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**Research Note**

# Effect of storage at different temperatures on the biological parameters of *Cotesia flavipes* Cameron

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**ABSTRACT**: Investigations on storage at 5 to 20°C for 5 to 30 days on biological parameters of *Cotesia flavipes* Cameron were carried in the laboratory. Adult emergence from cocoons of *C. flavipes* varied with storage time and temperature. The storage of cocoons for 10 and 15 days at 5, 10, 15 and 20°C did not affect adult emergence significantly and resulted in 95.96 to 97.58 per cent and 95.22 to 98.46 per cent adult emergence respectively and was at par with 5°C. Lowest temperature (5°C) significantly affected the female emergence (24 to 39 per cent) at different days of storage. Maximum female emergence (85 per cent) was observed when cocoons were stored for 10 days at 20°C followed by 82 per cent at 20°C for 15 days. The storage of cocoons at 10°C reduced female emergence, 51 to 60 per cent, while at 15°C it ranged from 68 to 76 per cent. Maximum cocoons (47.08) were formed from the adults who were emerged from the cocoons stored for 10 days at 20°C while 5°C temperature inhibited the growth and development with least number of cocoons.

**KEY WORDS**: *Cotesia flavipes,* endo larval parasitoid, *Chilo partellus,* maize stem borer

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*Cotesia flavipes* Cameron (Hymenoptera: Braconidae) is an important gregarious endo larval parasitoid of graminaceous stem borers. It is found in nature during *kharif* season throughout the country and proven as a dominant larval parasitoid of *Chilo partellus* Swinhoe by reducing the population up to 32-55 per cent (Divyal *et al.,* 2009; Padmaja and Prabhakar, 2004). The short life span and over lapping generation helps *C. flavipes* to be more successful in the maize crop. Due to its important role in the management of *C. partellus*, efforts have been made to augment the parasitoid in the maize ecosystem (Jalali and Singh, 2003). Storage of cocoons of *C. flavipes* at low temperature is an essential pre requisite for mass production and release protocols. Low temperature retards the development of parasitoids so as to synchronize their emergence in large numbers for augmentation during the availability of vulnerable stage of the host in the fields. Isolated information is available on the effect of temperature on the development of *C. flavipes,* its multiplication and storage. Therefore, it was planned to investigate the effect of cold storage on adult emergence and their sex and cocoon formation in successive generation of *C. flavipes* during storage.

For the present investigation, the nucleus culture of *C. flavipes* was collected from parasitized larvae of *C. partellus* from maize fields. These larvae were reared on split maize stem till the formation of cocoon of *C. flavipes* (Overholt *et al*., 1994). The cocoons were collected and kept in test tube for adult emergence. The culture was maintained in controlled condition at 27 ± 2°C temperature and 75±5 per cent relative humidity.

The effect of temperature during storage on the performance of *C. flavipes* was evaluated in the laboratory during 2010. One hundred cocoons of *C. flavipes* were kept in a BOD incubator for 30 days, maintained at 5, 10, 15 and 20°C. Twenty cocoons were taken out regularly from 10 days onwards up to 30 days at 5 days interval and maintained in test tubes to record the total adult emergence, per cent females emerged and number of cocoons formed in successive generations.

The data on adult emergence after storage at different temperatures *viz*., 5, 10, 15 and 20°C for varied durations *viz*., 10, 15, 20, 25 and 30 days showed that storage of cocoons for 10 days at different temperatures did not affect the adult emergence significantly (Table 1). There was no significant difference between different temperature for a storage period of 10 days. The observations recorded after 25 days of storage showed that at 15 and 20°C temperature, adults emerged prior to 25 days while emergence at 5 and 10°C was statistically at par. Similar results were obtained after prolonged storage for 30 days where 68.9 per cent adult emergence was recorded at 5°C. The storage of cocoons for longer duration in temperature ranges between 10 to 20°C, helped in the adult emergence earlier than required storage duration.

It is apparent from the present investigation that cessation of adult emergence was found only at minimum temperature 5°C and for 30 days. Storage of cocoons for longer duration with increased temperature did not inhibit the growth and development. The results of present finding provide empirical evidence that *C. flavipes* can be stored for 15 days at 20°C without any detrimental effect on adult emergence. It was successfully stored as cocoons at 5°C for 20 days, after which emergence declined considerably. The highest per cent adult emergence occurred at 20°C. This may be due to the fact that 20°C is the temperature closest to the development threshold of *C. flavipes*.

The effect of temperature on life history parameters of insects such as longevity and fecundity has been intensively studied (Mbapila, 1997; Rahim *et al.*, 1991). Getu *et al.* (2004) reported differences in longevity and fecundity in Indian and Pakistan populations of *C. flavipes* at different temperatures. Likewise, investigating the impact of cold storage on *Trichogramma* spp. clearly demonstrated that longer storage times accompanied with lower temperatures adversely influenced adult emergence (Jalali and Singh, 1992; Pitcher *et al.*, 2002; Rundle *et al.,* 2004; Lopez and Botto, 2005).

The number of cocoons formed at 20°C for 10 days was highest compared to other temperature. As the duration of store increased, the number of cocoons formed decreases. The data observed on number of cocoons formed from emerged adults are presented in Table 1. The data showed that storage of cocoons for 10 days at different temperatures affect the number of cocoons in successive generation.

It is clear from the data (Table 2) that storage of cocoons for 10 days at different test temperatures affects the sex ratio significantly. Minimum number of females (28 per cent) was observed at 5°C while maximum (85 per cent) was recorded at 20°C followed by 68 per cent and 51 per cent at 15 and 10°C respectively. Number of females emerged at 20°C was significantly superior than 15, 10 and 5°C and all the treatments differed significantly to each other. The females emerged after 20 days of storage at 15, 10 and 5°C was 76, 60 and 38 per cent, respectively while at 20 days of storage no females

**Table 1. Effect of temperature on adult emergence, cocoon formation and of *Cotesia flavipes* during storage**

| Temperature (°C) | Adult emergence (%) at different temperatures during storage for varied duration (days) | | | | | Mean number of cocoons formed at different temperatures during storage for varied duration (days) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **10** | **15** | **20** | **25** | **30** | **10** | **15** | **20** | **25** | **30** |
| 5 | 96.44 (79.19) | 95.22 (77.42) | 90.94 (72.50) | 85.56 (67.76) | 68.90 (56.11) | 20.20 (4.49) | 17.61 (4.19) | 10.53 (3.32) | 8.45 (2.99) | 3.39 (1.97) |
| 10 | 95.96 (78.48) | 96.64 (79.56) | 92.96 (74.63) | 83.42 (65.98) | 0.00 (0.64) | 28.84 (5.37) | 18.97 (4.35) | 12.23 (3.56) | 8.33 (2.97) | 0.00 (0.71) |
| 15 | 96.76 (79.69) | 97.46 (80.93) | 93.20 (74.99) | 0.00 (0.64) | 0.00 (0.64) | 30.93 (5.56) | 17.45 (4.17) | 17.40 (4.23) | 0.00 (0.71) | 0.00 (0.71) |
| 20 | 97.58 (81.65) | 98.46 (83.31) | 0.00 (0.64) | 0.00 (0.64) | 0.00 (0.64) | 47.08 (6.86) | 37.17 (6.09) | 0.00 (0.71) | 0.00 (0.71) | 0.00 (0.71) |
| SEm± | 1.39 | 1.23 | 0.76 | 0.88 | 0.33 | 0.14 | 0.11 | 0.10 | 0.04 | 0.04 |
| CD (*P* = 0.05) | 2.94 | 2.60 | 1.61 | 1.87 | 0.70 | 0.29 | 0.24 | 0.20 | 0.08 | 0.08 |
| CV % | 2.75 | 2.42 | 2.16 | 4.12 | 3.61 | 3.86 | 3.81 | 5.09 | 3.05 | 6.10 |

Values in parentheses represent angular retransformed values.

could emerge due to prior emergence of adults. The storage of cocoons at 15 and 20°C for 25 days could not inhibit the development and adults were emerged before the observation schedule while at 5 and 10°C female emergence was 24 and 54 per cent respectively and both significantly differed to each other. Similar results were obtained after prolonged storage for 30 days where 39 per cent females were recorded at 5°C while at 10 to 20°C female emergence was observed before the observation schedule and therefore, females could not be recorded.

Scanty information is available on the over-wintering of *C. flavipes* although such information could be used for enhancing parasitoid efficiency as a biological control agent against the maize stem borer and influences its geographical distribution and establishment of population in countries where the *C. partellus* causes damage to maize. Mbapila and Overholt (2001) reported that the development of *Cotesia* spp. from oviposition to cocoon formation and adult emergence was inversely related to temperature. Jiang *et al.* (2004) suggested that sex ratio of *C. flavipes* varied from male to female biased with increase in temperature. Tanwar (2004) reported no population of *C. flavipes* was found tolerant to low temperature.

Many studies on cold storage of hymenopteran parasitoids have focused on endoparasitoids, which are stored within their host larvae (Bayrama *et al.,* 2005; Pandey and Johnson, 2005). However, even if parasitoids are protected within host tissues they often experience detrimental effects due to cold storage (Ozder, 2004; Pandey and Johnson, 2005).

Contrary to this, parasitized eggs by *Trichogramma chilonis* Ishii could be stored for 20 days in the refrigerator without adverse effect on the adult emergence, their parasitization efficiency and sex ratio (Singh, 1997). Similarly, Khosa and Brar (2000) reported that *T. chilonis* could be stored in the refrigerator and successfully utilized for 23 days without adversely affecting their emergence and parasitization efficiency. Bayrama *et al.* (2005) reported that storage had a significant adverse effect on mean adult emergence of *Telenomus busseolae* Gahan and $F_1$ progeny sex ratio of the parasitoid became more male biased with increasing length of storage period. Luczynski *et al.* (2007) reported that adult emergence of *Encarsia formosa* Gahan was prevented at temperatures below 10°C, although the pupae continued to develop even at 4°C. Carvalho *et al.* (2008) reported that stored pupae of *C. flavipes* in refrigerated temperature for 5 days do not affect its development. Fatima *et al.* (2009) reported that pupae of *C. flavipes* irradiated at 20 GY could be stored for 2 months at 10°C without apparent loss of quality.

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**Table 2. Effect of temperature on females emerged of *Cotesia flavipes* during storage**

| Temperature (°C) | Female emerged (%) at different temperature during storage for varied duration (days) | | | | |
|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 |
| 5 | 28.00 (31.68) | 26.00 (30.91) | 38.00 (37.91) | 24.00 (29.60) | 39.00 (38.76) |
| 10 | 51.00 (45.57) | 54.00 (47.41) | 60.00 (50.66) | 54.00 (47.41) | 00.00 (6.42) |
| 15 | 68.00 (55.56) | 71.00 (57.30) | 76.00 (60.69) | 00.00(6.42) | 00.00 (6.42) |
| 20 | 85.00 (67.07) | 82.00 (65.07) | 00.00 (6.42) | 00.00 (6.42) | 00.00 (6.42) |
| SEm± | 0.94 | 0.81 | 1.07 | 0.49 | 0.47 |
| CD (*P* = 0.05) | 1.99 | 1.71 | 2.26 | 1.04 | 0.99 |
| CV % | 2.96 | 2.54 | 4.33 | 3.45 | 5.08 |

Values in parentheses represent arc sine retransformed values

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