Article

Food-plant catalogue of aphids (Aphididae: Homoptera) on malvids clade (Angiosperms: Eudicots: Eurosids) of flowering plants in India

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Received 11 January 2023; *Accepted 15 March 2023*; *Published online 5 March 2023*; *Published 1 June 2023*

Abstract
This article deals with the aphids infesting plants belonging to the clade malvids that includes 5 orders of eudicot angiosperms in India which are associated with aphids. This clade includes several highly economically important fruit trees (cashew, pistachio, mango, litchi, neem, lemon, orange, papaya, pomegranate, guava, jamun etc.), vegetable crops (cabbage, cauliflower, kale, radish etc.), oil seeds (mustard), textile fibres (jute, cotton), spices (cloves), medicinal plants (arjuna), essential oils (eucalyptus) etc. A total of 150 species of aphids belonging to 71 genera and 11 subfamilies were recorded to infest 172 species of this clade of flowering plants belonging to 105 genera, 21 families and 5 orders. Most of the aphids belong to the subfamily Aphidinae (38 genera, 80 species) and tribe Macrosiphini (36 genera, 54 species) followed by Greenideinae (6 genera, 23 species) and tribe Greenideini (3 genera, 20 species). Greenideinae are mostly associated with the family Myrtaceae. The maximum number of species of aphids utilise the plants belonging to the family Malvaceae (36 species of 22 genera) followed by Brassicaceae (23 species of 15 genera), Rutaceae (19 species of 10 genera), Anacardiaceae (15 species of 10 genera), Lythraceae (11 species of 8 genera), and Sapindaceae (11 species, of 5 genera), Myrtaceae (10 species of 5 genera) and remaining 14 families having less than 10 species of plants associated with aphids.

Keywords Aphididae; aphids, Brassicales; checklist; food plant associatetion; Geraniales; Malvales; Myrtales.

Arthropods
ISSN 2224-4255
URL: http://www.iaees.org/publications/journals/arthropods/online-version.asp
RSS: http://www.iaees.org/publications/journals/arthropods/rss.xml
E-mail: arthropods@iaees.org
Editor-in-Chief: WenJun Zhang
Publisher: International Academy of Ecology and Environmental Sciences

1 Introduction

The malvids are the one of the clade of eurosids which itself are a clade of rosids (core eudicots: angiosperms) which are systematically relatively well circumscribed and represent the largest subclade of core eudicots in terms of number of orders and families (Endress, 2010). Another clade of eurosids is fabids with uncertain circumscription. The malvids are made up of 8 orders: Brassicales, Crossosomatales, Geraniales, Huerteales, Malvales, Myrtales, Picramniales and Sapindales (APG IV, 2016) (Fig. 1). The malvids are easier to

characterize in floral structure than fabids. Picramniales, Sapindales, Huerteales, and many Brassicales have predominantly small flowers with commonly the presence of functionally unisexual flowers. Contorted petal, aestivation and polystemony are relatively common in most of the malvids (Endress, 2010).

The aphids (Hemiptera: Aphididae) are small, plant sap-sucking bugs and its many species are injurious to crops, orchards, ornamentals etc. (Fig. 1). Their small size, complex life-cycles with alternation of sexual and asexual generations, host plant alternation, polymorphism, short and telescopic generations are the major traits that make them highly prolific in reproduction (Singh and Singh, 2022a). They not only suck the nutrients out of the plants but also obstruct their normal physiology by secreting a high amount of honeydew that blocks stomata and promotes growth of black sooty moulds. In addition, they also transmit hundreds of viral diseases (Singh and Singh, 2021). Presently, all aphids belong to a single family Aphididae comprising 23 subfamilies and 5109 species belonging to 527 genera (Favret, 2023). In India, 794 species of aphids included in 208 genera have been recorded (Singh and Singh, 2019).

Fig. 1 A. Spirea aphid (*Aphis (Aphis) spiraecola* Patch), B. Cabbage aphid (*Brevicoryne brassicae* Linnaeus), C. Guava aphid (*Greenidea (Greenidea) ficicola* Takahashi), D. Cotton aphid (*Aphis (Aphis) gossypii* Glover), E. Green Peach aphid (*Myzus (Nectarosiphon) persicae* (Sulzer)), and F. Black bean aphid (*Aphis (Aphis) craccivora* Koch) on their respective food plant.

The catalogue of aphids and their food plants is a database that provides an index of known species of aphids associated with a known species of plants. As several species of aphids are notorious crop pests, their cataloguing along with their food plants is important. Food plants of Indian aphids were long back catalogued by Raychaudhuri (1983) and updated by Chakrabarti and Sarkar (2001). Recently, Singh (2023a, b), Singh and Agrawal (2021, 2022a, b, 2023), Singh and Khan (2022), Singh and Singh (2022b, c), Singh and Srivastava (2022a, b, c, d) and Singh et al. (2023a, b) compiled the checklist of aphids associated with different clades/order/families of plants. The present article deals with the aphids infesting food plants belonging to the malvids clade in the eudicots angiosperms (Fig. 2) recorded in India.

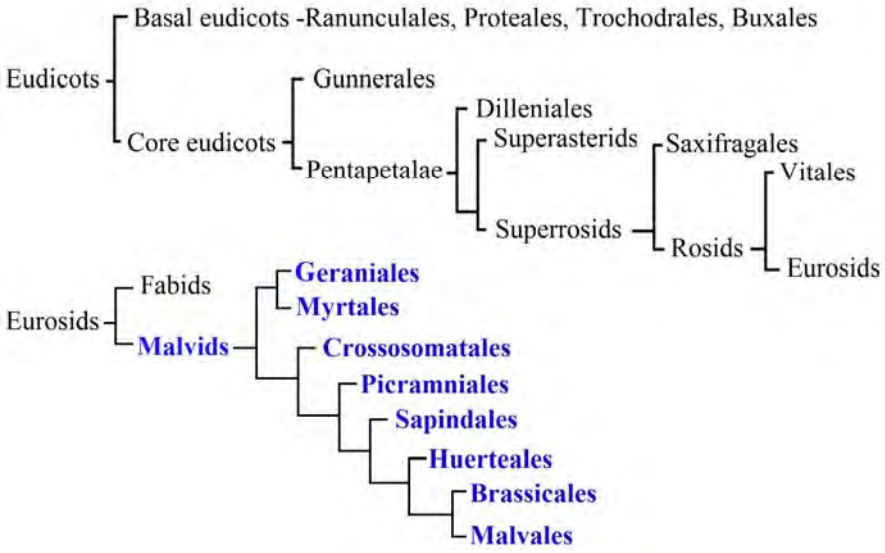

Fig. 2 Cladogram of subclades of eudicots (after APG, 2016) showing the relationships between orders of the clade malvids.

2 Materials and Methods

The aphids and host plant records in this checklist are taken from wide resources such as books, journals, proceedings, few authentic theses and websites up to January 10, 2023. It may inevitably contain some percentage of misidentifications, both of aphids and their host plants. Some aphid species may also be vagrant individuals on a given host plant. 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. If the specific name of the plant is invalid, only a generic name is given. In the present checklist, attempts have been made to present the valid scientific names of the aphids following Favret (2023), and of the plants following World Flora Online (WFO, 2023). In the first inventory of plant names, their synonyms recorded in India are also provided. For the synonymies of the aphids, Favret (2023) should be consulted. If an aphid species is identified only up to a generic level, it is considered as species if no other species of that genus is reported on that host plant and vice versa. Multiple references are avoided.

3 Results and Discussion

Eudicots flowering plants that belong to the clade malvids are distributed in 5 orders in India: Brassicales, Geraniales, Malvales, Myrtales and Sapindales (APG, 2016). Table 1 displays the number of plant species belonging to different families of the clade malvids in the world and in India; number of host plant species of each family infested by aphids; and the number of aphid species infesting these plants in India. It demonstrates

that the maximum number of species of aphids utilise the plants belonging to the family Malvaceae (36 species of 22 genera) followed by Brassicaceae (23 species of 15 genera), Rutaceae (19 species of 10 genera), Anacardiaceae (15 species of 10 genera), Lythraceae (11 species of 8 genera), and Sapindaceae (11 species, of 5 genera), Myrtaceae (10 species of 5 genera) and other 14 families having less than 10 species of plants associated with aphids.

Table 1 Number of plant species belonging to the different families of two orders of malvids clade of eurosids, Brassicales and Geraniales in the world and in India; number of host plant species of each family infested by aphids; and the number of aphid species infesting these plants in India.

Orders/Families	**Recorded in the world (WFO, 2023)**		**Recorded in India (BSI, 2023; eFOI, 2023)**		**Plants infested with aphids in India**		**Aphids infesting plants in India**	
	Genera	**Species**	**Genera**	**Species**	**Genera**	**Species**	**Genera**	**Species**
Order: Brassicales								
Brassicaceae	372	4060	76	276	15	23	15	31
Capparaceae	18	475	8	65	3	4	4	6
Cleomaceae	3	278	2	15	1	2	5	6
Moringaceae	1	14	1	3	1	1	1	3
Tropaeolaceae	1	109	1	1	1	1	4	5
Total	395	4936	88	360	21	31		
Order: Geraniales								
Geraniaceae	7	1236	4	47	3	8	16	21
Order: Malvales								
Dipterocarpaceae	18	565	5	31	1	2	1	2
Malvaceae	245	4465	25	116	22	36	20	32
Thymelaeaceae	54	938	14	23	4	4	3	5
Total	317	5968	44	170	27	42		
Order: Myrtales								
Combretaceae	11	660	5	46	2	6	9	13
Lythraceae	32	620	9	69	8	11	11	29
Melanostomataceae	185	6650	14	105	3	5	6	10
Myrtaceae	145	6045	21	217	5	10	10	27
Onagraceae	35	780	6	72	4	6	6	11
Total	408	14755	55	509	22	38		
Order Sapindales								
Anacardiaceae	77	701	24	74	10	15	13	23
Burseraceae	18	649	7	12	1	1	1	1
Meliaceae	52	669	23	80	4	5	5	8
Nitrariaceae	3	12	1	1	1	1	3	3
Rutaceae	158	1730	33	87	10	19	8	22
Sapindaceae	138	1751	22	57	5	11	8	24
Simaroubaceae	19	121	4	8	1	1	5	5
Total	465	5633	114	319	32	53	30	67

Table 2 demonstrates that 150 species of aphids belonging to 71 genera and 11 subfamilies were recorded to infest 172 species of malvids clade of eudicots flowering plants belonging to 105 genera, 21 families and 5 orders. Most of the aphids belong to the subfamily Aphidinae (38 genera, 80 species) and tribe Macrosiphini (36 genera, 54 species) followed by Greenideinae (6 genera, 23 species) and tribe Greenideini (3 genera, 20 species). Greenideinae are mostly associated with the family Myrtaceae.

Table 2 Number of aphid species belonging to different subfamilies/tribes including Brassicaceae (Singh and Agrawal, 2022a) and Sapindales (Singh et al., 2023) infesting plants in the malvids clade of eudicot angiosperms in India.

Subfamiles/tribes of Aphididae		**Number of aphid species**		**Total number of aphid species**	
Subfamilies	**Tribes**	**Genera**	**Species**	**Genera**	**Species**
Aiceoninae	-	1	1	1	1
Aphidinae	Aphidini	2	26		
	Macrosiphini	36	54	38	80
Calaphidinae	Calaphidini	2	3		
	Myzocallidini	1	1		
	Panaphidini	2	2		
	Therioaphidini	2	5	7	11
Chaitophorinae	Chaitophorini	2	14	2	14
Drepanosiphinae		2	4	2	4
Eriosomatinae	Eriosomatini	1	1		
	Fordini	5	7		
	Pemphigini	3	3	9	11
Greenideinae	Cervaphidini	2	2		
	Greenideini	3	20		
	Schoutedeniini	1	1	6	23
Hormaphidinae	Cerataphidini	3	3	3	3
Lachninae	Lachnini	1	1	1	1
Lizeriinae	-	1	1	1	1
Taiwanaphidinae	-	1	1	1	1
			Total	71	150

The detailed catalogue of host plants (orderwise, familywise) and aphid species are given below.

3.1 Order: Brassicales

The common character of almost all Brassicales is the production of glucosinolate compounds. It includes 12 families, but only 8 families are represented in India and 5 of them (Brassicaceae, Capparaceae, Cleomaceae, Moringaceae, Tropaeolaceae) are associated with aphids. The number of families along with genera and species recorded in the world and India are given in Table 1 which is associated with aphids in India. Table 1 demonstrates that 32 species of aphids belonging to 16 genera use 31 species of plants belonging to 21 genera of this order. The number of species of plants of these families and the numbers of species of aphids that use them as host plants in India are also given in Table 1.

3.1.1 Family: Brassicaceae

Brassicaceae is a highly economically important family, being mostly herbaceous or shrubs, and includes 372 genera and 4,060 accepted species (WFO, 2023). The family contains several agricultural crops, particularly the vegetables such as broccoli, cabbage, cauliflower, collards, kale (*Brassica oleracea* L.); Chinese cabbage, turnip (*Brassica rapa* L.); radish (*Raphanus sativus* L.); rocket salad/arugula (*Eruca vesicaria* (L.) Cav.); garden cress (*Lepidium sativum* l.); watercress (*Nasturtium officinale* R. Br.); oil seeds (*Brassica napus* L., rapeseed, possibly providing the largest volume of vegetable oils), *Sinapis alba* L. (white/yellow mustard), *Brassica juncea* (L.) Czern. (Indian mustard or brown mustard), *Brassica nigra* (L.) K. Koch (black mustard); few ornamental plants etc. Except in Antarctica and some parts of the tropics, the family Brassicaceae can be found everywhere on earth. The aphid association of this family has recently been documented by Singh and Agrawal (2022a) who stated that at least 23 species of plants of 15 genera of this family are infested by 31 species of aphids of 15 genera belonging to a single subfamily Aphidinae in India (Table 1). The maximum number of aphid species were found to colonise *Brassica oleracea* L. and *Raphanus sativus* L. (15 species each), followed by *Brassica napus* L. (9 species). Similarly, the maximum number of plant species (19 plant species) were infested by most pestiferous species, *Myzus (Nectarosiphon) persicae* (Sulzer), followed by *Lipaphis (Lipaphis) erysimi* (Kaltenbach) (18 plant species) and *Brevicoryne brassicae* L. (15 plant species) that always warrant their control measures in agriculture.

3.1.2 Family: Capparaceae

Capparaceae, commonly known as the caper family, comprises 18 genera and about 475 species, having a great variety of woody and herbaceous life forms and are mostly distributed in the tropics and subtropics of the world. It includes the medicinally important fruit crop, papaya (*Carica papaya* L.). In India, the family is represented by 8 genera and 65 species, out of which only 3 genera and 4 species are recorded as host plant of 6 species of aphids belonging to 4 genera (Table 1) as mentioned below.

3.2.1.1 *Capparis divaricata* Lam. (syn. *Capparis stylosa* DC.)

• *Aphis (Aphis) gossypii* Glover, 1877 (David, 1957a)

3.2.1.2 *Capparis spinosa* var. *canescens* Coss. syn. *Capparis leucophylla* DC.)

• *Aphis (Aphis) gossypii* Glover, 1877 (Kar et al., 1990)

3.2.1.3 *Crateva religiosa* G. Forst.

• *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843) (Raychaudhuri, 1973)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)

3.2.1.4 *Carica papaya* L.

• *Aphis (Aphis) craccivora* Koch, 1854 (Ghosh and Singh, 2004; Verghese et al., 2007)

• *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh and Singh, 2004; Verghese et al., 2007)

• *Aphis (Aphis) nerii* Boyer de Fonscolombe, 1841 (Paul Khurana and Bhargav, 1971)

• *Lipaphis (Lipaphis) pseudobrassicae* (Davis, 1914) (Paul Khurana and Bhargav, 1971)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Verghese et al., 2007; Suman and Suman, 2017)

3.1.3 Family: Cleomaceae

Cleomaceae is a small family comprising 278 species in 3 genera, mostly annual, herbaceous plants, and usually have glands that contain resins, and may have an aromatic or foetid smell. In India, only 15 species in 2 genera are recorded (eFOI, 2023) and among them only 2 species of type genus *Cleome* L. are found associated with 6 species of aphids in 5 genera (Table 1) as stated below.

3.1.3.1 *Cleome chelidonii* L.f.

• *Aphis (Aphis) gossypii* Glover, 1877 (Behura, 1963; David, 1956)

3.1.3.2 *Cleome gyandra* L. (syn. *Cleome pentaphylla* L.)

• *Aphis (Aphis) craccivora* Koch, 1854 (Behura, 1963; David, 1957a)

• *Aphis (Aphis) gossypii* Glover, 1877 (David, 1957a; Behura, 1963)
• *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843) (Raychaudhuri, 1973)
• *Brevicoryne brassicae* (Linnaeus, 1758) (Joshi and Poorani, 2007)
• *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) (David, 1957b; Behura, 1963)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (David, 1957b; Behura, 1963)

3.1.4 Family: Moringaceae

Moringaceae, or the horseradish tree family, is a woody, often quite stout-stemmed shrub or tree containing type genus *Moringa* Adans. including 14 species (WFO, 2023), and distributed in India, Madagascar, northeast and southwest Africa, and Arabia. In India, only 3 species of *Moringa* Adans. are recorded, out of which the *Moringa oleifera* Lam., a medicinal plant, is infested with 3 species of aphids (Table 1) as given below.

3.1.4.1 *Moringa oleifera* Lam.

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Ghosh, 1975)
• *Aphis (Aphis) craccivora* Koch, 1854 (Ahmad and Kumar, 2006; Joshi et al., 2016; Chandrakar and Gupta, 2020)
• *Aphis (Aphis) gossypii* Glover, 1877 (Usha Rani et al., 2010)

3.1.5 Family: Tropaeolaceae

The Tropaeolaceae is a very small and monotypic family containing 109 species in the genus *Tropaeolum* L. In India, only a single species is recorded to host 5 species of aphids in 4 genera (Type 1) as mentioned below.

3.1.5.1 *Tropaeolum majus* L.

• *Aphis (Aphis) gossypii* Glover, 1877 (Behura, 1965)
• *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) (Behura, 1965; Ghosh and Raychaudhuri, 1962)
• *Myzus (Myzus) ornatus* Laing, 1932 (Raychaudhuri, 1973)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)
• *Neomyzus circumflexus* (Buckton, 1876) (Ghosh and Raychaudhuri, 1968; Basu et al., 1972)

3.2 Order: Geraniales

Geraniales is a small order of the rosid subclade of eudicots flowering plants including two families, Francoaceae containing only 5 genera and 33 species, and the Geraniaceae having 7 genera and about 1236 species (WFO, 2023). Table 1 shows that 21 species of aphids belonging to 16 genera use 8 species of plants belonging to 3 genera of this order. In India, only the type family is recorded.

3.2.1 Family: Geraniaceae

The family Geraniaceae comprises about 1236 species in 7 genera (WFO, 2023) mostly distributed in temperate or warm temperate regions. Only a few geraniums are ornamental as well as few have medicinal importance. In India, the family is represented by 47 species in 4 genera and among them, 8 species in 3 genera are associated with 21 species of aphids in 16 genera (Table 1). Two species of aphids, *Indoidiopterus geranii* (Chowdhuri et al. 1969) and *Macrosiphum (Macrosiphum) pseudogeranii* Chakrabarti and Raychaudhuri, 1974) are strictly host specific, while others are polyphagous infesting plants belonging to different lineages. The detail checklist of food plants and aphids is given below.

3.2.1.1 *Erodium trifolium* (Cav.) Guitt.

• *Aphis (Aphis) odinae* (van der Goot, 1917) (Stary and Ghosh, 1979)

3.2.1.2 *Geranium divaricatum* Ehrh.

• *Indoidiopterus geranii* (Chowdhuri, Basu, Chakrabarti and Raychaudhuri, 1969) (Chowdhuri et al., 1969)
• *Micromyzodium filicium* David, 1958 (Ghosh, 1977)

3.2.1.3 *Geranium lucidum* L.

• *Cavariella (Cavariella) konoi* Takahashi, 1939 (Ghosh, 1977)

• *Macrosiphum (Macrosiphum) pseudogeranii* Chakrabarti and Raychaudhuri, 1974 (Chowdhuri et al., 1969; hosh, 1977a)
• *Micromyzodium filicium* David, 1958 (Ghosh, 1972; Ghosh, 1977)

3.2.1.4 *Geranium nepalense* Sweet

• *Aphis (Aphis) fabae* Scopoli, 1763 (Chakrabarti and Sarkar, 2001)
• *Macrosiphum (Macrosiphum) pseudogeranii* Chakrabarti and Raychaudhuri, 1974 (David, 1975; Maity and Chakrabarti, 1979)
• *Maculolachnus blackmani* Kanturski and Chakrabarti, 2022 (Kanturski and Chakrabarti, 2022)

3.2.1.5 *Geranium ocellatum* Jacquem. ex Cambess.

• *Aphis (Aphis) gossypii* Glover, 1877 (Chakrabarti, 1972)
• *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843) (Raychaudhuri, 1973)
• *Indoidiopterus geranii* (Chowdhuri, Basu, Chakrabarti and Raychaudhuri, 1969) (Chakrabarti et al., 1972b)
• *Myzus (Myzus) ornatus* Laing, 1932 (Chakrabarti, 1972)

3.2.1.6 *Geranium robertianum* L.

• *Indoidiopterus geranii* (Chowdhuri, Basu, Chakrabarti and Raychaudhuri, 1969) (Chakrabarti and Sarkar, 2001))

3.2.1.7 *Geranium wallichianum* D.Don

• *Indoidiopterus geranii* (Chowdhuri, Basu, Chakrabarti and Raychaudhuri, 1969) (Ghosh, 1977)
• *Macrosiphum (Macrosiphum) pseudogeranii* Chakrabarti and Raychaudhuri, 1974 (Ghosh, 1977)

3.2.1.8 *Geranium* spp.

• *Acutosiphon obliquoris* Basu, Ghosh and Raychaudhuri, 1970 (Chakrabarti et al., 1972a)
• *Acyrthosiphon (Acyrthosiphon) malvae* (Mosley, 1841) (Raychaudhuri, 1973)
• *Aphis (Aphis) craccivora* Koch, 1854 (Bhalla and Pawar, 1980; Sharma and Bhalla. 1964)
• *Capitophorus carduinus* (Walker, 1850) (Ghosh et al., 1970; Raychaudhuri, 1973)
• *Cavariella (Cavariella) aegopodii* (Scopoli, 1763) (Ghosh, 1986)
• *Cryptaphis geranicola* Shinji, 1935) (Ghosh, 1975)
• *Dysaphis (Cotoneasteria) microsiphon* (Nevsky, 1929) (Chakrabarti and Medda, 1993)
• *Indoidiopterus geranii* (Chowdhuri, Basu, Chakrabarti and Raychaudhuri, 1969) (Chakrabarti et al., 1972b; Chakrabarti and Raychaudhuri, 1975a)
• *Macrosiphoniella (Macrosiphoniella) sanborni* (Gillette, 1908) (Raychaudhuri, 1973)
• *Macrosiphum (Macrosiphum) pseudogeranii* Chakrabarti and Raychaudhuri, 1974 (Chakrabarti, 1972)
• *Myzus (Myzus) ornatus* Laing, 1932 (Raychaudhuri, 1973)
• *Thecabius (Thecabius) affinis* (Kaltenbach, 1843) (Chakrabarti and Maity, 1978)

3.2.1.9 *Pelargonium zonale* (L.) L'Hér.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)

3.2.1.10 Unidentified species

• *Impatientinum (Impatientinum) impatiens* (Shinji, 1922) (Ghosh and Raychaudhuri, 1970)

3.3 Order: Malvales

The order Malvales includes about 6455 species in 348 genera within 10 families WFO, 2023). The plants of this family are mostly shrubs and trees having almost a cosmopolitan distribution in the tropics and subtropics. The order includes economically important plants such as daphnes, hibiscus, hollyhocks, okra, jute, baobab trees, cotton, kapok, and durian. Among the 10 families of the order, 7 families were recorded in India and 3 families were associated with aphids (Table 1). Table 1 displays that 34 species of aphids belonging to 19

genera use 42 species of plants belonging to 27 genera of this order as stated below.

3.3.1 Family: Dipterocarpaceae

The family Dipterocarpaceae includes 18 genera and about 565 valid species (WFO, 2023) of mainly tropical lowland rainforest trees and is distributed widely in South America, Africa, India, China, Indonesia, Malayasia and Philippines. Several species are large reaching heights of 40-80 m, and are highly economically important as they supply valuable woods, aromatic essential oils, balsam, and resins, and are a source for plywood. In India, out of 31 species in 5 genera known (Table 1), only 2 species of *Shorea* Roxb. ex C.F.Gaertn. (sal) are infested by 2 species of aphids as given below.

3.3.1.1 *Shorea robusta* C.F. Gaertn.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Rao and Kulkarni, 1977)

3.3.1.2 *Shorea roxburghii* G.Don (syn. *Shorea talura* Roxb.)

• *Aphis (Aphis) gossypii* Glover, 1877 (Krishnamurthi, 1929; Behura, 1963)

3.3.2 Family: Malvaceae

The Malvaceae, also known as the mallows family, is a large heterogenous family comprising 245 genera with 4465 valid species (WFO, 2023) which are mostly herbaceous plants or shrubs. Most of the members are highly economically important crops as they yield vegetables (okra), textile fibres (cotton), cacao and durian. Many of them are ornamental also, e.g., hollyhock, mallow, and lime or linden tree. Both of the crops, okra and cotton, are heavily infested with several species of aphids, particularly *Aphis (Aphis) gossypii* Glover (Singh et al., 2014). Three species, *Abelmoschus esculentus* Moench and *Hibiscus rosa-sinensis* L. are more vulnerable for aphid attack as they are associated with 9 and 16 species of aphids, respectively. *Aphis (Aphis) gossypii* Glover and *Myzus (Nectarosiphon) persicae* (Sulzer) are highly polyphagopus on malvaceous crops as they feed 30 and 14 species of plants, respectively. Out of 116 species of plants in 25 genera that are known in India, only 36 species in 22 genera are associated with 32 species of aphids in 20 genera (Table 1) as mentioned below.

3.3.2.1 *Abelmoschus esculentus* Moench

• *Aphis (Aphis) craccivora* Koch, 1854 (Singh et al., 1999; Ahmad et al., 2020)

• *Aphis (Aphis) gossypii* Glover, 1877 (Agarwala et al., 1980; Singh et al., 1999)

• *Aphis (Aphis) longisetosa* Basu, 1969 (1970) (Agarwala et al., 1981)

• *Aphis (Aphis) odinae* (van der Goot, 1917) (Mondal et al., 1976)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Lefroy and Howlett, 1909)

• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Devi et al., 1986)

• *Aulacorthum (Aulacorthum) solani* (Kaltenbach, 1843) (Khan and Shah, 2017)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Verma et al., 1975; Khan and Shah, 2017)

3.3.2.2 *Abroma augustum* (L.) L.f.

• *Aphis (Aphis) gossypii* Glover, 1877 (Bhagat, 2012; Khan and Shah, 2017)

3.3.2.3 *Abutilon indicum* (L.) Sweet

• *Aphis (Aphis) gossypii* Glover, 1877 (GhulamUllah, 1940; Verma et al., 1975)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Mall, 2013)

• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)

• *Brachyunguis (Brachyunguis) calotropicus* Menon and Pawar, 1958 (Verma et al., 1975)

3.3.2.4 *Alcea rosea* L. (syn. *Althaea rosea* Cav.)

• *Aphis (Aphis) gossypii* Glover, 1877 (Basu, and Banerjee, 1958)

• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)
• *Macrosiphum (Macrosiphum) euphorbiae* (Thomas, 1878) (Ghosh, 1977; Bhalla and Pawar, 1980)
• *Metopolophium* sp. (Chowdhuri et al., 1970; Ghosh, 1977)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ghulam-Ullah, 1940; Sengupta et al., 1962)
• *Semiaphis* sp. (Raychaudhuri, 1973)

3.3.2.5 *Bombax ceiba* L. (syn. *Bombax malabaricum* DC.)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Raha, 1979)

3.3.2.6 *Corchorus capsularis* L.
• *Aphis (Aphis) gossypii* Glover, 1877 (Basu, and Banerjee, 1958; Raychaudhuri, 1973)

3.3.2.7 *Corchorus olitorius* L.
• *Aphis (Aphis) gossypii* Glover, 1877 (Basu, and Banerjee, 1958; Behura, 1963)
• *Uroleucon (Uromelan) jaceae* (Linnaeus, 1758) (Behura, 1963; Trehan and Halleppnawar, 1949)

3.3.2.8 *Corchorus* sp.
• *Aphis (Aphis) gossypii* Glover, 1877 (Ganguli and Ghosh, 1965)

3.3.2.9 *Folia lanceolata* ?
• *Aiceona (Aiceona) retipennis* David, Narayanan and Rajasingh, 1970 (Ghosh and Raychaudhuri, 1973; Ghosh and Basu, 1994)

3.3.2.10 *Gossypium arboreum* L. (syn. *Gossypium indicum* Medik.)
• *Aphis (Aphis) gossypii* Glover, 1877 (Behura, 1963; Ghosh and Singh, 2004)

3.3.2.11 *Gossypium barbadense* L.
• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)

3.3.2.12 *Gossypium herbaceum* L.
• *Aphis (Aphis) gossypii* Glover, 1877 (Krishnamurthi, 1929; Ghulam-Ullah, 1940; Singh et al., 1999)

3.3.2.13 *Gossypium hirsutum* L.
• *Aphis (Aphis) gossypii* Glover, 1877 (David, 1957a; Kataria and Kumar, 2012)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Kataria and Kumar, 2012)

3.3.2.14 *Gossypium* sp.
• *Aphis (Aphis) gossypii* Glover, 1877 (Lefroy and Howlett, 1909; Banerjee and Basu, 1955)
• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Behura, 1963)
• *Smynthurodes betae* Westwood, 1849 (Behura, 1965)

3.3.2.15 *Grewia asiatica* L.
• *Aphis (Aphis) craccivora* Koch, 1854 (Verma et al., 1975)
• *Aphis (Aphis) gossypii* Glover, 1877 (Singh and Singh, 2018)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Verma et al., 1975)

3.3.2.16 *Grewia oppositifolia* Roxb. ex DC.
• *Sinomegoura citricola* (van der Goot, 1917) (Dutta and Gautam, 1993)

3.3.2.17 *Grewia* sp.
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Raychaudhuri et al., 1981)
• *Aulacorthum (Perillaphis) perillae* (Shinji, 1924) (Raychaudhuri, 1978)

3.3.2.18 *Helicteres isora* L.
• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri et al., 1981; Ahmad et al., 2020)
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Raychaudhuri et al., 1981)

3.3.2.19 *Helicteres* sp.

• *Hyalomyzus raoi* Hille Ris Lambers, 1973 (Basu et al., 1973; Raychaudhuri, 1980)

3.3.2.20 *Hibiscus cannabinus* L.

• *Aphis (Aphis) craccivora* Koch, 1854 (Mall, 2013)

• *Aphis (Aphis) gossypii* Glover, 1877 (Singh et al., 1999)

• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)

3.3.2.21 *Hibiscus mutabilis* L.

• *Myzus (Myzus) ornatus* Laing, 1932 (Ghosh and Singh, 2004)

• *Aphis (Aphis) gossypii* Glover, 1877 (Kataria and Kumar, 2012; Pawar, 2015)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ghosh and Singh, 2004)

3.3.2.22 *Hibiscus rosa sinensis* L.

• *Aphis (Aphis) craccivora* Koch, 1854 (Ghosh and Singh, 2004; Ahmad and Kumar, 2006)

• *Aphis (Aphis) fabae* Scopoli, 1763 (Ghosh and Singh, 2004)

• *Aphis (Aphis) gossypii* Glover, 1877 (Singh et al., 1999; Ghosh and Singh, 2004)

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Singh et al., 1999; Ahmad and Singh, 2005)

• *Aphis (Aphis) odinae* (van der Goot, 1917) (David, 1956; Ghosh and Singh, 2004)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Ghosh and Singh, 2004; Agrawal and Singh, 2005)

• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963; Ghosh and Singh, 2004)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Mondal et al., 1976; Ghosh and Singh, 2004)

• *Aulacorthum (Aulacorthum) solani* (Kaltenbach, 1843) (Ghosh et al., 1970; Ghosh and Singh, 2004)

• *Eutrichosiphum pseudopasaniae* Szelegiewicz, 1968 (Basu et al., 1974; Ghosh and Singh, 2004)

• *Myzus (Myzus) ornatus* Laing, 1932 (Ghosh and Singh, 2004)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ghosh and Raychaudhuri, 1962; Ghosh and Singh, 2004)

• *Neomyzus circumflexus* (Buckton, 1876) (Ghosh and Singh, 2004)

• *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Rao and Kulkarni, 1975; Ghosh and Singh, 2004)

• *Schoutedenia ralumensis* Rübsaamen, 1905 (Agrawal and Singh, 2005)

• *Sitobion (Sitobion) rosaeiformis* (Das, 1918) (Ghosh and Raychaudhuri, 1962; Ghosh and Singh, 2004)

3.3.2.23 *Hibiscus sabdariffa* L.

• *Aphis (Aphis) craccivora* Koch, 1854 (Ganguli and Ghosh, 1965; Ahmad and Kumar, 2006)

• *Aphis (Aphis) gossypii* Glover, 1877 (Basu, and Banerjee, 1958; Ahmad et al., 2020)

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Ahmad et al., 2020)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri, 1973; Ahmad et al., 2020)

• *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Rao and Kulkarni, 1975; Ghosh and Singh, 2004)

3.3.2.24 *Hibiscus* sp.

• *Aphis (Aphis) gossypii* Glover, 1877 (George, 1927; Raychaudhuri et al., 1981)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri, 1978)

• *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843) (Raychaudhuri, 1973)

3.3.2.25 *Malachra capitata* L.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1978)

3.3.2.26 *Malva parviflora* L.

• *Aphis (Aphis) gossypii* Glover, 1877 (Behura, 1963)

3.3.2.27 *Malva pusilla* Sm. (syn. *Malva rotundifolia* L.)

• *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Raha and Raychaudhuri, 1981)

3.3.2.28 *Malva sylvestris* L.

• *Aphis (Aphis) gossypii* Glover, 1877 (Behura, 1963)

• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Maity and Chakrabarti, 1979; Ghulam-Ullah, 1940)
3.3.2.29 *Malvastrum coromandelianum* (L.) Garcke (syn. *Malvastrum tricuspidatum* A. Gray)
• *Aphis (Aphis) gossypii* Glover, 1877 (David, 1957a)
• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)
3.3.2.30 *Malvaviscus arboreus* Dill. ex Cav. (syn. *Malvaviscus conzonthiae* ? probably *Malvaviscus conzattii* Grenm.)
• *Aphis (Aphis) gossypii* Glover, 1877 (Rao, 1969; Ghosh and Agarwala, 1985)
• *Myzus (Myzus) ornatus* Laing, 1932 (Rao, 1969)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Rao, 1969)
• *Neomyzus circumflexus* (Buckton, 1876) (Rao, 1969)
3.3.2.31 *Microcos poniculata* L.
• *Cervaphis schouteniae* van der Goot, 1917 (Agarwala and Saha, 1985)
3.3.2.32 *Pavonia grandiflora* A.St.•Hil. (syn. *Malache grandiflora* Kuntze)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ghulam-Ullah, 1940)
3.3.2.33 *Pterospermum* spp.
• *Aulacorthum (Aulacorthum)* sp. (Ghosh et al., 1971a)
• *Cervaphis schouteniae* van der Goot, 1917 (Ghosh et al., 1971a)
• *Eutrichosiphum sinense* Raychaudhuri, 1956 (Raychaudhuri, 1973)
• *Eutrichosiphum subinoyi* Raychaudhuri, Ghosh, Banerjee and Ghosh, 1973 (Raychaudhuri, 1980)
3.3.2.34 *Sida acuta* Burm.f.
• *Aphis (Aphis) gossypii* Glover, 1877 (Rao, 1969; Raychaudhuri, 1978)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri, 1978; Singh and Singh, 1986)
3.3.2.35 *Sida cordifolia* L.
• *Aphis (Aphis) fabae* Scopoli, 1763 (Raha, 1979)
• *Aphis (Aphis) gossypii* Glover, 1877 (Agrawal and Singh, 2005)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Mall, 2013)
3.3.2.36 *Sida palmata* Cav.
• *Aphis (Aphis) gossypii* Glover, 1877 (Agarwala, 1979)
3.3.2.37 *Sida rhombifolia* L.
• *Aphis (Aphis) gossypii* Glover, 1877 (Agarwala, 1979)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri et al., 1981)
3.3.2.38 *Sida* spp.
• *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh and Agarwala, 1980)
• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Rao and Kulkarni, 1977)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Ghosh and Agarwala, 1980)
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Raychaudhuri, 1978)
• *Sumatraphis celti* Takahashi, 1935 (Raychaudhuri, 1973)
3.3.2.39 *Sterculia foetida* L.
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Agarwala, 1979)
3.3.2.40 *Sterculia* spp.
• *Aphis (Aphis) odinae* (van der Goot, 1917) (Mondal et al., 1976)
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Rao and Kulkarni, 1977)
• *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Raychaudhuri, 1973)

3.3.2.41 *Theobroma cacao* L.

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Ghosh, 1975; Srinivasnaik et al., 2016)

3.3.2.42 *Triumfetta pilosa* Roth

• *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843) (Agarwala, 1979)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Agarwala, 1979)

• *Neomyzus circumflexus* (Buckton, 1876) (Agarwala, 1979)

3.3.2.43 *Urena lobata* L.

• *Myzus (Myzus) ornatus* Laing, 1932 (Ghosh and Singh, 2004)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)

3.3.2.44 *Urena* spp.

• *Myzus (Myzus) ornatus* Laing, 1932 (Raychaudhuri, 1978)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1983)

3.3.2.45 Unidentified species

• *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh, 1977)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ghosh and Raychaudhuri, 1959)

3.3.3 Family: Thymelacaceae

The family Thymelaeaceae includes 938 valid species in 54 genera, mostly tree and shrubs and is distributed widely. Several species yield soft, easily worked yellowish wood and some provide strong fibre suitable for the making of cordage and paper. In India, 23 species in 14 genera are known and 4 species of them are associated with 5 species of aphids in 3 genera (Table 1) as stated below.

3.3.3.1 *Daphne* sp.

• *Aphis (Aphis) kurosawai* Takahashi, 1921 (Rishi, 1975)

3.3.3.2 *Edgeworthia grandenri* (Wall.) Meissn. (syn. *Edgeworthia grandii* ?)

• *Neomyzus circumflexus* (Buckton, 1876) (Agarwala, 1979)

• *Rhopalosiphum padi* (Linnaeus, 1758) (Agarwala, 1979)

3.3.3.3 *Eriosolena ïnvolucrata* (Wall.) Tiegh. (syn. *Daphne involucrata* Wall.)

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Chakrabarti, et al., 1971; Rao and Kulkarni, 1977)

3.3.3.4 *Wikstroemia indica* C.A.Mey. (syn. *Daphne cannabina* Lour.)

• *Aphis (Aphis) craccivora* Koch, 1854 (Chakrabarti and Sarkar, 2001; Debnath, 2010)

3.4 Order: Myrtales

Myrtales is the myrtle order of malvids clade of flowering plants, including 9 families, over 400 genera, and about 15,000 species distributed throughout the tropics and warmer regions of the world. The majority (84.25%) of these species belong to just two families, Melastomataceae and Myrtaceae (Table 1). It includes many trees (e.g., *Eucalyptus* spp.), shrubs such as the classic myrtle, several food and spice genera, and many ornamental plants. Out of 9 families, India hosts only 5 families and some members of all these families are associated with aphids. Table 1 demonstrates that 62 species of aphids belonging to 28 genera utilise 38 species of plants belonging to 22 genera of this order.

3.4.1 Family: Combretaceae

Combretaceae, also known as the white mangrove or Indian almond family, comprises about 660 species in 11 genera (WFO, 2023) of mostly trees and shrubs distributed along tropical seacoasts, in African savannas, and in Asiatic monsoon forests. The decoction of bark of one of the Indian species, *Terminalia arjuna* (Roxb.) ex DC. Wight and Arn. has long been used as cardiovascular drug in Ayurveda (Dwivedi and Chopra, 2014). Also, its leaves are fed on by the tassar silk moth, which produces the wild tassar silk of commercial

importance. In India, 46 species in 5 genera are recorded (BSI, 2023), however, only 6 species in 2 genera are associated with 13 species of aphids in 9 genera (Table 1) as per details given below.

3.4.1.1 *Combretum* sp.

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Raha, 1979)

3.4.1.2 *Terminalia arjuna* (Roxb.) ex DC. Wight and Arn. (syn. *Terminalia cuneata* Roth)

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri et al., 1981)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri et al., 1981; Suman and Suman, 2017)

• *Panaphis* sp. (Chakrabarti, 1988)

• *Paoliella (Paoliella) nirmalae* (David, 1969) (David, 1969a; Chakrabarti, 1988; Joshi, 2008)

• *Rhopalosiphum maidis* (Fitch, 1856) (Raychaudhuri et al., 1981; Suman and Suman, 2017)

3.4.1.3 *Terminalia catappa* L.

• *Aphis (Toxoptera) citricidus* (Kirkaldy, 1907) (Joshi and Poorani, 2007)

3.4.1.4 *Terminalia chebula* Retz.

• *Aphis (Aphis) craccivora* Koch, 1854 (Jadhav and Sathe, 2006)

3.4.1.5 *Terminalia paniculata* Roth

• *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) (Jadhav and Sathe, 2006)

3.4.1.6 *Terminalia tomentosa* Mart.ex Eichl.

• *Aphis (Aphis) gossypii* Glover, 1877 (Jadhav and Sathe, 2006)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Jadhav and Sathe, 2006)

3.4.1.7 Unidentified species

• *Aleurodaphis blumeae* van der Goot, 1917 (Ghosh and Basu, 1994)

• *Ceratovacuna lanigera* Zehntner, 1897 (Ghosh and Raychaudhuri, 1968)

• *Taiwanaphis (Taiwanaphis) dineni* Mandal, Agarwala and Raychaudhuri, 1979 (Mondal et al., 1979)

3.4.2 Family: Lythraceae

Lythraceae, also known as the loosestrife family, including about 620 species in 32 genera (WFO, 2023) of trees, small shrubs, and perennial herbs, distributed mainly in the tropics of the world. Among the economically important crops is pomegranate (*Punica granatum* L.) for the fruits, the water caltrop (*Trapa natans* L.) for the seeds and the henna (*Lawsonia inermis* L.) for the dye. Also, several species are ornamentals. However, in India, the family is represented by only 69 species in 9 genera (BSI, 2023) and among them, only 11 species in 8 genera are associated with 29 species in 11 genera of aphids (Table 1) with the following details.

3.4.2.1 *Cuphea* sp.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)

3.4.2.2 *Duabanga grandiflora* Walp. (syn. *Duabanga sonneratioides* Buch.•Ham.)

• *Aphis (Aphis) fabae* Scopoli, 1763 (Rao, 1969)

• *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh, 1990)

• *Aphis (Aphis) odinae* (van der Goot, 1917) (Ghosh and Raychaudhuri, 1970)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri, 1973

• *Eutrichosiphum sikkimense* (Raychaudhuri, Ghosh, Banerjee and Ghosh, 1973) (Raychaudhuri et al., 1973)

• *Greenidea (Greenidea) ficicola* Takahashi, 1921 (Raychaudhuri, 1973)

• *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri, 1970 (Ghosh et al., 1971b)

• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Raychaudhuri, 1973)

• *Tinocallis (Orientinocallis) distincta* Ghosh, Ghosh and Raychaudhuri, 1971 (Chakrabarti and Raychaudhuri, 1975b)

• *Tinocallis (Tinocallis) himalayensis* Ghosh, Ghosh and Raychaudhuri, 1971 (Chakrabarti and Raychaudhuri, 1975b; Ghosh et al., 1971b)

3.4.2.3 *Duabanga* sp.

• *Tinocallis (Orientinocallis) distincta* Ghosh, Ghosh and Raychaudhuri, 1971 (Raychaudhuri, 1973)

3.4.2.4 *Lagerstroemia floribunda* Jacq.

• *Aphis (Aphis) gossypii* Glover, 1877 (Maity and Chakrabarti, 1979)

3.4.2.5 *Lagerstroemia indica* L.

• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri, 1973)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Rao and Kulkarni, 1977)

• *Sarucallis kahawaluokalani* (Kirkaldy, 1907) (Mall, 2013)

3.4.2.6 *Lagerstroemia speciosa* Pers. (syn. *Lagerstroemia flos-reginae* Retz.)

• *Aphis (Aphis) craccivora* Koch, 1854 (Raychaudhuri, 1973)

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Raychaudhuri, 1978)

• *Sarucallis kahawaluokalani* (Kirkaldy, 1907) (Tripathy and Das, 2020)

3.4.2.7 *Lagerstroemia* spp.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri et al., 1980)

• *Aphis (Aphis) odinae* (van der Goot, 1917) (Mondal et al., 1976; Rao and Kulkarni, 1977)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Mondal et al., 1976; Rao and Kulkarni, 1977)

• *Sarucallis kahawaluokalani* (Kirkaldy, 1907) (Basu, 1961; David, 1969b)

• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Joshi and Poorani, 2007)

3.4.2.8 *Lawsonia inermis* L. (syn. *Lawsonia alba* Lam.)

• *Aphis (Aphis) fabae* Scopoli, 1763 (Singh et al., 1999)

• *Aphis (Aphis) gossypii* Glover, 1877 (David, 1958a; Ahmad et al., 2020)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Ahmad and Singh, 2005; Rohini et al., 2018)

• *Sarucallis kahawaluokalani* (Kirkaldy, 1907) (Basu, 1961)

3.4.2.9 *Punica granatum* L.

• *Aphis (Aphis) achyranthi* Theobald, 1929 (David, 1957a; Chakrabarti et al., 1972b)

• *Aphis (Aphis) fabae* Scopoli, 1763 (Rao, 1969)

• *Aphis (Aphis) gossypii* Glover, 1877 (Basu, and Banerjee, 1958; Ghosh, 1977)

• *Aphis (Aphis) longisetosa* Basu, 1969 (1970) (Saha et al., 1982)

• *Aphis (Aphis) punicae* Passerini, 1863 (Basu, and Banerjee, 1958; Khan and Shah, 2017; Ahmad et al., 2020)

• *Aphis* (*Aphis*) *ruborum* (Börner, 1931) (Saha et al., 1982)

• *Aphis (Aphis) solanella* Theobald, 1914 (Chaudhary et al., 2009)

• *Aphis (Aphis) spiraecola* Patch, 1914 (David and Rajasingh, 1969; Sarkar and Chakrabarti, 2015)

• *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843) (Ghosh, 1977; Sarkar and Chakrabarti, 2015)

• *Hysteroneura setariae* (Thomas, 1878) (Raychaudhuri, 1973)

• *Micromyzodium filicium* David, 1958 (Ghosh, 1977)

• *Myzus (Myzus) ornatus* Laing, 1932 (Raychaudhuri, 1973; Sarkar and Chakrabarti, 2015)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Verma et al., 1975; Suman and Suman, 2017)

• *Phorodon (Diphorodon)* sp. (Bhagat, 1984)

3.4.2.10 *Rotala* sp.

• *Aphis (Aphis) gossypii* Glover, 1877 (Rao, 1969)

3.4.2.11 *Trapa natans* var. *bispinosa* (Roxb.) Makino (syn. *Trapa bispinosa* Roxb.)

• *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Behura and Bohider, 1970; Halder et al., 2020)

3.4.2.12 *Woodfordia fruticosa* Kurz (syn. *Woodfordia floribunda* Salisb.)

• *Aphis (Aphis) gossypii* Glover, 1877 (Dutta and Gautam, 1993)
• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Rao and Kulkarni, 1977; Ghosh and Singh, 2004)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Ghosh and Singh, 2004)
• *Aphis (Aphis) umbrella* (Borner, 1950) (Behura, 1963)
• *Tinocallis (Tinocallis) kahawaluokalani* (Kirkaldy, 1907) (Ghosh and Singh, 2004)

3.4.3 Family: Melastomaceae

Melastomataceae is a moderately large family consisting of about 6650 species in 185 genera (WFO, 2023) distributed mostly in the New World tropics. They are annual or perennial herbs, shrubs, or small trees. The family is economically important as its members yield timber, edible fruits, dyes and also as ornamentals. In India, 105 species in 14 genera are recorded (BSI, 2023) but only 5 species in 3 genera are associated with 10 species in 6 genera of aphids (Table 3) as mentioned below.

3.4.3.1 *Melastoma* sp.

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Mondal et al., 1978)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Agarwala, 1979)

3.4.3.2 *Osbeckia capitata* Bentm. Ex Naudin

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973; Raychaudhuri et al., 1981)
• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Ghosh, 1990)
• *Capitophorus carduinus* (Walker, 1850) (Raychaudhuri, 1973)
• *Myzus (Myzus) ornatus* Laing, 1932 (Raychaudhuri, 1973)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)

3.4.3.3 *Osbeckia chinensis* L.

• *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh and Agarwala, 1980; Devi et al., 2000)
• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Mondal et al., 1978)
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Ghosh and Agarwala, 1980)
• *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843) (Raychaudhuri, 1978)
• *Myzus (Myzus) ornatus* Laing, 1932 (Ghosh and Agarwala, 1980)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ghosh and Agarwala, 1980)
• *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Mondal et al., 1978)

3.4.3.4 *Osbeckia crinita* Benth.

• *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh and Raychaudhuri, 1968; Rao, 1969)
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Ghosh and Raychaudhuri, 1968; Rao and Kulkarni, 1977)
• *Capitophorus* sp. (Rao, 1969)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Agarwala et al., 1980)

3.4.3.5 *Tibouchina semidecandra* Cogn.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)
• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Ghosh et al., 1970; Rao and Kulkarni, 1977)
• *Aphis (Aphis) spiraecola* Patch, 1914 (Raychaudhuri, 1973)
• *Macrosiphum (Macrosiphum) centranthi* Theobald, 1915 (David, 1975)
• *Myzus (Myzus) ornatus* Laing, 1932 (Raychaudhuri, 1973)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Raychaudhuri, 1973)

3.4.3.6 *Tibouchina* sp.

• *Aphis (Aphis) gossypii* Glover, 1877 (Agarwala, 1979)

• *Macrosiphum (Macrosiphum) centranthi* Theobald, 1915 (David, 1975)

3.4.4 Family: Myrtaceae

Myrtaceae, also known as the myrtle family, includes about 6045 species in 145 genera (WFO, 2023). All are woody and have rather leathery evergreen leaves with oil glands. Several species of this family are economically important, e.g. spices (clove, allspice), fruits (guava, jamun, rose apple) and essential oils (eucalyptus). Some species yield timber used as railway sleepers, while some are ornamentals. In India, 217 species are known under 21 genera, but only 10 species in 5 genera are associated with 27 species of aphids belonging to 10 genera (Table 1) as given below.

3.4.4.1 *Eucalyptus globulus* Labill.

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Ghosh and Singh, 2004; Mondal et al., 1978)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Ghosh and Singh, 2004)

3.4.4.2 *Eucalyptus* spp.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Rao and Kulkarni, 1977)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Rao and Kulkarni, 1977; Rohini et al., 2018)

• *Eutrichosiphum pseudopasaniae* Szelegiewicz, 1968 (Chakrabarti et al., 1972b)

3.4.4.3 *Eugenia uniflora* L. (syn. *Eugenia michelii* Lam.)

• *Aphis (Aphis) gossypii* Glover, 1877 (David, 1957a)

3.4.4.4 *Eugenia* spp.

• *Aphis (Aphis) fabae* Scopoli, 1763 (Raychaudhuri, 1973)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Agarwala, 1979)

• *Eutrichosiphum raychaudhurii* (Ghosh, 1969) (Raychaudhuri et al., 1981)

• *Eutrichosiphum tapatii* Mandal, Chatterjee and Raychaudhuri, 1979 (Agarwala, 1979)

• *Greenidea (Trichosiphum) anonae* (Pergande, 1906) (Ghosh et al., 1971c)

• *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri, 1970 (Ghosh and Agarwala, 1993)

• *Greenidea (Trichosiphum) formosana formosana* (Maki, 1917) (David, 1958b)

• *Greenidea (Trichosiphum) heterotricha* Ghosh, 1976 (Ghosh and Agarwala, 1993)

• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Ghosh, 1976)

• *Sinomegoura photiniae* (Takahashi, 1936) (Kar et al., 1990)

• *Tuberaphis breviseta* Ghosh, 1988 (Raha and Raychaudhuri, 1981)

3.4.4.5 *Melaleuca linearis* J.C.Wendl. and Schrad. (syn. *Callistemon linearis* (J.C.Wendl. and Schrad.) Colvill ex Sweet)

• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Rao and Kulkarni, 1977)

• *Aulacorthum (Aulacorthum) rhamni* Ghosh, Ghosh and Raychaudhuri, 1970 (1971) (Raychaudhuri, 1973)

• *Greenidea (Trichosiphum) anonae* (Pergande, 1906) (Raychaudhuri, 1973)

3.4.4.6 *Melaleuca lophantha* (Vent.) (syn. *Callistemon lonceolotus* (Sm.) Sweet)

• *Aphis (Aphis) gossypii* Glover, 1877 (Mall, 2013)

3.4.4.7 *Psidium guajava* L.

• *Aphis (Aphis) craccivora* Koch, 1854 (Singh et al., 1999)

• *Aphis (Aphis) eugeniae* van der Goot, 1917 (Ghosh, 1975)

• *Aphis (Aphis) gossypii* Glover, 1877 (David, 1957a; Ghosh and Singh, 2004)

• *Aphis (Aphis) nasturtii* Kaltenbach, 1843 (Singh et al., 1999; Ahmad et al., 2020)

• *Aphis (Aphis) spiraecola* Patch, 1914 (Ghosh and Singh, 2004; Sarkar and Chakrabarti, 2015)
• *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonscolombe, 1841 (Mondal et al., 1976; Ghosh and Singh, 2004)
• *Greenidea (Greenidea) decaspermi* Takahashi, 1933 (David et al., 1969; Raychaudhuri, 1980)
• *Greenidea (Greenidea) ficicola* Takahashi, 1921 (Ahmad and Singh 1995)
• *Greenidea (Greenidea) longirostris* Basu, 1969 (1970) (Agrawal and Singh, 2005)
• *Greenidea (Trichosiphum) formosana formosana* (Maki, 1917) (Raychaudhuri, 1956)
• *Greenidea* (*Trichosiphum*) *kumaoni* Chakrabarti and Raychaudhuri, 1978 (Samanta et al., 1983)
• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Ghosh, 1970; Singh et al., 1999)
• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Ghosh and Agarwala, 1985; Ghosh and Singh, 2004)
• *Pentalonia nigronervosa* Coquerel, 1859 (Biswas et al., 1969; Ghosh and Singh, 2004)
• *Rhopalosiphum rufiabdominalis* (Sasaki, 1899) (Ghosh and Singh, 2004; Suman and Suman, 2017)

3.4.4.8 *Psidium* spp.
• *Aphis (Aphis) gossypii* Glover, 1877 (Agarwala and Raychaudhuri, 1979)
• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Ghosh MR et al., 1971d)

3.4.4.9 *Syzygium cumini* (L.) Skeels (syn. *Eugenia jambolana* Lam.)
• *Aphis (Aphis) craccivora* Koch, 1854 (Jadhav and Sathe, 2006)
• *Aphis (Aphis) gossypii* Glover, 1877 (Jadhav and Sathe, 2006)
• *Greenidea (Greenidea) ficicola* Takahashi, 1921 (Rohini et al., 2018)
• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Raychaudhuri, 1973; Singh and Raychaudhuri, 1987)
• *Greenidea (Greenidea) ficicola* Takahashi (Mall, 2013)
• *Greenidea (Trichosiphum) anonae* (Pergande, 1906) (Joshi and Poorani, 2007)
• *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri, 1970 (Raychaudhuri, 1983)
• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Mall, 2013)

3.4.4.10 *Syzygium jambos* (L.) Alston
• *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri, 1970 (Ghosh and Singh, 2004)
• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Ghosh and Agarwala, 1993; Ghosh and Singh, 2004)

3.4.4.11 *Syzygium praecox* (Roxb.) Rathakr. and N.C.Nair (syn. *Eugenia praecox* Roxb.
• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Raha et al., 1977)

3.4.4.12 *Syzygium salicifolium* J.Graham (syn. *Eugenia heyneana* Duthie)
• *Chaitophorus eugeniae* Basu and Raychaudhuri, 1983 (Basu and Raychaudhuri, 1983)

3.4.4.13 *Syzygium tetragonum* Wall. ex Wight (syn. *Eugenia tetragona* Wight)
• *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri, 1970 (Raychaudhuri, 1973)
• *Greenidea (Trichosiphum) formosana formosana* (Maki, 1917) (Raychaudhuri, 1983)
• *Greenidea (Trichosiphum) psidii* van der Goot, 1917 (Ghosh et al., 1970; Raychaudhuri, 1980)

3.4.4.14 *Syzygium* sp.
• *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri, 1970 (Ghosh and Agarwala, 1993)

3.4.4.15 Unidentified species
• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri et al., 1980)
• *Tuberculatus (Orientuberculoides) konaracola* (Shinji, 1941) (Raychaudhuri, 1978; Raychaudhuri et al., 1984)

3.4.5 Family: Onagraceae

The Onagraceae, commonly known as the willowherb family or evening primrose family comprises about 780 species in 35 genera of herbs, shrubs, and trees (WFO, 2023) distributed widely in temperate and subtropical regions of both hemispheres. Plants of this family are popular garden plants (e.g. primeroses, fuchsias) and

common weeds in the gardens. In India, 72 species in 6 genera of plants of this family are known, out of which only 6 species in 4 genera are used as host plants by 11 species of aphids belonging to 6 genera (Table 3) as mentioned below.

3.4.5.1 *Epilobium hirsutum* L.

• *Aphis (Aphis) affinis* del Guercio, 1911 (Bhagat, 1985; Bhagat, 2012)

• *Aphis (Bursaphis) grossulariae* Kaltenbach, 1843 (Bhagat, 2012)

• *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Stary and Raychaudhuri, 1982; Chakrabarti and Debnath, 2009)

3.4.5.2 *Epilobium* sp.

• *Aphis (Aphis) gossypii* Glover, 1877 (Raychaudhuri, 1973)

• *Aphis (Aphis)* nr. *pollinosa* Walker, 1849 (Rishi, 1975)

3.4.5.3 *Fuchsia* sp.

• *Myzus (Myzus) ornatus* Laing, 1932 (Basu and Raychaudhuri, 1976)

• *Neomyzus circumflexus* (Buckton, 1876) (Dutta and Gautam, 1993)

• *Pseudomegoura magnoliae* (Essig and Kuwana, 1918) (Raychaudhuri et al., 1981)

3.4.5.4 *Ludwigia perennis* L. (syn. *Ludwigia parviflora* Roxb.)

• *Aphis (Aphis) gossypii* Glover, 1877 (Ghosh, 1990)

• *Sitobion (Sitobion) indicum* Basu, 1964 (Raychaudhuri et al., 1981)

3.4.5.5 *Ludwigia suffruticosa* Walter

• *Aphis (Aphis) spiraecola* Patch, 1914 (Raha, 1979)

3.4.5.6 *Oenothera biennis* L.

• *Aphis (Aphis) gossypii* Glover, 1877 (Verma et al., 1975)

• *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) (Verma et al., 1975)

3.5 Order: Sapindales

The order Sapindales, a group of flowering plants consisting of several economically important fruit trees such as cashew, pistachio, mango, litchi, neem, lemon, orange etc. The food plant association with aphids has already been recently documented by Singh et al. (2023). They have reported that 7 families of it are infested by 67 species of aphids (Homoptera: Aphididae) belonging to 6 subfamilies in India. Among them, the family Rutaceae are more vulnerable to aphid attack (19 species of plants infested by 22 species of aphids) followed by Anacardiaceae (15 species of plants infested by 23 species of aphids) and Sapindaceae (11 species of plants infested by 24 species of aphids) (Table 1). Among the aphid species, 6 species are highly polyphagous feeding on 8-24 plant species belonging to 2-5 families. Highly polyphagous species of aphids are *Aphis (Toxoptera) aurantii* Boyer de Fonsc. (25 plant species belonging to 13 genera and 5 families) followed by *Aphis (Toxoptera) citricidus* (Kirkaldy) (15 plant species belonging to 6 genera and 2 families), *Aphis (Aphis) odinae* (van der Goot) (14 plant species belonging to 8 genera and 2 families), *Aphis (Aphis) gossypii* Glover (13 plant species belonging to 6 genera and 4 families), and *Aphis (Aphis) spiraecola* Patch (9 plant species belonging to 5 genera and 3 families) (Singh et al., 2023).

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