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Comparative Development and Parasitization of *Trichogramma chilonis* Ishii and *Trichogrammatoidea bactrae* Nagaraja Under Different Temperature Conditions

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Abstract.- Development and parasitization of two egg parasitoids *Trichogramma chilonis* (TC) and *Trichogrammatoidea bactrae* (TrB) were compared after their exposure to different temperature regimes under laboratory conditions. There was no significant difference between species at different temperatures. However, biological response of both species varied significantly temperature wise. Their development from egg to adult emergence prolonged (26.3 and 25.6 days) at 15°C followed by 20°C (16.6 and17.0 days) and 25°C (13.0 and 12.6 days) for TC and TrB, respectively. Whereas, it was reduced to 7 days both at 30 and 35°C. No development was recorded at 10°C. Host parasitization was 90.6 and 90.4% at 25°C followed by 88.4 and 87.5% at 20°C and 83.5 and 81.4% at 15°C for TC and TrB respectively. Whereas, it decreased to 56.7 for TC and 54.4 for TrB at 35°C. The maximum adult emergence (94.4 vs. 93.8 %) was recorded at 25°C and the minimum (40.6 vs. 36.1%) at 35°C for TC and TrB, respectively. Adult males survived for a shorter period than adult females at all temperature regimes. However, survival was the maximum at low than at high temperatures. There was no significant difference in sex ratio against all temperatures. However, more females were recorded than males at 20 and 25°C. Significantly high change in ratio of males to female was 1: 1.9 and 1:1.7 in TC and TrB at 25°C than 1:1.6 and 1:1.7 at 20°C, respectively. All life parameters of both egg parasitoids were very favorable at 25°C for getting maximum adult recovery while high temperatures (30 and 35°C) and low temperatures (15 and 20°C) affected adversely the fitness of the parasitoids.

Key words: Parasitization, *Trichogramma chilonis* , *Trichogrammatoidea bactrae*.

INTRODUCTION

Trichogramma (Hymenoptera: Trichogrammatidae), the extremely tiny egg parasitoid wasps of lepidopterous pests are found in habitats that are naturally covered with vegetations every where and also on aquatic habitats. *Trichogramma* species are most widely used natural enemy due to their easy rearing in insectaries and voracious parasitizing habit on eggs of target hosts. Their inundative releases are being used in biological control of agricultural pests in cotton, maize, sugarcane, vegetables and fruits in more than 30 countries of the world (Li, 1994). In Pakistan, pest management (PM) practices in crops are mainly based on the heavy use of pesticides. In response the problems encountered in PM are the outbreak of secondary pests, pesticide resistance, health concerns to human beings in terms of water and environmental pollution (Anonymous, 1992). *Trichogramma chilonis* has potential to parasitized the eggs of bollworms in cotton (Ahmad *et al*., 2001). Many studies on *Trichogramma* have been conducted to see the parasitizing potential, searching ability and insect pest suppression during past several years. There is a need to develop quality parasitoids in insectaries to improve its quality by the study of its fitness parameters in accordance with natural conditions for successful field releases of parasitoids (Nadeem *et al*., 2004). For better adaptations of natural enemies in field and *in vitro* studies are imperative. Pak and Van Lenterene (1988) reported that the *Trichogramma* strains performed well in laboratory also have the ability to adopt in field conditions. The climatic extremes can also be a hazard in the way of successful adaptation in the

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field. Generally the insects are experienced with fluctuating temperatures in natural environment and can develop adaptations to upper and lower extreme limits of temperature. An efficient biological control programme with *Trichogramma* needs selection of strains with high efficiency against a target pest in a given set of environmental conditions (Hassan, 1994). Scholler and Hassan (2000) reported the life table of two *Trichogramma* spp. *i.e.*, *T. evanescens* and *T. cacoeciae*, that covers parasitization and longevity on one host at 20, 26, 30 and 35°C. Lower and upper temperature thresholds for *Trichogramma* species are 9 and 36°C, respectively (Kot, 1979). Kalyebi *et al*. (2004) compared parasitism rate at six temperatures (10, 15, 20, 25, 30 and 35°C) and two relative humidity levels (40-50 % and 70-80 %). Temperature and strains significantly affected the number of egg parasitoids while humidity did not. The present study was therefore planned to evaluate the best suited temperature for rearing of two wasp species by studying different life parameters at laboratory conditions, to develop good culture for inundative releases.

MATERIALS AND METHODS

Experiment was conducted in mass rearing laboratories of beneficial insects at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan. Eggs of *Sitotroga cerealella* were used as laboratory factitious host for both the species of parasitoids. Cultures of both species of *Trichogramma* were maintained on host eggs for several generations. Host culture (*S. cerealella*) was maintained on wheat grains in bio-control laboratory of NIAB. Each specie of *Trichogramma* was reared in glass vials as described by Morison (1970). Six temperature levels *viz*., 10, 15, 20, 25, 30 and 35°C were maintained in six incubators. Effect of temperatures (ranging from 10-35°C) on different life parameters, i.e. developmental period, percent parasitization, percent adult emergence and adult longevity of two egg parasitoid species, *i.e.*, TC and TrB in incubators was recorded. Honey solution (10%) was used to parasitoid adults as adult diet. Culture of egg parasitoids was maintained at 25±2°C and 65±5 % RH in the bio-control laboratory. Same aged (24 h) 500 *S. cerealella* eggs were glued on paper cards and then, parasitized by 100 parasitoid wasps of both species (24 h age) in glass vials separately for 24 h. After parasitization, three replications were made for each treatment and kept at respective temperature conditions in the incubators. Data was recorded daily regarding developmental period, percent parasitization, percent adult emergence and adult longevity of species. Sex ratio for both male and female were separated on the basis of type of antennae as identified by Pinto *et al*. (1978). Data were statistically following Steel and Torrie (1980). DMRT was applied to find the significance of our results.

RESULTS AND DISCUSSION

Results indicate that no development of either of the parasitoid species was observed at 10°C (Table I) as low temperature tends to stop the embryonic development inside the egg. No difference was recorded in between species with respect to their response to different levels of temperature ranged from 10-35°C. Developmental period from egg to adult emergence of both species was prolonged (26.3 and 26.6 days) at 15°C followed by 16.6 and 17.0 days at 20°C and 13.0 and 12.6 days at 25°C for TC and TrB, respectively. Whereas, developmental period reduced up to 7 days at 30 and 35°C for both species. Our findings are in line to the previous work done by Harrison *et al*. (1985) who reported that the developmental time of two *Trichogramma* species was decreased from 35 days to 7 days as the temperature increased from 15°C to 35°C. Similar findings were recorded in the present research that maximum parasitization, 90.6 and 90.4% was observed at 25°C, followed by 88.4 and 87.5 % at 30°C, 83.5 and 81.4% at 20°C, 72.2 and 74.6 % at 15°C for TC and TrB, respectively. Minimum parasitization for both species (56.7 vs. 54.0) was observed at 35°C. In our findings the parasitization and development observed was almost similar to the work done by Scholler and Hassan, (2000) who studied the life table of two *Trichogramma* species (*T. evanescens* and *T. cacoeciae*) on one host at 20, 26, 30 and 35°C and reported that longevity and percent parasitization were higher in *T. evanescens* than in *T. cacoeciae*.

Scott *et al*. (1997) reported that rearing of *T. carverae* at 14°C resulted in less parasitization as compared to more parasitization in rearing at

Table I.- Comparison of different life parameters (± SE) of egg parasitoid *T. chilonis* (TC) and *T. bactrae* (TrB)at different temperatures.

Temp. (°C)	Developmental period (days)		Parasitization (%)		Adult emergence (%)		Adult longevity (days)				Sex ratio			
							Male		Female		TC		TrB	
	TC	TrB	TC	TrB	TC	TrB	TC	TrB	TC	TrB	Male	Female	Male	Female
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	26.3± 0.87a	25.6± 0.66a	72.2± 1.11c	74.6± 1.68c	70.1± 1.16c	69.7± 1.65c	3.3± 0.33ab	3.6± 0.33a	5.6± 0.33a	5.3± 0.33a	1	1.4± 0.30b	1	1.3± 0.05b
20	16.6± 0.33b	17.0± 0.57b	83.5± 0.49b	81.4± 0.60b	92.2± 1.15ab	90.5± 1.22b	3.6± 0.33a	3.3± 0.33ab	6.3± 0.33a	5.6± 0.33a	1	1.6± 0.20ab	1	1.7± 0.05ab
25	13.0± 0.57c	12.6± 0.33c	90.6± 1.25a	90.4± 0.65a	94.4± 2.22a	93.8± 0.40ab	2.3± 0.33bc	2.3± 0.33b	3.6± 0.33b	3.3± 0.33bc	1	1.9± 0.05a	1	1.7± 0.08ab
30	7.0± 0.00d	7.0± 0.00d	88.4± 1.38a	87.5± 1.06a	91.8± 1.25b	90.7± 1.00b	1.6± 0.33c	1.6± 0.33c	2.3± 0.33c	2.6± 0.33bc	1	1.4± 0.15b	1	1.5± 0.05ab
35	7.0± 0.00d	7.0± 0.00d	56.7± 0.94a	54.0± 1.28a	40.6± 1.61b	36.1± 1.15b	1.3± 0.33c	1.3± 0.33c	1.6± 0.33c	2.3± 0.33bc	1	1.4± 0.05b	1	1.6± 0.57b

Means sharing same letters are statistically non significant (P<0.05).

ambient temperatures ranging from 25 to 30°C. Here, in our findings the maximum adult emergence of 94.4 and 93.8% for TC and TrB was recorded at 25°C, respectively. Likewise, Harrison *et al*. (1985) observed 91% parasitization at 25°C while we recorded 90% parasitization, so again our work was in line to the previous work. Minimum adult emergence of 40.6 and 36.1% for TC and TrB was observed at 35°C, respectively. At 30°C, 20°C and 15°C the percent adult emergence of 91.8 and 90.7, 92.2 and 90.5, 70.1 and 69.7 for TC and TrB, respectively were recorded. Adult females lived longer than males at all temperatures in both the species. However, the maximum male survival at 15°C for TC and TrB was 3.3 and 3.6 days, respectively. While the minimum male survival was evinced at 35°C for 1.3 days for both of TC and TrB. At 20°C the male longevity of 3.6 days for TC vs. 3.3 days for TrB was recorded. However male longevity of 1.3 to 1.6 days in both species was observed at 35 and 30°C, respectively. Females survived for a longer period at 20°C from 5.6 to 6.3 5.6 days, while at 35°C female tends to survive for 1.6 and 2.3 days for TC and TrB, respectively. The optimum period of survival *i.e.* 3.6 and 3.3 days for TC and TrB, in respect was observed at 25°C at which the maximum parasitization was recorded. The prolongation and reduction of female longevity period at 15 and 35°C, respectively have got the lower parasitization which is the most important parameter of the present study. More females were recorded than males in sex ratio comparison in both the species at all temperature levels. At 25°C male to female ratio was 1:1.9 and 1:1.7 in TC and TrB, respectively. Male to female sex ratio was low at both of extreme and lower levels of temperature, while it was intermediate at other levels of temperature. Harrison *et al*. (1985) reported that temperature had little effect on male to female ratio as females ratio slightly decreased at upper and lower limits of temperatures and our work is in agreement to their work.

It was concluded from the present studies that all life parameters of both egg parasitoids were very favorable at 25°C for getting maximum adult recovery while high temperatures of 30 and 35°C adversely affected the fitness of the parasitoids.

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