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Classification of Aphid on The Basis of Their Taxonomic Features

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Abstract: *The experiment was conducted at Quetta to classification of different aphis and thiers host in Balochistan .Aphids were collected randomly from different localities of Quetta such as Baleli, Shaikhmanda, Sariab and Brewrey, etc., during year 2013-2014 and identified them up to the specific level by running the keys of R.L. Blackman and V.F. Eastop. In the whole 5 aphids were identified on the basis of their antennal tubercles, length of third antennal segment, the basal and terminal process of last antennal segment, length of hind tarsus & number of hairs on it, shape or size of cauda and siphunculi. Several host plants were found being attacked by these identified aphids. In view of the greater variation in characters of the specimens in this area, non-availability of detailed descriptions, the keys have been constructed in order to make the future identification easier.*

Keywords: classification of aphids.

INTRODUCTION

Aphids (Hemiptera: Aphididae) are an important group of insects with worldwide distribution. They are one of the important vegetable pests (Capinera; 2002). Aphids have small, soft-bodies mostly in range between 1.5 to 3.5mm in length (Blackman and Eastop; 2000). Aphids are feeding insects causing direct or indirect mechanical and economical damage as they feed on plant`s sap with piercing sucking mouthparts; aphids also serve as the largest group of plant virus's vector (Blackman & Eastop; 2007, Chan et al.; 1991). Although they have extraordinary horticultural damaging effects, some of society's early interest involved aphid`s beneficial or positive attributes. Galls of certain aphid species have been used for centuries in medicine, tanning, and dyeing (Fagan; 1918). Successful use of Aphidiinae as biocontrol agents is affected by the knowledge about their taxonomy, host selection behavior, and ecology (Powell; 1994, Rehman and Powell; 2010), although they are more common in temperate zones (Blackman & Eastop; 2000). Some of the aphid species are significant invasive pests, threatening the agricultural ecosystems worldwide (Capinera; 2002, Blackman & Eastop; 2006).

Aphids have experienced some adaptations in relation to host plants so that many aphid taxa have biologically complex life cycles (Martin & Brown; 2008). Most aphid species comprise a set of closely related populations which may have diverged genetically so that they could be considered as host races, developing or sibling species (or subspecies) (Blackman & Eastop; 2007). The genus Aphis is one of the most difficult genera of aphids to identify because of morphological conservation and this problem is complicated by the fact that several species may live on a single host plant. Several authors in various countries have studied the taxonomy and morphology of Aphis species and in some cases have described several new species (Nieto Nafria et al.; 1999, Heie; 2000, Mier Durante et al.; 2003, Perez Hidalgo & Nieto Nafria; 2004, Voegtlin et al.; 2004). Aphid classification at various levels has been attempted using morphological characters, host-plants associations and life cycles (Heie; 1987, Blackman & Eastop; 1994, Shaposhnikov et al.; 1998, Kim et al.; 2010, 2011). However, morphological studies very often tend to be uncertain. Many aphids' characters are difficult to understand; in many cases, it is hard to define whether they are ancestral (plesiomorphes) or derived (apomorphies) (Heie; 2009).

Morphotaxonomy can be regarded as a reliable and powerful tool among applied entomologists for discrimination of aphid taxa (Poulios et al.; 2007). According to certain morphological characteristics, e.g, the 3-faceted eyes observed in aptera, the reduced antennal segments, and vestigial siphunculi (Zhang et al.; 1999). Different factors contribute to morphological diversity among aphids, including effects of environmental and biological factors (Margaritopoulos et al.; 2000). Aphids associated with cereals are destructive pests and are a limiting factor in cereal production worldwide (Dixon; 1987, Blackman and Eastop; 2000).

The green peach aphis (Myzus persicce) may at times do considerable damage to the foliage of the peach. The foliage of the cultivated cherry is deformed into gall-like masses by the feeding of the black cherry aphis (Myzus cerasi). There is a perception that certain insect pests of crops are well-studied biologically and that their taxonomy is in good order. This perception might lead to the

impression by those who are unfamiliar with the intricacies of acquiring taxonomic understanding of biological diversity that we know all there is to know. In fact, science is a discipline that continually builds on its previous discoveries and technologies as it advances our knowledge. Much research is needed even in economically important insect groups whose taxonomy might be regarded as advanced. Using the Aphidoidea as an example and, in particular, using the early works of North American aphidology as background, we explore various dimensions of taxonomic knowledge in this pest group.

A comprehensive work on aphid identification is still needed to be done especially in areas of Quetta of Balochistan province of Pakistan. Therefore, it was planned to identify aphids on the basis of their taxonomic features in Quetta areas. For this purpose, Aphids were collected randomly from different localities of Quetta during 2013-2014 to explore the aphid. In view of the greater variation in characters of the specimens in this area, non-availability of detailed descriptions, the keys have been constructed in order to make the future identification easier.

REVIEW OF LITERATURE

Aphids are small, soft-bodied insects generally of 1.5 to 3.5mm in length (Blackman and Eastop; 2000), they feed on plants with piercing sucking mouthparts. Additionally the mechanical damage they cause by this act, aphids as well serves as the prevailing group of vectors of plant viruses (Eastop; 1977, Chan et al.; 1991). Noted as long ago as in (R´eaumur's; 1737) work, honeydew is excreted from the anus and is high in plant sugars and other compounds. Furthermore having an influence on predators (Glen; 1973) and parasitoids (Faria; 2005), it serves as substrates for the growth of fungal complexes that cause sooty mold (Westcott ; 1971).

More than 250 species of the Aphidoidea (in the families Adelgidae, Phylloxeridae, and Aphididae) feed on agricultural or horticultural crops (Blackman and Eastop; 2000). Aphids are also reported as important pests of cereals worldwide (Vickerman and Wratten; 1979, Carter et al.; 1980). The genus Aphis L. is certainly the largest worldwide taxon of viviparous aphids (Rhynchota Aphidoidae), being it represented by nearly 600 valid species (Remaudière; 1997).

The earliest North American aphid descriptions (Rafinesque; 1817, 1818, Haldemann; 1844) were based almost entirely on coloration, general appearance, and host association. Subsequent workers (Walsh; 1863, Riley; 1879, and Miller et al.; 2006) relied on descriptions of general appearance but also routinely included measurements of body length in their species descriptions. (Walsh's; 1863) generic descriptions added comparisons to other morphological structures, e.g. relative length of siphunculi in comparison to tarsal length, antennal segment length, such as 'about half as long as the earlier (Monell ; 1879) or 'sub equal' (Oestlund; 1886).

Galls of certain aphid species (Baizongia pistacia [Linnaeus] and Schlechtendalia chinensis [Bell]) have been used for centuries in medicine, tanning, and dyeing (Fagan; 1918, Das; 1918) studied the Aphididae of Lahore. (Ghulam-ullah; 1940) described afew aphid species from Dehli. (Raychaudhuri; 1956) reviewed the Greenidea and related genera from India. (Eastop; 1961) studied the Aphididae (Homoptera) of West Africa.

(Chakrabarti and Raychaudhuri; 1978) provided a comprehensive account of 34 Callipteriane aphid species occurring in North-East India and Bhutan. (David; 1975) gave taxonomic revision of Macrosiphum of India. (Eastop and Hille-Ris-Lambers; 1976) surveyed fewer than 12 plant groups from India.

(Blackman and Eastop; 1984) reviewed the aphids on the world`s crops and gave illustrate key for their identification. (Hodjat; 1984) worked on aphids of Salicaecea of Iran and keyed 27 species. (Eastop and Hodjat; 1981) keyed 38 genera of common aphids from Iran. (Raha and Raychaudhari; 1983) recorded 59 species from Negaland. (Raychaudhary et al.; 1981) listed 43 species from South India. (Khaliq; 1965) studied the aphididae of Peshawer District. (Awan; 1973) identified 24 species of aphids from Layallpur.

(Shah; 1988) worked on the taxonomy of the aphids of the summer vegetables in Peshawer region. (Agarwala and Ghosh; 1984) gave a check list of Aphidoidea of India and listed 700 species. (Mondal et al.; 1978) gave aphid fauna of Sikkim and listed 17 species of genera Aphis, Rhopalosiphum, Hyseroneura, Melanaphis and Toxoptea. (Raychaudhuri et al.; 1978) worked on the root-infesting aphids from North-East India and gave information about 14 species of the subfamily Pemphiginae.

(Eastop; 1979) keyed 24 genera of the worldwide subtribe Aphidina. (Ghosh; 1979) listed 311 aphid species from India, Pakistan, Nepal, Sikkim and Bhutan, with notes on their food plants and distribution. (Raychaudhari et al.; 1980) studied 78 aphid species from North and North-West India. (Nasir; 1989) keyed 34 species from the Punjab province and gave a check list of Aphidoidea of the Punjab. (Blackman and Eastop; 1994) reviewed the aphids on the world`s trees and gave illustrated keys for their identification.

MATERIALS AND METHODS

Aphids were collected either by removing them with an ordinary camel-hair brush or by jarring the plants on white paper sheet from a wide range of habitats including crop field, gardens, grasses, weeds, trees etc. Specimens were collected from Quetta, Baleli, Shaikhmanda, Sariab and Brewery in the province of Balochistan during 2013-2014.

A few aphid colonies along with the attacked plant parts were also brought to the laboratory and then reared for 2-3 days by keeping them in small polythene bags with a small piece of cotton dipped in water in order to obtain well-developed adults. The large sized adults were then killed, preserved in 70% alcohol in vials and properly labeled.

The specimens were examined using binocular and the specimens were identified up to specific level by using the keys of Blackman and Eastop (1984).

The morphological terminology is illustrated for generalized aphids. The length of CAUDA is not included in body length of aphids. The following abbreviations are used:

BL	Body Length
ANT I, ANT II, etc	Antennal Segment I, II, etc
ANT PT	Terminal Process of Last Antennal Segment
R IV+V	Last Rostral Segment, (In Fact The Complex Formed By R Iv and R V, Which are Sometimes
HT I, HT II	First and Second Segment of Hind Tarsus
ABD TERG 1, 2, etc	Abdominal Tergites 1, 2, etc
SIPH	Siphinculus
CAUDA	CAUDA

Morphology and key characters help full while identifying the specimens:

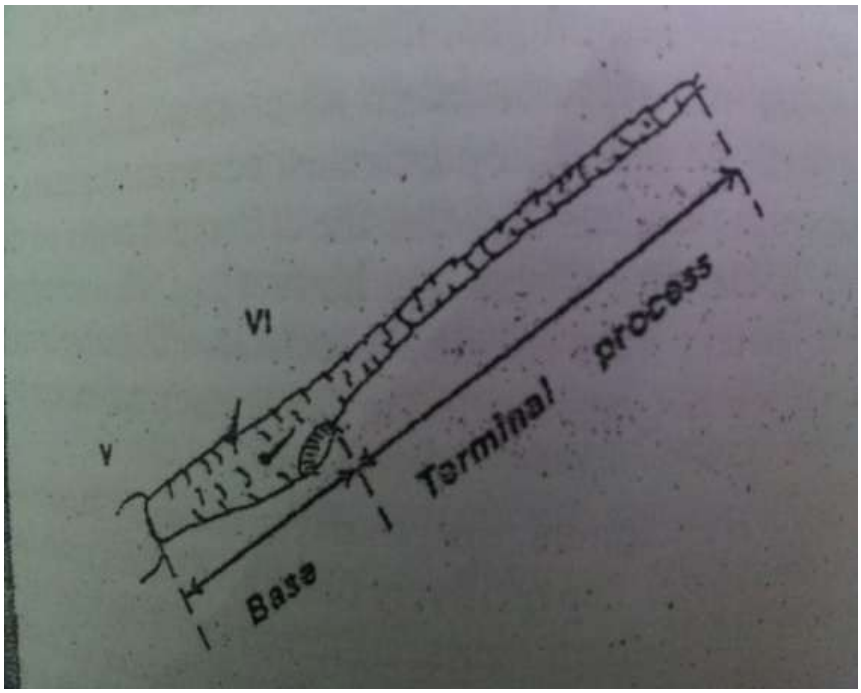

Fig 3.1: The base and terminal process of last antennal segment

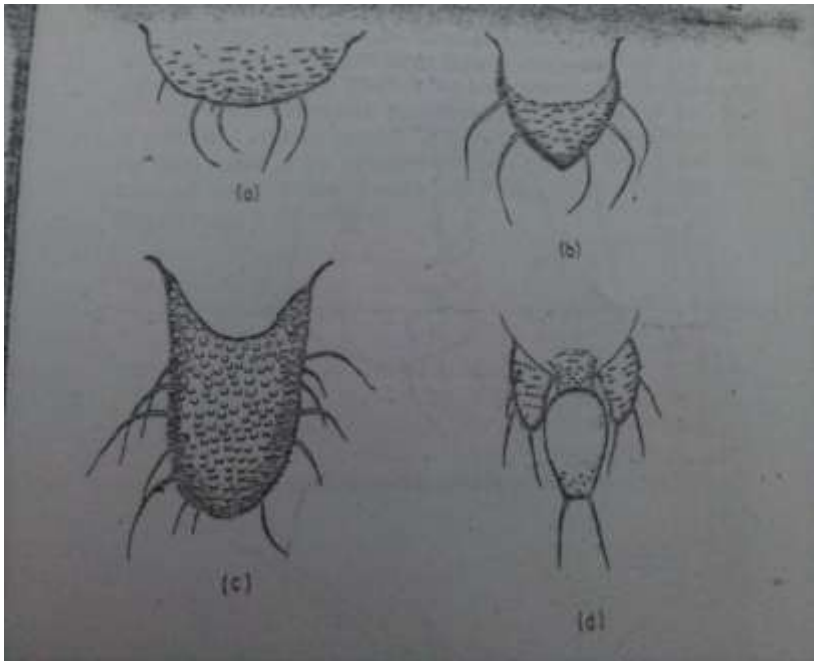

Fig 3.2: CAUDA of various aphids: a) broadly rounded; b) helmet-shaped; c) tounge-like; d) knobbed

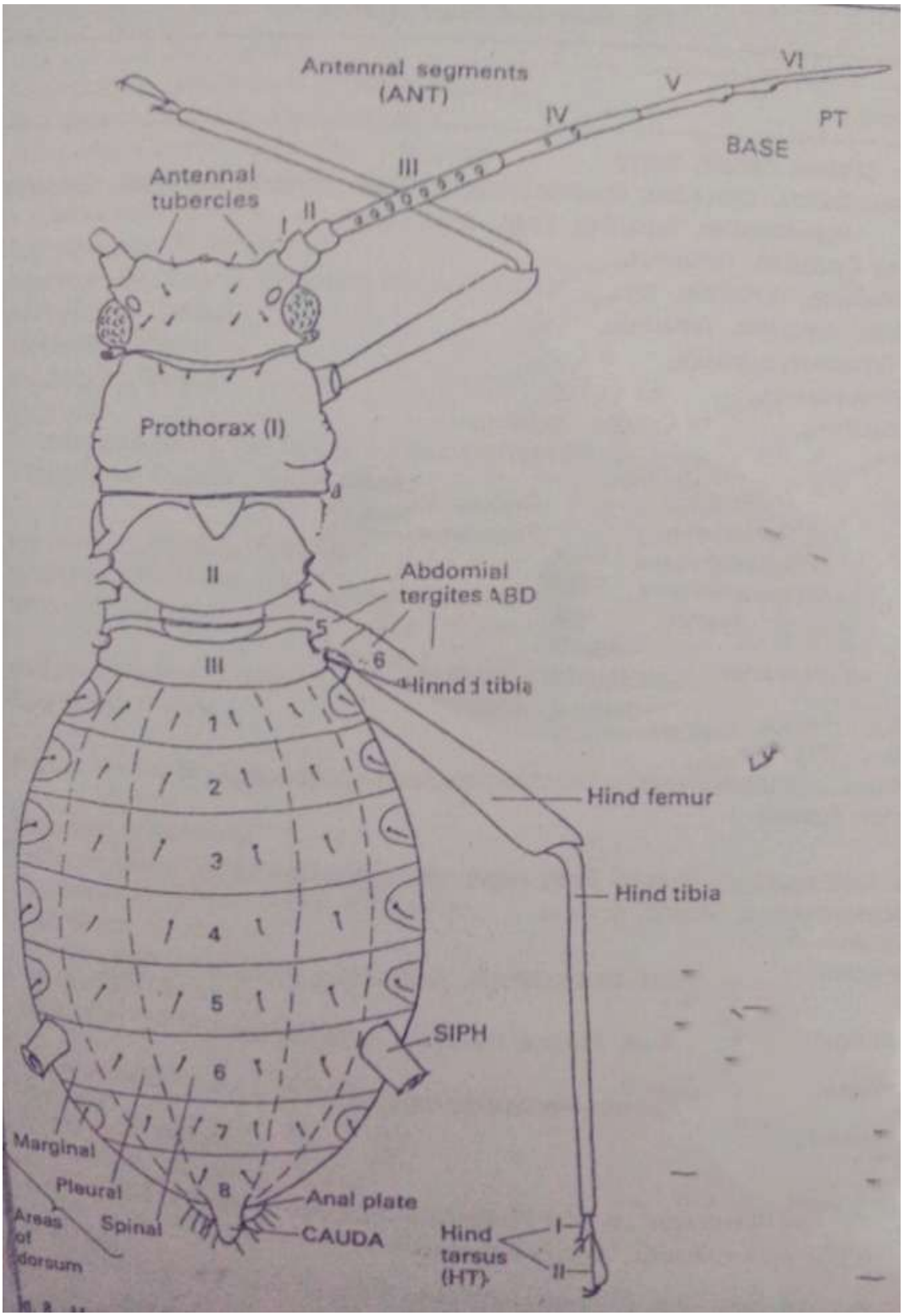

Fig 3.3: Morphology of a generalized aphid, with parts names in accordance with terminology used in keys

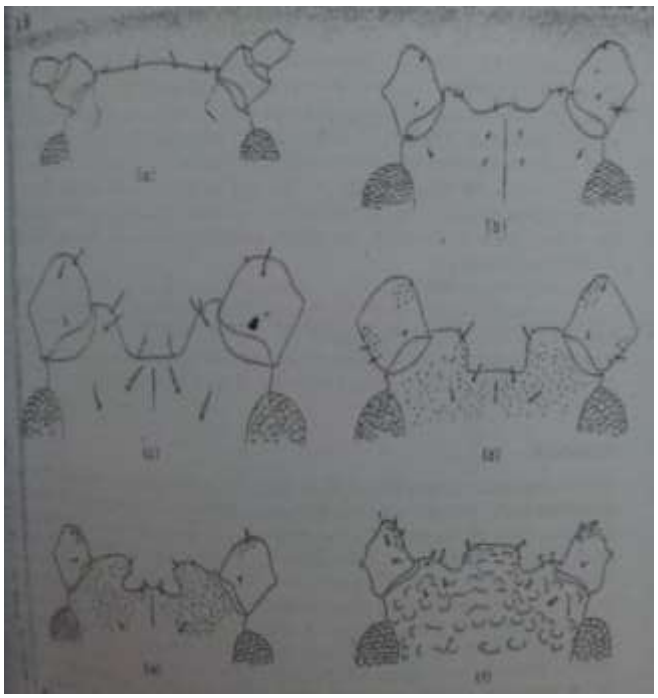

Fig 3.4: Dorsal view of heads of various species shows the degree of the antennal tubercles: a) undeveloped; b) diverging, with median frontal prominence; c) diverging, well developed; d) parallel; e) convergent; f) well developed median frontal projection

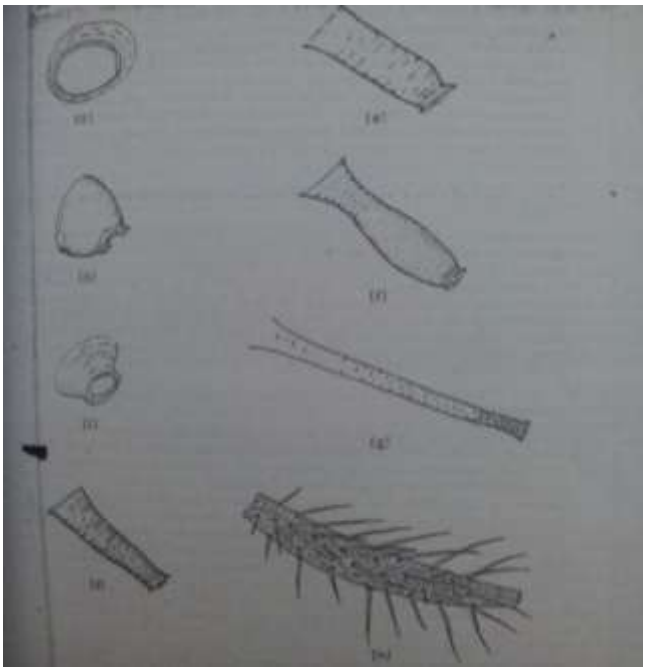

Fig 3.5: Various aphid siphunculi: a) pore-like; b) mammariform; c) truncate; d) tapering; e) swollen proximal to flange; f) clavate; g) with subapical zone of polygonal reticulation; h) greenideine

RESULTS:

Hosts and identified aphids:

HOSTS	**APHIDS**
Cabbage	Bravicoryne brassicae
Chrysanthemum	Aphis gossypii
Lettuce	Aphis fabae
Rose	Macrosiphum euphrobiae

Tomato	Aphis craccivora

1. Cabbage: (Brevicoryne brassicae)

1a. Terminal process longer than base of last antennal segment …… 2b.

1b. Terminal process shorter much than base of last antennal segment …. **2a.**

2a. Siphunculi absent, pale and more than 1.5 times longer than CAUDA …… **3a.**

2b. Siphunculi present, dusky or dark, less than 1.5 times longer than CAUDA …… 3b.

3a. CAUDA broadly triangular in dorsal view …… **Brevicoryne brassicae.**

3b. CAUDA tongue shaped …… Lipaphis erysimi.

Brevicoryne brassicae:

Brevicoryne is small genus. Brevicoryne brassicae (L.) is also known as cabbage aphid, Mealy cabbage aphid. They are medium sized, grayish green or dull mid green have dark head and dark dorsal thoracic and abdominal markings. They mostly feed on cabbage, cauliflower, Brussels sprout, radish, and mustard, makes large colonies under the leaves, on the flower heads which reduces the setting of seeds.

Chrysanthemum: (Aphis gossypii)

1a. CAUDA helmet shape …… 2b.

1b. CAUDA tongue-shaped …… **2a.**

2a. Antennal tubercles absent or weakly developed …… **3a.**

2b. Antennal tubercles well developed …… 3b.

3a. Terminal process of rostrum more than twice as long as last antennal segment …… **Aphis gossypii.**

3b. Terminal process of rostrum less than twice as long as base of last antennal segment …… Coloradoa rufomaculata.

Aphis gossypii:

Aphis gossypii are found variable in color. Large specimens are dark green or almost black. Adults observed in yellow to almost white in color produced in colonies, having pale or dusky cauda and dark siphunculi. Aphis gossypii are extremely polyphagous attacks commonly on cotton, cucurbits, eggplant, pepper, potato, hibiscus, rose and chrysanthemum.

1. **Lettuce: (Aphis fabae)**

1a. Antennal tubercles little developed …… **2a.**

1b. Antennal tubercles well developed …… 2b.

2a. Sphinculi usually darker than general body …… **3a.**

2b. Siphinculi pale at least on basal half, sometimes darker distally …… 3b.

3a. Lateral tubercles present at least on abdominal segment 1 and 7 …… **Aphis fabae.**

3b. Lateral tubercles absent from abdominal segment 1 and 7 …… Macrosiphum spp.

Aphis fabae:

It is very polyphagous on the secondary hosts including many crops in addition to which it is a virus vector in sugar beet. Young colonies are of matt black aphids on newly grown or young shoots. Aphis fabae have longer siphunculi, shorter lateral abdominal hair, and shorter cauda. They are highly attracted by ants, and attacks mostly on tomato, tobacco, lettuce, potato, crucifers, beets, peas and beans.

2. **Rose: (Macrosiphum euphorbiae)**

1a. Terminal process very short …… 2a.

1b. Terminal process longer than base of last antennal segment …… **2b.**

2a. Siphinculi merely pores on flat dark discs, as short cones, much shorter than CAUDA …… 3b.

2b. Siphinculi tubular, similar in length to or longer than CAUDA …… **3a.**

3a. Antennal tubercles moderately to well developed …… **4b.**

3b. Antennal tubercles weakly developed or absent …… 4a.

4a. CAUDA short, about as long as its basal width in dorsal view …… Pseudocercidis rosae.

4b. CAUDA tongue-shaped, clearly longer than its basal width in dorsal view …… **5b.**

5a. Siphinculi distinctly clavate …… Wahalgreniella nervata.

5b. Siphinculli cylindrical or tapering on distal half …… **6a.**

6a. Siphinculi usually dark or at least dusky on distal part …… **7a.**

6b. Siphinculli usually pale …… Myzus japonensis.

7a. Siphinculi pale at least over basal half, sometimes dusky towards apex …… **Macrosiphum euphorbiae.**

7b. Siphinculi wholly darker than body color, except sometimes at extreme base …… macrosiphum rosae.

Macrosiphum euphorbiae:

They have pear shaped body. Usually they are shiny green but sometimes are yellow or pink. Legs, siphunculi, and antenna are mainly same in color as body but siphunculi and antennae darker towards apices, sometimes antennae are entirely darker. Primary host for Macrosiphum euphorbiae is rose spp.

3. Tomato: (Aphis craccivora)

1a. Siphinculi wholly dark …… **2a.**

1b. Siphinculi pale, at least basally …… 2b.

2a. Antennal tubercles weakly developed …… **3a.**

2b. Antennal tubercles well developed …… Aulacorthum solani.

3a. dorsal abdomen with an extensive black patch centered on tergites 4-5 …… **4a.**

3b. dorsal abdomen with scattered black markings …… 4b.
4a. CAUDA black, tongue shaped, rather pointed and with 4-7 hair …… **Aphis craccivora.**
4b. CAUDA pale or dark, if black it usually bears more than 7 hair …… Aphis gossypii.

Aphis craccivora:
Aphis craccivora is also known as black legume aphid, cowpea aphids or groundnut aphid. Adults are shiny black small aphids; young ones are found focused on the growing points of the host and are lightly dusted with wax. Ants are highly attracted to Aphis craccivora. It attacks mostly on crucifers, tomato, beet, beans, and cucurbits.

Conclusion:

Overall, only a small fraction of the total variance in ecological traits (<10%) was explained by different degrees of ant attendance. This might indicate that many of the ecological variables that have been suggested to affect the expression of ant–herbivore interactions are of little importance or act only at small scales and therefore do not show up in a broad comparative analysis.

SUMMARY

Aphids (Hemiptera: Aphididae) are small, soft bodied insects comprising of 1.5 to 3.5mm in length. It is the important group of insects with worldwide distribution. They are one of the important vegetable pests. Aphids are feeding insects, causing direct or indirect mechanical and economical damage as they feed on plant`s sap with

piercing sucking mouthparts; aphids also serve as the largest group of plant virus's vector. Aphids have experienced some adaptations in relation to host plants so that many aphid taxa have biologically complex life cycles. The genus Aphis is one of the most difficult genera of aphids to identify because of morphological conservation and this problem is complicated by the fact that several species may live on a single host plant.

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