

## **Systematics, Distribution and Host Range of *Diaeretiella Rapae* (McIntosh) (Hymenoptera: Braconidae, Aphidiinae)**

**Rajendra Singh**

Department of Zoology  
D.D.U. Gorakhpur University  
Gorakhpur, U.P., India  
[rsingh\\_gpu@yahoo.com](mailto:rsingh_gpu@yahoo.com)

**Garima Singh**

Department of Zoology  
Rajasthan University  
Jaipur, India  
[garima\\_singh72@yahoo.in](mailto:garima_singh72@yahoo.in)

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**Abstract:** *Diaeretiella rapae* (McIntosh) (Hymenoptera: Braconidae, Aphidiinae) was described as *Aphidius rapae* by McIntosh in 1855. In 1960, Starý described a new genus *Diaeretiella* and put the species under it. A number of synonymy of *D. rapae* is listed herein. *D. rapae* is a polyphagous and exclusive aphid parasitoid. It parasitises about 98 species of the aphids infesting more than 180 plant species belonging to 43 plant families distributed in 87 countries throughout the world. However, the main hosts consist of *Brevicoryne brassicae* (Linn.), *Myzus persicae* (Sulzer), *Lipaphis erysimi* (Kalt.) and *Diuraphis noxia* (Kurdjumov). The food plants mainly include oleiferous and vegetable brassicas and cereal crops. The parasitoid has been used as a biocontrol agent against *D. noxia* infesting cereal crops.

**Keywords:** *Diaeretiella rapae*, systematic, distribution, host plants, aphids, cereal crops, brassica crops

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### **1. INTRODUCTION**

*Diaeretiella rapae* (McIntosh) (Hymenoptera: Braconidae, Aphidiinae) is a highly polyphagous parasitic wasp parasitising exclusively aphids (Homoptera: Aphididae) throughout the world infesting hundreds of plant species, both cultivated and wild (Table 1). *D. rapae* was reported as the most effective natural enemy against the cabbage aphid, *Brevicoryne brassicae* (Linn.) [1] and it has been observed to cause as high as 72% parasitism in the Netherlands [2] and 76% parasitism in Kenya [3]. In India, the rate of parasitism of mustard aphid, *Lipaphis erysimi* (Kaltenbach) on rape-seed mustard crop varied from 20% [4] to 51% [5] in Himachal Pradesh to 60-97% in Maharashtra [6]

Because of its widespread distribution and polyphagism, *D. rapae* is an important, naturally occurring parasitoid of several pest aphids on different crops worldwide [2-3, 6-12]. The earlier works on its biology, ecology and host killing efficiency, *D. rapae* has established its importance in controlling the mustard aphid [*L. erysimi*], cabbage aphid [*B. brassicae*], green peach aphid [*Myzus persicae* (Sulzer)] and RWA [*Diuraphis noxia* (Kurdjumov)] [2-3, 13-41]. The parasitoid was imported in USA from regions throughout the world to control the RWA [42-46] on wheat. Keeping in view the economic importance of the parasitoid, the present article reviews the informations available in literature regarding the taxonomy, nomenclature, distribution and aphid-host plant relations of *D. rapae*. All the generic names of aphids and plants were checked for their taxonomic validity using Aphid Species Files [<http://aphid.speciesfile.org>] for valid name of the aphids and GRIN [Germplasm Resources Information Network; <http://www.ars-grin.gov>], and ITIS [Integrated Information Taxonomic System; <http://www.itis.gov/>] for valid name of the plants.

## 2. TAXONOMY AND NOMENCLATURE OF DIAERETIELLA RAPAE

The parasitoid wasp was described as *Aphidius rapae* by McIntosh [47]. Several synonyms have since been used for the species [48]. Gahan [49] put the species under the genus *Diaeretus* Förster, 1862 and this name has been in general use until 1960. In this year, Starý [50] revised the genus *Diaeretus* and concluded that “the genus *Diaeretus* is monotypic including only the genotype *Aphidius leucopterus* Haliday, 1834 as it was originally stated by Förster in 1862”. He suggested that the other species, which were included by various authors in the genus *Diaeretus*, should be transferred to other genera of the family. Starý [50] described two new genera *Diaeretiella* Starý, 1960 and *Diaeretellus* Starý, 1960 that included most of the species kept under the genus *Diaeretus* Förster, 1862. *Diaeretiella* includes type species as *Aphidius rapae* McIntosh, 1855. Mackauer [51] refuted the view of Starý [50] and suggested that the female genitalia in *rapae* are typical to the genus *Aphidius* and concluded that the species should be included in the genus *Aphidius* Nees, 1818 under a subgenus *Diaeretiella* Starý, 1960 as *Aphidius (Diaeretiella) rapae* (McIntosh, 1855). In past, while describing its biology Hafez [2] agreed with the view of Mackauer [51]. Apart of the above discussion, the taxonomic details of *D. rapae* have also been discussed in recent past [52-54]. Following are the accepted synonymy of *D. rapae*:

- = *Aphidius affinis* Quilis, 1931, *EOS, Revista Espanola de Entomologia*, 7: 48-50, Spain
- = *Aphidius brassicae* Marshall, 1896 in Andre, *Spec. Hym. Eur. et d'Alg.*, 5, 597-598, England
- = *Aphidius rapae* Curtis, 1855, in McIntosh's *Book of the Garden*, 2, 194.
- = *Aphidius rapae* McIntosh, 1855 (Species - Type), *Book of the Garden*, 2, 194.
- = *Aphidius vulgaris* Bouche, 1834, *Naturgeschichte der Insekten, besonders in Hinsicht ihrer ersten Zustände als Larven und Puppen*. Berlin. 1-216, Italy.
- = *Diaeretus croaticus* Quilis, 1934, *EOS, Revista Espanola de Entomologia*. 10:5-19, Croatia.
- = *Diaeretus (Aphidius) obsoletus* Kurdjumov, 1913, *Rev. Russe Ent. St. Petersburg*, 13, 25-26, Ukraine.
- = *Diaeretus aphidum* Mukerji & Chatterjee, 1950, *Proc. R. Ent. Soc. Lond. (B)*, 19, 4-6, Pakistan.
- = *Diaeretus californicus* Baker, 1909, *Journal of Entomology*, 1, 22-25, USA.
- = *Diaeretus chenopodii* Förster, 1867: Kirchner, 1867, *Catalogus Hymenopterorum Europae. Vindobonae*, 125 (*nomen nudum*)
- = *Diaeretus napus* Quilis, 1931, *EOS, Revista Espanola de Entomologia*, 7, 25-84, Spain. Quilis, 1934, *EOS, Revista Espanola de Entomologia*, 10, 6-7, Czechoslovakia, Yugoslavia.
- = *Diaeretus nipponensis* Viereck, 1911, *Proceedings of the United States National Museum.*, 40, 182, Japan. Takahashi, 1925, *Dept. Agric. Govt. Res. Instt., Formosa Report*, 16, 1-74, Taiwan.
- = *Diaeretus plesiorapae* Blanchard, 1940, *Rev. Chil. Hist. Nat. Santiago*, 44, 45-48, Argentina.
- = *Diaeretus ferruginipes* Ashmead, 1890, *Insect Life*, 3:57-61, USA.
- = *Lipolexis chenopodiaphidis* Ashmead, 1888 (1889), *Proc. U.S. Nat. Mus.*, 11, 671, USA.
- = *Lysiphlebus crawfordi* Rohwer, 1909, *Transactions of the American Entomological Society*, 35:99-136, USA.
- = *Misaphidus halticae* Rondani, 1877, *Bollettino della Societa Entomologica Italiana*, 9:166-206, Italy.
- = *Trioxys piceus* Cresson, 1880, *USDA Annual Report for 1879*, 260, USA.
- = *Diaeretiella aphidum* (Mukerji & Chatterjee, 1950)
- = *Diaeretiella brassicae* (Marshall, 1896)

## Systematics, Distribution and Host Range of *Diaeretiella Rapae* (Mcintosh) (Hymenoptera: Braconidae, Aphidiinae)

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- = *Diaeretiella californicus* (Baker, 1909)
- = *Diaeretiella chenopodiaphidis* (Ashmead, 1889):
- = *Diaeretiella chenopodii* (Förster, 1867)
- = *Diaeretiella crawfordi* (Rohwer, 1909)
- = *Diaeretiella croaticus* (Quilis, 1934)
- = *Diaeretiella ferruginipes* (Ashmead, 1890)
- = *Diaeretiella halticae* (Rondani, 1877)
- = *Diaeretiella napus* (Quilis, 1931)
- = *Diaeretiella nipponensis* (Viereck, 1911)
- = *Diaeretiella obsoletus* (Kurdjumov, 1913)
- = *Diaeretiella piceus* (Cresson, 1879)
- = *Diaeretiella plesiorapae* (Blanchard, 1940)
- = *Diaeretiella rapae* (Curtis, 1855)
- = *Diaeretus chenopodiaphidis* (Ashmead, 1889): Timberlake 1918, *Proc. Haw. Ent.Soc.*, 3(5): 401.
- = *Diaeretus rapae* (Curtis, 1860): Gahan 1910, *Proc. Ent. Soc. Wash.*, 12:180.
- = *Diaeretiella vulgaris* (Bouche, 1834)

Recently, *D. rapae* was redescribed with morphological variability of several Indian populations [54-55].

### 3. DISTRIBUTION AND HOST RANGE OF DIAERETIELLA RAPAE

The origin of *D. rapae* is considered to be of Western Palaearctic [56] and at present it is almost cosmopolitan in distribution. It was recorded from about 87 countries of all continents except Antarctica (Table 1). In India, it was first recorded on *B. brassicae* [57] and then on *L. erysimi* [58]. Sethumadhvan and Dharmadhikari [59] studied its distribution in India. At present, it has been reported from almost all states of India where cabbage and mustard crops are cultivated (Table 2).

The parasitoid, *D. rapae* parasitises about 98 species of the aphids infesting more than 180 plant species belonging to 43 plant families distributed in 87 countries throughout the world (Table 1). However, the main hosts consist of *B. brassicae*, *M. persicae*, *L. erysimi* and *D. noxia*. The food plants include mainly oleiferous and vegetable brassicas and cereal crops. In India, fortunately, the notorious cereal pest *D. noxia* is not recorded so far. In the north eastern Uttar Pradesh *D. rapae* parasitises the aphids infesting several oleiferous crops such as *Brassica juncea* L., *Brassica rapa* subsp. *oleifera* (DC.) Metzg. and *Brassica nigra* (L.) W. D. J. Koch and vegetables such as *Raphanus sativus* L., *Brassica napus* L., *Brassica oleracea* var. *capitata* L., *Brassica oleracea* var. *botrytis* L., *Brassica oleracea* var. *gongyloides* L. etc. [60]. [1] (1957) In England [1] and in Germany [14] it was observed mainly parasitising on *B. brassicae*. However, in the Netherland it was observed parasitising on *M. persicae* in the field in a greater proportion than other species of aphidiine parasitoids when they infest brassica crops, however, a significant preference for *B. brassicae* was recorded [2]. Therefore, in Europe, *B. brassicae* and *M. persicae* both serve as important hosts for the parasitoid on brassica crops. In the last few decades, the parasitoid was found heavily parasitising RWA, *D. noxia* in European, American and to some extent to African countries (Table 1). However, little is known about crossing between different lines and strains, or about populations switching between different host species. Gonzalez *et al.* [43] reared *D. rapae* in USA that were obtained from 7 countries (Russia, Pakistan, Syria, Jordon, Spain, Yugoslavia and South Africa) but only the Pakistan strain merit first. RWA is not reported from India, although it has been recorded from Pakistan [61].

**Table1.** Distribution and host range of *Diaeretiella rapae* (Aphid species/Host plant species/Country/References)

**1. *Acyrtosiphon kondoi* Shinji**

- *Medicago sativa* L. (Fabaceae): Brazil [62]

**2. *Acyrtosiphon lactucae* (Passerini)**

- *Lactuca serriola* L. (Asteraceae): Canada [63], North west USA [64]

**3. *Acyrtosiphon pisum* (Harris)**

- *Medicago sativa* L. (Fabaceae) : Brazil [62]
- *Melilotus officinalis* (L.) Pall. (Fabaceae) : North west USA [64]
- *Melilotus* sp. (Fabaceae) : North west USA [64]

**4. *Amegosiphon platicaudum* (Narzikulov)**

- *Berberis thunbergia* DC. (Berberidaceae) : Iran [65]

**5. *Anuraphis* sp.**

- *Anchusa* sp. (Boraginaceae) : Central Asia [66]

**6. *Aphis cadiva* Walker**

- *Silene vulgaris* (Moench) Garcke (Caryophyllaceae): Montenegro [67]

**7. *Aphis craccivora* Koch**

- *Atriplex* sp. (Amaranthaceae): Iran [68,69]
- *Capsella* sp. (Brassicaceae): Tajikistan [70]
- *Capsella bursa-pastoris* (L.) Medik. (Brassicaceae): North west USA [64], Washington, USA [63]
- *Cardaria draba* L. (Brassicaceae): Iran [68, 69]
- *Glycyrrhiza glabra* L. (Fabaceae): Iran [65, 68-69, 71-72]
- *Glycyrrhiza* sp. (Fabaceae): Canada [73], Tajikistan [70]
- *Gossypium* sp. (Malvaceae): India [74], Tajikistan [70]
- *Lepidium draba* L. (Brassicaceae): Greece [67]
- *Solanum tuberosum* L. (Solanaceae): India [75]
- *Vicia faba* L. (Fabaceae): Egypt [41]

**8. *Aphis fabae* Scopoli**

- *Cestrum fasciculatum* (Schltdl.) Miers (Solanaceae) : India [76]
- *Chenopodium album* L. (Chenopodiaceae) : Canada [77], Pakistan [78- 80], Washington, USA [63]
- *Chenopodium* sp. (Chenopodiaceae) : Czech Republic [81]
- *Cirsium arvense* (L.) Scop. (Asteraceae) : North west USA [64]
- *Lactuca sativa* L. (Asteraceae) : Iran [68,69]
- *Phaseolus vulgaris* L. (Fabaceae) : Iran [68,69]
- *Spinacia oleracea* L. (Amaranthaceae) : Iran [68,69]

**9. *Aphis fabae solanella* Theobald**

- *Solanum melongena* L. (Solanaceae): Iran [68,69]

**10. *Aphis fabae cirsiacanthoidis* Scopoli**

- *Galium* L. (Rubiaceae) : Spain [82,83]

**11. *Aphis farinosa* Canelin**

- Host unknown : Central Asia [66]

**12. *Aphis gossypii* Glover**

- Host unknown : Czech Republic [84], Tajikistan [85]
- *Capsicum annuum* L. (Solanaceae) : Tunisia [86]
- *Citrus aurantium* L. (Rutaceae) : Greece [67]
- *Citrus deliciosa* Ten. (Rutaceae) : Greece [67]
- *Cucumis sativus* L. (Cucurbitaceae) : Iran [68,69,87], Pakistan [88]
- Cucurbits : Florida, USA [89]
- *Eucalyptus camaldulensis* Dehnh. (Myrtaceae) : Algeria [90]
- *Gossypium hirsutum* L. (Malvaceae) : Oklahoma, USA [91,92]
- *Hibiscus rosa-sinensis* L. (Malvaceae) : Algeria [90], Pakistan [80]
- *Hibiscus syriacus* L. (Malvaceae) : Italy [93]
- *Lactuca sativa* L. (Asteraceae) : Tunisia [86]
- *Leucas aspera* (Willd.) Link (Lamiaceae) : India [59]
- *Papaver somniferum* L. (Papaveraceae) : Pakistan [80]
- *Pistacia lentiscus* L. (Anacardiaceae) : Algeria [90]
- *Salsola* sp. (Amaranthaceae) : Iran [68,69]
- *Solanum melongena* L. (Solanaceae) : Cuba [94,95], Pakistan [80]
- *Solanum tuberosum* L. (Solanaceae) : Brazil [96], Japan [97,98]

**13. *Aphis helianthi* Monell**

- *Helianthus annuus* L. (Asteraceae) : Oklahoma, USA [91,92]
- *Ranunculus* sp. (Ranunculaceae) : North west USA [64]

**14. *Aphis illinoisensis* Shimer**

- *Vitis Vinifera* L. (Vitaceae) : Egypt [99]

**15. *Aphis longisetosa* Basu**

- *Punica granatum* L. (Punicaceae) : India [100]
- *Rubus ellipticus* Sm. (Rosaceae) : India [101]

**16. *Aphis nasturtii* Kaltenbach**

- *Solanum tuberosum* L. (Solanaceae) : Canada [77], Maine, USA [102,103]

**17. *Aphis nerii* B. de Fonsc.**

- Host unknown : Egypt [41]
- *Brassica* sp. (Brassicaceae) : USA [104]
- *Nerium oleander* L. (Apocynaceae) : Greece [105]

**18. *Aphis nr. fabae* Scopoli**

- *Spiranthes romanzoffiana* Cham. (Orchidaceae) : North west USA [64]

**19. *Aphis pomi* de Geer**

- *Crataegus* sp. (Rosaceae) : Tajikistan [66,70]

**20. *Aphis punicae* Passerini**

- *Punica granatum* L. (Punicaceae) : Iran [(65]

**21. *Aphis rumicis* Linnaeus**

- *Chenopodium album* L. (Chenopodiaceae) : Canada [77]

**22. *Aphis spiraecola* Patch**

- *Brassica rapa* subsp. *oleifera* (DC.) Metzg. (Brassicaceae) : Costa Rica [106]
- *Viburnum tinus* L. (Adoxaceae) : Greece [105]

**23. *Aphis umbrella* (Börner)**

- Host unknown : Mediterranean area [52], Greece [105]
- *Malva sylvestris* L. (Malvaceae) : Iran [68,69]

**24. *Aphis* sp.**

- *Caspicum annuum* L. (Solanaceae) : Japan [107]

**25. *Aspidaphis adjuvans* (Walker)**

- *Polygonum equisetiforme* Sm. (Polygonaceae) : Israel [108]

**26. *Aulacorthum solani* (Kaltenbach)**

- *Capsicum annuum* L. (Solanaceae) : British Columbia [109]
- *Malva neglecta* Mallr. (Malvaceae) : Greece [105]
- *Myosoton aquaticum* (L.) Moench (Caryophyllaceae) : Serbia [53]

**27. *Brachycaudus amygdalinus* (Schouteden)**

- Host unknown : Iran [66,110]
- *Polygonum* sp. (Polygonaceae) : Canada [52], Iraq [111]
- *Prunus dulcis* (Mill.) D. A. Webb (Rosaceae) : Greece [105]
- *Prunus* sp. (Rosaceae) : Canada [52], Iraq [111]

**28. *Brachycaudus cardui* (Linn.)**

- Host unknown : Iran [66,110]
- *Calendula arvensis* L. (Asteraceae) : Greece [105]
- *Carduus australis* L.f. (Asteraceae) : Greece [105]
- *Carduus crispus* L. (Asteraceae) : Greece [105]
- *Carduus pycnocephalus* L. (Asteraceae) : Greece [105]
- *Carduus* sp. (Asteraceae) : Washington, USA [63]
- *Onopordum acanthium* L. (Asteraceae) : North west USA [64]
- *Onopordum* sp. (Asteraceae) : Washington, USA [63]
- *Prunus* sp. (Rosaceae) : Canada [66]

**29. *Brachycaudus helichrysi* (Kaltenbach)**

- *Amsinckia* sp. (Boraginaceae) : Mediterranean area [52], North west USA [64]
- *Anthemis arvensis* L. (Asteraceae) : North west USA [64]
- *Anthemis cotula* L. (Asteraceae) : North west USA [64]
- *Anthemis* sp. (Asteraceae) : Mediterranean area [52], Washington, USA [63]
- *Carduus crispus* (Asteraceae) : Greece [105]
- *Carlina corymbosa* subsp. *graeca* (Heldr. & Sart.) Boiss (Asteraceae) : Greece [105]
- *Cirsium creticum* (Lam.) D'Urv. (Asteraceae) : Greece [105]
- *Cirsium tuberosum* (L.) All. (Asteraceae) : Greece [105]
- *Cirsium vulgare* (Savi) Ten. (Asteraceae) : Greece [105]
- *Conyza canadensis* (L.) Cronquist (Asteraceae) : North west USA [64]
- *Conyza* sp. (Asteraceae) : Europe [112,113]
- *Glebionis coronaria* (L.) Cass. ex Spach (Asteraceae) : Greece [105]
- *Heliotropium* sp. (Boraginaceae) : Pakistan [61]
- *Leucanthemella serotina* (L.) Tzvelev (Asteraceae) : Greece [105]
- *Leucanthemum vulgare* Lam. (Asteraceae) : Greece [105]
- *Melilotus sulcatus* Desf. (Fabaceae) : Greece [105]
- *Onopordum illyricum* L. (Asteraceae) : Greece [105]
- *Prunus dulcis* (Mill.) D. A. Webb (Rosaceae) : India [114,115]
- *Prunus persica* (L.) Batsch (Rosaceae) [307]
- *Rumex acetosella* L. (Polygonaceae) : Serbia [105]
- *Sonchus* sp. (Asteraceae) : India [116], North west USA [64]
- *Stellaria media* (L.) Vill. (Caryophyllaceae) : Greece [105]

**30. *Brachycaudus rumexicolens* (Patch)**

- Host unknown : France [117]
- *Rumex acetosella* L. (Polygonaceae) : Iraq [111]
- *Rumex acetosella* L. (Polygonaceae) : Mediterranean area [52,112]

**31. *Brachycaudus tragopogonis* (Kaltenbach)**

- *Tragopogon dubius* Scop. (Asteraceae) : Canada [63], North west USA [64]

**32. *Brachycaudus* sp.**

- Host unknown : Georgia [52]

**33. *Brachycorynella asparagi* (Mordvilko)**

- *Asparagus officinalis* L. (Asparagaceae) : Canada [63], Czech Republic [118], Michigan, USA [119], New Jersey, USA [120], North west USA [64], Switzerland [Nechols,1995]

**34. *Braggia* sp.**

- *Eriogonum elatum* Dougl. ex Benth. (Polygonaceae) : North west USA [64]
- *Eriogonum* sp. (Polygonaceae) : Washington, USA [63]

**35. *Brevicoryne barbareae* Nevsky**

- *Barbarea vulgaris* W.T. Aiton (Brassicaceae) : Central Asia [66]

**36. *Brevicoryne brassicae* (Linnaeus)**

- Host unknown : Algeria [83,122], Corsica [117], Cyprus [83], Georgia [52], Iraq [121], Italy [123,124,125], Lebanon [126], Morocco [122,83], Sicily [123]
- *Asparagus officinalis* L. (Asparagaceae) : Nepal [139]
- *Brassica* sp. (Brassicaceae) : Guatemala [127]
- *Brassica juncea* (L.) Czern. (Brassicaceae) : Iran [128,68,129]
- *Brassica napus* L. (Brassicaceae) : Azerbaijan [130], Brazil [131], Czech Republic [81], Iran [65,66,68,72,87,110,128,132-135]
- *Brassica napus* L. subsp. *napus* (Brassicaceae) : Australia [56,136]
- *Brassica nigra* L. (Brassicaceae) : India [100], North west USA [64]
- *Brassica oleracea* L. (Brassicaceae) : Argentina [137], Colorado, USA [138], India [100], Iran [68,128], Oklahoma, USA [91,92], North west USA [64], Pakistan [78,128,139], Poland [140], Porto Santo Island, Portugal [141], Portugal [142], Serbia [105]
- *Brassica oleracea* var. *botrytis* L. (Brassicaceae) : Greece [105], India [144], Pakistan [143], Slovenia [145]
- *Brassica oleracea* var. *capitata* L. (Brassicaceae) : Australia [56], Bohemia [138], Bulgaria [146,147], Canada [148], China [24], Denmark [149], Egypt [27,41], Finland [150], France [151-153], Germany [154,155], Greece [105], Hawaii [156], India [144], Iran [157-160], Israel [108], Jordan [161], Kenya [3], Lithuania [162,163], Mexico [164], Moravia [138], Netherlands [2], New Zealand [38], North west USA [64], Nigeria [15], Peru [165], Peru [165], Slovenia [145], Slovenia [145], Spain [166,138], Tajikistan [167], Tennessee, USA [9], Turkey [168-170], Ukraine [171,172]
- *Brassica oleracea* var. *gemmifera* DC. (Brassicaceae) : Germany [173], Slovenia [145], England [174], England [175]
- *Brassica oleracea* var. *italica* Plenck (Brassicaceae) : Slovenia [145]
- *Brassica oleracea* var. *viridis* L. (Brassicaceae) : Brazil [176-179], North west USA [64], Turkey [170]
- *Brassica rapa* L. (Brassicaceae) : Iran [68], Nepal [139]
- *Brassica rapa* subsp. *oleifera* (DC.) Metzg. (Brassicaceae) : Costa Rica [106], India [57,180], Nepal [139], Pakistan [139,181,182]
- *Brassica* sp. (Brassicaceae) : Brazil [183,131], Bulgaria [146], Cape Verde Islands [184], Central Asia [66], Chile [185-187], Cuba [94,95,188], Czech Republic [112,113,189], India [76,190,191,192,60], Japan [107], La Reunion [193], Lebanon [194], Moldova [195], Massachusetts, USA [196], Mediterranean area [52], Ohio, USA [48], Pakistan [80,197], Poland [198], Taiwan [199], Tajikistan [167], Uruguay [200], Uzbekistan [138], Washington, USA [63,138]
- *Descurainia sophia* (L.) Webb ex Prantl. (Brassicaceae) : Iran [68,133], North west USA [64]
- *Eruca vesicaria* subsp. *sativa* (Mill.) Thell.: Slovenia [145]
- *Erysimum* sp. (Brassicaceae) : North west USA [64]
- *Fortuynia bungei* Boiss (Brassicaceae) : Iran [68]
- *Lepidium virginicum* L. (Brassicaceae) : Brazil [131]



- *Malva neglecta* Mallr. (Malvaceae) : North west USA [64]
- *Nasturtium officinale* W. T. Aiton (Brassicaceae) : Brazil [167]
- *Raphanus raphanistrum* L. (Brassicaceae) : Brazil [167]
- *Raphanus sativus* L. (Brassicaceae) : India [100,115], Serbia [105], Turkey [168]
- *Ruta graveolens* L. (Rutaceae) : Serbia [105]
- *Sinapis arvensis* L. (Brassicaceae) : Czech Republic [81]
- *Sisymbrium altissimum* L. (Brassicaceae) : North west USA [64]
- *Sisymbrium sophia* L. (Brassicaceae) : India [191]

**37. *Capitophorus inulae* (Passerini)**

- *Dittrichia viscosa* (L.) Greuter (Asteraceae) : Israel [108]

**38. *Capitophorus* sp. :**

- Host unknown : Maine, USA [102]

**39. *Cavariella salicicola* (Matsumura)**

- *Salix eriocarpa* Fr. & Sav. : Japan [107]

**40. *Ceratovacuna lanigera* Zehntner**

- *Saccharum officinarum* L. (Poaceae) : India [201]

**41. *Chromaphis juglandicola* (Kaltenbach)**

- *Carya illinoensis* (Wangenh.) K. Koch : Turkey [202]

**42. *Cryptomyzus galeopsidis* (Kaltenbach)**

- Host unknown : Maine, USA [102,103]

**43. *Diuraphis muehlei* (Börner)**

- Host unknown : Canary Islands [203]

**44. *Diuraphis noxia* (Kurdjumov)**

- Host unknown : Algeria [52]
- *Aegilops cylindrical* Host (Poaceae) : North west USA [64]
- *Agropyron cristatum* (L.) Gaertn. (Poaceae) : North west USA [64]
- *Bromus tectorum* L. (Poaceae) : Iran [65,204]
- *Hordeum* sp. (Poaceae) : Macedonia [105]
- *Hordeum vulgare* L. (Poaceae) : Colorado, USA [8], Czech Republic [81], Iran 65], Italy [205], North west USA [64], Russia [206], Serbia [105], USA [91,92]
- *Triticum aestivum* L. (Poaceae) : Afghanistan [29,30], Angola [207], California, USA [44], Caucasus [138], Chile [185], China [208,138], Colorado, USA [209], Colorado, USA [210], Colorado, USA [8], Egypt [211], France [11], Iran [44,65,68,69,110,134,212-216], Italy [205], Jordan [138], Kazakhstan [138], Kenya [207], Kyrgyzstan [138], Mexico [217], Morocco [138], Nebraska, USA [209], North west USA [64], Pakistan [61], Pennsylvania [138], Russia [206], Saudi Arabia [205], Slovakia [218], SouthAfrica [207], Syria [43,219], Texas, USA [23,220], USA [7,12,104,221], Wyoming, USA [209]

**45. *Dysaphis plantaginea* (Passerini)**

- *Malus domestica* Borkh. (Rosaceae) : North west USA [64], USA [63]

**46. *Dysaphis tulipae* (Boyer de Fonsc.)**

- *Liriodendron tulipifera* L. (Magnoliaceae) : Algeria [52], Egypt [52], Libya [52] Morocco [52]

**47. *Hayhurstia atriplicis* (Linn.)**

- Host unknown : Algeria [52], Azerbaijan [222]
- *Atriplex* sp. (Amaranthaceae) : Czech Republic [189], Israel [108], Italy [123], Mexico [223]
- *Chenopodium album* L. (Chenopodiaceae): India [114], Iran [65,66,110,134], North west USA [64]. Serbia [105]
- *Chenopodium* sp. (Chenopodiaceae) : Czech Republic [81]
- *Suaeda* sp. (Amaranthaceae) : USA [63]

**48. *Hyadaphis foeniculi* (Passerini)**

- Host unknown : England [224]
- *Foeniculum vulgare* (Miller) (Apiaceae) : Argentina [225]
- *Lonicera* sp. (Caprifoliaceae): Serbia [105]

**49. *Hyadaphis tataricae* (Aizenberg)**

- *Lonicera tatarica* L. (Caprifoliaceae) : Turkey [171]

**50. *Hyalopterus pruni* (Geoffroy)**

- Host unknown : Iran [226,227]
- *Prunus persica* (L.) Batsch (Rosaceae) : Pakistan [80]
- Reed (Poaceae) : Egypt [41]

**51. *Hysteroneura setariae* (Thomas)**

- Host unknown : India [116]

**52. *Illinoia carylina* (Davidson)**

- *Aquilegia* sp. (Ranunculaceae) : North west USA [64]

**53. *Illinoia liriodendra* (Monell)**

- *Liriodendron tulipifera* L. (Magnoliaceae) : California, USA [228]

**54. *Lachnus swirskii persicae* Davatchi, H.R.L. & Remaudière**

- *Prunus persica* (L.) Batsch (Rosaceae) : Baluchistan [229]

**55. *Lipaphis erysimi* (Kaltenbach)**

- Host unknown : Iran [66,87,110]
- *Brassica juncea* (L.) Czern. : India [230,231]
- *Brassica napus* L. (Brassicaceae) : India [232], Brazil [131], North west USA [64], Pakistan [233]
- *Brassica nigra* (L.) W. D. J. Koch (Brassicaceae) : India [74,76]
- *Brassica oleracea* L. (Brassicaceae) : India [234]
- *Brassica oleracea* var. *botrytis* L. (Brassicaceae) : India [115]
- *Brassica oleracea* var. *capitata* subsp. *europaea* Lizg. (Brassicaceae) : La Reunion [193]
- *Brassica oleracea* var. *viridis* L. (Brassicaceae) : Brazil [235,236]

- *Brassica rapa* L. (Brassicaceae) : La Reunion [193,237]
- *Brassica rapa* subsp. *oleifera* (DC.) Metzg. (Brassicaceae) : Cuba [95,127,238], India [58,60,180,239,240], Nepal [241], Pakistan [80]
- *Brassica rapa* subsp. *rapa* L. (Brassicaceae) : England [25]
- *Brassica rapa* subsp. *trilocularis* (Roxb.) Hanelt (Brassicaceae) : Tennessee, USA [9]
- *Brassica* sp. (Brassicaceae) : Central Asia [66], China [241,242], Formosa [243], Maldiva [195], Mexico [223], Ohio, USA [48], Oklahoma, USA [91,92], Pakistan [78,181,244,245], Taiwan [199], Washington, USA [63]
- *Capsella bursa-pastoris* (L.) Medik. (Brassicaceae) : North west USA [64]
- *Erysimum cheiri* (L.) Crantz (Brassicaceae) : La Reunion [193]
- *Erysimum graecum* Boiss. & Heldr. (Brassicaceae) : Greece [105]
- *Erysimum* sp. (Brassicaceae) : Washington, USA [63]
- *Lepidium didymum* L. (Brassicaceae) : La Reunion [193]
- *Nasturtium officinale* W. T. Aiton (Brassicaceae): Brazil [235.]
- *Raphanus raphanistrum* L. (Brassicaceae) : Brazil [235]
- *Sisymbrium orientale* L. (Brassicaceae) : Greece [105]
- *Trifolium alexandrinum* L. (Fabaceae) : Iran [135]

**56. *Lipaphis fritzmuelleri* Börner**

- *Sisymbrium* sp. (Brassicaceae) : Czech Republic [112], Slovakia [112]

**57. *Lipaphis lepidii* (Nevsky)**

- *Cardaria draba* L. (Brassicaceae) : Iran [65,87,110,133]
- *Lepidium chalepense* L. (Brassicaceae) : Central Asia [66], Pakistan [246]
- *Lepidium draba* L. (Brassicaceae) : Greece [105]

**58. *Lipaphis pseudobrassicae* Davis**

- *Brassica napus* L. (Brassicaceae) : Iran [68,69]
- *Trogopogon graminifolia* DC. (Asteraceae) : Iran [68,69]
- *Brassica rapa* subsp. *oleifera* (DC.) Metzg. (Brassicaceae) : Pakistan [246]

**59. *Lipaphis rosssi* Börner**

- *Arabis hirsuta* (L.) Scop. (Brassicaceae) : Central Asia [112]

**60. *Lipaphis* sp.**

- *Diploaxis* sp. (Brassicaceae) : Malta [247]

**61. *Macrosiphoniella pseudoartemisiae* Shinji**

- *Artemisia* sp. (Asteraceae) : India [101]
- *Brassica* sp. (Brassicaceae) : India [100]

**62. *Macrosiphoniella sanborni* (Gillette) : Mediterranean area [52], Iraq [121]**

**63. *Macrosiphum euphorbiae* (Thomas) : Colombia [248]**

- *Avena sativa* L. (Poaceae) : Uruguay [200]

- *Chamaenerion angustifolium* (L.) Scop. subsp. *angustifolium* (Onagraceae) : Washington, USA [63]
- *Chamerion angustifolium* (L.) Holub (Onagraceae) : North west USA [64]
- *Lomatium nudicaule* (Pursh) J. M. Coult. & Rose (Apiaceae) : North west USA [64]
- *Solanum tuberosum* L. (Solanaceae) : Brazil [98,249]
- *Solanum* sp. (Solanaceae) : India [250], North west USA [64]
- *Triticum aestivum* L. (Poaceae) : Uruguay [200]

**64. *Macrosiphum* sp.**

- *Triticum aestivum* L. (Poaceae) : North west USA [64]

**65. *Mariaella lambersi* Szelegiewicz**

- Host unknown : Iran [66,110]
- *Myricaria germanica* (L.) Desv. : Central Asia [66]

**66. *Melanaphis donacis* (Passerini)**

- Host unknown : Iraq [111], Mediterranean area [52], Morocco [251]
- *Arundo donax* L. (Poaceae) : Malta [247]

**67. *Metopolophium dirhodum* (Walker): Iran [216]**

- Cereal crops (Poaceae) : Poland [252]
- Grass (Poaceae) : India [100,101]
- *Triticum aestivum* L. (Poaceae) : Brazil [253-255]

**68. *Microlophium carnosum* (Buckton)**

- Host unknown : France [256]

**69. *Myzus beybienkoi* (Narzikulov)**

- Host unknown : Iran [66,110]
- *Fraxinus sogdiana* Bunge (Oleaceae) : Central Asia [66]

**70. *Myzus cerasi* (Fabricius)**

- *Cerasus araxiana* (Da) (Rosaceae) : Central Asia [66]

**71. *Myzus certus* (Walker)**

- *Brassica* sp. (Brassicaceae) : China [242]
- *Stellaria* sp. (Caryophyllaceae) : Canada [203], Central Europe [257], Iraq [111], Maine, USA [258]

**72. *Myzus langei* (Börner)**

- Host unknown : Czech Republic [112]
- *Galium* spp. (Rubiaceae) : Central Europe [259]

**73. *Myzus ornatus* Laing**

- Host unknown : Chile [185]

**74. *Myzus persicae* (Sulzer)**

- Host unknown : Corsica [52], Georgia [222,260], Israel [261], Italy [83,125], La Reunion [193]
- *Brassica* sp. (Brassicaceae) : Nicaragua [262]

**Systematics, Distribution and Host Range of *Diaeretiella Rapae* (Mcintosh) (Hymenoptera: Braconidae, Aphidiinae)**

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- *Amsinckia menziesii* (Lehm.) A. Nelson & J.F. Macbr. (Boraginaceae) : North west USA [64]
- *Antirrhinum majus* L. (Plantaginaceae) : Greece [105]
- *Brassica napus* L. (Brassicaceae) : Pakistan [80]
- *Brassica nigra* (L.) W. D. J. Koch (Brassicaceae) : Greece [105]
- *Brassica oleracea* L. (Brassicaceae) : El Salvador [149], North west USA [64], Pakistan [80, 263]
- *Brassica oleracea* var. *botrytis* L. (Brassicaceae) : India [264,265]
- *Brassica oleracea* var. *capitata* L. (Brassicaceae) : Florida, USA [89], India [265]
- *Brassica oleracea* var. *gemmifera* DC. (Brassicaceae) : England [166]
- *Brassica oleracea* var. *viridis* L. (Brassicaceae) : Austria [149], Brazil [98,236], Ohio, USA [266]
- *Brassica rapa* subsp. *oleifera* (DC.) Metzg. (Brassicaceae) : Pakistan [80,143], Costa Rica [106]
- *Brassica rapa* subsp. *rapa* L. (Brassicaceae) : England [25]
- *Brassica rapa* subsp. *trilocularis* (Roxb.) Hanelt (Brassicaceae) : Tennessee, USA [9]
- *Brassica* sp. (Brassicaceae) : Cape Verde Islands [184], Central Asia [66], Chile [185], China [241], Cuba [95,238], Czech Republic [112,113], Hawaii islands [156, 267], Japan [268], Maldiva [195], Mexico [223], Taiwan [199], Uruguay [200], Washington, USA [63]
- *Capsella bursa-pastoris* (L.) Medik. (Brassicaceae) : Iran [65,66,68,69,72,87,110, 226,227, 269, 270]
- *Capsella* sp. (Brassicaceae) : Pakistan [61]
- *Capsicum annuum* L. (Solanaceae) : Brazil [98], British Columbia, USA [109], Greece [105]
- *Cardamine debilis* D. Don (Brassicaceae) : India [74]
- *Carthamus tinctorius* L. (Asteraceae) : North west USA [64]
- Cereals and vegetables : Argentina [271]
- *Chenopodium album* L. (Chenopodiaceae) : North west USA [64]
- *Chrysanthemum ×morifolium* Ramat. (Asteraceae) : Brazil [98]
- *Chrysanthemum* sp. (Asteraceae) : North west USA [64]
- *Citrus aurantium* L. (Rutaceae) : Greece [105]
- *Citrus sinensis* (L.) Osbeck : Greece [105]
- *Citrus* sp. (Rutaceae) : Greece [272]
- *Dysphania botrys* (L.) Mosyakin & Clemants (Chenopodiaceae) : Pakistan [61]
- *Euphorbia helioscopia* L. (Euphorbiaceae) : Pakistan [80]
- *Glebionis coronaria* (L.) Cass. ex Spach) (Asteraceae) : Greece [105]
- *Glebionis segetum* (L.) Fourr. (Asteraceae) : Greece [105]
- *Hibiscus rosa-sinensis* L. (Malvaceae) : Algeria [90]
- *Lactuca sativa* L. (Asteraceae) : France [273]

- *Lepidium draba* L. (Brassicaceae) : Greece [105]
- *Lepidium virginicum* L. (Brassicaceae) : Brazil [98]
- *Malva neglecta* Mallr. (Malvaceae): Greece [105], North west USA [64]
- *Matricaria chamomilla* L. (Asteraceae) : Greece [105]
- *Mirabilis jalapa* L. (Nyctaginaceae) : India [100]
- *Nicotiana tabacum* L. (Solanaceae) : Greece [105], India [59], Pakistan [80]
- *Papaver somniferum* L. (Papaveraceae) : India [274]
- *Phacelia tanacetifolia* L. Benthm. (Boraginaceae) : Greece [105]
- *Prunus persica* (L.) Batsch (Rosaceae) : Greece [105]
- *Raphanus raphanistrum* L. (Brassicaceae) : Brazil [98]
- *Raphanus sativa* L. (Brassicaceae) : India [100], Iran [65], North west USA [64], Pakistan [143]
- *Sisymbrium orientale* L. (Brassicaceae) : Greece [105]
- *Sisymbrium irio* L. (Brassicaceae) : Greece [105]
- *Sisymbrium sophia* L. (Brassicaceae) : India [191]
- *Solanum americanum* Mill. (Solanaceae) : Brazil [98]
- *Solanum lycopersicum* L. (Solanaceae) : France [273], North west USA [64]
- *Solanum melongena* L. (Solanaceae) : Iran [65]
- *Solanum tuberosum* L. (Solanaceae) : Belgium [275], Brazil [98], La Reunion [193], North west USA [64]
- *Sonchus oleraceus* L. (Asteraceae) : Brazil [98], North west USA [64]
- *Spinacia oleracea* L. (Chenopodiaceae) : North west USA [64]
- *Urtica urens* L. (Urticaceae) : Greece [105]

**75. *Myzus* spp.**

- *Forsythia* sp. (Oleaceae): Washington, USA [63]

**76. *Nasonovia ribisnigri* (Mosely)**

- *Lactuca sativa* (L.) (Asteraceae) : Iran [276]

**77. *Phorodon humuli* (Shrank)**

- *Humulus lupulus* L. (Cannabaceae) : North west USA [64], Washington, USA [63]
- *Lamium amplexicaule* L. (Lamiaceae) : North west USA [64], Washington, USA [63]

**78. *Pseudobrevicoryne leclanti* Petrovic & Remaudière**

- *Arabis alpina* L. (Brassicaceae) : Montenegro [105]

**79. *Rhopalomyzus loniceræ* (Siebold)**

- *Phalaris* sp. (Poaceae) : Czech Republic [277]

**80. *Rhopalosiphum insertum* (Walker)**

- *Malus domestica* Borkh. (Rosaceae) : North west USA [64], Washington, USA [63,257]

**81. *Rhopalosiphum maidis* (Fitch)**

- Host unknown : France [278], Morocco [278]

- *Avena sativa* L. (Poaceae) : Brazil [279]
- *Capsella bursa-pastoris* (L.) Medik. (Brassicaceae) : North west USA [64]
- Cereal crops (Poaceae) : Pakistan [61]
- *Hordeum* sp. (Poaceae) : Canada [52,66,280]
- *Hordeum vulgare* L. (Poaceae) : Greece [105], Iran [66,68,69,110,212], Italy [205], North west USA [64], Oklahoma, USA [91,92]
- *Hordeum vulgare* L. subsp. *vulgare* (Poaceae) : Greece [105]
- *Panicum miliaceum* L. (Poaceae) : North west USA [64], Washington, USA [63]
- *Sorghum bicolor* (L.) Moench (Poaceae) : Cuba [281]
- *Triticum aestivum* L. (Poaceae) : Brazil [253,254], Italy [205]
- *Triticum* sp. (Poaceae) : Chile [185], Egypt [282]
- *Triticum turgidum* subsp. *durum* (Desf.) Husn.) (Poaceae) : Greece [105]

**82. *Rhopalosiphum padi* (Linnaeus)**

- *Bromus ramosus* Huds. (Poaceae) : Greece [105]
- Cereal crops (Poaceae) : Poland [252]
- *Hordeum murinum* L. (Poaceae) : Greece [105,283]
- *Hordeum vulgare* L. (Poaceae) : Canada [284,285], Greece [105], Iran [68,69,87,110,212,216], Italy [205], North west USA [64], Oklahoma, USA [91,92]
- *Poa* sp. (Poaceae) : Mediterranean area [52]
- *Secale* sp. (Poaceae) : USA [286]
- *Triticum aestivum* L. (Poaceae) : Brazil [254], Italy [205], North west USA [64], Pakistan [80], Washington, USA [63,104]
- *Triticum* sp. (Poaceae) : Egypt [282]
- *Triticum turgidum* subsp. *durum* (Desf.) Husn.) (Poaceae) : Greece [105,283]
- *Zea mays* L. (Poaceae): Iran [129], North west USA [64], Washington, USA [63]

**83. *Saltusaphis scirpus* Theobald**

- Host unknown: Iran [110]

**84. *Saltusaphis* sp.**

- *Carex* sp. (Cyperaceae) : Central Asia [66]

**85. *Schizaphis graminum* (Rondani)**

- Host unknown: Israel [288]
- *Avena sativa* L. (Poaceae): Brazil [279], Romania [288]
- *Brumus tectorum* L. (Poaceae) : Iran [66, 68,69,110,212,216]
- Cereals (Poaceae) : Argentina [290], Korea [291], Slovakia [291]
- Grain sorghum (Poaceae) : Brazil [292]
- *Hordeum vulgare* L. (Poaceae): Italy [205], Italy [205], Oklahoma, USA [91, 92]
- *Hordeum vulgare* L. subsp. *vulgare* (Poaceae) : Romania [288]

- *Solanum lycopersicum* L. (Solanaceae): Argentina [293]
- *Sorghum bicolor* (L.) Moench (Poaceae) : Brazil [294]
- *Triticum aestivum* L. (Poaceae) : Canada [285], Chile [185], Czech Republic [81], Idaho, USA [295], Italy [205], Mediterranean area [52], Pakistan [80, 143], Texas, USA [296], Pakistan [61,297]
- *Triticum aestivum* L. *subsp. aestivum* (Poaceae) : Romania [288]
- *Triticum* sp. (Poaceae) : Egypt [211,282]
- *Zea mays* L. (Poaceae) : Pakistan [143]

**86. *Schizaphis rotundiventris* (Signoret)**

- Host unknown : Czech Republic [84,189]

**87. *Schizaphis scirpi* (Passerini)**

- *Typha angustifolia* L. (Typhaceae) : Czech Republic [278], Europe [112]
- *Typha latifolia* L. (Typhaceae) : Serbia [53]

**88. *Scizaphis graminum* (Rondani)**

- *Avena sativa* L. (Poaceae) : Uruguay [298]
- *Hordeum vulgare* L. (Poaceae): Pakistan [299]
- *Sorghum bicolor* (L.) Moench (Poaceae) : Pakistan [299], Texas, USA [301]
- *Triticum aestivum* L. (Poaceae) : Uruguay [200]

**89. *Scizaphis longicaudata* Hille Ris Lambers**

- Host unknown : Mediterranean area [52], Sicily [259,301]

**90. *Sipha maydis* Passerini**

- *Hordeum vulgare* L. (Poaceae) : Pakistan [299]
- *Sorghum bicolor* (L.) Moench (Poaceae) : Pakistan [299]
- *Triticum aestivum* L. (Poaceae) : Pakistan [302]

**91. *Sitobion avenae* (Fabricius)**

- *Avena sativa* L. (Poaceae) : Brazil [279]
- Cereal crops (Poaceae) : Poland [252]
- *Dactylis glomerata* L. (Poaceae) : Washington, USA [12,63]
- *Gastridium phleoides* (Nees & Meyen) : Iran [68,69]
- *Hordeum vulgare* L. (Poaceae) : Italy [205,301]
- *Setaria pumila* (Poir.) Roem. & Schult. (Poaceae) : North west USA [64]
- *Triticum aestivum* L. (Poaceae) : Chile [303], Brazil [254], Canada [285], Czech Republic [284], Iran [68,69,87,110,134,212], Italy [205], Mediterranean area [52], North west USA [64], Pakistan [61], Washington, USA [12,63]
- *Triticum* sp. (Poaceae) : Egypt [210,282]

**92. *Sitobion rosaeformis* (Das)**

- *Rosa* sp. (Rosaceae) : India [101]

**93. *Sitobion* sp.**

- *Lolium* sp. (Poaceae) : Czech Republic [112]



**94. *Toxoptera aurantii* (Boyer de Fonsc.)**

- *Citrus aurantium* L. (Rutaceae) : Greece [105]
- *Citrus* sp. (Rutaceae) : Corsica [304], France [304], Italy [304], Lebanon [305], Sicily [304], Spain [304]

**95. *Uroleucon ivae* Robinson**

- *Cyclachaena xanthiifolia* (Nutt.) Fresen. (Asteraceae) : North west USA [64], Washington, USA [63]

**96. *Uroleucon sonchi* (Linnaeus)**

- Host unknown : Iran [66], Iraq [111]
- *Sonchus* sp. (Asteraceae) : Mediterranean area [52]

**97. *Uroleucon* sp.**

- *Brassica oleracea* L. (Brassicaceae) : North west USA [64]
- *Baccharis* sp. (Asteraceae) : Chile [185], Iraq [111], Washington, USA [63]
- *Crepis biennis* L. (Asteraceae) : Czech Republic [112]

**98. *Xerobion eriosomatium* Nevsky**

- *Bassia prostrata* (L.) A. J. Scott (Chenopodiaceae) : Central Asia [66]

**Table2.** Records and distribution of host-complexes of *Diaeretiella rapae* in India (Aphid species/states/host plant species/references)

**1. *Aphis craccivora* Koch**

Punjab: Host unknown [74]

**2. *Aphis fabae***

Karnataka: *Cestrum tasciculatum* [76]

**3. *Aphis gossypii***

Assam: *Leucas aspera* [59]

**4. *Brachycaudus helichrysi***

Jammu & Kashmir: *Prunus persica* [306]

Uttarakhand: *Prunus amygdallus* [114]

Uttar Pradesh: *Prunus amygdalus* [307]

**5. *Brevicoryne brassicae***

Bihar: *Brassica oleracea* var. *capitata* [144], *Brassica oleracea* var. *botrytis* [144]

Gujarat: *Brassica oleracea* var. *capitata* [308], *Brassica oleracea* var. *botrytis* [308]

Himachal Pradesh: *Brassica rapa* subsp. *oleifera* [180], *Brassica* sp. [59,57,190]

Kashmir: *Brassica* sp. [76,190,191]

Meghalaya: *Brassica* sp. [192]

Uttarakhand: *Brassica* sp. [114]

Uttar Pradesh: *Brassica* sp. [60,190,309], *Brassica rapa* subsp. *rapa* [310], *Raphanus sativus* [308,311]

**6. *Ceratovacuna lanigera***

Nagaland: Sugarcane [201]

7. *Hayhurstia atriplicis*

Uttar Pradesh: *Chenopodium album* [307]

8. *Haylopterus atriplicis*

Uttarakhand: *Chenopodium album* [59, 76, 114]

9. *Lipaphis erysimi*

Assam: *Brassica* sp. [144], *Brassica nigra* [144]

Bihar: *Brassica rapa* subsp. *oleifera* [144]

Delhi: *Brassica rapa* subsp. *oleifera* [307]

Gujarat: *Brassica rapa* subsp. *oleifera* [308], *Brassica juncea* [312]

Himachal Pradesh: *Brassica rapa* subsp. *oleifera* [5,54,59, 180,234]

Jammu and Kashmir: *Sinapis arvensis* [313], *Zea mays* [313]

Karnataka: *Brassica* sp. [76], *Brassica nigra* [76]

Manipur: *Brassica* sp. [314], *Brassica nigra* [314]

Madhya Pradesh: *Brassica rapa* subsp. *oleifera* [239], *Lipaphis erysimi* [315]

Meghalaya: *Brassica* sp. [232], *Brassica juncea* [316], *Brassica nigra* [232], *Brassica rapa* subsp. *oleifera* [316]

Maharashtra: *Brassica rapa* subsp. *oleifera* [230]

Punjab: *Brassica* sp. [74], *Brassica nigra* [74]

Rajasthan: *Brassica rapa* subsp. *oleifera* [264]

Sikkim: *Brassica rapa* subsp. *oleifera* [234]

Uttarakhand: *Brassica rapa* subsp. *oleifera* [307], *Brassica oleracea* var. *botrytis* [307]

Uttar Pradesh: *Brassica oleracea* var. *botrytis* [307,311], *Brassica oleracea* var. *capitata* [311], *Brassica oleracea* [311], *Brassica rapa* subsp. *oleifera* [60,311, 304], *Brassica rapa* subsp. *rapa* [311], *Raphanus sativus* [311], *Trifolium alexandrinum* L. (Fabaceae) [313]

10. *Myzus persicae*

Himachal Pradesh: *Brassica* sp. [317]

Kashmir: *Cyphomandra betacea* [59,190,318], *Cardamine debilis* [59,190,318]

Manipur: *Brassica oleracea gongylodes* [314]

Madhya Pradesh: *Papaver somniferum* [274], *Brassica oleracea pekinensis* [274]

Punjab: *Nicotiana tabacum* [59], *Cyphomandra betacea* [74], *Cardamine debilis* [74]

Rajasthan: *Brassica oleracea botrytis* [264], *Brassica oleracea capitata* [264]

Uttar Pradesh: *Brassica* sp. [307]

11. *Metopolophium (Metopolophium) dirhodum*

Uttar Pradesh: Cereals [307]

12. *Sitobion avenae eleusinae*

Punjab: Wheat [74]

**Hosts unknown**

Assam [201]

Himachal Pradesh [4,180]

Madhya Pradesh [239,274,315,320,321]

Manipur [265]

Meghalaya [232]

Punjab [57,322,323]

Rajasthan [264]

Sikkim [324]

Uttar Pradesh [114,240,325,326]

#### **4. CONCLUSION**

*D. rapae* is a highly polyphagous parasitic wasp and parasitises exclusively aphids of several species, however, it is most effective natural enemy of the cabbage aphid (*B. brassicae*) mustard aphid (*L. erysimi*) and green peach aphid (*M. persicae*) on brassica crops such as cabbage and mustard crop through out the world. In addition, in most of the European, American and African countries, it parasitizes Russian wheat aphid (*D. noxia*) infesting cereal crops such as wheat, barley, oat, corn etc. Biological studies of *D. rapae* indicate that the parasitoid has potential to control the population of the abovementioned aphid species which are major pests of their host plants.

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**AUTHORS' BIOGRAPHY**



**Dr. Rajendra Singh** is Professor & Head of the Department of Zoology and Department of Biotechnology, D.D.U. Gorakhpur University, Gorakhpur and has 38 years of experience in the fields of bioecology and biosystematics of aphids and their parasitoids and predators, published about 200 research articles of international repute, authored 6 text/reference books, supervised one D.Sc. and 25 Ph. D. students, and completed 12 research projects. He is fellow/life member of several scientific organizations/societies, Chief Editor of *Journal of Aphidology* and is on the editorial/ reviewer panel of several International Journals. Prof. Singh also served in the university as Pro-Vice Chancellor.



**Ms. Garima Singh** is a Ph.D. Student in the Department of Zoology, Rajasthan University, Jaipur and doing research work on the factors affecting progeny sex ratio of an aphid parasitoid, *Lipolexis oregmae* (Gahan) (Hymenoptera: Braconidae, Aphidiinae). She has published two review articles. She has compiled the food plants of cotton aphid, *Aphis gossypii* Glover recorded in India.