



## Aphids (Insecta: Homoptera: Aphididae) infesting plants of the order Caryophyllales and Santalales (Eudicots: Superasterids: Angiospermae) in India

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### Abstract

The present article deals with the checklist of aphids (Aphididae: Homoptera) and their food plants belonging to 6 families (Amaranthaceae, Basellaceae, Caryophyllaceae, Nyctaginaceae, Plumbaginaceae, and Portulacaceae) of the order Caryophyllales; and 2 families (Loranthaceae and Santalaceae) of the order Santalales. The plants belonging to the family Amaranthaceae are more vulnerable to aphid attack (16 species of plants infested by 32 species of aphids), followed by Caryophyllaceae (11 species of plants infested by 18 species of aphids) and Nyctaginaceae (5 species of plants infested by 12 species of aphids). Out of 44 species of the aphids recorded on these plants, 37 species are almost monophagous, feeding on 1-7 plant species belonging to 1-2 families, and the remaining 7 species are polyphagous, feeding on 6-19 plant species belonging to 3-5 families. Highly polyphagous species are *Aphis (Aphis) gossypii* Glover (19 plant species belonging to 14 genera and 5 families), followed by *Myzus (Nectarosiphon) persicae* (Sulzer) (16 plant species belonging to 12 genera and 4 families) and *Aphis (Aphis) craccivora* Koch (14 plant species belonging to 11 genera and 4 families).

**Keywords:** amaranthaceae, basellaceae, caryophyllaceae, loranthaceae, nyctaginaceae, plumbaginaceae, portulacaceae, santalaceae, aphids, aphididae, checklist

### Introduction

Aphids also known as greenfly, blackfly, plant-lice, ant-cow, etc. are soft-bodied plant sap-sucking insects belonging to the family Aphididae (Order Hemiptera, Suborder Sternorrhyncha, Infraorder Aphidomorpha, Superfamily Aphidoidea). They are small, less than 7 mm long, sap sucking insects. They are cosmopolitan but most abundant in temperate climates. Globally, more than 250 species of aphids are notorious pests of agricultural and horticultural crops [1]. Aphids directly damage plants via sucking their nutrients causing reduced vigour, and by pouring toxic saliva. Some aphids make different kinds of leaf and stem galls [2]. In addition, aphids also damage crops indirectly by secreting high amount of honeydew that blocks stomata that hampers normal plant physiological processes, supporting growth of black sooty mould which reduces photosynthesis, and transmitting viral diseases [3]. *Myzus (Nectarosiphon) persicae* Sulzer alone transmits more than 110 plant viruses [1]. Small size, thelytokous parthenogenetic viviparity, complex life-cycles with alternation of sexual and asexual generations, host plant alternation, polymorphism, short and telescopic generations are the major traits that make aphids highly prolific in reproduction [3,4]. Unlike many taxa, aphid species diversity is much lower in the tropics than in the temperate zones. At present all true aphids belong to a single family Aphididae which consists of 23 subfamilies, and 5109 species under 527 genera [5]. In India, 794 species of aphids under 208 genera are reported out of which about 385 are endemic [6]. Raychaudhury [7] was the first to catalogue the food plants of Indian aphids while Chakrabarti and Sarkar [8] updated this catalogue. Recently, food plant catalogue of Indian aphids was updated [9-18].

Caryophyllales is one of a diverse and heterogeneous order of Superasterids clade of Eudicots flowering plants. It include 38 families comprising 787 genera and 12,485 species globally [19]. The betalain pigments are found in almost all plants of this order. However, the order is represented only by 14 families in India [20] out of which only 7 families (Amaranthaceae, Basellaceae, Caryophyllaceae, Nyctaginaceae, Plumbaginaceae, Polygonaceae and Portulacaceae) that include the cacti, carnations, amaranths, ice plants, beets, and many carnivorous plants are reported as food plants by the aphids. Out of these families, the detail aphid-food plant checklist of one family, Polygonaceae, has already been documented [21].

The Santalales is also an order of Superasterids clade of Eudicots flowering plants and includes 7 families comprising 178 genera and 2,164 species globally [19] with a wide distribution, but mostly grow in tropical and subtropical regions. However, the order is represented only by 7 families in India [20] out of which only 2 families (Loranthaceae and Santalaceae) that include the mistletoe (an obligate hemiparasitic plants) and sandalwoods serve as food plants of the aphids.

### Materials and Methods

The aphid and host plant records in this checklist are taken from a wide variety of resources such as books, journals, proceedings and a few authentic theses and websites up to July 15, 2022, unavoidably including some percentage of misidentifications, both of aphids and their host plants. Some aphid species may also be vagrant individuals. In older literature, several errors crept in the scientific names of both the aphids and plants and even in the recent ones as

such contents become outdated quickly and, due to their perceived comprehensiveness, authors often overlook newer sources of data. The names of aphids, as well as plant that were misspelled in the original records have been corrected where we logically ascertain the intended species. Also, the research on aphid taxonomy as well as their host plants is continuous with the description of new taxa, the modified status of others, and the publication of other nomenclatural decisions. In the present checklist, attempts have been made to provide the valid scientific names of the aphids following Favret <sup>[5]</sup>, and of the plants, TPL <sup>[19]</sup> and WFO <sup>[22]</sup>. In the first inventory of plant names, their synonymies recorded in India are also mentioned. The synonymies of the aphids recorded in India on these plants are given by Singh & Singh <sup>[9-18]</sup>. Only 1-2 references of each record were cited.

## Results and Discussion

### Order: Caryophyllales

The plant order Caryophyllales includes economically important plants such as cacti, carnations, amaranths, ice plants, beets, and many carnivorous plants under 7 families in India serving as food plants of aphids. Following is the updated checklist of aphids infesting plants belonging to these families in India.

#### 1. Family: Amaranthaceae

Amaranthaceae contains 265 genera and over 2,100 species, making it the most species-rich in the order Caryophyllales <sup>[19]</sup>. In India, the family includes 19 genera and 57 species, distributed widely <sup>[20]</sup>. Most species are annual or perennial herbs or shrubs; others are shrubs, rarely trees. Many of the species such as spinach (*Spinacia oleracea* L.), bathua (*Chenopodium album* L.) and beet (*Beta vulgaris* L.) are used as vegetables. The seeds of *Chenopodium* spp. are used as pseudocereals and are taken during fast. Few species of *Amaranthus* are popular garden ornamental plants. In India, 15 species of Amaranthaceae belonging to 10 genera are reported to serve as food plants of 31 species of aphids under 21 genera belonging to 3 subfamilies. *Chenopodium album* L. is infested by 11 species of aphids followed by *Beta vulgaris* L. (8 species of aphids), *Spinacia oleracea* L. and *Amaranthus viridis* Desf. (each 6 species of aphids) and others by less number of aphid species. Among the aphid species, *Aphis (Aphis) gossypii* Glover is highly polyphagous infesting 10 species of plants of Amaranthaceae followed by *Myzus (Nectarosiphon) persicae* (Sulzer) and *Aphis (Aphis) craccivora* Koch (each 8 species), *Aphis (Aphis) fabae fabae* Scopoli (each 6 species), *Myzus (Myzus) ornatus* Laing (5 species) and others less number of plant species. Following is the food plant checklist of aphid species recorded on Amaranthaceae.

#### A. Subfamily: Aphidinae

##### 1. *Aphis (Aphis) achyranthi* Theobald, 1929

- *Achyranthes bidentata* Blume <sup>[23]</sup>
- *Achyranthes* sp. <sup>[24]</sup>

##### 2. *Aphis (Aphis) craccivora* Koch, 1854

- *Achyranthes aspera* L. <sup>[24, 25]</sup>
- *Amaranthus spinosus* L. <sup>[26, 27]</sup>
- *Amaranthus tricolor* L. (syn. *Amaranthus gangeticus* L.) <sup>[24, 25]</sup>
- *Amaranthus viridis* Desf. <sup>[24, 25]</sup>
- *Beta vulgaris* L. <sup>[28]</sup>

- *Chenopodium album* L. <sup>[29]</sup>
- *Gomphrena globosa* L. <sup>[27]</sup>
- *Kochia* sp. <sup>[24]</sup>

##### 3. *Aphis (Aphis) fabae fabae* Scopoli, 1763

- *Alternanthera philoxeroides* (Mart.) Griseb. <sup>[30]</sup>
- *Amaranthus cruentus* L. (syn. *Amaranthus paniculatus* L.) <sup>[8]</sup>
- *Amaranthus viridis* Desf. <sup>[31]</sup>
- *Atriplex rosea* L. <sup>[32]</sup>
- *Beta vulgaris* L. <sup>[32]</sup>
- *Chenopodium album* L. <sup>[32]</sup>
- *Chenopodium* sp. <sup>[33]</sup>

##### 4. *Aphis (Aphis) gossypii* Glover, 1877

- *Achyranthes aspera* L. <sup>[34]</sup>
- *Achyranthes bidentata* Blume <sup>[35]</sup>
- *Achyranthes* sp. <sup>[30]</sup>
- *Alternanthera nodiflora* R. Br. <sup>[36]</sup>
- *Amaranthus spinosus* L. <sup>[24]</sup>
- *Amaranthus tricolor* L. (syn. *Amaranthus gangeticus* L.) <sup>[37]</sup>
- *Amaranthus viridis* Desf. <sup>[27]</sup>
- *Beta vulgaris* L. <sup>[38]</sup>
- *Celosia argentea* L. <sup>[24]</sup>
- *Chenopodium album* L. <sup>[30]</sup>
- *Chenopodium* sp. <sup>[39]</sup>
- *Spinacia oleracea* L. <sup>[24]</sup>

##### 5. *Aphis (Aphis) nasturtii* Kaltenbach, 1843

- *Achyranthes aspera* L. <sup>[30]</sup>
- *Chenopodium* sp. <sup>[30]</sup>

##### 6. *Aphis (Aphis) raji* (Kumar & Burkhardt, 1970)

- *Cyathula tomentosa* (Roth) Moq. <sup>[40, 41]</sup>

##### 7. *Aphis (Aphis) rhamnifila* David, Narayanan & Rajasingh, 1972

- *Chenopodium album* L. <sup>[27]</sup>

##### 8. *Aphis (Aphis) spiraecola* Patch, 1914

- *Achyranthes* sp. <sup>[30]</sup>
- *Amaranthus viridis* Desf. <sup>[30, 41]</sup>
- *Chenopodium album* L. <sup>[30]</sup>
- *Chenopodium* sp. <sup>[39]</sup>
- *Spinacia oleracea* L. <sup>[30]</sup>

##### 9. *Aphis (Toxoptera) aurantii* Boyer de Fonscolombe, 1841

- *Amaranthus* sp. <sup>[39]</sup>

##### 10. *Hyalopterus pruni* (Geoffroy, 1762)

- *Chenopodium album* L. <sup>[24]</sup>

##### 11. *Melanaphis arundinariae* (Takahashi, 1937)

- *Chenopodium album* L. <sup>[42]</sup>

##### 12. *Rhopalosiphum rufiabdominalis* (Sasaki, 1899)

- Unidentified sp. <sup>[26]</sup>

##### 13. *Acyrtosiphon (Acyrtosiphon) pisum* (Harris, 1776)

- *Chenopodium album* L. <sup>[43, 44]</sup>

**14. *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843)**

- *Amaranthus* sp. [30]
- *Beta vulgaris* L. [38]
- *Chenopodium* sp. [30]

**15. *Brevicoryne brassicae* (Linnaeus, 1758)**

- *Beta vulgaris* L. [30]

**16. *Capitophorus mitegoni* Eastop, 1956**

- *Amaranthus cruentus* L. (syn. *Amaranthus paniculatus* L.) [8]

**17. *Dysaphis (cotoneasteria) microsiphon* (nevsky, 1929)**

- *Chenopodium album* L. [8]

**18. *Hayhurstia atriplicis* (Linnaeus, 1761)**

- *Chenopodium album* L. [44]
- *Chenopodium* sp. [44]

**19. *Hyadaphis coriandri* (Das, 1918)**

- *Atriplex hortensis* L. [36]

**20. *Hyalomyzus raoi* Hille Ris Lambers, 1973**

- *Chenopodium* sp. [30, 44]

**21. *Hyperomyzus (Hyperomyzus) lactucae* (Linnaeus, 1758)**

- Unidentified sp. [41]

**22. *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)**

- *Amaranthus caudatus* L. [27]
- *Beta vulgaris* L. [24]
- *Chenopodium album* L. [27]
- *Spinacia oleracea* L. [26]

**23. *Micromyzus niger* van der Goot, 1917**

- *Cheilanthes farinose* Kaulf. [45]

**24. *Myzackaia verbasci* (Chawdhuri et al., 1969)**

- *Amaranthus* sp. [34]

**25. *Myzus (Myzus) ornatus* Laing, 1932**

- *Achyranthes* sp. [30]
- *Alternanthera philoxeroides* (Mart.) Griseb. [30]
- *Amaranthus* sp. [30, 39]
- *Chenopodium album* L. [30]
- *Chenopodium* sp. [39]
- *Spinacia oleracea* L. [30]

**26. *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)**

- *Achyranthes* sp. [30]
- *Alternanthera philoxeroides* (Mart.) Griseb. [30]
- *Amaranthus* sp. [39]
- *Amaranthus spinosus* L. [30]
- *Amaranthus viridis* Desf. [27, 30]
- *Beta vulgaris* L. [24, 29]
- *Beta vulgaris* var. *bengalensis* L. [24]
- *Chenopodium album* L. [27, 33]
- *Chenopodium* sp. [39]
- *Spinacia oleracea* L. [26, 27]

**27. *Myzus (Sciomyzus) cymbalariae* Stroyan, 1954**

- *Amaranthus viridis* Desf. [46]

**28. *Neomyzus circumflexus* (Buckton, 1876)**

- *Achyranthes aspera* L. [30]
- *Alternanthera philoxeroides* (Mart.) Griseb. [30]
- *Amaranthus* sp. [30]
- *Chenopodium* sp. [30]

**29. *Sitobion (Sitobion) avenae* (Fabricius, 1775)**

- *Spinacia oleracea* L. [47]

**B. Subfamily: Greenideinae**

**30. *Greenidea (Greenidea) ficicola* Takahashi, 1921**

- *Alternanthera philoxeroides* (Mart.) Griseb. [30]

**C. Subfamily: Hormaphidinae**

**31. *Parathoracaphis manipurensis* (Pramanick, Samanta & Raychaudhuri, 1983)**

- *Amaranthus* sp. [48]

**2. Family: Basellaceae**

Basellaceae is a very small family of the order Caryophyllales, and comprises 19 species under 4 genera of herbaceous climber plants. In India, only 3 species belonging to 2 genera are known, out of which only one species *Basella alba* L. is known to serve as food plant of only two species of aphids, *Aphis (Aphis) gossypii* Glover and *Myzus (Nectarosiphon) persicae* (Sulzer). *Basella alba* L. (Malabar spinach) is cultivated for its edible leaves and is native to the Indian subcontinent. Following is the food plant checklist of aphid species recorded on Basellaceae.

**A. Subfamily: Aphidinae**

**1. *Aphis (Aphis) gossypii* Glover, 1877**

- *Basella alba* L. (syn. *Basella rubra* L.) [49]

**2. *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)**

- *Basella alba* L. (syn. *Basella rubra* L.) [49]

**3. Family: Caryophyllaceae**

Caryophyllaceae, also known as the pink family or carnation family, is comparatively large family of mostly herbaceous plants of the order Caryophyllales with 91 genera and 2456 known species [19] with cosmopolitan distribution but is best represented in temperate climates. Many species are grown as ornamental plants while few are widely spread weeds. Several plants of this family are of medicinal importance [50]. In India, the family is represented by only 150 species of 30 genera [20].

In India, 11 species of Caryophyllaceae belonging to 7 genera are reported to serve as food plants of 18 species of aphids described under 11 genera belonging to 2 subfamilies. *Drymaria cordata* (L.) Willd. ex Schult. and *Stellaria media* (L.) Vill. each is infested by 8 species of aphids followed by *Cerastium glomeratum* Thuill (4 species of aphids), *Stellaria monosperma* Buch. -Ham. ex D. Don (3 species of aphids) and others by less number of aphid species. Among the aphid species, *Myzus (Nectarosiphon) persicae* (Sulzer) is highly polyphagous infesting 7 species of plants of Caryophyllaceae followed by *Myzus (Nectarosiphon) ascalonicus* Doncaster (6 species), *Aphis (Aphis) gossypii* Glover and *Rhopalosiphum rufiabdominalis* (Sasaki) (each 4 species) and others less number of plant species. Following is the food plant checklist of aphid species recorded on Caryophyllaceae.

**A. Subfamily: Aphidinae****1. Aphis (Aphis) gossypii Glover, 1877**

- *Drymaria cordata* (L.) Willd. ex Schult. [38]
- *Stellaria media* (L.) Vill. [30]

**2. Aphis (Aphis) spiraecola Patch, 1914**

- *Dianthus* sp. [30]

**3. Aphis (Aphis) umbrella (Borner, 1950)**

- *Dianthus caryophyllus* L. [24]

**4. Aphis (Toxoptera) citricidus (Kirkaldy, 1907)**

- *Dianthus* sp. [30]

**5. Rhopalosiphum maidis (Fitch, 1856)**

- *Silene conoidea* L. [43, 44]

**6. Rhopalosiphum rufiabdominalis (Sasaki, 1899)**

- *Dianthus* sp. [51]
- *Drymaria* sp. [30]
- *Stellaria media* (L.) Vill. [30]
- *Stellaria* sp. [30]

**7. Acyrthosiphon (Acyrtosiphon) pisum (Harris, 1776)**

- *Dianthus dampieri* (?) [24, 33]

**8. Aphidura ornatella Narzikulov & Winkler, 1960**

- *Saponaria* sp. [40]

**9. Aphidura sp.**

- *Saponaria* sp. [52]

**10. Aulacorthum (Aulacorthum) solani (Kaltenbach, 1843)**

- *Dianthus* sp. [51]
- *Drymaria cordata* (L.) Willd. ex Schult. [30]

**11. Brachycaudus (Brachycaudus) helichrysi (Kaltenbach, 1843)**

- *Cerastium fontanum vulgare* (Hartm. Greuter & Burdet (syn. *Cerastium vulgatum*) [30, 44]
- *Drymaria cordata* (L.) Willd. ex Schult. [30]

**12. Lipaphis (Lipaphis) erysimi (Kaltenbach, 1843)**

- *Drymaria cordata* (L.) Willd. ex Schult. [44]

**13. Macrosiphum (Macrosiphum) centranthi Theobald, 1915**

- *Silene coel-rosa* (L.) Godr. (syn. *Agrostemma coelirosa* L.) [24]

**14. Macrosiphum (Macrosiphum) hellebori Theobald & Walton 1923**

- *Ranunculus* sp. [53]
- *Silene coeli-rosa* (L.) Godr. (syn. *Agrostemma coeli-rosea* L.) [53]

**15. Myzus (Myzus) ornatus Laing, 1932**

- *Stellaria media* (L.) Vill. [30]
- *Stellaria monosperma* Buch. -Ham. ex D. Don [30]

**16. Myzus (Nectarosiphon) ascalonicus Doncaster, 1946**

- *Cerastium glomeratum* Thuill [46]
- *Stellaria media* (L.) Vill. [30, 46]

- *Stellaria monosperma* Buch. -Ham. ex D. Don [30]

**17. Myzus (Nectarosiphon) persicae (Sulzer, 1776)**

- *Cerastium glomeratum* Thuill. (syn. *Cerastium vulgatum* L.) [44]
- *Cerastium holosteoides* Fries em Hyle. [44]
- *Dianthus caryophyllus* L. [24, 30]
- *Dianthus* sp. [33]
- *Drymaria cordata* (L.) Willd. ex Schult. [38]
- *Silene conoidea* L. [43]
- *Stellaria media* (L.) Vill. [24, 30]

**18. Neomyzus circumflexus (Buckton, 1876)**

- *Drymaria cordata* (L.) Willd. ex Schult. [38]

**B. Subfamily: Chaitophorinae****19. Siphia (Rungisia) maydis Passerini, 1860**

- *Stellaria media* (L.) Vill. [41]

**D. Family: Nyctaginaceae**

Nyctaginaceae, the four o'clock family, is a small family containing 34 genera and 450 species of flowering plants, widely distributed in tropical and subtropical regions [19]. The Garden four-o'clocks, *Mirabilis jalapa* L., *Bougainvillea glabra* Choisy and *Bougainvillea spectabilis* Willd. are grown as ornamental plants. In India, the family Nyctaginaceae includes only 6 genera and 14 species [20]. They are called four o'clock as certain members of the group (*Mirabilis* spp.) blossom in greatest numbers in late afternoon. *Boerhaavia diffusa* L., commonly known as punarnava (meaning that which rejuvenates or renews the body in Ayurveda), has medicinal property and its roots are used to treat asthma, anemia and jaundice [54] and its leaves are often used as a green vegetable in certain region of India. Out of 14 species of the family recorded in India, only 5 species served as food plants of 12 species of aphids under 6 genera belonging to single subfamily. *Bougainvillea spectabilis* Willd. and *Mirabilis jalapa* L. each are infested by 9 species of aphids followed by *Boerhavia diffusa* L. (3 species), *Boerhavia hispida* (?) and *Bougainvillea glabra* Choisy (each 2 species). Among the aphid species, *Aphis (Aphis) gossypii* Glover is highly polyphagous infesting 5 plant species followed by *Aphis (Aphis) craccivora* Koch and *Aphis (Aphis) spiraecola* Patch, each infesting 4 species of plants and other aphid species infest less number of plant species. Following is the food plant checklist of aphid species recorded on Nyctaginaceae in India.

**A. Subfamily: Aphidinae****1. Aphis (Aphis) craccivora Koch, 1854**

- *Boerhavia diffusa* L. [34]
- *Bougainvillea* sp. [24]
- *Bougainvillea spectabilis* Willd. [30, 51]
- *Mirabilis jalapa* L. [55]

**2. Aphis (Aphis) fabae Scopoli, 1763**

- *Bougainvillea spectabilis* Willd. [49]
- *Mirabilis jalapa* L. [30]

**3. Aphis (Aphis) gossypii Glover, 1877**

- *Boerhavia hispida* (?) [30]
- *Bougainvillea glabra* Choisy [56]
- *Bougainvillea spectabilis* Willd. [51]
- *Bougainvillea* sp. [57]



- *Mirabilis jalapa* L. [30, 39]
- 4. *Aphis (Aphis) solanella* Theobald, 1914**
  - *Mirabilis jalapa* L. [35]
- 5. *Aphis (Aphis) spiraecola* Patch, 1914**
  - *Boerhavia hispida* (?) [30]
  - *Boerhavia diffusa* L. [38]
  - *Bougainvillea spectabilis* Willd. [27, 30]
  - *Mirabilis jalapa* L. [30]
- 6. *Aphis (Toxoptera) aurantii* Boyer de Fonscolombe, 1841**
  - *Bougainvillea glabra* Choisy [30]
  - *Bougainvillea spectabilis* Willd. [49]
- 7. *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843)**
  - *Bougainvillea spectabilis* Willd. [58]
- 8. *Capitophorus hippophaes javanicus* Hille Ris Lambers, 1953**
  - *Mirabilis jalapa* L. [30]
- 9. *Myzus (Myzus) ornatus* Laing, 1932**
  - *Bougainvillea spectabilis* Willd. [27, 30]
  - *Mirabilis jalapa* L. [30]
- 10. *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)**
  - *Boerhavia diffusa* L. [38]
  - *Bougainvillea spectabilis* Willd. [30]
  - *Mirabilis jalapa* L. [30, 39]
- 11. *Neomyzus circumflexus* (Buckton, 1876)**
  - *Bougainvillea spectabilis* Willd. [30]
  - *Mirabilis jalapa* L. [58]
- 12. *Sinomegoura citricola* (van der Goot, 1917)**
  - *Bougainvillea* sp. [30]

**E. Plumbaginaceae**

The Plumbaginaceae, also known as the leadwort family or the plumbago family, is a small family of the order Caryophyllales, with a worldwide distribution. It includes 24 genera and 635 species [19]. Most of the species of this family are perennial herbs. Several species of this family are important for its garden ornamentals. In India, the family is represented by only 8 genera and 18 species [20] out of which only one species *Plumbago zeylanica* L. serves as food plant of three aphid species, *Aphis (Aphis) craccivora* Koch, 1854 [24], *Aphis (Aphis) gossypii* Glover, 1877 [59] and *Hysteroneura setariae* (Thomas, 1878) [34].

**F. Portulacaceae**

The Portulacaceae, also known as the purslane family, is also a small family of the order Caryophyllales, including 258 species in 10 genera [19] with a worldwide distribution. In India, the family comprises only 3 genera and 11 species [20]. Only two species of this family were reported to serve as food plant of two species of aphids, viz. *Portulaca grandiflora* Hook. by *Aphis (Aphis) gossypii* Glover, 1877 [27] and *Portulaca oleracea* L., by *Aphis (Aphis) craccivora* Koch, 1854 [60] and *Aphis (Aphis) gossypii* Glover, 1877 [36].

**Order: Santalales**

The plant order Santalales includes mistletoes (Loranthaceae) which are often considered pests that kill trees and devalue natural habitats and highly economically important sandalwood (Santalaceae) in India serving as food plants of aphids. Following is the updated checklist of aphids infesting plants belonging to these families in India.

**1. Loranthaceae**

The family Loranthaceae, commonly known as the showy mistletoes, includes 79 genera and 886 species of woody plants [19], many of them hemiparasites. *Scurrula cordifolia* (Wall.) G. Don (syn. *Loranthus cordifolius* (Wall.)), commonly known as heart-leaf mistletoe, is a parasitic shrub and is infested by a single aphid species, *Tuberaphis loranthi* (van der Goot, 1917) [8, 61]. In addition, one unidentified species of the genus, *Loranthus* (possibly it belongs to *Scurrula*) is used as food plant by two species of aphids, *Aphis (Toxoptera) aurantii* Boyer de Fonscolombe, 1841 [38] and *Aphis (Toxoptera) citricidus* (Kirkaldy, 1907) [30].

**2. Santalaceae**

The Santalaceae is a widely distributed family of flowering plants *Santalum album* L., or Indian sandalwood, is the only plant of this family which was found to be fed by a single species of aphid, *Aphis (Toxoptera) aurantii* Boyer de Fonscolombe, 1841 [24, 26]. The species is native to southern India and is considered sacred in Hinduism because of its fragrant qualities.

Of the 38 families grouped into the order Caryophyllales of the world, only 14 families, including 578 species, are represented in India, out of which 64 species of plants are colonised by 93 species of aphids. The detail food plant-aphid checklist was already prepared for one family Polygonaceae [21]. Among other Caryophyllales, the plants belonging to the family Amaranthaceae are more vulnerable to aphid attack (16 species of plants infested by 32 species of aphids), followed by Caryophyllaceae (11 species of plants infested by 18 species of aphids) and Nyctaginaceae (5 species of plants infested by 12 species of aphids) (Table 1).

**Table 1:** Number of plant species belonging to the different families of the order Caryophyllales in the world and India; number of host plant species of each family infested by aphids; and number of aphid species infesting these plants.

Families	In world		In India			
	Genera	Species	Genera	Species	Host plant species infested by aphids	Aphid species infesting these host plants
Order: Caryophyllales						
1. Amaranthaceae	178	2052	19	57	16	32
2. Basellaceae	4	19	2	3	1	2
3. Caryophyllaceae	91	2456	30	150	11	18
4. Nyctaginaceae	34	450	6	14	5	12

5. Plumbaginaceae	24	635	8	18	1	2
6. Polygonaceae	59	1384	16	117	30	75
7. Portulacaceae	10	258	3	11	2	2
Order: Santalales						
8. Loranthaceae	79	886	8	64	1	3
9. Santalaceae	42	992	9	15	1	1
Total	521	9,132	101	449	68	44

Out of 44 species of the aphids recorded, 37 species are almost monophagous, feeding on 1-7 plant species belonging to 1-2 families, and the remaining 7 species are polyphagous, feeding on 6-19 plant species belonging to 3-5 families. Highly polyphagous species are *Aphis (Aphis) gossypii* (19 plant species belonging to 14 genera and 5 families), followed by *Myzus (Nectarosiphon) persicae* (16 plant species belonging to 12 genera and 4 families) and *Aphis (Aphis) craccivora* (14 plant species belonging to 11

genera and 4 families) (Table 2). Earlier, these species have been found highly polyphagous feeding on hundreds of the plant species belonging to several families, e.g. *Aphis (Aphis) gossypii* (569 species of plants belonging to 103 families) [62], *Myzus (Nectarosiphon) persicae* (293 species of plants belonging to 64 plant families) [63] and *Aphis (Aphis) craccivora* (210 species of plants belonging to 46 families) [64].

**Table 2:** Number of families, genera and species of plants belonging to the order Caryophyllales and Santalales infested by different species of aphids in India.

Aphid species	Plants infested by aphids		
	Families	Genera	Species
<i>Acyrtosiphon (Acyrtosiphon) pisum</i>	2	2	2
<i>Aphidura ornatella</i>	1	1	1
<i>Aphis (Aphis) achyranthi</i>	1	1	1
<i>Aphis (Aphis) craccivora</i>	4	11	14
<i>Aphis (Aphis) fabae fabae</i>	1	5	7
<i>Aphis (Aphis) gossypii</i>	5	14	19
<i>Aphis (Aphis) nasturtii</i>	1	2	2
<i>Aphis (Aphis) raji</i>	1	1	1
<i>Aphis (Aphis) rharnifila</i>	1	1	1
<i>Aphis (Aphis) solanella</i>	1	1	1
<i>Aphis (Aphis) spiraeicola</i>	3	8	9
<i>Aphis (Aphis) umbrella</i>	1	1	1
<i>Aphis (Toxoptera) aurantii</i>	4	4	5
<i>Aphis (Toxoptera) citricidus</i>	2	2	2
<i>Aulacorthum (Aulacorthum) solani</i>	1	2	2
<i>Brachycaudus (Brachycaudus) helichrysi</i>	3	6	6
<i>Brevicoryne brassicae</i>	1	1	1
<i>Capitophorus hippophaes javanicus</i>	1	1	1
<i>Capitophorus mitegoni</i>	1	1	1
<i>Dysaphis (cotoneasteria) microsiphon</i>	1	1	1
<i>Greenidea (Greenidea) ficicola</i>	1	1	1
<i>Hayhurstia atriplicis</i>	1	1	1
<i>Hyadaphis coriandri</i>	1	1	1
<i>Hyalomyzus raoi</i>	1	1	1
<i>Hyalopterus pruni</i>	1	1	1
<i>Hyperomyzus (Hyperomyzus) lactucae</i>	1	1	1
<i>Hysteroneura setariae</i>	1	1	1
<i>Lipaphis (Lipaphis) erysimi</i>	2	2	5
<i>Macrosiphum (Macrosiphum) centranthi</i>	1	2	2
<i>Macrosiphum (Macrosiphum) hellebori</i>	1	2	2
<i>Melanaphis arundinariae</i>	1	1	1
<i>Micromyzus niger</i>	1	1	1
<i>Myzackaia verbasci</i>	1	1	1
<i>Myzus (Myzus) ornatus</i>	3	8	9
<i>Myzus (Nectarosiphon) ascalonicus</i>	1	2	3
<i>Myzus (Nectarosiphon) persicae</i>	4	12	16
<i>Neomyzus circumflexus</i>	3	7	7
<i>Parathoracaphis manipurensis</i>	1	1	1
<i>Rhopalosiphum maidis</i>	1	1	1
<i>Rhopalosiphum rufiabdominalis</i>	2	4	4
<i>Sinomegoura citricola</i>	1	1	1
<i>Sipha (Rungisia) maydis</i>	1	1	1
<i>Sitobion (Sitobion) avenae</i>	1	1	1
<i>Tuberaphis loranthi</i>	1	1	1

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