

Aphids and their Host Affinity- V: *Macrosiphum* and *Microsiphum* spp.

Y. S. Rathore¹ and S. N. Tiwari^{2*}

¹Ex- Principle Scientist, Indian Institute of Pulse Research, Kanpur 208 026 (U.P.)

² Professor, Deptt.of Entomology, G.B. Pant University of Agriculture and Technology, Pantnagar,

Udham Singh Nagar 263 145 (Uttarakhand)

*Corresponding Author E-mail: drsntiwari@gmail.com

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ABSTRACT

Host-plant relationships of species of Macrosiphum and Microsiphum was investigated. Macrosiphum feeds on ferns and pines in gymnosperms and selects very primitive plants from order Magnoliales, Annonales, Ranales, Butamales and Alismatales and continues selecting plants from advanced orders. About 62.67% species are monophagous. A generalized picture revealed distinct preference of Macrosiphum to dicotyledons and herbaceous plants (herbaceae) showed greater preference over woody plant species (lignosae). Plants from Rosaceae, Fabaceae (lignosae), Asteraceae, Apiaceae, Brassicaceae, Solanaceae and Scrophulariaceae (herbaceae) were selected in large numbers as food plants. M. euphorbiae and M. rosae are considered the most harmful species and also clustered together in molecular studies. However, their preference and host range were different. Evolutionary lineages were also investigated for M. euphorbiae. Microsiphum spp. are strictly monophagous on Asteraceae and individually select their host plants from Achillea, Artemisia and Pyrethrum.

Key words: *Macrosiphum, Microsiphum, Dicotyledons, Monocotyledons, GAI*

INTRODUCTION

Species in the genera *Macrosiphum* and *Microsiphum* belong to the tribe Aphidinae: Microsiphini and there are about 2000 species in this tribe¹. *Macrosiphum* genus is comprised of large number of species, whereas *Microsiphum* consists of 11 species. Some of the species in *Macrosiphum* are highly polyphagous and widely distributed and inflict severe losses to agricultural and horticultural crops. Thorsteinson² opined that insects select their food plants from taxonomic groups.

Rathore and Lal³, Rathore and Tiwari^{4,5} also observed the similar host selection pattern in the case of pod borer (*Maruca vitrata*), whitefly (*Bemisia tabaci*) and three species of aphid (*Hyadaphis*, *Uroleucon*, *Viteus*), respectively. Rathore and Ali⁶ shared the above opinion in nematode *Meloidogyne incognita*. In the present endeavor authors attempted to investigate whether such hypothesis is applicable in the species of genera *Macrosiphum* and *Microsiphum*.

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MATERIALS AND METHODS

Information on the species and their host plants of both the genera (*Macrosiphum* and *Microsiphum*) was extracted from the extensive work of Blackman and Eastop^{7,8,9,10} and others. However, in recent literature newer names are appearing due to taxonomic advancement and synonymy. Speciation in aphids has been influenced by host plants, particularly host shifts and adaptation to new hosts¹¹. Nevertheless, authors used the information published by Blackman and Eastop. Moreover, our intention was not to judge the correctness of the species but to find out the relationships between existing species with their host plants. Host plants were, therefore, aligned with the families and orders as described by Hutchinson¹². He divided angiosperms into two subphyla: dicotyledons and monocotyledons. Dicotyledons were further divided into lignosae (primarily woody plants) and herbaceae (primarily herbaceous

plants). Similarly, monocotyledons were separated into three: calyciferae (calyx bearers-with distinct calyx and corolla), corolliferae (calyx and corolla are more or less similar) and glumiflorae (perianth is much more reduced or represented by lodicules). The terms mono-, oligo- and polyphagous were adopted as per definitions of Bernays and Chappman¹³. General Affiliation Index (GAI) was employed as described by Rathore and Tiwari¹⁴. For other details readers are referred to first part of the publication on Aphids and their host affinity-I: *Acyrtosiphon* spp. by Rathore and Tiwari¹⁵.

RESULTS AND DISCUSSION

Compiled information revealed presence of 149 species of *Macrosiphum* (Table 1) and 11 of *Microsiphum* (Table 4). In *Macrosiphum* 63.76% species were categorized as monophagous, 10.07% oligophagous and 26.17% polyphagous.

Table 1: Relationships of host taxonomic groupings with *Macrosiphum* species

<i>Macrosiphum</i> spp.	Host plants with taxonomic group	No. of host species	GAI	Status
<i>M. adianti</i>	Others: Adiantaceae (2), Dryopteridaceae (4), Polypodiaceae (1)	7	0.820	Polyphagous
<i>M. aetheocornum</i>	Dicot-herbaceae: Geraniaceae (1) (<i>Geranium viscosissimum</i>)	1	1.000	Monophagous
<i>M. agrimoniellum</i>	Dicot-lignosae: Rosaceae (2) (<i>Agrimonia eupatoria</i> , <i>A. gryposepala</i>)	2	1.333	Monophagous
<i>M. albertinae</i>	Dicot-lignosae: Santalaceae (2) (<i>Thesium divaricatum</i> , <i>T. intermedium</i>)	2	1.333	Monophagous
<i>M. albifrons</i>	Dicot-lignosae: Fabaceae (16)	16	3.600	Oligophagous
<i>M. alpinum</i>	Dicot-herbaceae: Asteraceae (1) (<i>Senecio alpinus</i>)	1	1.000	Monophagous
<i>M. amygdaloides</i>	Dicot-lignosae: Euphorbiaceae (3) (<i>Euphorbia amygdaloides</i> , <i>E. characias</i> , <i>E. semiperfoliata</i>)	3	1.667	Monophagous
<i>M. artemisiae</i>	Dicot-lignosae: Malvaceae (1) (<i>Althaea officinalis</i>)	1	1.000	Monophagous
<i>M. atragenae</i>	Dicot-herbaceae: Ranunculaceae (2) (<i>Clematis alpine</i> , <i>C. glauca</i>)	2	1.333	Monophagous
<i>M. audeni</i>	Dicot-herbaceae: Nymphaeaceae (1) (<i>Nuphar lutea</i>)	1	1.000	Monophagous
<i>M. badium</i>	Monocot-corolliferae: Liliaceae (3) (<i>Maianthemum dilatatum</i> , <i>M. racemosum</i> , <i>M. stellatum</i>)	3	1.667	Monophagous
<i>M. berchemiae</i>	Dicot-lignosae: Rhamnaceae (1) (<i>Berchemia lineata</i>)	1	1.000	Monophagous
<i>M. berkamiae</i>	Dicot-lignosae: Rhamnaceae (1) (<i>Berchemia racemosa</i>)	1	1.000	Monophagous
<i>M. bisensoriatum</i>	Dicot-lignosae: Grossulariaceae (1) (<i>Ribes lacustre</i>)	1	1.000	Monophagous
<i>M. bupleuri</i>	Dicot-herbaceae: Apiaceae (2) (<i>Bupleurum aureum</i> , <i>B. longifolium</i>)	2	1.333	Monophagous
<i>M. californicum</i>	Dicot-lignosae: Salicaceae (7) (<i>Salix amygdaloides</i> , <i>S. koriyanagi</i> , <i>S. lasiandra</i> , <i>S. lasiolepis</i> , <i>S. lutea</i> , <i>S. scouleriana</i> , <i>S. triandra</i>)	7	3.000	Monophagous
<i>M. carpinicolens</i>	Dicot-lignosae: Corylaceae (1) (<i>Carpinus caroliniana</i>)	1	1.000	Monophagous
<i>M. centranthi</i>	Dicot-lignosae: Anacardiaceae (1), Fabaceae (1), Melastomataceae (1), Rosaceae (1); Dicot-herbaceae: Apiaceae (1), Asteraceae (1), Caryophyllaceae (1), Crassulaceae (1), Ranunculaceae (1), Valerianaceae (4)	13	0.484	Polyphagous
<i>M. cerinthiacum</i>	Dicot-herbaceae: Boraginaceae (1) (<i>Cerintho minor</i>)	1	1.000	Monophagous
<i>M. cholodkovskiyi</i>	Dicot-lignosae: Rosaceae (4); Dicot-herbaceae: Apiaceae (1), Chenopodiaceae (1), Onagraceae (1), Valerianaceae (1)	8	0.588	Polyphagous
<i>M. claytoniae</i>	Dicot-herbaceae: Portulacaceae (1) (<i>Montia sibirica</i>)	1	1.000	Monophagous
<i>M. clematifoliae</i>	Dicot-herbaceae: Ranunculaceae (1) (<i>Clematis florida</i>)	1	1.000	Monophagous
<i>M. clydesmithi</i>	Dicot-lignosae: Rosaceae (1); Others: Dennstaedtiaceae (1), Pteridaceae (1)	3	0.556	Polyphagous
<i>M. constrictum</i>	Dicot-herbaceae: Saifragaceae (1), Scrophulariaceae (1)	2	0.667	Polyphagous
<i>M. corallorhizae</i>	Monocot-corolliferae: Orchidaceae (2) (<i>Corallorhiza maculata</i> , <i>C. striata</i>)	2	1.333	Monophagous
<i>M. coryli</i>	Dicot-lignosae: Corylaceae (2) (<i>Corylus americana</i> , <i>C. cornuta</i>)	2	1.333	Monophagous

<i>M. corylicola</i>	Dicot-lignosae: Corylaceae (3) (<i>Carpinus laxiflora</i> , <i>Corylus heterophylla</i> , <i>C. sieboldiana</i>)	3	1.667	Oligophagous
<i>M. creelii</i>	Dicot-lignosae: Fabaceae (7)	7	1.286	Oligophagous
<i>M. cuscutae</i>	Dicot-lignosae: Malvaceae (1), Vitaceae (1); Dicot-herbaceae: Acanthaceae (1), Convolvulaceae (1)	4	0.500	Polyphagous
<i>M. cyatheae</i>	Others: Cyatheaceae (1), Dennstaedtiaceae (1)	2	1.167	Polyphagous
<i>M. cystopteris</i>	Others: Dryopteridaceae (1) (<i>Cystopteris bulbifera</i>)	1	1.000	Monophagous
<i>M. daphnidis</i>	Dicot-lignosae: Thymeliaceae (7) (<i>Daphne cneorum</i> , <i>D. indica</i> , <i>D. laureola</i> , <i>D. mezereum</i> , <i>D. striata</i> , <i>D. x burkwoodii</i> , <i>D. x mantensiana</i>)	7	3.000	Monophagous
<i>M. diervillae</i>	Dicot-lignosae: Caprifoliaceae (1) (<i>Diervilla lonicera</i>)	1	1.000	Monophagous
<i>M. doricicola</i>	Dicot-herbaceae: Asteraceae (1) (<i>Doronicum austriacum</i>) <i>M. dryoteridis</i> Others: Blechnaceae (1), Dryoteridaceae (9), Polypodiaceae (1), Thelypteridaceae (3)	14	1.333	Polyphagous
<i>M. echinocysti</i>	Dicot-lignosae: Cucurbitaceae (1) (<i>Echinocystis</i> sp.)	1	1.000	Monophagous
<i>M. edrossi</i>	Dicot-lignosae: Urticaceae (1) (<i>Urtica</i> sp.)	1	1.000	Monophagous
<i>M. eophorbiae</i>	Dicot-lignosae: Proteaceae (1), Rubiaceae (1); Monocot-corrilliferae : 1 Iridaceae (1)		0.556	Polyphagous
<i>M. equiseti</i>	Others: Equisetaceae (3) (<i>Equisetum arvense</i> , <i>E. pretense</i> , <i>E. sylvaticum</i>)	3	1.667	Monophagous
<i>M. eupatorii</i>	Dicot-herbaceae: Asteraceae (1) (<i>Eupatorium rugosum</i>)	1	1.000	Monophagous
<i>M. euphorbiae</i>	Dicot-lignosae: Anacardiaceae (2), Annonaceae (1), Apocynaceae (7), Aquifoliaceae (2), Araliaceae (3), Asclepiadaceae (2), Bignoniaceae (4), Bombacaceae (1), Buddlejaceae (1), Cactaceae (1), Calycanthaceae (1), Cannabaceae (1), Caprifoliaceae (12), Caricaceae (1), Celastraceae (3), Cistaceae (3), Clusiaceae (7), Cornaceae (1), Cucurbitaceae (10), Epacridaceae (1), Ericaceae (9), Escalloniaceae (1), Euphorbiaceae (13), Fabaceae (32), Greyiaceae (1), Grossulariaceae (1), Hydrangeaceae (7), Linaceae (1), Loasaceae (1), Magnoliaceae (2), Malvaceae (17), Martyniaceae (1), Myriaceae (1), Myrtaceae (1), Nyctaginaceae (3), Oleaceae (3), Passifloraceae (3), Pedaliaceae (1), Pittosporaceae (2), Rhamnaceae (2), Rosaceae (64), Rubiaceae (7), Rutaceae (2), Simaroubaceae (1), Stilbaceae (1), Styracaceae (1), Theaceae (1), Thymeliaceae (3), Turneraceae (1), Urticaceae (6), Verbenaceae (5), Violaceae (1), Vitaceae (3); Dicot-herbaceae: Acanthaceae (4), Aizoaceae (2), Amaranthaceae (12), Apiaceae (24), Asteraceae (150), Balsaminaceae (3), Berberidaceae (2), Boraginaceae (14), Brassicaceae (29), Camanulaceae (2), Caryophyllaceae (15), Chenopodiaceae (14), Cleomaceae (1), Convolvulaceae (6), Crassulaceae (6), Dipsacaceae (1), Fumariaceae (7), Gentianaceae (2), Geraniaceae (6), Lamiaceae (23), Lardizabalaceae (1), Myoporaceae (1), Nymphaeaceae (1), Onagraceae (9), Orobanchaceae (1), Oxalidaceae (3), Papaveraceae (8), Plantaginaceae (2), Plumbaginaceae (1), Phytolaccaceae (2), Polemoniaceae (6), Polygonaceae (21), Portulacaceae (3), Primulaceae (6), Ranunculaceae (18), Scrophulariaceae (31), Saifragaceae (7), Solanaceae (44), Tropaeoleaceae (1), Valerianaceae (5); Monocot-calciferae: Alismataceae (1), Butamoceae (1), CFannaceae (1), Commelinaceae (1); Monocot-corrilliferae: Agavaceae (1), Alstromeriaceae (1), Amaryllidaceae (1), Araceae (4), Dioscoreaceae (1), Haemodoraceae (1), Iridaceae (1), Liliaceae (17), Orchidaceae (1); Monocot-Glumiflorae: Poaceae (7); Others: Osmundaceae (1)	809	1.291	Polyphagous
<i>M. fagopyri</i>	Dicot-herbaceae: Polygonaceae (1) (<i>Fagopyrum cymosum</i>)	1	1.000	Monophagous
<i>M. floridiae</i>	Dicot-lignosae: Rosaceae (1) (<i>Rosa laevigata</i>)	1	1.000	Monophagous
<i>M. funestum</i>	Dicot-lignosae: Rosaceae (6), Rubiaceae (1); Dicot-herbaceae: Boraginaceae (1), Geraniaceae (1)	9	0.917	Polyphagous
<i>M. fuscicornis</i>	Dicot-herbaceae: Onagraceae (1) (<i>Epilobium angustifolium</i>)	1	1.000	Monophagous
<i>M. gaurae</i>	Dicot-lignosae: Asclepiadaceae (1); Dicot-herbaceae: Asteraceae (1), Onagraceae (4)	6	0.800	Polyphagous
<i>M. gei</i>	Dicot-lignosae: Rosaceae (8); Dicot-herbaceae: Apiaceae (20), Boraginaceae (2), Caryophyllaceae (2)	32	1.259	Polyphagous
<i>M. geranii</i>	Dicot-herbaceae: Geraniaceae (2) (<i>Geranium maculatum</i> , <i>G. pretense</i>)	2	1.333	Monophagous
<i>M. hamiltoni</i>	Dicot-lignosae: Cornaceae (1) (<i>Cornus alternifolia</i>)	1	1.000	Monophagous
<i>M. hartigi</i>	Dicot-herbaceae: Caryophyllaceae (1) (<i>Silene vulgaris</i>)	1	1.000	Monophagous
<i>M. helianthi</i>	Dicot-herbaceae: Asteraceae (1) (<i>Helianthus annuus</i>)	1	1.000	Monophagous
<i>M. hellebori</i>	Dicot-herbaceae: Ranunculaceae (7) (<i>Helleborus foetidus</i> , <i>H. kochii</i> , <i>H. lindus</i> , <i>H. niger</i> , <i>H. odoratus</i> , <i>H. puurascens</i> , <i>H. viridis</i>)	7	3.000	Monophagous
<i>M. holmani</i>	Dicot-herbaceae: Apiaceae (1) (<i>Sanicula europaea</i>)	1	1.000	Monophagous
<i>M. holodisce</i>	Dicot-lignosae: Rosaceae (1) (<i>Holodiscus discolor</i>)	1	1.000	Monophagous
<i>M. impatientis</i>	Dicot-lignosae: Rosaceae (2); Dicot-herbaceae: Balsamianaceae (2)	4	1.000	Polyphagous
<i>M. incertum</i>	Dicot-herbaceae: Caryophyllaceae (1) (<i>Stellaria</i> sp.)	1	1.000	Monophagous
<i>M. inexpectatum</i>	Dicot-lignosae: Euphorbiaceae (1) (<i>Euphorbia insularis</i>)	1	1.000	Monophagous
<i>M. insularis</i>	Monocot-corrilliferae: Convallariaceae (3)	3	1.000	Oligophagous
<i>M. isodonis</i>	Dicot-herbaceae: Lamiaceae (1) (<i>Isodon japonicus</i>)	1	1.000	Monophagous
<i>M.</i>	Dicot-herbaceae: Asteraceae (2) (<i>Senecio nemoralis</i> , <i>Jacobaea salsamita</i>)	2	1.000	Oligophagous

<i>jacobaeabalsamita</i>				
<i>M. jasmine</i>	Dicot-lignosae: Oleaceae (1) (<i>Jasminum</i> sp.)	1	1.000	Monophagous
<i>M. jeanae</i>	Dicot-herbaceae: Sarraceniaceae (1) (<i>Sarracenia pururea</i>)	1	1.000	Monophagous
<i>M. kiowanepum</i>	Dicot-lignosae: Melianthaceae (1), Rosaceae (1); Dicot-herbaceae: Asteraceae (1), Scrophulariaceae (1)	4	0.500	Polyphagous
<i>M. kiwanepus</i>	Dicot-lignosae: Rosaceae (1); Monocot- corolliferae: Hyacinthaceae (1)	2	0.667	Polyphagous
<i>M. knautiae</i>	Dicot-herbaceae: Dipsacaceae (3) (<i>Knautia arvensis</i> , <i>K. dipsacifolia</i> , <i>K. drymeia</i>)	3	1.667	Monophagous
<i>M. kuricola</i>	Dicot-lignosae: Fagaceae (1) (<i>Quercus mangolica</i>)	1	1.000	Monophagous
<i>M. lambi</i>	Others: Dryopteridaceae (2) (<i>Athyrium filixfemina</i> , <i>Dryopteris thelypteris</i>)	2	1.000	Oligophagous
<i>M. lapponicum</i>	Others: Dryopteridaceae (2) (<i>Athyrium alpestre</i> , <i>A. distentifolium</i>)	2	1.333	Monophagous
<i>M. laseri</i>	Dicot-herbaceae: Apiaceae (2) (<i>Laser trilobum</i> , <i>Laseritium latifolium</i>)	2	1.000	Oligophagous
<i>M. lili</i>	Monocot-corolliferae: Liliaceae (5) (<i>Lilium canadense</i> , <i>L. henryi</i> , <i>L. speciosum</i> , <i>L. superbum</i> , <i>L. tigrinum</i>)	5	2.333	Monophagous
<i>M. lisae</i>	Dicot-herbaceae: Onagraceae (1) (<i>Epilobium angustifolium</i>)	1	1.000	Monophagous
<i>M. longirostratum</i>	Others: Dryopteridaceae (1) (<i>Woodsia mollis</i>)	1	1.000	Monophagous
<i>M. ludoviciana</i>	Dicot-herbaceae: Convolvulaceae (1) (<i>Convolvulus</i> sp.)	1	1.000	Monophagous
<i>M. martini</i>	Dicot-lignosae: Melianthaceae (1) (<i>Zigadenus nuttallii</i>)	1	1.000	Monophagous
<i>M. martorelli</i>	Dicot-lignosae: Sterculiaceae (1) (<i>Theobroma cacao</i>)	1	1.000	Monophagous
<i>M. meixneri</i>	Dicot-lignosae: Euphorbiaceae (2) (<i>Euphorbia austriaca</i> , <i>E. hyberna</i>)	2	1.333	Monophagous
<i>M. melampyri</i>	Dicot-herbaceae: Scrophulariaceae (4) (<i>Digitalis ambigua</i> , <i>Melampyrum memorosum</i> , <i>M. pretense</i> , <i>M. sylvaticum</i>)	4	1.500	Oligophagous
<i>M. mentzeliae</i>	Dicot-lignosae: Losaceae (1) (<i>Mentzelia albicaulis</i>)	1	1.000	Monophagous
<i>M. mertensiae</i>	Dicot-herbaceae: Boraginaceae (1) (<i>Mertensia</i> sp.)	1	1.000	Monophagous
<i>M. mesosphaeri</i>	Dicot-herbaceae: Lamiaceae (13)	13	2.500	Oligophagous
<i>M. miho</i>	Others: Dryopteridaceae (2), Polypodiaceae (1)	3	0.833	Polyphagous
<i>M. minatii</i>	Dicot-herbaceae: Ranunculaceae (1) (<i>Delphinium</i> spp.)	1	1.000	Monophagous
<i>M. mordvilkoii</i>	Dicot-lignosae: Rosaceae (6) (<i>Rosa acicularis</i> , <i>R. alba</i> , <i>R. davurica</i> , <i>R. maximowicziana</i> , <i>R. multiflora</i> , <i>R. rugosa</i>)	6	2.667	Monophagous
<i>M. multipilosum</i>	Dicot-herbaceae: Asteraceae (1) (<i>Helichrysum punctatum</i>)	1	1.000	Monophagous
<i>M. naazamii</i>	Dicot-herbaceae: Asteraceae (1) (<i>Cirsium japonicum</i>)	1	1.000	Monophagous
<i>M. nasonovi</i>	Dicot-lignosae: Ericaceae (5); Dicot-herbaceae: Menyanthaceae (1); Monocot- calyciferae: Scheuchzeriaceae (1)	7	0.820	Polyphagous
<i>M. niwanistum</i>	Dicot-herbaceae: Boraginaceae (1) (<i>Mertensia paniculata</i>)	1	1.000	Monophagous
<i>M. occidentale</i>	Dicot-lignosae: Rosaceae (1) (<i>Oemleria cerasiformis</i>)	1	1.000	Monophagous
<i>M. olmsteadi</i>	Dicot-herbaceae: Asteraceae (1) (<i>Aster macrophyllus</i>)	1	1.000	Monophagous
<i>M. oregonense</i>	Dicot-lignosae: Caprifoliaceae (1) (<i>Lonicera nigra</i>)	1	1.000	Monophagous
<i>M. oregonense</i>	Monocot-corolliferae: Araceae (1) (<i>Lysichiton americanum</i>)	1	1.000	Monophagous
<i>M. orthocarpus</i>	Dicot-herbaceae: Scrophulariaceae (1) (<i>Orthocarpus purpurascens</i>)	1	1.000	Monophagous
<i>M. osmaroniae</i>	Dicot-lignosae: Rosaceae (1); Others: Dennstaedtiaceae (1)	2	0.667	Polyphagous
<i>M. pachysiphon</i>	Dicot-lignosae: Rosaceae (7); Dicot-herbaceae: Asteraceae (1), Berberidaceae (1), Polygonaceae (1)	10	0.800	Polyphagous
<i>M. pallens</i>	Dicot-herbaceae: Asteraceae (2) (<i>Ambrosia trifida</i> , <i>Silphium integrifolium</i>)	2	1.000	Oligophagous
<i>M. pallidum</i>	Dicot-lignosae: Rosaceae (7), Rubiaceae (1); Dicot-herbaceae: Apiaceae (1), Asteraceae (5), Balasaminaceae (3), Onagraceae (2); Monocot-corolliferae: Liliaceae (1)	20	0.880	Polyphagous
<i>M. parvifolii</i>	Dicot-lignosae: Ericaceae (3) (<i>Gaultheria mucronata</i> , <i>Vaccinium alaskaense</i> , <i>V. parvifolium</i>)	3	1.250	Oligophagous
<i>M. pechumani</i>	Dicot-lignosae: Ericaceae (1), Malvaceae (1), Rosaceae (1); Monocot-corolliferae: Convallariaceae (3)	6	0.615	Polyphagous
<i>M. penfroense</i>	Dicot-herbaceae: Caryophyllaceae (1) (<i>Silene uniflora</i>)	1	1.000	Monophagous
<i>M. perillae</i>	Dicot-lignosae: Rosaceae (1); Dicot-herbaceae: Lamiaceae (5)	6	1.000	Polyphagous
<i>M. polanense</i>	Dicot-herbaceae: Asteraceae (1) (<i>Cicerbita alpine</i>)	1	1.000	Monophagous
<i>M. potentillae</i>	Dicot-lignosae: Rosaceae (1) (<i>Potentilla anserine</i>)	1	1.000	Monophagous
<i>M. potentillicaulis</i>	Dicot-lignosae: Rosaceae (1) (<i>Potentilla bakeri</i>)	1	1.000	Monophagous
<i>M. prenanthidis</i>	Dicot-herbaceae: Asteraceae (1) (<i>Prenanthes purpurea</i>)	1	1.000	Monophagous
<i>M. pseudocoryli</i>	Dicot-lignosae: Corylaceae (3) (<i>Corylus americana</i> , <i>C. cornuta</i> , <i>Ostrya virginiana</i>)	3	1.250	Oligophagous
<i>M. pseudogeranii</i>	Dicot-herbaceae: Geraniaceae (2), Polygonaceae (1)	3	0.833	Polyphagous
<i>M. ptericolens</i>	Others: Cyatheaceae (1), Dennstaedtiaceae (2), Dryopteridaceae (2)	5	0.778	Polyphagous
<i>M. pteridis</i>	Dicot-lignosae: Rosaceae (1); Others: Dennstaedtiaceae (1)	2	0.667	Polyphagous
<i>M. pulcherimum</i>	Dicot-herbaceae: Asteraceae (1) (<i>Lactuca</i> spp.)	1	1.000	Monophagous

<i>M. pyrifoliae</i>	Dicot-lignosae: Rosaceae (2); Dicot-herbaceae: Brassicaceae (1)	3	0.833	Polyphagous
<i>M. ranunculi</i>	Dicot-herbaceae: Ranunculaceae (1) (<i>Ranunculus auricomus</i>)	1	1.000	Monophagous
<i>M. raysmithi</i>	Dicot-lignosae: Caprifoliaceae (1) (<i>Lonicera ledebourii</i>)	1	1.000	Monophagous
<i>M. rebecca</i>	Others: Adiantaceae (1) (<i>Adiantum</i> spp.)	1	1.000	Monophagous
<i>M. rhamnii</i>	Others: Dennstaedtiaceae (1), Polypodiaceae (1), Pteridaceae (1)	3	0.714	Polyphagous
<i>M. rosae</i>	Dicot-lignosae: Aquifoliaceae (3), Bignoniaceae (1), Buxaceae (1), Caprifoliaceae (3), Ericaceae (1), Hydrangeaceae (1), Oleaceae (1), Rosaceae (48); Dicot-herbaceae: Asteraceae (2), Dipsacaceae (18), Onagraceae (1), Polygonaceae (1), Valerianaceae (6) Others: Pteridaceae (1)	88	1.712	Polyphagous
<i>M. rubiarctici</i>	Dicot-lignosae: Rosaceae (3) (<i>Rubus arcticus</i> , <i>R. saxatilis</i> , <i>R. stellatus</i>)	3	1.667	Monophagous
<i>M. rudbeckiarum</i>	Dicot-lignosae: Rosaceae (1); Dicot-herbaceae: Asteraceae (3)	4	1.000	Polyphagous
<i>M. rufiabdominale</i>	Dicot-herbaceae: Asteraceae (1) (<i>Picnomon acarna</i>)	1	1.000	Monophagous
<i>M. salvia</i>	Dicot-lignosae: Malvaceae (1); Dicot-herbaceae: Amaranthaceae (1), Lamiaceae (8)	10	0.923	Polyphagous
<i>M. scoliopi</i>	Dicot-lignosae: Ericaceae (1) (<i>Rhododendron albiflorum</i>)	1	1.000	Monophagous
<i>M. sibiricum</i>	Dicot-lignosae: Urticaceae (1) (<i>Urtica angustifolia</i>)	1	1.000	Monophagous
<i>M. silvaticum</i>	Dicot-herbaceae: Dipsacaceae (2) (<i>Knautia arvensis</i> , <i>K. silvatica</i>)	2	1.333	Monophagous
<i>M. solum</i>	Dicot-herbaceae: Geraniaceae (1) (<i>Geranium</i> spp.)	1	1.000	Monophagous
<i>M. sorbi</i>	Dicot-lignosae: Rosaceae (1); Dicot-herbaceae: Saxifragaceae (1)	2	1.000	Polyphagous
<i>Macrosiphum</i> sp.	Dicot-lignosae: Caprifoliaceae (1), Cucurbitaceae (1), Ericaceae (1), Euphorbiaceae (1), Fabaceae (4), Malvaceae (1), Rosaceae (4), Urticaceae (1); Dicot-herbaceae: Aizoaceae (5), Boraginaceae (1), Fumariaceae (1), Geraniaceae (1), Oxalidaceae (1), Papaveraceae (1), Polemoniaceae (1), Ranunculaceae (1), Scrophulariaceae (4); Monocot-corrilliferae: Araceae (1)	32	0.640	Polyphagous
<i>M. sp. nr. geanae</i>	Dicot-herbaceae: Serraceniaceae (1) (<i>Darlingtonia californica</i>)	1	1.000	Monophagous
<i>M. stanleyi</i>	Dicot-lignosae: Caprifoliaceae (5) (<i>Sambucus callicarpa</i> , <i>S. cerulea</i> , <i>S. melanocarpa</i> , <i>S. microbotrys</i> , <i>S. pubens</i>)	5	2.333	Monophagous
<i>M. stellariae</i>	Dicot-lignosae: Apocynaceae (1), Rosaceae (1); Dicot-herbaceae: Amaranthaceae (1), Apiaceae (3), Brassicaceae (1), Caryophyllaceae (9), Chenopodiaceae (1), Papaveraceae (2), Polygonaceae (1), Ranunculaceae (1), Valerianaceae (1); Monocot-corrilliferae: Liliaceae (1)	23	0.625	Polyphagous
<i>M. tenuicauda</i>	Dicot-lignosae: Urticaceae (2); Dicot-herbaceae: Apiaceae (1), Brassicaceae (1)	4	0.667	Polyphagous
<i>M. tiliae</i>	Dicot-lignosae: Tiliaceae (1) (<i>Tilia americana</i>)	1	1.000	Monophagous
<i>M. timpanogus</i>	Dicot-lignosae: Fabaceae (1) (<i>Lupinus</i> sp.)	1	1.000	Monophagous
<i>M. tinctum</i>	Dicot-herbaceae: Onagraceae (7) (<i>Epilobium angustifolium</i> , <i>E. collinum</i> , <i>E. hirsutum</i> , <i>E. molle</i> , <i>E. montanum</i> , <i>E. palustre</i> , <i>E. roseum</i>)	7	3.000	Monophagous
<i>M. tolmiea</i>	Dicot-herbaceae: Saxifragaceae (3) (<i>Mitella caulescens</i> , <i>Tellima grandiflora</i> , <i>menziesii</i>)	3	1.000	Oligophagous
<i>M. trollii</i>	Dicot-herbaceae: Ranunculaceae (1) (<i>Trollius europaeus</i>)	1	1.000	Monophagous
<i>M. tuberculiceps</i>	Dicot-herbaceae: Berberidaceae (1) (<i>Achlys triphylla</i>)	1	1.000	Monophagous
<i>M. valerianae</i>	Dicot-herbaceae: Onagraceae (1), Valerianaceae (3)	4	1.000	Polyphagous
<i>M. vancouveriae</i>	Dicot-herbaceae: Berberidaceae (1) (<i>Vancouveria hexandra</i>)	1	1.000	Monophagous
<i>M. vandenboschi</i>	Dicot-lignosae: Corylaceae (1) (<i>Corylus cornuta</i>)	1	1.000	Monophagous
<i>M. venaefuscae</i>	Dicot-herbaceae: Polygonaceae (3) (<i>Fallopia convolvulus</i> , <i>Polygonum cristatum</i> , <i>Rumex crispus</i>)	3	1.000	Monophagous
<i>M. verbenae</i>	Dicot-lignosae: Verbenaceae (2) (<i>Verbena officinalis</i> , <i>V. stricta</i>)	2	1.333	Monophagous
<i>M. vereshthagini</i>	Dicot-herbaceae: Ranunculaceae (1) (<i>Cimicifuga foetida</i>)	1	1.000	Monophagous
<i>M. violae</i>	Dicot-lignosae: Violaceae (1) (<i>Viola glabella</i>)	1	1.000	Monophagous
<i>M. walkeri</i>	Dicot-herbaceae: Asteraceae (1); Others: Adiantaceae (2), Davalliaceae (2), Dryopteridaceae (5), Oleandraceae (2), Osmundaceae (1), Polypodiaceae (2)	15	0.708	Polyphagous
<i>M. weberi</i>	Dicot-herbaceae: Asteraceae (1), Dipsacaceae (3)	4	0.857	Polyphagous
<i>M. wilsoni</i>	Monocot-corrilliferae: Liliaceae (2) (<i>Disporum hookeri</i> , <i>D. smithii</i>)	2	1.333	Monophagous
<i>M. woodsiae</i>	Others: Adiantaceae (1), Dryopteridaceae (4), Pteridaceae (1)	6	1.000	Polyphagous
<i>M. woodwardiae</i>	Others: Dryopteridaceae (1) (<i>Dryopteris varia</i>)	1	1.000	Monophagous
<i>M. zionense</i>	Dicot-lignosae: Fabaceae (2) (<i>Lupinus</i> spp., <i>Thermopsis pinetorum</i>)	2	1.000	Oligophagous

Number of monophagous species was much higher than the other two categories. More monophagous species were recorded on herbaceous plants (herbaceae) than on woody plants (lignosae). In monocotyledons, only

corolliferous plants shared 3.36%. A sizeable number of *Macrosiphum* species were observed to feed upon non-angiosperms (mainly ferns) (Table 2). In oligophagous category, aphid species harboured in similar

numbers both on lignosae and herbaceae. Again corolliferous plants were accepted and non-angiosperms plants were also served as a host of one aphid species. In polyphagous group more plants were preferred in

combination of lignosae + herbaceae than the two groups alone (Table 2). Calyciferae and glumiflorae in monocotyledons showed rare contribution.

Table 2: Distribution of *Macrosiphum* species to different taxonomic groups of plants

Plant Taxonomic groups	No. (%) Aphid spp.		
	Monophagous	Oligophagous	Polyphagous
Lignosae	39 (26.17)	6 (4.03)	2 (1.34)
Herbaceae	45 (30.20)	7 (4.70)	4(2.68)
Calyciferae	0 (0.00)	0 (0.00)	-
Corolliferae	5 (3.36)	1 (0.67)	-
Glumiflorae	0 (0.00)	0 (0.00)	-
Lignosae+ Herbaceae	-	-	15 (10.07)
Lignosae+ Corolliferae	-	-	3 (2.01)
Lignosae+ Others	-	-	1 (0.67)
Lignosae+ Herbaceae+ Calyciferae	-	-	1 (0.67)
Lignosae+ Herbaceae+ Corolliferae	-	-	3 (2.01)
Lignosae+ Herbaceae+ Others	-	-	1 (0.67)
Lignosae+ Herbaceae+ Glumiflorae+ Others	-	-	1 (0.67)
Herbaceae+Others	-	-	1 (0.67)
Others	6 (4.03)	1 (0.67)	-
Total	95 (63.76)	15 (10.07)	39 (26.17)

In most of the time GAI values for monophagous species were 1.000 but ranged from 1.000 to 1.667. In exceptional cases, it has gone to 3.000 because of large number of species belonging to the same genus. Similarly values were also bit abnormal sometimes in oligophagous and polyphagous species due to the same reason. However, such variations are expected in biological specimens. Nevertheless, values of GAI were more or less in the expected range.

A generalized bird-eye view presented in Table 3 revealed distinct preference to

dicotyledons (89.67%) followed by monocotyledons and others (non-angiosperms mainly ferns). Among dicotyledons, herbaceous plants showed greater preference than woody plants. Corolliferous plants in monocotyledons had an edge on others category. Ratio between species vs. families was 4.582 and 3.409 in herbaceae and lignosae indicated more clumped affiliation in herbaceae than in lignosae. Such ratio was much less 1.838 in case for plants in others category as most of these species were fern feeders.

Table 3: Taxonomic relationships of species of *Macrosiphum* to the host plants

Parameters	Host plants						Total
	Dicotyledons		Monocotyledons				
	Lignosae	Herbaceae	Calyciferae	Corolliferae	Glumiflorae	Others*	
Species	508 (36.29)	747 (53.38)	5 (0.38)	65 (4.64)	7 (0.50)	68 (4.88)	1400
Genera	281 (33.57)	443 (52.93)	5 (0.59)	51 (6.09)	7 (0.84)	50 (5.47)	837
Families	149 (39.63)	163 (43.35)	5 (1.33)	21 (5.59)	1 (0.27)	37 (9.84)	376
Orders	131 (41.07)	140 (43.89)	5 (1.57)	21 (6.58)	1 (0.31)	21 (6.58)	319
Total	1069 (36.46)	1493 (50.92)	20 (0.68)	158 (5.39)	16 (0.55)	176 (6.00)	2932

* Primitive plant species other than Angiosperms; Figures in parentheses are % values

M. euphorbiae, the potato aphid, is widespread in Nearctic (native), Palearctic (introduced), Ethiopian (introduced), Neotropical (introduced) and Australian (introduced) regions. It is highly destructive and its host range extended to an almost worldwide distribution^{16,17,18,19,20}. It is a polyphagous species and feeds upon 809 host plants which spread out in 53 families (34 orders), 40 families (22 orders), 14 families (14 orders), and one family (one order) in lignosae, herbaceae, monocotyledons and others (non-angiosperms), respectively. Although Miner and Wason¹⁸ has documented as on feeding over 200 species in 20 different plant families and most notable host plants come from family Solanaceae (potatoes and tomatoes) and Brassicaceae (cabbage and lettuce). In present study we observed *M. euphorbiae* feeding on large number of plant species in families Rosaceae, Fabaceae, Malvaceae in lignosae (dicot), Asteraceae, solanaceae, Brassicaceae Scrophulariaceae, Lamiaceae, Apiaceae in herbaceae (Dicot) and in Liliaceae (monocot). It is a vector of many plant diseases, including 40 non-persistent viruses and several persistent viruses e.g. yellow net virus, pea leaf roll virus and potato leaf roll virus^{21,22}. Molecular study based on fragments COI and 12S rRNA genes revealed that *Macrosiphum* appears to be paraphyletic and the two species viz., *M. euphorbiae* and *M. rosae* clustered together²³. However, *M. euphorbiae* feeds mainly on dicotyledons but host range includes monocotyledons as well as non-angiosperms like ferns, whereas host range of *M. rosae* is restricted to dicotyledons only and mainly to plants in family Rosaceae (44 host plants). *M. euphorbiae* also infests plants from very primitive orders like Magnoliales (lignosae), Ranales (herbaceae) and Butamales and Alismatales (monocotyledons). In the evolutionary or phylogenetic system of Hutchinson¹² both Magnoliales and Ranales are considered as parallel groups, but widely different in their relationships and development. Although, *M. rosae* was not reported to feed such primitive plants from dicotyledons.

While studying the genetic structure of 15 populations of *M. euphorbiae* by RAPD markers Raboudi *et al.*¹⁹ observed three clusters. Populations from south Tunisia were differentiated in one group irrespective of host plants, whereas the other populations were distributed between two groups independently of the geographic origin and host plants.

Evolutionary pattern of host range of *M. euphorbiae* demonstrated that it feeds on very primitive plants like ferns in gymnosperms and from order Magnoliales (Magnoliaceae) and Annonales (Annonaceae) in lignosae group of dicotyledons and Ranales (Nymphaeaceae, Ranunculaceae) in herbaceae group of dicotyledons. In monocotyledons host plants from primitive orders Butamales (Butomaceae) and Alismatales (Alismataceae) contributed in the host range of this aphid. Plants from advanced orders from all the groups were infested. In lignosae plants from 62.95% orders were infested, whereas in herbaceae and monocotyledons they were to the tune of 78.57 and 58.82%, respectively. Since the host range of this species encompasses large number of plant orders, therefore, functional evolutionary lineages were selected and delineated as follows:

In lignosae (dicotyledons)

1. Rosales—Leguminales—Cunanales—
Styracales—Araliales= contributed 124 host
species

2. Bixales—Tiliales--Celastrales—
Loganiales—Rubiales—Apocynales—
Bignoniales— Verbenales= 41

3. Bixales—Tiliales—Malvales—
Euphorbiales—Rhamnales= 39

In herbaceae (dicotyledons)

1. Ranales—Saxifragales—Campanales—
Asterales= 178

2. Ranales—Saxifragales—Solanales—
Personales= 112

In monocotyledons

1. Butamales—Liliales—Iridales= 32

MICROSIPHUM SPP.

About 10 Palearctic species forming ant-attended colonies and are related to *Macrosiphoniella*¹⁰. The species in north-west Europe were reviewed by Heie²⁴ and those in

eastern Europe by Bozhko²⁵. Kadyrbekov²⁶ revised the genus and provided the keys to the species. All the *Microsiphum* spp. are strictly monophagous and feed individually on plants from Asteraceae only. Their host range is restricted to three genera only viz., *Achillea*,

Artemisia and *Pyrethrum*. GAI values were in the range of 1.000-1.667 (Table 4). Kadyrbekov²⁶ on the basis of geographic variation in certain characters declared *M. heptapotamicum* as a synonym of *M. ptarmicae*.

Table 4: Host plants with taxonomic groupings of *Microsiphum* species

<i>Microsiphum</i> spp.	Host plants with taxonomic group	No. of host species	GAI	Status
<i>M. diversisetosum</i>	Dicot-herbaceae: Asteraceae (1) (<i>Artemisia abrotanum</i>)	1	1.000	Monophagous
<i>M. giganteum</i>	Dicot-herbaceae: Asteraceae (1) (<i>Artemisia dracunculus</i>)	1	1.000	Monophagous
<i>M. heptapotamicum</i>	Dicot-herbaceae: Asteraceae (1) (<i>Achilleamille folium</i>)	1	1.000	Monophagous
<i>M. jazykovi</i>	Dicot-herbaceae: Asteraceae (2) (<i>Artemisia absinthium</i> , <i>A. dracunculus</i>)	2	1.333	Monophagous
<i>M. millefolii</i>	Dicot-herbaceae: Asteraceae (2) (<i>Achilleamille folium</i> , <i>A. nobilis</i>)	2	1.333	Monophagous
<i>M. nudum</i>	Dicot-herbaceae: Asteraceae (3) (<i>Achilleamille folium</i> , <i>A. nobilis</i> , <i>A. setacea</i>)	3	1.667	Monophagous
<i>M. procerae</i>	Dicot-herbaceae: Asteraceae (1) (<i>Artemisia procera</i>)	1	1.000	Monophagous
<i>M. ptarmicae</i>	Dicot-herbaceae: Asteraceae (1) (<i>Achillea ptarmicae</i>)	1	1.000	Monophagous
<i>M. pyrethri</i>	Dicot-herbaceae: Asteraceae (1) (<i>Pyrethrum millefoliatum</i>)	1	1.000	Monophagous
<i>M. subalpica</i>	Dicot-herbaceae: Asteraceae (1) (<i>Artemisia procera</i>)	1	1.000	Monophagous
<i>M. woronieckae</i>	Dicot-herbaceae: Asteraceae (1) (<i>Artemisia austriaca</i> , <i>A. vulgaris</i>)	2	1.333	Monophagous

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