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Distribution, Hosts and Biology of *Diaeretiella rapae* (M'Intosh) (Hymenoptera: Braconidae: Aphidiinae) in Punjab, Pakistan

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Abstract .- *Diaeretiella rapae* (M'Intosh) (Hymenoptera: Braconidae, Aphidiinae) aphid parasitoid is reported from various districts of Punjab Province of Pakistan from a wide range of host aphids and plant associations, including some new evidences. Biological information centered development, life-stages and their micrographes, mating and oviposition, adult lon gevity and food have been discussed. Biology of the parasitoid reared on *Myzus persicae* aphids in the laboratory at 23±1°C have been discussed. The development cycle from larva to adult was completed in about 11.5 days at 21-23°C. The pre-mating period of males (n=10) varied between 20 and 40 minutes (mean: 28.8 min), however it was longer in females most of which rejected all copulatory attempts at least two hours after emergence . When newly emerged females were confined with males for a period of 12 h, all mated *i.e.*, they produced progeny of both sexes. Copulation time (n = 10 pairs) was between 30 and 60 s (mean: 46.3 s). Oviposition time (n = 10 females) was between 46 and 64 s (mean: 52.6 s). Female lived longer (11.1± 0.16 days) than males (9.4 ± 0.18 days) when offered honey and water. The lifespan of adult females was shorter (10.2 ± 0.05 days) in the presence of host aphids and host plant leaves than only with honey and water.

Key words: *Diaeretiella rapae, Myzus persicae,* aphid parasitoid.

INTRODUCTION

Diaeretiella rapae (M'Intosh) (Hymenoptera: Braconidae, Aphidiidae) is an aphid parasitoid already reported on a few host plants and aphid species from Pakistan (Starỳ *et al*., 1998; Naeem *et al*., 2005). It attacks aphids of cruciferous plants and has been reported as a solitary endoparasitoid (Ayal, 1987; Kant *et al*., 2008). Bayhan *et al*. (2007) determined the development time and parasitization rate of *Diaeretiella rapae* (M'Intosh) on *Brevicoryne brassicae* (L.) feeding on different *Brassica* cultivars in the laboratory at 20°C.

Under laboratory conditions, egg-to-adult development ranges from 9 to 15 days. Adult females live for 10-15 while males live for 7 to 10 days (Hafez, 1961; Simpson *et al*., 1975; Reed *et al*., 1992). Females live significantly longer than males at constant temperatures, 10.0, 21.1 and 26.7°C on *Diuraphis noxia* (Mordwilko) (Bernal and González, 1997). A lot of work on its reproductive behavior (Kant and Sandanayaka, 2009), parasitism rate, seasonal abundance and biology have been done worldwide (Akhtar *et al*., 2010).

Keeping in view its utilization as bio-control agent in various studies worldwide, a survey was conducted in order to determine its distribution and host range throughout Punjab. In addition its biology was studied under laboratory conditions. These studies will help to utilize this biological control agent in various integrated pest management programmes against various aphid species on various host plants in Pakistan.

MATERIALS AND METHODS

Collection and identification

Plant parts (Leaves, stem, flowers and fruits) bearing mummified aphids and live aphids were collected from various areas of Punjab Province of Pakistan. Plant parts bearing mummified aphids were placed in Polythene bags and taken to the laboratory. Aphids were preserved in 70% alcohol for later identification up to species level. Aphid mummies also were placed in small glass vials. In the laboratory, mummified aphids were reared in the vials for 4-8 days by keeping a small piece of moistened cotton in order to keep appropriate moisture. The vials were covered with a piece of muslin cloth to provide aeration in the vials and

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carefully labeled. Adult parasitoids were also collected directly from various habitats with the help of arial net and placed in plastic bags. Emerged parasitoids were killed by keeping them in refrigerator for 5 minutes. The specimens were mounted by sticking them on the triangular shaped white cards with the help of a needle. Each specimen was labeled and placed in collection boxes. Some adult parasitoids were also preserved in 70% ethyl alcohol in glass vials and preserved dry in glass vials. Host plants were identified in the field or plant parts like leaves and flowers were dried, preserved then identified latter on. The specimens were identified to species level using taxonomic keys of Raychaudhuri (1990). The illustrations were prepared using a Nikon microscope (SMS-1500, with 30x 1-11.25x magnification). Measurements were taken using ocular micrometer in Noif microscope (XSZ 107BN, with 10X10X magnification).

Rearing of Myzus persicae

Adult females of *M. persicae* were collected from the cabbage and brassica crops. In laboratory, female aphids (n. 50) were released on the leaves of potted cabbage plants (no. 3) in order to maintain aphid culture.

Rearing of Diaeretiella rapae

Both male and female individuals of *D. rapae* were collected from Brassica field and then reared on *M. persicae* aphids in the laboratory at 23±1°C. Male and female parasitoids were released in separate glass jars and were kept there for mating. Fifty aphids (3rd instar obtained from aphid culture) were placed in 4 glass jars, containing *Brassica* and cabbage leaves, covered with muslin cloth. Three mated females were taken and released in glass jar with aphids for 48 hours. They were provided with food as cotton soaked with 10% honey solution. Mummified aphid on the *Brassica* and cabbage leaves were collected from glass jars after 4-5 days and put in small gelatinazed capsules (2x0.5cm) until emergence. Emerged individuals were again used to maintain culture of *D. rapae.*

Life cycle of Diaeretiella rapae

In order to study the life cycle of *D. rapae,* 120 aphids (3rd instar of *M. persicae* from aphid culture) were reared on cabbage leaves in three glass jars. Fifteen mated females of *D. rapae* (from maintained culture) were released in each jar for a period of 48 hours. After removal of females from the jars, mummified aphids (atleast 10 from each jar) were also removed after every 24 hours for dissection. Ten mummified aphids from each jar were taken on daily basis and were dissected under the microscope (Swift SM-80 with magnification 2X and 4X). Various developmental stages of *D. rapae* were observed at 23±1°C under Nikon microscope, coloured photograph of each stage was also taken. Colour of various larval instars, colour of pupae, development of antennal segments, head, thorax, abdomen, wings and legs were observed. Number of days taken by various life stages were also recorded. The coloured plates of all life developmental stages were prepared.

Determination of mating time, copulation time and oviposition time

In order to observe pre-mating time and copulation time, ten observations were made by releasing 10 males and 10 females of *D. rapae* in Petri dishes plates. Time was noted by stop watch. Similarly oviposition time was also noted for 10 females when released in petri plates containing 3rd instar aphids (*M. persicae*).

Adult longevity on various food sources

Five *D. rapae* individuals both males and females were released in petri plates supplied with artificial diet (pure honey and water on cotton wool). Experiment was replicated four times, number of days of insect life from 1st day of release of adult till death were counted. Adults were allowed to feed on artificial diet until death. Similarly five females *D. rapae* were released for their whole life time (until death) on potted plants of cabbage with 3rd instars nymphs of *M. persicae* in laboratory. Potted plants were wrapped with polythene bages. Polythene bages were provided with a piece of muslin cloth for ventilation. This experiment was also replicated four times, number of days of life from 1st day of release of adult until death was counted.

RESULTS AND DISCUSSION

Diaeretiella rapae (M'Intosh, 1855)

Differentiating morphological characters of the species under study have been given in Figure 1.

Material examined

Aphis fabae on wild spinach, Islamabad, 29-iii-08, 18♀ and 9♂; Rawalpindi, 28-iii-07, 27♀ and 12♂; Attock, 29-iii-07, 5♀ and1♂; Khushab, 10-iv-06, 9♀and 10♂.

Aphis gossypii on *Papaver somniferum*, Rawalpindi, 29-iii-08, 25♀and 18♂; Islamabad, 24-iii-05, 11♀and 6♂; Lahore, 27-iii-07, 9♀ and 5♂; Multan, 22-iii-06, 13♀ and 4♂; Attock, 28-iii-08, 12♀ and 4♂. *Solanum melongena*, Layyah, 23-iii-05, 6♀ and 2♂; Bhakkar, 22-iii-06, 9♀ and 1♂; Mainwali, 26-iii-07, 9♀and 4♂; D.G. Khan, 21-iii-05, 18♀ and 7♂; Muzafar Garh, 23-iii-07, 11♀ and 5♂. *Hibiscus rosa-sinensis*, 29-iii-05, 15♀and 10♂; Islamabad, 20-iii-06, 21♀and16♂; Lahore, 27-iii-07, 29♀ and 15♂.

Brevicoryne brassicae on Brassica napus, Rawalpindi, 18-iii-08, 25♀ and 22♂; Islamabad, 14-iii-05, 24♀ and 0♂; Attock, 28-iii-06, 35♀ and 22♂; Jhelum, 28-iii-07, 45♀ and 22♂; Gujrat,16-iii-05, 34♀ and 23♂; Narowal, 22-iii-07, 15♀ and 10♂; Pakpatan, 18-iii-06, 45♀ and 12♂; D.G. Khan, 11-iii-08, 35♀ and 17♂; Muzafar garh, 17-iii-07, 34♀ and 12♂; Lahore, 12-iv-05, 25♀ and 12♂; Faisalabad, 19-iii-08, 35♀ and 18♂; Vihari, 12-iii-08, 29♀ and 12♂; Khanewal, 24-iii-06, 55♀ and 34♂; Sahiwal, 18-iii-07, 38♀ and 28♂; Okara, 22-iii-08, 25♀ and 32♂; Multan, 18-iii-06, 45♀ and 19♂; Bahawalpure, 21-iii-07, 24♀ and 18♂; Bahawalnager, 27-iii-07, 39♀ and 22♂; Gujranwala, 7-iv-08, 55♀ and 29♂; Layyah, 27-iii-07, 39♀ and 12♂; Bhakkar, 27-iii-07, 29♀ and 22♂; Mianwali, 1-iv-07, 9♀ and 3♂. *Brassica oleracea*, Rawalpindi, 23-iii-06, 5♀ and 8♂; Islamabad, 24-iii-07, 14♀ and 8♂; Jhelum, 25-iii-07, 5♀ and 9♂. *Brassica campestris* L., Rawalpindi, 18-iii-08, 35♀ and 12♂; Islamabad, 14-iii-06, 15♀ and 8♂; Attock, 28-iii-05, 35♀ and 10♂; Jhelum, 28-iii-06, 25♀ and 8♂; Gujrat,16-iii-07, 20♀ and 23♂; Narowal, 22-iii-07, 35♀ and 10♂; Pakpatan, 18-iii-08, 25♀ and 20♂; D.G. Khan, 1-iv-08, 18♀ and 10♂; Muzafar garh, 17-iii-07, 10♀ and 15♂; Lahore, 12-iv-05, 45♀ and 20♂; Faisalabad, 19-iii-06, 25♀ and 18♂; Vihari, 12-iii-08, 29♀ and 12♂; Khanewal, 24-iii-06, 35♀ and 24♂; Sahiwal, 18-iii-08, 40♀ and 28♂; Okara, 22-iii-07, 50♀ and 32♂; Multan, 18-iii-06, 55♀ and 35♂; Bahawalpure, 21-iii-07, 45♀ and 18♂; Bahawalnager, 17-iii-07, 39♀ and 32♂; Gujranwala, 2-iv-08, 45♀ and 24♂; Layyah, 27-iii-07, 38♀ and 34♂; Bhakkar, 27-iii-07, 60♀ and 45♂; Mianwali, 1-iv-07, 54♀ and 20♂; Murree*, 1-v-07, 5♀.

Hyalopterus pruni on *Prunus persica*, Islamabad, 1-iv-08, 18♀ and 3♂; Rawalpindi, 28-iii-07, 7♀ and 2♂.

*Lipaphis erysimi** (Kaltenbach) on *Brasica campestris* L. Rawalpindi, 18-iii-08, 35♀ and 18♂; Attock, 28-iii-05, 25♀ and 12♂; Jhelum, 28-iii-06, 35♀ and 12♂; Narowal, 22-iii-07, 23♀ and 8♂; Pakpatan, 18-iii-08, 45♀ and 24♂; D.G. Khan, 1-iv-08, 35♀ and 18♂; Muzafar garh, 17-iii-07, 24♀ and 35♂; Lahore, 12-iv-05, 25♀ and 12♂; Faisalabad, 19-iii-06, 15♀ and 8♂; Khanewal, 24-iii-06, 25♀ and 14♂; Sahiwal, 18-iii-08, 30♀ and 18♂; Multan, 18-iii-06, 45♀ and 18♂; Bahawalpure, 21-iii-07, 16♀ and 8♂; Bahawalnager, 17-iii-07, 19♀ and 12♂; Gujranwala, 2-iv-08, 15♀ and 9♂; Layyah, 27-iii-07, 19♀ and 12♂; Mianwali, 1-iv-07, 49♀ and 32♂.

Myzus persicae on *Nicotiana tobacum*, D.G. Khan, 29-iii-06, 28♀ and 8♂; D.G. Khan, 29-iii-07, 15♀ and 8♂; Layyah, 27-iii-06, 29♀ and 18♂. *Euphorbia helioscopia*, D.G. Khan, 22-iii-05, 17♀ and 9♂; Rawapindi, 27-iii-06, 10♀ and 8♂; Islamabad, 21-iii-07, 27♀ and 18♂. *Brassica napus*, Rawalpindi, 28-iii-06, 25♀ and 12♂; Islamabad, 24-iii-07, 20♀ and 18♂; Attock, 20-iii-05, 5♀ and 2♂; Jhelum, 25-iii-07, 25♀ and 10♂; Gujrat,24-iii-05, 35♀ and 14♂; Bahawalpure, 21-iii-07, 36♀ and 18♂; Bahawalnager, 24-iii-06, 9♀ and 2♂; Gujranwala, 8-iv-06, 5♀ and 9♂; Layyah, 27-iii-07, 9♀ and 8♂; Bhakkar, 27-iii-05, 19♀ and 8♂; Mianwali, 11-iii-05, 23♀ and 18♂. Faisalabad, 19-iii-06, 35♀ and 18♂; Lahore, 22-iii-06, 22♀ and 16♂. *Brassica oleracea*, Rawalpindi, 23-iii-06, 15♀ and 9♂; Islamabad, 24-iii-07, 20♀ and 18♂; Jhelum, 25-iii-07, 25♀ and 10♂; Gujrat, 24-iii-05, 35♀ and 14♂. *Brassica campestris** L., Rawalpindi*, 18-iii-08, 55♀ and 22♂; Islamabad*, 14-iii-06, 20♀ and 8♂; Attock, 28-iii-05, 25♀ and 12♂; Jhelum, 28-iii-06, 35♀ and 12♂; Gujrat, 16-

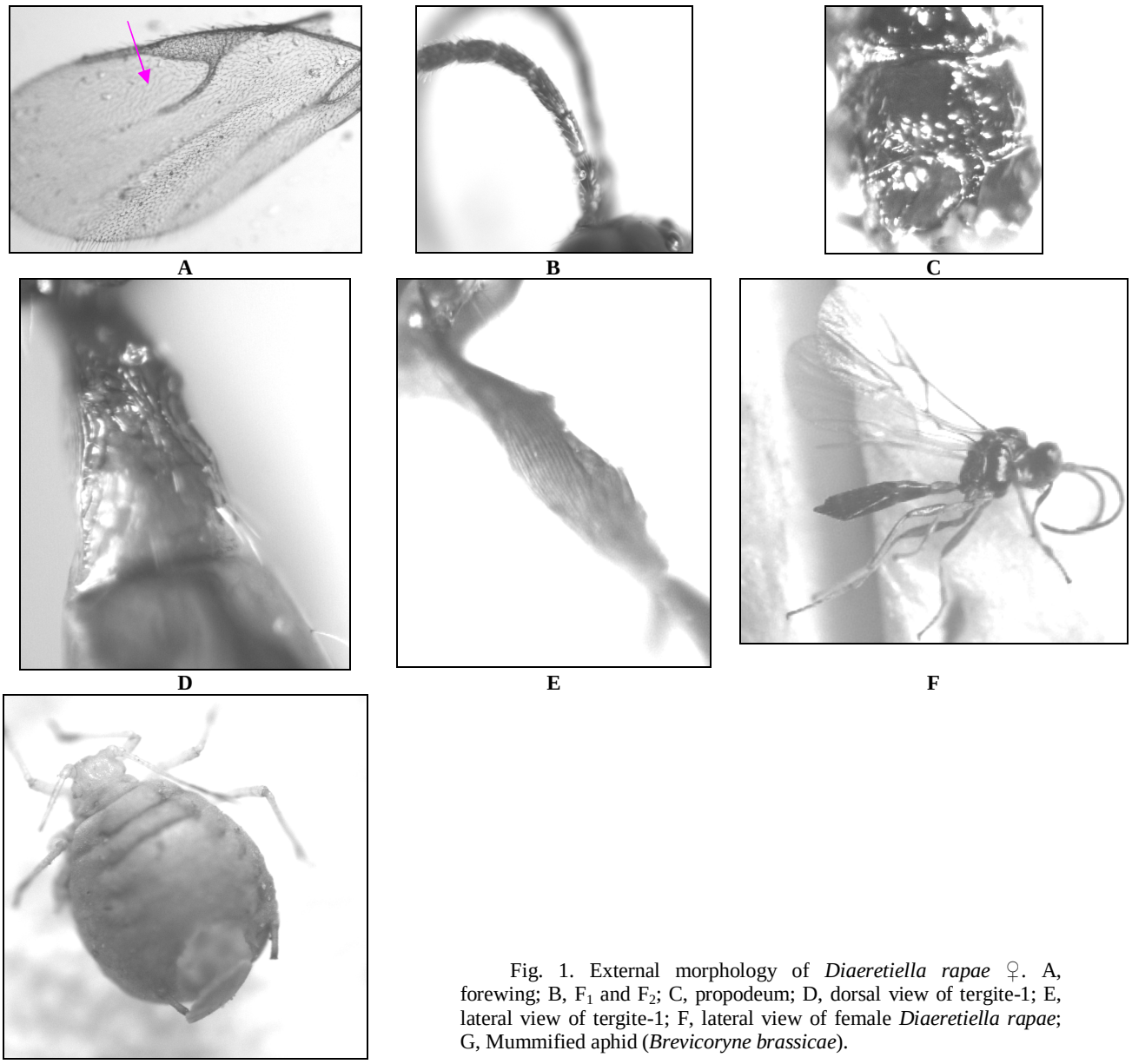

Fig. 1. External morphology of *Diaeretiella rapae* ♀. A, forewing; B, F_1 and F_2; C, propodeum; D, dorsal view of tergite-1; E, lateral view of tergite-1; F, lateral view of female *Diaeretiella rapae*; G, Mummified aphid (*Brevicoryne brassicae*).

iii-07, 24♀ and 13♂; Narowal, 07, 45♀ and 13♂; Pakpatan, 18-iii-08, 55♀ and 22♂; D.G. Khan, 1-iv-08, 25♀ and 10♂; Muzafar garh, 17-iii-07, 14♀ and 22♂; Lahore, 12-iv-05, 55♀ and 22♂; Faisalabad, 19-iii-06, 15♀ and 8♂; Vihari, 12-iii-08, 9♀ and 2♂; Khanewal, 24-iii-06, 25♀ and 14♂; Sahiwal, 18-iii-08, 30♀ and 18♂; Okara, 22-iii-07, 35♀ and 12♂; Multan, 18-iii-06, 25♀ and 10♂; Bahawalpure, 21-iii-07, 16♀ and 8♂; Bahawalnager, 17-iii-07, 19♀ and 12♂; Gujranwala, 2-iv-08, 15♀ and 9♂; Layyah, 27-iii-07, 19♀ and 12♂; Bhakkar, 27-iii-07, 29♀ and 12♂; Mianwali, 1-iv-07, 29♀ and 22♂.

Rhopalosiphum padi on *Triticum estivum*, Rawalpindi, 30-iii-06, 23♀and 19♂; Jhelum, 27-iii-05, 9♀and 2♂; Attock, 25-iii-05, 24♀and 18♂; Lahore, 21-iii-07, 28♀and 13♂; Khushab, 10-iv-08, 15♀and 10♂: Bahawalpure, 26-iii-07, 6♀ and 4♂; Bahawalnager, 28-iii-06, 19♀ and 8♂; Gujranwala, 8-iv-06, 2♀ and 1♂; Layyah, 27-iii-07, 15♀ and

6♂; Bhakkar, 29-iii-05, 5♀ and 5♂; Chakwal, 25-iii-05, 4♀.

*Schizaphis graminum** on *Triticum estivum*, Islamabad, 30-iii-06, 24♀and 9♂; Khushab, 27-iii-05, 12♀and 3♂; Attock, 25-iii-05, 4♀and 8♂; Faisalabad, 26-iii-07, 8♀and 3♂; Khushab, 10-iv-08, 5♀and 1♂; Gujranwala, 8-iv-06, 2♀ and 1♂; Layyah, 27-iii-07, 15♀ and 6♂; Bhakkar, 29-iii-05, 9♀ and 5♂.

*Sitobion avenae** on *Triticum estivum*, Khushab, 23-iii-06, 8♀and 3♂; Islamabad, 21-iii-08, 22♀and 19♂; Attock, 27-iii-06, 14♀and 3♂; Gujranwala, 28-iii-06, 12♀ and 8♂; Layyah, 22-iii-05, 15♀ and 9♂; Bhakkar, 20-iii-05, 29♀ and 15♂; Mainwali, 26-iii-06, 8♀and 3♂; D.G. Khan, 28-iii-08, 11♀ and 9♂; Muzafar Garh, 29-iii-05, 18♀ and 5♂; Jhung, 25-iii-06, 22♀ and 15♂.

This species was collected from a number of different localities from various host plants. Its wide distribution indicates its ability to adapt to varied environment of both plain and high elevation areas in addition to wide aphid host rang as reported by Pike *et al*. (1999).

Mummy and emergence of adults

Whitish to golden mummies were found in groups of several specimens each during October to May which indicates a gradual oviposition by a parasite female in an aphid colony (Fig. 1G). Pupation took place inside in the mummified aphids. Mummies were rounded to oval with emergence hole located on the dorsum. Emergence hole located anterior to cornicles or sometimes removing one of the cornicle was about rounded, bearing an emergence lid or on average absent**.**

Variation in morphology of adults

This is a highly variable species. Colour varies from light yellow to dark brown and in some cases black due to variations in temperature of various localities of Punjab Province. The number of antennal segments varies from 13 to 15. Results regarding number of antennal segments differed from those of Raychaudhuri (1990) who observed only 14 numbers of antennal segments. Similarly the areola of propodeum varies from narrow to wide and in many individuals the areola is elongate and anteriorly narrow.

* indicates new locality or association record.

Development on Myzus persicae

Various life stages of *D. rapae* were studied on *M. persicae* in the laboratory at 23±1°C. During the oviposition, mated female wasp laid eggs singly in the adipose tissues (abdomen) of aphid. Parasitized aphid continued feeding and remains attached to leaves of host plant after oviposition.

Larva and pupae

After 72±1 hours, creamy white larvae were observed, feeding on soft tissue inside the aphid's abdomen. Mummified aphid changed into golden yellow (Fig. 2B). Our observations were associated with He and Wang (2008) and Hafez (1961). After 96±2 hours, dissections showed that creamy white larvae changed into yellow colour. There was brown eye spot present on pointed end (anterior region) (Fig. 2C and D). On 5th day it changed into perpupal stage, colour was still yellow but it was totally changed from 4th day larvae, clear differentiation among head thorax and abdomen exited. Antennae, legs and wings started to develop but transparent in colour (Fig. 2E). There were four larval instars completed inside the mummified aphid. The abdomen was cleaned out, and then thorax and head. Pupa on sixth day, initiation segmentations, head and thorax changed into black colour; antennae and wings were not fully developed at that time (Fig. 2F). On 7th day, pupa changed into adult (Fig. 2G).

Adult

On 9th day, adult completely changed and turned into black. Adult stage lasts for about 2 days and changed into fully developed adult on 11th day (Fig. 2I). Adult emerged by making a hole in the abdomen of its host (Fig. 2J). After the emergence of *D. rapae*, dead host is called as mummy (Fig. 2K). Total life cycle of *D. rapae* inside the host (*M. persicae*) from oviposition to emergence was completed in 11.5 days which correlated with the study of Dhiman (2006). The development behaviour of *D. rape* was about similar to the results given by Starý (1970) for *Aphidius* species. Adult female laid one egg in the host. The resultant larva lived in the body cavity and finally consumed all leaving just exoskeleton of aphids. Larva made a hole with one of its mandibles in the venter of aphid

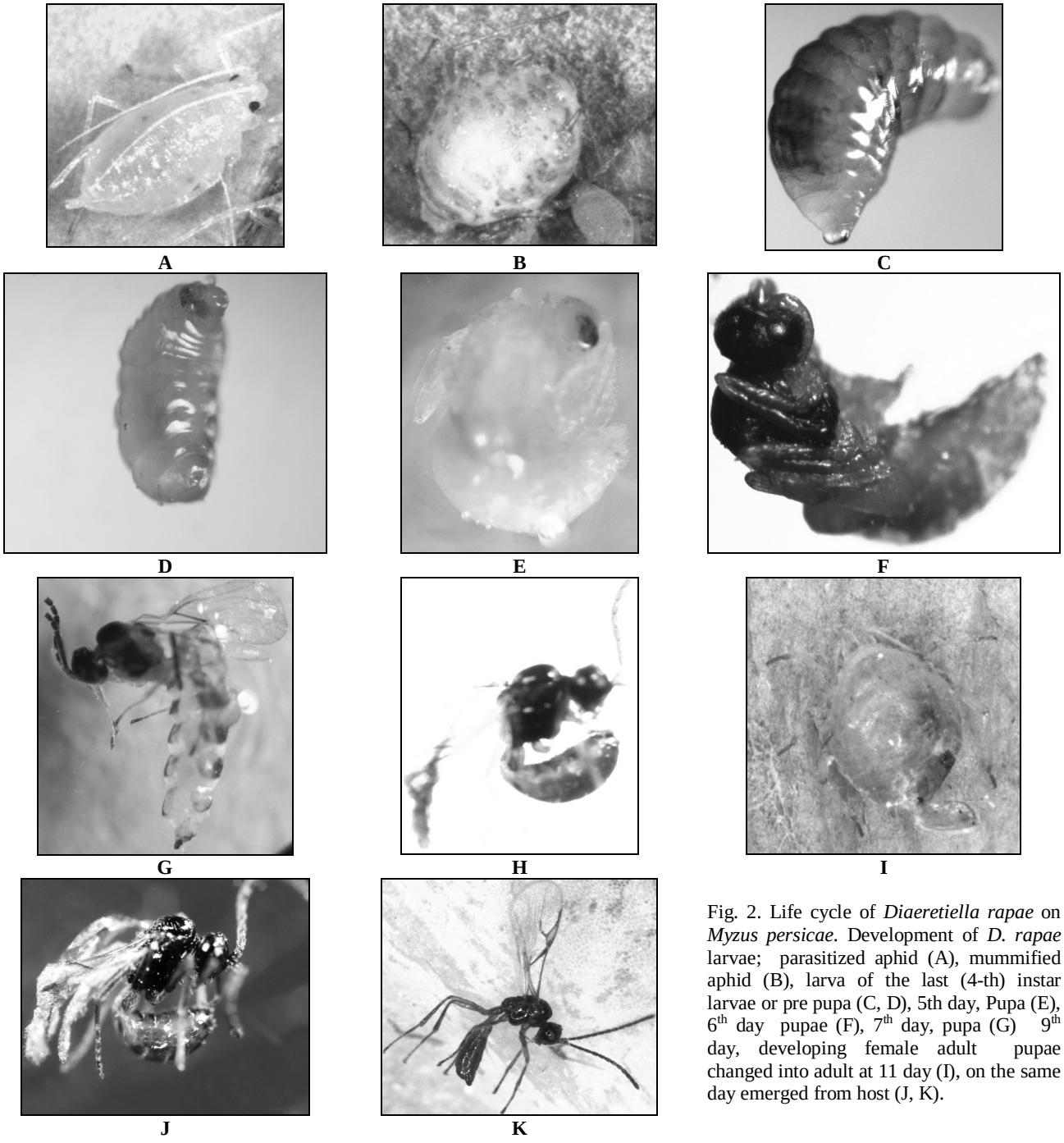

Fig. 2. Life cycle of *Diaeretiella rapae* on *Myzus persicae*. Development of *D. rapae* larvae; parasitized aphid (A), mummified aphid (B), larva of the last (4-th) instar larvae or pre pupa (C, D), 5th day, Pupa (E), 6th day pupae (F), 7th day, pupa (G) 9th day, developing female adult pupae changed into adult at 11 day (I), on the same day emerged from host (J, K).

body and stuck the latter to the plant part with a silk-like secretion. The larva pupated inside the aphid body and aphid changed into a mummy. The developing wasp cut with its mandibles a circular exit hole in the mummy, usually between the siphunculi. The development cycle completed in about 11.5 days at 21-23°C.

Mating and oviposition behavior

A few males copulated with virgin females within a few minutes of emergence where as others showed no attraction towards virgin females until

two to three hours after emergence. Mostly pre-mating period of males (n = 10) was between 20 and 40 minutes with mean time 28.8 minutes, however it was longer in females most of which rejected all copulatory attempts at least two hours after emergence (Table I). When newly emerged females were confined with males for a period of 12 hours, all were found to be mated *i.e.*, they produced progeny of both sexes. Copulation time (n = 10 pairs) was between 30 and 60 seconds with mean time of 46.3 seconds. Oviposition time (n = 10 females) was between 46 and 64 seconds with mean time of 52.6 seconds. All our observations agree with the observations of Sheng and Carver (1985).

Table I. Various biological parameters of *Diaeretiella rapae* at 23±1°C

Number of observations (n)	Pre-mating time of male (minutes)	Copulation time (Seconds)	Oviposition time (Seconds)
1	20	30	46
2	24	39	52
3	25	40	50
4	26	45	46
5	28	55	48
6	30	59	56
7	35	44	59
8	22	42	47
9	38	49	58
10	40	60	64
Mean	28.8	46.3	52.6
S.D.	6.8	9.5	6.3
S.E.	2.2	3	2

Adult longevity

Data analysis showed that diet had a significant effect on adult parasitoids longevity. Mean comparison revealed increased longevity of females (n=20, 11.1±0.53 days) fed on honey and water in comparison to males (n = 20, 9.4±0.45) (Fig. 3). Least days were taken by males which were fed on honey and water when compared with females (n=20, 10.2±0.49) feeding on other food sources and males on honey plus water which were statistically significant from one an other at 0.05 probability (One way Anova F =137.8, *df:* 2, P= 0.00). (*Aphidius smithi* and *Aphidius ervi* responded in the same way (Wiackowski, 1962). Providing parasitoids with food will result in increased longevity and subsequent parasitism rates (Azzouz *et al*., 2004; Irvin *et al*., 2007). Similar results were found by Hofsvang and Hagvar (1986) on *Ephedrus cerasicola*. Longevity is generally influenced by searching activity, body size, mating, oviposition, temperature, humidity, photoperiod and diet (Jervis and Copland, 1996). The adult parasitoid of *Trioxys palidius* lived shorter when fed only on water and honey solution compared to those kept with hosts and fed upon honeydew and first instar nymphs of *Chromaphis juglandicola*. It was even shorter when they were kept without hosts and food (Rakhshani, 2001).

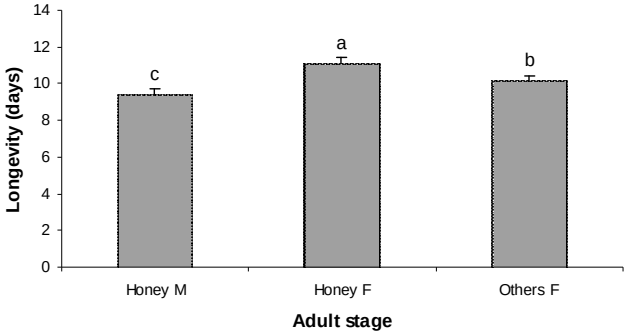

Fig. 3. Comparison of different diet sources on adult longevity of *Diaeretiella rapae* (mean values with SD, n=20). Bars with different letters are significantly different, ANOVA p-values for 'a' vs 'b' <0.0001; 'a' vs 'c' <0.001 and 'b' vs 'c' <0.001.

Seasonal occurrence and aphid/plant associations

In Punjab, *D. rapae* was found abundant from October to May namely on cruciferous plants associated with *B. brassicae*, *L. erysimi* and *M. persicae*. To a lesser extent, also some other associations were determined (*Aphis gossypii*, *A. fabae*, *Hyalopterus pruni*, *Rhopalosiphum padi*, *Schizaphis graminum* and *Sitobion avenae*).

In general, this parasitioid species can be classified as a typical representative of the agricultural landscape in Punjab, apparently interacting between aphid/plant associations in the course of the season. The knowledge of the aphid-parasitoid-plant associations is one of the main elements when developing integrated management strategies. The information supplied by the host records of parasitoid species contributes to the

knowledge concerning the beneficial fauna that could lead to the study of the probable effectiveness of parasitoid against aphids anywhere Kavallieratos *et al.* (2001). So our results can become a basis for developing IPM strategies against various species of aphids on cereal crops, oilseed crops, ornamental crops and vegetables as all these agro-ecosystems are interacting with each other on the basis of *D. rapae*- aphid and host plant associations. Vaughn and Antolin (1998) presented outstanding information on the population genetics of *D. rapae* on various host aphids in an agricultural area in the U.S.A.

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