Original Research Article

Effect of cold storage of trichocard on adult emergence and parasitization of *Trichogramma chilonis*

Abstract

The present study was carried out to evaluate the temperature for proper storage of trichocards parasitized by *T. chilonis* (Ishii) prepared from host egg *Corcyra cephalonica*. The effect of different temperature treatment on parameters like adult emergence and parasitization of *T. chilonis* and parasitization on stored *Corcyra* egg. Parasitized trichocard and non-irradiated eggs of *Corcyra* were kept at 4±1°C, 8±1°C, 10±1°C and 12±1°C. Storage temperature of 10±1°C showed highest per cent adult emergence (73.00%) for 15 days of storage which was declining (57.50%) when stored for 35 days. For 45 days of storage 4±1°C and 8±1°C recorded highest 50.50 and 51.80 per cent adult emergence of *T. chilonis* respectively. Treatment with storage temperature of 4±1°C showed maximum per cent parasitization (92.30%) by emerged *trichogramma* adult from stored trichocard which was decreasing with increase in temperature and storage days. Per cent parasitization by *Trichogramma* on stored *Corcyra* eggs recorded highest per cent parasitization at 4±1°C for 15 days later it was declining with increase in storage days. Storage was listed that at 4±1°C and 10±1°C were condusive for storage of parasitoid trichocard and eggs of *C. cephalonica* and 12±1°C is not suitable for storage as very low (9%) adult emergence recorded for 15 days with nil per cent parasitization.

Keywords: Adult emergence, Parasitization, *Trichogramma chilonis*, Storage, *Corcyra cephalonica*

Introduction

Chemical pesticides are widely used in Agriculture because of their immediate and tangible effect. However due to heavy use of pesticides causes heavy damage to the living organism and both environment (Gupta and Dikshit 2010) so environment friendly an alternative to solve pressing the need of pest management is Biological control (Ghosh and Ballal 2018). *Trichogramma* species are mostly used in biological control as a egg parasitoids for different insect pestof different crops through augmentation and release. Trichogrammatids insect can be easily reared inlaboratories and have a great parasitizing potential against the egg of target host (Nadeem *et al.*2010).

Trichogrammatids are a group of minute wasps of great importance to biological control. The egg parasitoid *Trichogramma chilonis* is dominant species in India. *Trichogramma chilonis* is dominant species in India which is very aggressive parasitoid gives near to 100 per cent parasitization according to availability of favourable condition as it has ability to increase their capability (Nagarkata and Nagaraja 1979). Among *Trichogramma* species *Trichogramma chilonis* (Ishii) the egg parasitoid (Hymenoptera; Trichogrammatidae) is an important in IPM of lepidopteran insect pest of crop and vegetables like cotton, tomato, cabbage and apple (Smith 1996). The *trichogramma* species have proved to be effective when it followed by inundative release against the several pest especially when the its development is not interrupted by different chemical pesticides (Garcia *et al* 1995b; Briere *et al* 1999).

Generally, problem is that parasitoid wasps is not available when farmer demands for it also if it is available at the time of field release the price is high which is not affordable by farmers (Lu *et al* 2019; Tezze and Botto 2004; Ayvaz *et al*. 2008). These problem is solved by following the technique of storage trichocard at cold temperature helps in mass production as and when required (Tezze and Botto 2004). Technique of coldstorage must ensure the availability good parasitized trichocard at the time of release in sufficient number (Bigler 1994).

The storage of parasitoid pupae retards their development so as to harmonize the emergence with preserve of vulnerable stages of host in the field. Therefore, the cold storage technique development almost important for biocontrol for helping efficient in mass production to obtain a desired stage of development for field release of agents and for research used standardized stocks will be available (Ravensberg,1992 and Greenberg *et al.*1996).

Thus low temperature storage is considering indispensable prerequisite in biological control (Nadeem *et al.* 2010) suggested that the developmental period of parasitoid is directly influenced by the temperature. To get high rate emergence in laboratory in summer season, artificial manipulation in temperature is necessary for successful rearing (Rajendran 1999). Long term storage through storability can improve time availability for field release of endoparasitoid also leading to decrease in production cost. If we are able to enhance shelf life of *T. chilonis* and trichocard will be available in off season thus helpful to entrepreneurs and biological laboratories.

Hence the present experiment was conducted to estimate the effects of storing the pupae of egg parasitoid *T. chilonis* Ishii at low temperature on its emergence and parasitizing potential of laboratory

reared *T. chilonis* on eggs its factitious host *Corcyra cephalonica.*

Material and Method

The present study on effect of cold storage on the adult emergence and parasitization of *T. chilonis* and *Corcyra cephalonica* was carried out at Biocontrol laboratory, College of Agriculture Nagpur. The experiments were carried out for host eggs *C. cephalonica* with a completely randomized experimental design with four different temperatures as a treatment replicating5 times.

Rearing of *Corcyra cephalonica*

Culture of *C. cephalonica* was obtained from the Biocontrol lab College of Agriculture Nagpur and maintained in controlled condition 27-30°C temperature 70±1% humidity (RH) with complete darkness in laboratory for successive generations on sorghum grains in Biocontrol laboratory College of Agriculture Nagpur. The moth emerged from 40th days were collected daily and transferred into specially design egg laying chamber having iron mesh both externally and internally on top and bottom respectively and fresh eggs were collected from egg laying chamber and used for making trichocards.

Culturing of *Trichogramma chilonis*

Experiment was conducted to find out the best storage temperature and duration for the parasitoid. Nucleus culture of *T. chilonis* was procured from Biocontrol lab College of Agriculture, Nagpur. Eggs obtained from *C. cephalonica* were treated with UV rays (30 WUV tube for 40-45 min) to prevent hatching. 2000 eggs of *Corcyra* counted manually were pasted on the 14×20 cm century card and 5 days after parasitization of this parasitoid card in pupal stage were stored at 4 different temperature regimes viz. 4±1°C, 8±1°C, 10±1°C and 12±1°C each for 15, 25, 35 and 45 days in refrigerator and Biological oxygen demand incubators with complete darkness.

Per cent adult emergence of *T. chilonis*

After fixed storage days parasitized strips were taken out from the refrigerator and BOD incubators. Per cent adult emergence of *Trichogramma* adult was calculated from *Corcyra* eggs by counting host egg in which there was an orifice intented for exit of adults under stereozoom microscope.

$$\% \text{ Emergence} = \frac{\text{Total no. of adult emergence}}{\text{Total no. of eggs}} \times 100$$

Per cent parasitization by emerged of *T. chilonis*

The adult emerged from stored trichocard at 4±1°C, 8±1°C, 10±1°C and 12±1°C each for 15, 25, 35 and 45 days. The emerged adult of *Trichogramma* were exposed to irradiated *Corcyra* eggs @ 8000 eggs/ strips. Per cent parasitization were calculated by using formula.

$$\% \text{ Parasitization} = \frac{\text{Total no. of parasitized eggs}}{\text{Total no. of eggs exposed}} \times 100$$

Statistical analysis

Data recorded during present study on per cent parasitization by *T. chilonis* on stored *Corcyra* egg were Statistically analyzed by using OPSTAT software which is available online on Hissar Agricultural University, Hissar.

Results

Per cent emergence of *T. chilonis*

The result on per cent adult emergence of *T. chilonis* observed that storage of trichocard at different temperature for storage of 15 days recorded significantly maximum adult emergence 73.00 per cent and lowest 9.00 per cent from 10±1°C and 12±1°C respectively (Table 1). After twenty-five days of stored trichocard gives maximum 68.00 per cent adult emergence when it stored at 10±1°C. The moderate and lowest adult emergence recorded at 10±1°C and 12±1°C is 57.50 and 3.20 per cent respectively. When trichocard stored upto thirty-five days significantly maximum adult emergence obtained from different temperature. It was evidenced that results mentioned from present study *T. chilonis* adult emergence per cent was reduced as increase in temperature and number of storage days. The present study enunciated that adult emergence upto 35 days at 10±1°C is pertinent with the study of Mohamed*et al*. (2020) who elucidated pupal stage of *Trichogrammatoidae bactrae* could be stored at 10°C upto 28-30 days giving maximum performance of adult emergence 93.80 per cent. However, at 45 days of storability rate of trichocards are to be doubled for field release to achieved maximum emergence. Thus the present study is in collaborated with the studies of Singh *et al.* (1997) who reported that *Trichogramma chilonis* Ishii can be stored at 5°C upto 3 weeks without hampering their per cent adult emergence and Ayvaz *et al*. (2008) who investigated that pupae of *Trichogramma evanescens* can be stored 4^0C for upto 3 weeks without affecting performance of *T. chilonis*.

Per cent parasitization by emerged *T. chilonis*

The result on per cent parasitization of *Trichogramma chilonis* revealed that after fifteen days storage, the parasitization per cent was differed in accord with different low temperarure. At 4±1°C,the highest parasitization (85.24%) was observed (Table 2) followed by 8±1°C. However, the lowest parasitization

(76%) of *T. chilonis* observed from 10±1°C when trichocard stored for 15 days. The highest parasitization percentage of *T. chilonis* obtain when it was reared at 4±1°C (70.24%) followed by 10±1°C 60.00%). The lowest per cent parasitization of *T. Chilonis* assessed, when it was reared at 8±1°C (56.75%) for thirty-five days of storage. Trichocard storage at forty-five days obtained results on parasitization were remarkable by parasitoid. The topmost per cent parasitization of *T. Chilonis* listed at 4±1°C (60.87%) followed by 8±1°C (51.37%) when trichocard stored for forty-five days. Emergence was lowest and totally nil at 12±1°C so there was no parasitization occurred. It was evidenced that results mentioned from present study *T. chilonis* adult emergence per cent was reduced as increase in temperature and number of storage days. The present study is in collaborated with the studies of Singh *et al.* (1997) who reported that *Trichogramma chilonis* Ishii can be stored at 5°C upto 3 weeks without hampering their per cent efficiency of parasitization SimilarlyTezze and Botto (2004) reported storage of trichocards upto 50 days at 4±1°C without affecting performance of *T.chilonis* on parasitization.

Conclusions

Obtained results proved that pupae of *T. chilonis* stored at 4±1^{o} and 8±1^{o}C were found to be the effective for maximum adult emergence and per cent parasitization after storage of trichocard upto 35 and 45 days. The treatment 10±1°C found significant upto 15 days for storage of trichocard for adult emergence of *T. chilonis* followed by 25 and 35 days. However, treatment 12±1°C recorded non-significant at 15 to 45 days of storage. The data recorded during present study may be utilized for improving the availability of trichocard in offseason for field release.

References

Ayvaz A, Karasu E, Karaborklu J and Tuncbilek AS, 2008. Effects of cold storage, rearing temperature, parasitoid age and irradiation on the performance of *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae). Journal Stored ProductionResearch. 44:232-240.

Bigler F. 1994. Quality control in *Trichogramma* production in biological control with egg parasitoid. Wajnberg, E., S.A. Hassan (Eds), CAB International, Wallingford, UK. 93-111.

Briere FJ, Pracos P, Roux AL, Pierre JS. 1999. A novel rate model of temperature-dependent development for arthropods. Environ Entomol. 28(1): 22–29. https://

doi.org/10.1093/ee/28.1.22

Garcia P, Oliveira L, Tavares J. Comparative biology of three Trichogramma spp. populations captured in Azores. 1995b. Bol Mus Munic Funchal 4: 311–318.

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

Greenberg, S. M., D. A. Nordund and E. G. King, 1996. Mass production of species. Experience in the former Soviet Union, china, United States and Western Europe. Biocontrol News Inform. 17(3):51-60.

Gupta S, Dikshit AK (2010). An ecofriendly approach for pest control. Journal of Biopesticides 3(1):186-188

Lü X, Han S, Li J, Liu J, Li Z (2019) Effects of cold storage on the quality of *Trichogramma dendrolimi* Matsumura (hymenoptera: Trichogrammatidae) reared on artificial medium. Pest Manag Sci 75(5):1328–1338

Mohamed HO, EL- Heneidy AH. (2020). Effect of cold storage temperature on quality of the parasitoid *Trichogrammatoidea bactrae* Nagaraja (Hymenoptera: Trichogrammatidae). Egyptian journal of biological pest control.30:87

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

Nagarkatti, S., and H. Nagaraja, 1979. The status of *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae). Oriental Insects. 13:115-118.

Rajendran, B. 1999. Emergence of *Trichogramma chilonis* from the parasitoid cards under laboratory conditions during 1996-1998. Coop. Sugar, 31: 331

Ravenberg, W. J., 1992. Production and utilization of natural enemies in western European greenhouse crops. In Advances in insects rearing for Research and Pest Management, Anderson, T. E., N.C.Leppla (Eds.), Westview, Boulder. CO. 465-487.

Singh, J., K. S. Brar, D.R.C. Bhaketia and M.Shenhmar, 1997. Effect of storage on emerge, sex ratio and parasitization effieciency of *T. chilonis* Ishii. Third Agricultural Science Congrass, Agricultural University, Ludhiana March 12(15):249.

Smith, S.M. 1996. Biological control with Trichogramma: advances, successes, and potential of their use. Ann. Rev. Entomol., 41: 375-406

Tezze, A. A., and E. N. Botto, 2004. Effect of cold storage on the quality of *Trichohramma nerudai*

(Hymenoptera: Trichogrammatidae). Journal of Biological Control. 30:1.

Table 1: Effect of storage of *T.chilonis* on adult emergence (%)

No of storagedays	Per cent adult emergence at different temperature			
	4±1°C	**8±1°C**	**10±1°C**	**12±1°C**
15	66.72 (54.78)	69.90 (56.72)	73.00 (58.72)	9.00 (17.41)
25	62.00 (51.98)	66.50 (54.74)	68.00 (55.57)	5.30 (13.23)
35	55.80 (48.37)	56.30 (48.66)	57.50 (49.33)	3.20 (10.26)
45	50.50 (44.94)	51.80 (46.04)	0.00 (0.32)	0.00 (0.32)
F test	Sig	Sig	Sig	NS
SD (±m)	1.67	2.05	0.97	0.55
CD@1%	5.06	6.22	2.93	1.69

*Fig in parentheses are arc sin transformed value.

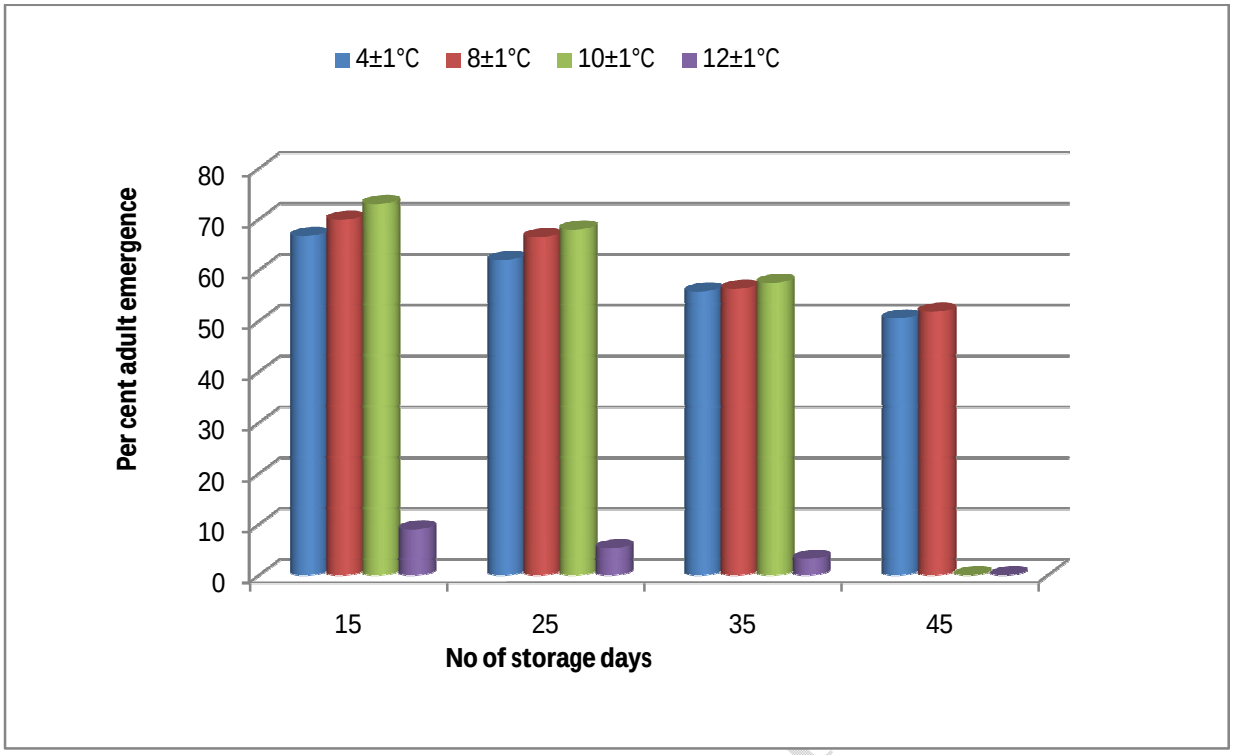

Fig 1: Per cent adult emergence of *T.chilonis*

Table 2: Effect of storage on per cent parasitization by emerged *T.chilonis* from stored trichocard(%)

No of storage days	Per cent parasitization by emerged *T.chilonis* at different temperature			
	4±1°C	**8±1°C**	**10±1°C**	**12±1°C**
15	85.24 (68.21)	80.82 (65.19)	76.00 (61.67)	0.00 (0.32)
25	73.63 (59.16)	69.00 (56.30)	64.87 (53.74)	0.00 (0.32)
35	70.24 (57.24)	56.75 (48.89)	60.00 (52.48)	0.00 (0.32)
45	60.87 (51.35)	51.37 (45.79)	0.00 (0.32)	0.00 (0.32)
F test	Sig	Sig	Sig	NS
SD (±m)	2.78	2.74	3.06	
CD@1%	8.43	8.30	9.27	

*Fig in parentheses are arc sin transformed value

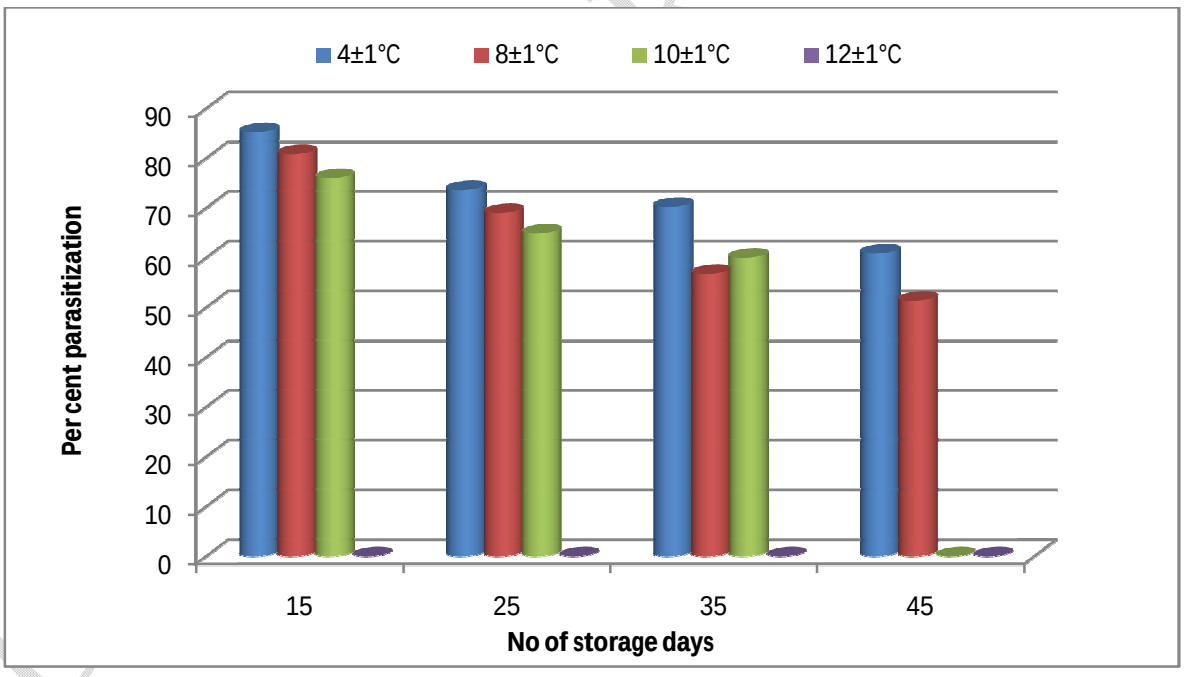

Fig 2: Per cent parasitization by emerged *T.chilonis* from stored trichocard