



Host Plant Affinity with Taxonomic Groups in Aphids –A Case Study

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Abstract

Host taxonomic affinity of 18 species of *Hyadaphis*, *Uroleucon compositae* and *Viteus vitifoliae* was examined. It was observed that most *Hyadaphis* species alternate host with *Lonicera* in Caprifoliaceae (primary) and Apiaceae (secondary) in their life cycle. Most monophagous species of this genus select plants from Caprifoliaceae or Apiaceae. In *U. compositae* 87% plants were associated with Asteraceae and in *V. vitifoliae* feeding was exclusively restricted to Vitaceae. A rational answer is needed to validate aphid responses to their specific host/family.

Key words: Aphid, *Hyadaphis* spp., *Uroleucon compositae*, *Viteus vitifoliae*, dicotyledons, monocotyledons, angiosperms

Introduction

Aphids or plant lice are cosmopolitan, have diverse host range and display a complicated life cycle. Some of them are host alternating species while others live and multiply on particular host community. Like other insects, aphids too select host plants which could support maximum survival and produce suitable homeostasis for phonological and nutritive conditions to feed and reproduce well. The numbers of such supportive host plants constitute the host range for a species. Whether these supportive plants, in any way, are associated with taxonomic groups. Thorsteinson (1960) hold the view that most of the insects select their host plants from certain taxonomic groups while others feed indiscriminately. Rathore and Lal (1998) and Rathore and Tiwari (2014) observed such associations in the case of pod borer, *Maruca vitrata*, and whitefly, *Bemisia tabaci*, respectively. In the present study such affiliations were examined in the case of species of *Hyadaphis* (Aphidinae : Microsiphini), *Uroleucon compositae* (Aphidinae : Micosiphini) and *Viteus vitifoliae* (Phylloxeridae).

Materials and Methods

Host plants of species of *Hyadaphis*, *U. compositae* and *V. vitifoliae* were extracted from publications of Blackman and Eastop (2000, 2006), Bhagat (2012) and downloaded from internet (Aphidnet, 2015). These host plants were aligned with families and orders following classification of Hutchinson (1973). Hutchinson divided angiosperms (flowering plants) in subphylum dicotyledons and monocotyledons. The two subphyla were further divided into divisions viz, Lignosae (primarily woody plants) and Herbaceae (primarily herbaceous plants) in dicotyledons, and 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) in monocotyledons. The term monophagy was applied where aphids were feeding on species of one genus, oligophagy when feeding on species of few genera in a single family. Polyphagy was used when aphids were feeding on wide range of host plants in different taxonomic groups (Bernays and Chapman 1994).

Results and discussion

Host species along with their families are presented in Table 1. Information revealed that out of 18 species of *Hyadaphis*, 13 are monophagous and feeding either on a single species or more than one species of a single genus. The distribution of monophagous species was 4 in Caprifoliaceae (*Lonicera* sp.), 5 in Apiaceae (*Bupleura*, *Carum* and *Ferula* sp.), 1 in Liliaceae (*Veretrum* sp.), 2 in Poaceae (*Pragmites australis*) and 1 in Rutaceae (*Haplophyllum dshungaricum*). Blackman and Eastop (2000) opined that host specific aphids may sometimes infest certain plants of which they are not normally associated and their actual host is somewhere else. However, in the case of these monophagous species no other hosts have been reported. Among polyphagous species *H. coriandri*, *H. foeniculi* and *H. passerinii* are noteworthy. It is reported that *Lonicera* sp. (Caprifoliaceae) serves as primary host and plants from Apiaceae as secondary hosts and many of them are crop plants. *H. coriandri* shares 13.79% plants from Caprifoliaceae and 72.41% from Apiaceae. Some other plants have also been reported from four families viz., Rosaceae (*Rubus fruticosus*), Fabaceae (*Glycine max*), Asteraceae (*Helianthus annuus*) and Lamiaceae (*Mentha longifolia*). In *H. foeniculi* 27.27% served as primary host while 68.18% came from Apiaceae as secondary hosts. It also infested some plants from Brassicaceae (*Cakile maritime*), Scrophulariaceae (*Penstemon* spp.), and Zygophyllaceae (*Tribulus bimucronatus*). Contribution of primary host increased to 54.17% for *H. passerinii* and that of secondary host 48.83%. *H. coriandri* ventured through 23 genera (6 families) of host plants, whereas *H. foeniculi* and *H. passerinii* shared 37 genera (5 families) and 10 genera (2 families), respectively. These findings are in accordance of Blackman and Eastop (2006). Aforesaid three species infested only dicotyledonous plants to the tune of 6 in Lignosae and 23 in Herbaceae by *H. coriandri*; 19 in Lignosae and 47 in Herbaceae by *H. foeniculi*, and *H. passerinii* utilized 13 from Lignosae (only *Lonicera* spp.) and 11 from Herbaceae. Aphid species *H. galaganiae* and *Hyadaphis* sp. also had host species from Caprifoliaceae and Apiaceae only. This indicted greater affinity of *Hyadaphis* to dicotyledons except *H. amygdali*, *H. pruni* and *H. veratri* which preferred monocotyledons from divisions of Glumiflorae and Corolliferae, respectively and none from Calyciferae.

Uroleucon compositae (= *Dactynotus compositae*) is medium sized to large sized shiny very dark red to almost black aphid (Blackman and Eastop, 2000). It feeds on wide range of host plants, mostly belonging to Asteraceae (Blackman and Eastop, 2000) and becomes a serious pest on some crops like safflower, *Carthamus tinctoria* (Bindra and Rathore, 1967; Ghorpade, 1995), and serves as an efficient vector of safflower mosaic virus (Rawinder et al, 1990) and passion fruit woodiness *potyvirus* (Blackman and Eastop, 2000). Study on taxonomic affinity revealed that *U. compositae* infests 103 plant species, 7 from dicotyledons-lignosae (6.80%), 93 dicotyledons-herbaceae (90.29%), 2 from monocot-corrilliferae and 1 monocot-glumiflorae totaling 2.91% for monocots. The most contributing family was Asteraceae (Compositae) which had 81 plants (87.01%) in herbaceae division and spread out in 47 genera. Thus, 1/4 th of this was shared by genera *Vernonia*, *Helichrysmus*, *Crassocephalus* and *Conyza*, etc.

Asteraceae is exceedingly large and widespread family of angiosperms and found everywhere except Arctic and Antarctic (Wikipedia, 2015). *U. compositae* is widely distributed in Africa and on the Indian subcontinent and also recorded from Sicily, Reunion, Mauritius, Taiwan and South America (Blackman and Eastop, 2000). This shows that host species of this aphid from Asteraceae are available round the globe.

Viteus vitifoliae, is small in size and yellow in colour, feeds on underside of leaves and vine roots and forms gall like structures. In case of severe infestation the vines are usually killed. It feeds on 10 species of *Vitis* (Table 1) and is monophagous.

Manifestation of description elucidate that aphid species discussed above has species specific preference and are aligned to a particular family(s) or genera. *H. passerinii*, though polyphagous, is associated with two families only i.e. Caprifoliaceae and Apiaceae. Caprifoliaceae serves as primary host and has 13 species of the genus *Lonicera* only, whereas secondary host comprised of 11 species belonging to 9 genera. Because of their host alteration they are also called sequentially monophagous (Dixon, 1987). Some other species of *Hyadaphis*, either polyphagous or monophagous, also show their affiliation either to both or any of the two host plants. *U. compositae*, though cosmopolitan in distribution and highly polyphagous showed distinct preference to Asteraceae. *Carthamus tinctoria* is a widely grown field crop is a single species in *Carthamus* genus is severely attacked by this aphid. *V. vitifoliae* has long history of devastating vine industry in Europe. It is distributed in North America, Europe, the Mediterranean, the Middle East, Africa, Korea, Australia, New Zealand and South America. In spite of such a wide distribution, exposure to varied climatic conditions, living in different agroecological zones and niches, *V. vitifoliae* is exclusively associated with *Vitis* spp. We have to focus our attention to find out why these aphids have so strong association to their respective families or genera. Do these families possess (i) some kind of attractants and gustatory stimulants, or (ii) the gut flora dictates the host selectivity, or (iii) friendly host and aphid gene relationships is enforcing host acceptance, or (iv) number of genes/loci/alleles are restricting the host change. For example. *V. vitifoliae* is feeding on *Vitis* species for more than 200 years and has no other alternate host and has a limited capacity for natural spread. The confined population has more likely chance to change allele frequency. All needs to be investigated.

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Annexure

Table 1. Showing host affinity with plant taxonomic groups in three aphids

Aphid species	No. of host species with their families	Total	Status
<i>H. coriandri</i>	Apiaceae (21), Asteraceae (1), Caprifoliaceae (4), Fabaceae (1), Lamiaceae (1), Rosaceae (1)	29	Polyphagous
<i>H. foeniculi</i>	Apiaceae (45), Brassicaceae (1), Caprifoliaceae (18), Scrophulariaceae (1), Zygophyllaceae (1)	66	Polyphagous
<i>H. passerinii</i>	Apiaceae (11), Caprifoliaceae (13)	24	Polyphagous
<i>H. agabiformis</i>	Apiaceae (1)- <i>Bupleurum linearifolium</i>	1	Monophagous
<i>H. amygdali</i>	Poaceae (1)- <i>Phragmites australis</i>	1	Monophagous
<i>H. bicincta</i>	Caprifoliaceae (1)- <i>Lonicera nigra</i>	1	Monophagous
<i>H. bupleuri</i>	Apiaceae (3)- <i>Bupleurum aureum</i> , <i>B. falcatum</i> , <i>B. rossicum</i>	3	Monophagous
<i>H. coerulescens</i>	Caprifoliaceae (1)- <i>Lonicera spp.</i>	1	Monophagous
<i>H. ferganica</i>	Caprifoliaceae (1)- <i>Lonicera nummularifolia</i>	1	Monophagous
<i>H. ferulae</i>	Apiaceae (1)- <i>Ferula leiophylla</i>	1	Monophagous
<i>H. galaganiae</i>	Apiaceae (1)- <i>Mauretia fragrantissima</i> , Caprifoliaceae (1)- <i>Galagania fragrantissima</i>	2	Polyphagous
<i>H. haplophylli</i>	Rutaceae (1)- <i>Haplophyllum dshungaricum</i>	1	Monophagous
<i>H. mongolica</i>	Apiaceae (1)- <i>Bupleurum scorzoneraefolium</i>	1	Monophagous
<i>H. polonica</i>	Apiaceae (1)- <i>Carum carvi</i>	1	Monophagous
<i>H. pruni</i>	Poaceae (1)- <i>Phragmites australis</i>	1	Monophagous
<i>H. tataricae</i>	Caprifoliaceae (3)- <i>Lonicera caprifolium</i> , <i>L. maackii</i> , <i>L. tatarica</i>	1	Monophagous
<i>H. veratri</i>	Liliaceae (1)- <i>Veretrum sp.</i>	1	Monophagous
<i>Hyadaphis sp.</i>	Apiaceae (1)- <i>Bupleurum sp.</i> , Caprifoliaceae (2)- <i>Lonicera nummularifolia</i> , <i>L. webbiana</i>	3	Polyphagous
<i>Uroleucon compositae</i>	Dicot-Lignosae: Cistaceae (1), Fabaceae (2), Malvaceae (1), Rubiaceae (2), Tiliaceae (1); Dicot-Herbaceae: Acanthaceae (3), Apiaceae (2), Asteraceae (81), Brassicaceae (1), Campunulaceae (1), Lamiaceae (2), Polygonaceae (1), Scrophulariaceae (1), Solanaceae (1); Monocot- Corolliferae: Agavaceae (1), Araceae (1); Glumiflorae- Poaceae (1)	103	Polyphagous
<i>Viteus vitifoliae</i>	Vitaceae (10)- <i>Vitis aestivalis</i> , <i>V. bourquiniana</i> , <i>V. candicans</i> , <i>V. champini</i> , <i>V. cinerea</i> , <i>V. cordifolia</i> , <i>V. labrusca</i> , <i>V. riparia</i> , <i>V. rupestris</i> , <i>V. vinifera</i>	10	Monophagous

Figures in parentheses are number of host species for a given family, Total indicates total number of host plants for a aphid species