



## Parasitization preference of *Diaeretiella rapae* (Hymenoptera: Braconidae) among different aphids in vegetable ecosystem

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Sucking insect pests are considered as one of the major limiting biotic factors for production of vegetables in India. Among these, aphids alone have the potential to inflict yield losses up to 82% in case of cruciferous crops where insecticides were not applied (Razaq *et al.* 2011). Besides sucking the sap and thereby devitalize the plant, the problem gets aggravated still further as many of them also serve as vector in transmitting the viral diseases. Most of the vegetable crops including cabbage, cauliflower, radish, cowpea, chillies, brinjal and field bean are highly infested with different aphid species throughout their growing period (Halder *et al.* 2011). Several insecticides are known to be effective and recommended for control of these aphids but their ill-effects in the context of environmental pollution, resurgence of other sucking pests and resistance to the pesticides, lethal effects to non-target organisms etc can not be ruled out. Hence, search for suitable and sustainable alternatives like bioagents highly specific to these pests is imperative.

*Diaeretiella rapae* (McIntosh) (Hymenoptera: Braconidae) is one of the promising and a common, solitary, cosmopolitan endoparasitoid of aphids on a number of host plants (Pramanik *et al.* 2012); the complete host list includes more than sixty aphid species, but only five to six host species are commonly attacked (Pike *et al.* 1999). However, knowledge about its host preference for different aphids in vegetable ecosystem is very scanty. Therefore, the current study focussed on identification of the most preferred aphid(s) under natural field conditions which might serve as potential host for the parasitoid and its population dynamics in the vegetable ecosystem. Such information generated can be taken advantage to devise the suitable ecofriendly management practices to control these aphids.

During *rabi* season of 2012-13, the incidence of *D. rapae* was observed among the different vegetable aphids

in and around the farm of Indian Institute Vegetable Research, Varanasi (82°52' E longitude and 25°12' N latitude), Uttar Pradesh, India. Five species of major vegetable aphids, viz. *Lipaphis erysimi* Kalt. infesting Indian mustard (*Brassica juncea* (L) Czern.), *Myzus persicae* (Sulzer) feeding on cauliflower (*Brassica oleracea* var botrytis L), *Aphis craccivora* Koch on field bean (*Lablab purpureus* (L.) Sweet), *Brevicoryne brassicae* (L) on cabbage (*Brassica oleracea* var capitata), *Aphis spiraecola* Patch on egg plant (*Solanum melongena* L) were selected for investigation under natural field conditions at the research farm of IIVR, Varanasi. The spirea aphid, *Aphis spiraecola* though a serious pest of temperate and tropical fruit crops, recently noticed in serious proportion on egg plants in and around Varanasi region was also observed for parasitisation. To determine the preference of *D. rapae* for different aphid species, infested samples from respective crops were collected periodically from field and kept separately for emergence of the parasitoid. The numbers of mummified and normal aphids were recorded. Per cent aphid parasitizations by *D. rapae* were periodically computed by number of mummified aphids per leaf/total number of aphids present on that leaf at weekly interval from January to April, 2013. For calculating parasitoid emergence, mummified aphids were collected along with their respective host plants and placed over moistened filter paper kept in petri plates (9 cm dia × 1.8 cm depth) and maintained under laboratory conditions at 28±2°C, 70-80% relative humidity and a photoperiod of 13:11 (L:D) hour and observed regularly for the emergence of adult *D. rapae*. The per cent emergence was worked out by the following formula:

$$\text{Emergence (\%)} = \frac{\text{Total number of } D. rapae \text{ adults emerged}}{\text{Total number of mummified aphids}} \times 100$$

In order to find out influence of prey sizes on parasitisation by *D. rapae* the sizes of the twenty aphids each of, viz. *M. persicae*, *B. brassicae* and *L. erysimi* feeding on cruciferous vegetables were mounted on microscope slides and its morphometrical studies of different appendages were measured under a stereomicroscope using

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Table 1 Morphometrical variations among different cruciferous aphids

Host aphids	Head Width (mm)	Thorax width (mm)	Abdomen		Total body length (mm)	Hind tibial length (mm)
			Length (mm)	Width (mm)		
<i>M. persicae</i>	0.64 <sup>c</sup> ±0.12	0.83 <sup>c</sup> ±0.15	1.34 <sup>b</sup> ±0.11	1.01 <sup>a</sup> ±0.10	2.81 <sup>b</sup> ±0.23	0.51 <sup>c</sup> ±0.05
<i>B. brassicae</i>	0.56 <sup>b</sup> ±0.08	0.75 <sup>b</sup> ±0.10	1.20 <sup>a</sup> ±0.13	0.97 <sup>a</sup> ±0.12	2.50 <sup>a</sup> ±0.22	0.39 <sup>b</sup> ±0.04
<i>L. erysimi</i>	0.51 <sup>a</sup> ±0.10	0.67 <sup>a</sup> ±0.05	1.11 <sup>a</sup> ±0.12	0.93 <sup>a</sup> ±0.11	2.29 <sup>a</sup> ±0.22	0.32 <sup>a</sup> ±0.04

Figures followed by same letter with in a column are not significantly different from each other at 5% level by DMRT

a micrometer with a readability of 0.01 mm and expressed as mean (±SE).

*D. rapae* is a polyphagous parasitoid that has been known to feeding on different species of aphids infesting major agricultural and horticultural crops. In our present study, it was found that among the five aphid species, the parasitoid was most active on aphids infesting cruciferous plants and least active on aphid infesting brinjal and field bean. The highest parasitization (59.33%) was observed in case of *M. persicae* feeding on cauliflower (Fig 2) followed by cabbage aphid, *B. brassicae* (51.50%) and mustard aphid, *L. erysimi* (46.50%). *A. spiraeicola* infesting brinjal had lowest preference as only 19.67% aphids were parasitized by *D. rapae* under field conditions followed by black bean aphid, *A. craccivora* (23.67%). Interestingly, the aphids feeding on cruciferous vegetables had higher rate of parasitization than the other crops indicating their preference towards cruciferous aphids. Our study was in accordance with the observation of Read *et al.* (1970) who reported that more *D. rapae* were found in crucifer patches than in non-crucifer habitats. Vaughn *et al.* (1996) found evidence of antennal receptors that respond specifically to the volatile compound allyl isothiocyanate released by damaged crucifer plants. According to Baer *et al.* (2004), consistent olfactory attraction to cruciferous plants suggests that crucifer-feeding aphids were an ancestral host species of *D. rapae*.

Periodical observation was taken on emergence of *D. rapae* adults from different mummified aphids kept under laboratory conditions. Significant variation was observed in their recovery from the different host aphids. Highest parasitoid emergence was recorded from *L. erysimi* (88%) followed by *B. brassicae* (81%) and *M. persicae* (80%) which were statistically on par. Among the three cruciferous

aphids, the parasitization was lowest in *L. erysimi* (46.5%) but the recovery of *D. rapae* adults was significantly higher than the other host aphids (Fig 2).

Observation on periodical incidence of *D. rapae* indicated that its occurrence initiated from the third week of January coinciding with the increasing temperature in Varanasi region, Uttar Pradesh. Its first incidence was observed on *M. persicae* (5.67% parasitization) infesting cauliflower and mustard aphid, *L. erysimi* (2.33%) and from February onwards its parasitization were recorded in almost all the vegetable aphids except *A. spiraeicola* feeding on brinjal indicating the preference of cruciferous aphids over other vegetable aphids by the *D. rapae* (Fig 1). The initiation of parasitization (3.57%) by *D. rapae* on *A. spiraeicola* was noted during third week of February and reached at its peak (19.67%) during last week of March. However, the peak period of parasitization by *D. rapae* on *M. persicae* (59.33%), *A. craccivora* (23.67%) and *A. spiraeicola* (19.63%) was last fortnight of March where as for *B. brassicae* the peak period of parasitisation (51.50%) was second week of April (Fig 1). Thus the major activity of this parasitoid was noted during March – April in this region. Incidence of *D. rapae* on *L. erysimi* was drastically reduced from April onwards as the rapeseed and mustard crops were in their maturity stage and/or harvested in this region. Comparatively lower mean temperature (<20°C) prevailed during December, 2012 and continued up to first fortnight of January, 2013 might be responsible for no incidence of this braconid endoparasitoid during this period and gradual increasing temperature up to March favoured their parasitization where as relatively higher temperature (>30°C) from April, 2013 onwards and lack of suitable aphid hosts again restrict their activity.

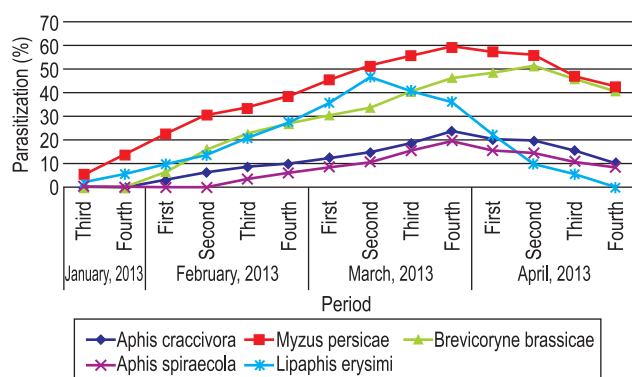


Fig 1 Incidence of *D. rapae* weekly parasitization different aphids species by *D. rapae* in cruciferous and other vegetables

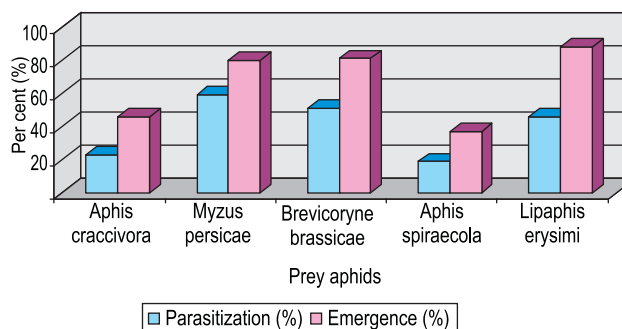


Fig 2 Parasitization and emergence of *Diaeretiella rapae* from different host aphids infesting different vegetable crops

Since, cruciferous aphids are highly preferred by this nymphal endoparasitoid, so morphological variations among these three aphids, viz. *M. persicae*, *B. brassicae* and *L. erysimi* were studied to find out their possible role in host selection/preference by *D. rapae*, if any. Morphometrical studies revealed that *M. persicae* had higher head ( $0.64 \pm 0.12$  mm), thorax ( $0.83 \pm 0.15$  mm) and abdomen size (length  $1.34 \pm 0.11$  mm and width  $1.01 \pm 0.10$  mm) resulting highest body length ( $2.81 \pm 0.23$  mm) than *B. brassicae* and *L. erysimi* (Table 1). Aphid's hind tibial length is known to be proportionate with their body size, so hind tibial lengths of three aphids were also measured. Maximum tibial length was recorded in *M. persicae* ( $0.51 \pm 0.05$  mm) and their descending order is as followed *M. persicae* > *B. brassicae* > *L. erysimi*. It has been observed from the foregoing observation that the parasitoid, in general, was most active on aphids infesting cruciferous crops and *M. persicae* on cauliflower in particular. Comparatively higher body size and tibial length of *M. persicae* recorded in present investigation might be responsible for its preference towards this parasitoid as was evident from maximum parasitization over other aphids which were prevalent simultaneously on one or the other host plants under natural conditions. Similarly, Harvey *et al.* (2004) reported that larger host size was often preferred by the parasitoid for oviposition and Islam and Copland (1997) concluded that size of host could also affect parasitoid's attack rate. In another study, He and Wang (2006) documented that host age or body size may reflect the quality of the hosts for parasitoid development. Kakakhel (2006) observed a strong relationship between hind tibial length of aphids and female parasitoids was existed under both field and pot experiments.

#### SUMMARY

Solitary, polyphagous, endoparasitoid *Diaeretiella rapae* (McIntosh) is considered as one of the prominent parasitoid of aphids on several host plants under natural field conditions. However, knowledge about its affinity and host preference towards different prey aphids is very scanty. So the present study on host preference of *D. rapae* revealed differential response for its parasitization to different aphid species infesting vegetable crops. It preferred maximum to cruciferous aphids, viz. *Myzus persicae* (59%) followed by *Brevicoryne brassicae* (51%) and *Lipaphis erysimi* (46%) than the other vegetable aphids like *Aphis craccivora* (23.67%) and *Aphis spiraeicola* (19.67%). Seasonal incidence of *D. rapae* also indicated that its first occurrence was observed on *M. persicae* (13.67%) and *L. erysimi* (5.67%) during second fortnight of January, 2013 whereas *A. spiraeicola* feeding on brinjal parasitized last indicating the preference of cruciferous aphids over other vegetable aphids. However, among the cruciferous aphids, highest parasitoid emergence was observed from *L. erysimi* (88%) followed by *B. brassicae* (81%) and *M. persicae* (80%).

Comparatively higher body size ( $2.81 \pm 0.23$  mm) and tibial length ( $0.51 \pm 0.05$  mm) of *M. persicae* by the parasitoid for its parasitization and variation in nutritional quality in *L. erysimi* as food substrate towards *D. rapae* for its higher emergence might be responsible for their preference over the other host aphids.

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