

APHIDS AND THEIR HOST AFFINITY-I: *ACYRTHOSIPHON* SPP.

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Abstract: In the present study, 93 species of *Acyrtosiphon* were included for host-aphid relationships out of which 66, were designated as monophagous. Forty- eight *Acyrtosiphon* species were feeding on single host in lignosae of dicotyledons whereas in herbaceae, division of dicotyledons only 18 aphid species was monophagous. Eleven species were noted as oligophagous, 8 in lignosae and 3 in herbaceae division of dicotyledons with GAI 1.000 to 2.400. Sixteen species were categorized as polyphagous and their GAI was in the range of 0.556-2.333. *Acyrtosiphon caraganae* had maximum number of host plants (21) from lignosae and all 21 plant species from Fabaceae. Maximum confamilial load was shared by the family Rosaceae (order-Rosales) serving host of 32 *Acyrtosiphon* species while maximum number of plant species (98.09%) was accepted from dicotyledons and monocots shared very nominal part accounting less than 2%.

Keywords: *Acyrtosiphon* spp., Monocotyledons, Dicotyledons, General Affiliation Index.

INTRODUCTION

Aphids (Hemiptera: Aphidinae) also known as plant lice are distributed worldwide but are most common in temperate zones. About 4700 species are known in the family Aphidinae [1]. Of these, 450 species have been recorded from crop plants [2] but only about 100 have successfully exploited agricultural environment to the extent that they are of significant economic importance. Many aphid species are monophagous. They feed on sap of phloem vessels of the plant and under high pressure it is forced into the aphid's food canal. Occasionally, aphids also ingest xylem sap which is more dilute than phloem sap [3, 4]. Xylem sap is under negative hydrostatic pressure and requires active sucking, suggesting important role in aphid physiology [5]. The xylem sap ingestion has been observed following dehydration period to replenish their water balance and to rehydrate [6]. However, recent studies have shown that aphids consume more xylem sap than expected and they notably do so when they are not dehydrated and when their fecundity decreases [7]. This suggests aphids consume xylem sap for another reasons than replenishing water balance.

Plant sap is an unbalanced diet for aphids, as it lacks essential amino acids which aphids cannot synthesize [4]. Essential amino acids are provided to aphids by bacterial symbionts

harboured in special cells, bacteriocytes. These symbionts recycle glutamate, a metabolic waste of their host, into essential amino acids [8, 9].

Aphids probably appeared around 280 million years ago in the early Permian period. They probably fed on plants like Cordaitales or Cycadophyta. The oldest known aphid fossil is of the species *Triassoaphis cubitus* from Triassic [10]. Earlier the number of aphid species was small but increased considerably with the appearance of angiosperms 160 million years ago. Angiosperms allowed aphids to specialize.

Plants exhibiting aphid damage can have variety of symptoms, such as decreased growth rates mottled leaves, yellowing, stunted growth, curled leaves, wilting, low yields and death. Removal of sap creates lack of vigour in the plant, and aphid saliva is toxic to the plants.

Aphids frequently transmit disease causing organisms like plant viruses to their hosts. The green peach aphid, *Myzus persicae* is a vector of more than 110 plant viruses. Aphids contributed to the spread of late blight, *Phytophthora infestans* among potatoes in the Irish potato famine of the 1840's [11].

The plants which produce phytoestrogen, Coumestrol, such as alfalfa, damage by aphid is linked with higher concentration of Coumestrol [12]. Coating of plants with honeydew can contribute to the spread of fungi which can damage plants. Honeydew also reduces the effectiveness of fungicides as well [13].

Aphids feed on wide range of plant species and have a complex life cycle. Some of them are host alternating species while others live and multiply on particular host community. Whether these particular host plant species in any way are associated with plant taxonomic group(s)? Thorsteinson [14] hold the view that most of the insects select their host plants from certain taxonomic groups while other feeds indiscriminately. Rathore and Lal [15] and Rathore and Tiwari [16, 17, 18] observed such associations in pod borer, *Maruca vitrata*, whitefly, *Bemisia* spp., and aphids, respectively. In the present study we endeavoured to examine such taxonomic associations in different species of the genera *Acyrtosiphon*, *Aphis*, *Brevicoryne*, *Macrosiphum*, *Microsiphum*, *Myzus*, *Schizaphis*, and *Toxoptera*. To avoid the length of the article each genera has been discussed separately.

MATERIALS AND METHODS

The information on host plant species of various aphids has been extracted mainly from the publications of Blackman and Eastops [2, 19]. These host species were aligned with the families and orders following classification of Hutchinson [20], who divided angiosperms (flowering plants) into subphylum dicotyledons and monocotyledons. Each subphylum was divided into divisions. For e.g. dicotyledons was partitioned into lignosae (fundamentally

woody plants) and herbaceae (fundamentally herbaceous plants). The term herbaceae is being loosely used by many for luxuriant growth irrespective whether they are taxonomically accepted or not. Monocotyledons were divided into 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 term monophagous was used for aphids feeding on plants of one genus, oligophagous when feeding on species of few genera in a single family. Polyphagous was used when aphids were feeding on wide range of plants in different taxonomic groups [21].

The affiliation of aphids to different plant taxonomic groups was also evaluated by using General Affiliation Index (GAI) values following the method described by Rathore and Tiwari [22] which is as follows:

$$\text{GAI} = \text{THs} + 2 / \text{G} + \text{F} + \text{O}$$

Where, THs=Total no. of plants of a given aphid species, G= number of host genera, F= number of host families and O= number of host plant orders. Value of 2 was used as a correction factor. GAI value equal or greater than 1 indicated greater affiliation (mostly monophagy) and less than 1 showed less affinity (oligophagy and polyphagy).

RESULTS AND DISCUSSION

1. *Acyrtosiphon* species (Aphidinae: Macrosiphini)

A genus is widespread in the palaeartic and north oriental regions [23] and living without host alteration [2]. In the present study 93 species of *Acyrtosiphon* were included for host-aphid relationships. Out of 93, 66 were designated as monophagous. Forty-eight aphid species were feeding on single host in lignosae of dicotyledons. They are viz., *A. assinibionensis*, *A. boreale*, *A. breviorne*, *A. capitellum*, *A. fragariaevescae*, *A. fragrum*, *A. malvae* ssp. *borealis*, *A. malvae* (*s. lat.*), *A. malvae* ssp. *agrimoniae*, *A. malvae* ssp. *poterii*, *A. malvae* ssp. *sanguisorbae*, *A. pentatrichopus*, *A. purshiae*, *A. rubi* ssp. *elliptivi*, *A. rubifoliae*, *A. scalare*, *A. shinanonus*, *A. soldatovi*, *A. solatovi* ssp. *tadzhikistanica*, *A. vandenboschi* and *A. wastintae* were found feeding on Rosaceae; *A. astragali*, *A. cytisorum*, *A. echinospartii*, *A. ericetorum*, *A. euphorbiae*, *A. genistae*, *A. hissaricum*, *A. occidentale*, *A. arvus*, *A. phaseoli*, *A. pisivorum*, *A. pisum* ssp. *spartii*, *A. sophorae*, *A. supranubium*, *A. umarovi* on Fabaceae; *A. ecorscae*, *A. matilai*, *A. paraeuphorbiaceae*, *A. tharacum* on Euphorbiaceae; *A. brachysiphon*, *A. knechteli* on Ericaceae; *A. aurtandicum* on Salicaceae; *A. evodiae* on Rutaceae; *A. malvae* ssp. *geranii* on Geraniaceae; *A. argus*, *A. dophnidis* on Thymelaeaceae; *A. mordvolkoi* on Linaceae. Family Rosaceae had 21 aphid species followed by Fabaceae

(15), Euphorbiaceae (4), Ericaceae (2), Geraniaceae (1), Salicaceae (1), Rutaceae (1), Thymelaeaceae (2), and Liliaceae (1) (Table 1).

Table 1. Showing affinity of host taxonomic groups to *Acyrtosiphon* species

<i>Acyrtosiphon</i> species	Families of host plants	No.of host plants	GAI	Status
<i>A. argus</i>	Dicot-lignosae: Thymelaeaceae (1) (<i>Daphne odora</i>)	1	1.000	Monophagous
<i>A. assiniboinensis</i>	Dicot-lignosae: Rosaceae (1) (<i>Potentillafruticosa</i>)	1	1.000	Monophagous
<i>A. astragali</i>	Dicot-lignosae: Fabaceae (1) (<i>Astragalus sp.</i>)	1	1.000	Monophagous
<i>A. auctum</i>	Dicot-herbaceae: Brassicaceae (2), Caryophyllaceae (5)	7	0.900	Polyphagous
<i>A. auriculae</i>	Dicot-herbaceae: Primulaceae (4) (<i>Primula glaucescens</i> , <i>P. marginata</i> , <i>P. palinuri</i> , <i>P. x auricular</i>)	4	2.000	Monophagous
<i>A. aurlandicum</i>	Dicot-lignosae: Salicaceae (1) (<i>Salix lapponum</i>)	1	1.000	Monophagous
<i>A. bidentacula</i>	Dicot-herbaceae: Asteraceae (12), Lamiaceae (1), Papaveraceae (1)	14	0.800	Polyphagous
<i>A. bistorti</i>	Dicot-herbaceae: Polygonaceae (1) (<i>Persicariabistorta</i>)	1	1.000	Monophagous
<i>A. boreale</i>	Dicot-lignosae: Rosaceae (11 species of <i>Potentilla</i>)	11	4.333	Monophagous
<i>A. brachysiphon</i>	Dicot-lignosae: Ericaceae (2) (<i>Vacciniummyrtilus</i> , <i>V. uliginosum</i>)	2	1.333	Monophagous
<i>A. brevicorne</i>	Dicot-lignosae: Rosaceae (2) (<i>Dryas integrifolia</i> , <i>D. octopetala</i>)	2	1.333	Monophagous
<i>A. capitellum</i>	Dicot-lignosae: Rosaceae (1) (<i>Fragaria vesca</i>)	1	1.000	Monophagous
<i>A. caraganae</i>	Dicot-lignosae: Fabaceae (21)	21	1.917	Oligophagous
<i>A. chelidonii</i>	Dicot-herbaceae: Papaveraceae (2) (<i>Chelidoniummajus</i> , <i>C. simense</i>)	2	1.333	Monophagous
<i>A. churchillense</i>	Dicot-lignosae: Fabaceae (5) (<i>Hedysarummackenzii</i> , <i>Melilotus alba</i> , <i>Oxytropiscampestris</i> , <i>O. deflexa var. sericea</i> , <i>O. hudsonica</i>)	5	1.400	Oligophagous
<i>A. corscae</i>	Dicot-lignosae: Euphorbiaceae (1) (<i>Euphorbia spinosa</i>)	1	1.000	Monophagous
<i>A. crepidis</i>	Dicot-herbaceae: Asteraceae (1) (<i>Crepistenuifolia</i>)	1	1.000	Monophagous
<i>A. cyparissiae</i>	Dicot-lignosae: Cucurbitaceae (2), Euphorbiaceae (10)	12	2.333	Polyphagous
<i>A. cytisorum</i>	Dicot-lignosae: Fabaceae (1) (<i>Cytisusmultiflorus</i>)	1	1.000	Monophagous
<i>A. daphnidis</i>	Dicot-lignosae: Thymelaeaceae (1) (<i>Daphne gnidium</i>)	1	1.000	Monophagous
<i>A. daturae</i>	Dicot-herbaceae: Solanaceae (1) (<i>Datura spp.</i>)	1	1.000	Monophagous
<i>A. dauricum</i>	Dicot-herbaceae: Asteraceae (1) (<i>Saussureasalicifolia</i>)	1	1.000	Monophagous
<i>A. echinospartii</i>	Dicot-lignosae: Fabaceae (1) (<i>Echinospartumbarnadesii</i>)	1	1.000	Monophagous
<i>A. elaeocarpi</i>	Dicot-herbaceae: Asteraceae (1) (<i>Elaeocarpu serratus</i>)	1	1.000	Monophagous
<i>A. ericetorum</i>	Dicot-lignosae: Fabaceae (1) (<i>Genistaangalica</i>)	1	1.000	Monophagous
<i>A. euphorbiae</i>	Dicot-lignosae: Euphorbiaceae (6) (<i>Euphorbia esula</i> , <i>E. helioscopia</i> , <i>E. palustris</i> , <i>E. pithyusa</i> , <i>E. polychroma</i> , <i>E. stricta</i>)	6	2.667	Monophagous
<i>A. evodiae</i>	Dicot-lignosae: Rutaceae (1) (<i>Euodiatriphylla</i>)	1	1.000	Monophagous
<i>A. fragariaevescae</i>	Dicot-lignosae: Rosaceae (1) (<i>Fragaria grandiflora</i>)	1	1.000	Monophagous
<i>A. fragrum</i>	Dicot-lignosae: Rosaceae (1) (<i>Fragaria spp.</i>)	1	1.000	Monophagous
<i>A. genistae</i>	Dicot-lignosae: Fabaceae (1) (<i>Genistatinctoria</i>)	1	1.000	Monophagous
<i>A. ghanii</i>	Dicot-herbaceae: Asteraceae (2) (<i>Scorzonerasubaphylla</i> , <i>Sonchusoleraceus</i>)	2	1.000	Oligophagous
<i>A. glaucii</i>	Dicot-herbaceae: Papaveraceae (3) (<i>Glauciumcorniculatum</i> , <i>G. elegans</i> , <i>G. fimbriigerum</i>)	3	1.667	Monophagous
<i>A. gossypii</i>	Dicot-lignosae: Fabaceae (26), Malvaceae (5), Rosaceae (2), Zygophyllaceae (6); Dicot-herbaceae: Asteraceae (1), Brassicaceae (5), Chenopodiaceae (1), Solanaceae (1); Monocot-glumiflorae: Poaceae (1)	48	0.927	Polyphagous
<i>A. hissaricum</i>	Dicot-lignosae: Fabaceae (1)	1	1.000	Monophagous
<i>A. ignotum</i>	Dicot-lignosae: Hydrangeaceae (1), Rosaceae (19); Monocot-glumiflorae: Poaceae (1)	21	2.300	Polyphagous
<i>A. ilka</i>	Dicot-lignosae: Euphorbiaceae (1), Fabaceae (1), Linaceae (2); Dicot-herbaceae: Apiaceae (2), Asteraceae (9), Brassicaceae (3), Caryophyllaceae (2), Papaveraceae (7), Scrophulariaceae (2); Monocot-corolliferae: Iridaceae (1)	30	0.711	Polyphagous
<i>A. knechteli</i>	Dicot-lignosae: Ericaceae (1) (<i>Vacciniumuliginosum</i>)	1	1.000	Monophagous
<i>A. kondoi</i>	Dicot-lignosae: Fabaceae (20); Dicot-herbaceae: Scrophulariaceae (1); Monocot-glumiflorae: Poaceae (1)	22	1.200	Polyphagous
<i>A. lactucae</i>	Dicot-herbaceae: Asteraceae (4) (<i>Lactuca sativa</i> , <i>L. serriola</i> , <i>L. virosa</i> , <i>Sonchusoleraceus</i>)	4	1.500	Oligophagous
<i>A. lambersi</i>	Dicot-herbaceae: Papaveraceae (3) (<i>Glauciumflavum</i> , <i>G. grandiflorum</i> , <i>G. leiocarpum</i>)	3	1.667	Monophagous
<i>A. loti</i>	Dicot-lignosae: Fabaceae (17); Monocot-glumiflorae: Poaceae (5)	22	1.500	Polyphagous
<i>A. macrosiphon</i>	Dicot-lignosae: Caprifoliaceae (2), Rosaceae (4)	6	1.143	Polyphagous
<i>A. malvae</i>	Dicot-lignosae: Clusiaceae (1), Fabaceae (1), Malvaceae (5), Rosaceae (4), Urticaceae (1), Verbenaceae (1); Dicot-herbaceae: Asteraceae (4), Boraginaceae (1), Brassicaceae (1), Convolvulaceae (1), Fumariaceae (3), Geraniaceae (30), Polygonaceae (1), Scrophulariaceae (3)	57	1.073	Polyphagous

<i>A. malvae</i> ssp. <i>borealis</i>	Dicot-lignosae: Rosaceae (1) (<i>Duchesneaindica</i>)	1	1.000	Monophagous
<i>A. malvae</i> (s. lat.)	Dicot-lignosae: Rosaceae (2) (<i>Potentillagracilis</i> , <i>P. megalantha</i>)	2	1.333	Monophagous
<i>A. malvae</i> group	Dicot-lignosae: Lythraceae (1), Malvaceae (1), Rosaceae (4); Dicot-herbaceae: Asteraceae (1), Lamiaceae (1), Ranunculaceae (1), Scrophulariaceae (1)	10	0.591	Polyphagous
<i>A. malvae</i> ssp. <i>agrioniae</i>	Dicot-lignosae: Rosaceae (2) (<i>Agrimoniaeupatoria</i> , <i>A. odorata</i>)	2	1.333	Monophagous
<i>A. malvae</i> ssp. <i>geranii</i>	Dicot-herbaceae: Geraniaceae (3) (<i>Erodiumcicutarium</i> , <i>E. moschatum</i> , <i>E. trichomanefolium</i>)	3	1.667	Monophagous
<i>A. malvae</i> ssp. <i>poterii</i>	Dicot-lignosae: Rosaceae (1) (<i>Sanguisorba minor</i>)	1	1.000	Monophagous
<i>A. malvae</i> ssp. <i>potha</i>	Dicot-lignosae: Rosaceae (11)	11	2.167	Oligophagous
<i>A. mavae</i> ssp. <i>rogersii</i>	Dicot-lignosae: Rosaceae (4) (<i>Fragariamuschata</i> , <i>F.xananassa</i> , <i>F.x Viridis</i> , <i>potentillafruticosa</i>)	4	1.500	Oligophagous
<i>A. malvae</i> ssp. <i>sanguisorbae</i>	Dicot-lignosae: Rosaceae (1) (<i>Sanguisorba minor</i>)	1	1.000	Monophagous
<i>A. matilei</i>	Dicot-lignosae: Euphorbiaceae(1) (<i>Euphorbia spinosa</i>)	1	1.000	Monophagous
<i>A. moltshanovi</i>	Dicot-lignosae: Euphorbiaceae (1); Dicot-herbaceae: Asteraceae (1), Apiaceae (1)	3	0.556	Polyphagous
<i>A. mordvilkoii</i>	Dicot-lignosae: Linaceae (1) (<i>Linum sitatissimum</i>)	1	1.000	Monophagous
<i>A. nigripes</i>	Dicot-herbaceae: Apiaceae (1) (<i>Laserpitium siler</i>)	1	1.000	Monophagous
<i>A. nigripes</i> ssp. <i>blatnyi</i>	Dicot-herbaceae: Apiaceae (4) (<i>Seseliaustriacum</i> , <i>S. elatum</i> , <i>S. leucospermum</i> , <i>S. osseum</i>)	4	2.000	Monophagous
<i>A. nigripes</i> ssp. <i>peucedani</i>	Dicot-herbaceae: Apiaceae (2) (<i>Peucedanum officinale</i> , <i>P. Ruthenicum</i>)	2	1.333	Monophagous
<i>A. occidentale</i>	Dicot-lignosae: Fabaceae (1) (<i>Caraganaarborescens</i>)	1	1.000	Monophagous
<i>A. ononis</i>	Dicot-lignosae: Fabaceae (6) (<i>Melilotus officinalis</i> , <i>Ononisfruticosa</i> , <i>O. hircine</i> , <i>O. pseudohircina</i> , <i>O. repens</i> , <i>O. spinosa</i>)	6	2.000	Oligophagous
<i>A. papaverinum</i>	Dicot-herbaceae: Papaveraceae (1) (<i>Papaver somniferum</i>)	1	1.000	Monophagous
<i>A. papaverisuctum</i>	Dicot-herbaceae: Papaveraceae (1) (<i>Papaver somniferum</i>)	1	1.000	Monophagous
<i>A. paraeuphorbiae</i>	Dicot-lignosae: Euphorbiaceae (1) (<i>Euphorbia</i> spp.)	1	1.000	Monophagous
<i>A. parvum</i>	Dicot-lignosae: Fabaceae (10)	10	2.400	Oligophagous
<i>A. parvus</i>	Dicot-lignosae: Fabaceae (1) (Anthyllishermanniae)	1	1.000	Monophagous
<i>A. pentatrichopus</i>	Dicot-lignosae: Rosaceae (1) (<i>Rosa fendleri</i>)	1	1.000	Monophagous
<i>A. phaseoli</i>	Dicot-lignosae: Fabaceae (1) (<i>Phaseolus</i> spp.)	1	1.000	Monophagous
<i>A. pisivorum</i>	Dicot-lignosae: Fabaceae (1) (<i>Pisum sativum</i>)	1	1.000	Monophagous
<i>A. pisum</i>	Dicot-lignosae: Apocynaceae (1), Celastraceae (1), Cucurbitaceae(1), Euphorbiaceae (1), Fabaceae (148), Rosaceae (2), Rubiaceae (1), Urticaceae (1), Violaceae (1), Zygophyllaceae (1); Dicot-herbaceae: Asteraceae (3), Brassicaceae (2), Caryophyllaceae (1), Fumariaceae (1), Ranunculaceae (1), Resedaceae (1), Scrophulariaceae (1), Solanaceae (3); Monocot-calyciferae: Alismataceae (1), Musaceae (1), Monocot-corolliferae: Liliaceae (1)	174	1.586	Polyphagous
<i>A. pisum</i> ssp. <i>spartii</i>	Dicot-lignosae: Fabaceae (2) (<i>Cytisusnigricans</i> , <i>C. scoparius</i>)	2	1.333	Monophagous
<i>A. porrifolii</i>	Dicot-herbaceae: Asteraceae (1) (<i>Hieraciumporrifolium</i>)	1	1.000	Monophagous
<i>A. primulae</i>	Dicot-herbaceae: Primulaceae (3) (<i>Primula acaulis</i> , <i>P. kewensis</i> , <i>P. veris</i>)	3	1.667	Monophagous
<i>A. pseudodirhodum</i>	Dicot-lignosae: Rosaceae (6)	6	1.000	Oligophagous
<i>A. purshiae</i>	Dicot-lignosae: Rosaceae (1) (<i>Purshia tridentate</i>)	1	1.000	Monophagous
<i>A. ranunculum</i>	Dicot-herbaceae: Ranunculaceae (1) (<i>Thalictrum pauciflorum</i>)	1	1.000	Monophagous
<i>A. rubi</i>	Dicot-lignosae: Ericaceae (1), Fabaceae (1), Rosaceae (8); Dicot-herbaceae: Asteraceae (6), Polygonaceae (3)	19	0.954	Polyphagous
<i>A. rubi</i> ssp. <i>elliptici</i>	Dicot-lignosae: Rosaceae (1) (<i>Rubus ellipticus</i>)	1	1.000	Monophagous
<i>A. rubifoliae</i>	Dicot-lignosae: Rosaceae (1) (<i>Potentilla nepalensis</i>)	1	1.000	Monophagous
<i>A. scalare</i>	Dicot-lignosae: Rosaceae (1) (<i>Potentilla fruticosa</i>)	1	1.000	Monophagous
<i>A. scariolae</i>	Dicot-herbaceae: Asteraceae (4) (<i>Lactucasaligna</i> , <i>L. serriola</i> , <i>L. virosa</i> , <i>Sonchus arvensis</i>)	4	1.500	Oligophagous
<i>A. shinanonus</i>	Dicot-lignosae: Rosaceae (1) (<i>Geum calthifolium</i>)	1	1.000	Monophagous
<i>A. soldatovi</i>	Dicot-lignosae: Rosaceae (1) (<i>Spiraea salicifolia</i>)	1	1.000	Monophagous

<i>A. soldatovi</i> ssp. <i>tadzhikistanica</i>	Dicot-lignosae: Rosaceae (1) (<i>Spiraea hypericifolia</i>)	1	1.000	Monophagous
<i>A. sophorae</i>	Dicot-lignosae: Fabaceae (2) (<i>Sophora alopecuroides</i> , <i>S. japonica</i>)	2	1.333	Monophagous
<i>Acyrthosiphon</i> sp.	Dicot-lignosae: Ericaceae (1), Thymeliaceae (1)	2	0.667	Polyphagous
<i>Acyrthosiphon</i> sp.nr. <i>pseudodirhodum</i>	Dicot-lignosae: Rosaceae (2) (<i>Cercocarpus montanus</i> , <i>Holodiscus discolor</i>)	2	1.000	Oligophagous
<i>Acyrthosiphon</i> sp. nr. <i>malvae</i>	Dicot-herbaceae: Ranunculaceae (1) (<i>Ranunculus acris</i>)	1	1.000	Monophagous
<i>A. supranubium</i>	Dicot-lignosae: Fabaceae (1) (<i>Cytisus supranubius</i>)	1	1.000	Monophagous
<i>A. thracicum</i>	Dicot-lignosae: Euphorbiaceae (3) (<i>Euphorbia epithymoides</i> , <i>E. platyphyllos</i> , <i>E. polychrome</i>)	3	1.667	Monophagous
<i>A. umarovi</i>	Dicot-lignosae: Fabaceae (1) (<i>Astragalus</i> spp.)	1	1.000	Monophagous
<i>A. vandenboschi</i>	Dicot-lignosae: Rosaceae (1) (<i>Potentilla glandulosa</i>)	1	1.000	Monophagous
<i>A. vasiljevi</i>	Dicot-lignosae: Cucurbitaceae (1); Dicot-herbaceae: Asteraceae (1)	2	0.667	Polyphagous
<i>A. wasintae</i>	Dicot-lignosae: Rosaceae (1) (<i>Potentilla fruticosa</i>)	1	1.000	Monophagous

In herbaceae, division of dicotyledons only 18 *Acyrthosiphon* species was monophagous. They are *A. crepidis*, *A. dauricum*, *A. elaeocarpi*, *A. porrifolii* on Asteraceae; *A. nigripes*, *A. nigripes* ssp. *peucedani*, *A. nigripes* ssp. *blotnyi* on Apiaceae; *A. chelidonii*, *A. glaucii*, *A. lambersi*, *A. papavericum*, *A. papavertisuctum* on Papaveraceae; *A. auriculae*, *A. primulae* on Primulaceae; *A. ranunculum*, *Acyrthosiphon* sp. nr. *malvae* on Ranunculaceae; *A. bistorti* on Polygonaceae and *A. daturae* on Solanaceae. Number of species associated was 5 in Papaveraceae followed by Asteraceae (4), Apiaceae (3), Primulaceae (2), Ranunculaceae (2) and Polygonaceae and Solanaceae each (1).

Eleven species were noted as oligophagous, 8 in lignosae and 3 in herbaceae division of dicotyledons. Their GAI ranged from 1.000 to 2.400. Sixteen species were categorized as polyphagous and their GAI was in the range of 0.556-2.333 (Table 1).

Association of some of *Acyrthosiphon* species which had maximum number of host plants revealed a definite confamilial relationship. The following information showed that *A. caraganae* feeds on 21 plant species from lignosae had all 21 from Fabaceae. Similarly, *A. gossypii*, *A. ignotum*, *A. ilka*, *A. kondoi*, *A. loti*, *A. malvae* and *A. pisum* showed a strong confamilial affinity (Table 2).

Table 2. Confamilial relationships of some *Acyrthosiphon* species

<i>Acyrthosiphon</i> spp.	Total no. of host plants	Lignosae/Herbaceae/Monocotyledons	No. Of host species in prominent families
<i>A. caragane</i>	21	21/0/0	21 Fabaceae
<i>A. ignotum</i>	21	20/0/1	19 Rosaceae
<i>A. ilka</i>	30	4/25/1	9 Asteraceae + 7 Papaveraceae
<i>A. gossypii</i>	48	39/8/1	26 Fabaceae
<i>A. kondi</i>	22	20/1/1	20 Fabaceae
<i>A. loti</i>	22	17/0/5	17 Fabaceae
<i>A. malvae</i>	57	13/44/0	30 Geraniaceae
<i>A. pisum</i>	174	158/13/3	148 Fabaceae

Table 3 revealed that maximum confamilial load was shared by the family Rosaceae (order-Rosales) serving host of 32 *Acyrthosiphon* species followed by family Fabaceae (25) of order Leguminales, Asteraceae (16) of order Asterales, Euphorbiaceae (9) of order Euphorbiales

and Papaveraceae (7) of order Rhoadales. Monocot was represented by 5 families viz., Alismataceae, Iridaceae, Liliaceae and Musaceae each having one aphid species to their credit, whereas family Poaceae served host of 4 *Acyrtosiphon* species. Blackman and Eastop [2] mentioned that species of *Acyrtosiphon* prefer to live on dicotyledons particularly Leguminosae, Rosaceae and Euphorbiaceae. Our explanation is in agreement with Blackman and Eastop [2].

Table 3. Species of *Acyrtosiphon* associated with different plant families and orders

Sl. No.	Order	Family	Species	Total no. of species
1	Rosales (6)	Rosaceae	<i>A. assiniboinensis</i> , <i>A. boreale</i> , <i>A. brevicorne</i> , <i>A. capitellum</i> , <i>A. fragariaevescae</i> , <i>A. fragrum</i> , <i>A. gossypii</i> , <i>A. ignotum</i> , <i>A. macrosiphon</i> , <i>A. malvae</i> , <i>A. malvae</i> ssp. <i>borealis</i> , <i>A. malvae</i> (s.lat.), <i>A. malvae</i> group, <i>A. malvae</i> ssp. <i>agrioniae</i> , <i>A. malvae</i> ssp. <i>poterii</i> , <i>A. malvae</i> ssp. <i>potha</i> , <i>A. malvae</i> ssp. <i>rogersii</i> , <i>A. malvae</i> ssp. <i>sanguisorbae</i> , <i>A. pentatrachopus</i> , <i>A. pisum</i> , <i>A. pseudodirhodum</i> , <i>A. purshiae</i> , <i>A. rubi</i> , <i>A. rubi</i> ssp. <i>elliptici</i> , <i>A. rubifoliae</i> , <i>A. scalare</i> , <i>A. shinanonus</i> , <i>A. soldatovi</i> , <i>A. soldatovi</i> ssp. <i>tadzhikistanica</i> , <i>Acyrtosiphon</i> sp. nr. <i>pseudodirhodum</i> , <i>A. vandenboschi</i> , <i>A. wasintae</i>	32
2	Leguminales (7)	Fabaceae	<i>A. astragali</i> , <i>A. caraganae</i> , <i>A. churchillense</i> , <i>A. cytorum</i> , <i>A. echinospartii</i> , <i>A. ericetorum</i> , <i>A. genistae</i> , <i>A. gossypii</i> , <i>A. hissaricum</i> , <i>A. ilka</i> , <i>A. kondi</i> , <i>A. loti</i> , <i>A. malvae</i> , <i>A. occidentale</i> , <i>A. ononis</i> , <i>A. parvum</i> , <i>A. parvus</i> , <i>A. phaseoli</i> , <i>A. pisivorum</i> , <i>A. pisum</i> , <i>A. pisum</i> ssp. <i>spartii</i> , <i>A. rubi</i> , <i>A. sophorae</i> , <i>A. supranubium</i> , <i>A. umarovi</i>	25
3	Cunoniales (8)	Hydrangeaceae	<i>A. ignotum</i>	1
4	Araliales (10)	Caprifoliaceae	<i>A. macrosiphon</i>	1
5	Salicales (12)	Salicaceae	<i>A. aurlandicum</i>	1
6	Urticales (19)	Urticaceae	<i>A. malvae</i> , <i>A. pisum</i>	2
7	Thymelaeales (21)	Thymelaeaceae	<i>A. argus</i> , <i>A. daphnidis</i> , <i>Acyrtosiphon</i> sp.	3
8	Violales (26)	Violaceae	<i>A. pisum</i>	1
9	Cucurbitales (30)	Cucurbitaceae	<i>A. cyparissiae</i> , <i>A. pisum</i> , <i>A. vasiljevi</i>	3
10	Malvales (33)	Malvaceae	<i>A. gossypii</i> , <i>A. malvae</i> , <i>A. malvae</i> group	3
11	Malpighiales (34)	Linaceae Zygophyllaceae	<i>A. ilka</i> , <i>A. mordvilkoii</i> <i>A. gossypii</i> , <i>A. pisum</i>	2 2
12	Euphorbiales (35)	Euphorbiaceae	<i>A. corscae</i> , <i>A. cyparissiae</i> , <i>A. euphorbiae</i> , <i>A. ilka</i> , <i>A. matilei</i> , <i>A. moltshanovi</i> , <i>A. paraeuphorbiae</i> , <i>A. pisum</i> , <i>A. thracicum</i>	9
13	Ericales (38)	Ericaceae	<i>A. brachysiphon</i> , <i>A. knechteli</i> , <i>A. rubi</i> , <i>Acyrtosiphon</i> sp.	4
14	Guttiferales (39)	Clusiaceae	<i>A. malvae</i>	1
15	Myrtales (40)	Lythraceae	<i>A. malvae</i> group	1
16	Celastrales (41)	Celastraceae	<i>A. pisum</i>	1
17	Rutales (47)	Rutaceae	<i>A. evodiae</i>	1
18	Apocynales (51)	Apocynaceae	<i>A. pisum</i>	1
19	Rubiales (52)	Rubiaceae	<i>A. pisum</i>	1
20	Verbenales (54)	Verbenaceae	<i>A. malvae</i>	1
21	Ranales (55)	Ranunculaceae	<i>A. malvae</i> group, <i>A. pisum</i> , <i>A. ranunculum</i> , <i>Acyrtosiphon</i> sp. nr. <i>malvae</i>	4
22	Rhoadales (59)	Fumariaceae Papaveraceae	<i>A. malvae</i> , <i>A. pisum</i> <i>A. bidentacula</i> , <i>A. chelidonii</i> , <i>A. glaucii</i> , <i>A. ilka</i> , <i>A. lambersi</i> , <i>A. papaverinum</i> , <i>A. papaverisuctum</i>	2 7
23	Brassicales (60)	Brassicaceae	<i>A. auctum</i> , <i>A. gossypii</i> , <i>A. ilka</i> , <i>A. malvae</i> , <i>A. pisum</i>	5
24	Resedales (61)	Resedaceae	<i>A. pisum</i>	1
25	Caryophyllales (62)	Caryophyllaceae	<i>A. auctum</i> , <i>A. ilka</i> , <i>A. pisum</i>	3
26	Polygonales (63)	Polygonaceae	<i>A. bistorti</i> , <i>A. malvae</i> , <i>A. rubi</i>	3
27	Chenopodiales (64)	Chenopodiaceae	<i>A. gossypii</i>	1
28	Primulales (67)	Primulaceae	<i>A. auriculatae</i> , <i>A. primulae</i>	2
29	Umbellales (72)	Apiaceae	<i>A. ilka</i> , <i>A. moltshanovi</i> , <i>A. nigripes</i> , <i>A. nigripes</i> ssp. <i>blattnyi</i> , <i>A. nigripes</i> ssp. <i>peucedani</i>	5
30	Asterales (76)	Asteraceae	<i>A. bidentacula</i> , <i>A. crepidis</i> , <i>A. dauricum</i> , <i>A. elaeocarpi</i> , <i>A. ghanii</i> , <i>A. gossypii</i> , <i>A. ilka</i> , <i>A. lactucaae</i> , <i>A. malvae</i> , <i>A. malvae</i> group, <i>A. moltshanovi</i> , <i>A. pisum</i> , <i>A. porrifolii</i> , <i>A. rubi</i> , <i>A. scariolae</i> , <i>A. vasiljevi</i>	16
31	Solanales (77)	Convolvulaceae Solanaceae	<i>A. malvae</i> <i>A. daturae</i> , <i>A. gossypii</i> , <i>A. pisum</i>	1
32	Personales (78)	Scrophulariaceae	<i>A. ilka</i> , <i>A. kondi</i> , <i>A. malvae</i> , <i>A. malvae</i> group, <i>A. pisum</i>	5

33	Geraniales (79)	Geraniaceae	<i>A. malvae</i> , <i>A. malvae</i> ssp. <i>geranii</i>	2
34	Boraginales (81)	Boraginaceae	<i>A. malvae</i>	1
35	Lamiales (82)	Lamiaceae	<i>A. bidenticula</i> , <i>A. malvae</i> group	2
36	Alismatales (84)	Alismataceae	<i>A. pisum</i>	1
37	Zingiberales(94)	Musaceae	<i>A. pisum</i>	1
38	Liliales (95)	Liliaceae	<i>A. pisum</i>	1
39	Iridales (100)	Iridaceae	<i>A. ilka</i>	1
40	Graminales (111)	Poaceae	<i>A. gossypii</i> , <i>A. ignotum</i> , <i>A. kondoi</i> , <i>A. loti</i>	4

Values in parantheses indicate position of an order on evolutionary scale

An overall view across taxonomic groups revealed that maximum number of plant species (98.09%) was accepted from dicotyledons and monocots shared very nominal part accounting less than 2% (Table 4). Among dicotyledons woody plants in lignosae associated with 71.07% plants, whereas in herbaceae 27.03%. Interestingly, number of genera accounted for had similar proportion both in lignosae and herbaceae indicating dominant role played by certain families. The confamilial information in Table 1 &2 undoubtedly showed the greater role of families like

Rosaceae and Fabaceae in lignosae. Families and orders followed the same trend as in case of genera. Among monocotyledons family Poaceae showed some preference to aphid species like *A. gossypii*, *A. ignotum*, *A. kondoi* and *A. loti*. On other monocot plant species *A. pisum* was more prominent.

Table 4. Distribution of host species in different taxonomic groups

Parameters	Host species							
	Lignosae	Herbaceae	Calyciferae	Corolliferae	Glumiflorae	Total	Dicot	Monocot
Plant species	447 (71.07)	170 (27.03)	2 (0.32)	2 (0.32)	8 (1.27)	629	617 (98.09)	12 (1.91)
Plant genera	118 (48.36)	116 (47.54)	2 (0.82)	2 (0.82)	6 (2.46)	244	234 (95.90)	10 (4.10)
Plant families	21 (48.84)	17 (39.53)	2 (4.65)	2 (4.65)	1 (2.33)	43	38 (88.37)	5 (11.63)
Plant orders	20 (50.00)	15 (37.50)	2 (5.00)	2 (5.00)	1 (2.50)	40	35 (87.50)	5 (12.50)

Figures in parentheses are per cent values

A. pisum is the most dominating species in the entire genus. Its complete genome has been investigated and has coevolved with endoparasites *Buchnera aphidicola* and *Regiella insecticola*. It has wide range of host species accounting at least 174 and General Affiliation Index (GAI) 1.586 (Table 1). Its host families and orders revealed that aphid does not feed on plants of very primitive families in lignosae. It starts from Rosales, the 6th on evolutionary scale, and up to the advanced ones Rubiales and Apocynales 51st and 52nd on evolutionary scale, respectively. However, in herbaceae, it started accepting plants from primitive family Ranunculaceae in order Ranales and randomly selected host species from some advanced orders also. The possible phylogenetic lineages were as follows:

1. Rosales—Leguminales (150 host species)
2. Celastrales—Loganiales—Rubiales—Apocynales (3 host species)

3. Celastrales—Malpighiales—Euphorbiales (3 host species)

4. Ranales—Rhoeadales—Brassicales—Resedales (5 host species)

The most contributing evolutionary lineage was Rosales—Leguminales. Rosales is a prolific group mainly spread into temperate regions. Leguminales derived from Rosales. Fabaceae is the most advanced family of Leguminales (Hutchinson 1973). Celastrale group basically derived from Bixales side showed less preference. In herbaceae, the lineage shows by this aphid is clear but not very common in other insects and nematodes. The Rosales—Leguminales is by far the most prominent lineage and the preference rests with the host plants belonging to Fabaceae.

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