Indian Journal of Entomology Online published Ref. No. e21104 DoI.: 10.5958/IJE.2021.111

EFFECT OF SHORT-TERM COLD STORAGE OF PUPAE AND PARASITIZATION EFFICIENCY OF EGG PARASITOID *TRICHOGRAMMA CHILONIS* (ISHII)

Suchismita Balabantaray* and S M A Mandal

Department of Entomology, Odisha University of Agriculture and Technology,
Bhubaneswar 751003, Odisha, India
*Email: suchi.balabantaray26@gmail.com (corresponding author)

ABSTRACT

The fitness parameters of *Trichogramma chilonis* (Ishii) such as adult emergence (%) from pupae and parasitisation of host *Corcyra cephalonica* Stainton were evaluated under laboratory conditions after storing the pupae at five constant temperatures (5, 7.5, 10, 12.5 and 15°C) for nine storage durations (5, 10, 15, 20, 25, 30, 35, 40 and 45 days) in incubators. Maximum adult emergence of 94.27% was observed at 7.5°C for 5 days. The emergence got gradually reduced to 77.03% at 30 days after storage and further reduced to 54.48% at 45 days. The maximum parasitization of 93.52% was observed at 7.5°C for 5 days which gradually decreased with increase in storage duration. The parasitization was 73.76% at 30 days after storage and 56.74% at 45 days after storage. The next best temperature was 10°C followed by 5°C. The temperatures viz., 12.5 and 15°C were found unsuitable for the storage of *T. chilonis* pupae.

Key words: Effect, storage, pupae, *Trichogramma chilonis*, pupae, *Corcyra cephalonica*, temperature, parasitization efficiency, adult emergence, fitness costs

Insecticides are very popular and widely used in agriculture but these are general biocides causing harm to both living organisms as well as to the environment. In recent decades, awareness of the impact of pesticides on the environment and human health calls for efforts to reduce reliance on chemical control. Biological control could be more widely used as component of IPM. The egg parasitoid *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammatidae) is of great importance to biological control. Trichogrammatids are the most widely utilized biological control agents due to their easy rearing (Nadeem et al., 2010). *Trichogramma* egg parasitoids are being used as an important component in IPM of lepidopterous borer pests of sugarcane, cotton, maize, rice etc. Efficient storage of parasitoid pupae at cold temperature is a prerequisite in biological control. This leads to delay in the parasitoid development into adult so as to synchronize their emergence in large numbers with occurrence of vulnerable stage of the host in the fields (Kumar et al., 2005). According to Nadeem et al. (2010) temperature directly influences the developmental period of parasitoids. This study evaluates the effect of low temperatures and duration of storage of the pupae of *T.chilonis,* and consequent effect on the parasitisation.

MATERIALS AND METHODS

Laboratory experiments were conducted on the cold storage of pupae of *T.chilonis* and its effect on parasitization efficiency at the Biocontrol Laboratory, Department of Entomology, OUAT during 2018-20. Ten pairs (in mating condition) of 12 hr old *T. chilonis* adults were released into each specimen tube (7x 2 cm) containing paper card strip (5x 2 cm) glued with 200 Nos. of UV light treated (30W ultraviolet lamp for 1 hr and 30 min) *Corcyra* eggs. After parasitisation for 24 hr, the *Corcyra* egg cards were taken out and kept under standard laboratory condition i.e., 282°C and 75.5% RH for 5-6 days. When the parasitoid eggs hatched, larvae completing the stage and pupating inside the host eggs were counted. The host eggs turn black during pupation of the parasitoid larvae. The black egg cards were stored at five temperatures viz., 5.0, 7.5, 10.0, 12.5 and 15.0°C each for 5, 10, 15, 20, 25, 30, 35, 40 and 45 days in BOD incubator in complete darkness. The egg cards were removed from the incubator on completion of the respective storage duration and placed at the standard laboratory condition for adult emergence. The emerged parasitoids were provided with UV light treated *Corcyra* egg card for egg laying (parasitization). The % emergence and parasitization were worked out for each

temperature and duration combination. Observations on the number of adults emerged and parasitized eggs were made daily under stereozoom microscope. The data were subjected to statistical analysis.

RESULTS AND DISCUSSION

Data given in Table 1 reveal that the maximum adult emergence (%) was observed from pupae stored at 7.5°C for 5 days (94.27 %) followed by 10 days (93.80 %) which were at par. These were followed by pupae stored at 10°C for 5 days (91.95 %) and 10 days (90.60 %) and stored at 5°C for 5 days (90.23%). There was no significant difference among these treatments. The emergence decreased gradually with the increase in storage duration for all the temperatures. The emergence reduced to 77.03% after storing for 30 days and further reduced to 54.48% after storing for 45 days at 7.5°C. Similar trends of reduction in adult emergence were found at 10°C (72.67% emergence at 30 days and 51.56% at 45 days) and 5°C (70.32% emergence at 30 days and 50.52% at 45 days). Emergences of adults were comparatively lower when pupae were stored at 12.5°C and 15°C. There was no adult emergence beyond 40 days when pupae were stored at 12.5°C and beyond 20 days when pupae were stored at 15°C. These results reveal that *T. chilonis* parasitized trichocards upon blackening could be stored effectively up to 30 days at 7.5°C. That was followed by storage at 10°C and 5°C up to 30 days.

Earlier work of Bhargavi and Naik (2015) on effect of low temperature storage of trichocards parasitized by *T.chilonis* showed that the mean % adult emergence were 96.50, 95.72, 70.25, 36.88, 30.14, 32.25, 33.26, 13.55 and 0.00 for a period of 5, 10, 15, 20, 25, 30, 35, 40 and 45 days, respectively. Their results showed that the parasitoid can be stored at 15°C effectively for 15 days, which indicated slight deviation from the present findings. The study on *T. bourarachae* by Abbes et al. (2020) showed that wasps treated at the induction temperature of 15°C for 5 days can be stored at 4± 1°C for >30 days without significant loss of their performance. Pathak et al. (2010) observed the suitable temperature for the storage of *T. chilonis,* and found that the cards can be stored at 15°C for 30 days after 5 days of parasitisation, with maximum parasitoid emergence (72.4%). Nadeem et al. (2010) revealed that maximum emergence (96.6%) of *T. chilonis* was at 10°C after 5 days storage, and parasitoids complete their development due to moderate temperature at 16 and 12°C, emerged after 25 days and 40 days storage,

Table 1. Effect of storage of *T. chilonis* pupae on adult emergence (%) and parasitization (%)

Storage Duration (Days)	Mean adult emergence (%) Storage temperatures						Parasitization (%) Storage temperatures					
	5°C	7.5°C	10°C	12.5°C	15°C	Mean	5°C	7.5°C	10°C	12.5°C	15°C	Mean
5	90.23 (71.78)	94.27 (76.29)	91.95 (73.58)	85.32 (67.48)	75.96 (60.62)	87.55	90.34 (71.94)	93.52 (75.36)	91.41 (72.94)	76.12 (60.76)	69.56 (56.50)	84.19
10	89.67 (71.27)	93.80 (75.66)	90.60 (72.14)	83.44 (66.00)	71.65 (57.82)	85.83	87.17 (69.04)	90.64 (72.22)	88.63 (70.28)	63.30 (52.69)	60.82 (51.24)	78.11
15	86.04 (68.06)	89.04 (70.69)	88.87 (70.53)	71.20 (57.52)	49.42 (44.64)	76.91	84.17 (66.57)	86.89 (68.76)	85.63 (67.70)	51.60 (45.90)	45.93 (42.64)	70.84
20	81.64 (64.61)	85.25 (67.42)	83.62 (66.13)	51.22 (45.68)	32.87 (34.98)	66.92	80.28 (63.64)	82.93 (65.58)	81.67 (64.63)	39.96 (39.19)	34.48 (35.93)	63.87
25	76.00 (60.67)	81.77 (64.75)	78.05 (62.06)	42.66 (40.76)	0.00 (0.00)	55.70	75.37 (60.25)	78.24 (62.17)	76.67 (61.10)	32.75 (34.88)	0.00 (0.00)	52.61
30	70.32 (56.98)	77.03 (61.36)	72.67 (58.49)	36.37 (37.07)	0.00 (0.00)	51.28	70.35 (57.00)	73.76 (59.17)	71.78 (57.89)	25.15 (30.07)	0.00 (0.00)	48.21
35	64.48 (53.41)	68.38 (55.78)	66.04 (54.33)	22.56 (28.33)	0.00 (0.00)	44.29	63.30 (52.70)	69.93 (56.72)	65.62 (54.08)	19.35 (26.07)	0.00 (0.00)	43.64
40	57.49 (49.29)	60.71 (51.18)	58.11 (49.66)	11.63 (19.89)	0.00 (0.00)	37.59	57.67 (49.39)	63.89 (53.05)	59.64 (50.54)	12.56 (20.71)	0.00 (0.00)	38.75
45	50.52 (45.29)	54.48 (47.56)	51.56 (45.88)	0.00 (0.00)	0.00 (0.00)	31.31	51.67 (45.94)	56.74 (48.86)	53.30 (46.87)	0.00 (0.00)	0.00 (0.00)	32.34
Mean	74.04	78.30	75.72	44.93	25.54		73.37	77.39	74.93	35.64	23.42	
	SE(m)±			CD (p=0.05)			SE(m)±			CD (p=0.05)		
Temperature	0.229			0.645			0.265			0.747		
Duration	0.307			0.865			0.356			1.002		
T x D	0.687			1.934			0.796			2.241		

*Figures in parentheses angular transformed values

respectively. Ghosh and Ballal (2018) observed with *T. chilonis* that it can be stored up to 30 days at 10°C, with a minimum of 60% emergence, which supports the present finding.

The results in Table 1 also reveal that maximum parasitization was observed with 7.5°C storage for 5 days (93.52 %), followed by that of 10 days (90.64%) at 7.5°C and after 5 days of storage at 10°C (91.41 %) and at 5°C (90.34 %). The parasitization after 10 days storage was 82.17% (5°C) and 80.97% (10°C). There was gradual reduction in the parasitization with increase in storage duration in all the storage temperatures. The parasitization obtained with storage at 7.5°C got reduced to 73.76% after 30 days of storage; and further reductions were noticed (56.74%- 45 days; after 30 days at 5°C- 70.35 %; and at 10°C- 71.78 %); and after 45 days to 51.67 %- 5°C and 53.30%- 10°C; and when pupae were stored at 12.5°C, it was 76.12% after 5 days; and at 15°C, it was 69.56 % after 5 days; it further reduced to 12.56% after 40 days- at 12.5°C and 34.48% after 20 days- at 15°C. The parasitization of trichocards was nil (0.00 %) after 40 days at 12.5°C and after 20 days at 15°C due to emergence of adults during storage.

Thus, *T. chilonis* could parasitize the host eggs (*C. cephalonica*) satisfactorily when pupae were stored up to 30 days at 7.5°C followed by 10°C and 5°C. Pitcher et al. (2002) reported that there were no adverse effects on parasitization when *T. ostriniae* pupae were stored at 9°C for 30 days but the parasitization decreased at 12°C for 30 days. Khosa and Brar (2000) suggested that the parasitoid could be cold stored for 22 days in refrigerator at 8-10°C without affecting its parasitization efficiency. Vigneswaran et al. (2017) revealed that maximum parasitism (96.00%) was observed at 10°C with 5 days of storage which decreased to 53.66% at 30 days of storage. It is concluded that *T. chilonis* pupae can be stored up to 30 days at 7.5°C followed by10°C and 5°C without any detrimental effect on its parasitization efficiency in terms of adult emergence and parasitization.

ACKNOWLEDGEMENTS

The authors acknowledge the assistance rendered by the Department of Science and Technology, Government of India, New Delhi through INSPIRE Fellowship.

REFERENCES

Abbes K, Zouba A, Harbi A, Chermiti B. 2020. Effect of cold storage on the performance of *Trichogramma bourarachae* (Pintureau and Babault) (Hymenoptera: Trichogrammatidae). Egyptian Journal of Biological Pest Control 30(27): 1-6.

Bhargavi M, Naik K V. 2015. Effect of low temperature storage of trichocards parasitised by *Trichogramma chilonis* (Ishii) and *Trichogramma japonicum* (Ashmead). Asian journal of bio science 10(1): 43-47.

Ghosh E, Ballal C R. 2018. Short-term storage of the egg parasitoids, *Trichogramma* and *Trichogrammatoidea*. Egyptian Journal of Biological Pest Control 28: 34.

Khosa S S, Brar K S. 2000. Effect of storage on the emergence and parasitization efficiency of laboratory reared and field collected populations of *Trichogramma chilonis* ishii. Journal of Biological Control 14(2): 71-74.

Kumar P, Shenhmar M, Brar K S. 2005. Effect of low temperature storage on the efficiency of three species of trichogrammatids. Journal of Biological Control 19(1): l7-22.

Nadeem S, Ashfaq M, Hamed M, Ahmed S. 2010. Optimization of short and long term storage duration for *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammatidae) at low temperatures. Pakistan Journal of Zoology 42(1): 63-67.

Pathak S K, Dubey M N, Yadav P R. 2010. Suitability of temperature for the storage of *Trichogramma chilonis*. Journal of Experimental Zoology India 13(1): 53-55.

Pitcher S A, Hoffmann M P, Gardner J, Wright M G, Kuhar T P. 2002. Cold storage of *Trichogramma ostriniae* reared on *Sitotroga cerealella* eggs. Biological Control 47: 525-535.

Vigneswaran S, Jethva D M, Wadaskar P S, Balas T K. 2017. Effect of cold temperature durations on the emergence and parasitization efficiency of laboratory reared *Trichogramma chilonis* (Ishii). International Journal of Current Microbiology and Applied Sciences 6(5): 1191-1199.

(Manuscript Received: May, 2021; Revised: September, 2021;
Accepted: September, 2021; Online Published: November, 2021)
Online published (Preview) in www.entosocindia.org Ref. No. e21104