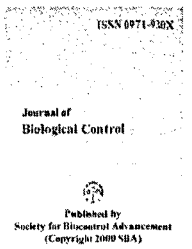

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Research Note

Parasitism potential and low temperature response of *Trichogramma kashmirica* Nagaraja, Ahmad and Gupta (Hymenoptera: Trichogrammatidae)

M. JAMAL AHMAD*, S. BILAL AHMED AND MUNAZZA YAQOOB

Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology (Kashmir), Shalimar Campus, Srinagar 191 121, Jammu and Kashmir, India.

**Corresponding author E-mail*: ahmad_j@rediffmail.com

ABSTRACT: The parasitism potential and low temperature storage response of *Trichogramma kashmirica* Nagaraja, Ahmad and Gupta was studied at 27±1°C and 65±5 per cent RH. The females on average parasitized 81.0±20.0 eggs of *Corcyra cephalonica* during their life span of 7.01±1.99 days. The per cent emergence and females declined from 96.0 to 60.6 and 88.3 to 86.8, respectively, after storage for 45 days at 6°C. Adult emergence and longevity of females were negatively correlated, whereas developmental period was positively correlated with storage period.

KEY WORDS: *Trichogramma kashmirica*, parasitizing potential, emergence, per cent females, cold storage

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Trichogramma kashmirica Nagaraja, Ahmad and Gupta was collected from the eggs of an unidentified host, infesting early stage of transplanted paddy, at Anantnag, Kashmir, India (Nagaraja *et* al., 2007). In view of escalating demand for *Trichogramma* as an important component in integrated management of many lepidopterous pests, techniques have been standardized by different workers for their mass production and storage for the purpose of large scale field releases. The basic purpose of cold storage of *Trichogramma* species, in their pre-pupal or pupal stages, is to delay their emergence thereby enabling storage of surplus material for use at appropriate time and ensuring large scale availability (Rundle *et al.*, 2004).

Though sufficient information is available on the aspect of low temperature storage of different *Trichogramma* spp. (Jalali and Singh, 1992; Ozder, 2008; Rundle *et al.*, 2004; Patterson, 1931; Schread and Garman, 1934; Volkoff and Daumal, 1994; Lopez and Morrison, 1980), parasitizing efficiency and low temperature storage of *T. kashmirica* has not been studied. The response of trichogrammatids to low temperature varies from species to species. Jalali and Singh (1992) suggested low temperature storage for 49 days at 10°C for *Trichogramma achaeae*, *T. chilonis*, *T. japonicum* and *Trichogrammatoidea eldanae* and Rundle *et al.* (2004) opined two weeks of cold storage at 3°C as best, but indicated that adult emergence failed if stored for two months at this temperature.

In the present study, storage of embryos of *T. kashmirica* was done at 6°C to study the optimum storage period, emergence pattern and other parameters, after storage at 27±1°C. *Trichogramma kashmirica* reared from the eggs of an unidentified host on paddy during July-September 2008 was multiplied on the eggs of *Corcyra cephalonica* (Stainton) in The Biological Control Laboratory, Entomology Division of SKUAST-K, Srinagar. Five mating pairs from freshly emerged culture of *T. kashmirica* were isolated and individual pairs transferred into separate glass test tubes (15x2.5 cm.) and plugged with cotton plugs covered with muslin. 'Tricho' cards measuring 5.0x2.0 cm were prepared as per standard technique (Jalali *et al.*, 2003), containing approximately 100 sterilized eggs of C. *cephalonica.* Individual Tricho card was offered to each pair for parasitism for 24 hours after which they were replaced by a new one till all females died. Diluted honey (30.0%) was used as food for the parasitoids. The parasitised egg cards of each day were kept separately for further observations. Observations on % females, emergence, parasitism and female longevity

were recorded on each day to obtain these parameters during its life span. The experiment was replicated five times. In order to study the effects of low temperature storage, five-day-old embryos of *T. kashmirica* were stored in a refrigerator maintained at 6°C. At 5-day intervals, five strips (5.0 x 2.0 cm.) from the above mentioned stock card were cut with the help of a pair of scissors and transferred separately to individual test tubes (12.0 x 2.5 cm.), plugged with cotton, and kept in a thermostat BOD maintained at 27±1°C and 65±5% RH. The samples were observed for the emergence of parasitoids. Observations on % emergence of adult, % females and longevity of emerged females were recorded. Increase in developmental period was recorded by adding storage period to time taken after removal from storage and age of embryos.

The data were analyzed using Minitab version 13.2. CD values for % emergence and % females were based on arc sine transformation of data, whereas those of % hatching of adults, longevity of females and increase in developmental period were based on square root transformations ($\sqrt{n+0.5}$). Untransformed data of individual parameters were separately subjected to regression analysis against period of low temperature storage. The values of 'y' for each parameter, *viz.*, % adult emergence, duration of hatching, longevity of emerged females, % females and increase in developmental period were based on linear model Y= a+ bx, where 'a' and 'b' represent constant values and 'x', the period of low temperature.

At normal room temperature, a mated female of *T. kashmirica* parasitized an average of 81.0±20.08 eggs of *C. cephalonica* during its average life time of 7.33±1.99 days. Average number of parasitized eggs declined from 43.8±5.21 to 1.4±2.19 from the first day to the 9th day. Average longevity of female and male was 7.33±1.99 and 2.85±0.91 days and per cent adult emergence and per cent females were 98.2 and 89.2, respectively. The reduction in per cent adult emergence from 88.3 to 86.8, (Table 1) was non-significant for up to 30 days of storage and a significant decline was observed after that (Table 1). Duration of adults hatching from refrigerated pupae and their longevity at 27±1°C declined from 6.6 to 4.2 and 5.6 to 3.0 days, respectively, during storage of 5-45 days (Table 1). Per cent decline in each of these parameters was found statistically significant at each storage period. An increase in developmental period of the parasitoids from 7.64 to 45.2 days due to low temperature storage was recorded (Table 1).

Regression models Y= a+ bx were found best fit for % adult emergence (Y= 101.53– 0.77x; R^2= 0.76; r= -0.87**), duration of hatching (Y= 7.62-0.08x; R^2=0.81; r=- 0.9**), longevity of emerged females (Y= 6.44-0.08x; R^2=0.74; r=-0.86**), and increase in developmental period

Table 1. Effect of low temperature on biological parameters of *T. kashmirica*

Storage period (in days)	% Adult emergence	% females	Duration of hatching (in days)	Longevity of females (in days) period	Increase in developmental (in days)
Untreated (Control)	98.2 (83.2)^{a}	89.2^{a}	9.0^{a}	7.33^{a}	-
5	96.0 (79.3)^{a}	88.3^{a}	6.6^{b}	5.6^{b}	7.64 (2.8)^{a}
10	93.5 (75.6)^{ab}	88.1^{a}	6.4^{b}	5.5^{b}	12.4 (3.5)^{b}
15	90.7 (72.9)^{ab}	87.2^{a}	6.0^{c}	5.0^{c}	17 (4.1)^{c}
20	87.2 (69.4)^{ab}	87.5^{a}	5.6^{d}	4.5^{d}	21.6 (4.6)^{d}
25	86.2 (68.9)^{ab}	88.6^{a}	5.2^{e}	4.2^{e}	26.32(5.1)^{e}
30	85.6 (68.3)^{ab}	87.3^{a}	5.0^{e}	4.0^{f}	31.44 (5.6)^{f}
35	75.1 (60.9)^{c}	86.8^{a}	4.8^{ef}	3.5^{fg}	35.82(5.9)^{g}
40	69.4 (56.6)^{c}	88.2^{a}	4.6^{ef}	3.4^{g}	40.62 (6.4)^{h}
45	60.6 (51.3)^{cd}	87.5^{a}	4.2^{g}	3.0^{h}	45.2 (6.7)^{i}
C.D. (0.05)	5.4	5.7	0.21	0.1	0.04

Figures in columns represent means of 5 replications; values in parentheses are arc sine transformation of first column and "n+0.5 of the last column; similar alphabetical superscripts indicate that the values are statistically on par at $P = 0.05$

(Y= 2.92+ 0.94x; R^2=0.98; r= 0.99**) except % females (Y= 88.45-0.02x; R^2=0.19; r=-0.45 NS). A positive correlation for increase in developmental period as indicated above was obtained in relation to period of low temperature storage. However, negative correlation for % adult emergence, longevity of females, and duration of hatching at room temperature, as obvious from their r- values, indicated the adverse impact of low temperature storage of *T. kashmirica* at 6°C.

Like most of the trichogrammatids, *T. kashmirica* also parasitized maximum number of eggs on the first day, indicating the presence of maximum number of mature eggs in the ovarioles immediately after mating of parasitoids as observed by Donaldson *et al.* (1988). Decline in parasitizing potential of the parasitoids with advancing age of female has been reported for *T. brassicae* and *T. cacaeciae* (Volkoff and Daumal, 1994).

Early hatching of adults from materials refrigerated beyond 30 days as compared to 5–30 days of refrigeration was probably due to comparatively quick start of arrested embryonic development. However, decline in the average longevity of females from refrigerated material indicated the negative impact of cooling on the survival ability of parasitoids as observed by Ozder (2008) and Rundle *et al.* (2004). Our observations on over five times increase in the incubation period of *T. kashmirica* at 6°C are in agreement with Jalali and Singh (1992) who also reported four times increase in incubation period of *T. achaeae*, *T. chilonis* and *Trichogrammatoidea eldanae* when stored at 5°C. Gou (1985) also reported an increase in incubation period for up to 90 days in case of *T. ostriniae* at 8°C.

The present study indicates cold tolerance in *T. kashmirica* which can be exploited for low temperature storage at 6°C for 45 days for the purpose of mass production. Negative impacts on longevity of females and % hatching however suggest 10 days of storage at 6°C as optimum till further information related to the functional aspects of the parasitoids is investigated.

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