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Research Article

Response of *Sitotroga cerealella* (Olivier) and *Trichogramma chilonis* (Ishii) towards chilling temperature

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Citation

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Abstract

Studies were conducted to evaluate the impact of storability of *S. cerealella* and *T. chilonis* at zero and control temperature for different time interval i.e. (2, 6, 12, and 24) h. Research reveals that different tem, time interval effect the parameters like incubation, emergence, hatching and longevity. Three different sets of experiments were conducted to observe hatching (%) and incubation period of *S. cerealella*, emergence (%) and adult longevity of *T. chilonis* from parasitized pupae and parasitism of *S. cerealella* eggs, subsequent emergence (%) of *T. chilonis* from the parasitized eggs and their adult longevity. Interpretation of findings unravels that eggs stored for shorter period of time i.e. 2 hours resulting in higher hatching (85.33%) and incubation period (8.13 days). Higher pupal emergence (82.66%) of *T. chilonis* and adult longevity (6.23 days) for storage period of 2 hours and an increase in duration decline was recorded. Significantly higher parasitism (86.66%) of *S. cerealella*, emergence (92.71%) and adult longevity (6.13 days) was recorded for storage period of 2 hours and with increase in duration the declension was recorded in parameters under study.

Keywords: Adult longevity; Chilling temperature; Emergence (%); Incubation period; Parasitism

Introduction

Trichogramma chilonis is an important egg parasitoid used for the management of sugarcane borer, *Diatraea saccharalis* (Fabricius) [1]. Rearing of *T. chilonis* is important for continuous supply of parasitoids, mass rearing of this parasitoid is facilitated by *S. cereallela*. This moth can easily be reared on wheat or other grains [2, 3].

Large scale rearing of *T. chilonis* is parallel with various factors such as temperature, photoperiod, relative humidity and quality of host's eggs. Productivity and host acceptance of the wasp is effected by egg size and newly emerged wasp [4]. Effectiveness of *T. chilonis* may vary due to various abiotic factors [5]. Frequent change in the climatic conditions particularly in temperature, constitute an environment difficult for the insect to adapt [6]. Host age of the moth greatly affects the parasitization rate of parasitoid in two different ways, firstly preference of parasitoid female for oviposition and secondly indication of resource quality available for developing parasitoid larvae [7, 8].

To improve egg parasitoid rearing and increased supply of *T. chilonis*, chilled host eggs have also been used and stored under chilled conditions for longer period and continuous supply of host eggs [9]. Host eggs are exposed to super cooling temperature particularly below freezing point (0°C) that supported survival at later stages of egg development than fresh eggs [10]. Different scientists [11-13] have observed the impact of cold storage on parasitism of *T. chilonis*. Purpose of the study was to observe the impact of chilled temperature on *S. cerealella* eggs and *T. chilonis* pupae.

Materials and methods

To observe the effect of low temperature on *S. cerealella* and *T. chilonis* a study was conducted at bio-control lab of department of Entomology during 2016. *S. cerealella* and *T. chilonis* were reared as described by [14]. Three different experiments were conducted which are elaborated as follow:

Effect of low temperature on *S. cerealella* eggs

Twelve and 24 hours old batches of 50 fresh eggs of *S. cerealella* were pasted on cards and placed in an incubator at 0°C along with control, each for different time intervals (2, 4, 6 and 8) hours. Experiment was replicated three times and data of hatching (%) and hatching duration (incubation period) were recorded. Design used was factorial CRD.

Effect of low temperature on pupae of *T. chilonis*

Batches of 50 fresh pupae of *T. chilonis* were placed in an incubator at 0°C and a control for different time intervals (2, 4, 6 and 8) hours. For each temperature the experiment was replicated three times. Data of percent adult emergence and adult longevity were recorded. Design used was factorial CRD.

Effect of low temperature on *S. cerealella* eggs and subsequent effect on emerging *T. chilonis*

In this experiment (12 and 24) hours old batches of 50 fresh of eggs each of *S. cerealella* were pasted on cards and placed in an incubator at 0°C and a control for different time interval (2, 4, 6 and 8) hours. After that the same eggs of *S. cerealella* were exposed to two fresh pairs of *T. chilonis* for parasitization. Data of % parasitism, adult emergence and adult longevity were recorded. Design used was factorial CRD.

Results and discussion

Effect of low temperature on hatching (%) and incubation period of *S. cerealella*

Data regarding hatching (%) and incubation period of *S. cerealella* is presented in (Table 1) which revealed that egg age (h), temperature (^{o}C) and storage period (h) had significantly affected hatching and incubation period. Twelve hours aged eggs of *S. cerealella* had significantly higher hatching (%) (85.33%) and incubation period (8.13 days) for eggs stored for 2 hours, while lower hatching (%) (47.33%) and incubation period (6.10 days) was recorded for eggs stored for 8 hours. Similarly, for 24h aged eggs of *S. cerealella* significantly higher hatching (80.66%) and incubation period (6.06 days) was recorded for eggs stored for 2 hours, while lower hatching (44.66%) and incubation period (4.96 days) was recorded for eggs stored for 8 hours. In control, hatching of *S. cerealella* eggs was significantly higher than all the treatments for both 12h and 24h aged eggs stored for (2h) and lowest (0.00% each) for (4, 6, and 8h) stored eggs, though control yielded lower incubation period in relation to 12 and 24h old eggs. It is evident from the table chilling temperature can be effective for shorter duration and as the duration is increased there is a decrease in hatching (%) and incubation period, also 12h aged eggs are more productive in comparison to 24h aged eggs in respect to the studied parameters. However pattern of hatching (%) and incubation period is quite similar in both (12 and 24h) aged eggs. Our findings are in agreement to [15] they observed the impact of chilling (at -1°C)

on eggs of *S. cerealella* at different duration of time and noted that higher hatching (%) was for eggs stored till 2h (81.2%) and with the increase in storage duration hatching declined to 0.8% for 72h period of storage. **[16]** also stored eggs of *Rhyzopertha dominica* on low temperature and found out that with increase in storage duration higher mortality was reported.

Table 1. Effect of low temperature on hatching (%) and incubation period of *S. cerealella* eggs

Storage Period (Hours)	Hatching %				Incubation Period			
	12h	(Control)	24h	(Control)	12h	(Control)	24h	(Control)
2	85.33b	90.00a	80.66c	87.33 b	8.13a	3.10 f	6.06 c	6.06 c
4	72.00d	0.00 i	68.00e	0.00i	7.10b	0.00 g	4.96 d	0.00 g
6	62.66 f	0.00i	62.66f	0.00i	7.06b	0.00 g	4.06 e	0.00 g
8	47.33 g	0.00i	44.66h	0.00i	6.10c	0.00 g	4.96 d	0.00 g
LSD Value	2.54				0.18			

Effect of low temperature on emergence and adult longevity of *Trichogramma chilonis*

Data illustrated in (Table 2) shows that temperature (°C) and storage period (h) had significantly different effect on emergence (%) and adult longevity of *T. chilonis* from pupae. Significantly higher emergence (82.66%) and adult longevity (6.23 days) of *T. chilonis* was recorded for pupae stored for 2 hours, and lower emergence (38%) and adult longevity (3.16 days) for pupae stored for 8 hours. In control, emergence (%) and adult longevity was significantly higher than all the treatments i.e. (88.66%) and (7.16 days) for 2h stored pupae and lowest (0.00%, each) for 4, 6 and 8h pupae. It is evident from (Table 2) that pupae stored for shorter interval results in higher emergence (%) and with increase in time of storage emergence declined. Also control recorded higher emergence (%) as compare to all storage periods. Our findings on decreased adult longevity at 8°C for prolonging storage are pertinent with the study reported by **[17]**, where adult longevity of egg parasitoid *T. cacoeciae* was decreased after 31 days storage at 8°C. **[18]** exemplified the storage temperatures lower than 10°C and storage times 3 week or longer had a negative impact on longevity. Our study is also in coherence with that of **[19]** who studied that acclimation for 30 days at 10°C or 24 days at 13°C allowed *T. brassicae* immatures to develop with a lower mortality than those exposed directly at 5°C. Longevity and fecundity of females decreased at a lower rate with acclimation at 10 °C suggesting that acclimation at 13°C may have depleted the energy reserves of individuals more than acclimation at 10°C.

Effect of low temperature on parasitism of *Sitotroga cerealella* and subsequent emergence and adult longevity of *T. chilonis*

Data contained in (Table 3) shows that egg age (h), temperature (°C) and storage period (h) had significantly different effect on parasitism (%) of *S. cerealella* eggs and subsequent emergence (%) and adult longevity of *T. chilonis*. For 12h aged eggs of *S. cerealella* significantly higher parasitism (86.66%), emergence (92.71%) and adult longevity (6.13 days) was recorded for eggs stored for 2 hours and lower parasitism (54%), emergence (77.88%) and adult longevity (4.10 days) was recorded for eggs stored for 8 hours. Similarly, for 24h aged

eggs of *S. cerealella*higher parasitism (91.33%), emergence (81.54%) and adult longevity (5.20 days) was recorded for eggs stored for 2 hours and lower parasitism (34.66%), emergence (80.16%) and adult longevity (3.10 days) was recorded for eggs stored for 8 hours. In control, parasitism (%) of *S. cerealella* eggs and emergence (%) and adult longevity of *T. chilonis*was significantly higher than all the treatments for both 12h and 24h aged eggs stored till 2hours and lower (0.00%, each) for 4, 6 and 8 hoursstored eggs. From these findings it is clear that adult of *T. chilonis* had a better approach of parasitism towards 12h old eggs stored for short interval of time in comparison to 24h old eggs stored for similar duration.Our findings are also co-related to [15] they reported the parasitism of 24h old eggs *S. cerealella* by *T. chilonis* and found that maximum parasitism of 49% for 2h stored eggs and less than 2% for 72h storage period at chilling temperature. [9] also observed that parasitism is affected by host eggs age and storage period. Eggs stored for short interval results in higher parasitism and while eggs stored for longer period results in low parasitism which may be due to the deformity of embryo.

Table 2. Effect of low temperature on emergence and adult longevity of *Trichogramma chilonis*

Temperatures (ºC)	Storage Period (h)	Emergence (%)	Adult Longevity (days)
0	2	82.66 b	6.23 b
	4	66.00 c	5.03 c
	6	51.66 d	4.10 d
	8	38.00 e	3.16 e
25 (Control)	2	88.66 a	7.10 a
	4	0.00 f	0.00 f
	6	0.00f	0.00 f
	8	0.00 f	0.00 f
LSD Value		2.80	0.18

Table 3. Effect of low temperature on parasitism of sitotroga cerealella and subsequent emergence and adult longevity of *T. chilonis*

Storage Period (Hours)	Parasitism %				Emergence %				Adult Longevity (days)			
	12h	(Control)	24h	(Control)	12h	(Control)	24h	(Control)	12h	(Control)	24h	(Control)
2	86.66 b	91.33 a	61.33 d	90.66 a	92.71 a	94.85 a	87.33 b	95.61 a	6.13 c	8.10 a	5.20 d	7.13 b
4	82.00 c	0.00 g	51.33 e	0.00 g	89.24 b	0.00 f	81.54 cd	0.00 f	6.13 c	0.00 g	4.10 e	0.00 g
6	64.00 d	0.00 g	36.66 f	0.00 g	83.38 c	0.00 f	80.50 cde	0.00 f	5.13 d	0.00 g	3.13 f	0.00 g
8	54.00 e	0.00 g	34.66 f	0.00 g	77.88 e	0.00 f	80.16 de	0.00 f	4.10 e	0.00 g	3.10 f	0.00 g
LSD Value	2.79				3.20				0.20			

Conclusion and recommendation

It is concluded from the experiment that storage of *S. cerealella* eggs and *T. chilonis* pupae at low temperature for shorter interval provided efficient results. All the parameters under observation yielded encouraging

results when observed for short duration of time. It is recommended to store *S. cerealella* eggs and *T. chilonis* pupae at 0°C for shorter duration so we can have the population of T. chilonis available round the year for biological control programs.

Author's contributions

Conceived and designed the experiments: J Sarwar & IA Khan, Performed the experiments: J Sarwar & A Usman, Analyzed the data: F Amin & HMF Ayub, Wrote the paper: J Sarwar.

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