt, 1994) and host species are differ in various qualities (e.g., size, chorion thickness, and distribution), the present study was conducted to investigate the effect of host species on components of wasp fitness over several generations in the laboratory. The efficiency of *T. bactrae* was measured as female fecundity and longevity, survival of progeny and the sex ratio. The aims of the study are to identify (1) whether the wasp efficacy deteriorate after rearing for several generations on the same host, and (2) whether the rearing of parasitoids on one factitious host species (*S. cerealella*) for several generations would influence the acceptance of the target host species (*P. gossypiella*).

MATERIAL AND METHODS

The experiments were carried out in the Bollworms Department, Plant protection Research Institute, ARC, Dokki, Giza, Egypt.

Rearing of insects:

Host rearing:

Pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) was reared for several generations on modified artificial diet as described by Abd El-Hafez *et al.* (1982). While the Angoumois grain moth, *Sitotroga cerealella* was reared on soft wheat according to the method of El-Sharkawy (2002) which was a modification of Hassan (1993).

Parasitoid rearing

The parasitoid, *T. bactrae* was reared in the laboratory either on pink bollworm (target pest) or on Angoumois grain moth (factitious host) as described by Abd El Hafez (1994) and Shalaby *et al.* (1999), respectively.

Experimental techniques:

Four lines were established for rearing *T. bactrae.* The first two lines were established to evaluate changes in *T. bactrae* quality during their mass rearing on the same host for several generations (31 generations). In the first

line, parasitoids were reared continuously on the target host *P. gossypiella* eggs (PP line) while they were reared on eggs of the factitious host *S. cerealella* in the second line (SS line). These two lines were originated from laboratory cultures reared separately on *S. cerealella* and *P. gossypiella* eggs, respectively. The third line (SP line) was done to evaluate the acceptability of *P. gossypiella* eggs by *T. bactrae* females. Parasitoids were reared on *S. cerealella* eggs for 28 generations and tested every three generations on the target host *P. gossypiella* eggs. As for the fourth line (SSP), parásitoids were reared for 31 generations on *S. cerealella* eggs but were inoculated every six generations with eggs of *P. gossypiella* (about one third its required eggs). The lines SS, SP and SSP were originated from culture reared on *P. gossypiella* eggs. All experiments were maintained at 27 ±1 °C and 80 ±5 % R. H. To avoid super-parasitism, host eggs were renewed daily. Observations were done every three generations on 20 mated females selecting randomly from each rearing line. These females were maintained individually in glass vials containing a new card of the tested host eggs. Number of progeny/ female, females' longevity, percentage of emergence and the sex-ratio of the produced progeny were estimated. The general productivity of *T. bactrae* (mean number of the produced offspring females/ one *Trichogramma* female) on each line was determined as described previously by Tshernysher and Afonina (1995) as follows:
General productivity = (rate of emergence x sex-ratio x fecundity).

Analysis of variance were done on all data (ANOVA) and when statistical differences existed within a data set, Duncan's multiple range test was used to separate the means (Snedecor & Cochran 1980).

RESULTS AND DISCUSSION

Quality parameters of *T. bactrae* females and their offspring through many generations in four different rearing lines are recorded in Tables (1-5). These parameters included females' fecundity and longevity, percentage of emerged progeny, sex ratio and subsequently females' general productivity. As mentioned above, the rearing lines were started with parasitoids from two laboratory stock cultures reared separately for several generations on *P. gossypiella* and *S. cerealella* eggs, respectively. Quality of the laboratory stock cultures (the used parasitoids) was determined before starting each of the four rearing lines and used as an index for determining changes in female's quality through all generations. Otherwise, quality of the produced females at each rearing line was determined after the first generation and subsequently every three generations.

Females' fecundity: Fecundity of females in the four rearing lines compared with those of laboratory stock cultures are presented in Table (1). Statistically, highly significant differences were obtained between the four rearing lines ($F=158.47$, $P<0.0001$). In the first rearing line (PP line), fecundity of the parasitoid females reared from *S. cerealella* eggs (28.43 ± 1.45 progeny/ ♀) was greatly affected by changing their parental rearing host to *P. gossypiella* eggs as it averaged 62.26 and 66.21 progeny/♀ at the 1st and 4th generations, respectively. These values did not differ significantly than those reared on *P. gossypiella* eggs in the laboratory stock (57.0±13.24 progeny/♀). At the 7th generation, female's fecundity (43.06 progeny/ ♀) decreased significantly to be below that of the laboratory stock by 32.37%. Consequently conflicted values were recorded for female's fecundity in the remaining generations. So females recovered their fecundity until the 16th generation where it declined to 47.93 progeny/ ♀ at the 19th one. Again females recovered their fecundity with insignificant gradual decrease until the 31st generation. It averaged 61.6, 59.75, 58.3 and 54.0 progeny/ female at 22nd, 25th, 28th and 31st generations, respectively. The whole mean of female's fecundity after continuous rearing of *T. bactrae* for 31 generations on *P. gossypiella* eggs averaged 57.05 progeny/ female. This average was in close with that of laboratory stock culture. Generally, there is no obvious deterioration through the rearing generations

In the second line (SS line), parents were originated from *P. gossypiella* eggs and reared continuously for 31 generations on *S. cerealella* eggs. Regarding data in Table (1), high female's fecundity averaged 50.1 progeny/ female was recorded at the first generation. This high value may due to the effect of the previous host (*P. gossypiella*) which consider large in size than the current one and consequently produced large and more fecund females (Abd El- Hafez, 2001). Accordingly, fecundity of parasitoid females from this host retarded at the 4th generation (26.19 progeny/ ♀) to be near that of laboratory stock culture (28.43 ±1.45 progeny/♀). More reduction in fecundity occurred at 16th generation (19.5 progeny/ ♀) while it increased again until the 31st one. By exception of 1st and 16th generations, fecundity of *T. bactrae* females was stable. The whole mean of fecundity (**27.30** progeny/ female) did not differ significantly than that of laboratory stock culture. Accordingly, there is no deterioration in females' fecundity by continuous rearing on this factitious host.

In the third rearing line (SP line), parasitoids were reared on *S. cerealella* eggs for 28 generations while the acceptability of these females to *P. gossypiella* eggs was tested every three generations. To evaluate this acceptability, data on each tested generation was compared with its figure in the previous rearing line (SS line). Regarding of data in Table (1) it could be noted that fecundity of females were oscillated between increasing and decreasing through the first 19 generations and began to decreased until the 28th one. Moreover, high increase in females' fecundity was obvious when they were tested on *P. gossypiella* eggs than on *S. cerealella* eggs. For example, females' fecundity of SP line averaged 31.5, 45.08, 46.09, 51.5, 30.33, 59.83 progeny/ female at 4th, 7th, 10th, 13th, 16th and 19th generations opposed to 23.57, 23.57, 26.84, 26.76, 27.76 and 17.86 progeny/ female of SS line, respectively. In addition, the whole mean of fecundity averaged **40.23** and 25.34 progeny/ ♀ in the two rearing lines, respectively. These results indicated that the continuous rearing of the parasitoid on the factitious host *S. cerealella* eggs for 28 generations did not loss the parasitoid acceptance to the target host, *P. gossypiella* eggs.

As for the 4th rearing line (SSP line), data in Table (1) show that females reared on *Sitotroga* eggs became more fecund when introduced *P.*

gossypiella eggs, every six generations (the whole mean increased from 25.34 progeny/♀ in SS line to 29.71 progeny/♀ in SSP line). Generally fecundity was higher than their identical in SS line. Also it was conflicted through the tested generations and not differed significantly than laboratory stock culture until the 28th generation.

Table (1): Fecundity of *T. bactrae* females (mean ± S.D. progeny/ ♀) over time of rearing at four different lines comparing with laboratory stock culture (Lab.S).

Generation (G)	Rearing lines							
	PP		SS		SP		SSP	
	progeny/ ♀	% changes than (Lab. S.)	progeny/ ♀	% changes than (Lab. S.)	progeny/ ♀	% changes than (Lab. S.)	progeny/ ♀	% changes than (Lab. S.)
(Lab. S.)	**57.0 ^{abc}± 13.24**		**28.43^{b} ± 1.45**		**28.43^{c} ± 1.45**		**28.43^{cde} ± 1.45**	
1st	62.26^{ab} ± 21.86	8.45	50.10^{a} ± 11.73	43.25	50.10^{a} ± 13.22	43.25	50.10^{a} ± 11.73	43.25
4th	66.21^{a} ± 19.23	13.91	26.19^{bc} ± 6.54	-8.55	34.11^{c} 11.40±	16.65	25.35^{de} ± 7.21	-12.15
7th	43.06^{d} 15.24±	-32.37	26.84^{b} ± 7.99	-5.92	45.08^{b} ± 14.57	36.93	28.29^{cde} ± 7.10	-0.49
10th	61.93^{ab} ± 21.68	7.96	27.70^{b} ± 13.67	-2.64	49.35^{b} ± 8.55	42.39	54.22^{a} ± 15.82	47.57
13th	52.73^{bcd} ± 10.68	-8.10	29.54^{b} ± 9.41	3.76	52.55^{b} ± 12.17	45.90	31.25^{cd} ± 7.70	9.02
16th	59.83^{ab} ± 9.17	4.73	19.50^{c} ± 6.63	-45.79	34.40^{c} ± 10.62	17.35	34.56^{bc} ± 19.11	17.74
19th	47.93^{cd} ± 10.99	-18.92	24.60^{bc} ± 5.40	-15.57	59.83^{a} ± 13.30	52.48	38.83^{b} ± 15.60	26.78
22nd	61.60^{ab} ± 15.48	7.47	25.21^{bc} ± 8.75	-12.77	28.23^{c} ± 9.95	-0.71	34.89^{bc} ± 8.95	18.52
25th	59.75^{ab} ± 13.61	4.60	25.06^{bc} ± 8.33	-13.45	29.22^{c} ± 7.55	2.70	23.75^{ef} ± 7.15	-19.71
28th	58.30^{abc} ±15.15	2.23	22.79^{bc} ± 9.29	-24.75	30.71^{c} ± 6.89	7.42	22.70^{ef} ± 7.66	-25.24
31st	54.00^{bcd} ± 13.85	-5.56	22.79^{bc} ± 9.30	-24.75			17.60^{f} ± 6.07	-61.53
Mean of generations	**57.05 ±18.14**	0.10	**27.30 ± 11.16**	-4.13	**40.23 ± 15.64**	31.26	**32.87 ± 14.49**	13.50
L.S.D	**10.066**		**5.86**		**7.052**		**6.86**	

Emerged progeny: The percentage of emerged progeny was estimated by the ratio of the number of emerged adults to the number of observed progeny in parasitized eggs. Data in Table (2) show high percentages of progeny emerged in all the rearing lines. Significantly the higher percentages of adult emergence were recorded when *P. gossypiella* eggs were used either in continuous rearing (PP line) or on the testing of acceptability (SP line). Mean percentage of emerged progeny varied insignificantly between PP (93.18%) & SP (92.74%) lines and between SS (88.57%) & SSP (86.98%) lines while the first pairs was significantly different than the second one (F value= 22.7, LSD= 1.545, P>0.5). By exception of SSP rearing line, lower changes in the percentages of parasitoid emergence were observed through the tested generations. They ranged between 84.49- 96.78%, 82.86- 95.32%, 87.23-96.61% and 73.28- 95.79% in PP, SS, SP and SSP lines, respectively.

Table (2): Emergence of *T. bactrae* progeny (% ± S. D.) over time of rearing at four different lines comparing with laboratory stock culture(Lab. S.)

Generation (G)	Rearing lines							
	PP		SS		SP		SSP	
	%	% changes than (Lab. S..)	%	% changes than (Lab. S.)	%	% changes than (Lab. S.)	%	% changes than (Lab. S.))
(Lab. S.)	94.8 ^{ab}± 3.58		93.2^{a} ± 5.36		93.2^{a} ± 5.36		93.2^{a} ± 5.36	
1st	96.51^{a} ± 4.48	1.77	95.32^{a} ± 3.55	2.22	94.50^{ab} ± 4.69	1.38	95.32^{ab} ± 3.55	
4th	94.27^{ab} ± 7.27	-0.56	86.43^{ab} ± 7.07	-7.83	91.96^{abc} ± 6.76	-1.35	86.43^{de} ± 7.08	-10.29
7th	96.78^{a} ± 3.98	2.05	87.77^{ab} ± 9.40	-6.19	96.61^{a} ± 1.77	3.53	87.77^{cde} ± 9.39	-8.60
10th	95.35^{ab} ± 3.02	0.58	90.01^{a} ± 4.55	-3.54	96.63^{a} ± 1.94	3.55	93.97^{abc} ± 4.55	-1.44
13th	95.94^{ab} ± 3.61	1.19	88.56^{ab} ± 9.27	-5.24	92.83^{abc} ± 4.15	-0.40	88.85^{bcde} ± 9.27	-7.28
16th	84.49^{d} ± 11.28	-12.20	90.94^{a} ± 7.47	-2.49	94.49^{ab} ± 4.42	1.37	91.29^{abcd} ± 7.47	-4.41
19th	91.67^{c} ± 8.78	-3.41	88.79^{ab} ± 10.15	-4.97	94.27^{c} ± 4.98	1.14	85.14^{de} ± 10.15	-11.96
22nd	91.99^{c} ± 8.80	-3.05	86.14^{ab} ± 7.59	-8.20	88.50^{c} ± 7.07	-5.31	95.79^{a} ± 7.59	0.49
25th	91.90^{c} ± 5.48	-3.16	90.09^{ab} ± 10.87	-3.45	87.23^{c} ± 6.24	-6.84	73.28^{g} ± 10.87	-30.08
28th	91.91^{c} ± 4.56	-3.14	82.86^{b} ± 16.37	-12.48	90.39^{bc} ± 5.16	-3.11	76.63^{fg} ± 6.36	-24.39
31st	94.22^{ab} ± 3.90	-0.62	87.39^{ab} ± 7.18	-6.65			82.34^{ef} ± 7.18	-15.76
Mean of generations	**93.18 ± 6.87**	-1.73	**88.57 ± 11.24**	**-7.62**	**92.74 ± 7.42**	-0.49	**86.98 ± 11.24**	**-9.58**
L.S.D	**3.86**		**6.18**		**4.39**		**5.91**	

Sex- ratio: Sex-ratio was calculated as the percentage of females in the emerged progeny. Data in Table (3) indicate that females are dominated in all generations of the four rearing lines. Also, a realized higher percentage of females (69.96 ± 9.65 %) produced when they utilized *P. gossypiella* eggs and lower percentage when utilized *S. cerealella* eggs (58.55 ± 7.64%). When females from *S. cerealella* culture were tested on *P. gossypiella* eggs (SP line) the percentage of females increased significantly to 62.11 ± 12.33%. Also when the parasitoids in this culture were inoculated with *P. gossypiella* eggs (SSP line) the percentage of females increased insignificantly to 60.03 ± 7.64%. Regarding generations in each rearing line, it could not found a limited trend on percentage of females over time.

Table (3): Percentage of females in *T. bactrae* progeny over time of rearing at four different lines comparing with laboratory stock culture (Lab.S.)

Generation (G)	Rearing lines							
	PP		SS		SP		SSP	
	% Female	%changes than (Lab. S.)	% Female	%changes than (Lab. S.)	% Female	%changes than (Lab. S.)	% Female	%changes than (Lab. S.)
(Lab. S.)	65.80^{d} ± 2.68		62.7^{abc} ± 2.46		62.7^{abc} ± 2.46		62.7^{abc} ± 2.46	
1st	64.90^{d} ± 8.17	-1.39	62.81^{abc} ± 10.20	0.18	61.42^{bc} ± 11.05	-2.08	62.81^{ab} ± 10.29	0.18
4th	65.16^{d} ± 10.37	-0.98	57.01^{cde} ± 8.10	-9.98	57.02^{cd} ± 4.97	-9.96	57.01^{c} ± 8.09	-9.98
7th	66.85^{cd} ± 10.65	1.57	57.92^{bcd} ± 7.29	-8.25	71.79^{a} ± 6.61	12.66	57.92^{bc} ± 7.29	-8.25
10th	77.65^{a} ± 7.62	15.26	63.68^{a} ± 6.62	1.54	63.03^{b} ± 3.66	0.52	65.79^{a} ± 6.62	4.70
13th	68.55^{cd} ± 14.14	4.01	65.85^{a} ± 4.45	4.78	62.34^{bc} ± 7.04	-0.58	61.98^{abc} ± 4.45	-1.16
16th	70.42^{bcd} 2.95	6.56	51.40^{e} ± 8.54	-21.98	62.14^{bc} ± 6.53	-0.90	60.46^{abc} ± 8.53	-3.70
19th	65.30^{d} ± 6.92	-0.77	58.49^{bcd} ± 9.21	-7.20	54.97^{d} ± 8.26	-14.06	58.80^{bc} ± 9.21	-6.63
22nd	71.09^{bcd} ± 5.52	7.44	54.73^{de} ± 5.14	-14.56	70.84^{a} ± 11.38	11.49	60.52^{abc} ±	-3.60
25th	70.52^{bcd} ± 8.35	6.69	59.40^{bcd} ± 3.52	-5.56	60.35^{bcd} ± 8.99	-3.89	61.45^{abc}	-2.03
28th	76.24^{ab} ± 9.67	13.69	56.18^{de} ± 7.92	-11.61	57.18^{cd} ± 5.64	-9.65	56.91^{bc}	-10.17
31st	72.93^{abc} ± 9.21	9.78	56.54^{cde} ± 9.25	-10.89			56.69^{c} ± 9.25	-10.60
Mean of generations	**69.96 ± 9.65**	**5.95**	**58.55 ± 7.64**	**- 7.09**	**62.11 ± 12.33**	**-0.95**	**60.03 ± 7.64**	**- 4.45**
L.S.D	**5.578**		**5.619**		**5.11**		**4.731**	

Females' longevity: Female's longevities varied significantly among the four rearing lines (F= 50.80, LSD=0.157; P<0.05). The average longevity of females decreased and increased through the tested generations in all the rearing lines (Table 4). It ranged between 2.29- 3.73, 1.25- 1.93, 1.4- 2.78 and 1.47- 2.1 days in PP, SS, SP and SSP lines, respectively. Regarding the whole mean of the these generations, it could be indicated that females reared on *P. gossypiella* eggs lived significantly the longest period (2.88 days), whereas, those reared on *Sitotroga* eggs lived significantly the shortest one (1.64 days). On the other hand females from the SP and SSP lines lived intermediate periods (2.21 and 1.87 days, respectively).

Table (4): Longevity of *T. bactrae* females over time of rearing at four different lines comparing with laboratory stock culture (Lab.S.).

Generation (G)	Rearing lines							
	PP		SS		SP		SSP	
	Longevity (days)	% changes than (Lab. S.)	Longevity (days)	% changes than (Lab. S.)	Longevity (days)	% changes than (Lab. S.)	Longevity (days)	% changes than (Lab. S.))
(Lab. S.)	3.03^{ab} ± 0.68		2.79^{a} ± 1.25		2.79^{ab} ± 1.25		2.79^{a} ± 1.25	
1st	2.45^{bc} ± 0.99		1.80^{bc} ± 0.57		2.38^{abc} ± 0.91		1.89^{bcde} ± 0.57	
4th	3.00^{ab} ± 0	18.33	1.90^{b} ± 0.96	5.26	2.05^{bcd} ± 0.89	-7.32	1.93^{bcde} ± 0.96	5.26
7th	2.29^{c} ± 0	-6.99	1.93^{b} ± 1.63	6.74	2.10^{bcd} ± 0.72	-4.76	2.22^{b} ± 1.06	5.26
10th	2.63^{bc} ± 1.34	6.84	1.71^{bcd} ± 0.88	-5.26	1.90^{cde} ± 1.02	-15.79	2.10^{bc} ± 1.05	14.29
13th	2.29^{c} ± 0.83	-6.99	1.73^{bcde} ± 1.05	-4.05	2.55^{ab} ± 0.52	13.73	2.00^{bcd} 0.67	10.00
16th	2.44^{bc} ± 0.75	34.32	1.77^{bc} ± 0.67	-1.69	1.40^{e} ± 0.44	-57.14	1.50^{de} ± 0.67	-20.00
19th	2.55^{bc} ± 1.09	3.92	1.50^{bcd} ± 0.84	-20.00	2.78^{a} ± 0.67	20.86	1.83^{bcde} ± 0.84	1.64
22nd	2.84^{abc} ± 0.69	13.73	1.80^{b} ± 0.64	0.00	2.58^{ab} ± 1.03	14.73	1.47^{e} ± 0.84	1.64
25th	3.00^{ab} ± 0.97	18.33	1.36^{cd} ± 0.68	-32.35	1.73^{de} ± 0.83	-27.17	1.6^{cde} ± 0.64	-22.45
28th	3.45^{a} ± 0.69	28.99	1.27^{d} ± 0.52	-41.73	1.91^{cde} ± 0.46	-15.18	1.45^{e} ± 0.68	-20.00
31st	3.44^{a} ± 0.82	28.78	1.25^{d} ± 0.82	-44.00			1.46^{e} ± 0.52	-23.29
Mean of generations	2.88 ± 1.01	14.90	1.64 ± 0.97	-9.88	2.12 ± 0.94	-3.77	1.75 ± 0.97	-2.64
L.S.D	0.59		0.435		0.493		0.462	

General productivity (GP): General productivity (the mean number of the produced offspring females/one *Trichogramma* female) is the best parameter to evaluate *Trichogramma* quality. Data of the present parameter reveal that PP line produced females with higher GP than the other three lines (Table 5). GP of the produced females in this line was in close with that of laboratory stock culture (35.56 females/ ♀) and ranged between 25.69- 40.85 females/ female with an average of 37.21 females/ ♀ for the 31 generations. On the contrary, SS line produced females with lower GP than laboratory stock culture (16.61 Females/ ♀) as it ranged between 7.95- 28.35 females/ ♀ and averaged 13.36 females/ ♀ for the same generations. Regarding GP values of the SP line, it could be indicated that females of SS line still accepted *P. gossypiella* eggs over time, as GP of females ranged between 13.56- 31.27 females/ ♀ and averaged 23.23 females/ ♀ when tested on *P. gossypiella* eggs. Otherwise, some enhancement occurred in GP of the produced females by adding *P. gossypiella* eggs to the culture of SS line. GP ranged between 7.47- 30.97 females/ female and averaged 16.07 females/ ♀ after 31 generations.

Table (5): General productivity of *T. bactrae* females over time of rearing at four different lines.

Generation (G)	General productivity (females/ one female) for the rearing lines			
	PP	SS	SP	SSP
(Lab. S.)	**35.56**	**16.61**	**16.61**	**16.61**
1st	39.00	28.35	22.52	28.35
4th	40.67	11.62	17.32	11.61
7th	27.86	11.99	31.27	11.99
10th	45.85	15.38	28.07	30.97
13th	34.68	15.61	29.80	16.09
16th	35.60	12.98	17.81	18.21
19th	28.69	9.28	31.00	16.34
22nd	40.28	11.60	17.70	17.58
25th	38.72	12.03	13.56	9.58
28th	40.85	10.15	13.84	8.60
31st	37.11	7.95		7.47
Mean of generations	**37.21**	**13.36**	**23.23**	**16.07**

In this study, females from the four rearing lines had higher female bias in all generations and this is in agreement with that found by Pratissoli *et al.* (2004) who stated that sex ratio of the offspring of *T. pretiosum* was not affected by the timing of parasitism when the parasitoid reared on eggs of *Anagasta kuehniella* for 23 generations. They added that variability in the parasitism rate was lower from 17th generation. On the other hand, females' longevity, fecundity and progeny survival were lower when the rearing and tested host was *S. cerealella* eggs and these findings reflected on females' general productivity. These results are in agreement with those reported by many investigators. Salt (1940) mentioned that the most marked effect of different hosts on *T. evanescens* is their influence on the size of the parasite. Also, Hohmann *et al.* (1988) found that females reared from *S. cerealella* eggs were significantly smaller than those reared from the cabbage lopper eggs (*T. ni*) and produced low-quality *Trichogramma platneri* females. In addition, Abd El-Hafez (2001) stated that *T. evanescens* and *T. bactrae* females emerged from *S. cerealella* eggs are smaller, shorter lived and less fecund than those emerged from *P. gossypiella*, *E. insulana*, *A. ipsilon*, *C. cephalonica* and *E. kuehniella* eggs.

We found great fluctuation in the important aspects of parasitoid fitness across generations. These findings were explained previously by many authors. Hopper *et al.* (1993) and Godfray (1994) stated that attributes of an animal that are related to behavior such as rate of parasitism are expected to be variable because many factors influence behavior. Where the efficiency of parasitoids kept in the laboratory for many generations can change over time as a result of changes in the laboratory such as food, temperature, light, and disease levels, or changes in the bioassay used to measure wasp performance. While changes in parasitoid performance in a single healthy colony over many generations may be a genetic response to selection on the wasp population when external factors are constant. Also, Penn *et al.* (1998) reported that the decline of fitness of parasitoids reared for many generations in the laboratory is commonly observed and can be due to genetic inbreeding, disease, or suboptimal conditions. In addition, Hopper *et al.,* (1993) revealed that the measured characters are closely related to fitness while genetic drift is not likely to have caused measurable differences among stocks or colonies in a few generations. According to these reports, fluctuating changes that detected over time in the present study could be due to temporal variations in the used hosts' quality because they reared on different nutrition sources.

Our results show also that females from *S. cerealella* eggs successfully parasitized more host eggs and produced more females when tested on *P. gossypiella* eggs than when tested on eggs of the species on which they had been reared. This means that females from *S. cerealella* accepted *P. gossypiella* eggs over time of rearing. Meanwhile, the less rearing cost of *S. cerealella* opposed to the more expensive one for other target hosts i.e., *P. gossypiella* support its selection to be the commonly factitious host used for rearing *Trichogramma*. We suggested that factitious hosts which used as nutrition source must be changed or replaced from time to another to avoid strain deterioration.

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هل التربية المستمرة لطفيل الترايكوجراما على نفس العائل لعدة أجيال تؤثر على كفاءة الطفيل؟

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أجريت دراسة معملية على طفيل *Trichogrammatoidea bactrae* المتخصص في التطفل على بيض دودة اللوز القرنفلية. تهدف هذه الدراسة إلى معرفة مدى حدوث التدهورلسلالة الطفيل نتيجة التربية المستمرة سواء على العائل البديل المستخدم في التربية على نطاق تجاري (بيض فراشة الحبوب) أو على العائل المستهدف في المكافحة (بيض فراشة دودة اللوز القرنفلية). كما تهدف الدراسة أيضا إلى معرفة هل التربية المستمرة على بيض فراشة الحبوب يؤثر على قبول الطفيل لبيض العائل المستهدف (دودة اللوز القرنفلية)؟ وقد تمت الدراسة بعمل أربعة خطوط لتربية الطفيل حيث يتم في الخطين الأول والثاني دراسة مدى تدهور السلالة. ويتم في الخط الثالث إختبارمدى تقبل الطفيل لبيض العائل المستهدف بعد التربة على العائل البديل، أما الخط الرابع فلدراسة تأثير تطعيم التربية على العائل البديل ببيض من العائل المستهدف. هذا وقد تم مقارنة النتائج المتحصل عليها بتلك الخاصة بسلالات الآباء الموجودة بالمعمل. وقد أوضحت النتائج أن الطفيل أظهر كفاءة عالية على بيض دودة اللوز القرنفلية بالمقارنة ببيض فراشة الحبوب، وأن كفاءة الطفيل لم تتغير معنويا عن تلك الخاصة بالآباء بعد التربية لمدة ٣١جيلا على كل من العائلين مما يدل على عدم حدوث تدهور. كما أن التربية المستمرة للطفيل على بيض فراشة الحبوب لمدة ٢٨ حيلا لم تؤثر على تقبل الطفيل لبيض دودة اللوز القرنفلية. ومن ناحية أخرى فإن تطعيم التربية على بيض فراشة الحبوب ببيض دودة اللوز القرنفلية أدى الى تحسين كفاءة الطفيل بالمقارنة بالتربية على بيض فراشة الحبوب فقط.