

Research Article



Systematics, Host Plants and Distribution of Aphids (Hemiptera: Aphididae) Infesting Tree Flora in Azad Kashmir, Pakistan

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Abstract | Taxonomic studies on aphids in general and tree dwelling aphids in particular have received much less attention in Pakistan with to-date no work reported from Azad Kashmir-Pakistan, where natural tree flora abounds and silviculture is common. Surveys conducted during 2015-2016 in the Poonch Division of Azad Kashmir-Pakistan, yielded 24 aphid species in 14 genera, representing subfamilies, Aphidinae, Lachninae, Calaphidinae, Hormaphidinae and Chaitophorinae, infesting 28 tree species in 22 genera, 17 families and 12 orders. Genera *Aphis*, *Cinara* and *Myzus* had 7, 3 and 2 species, respectively. *Hoplochaitophorus quercicola* (Monell, 1879) and *Pterocomma beulahense* (Cockerell, 1904) are new records for Pakistan. *Astegopteryx bambusae* (Buckton, 1893) is also represented as new record for the country. Data also have 3 second-finding, 6 third-finding, 11 new host plants and 71 new locality records in Pakistan. *Aphis gossypii* and *Aphis craccivora* were found infesting 8 tree species in 8 genera and 6 in 6 genera respectively. Rosaceae with 5 species in 4 genera carrying 9 aphid species in 5 genera was the most aphid-prone family. Systematics, host range, distribution of the related aphids and catalogue of host plant-tree species in the studied area from Pakistan are given herewith.

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Introduction

Significance of trees as the renewable source of multiple human necessities such as food, drugs, shade, fuel, timber, aestheticizing-agents and guarantor of healthy environment especially in this era of ecological backlash cannot be overemphasized (Saxe et al., 2001; Depommier, 2003; Seth, 2003; Rao et al., 2004; Parmesan, 2006; Khan and Khatoon, 2007; Allen et al., 2010; Anderegg et al., 2013). Tree flora of Azad Kashmir-Pakistan serves as an essential source of fruits, drugs, forage, timber and fire for the inhabitants of the region (Bano et al., 2013; Rashid et

al., 2015). In Kashmir fruits are frequently consumed and domesticated with almost every household having 3-4 fruit tree species in its garden (Azad Kashmir Statistical Book, 1998).

Trees, both wild and cultivated, are exposed to a number of adverse biotic-factors including insects. Aphids or plant lice, as with other plants, constitute an essential arthropod taxon for their negative impact on host tree species. Out of 5128 world-widely recorded species of aphids (Favret, 2018), 1760 are tree dwellers (Blackman and Eastop, 2008). Being phloem sap feeders, aphids reduce growth and reproduction,

spread viral diseases, induce galls or leaf deformations, cause early leaf fall, shoot dieback and even death of the infested tree species (Gildow et al., 2004; Straw et al., 2005; Chakrabarti et al., 2007; Zvereva et al., 2010; Campolo et al., 2014). The honeydew excreted by aphids drips on plant parts attracts ants, wasps and flies besides promoting black mold which in turn reduces photosynthesis (Wood et al., 1988). Faunal/taxonomic works made on aphids in the country till to date tended to be indiscriminate and mainly herbaceous flora biased (Irshad, 2001; Mahmood et al., 2002; Khan et al., 2007; Aheer et al., 2008; Hassan et al., 2010; Bodlah et al., 2011; Mushtaq et al., 2013) with no specific work on tree dwelling aphids. Given significance of tree flora, particularly vis-a-vis inhabitants of the study area, the present study was undertaken to comprehensively explore aphid fauna infesting tree species in the Poonch Division of Kashmir-Pakistan. The study will not only provide a systematic appraisal of the aphid species and their host tree species but will also serve as a baseline for future aphid-tree related works in the region besides enabling the Integrated Pest Management operators to evolve effective control-measure (s) for a target aphid-pest.

Materials and Methods

Samples of aphids were collected in 2015-2016 from fruit and wild tree species from localities viz., Rawalakot, Khaigala, Alisojal, Hajira, Abbaspur, Taulipir, Banjosa, Bagh, Haveli, Sudhnoti, Trarkhal, Thorar, Pallandri and Mong in the Poonch division of Azad Kashmir- Pakistan by two methods. Firstly, transferring specimens from plant part into screw-lidded transparent plastic vials containing 70% ethanol, with a fine horse hair brush. Secondly, infested plant part(s) was/were cut from the plant and put in polyethylene-zipper bag and were brought to the Entomology Laboratory, University of Poonch, Rawalakot, Azad Kashmir-Pakistan for augmenting data for taxonomic studies and preservation. Plant parts, twigs bearing leaves, flowers and/or fruits of sampled wild tree species were submitted to National Herbarium-NARC, Islamabad for identification. Locality-name, date and color of alive specimens were recorded and adult apterous viviparous female were diagnostically evaluated, under Olympus binocular at 40X-100X magnification, based on Blackman and Eastop (1994, 2008 and 2012). Classification system of Blackman and Eastop (2012), Remaudiere and

Remaudiere (1997), Nafria (2013) and Favret (2018) were referred to for determining taxonomic status of aphid species. Voucher specimens of the identified aphid species were deposited in the Entomology laboratory, University of Poonch Rawalakot, Azad Kashmir-Pakistan.

Results and Discussion

Twenty-four aphid species in 15 genera representing 6 subfamilies viz., Aphidinae, Lachninae, Calaphidinae, Chaitophorinae, Greenideinae and Hormaphidinae, comprising 8 tribes, Aphidini, Rhopalosiphini, Macrosiphini, Lachnini Calaphidini, Chaitophorini, Greenidieni and Hormophadini (List. 1) were found infesting 28 tree species under 22 genera in 17 plant families under 12 orders in the study area (List. 2). Three species (marked¹) under one genus each, as first records for Pakistan, 3 species (marked ²) in 3 genera recorded as second and 6 species (marked ³) in 5 genera as third occurrence records in Pakistan are included. Twenty-one species in 14 genera are new records for the study area. However new locality records are presented for all studied species. Diagnostic features of studied species, except 6 species of genus *Aphis* (Table 1), are included in the List 1.

Abbreviations, symbols and legends used in the systematic account

Anatomical terms and symbols: abd abdomen; absg abdominal segment; ansg antennal segment; b6 base of antennal segment 6; siph siphunculi; cd cauda; cb caudal base; cl caudal length; lfh longest femoral hair; pt processus terminalis; rtm rostrum; urs ultimate rostral segment; tfsh trochantro-femur suture of hind leg; ≈ about, > more than, < less than; **Superscripts:** * new to study area, ¹ new to Pakistan, ² 2nd finding record in Pakistan, ³ 3rd finding record in Pakistan; ¹, ² and ³ by default are new to the study area; **Acronyms:** AtVF apterous viviparous female; AlVF alate viviparous female; NPH new primary host; **Localities:** RW Rawalakot; KG Khaigala; AS Alisojal; HJ Hajira; AP Abbaspur; TP Taulipir; BJ Banjosa; BG Bagh; HV Haveli; SD Sudhnoti; TK Trarkhal; TH Thorar; PL Pallandri; MG Mong. **Tree species name in bold font:** New primary host plant record for Pakistan; **Abbreviated locality name in bold font:** New locality record for Pakistan; **Reference Pakistan:** Previous record in Pakistan.

Table 1: Diagnostic features of apterous viviparous female of 6 studied species of genus *Aphis*.

Characters	<i>A. craccivora</i>	<i>A. fabae</i>	<i>A. gossypii</i>	<i>A. pomi</i>	<i>A. punicae</i>	<i>A. citricola</i>
body length	1.5-2	2.6-2.4	0.93-1.32	1-1.32	0.92-1.46	0.91-1.27
body width	0.7-0.97	0.78-1.4	0.41-0.65	0.78-0.96	0.42-0.64	0.68-0.7
color of AtVF in life	dark brown	black	dark brown	light green	pale	yellow
dorsal dark patch	present	absent	absent	absent	absent	absent
siphunculi	shape	tubular, imbricated	tubular, imbricated	tubular	tubular	tubular
	color	black	dark	black	pale	black
cauda	color	dark	black	dusky	pale-dusky	black
	shape	tongue like	tongue like	tongue like	tongue like	tongue like
	noh	> 1	> 1	4-8	4-6	7
pt/b6	≈ 3X	< 2X	> 3X	> 3X	≈ 2.5	≈ 2.5
lfh/tfsh	-	-	< 1	-	≈ 1	> 1
siph/cd	≈ 2X	≈ 2X	≈ 2X	< 2X	≈ 1	< 2X

List 1: Systematics, Diagnostic features, Host Plant range and Distribution of Studied Aphid Species

Hemiptera: Sternorrhyncha: Aphidomorpha:

Aphidoidea: Aphididae

APHIDINAE: APHIDINI: APHIDINA

Aphis Linnaeus, 1857

Aphis craccivora (Koch, 1854)*

Material examined: *Eriobotrya japonica*: 4 AtVF, 2 ALVF, HJ, 10-10-2015; *Psidium guajava*: 4 AtVF, AP, 11-10-2015. *Robinia pseudoacacia*: 2 AtVF, RW25-4-2016. *Ailanthus altissima*: 6 apterae, HJ, 28-XII-2016. *Cassia surratensis*: 3 AtVF, 1 ALVF, TH07-08-2016. *Ficus carica*: HJ, 28-XII-2015 and *Punica granatum*: 6 AtVF, HJ 15-III-2015; 4 AtVF, AP 16- III-2015; 2 AtVF, TH 04-IV-2015; 2 AtVF, BJ 5-IV-2015; 4 AtVF, AS 02-VI-2016; 4 AtVF, RW 25-5-2016 and 2 AtVF BG 27-VI-2016.

Reference Pakistan: Naumann-Etienne and Remaudiere (1995), Irsha (2001), Bodlah et al. (2011).

Aphis fabae Scopoli, 1763

Material examined: *Leucocaea leucocephala*: 2 AtVF, AP:7-Xi-2015; 4 AtVF, 1 ALVF, HJ, 20-XI-2016; 4 AtVF, TH18-XI-2016 and BG,25-XI-2016. *Lonicera quinquelocularis*, RW 10-V-2015.

Reference Pakistan: Naumann-Etienne and Remaudiere (1995), Irshad (2001), Bodlah et al. (2011), Amin et al. (2017).

Aphis gossypii Glover, 1877

Material examined: *Hibiscus rosa-sinensis*: 2 AtVF, HJ 27-X-2016; 4 AtVF, 2 ALVF, AP 28-X-2016; 1 AtVF, BG 02-XI-2016). *A. altissima*: 6 apterae, HJ, 28-XII-2016. *L. leucocephala*: 6 AtVF, 2 ALVF,

AP: 7-Xi-2015; 2 AtVF, HJ, 20-XI-2016; 2 AtVF, TH: 18-XI-2016 and 4 AtVF, BG,25-XI-2016. *E. japonica*: 2 ATVF, RW 25-V-2016. *Broussonettia papyrifera*: 4 AtVF, HJ, 21-XI-2016; 6 AtVF, TK10-XI-2016; 2 AtVF PL10-XI-2016; 2 AtVF MG 10-XI-2016, TH, 6-XI-2016; *F. carica*: 2 AtVF, 1 ALVF, HJ, 10-III-2016; *P. granatum*: 6 AtVF, HJ, 15-III-2015; 4 AtVF, AP, 16- III-2015; 2 AtVF, TH, 04-IV-2015; 2 AtVF, BJ 5-IV-2015; 4 AtVF, AS 02-VI-2016; 4 AtVF, RW 25-5-2016 and 2 AtVF BG, 27-VI-2016 and *Salix alba*: 4 AtVF, HJ,10-III-2016.

Reference Pakistan: Das (1918), Lambers (1966); Naumann-Etienne and Remaudiere (1995), Irshad (2001), Bodlah et al. (2011), Amin et al. (2017).

Aphis pomi De Geer, 1773*

Material examined: *Malus pumila*: 4 AtVF, 2 ALVF, RW19-III-2015; 4 AtVF, 1 ALVF; TP, 02-V-2015; 4 ATVF; 2 AtVF, AS 10-VI-2015; 4 AtVF, 2 ALVF, KG 14-V-2015; 2 AtVF, AP, 25-III-2016; 3 AtVF, 1 ALVF, BJ17-V-2016; 2 AtVF, TK 20-III-2016; 6 AtVF PL 20-III-2016; 4 AtVF, 2 ALVF, BG 27-VI-2016.

Reference Pakistan: Naumann and Remaudiere (1995).

Aphis punicae Passerini, 1863

Material examined: *P. granatum*: 6 AtVF, HJ 15-III-2015; 4 AtVF, AP 16- III-2015; 2 AtVF, TH 04-IV-2015; 2 AtVF, BJ 5-IV-2015; 6 AtVF KG; 4 AtVF, AS 02-VI-2016; 4 AtVF, RW 25-5-2016; 2 AtVF, BG 27-VI-2016; 4 AtVF TK17-IV-205 ; 2 AtVF PL 4-IV-2016; 6 AtVF, TH 4-IV-2016; 4 AtVF HV 12-IV-205.

Reference Pakistan: Alam et al. (1969); Naumann

and Remaudiere (1995).

Aphis spiraecola Patch, 1914*

Material examined: *E. japonica*: 4 AtVF, HJ, 24-10-2016; 2 AtVF, AP, 25-10-2016; 2 AtVF, KG 2-IV-2015; 6 AtVF RW 2-IV-2015; 4 AtVF, TH 4-IV-2016; 2 AtVF PL 4-IV-2016; MG 4-IV-2016; 6 AtVF BG 10-IV-2015.

Reference Pakistan: Naumann and Remaudiere (1995).

Aphis (Toxoptera) aurantii Boyer de Fonscolombe, 1841²

Diagnosis: Live AtVF reddish brown, about 1.50-1.85 mm long and 0.86 mm broad, oval; Ante with black and white bands; stridulatory apparatus present; **Material examined:** *Citrus* sp.: 6 AtVF, HJ, 15-XI-2015; 4 AtVF, AP, 16-XI-2015; 4 AtVF, 2 TH 24-IX-2016.

Reference Pakistan: Naumann and Remaudiere (1995).

APHIDINAE: APHIDINI: RHOPALOSIPHINA

Rhopalosiphum Koch, 1854

Rhopalosiphum nymphaeae (Linnaeus, 1761)*

Diagnosis: Live AtVF dull green to dull olive, ≈ 1.50-2.02 long and 0.76-1.04 mm wide, elongate and waxed; dorsal reticulated roundish bead-like spinules present; siph pale, tubular, clavate near the distal end and laid alongside dorsum; **Material examined:** *Prunus domestica*: 4 AtVF, AS 10-VI-2015; 2 AtVF, KG 14-V-2015 and *P. armeniaca*: 1 AtVF, BJ, 17-V-2016; 2 AtVF, 2 AtVF, RW 25-V-2016 and 6 AtVF, BG 27-VI-2016.

Reference Pakistan: Lahore (Pakistan) Das, 1918; Naumann and Remaudiere, 1995.

APHIDINAE: MACROSIPHINI

Berberidaphis Narzikulov, 1960

Berberidaphis lydiae (Narzikulov, 1957)²

Diagnosis: Live AtVF pale, 1.02-1.75 mm long and 0.53-0.65 mm wide and rather ovate; siph pale, markedly clavate on one side; **Material examined:** *Berberis lyceum*: 4 AtVF, RW 29-XII-2016.

Reference Pakistan: Naumann and Remaudiere (1995).

Brachycaudus van der Goot, 1913

Brachycaudus helicyrsi (Kaltenbach, 1843)*

Diagnosis: Live adult AtVF bright yellowish white, ≈ 1.12-1.25 mm long and 0.47-0.63 broad and elongate; Appendages pale; cd pale, short,

semicircular with 8-10 hairs; **Material examined:** *Prunus domestica*: 4 AtVF, AS 10-VI-2015; 2 AtVF, KG 14-V-2015; *P. armeniaca*: 1 AtVF, BJ, 17-V-2016.

Reference Pakistan: Alam and Hafeez (1963); Naumann and Remaudiere (1995) and Irshad (2001).

Myzus Passerini, 1860

Myzus ornatus Laing 1932*

Diagnosis: Live adult AtVF yellowish green, ≈ 1.92-2.30 mm long and 1.18-1.40 mm broad; abd with mid-dorsally broken transverse bands; siph short, incised below flange, longer than cd; **Material examined:** *Tecoma stans*: 4 AtVF, 2 AtVF, BG; 4 AtVF, HJ; 4 AtVF, 2 AtVF, AP; 2 AtVF, TH 30-X-2016.

Reference Pakistan: Naumann and Remaudiere (1995).

Myzus persicae (Sulzer, 1776)

Diagnosis: Live adult AtVF light green to yellowish green; ≈ 2.00-2.25 mm long and 0.96-1.17 mm wide; ant well developed and characteristically have inner faces converged; **Material examined:** *Prunus persica*: 2 AtVF, BG, 14-X-2016; 1 AtVF, RW, 17-X-2016; 2 AtVF, AS 10-VI-2016; 2 AtVF, BJ 27-VI-2015. *Ficus* sp.: 4 AtVF, HJ 15-III-2016.

Reference Pakistan: Naumann and Remaudiere (1995), Irshad (2001), Bodlah et al. (2011), Amin et al. (2017).

Pterocomma Buckton 1879

Pterocomma beulahense (Cockerell, 1904)¹

Diagnosis: Live adult AtVF yellowish olive green, medium sized, rather elongate; siph distinctly yellowish than rest of the body; cd broad and bears more than 20 long pointed hairs; **Material examined:** *Populus ciliata* Wall. Ex. Royale: Hajira: 4. AtVF.

Reference Pakistan: New.

CHAITOPHORINAE: CHAITOPHORINI

Chaitophorus (Koch, 1854)

Chaitophorus pakistanicus Lambers (1966)³

Diagnosis: Live adult AtVF apple green, ≈ BL 1.15 and 65 mm broad and rather pear shaped. Dorsum hairy; siph pale, stumpy and with reticulated sculpturing; **Material examined:** *Salix acmophylla*: 4 AtVF, HJ; 6 AtVF, TH 18-XI-2016.

Reference Pakistan: Lambers (1966), Naumann and Remaudiere (1995).

GREENIDEINAE: GREENIDEINI

Greenidea Schouteden, 1905

Greenidea (Trichosiphum) psidii van der Goot, 1917³

Diagnosis: Live adult AtVF yellowish brown to dark brown ≈ 2.05 - 2.35 mm long and 1.16 - 1.30 mm long and pear shaped; siph reticulated at the base, long, densely haired and longer than cd; **Material examined:** *Psidium guajava*: AP; 4 AtVF 16-III-2015.

Reference Pakistan: Blackman and Eastop, 2012.

Greenidea (Greenidea) ficicola Takahashi, 1921³

Diagnosis: Live adult AtVF yellowish white with small brown patches on dorsum; ≈ 1.85-2.30 mm long and 0.73 to 1.14 wide pear shaped; siph brown and bearing long stiff hairs; **Material examined:** *Ficus religiosa*. HJ; 6 AtVF 10-III-2016.

Reference Pakistan: Naumann and Remaudiere (1995), Blackman and Eastop (2012).

HORMAPHIDINAE: CERATAPHIDINI

Astegopteryx Karsch 1890

Astegopteryx bambusae (Buckton, 1893)¹

Diagnosis: Live adult AtVF apple to pale green with transverse diffused streaks of green on abd, ≈ 1.30-1.38 mm long and 0.80-0.90 mm broad and pear shaped. Frontal horns present; **Material examined:** *Bambusa* sp. 6 AtVF, AP 16-XI-2015.

Reference Pakistan: Blackman and Eastop, 1994.

LACHNINAE: LACHNINI

Pterochloroides Mordvilko 1914

Pterochloroides persicae (Cholodkovsky 1899)

Diagnosis: Live adult AtVF dark brown to greyish black with characteristic dorsal grey markings, ≈ 2.50-2.60 mm long and 1.04-1.22 mm wide; siph placed on small cones; **Material examined:** *Prunus armenica*: 4 AtVF, RW, 10-V-2015; 2 AtVF, BG 10-X-2016; 2 AtVF, TH 12-X-2016.

Reference Pakistan: Lahore, Das 1918, Alam et al., (1969); Naumann and Remaudiere (1995), Irshad (2001).

LACHNINAE: EULACHNINI

Genus: *Cinara* Curtis, 1835

Cinara (Cupressobium) cupressi (Buckton, 1881)²

Diagnosis: Live adult AtVF brown, white waxed, ≈ 1.80-2.50 mm long, 90-1.03 mm wide, Dorsum with characteristic fork. rtm extends beyond hcx; siph cones encircled by hairs; **Material examined:** *Cupress* sp.: 4 AtVF, RW 10-V-2016; 6 AtVF, HJ15-3-2016; 4

AtVF, AP 16-III-2015, 3 AtVF TK 20-III-2016; 4 AtVF, BG 27-VI-2016; 4 AtVF TH4-IV-2015.

Reference Pakistan: Remaudiere and Binazzi (2003).

Cinara lachnirostris Hille Ris Lambers, 1966³

Diagnosis: Live adult AtVF dull pale, ≈ 2.30-3.12 mm long and 1.82-2.24 mm broad and pear shaped; rtm ≈ as long as bl; siph cones hairy around; cd knobbed and with 16-18 long hairs; **Material examined:** *Pinus wallichiana*: 6 AtVF, RW 4-IV-2016.

Reference Pakistan: Naumann and Remaudiere (1995), Blackman and Eastop (2012).

Cinara maculipes Hille Ris Lambers, 1966³

Diagnosis: Live adult AtVF Dark brown to black with small dense hairs; ansg 6 < ansg5; rtm dark, long reaching absg 2-3. Legs maculate; basal diameter siph ≈ equal to URS; **Material examined:** *P. wallichiana*: 6 AtVF, RW 4-IV-2016.

Reference Pakistan: Lambers (1966), Naumann and Remaudiere (1995).

CALAPHIDINAE: PANAPHIDINI: PANAPHIDINA

Chromaphis Walker, 1870

Chromaphis juglandicola (Kaltenbach, 1843)³

Diagnosis: Live Adult AtVF translucently light pale to yellowish brown, ≈ 1.55-1.95 mm long and 70-85 mm broad and rather elongate; Paired dark to brown dots on abd terga 4 and 5; **Material examined:** *Juglans regia*: RW, 14-V-2016.

Reference Pakistan: Blackman and Eastop, 2012. NLR.

Hoplochaitophorus Granovsky, 1933

Hoplochaitophorus quercicola (Monell, 1879)¹

Diagnosis: Live AtVF yellowish pale, pear shaped, ≈ 1.56 long and 0.78 wide; ante long with pale and dark bands; dorsum with 2 rows of rectangular dark bands with 2 complete large transverse bands near siph cones; cd pale and knobbed; **Material examined:** *Quercus serrata*: RW, 29-XII-2016.

Reference Pakistan: New.

Panaphis Kirkadly, 1904

Panaphis juglandis (Goetze, 1778)³

Diagnosis: Live adult ATVF yellow with brown transverse strips, ≈ 1.65- 2.04 mm long and 0.88-1.56 mm broad; lateral tubercles bearing long pointed hairs siph cones smooth; **Material examined:** on *J. regia*: 2 AtVF, RW.

Reference Pakistan: Blackman and Eastop (2012), Naumann and Remaudiere (1995), NLR.

Table 2: Dominance-order of studied subfamilies of Aphididae in infesting per number of tree species and plant families.

Subfamily	No. of aphid species/ genera	% aphid species/6 subfamilies	No. of host tree species /genera	% host tree species/ aphid family	No. of host tree families	% host tree family/aphid family
Aphidinae	13/6	54%	9/ 7	50%	4	33%
Lachninae	4/2	17%	3/3	17%	3	25%
Calaphidine	3/3	13%	2/2	11%	2	17%
Greenideine	2/1	8%	2/1	11%	1	8.3%
Chaitophore	1/1	4%	1/1	6%	1	8.3%
Hormaphide	1/1	4%	1/1	6%	1	8.3%

Twenty-eight tree species in 22 genera stretching over 17 families and 12 orders were found afflicted by Aphididae in the studied area (List. 2). Genus *Prunus* had 3, the highest number of host plant species that collectively have 5 aphid species under 4 genera. A maximum of 3 aphid species were carried by 3 host plants each, 11 tree species carried 2 aphid species each while 16, the highest number of studied tree species carried one species each.

Of the 24 studied aphid species 8 (36%) under 7 genera were recorded on 8 fruit-tree species while 16 (64%) aphid species under 11 genera were found on 23 wild-tree species. These 16 species due to varied host ranges showed different degree of infestation to host tree species. Over prevalence of polyphagous aphid species (Aphidinae) and their multiple-infestation on fruit-tree species and ornamental tree species is compatible to their documented intimate-association with domesticated host plant species (Derivers et al., 2010). Genus *Aphis* had 6 species, highest number of species had by any of the 15 studied genera followed by *Cinara* and *Myzus* having 3 and 2 species respectively while remaining 7 genera had monospecific representation. *Aphis gossypii* and *A. craccivora* infesting 6 tree species each under as such genera were the most polyphagous studied species. Encounter of *C. lachnirostris*, *C. maculipeson* on *P. wallichianain* in the study area does not augur well for exquisite blue fir and warrants regular surveys in the region. Similarly, heavy infestation of *Aphis* species noted on Rosaceae species and ornamental tree species points to their extended host range and potential threat to regional tree flora. Two first records *P. beulahense* and *H. quercicola* are both Nearctic species. *Astegpteros bambusae* (Buckton) is a new species record for Pakistan vis-a-vis its rather dubious distribution records (Blackman and Eastop, 1994; Naumann-Etienne and Remaudiere, 1995). The source of these citations is Doncaster (1966).

Scrutiny of the related literature reveals that the latter citation probably refers distribution of this species in Bangladesh (East Pakistan in 1969). Five studied aphid subfamilies varied in number of species and genus/genera (Table 2). Palatability of studied host tree families to the aphid species (Table 3) also varied and was dominated by Rosaceae, with 4 host plant species in 3 genera carrying 7 aphid species (in 4 genera).

Table 3: Palatability-order of studied host tree families to studied aphids.

Host-tree family	Tree species/ genera	No. of aphid species harbored/ genera	No. of aphid subfamilies/ host-tree family
Rosaceae	5/3	7/5	2
Moraceae	4/ 2	4/ 2	2
Salicaceae	3/3	3/ 3	2
Fabaceae	3/3	3/1	1
Myrtaceae	1/ 1	4/ 2	1
Bignoniaceae	1/1	3/3	1
Juglandaceae	1/1	2/2	1
Caprifoliaceae	1/1	1/1	1
Fagaceae	1/1	1/1	1
Lythraceae	1/1	1/1	1
Malvaceae	1/ 1	1/1	1
Berberidaceae	1/1	1/1	1
Cupressaceae	1/1	1/1	1
Caprifoliaceae	1/1	2/1	1
Pinaceae	1/1	2/1	1
Poaceae	1/1	1/1	1
Rutaceae	1/1	1/1	1
Simaroubaceae	1/ 1	2/ 1	1

List. 2: Host-plant tree-Aphid species associations in Azad Jammu and Kashmir-Pakistan

- Ailanthus altissima* (Mill.) Swingle. (Mill.) Swingle / Jungli Toon (Sapindales: Simaroubaceae): *A. craccivora* and *A. gossypii*.

- *Bambusa sp.* (L.) Bamboo /Nar, Bans (L.) Voss (Poales: Poaceae): *A. bambusae*.
- *Berberis lyceum* Royle Berbery/Sumbalu (Ranunculales: Berberidaceae) *B. lydiae*.
- *Broussonetia papyrifera* L. Vent. Paper mulberry/ Sufaid Toot (Rosales: Moraceae): *A. gossypii*, *A. craccivora*.
- *Cassia surratensis* Burm.f. (Fabales: Fabaceae): *A. craccivora*.
- *Citrus sp.* (L.) Osbeck Orange/Malta (Sapindales: Rutaceae) *A. (T. aurantii)*.
- *Cupress sp.* L. Cedar /More Pankh (Pinales: Cupressaceae) *C. cupressi*.
- *Eriobotrya japonica* (Thunb.) Lindl, Loquat (Rosales: Rosaceae): *A. gossypii* and *A. craccivora*
- *Ficus carica* L. Fig/Injeer (Rosales: Moraceae): *A. citricidus*, *A. spiraeicola*, *A. gossypii*.
- *Ficus religiosa* L. /Peepal (Rosales: Moraceae): *G. ficicola*.
- *Ficus sp.* (Rosales: Moraceae): *M. persicae*.
- *Hibiscus rosa-sinensis* L. Chinese Hibiscus, China rose (Malvales: Malvaceae) *A. gossypii*.
- *Juglans regia* L. Walnut/Akhroat (Fagales: Juglandaceae): *C. juglandicola*, and *P. juglandis*
- *Leucocaena leucocephala* (lam.) de Wit Vilayti Kikar, Kubabhal/ White popinac (Fabales: Fabaceae): *A. gossypii*, *A. fabae*.
- *Lonicera quinquelocularis* Hrdw. Honeysuckle (Dipsacales: Caprifoliaceae): *A. gossypii*, *A. fabae*.
- *Malus pumila* Mill. Apple/saib (Rosales: Rosaceae): *A. pomi*.
- *Pinus wallichiana* A. B. Jacks. Fir/Blue pine (Pinales: Pinaceae): *C. lachnirostris*, *C. maculipes*
- *Populus ciliata* Wall. Ex. Royle (Malpighiales: Salicaceae): *Pterocomma beulahense*.
- *Prunus armeniaca* L.: (Rosales: Rosaceae) *M. persicae* and *Pterochloroides persicae*.
- *Prunus domestica* L. Apricot/Khubani (Rosales: Rosaceae) *R. nymphaeae*
- *Prunus persica* (L.) Batsch Peach/Aru (Rosales: Rosaceae) *M. persicae* and *B. helichrysi*
- *Psidium guajava* L. Guagava/Amrood (Myrtales: Myrtaceae): *A. spiraeicola*, *A. gossypii*, *A. craccivora* and *Greenidea psidii*.
- *Punica granatum* L. Pomegranate/Daruna (Myrtales: Lythraceae) *A. craccivora*, *A. gossypii* and *A. puicae*.
- *Quercus serrata* Murray Jolcham oak/Shah baloot (Fagales: Fagaceae) *H. quercicola*
- *Robinia pseudoacacia* L. (Fabales: Fabaceae): *A. craccivora*.
- *Salix acmophylla* L. Willow (Malpighiales: Salicaceae): *C. pakistanicus*. (Hajira, thorar)
- *Salix alba* L. Willow (Malpighiales: Salicaceae): *A. gossypii*.
- *Tecoma stans* (L.) Juss. ex Kunth Orange Bells (Limiales: Bignoniaceae): *A. gossypii*, *M. ornatus*.

Conclusions and Recommendations

Present study, for the first time, has systematically dealt with aphid-tree flora associations in the study area and will serve as the baseline for future, taxonomical/faunal, ecological studies on aphids-host tree species and IPM practitioners dealing with tree-infesting aphid species of the study area. Given the cryptic nature of tree dwelling aphids, limited scope of present study, lack of link roads in the study area it would be logically assumed that the area may still have many undiscovered tree infesting aphid species, further studies are therefore warranted.

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Author's Contribution

MA collected, identified the specimens, studied the related literature and prepared the manuscript. KM suggested the problem and helped in improvement of manuscript. IB guided and assisted in identification process.

Novelty Statement

The paper is first study on the subject in the country. It comprehensively encompasses systematics, diagnosis, host plants (Tree species) and distribution of the aphids (Plant lice) in the Poonch Division of Azad Jammu and Kashmir-Pakistan where trees (Fruit and wild) are a vital component of sustainable agriculture and ethnobotanical culture.

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