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Effect of low holding temperatures on mummies of *Copidosoma koehleri* Blanchard (Hymenoptera : Encyrtidae)

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ABSTRACT : Storage studies were conducted on the mummies of *Copidosoma koehleri* Blanchard, an encyrtid polyembryonic parasitoid of the potato tuber moth, *Phthorimaea operculella*. The effect of storing *C. koehleri* mummies at 10°C and 15°C for periods ranging from 10 to 50 days was studied in the laboratory. Pre-emergence period was considerably delayed in the case of mummies stored at 10°C. The number of adults emerging per mummy was higher when stored at 15°C, but at this storage temperature, beyond 30 days, emergence occurred in storage. Considering the different storage temperature - period combinations, storage at 10°C for 10 days was most suitable as in this treatment, high per cent survival, maximum number of adults per mummy, and maximum fecundity were obtained. Hence, storage of *C. koehleri* mummies for 10 days at 10°C is suggested.

KEY WORDS : *Copidosoma koehleri*, mummies, *Phthorimaea operculella*, storage

Copidosoma koehleri Blanchard (Hymenoptera: Encyrtidae), a polyembryonic parasitoid was imported into India for trials against the potato tuber moth, *Phthorimaea operculella* (Zeller) (Lepidoptera : Gelechiidae). *Copidosoma koehleri* is known to give good control of *P. operculella* (Sankaran and Girling, 1980). This parasitoid has proved its potential in India (Khandge *et al.*, 1979), Australia (Horne, 1990) and even in the sprayed fields in South Africa (Kfir, 1989).

The possibility of delaying the emergence of *C. koehleri* adults from the mummies by holding them at low temperatures is contemplated in this study to facilitate timely releases. The effect of cold storage on the stored mummies and on the adults emerging from them was studied to find out the optimum storage temperature and the safe period of storage at which the ability to survive and progeny production are maximum.

MATERIALS AND METHODS

Copidosoma koehleri parasitoids were reared on 0-1 day old eggs of potato tuber moth. The host eggs were exposed to the parasitoids at the rate of 50 eggs per female parasitoid. The parasitised eggs were later placed on punctured potatoes spread on sterilised sand in ventilated plastic containers. The containers were regularly checked for mummy formation. When formed, the mummies were collected and kept in separate tubes at the rate of ten mummies per tube and placed inside Biological Oxygen Demand (BOD) incubators. These incubators were maintained at 10± 1°C and 15 ± 1°C with a relative humidity of 65 ± 2%. Three tubes with ten mummies in each were removed from the two BOD incubators at ten day interval. The pre emergence period (time required for the adults to emerge from the mummies after removal from storage), per cent adult emergence (per cent mummies from which adults emerged), number of adults emerged per mummy and the fecundity of the adults emerging from the stored mummies were observed. Two way analysis of variance was done to compare the different storage treatments. Student's t- test was done to compare the storage batches with a control batch maintained at room temperature(26 ± 2°C).

RESULTS AND DISCUSSION

The per cent adult emergence from the mummies stored at 10°C ranged from 53.3 to 94.6% (Table 1). However, there was no emergence from the mummies which were stored for more than 30 days at this temperature. This proves that it is lethal to store

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Table 1. Effect of storage of *C. koehleri* mummies on per cent adult emergence

Storage Temperature	Storage Period (Days)				
	10	20	30	40	Mean
10°C	94.60	53.30	83.30	0.00	51.98
	(82.19)	(47.26)	(70.22)	(4.05)	(50.93)
15°C	100.00	100.00	100.00	100.00	100.00
	(90.00)	(90.00)	(90.00)	(90.00)	(90.00)
Mean	97.28	76.67	91.65	50.00	
	(86.10)	(68.63)	(80.11)	(47.03)	
	T	D	T x D		
S Em±	2.94	4.15	5.87		
CD(P= 0.05)	8.80	12.44	17.60		

Figures in parentheses are transformed values

Table 2. Effect of storage of *C. koehleri* mummies on pre emergence period

Storage Temperature	Storage Period (Days)			
	10	20	30	Mean
10°C	7.00	6.00	6.00	6.33
15°C	4.67	2.67	1.33	2.89
Mean	5.83	4.33	3.67	
	T	D	T x D	
S Em±	0.75	0.91	1.29	
CD(P= 0.05)	2.30	NS	NS	

C. koehleri mummies for more than 30 days at 10°C. At 15°C, emergence occurred even up to 40 days of storage, but beyond 30 days, emergence occurred in the BOD itself. Singh and Srivastava (1988) have also found that storage of *Trioxys indicus* Subba Rao and Sharma (Hymenoptera : Aphidiidae) mummies beyond 20 days at 6 and 8°C, resulted in adult emergence in the refrigerators itself.

Irrespective of the storage temperature, the mean per cent adult emergence from the mummies stored at 10 and 15°C reduced significantly beyond 30 days of storage (Table 1). However, taking only the storage temperature into consideration, cent per cent emergence could be obtained from 15°C storage batches and only about 52% adult emergence from 10°C storage batches. Among the different storage temperature - period combinations, maximum adult emergence could be obtained from mummies stored at 10°C for 10 days (94.6%) which was on par with the adult emergence from mummies stored at 15°C (100%).

The pre emergence periods of mummies removed from storage at 10 and 15°C after 10, 20 and 30 days were compared (Table 2). Irrespective of the duration of storage, the pre emergence period was significantly longer in the case of mummies stored at 10°C than those at 15°C. This could indicate a retarded rate of morphological transition when the mummies were stored at 10°C. This knowledge regarding the delay in pre emergence period due to storage of mummies at 10°C could be utilised for preventing emergence of adults in transit while sending consignments.

Irrespective of the duration of storage, the mean number of adults obtained per mummy stored at 15°C (25.00) was significantly more than the number obtained at 10°C (16.50) (Table 3). Comparison between the different durations of storage, irrespective of the storage temperature, indicates that the number of adults per mummy was highest when stored for 10 days beyond which the number reduced significantly (Table 3). Among the different storage temperature - period combinations, 10°C-10 days was considered to be superior as maximum number of adults could be obtained from the mummies stored at this temperature. However, at 10°C when duration of storage was increased, the number of adults emerging per mummy reduced significantly and at 30 days of storage, minimum emergence was recorded (Table 3). At 15°C, the number of adults emerging per mummy ranged between 23 and 28 at different periods of storage (10 to 40 days) and they were all on par but significantly lesser in comparison to 10°C - 10 days batch. Jarry and Tremblay (1989) had observed that increasing the duration of storage of mummies of *Lysiphlebus fabarum* (Marsh) (Hymenoptera : Braconidae) for more than 6 days at 6±1°C and for more than 32 days at 9±1°C led to reduction in adult emergence. Our studies indicate that the effect of different durations of storage on the number of adults emerging from the stored mummies was more evident in the case of storage at 10°C than at 15°C. The stored mummies were compared with a set of mummies kept at room temperature (Table 4). With reference to per cent adult emergence, storage at 15°C for different durations and storage for 10 days at 10°C were on par with the control. The 10°C -10 days batch was also on par with the control and superior to the other storage treatments with reference to the number of adults obtained per mummy.

Flanders (1938) had mentioned that if storage is prolonged in parasitic hymenoptera, the reproductive organs and in turn fertility are most likely to be affected. In our study, the fecundity of the females obtained from mummies stored at 10°C till 30 days was comparable to the control batch (Table 4). The fecundity of the females from 15°C storage batches was significantly reduced and no progeny could be produced by the females emerging from mummies stored for more than 20 days.

Considering the extended pre emergence period, higher per cent emergence, greater number of adults emerging from the stored mummies and the higher progeny production, it is concluded that storage of *C. koehleri* mummies for 10 days at 10°C is ideal.

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Table 3. Effect of storage of *C. koehleri* mummies on number of adults emerged / mummy

Storage Temperature	Average no. of adults emerged / mummy (Days after storage)				
	10	20	30	40	Mean
10°C	45.33	15.33	5.33	0.00	16.50
15°C	28.00	23.33	23.67	25.00	25.00
Mean	36.67	19.33	14.50	12.50	

	T	D	T x D
S Em±	1.26	1.78	2.51
CD (P= 0.05)	3.77	5.33	7.54

Table 4. Adult emergence, number of adults / mummy and fecundity of adults obtained from mummies

Treatment	Adult emergence (%)	Mean no. of adults/ mummy	Mean fecundity
10°C - 10 days	94.60^{a}	45.00^{a}	4.17^{a}
10°C - 20 days	53.30^{b}	15.00^{c}	3.55^{a}
10°C - 30 days	60.00^{b}	5.00^{d}	5.75^{a}
10°C - 40 days	0.00^{e}	0.00^{e}	-
15°C - 10 days	100.00^{a}	28.00^{b}	3.15^{b}
15°C - 20 days	100.00^{a}	23.00^{b}	3.01^{b}
15°C - 30 days	100.00^{a}	24.00^{b}	0.00^{c}
15°C - 40 days	100.00^{a} *	25.00^{b}	0.00^{c}
15°C - 50 days	100.00^{a} *	11.00^{c}	0.00^{c}
Control (Room Temp.)	100.00^{a}	41.00^{a}	13.75^{a}

* Emergence occurred in storage

Values followed by the same letter are not statistically different (P = 0.05)

REFERENCES

FLANDERS, S. E. 1938. The effect of cold storage on the reproduction of parasitic hymenoptera. *J. econ. Ent.*, **31**:633-634.

HORNE, P. A. 1990. The influence of introduced parasitoids on the potato moth, *Phthorimaea operculella* (Lepidoptera : Gelechiidae) in Victoria, Australia. *Bull. entomol. Res.*, **80**:159-163.

JARRY, I. and TREMBLAY, E. 1989. Cold storage of *Lysiphlebus fabarum* (Marsh) mummies (Hymenoptera : Braconidae). *Bolletino del Laboratorio di Entomologia Agraria 'Filippo Silvestri*, **46**:199-206.

KFIR, R. 1989. Effect of pesticides on *Copidosoma koehleri* Blanchard (Hymenoptera : Encyrtidae), a parasite introduced into South Africa for biological control of potato tuber moth. *J. entomol. Soc. S. Africa*, **52**:180-181.

KHANDGE, S. V. PARLEKAR, G. Y. and NAIK, L. M. 1979. Inundative releases of *Copidosoma koehleri* Blanchard (Hymenoptera : Encyrtidae), for control of the potato tuber worm, *Phthorimaea operculella* Zeller. *J. Maharashtra Agric. Univ.*, **4**:165-169.

SANKARAN, T. and GIRLING, D. J. 1980. The current status of the biological control of the potato tuber moth. *Biocontrol News Inf.*, **1**:207-211.

SINGH, R. and SRIVASTAVA, M. 1988. Effect of cold storage of mummies of *Aphis craccivora* Koch. subjected to different pre - storage temperatures on per cent emergence of *Trioxys indicus* Subba Rao and Sharma. *Insect Sci. Applic.*, **9**:655-657.