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Effect of storage duration on survival of aphid mummies, *Diaeretiella rapae* (McIntosh) (Hymenoptera: Braconidae)

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Abstract

Aphid mummy, *Diaeretiella rapae* (McIntosh) parasitizes more than 60 aphid species among which five to six species are common pests that attack agricultural and horticultural crops. This study was designed and conducted during 2019-20 and 2020-21 in the Bio-control laboratory, IGKV, Raipur, Chhattisgarh to find out maximum percent adult survival and longevity under three levels of storage temperature (*viz.*, 4 °C, 9 °C, 12 °C and Control (20 °C) with storage durations of (one to five weeks) Significantly maximum survivability of emerged adult parasitoid, *D. rapae* from mummified aphids (84.52%) and highest adult longevity (9.00 days) were recorded at in controlled conditions while lowest percentage of adult emergence (21.18 %) was recorded in five weeks of storage. Higher adult longevity was found in control (8.96 days) followed by one week of storage (8.40) days. Adult longevity further declined to 8.60, 7.58, 6.78, 5.00 and 4.20 days with 1, 2, 3, 4 and 5 weeks of storage. There was significant reduction in emergence with time. It was observed that approximately 7.00% reduction in adult emergence was seen after one week of storage (78.60%) as compared to control (84.50%). Significantly lowest adult emergence was observed in five weeks of storage (19.00%) at 4 °C. Only 50.00 percent survivability of mummified aphid was recorded after two weeks of storage duration. Maximum survivability was recorded at 9 °C and 70-75% RH of one weeks of storage (74.20%). Adult longevity was observed highest in control (8.80 days) which was on par with one week of storage (8.40 days). Highest percent of adult emergence was recorded in one week of storage (72.20%) but in control treatment adult emergence was greater than that of one week of storage (76.40%). Highest survival percent and adult emergence after storage of mummified aphid, *D. rapae* were recorded under controlled conditions *ie* at 20 °C followed by 4 °C, 9 °C and 12°C one week after storage. Hence for the storage of mummified aphids, higher temperature 20 °C seemed to be better. Percent reduction in survival was observed minimum in one week of storage & it was maximum in 5th week of storage duration.

Keywords: *Diaeretiella rapae*, adult longevity, survivability, adult emergence

Introduction

Biological control has been a valuable tactic in pest management programs around the world for many years which is the need of the hour towards an eco-friendly management of insect pests to sustain a healthy and pollution free environment and to save the non target species. The entomophagous group is represented by predators and parasitoids among which order Hymenoptera is the most dominating. Mummified aphid, *Diaeretiella rapae* (McIntosh) was recorded as the most efficient and successful parasitoids of aphids on cabbage under field conditions. Aphid nymphs were parasitized by female of *D. rapae*. Females mostly preferred medium to large sized nymphs for parasitization. Aphids turned brown in colour after parasitization and later turned to golden yellow in colour. Emergence hole made by parasitoid on aphid was clearly seen on posterior side of the abdomen. There was only one exit hole per mummified aphid. The present study was conducted during 2019-20 and 2020-21 in the Bio-control laboratory, department of Entomology, IGKV, Raipur, Chhattisgarh. Different storage temperatures under refrigeration were taken as treatments along with control (room temperature) under laboratory conditions for comparing effects of different storage temperature at varying duration of storage such as 1, 2, 3, 4 and 5 weeks. The study was planned to search for the feasibility of utilizing aphid mummies as a bioagent against aphids for its management against cabbage crop.

Material and methods

Culture of *D. rapae* were collected from BIPM plots behind Biocontrol laboratory, IGKV,

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Raipur and reared on green peach aphid (*Myzus persicae*) under laboratory conditions. 500 aphids were released on cabbage leaves and kept in plastic jars and covered with muslin cloths. 10 pairs of male and female of adult *D. rapae* were collected through aspirator and introduced in to plastic jars and covered with muslin cloth. After 2-3 days of aphid mummification, *D. rapae* mummies were separated from the cabbage leaves carefully with a camel hair brush and kept on glass vials. 20 mummies were introduced in each glass vial with (5 replications) for each treatments for testing on storage duration. Treatments consisted of combination of three temperature levels (4°C, 9°C, 12°C and Control (20°C) with storage durations (one to five weeks).

After passing through different storage durations at various temperature levels, the mummies were removed from the chamber and shifted to petridish and observed for adult emergence. Data on percentage adult emergence and adult longevity were recorded. Percent reduction in survival was observed under three temperature levels (4°C, 9°C, 12°C and Control (20°C) with storage durations (one to five weeks).

Result and Discussion

Effect of storage at 4°C and 90-95% RH

Table 1: Effect of cold storage (4°C, 90-95 % RH) for different duration of time on adult emergence and adult longevity of mummified aphid, *D. rapae*

Treatment (Duration of storage)	Survival %	Adult longevity (days)	Percent reduction in survival
One Week	78.60 (62.49)b	8.60 (2.93)a	7.00
Two Weeks	51.62 (45.94)c	7.58 (2.73)b	38.92
Three Weeks	45.50 (42.41)d	6.78 (2.60)b	46.17
Four Weeks	31.98 (34.40)e	5.00 (2.24)c	62.16
Five Weeks	19.00 (25.79)f	4.20 (2.05)d	77.52
Control (15-20°C Temp and RH 55-65%)	84.52 (66.87)a	9.00 (3.01)a	-
SEm±	0.55	0.02	
CD at 5%	2.91	0.19	
CV %	4.82	5.49	



Fig 1: Aphid mummies stored in refrigerator



Fig 2: Adult of *D. rapae*

The survivability of *D. rapae* at five different duration of exposure (1, 2, 3, 4, 5 weeks) at 4°C and 90-95% RH were observed. There were significant reductions in emergence with time. It was observed that approximately 7.00 % reduction in adult emergence was seen after one week of storage (78.60%) as compared to control (84.52%). The percent adult emergence further reduced from 51.62%, 45.50% and 31.98% after 2, 3 and 4 weeks of storage respectively, (Table 1 and Fig.1). Significantly lowest adult emergence was observed after five weeks of storage (19.00%). About fifty percent survivability of aphid mummies were recorded after two weeks of storage.

Longevity of emerged adults were also significantly reduced after storage at different duration of weeks at 4°C and 90-95% RH. Highest adult longevity was observed in control (9.00 days). Statistically, it was observed that as the period of storage weeks increased the adult longevity decreased and declined from 8.60, 7.58, 6.78, 5.00 and 4.20 days under 1, 2, 3, 4 and 5 weeks of storage. Percent reduction in survival was observed 7.00% in one week of storage. The percent reduction in survival further increased from 38.92%, 46.17%, 62.16% and 77.52% after 2, 3, 4 and 5 weeks of storage.

Effect of storage at temperature 9°C and 70-75% RH

Statistically significant decline in adult emergence of *D. rapae* was observed from aphid mummies in one to five weeks of storage at a temperature of 9°C and 70-75% RH. Significantly highest percent of adult emergence was recorded in control (77.68%) followed by one week of storage (74.20%). Nearly 16% reduction in adult emergence was recorded after two weeks of storage of aphid mummies as compared to one week. Statistically significant reduction in adult emergence was seen in five week of storage (16.78%). Adult emergence in second, third and fourth weeks of storage were 58.72%, 46.70% and 27.40% respectively which depicted significant reduction in percent adult emergence.

Adult longevity was observed highest in control (8.80) followed by one week of storage (8.40). Statistically significant lowest adult longevity was observed in five weeks of storage (4.60 days) (Table 2). Adult longevity in two, three and four weeks after storage were 7.40, 6.60 and 5.00 days respectively. Percent reduction in survival was seen 4.48% in one week of storage, as it is observed that storage duration was increased the percent reduction in survival was also increased from 24.41%, 39.88%, 64.73% and 78.40% after 2,3,4 & 5 weeks of storage.

Table 2: Effect of storage at (90C, 70-75 % RH) at different durations on adult Emergence and adult longevity of mummified aphids

Treatment (Duration of storage)	Survival %	Adult longevity (days)	Percent reduction in survival
One Week	74.20 (59.49)a	8.40 (2.89)a	4.48
Two Weeks	58.72 (50.07)b	7.40 (2.71)b	24.41
Three Weeks	46.70 (43.10)c	6.60 (2.56)c	39.88
Four Weeks	27.40 (31.48)d	5.00 (2.23)d	64.73
Five Weeks	16.78 (24.14)e	4.60 (2.14)d	78.40
Control (15-20°C Temp and RH 55-65%)	77.68 (61.85)a	8.80 (2.97)a	
SEm±	0.67	0.01	
CD at 5%	3.40	0.14	
CV %	5.78	4.23	

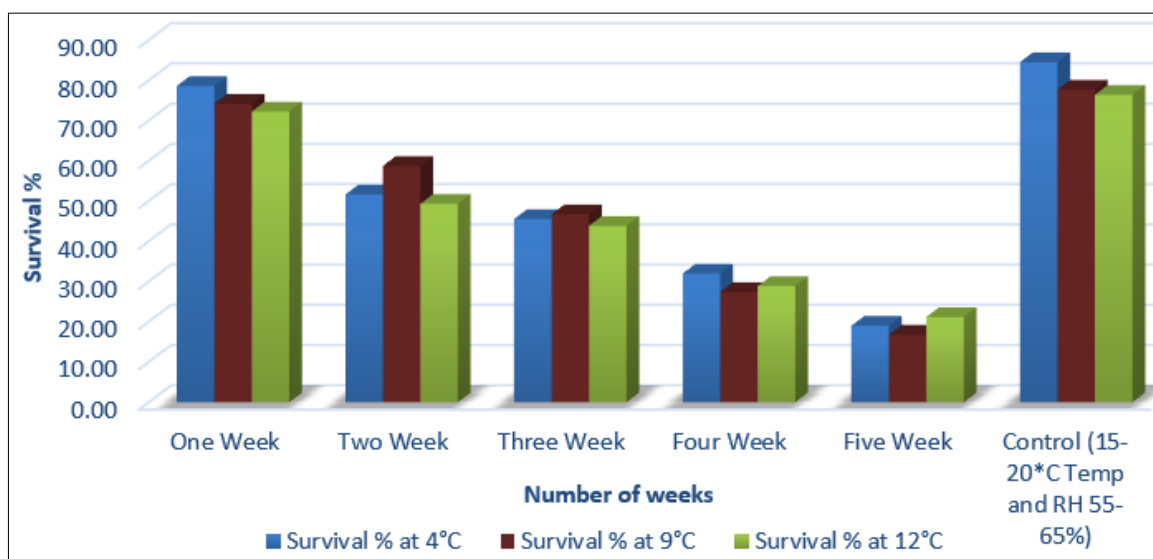


Fig 3: Survival percentage of mummified aphid, *D. rapae* at 4 °C, 9 °C and 12 °C

Effect of cold storage at temperature of 12°C and 80-85 % RH

Highest percent of adult emergence at 12°C were recorded in one week of storage duration (72.22%) but in control treatment, adult emergence was greater than one week of storage (76.40%) (Table 3.) Lowest percentage of adult emergence was found after five weeks of storage period (21.18%) while the percentage of adult emergence recorded in second, third, fourth and fifth weeks were 49.30, 43.84, 28.86 percent respectively. Maximum adult longevity was found in control (8.96 days)

followed by one week of storage (8.40). Minimum adult longevity observed in five weeks of storage period (4.60 days). This is more or less similar to Read *et al.* (1992b) who also mentioned that the female parasitoid lived for 10 to 15 days. Adult longevity significantly reduced in two, three, four and five weeks of storage with 7.40, 5.66, 5.00, 4.60 days respectively. Minimum percent reduction in survival was observed 5.47% in one week storage duration, further it was noticed that percent reduction in survival was Maximum 35.47%, 42.62%, 62.22% & 72.28% in 2,3,4 & 5 weeks of storage.

Table 3: Effect of storage at (12 °C, 80-85 % RH) at different periods on adult Emergence and adult longevity of mummified aphid, *D. rapae*

Treatment (Duration of storage)	Survival %	Adult longevity (days)	Percent reduction in survival
One Week	72.22 (58.28)a	8.40 (2.90)a	5.47
Two Weeks	49.30 (44.6)b	7.40 (2.72)b	35.47
Three Weeks	43.84 (41.46)b	5.66 (2.37)c	42.62
Four Weeks	28.86 (32.48)c	5.00 (2.24)cd	62.22
Five Weeks	21.18 (27.31)d	4.60 (2.15)d	72.28
Control (15 ^o -20 ^o C Temp and RH 55-65%)	76.40 (61.04)a	8.96 (2.99)a	
SEm±	0.65	0.01	
CD at 5%	3.27	0.16	
CV %	5.68	4.97	

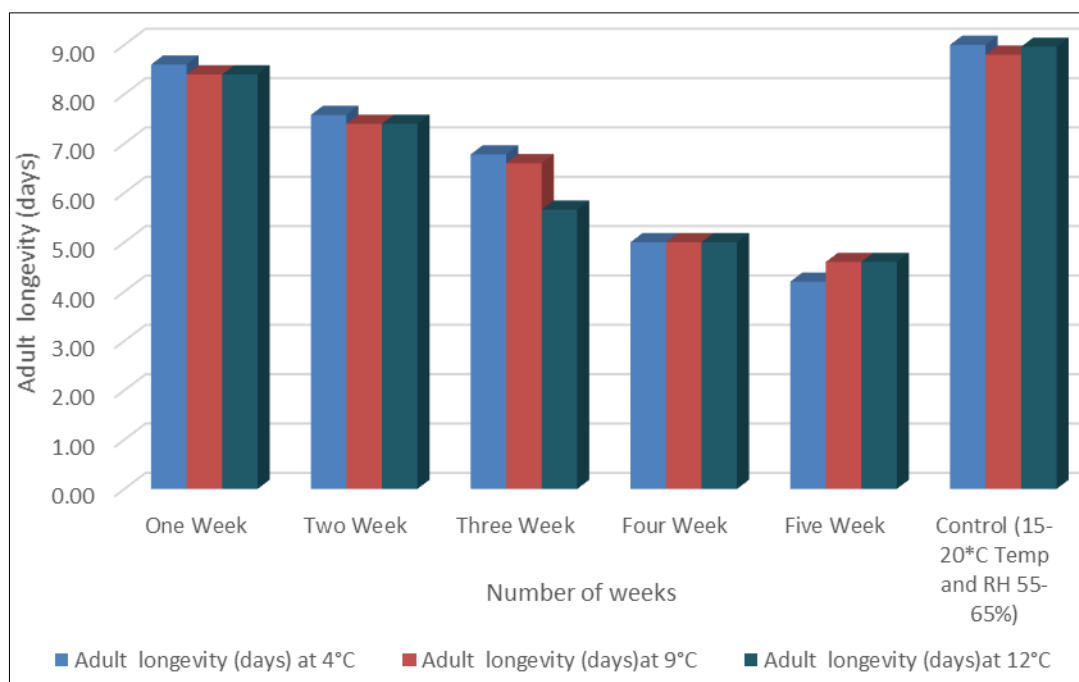


Fig 4: Adult longevity (days) of mummified aphid, *D. rapae* at 4 °C, 9 °C and 12 °C

According to the results obtained in the present studies, the percentage of survivability in the same period of storage at a temperature 4 °C, 9 °C and 12 °C was reduced as compared to control treatment (Fig). This shows that on reducing the storage temperature, the number of emerged adults from the mummies also reduced, hence for storage of aphid mummies higher temperature-20 °C seemed to be more appropriate.

The present findings are in accordance with Desai (2000) [2], who also reported that higher fecundity of *D. rapae* at lower relative humidity (55% RH) and emergence of the parasitoid was more at higher (25±1 °C) temperature coupled with lower (55%) RH with irrespective of host crop.

Results of the present investigation are in match with Dhiman and Kumar (1991) [3], who also observed the effect of temperature and relative humidity on development of *D. rapae* parasitizing *Lipaphis erysimi* (Kalt) and stated that the optimum temperature for rapid multiplication of the parasitoid was 24 to 28 °C temperature.

The present results are also in concurrence with Chen *et al.* (2008) [1] stating that indirect chilling injury is caused by prolonged exposure to moderately low temperature, which was observed in the present study too, might have been one of the reasons, which become progressively more lethal, with the increase in the duration of cold storage.

Conclusion

Thus, in the present studies, it was observed that, Maximum survivability (84.52%) and adult longevity of mummified aphid forming parasitoid (*D. rapae*) were recorded (9.00 days) in controlled conditions. Adult longevity further declined to 8.60, 7.58, 6.78, 5.00 and 4.20 days with 1, 2, 3, 4 and 5 weeks of storage. There was significant reduction in emergence with time. It was observed that approximately 7% reduction in adult emergence was seen after one week of storage (78.60%) as compared to control (84.50%). Significantly lowest adult emergence was observed in five weeks of storage (19.00%). Only Fifty percent of mummified aphid survivability was recorded in after two weeks of storage duration. Highest survivability was recorded at 9°C in one

weeks of storage (74.20%). Adult longevity was observed highest in control (8.80) which was on par with one weeks of storage (8.40). Highest percent of adult emergence (72.20%) but in control treatment adult emergence was greater than that of one weeks of storage (76.40%). Lowest percentage of adult emergence was found in five weeks of storage period (21.18 %). Higher adult longevity was found in control (8.96 days) followed by one weeks of storage (8.40) days. Percentage of survivability in the same period of storage at a temperature 4 °C, 9 °C and 12 °C was reduced when compared to control treatment. Results indicated that on reducing the storage temperature, the number of adult emergence from the mummies also reduced. Thus, for the storage of aphid mummies, higher temperature 15-20 °C appears to be better. Percent reduction in survival was observed minimum in one week of storage & it was maximum in 5th week of storage duration at different temperature.

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