

Aphids and their Host Affinity- VI: *Myzus* spp.

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Received: 20.04.2017 | Revised: 29.04.2017 | Accepted: 30.04.2017

ABSTRACT

Host-plant relationships of Myzus species, in general, revealed greater preference to plant species of dicotyledons (93.45%) than monocotyledons. In dicotyledons major contribution was of herbaceae (primarily herbaceous plants) (58.22%) than that of lignosae (primarily woody plants) (35.33%) and host-plant species: family ratio was 7.544 and 4.788, respectively. Out of 61 Myzus spp., 45.90% were monophagous, 6.56% oligophagous and 47.56% polyphagous. Small number of host-plants was shared by monocotyledons and non-angiosperms. M. persicae, M. ornatus, M. ascalonicus and M. cymbalariae are regarded as serious polyphagous species and they encompass large number of plant species in their host range.

Key words: Host-plant relationship, *Myzus* spp., Dicotyledons, Monocotyledons, GAI

INTRODUCTION

Myzus species (Aphidinae: Macrosiphini) are from old world, mostly oriental¹ and distributed worldwide. They are phloem feeder and some of them are highly polyphagous and efficient vector of several viral diseases. Thorsteinson² postulated that phytophagous insects generally select their host from taxonomically related plant species. Rathore and Lal³, Rathore and Ali⁴, Rathore and Tiwari^{5,6} and Rathore and Tiwari⁷ observed similar host relationships in pod borer (*Maruca vitrata*), root-knot nematode (*Meloidogyne incognita*), whitefly (*Bemisia tabaci* and 42 species of *Bemisia*) and in three

species of aphids (*Hyadaphis*, *Uroleucon* and *Viteus* spp.), respectively. *Myzus* species is an exceptional group of aphids and authors, therefore, attempted to address the host-plant relationships of this group of aphids.

MATERIALS AND METHODS

Information on species of *Myzus* was obtained from the extensive publications of Blackman and Eastop^{8,9,10} and others. Host-plant species reported were thus aligned with the families and orders as per taxonomic classification of Hutchinson¹¹. Hutchinson divided angiosperms into subphylum dicotyledons and monocotyledons.

Cite this article: Rathore, Y.S. and Tiwari, S.N., Aphids and their Host Affinity- VI: *Myzus* spp., *Int. J. Pure App. Biosci.* 5(2): 937-944 (2017). doi: <http://dx.doi.org/10.18782/2320-7051.2919>

Dicotyledons were further divided on the basis of their evolutionary habit i.e. lignosae (primarily woody plants) and herbaceae (primarily herbaceous plants). Monocotyledons were partitioned into calyciferae (with distinct calyx and corolla), corolliferae (calyx and corolla are more or less similar) and glumiflorae (perianth are much more reduced or represented by lodicules). To account the closeness of relationships a General Affiliation Index (GAI) was utilized as described by Rathore and Tiwari¹². To categorize aphid species into mono-, oligo- and polyphagous the terminology of Bernays and Chapman¹³ was adopted. For further details readers are referred to first part of publication “Aphids and heir host affinity-I: *Acyrtosiphon* spp.” by Rathore and Tiwari¹⁴.

RESULTS AND DISCUSSION

Different species of this genus are reported in Table 1. Out of these 45.90% were categorized as monophagous, 6.56% oligophagous and 47.56% polyphagous. Among monophagous more number showed monophagy on herbaceous plants (herbaceae) than on lignosae. Three fourth species were oligophagous on herbaceae and 1/4th on Poaceae in monocotyledons. The GAI values in monophagous species ranged from 1.000 to 2.333. In most of the cases values were around 1.000. However, where the number of host species was more in the same genus the GAI values were found higher. In case of *Myzus*, the host-aphid affinity is so close that that GAI values even in polyphagous species did not vary greatly as observed in other aphid genera.

Table 1: Relationships of host taxonomic groups with *Myzus* species

<i>Myzus</i> spp.	Host plants with taxonomic group	No. of host species	GAI	Status
<i>M. ajugae</i>	Dicot-herbaceae: Lamiaceae (3) (<i>Ajugagenevensis</i> , <i>A. orientalis</i> , <i>A. repetans</i>)	3	1.667	Monophagous
<i>M. alectorolophi</i>	Dicot-herbaceae: Scrophulariaceae (1) (<i>Rhinanthusalectorolophus</i>)	1	1.000	Monophagous
<i>M. amygdalinus</i>	Dicot-lignosae: Rosaceae (3) (<i>Prunus amygdalus</i> , <i>P. mahaleb</i> , <i>P. dulcis</i>); Dicot-herbaceae: Scrophulariaceae (1) (<i>Veronica anagallis</i>)	4	1.000	Polyphagous
<i>M. antirrhinii</i>	Dicot-lignosae: Buddlejaceae (2), Fabaceae (2), Nyctaginaceae (1), Pittosporaceae (2); Dicot-herbaceae: Asteraceae (1), Boraginaceae (1), Brassicaceae (3), Caryophyllaceae (1), Chenopodiaceae (2), Polygonaceae (1), Scrophulariaceae (2), Solanaceae (5)	23	0.581	Polyphagous
<i>M. asamensis</i>	Dicot-herbaceae: Saxifragaceae (1) (<i>Saxifraga punctata</i>)	1	1.000	Monophagous
<i>M. ascalonicus</i>	Dicot-lignosae: Araliaceae (1), Caprifoliaceae (1), Cistaceae (2), Cornaceae (1), Fabaceae (2), Malvaceae (1), Rosaceae (18), Rubiaceae (3), Urticaceae (2), Violaceae (4); Dicot-herbaceae: Apiaceae (6), Astera ceae, (33), Boraginaceae (4), Brassicaceae (24), Campanulaceae (7), Caryophyllaceae (18), Chenopodiaceae (1), Crassulaceae (1), Geraniaceae (4), Hydrophyllaceae (1), Lamiaceae (4), Onagraceae (2), Oxalidaceae (1), Papaveraceae (1), Plantaginaceae (4), Polemoniaceae (3), Polygonaceae (6), Portulacaceae (2), Primulaceae (3), Ranunculaceae (8), Saxifragaceae (1), Scrophulariaceae (8), Solanaceae (3), Valerianaceae (1); Monocot-corolliferae: Amaryllidaceae (4), Araceae (1), Iridaceae (3), Liliaceae (12), Orchidaceae (2); Monocot-glumiflorae: Cyperaceae (1), Poaceae (4)	208	1.005	Polyphagous
<i>M. asiaticus</i>	Dicot-lignosae: Rosaceae (1) (<i>Padusasiatica</i> , <i>P. racemosa</i>)	2	1.333	Monophagous
<i>M. asteriae</i>	Dicot-herbaceae: Asteraceae (4) (<i>Aster spathulifolius</i> , <i>Boltonia- Indica</i> , <i>Kalimerisincisa</i> , <i>K. yomena</i>)	4	1.200	Oligophagous
<i>M. beybienkoi</i>	Dicot-lignosae: Oleaceae (1) (<i>Fraxinuspotamophila</i>)	1	1.000	Monophagous
<i>M. biennis</i>	Dicot-herbaceae: Onagraceae (1) (<i>Oenotherabiennis</i>)	1	1.000	Monophagous
<i>M. boehmeriae</i>	Dicot-lignosae: Urticaceae (5) (<i>Boehmeria japonica</i> , <i>B. nipononivea</i> , <i>B. nivea</i> , <i>B. platanifolia</i> , <i>B. spicata</i>)	5	2.333	Monophagous
<i>M. borealis</i>	Dicot-lignosae: Rubiaceae (2) (<i>Galiumboreale</i> , <i>G. rubioides</i>)	2	1.333	Monophagous
<i>M. brevisiphon</i>	Dicot-lignosae: Ericaceae (2); Dicot-herbaceae: Polygonaceae (3)	5	1.000	Polyphagous
<i>M. cerasi</i>	Dicot-lignosae: Rosaceae (14), Rubiaceae (12); Dicot-herbaceae: Asteraceae (1), Brassicaceae (11), Gentianaceae (1), Plantaginaceae (1), Polygonaceae (1), Scrophulariaceae (10); Monocot-corolliferae: Similacaceae (1)	52	1.350	Polyphagous
<i>M. certus</i>	Dicot-lignosae: Apocynaceae (1), Violaceae (3); Dicot-herbaceae: Amaranthaceae (1), Apiaceae (1), Asteraceae (1), Brassicaceae (4), Caryophyllaceae (27), Crassulaceae (1), Polygonaceae (6), Portulacaceae	46	1.116	Polyphagous

	(1)			
<i>M. cornutus</i>	Dicot-lignosae: Rosaceae (1) (<i>Prunuscornuta</i>)	1	1.000	Monophagous
<i>M. cymbalariae</i>	Dicot-lignosae: Euphorbiaceae (1), Fabaceae (3), Rosaceae (2), Rubiaceae (2), Urticaceae (1), Violaceae (2); Dicot-herbaceae: Amaranthaceae (1), Asteraceae (9), Brassicaceae (2), Caryophyllaceae (9), Lamiaceae (1), Oxalidaceae (1), Plantaginaceae (1), Polygonaceae (1), Primulaceae (1), Scrophulariaceae (1), Solanaceae (1); Monocot-corolliferae: Amaryllidaceae (2), Araceae (1), Iridaceae (2), Liliaceae (2); Others: Polypodiaceae (1)	47	0.583	Polyphagous
<i>M. debregeasiae</i>	Dicot-lignosae: Rubiaceae (1), Urticaceae (1)	2	0.667	Polyphagous
<i>M. dianthicola</i>	Dicot-herbaceae: Caryophyllaceae (1) (<i>Dianthus caryophyllus</i>)	1	1.000	Monophagous
<i>M. duriatae</i>	Dicot-herbaceae: Gesneriaceae (1) (<i>Aeschynanthus radicans</i>)	1	1.000	Monophagous
<i>M. dycei</i>	Dicot-lignosae: Ulmaceae (2), Urticaceae (9); Dicot-herbaceae: Asteraceae (1), Brassicaceae (1), Polygonaceae (1), Scrophulariaceae (1), Valerianaceae (1)	14	0.818	Polyphagous
<i>M. erythraeae</i>	Dicot-herbaceae: Gentianaceae (1) (<i>Centaurium vulgare</i> , <i>C. erythraeae</i>)	2	1.333	Monophagous
<i>M. fataunae</i>	Dicot-lignosae: Moraceae (1), Urticaceae (2)	4	0.857	Polyphagous
<i>M. filicis</i>	Others: Dennstaedtiaceae (1) (<i>Dennstaedtia appendiculata</i>)	1	1.000	Monophagous
<i>M. formosanus</i>	Dicot-lignosae: Rosaceae (1); Dicot-herbaceae: Menispermaceae (1), Polygonaceae (4)	6	0.889	
<i>M. godetiae</i>	Dicot-herbaceae: Onagraceae (1) (<i>Clarkia amoena</i>)	1	1.000	Monophagous
<i>M. hemerocallis</i>	Monocot-corolliferae: Amaryllidaceae (1), Liliaceae (6)	7	1.125	Polyphagous
<i>M. icelandicus</i>	Dicot-herbaceae: Brassicaceae (1), Caryophyllaceae (3), Crassulaceae, (2), Gentianaceae (1), Polygonaceae (1)	8	0.556	Polyphagous
<i>M. indicus</i>	Dicot-lignosae: Urticaceae (1) (<i>Boehmeria</i> sp.); Monocot-calyciferae: Commelinaceae (1) (<i>Aneilema</i> sp.)	2	0.667	Polyphagous
<i>M. inuzakurae</i>	Dicot-lignosae: Rosaceae (1) (<i>Prunus buergeriana</i>)	1	1.000	Monophagous
<i>M. isodonis</i>	Dicot-herbaceae: Lamiaceae (1) (<i>Isodon</i> sp.)	1	1.000	Monophagous
<i>M. japonensis</i>	Dicot-lignosae: Rosaceae (2) (<i>Rosa davurica</i> , <i>R. rugosa</i>)	2	1.333	Monophagous
<i>M. kalimpongensis</i>	Dicot-herbaceae: Asteraceae (1), Lamiaceae (1)	2	0.667	Polyphagous
<i>M. kawatabiensis</i>	Dicot-herbaceae: Polygonaceae (1) (<i>Polygonum thunbergii</i>)	1	1.000	Monophagous
<i>M. lactucicola</i>	Dicot-herbaceae: Asteraceae (7)	7	1.286	Oligophagous
<i>M. langei</i>	Dicot-lignosae: Rubiaceae (5); Dicot-herbaceae: Primulaceae (1)	6	1.333	Polyphagous
<i>M. lefroyi</i>	Others: Fern	1	1.000	Monophagous
<i>M. ligustri</i>	Dicot-lignosae: Oleaceae (2) (<i>Ligustrum ovalifolium</i> , <i>L. vulgare</i>)	2	1.333	Monophagous
<i>M. linariae</i>	Dicot-herbaceae: Scrophulariaceae (2) (<i>Linaria dalmatica</i> , <i>L. genistifolia</i>)	2	1.333	Monophagous
<i>M. lythri</i>	Dicot-lignosae: Lythraceae (7), Rhamnaceae (1), Rosaceae (3); Dicot-herbaceae: Droseraceae (1), Haloragidaceae (1), Onagraceae (8), Scrophulariaceae (1)	22	1.043	Polyphagous
<i>M. manoji</i>	Dicot-lignosae: Araliaceae (1) (<i>Hedera nepalensis</i>)	1	1.000	Monophagous
<i>M. moriokae</i>	Dicot-lignosae: Urticaceae (3) (<i>Boehmeria japonica</i> , <i>B. nipononivea</i> , <i>B. nivea</i>)	3	1.667	Monophagous
<i>M. mumecola</i>	Dicot-lignosae: Rosaceae (4) (<i>Prunus americana</i> , <i>P. mume</i> , <i>Prunus</i> sp., <i>Rubia cordifolia</i>), Caprifoliaceae (1) (<i>Lonicera quinquelocularis</i>)	5	1.000	Polyphagous
<i>M. mushaensis</i>	Dicot-lignosae: Rosaceae (5); Dicot-herbaceae: Lamiaceae (2)	7	1.286	Polyphagous
<i>M. myosotidus</i>	Dicot-herbaceae: Boraginaceae (1) (<i>Myosotis scorpioides</i>)	1	1.000	Monophagous
<i>M. ninae</i>	Dicot-herbaceae: Asteraceae (1) (<i>Artemisia</i> spp.)	1	1.000	Monophagous
<i>M. obtusirostris</i>	Monocot-glumiflorae: Poaceae (3) (<i>Apluda mutica</i> , <i>Papalum</i> spp., <i>Zea mays</i>)	3	1.000	Oligophagous
<i>M. oenotherae</i>	Dicot-herbaceae: Onagraceae (2) (<i>Oenothera biennis</i> , <i>O. subulifera</i>)	2	1.333	Monophagous
<i>M. ornatus</i>	Dicot-lignosae: Apocynaceae (4), Araliaceae (2), Begoniaceae (1), Bignoniaceae (6), Buddlejaceae (2), Cactaceae (2), Canellaceae (1), Caprifoliaceae (8), Cistaceae (4), Clusiaceae (6), Cornaceae (1), Cucurbitaceae (1), Dilleniaceae (1), Ericaceae (8), Euphorbiaceae (3), Fabaceae (22), Fouquieriaceae (1), Garryaceae (1), Hamamelidaceae (1), Hydrangeaceae (6), Loganiaceae (1), Lythraceae (3), Malvaceae (11), Melastomataceae (9), Meliaceae (1), Myrsinaceae (1), Myrtaceae (3), Nyctaginaceae (2), Oleaceae (2), Passifloraceae (1), Polygonaceae (1), Rhamnaceae (2), Rosaceae (36), Rubiaceae (9), Rutaceae (2), Styracaceae (1), Tiliaceae (2), Ulmaceae (2), Urticaceae (4), Verbenaceae (13), Violaceae (4), Vitaceae (1); Dicot-herbaceae: Acanthaceae (10), Amaranthaceae (5), Apiaceae (25), Asteraceae (108), Balsaminaceae (2), Boraginaceae (11), Brassicaceae (26), Campanulaceae (2), Caryophyllaceae (6), Chenopodiaceae (4), Convolvulaceae (2), Crassulaceae (2), Fumariaceae (1), Gentianaceae (2), Geraniaceae (5), Gesneriaceae (2), Lamiaceae (46), Lardizabalaceae (1), Onagraceae (5), Oxalidaceae (2), Papaveraceae (1), Plantaginaceae (5), Plumbaginaceae (1), Polygonaceae (16), Portulacaceae (1), Primulaceae (10), Ranunculaceae (8), Saxifragaceae (1), Scrophulariaceae (21), Solanaceae (10), Tropeolaceae (1), Valerianaceae (3); Monocot-calyciferae: Cannaceae (1), Commelinaceae (2), Zinziberaceae (1); Monocot-corolliferae: Araceae (3), Astromeriaceae (1), Iridaceae (4),	564	1.192	Polyphagous

	Liliaceae (6), Orchidaceae (2); Monocot-glumiflorae: Poaceae (7)			
<i>M. padellus</i>	Dicot-lignosae: Rosaceae (1) (<i>Prunus padus</i>); Dicot-herbaceae: Lamiaceae (1) (<i>Galeopsis speciosa</i>), Scrophulariaceae (3) (<i>Pedicularis resupinata</i> , <i>P. verticillata</i> , <i>Rhinanthus</i> spp.)	5	0.875	Polyphagous
<i>M. persicae</i>	Dicot-lignosae: Acearaceae (2), Anacardiaceae (4), Apocynaceae (17), Aquifoliaceae (1), Araliaceae (8), Asclepidaceae (11), Begoniaceae (2), Bignoniaceae (12), Bombacaceae (1), Buddlejaceae (5), Buxaceae (4), Cactaceae (6), Cannabaceae (2), Caprifoliaceae (22), Caryaceae (1), Casurinaceae (2), Celastraceae (1), Cercidiphyllaceae (1), Cistaceae (8), Clethraceae (2), Clusiaceae (12), Cobeeaceae (1), Colycanthaceae (1), Combretaceae (1), Cornaceae (3), Cucurbitaceae (10), Dilleniaceae (1), Ebenaceae (1), Ericaceae (4), Escalloniaceae (2), Eucommiaceae (1), Euphorbiaceae (23), Fabaceae (73), Flacourtiaceae (1), Frankeniaceae (1), Grossulariaceae (1), Hamamelidaceae (2), Hydrangeaceae (1), Juglandaceae (1), Lauraceae (2), Linaceae (1), Loganiaceae (1), Lythraceae (6), Magnoliaceae (3), Malpighiaceae (1), Malvaceae (42), Martyniaceae (1), Melastomataceae (2), Melianthaceae (2), Moraceae (2), Moringaceae (1), Myrtaceae (18), Nyctaginaceae (5), Oleaceae (5), Passifloraceae (1), Pedaliaceae (1), Pittosporaceae (2), Platanaceae (1), Proteaceae (2), Rhamnaceae (5), Rosaceae (65), Rubiaceae (16), Rutaceae (8), Sapindaceae (2), Sterculiaceae (4), Styracaceae (1), Tamaracaceae (1), Theaceae (1), Thymeliaceae (2), Tiliaceae (1), Trochodendraceae (1), Ulmaceae (2), Urticaceae (9), Verbenaceae (21), Violaceae (6), Vitaceae (1), Zygophyllaceae (6); Dicot-herbaceae: Acanthaceae (13), Aizoaceae (2), Amaranthaceae (16), Apiaceae (28), Aristolochiaceae (2), Asteraceae (201), Balsaminaceae (2), Basellaceae (1), Berberidaceae (2), Boraginaceae (24), Brassicaceae (76), Campanulaceae (2), Caryophyllaceae (30), Chenopodiaceae (18), Cleomaceae (7), Convolvulaceae (26), Crassulaceae (9), Dipsacaceae (2), Fumariaceae (4), Geraniaceae (6), Gesneriaceae (6), Haloragidaceae (1), Hydrophyllaceae (3), Illebraceae (2), Lamiaceae (23), Myoporaceae (8), Oxalidaceae (10), Onagraceae (6), Orobanchaceae (1), Paeoniaceae (1), Papaveraceae (9), Piperaceae (2), Plantaginaceae (3), Plumbaginaceae (4), Polemoniaceae (3), Polygonaceae (25), Portulacaceae (4), Primulaceae (13), Ranunculaceae (13), Resedaceae (4), Saxifragaceae (3), Scrophulariaceae (35), Solanaceae (80), Tropaeolaceae (2), Valerianaceae (3); Monocot-calciferae: Bromeliaceae (2), Cannaceae (2), Commelinaceae (4), Marantaceae (1), Musaceae (1), Zingiberaceae (1); Monocot-corylliferae: Agavaceae (4), Alstroemeriaceae (1), Amaryllidaceae (4), Araceae (5), Haemodoraceae (1), Iridaceae (8), Liliaceae (20), Orchidaceae (8), Philesiaceae (1), Ruscaceae (1), Smilacaceae (2), Typhaceae (1); Monocot-glumiflorae: Poaceae (1); Others: Adiantaceae (1), Marsileaceae (2), Cupressaceae (1)	1336	1.426	Polyphagous
<i>M. philadelphi</i>	Dicot-lignosae: Hydrangeaceae (2) (<i>Hydrangea macrrophylla</i> , <i>Philadelphus</i>), Philadelphaceae (1) (<i>Deutzia crenata</i>)	3	0.833	Polyphagous
<i>M. pileae</i>	Dicot-lignosae: Urticaceae (1) (<i>Pilea hamaoi</i>); Dicot-herbaceae: Asteraceae (1) (<i>Gynura crepidioides</i>)	2	0.667	Polyphagous
<i>M. Polaris</i>	Dicot-herbaceae: Caryophyllaceae (3) (<i>Cerastium alpinum</i> , <i>C. fontanum</i> , <i>Dianthus caryophyllus</i>)	3	1.250	Oligophagous
<i>M. siegesbeckiae</i>	Dicot-lignosae: Verbenaceae (1); Dicot-herbaceae: Asteraceae (8), Lamiaceae (2)	11	0.867	Polyphagous
<i>M. sorbi</i>	Dicot-herbaceae: Lamiaceae (1) (<i>Sorbaria tomentosa</i>)	1	1.000	Monophagous
<i>Myzus sp.</i>	Dicot-lignosae: Caprifoliaceae (1), Fabaceae (1), Hydrangeaceae (1), Rosaceae (3), Rubiaceae (2); Dicot-herbaceae: Asteraceae (1), Caryophyllaceae (1), Geraniaceae (1), Lamiaceae (1), Portulacaceae (1), Scrophulariaceae (1), Solanaceae (1)	15	0.514	Polyphagous
<i>M. stellariae</i>	Dicot-herbaceae: Caryophyllaceae (2) (<i>Stellaria aquatic</i> , <i>Stellaria</i> spp.)	2	1.333	Monophagous
<i>M. titschaki</i>	Dicot-herbaceae: Caryophyllaceae (1) (<i>Stellaria holostea</i>); Monocot- glumiflorae: Juncaceae (1) (<i>Juncus</i> spp.)	2	0.667	Polyphagous
<i>M. varians</i>	Dicot-lignosae: Rosaceae (2); Dicot-herbaceae: Asteraceae (1), Brassicaceae (1), Lamiaceae (1), Ranunculaceae (13)	18	1.333	Polyphagous

Host preference of different *Myzus* species was species specific. However, a generalized affinity based on 61 species is presented in Table 2. The data revealed that 93.45% plant
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species from dicotyledons were accepted by *Myzus* species and only small number of host plants was shared from monocotyledons and other than angiosperms. In dicotyledons, major

contribution was of herbaceae (58.22%) as compared to lignosae (35.23%). In monocotyledons, corolliferae contributed more than other host categories (Table 2). Host-plant species: host-plant genera ratio was 1.850 and 1.710 in lignosae and herbaceae, respectively and showed that number of species per host-plant genus did not differ much. Nevertheless, host-plant species: host-plant families' ratio indicated much higher

affinity to herbaceae (7.544) than in lignosae (4.788). This ratio was still wider on order basis. Percentage based on totalling all host-plant parameters (Table 2) also revealed greater affiliation of *Myzus* species to host plants belonging to herbaceae. It is interesting to observe that *Myzus* species feed on host plants from very primitive orders to the most advanced. Not only that some species prefer ferns and pines in gymnosperms.

Table 2: Host relationships with *Myzus* species

Parameters	Host plants						Total
	Dicotyledons		Monocotyledons			Others*	
	Lignosae	Herbaceae	Calyciferae	Corolliferae	Glumiflorae		
Species	881 (35.23)	1456 (58.22)	15 (0.60)	110 (4.39)	32 (1.28)	7 (0.28)	2501
Genera	476 (33.40)	809 (56.77)	15 (1.05)	88 (6.18)	31 (2.18)	6 (0.42)	1425
Families	184 (42.99)	193 (45.10)	9 (2.10)	31 (7.24)	5 (1.17)	6 (1.40)	428
Orders	132 (40.12)	154 (46.81)	5 (1.52)	27 (8.21)	5 (1.52)	6 (1.82)	329
Total	1673 (35.72)	2612 (55.78)	44 (0.94)	256 (5.47)	73 (1.56)	25 (0.53)	4683

Others* Host plants other than angiosperms; Figures in parantheses are % values

Since host alternating species feed primarily on woody plants. The monophagous species in lignosae infest plants from families Rosaceae, Araliaceae, Urticaceae, Oleaceae and Rubiaceae on 6th, 10th, 19th, 50th and 52nd on evolutionary scale, respectively and many of them (more than 40%) were hosting on Rosaceae alone. Host species plays a greater role in speciation¹⁵ in case of European and Turkish populations of *M. cerasi* from different winter hosts (*Prunus* spp.) when subjected to phylogenetic analysis. *M. cerasi* emerged as paraphyletic and formed two clades corresponding to subspecies living specifically on *Prunus avium* and *P. cerasus* confirming existence of two morphologically similar winter host-specific subspecies of *M. cerasi* in Europe to *M. cerasi cerasi* (n=118) and *M. cerasi peruniavium* (n=110). *M. cerasi* population was more paraphyletic than *M. borealis*.

In our study *M. persicae* is feeding on highest number of plants, therefore, selected for separate discussion. It is an extremely polyphagous species and feeds on 1336 plant species from 714 genera and 144 families. The most preferred host plants fall in herbaceae

(55.09%) as compared to lignosae (38.82%). Contribution of all categories of monocotyledons to the host range is 6.29% and of non-angiosperms (ferns and pines) only to the tune of 0.30%. Therefore, dicotyledons by and large contributed in the host range of this aphid, both as primary and secondary hosts. Greater affinity was noticed to plants of the families viz., Apocynaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Malvaceae, Myrtaceae, Rosaceae, Rubiaceae and Verbanaceae in lignosae, and Amaranthaceae, Apiaceae, Asteraceae, Boraginaceae, Brassicaceae, Caryophyllaceae, Chenopodiaceae, Convolvulaceae, Lamiaceae, Polygonaceae, Ranunculaceae and Solanaceae in herbaceae. In monocotyledons Liliaceae, Iridaceae, Orchidaceae and Poaceae were on preferred list. However, viviparous stage feeds widely while the oviparous are restrictive to primary or overwintering hosts of the genus *Prunus* particularly, the peach and peach hybrids but also apricot and plum¹⁶.

The plant species: genera and plant species: families ratios were 1.855 and 6.649 in lignosae and 2.044, 16.356 in herbaceae strongly supported greater affinity of

herbaceous plants over lignosae and as well as on others. Affinity at family level was more pronounced in herbaceae than of the genera. Evaluation of the combined effect of all the host parameters (species, genera, families, orders) revealed that herbaceous plants harboured 51.23% followed by lignosae (39.79), calyciferae (1.36%), corolliferae (5.45%), glumiflorae (1.58%) and others-gymnosperms (0.57%). Value of GAI was 1.426, which was quite low for such a polyphagous species is marked by strong affinity and low variability. Molecular diversity analysis showed that genetic variability in *M. persicae* was not as much as was expected¹⁷.

Feeding by *M. persicae* causes damage to plants not only by creating water stress, wilting, reduced growth rate but major damage occurs through transmission of plant viruses. Nymphs and adults are equally capable of transmitting the disease¹⁸. Both persistent and non-persistent viruses are effectively transmitted by this species. Kennedy et al¹⁹ listed over 100 viruses transmitted by *M. persicae*. The plants of Solanaceae, Compositae (Asteraceae), Chenopodiaceae, Cruciferae (Brassicaceae), Cucurbitaceae, etc. were showed to be more vulnerable to important viruses.

For long time population of *M. persicae* on tobacco was considered to be different from other plants²⁰. Molecular studies provided evidence that aphid on tobacco are not distinct at the species level^{21,22}. Eastop and Blackman²³ named this as *M. persicae* ssp. *nicotinae*. Multivariate morphometric analysis carried out using 9 characters of 47 populations of *M. persicae* originating from peach and tobacco from two locations²⁴. Results showed distinct discrimination between the population of peach and tobacco. The most important discrimination character was greater length of rostral segment in the aphid from tobacco plant than in those in peach. This indicated there are two subspecies *M. persicae* and *M. persicae nicotinae*²⁴.

A study on retroactive influences on generalist aphid *M. persicae* s. str. and

specialist *M. persicae* ssp. *nicotinae* revealed that when former was exposed to an alternative host for different periods, odour attraction to the rearing host persisted after 72 hours of experience on the alternate host, whereas in *M. persicae* ssp. *nicotinae* the attraction of rearing host was lost after 12 hours of experience of alternative host. In addition specialist showed lower levels of gene for expression which could be associated with learning differences²⁵. This showed that *M. persicae* s. str. was making more significant use of learning in selecting hosts of its choice than the *nicotinae*.

While determining the spatial and temporal genetic population structure of 923 individuals of *M. persicae* collected from six plant families were genotyped for 8 microsatellite loci²⁶. They observed moderate polymorphism and there was no difference in alleles between primary and secondary hosts or between geographical areas. The proportion of unique genotypes found in the primary host was similar in north and south while on the secondary host it was higher in north than in the south. Heterozygosity excess and linkage disequilibrium suggest a high representation in warmer climate and on the secondary hosts.

Evolutionary pattern of host affinity revealed that *M. persicae* selected host plants from gymnosperms (3 species of ferns and one of pines) and from Magnoliales (lignosae) and Ranales (herbaceae) of angiosperms-dicotyledons. In evolutionary system order Magnoliales and Ranales are parallel groups and widely different in their relationships and further development¹¹.

Following productive evolutionary lineages were observed in lignosae:

1. Magnoliales—Dilleniales—Rosales—
Leguminales = 145 host species
2. Magnoliales—Dilleniales—Rosales—
Cunoniales—Araliales = 119 host species
3. Magnoliales—Dilleniales—Bixales—
Tiliales—Celastrales—Loganiales—
Apocynales, Bignoniales, Rubiales,
Verbenales = 114 host species

4. Magnoliales—Dilleniales—Bixales—

Tiliales—Malvales—Euphorbiales—

Rhamnales—Ebenales = 93 host species

Interestingly it was also noticed that out of three basal stocks viz., Rosales, Theales, and Bixales, Rosales stock contributed 213 host species from 9 orders out of 14 (9/14), Theales 6 from 2 orders (2/3) and 277 from 26 orders (26/32) indicating that Rosales is a very prolific stock and more contributory in lignosae.

Following productive evolutionary lineages were observed in herbaceae:

1. Ranales—Saxifragales—Campanales—

Asterales = 229 host species

2. Ranales—Saxifragales—Solanales—

Personales = 187 host species

3. Ranales—Rhoeadales—Brassicales—

Resedales – 114 host species

4. Ranales—Caryophyllales—Polygonales—

Chenopodiales = 112 host species

In herbaceae, orders Asterales, Brassicales, Caryophyllales, Chenopodiales, Personales, Ranales, Solanales and Umbellales shared strongly in host range and contributed maximum number of host species.

In monocotyledons two weak evolutionary lineages were evident:

1. Liliales—Haemodorales—Orchidales = 32 host species

2. Commelinales—Bromeliales—

Zingiberales = 11 host species

In spite of that the share of monocotyledons was very much limited in the host range of *M. persicae*, interestingly 10 orders out of 17 (10/17) contributed 73 host species from Liliales stock, 11 from Commelinales (3/5) and none from Alismatales stock (0/6).

The information presented in the preceding paragraphs undoubtedly signifies that *M. persicae* is a polyphagous species and detrimental to all kinds of vegetation in all favourable niches. The other polyphagous species like *M. ascalonicus* reported on 208 host species (Species: family ratio 5.070, lignosae 3.500, herbaceae 6.080) and in *M. ornatus* 564 host species (species: family ratio 6.795, lignosae 4.571, herbaceae 10.781) are also notorious but follow *M. persicae*.

Acknowledgments

Authors are grateful to Mr. Akhilesh Rathore for providing all necessary help in retrieving the required information.

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