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Biology of aphid mummy (*Diaeretiella rapae*) (McIntosh) and testing of its host preference among different species of aphids under laboratory conditions at Raipur, Chhattisgarh

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Abstract

Diaeretiella rapae (McIntosh), commonly known as aphid mummy is a ubiquitous cosmopolitan parasitoid with a wide range of hosts such as green peach aphid (*Myzus persicae*), Russian wheat aphid (*Diuraphis noxia*, *Rhopalosiphum padi* and *Schizaphis graminum*), cotton aphid (*Aphis gossypii*), broadbean aphid (*Aphis craccivora*), corn leaf aphid (*R. maidis*), reed plant aphid (*Hyalopterus pruni*) and oleander aphid (*Aphis nerii*). Testing of the parasitizing efficiency of aphid mummies (*D. rapae*) on different species of aphids was conducted during the year 2019-20 and 2020-21 at Biocontrol laboratory of the Department of Entomology, Indira Gandhi Agricultural University, Raipur (C.G.). The immature stages (eggs, larvae and pupae) of *D. rapae* passes within the body of its host. The duration of egg to pupa ranged from 8 to 10 days with an average of 8.84 ± 0.39 days. Longevity of female and male was recorded up to 6 to 8 and 5 to 6 days with an average of 7.20 ± 0.41 and 5.44 ± 0.17 days respectively. The result showed that the female lived slightly longer than the male. Total duration of life cycle egg to adult stage of female and male were observed from 14 to 18 and 13 to 16 days with mean value of 16.18 ± 0.74 and 14.80 ± 0.52 days, thus females took relatively more time to complete one generation as compared to males. Among the four aphid species tested, highest parasitization (60.60%) was observed in case of cabbage aphid, *Brevicoryne brassicae* followed by green peach aphid, *Myzus persicae* (56.82%) and mustard aphid, *Liphaphis erysimi* (37.72%). *Aphis craccivora* infesting cowpea had lowest preference as only (23.42%) aphids were parasitized by *D. rapae* under laboratory conditions.

Keywords: aphid mummy, *Diaeretiella rapae* (McIntosh), testing, host preference

Introduction

Aphid mummy, *Diaeretiella rapae* (McIntosh) parasitizes more than 60 aphid species among which Five to six aphid species are common hosts that attack on agricultural and horticultural crops. *D. rapae* is a common cosmopolitan parasitoid with a wide range of hosts such as green peach aphid (*Myzus persicae*), Russian wheat aphid (*Diuraphis noxia*, *Rhopalosiphum padi*, corn leaf aphid (*R. maidis*) and *Schizaphis graminum*), cotton aphid (*Aphis gossypii*), broadbean aphid (*Aphis craccivora*), oleander aphid (*A. nerii*), reed plant aphid (*Hyalopterus pruni*) (El- Heneidy *et al.*, 2006; Saleh *et al.*, 2006, and Saleh and Gatwaary, 2007) [4, 8, 7]. The cabbage aphid, *Brevicoryne brassicae* (Linn.), is one of the most important insect pests of the family Aphididae. They are grayish green with a waxy covering that gives them a grayish-white appearance with short siphunculi. Adults are present in both wingless and winged form. However, wingless females producing live young (nymphs) are the most common. The cabbage aphid, *Brevicoryne brassicae* (Linn.), is one of the most preferred host of *D. rapae*.

Materials and Methods

Investigations on the biology of *D. rapae* were carried out in the Biocontrol laboratory of the Department of Entomology, Indira Gandhi Agricultural University, Raipur (C.G.), by using cabbage plant. The laboratory temperature during the period of study ranged between 25-38°C, with RH ranging between 55-60%.

In order to study the biology of *D. rapae*, plastic jars (25 numbers) containing cabbage leaves were used in which aphids were released in each plastic jar. A freshly emerged pair of *D. rapae* was released in each plastic jars on fresh leaves containing aphids for parasitization and then removed after 24 hours, *D. rapae* is an endoparasitoid, all the immature stages *i.e.* eggs, larvae, pupae passes in side its host (aphid).

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Therefore, period from day of parasitization up to the emergence of adults was recorded regularly. Observation on immature stages (egg to pupae) and adult stages were also recorded. The adult emerged from the pupae were collected and a pair of *D. rapae* was kept in plastic jar along with aphids for parasitization and providing 10% honey solution as feed. Ten pairs of *D. rapae* were kept separately in plastic jars and longevity of male and female were recorded. Sex ratio (male: female) of *D. rapae* emerged from 25 mummified aphid from laboratory reared aphid was also worked out.

Testing of the parasitizing efficiency of aphid mummies (*D. rapae*) on different species of aphids was conducted under laboratory conditions in completely randomized design (CRD) with four different treatments (different species of aphids) replicated five times. Four different species of aphids viz., mustard aphid, *Lipaphis erysimi*, green peach aphid, *Myzus persicae*, cabbage aphid, *Brevicoryne brassicae* L., and cowpea aphid, *Aphis craccivora* Koch. were collected from the mustard, cauliflower, cabbage and cowpea fields respectively and reared under laboratory conditions. In each replication, 20 nymphs of aphids were kept in plastic jars along with leaves and twigs of their respective hosts. Aphid mummies were collected from the cabbage field and brought to the Bio-control laboratory. The emerged parasitoids were collected and sexed.

After 24 hours one pair of *D. rapae* was introduced in to each plastic jar. Counted numbers of aphids were released on infested twigs/leaves. After 2 to 3 days of exposure, the pair of parasitoid was removed from the plastic jar. Such individuals of aphids were reared in laboratory conditions by providing their respective feed until the emergence of parasitoids from mummified aphids. The extent of parasitism was calculated based on the number of individuals out of the total of each species parasitized by *D. rapae*.

Results and Discussion

Biology of aphid mummies under laboratory conditions

The immature stages (eggs, larvae and pupae) of *D. rapae* passes within the body of its host as it is an endoparasitoid. As per the data presented in Table 1, the duration of egg to pupa ranged from 8 to 10 days with an average of 8.84 ± 0.39 days. Longevity of female and male was recorded up to 6 to 8 and 5 to 6 days with an average of 7.20 ± 0.41 and 5.44 ± 0.17 days respectively. The result showed that the female lived slightly longer than the male. Total duration of life cycle from egg to adult stage of female and male observed to be on 14 to 18 and 13 to 16 days with mean value of 16.18 ± 0.74 and

14.80 ± 0.52 days respectively. Silva *et al.* (2011) [9] recorded that 10.5 to 11.5 days of developmental period of *D. rapae* on three different species of aphids which is slightly lesser than the present results. The result revealed that the female took relatively more time to complete one generation than the male.

The present results are in conformity with Reed *et al.* (1992b) [6] who also reported that the adult of *D. rapae* lived for 10 to 15 days. The slight variation in adult longevity might be attributive to differences in sex, host insects and environmental conditions during the study period.

The adult female parasitoid was bigger than the male. The head and thorax were blackish in colour. The antenna was dark brownish to black in colour. The abdomen and legs were brownish in colour. Wings were transparent and hyaline, pterostigma was greenish yellow in colour. Antenna was filiform and mostly 14 segmented in female sometimes 13 or 15 segmented and comparatively shorter than male. The antenna in male was 16 to 17 segmented, scape and pedicel were almost of same length. (Plate 1)

Sex ratio of *D. rapae* showed that out of 25 adults collected from the cabbage field, 21 emerged out of which, 9 were males and 12 females. Male to female sex ratio was 1:1.33. In laboratory conditions out of 24 adults 10 were male and 14 were female and sex ratio was 1:1.40 (Table 2). It indicates that ratio of female on *D. rapae* was higher than the male. Similar findings were recorded by Abidi *et al.* (1989) [1], Anonymous (1999) [2] and Reed *et al.* (1992b) [6].

Table 1: Duration of different life stages of aphid mummy, *D. rapae*

Life stages of <i>D. rapae</i>	Range (days)	Mean \pm SEM	SD
Egg to pupa	8-10	8.84 ± 0.39	0.87
Adult Female	6-8	7.2 ± 0.41	0.91
Adult Male	5-6	5.44 ± 0.17	0.38
Life span female	14-18	16.18 ± 0.74	1.66
Life span Male	13-16	14.80 ± 0.52	1.17

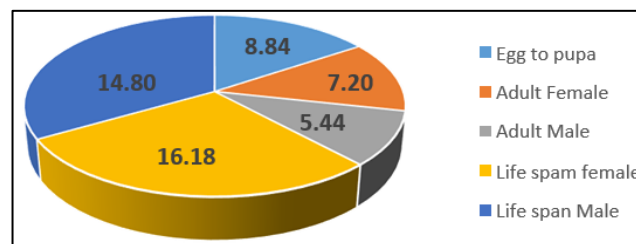


Fig 1: Duration of different life stages of *D. rapae*

Table 2: sex ratio of *D. rapae* in field collected and laboratory reared adults

Field collected					Laboratory reared			
Month	No. of samples	Male	Female	Sex ratio	No. of samples	Male	Female	Sex ratio
January- February	21	9	12	1: 1.33	24	10	14	1:1.40

Testing of host preference by aphid mummies, *D. rapae* among different species of aphids

Aphid mummy, *Diaretiella rapae* (McIntosh) (Hymenoptera: Braconidae) is one of the promising and common solitary, cosmopolitan endoparasitoid of aphid species. Generally, it prefers certain aphid species. The preference of host by the parasitoid largely depends on the size of host convenient for parasitization and availability of nutrients required for its development. The parasitoids have specific food requirement and they prefer to parasitize the best suited host by selecting species depending up on the chemical composition

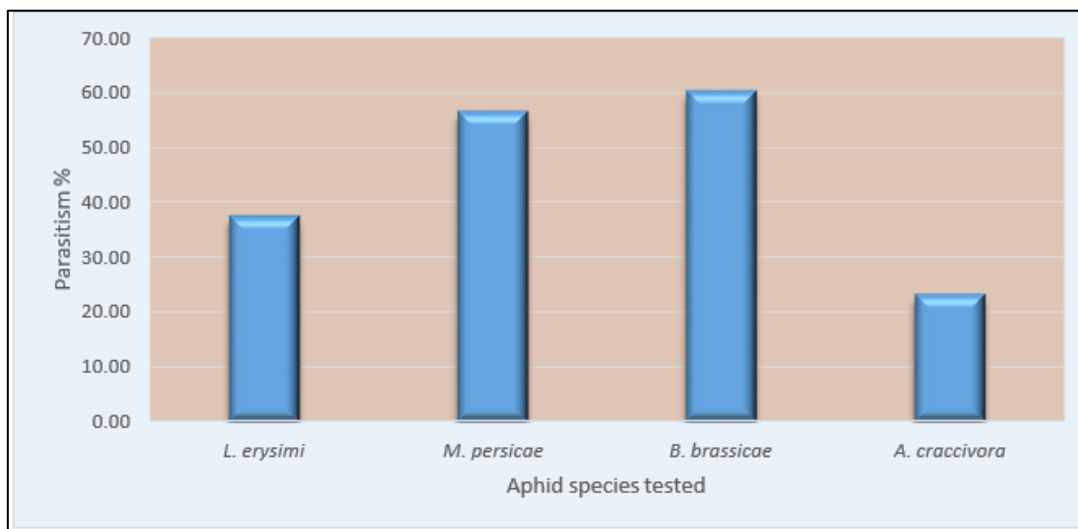
appropriate for the host species.

The data on host preference by *D. rapae* indicated that there was significant difference in preference between different species of aphids. It was observed that among four aphid species tested, highest parasitization (60.60%) was observed in case of *Brevicoryne brassicae* (cabbage aphid) followed by green peach aphid, *Myzus persicae* (56.82%) and mustard aphid, *Liphaphis erysimi* (37.72%). *Aphis craccivora* infesting cowpea had lowest preference as only (23.42%) aphids were parasitized by *D. rapae* under laboratory conditions. (Plate 2)

Table 3: Host preference by *D. rapae* by different species of aphids based on percentage parasitization /mummification.

Treatment	Aphid species tested	Parasitism %
T1	<i>Lipaphis erysimi</i>	37.72 ^b (37.88)
T2	<i>Myzus persicae</i>	56.82 ^a (48.97)
T3	<i>Brevicoryne brassicae</i>	60.60 ^a (51.13)
T4	<i>Aphis craccivora</i>	23.42 ^c (28.91)
SEm ±		1.61
CD at 5%		3.70
CV %		6.61

Note: Figure in parenthesis are re-transformed value and those outside are arc sign transformed value

**Fig 2:** Graphical representation of percent parasitization /mummification of different species of aphids by *D. rapae***Plate 1:** Adult female of *Diaeretiella rapae***Plate 2:** Mummification of aphids by adult *D. rapae*

Significantly more number of *B. brassicae* and *M. persicae* were parasitized by *D. rapae* over *L. erysimi* and *A.*

craccivora. These results are in agreement with the report of Silva *et al.* (2011) ^[9] who reported that the parasitization by *D. rapae* was higher on *M. persicae* than *L. erysimi* among the four different spp. of aphids tested by them. Significantly least preference for parasitization was observed in case of *A. craccivora* (fig. 4.48).

It is observed that aphids feeding on cruciferous vegetables had higher rate of parasitization as compared to other crops, indicating their preference towards cruciferous aphids. The result is in accordance with Read *et al.* (1970) ^[5], who reported that more *D. rapae* were found in crucifer patches than in non-crucifer habitats.

Vaughn *et al.* (1996) ^[10] found evidence of antennal receptors that respond specially to the volatile compound allyl isothiocyanate released by damaged crucifer plants. According to Baer *et al.* (2004) ^[3] consistent olfactory attraction to cruciferous plants suggests that crucifer feeding aphids were an ancestral host species of *D. rapae*.

Conclusion

The duration of *D. rapae* from egg to pupa was of 8.84 ± 0.39 days. Longevity of female and male was 7.20 ± 0.41 and 5.44 ± 0.17 days respectively. Female lived slightly longer than the male. Total duration of life cycle egg to adult stage of female and male were observed from 14 to 18 and 13 to 16 days with mean value of 16.18 ± 0.74 and 14.80 ± 0.52 days, thus females took relatively more time to complete one generation as compared to males. Among the four species of aphids tested, highest parasitization (60.60%) was observed in case of cabbage aphid *Brevicoryne brassicae* followed by green peach aphid, *Myzus persicae* (56.82%) and mustard aphid, *Lipaphis erysimi* (37.72%). *Aphis craccivora* infesting cowpea had lowest preference as only (23.42%) aphids were parasitized by *D. rapae* under laboratory conditions.

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