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RESEARCH ARTICLE

Aphids fauna (Aphidoidea: Hemiptera) and their host association of Al Bahah Province, Saudi Arabia

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Abstract Aphid habitats are aplenty in the Al Bahah Province, Saudi Arabia because of the abundance of native and introduced plants there and the region's moderate temperature. But no prior surveys of aphids from the province have been conducted. Fifty-five aphid species from 30 genera were identified. Six aphid species namely, *Macrosiphum euphorbiae* (Thomas, 1878), *Brachycaudus rumexicolens* (Patch, 1917), *Uroleucon sonchi* (Linnaeus, 1767), *Brachycaudus helichrysi* (Kaltenbach, 1843) and *Myzus persicae* (Sulzer, 1776) were the most prevalent aphid species according to the quantity of samples gathered. In this research, 102 species of host plants for aphids were identified, comprising 82 genera. The most frequent aphid hosts plant during the recent findings were species of the Asteraceae, Chenopodiaceae, Euphorbiaceae, Fabaceae, Poaceae, and Solanaceae families. Aphid species varied from one to six in number per plant host species. There is a key provided for identifying the different kinds of aphids in KSA.

Keywords: Aphids, Aphidoidea, biodiversity, Al Bahah Province, host plants.

Introduction

Aphids belong to the superfamily Aphidoidea within suborder Sternorrhyncha in Hemiptera, and important insects distributed throughout the world [1–3]. There are approximately more than 5000 aphid species worldwide have been recorded [4]. Ninety-five percent of aphid species are either monophagous or oligophagous, and the remaining five percent are polyphagous, meaning that they multiply on natural plants [5,6]. Aphids are infesting more than 300 plant families which defined their importance for taxonomic study [7,8]. However, aphids require precise, systematic and taxonomic research work for their identification [9]. A total of 56 host plant families and 63 aphid species have been identified previously in the Saudi Arabia [10–14]. The study covered mostly Riyadh, Tabuk, Jizan, and Asir areas, but Al Bahah was not included. The insect fauna of Al Bahah Province was studied for four years and a preliminary list of 582 insect species and subspecies including two new species [15]. However, no aphid species were found in their study. But in current study 15 new aphid records were added to Saudi aphid fauna [2,16].

Al Bahah Province is included in the Afrotropical Region of KSA comprises varying topography [15]. It has moderate temperature 12-23C° and humidity ranging between 52% - 67% due to the high altitude which ranges from 1500 to 2450 m. Al Bahah Province comprises numerous forests, diverse nature, and plant communities, including agricultural production

[17,18]. This study's objective is to catalogue aphid species and their host plants. Moreover, key to aphid species in KSA are given.

Materials and Methods

Al Bahah Province was selected for aphid samples collection due to the lack of taxonomic and faunistic treatments of aphids in Al Bahah Province, and the highest diversity of plants covers in that region. Six districts Baljurashi, Al Mandaq, Al Qura, Al Mekhwah, Al Aqiq and Qelwa divided the province. The province is divided into two major Physiographic areas the low land coastal plain and mountainous area that reach 2450 m [15].

Al Bahah Province was visited eight times with different dates during the study. Specific plant host taxa on wild or cultivated trees were inspected for aphids. Each plant was examined for the presence of aphid colonies. Each aphid colony was sampled and placed separately in a labeled vial.

Two types of sampling methods were used to collect aphids, by beating sheets and by pan traps. Using a camel brush, all the collected aphids were placed in vials marked with 75% ethanol for preservation. The aphid host plants were placed in plastic bags by detaching the required plant portion for identification by specialists. The aphid specimens were settled on slides [19]. Aphids were identified by using several references. All labeled aphid slides were deposited in arthropods depository at King Saud University. The general morphology features of aphids were drawn for the identification purpose (Figure 1).

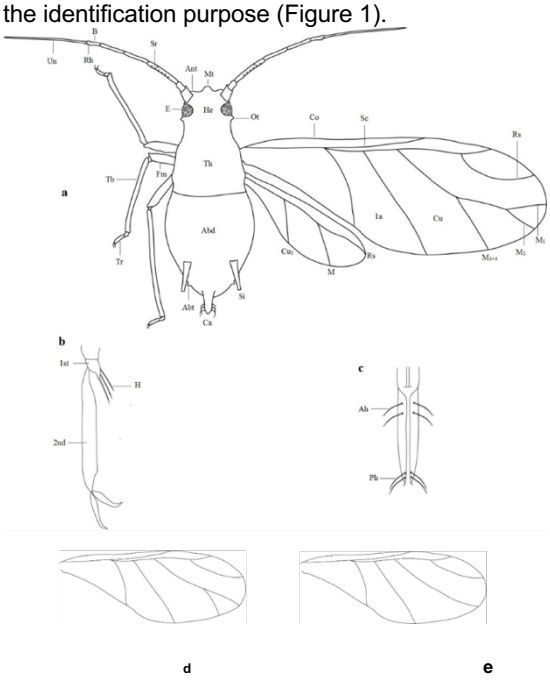


Figure 1. General outline sketch of *Aphis gossypii* as model aphid for showing morphological features: a, dorsal view of alate viviparous female: 1a = first anal fork, Ab = abdomen, Ant = antennal tubercle, B = basal part of last antennal segment, Ca = cauda, Co = costa, Cu = cubitus, E = eye, Fm = femur, He = head, M = media, Mt = Median frontal tubercle, Ot = ocular tubercle, Rh = primary rhinaria, Rs = radial sector, Si = siphunculus, Sc = subcosta, Sr = secondary rhinaria, Tb = tibia, Th = thorax, Tr = tarsus, Un = unguis. b, tarsus: H = hair. c, rostrum: Ah = accessory hair, Ph = primary hair. d, fore wing media once branched. e, fore wing media simple, Abt = abdominal tubercle

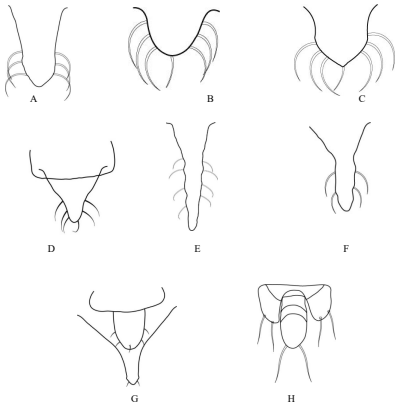


Figure 2. Types of Cauda: A. tongue like, *Aphis gossypii*; B. helmet-shaped, *Brachycaudus rumexicolens*; C. pentagonal, *Dysaphis foeniculus*; D. triangular, *Brevicoryne brassicae*; E. tapering towards base, *Macrosiphum euphorbiae*; F. finger like, *Hayhurstia atriplicis*; G. dorsal view of supracaudal process, *Cavariella aegopodii*; H. knobbed with bilobed anal plate, *Therioaphis trifolii*.

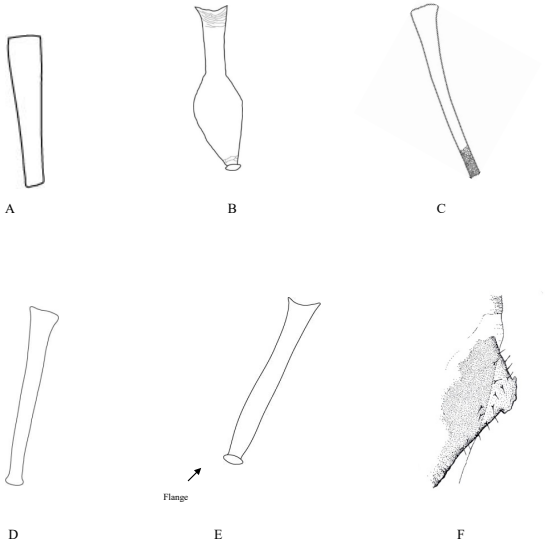


Figure 3. Types of Siphunculi: A. tapering, *Aphis gossypii*; B. swollen, *Eucarazzia elegans*; C. with

subapical zone of polygonal reticulation, *Uroleucon sonchi*; D. cylindrical, *Metopolophium dirhodum*, E. cylindrical and swollen slightly distally with flange, *Myzus persicae*; F. hairy cone, *Pterochloroides persicae* (from Aldryhim & Khalil, 1996).

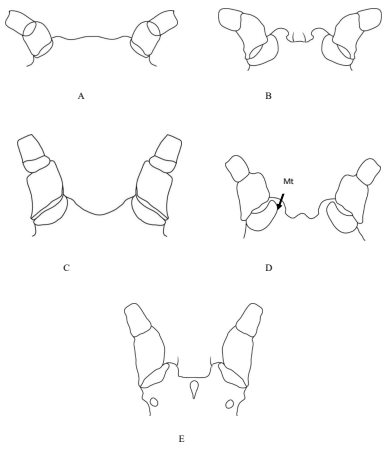


Figure 4. Examples of antennal tubercles: A. undeveloped, *Aphis fabae*; B. convergent, *Myzus persicae*; C. divergent *Macrosiphum euphorbiae*; D. divergent with frontal median tubercles (Mt), *Metopolophium dirhodum.*; E. parallel, *Aulacorthum solani*.

Results and Discussion

370 aphid samples have been collected from the Province of Al Bahah for this investigation. From 30 genera, a total of 55 aphid species were discovered. Materials of each species are provided which include location, date and host plants.

Aphis craccivora Koch, 1854

Materials: Al Qahman village, 24.IV.2013 on *Phragmanthera austroarabica*.; Al Bahah city, 25.IV.2013 on *Calendula arvensis*.; Alleistah, 26.IV.2013 on *Anagyris foetida* (2 collections).

Aphis fabae Scopoli, 1763

Materials: Bani Kabeer, 25.VI.2012 on *Solanum lycopersicum*.; Wadi fig, 13.VIII.2014 on *Solanum nigrum*.; Al Bahah, 15.IV.2013 on trap.

Aphis gossypii Glover, 1877

Materials: Bani Kabeer, 24.X.2014 on *Bromus* sp.; Al Aqiq, 10.XI.2014 on Scrophulanaceae.; Al Atawlah, 29.IV.2014 on *Vitis vinifera*.; Bani Farwa, 25.VII.2013 on *Vitis vinifera*.; Al Bahah, 12.IX.2013 on *Bromus* sp.

Aphis hillerislambersi Nieto & Mier, 1976

Materials: Al Bahah, 22.V.2013 on *Euphorbia schimperiana* (2 collections).; Bani kabeer, 25.VII.2013 on *Euphorbia schimperiana*.

Aphis illinoisensis Shimer, 1866

Materials: Al Bahah, 25.X.2013 on *Vitis vinifera* (6 collections).

Aphis middletonii Thomas, 1879

Materials: Zafar, 18.IV.2013 from trap.

Aphis nerii Boyer de Fonscolombe, 1841

Materials: Wadi Thee Ain, 7.III.2013 on *Leptadenia arborea*.; Al-Atawilah, 24.IV.2013 on *Calotropis procera*.; Al Bahah city, 25.IV.2013 on *Nerium oleander*.; Al Aqiq, 25.IV.2013 on *Pergularia tomentosa*.; Al Bahah, 23.V.2013 on yellow water pan trap (5 collections).

Aphis punicae Passerini, 1863

Materials: Al Bahah, 24.IV.2013 on *Punica granatum* (4 collections).

Aphis spiraecola Patch, 1914

Materials: Al Bahah, 23.V.2013 on yellow water pan trap (6 collections).

Brachyunguis harmalae Das, 1918

Materials: Al Aqiq, 25.IV.2013 on *Calotropis procera*.

Hystoneura setariae (Thomas, 1878)

Materials: Al Bahah city, 25.IV.2013 on grass.; Al Bahah, 21.V.2013 on *Cenchrus ciliaris* (3 collections).; Al Bahah city, 22.V.2013 on *Euphorbia peplus*.; Bani Kabeer, 22.V.2013 on *Cynodon dactylon* (3 collections).; Bani Kabeer, 22.V.2013 on *Stipa capensis* (2 collections).; Bani Kabeer, 22.V.2013 on *Tagetes minuta*.; Al Aqiq, 4.VI.2014 on *Hyparrhenia hirta* (2 collections).; Bani Kabeer, 21.V.2014 on *Eragrostis* sp.; Bani Kabeer, 21.V.2014 on *Eragrostis* sp.; Biljureshi, 3.VI.2014 on Poaceae.; Wadi Turubah, 4.VI.2014 on *Panicum coloratum*.; Al Aqiq, 14.VIII.2014 on yellow water pan trap.; Wadi Turubah,

3.IX.2013 on *Panicum* sp

Rhopalosiphum maidis (Fitch, 1856)

Materials: Al Qura, 24.IV.2013 on *Cenchrus ciliaris*.; Wadi Allehian, 25.IV.2013 on *Zea mays*.; Jabal Shaeda Al Aila, 15.II.2014 on unknown plant.

Acyrthosiphon gossypii Mordivilko, 1914

Materials: Biljureshi, 26.IV.2014 on *Astragalus atropilosulus*.

Acyrthosiphon ?ilka Mordvilko, 1914

Materials: Al Bahah city, 22.V.2013 on *Euphorbia peplus*.; Biljureshi, 04.IX.2014 on yellow water pan trap.

Acyrthosiphon kondoi Shinji, 1938

Materials: Biljureshi, 04.IV.2014 on yellow water pan trap.; Biljureshi, 04.IV.2014 on *Medicago sativa*.

Acyrthosiphon lactucae (Passerini, 1860)

Materials: Wadi fig, 3.VI.2014 on *Lactuca saligna* (4 collections).; Wadi Turubah, 4.VI.2014 on *Lactuca saligna*.; Baua, 21.V.2013 on *Lactuca serriola*.

Acyrthosiphon pisum (Harris, 1776)

Materials: Al Bahah city, 22.V.2013 on *Medicago sativa* (2 collections).; Al Mandiq, 28.IV.2014 on *Ricinus communis*.; Al Mandiq, 28.IV.2014 on Fabaceae.; Wadi fig, 3.VI.2014 on *Atriplex suberecta*.

Aulacorthum solani (Kaltenbach, 1843)

Materials: Al Mandiq, 6.III.2013 on *Solanum nigrum*., Biljureshi, 04.IV.2014 on yellow water pan trap.; Al Mandiq, 28.IV.2014 on *Commicarpus* sp.

Aulacorthum ?palustre Hille Ris Lambers, 1947

Materials: Wadi fig, 22.V.2013 on *Ambrosia maritima*.

Brachycaudus helichrysi (Kaltenbach, 1843)

Materials: Al Bahah city, 24.IV.2013 on *Bromus* sp.; Wadi fig, 22.V.2013 on *Rumex stendelii* (2 collections).; Al Bahah city, 22.V.2013 on *Pulicaria vulgaris*.; Al Bahah city, 22.V.2013 on *Senecio cineraria*.; Al Bahah, 22.V.2013 on *Achillea biebersteinii* (3 collections).; Biljureshi, 22.V.2013 on *Salix mucronata* (3 collections).; Biljureshi, 22.V.2013 on *Salsola kali*.; Wadi fig, 22.V.2013 on *Echinops* sp.; Al Bahah city, 22.V.2013 on *Senecio cineraria*.; Bani Kabeer, 22.V.2013 on *Osteospermum vaillantii* (3 collections).; Bani Kabeer, 22.V.2013 on *Amygdalus communis*.; Wadi Turubah, 23.V.3013 on yellow water pan trap (2 collections).; Biljureshi, 26.IV.2014 on *Salix* sp.; Al Mandiq, 28.IV.2014 on *Helianthus annuus*.

Brachycaudus rumexicolens (Patch, 1917)

Materials: Rahwah, 2 24.IV.2013 on *Chenopodium album*.; Midan Al Shosadaa, 25.IV.2013 on *Brassica oleracea*.; Al Bahah, 22.V.2013 on *Rumex nervosus* (9 collections).; Al Bahah, 22.V.2013 on *Rumex stendelii* (2 collections).; Bani Kabeer, 22.V.2013 on *Nicotiana glauca*.; Bani Kabeer, 22.V.2013 on *Ochradenus baccatus*.; Bani Kabeer, 22.V.2013 on *Vigna* sp.; Al Bahah, 23.V.3013 on yellow water pan trap (5 collections).; Al Mandiq, 28.IV.2014 on *Commicarpus* sp.; Al Mandiq, 28.IV.2014 on *Datura innoxia*.; Al Mandiq, 28.IV.2014 on *Rumex vesicarius*.

Brevicoryne brassicae (Linnaeus, 1758)

Materials: Al Bahah, 25.IV.2013 on *Brassica oleracea* (2 collections).; Biljureshi, 04.VII.2013 on *Sonchus oleraceus*.

Capitophorus elaeagni (del Guercio, 1894)

Materials: Biljureshi, 25.IV.2014 on grass.; Al Aqiq, 26.IV.2014 on *Aerva javanica*.

Caveriella aegopodii (Scopoli, 1763)

Materials: Al Bahah, 25.IV.2013 on *Ferula communis* (3 collections).

Coloradoa rufomaculata (Wilson, 1908)

Materials: Wadi fig, 22.V.2013 on *Ambrosia maritima*.

Dysaphis apiifolia (Theobald, 1923)

Materials: Al Bahah city, 22.V.2013 on trap.

Dysaphis foeniculus (Theobald, 1922)

Materials: Rahwah, 24.IV.2013 on *Rumex stendelii*.; Al Mandiq, 28.IV.2014 on *Nicotiana glauca*.; Bani Farwa, 04.V.2013 on trap (3 collections).

Dysaphis plantaginea (Passerini, 1860)

Materials: Biljureshi, 04.IV.2014 on yellow water pan trap (2 collections).

Eucarazzia elegans (Ferrari, 1872)

Materials: Al Mandiq, 28.V.2013 on *Lavandula pubescens* (3 collections).

Hyadaphis coriandri (Das, 1918)

Materials: Wadi Turubah, 27.IX.2013 on *Foeniculum vulgare* (5 collections).; Al Bahah city, 12.VIII.2014 on *Lactuca saligna*.; Biljureshi, 04.IX.2013 on trap (10 collections).

Hayhurstia atriplicis (Linnaeus, 1761)

Materials: Al-Mandiq, 27.IX.2013 on *Chenopodium glaucum*.; Al-Aqiq, 04.IX.2013 on *Sorghum bicolor*.; Biljureshi, 28.IV.2014 on *Atriplex suberecta* (5 collections).; Bani Kabeer, 15.VII.2014 on yellow water pan trap (5 collections).

Hyperomyzus lactucae (Linnaeus, 1758)

Materials: Mandiq, 15. VIII.2014 on *Bidens biternata*.; Al Bahah city, 22.V.2013 on *Amaranthus viridis*.; Al Bahah city, 22.V.2013 on *Chenopodium album*.; Al Bahah city, 23.V.2013 on yellow water pan trap.; Al Qura, 27.IV.2014 on *Sonchus oleraceus* (4 collections).; Al Aqiq, 22.V.2013 on trap (3 collections).

Lipaphis erysimi (Kaltenbach, 1843)

Materials: Baidah, 24.IV.2013 on *Convolvulus arvensis*.; Biljureshi, 22.V.2013 on *Osteospermum vaillantii*.; Biljureshi, 15.VIII.2014 on *Eragrostis* sp.; Mandiq, 27.IV.2014 on yellow water pan trap (7 collections).

Macrosiphoniella absinthii (Linnaeus, 1758)

Materials: Biljureshi, 15.VIII.2014 on *Artemisia absinthium*.

Macrosiphoniella sanborni (Gillette, 1908)

Materials: Biljureshi, 15.VIII.2014 from *Ambrosia* sp.

Macrosiphum euphorbiae (Thomas, 1878)

Materials: Al Bahah city, 6.III.2013 on *Malus domestica*.; Aqiq, 14.VI.2014 on Asteraceae.; Mandiq, 15.VIII.2014 on *Withania somnifera* (2 collections).; Wadi Turubah, 6.III.2013 on unknown plant.; Al Bahah, 24.IV.2013 on *Tagetes patula* (2 collections).; Bani Kabeer, 24.IV.2013 on unknown host plant.; Rahwah, 24.IV.2013 on *Rumex stendelii* (4 collections).; Rahwah, 24.IV.2013 on *Sonchus oleraceus* (4 collections).; Rahwah, 24.IV.2013 on *Osteospermum vaillantii*.; Al Qahman village, 24.IV.2013 on unknown host plant.; Bani Kabeer, 15.VII.2014 on *Bidens biternata*.; Bani Kabeer, 15.VII.2014 on *Cardaria draba*.; Bani Kabeer, 15.VII.2014 on *Capsicum annuum*.; Bani Kabeer, 15.VII.2014 on *Lactuca sativa*.; Bani Kabeer, 15.VII.2014 on *Tecoma stans* (2 collections).; Bani Farwah, 25.IV.2013 on *Gomphocarpus* (=*Asclepias*) *fruticosus*.; Biljureshi, 15.VII.2014 on *Malva verticillata* (2 collections).; Alleistah, 26.IV.2013 on *Caylusea hexagyna*.; Bani Kabeer, 22.V.2013 on *Lolium rigidum*.; Wadi fig, 22.V.2013 on *Mentha citrata*.; Al Bahah city, 22.V.2013 on *Amaranthus viridis*.; Al Bahah, 22.V.2013 on *Nicotiana glauca* (3 collections).; Al Bahah city, 22.V.2013 on Asteraceae.; Al Bahah, 22.V.2013 on *Chenopodium album* (2 collections).; Al Bahah, 22.V.2013 on *Lactuca serriola* (3 collections).; Wadi fig, 22.V.2013 on *Euphorbia peplus*.; Wadi fig, 22.V.2013 on *Cupressus sempervirens*.; Wadi fig, 22.V.2013 on *Ambrosia maritima*.; Wadi fig, 22.V.2013 on *Conyza* sp.; Bani Kabeer, 22.V.2013 on unknown host plant.; Bani Kabeer, 22.V.2013 on *Chenopodium glaucum* (2 collections).; Bani Kabeer, 22.V.2013 on *Tagetes minuta*.; Bani Kabeer, 22.V.2013 on *Lepidium africanum*.; Bani Kabeer, 15.VII.2014 on yellow water pan trap.; Biljureshi, 15.VII.2014 on unknown host plant.; Aqia, 15.VII.2014 on *Sorghum bicolor*.; Biljureshi, 26.IV.2014 on Ranunculaceae.; Biljureshi, 15.VII.2014 on *Cenchrus ciliaris*.; Biljureshi, 26.IV.2014 on unknown host., Biljureshi, 15.VII.2014

on trap.; Al Mandiq, 28.IV.2014 on *Helianthus annuus*.; Al Mandiq, 28.IV.2014 on *Ricinus communis*.; Noman bin moqra, 30.IV.2014 on *clutya lanceolata*.;; Zidra, 1.V.2014 on *Solanum nigrum* (2 collections).; Wadi fig, 1.V.2014 on unidentified plant.; Biljureshi, 3.VI.2014 on *Hibiscus rosa-sinensis*.; Rawa, 4.VI.2014 on *Chenopodium murale*.; Wadi Turubah, 4.VI.2014 on *Amaranthus hybridus*.; Wadi fig, 5.VI.2014 on *Chenopodium ficifolium.*

Macrosiphum rosae (Linnaeus, 1758)

Materials: Mandiq, 15.VII.2014 on *Rosa* sp.

Metopolophium dirhodum (Walker, 1848)

Materials: Al Mandiq, 6.III.2013 on *Solanum nigrum*.; Biljureshi, 15.VII.2014 on *Sonchus oleraceus*.; Biljureshi, 15.VII.2014 on unknown plant.; Biljureshi, 15.VII.2014 on *Avena fatua*.; Biljureshi, 15.VII.2014 on *Medicago sativa*.

Myzus ?cerasi (Fabricius, 1775)

Materials: Biljureshi, 15.VII.2014 on trap (2 collections).

Myzus persicae (Sulzer, 1776)

Materials: Wadi Sadr, 6.III.2013 on *Lavandula pubescens*.; Rahwah, 24.IV.2013 on *Chenopodium album*.; Biljureshi, 15.VII.2014 on *Cardaria draba*.; Biljureshi, 15.VII.2014 on *Capsicum annuum*.; Biljureshi, 15.VII.2014 on *Malva parviflora*.; Banu Kabeer, 22.V.2013 on *Rumex* sp.; Banu Kabeer, 22.V.2013 on *Malva verticillata*.; Biljureshi, 15.VII.2014 on *Vigna* sp.; Jabal Shaeda Al Aila, 15.II.2014 on *Sisymbrium irio*.; Biljureshi, 26.IV.2014 on Ranunculaceae.; Biljureshi, 26.IV.2014 on *Sonchus oleraceus*.; Biljureshi, 26.IV.2014 on *Cynodon dactylon*.; Al Qura, 27.IV.2014 on *Convolvulus arvensis*.; Al Mandiq, 28.IV.2014 on *Commicarpus* sp.; Al Mandiq, 28.IV.2014 on *Ricinus communis*.; Al Mandiq, 28.IV.2014 on *Verbascum* sp.; Biljureshi, 15.VII.2014 on trap (4 collections).

Rhodobium porosum (Sanderson, 1900)

Materials: Al Bahah city, 6.III.2013 on *Rosa* sp.

Sitobion africanum (Hille Ris Lambers, 1954)

Materials: Al Bahah, 25.IV.2013 on *Ficus microcarpa* (2 collections).; Wadi Thee Ain, 25.IV.2013 on *Setaria verticillata*.; Al Bahah city, 22.V.2013 on *Ficus Nitida*.; Wadi Turubah, 23.V.2013 on *Hyparrhenia hirta* (2 collections).

Sitobion asirum Aldryhim & Illharco, 1996

Materials: Al Bahah, 24.IV.2013 on *Phragmanthera austroarabica* (4 collections).

Sitobion avenae (Fabricius, 1775)

Materials: Biljureshi, Biljureshi, 15.VII.2014 on *Hyparrhenia hirta*.; Wadi Turubah, 4.VI.2014 on *Panicum coloratum*.; Al Aqiq, 15.VII.2014 on trap.

Sitobion fragariae (Walker, 1848)

Materials: Biljureshi, 15.VII.2014 on *Hordeum murinum*.

Sitobion ?phyllanthi (Takahashi, 1937)

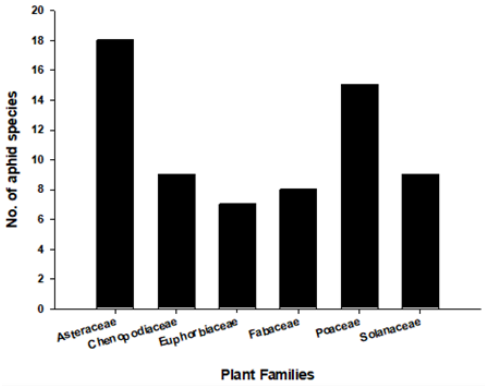
Materials: Al Bahah, 22.V.2013 on *Euphorbia peplus* (2 collections).

Uroleucon compositae (Theobald, 1915)

Materials: Wadi Fig, 22.V.2013 on *Mentha citrata*.; Biljureshi, 15.VII.2014 on *Osteospermum vaillantii*.

Uroleucon sonchi (Linnaeus, 1767)

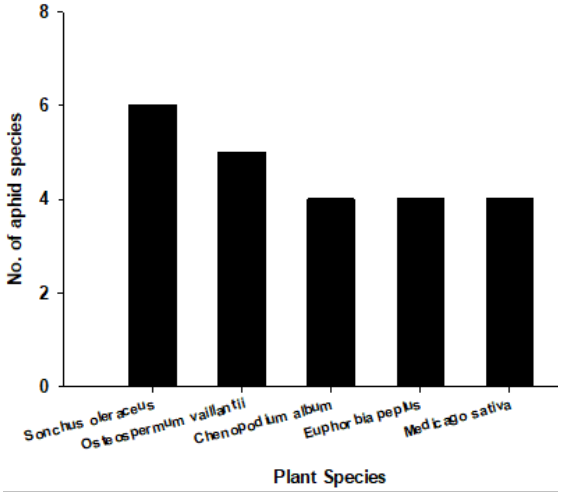
Materials: Wadi Thee Ain, 7.III.2013 on *Convolvulus arvensis*.; Biljureshi, 15.VII.2014 on *Bidens biternata*.; Al Bahah, 24.IV.2013 on *Sonchus oleraceus* (10 collections).; Al Qura, 24.IV.2013 on *Solanum incanum*.; Biljureshi, 15.VII.2014 on *Lactuca serriola*.; Biljureshi, 15.VII.2014 on *Silybum marianum*.; Biljureshi, 15.VII.2014 on *Gomphocarpus* (=*Asclepias*) *fruticosus*.; Biljureshi, 15.VII.2014 on *Amaranthus viridis*.; Biljureshi, 15.VII.2014 on *Cichorium intybus*.; Rawa, 4.VI.2014 on *Chenopodium murale*.; Biljureshi, 15.VII.2014 on trap (4 collections).



Wahlgreniella nervata (Gillette, 1908)

Materials: Mushtal Khadir, 22.V.2013 on *Rosa* sp.; Biljureshi, 15.VII.2014 on *Rosa* sp.

Therioaphis trifolii (Buckton, 1899)



Materials: Al Bahah, 25.IV.2013 on *Medicago sativa* (2 collections).

Pterochloroides persicae (Cholodkovsky, 1899)

Materials: Biljureshi, 22.V.2013 on *Salix mucronata*.

Baizongia pistaceae (Linnaeus, 1767)

Materials: Biljureshi, 15.VII.2014 on yellow water pan trap (3 collections).

Smynthurodes betae Westwood, 1849

Materials: Biljureshi, 15.VII.2014 on Poaceae.

Tetraneura sp.

Materials: Biljureshi, 15.VII.2014 on *Vigna* sp.

With these 55 aphid species, surveys constituted the most imported input to KSA aphid fauna from Al Bahah Province. This number of Aphidoidea represents about 86% of the Aphidoidea species previously reported from KSA [10–13]. The high aphid diversity in Al Bahah Province, KSA is probably the result of relatively high diversity of plants and favorable climate. Moreover, average air temperature reported for Al Bahah Province ranges 12-23°C [15], favorable for aphid life histories. Whereas range of air temperatures required for aphid development is 7-25°C [20–22].

The Aphidoidea species, *B. helichrysi*, *B. rumexicolens*, *M. euphorbiae*, *M. persicae* and *U. sonchi* were the most common taxa in terms of number of samples that were collected (Figure 5).

Figure 5. Most common aphids in Al Bahah, Saudi Arabia

The Asteraceae, Chenopodiaceae, Euphorbiaceae, Fabaceae, Poaceae and Solanaceae were most common aphid hosts during the current study (Figure 6).

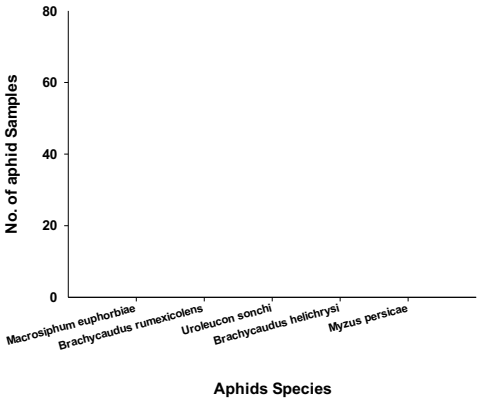


Figure 6. The number of aphid species collected from the most common plant families.

The most diverse range of aphid species attacked *Sonchus oleraceus, Osteospermum vaillantii, Chenopodium album, Euphorbia peplus,* and *Medicago sativa* (Figure 7).

Figure 7. The number of aphid species collected from the most common plant species.

Aphid species counted were 6, 5, 4, 4, and 4, in that order. In the current study, yellow pan traps collected 29 Aphidoidea species. The aphid *A. spiraecola* was the most common alatae collected only by the yellow pan trap.

These species were collected during each visit to Al Bahah Province during this study. The above Aphidoidea are polyphagous and have wide host ranges [8].

Key to Saudi Arabian aphid species

This key was constructed to include all known species from KSA. Key was constructed for apterae viviparous females but apterae of *Tetraneura* sp., *Baizongia pistaciae*, *Smynthurodes betae*, and *Dysaphis plantaginea* were not collected in this study. This key is modified from several references' keys [8,13,19,23–34].

1- Abdominal tergite VIII with posteriorly projecting supracaudal process above the cauda (Figure 2)……..…***Cavariella aegopodii***

- No supracaudal process as above…….……...2

2- Unguis shorter than base of last antennal segment ……....3

- Unguis longer than base of last antennal segment ……...10

3- Ultimate rostral segment not clearly divided into segment IV and V; apterae with compound eyes composed of 3 facets, if with more than Siphunculi absent……...…….……..……..4

- Ultimate rostral segment clearly divided into segments IV and V; apterae with compound eyes composed of many face……..8

4- Siphunculi present..……..…5

- Siphunculi absent…..……...6

5- Apterae with two segmented tarsi; in alate media of forewing once branched…..... ***Eriosoma lanigerum***

- Apterae with one segmented tarsi, in alate media of forewing simple…….. ***Tetraneura* sp.**

6- Abdominal tergite 1-5 usually with marginal wax glands……7

- Abdominal tergite 1-5 without marginal wax glands….....***Smynthurodes betae***

7- First tarsal segments usually with two sense pegs between two long hairs; ANT III shorter than last antennal segment…… ***Baizongia pistacia***

- First tarsal segments with one sense peg between two long hairs. ANT III longer than last antennal segment……....***Geoica lucifuga***

8- Siphunculi hairy cones (Figure 3)……9

- Siphunculi tube like (Figure 3) ……..11

9- On *Prunus* sp.; body length more than 3.5 mm……***Pterochloroides persicae***

- On *Pinus* sp.; body length less than 3.5 mm……***Cinara maghrebica***

10- Siphunculi 0.8-0.9 times as long as third antennal segments, 0.10 times as long as body……..…***Brachyunguis tamaricis***

- Siphunculi 0.30-0.40 as long as third antennal segment, 0.05 times as long as body…… ***Brachyunguis harmale***

11- Cauda knobbed in dorsal view; anal plate bilobed (Figure 2) ……..…….……..12

- Cauda rounded, helmet shaped, pentagonal, triangular or tongue like in dorsal view (Figure 2) ……13

12- Abdominal tergites 1-5 each with long capitate hairs.....…***Therioaphis trifolii***

- Abdominal tergites without capitate hairs……..…***Saltusaphis scirpus***

13- Siphunculi with a subapical zone of polygonal reticulation ……..…….14

- Siphunculi without a subapical zone of reticulation……..……..……..29

14- Antennal tubercles well developed; antennae with secondary rhinaria (Figure 4)…….....…….....15

- Antennal tubercles undeveloped; antennae without secondary rhinaria……... ……....***Pseudaphis arabica***

15- Siphunculi with polygonal reticulation extending over distal 0.4-0.7 of length; ultimate rostral segment stiletto-shaped….....16

- Siphunculi with polygonal reticulation extending over distal 0.1-0.4 of length; ultimate rostral segment not stiletto-shaped……..……..……...17

16- Abdominal tergite 1-5 each with dark sclerites around bases of spinal hairs to form a series of paired patches, ANT III with 29-55 rhinaria……..***Macrosiphoniella absinthii***

- Abdominal tergite 1-5 without sclerites. ANT III with 3-45 rhinaria.***Macrosiphoniella sanborni***

17- First tarsal segments with five hairs.……18

- First tarsal segments with three hairs.....21

18- Cauda dark, siphunculi uniformly dark….19

- Cauda pale, siphunculi not uniformly dark……..……...20

19- Lateral abdominal tubercles present, cauda bearing 13-28 hairs……...***Uroleucon jaceae***

- Lateral abdominal tubercles absent, cauda bearing 10-21 hairs…….***Uroleucon compositae***

20- Scleroites at bases of dorsal hairs absent or indistinct; antesiphuncular sclerite absent; ANT III partly pale..……..… ***Uroleucon sonchi***

- Scleroites at bases of dorsal hairs distinct; antesiphuncular sclerite present; Antennae completely dark……..……***Uroleucon cichorii***

21- Head with minute spicules, at least ventrally. Antennal tubercles well developed, steep sided…….22

- Head smooth. Antennal tubercles variably developed, with inner faces broadly divergent……..……...23

22- Head spiculose dorsally as well as ventrally, apices of siphunculi

dark……***Aulacorthum solani***

- Head with very few spiculose on dorsal side, apices of siphunculi pale or dusky……..***Aulacorthum? palustre***

23- Antennal tubercles not well developed; hairs on third antennal segments inconspicuous, not more than 0.67 times as long as the basal diameter of ANT III..…..……24

- Antennal tubercles well developed; hairs on third antennal segment conspicuous, more than 0.75 times as long as the basal diameter of ANT III……..……..……..…...28

24- Siphunculi pale to dusky..***Sitobion asirum***

- Siphunculi dark to black……..……25

25- Abdomen with dorsal pigmentation consisting of well-defined segmentally arranged dark transverse bars ……..……26

- Dorsal pigmentation often present but with weak defined boundaries…….....…….....27

26- On Euphorbiaceae …***Sitobion? phyllanthi***

- Not on Euphorbiaceae……..… ……***Sitobion africanum***

27- Siphunculi 1.7-2.7 times longer than cauda which is rounded at apex…….***Sitobion fragariae***

- Siphunculi 1.1-1.4 times longer than cauda which tapers distally to a more pointed apex……..……..……..***Sitobion avenae***

28- Siphunculi, front of head, ANT I and II are dark..……..***Macrosiphum rosae***

- Siphunculi pale at least at the base; front of head, ANT I and II not dark……..…..***Macrosiphum euphorbiae***

29- Distance between centers of spiracular pores of abdominal segments 2 and 3 not more than 2.1 times the distance between centers of those on segments 1 and 2. Lateral abdominal tubercles present on abdominal segments I and VII……..……..……..…..30

- Distance between centers of spiracular pores of abdominal segments 2 and 3 more than 2.1 times the distance between the centers of those on segments 1 and 2. Lateral abdominal tubercles usually absent from segments I and VII...……..…...50

30- Lateral abdominal tubercles of 7th tergite placed more ventrally than spiracle of that segment ……..…..31

- Lateral abdominal tubercles of 7th tergite placed more dorsally than spiracle of that segment ……..……..44

31- Third and fourth antennal segments of apterae with secondary rhinaria……...***Aphis middletonii***

- Third antennal segment of apterae with 0-2 secondary rhinaria and fourth without secondary rhinaria……..……..32

32- Siphunculi shorter than cauda…..……33

- Siphunculi longer than cauda……..….35

33- Unguis less than twice as long as basal part of last antennal segment; cauda twice as long as Siphunculi……..***Aphis hillerislambersi***

- Unguis more than twice as long as basal part of last antennal segment; cauda less than twice as long as Siphunculi……..……34

34- On *Prunus* sp.; body rather elongate; cauda with less than six hairs…..…***Hyalopterous pruni***

- On Poaceae; body rather ovate; cauda with more than six hairs.....***Melanaphis sacchari***

35- First tarsal chaetotaxy 3:3:3…..***Aphis nerii***

- First tarsal chaetotaxy 3:3:2……..…..36

36- Dorsal abdomen with solid black central patch; cauda dark……..***Aphis craccivora***

- Dorsal abdomen without central patch; pale or dark cauda……..…37

37- Siphunculi darker than cauda…….……...38

- Cauda and siphunculi both dark..……42

38- Siphunculi pale; cauda with 7-9 hairs…… ***Aphis punicae***

- Siphunculi dusky to dark; cauda with less than 7 hairs……..……..….39

39- Third antennal segment frequently bearing secondary rhinaria; unguis less than twice as long as basal part of last antennal segment……..…..……..***Aphis affinis***

- Third antennal segment without rhinaria, unguis more than twice as long as basal part of last antennal segment……..……40

40- Siphunculi up to 0.2 as long as body length; Head and antennal segments differently pigmented……..……...41

- Siphunculi 0.24-0.40 as long as the body length; Head, ANT I, II and basal part of III very pale, contrasting with dark rest of antennae……..……***Aphis coreopsidis***

41- Longest hair on hind femur shorter than diameter of femur at its base……***Aphis gossypii***

- Longest hair on hind femur longer than diameter of femur at its base……..***Aphis nasturtii***

42- Abdominal tergite VIII normally with 4 hairs; dorsal side of abdomen without dark sclerites……..…***Aphis spiraecola***

- Abdominal tergite VIII normally with 2 or 3 hairs; dorsal side of abdomen with small dark sclerites……..……..……..43

43- Hind tibia wholly black..***Aphis illinoisensis***

- Hind tibia mostly pale, merely black distally.....***Aphis fabae***

44- Siphunculi as pale as body……***Shizaphis graminum***

- Siphunculi darker than body……..45

45- Siphunculi without flange ……..46

- Siphunculi with flange ……...48

46- Cauda more than half as long as Siphunculi……***Hysteroneura setariae***

- Cauda less than half as long as Siphunculi……..…47

47- On *Cyperus* rotundus; abdominal tergite VIII bearing three hairs……..….***Schizaphis rotundiventris***

- On *Typha* sp.; abdominal tergite VIII bearing 3-6 hairs..……***Paraschizaphis rozasevedoi***

48- Antennae with 5 segments; abdominal tergite VIII with 4-8 hairs.....***Rhopalosiphum rufiabdominalis***
- Antennae with 6 segments; abdominal tergite VIII with 2 hairs……..……..49
49- Body elongate; unguis 2.5 times as long as base of last antennal segment……..***Rhopalosiphum maidis***
- Body ovate; unguis three or more times as long as base of last antennal segment…….…..***Rhopalosiphum padi***
50- Dorsum with fan-shaped or capitate hairs……..……....51
- Dorsum without fan shaped or capitate hairs…….....…….53
51- Dorsum with capitate hairs….....…...***Capitophorus elaeagni***
- Dorsum with fan-shaped hairs……..…52
52- Fan-shaped hairs found on frontal and dorsal body…..… ***Coloradoa rufomaculata***
- If fan-shaped hairs found not on frontal……..…….. ***Hayhurstia atriplicis***
53- Cauda triangular…***Brevicoryne brassicae***
- Cauda not triangular……...54
54- Siphunculi very strongly swollen, maximum diameter at least three times than minimum diameter .....……***Eucarazzia elegans***
- Siphunculi not swollen if swollen, then maximum diameter less than three times than minimum diameter……55
55- Cauda pentagonal or helmet-shaped ..…56
- Cauda not pentagonal or helmet-shaped...61
56- Cauda pentagonal ……..57
- Cauda helmet-shaped ……..….60
57- Abdominal tergite VII with pair of marginal tubercles (sometime on one side only)…….……58
- Abdominal tergite VII without marginal tubercle…….....…***Dysaphis plantaginea***
58- Antennal hairs long and conspicuous, longer than the basal diameter of third antennal segment……...***Dysaphis emicis***
- Antennal hairs short, shorter than the basal diameter of third antennal segment…….……...59
59- Siphunculi 2-3 times longer than their basal width……..……***Dysaphis apiifolia***
- Siphunculi less than 2 times longer than their basal width…….. ***Dysaphis foeniculus***
60- Siphunculi as long as their basal width.....***Brachycaudus rumexicolens***
- Siphunculi at least twice as long as their basal width……..….***Brachycaudus helichrysi***
61- Antennal tubercles convergent ……....62
- Antennal tubercles undeveloped, parallel or with frontal median tubercles.....….65
62- Inner faces of antennal tubercles bearing rounded or finger-like processes……....***Ovatus crataegarius***
- Inner faces of antennal tubercles without processes…….....……..…..63
63- Siphunculi swollen over distal half ……***Myzus persicae***
- Siphunculi tapering or cylindrical……..64
64- Dorsum with spots and transverse streaks; siphunculi dusky……....***Myzus ornatus***
- Dorsum completely dark brown or black; siphunculi black…….....……..***Myzus ?cerasi***
65- Antennae tubercles inner surface approximately parallel ……..66
- Antennal tubercles not parallel……..68
66- Third antennal segment bears more than four secondary rhinaria; median frontal tubercle distinctly developed……...***Rhodobium porosum***
- Third antennal segment bears 1-3 secondary rhinaria; Median frontal tubercle not distinctly developed ……..……..…67
67- Head spiculose dorsally as well as ventrally, apices of siphunculi dark……..…..…..***Aulacorthum solani***
- Head with very few spiculose on dorsal side, apices of siphunculi pale or dusky……...…….***Aulacorthum ?palustre***
68- Siphunculi slightly clavate to swollen……69
- Siphunculi not as above…..……..……..72
69- Third antennal segment of apterae with secondary rhinaria.....***Hyperomyzus lactuce***
- Third antennal segment of apterae without secondary rhinaria……..……..70
70- Siphunculi longer than cauda……***Lipaphis erysimi***
- Siphuculi shorter than cauda…..……....71
71- Siphunculi 3-4 times longer than their basal widths……..……..***Hayhurstia atriplicis***
- Siphunculi less than twice as long as their basal width…..…….……***Hyadaphis coriandri***
72- Spiracular apertures round; third antennal segment of apterae with many rhinaria; antennal hairs long and conspicuous..……..***Nasonovia ribis-nigri***
- Spiracles reinform; third antennal segment of apterae with or without only a few secondary rhinaria; antennal hairs short and inconspicuous……..……73
73- Front of head with median tubercles well developed ……..……..74
- Front of head with median tubercles undeveloped……75
74- Antennae progressively darker from base to apex; unguis less than three times longer than base of last antennal segment; cauda less than eight hairs.***Metopolophium festucae cerealium***
- Antennae not as above; unguis 3-4 times longer than base of last antennal segment; cauda with more than eight hairs……***Metopolophium dirhodum***
75- Siphunculi tapering or cylindrical; ANT III usually with rhinaria……..….76
- Siphunculi clavate; ANT III without rhinaria…….…... ***Wahlgreniella nervata***
76- Siphunculi more than four times as long as

cauda……***Acyrthosiphon gossypii***

- Siphunculi less than two times as long as cauda……..……..……77

77- Ultimate rostral segment with 16-25 accessory hairs……***Acyrthosiphon lactucae***

- Ultimate rostral segment with less than 10 hairs.....78

78- First antennal segments bearing more than 12 hairs……..…….***Acyrthosiphon pisum***

- First antennal segments bearing less than 12 hairs……...79

79- Unguis 4.5-6 times as long as the base of last antennal segment; ultimate rostral segment 0.5-0.67 times as long as HT II...……..…***Acyrthosiphon kondoi***

- Unguis less than 4.5 times as long as the base of last antennal segment; ultimate rostral segment at least 0.9 times as long as HT II……..……..***Acyrthosiphon ?ilka***

Author Contributions

Sabir Hussain: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. Muhammad Naeem: Writing – review & editing. Muhammad Rafiq Shahid: Validation. Zainab Baloch: Data curation. Javed Iqbal: Editing. Jahansher Qambrani: Figures and tables. Manzoor Ahmed: Editing. Conceptualization. Huanhuan Chen: Supervision.

Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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Data Availability

Data will be made available on request

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