



## ASSOCIATION OF THE APHIDS (INSECTA: HOMOPTERA: APHIDIDAE) WITH MONOCOTS FLOWERING PLANTS IN INDIA

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**Abstract:** The present paper deals with the association of aphids (Homoptera: Aphididae) with the monocots flowering plant in India. The analysis of data revealed that only 7.66% of the total monocot species recorded in the world is known in India and amongst them only 6.55% (301 species) are associated with 181 species of the aphids. Poaceae is the most suffered family of the monocots by the aphid infestation (163 species of plants are associated with 142 species of aphids including earlier records) followed by Orchidaceae (36 species of plants are associated with 13 species of aphids), Cyperaceae (17 species of plants are associated with 27 species of aphids), Araceae (10 species of plants are associated with 17 species of aphids) and less than 10 species of plants in other families. In India, members of only 6 subfamilies of the aphids are associated with monocots flowering plants. Aphidinae is the largest (75 species) subfamily among them followed by Eriosomatinae (13 species), Hormaphidinae (7 species), Calaphidinae (4 species), Greenideinae (2 species) and Lachninae (single species) excluding the aphids listed earlier on Poaceae. *Aphis (Aphis) gossypii* Glover is the highly polyphagous species and feeds on 25 species of monocots belonging to 15 families excluding Poaceae of which it is associated with 6 species. Two species, *Sitobion (Sitobion) indicum* Basu and *Sitobion (Sitobion) luteum* (Buckton) are highly host specific and are associated with only 2 families, Orchidaceae and Cyperaceae.

**Keywords:** Aphididae, Aphids, Araceae, Checklist, Cyperaceae, Monocots, Orchidaceae.

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### INTRODUCTION

Arthropoda is the largest phylum that includes Insecta, which is the largest class of animals (Verma and Prakash, 2020). The Insecta includes soft-bodied plant sap-sucking aphids (Hemiptera: Sternorrhyncha: Aphidomorpha: Aphidoidea: Aphididae). The aphids are small

(<7 mm long), cosmopolitan in distribution but most abundant in temperate climates. More than 250 species of aphids are known to damage agricultural and horticultural crops (Singh and Singh, 2016). They either directly harm the plants *via* sucking their nutrients causing reduced vigour, and by toxic saliva or indirectly



harm by secreting high amount of honeydew that blocks stomata hampering normal plant physiology, supporting growth of black sooty mould which reduces photosynthesis, and transmitting viral diseases. *Myzus (Nectarosiphon) persicae* (Sulzer) alone transmits more than 110 plant viruses (Singh and Singh, 2021). 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 (Singh and Ghosh, 2002; Singh and Singh, 2022a). 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 (Favret, 2022). In India, 794 species of aphids under 208 genera are reported out of which about 385 are endemic (Singh and Singh, 2019). Raychaudhury (1983) was the first to catalogue the food plants of Indian aphids while Chakrabarti and Sarkar (2001) updated this catalogue after almost 2 decades. In recent years, Singh et al. (2014, 2015a, b, 2018) and Singh and Singh (2016a, b, 2017a-h, 2018) updated the food plant checklist of Indian aphids.

The Monocots is the clade of flowering plants (Angiosperms) and is distinguished by others by having the seeds typically with only one embryonic leaf, or cotyledon as compared to dicots that have two cotyledons. These plants are both economically and culturally important. They provide us food (cereal grains, starchy root crops, palms, sugarcane, orchids, lilies, etc.), spices (cardamom, ginger, turmeric, etc.), fruits (banana, pineapples, etc.) and building materials (bamboos, canes, reeds, etc.) and many medicines (Fay, 2013). Several monocots are ornamentals such as lilies, daffodils, irises, amaryllis, cannas, bluebells, orchids, tulips, etc. In spite of having structural similarities, the monocots are also a highly diverged group of plants including 11 orders (Acorales, Alismatales, Asparagales, Dioscoreales, Liliales, Pandanales, Petrosaviales, Arecales, Commelinales, Poales, Zingiberales), 79 families and over 60,000 species (WFO, 2022). The present checklist deals with the association of

aphids with these monocots flowering plants in India.

## 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 August 5, 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 plants that were misspelt 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 (Singh and Singh, 2022). In the present checklist, attempts have been made to provide the valid scientific names of the aphids following Favret (2022), and of the plants, following (WFO, 2022). In the first inventory of plant names, their synonyms recorded in India are also provided. The synonymies of the aphids recorded in India on these plants are given by Singh and Singh (2016, 2017a-h, 2018, 2021) and Singh et al. (2014, 2015, 2018) for different subfamilies. Only 1-2 references of each record were cited.

## RESULTS AND DISCUSSION

The Monocots of flowering plants are divided into 11 orders and 79 families. However, in India, these monocots are represented by only 9 orders and 23 families having 4,594 species described under 631 genera (Table 1). The analysis of data revealed that only 7.66% of the total monocot species are known in India and amongst them only 6.55% are recognized as food plants by 187 species of the aphids belonging to 76 genera (Table 1). Regarding the species composition, Poaceae is the most speciose family having 1,506 species of 266 genera followed by Orchidaceae (1,330 species, 161 genera), Cyperaceae (583

species, 33 genera), Araceae (250 species, 29 genera), and others have less than 250 species. Same trend is also observed in the number of species used as food plants by the aphids (Table 1). The family Poaceae is highly associated with aphids (163 species of plants with 142 species of aphids, Singh *et al.*, 2015a and present list, Table 1) followed by Orchidaceae (36 species of plants with 13 species of aphids), Cyperaceae (17 species of plants with 27 species of aphids), Araceae (10 species of plants with 17 species of aphids) and less than 10 species of plants in other families (Table 1). Regarding the diversity of aphids associated with monocots in India, 15 subfamilies of the aphids are known out of 23 subfamilies recorded comprising 794 species of aphids under 208 genera (Singh & Singh, 2019). Among them, six subfamilies of the aphids are

associated with monocots flowering plants in India, Aphidinae being the the largest (74 species) among them followed by Eriosomatinae (13 species), Hormaphidinae (7 species), Calaphidinae (4 species), Greenideinae (2 species) and Lachninae (single species) (Table 2) except the records of aphids on Poaceae which is given elsewhere (Singh *et al.*, 2015a). *Aphis (Aphis) gossypii* Glover is a highly polyphagous aphid infesting 569 species of 103 families of plants, mostly Eudicots flowering plants in India (Singh *et al.*, 2014). However, it is associated with only 25 species of monocots belonging to 15 families (Table 2). Two species of aphids, *Sitobion (Sitobion) indicum* Basu and *Sitobion (Sitobion) luteum* (Buckton), though feed on 22 and 19 species of plants (Table 2), they are restricted to only 2 families, Orchidaceae and Cyperaceae,

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

Order/families	World				India			
	Genera	Species	Genera	Species	Host plant species infested by aphids		Aphid species infesting these host	
					Genera	Species	Genera	Species
<b>Acorales</b>								
1. Acoraceae	1	2	1	1	1	1	1	2
<b>Alismatales</b>								
2. Alismataceae	17	115	7	17	1	2	1	2
3. Aponogetonaceae	1	64	1	11	1	1	1	1
4. Araceae	114	3,750	29	205	10	10	10	17
5. Hydrocharitaceae	16	135	9	21	3	3	1	1
<b>Arecales</b>								
6. Areaceae	185	2,867	20	96	3	3	6	7
<b>Asparagales</b>								
7. Amaryllidaceae	77	2,647	17	62	3	5	5	7
8. Asparagaceae	116	3,057	16	100	4	4	2	3
9. Asphodelaceae	44	1340	5	8	2	2	2	2
10. Iridaceae	75	2,790	4	27	2	2	5	7
11. Orchidaceae	862	3,200	161	1,330	22	36	7	13
<b>Commelinales</b>								
12. Commelinaceae	43	731	15	203	2	2	1	1
13. Pontederiaceae	2	48	2	5	1	1	1	1
<b>Dioscoreales</b>								
14. Dioscoreaceae	6	748	2	38	1	3	4	5

<b>Liliales</b>								
15. Alstroemeriaceae	4	294	2	3	1	1	1	1
16. Liliaceae	17	836	8	40	1	1	2	2
17. Smilacaceae	1	313	1	3	1	3	6	14
<b>Poales</b>								
18. Cyperaceae	140	6,000	33	583	8	17	15	27
19. Poaceae	992	13,000	266	1,506	83	163	60	142
<b>Zingiberales</b>								
20. Cannaceae	1	19	1	8	1	1	8	11
21. Costaceae	6	138	1	1	1	1	1	1
22. Marantaceae	29	676	6	9	2	2	2	2
23. Musaceae	3	102	2	27	2	5	8	9
24. Zingiberaceae	86	1,852	22	245	7	7	7	7
<b>Total</b>	<b>2692</b>	<b>40,729</b>	<b>631</b>	<b>4,594</b>	<b>162</b>	<b>275</b>	<b>76</b>	<b>187</b>

Following is the detail orderwise/familywise checklist of food plants of aphids infesting monocots flowering plants in India:

#### A. Order: Acorales

Acorales is the most basal lineage among the monocots which are distinguished by having a single seed leaf. The order includes the single family Acoraceae and a single genus, *Acorus* L., which comprises only two valid species (WFO, 2022) distributed mostly in Asia, Europe and North America (GBIF, 2022). In India, two aphid species were recorded on a single species, *Acorus calamus* L. (sweet flag) which have been traditionally used medicinally against a wide range of health ailments (Sharma *et al.*, 2020).

##### 1. Family: Acoraceae

###### ● *Acorus calamus* L.

- *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh, 1970)
- *Aphis (Toxoptera) aurantii* Boyer de Fonsc., 1841 (Ghosh, 1970; Rao and Kulkarni, 1977)

#### B. Order: Alismatales

The Alismatales are herbaceous basal monocots containing 4,287 species under 173 genera and 14 families (Christenhusz and Byng, 2016), with cosmopolitan distribution, both terrestrial and aquatic or semiaquatic. In India, only 9 families were recorded under the order comprising 346

species under 57 genera (BSI, 2022) out of which only 4 families (Alismataceae, Aponogetonaceae, Araceae, Hydrocharitaceae) containing 16 species were found as food plants of 17 species of aphids. Following is the checklist of food plants of families under the order Alismatales used as food plants by the aphids in India.

##### 1. Family: Alismataceae

The Alismataceae, also known as water-plantains is a family of cosmopolitan distribution. Most of the species are perennial herbaceous aquatic plants growing in ponds. Several species are used as vegetable, animal fodder and as ornamental plants in ponds and aquariums. Globally the family Alismataceae comprises 148 species under 18 genera (WFO, 2022), but in India, it is represented by only 17 species kept in 7 genera (BSI, 2022), out of which only following 2 species of *Sagittaria* L. are infested with 2 species of aphids.

###### ● *Sagittaria guayanensis* Kunth

- *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Rao, 1969)

###### ● *Sagittaria sagittifolia* L.

- *Rhopalosiphum maidis* (Fitch, 1856) (Dharmadhikari and Ramaseshiah, 1970)
- *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Rao, 1969; Raychaudhuri, 1978)

## 2. Family: Aponogetonaceae

The family Aponogetonaceae consists of only one genus, *Aponogeton* L.f., with 64 known species (WFO, 2022) of aquatic plants found in tropical to warm temperate regions of Africa, Asia and Australasia. Some species are used as vegetables for humans, fodder for livestock and as ornamental plants in aquariums. Though in India, 15 species are recorded (BSI, 2022), only one doubtful species was reported as food plant by a single species of aphid as given below.

- *Aponogeton monocharia* L. (?)
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (David, 1958; Behura and Bohider, 1970)

## 3. Family: Araceae

The widely distributed Araceae, commonly known as arum family, is the largest family of the order Alismatales comprising 3,750 species under 114 genera (Christenhusz and Byng, 2016) with spadix type of inflorescence. Several species are used as indoor plants due to their decorative leaves. The starchy rhizome and even leaves of several species of Araceae are consumed as vegetables. In India, the family is represented by 205 species belonging to 29 genera (BSI, 2022) out of which 10 species were found to serve as food plants by 17 species of aphids belonging to 10 genera. *Colocasia esculenta* (L.) Schott is the most suffered plant species infested by 6 species of aphids while other plant species of Araceae are associated with either 1 or 2 aphid species. Recently, an invasive species, *Patchiella reaumuri* (Kaltenbach) of Western Palearctic origin, was first time recorded in India as a devastating pest of *Colocasia esculenta* (L.) in storage in Meghalaya state (Firake *et al.*, 2022). *Aphis (Aphis) gossypii* Glover and *Pentalonia nigronervosa* Coquerel each were found to infest 4 species of plants while other aphid species infest 1-3 plant species as given below.

- *Alocasia macrorrhizos* (L.) G. Don (syn. *Alocasia indica* (Lour.) Spach; *Calocasia indica* (Lour.) Kunth)
  - *Aphis (Aphis) gossypii* Glover, 1877 (Basu, and Banerjee, 1958; Raychaudhuri, 1973)
  - *Pentalonia nigronervosa* Coquerel, 1859 (George, 1927; Bhanotar and Ghosh, 1969)

- *Caladium* sp.
  - *Pentalonia nigronervosa* Coquerel, 1859 (David, 1956a; Behura, 1963)
- *Calla* sp.
  - *Aulacorthum (Aulacorthum) solani* (Kalt., 1843) (Raychaudhuri *et al.*, 1981)
- *Calloopsis* sp.
  - *Uroleucon (Uromelan) jaceae* (Linnaeus, 1758) (Trehan and Halleppnawar, 1949; Behura, 1963)
  - *Colocasia esculenta* (L.) Schott (syn. *Colocasia antiquorum* Schott.)
  - *Aphis (Aphis) craccivora* Koch, 1854 (Raha, 1979)
  - *Aphis (Aphis) gossypii* Glover, 1877 (Ahmed and Singh, 1994a; Mall, 2013)
  - *Aphis (Aphis) nasturtii* Kalt., 1843 (Raychaudhuri, 1973; Rao and Kulkarni, 1977)
  - *Aphis (Aphis) spiraecola* Patch, 1914 (Bhalla, 1971; Bhalla and Pawar, 1980)
  - *Pentalonia caladii* van der Goot, 1917 (Bhadra and Agarwala, 2010)
  - *Pentalonia nigronervosa* Coquerel, 1859 (Behura, 1963; Ghosh, 1975)
  - *Patchiella reaumuri* (Kaltenbach, 1843) (Firake *et al.*, 2022)
- *Colocasia* spp.
  - *Aphis (Aphis) craccivora* Koch, 1854 (Raha *et al.*, 1977)
  - *Aphis (Aphis) fabae* Scopoli, 1763 (Raychaudhuri, 1978)
  - *Aphis (Aphis) gossypii* Glover, 1877 (Rao, 1969; Ahmad *et al.*, 2020)
  - *Aphis (Aphis) punicae* Passerini, 1863 (Behura, 1963; Ahmad *et al.*, 2020)
  - *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)
  - *Brachycaudus (Brachycaudus) helichrysi* (Kalt., 1843) (Raha, 1979)
  - *Hydrnaphis colocasiae* Raychaudhuri, Raha and Raychaudhuri, 1977 (Raha, 1979; Singh *et al.*, 1980)

- *Pentalonia nigronervosa* Coquerel, 1859 (George, 1927; Raha and Raychaudhuri, 1981)
- *Pseudomegoura magnoliae* (Essig and Kuwana, 1918) (Datta et al., 1982)
- *Dieffenbachia seguine* (Jacq.) Schott
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Agrawal and Singh, 2005; Mall, 2013)
- *Lemna* sp.
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Behura, 1963)
- *Pistia* sp.
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Raha et al., 1977; Joshi and Poorani, 2007)
- *Pothos scandens* L.
  - *Greenidea (Greenidea) ficicola* Takahashi, 1921 (Agrawala, 1979)
- *Typhonium trilobatum* (L.) Schott
  - *Aphis (Aphis) gossypii* Glover, 1877 (Basu and Banerjee, 1958; Raychaudhuri, 1973)

#### 4. Family: Hydrocharitaceae

The family Hydrocharitaceae is a small family of annual or perennial aquatic plants consisting of valid 14 genera and 157 species (WFO, 2022) and is widely distributed mostly in tropics. While few species of this family are used as ornamentals in aquariums, some species are major weeds in water bodies. In India, 21 species are known under 9 genera (BSI, 2022) out of which only 3 species were found as food plants by a single species of aphid *Rhopalosiphum nymphaeae* (Linnaeus) as mentioned below.

- *Hydrilla* sp.
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Basu and Raychaudhuri, 1967; Behura and Bohider, 1970)
- *Ottelia alismoides* (L.) Pers.
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Rao, 1969)
- *Vallisneria spiralis* L.
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Behura and Bohider, 1970; Ghosh and Singh, 2004)

- *Vallisneria* sp.
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Basu and Raychaudhuri, 1967; Raychaudhuri, 1973)

#### C. Order: Arecales

The order Arecales has only single family Arecaceae (=Palmae) which comprises the palms with 2,867 species under 185 genera (WFO, 2022) and includes some of the most economically important plants. They are the major source of vegetable oil (palm oil) in the world. They are also used as food (sago, dates), as well as stimulants (betel nut). In India, the family is represented by 20 genera and about 96 species (BSI, 2022) among which only 3 species of palm were reported to serve as food plants for 6 species of aphids as mentioned below.

##### 1. Family: Arecaceae

- *Areca catechu* L.
  - *Cerataphis lataniae* (Boisduval, 1867) (More et al., 2003; Dubey et al., 2021)
  - *Tuberaphis xinglongensis* (Zhang, 1982) (Joshi et al., 2021)
- *Cocos nucifera* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Ganguli and Ghosh, 1965)
  - *Cerataphis brasiliensis* (Hempel, 1901) (Josephraj Kumar et al., 2011; Dath and Balakrishnan, 2016).
- *Elaeis guineensis* Jacq.
  - *Astegopteryx rhapsidis* (van der Goot, 1917) (Dhileepan, 1992)
  - *Hysteroneura setariae* (Thomas, 1878) (Dhileepan, 1991)
  - *Schizaphis (Schizaphis) rotundiventris* (Signoret, 1860) (Dhileepan, 1991)

#### D. Order: Asparagales

The Asparagales is one of the largest order of plants in the monocots having 14 families, 1,053 genera, and 35,892 species (Christenhusz and Byng, 2016). They are mostly herbaceous perennials but few of them are climbers and tree-like. The plants of this order are highly economically important, they are used as food and flavourings (*Allium cepa* L.-onion, *Allium sativa* L.-garlic, asparagus, vanilla,

saffron), in medicinal or cosmetic applications (Aloe vera L.), as cut flowers (freesia, gladiolus, iris, orchids), and as garden ornamentals (day lilies, lily of the valley, Agapanthus). In India, the order Asparagales includes 5 families (Amaryllidaceae, Asparagaceae, Asphodelaceae, Iridaceae, Orchidaceae), 203 genera and 1,527 species which are widely distributed (BSI, 2022) among which only 49 species were reported to serve as food plants for 32 species of aphids as mentioned below.

### 1. Family: Amaryllidaceae

The Amaryllidaceae is a monocot family of herbaceous, mainly terrestrial, perennial and bulbous plants in the order Asparagales. It contains 2,647 species under 77 genera globally (WFO, 2022) which are mainly distributed in tropical to subtropical parts of the world. The family includes several plants of economic importance as ornamental garden plants (daffodils, snowdrops, snowflake), pot plants (amaryllis), and vegetables (onions, garlic). In India, the family is represented by 62 species belonging to 17 genera (BSI, 2022), among which only 5 species of plants belonging to 3 genera were found associated with 7 species of aphids under 5 genera as described below.

- *Agapanthus africanus* (L.) Hoffmanns. (syn. *Agapanthus umbellatus* L.'Hér)
  - *Myzus (Myzus) hemerocallis* Takahashi, 1921 (Behura, 1963; David, 1956b)
  - *Sitobion (Sitobion) graminis* Takahashi, 1950 (David, 1957; Behura, 1963)
- *Allium ascalonicum* L.
  - *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)
- *Allium cepa* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973; Suman and Suman, 2017)
  - *Rhopalosiphum rufiabdominale* (Sasaki, 1899) (Raychaudhuri, 1973; Rao and Kulkarni, 1975)
- *Allium sativum* L.
  - *Lipaphis (Lipaphis) erysimi* (Kalt., 1843) (Ahmed and Singh, 1995)

- *Rhopalosiphum rufiabdominale* (Sasaki, 1899) (Raychaudhuri, 1973; Rao and Kulkarni, 1975)
- *Sitobion (Sitobion) rosaeiformis* (Das, 1918) (Raychaudhuri, 1973)
- *Sitobion (Sitobion) sp.* (Ghosh *et al.*, 1970)
- *Crinum sp.*
  - *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)

### 2. Family: Asparagaceae

The family Asparagaceae is a large family in the order Asparagales consisting of about 3,057 species under 116 genera (WFO, 2022) and is widely distributed. Several plants of the family are of economic importance both as medicinal (asparagus) as well as ornamental plants in houses (snake plant, corn cane, spider plant) and gardens (asparagus, yucca, bluebell). In India, the family is poorly represented, only 100 species described under 16 genera are known, among which only 4 species were recorded as food plants by only 3 species of aphids as given below.

- *Agave angustifolia* Haw.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Behura and Roy, 1980)
- *Chlorophytum sp.*
  - *Hysteroneura setariae* (Thomas, 1878) (Joshi and Poorani, 2007)
- *Convallaria majalis* L.
  - *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1965)
- *Polianthes tuberosa* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Pawar, 2016)

### 3. Family: Asphodelaceae

Asphodelaceae is a moderately large family comprising 1340 species and 44 genera (WFO, 2022). It is distributed throughout the tropics and temperate zones. Some species of this family are cultivated for ornamentals and for their leaf sap (*Aloe vera* L.) that has medicinal and cosmetic uses. Its representation in India is very poor, only 8 species and 5 genera are known (BSI, 2022) and only 2 species are known to be associated with 2 species of aphids as mentioned below.

- *Aloe vera* (L.) Burm. f.
  - *Aphis (Aphis) fabae* Scopoli, 1763 (Sreedhar, 2020)
- *Hemerocallis fulva* (L.) L.
  - *Myzus (Myzus) hemerocallis* Takahashi, 1921 (David, 1956b; Behura, 1963)

#### 4. Family: Iridaceae

Iridaceae is a moderately large family in the order Asparagales including 75 genera and 2,790 species (WFO, 2022). The members of this family are perennial herbs. Many species are cultivated as ornamental plants in pot and garden both (e.g. leopard lilies) while few are commercially cultivated for cut flowers, e.g. gladioli. In India, only 4 genera and 27 species are reported, out of which only 2 species are infested with 7 species of aphids.

- *Gladiolus* sp.
  - *Aphis (Aphis) craccivora* Koch, 1854 (Sood, 1988)
  - *Aphis (Aphis) gossypii* Glover, 1877 (Behura, 1963; Ramesh, 1994)
  - *Aulacorthum (Aulacorthum) solani* (Kalt., 1843) (Raychaudhuri et al., 1980)
  - *Dysaphis (Dysaphis) tulipae* (Boyer de Fonsc., 1841) (Chakrabarti and Sarkar, 2001)
  - *Macrosiphum (Macrosiphum) euphorbiae* (Thomas, 1878) (Ramesh, 1994)
  - *Myzus (Myzus) ornatus* Laing, 1932 (Basu, 1969)
  - *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ramesh, 1994)
- *Iris domestica* Goldblatt. and Mabb. (syn. *Belamcanda chinensis* (L.) DC.)
  - *Myzus (Myzus) ornatus* Laing, 1932 (Raha, 1979)

#### 5. Family: Orchidaceae

Orchidaceae, commonly known as the orchid family, is the second largest family after Asteraceae with a highly diverse and widespread distribution including about 32,000 species described under 862 genera (WFO, 2022). They are almost cosmopolitan with the richest

diversity in the tropics. All orchids are perennial herbs that lack any permanent woody structure. Several plants of this family are of high economic value and are cultivated for its colourful and fragrant flowers. Vanilla is grown for its seeds which are commercially important as flavouring in baking, for perfume manufacturer and aromatherapy. Few saprophytic orchids are consumed as food by natives. In India, 161 genera and 1,330 species of orchids are known (BSI, 2022) and among them only 36 species under 21 genera were observed associated with only 13 species of aphids, out of which two species, *Sitobion (Sitobion) indicum* Basu and *Sitobion (Sitobion) luteum* (Buckton) infest 21 and 18 species of orchids, respectively. The detail food plant-aphid association is given below.

- *Aerides roseum* Loddiges ex Lindl. and Paxt. (syn. *Aerides fieldingi* Lodd. ex E.Morr.)
  - *Cerataphis orchidearum* (Westwood, 1879) (Basu, 1969; Ghosh, 1980)
- *Acampe praemorsa* (Roxb.) Blatt. and McCann
  - *Macrosiphum (Macrosiphum) sp.* (Nagrare, 2005)
- *Bambuseria bambusifolia* (Lindl.) Schuit., Y.P.Ng and H.A.Pedersen (syn. *Eria bambusifolia* Lindl.)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Ghosh et al., 1970; Raychaudhuri, 1980)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- *Calanthe sylvatica* (Thouars) Lindl. (syn. *Calanthe masuca* (D. Don) Lindl.)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Ghosh et al., 1970; Raychaudhuri, 1980)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- *Calanthe* sp.
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975)
- *Chloraea gaviu* Lindl. (syn. *Cymbidium luteum* (Lam.) Willd.)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Raychaudhuri, 1980)



- *Cleisthes grandiflora* (Aubl.) Schltr. (syn. *Cymbidium grandiflorum* Sw.)
  - *Neomyzus circumflexus* (Buckton, 1876) (Raychaudhuri, 1973)
- *Cymbidium eburneum* Lindl.
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975; Ghosh, 1980)
  - *Sitobion (Sitobion) pseudoluteum* Ghosh, 1969 (Raychaudhuri, 1980; Ghosh, 1980)
- *Cymbidium elegans* Lindl. (syn. *Cymbidium longifolium* D. Don)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975; Ghosh, 1980)
  - *Sitobion (Sitobion) pseudoluteum* Ghosh, 1969 (Raychaudhuri, 1973; Ghosh, 1980)
- Cymbidium ensifolium* (L.) Swartz
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Ghosh *et al.*, 1970; Raychaudhuri, 1980)
- Cymbidium lowianum* (Rchb.f.) Rchb.f.
  - *Aphis (Toxoptera) aurantii* Boyer de Fonsc., 1841 (Nagrare, 2005)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Ghosh *et al.*, 1970)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- Cymbidium munronianum* King and Pantl.
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Ghosh *et al.*, 1970; Raychaudhuri, 1980)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- Cymbidium sinense* (And.) Willd.
  - *Sitobion (Sitobion) pseudoluteum* Ghosh, 1969 (Ghosh, 1980)
- Cymbidium tracyanum* L. Castle
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Ghosh *et al.*, 1970; Raychaudhuri, 1980)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- Cymbidium* sp.
  - *Aphis (Aphis) nasturtii* Kalt., 1843 (Rao and Kulkarni, 1977)
  - *Macrosiphum (Macrosiphum)* sp. (Nagrare, 2005)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Basu, 1964; Raychaudhuri, 1980)
- Cypridium* sp.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)
- Dendrobium chrysotoxum* Lindl.
  - *Aphis (Toxoptera) aurantii* Boyer de Fonsc., 1841 (Kar *et al.*, 1990)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Thithila *et al.*, 2015)
- Dendrobium crepidatum* Lindl. and Paxton
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Thithila *et al.*, 2015)
- Dendrobium densifolium* Schlechter
  - *Aphis (Toxoptera) aurantii* Boyer de Fonsc., 1841 (Nagrare, 2003, 2005)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Ghosh and Raychaudhuri, 1968a; Raychaudhuri, 1980)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh and Raychaudhuri, 1968a; Ghosh, 1980)
- Dendrobium fimbriatum* Hook.
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Thithila *et al.*, 2015)
- Dendrobium longicornu* Lindl.
  - *Myzus (Myzus) ornatus* Laing, 1932 (Raychaudhuri, 1973)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975; Raychaudhuri, 1980)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- Dendrobium nobile* Lindl.
  - *Macrosiphum (Macrosiphum)* sp. (Nagrare, 2005)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Nagrare *et al.*, 2009; Thithila *et al.*, 2015)
- Dendrobium williamsonii* Day and Rchb.f.
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Thithila *et al.*, 2015)

- *Dendrobium* sp.
  - *Aulacorthum (Neomyzus) dendrobii* Basu, 1969 (Ghosh, 1980; Debnath & Chakrabarti, 2020)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Basu, 1969; David, 1975)
- *Dilomilis montana* (Sw.) Summerh. (syn. *Cymbidium montanum* (Sw.) Sw.)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Raychaudhuri, 1980)
- *Epidendrum radicans* Pav. ex Lindl.
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Sangma *et al.*, 2018)
- *Epidendrum* sp.
  - *Cerataphis orchidearum* (Westwood, 1879) (David *et al.*, 1971)
  - *Macrosiphum (Macrosiphum) sp.* (Nagrare, 2005)
- *Eria* sp.
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975)
- *Goodyera procera* Hook.
  - *Macrosiphum (Macrosiphum) sp.* (Nagrare, 2005)
- *Liparis viridiflora* Lindl.
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Thithila *et al.*, 2015)
- *Oncidium* sp.
  - *Aphis (Toxoptera) aurantii* Boyer de Fonsc., 1841 (Nagrare, 2004)
- *Orchis* sp.
  - *Aphis (Toxoptera) aurantii* Boyer de Fonsc., 1841 (Rohini *et al.*, 2018)
- *Otochilus porrecta* Lindl.
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Raychaudhuri, 1973; David, 1975)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- *Paphiopedilum insigne* (Wall. ex Lindl.) Pfitzer
  - *Neomyzus circumflexus* (Buckton, 1876) (Raychaudhuri, 1973)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975; Raychaudhuri, 1980)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- *Paphiopedilum venustum* (Wall. ex Sim.) Pfitzer
  - *Aulacorthum (Aulacorthum) solani* (Kalt., 1843) (Ghosh *et al.*, 1970; Raychaudhuri, 1980)
- *Phaius tankervilleae* (Banks) Blume
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Thithila *et al.*, 2015)
- *Thunia alba* (Lindl.) Rchb.f. (syn. *Thunia marshalliana* Rchb.f.)
  - *Cerataphis orchidearum* (Westwood, 1879) (Ghosh, 1978)
- *Vanda coerulea* Griff. Ex Lindl.
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980; Nagrare, 2006)
- *Vanda cristata* Wall. ex Lindl.
  - *Macrosiphum (Macrosiphum) sp.* (Nagrare, 2005)
- *Vanilla* sp.
  - *Cerataphis orchidearum* (Westwood, 1879) (Joshi and Poorani, 2007)
- Unidentified species
  - *Micromyzus kalimpongensis* Basu, 1967 (1968) (Mondal *et al.*, 1978; Basu and Raychaudhuri, 1980)
  - *Neomyzus circumflexus* (Buckton, 1876) (Basu, and Banerjee, 1958; Behura, 1963)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (Raychaudhuri, 1978)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)

#### E. Order: Commelinales

Commelinales is an order of monocot flowering plants comprising 919 species, 63 genera kept under 5 families (WFO, 2022). In India, only 18 genera and 209 species of 3 families are known, out of which aphids are associated with only 2 families.

**1. Family: Commelinaceae**

The Commelinaceae, also known as the dayflower family or spiderwort family, is the largest family in the order Commelinales with 731 known species in 43 genera (WFO, 2022) and is widely distributed. The plants of this family are usually terrestrial perennials, but a few species are annuals. In India, 15 genera and 203 species are known (BSI, 2022) out of which only two species is known to serve as food plant by a highly polyphagous aphid species as mentioned below.

- *Commelina benghalensis* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Rao, 1969; Ghosh and Agarwala, 1980)
- *Commelina* sp.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Behura, 1965; Raychaudhuri *et al.*, 1981)
- *Cyanotis axillaris* (L.) D. Don
  - *Aphis (Aphis) gossypii* Glover, 1877 (Dharmadhikari & Ramaseshiah, 1970)

**2. Family: Pontederiaceae**

Pontederiaceae is a small family of heterostylous aquatic plants, distributed in tropics and subtropics. The family contains two genera with 48 known species (WFO, 2022). The water hyacinth (*Pontederia crassipes* Mart.) is an invasive species in many waterbodies and is the only species which is associated with a single species of aphid in India as mentioned below.

- *Pontederia crassipes* Mart. (syn. *Eichhornia crassipes* (Mart.) Solms)
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Behura and Bohider, 1970; Raychaudhuri, 1978)

**F. Order: Dioscoreales**

The Dioscoreales is an order of monocot plants consisting of 3 families, 22 genera and 849 species (WFO, 2022) of vines or herbaceous forest floor plants and is widely distributed particularly in tropics and subtropics of the world. In India, 5 genera and 50 species under 2 families are known (BSI, 2022) out of which only 5 species of aphids are associated with two species of the family Dioscoreaceae as mentioned below.

**1. Family: Dioscoreaceae**

- *Dioscorea bulbifera* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Bhagat, 2012)
- *Dioscorea deltoidea* Wall.
  - *Aphis (Aphis) verbasci* Schrank, 1801 (Chakrabarti & Debnath, 2009)
  - *Aulacorthum (Aulacorthum)* sp. (Bhagat, 2012)
- *Dioscorea* sp.
  - *Brevicoryne brassicae* (Linnaeus, 1758) (Chakrabarti & Debnath, 2009)
  - *Myzus (Myzus) ornatus* Laing, 1932 (Chakrabarti and Sarkar, 2001)

**G. Order: Liliales**

The order Liliales consists mostly of perennial erect or twining herbaceous plants and has worldwide distribution. The order includes 10 families, 59 genera and about 1,987 species (Christenhusz and Byng, 2016; WFO, 2022). However, in India, only 22 genera and 1,443 species in 3 families are known among which only 6 species were reported to serve as food plants for 17 species of aphids as mentioned below.

**1. Family: Alstroemeriaceae**

The family Alstroemeriaceae with 294 known species in 4 genera (WFO, 2022), almost entirely native to the Americas, but only 3 species of 2 genera are known from India (EFI, 2022) and among them, only one species is associated with single species of aphids as mentioned below.

- *Bomarea multiflora* Mirb. (syn. *Bomarea caldasii* (Kunth) Herb.)
  - *Brachycaudus (Brachycaudus) helichrysi* (Kalt., 1843) (Basu, and Banerjee, 1958; Behura, 1963)

**2. Family: Liliaceae**

The family, Liliaceae is the family of lilies and comprises 17 genera and 836 species (WFO, 2022). They are perennial, herbaceous, often bulbous geophytes and are widely distributed, mainly in temperate regions of the Northern Hemisphere and are important ornamental plants, e.g. lilies and tulips. In India, 8 genera and 40 species of Liliaceae were recorded among

which only one species is associated with 2 species of aphids as mentioned below.

- *Lilium* spp.
  - *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Singh et al., 2015)
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Singh et al., 2015).
- 3. Family: Smilacaceae**  
Smilacaceae is the family of the greenbriers including single genus *Smilax* L. with 313 species globally (WFO, 2022), but in India, it is represented by only 35 species. Among them only 3 species and several unidentified species are associated with 14 species of aphids as described below.
- *Smilax aspera* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Chakrabarti and Sarkar, 2001)
- *Smilax elegans* Wall. ex Kunth (syn. *Smilax parvifolia* Wall. ex Hook.f.)
  - *Sitobion (Sitobion) miscanthi* (Takahashi, 1921) (Chakrabarti and Sarkar, 2001)
  - *Impatientinum (Impatientinum) asiaticum dalhousiensis* Verma, 1969 (Ghosh, 1977a; Bhalla and Pawar, 1980)
- *Smilax ferox* Wall. ex Kunth.
  - *Sitobion (Sitobion) sikkimense* (Ghosh and Raychaudhuri, 1968) (Basu et al., 1973; David, 1975)
- *Smilax* spp.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri et al., 1980)
  - *Aphis (Aphis) spiraeicola* Patch, 1914 (Raychaudhuri et al., 1980)
  - *Impatientinum (Impatientinum) asiaticum* Nevsky, 1929 (Chakrabarti and Sarkar, 2001)
  - *Impatientinum (Impatientinum) asiaticum dalhousiensis* Verma, 1969 (Chakrabarti et al., 1972b; Raychaudhuri et al., 1980)
  - *Impatientinum (Impatientinum) impatiens* (Shinji, 1922) (Ghosh et al., 1971a; Basu and Raychaudhuri, 1980)
  - *Myzus (Myzus) cerasi umefoliae* (Shinji, 1924) (Maity et al., 1980)

- *Rhopalosiphoninus (Myzosiphon) smilacifoliae* (Ghosh and Raychaudhuri, 1968) (Ghosh and Raychaudhuri, 1968a; Raychaudhuri, 1980)
- *Sinomegoura citricola* (van der Goot, 1917) (Ghosh and Raychaudhuri, 1968a; Raha and Raychaudhuri, 1981)
- *Sinomegoura rhododendri* (Takahashi, 1937) (Ghosh and Raychaudhuri, 1968a; Raychaudhuri, 1980)
- *Sitobion (Sitobion) mimosae* (Ghosh, Basu and Raychaudhuri, 1977) (Kar et al., 1990)
- *Sitobion (Sitobion) miscanthi* (Takahashi, 1921) (Raychaudhuri et al., 1980)
- *Sitobion (Sitobion) rosaeiformis* (Das, 1918) (Raychaudhuri et al., 1980)
- *Sitobion (Sitobion) sikkimense* (Ghosh and Raychaudhuri, 1968) (David, 1975; Raychaudhuri, 1980)
- *Sitobion (Sitobion) smilacicola* (Takahashi, 1924) (Ghosh and Raychaudhuri, 1968b; Chakrabarti et al., 1974)

#### H. Order: Poales

The Poales is one of the large order of the monocots comprising 14 families, 1,017 genera and over 23,783 species (Christenhusz and Byng, 2016). Except Greenland and Antarctica, it is found everywhere on earth and are the most economically important group of monocots, as this family includes the true grains, pasture grasses, pineapple, sugar cane, and bamboo. In India, the order includes only 8 families, 311 genera and 2,277 species/subspecies/varieties (Kellogg et al., 2020; BSI, 2022) out of which only plants belonging to two families (Cyperaceae, Poaceae) are associated with aphid infestation as mentioned below.

#### 1. Family: Cyperaceae

The Cyperaceae is a grass-like family having plants known as sedges. The family is second large in order Poales with about 6,000 species described in about 140 genera (WFO, 2022) distributed widely. It includes some economically important plants like water chestnut, papyrus sedge, cotton-grass, spike-rush, sawgrass,

nutsedge, etc. In India, 33 genera and 583 species are known in this family (BSI, 2022) out of which 15 species of 7 genera are associated with 27 species of aphids under 14 genera. Four species of aphids, *Acutosiphon obliquoris* Basu, Ghosh and Raychaudhuri; *Hysteroneura setariae* (Thomas), *Rhopalosiphum padi* (Linnaeus) and *Schizaphis (Schizaphis) rotundiventris* (Signoret), each are associated with 4 species of plants of Cyperaceae as stated below.

- *Carex cespitosa* L. (syn. *Carex ferax* Raeuch.)
  - *Acutosiphon obliquoris* Basu, Ghosh and Raychaudhuri, 1970 (Ghosh and Basu, 1997)
- *Carex filicina* Nees
  - *Acutosiphon obliquoris* Basu, Ghosh and Raychaudhuri, 1970 (Chakrabarti *et al.*, 1972a; Raychaudhuri, 1980)
  - *Pseudaphis abyssinica* Hille Ris Lambers, 1954 (Raychaudhuri, 1980)
  - *Vesiculaphis sikkimensis* Mandal, Agarwala and Raychaudhuri, 1979 (Mondal *et al.*, 1979)
- *Carex* sp.
  - *Acutosiphon obliquoris* Basu, Ghosh and Raychaudhuri, 1970 (Ghosh MR *et al.*, 1976)
  - *Geoica lucifuga* (Zehntner, 1897) (Raychaudhuri *et al.*, 1978a)
  - *Geoica sikkimensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
  - *Hysteroneura setariae* (Thomas, 1878) (Agarwala, 1979)
  - *Rhopalosiphum rufiabdominale* (Sasaki, 1899) (Pal and Raychaudhuri, 1978)
  - *Vesiculaphis sikkimensis* Mandal, Agarwala and Raychaudhuri, 1979 (Mondal *et al.*, 1979)
- *Cymbidium elegans* Lindl. (syn. *Cyperorchis elegans* (Lindl.) Blume)
  - *Sitobion (Sitobion) indicum* Basu, 1964 (David, 1975)
- *Cymbidium elegans* Lindl. (syn. *Cyperorchis elegans* (Lindl.) Blume)
  - *Sitobion (Sitobion) luteum* (Buckton, 1876) (Ghosh, 1980)
- *Cyperus articulatus* L.
  - *Rhopalosiphum padi* (Linnaeus, 1758) (Mall, 2013)
- *Cyperus cyperoides* (L.) Kuntze syn. *Cyperus umbellatus* Hillebr.
  - *Schizaphis (Schizaphis) rotundiventris* (Signoret, 1860) (Raychaudhuri, 1980)
- *Cyperus exaltatus* Retz.
  - *Schizaphis (Schizaphis) hypersiphonata* Basu, 1970 (Ghosh *et al.*, 1971b)
  - *Schizaphis (Schizaphis) rotundiventris* (Signoret, 1860) (Raychaudhuri, 1980)
- *Cyperus glomeratus* L. (syn. *Cyperus australis* Schrad.)
  - *Rhopalosiphum padi* (Linnaeus, 1758) (Rao and Kulkarni, 1975)
- *Cyperus iria* L.
  - *Saltusaphis scirpus* Theobald, 1915 (David and Ghorpade, 1974)
- *Cyperus niveus* Retz.
  - *Schizaphis (Schizaphis) graminum* (Rondani, 1852) (Behura, 1963)
- *Cyperus rotundus* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Rizvi and Paul Khurana, 1970; Chakrabarti, 1972)
  - *Geoica lucifuga* (Zehntner, 1897) (Ghosh, 1977b; Ghosh and Singh, 2004)
  - *Hysteroneura setariae* (Thomas, 1878) (Singh *et al.*, 1999; Mall, 2013)
  - *Myzus (Myzus) ornatus* (Laing, 1932) (Mall, 2013)
  - *Rhopalosiphum maidis* (Fitch, 1856) (Ahmed and Singh, 1994b; Ghosh and Singh, 2004)
  - *Rhopalosiphum padi* (Linnaeus, 1758) (Rohini *et al.*, 2018)
  - *Rhopalosiphum rufiabdominale* (Sasaki, 1899) (Rao and Kulkarni, 1975; Mall,

- 2013)
- *Schizaphis (Schizaphis) graminum* (Rondani, 1852) (Behura, 1963; Ghosh and Singh, 2004)
  - *Schizaphis (Schizaphis) hypersiphonata* Basu, 1970 (Basu *et al.*, 1973)
  - *Schizaphis (Schizaphis) minuta* (van der Goot, 1917) (Ghosh, 1975)
  - *Schizaphis (Schizaphis) rotundiventris* (Signoret, 1860) (Behura, 1965; Bhalla and Pawar, 1980)
  - *Sitobion (Sitobion) miscanthi* (Takahashi, 1921) (Raychaudhuri, 1980; Ghosh and Singh, 2004)
  - *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki, 1899) (Ghosh, 1970; Rao and Kulkarni, 1975)
  - *Therioaphis (Therioaphis) ononidis* (Kalt., 1846) (Buckton, 1899; Ghulam-Ullah, 1940)
  - *Therioaphis (Therioaphis) trifolii* (Monell, 1882) (Behura, 1963; Ghosh and Singh, 2004)
  - *Vesiculaphis caricis* (Fullaway, 1909) (Basu, 1969; Ghosh and Singh, 2004)
  - *Cyperus* sp.
    - *Acutosiphon obliquoris* Basu, Ghosh and Raychaudhuri, 1970 (Ghosh, 1977a)
    - *Hysteroneura setariae* (Thomas, 1878) (David *et al.*, 1967)
    - *Rhopalosiphum padi* (Linnaeus, 1758) (Bhalla and Pawar, 1980)
    - *Saltusaphis scripus* Theobald, 1915 (Ghosh and Quednau, 1990)
    - *Schizaphis (Schizaphis) rotundiventris* (Signoret, 1860) (Raychaudhuri, 1980)
    - *Schizaphis (Schizaphis) graminum* (Rondani, 1852) (Mall, 2013)
    - *Sitobion (Sitobion) miscanthi* (Takahashi, 1921) (Raychaudhuri, 1980)
  - *Kyllinga* sp.
    - *Geoica lucifuga* (Zehntner, 1897) (Singh and Singh, 1985)
    - *Tetraneura (Tetraneura) kalimpongensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
    - *Schoenoplectiella articulata* (L.) Lye (syn. *Scirpus articulatus* L.)
      - *Hysteroneura setariae* (Thomas, 1878) (Mall, 2013)
    - *Schoenoplectus lacustris* (L.) Palla (syn. *Scirpus lacustris* L.)
      - *Aphis (Toxoptera)* sp. (Behura, 1963)
      - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Behura and Bohider, 1970)
    - *Scirpus* sp.
      - *Rhopalosiphum padi* (Linnaeus, 1758) (David and Ghorpade, 1974; Rohini *et al.*, 2018)
    - *Scleria terrestris* (L.) Fassett (syn. *Scleria elata* Thwaites)
      - *Carolinaia (Juncomyzus) scirpi* (van der Goot, 1917) (Ghosh and Raychaudhuri, 1972; Raychaudhuri, 1980)
    - Unidentified species
      - *Acutosiphon obliquoris* Basu, Ghosh and Raychaudhuri, 1970 (Basu and Raychaudhuri, 1980)
      - *Geoica lucifuga* (Zehntner, 1897) (Raychaudhuri, 1980)

## 2. Family: Poaceae

The family Poaceae (=Gramineae) is one of the most speciose monocot plant families, comprising over 13,000 species under 992 genera (WFO, 2022). Except Greenland and Antarctica, it is found everywhere on earth and are the most economically important group of monocots, as it includes the true grains, pasture grasses, sugar cane, and bamboo. Species in this family have been cultivated for staple food crops (rice, wheat, maize, sorghum, oat, barley, sugarcane, etc.), fodder for animals, biofuel, building materials (bamboos), paper, garden design and landscaping (grasses), among other things. In India, 1506 species/subspecies/varieties are known under 266

genera (Kellogg, 2020). Singh *et al.* (2015) have already listed the association of plants of this family with aphids and mentioned a total of 198 species of plants associated with 141 species of aphids belonging to 55 genera. The additional association of food plants of Poaceae with aphids are listed below which demonstrates that 13 plants of Poaceae are also associated with 21 species of aphids. Maximum number of aphid species (44 aphid species) colonised on *Bambusa* spp. followed by *Triticum aestivum* subsp. *aestivum* L. (29 aphid species), *Eleusine coracana* Gaertn. (18 aphid species), *Saccharum spontaneum* L. (16 aphid species), *Sorghum bicolor* (L.) Moench (14 aphid species), *Bambusa bambos* (L.) Voss. (13 aphid species), *Oryza sativa* L. (13 aphid species), *Pennisetum glaucum* R. Br. (12 aphid species), and *Zea mays* L. (12 aphid species). Similarly, maximum number of plant species (66 plant species) were colonized by *Hysteroneura setariae* (Thomas, 1878) followed by *Sitobion (Sitobion) miscanthi* (Takahashi, 1921) (48 plant species), *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki, 1899) (38 plant species), *Rhopalosiphum maidis* (Fitch, 1856) (35 plant species), *Geoica lucifuga* (Zehntner, 1897) (21 plant species), *Melanaphis sacchari* (Zehntner, 1897) (19 plant species), *Rhopalosiphum padi* (Linnaeus, 1758) (19 plant species), *Rhopalosiphum rufiabdominale* (Sasaki, 1899) (18 plant species), *Schizaphis (Schizaphis) graminum* (Rondani, 1852) (16 plant species), *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (11 plant species) and other aphid species with less than 10 number of plant species.

- *Agrostis* sp.
  - *Sitobion (Sitobion) africanum* (Hille Ris Lambers, 1954) (Behura, 1963)
- *Axonopus* sp.
  - *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (Singh and Singh, 1985)
- *Bambusa bambos* (L.) Voss (syn. *Bambusa arundinacea* (Retz.) Willd.)
  - *Melanaphis donacis* (Passerini, 1862) (Mall, 2013)
  - *Melanaphis meghalayensis meghalayensis* Raychaudhuri and Banerjee, 1974 (Das and Chakrabarti 1989a)
- *Takecallis himalayensis* Chakrabarti, 1988 (Das and Chakrabarti 1989)
- *Bambusa nutans* Wall. ex Munro
  - *Astegopteryx bambusae* (Buckton, 1893) (Senthilkumar and Murugesan, 2015)
- *Bambusa vulgaris* Schrad. ex J.C. Wendl.
  - *Astegopteryx bambusae* (Buckton, 1893) (Senthilkumar and Murugesan, 2015)
- *Bothriochloa pertusa* (L.) A. Camus
  - *Sitobion (Sitobion) avenae* (Fabricius, 1775) (Behura, 1963)
- *Bromus inermis* Leyss.
  - *Macrosiphum* sp. (Chakrabarti & Debnath, 2009)
- *Cymbopogon nardus* (L.) Rendle
  - *Sitobion (Sitobion) avenae* (Fabricius, 1775) (Bhagat, 2012)
- *Chrysopogon nodulibarbis* (Hochst.) Henrard (syn. *Chrysopogon zeylanicus* Thwaites)
  - *Sitobion (Sitobion) africanum* (Hille Ris Lambers, 1954) (Behura, 1963; David, 1975)
  - *Sitobion (Sitobion) fragariae* (Walker, 1948) (Behura, 1963; David, 1975)
- *Chrysopogon* sp.
  - *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (Singh and Singh, 1985)
- *Cynodon dactylon* (L.) Pers.
  - *Sitobion (Sitobion) avenae* (Fabricius, 1775) (Rohini *et al.*, 2018)
- *Cynodon* sp.
  - *Ceratovacuna cynodonti* Chakrabarti & Debnath, 2011 (Chakrabarti & Debnath, 2011)
- *Dendrocalamus strictus* Nees
  - *Astegopteryx bambusae* (Buckton, 1893) (Senthilkumar and Murugesan, 2015)
- *Echinochloa* sp.

- *Chaetogeioica graminiphaga* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
- *Geoica sikkimensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
- *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (Singh and Singh, 1985)
- *Eleusine coracana* (L.) Gaertn.
  - *Forda orientalis* George, 1920 (Musthak Ali and Sharatchandra, 1986)
- *Enteropogon* sp.
  - *Sitobion (Sitobion) africanum* (Hille Ris Lambers, 1954) (David, 1957; Behura, 1963)
  - *Sitobion (Sitobion) fragariae* (Walker, 1948) (David, 1957)
- *Hordeum vulgare* L.
  - *Cavariella (Cavaraiellia) aquatica* (Gillette & Bragg, 1916) (Bhagat, 2012)
- *Hymenachne* sp.
  - *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (Singh and Singh, 1985)
- *Imperata cylindrica* (L.) P.Beauv.
  - *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Singh & Singh, 1985)
  - *Tetraneura (Tetraneura) sikkimensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
- *Ischaemum rugosum* Salisb.
  - *Sitobion (Sitobion) fragariae* Walker, 1848) (David, 1975; Behura, 1963)
- *Isachne albens* Trin.
  - *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki, 1899) (Singh and Singh, 1985)
- *Microchloa* sp.
  - *Chaetogeioica polychaeta* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
  - *Tetraneura (Tetraneura) sikkimensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
- and Singh, 1985)
  - *Panicum paludosum* Roxb.
    - *Brachysiphoniella montana* (van der Goot, 1917) (Singh *et al.*, 2011)
    - *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (Singh and Singh, 1985)
  - *Paspalum* sp.
    - *Tetraneura (Tetraneura) kalimpongensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
    - *Tetraneura (Tetraneura) sikkimensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
  - *Pennisetum glaucum* (L.) R. Br.
    - *Rhopalosiphum padi* (Linnaeus, 1758) (Mall, 2013)
  - *Phyllostachys* sp.
    - *Kaochiaoja sikkimensis* Joshi & Blackman, 2017 (Joshi & Blackman, 2017)
  - *Poa annua* L.
    - *Forda marginata* Koch, 1857 (Chakrabarti & Sarkar, 2001)
    - *Geoica lucifuga* (Zehntner, 1897) (Raychaudhuri *et al.*, 1978b)
    - *Hysteroneura setariae* (Thomas, 1878) (Raychaudhuri, 1973)
    - *Matsumuraja capitophoroides* Hille Ris Lambers, 1966 (Banerjee *et al.*, 1991)
    - *Metopolophium (Metopolophium) chandrani* (David and Narayanan, 1968) (David and Narayanan, 1968; Ghosh, 1977a)
    - *Rhopalosiphum padi* (Linnaeus, 1758) (Chakrabarti, 1972; Raychaudhuri *et al.*, 1980)
    - *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Chakrabarti & Sarkar, 2001)
    - *Sitobion (Sitobion) alopecuri* (Takahashi, 1921) (David, 1975)
    - *Sitobion (Sitobion) miscanthi* (Takahashi, 1921) (Chakrabarti, 1972; David, 1975)
  - *Poa flexuosa* Sm.



- *Sipha (Rungsia) maydis* Passerini, 1860 (Chakrabarti & Debnath, 2009)
- *Polytoca* sp.
  - *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (Singh and Singh, 1985)
- *Saccharum officinarum* L.
  - *Aphis (Aphis) nerii* Boyer de Fonscolombe, 1841 (Suman and Suman, 2017)
  - *Forda orientalis* George, 1928 (Jasmine and Ananthanarayana, 1975)
  - *Micromyzodium dasi* Verma, 1970 (Chakrabarti & Debnath, 2009)
  - *Tetraneura (Indotetraneura) javensis* van der Goot, 1917 (Jasmine and Ananthanarayana, 1975)
- *Setaria* sp.
  - *Tetraneura (Indotetraneura) basui* Hille Ris Lambers, 1970 (Singh and Singh, 1985)
  - *Tetraneura (Tetraneura) kalimpongensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
  - *Tetraneura (Tetraneura) sikkimensis* Raychaudhuri, Pal & Ghosh, 1978 (Singh and Singh, 1985)
- *Sorghum bicolor* (L.) Moench (syn. *Sorghum vulgare* Pers.)
  - *Sitobion (Sitobion) leelamaniae* (David, 1958) (David, 1958)
  - *Forda hirsuta* Mordvilko, 1928 (David, 1958)
  - *Geoica lucifuga* (Zehntner, 1897) (George, 1924)
- *Triticum aestivum* L.
  - *Aphis (Aphis) nerii* Boyer de Fonscolombe, 1841 (Kataria and Kumar, 2012; Pawar, 2015)
- *Zea mays* L.
  - *Aphis (Aphis) nerii* Boyer de Fonscolombe, 1841 (Kataria and Kumar, 2012; Pawar, 2015)

### I. Order: Zingiberales

Zingiberales is one of an ecologically and

morphologically diverse and species-rich order of monocots having large rhizomatous herbaceous plants but lacking an aerial stem, except when flowering. The order contains 8 families, 130 genera and 3,043 species (WFO, 2022). The plants are used as ornamental plants (Bird of Paradise flower), food crops (bananas, plantains), spices and traditional medicines (ginger, cardamom, turmeric, galangal). In India, Zingiberales include only 5 families (Cannaceae, Costaceae, Marantaceae, Musaceae, Zingiberaceae), 32 genera and 293 species (BSI, 2022) and 15 species of plants of these five families are associated with aphids as stated below.

#### 1 Family: Cannaceae

The family includes single genus *Canna* L. having 19 species globally (WFO, 2022) but in India, only 8 species are known (BSI, 2022). Several cultivars of cannas are cultivated as garden plants as well as source of starch for human and pet animals. The only identified species known in India and is associated with 8 aphid species is *Canna indica* L. Six species of aphids are found on unidentified species of canna.

- *Canna indica* L. (syn. *Canna orientalis* Bouche)
  - *Hyalopterus pruni* (Geoffroy, 1762) (Raychaudhuri, 1978)
  - *Myzus (Myzus) ornatus* Laing, 1932 (Ghosh and Agarwala, 1980)
  - *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973; Ghosh and Agarwala, 1980)
  - *Neomyzus circumflexus* (Buckton, 1876) (Raychaudhuri, 1978; Ghosh and Agarwala, 1980)
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Raychaudhuri, 1978)
  - *Rhopalosiphum padi* (Linnaeus, 1758) (Raychaudhuri, 1978)
- *Canna* sp.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Banerjee and Basu, 1955; Raychaudhuri, 1973)
  - *Aphis (Aphis) spiraecola* Patch, 1914

(Agarwala, 1979)

- *Brachycaudus (Brachycaudus) helichrysi* (Kalt., 1843) (Raha, 1979)
- *Micromyzus kalimpongensis* Basu, 1968 (Basu, 1967)
- *Rhopalosiphum padi* (Linnaeus, 1758) (Raha, 1979; Raychaudhuri et al., 1980)
- *Sitobion (Sitobion) miscanthi* (Takahashi, 1921) (Chakrabarti and Sarkar, 2001)

## 2. Costaceae

The family Costaceae, also known as the Costus family or spiral ginger, contains 6 genera and 138 known species (WFO, 2022). In India, only one species, *Costus productus* Gleason ex Maas, cultivated at few places for its edible flowers, is also associated with a single species of aphid, *Aphis (Aphis) gossypii* Glover, 1877 (Rohini et al., 2018).

## 3. Family: Marantaceae

The Marantaceae, also known as arrowroot or prayer-plant family, includes 29 genera and 676 species in the world (WFO, 2022). They are specially known for their unique secondary pollination presentation. Some species of *Maranta* L. are well known for having digestible starch, the arrowroot. Many species of this family have multicolored leaves and hence are grown as ornamental plant in garden. However, in India, only 9 species are known under 6 genera among which only 2 species are associated with 2 species of aphids as mentioned below.

- *Goeppertia zebrina* Nees (syn. *Maranta zebrina* Sims.)
  - *Pentalonia nigronervosa* Coquerel, 1859 (Joshi and Poorani, 2007; Joshi, 2008)
- *Maranta leuconeura* E. Morren
  - *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Mall, 2013)

## 4. Family: Musaceae

The Musaceae, also known as banana family, includes only 3 genera and 102 species (WFO, 2022) and distributed in the tropics of Africa and Asia. They are largest herbaceous plants having leaves with overlapping basal sheaths that form a pseudostem. Banana is cultivated commercially while few species/cultivars are grown as

ornamental plants. In India, only 27 species under 2 genera are known but only following 5 species are associated with 7 species of aphids as stated below.

- *Ensete superbum* (Roxb.) Cheesman (syn. *Musa superba* Roxb.)
  - *Pentalonia nigronervosa* Coquerel, 1859 (David, 1956a; Selvarajan and Balasubramanian, 2013)
- *Musa acuminata* Colla (syn. *Musa cavendishii* Lamb.)
  - *Pentalonia nigronervosa* Coquerel, 1859 (David, 1956a; Vazhacharickal et al., 2019)
- *Musa balbisiana* Colla
  - *Pentalonia nigronervosa* Coquerel, 1859 (George, 1927; Vazhacharickal et al., 2019)
- *Musa ornata* Roxb.
  - *Pentalonia nigronervosa* Coquerel, 1859 (Poorani et al., 2022)
- *Musa paradisica* L.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973; Ghosh and Singh, 2004)
  - *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri, 1973)
  - *Capitophorus formosartemisiae* (Takahashi, 1921) (Chakrabarti and Sarkar, 2001)
  - *Lachnus* sp. (Behura, 1965)
  - *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973; Ghosh and Singh, 2004)
  - *Pentalonia nigronervosa* Coquerel, 1859 (David, 1956a; Raychaudhuri, 1980)
  - *Schoutedenia ralumensis* Rübsaamen, 1905 (Ganguli and Ghosh, 1965; Ghosh and Singh, 2004)
  - *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki, 1899) (Rao and Kulkarni, 1975; Suman and Suman, 2017)
- *Musa* spp.
  - *Aphis (Aphis) gossypii* Glover, 1877 (Rao, 1969)

- *Brachycaudus (Brachycaudus) helichrysi* (Kalt., 1843) (Raha, 1979)
- *Pentalonia nigronervosa* Coquerel, 1859 (Basu and Banerjee, 1958; Johnson, 1983)

### 5. Family: Zingiberaceae

Zingiberaceae, also known as the ginger family, is the largest family in the order Zingiberales comprising 86 genera and 1,852 species in the world (WFO, 2022) distributed mostly in the tropics of northern hemisphere. The species of this family are aromatic herbaceous perennial herbs with creeping horizontal or tuberous rhizomes. Several species are ornamental (shell ginger, summer tulip, globba, ginger lily), spice and medicinal plants (ginger, myoga, turmeric, cardamon). In India, the family is represented by 22 genera and 245 species (BSI, 2022) out of which 7 species of 7 genera are associated with 7 species of aphids. Two species, *Micromyzus kalimpongensis* Basu and *Pentalonia nigronervosa* Coquerel, each infests 5 species of plants of this family as stated below.

- *Alpinia versicolor* K.Schum.
  - *Pentalonia nigronervosa* Coquerel, 1859 (Joshi and Poorani, 2007)
- *Amomum subulatum* Roxb.
  - *Micromyzus kalimpongensis* Basu, 1968 (Basu, 1967)
- *Amomum* sp.
  - *Pentalonia nigronervosa* Coquerel, 1859 (Behura, 1965)
- *Curcuma longa* L. (syn. *Curcuma domestica* Velton)
  - *Aphis (Aphis) gossypii* Glover, 1877 (Basu and Banerjee, 1958; Agarwala, 1979)
  - *Micromyzus kalimpongensis* Basu, 1968 (Ghosh *et al.*, 1970; Raha and Raychaudhuri, 1981)
  - *Pentalonia nigronervosa* Coquerel, 1859 (Basu and Raychaudhuri, 1980; Suman and Suman, 2017)
  - *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Ghosh *et al.*, 1970; Basu and Raychaudhuri, 1980)
- *Elettaria cardamomum* (L.) Maton

- *Aphis (Aphis) gossypii* Glover, 1877 (Behura and Roy, 1980)
- *Micromyzus kalimpongensis* Basu, 1968 (Basu and Raychaudhuri, 1980; Mondal *et al.*, 1978)
- *Pentalonia nigronervosa* Coquerel, 1859 (David, 1956a; Suman and Suman, 2017)
- *Globba* sp.
  - *Sitobion (Sitobion) takahashii* (Eastop, 1959) (Kar *et al.*, 1990)
- *Hedychium coronarium* J. Koeing
  - *Micromyzus kalimpongensis* Basu, 1968 (Basu, 1967; Raychaudhuri, 1980)
- *Hedychium* sp.
  - *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)
  - *Pentalonia nigronervosa* Coquerel, 1859 (Raychaudhuri, 1980)
- *Zingiber officinale* Roscoe
  - *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973; Ghosh and Singh, 2004)
  - *Cavariella (Cavariella) aegopodii* (Scopoli, 1763) (Basu *et al.*, 1972; Ghosh and Singh, 2004)
- *Zingiber* sp.
  - *Micromyzus kalimpongensis* Basu, 1968 (Agarwala, 1979)

Table 2 summarise the number of families, genera and species of plants belonging to the monocots of flowering plants infested by different species of aphids (subfamily-wise) in India. A total of 102 species of aphids are found associated with monocots plants excluding the list prepared by Singh *et al.* (2014). It demonstrates that *Aphis (Aphis) gossypii* Glover is highly polyphagous infesting 25 species of plants belonging to 15 families of monocots followed by *Pentalonia nigronervosa* (16 species), *Hysteronera setariae* (Thomas) and *Myzus (Nectarosiphon) persicae* (Sulzer) (7 species each) and *Aphis (Toxoptera) aurantii* Boyer de Fonsc. and *Myzus (Myzus) ornatus* Laing (6 species each); and other aphid species infest 1 to 5 species of plants.

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

Subfamily/Aphid species	Plants infested by aphids		
	Families	Genera	Species
<b>A. Subfamily: Aphidinae</b>			
1. <i>Acutosiphon obliquoris</i>	2	2	4
2. <i>Aphis (Aphis) craccivora</i>	2	2	3
3. <i>Aphis (Aphis) fabae</i>	2	2	2
4. <i>Aphis (Aphis) gossypii</i>	15	22	26
5. <i>Aphis (Aphis) nasturtii</i>	2	2	2
6. <i>Aphis (Aphis) nerii</i>	1	3	3
7. <i>Aphis (Aphis) punicae</i>	1	1	1
8. <i>Aphis (Aphis) spiraecola</i>	4	4	4
9. <i>Aphis (Aphis) umbrellae</i>	2	2	2
10. <i>Aphis (Aphis) verbasci</i>	1	1	1
11. <i>Aphis (Toxoptera) aurantii</i>	3	4	6
12. <i>Aulacorthum (Aulacorthum) solani</i>	3	3	3
13. <i>Aulacorthum (Neomyzus) dendrobii</i>	1	1	1
14. <i>Brachycaudus (Brachycaudus) helichrysi</i>	4	4	4
15. <i>Brachysiphoniella montana</i>	1	1	1
16. <i>Brevicoryne brassicae</i>	1	1	1
17. <i>Capitophorus formosartemisiae</i>	1	1	1
18. <i>Carolinaia (Juncomyzus) scirpi</i>	1	1	1
19. <i>Cavariella (Cavariella) aegopodii</i>	1	1	1
20. <i>Cavariella (Cavariella) aquatica</i>	1	1	1
21. <i>Dysaphis (Dysaphis) tulipae</i>	1	1	1
22. <i>Hyalopterus pruni</i>	1	1	1
23. <i>Hydroneura colocasiae</i>	1	1	1
24. <i>Hysteroneura setariae</i>	4	6	7
25. <i>Impatientinum (Impatientinum) asiaticum</i>	1	1	1
26. <i>Impatientinum (Impatientinum) asiaticum dalhousiensis</i>	1	1	1
27. <i>Impatientinum (Impatientinum) impatiens</i>	1	1	1
28. <i>Kaochiaoja sikkimensis</i>	1	1	1
29. <i>Lipaphis (Lipaphis) erysimi</i>	1	1	1
30. <i>Macrosiphum (Macrosiphum) euphorbiae</i>	1	1	1
31. <i>Matsumuraja capitophoroides</i>	1	1	1
32. <i>Melanaphis donacis</i>	1	1	1

Subfamily/Aphid species	Plants infested by aphids		
	Families	Genera	Species
33. <i>Melanaphis meghalayensis meghalayensis</i>	1	1	1
34. <i>Metopolophium (Metopolophium) chandrani</i>	1	1	1
35. <i>Micromyzodium dasi</i>	1	1	1
36. <i>Micromyzus kalimpongensis</i>	3	7	7
37. <i>Myzus (Myzus) cerasi umefoliae</i>	1	1	1
38. <i>Myzus (Myzus) hemerocallis</i>	2	2	2
39. <i>Myzus (Myzus) ornatus</i>	5	6	7
40. <i>Myzus (Nectarosiphon) persicae</i>	7	7	7
41. <i>Neomyzus circumflexus</i>	2	3	4
42. <i>Pentalonia caladii</i>	1	1	1
43. <i>Pentalonia nigronervosa</i>	4	10	16
44. <i>Pseudaphis abyssinica</i>	1	1	1
45. <i>Pseudomegoura magnoliae</i>	1	1	1
46. <i>Rhopalosiphoninus (Myzosiphon) smilacifoliae</i>	1	1	1
47. <i>Rhopalosiphum maidis</i>	4	4	4
48. <i>Rhopalosiphum nymphaeae</i>	9	13	15
49. <i>Rhopalosiphum padi</i>	3	5	9
50. <i>Rhopalosiphum rufiabdominale</i>	3	3	6
51. <i>Schizaphis (Schizaphis) graminum</i>	1	1	3
52. <i>Schizaphis (Schizaphis) hypersiphonata</i>	1	1	2
53. <i>Schizaphis (Schizaphis) minuta</i>	1	1	1
54. <i>Schizaphis (Schizaphis) rotundiventris</i>	2	2	5
55. <i>Sinomegoura citricola</i>	1	1	1
56. <i>Sinomegoura rhododendri</i>	1	1	1
57. <i>Sipha (Rungsia) maydis</i>	1	1	1
58. <i>Sitobion (Sitobion) africanum</i>	1	3	3
59. <i>Sitobion (Sitobion) alopecuri</i>	1	1	1
60. <i>Sitobion (Sitobion) avenae</i>	1	3	3
61. <i>Sitobion (Sitobion) fragariae</i>	1	3	3
62. <i>Sitobion (Sitobion) graminis</i>	1	1	1
63. <i>Sitobion (Sitobion) indicum</i>	2	12	22
64. <i>Sitobion (Sitobion) leelamaniae</i>	1	1	1
65. <i>Sitobion (Sitobion) luteum</i>	2	12	20
66. <i>Sitobion (Sitobion) mimosae</i>	1	1	1
67. <i>Sitobion (Sitobion) miscanthi</i>	4	4	6

Subfamily/Aphid species	Plants infested by aphids		
	Families	Genera	Species
68. <i>Sitobion (Sitobion) pseudoluteum</i>	1	1	3
69. <i>Sitobion (Sitobion) rosaeiformis</i>	2	2	2
70. <i>Sitobion (Sitobion) sikkimense</i>	1	1	2
71. <i>Sitobion (Sitobion) smilacicola</i>	1	1	1
72. <i>Sitobion (Sitobion) takahashii</i>	1	1	1
73. <i>Uroleucon (Uromelan) jaceae</i>	1	1	1
74. <i>Vesiculaphis caricis</i>	1	1	1
75. <i>Vesiculaphis sikkimensis</i>	1	1	2
<b>B. Subfamily: Calaphidinae</b>			
76. <i>Saltusaphis scripus</i>	1	1	2
77. <i>Takecallis himalayensis</i>	1	1	1
78. <i>Therioaphis (Therioaphis) ononidis</i>	1	1	1
79. <i>Therioaphis (Therioaphis) trifolii</i>	1	1	1
<b>C. Subfamily: Eriosomatinae</b>			
80. <i>Chaetogeoica graminiphaga</i>	1	1	1
81. <i>Chaetogeoica polychaeta</i>	1	1	1
82. <i>Forda hirsuta</i>	1	1	1
83. <i>Forda marginata</i>	1	1	1
84. <i>Forda orientalis</i>	1	2	2
85. <i>Geoica lucifuga</i>	3	5	5
86. <i>Geoica sikkimensis</i>	1	2	2
87. <i>Patchiella reaumuri</i>	1	1	1
88. <i>Tetraneura (Indotetraneura) basui</i>	1	7	7
89. <i>Tetraneura (Indotetraneura) javensis</i>	1	1	1
90. <i>Tetraneura (Tetraneura) kalimpongensis</i>	2	3	3
91. <i>Tetraneura (Tetraneurella) nigriabdominalis</i>	3	3	3
92. <i>Tetraneura (Tetraneura) sikkimensis</i>	1	4	4
<b>D. Subfamily: Greenideinae</b>			
93. <i>Greenidea (Greenidea) ficicola</i>	1	1	1
94. <i>Schoutedenia ralumensis</i>	1	1	1
<b>E. Subfamily: Hormaphidinae</b>			
95. <i>Astegopteryx bambusae</i>	1	2	3
96. <i>Astegopteryx rhapsidis</i>	1	1	1
97. <i>Cerataphis brasiliensis</i>	1	1	1
98. <i>Cerataphis lataniae</i>	1	1	1

Subfamily/Aphid species	Plants infested by aphids		
	Families	Genera	Species
99. <i>Cerataphis orchidearum</i>	1	4	4
100. <i>Ceratovacuna cynodonti</i>	1	1	1
101. <i>Tuberaphis xinglongensis</i>	1	1	1
<b>F. Subfamily: Lachninae</b>			
102. <i>Lachnus sp.</i>	1	1	1

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