Research Article

The composition of Aphidofauna (Hemiptera: Aphidoidea) and their hostplant range in Quetta, Pakistan

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Citation

Sabina Noor, Nosheen Rafique, Heera Batool, Masooma Ali, Mehreen Batool and Safia Ali. The composition of Aphidofauna (Hemiptera: Aphidoidea) and their hostplant range in Quetta, Pakistan. Pure and Applied Biology. Vol. 9, Issue 3, pp2014-2024. <http://dx.doi.org/10.19045/bspab.2020.90215>

Received: 06/03/2020

Revised: 30/05/2020

Accepted: 05/06/2020

Online First: 15/06/2020

Abstract

This study was carried out during May- October 2018 and accounts as the first record of aphid's biodiversity and their host plant range in Quetta. A total of 50 various host plants from Quetta were sampled, which were identified into 19 species. These most commonly included *Rosa chinensis*, *Nerium oleander*, *Punica granatum*, *Solanum nigrum*, *Ficus carica*, and *Mirabilis jalapa*. About 9,475 aphid individuals were recorded on the sampled host plants from various sites of Quetta, namely accounted as the suburban, urban, cantonment, agricultural research area, and SBK Women's University. After collection, the samples were brought into laboratory, individuals were preserved in 70% alcohol, examined under a microscope (LEICA MZ6) with the help of identification keys. A total of 14 genera identified which included, *Toxoptera*, *Aphis*, *Myzus*, *Ceruraphis*, *Elatobium*, *Amphorophora*, *Acyrtosiphon*, *Hayhurstia*, *Aphis nerii*, *Brachycaudus*, *Macrosiphum euphorbiae*, *Anoecia*, *Dysaphis*, and *Brevicoryne*. Among these *Aphis*, *Myzus*, *Toxoptera*, *Aphis nerii*, and *Acyrtosiphon* were most abundant, while *Aphis*, *Myzus*, and *Toxoptera* were the most common genus in all sampling sites. Since there is a lack of documentation of such vicious pests on the economically significant hostplants from this native region. This study will imply fruitful impacts on pest control in near future.

Keywords: Abundant; Aphids; Biodiversity; Pest; Phytophagous

Introduction

Aphids are considered an important group of phytophagous insects due to their polymorphism, heteroecious behavior, and reproductive habits [1]. These insects have a complex life cycle with multiple asexual and a single sexual generation [2]. Aphids are reported as serious pests of crops, fruits, and oilseeds, resulting in dimpling of fruit and curling of leaves or specialist gall inducers [3-6]. On the other hand, forcing these individuals to have great dispersion and colonize new plants [7].

These species are cosmopolitan pests on cultivated *Fragaria* species (strawberries) and contemplated as a vector of diverse plant viruses [8], effecting 164 viral diseases by approximately 200 species [9]. Under predator attack, these insects secrete droplets from the back of their abdomen which triggers various behavioral reactions for alertness [10] and some have the direct defensive function by gluing predator mouthparts together [11]. Host plant variety and natural enemies affect the growth and migration of aphids

to the greatest [12]. Aphid's population flourish well in between 13.7°-30.3°C temperature and 45.3% relative humidity [13]. However, in this temperate region highest population of aphids is observed in March (7.7 - 25.02 °C temperature) [14]. More or less 1,015 aphid species are accounted for in the Indian region [15]. Around 300 aphid species are reported from Pakistan [16] out of which eight species from eight genera are recorded in four districts of Rawalpindi [5].

Aphid's distributional records from Pakistan contain two families with 10 genera and 15 species in different parts of Northern areas [17]. Most recent studies documents the *Rosa* species infestation in Azad Jammu Kashmir by 12 aphid species also includes six new records [18]. Aphids are the most damaging pest of ornamental plants and vegetable crops. There is no such study attributed to the diversity of aphids with their respective host plant range in the Quetta region. The purpose of this study is to recognize the latest aphidofauna with its specific host plant range. This study will support to implicate policy-making and pest management strategies for these destructive pests on

economically significant plants in this native region.

Materials and methods

The survey and collection of aphids for this study were carried out at different sites of the Quetta region is shown in the map (Fig. 1), from May-October, 2018. These sites were further categorized into five (5), depending on their demographic level as the suburban to site 1, urban to site 2, cantonment to site 3, arid zone to site 4, and university campus to site 5. A total of 50 samples were collected by cutting the branch of vegetation with the help of scissors, placed in airtight plastic bags, and then brought into the zoology laboratory of Sardar Bahadur Khan Women's University. Where individually vegetative infested aphid colony was counted and at least ten adults (alate/apterae) were preserved in 70% alcohol in test tubes of size (6ml). Each sample was supplied with a voucher number and labeled with the date of collection and area, respectively. Aphid samples were observed under dissecting microscope (LEICA MZ6) directly. The characteristics in response to their morphology were observed and compared with the keys provided by [8, 19-24].

Figure 1. Map of Balochistan, in map Quetta region (enlarged) with multiple collections sites (as shown in legend)

Results

A faunistic survey on the presence and abundance of aphids was made in different areas of Quetta, from May to October 2018. The surveys resulted in the

collection of total 9,475 individuals described into 14 genera of aphids as *Aphis*, *Myzus*, *Toxoptera*, *Ceruraphis*, *Elatobium*, *Amphorophora*, *Acyrtosiphon*, *Hayhurstia*, *Aphis nerii*,

Brachycaudus, *Macrosiphum euphorbiae*, *Anoecia*, *Dysaphis* and *Brevicoryne*. The overall percentage abundance of aphids during this study is concluded (Fig. 2). The formerly mentioned aphid genera were encountered on 19 different host plants which particularly included; *Rosa chinensis*, *Nerium oleander*, *Brassica oleracea*, *Lagenaria siceraria*, *Punica*

granatum, *Solanum nigrum*, *Zinnia elegans*, *Mentha canadensis*, *Vitis vinifera*, *Mirabilis jalapa*, *Pinus wallichiana*, *Ficus carica*, *Rosa laevigata*, *Solanum lycopersicum*, *Capsicum annuum*, *Cestrum nocturnum*, *Lactuca sativa*, *Cucurbita moschata* and *Populus tomentosa* (Table 1). The results of each site are devised separately.

Figure 2. Percentage (%) Abundance of all the Aphid Genera Collected in Quetta

Table 1. Aphid genera encountered on particular hostplant in Quetta

S#	Genera	Plant species	%age prevalence
1	<i>Aphis</i>	<i>Punica granatum</i> and <i>Solanum nigrum</i>	21.4%
2	<i>Aphis nerii</i>	<i>Zinnia elegans</i> and <i>Nerium oleander</i>	6.2%
3	<i>Acyrthosiphon</i>	<i>Populus tomentosa</i> , <i>Brassica oleracea</i> and <i>Solanum lycopersicum</i>	12.2%
4	<i>Anoecia</i>	<i>Vitis vinifera</i> and <i>Ficus carica</i>	3.8%
5	<i>Amphorophora</i>	<i>Rosa chinensis</i> and <i>Rosa laevigata</i>	2.2%
6	<i>Brevicoryne</i>	<i>Brassica oleracea</i>	1.4%
7	<i>Brachycauda</i>	<i>Mentha canadensis</i>	2.4%
8	<i>Ceruraphis</i>	<i>Cestrum nocturnum</i>	5%
9	<i>Dysaphis</i>	<i>Populus tomentosa</i> and <i>Lactuca sativa</i>	3.8%
10	<i>Elatobium</i>	<i>Pinus wallichiana</i>	6.2%
11	<i>Hayhurstia</i>	<i>Capsicum annuum</i>	0.4%
12	<i>Myzus</i>	<i>Punica granatum</i> and <i>Mirabilis jalapa</i>	21.4%
13	<i>Macrosiphum euphorbiae</i>	<i>Rosa laevigata</i> and <i>Cestrum nocturnum</i>	3.6%
14	<i>Toxoptera</i>	<i>Cucurbita moschata</i> and <i>Lagenaria siceraria</i>	15.8%

Diversity of aphids in site 1

A total of 14 plant samples gathered from various parts of suburban areas, were infested by eight genera of aphids (Table 2). The 2,773 individuals encountered on this vegetation included chiefly of *Aphis* (Fig. 3), *Myzus*, *Macrosiphum euphorbiae*, *Acyrtosiphon*, *Aphis nerii*, *Toxoptera*, *Amphorophora*, and *Elatobium*. Among these 14 plant samples, the most abundant genera were *Aphis*,

Myzus followed by *Aphis nerii* with the least abundant *Elatobium* (Fig. 4). The hostplants from site 1 were recognized as, *Punica granatum*, *Nerium oleander*, *Solanum nigrum*, *Vitis vinifera*, *Mirabilis jalapa*, *Rosa chinensis*, *Zinnia elegans*, *Pinus wallichiana*, *Ficus carica*, *Rosa laevigata*, *Solanum lycopersicum*, *Cestrum nocturnum*, *Lactuca sativa*, *Populus tomentosa*.

Table 2. Compiled data of aphidofauna with hostplant collected in various sites of Quetta

S#	Locality/Sites	No. of Plants collected	No. of aphid individuals encountered	No. of Aphid genera encountered
1.	Sub-urban Area	14	2,773	08
2.	Urban Area	14	2,227	08
3.	Quetta Cantonment	12	2,079	08
4.	Arid Zone	08	1,826	05
5.	SBKWU, Quetta	03	570	04
6.	Total	19 hostplants	9,475 individuals	14 Aphid genera

Figure 3. Genus *Aphis* spotted on *Solanum nigrum* (black nightshade) from site 1

Figure 4. Percentage (%) distribution of 2,773 aphids in suburban sites of Quetta

Diversity of aphids in site 2

The diversity of aphid genera in this site contained 2,227 individuals inhabited on 14 plant samples (Table 2). The most numerous of which were from genus *Toxoptera* (Fig. 5), *Aphis* following *Myzus*. The least encountered genera were *Hayhurstia* and *Macrosiphum euphorbiae* with only 2% abundance (Fig. 6). These

genera were obtained from host plants particularly includes *Mentha canadensis*, *Vitis vinifera*, *Pinus wallichiana*, *Brassica oleracea*, *Ficus carica*, *Lagenaria siceraria*, *Cucurbita moschata*, *Nerium oleander*, *Rosa chinensis*, *Punica granatum*, *Solanum nigrum*, *Capsicum annuum*, *Cestrum nocturnum*, and *Lactuca sativa*.

Figure 5. Genus *Toxoptera* found on *Cucurbita moschata* (pumpkin) from site 2

Figure 6. Percentage (%) distribution of 2,227 aphids in urban sites of Quetta

Diversity of aphids in site 3

At site 3 which includes the cantonment area of Quetta, a total of 2,079 individuals of aphids were gathered from 12 plant samples (Table 2). These included particularly *Zinnia elegans*, *Mirabilis jalapa*, *Solanum nigrum*, *Nerium oleander*, *Rosa chinensis*, *Punica granatum*, *Vitis vinifera*, *Ficus carica*, *Rosa laevigata*, *Solanum lycopersicum*,

Populus tomentosa, and *Mentha canadensis*. These host plants inhabited eight aphid genera among which *Aphis*, *Myzus* followed by *Aphis nerii* (Fig. 7) were most dominant in abundance. While *Anoecia*, *Brachycaudus*, *Dysaphis*, and *Macrosiphum euphorbiae* (Fig. 8) were encountered in moderate, except for *Amphorophora*, as it was collected in the least quantity (Fig. 9).

Figure 7. *Aphis nerii* detected on *Nerium oleander* (oleander) in site 3 and 4

Figure 8. *Macrosiphum euphorbiae* species observed on *Rosa chinensis* (Chinese rose)

Figure 9. Percentage (%) distribution of 2,079 aphids in cantonment sites of Quetta

Diversity of aphids in site 4

This site collection comprised of 1,826 aphids dwelled on particularly *Solanum lycopersicum*, *Vitis vinifera*, *Punica granatum*, *Nerium oleander*, *Cestrum nocturnum*, *Rosa chinensis*, and *Mirabilis jalapa*. The aphid diversity derived from

the Balochistan Agriculture Research Center (BARC) comprised of five genera, chiefly of *Acyrtosiphon*, followed by *Aphis nerii* and *Myzus*. Whereas *Anoecia* following *Ceruraphis* were comparatively least in quantity among the five genera (Fig. 10).

Figure 10. Percentage (%) distribution of 1,826 aphids in Arid zone Research Institute of Quetta

Diversity of aphids in site 5

The last site selected for this study was the university campus (Sardar Bahadur Khan Women's). At this site, only three plant samples infested with aphid were obtained. These host plants were *Cestrum*

nocturnum, *Punica granatum* (Pomegranate), *Rosa chinensis* (common rose) were collected from Sardar Bahadur Khan Women University encountering aphid genera such as *Amphorophora*, *Ceruraphis*, *Aphis*, and *Myzus* (Fig. 11).

Figure 11. Percentage (%) distribution of 570 aphids in SBKWU of Quetta

Discussion

This study describes the composition of aphidofauna and their hostplant range in

Quetta, conducted during April – October 2018. A total of 9,475 individuals gathered

were assembled into 14 aphid genera infesting 19 host plant species, hence reports the first documentation from the Quetta division of Balochistan, Pakistan. Pertaining to their specific morphological characters aphids were identified up to generic level with the help of identification keys described by [8, 19]. The studied features included length of siphunculi, legs, caudal shape, and antennal segments. While studies proved that these species were not homogeneous morphological entities and exist in multiple phenotypic forms on various plants [25]. Similar studies reports 15 species of aphids belonging to two families from Northern areas of Pakistan [17]. During the study aphid, individuals were collected harboring various hostplants. Though among all the localities of the Quetta region the most common host plants infested by aphids were, *Punica granatum*, *Rosa chinensis*, *Nerium oleander*, *Solanum nigrum*, *Mirabilis jalapa*, and *Ficus carica*. However, [18] stated wild *Rosa* species is the most common inhabited hostplant by aphids in Azad Jammu and Kashmir. Similar findings were obtained in the coastal areas of Tunisia as aphid fauna sustains a greater number on family Rosacea [26]. Several studies around the world prove that aphid genera don't have a species-specific host plant range. Hence, a single plant contained more than one aphid genera at a time. This study also analyzed the occurrence of the same aphid genera on two or more host plants at the same time. With overlapping hostplants and most common genera assessed in this investigation included; *Aphis*, *Aphis nerii*, *Acyrtosiphon*, *Anoecia*, *Amphorophora*, *Dysaphis*, *Myzus*, *Macrosiphum euphorbiae*, and *Toxoptera*. Subsequently, in Germany, [27] showed that the abundance of these ubiquitous pests is influenced by fluctuations in plant species richness. Our findings were persistent with [28], to suggest *Macrosiphum euphorbiae* the most abundant rose infesting aphid.

Furthermore, *Aphis* and *Myzus* species were described abundant from Punjab as well [29]. Despite the existence of multiple hostplants; genus *Myzus*, *Aphis*, *Toxoptera*, and *Acyrtosiphon* were the most common among all the collection sites in Quetta. However, *Lipaphis erysimi*, *Brevicoryne brassicae*, and *Macrosiphum euphorbiae* were reported plentiful in Rawalpindi. The most common aphid species of Jehlum were *Sitobion avenae* and *Metopolophium dirhodum* [5].

Conclusion

This study deliberates the presence of 14 aphid genera harboring the native plant fauna of the Quetta region. These aphid genera were encountered on 19 host plants in various sites of this native region. The most common genera were *Aphis*, *Myzus*, *Toxoptera*, *Acyrtosiphon*, and *Macrosiphum euphorbiae*. Further extensive surveys and investigation should be carried out to contemplate the diverse and rich fauna of this region up to species level. Moreover pest control strategies should be rehearsed among the common population for the eradication of such voracious pests.

Authors' contributions

This study was suggested and devised by Sabina and Nosheen. The survey, collection, and identification was done by Heera Batool, Masooma Ali, Mehreen Batool, and Safia Ali. The final assemblage of the manuscript was written, reviewed, and analyzed by Sabina Noor.

Acknowledgments

All the authors are grateful to the authorities of SBK Women's University for granting the conveyance services to the visiting sites. The authors pay their gratitude to the authorities of the Balochistan Agricultural Research Center for sufficient help and guidance in this study.

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