A THESIS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Molecular Phylogeny of Macrosiphini (Hemiptera: Aphididae): Taxonomic Notes on the Two Genera *Myzus* and *Uroleucon* in the Korean Peninsula

수염진딧물족의 분자계통 및 한반도산 혹진딧물속과 흰끝수염진딧물속의 분류학적 연구

By
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By
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Program in Entomology
Department of Agricultural Biotechnology
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Abstract

The aphid tribe Macrosiphini Wilson, 1910 (Hemiptera: Aphididae: Aphidinae) is one of the most controversial group within aphids systematics. In this study, I conducted taxonomy, phylogeny and evolutionary approaches of Macrosiphini by two chapters: 1. Molecular phylogeny of Macrosiphini: An evolutionary hypothesis for the *Pterocomma*-group habitat adaptation. 1-2-1. Taxonomic review of the genus *Myzus* (Hemiptera: Aphididae) in the Korean Peninsula. 2-2. Taxonomic review of the genus *Uroleucon* (Hemiptera: Aphididae) in the Korean Peninsula. To understand systematics and evolution of the Macrosiphini, I analysed 2,876 bp from one nuclear gene (EF-1α) and four mitochondrial genes (COI, tRNA + COII, 16S) from 107 terminal taxa representing 57 genera of Macrosiphini *s.l.* (the former Macrosiphini + genera in former Pterocommatini). Our findings support both the monophyly of Macrosiphini *s.l.*, and of two subordinate groups (Macrosiphini *s.str* and the *Pterocomma*-group), as well as the transfer of *Capitophorus*, *Pleotrichophorus*, *Liosomaphis* and *Vesiculaphi*s to the *Pterocomma*-group—a result not previously suggested by analyses of molecular data. Ancestral state reconstructions, host association and host ecology are discussed. Furthermore, I analysed five mitochondrial (COI+COII, 12+16S, NADH1) and nuclear (EF-1α) genes from 29 terminal taxa representing three major subgenera of *Uroleucon* (*Uroleucon*, *Uromelan* and *Lambersius*), including all of the species occurring on different distributions. To reconstruct the phylogeny of *Uroleucon*, we used maximum likelihood. Our results show that genus *Uroleucon* is monophyletic, and subgenera *Uromelan* s.str., *Lambersium* s.str., and *Uroleucon* s.l., are paraphyletic in molecular data. Rather, distributions of the species and host plant origins have influenced in *Uroleucon* phylogeny. For the *Uroleucon* phylogeny study, I discussed host associations, morphological characters and geographical relationships. The results of taxonomic review revealed that a total of 6 new records including 5 new species and 1 new record to Korea, which are *Myzus pruni* sp. nov., *Myzus asterale* sp. nov., *Myzus raphani* sp. nov., *Uroleucon chrysanthemicola* sp. nov., *Uroleucon echinopsis* sp. nov., and *Uroleucon adenophora* (Matsumura, 1918). Twenty-one species of *Myzus* and twenty species of *Uroleucon* are described in the taxonomic study.

Key words: Taxonomy, *Myzus*, *Uroleucon*, Macrosiphini, *Pterocomma*-group, habitat, evolution.

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TABLES OF CONTENTS

CHAPTER 1. MOLECULAR PHYLOGENY OF MACROSIPHINI (HEMIPTERA: APHIDIDAE): AN EVOLUTIONARY HYPOTHESIS FOR THE *PTEROCOMMA*-GROUP HABITAT ADAPTATION

CHAPTER 2. TAXONOMIC REVIEW OF TWO GENERA OF MACROSIPHINI (HEMIPTERA: APHIDIDAE)

2-1. TAXONOMIC REVIEW OF THE GENUS *MYZUS* (HEMIPTERA: APHIDIDAE) IN THE KOREAN PENINSULA

2-2. TAXONOMIC REVIEW OF THE GENUS *UROLEUCON* (HEMIPTERA: APHIDIDAE) IN THE KOREAN PENINSULA

LIST OF TABLES

CHAPTER 1. MOLECULAR PHYLOGENY OF MACROSIPHINI (HEMIPTERA: APHIDIDAE): AN EVOLUTIONARY HYPOTHESIS FOR THE *PTEROCOMMA*-GROUP HABITAT ADAPTATION

CHAPTER 2.

2-1. TAXONOMIC REVIEW OF THE GENUS *MYZUS* (HEMIPTERA: APHIDIDAE) IN THE KOREAN PENINSULA

2-2. TAXONOMIC REVIEW OF THE GENUS *UROLEUCON* (HEMIPTERA: APHIDIDAE) IN THE KOREAN PENINSULA

LIST OF FIGURES

CHAPTER 1. MOLECULAR PHYLOGENY OF MACROSIPHINI (HEMIPTERA: APHIDIDAE): AN EVOLUTIONARY HYPOTHESIS FOR THE *PTEROCOMMA*-GROUP HABITAT ADAPTATION

branches. All support values are indicated in Supplementary data 1 to 3. Results from analyses of ancestral state reconstruction for host preference as reported by BayesTraits MultiState analysis are indicated as pie charts showing the relative likelihoods of each host at the respective nodes. Red-highlighted names indicate genera formerly in Pterocommatini.

Figure 3. (A) *Pterocomma pilosum* living under the bark of *Salix gracilistyla* (Malphigiales), (B) *Cryptosiphum* sp. on *Artemisia* sp. (Asterales), (C) *Myzus persicae* making pseudo-gall on leaves of *Prunus persica* (Rosales) and (D) *Megoura crassicauda* on the stems of *Vicia* sp. (Fabales). Photos by Hwalran Choi.

Figure 4. Maximum likelihood topology tree in *Uroleucon* with bootstrap supports value. Alphabets within the tree present representative nodes. Maximum-likelihood bootstrap values (ML) and Baysian Inference (BI) (If greater> 50) are shown above branches.

CHAPTER 2.

2-1. TAXONOMIC REVIEW OF THE GENUS *MYZUS* (HEMIPTERA: APHIDIDAE) IN THE KOREAN PENINSULA

Plate 1-18. Micro slide specimens of *Myzus* in Appendix.

2-2. TAXONOMIC REVIEW OF *UROLEUCON* (HEMIPTERA: APHIDIDAE) IN THE KOREAN PENINSULA

Plate 19-36. Micro slide specimens of *Uroleucon* in Appendix

Chapter 1.

Molecular phylogeny of Macrosiphini (Hemiptera: Aphididae)

Abstract

Macrosiphine aphids are systematically controversial insects because of their complexed host associations and plesiomorphic characters. I reconstructed the phylogeny using maximum likelihood, maximum parsimony and Bayesian methods. Our findings support both the monophyly of Macrosiphini *s.l.*, and of two subordinate groups (Macrosiphini *s.str* and the *Pterocomma*-group). Furthermore, the Macrosiphini phylogeny indicates that host associations are consistent also with host ecology, with a partitioning of aphid-host relationships into riparian and periaquatic habitats versus drier forest/shrubland habitats. Additionally, the largest Macrosiphine group, the genus *Uroleucon* is studied for their phylogeny. Our results show that genus *Uroleucon* is monophyletic but taxonomic knowledge is incongruent in subgeneric level. Rather, distributions of the species and host plant origins have influenced in *Uroleucon* phylogeny. Host associations, morphological characters and geographical regions are discussed.

Key words: Macrosiphini, *Pterocomma*-group, *Uroleucon*, host associations, habitat, evolution.

Introduction

Aphids (Family Aphididae) are one of the most important pests of agricultural crops, utilizing hosts from more than 40 plant families (Kim *et al.*, 2011). Since they are also generally small-bodied insects, with soft cuticle and a generally high degree of host specificity, they are also very sensitive to environmental change (Blackman and Eastop, 2000; Kindlmann *et al.*, 2010). Thus, they have evolved to occupy various specialized habitats and have well developed biological defense mechanisms including pseudo-gall construction (Sano and Akimoto, 2011) and adaptations for living both subcortically (under bark) and symbiotically with ants (Clark *et al.*, 1999; Offenberg, 2001). Aphididae have diversified in association with environmental change since the Cretaceous (von Dohlen and Moran, 2000), and among the 24 subfamilies now recognized, Aphidinae contains close to half of the total number of described aphid species and genera (>2,400 species in 273 genera; Favret, C. Aphid Species File. Version 5.0/5.0. [17. Sep. 2014]). According to recent divergence dating, Aphidinae also originated in the late Cretaceous, with a rapid radiation ensuing in the early Tertiary (von Dohlen and Moran, 2000).

Like other aphids, reproduction in subfamily Aphidinae involves cyclical parthenogenesis, where growth and development of embryos occurs without fertilization, with either multiple generations or a single generation of asexual (female-only) reproduction. Although the life cycles of a few species involve polyphagy (multiple hosts), most species of Aphidinae are either host-specific (monoecious; Blackman and Eastop, 2006), living on the same host plant without migration, or they alternate between woody plants (primary hosts) used for sexual reproduction and herbaceous plants (secondary hosts) used for the parthenogenetic part of the cycle (heteroecious; Dixon, 1987; Blackman and Eastop, 1994, 2000). Host alternation, the ability to switch hosts during different parts of the life cycle, is a successful way to optimize the nutrition derived from alternative host plants in the field, and could be the key to understanding the evolution of this phytophagous insect group (Guldemond, 1990; Moran, 1992; von Dohlen *et al*., 2006; Jousselin *et al*., 2010; Kim *et al*., 2011). As the angiosperm radiation proceeded through the Eocene (von Dohlen *et al*., 2006; Kim *et al*., 2011), the ability of aphids to alternate between different host plants (especially of taxonomically distinct plants) could have greatly promoted their simultaneous radiation alongside the diversifying angiosperms. Furthermore, host alternation has been suggested as a crucial factor in driving diversification of aphids in general (i.e., aphids have speciated by colonizing and then specializing on different host plant species) (e.g., Peccoud *et al*., 2010).

Aphidinae are divided among the tribes Aphidini and Macrosiphini. The worldwide-distributed Macrosiphini, with more than 1,700 described species in 239 genera, are one of the largest aphid groups, comprising more than half of all described species of Aphidinae (Favret, C. Aphid Species File. Version 5.0/5.0. [17. Sep. 2014]), most of which have been recorded from the Northern hemisphere (von Dohlen *et al*., 2006; Foottit *et al*., 2008). The broad host range of Macrosiphini includes more than 40 plant families (Blackman and Eastop, 1994, 2000, 2006) and, as such, many species are agricultural pests (e.g., on peaches, apples, napa cabbages, potatoes and other crops). For example, the peach-potato aphid (*Myzus persicae*) is globally important as a disease vector, affecting plants in numerous families

(Blackman and Eastop, 2000). Thus, both the host specificity and ecological importance of Macrosiphini have been studied extensively (Dixon, 1998).

The phylogenetic relationships within Macrosiphini *s.l.* (Macrosiphini + former Pterocommatini) have not been resolved due to the species richness, diverse host ranges and, most importantly, the indistinct characteristics relative to the formerly separated Pterocommatini (von Dohlen *et al*., 2006; Ortiz-Rivas and Martinez-Torres, 2010; Kim *et al*., 2011; Nieto Nafría and Favret, 2011; Nováková *et al*., 2013). Furthermore, previous taxonomic studies (Table 1, Fig. 1) have suggested that Macrosiphini *s.l.* are a problematic group because of the lack of morphological synapomorphies (Hille Ris Lambers, 1939, 1950; Heie, 1980). von Dohlen *et al.* (2006) confirmed the subdivision of Macrosiphini (into 'anuraphidine', 'myzine' and 'dactynotine' subgroups) with a phylogenetic analysis of tRNA + COII and EF-1α sequence data. They suggested monophyly of Macrosiphini *s.str.*, excluding the genus *Cavariella* (reconstructed as the sister group of *Pterocomma*). Ortiz-Rivas and Martinez-Torres (2010) treated *Pterocomma* as the monotypic subfamily Pterocommatinae, which was recovered as the sister clade of the Aphidinae (Aphidini + Macrosiphini *s.str.*) but with only low support. Furthermore, they only sampled a single species of *Pterocomma*. Kim *et al.* (2011) reconstructed the phylogeny of Aphidini including a single species each of *Pterocomma* and *Cavariella* as sister taxa. They suggested that *Cavariella* should be transferred into Pterocommatinae because *Pterocomma* and *Cavariella* share Salicaceae hosts and have common morphological characters of the fundatrix (where mature wingless females hatch from over-wintering eggs). More recently, Nováková *et al.* (2013) reconstructed the phylogeny of aphids using DNA from the symbiont

Buchnera aphidicola. Although Macrosiphini *s.l.* were paraphyletic, including Pterocommatini and Aphidini species, they recovered Aphidinae symbionts as monophyletic. Symbionts from three Macrosiphini species (*Aspidophorodon longicaudus*, *Capitophorus hudsonicus*, *Muscaphis stroyani*) and *Pterocomma* formed a clade that was the sister group of symbionts from the remaining Macrosiphini + Aphidini. However, further studies are needed to determine whether this symbiont phylogeny accurately reflects the phylogeny of their hosts.

Due to the uncertain relationships within Macrosiphini, and especially of the former Pterocommatini genera, the phylogeny of Macrosiphini *s.l.* is in need of re-analysis incorporating a variety of perspectives. In host preference studies, previous researchers considered the primary hosts of Macrosiphini to belong only to the plant family Rosaceae (Hille Ris Lambers, 1939, 1950; Heie, 1980). This became an ambiguous criterion, however, because previous morphology-based classifications have resulted in a broader range of hosts for the tribe, including genera in Salicaceae as well as Rosaceae. Additionally, the genus *Cavariella*, which prefers *Salix* hosts, shares morphological synapomorphies with other genera formerly in Macrosiphini that prefer Rosaceae (excluding Pterocommatini). Salicaceae (*Salix* and *Populus*) are major host plants of not only *Cavariella* but also of genera in the former Pterocommatini. Interestingly, these taxa share common habitats and host plant species. For the former Pterocommatini, recorded host plants mostly occur in riparian and generally periaquatic habitats such as riversides, lakesides and surrounding wetlands (Blackman and Eastop, 1994, 2006; Lichvar *et al.*, 2014). The genus *Cavariella* also contains hygrophilic species, and both their primary and secondary hosts (*Salix* and species of Apiales, respectively) live in periaquatic habitats. *Cavariella* and the former Pterocommatini are also interesting in being associated with ants on the knots or cracks of their host trees. During seasonal changes they are carried to the roots (near the ground) by their ant associates. Thus, we are interested in the correlation of host habitats and the evolution of Macrosiphini *s.l.* Although this phenomenon of host-habitat association has been observed in other host-specific insects such as tachinid flies parasitic on Lepidoptera and gall making cecid midges (e.g., Stireman *et al*., 2009, 2010), it has not yet been reported for aphids.

The main purpose of this study is to reconstruct the phylogeny of Macrosiphini *s.l.*, adding molecular data for numerous previously unstudied genera. We increased sampling of the former Pterocommatini (to seven species in two genera, *Plocamaphis* and *Pterocomma*) and therefore evaluate the monophyly of included genera for the first time using molecular data. Our new phylogenetic hypothesis also includes ~40% of Macrosiphini *s.l.* genera and all subgroups of Börner and Heinze (1957), except 'Acaudinini' (Table 1). We tested the monophyly of Macrosiphini *s.l.* to determine whether it belongs in Aphidinae or is polyphyletic, with subgroups distributed in different aphid subfamilies. We statistically analyzed definitions of Macrosiphini *s.l.* using the most extensive sampling to date for this group. Additionally, to discuss the ancestral habitats and host evolution within Macrosiphini *s.l.*, we evaluated the primary host preferences, host habitats and host alternation characters for the tribe. Furthermore, we analysed five mitochondrial (COI/COII, 12/16S, NADH1) and nuclear (EF-1α) genes from 29 terminal taxa representing three major subgenera of *Uroleucon* (*Uroleucon*, *Uromelan* and *Lambersius*), including all of the species occurring on different distributions, and reconstructed the phylogeny using maximum likelihood method.

Materials and Methods

Taxon sampling

For Macrosiphini molecular analyses, we selected a total of 107 species and 57 genera, including 12 genera not previously included in phylogenetic analyses of Macrosiphini *s.l.* (*Cryptaphis*, *Cryptomyzus*, *Hyperomyzus*, *Idiopterus*, *Illinoia*, *Matsumuraja*, *Neotoxoptera*, *Ovatus*, *Plocamaphis*, *Pleotrichophorus*, *Semiaphis*, and *Vesiculaphis*) and 9 outgroup species (Table S3). The tribes Aphidini and Macrosiphini and the former Pterocommatini were selected as Aphidinae ingroup taxa. The rank of Pterocommatini is controversial; in this study we followed the Aphidinae classification proposed by Blackman and Eastop (2000) and von Dohlen *et al.* (2006). Specifically, we sampled the 14 subunits of Macrosiphini, as divided by Börner and Heinze (1957), except Acaudini. Moreover, we included species from all of the genera included in Miyazaki's (1971) 'genera I to VIII' and the four subtribes of Macrosiphini recognized by Shaposnikov (1998). This study includes two families, the ingroup taxa sampled from Aphidinae and outgroup taxa sampled from the subfamilies Calaphidinae, Chaitophorinae and Eriosomatinae (Aphididae), as well as an outgroup species from Adelgidae, representing the lineage closest to Aphididae (Kim *et al.*, 2011). For *Uroleucon* molecular analyses, A total of 29 species for three main subgenera *Uroleucon*, *Uromelan* and *Lambersius*, including two outgroup species of *Macrosiphoniella* Del Guercio, 1911, were selected for molecular analysis (Table 3). Taxon sampling is followed by classification of

Blackman and Eastop (2006). Outgroup taxa, *Macrosiphoniella* were chosen due to closer lineage with *Uroleucon* (Moran *et al.*, 2011). Newly uploaded species for this study is deposited in the College of Agriculture and Life Sciences (Seoul National University, Korea) as slide voucher samples. Abbreviations in Table 3 present following as: P, Palearctic; N, Nearctic; A, Africa; Neo, neotropical; A, Asteraceae; B, Boraginaceae; C, Campanulaceae. All DNA-extracted species are deposited in the College of Agriculture and Life Sciences (Seoul National University, Korea) as slide voucher samples.

DNA extraction, PCR amplification, and sequencing

Aphids were collected into 95–99% ethanol for DNA extraction. Genomic DNA was extracted from the same colonies and/or single individuals using the DNeasy Blood and Tissue Kit (QIAGEN, Inc.). After extraction, all genomic templates were stored in a -35°C freezer in the College of Agriculture and Life Sciences (Seoul National University, Korea). To make voucher specimens from the DNA-extracted samples, we used a nondestructive DNA extraction protocol, slightly modified from the method of Favret (2005). To extract DNA, whole bodies of individuals were put in the lysis buffer with proteinase K solution at 56°C for 4 h. Only DNA solids were used for PCR; remaining aphid cuticles were mounted on permanent microscope slides. PCR was performed using the *TaKaRa Ex Taq* system (Takara Bio, Inc., Japan) and the reactions were performed in 50 μL volumes containing 2 μL of each primer, (2.5 mM each), 10 mM dNTPs, 10× *Ex Taq* Buffer (20 mM Mg^{2+} plus), 5 U/μL *TaKaRa Ex Taq* Polymerase and 3 μL genomic DNA template. The thermal cycling program consisted of initial denaturation for 5 min at 94°C, followed by 38 cycles of 98°C for 10 s, 43–50°C for 30 s, 72°C for 60 s, and a subsequent final extension at 72°C for 10 min. The PCR products were cleaned using a QIAquick PCR purification kit (QIAGEN, Inc.) and sequenced at Macrogen, Inc. (Geumcheon-Gu, Seoul, Republic of Korea). Partial sequences of the mitochondrial cytochrome *c* oxidase subunit I (COI) gene, the leucine tRNA plus cytochrome oxidase II (tRNA+COII) genes, the 16S ribosomal RNA gene and the nuclear elongation factor-1α (EF-1α) gene were chosen as molecular markers (Table S1). These genes are widely used in molecular phylogenetics (e.g., von Dohlen *et al*., 2006; Rindal *et al*., 2009; Kim *et al*., 2011; Shin *et al*., 2013). The primer-specific annealing temperatures of each primer set were 43°C for COI, 42–45°C for tRNA/COII, 48.5°C for 16S and 53–58°C for EF-1α.

Alignment and characterization of gene fragments

The character sets used for the Macrosiphini phylogeny analyses were 605 bp of COI, 674 bp of tRNA+COII, 567 bp of 16S and 1,007 bp of EF-1α, for a total of 2,876 bp of sequences. Raw sequences were examined and corrected using SeqMan II (ver. 5.01, 2001: DNA-star). Alignments were constructed with MAFFT (Katoh *et al*., 2002, 2005; Katoh and Toh, 2008) partitioned by gene (COI, tRNA+COII, 16S, EF-1α) via the online server (ver. 6; http://mafft.cbrc.jp/alignment/software/). The Q-INS-I strategy was chosen for the tRNA+COII, 16S and EF-1α genes using default settings (gap opening penalty = 1.53 and offset value = 0.00), which has been recommended for RNA secondary structure and small data sets (<200 sequences; Katoh *et al*., 2005). COI sequences had no indels; thus, they were aligned using the FFT-NS-I strategy implemented by the MAFFT online server with default settings.

The character sets used for the *Uroleucon* phylogeny analyses were 558 bp of COI/COII, 910 bp of 12/16S rRNA, 1,460 bp of NADH1, 1,070 bp of EF1α, for a total of 3,998 bp of sequences. Raw sequences were examined and corrected using SeqMan II (ver. 5.01, 2001: DNA-star). Alignments were conducted by MAFFT (Katoh et al., 2002, 2005; Katoh and Toh, 2008) separating by gene partitions (COI/COII, 12/16S rRNA, NADH1 and EF1α) via the online server (ver. 6; http://mafft.cbrc.jp/alignment /software/). The Q-INS-I strategy was chosen for the 12/16S rRNA, NADH1 and EF1α genes using the default setting (gap opening penalty=1.53 and offset value=0.00), which consider RNA secondary structure and small data sets (<200) (Katoh et al., 2005).

Phylogenetic analyses

A maximum-parsimony (MP) analysis was performed with PAUP*4.0b10 (Swofford, 2002) carrying out a heuristic search procedure, tree-bisection-reconnection (TBR) branch swapping, and 1,000 random sequence additions with 10 max trees held at each pseudoreplicate. All characters were treated as unordered and equally weighted for MP analysis. Then, 1,000 MP bootstrap replicates were performed using a heuristic search procedure, with a maximum tree setting of 200 trees. Finally, PAUP selected the 200 most parsimonious trees to generate a 50% majority-rule consensus tree (Fig. 2). We marked nodal support values on the consensus tree manually based on a bootstrap 50% majority-rule consensus tree (Fig. S3).

Maximum-likelihood analysis (ML) was conducted with RAxML 8.1.5 (Stamatakis, 2014). The resulting topology was used in the reconstruction of ancestral states for host preference, host habitat and host alternation. ModelTest 3.06 (Posada and Crandall, 1998) was used to select the best-fitting nucleotide substitution model; the GTR+I+G model was used for each gene partition. ML analyses of the combined data set were performed in CIPRES (Miller *et al.*, 2010). The data were partitioned into COI, tRNA+COII, COI+COII, 16S, 12/16S and EF-1α sequences, and 1,000 bootstrap replicates were performed using the thorough bootstrap algorithm with 10 ML tree searches. Additionally, each genes and combined mitochondrial genes are analysed for constructing trees.

Bayesian phylogenetic analysis (BP) was implemented for the combined data set using MrBayes 3.1.2 (Ronquist and Huelsenbeck, 2003). We analyzed the combined data set using partitioned Bayesian analysis, in which the data were partitioned into COI, COI+COII, tRNA+COII, 16S, 12/16S and EF-1α segments, with BP performed using a partitioning scheme that maximized the likelihood based on the GTR+I+G model with specific model scores estimated with ModelTest 3.06 for each gene region. For the BP analyses, four chains (three heated and one cold) were run, starting from a random tree and proceeding for 10 million Markov-chain Monte Carlo (MCMC) generations, sampling the chains every 100th cycle. Burn-in was set at 10% of the sampled number of trees. Convergence was confirmed by monitoring likelihood values graphically. A 50% majority-rule consensus tree was constructed from the remaining trees to estimate posterior probabilities (PP).

Reconstruction of ancestral host preferences, host habitats and host alternation

To reconstruct ancestral host preferences, host plants for each species were coded as below. Primary woody hosts were coded for heteroecious aphids. Monoecious aphids use either a single herbaceous plant or woody plant species, if they feed on it for the whole life cycle. Host information was found mainly in Blackman and Eastop (Miyazaki, 1971; Blackman and Eastop, 1994, 2000, 2006; Lee *et al.*, 2002). Host types were coded as follows: a, Rosales; b, Fabales; c, Sapindales; d, Dipsacales; e, Solanales; f, Brassicales; g, Malpighiales; h, Geraniales; i, Lamiales; j, Saxifragales; k, Asterales; l, Malvales; m, Ericales; n, Liliales; o, Ranunculales; p, Gornales; q, Myrtales; r, Fagales; s, Poales; t, Cryophyllales; u, Polypodiales; v, Pinales, w, Magnoliales; and x, Asparagales. Each type is presented in Fig. 2 in a different color (see also Table S3). To reconstruct ancestral host habitats for each species, these were coded as 'Forest', 'Shrubland' or 'Wet area'; these are listed along with the host preference information for each species in Table S3. We also tested a dual-habitat type coding ('Dry' vs 'Wet'), where 'Forest' and 'Shrubland' were combined and coded as 'Dry' host habitats. Host alternation characters were coded as 'Monoecy on Shrubs', 'Heteroecy' or 'Monoecy on Trees'. To reconstruct ancestral transitions from heteroecy to monoecy, or vice versa, we also tested a dual-host alternation coding ('Monoecy vs. Heteroecy'), where 'Monoecy on Shrubs' and 'Monoecy on Trees' were combined and coded as 'Monoecy'.

The ancestral states for host preference, host habitat and host alternation were reconstructed for selected nodes on a reference tree, the ML phylogenetic consensus topology (Fig. 2, Table S2–S3). We used

BayesTraits (PC ver. 1.0.) (Pagel *et al.*, 2004; Pagel and Meade, 2007), a Bayesian method of ancestral state reconstruction that uses multistate ML methods to derive posterior probabilities for trait values at internal nodes of the phylogeny (Pagel *et al.*, 2004). BayesMultiState (implemented in BayesTraits) using MCMC with multiple character-state options was selected for evolutionary analysis because some taxa had more than one primary host. First, the phylogenetic trees were reconstructed by ML (Fig. 2), and a set of the most likely 1,000 trees, found by RAxML 8.1.5 in CIPRES, was used in the BayesMultiState analysis. The polytomies in each of the trees were resolved to adjust branch length to 0.0 in Mesquite (Maddison and Maddison, 2014). The rate deviation was set to 10. A hyper prior approach was used with an exponential prior seeded from a uniform prior in the interval 0–10; thus, acceptance rates in the preferred range of 20–40% were achieved, as recommended (Pagel *et al.*, 2004; Pagel and Meade, 2007).

The host habitat and host alternation states were also visualized and mapped onto our ML chronogram using the parsimony ancestral state reconstruction algorithm implemented in Mesquite V2.75 (Maddison and Maddison, 2011). For host habitats we mapped the states 'Forest', 'Shrubland' and 'Wet area'; for host alternation, we mapped the states 'monoecy on shrubs', 'heteroecy' and 'monoecy on trees'.

Topology-based hypotheses testing

We specified three alternative hypotheses to assess using constraint-based topology tests: (1) (Aphidini + Macrosiphini) + Pterocommatini (AM). The 'traditional' classification treats Aphidini + Macrosiphini as a monophylum with Pterocommatini as the sister group (Börner, 1952; Heie, 1980;

Shaposhnikov, 1998), and recent molecular studies supports the monophyly of clade Aphidini + Macrosiphini (Ortiz-Rivas and Martinez-Torres, 2010; Kim *et al*., 2011); (2) (Pterocommatini + Macrosiphini) + Aphidini (PM). von Dohlen *et al*. (2006) and other taxonomic studies suggest that Pterocommatini + Macrosiphini is a monophylum; (3) (Aphidini + Pterocommatini) + Macrosiphini (AP). This hypothesis has not previously been suggested.

For the Bayes factor test, we constrained the topology based on the standard approach of Bergsten *et al*. (2013). In these analyses, we calculated the marginal likelihood of AM and AP using an absolute monophyly constraint for these two hypotheses as an informed topology prior, whereas the marginal likelihood of PM was calculated from an unconstrained analysis with an uninformative prior across topology space. This is an approach taken in many empirical studies (e.g., Lavoué *et al*., 2007; Marek and Bond, 2007; Parker *et al*., 2007; Azuma *et al*., 2008; Yamanoue *et al*., 2008; Pavlicev *et al*., 2009; Tank and Olmstead, 2009; Makowsky *et al*., 2010; Yang *et al*., 2010; Knight *et al*., 2011; Bergsten *et al*., 2013).

To calculate the marginal likelihood of the models, we used the stepping-stone sampling method of Xie *et al*. (2011) and Bergsten *et al*. (2013), using MrBayes 3.2 (Ronquist *et al*., 2012). Similar to Xie *et al*. (2011), we used 0.4 for the α-shape parameter of the beta distribution, which is within the range these authors found to be optimal. An initial 204,000 generations were discarded as burn-in, and then 204,000 MCMC steps were sampled every 100th generation for each of 48 β-values between 1 (posterior) and 0 (prior). The contribution to the marginal likelihood from each step was estimated from a sample size of 2,040. The same settings were used for four independent runs for each tested model, each with one cold and one heated chain, and the arithmetic mean across runs of the estimated marginal likelihood for each model was used to calculate the Bayes factor.

Results

Macrosiphini Phylogenetic analyses of the combined dataset

The ML bootstrap (Fig. S1), MP bootstrap (Figs. S1, S3, respectively) and PP values (Fig. S2) are shown in Fig. 2, plotted on the ML phylogeny. Although the backbones of the trees from all three analyses are identical, Macrosiphini *s.l.* (Node 3 in Fig. 2) had only moderate support due to the polytomy in the MP analysis (Fig. S3). A monophyletic Aphidini was strongly supported in ML, MP and BP analyses (Node 1 in Fig. 2). Furthermore, the new *Pterocomma*-group (Node 4, Fig. 2) was strongly supported in all analyses that included five former Macrosiphini genera and *Pterocomma* and *Plocamaphis* of the former Pterocommatini. Detailed phylogenies for ML, BP and MP are presented in Fig. S2, S3, S6, S7, S8, S9 and S10.

The subfamily Aphidinae was strongly supported as monophyletic in all analyses (Node 1 in Fig. 2). The current Aphidinae includes two tribes, Aphidini and Macrosiphini *s.l.* (Node 2 and 3 in Fig. 2). A monophyletic Aphidini (Node 2 in Fig. 2) was strongly supported in all analyses whereas Macrosiphini *s.l.* was only moderately supported by ML (54) and BP (0.85) analyses (<50% bootstrap support in MP analysis). However, our phylogeny suggests that Macrosiphini *s.l.* comprises two separate sister groups—the '*Pterocomma*-group' and 'Macrosiphini *s.str.*'.

The *Pterocomma*-group (Node 4 in Fig. 2) was strongly supported in all three analyses and not only contains *Pterocomma* and *Plocamaphis* from the former Pterocommatini, but also includes some genera from Macrosiphini (*Capitophorus*, *Cavariella*, *Liosomaphis*, *Pleotrichophorus*, *Plocamaphis*, *Pterocomma* and *Vesiculaphis*). Therefore, our results strongly suggest that several genera previously classified as Macrosiphini *s.str.* in fact are more closely related to *Pterocomma*-group genera. The monophyly of four *Capitophorus* species + *Pleotrichophorus glandulosus* was strongly supported by all analyses; thus, the genus *Capitophorus* is paraphyletic. *Cavariella* and *Plocamaphis* are each monophyletic, supported by very high MP, ML and BP support values. *Pterocomma*, the type genus of Pterocommatini, was polyphyletic: *Pterocomma jacksoni* was strongly supported as the sister species of two *Plocamaphis* species in ML and BP analyses (*Pterocomma jacksoni* (*Plocamaphis flocculosa*, *Plocamaphis coreana*)) (Figs. 2, S1, S2), but an alternative relationship was found in MP analysis ((*Pterocomma jacksoni*, *Liosomaphis atra*) + (*Plocamaphis flocculosa*, *Plocamaphis coreana*); Fig. S3). One clade (*Vesiculaphis caricis* + *Liosomaphis atra*) was the sister group of the former Pterocommatini (plus *Cavariella*), and another clade (*Capitophorus* + *Pleotrichophorus*) was the sister group of all remaining *Pterocomma*-group genera (Nodes 4, 6, and 7 in Fig. 2).

Macrosiphini *s.str.* (Node 5 in Fig. 2) was strongly supported in the BP analysis, but only moderately supported in MP and ML analyses. Macrosiphini *s.str.* contains primarily Macrosiphini species, as has been suggested previously (Heie, 1980; Shaposhnikov, 1998; Blackman and Eastop, 2000), with no species from the *Pterocomma*-group needing to be transferred there (Fig. 2). The topologies of the MP, ML and BP trees differ slightly in the relationships within this group (Fig. S1, S2 and S3). Node 12 represents two clusters largely equivalent to Börner and Heinze's (1957) former subfamilies 'Myzinae' (Node 14 in Fig. 2) and 'Dactynotinae' (Node 16 in Fig. 2). The genera *Megoura*, *Brachycaudus*, *Uroleucon* and *Sitobion* are monophyletic (Nodes 17, 22, 23, 26 in Fig. 2), with strong support in all three analyses. The genera *Hyadaphis*, *Diuraphis*, *Semiaphis*, *Cryptosiphoum*, *Brevicoryne* and *Hayhurstia* form a clade with strong support in all three analyses (node 25;'Anuraphidinae' in Börner and Heinze, 1957). The genus *Myzus* wass polyphyletic, appearing in a mixed clade in the ML and BP trees along with the genera *Eumyzus*, *Ovatus* and *Tuberocephalus* (with strong support; Node 15 in Fig. 2); furthermore, *Myzus ornatus* was completely separated from other *Myzus* in the MP topology and placed close to *Anuraphis pyrilaseri* (Node 15 in Fig. 2, Fig. S2 and S3). The genus *Macrosiphoniella* was paraphyletic with respect to *Metopeurum fuscoviride* (Node 21 in Fig. 2), and this relationship was strongly supported in all three analyses. The genera *Acyrthosiphon* and *Macrosiphum* were shown to be polyphyletic, but these relationships were not strongly supported. *Acyrthosiphon vandenboschi* was separated from *A. pisum* but placed rather close to *Aulacorthum solani*, with high ML bootstrap and PP support values (Node 24 in Fig. 2). *Macrosiphum* species showed a polyphyletic relationship that suggests *M. perillae* is the sister group of the clade ((*Impatientinum* + *Metopolophium*), *Sitobion*); remaining *Macrosiphum* species were indicated as monophyletic by MP analysis, but not in ML and BP analyses (Node 19 in Fig. 2).

Macrosiphini Phylogenetic analyses of the combined dataset

For the combined dataset, ML analysis yielded with partitions 1,000 bootstraps. The ML bootstraps and BI are shown in Fig. 4 based on ML molecular phylogeny. For ML and BI analyses, the GTR+I+G model was used as the most appropriate for the combined dataset evaluated by ModelTest 3.06. Outgroup *Macrosiphoniella* is monophyletic with strong ML and BI support (Fig. 4). The genus *Uroleucon* is a monophyletic that is clearly divided from outgroups by strong ML and BI support value (A in Fig. 4). In the subgeneric level, three main subgenera denied monophyletic (B in Fig. 4). *Lambersius* showed paraphyletic with moderate support value (C in Fig. 4). Two subgenera, *Uroleucon* and *Uromelan* denied monophyletic (C, D in Fig. 4). Two *Uromelan* species, *U. rurale* and *U. helianthicola* made a clade with strong ML and BI support and it nested within *Lambersius* clade (B, C in Fig. 4). All nominotypical subgenus species were nested in node D (Fig. 4) and it mixed with *Uromelan* species with strong BI value. Among them, there were two groups constructed with strong ML and BI value (E, F in Fig. 4). First is two *Uroleucon* species, *U. obscurum* and *U. picridis* in Node E (Fig. 4). Second is two subgenera combined group, 9 *Uroleucon* species and 9 *Uromelan* (E, F in Fig. 4). In within node F, there were several clades with strong ML support values. Each of two *Uromelan* species, (*U. gobonis* and *U. cephalonopli*) and (*U. aeneum* and *U. jaceae*) made a clade in node G and H, respectively (Fig. 4). In node I, Six *Uroleucon* species made a clade with strong ML and BI values (Fig. 4).

Maximum likelihood ancestral character state reconstructions

The ancestral host preferences of Aphidinae were estimated for each tribe and for some important genera based on the preferred ML topology (Fig. 2). The Bayes MultiState analysis allowed for free rates of host preference-type transitions among the 24 types (Fig. 2, Table S3). A preference for Rosales hosts for Aphidinae (Node 1 in Fig. 2) was reconstructed with >95% probability (Rosales = 99%). A host preference for Rosales (type: a) for both Aphidini and Macrosiphini *s.l.* was also reconstructed with a probability >95% (Rosales 96% for both nodes; Nodes 2 and 3 in Fig. 2).The ancestral host preference for the *Pterocomma*-group (Node 4 in Fig. 2) was suggested to be a mixture of Malpighiales and Rosales (Malpighiales 49% and Rosales 29%). At the genus level, the ancestral state for the *Capitophorus*-group (*Capitophorus* + *Pleotrichophorus*) was predominantly Rosales with a probability of 99% (Node 6 in Fig. 2), whereas that for the remaining clade was Malpighiales with probability of 85% (Node 7 in Fig. 2). Thus, Rosales were the likely ancestral hosts for all the tribes of Aphidinae. Habitat transitions could have occurred more than once independently in *Megoura* and the clade ((*Macrosiphoniella* + *Metopeurum*), *Uroleucon*) within Macrosiphini *s.str.* (Node 5 in Fig. 2). Furthermore, habitat shifts between Rosales and Malpighiales may have occurred within the *Pterocomma*-group at least once. The ancestral host preference for Macrosiphini *s.str.* was reconstructed as completely Rosales with a probability >95% (Rosales 99%; Node 5 in Fig. 2). The ancestral host preference for the genus *Megoura* was reconstructed as predominantly Fabales, with a probability of 99% (Node 17 in Fig. 2), whereas that of the clade ((*Macrosiphoniella* + *Metopeurum*), *Uroleucon*) was reconstructed as predominantly Asterales, with a probability of 99% (Node 20 in Fig. 2).

The ancestral host habitat of Aphidinae, Macrosiphini *s.l.* and the *Pterocomma*-group was reconstructed to be wet habitats with more than 80% probability (Nodes 1, 3 and 4 in Table S2). Furthermore wet habitats were reconstructed as the ancestral habitat for all internal nodes as well as for the *Pterocomma*-group with > 99% probability (except Node 7, 97% in the 'Dry' vs. 'Wet' analysis; Table S2). In contrast, the ancestral host habitat reconstructed for Macrosiphini *s.str.* and all internodes was reconstructed as dry habitats with more than 90% probability (Nodes 5, 11, 13, 14, 16, 17, 19, and 20 in Table S2).

In the 'Monoecy' vs. 'Heteroecy' host alternation ancestral state reconstruction analysis, heteroecy—the ability to utilize more than one host—was reconstructed as the ancestral state for most clades. This was also suggested by the other 3-state host alternation analysis performed with the Bayes MultiState method (Table S2) and ancestral state mapping (Fig. S5). The ancestral state for three nodes was reconstructed as monoecy with a probability of > 85% (Table S2). Mapping of host alternation onto the chronogram suggests that the ancestral state for Macrosiphini *s.l.* was heteroecy (Fig. S5). The ancestral state for the former Pterocommatini (genera *Plocamaphis* and *Pterocomma*) could have been reconstructed as monoecy on trees; however, as revealed by our analysis, the ancestral state of the new *Pterocomma*-group was reconstructed as heteroecy (Node 4 in Fig. 2), which is also congruent with the Bayes MultiState analyses for host alternation. Monoecy on shrubs is uncommon in the *Pterocomma*-group, but the Bayes MultiState analyses suggested this was the ancestral host alternation state for the genera *Macrosiphoniella*, *Macrosiphum* (including closely related species), *Megoura* and *Uroleucon* (all within Macrosiphini *s.str.*).

Topology-based hypothesis testing

We tested topological hypotheses using a Bayesian stepping-stone sampling approach. Three constrained hypotheses based on the ML tree were implemented. In the backbone-constrained analysis, Aphidini + Macrosiphini (AM), Aphidini + Pterocommatini (AP) and Pterocommatini + Macrosiphini (PM) were constrained to be monophyletic (Table 2). The estimate of the marginal likelihood was -37478.40 for AM, -37484.09 for AP and -37495.90 for PM. In the preferred Bayes factor test, AM vs. AP was 5.69, AP vs. PM was 11.81 and PM vs. AM was -17.50. Thus, the two hypothesis tests for AM and AP were positive evidence for rejection, and PM was denied in the model test (Table 2).

Discussion

Pterocomma-group

As suggested by Nieto Nafría and Favret (2011), the current concept of Macrosiphini incorporates all genera formerly in Pterocommatini because of the results of previous molecular studies. These studies also pointed out the lingering controversial status of Pterocommatini that had emerged from the variable placements it has had with respect to Macrosiphini and Aphidini (von Dohlen *et al*., 2006; Ortiz-Rivas and Martinez-Torres, 2010; Kim *et al*., 2011; Nováková *et al*., 2013) (Table 1). von Dohlen *et al*. (2006) suggested the possibility of a sister group relationship between *Pterocomma* (e.g., Fig.

3A) and *Cavariella* within Macrosiphini *s.l.*, providing crucial initial evidence regarding the phylogenetic status of these two tribes. However, Ortiz-Rivas and Martinez-Torres (2010) and Kim *et al.* (2011) suggested a different relationship, that the *Pterocomma* + *Cavariella* clade may be the sister group of a monophyletic clade comprising Macrosiphini + Aphidini. More recently, Nováková *et al.* (2013) indicated that phylogenetic re-examination and further study of Macrosiphini and Pterocommatini could help resolve one of the most significant outstanding issues in aphid systematics and evolution. Hence, until now the phylogenetic relationships of Macrosiphini and Pterocommatini have remained controversial, with no consensus between taxonomic and phylogenetic approaches having yet been possible.

In this study, we inferred the phylogenetic relationships of the *Pterocomma*-group using the most broadly sampled molecular data set yet compiled for the former Pterocommatini and also for Macrosiphini. Five species of *Pterocomma* (Pterocommatini), two species of *Plocamaphis* (Pterocommatini), nine species of *Cavariella* (Macrosiphini) and (unexpectedly) four genera of Macrosiphini (*Capitophorus*, *Pleotrichophorus*, *Liosomaphis*, and *Vesiculaphis*) were nested within the *Pterocomma*-group (Node 4 in Fig. 2) as a clade separated from Macrosiphini *s.str.* (Node 5 in Fig. 2). Furthermore, our current data didn't support monophyly of former Pterocommatini genus *Pterocomma* relating with another former Pterocommatini genus *Plocamaphis*. Taxonomically, outside species of the genus *Pterocomma* clade, *Pterocomma jacksoni* has moderate siphunculus than other *Pterocomma* species (They have much swollen siphunculus) (Blackman and Eastop, 1994). It implicates morphology of siphunculs is homoplastic characaters in *Pterocomma* genus, and further systematic studies are required

Macrosiphini *s.str.*

The taxon sample for Macrosiphini *s.str.* in our study is the most extensive to date (Node 5 in Fig. 2) and we found some similarities between our results and those of previous studies. In our study, the genera *Brevicoryne*, *Cryptosiphum*, *Diuraphis*, *Hayhurstia*, *Hyadaphis* and *Semiaphis* all accorded with the concepts of Anuraphidinae by Börner and Heinze (1957) and Shaposhnikov *et al.* (1998) (Node 25 in Fig. 2). The morphology of all of these genera is more similar to that of Aphidini than to other Macrosiphini, such as in the presence of vestigial appendages. In comparison with other Macrosiphini species, they did not evolve morphological structures used for communication, such as the long siphunculus or long antennae (Nault *et al.*, 1973; Mondor *et al.*, 2002). Instead of elongated appendages, for protection in life they have evolved, for example, the ability to produce a wax dust coating over their body or the ability to construct leaf rolls within which they can hide (Fig. 3B). Nodes 15 and 26 in Fig. 2 primarily include *Myzus* and *Brachycaudus* species, respectively, and the more inclusive clade (Node 14) containing these genera shows mixed relationships involving several genera (*Anuraphis*, *Dysaphis*, *Eumyzus*, *Longicaudinus*, *Ovatus* and *Tuberocephalus*). The morphologies of *Myzus* and *Brachycaudus* are similar, both having medium-sized appendages and a developed antennal tubercle. Moreover, they alternate between using trees and herbaceous plants as hosts. Their host trees are commonly Prunoidea and Maloidea (Rosales) and their herbaceous host plants are from various families (e.g., Apiaceae, Asteraceae, Campanulaceae, Plantaginaceae, Polygonaceae, Valerianaceae). Making pseudo-galls on leaves (Fig. 3C) is also a distinctive feature of the genera within Nodes 13 and 14 (but as yet unknown in *Longicaudinus corydalisicola*). Interestingly, the genus *Myzus* are revealed paraphyly in clade 15 showing mixed relationship with *Myzus*–like aphids such as *Eumyzus*, *Ovatus* and *Tuberocephalus* (Favret, C. Aphid Species File. Version 5.0/5.0. [17. Sep. 2014]). It implicates taxnomomic phylogeny are incongruent with molecular data within subgeneric level of the genus *Myzus*. Rather than morphololological similaritis, *Myzus* and *Myzus*-like genera seem to be involved in host alternating.

Based on taxonomic studies, the species in node 19 in Fig. 2 commonly have elongated appendages with long antennae, cauda and siphunculus (Fig. 3D) (Blackman and Eastop, 2000). Some species also alternate between host trees (Rosoidea [Rosales]) and herbaceous plants, but most species that live on herbaceous plants have only a simple life cycle. They might have evolved elongate appendages to search for various herbaceous plants (Mackenzie and Dixon, 1990; Mondor *et al.*, 2002). Interestingly, the genera *Megoura*, *Uroleucon* and *Sitobion* are each monophyletic (Fig. 2; nodes 17, 22 and 23, respectively), prefer to feed on herbaceous plants and have a simple life cycle (no host alternation). For example, *Megoura* and *Uroleucon* are host specific on Fabaceae and Asteraceae, respectively. Indeed, the host “Asterales” is a key character for classifying *Uroleucon* together with the genera *Macrosiphoniella* and *Metopeurum* (Fig. 2, Node 20). These three genera could have rapidly adapted to Asteraceae and do share morphological similarities, including the ‘spotted line’ on the abdomen and the ‘reticulated siphunculus’. All genera except *Cryptaphis* in the *Macrosiphum* lineage

(*Acyrthosiphon*, *Aulacorthum*, *Illinoia*, *Macrosiphum*) share a narrow siphunculus and tongue-shaped antennal tubercle. Furthermore, the genus *Aulacorthum* shows monophyly and it accords with previous study (Lee *et al.*, 2013) Thus, our newly hypothesized generic groupings within Macrosiphini *s.str.* are congruent with previous morphological hypotheses (Börner and Heinze, 1957; Shaposhnikov *et al.*, 1998).

Uroleucon

The genus *Uroleucon* Mordvilko, 1914 is one of the species-rich aphids, including over 190 described species (Nieto Nafrìa *et al.*, 2007; Favret *et al.*, 2018), and is host specific (monoecious holocyclic aphids; Blackman and Eastop, 2006) on Asteraceae, although a few species are associated with Campanulaceae (ex; *Uroleucon adenophora* on *Adenophora* spp.) and other plant families (ex; *Uroleucon jaceae on* Boraginaceae) (Blackman and Eastop, 2006). Morever, they make serious damages to agricultural crops such as lettuce, safflower and variable *Cirsium* species. (Lee *et al.*, 2002; Auad and Moraes, 2003; Blackman and Eastop, 2006). All species of *Uroleucon* are subdivided into 6 subgenera: *Uroleucon*, *Uromelan*, *Lambersius*, *Belochilum*, *Divium* and *Satula*. (Nieto Nafrìa *et al.*, 2007, Favret *et al.*, 2015). Among them, three major subgenera, *Uroleucon*, *Uromelan* and *Lambersius*, are dominant groups with valid 187 species. However, remaining three minor subgenera, *Belochilum*, *Divium* and *Satula* contain only 1 species, respectively.

Taxonomic study of *Uroleucon* has been extensively conducted by over the world. (Favret, C. Aphid Species File. Version 5.0/5.0. [17. Sep. 2014]). Like other Macrosiphini species, *Uroleucon* presents representative characters such as developed antenna, appendages, cauda and siphunculus, and previous authors have divided nominotypical subgenus (*Uroleucon*), *Uromelan* and *Lambersius* by pigmentation of cauda and color in live following by: i) Nominotypical subgenus and *Uromelan* are reddish to dark in live. *Lambersius* is greenish in live with pale cauda and siphunculus. ii) Cauda's pigmentation of nominotypical subgenus is pale, but *Uromelan* is dark. However, these typical morphological characters to distinguish three main subgenera are still controversial because of homoplasious characters and incongruent with molecular phylogeny by Moran (1999). So far, other morphological characters have been suggested to define at subgenus level (Carvalho *et al*., 1998) but it has been not acceptable due to inconsistent morphological characters (Blackman and Eastop 2006; Nieto Nafrìa *et al*., 2007). Furthermore, some species are defined by either continental isolations or dominant species distribution. For example, the species occurring on Palearctic region was named "Old World species". In contrast, the species occurring on Nearctic region was named "New World species" (Moran *et al*., 1998, Blackman and Eastop 2006; Nieto Nafrìa *et al*., 2007).

Phylogenetic study in *Uroleucon* genus has been little known, although their subgeneral status and morphological keys are controversial. Moran *et al*., (1999) had conducted molecular phylogeny using European and North American species. The study discovered incongruent of molecular topology and taxonomic definition for main subgenera, and it discussed association of biogeographic and host relation. However, they included restricted sampling only; European, North American species and only one species, *Uroleucon rapunculoidis* occurring on Campanulaceae plants.

Our data set presents that the genus *Uroleucon* is monophyletic but previous taxonomic concept is incongruent within subgeneric level. Thus, morphological characters such as cauda's pigmentation or live body colors are insufficient to define three subgenera *Uroleucon*, *Uromelan* and *Lambersius*, and it revealed homoplacious character. This view of phylogenetic relationship of three main subgenera accorded with Moran *et al*. (1999)'s topology. However, reconstructed tree shows new relationship in node C (Fig. 4). Four species nested in C are from different subgenera, two *Lambersius* species and two *Uromelan* species, respectively. Thus, those species seems to fail monophyly based on subgeneric taxonomic concept. They, however, shared morphological similarities; less developed scleroties on abdomen, pale cauda, green body except *U. helianthicola*. Those chracters are more likey *Lambersius* morphology than *Uromelan*. In the other hands, node D comprises two subgenera, *Uroleucon* and *Uromelan* without *Lambersius*, and they have typically *Uroleucon* and *Uromelan* morphology such as well-developed scleroties, pale or dark cauda, reddish to blackish body colors.

Because of homoplacious chracters within subgenera, several studies suggested new modified classification. Carvalho *et al*., (1998) conducted classification the genus using geographic association, and it was divided by two geographic diffierences: Old world species (occurring on mostly Palearctic region) and New World species (occurring on mostly Nearctic region). Apparently, Our result supports monophyly of new World species in node B (Fig. 4). However, Some of new World species have been nested in Old word species in node D (Fig. 4). Thus, Nearctic region requires redefinition of the concept due to the separated Nearctic clade (C, I Fig. 4).

Uroleucon is thought to be host specific and intercontinental relationship in genus (Moran *et al*., 1999; Blackman and Eastop, 2006). However, it has been insufficient to prove association of biogeography and host origin due to lack of sampling. Here, we extended geographic diversity to Nearctic, Neotropicals, Africa, Paleartic (Asia+Europe) in our analysis. Specially, seven species occurring on only Asia are added for the first time (*U. adenophora*, *U. chrysanthemicola*, *U. formosanum*, *U. fuchuense U. cephalognopli*, *U. gobonis*, and *U. monticola*) in *Uroleucon* phylogenetic study. And, two species, *U. adenophora* and *U. rapunculodis* occurring on Campanulaceae plants are discussed. Consequently, seven Asian species are nesed in node D (Fig. 4), and they have showed mixed clade with old World and new World species both. Morphologically, closed species such as *U. obscurum*/ *U. picridis* and *U. cephalonopli*/ *U. gobonis* made a clade, respectively. Furthermore, most of old World species in node D of Fig. 4) have been associated with host tribal level, Cynareae or Cichorieae (Table 3), but New World species have been closely associated with host tribe, Heliantheae (C in Fig. 4). Through the results, new World species seem to be more related with host association since plant tribe, Heliantheae is originally native of Nearctic region.

Implications of host preference and associated morphological traits

The subfamily Aphidinae has two specific ecological characteristics: host alternation and host diversification. Host-alternating species move between trees and/or herbaceous plants in cold and warm seasons. In contrast, some species are monoecious on a wide variety of herbs and shrubs, such as the genus *Uroleucon*, species of which are each host specific on a single species

(Blackman and Eastop, 2000). Above all, the adaptation of *Pterocomma*-group species to their hosts is a crucial factor for separating this group from Macrosiphini *s.str.* within Aphidinae, and morphological changes within this group may be linked to their host associations. We assumed that the evolution of Macrosiphini *s.l.* was most strongly influenced by the interactions between the aphids and their primary hosts, but that the evolution of specific adaptions, such as the evolution of communication characters like the siphunculus and elongate antennae, was promoted instead by the various secondary hosts utilized by these aphids. In previous taxonomic studies, Macrosiphini (*s.str.*) were classified as a separate group based largely on their primary hosts, various taxa in Rosaceae (Hille Ris Lambers, 1939, 1950; Heie, 1980). Our ancestral state reconstructions suggest that the ancestor of the *Pterocomma*-group could have occurred commonly on both Salicaceae (Malpighiales) and Elaeagnaceae (Rosales) (Node 4 in Fig. 2), whereas the ancestor of Macrosiphini *s.str.* primarily emerged only on Rosaceae (Node 5 in Fig. 2). That is, the *Pterocomma*-group could have shifted to Salicaceae hosts from an ancestral Rosaceae group (Node 3 in Fig. 2). In contrast, Macrosiphini *s.str.* could have adapted to host alternation and/or changed to use diverse hosts, such as in the genera *Macrosiphoniella* (Node 21 in Fig. 2) and *Hyperomyzus* (Node 18 in Fig. 2). The habitats of Salicaceae (Malpighiales) are generally very wet, and are usually at the waterside. However, the habitats of Rosales are most commonly found at the base of mountains, and are much drier than the habitats of Salicaceae (Table S3). Interestingly, Elaeagnaceae (the Rosales hosts of *Pterocomma*-group species in this study) are found in wet or periaquatic habitats. Furthermore, the secondary hosts of host-alternating species are also found in these habitats. Thus, although it has been suggested that host plants diverged prior to their aphid herbivores (Karrenberg, 2002; Kim *et al*., 2011) we further suggest that different habitats (e.g., 'wet' vs. 'dry' environments), perhaps also in association with geographical isolation of both the *Pterocomma*-group and Macrosiphini *s.str*., may also be a critical factor in the evolution of this group.

Typically, *Macrosiphoniella*, *Uroleucon* and *Pleotrichophorus* species feeding on Asteraceae herbaceous plants have elongate antennae, cauda and siphunculus. We assume that there is a strong selective force favoring longer appendages in macrosiphine aphids that search for herbaceous plant hosts (e.g., see Blackman and Eastop, 2000). However, the genera *Cavariella* and *Semiaphis* live on both trees and herbaceous plants, have medium-sized or vestigial appendages and alternate between trees and herbaceous plant hosts. Shaposnikov (1998) mentioned that vestigial appendages were ancestral characters and evolved early in Macrosiphini. If this is correct, the subfamily Aphidinae could have adapted to environmental changes after the Eocene, with widespread cooling and associated shrubland expansion (Lear *et al*., 2008; Eberle and Greenwood, 2012). Consequently, the host preferences of Macrosiphini could correlate with their morphological characteristics, several of which may have been modified as adaptations to their environments.

Habitat divergence hypothesis

We propose a new phylogenetic hypothesis for the *Pterocomma*-group and Macrosiphini *s.str*. that is consistent both with patterns of host use and the distribution of host species in different habitats.The hypothesized ancestral primary hosts of Macrosiphini *s.str*. (Rosales; node 5 in Fig. 2) and the *Pterocomma*-group (Malpighiales (*Salix*) + Rosales; node 4 in Fig. 2) diverged in the early to late Cretaceous (Wang *et al*., 2009), and these host differences also correspond to the different dominant habitats of these two aphid groups. Most species in the genus *Salix* are periaquatic plants, growing at river- and stream edges, lakesides and in wetlands (Lichvar *et al*., 2014). However, Rosales habitats are variable and these plants (except *Elaeagnus*) live mostly in forests. Comparing host habitats (Table S3) with our results (Fig. 2, Fig. S4, Table S2), Macrosiphini *s.l.* have diverged into these different broad habitat types—wet areas, where only *Pteracomma*-group species are found, and forest/shrubland habitats, where only Macrosiphini (and also two species from the *Pteracomma*-group) are found (Fig. 2, Fig. S4 and Table S2). Species in the *Pterocomma*-group occur on plants living in wet areas, such as *Salix* and *Elaeagnus* (Node 4 in Fig. 2). In contrast, species of Macrosiphini *s.str*. (Node 5 in Fig. 2) occur only in forests and/or shrublands (Table S3), where it is much drier than the habitats where *Pterocomma*-group hosts grow. The secondary hosts of the *Pterocomma*-group are also found in wet habitats, but are restricted to sunny sites or areas with low moisture stress (e.g., Umbelliferae/Apiaceae, hosts of *Cavariella*; Cyperaceae, hosts of *Vesiculaphis caricis*) (Chandler *et al*., 2004; Leck *et al*., 2005). However, the ancestral state of node 6 is Rosales (*Capitophorus* spp., *Pleotrichophorus glandulosus*; Fig. 2). All *Capitophorus* live on wet-area Rosales, e.g., '*Elaeagnus'* (Table S3). Unlike other species in the *Pterocomma*-group (Node 4 in Fig. 2), *Pleotrichophorus glandulosus* and *Vesiculaphis caricis* are the only species in this group that live in forest/shrubland habitats. The primary host plants of *Cavariella* include only species of *Salix*, whereas *Pterocomma* shows host specificity at the family level, using only hosts from two genera in Salicaceae (*Populus* and *Salix*; Blackman and Eastop, 1994). Additionally, our ancestral state reconstructions and Bayes MultiState analyses demonstrate that periaquatic habitats could be ancestral for the *Pterocomma*-group. Additionally, these host habitats could also have been ancestral for Macrosiphini *s.l.* (Table S2), with the host habitat preference subsequently shifting to drier forested habitats—now the dominant host habitat of Macrosiphini *s.str.*

Geographical isolation of host habitats appears to have resulted in different evolutionary traits in the *Pterocomma*-group and Macrosiphini *s.str.*, and this may have influenced the adaptation of these aphids to their hosts as well as speciation within each group. Ultimately, different host habitats could be associated with morphological differences or the presence of monoecious species of herbaceous plants. The *Pterocomma*-group seems to be of low mobility, with little host alternation and lack of morphological divergence from the characters of other Macrosiphini (Moran, 1992). In contrast, Macrosiphini *s.str.* are optimized for host alternation and the higher mobility needed for seeking out complementary hosts (Mackenzie, 1990). Exceptionally, *Capitophorus*, nested within the *Pterocomma*-group (Node 6 in Fig. 2), has been included in Macrosiphini *s.str.* in morphological and host-preference studies (Blackman and Eastop, 2000). However, the primary host of *Capitophorus* is *Elaeagnus*, which occurs in wet habitats in comparison to other Rosaceae plants (Table S3). Furthermore, the genus *Elaeagnus* was distantly related to other Rosaceae plants in a recent phylogenetic study (Zhang *et al.*, 2011).

A study of aphid symbionts could corroborate our new hypothesis. According to Nováková *et al.* (2013), symbionts from the genera *Aspidophorodon* and *Muscaphis* formed a clade with *Capitophorus* + *Pterocomma* symbionts, of which the aphid hosts are consistent with *Salix* and mosses, respectively. Unfortunately, *Aspidophorodon* and *Muscaphis* have not been included in any previous molecular phylogenetic study.

To better understand the evolution of Macrosiphini *s.l.*, we suggest that future studies should test our new hypothesis using even greater taxon sampling than was possible here. Our hypothesis states that host habitats drive speciation within Macrosiphini *s.l.* Additionally, we suggest a new and strongly supported tribal-level relationship for the *Pterocomma*-group that includes periaquatic species from the former Macrosiphini *s.str.* The phylogeny of symbionts is more likely consistent with our host habitat hypothesis (Nováková *et al.*, 2013). Host transitions may have occurred within the *Pterocomma*-group at least once among the wet area habitat hosts *Elaeagnus* and *Salix* (Fig. 2). Moreover, Macrosiphini *s.str.* have independently evolved different host associations more than once in drier forest/shrubland areas (Fig. 2). Thus, Macrosiphini speciation could have been greatly influenced by the geographic and environmental separation of the habitats of their hosts, as well as by the rapid radiation of the angiosperms.

Conclusions and future study

Our study has reconstructed a novel phylogeny for Macrosiphini that, to date, is the most broadly sampled study for both Macrosiphini and the *Pterocomma*-group. In particular, we confirmed the status of the

Pterocomma-group and Macrosiphini *s.str.* as reciprocally monophyletic groups, based on phylogenetic and topology-based hypothesis tests. Our topology-based tests suggest that each of three clades, namely Aphidini, Macrosiphini *s.str.*, and the *Pterocomma*-group, do not belong to any other group of Aphidinae (Table 2). In further studies, we expect to clarify the status of Macrosiphini within Aphididae using even denser taxon sampling, and we plan to include the single representative tribal or sub-tribal level taxon missing in the present study, the 'Acaudinini' *sensu* Börner (1952). New phylogenomic methods and symbiont studies could improve the tree for aphids (Nováková *et al.*, 2013; Misof *et al.*, 2014).

This study is, of course, not comprehensive for all species of *Uroleucon* and definition for status of three main subgenera. Nevertheless, we are confident that our study has reconstructed the phylogeny of *Uroleucon* extending different origined taxon sampling and diverse host associations. Especially, we verified seven species occurring on only Asia region are evolved with other Palearctic species and Nearctic species both. In contrast, Nearctic species nested in subgeus *Lambersius* have reconstructed their own lineage and coevolved with host tribe, Heliantheae. Two species occurring on host family Campanulaceae denied monophyletic relationship and they mixed with other species occurring on Asteraceae. For the further study, we expect to clarify the status of subgenera of *Uroleucon* with denser taxon sampling. Advanced approach in genomics and phylogenetic studies are strongly required in this complex group to understand the evolution and taxonomic status.

The family Aphididae is one of the most recently radiated angiosperm-associated insect groups, but aphid diversity is greater than that of their relatives, such as scale insects, jumping plant lice, and whiteflies (Moran, 1992; Kim *et al*., 2011). The phylogeny of Aphididae is therefore an important key for understanding the history of plants as well as the evolution of symbioses involving bacteria and ants. Advances in genomics and phylogenetic studies are required within these complex groups to reveal the evolution and history of diversification in the most successfully evolved sap-sucking insects. To understand the phylogenetic relationships of Aphidinae, further studies are required with increased taxon sampling using phylogenomics and symbiotic approaches.

Table 1. Historical classifications of Aphidinae (Pterocommatini, Aphidini, Macrosiphini).

Börner and Heinze (1957)	Shaposhnikov (1998)	von Dohlen *et al*. (2006)	Ortiz-Rivas and Martinez-Torres (2010)	Nieto Nafría and Favret (2011)	Kim *et al*. (2011)
Pterocommatinae	**Pterocommatinae**	**Aphidinae**	**Pterocommatinae**	**Aphidinae**	**Pterocommatinae**
Aphidinae	**Aphidinae**	**Aphidini**	**Aphidinae**	**Aphidini**	*Pterocomma*
Aphidini	**Aphidini**	Aphidina	**Aphidini**	Aphidina	*Cavariella*
Rhopalosiphonini	Aphidina	Rhopalosiphina	Aphidina	Rhopalosiphina	**Aphidinae**
Anuraphidinae	Rhopalosiphina	**Macrosiphini**	Rhopalosiphina	**Macrosiphini**	**Aphidini**
Acaudinini	**Macrosiphini**	**Pterocommatini**			Aphidina
Anuraphidini	**Anuraphidina**				Rhopalosiphina
Anuraphidina	**Liosomaphidina**				**Macrosiphini**
Brachycaudina	**Macrosiphina**				
Crytosiphonini	**Myzina**				
Myzinae					
Brachycolini					
Brachycolina					
Coloradoina					
Myzaphidini					
Liosomaphidini					
Phorodontini					
Myzini					
Myzina					
Pentalonina					
Crytomyzini					
Nasonoviini					
Dactynotinae					
Aulacorthini					
Microlophiina					
Aulacorthina					
Macrosiphonini					
Macrosiphonina					
Sitobiina					
Dactynotini					
Dactynotina					
Metopeurina					
Megourini					
Megourina					
Wahlgreniellina					

Table 2. Estimations of the marginal likelihood using stepping-stone sampling runs (SS) of three constrained hypotheses based on ML tree

	AM	AP	PM
SS (Mean)	-37478.40	-37484.09	-37495.90
Bayes factor	5.69	11.81	-17.50

Note: AP = Aphidini +Pterocommatini, PM: Pterocommatini+ Macrosiphini, AM = Aphidini + Macrosiphini

Table 3. Taxa used in this study study with GenBank accession numbers.

Genus	Subgenus	Species	Distrubution	Host plants	No.DNA			
					COI/COII	EF1A	12/16S	NADH1
Macrosiphoniella	*Macrosiphoniella*	*hokkaidensis*	P	A	N	N	N	N
	Sinosiphoniella	*kuwayamai*	p	A	N	N	N	N
Uroleucon	*Uroleucon*	*astronomus*	N/Neo	A	AF059688	AF068468	AF069101	AF05704
		ambrosiae	N/Neo	A	AF059686	AF068466	AF069099	AF05704
		formosanum	P	A	N	N	N	N
		fuchuense	P	A	N	N	N	N
		gigantiphagum	N	A	DQ005186	DQ005147	_	_
		jaceicola	P	A	AF059694	AF068475	AF069108	_
		monticola	P	A	N	N	N	N
		nigrotibium	N	A	N	N	N	N
		obscurum	P	A	AF059697	AF068478	AF069111	AF05705
		picridis	P	A	N	N	N	N
		rudbeckiae	N	A	AF059687	AF068467	AF069100	AF05704
		russellae	N	A	DQ005175	DQ005149	_	_
		sonchi	Worldwide	A/B	DQ005187	DQ005148	AF069106	AF05705
		tanaceti	P/N	A	DQ005177	DQ005150	_	_
	Uromelan	*adenophora*	P	C	N	N	N	N
		aeneum	P/Neo/A	A	AF059689	AF068469	AF069102	AF05705
		cephalonopli	P	A	N	N	N	N
		chrysanthemicola	P	A	N	N	N	N
		eupatorifoliae	N	A	N	N	N	N
		gobonis	P	A	N	N	FJ982415	N
		helianthicola	N	A	AF059684	AF068464	AF069097	AF05704
		jaceae	P	A/B	AF059690	AF068470	AF069103	AF05705
		rapunculoidis	P	C	AF059691	AF068472	AF069105	AF05705
		rurale	N	A	AF059685	AF068465	AF069098	AF05704
		solidaginis	P/N/A	A	_	AF068471	AF069104	AF05705
	Lambersius	*caligatum*	N	A	AF059693	AF068474	AF069107	AF05705
		erigeronense	N	A	N	N	AF069109	AF05705

References for Accession numbers follow as:
AF057045-AF069113, Moran *et al*. Phylogenetics and evolution of the aphid genus Uroleucon based on mitochondrial and nuclear DNA sequences. *Systematic Entomology* 24.1 (1999): 85-93. DQ005147-DQ005187, von Dohlen *et al*. A test of morphological hypotheses for tribal and subtribal relationships of Aphidinae (Insecta: Hemiptera: Aphididae) using DNA sequences. *Molecular phylogenetics and evolution* 38.2 (2006): 316-329. FJ982415, Lee and Lee. Molecular and morphological characterization of two aphid genera, *Acyrthosiphon* and *Aulacorthum* (Hemiptera: Aphididae). Journal of Asia pacific 16.1 (2013): 29-35. N, newly uploaded data in this thesis (deposited in Insect Biosystematics Laboratory, SNU).-, missing data.

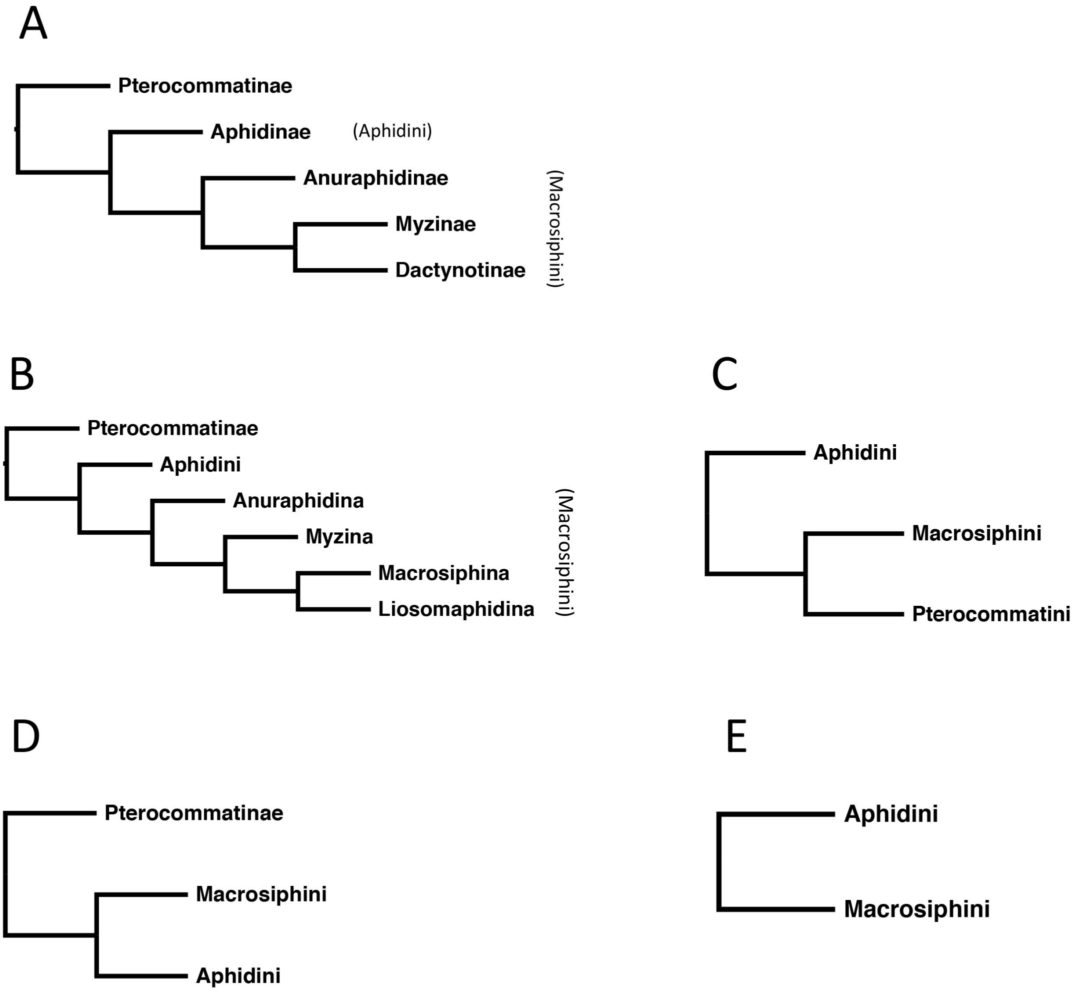


Figure 1. Previous and current hypotheses about relationships with subfamily or tribal positions of Aphidini, Macrosiphini, and Pterocommatini (Pterocommatinae).

(A) Cladogram after Börner (1952) and Börner and Heinze (1957), (B) Cladogram after Shaposhnikov *et al.* (1998), who suggested that Liosomaphidina was an unstable group because of its irregular chromosome numbers, (C) Cladogram after von Dohlen *et al*. (2006), which contained the first results understanding relationships within Aphidinae using molecular data and suggested the possibility of a closer relationship between Macrosiphini and Pterocommatini, (D) Cladogram after Ortiz-Rivas and Martinez-Torres (2010), and (E) Cladogram after Nieto Nafría and Favret (2011). Registers of Family-group and Genus-group Taxa of Aphidoidea (Hemiptera Sternorrhyncha).

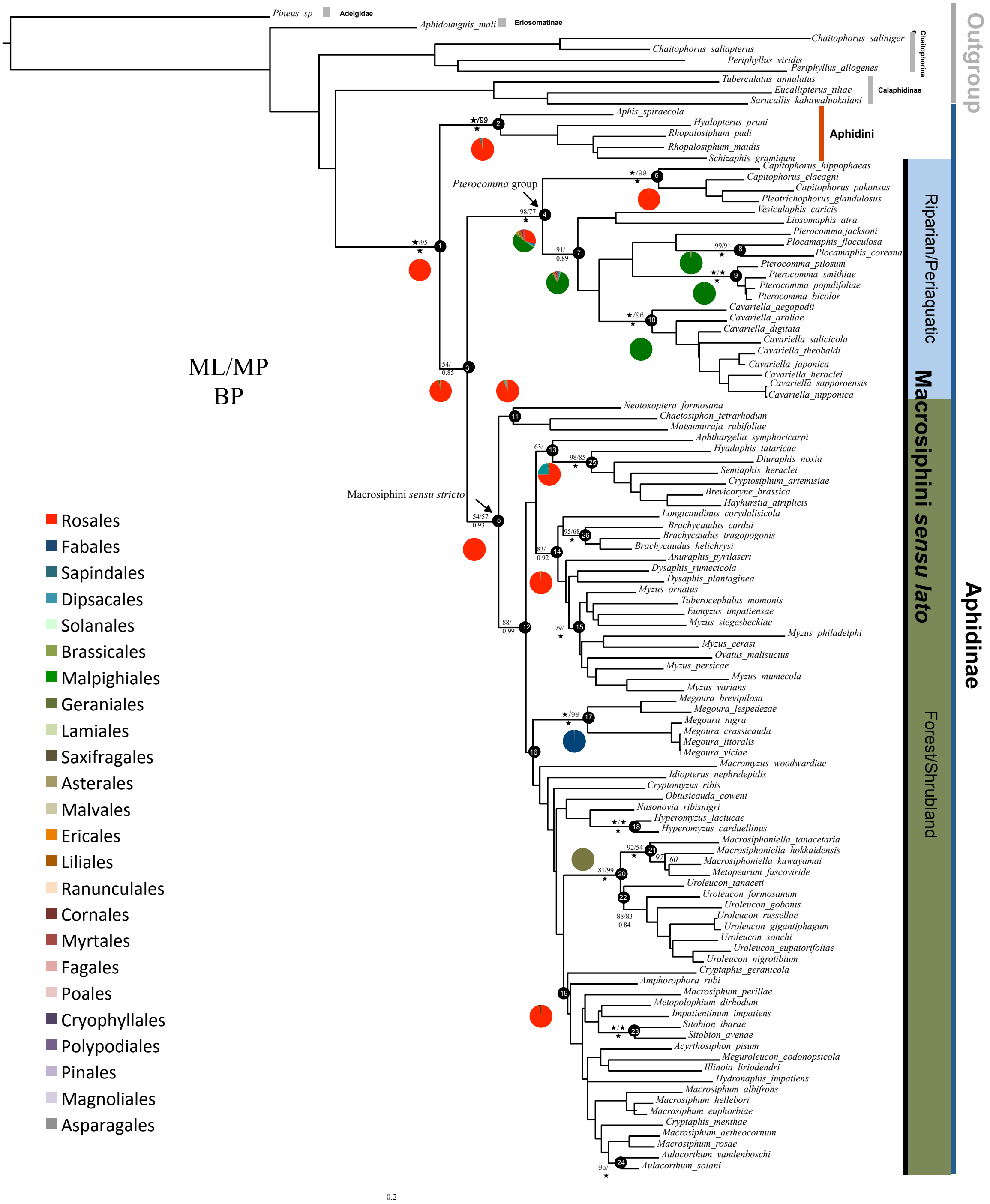


Figure 2. Maximum likelihood topology tree in Aphidinae with bootstrap

support values. Numbers within the circles present representative nodes and support values. Maximum-likelihood bootstrap values (ML) (if >50, ★ = 100; Fig. S1) and parsimony bootstrap values (MP) (if >50; ★ = 100; Fig. S3) are shown above branches on the left and right sides, respectively. Bayesian posterior probabilities (PP) (if >0.50, ★ = 1.00; Fig. S2) are shown below branches. All support values are indicated in Supplementary data 1 to 3. Results from analyses of ancestral state reconstruction for host preference as reported by BayesTraits MultiState analysis are indicated as pie charts showing the relative likelihoods of each host at the respective nodes. Red-highlighted names indicate genera formerly in Pterocommatini.

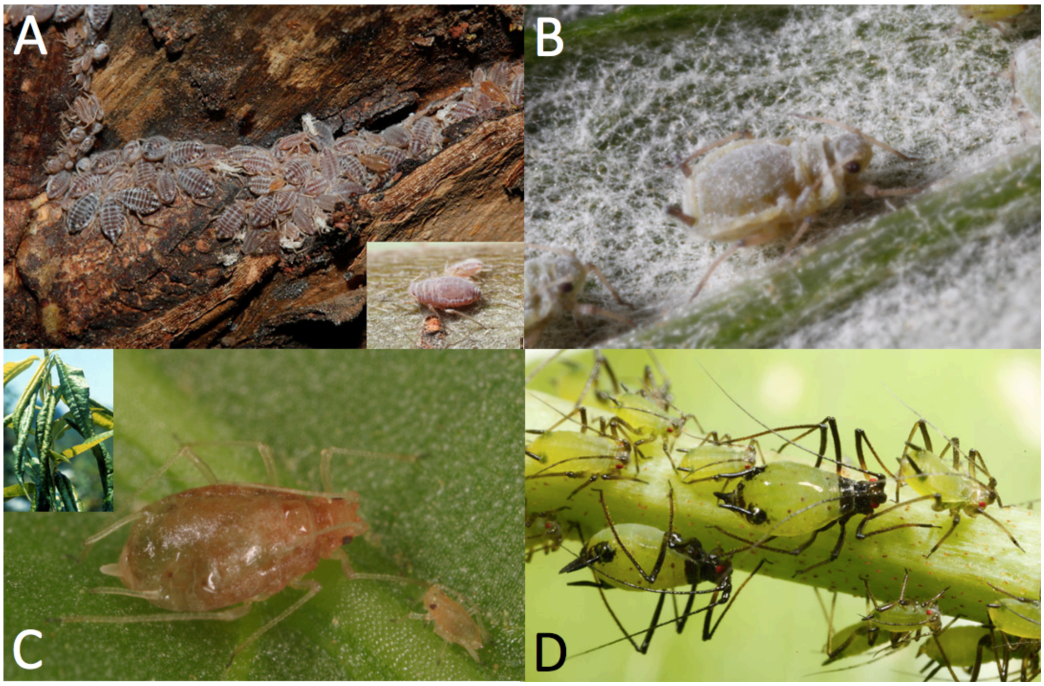


Figure 3. (A) *Pterocomma pilosum* living under the bark of *Salix gracilistyla* (Malphigiales), (B) *Cryptosiphum* sp. on *Artemisia* sp. (Asterales), (C) *Myzus persicae* making pseudo-gall on leaves of *Prunus persica* (Rosales) and (D) *Megoura crassicauda* on the stems of *Vicia* sp. (Fabales). Photos by Hwalran Choi.

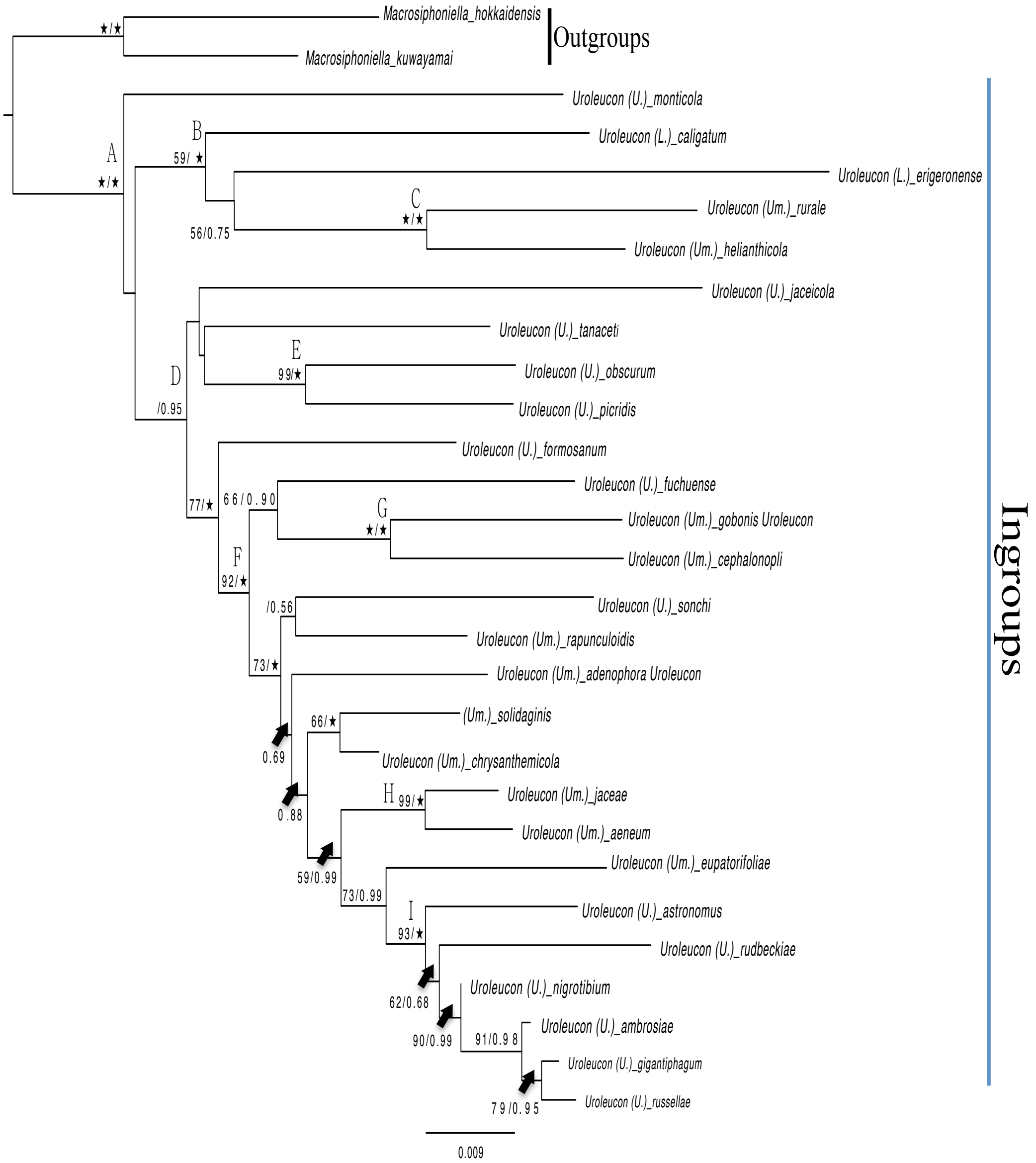
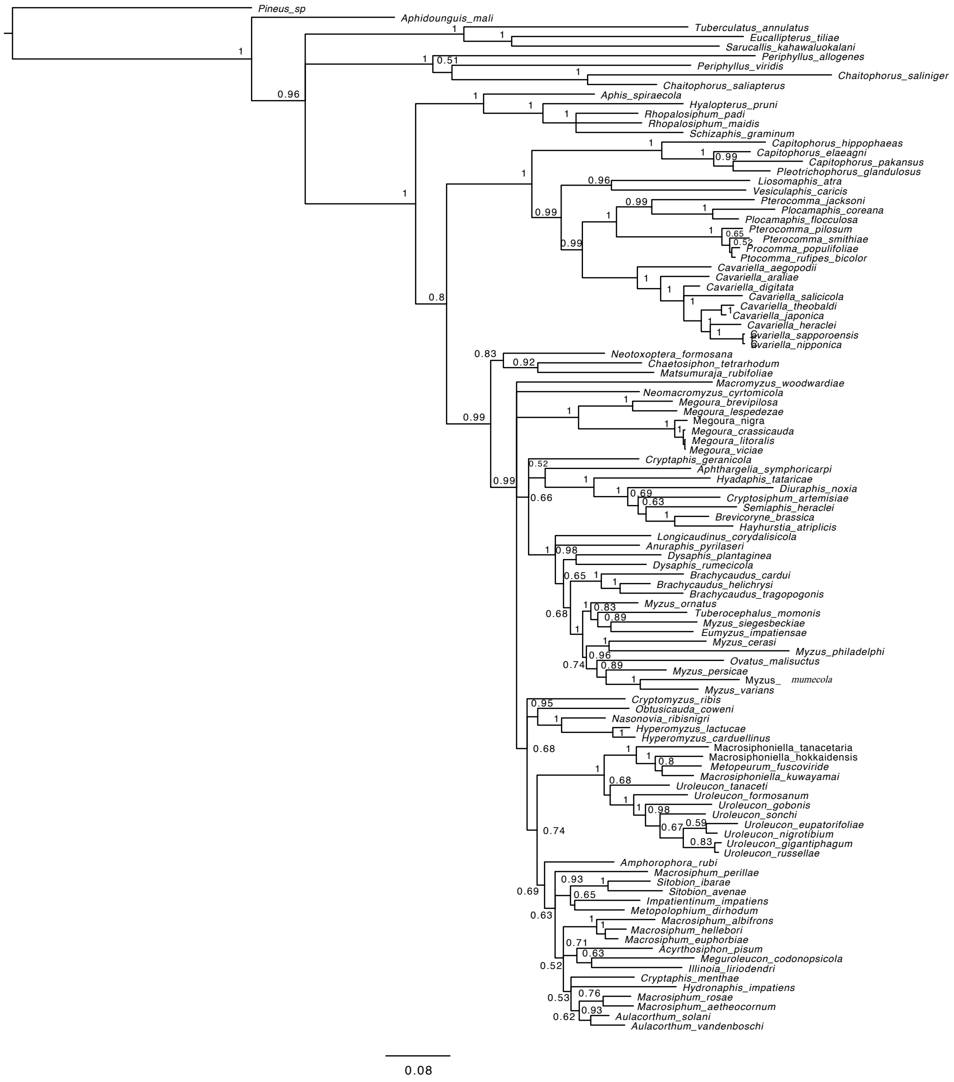
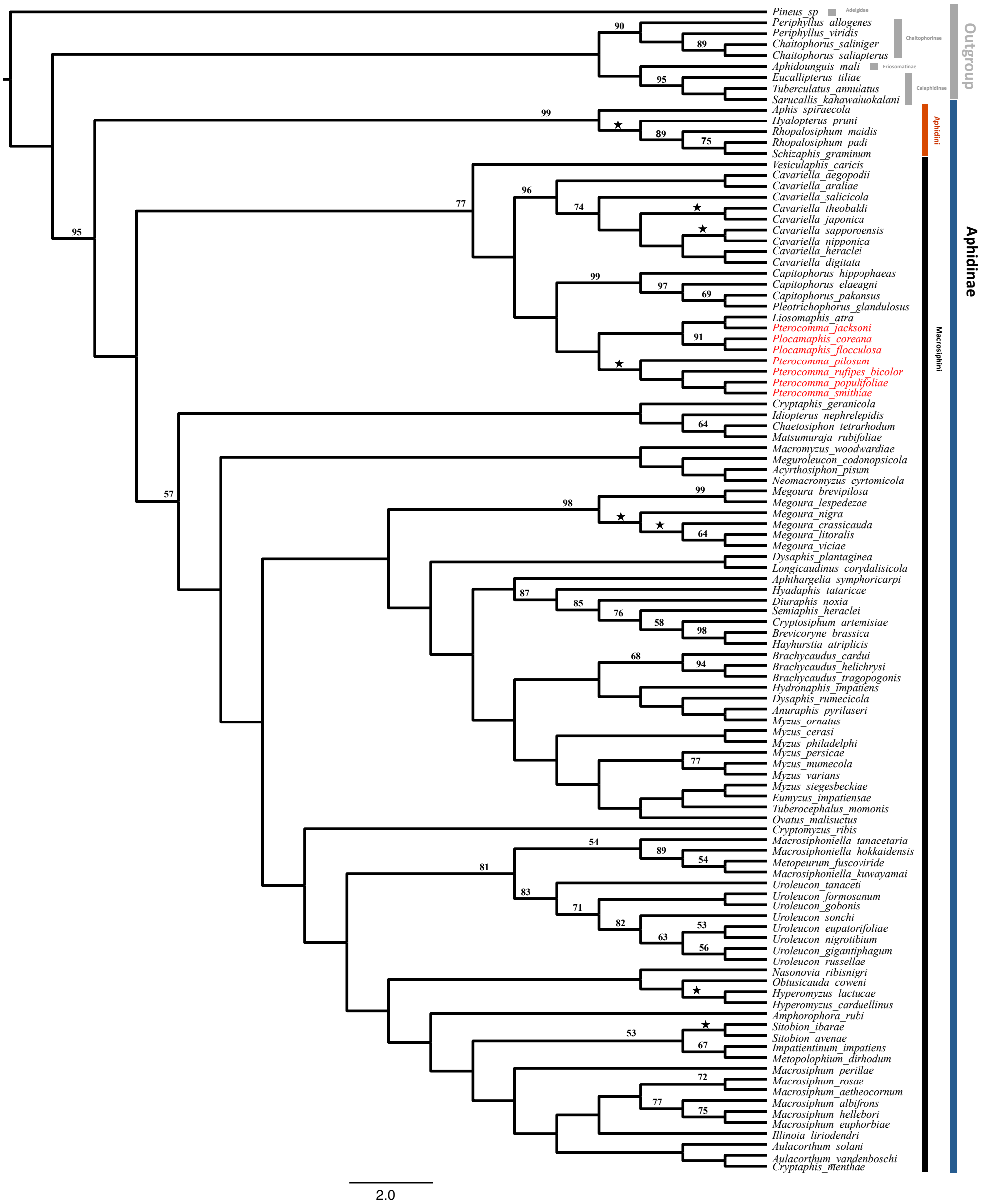


Figure 4. Maximum likelihood topology tree in *Uroleucon* with bootstrap support value. Alphabet A to I present representative nodes. Maximum-likelihood bootstrap (ML) and Baysian Inference (BI) values are shown above branches on the left and right sides, respectively (if greater> 50).

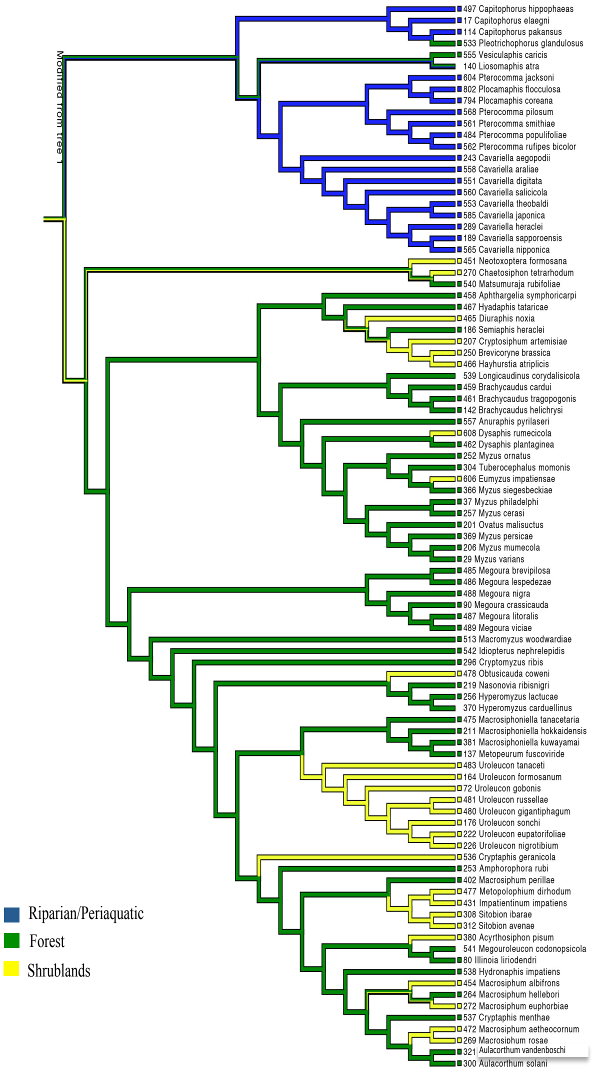
Supplementary Figure 1. Phylogenetic relationships inferred from maximum-likelihood analyses of 5 genes sequenced from Aphididae, with maximum-likelihood bootstrap support values shown to the right of the nodes they refer to.



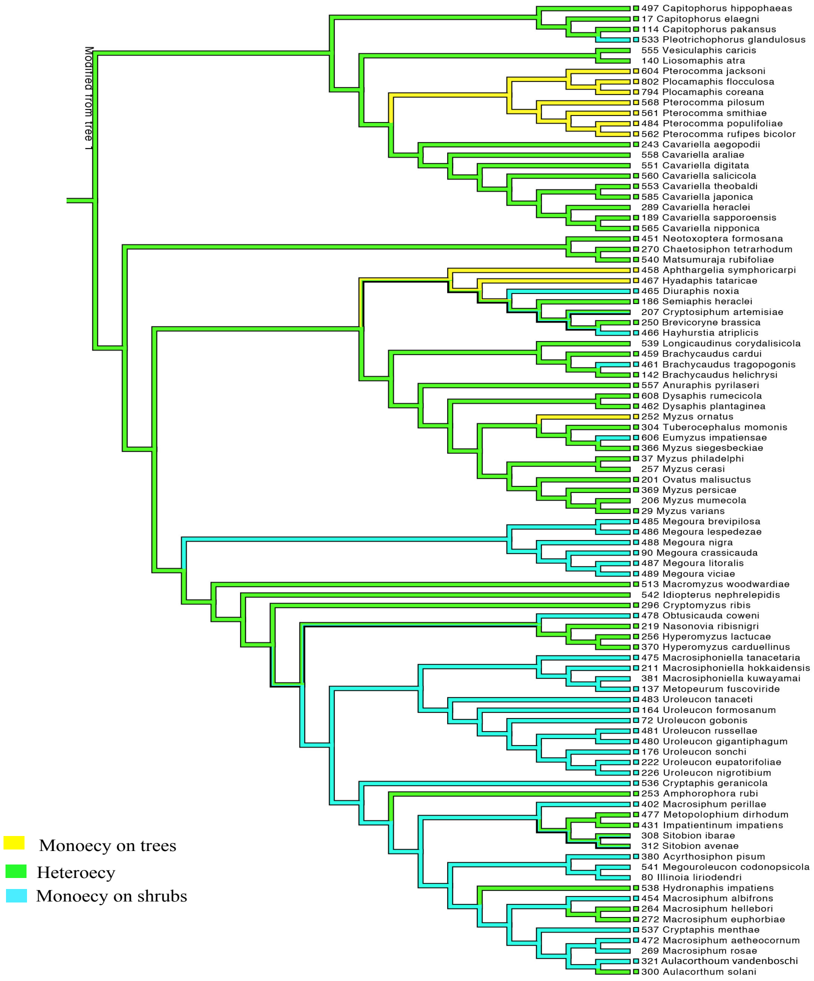
Supplementary Figure 2. Phylogenetic relationships inferred from Bayesian analysis of 5 genes sequenced from Aphididae, with posterior probabilities values plotted to the right of the nodes they refer to.



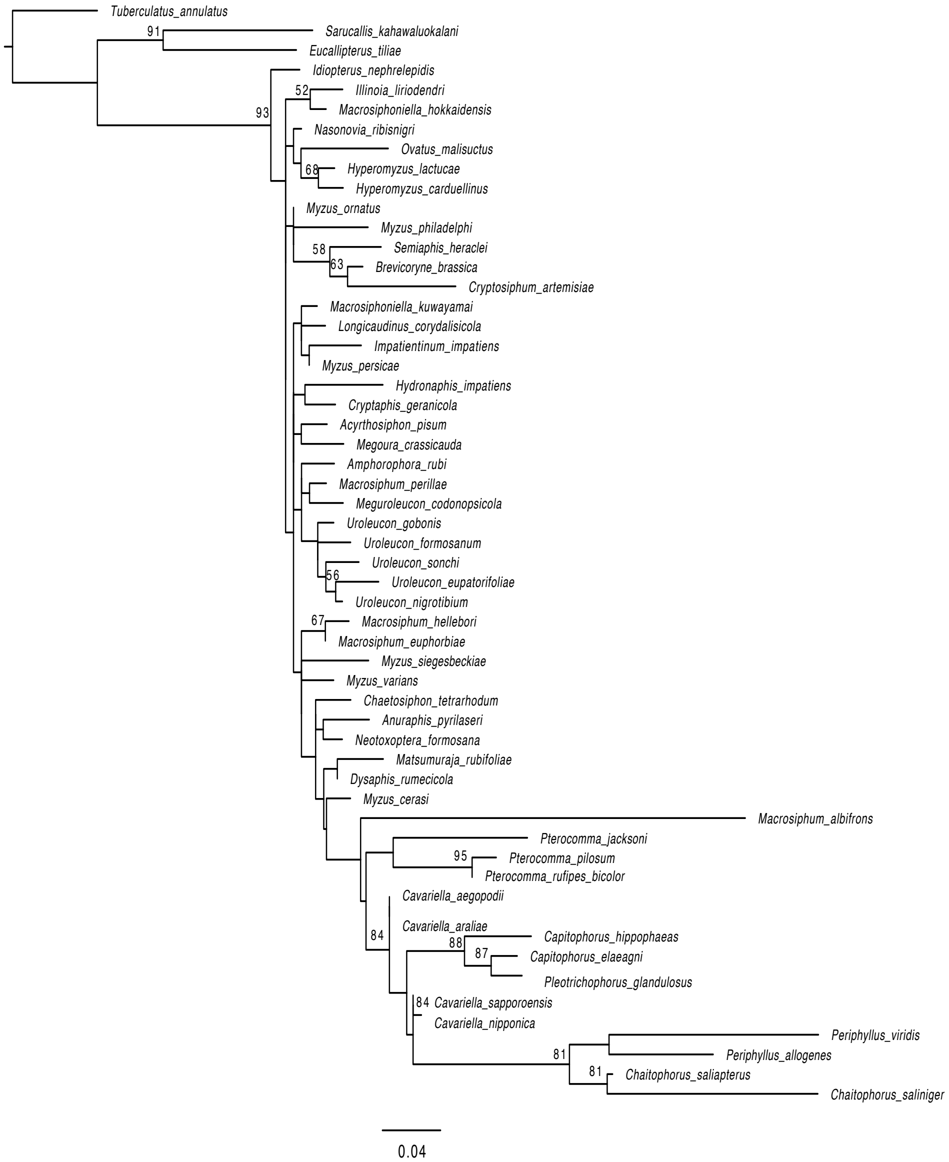
Supplementary Figure 3. Phylogenetic relationships inferred from maximum parsimony analysis of 5 genes sequenced from Aphididae, with bootstrap support values shown above the nodes they refer to.



Supplementary Figure 4. Parsimony ancestral state reconstruction mapping of host habitats shown on maximum-likelihood based chronogram. Italics are omitted on species name.



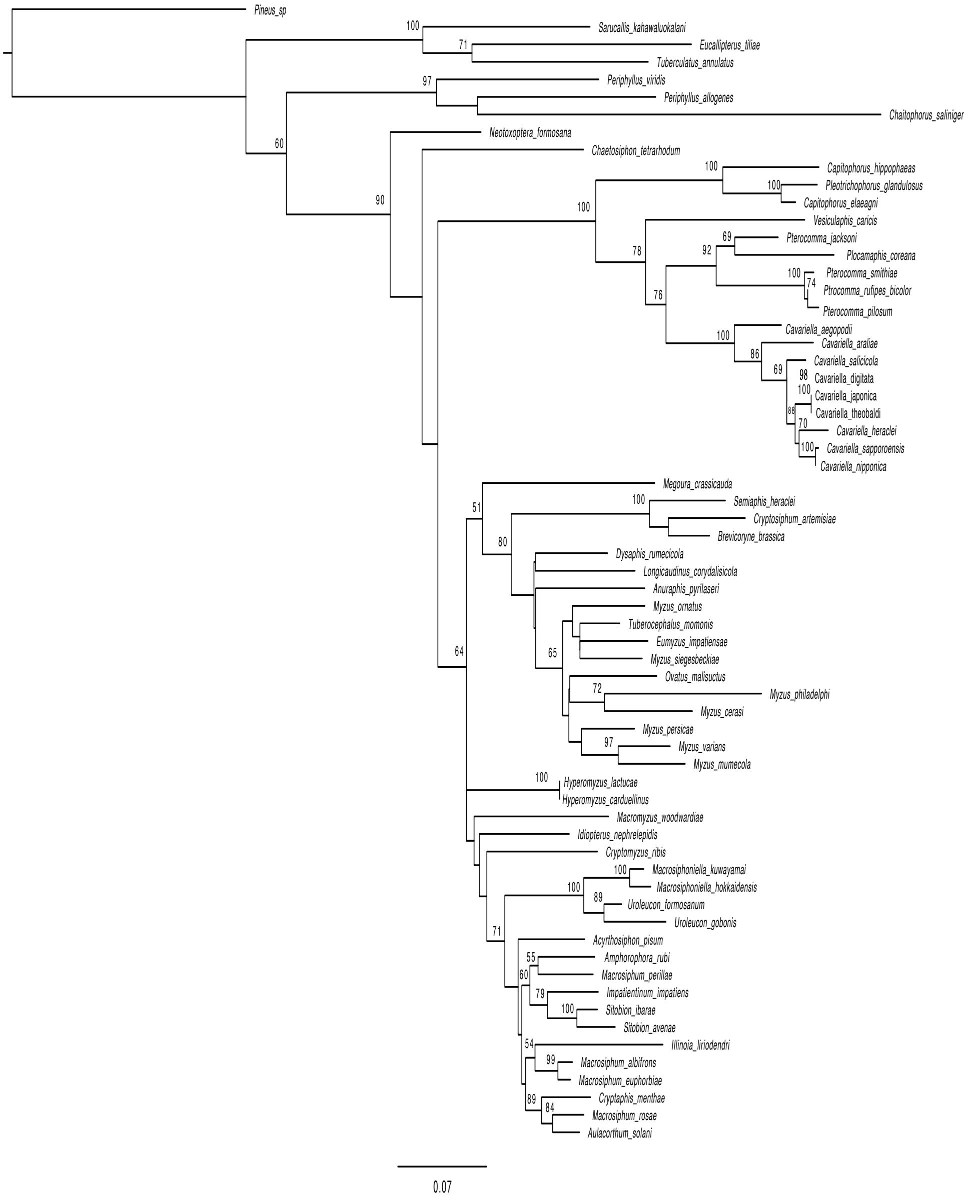
Supplementary Figure 5. Parsimony ancestral state reconstruction mapping of host alternation shown on maximum-likelihood based chronogram. Italics are omitted on species name.



Supplementary Figure 6. Phylogenetic relationships inferred from maximum-likelihood analyses of 16S genes sequenced from Aphididae. Maximum-likelihood bootstrap support value is shown to above branches (if greater> 50).

Supplementary Figure 7. Phylogenetic relationships inferred from maximum-likelihood analyses of COI genes sequenced from Aphididae. Maximum-likelihood bootstrap support value is shown to above branches (if greater> 50).

Supplementary Figure 8. Phylogenetic relationships inferred from maximum-likelihood analyses of tRNA/COII genes sequenced from Aphididae. Maximum-likelihood bootstrap support value is shown to above branches (if greater> 50).



Supplementary Figure 9. Phylogenetic relationships inferred from maximum-likelihood analyses of EF1a genes sequenced from Aphididae. Maximum-likelihood bootstrap support value is shown to above branches (if greater> 50).

Supplementary Figure 10. Phylogenetic relationships inferred from maximum-likelihood analyses of four mitochondrial genes sequenced from Aphididae. Maximum-likelihood bootstrap support value is shown to above branches (if greater> 50).

Supplementary Table 1. Primers used for DNA amplication and sequencing.

Gene Location	Primer name	Sequence	Reference
COI	LCO1490	5'-GGTCAACAAATCATAAAGATATTGG-3'	Folmer et al. 1994
	HCO2198	5'-TAAACTTCAGGGTGACCAAAAAATCA-3'	
tRNA/COII	2993+	5'-CATTCATATTCAGAATTACC-3'	Stern 1994
	A3772	5'-GAGACCATTACTTGCTTTCAGTCATCT-3'	Normark 1996
EF-1α	EF2	5'-ATGTGAGCAGTGTGGCAATCCAA-3'	Palumbi 1996
	EF3	5'-GAACGTGAACGTGGTATCAC-3'	von Dohlen et al. 2002
16sRNA	16SAR-L	5'-CGCCTGTTTATCAAAAACAT-3'	Rindal, Soli et al. 2009
	16SBR-H	5'-CCGGTCTGAACTCAGATCACGT-3'	

Supplemetary Table 2. Results of the BayesMultiState analysis of ancestral host habitats and host alternation.

		Host habitat					Host Alternation				
Node in Fig 2		Dry	Wet	Forest	Shrubland	Wet	Monoecy	Heteroecy	Monoecy on trees	Heteroecy	Monoecy on shrubs
Aphidinae	1	15.66%	**84.34%**	3.92%	1.14%	**94.94%**	1.28%	**98.72%**	0.30%	**95.63%**	4.07%
Aphidini	2	**96.60%**	3.40%	**86.74%**	7.42%	5.84%	1.50%	**98.50%**	0.52%	**93.09%**	6.38%
Macrosiphini s. l.	3	13.65%	**86.35%**	2.40%	1.40%	**96.20%**	1.18%	**98.82%**	0.41%	**95.65%**	3.93%
	4	0.42%	**99.58%**	0.05%	0.20%	**99.75%**	2.85%	**97.15%**	4.24%	**78.04%**	**17.72%**
	6	0.19%	**99.81%**	0.01%	0.12%	**99.87%**	1.07%	**98.93%**	0.16%	**94.86%**	4.98%
Pterocomma group	7	2.63%	**97.37%**	0.27%	0.44%	**99.28%**	3.37%	**96.63%**	8.78%	**62.84%**	**28.39%**
	9+10	0.01%	**99.99%**	0.00%	0.03%	**99.97%**	3.26%	**96.74%**	8.97%	**61.78%**	**29.25%**
	9	0.06%	**99.94%**	0.02%	0.10%	**99.89%**	**87.86%**	12.14%	**93.27%**	1.89%	4.84%
	10	0.01%	**99.99%**	0.00%	0.01%	**99.99%**	0.68%	**99.32%**	0.17%	**97.08%**	2.74%
	5	**89.55%**	10.45%	**68.30%**	16.77%	14.92%	0.80%	**99.20%**	0.11%	**97.70%**	2.19%
	11	**96.98%**	3.02%	**47.71%**	**49.86%**	2.43%	1.00%	**99.00%**	0.20%	**96.40%**	3.39%
	13	**99.28%**	0.72%	**92.59%**	6.13%	1.27%	1.92%	**98.08%**	0.21%	**91.85%**	7.94%
	14	**90.41%**	9.59%	**83.36%**	2.60%	14.03%	0.70%	**99.30%**	0.15%	**97.61%**	2.24%
Macrosiphini *s. str.*	16	**99.47%**	0.53%	**97.03%**	1.90%	1.06%	1.20%	**98.80%**	0.06%	**96.54%**	3.40%
	17	**97.11%**	2.89%	**89.62%**	5.42%	4.96%	**92.45%**	7.55%	0.12%	8.38%	**91.50%**
	19+20	**99.77%**	0.23%	**70.17%**	**29.59%**	0.24%	3.40%	**96.60%**	0.02%	**64.44%**	**35.54%**
	20	**99.75%**	0.25%	**28.40%**	**71.51%**	0.09%	**98.98%**	1.02%	0.01%	0.88%	**99.11%**
	19	**99.74%**	0.26%	**76.20%**	**23.46%**	0.34%	2.46%	**97.54%**	0.02%	**75.61%**	**24.37%**
	16+17	**90.67%**	9.33%	**80.98%**	5.11%	13.91%	1.66%	**98.34%**	0.20%	**93.42%**	6.38%

Supplementary Table 3. Taxa used in this study with GenBank accession numbers (The standard of host preference is based on primary host and monoecious plants).

Higher taxon	Genus	Species	Locality country	Host preference	Habitat	Reference	GenBank Accession			
							COI	16sRNA	tRNA-COII	EF1A
Macrosiphini *s.str.*	*Aulacorthum*	*vandenboschi*	Korea	Rosales	Forest	Blackman and Eastop (2006)	KY012341	_	KY012342	KY012343
	Acyrthosiphon	*pisum*	Korea	Fabales	Shrubland	Blackman and Eastop (2006)	KX631514	KX631456	KX631600	KX631645
	Amphorophora	*rubi*	Newzealand	Rosales	Forest	Blackman and Eastop (2006)	KX631519	KX631454	KX631601	KX631640
	Anuraphis	*pyrilaseri*	Korea	Rosales	Forest	Blackman and Eastop (2006)	KX631526	KX631457	KX631592	KX631666
	Aphthargelia	*symphoricarpi*	U.S.A	Dipsacales	Forest	Lee (2002)	EU701514[1]	_	DQ005167[2]	DQ005160[2]
	Aulacorthum	*solani*	Korea	Solanales	Forest	Lee (2002)	KX631512	HG810152[14]	HQ528278[3]	KX631638
	Brachycaudus	*cardui*	Canada, U.S.A	Rosales	Forest	Blackman and Eastop (2006)	EU701531[1]	_	AY219756[2]	AY219735[2]
	Brachycaudus	*helichrysi*	India	Rosales	Forest	Lee (2002)	KX631523	_	DQ005172[2]	DQ005146[2]
	Brachycaudus	*tragopogonis*	France, U.S.A	Rosales	Forest	Blackman and Eastop (2006)	EU189670[4]	_	DQ005173[2]	DQ005145[2]
	Brevicoryne	*brassica*	Newzealand	Brassicales	Shrubland	Lee (2002)	KX631530	KX631474	KX631616	KX631671
	Chaetosiphon	*tetrarhodum*	Newzealand	Rosales	Shrubland	Blackman and Eastop (2006)	KX631549	KX631472	KX631624	KX631667
	Cryptaphis	*geranicola*	Korea	Geraniales	Shrubland	Blackman and Eastop (2006)	KX631543	KX631478	KX631621	_
	Cryptaphis	*menthae*	Korea	Lamiales	Forest	Blackman and Eastop (1994)	KX631513	_	KX631608	KX631639
	Cryptomyzus	*ribis*	Korea	Saxifragales	Forest	Blackman and Eastop (1994)	KX631520	_	KX631609	KX631646
	Cryptosiphum	*artemisiae*	China	Asterales	Shrubland	Blackman and Eastop (2006)	KX631532	KX631482	KX631615	KX631670
	Diuraphis	*noxia*	unknown	Poales	Shrubland	Blackman and Eastop (2006)	_	_	DQ005181[2]	DQ005144[2]
	Dysaphis	*plantaginea*	Canada, U.S.A	Rosales	Forest	Blackman and Eastop (2006)	EU701636[1]	_	DQ005180[2]	DQ005143[2]
	Dysaphis	*rumecicola*	Korea	Cryophyllales	Shrubland	Lee (2002)	KX631525	KX631444	KX631591	KX631662
	Eumyzus	*impatiensae*	Korea	Ericales	Shrubland	Blackman and Eastop (2006)	KX631527	_	KX631620	KX631655
	Hayhurstia	*atriplicis*	Canada, U.S.A	Cryophyllales	Shrubland	Blackman and Eastop (2006)	EU701679[1]	_	DQ005169[2]	DQ005141[2]
	Hyadaphis	*tataricae*	Canada, U.S.A	Dipsacales	Forest	Blackman and Eastop (2006)	EU701683[1]	_	DQ005174[2]	DQ005142[2]
	Hydronaphis	*impatiens*	Korea	Rosales	Forest	Blackman and Eastop (1994)	KX631544	KX631477	HM117772[15]	HM117786[15]
	Hyperomyzus	*lactucae*	Newzealand	Saxifragales	Forest	Blackman and Eastop (2006)	KX631521	KX631467	KX631605	KX631647
	Hyperomyzus	*carduellinus*	Korea	unknown	unknown		KX631522	KX631470	KX631606	KX631648
	Idiopterus	*nephrelepidis*	Korea	Polypodiales	Forest	Su and Qiao (2014)	KX631545	KX631469	KX631619	KX631653
	Illinoia	*liriodendri*	Korea	Magnoliales	Forest	Blackman and Eastop (1994)	KX631508	KX631455	KX631594	KX631636
	Impatientinum	*impatiens*	Korea	Liliales	Shrubland	Blackman and Eastop (2006)	KX631515	KX631466	KX631607	KX631641
	Liosomaphis	*atra*	India	unknown	unknown		KX631562	_	KX631627	_
	Longicaudinus	*corydalisicola*	Korea	unknown	unknown		KX631541	KX631450	KX631593	KX631661
	Macromyzus	*woodwardiae*	Korea	Polypodiales	Forest	Blackman and Eastop (2006)	KX631563	_	_	KX631664
	Macrosiphoniella	*hokkaidensis*	China	Asterales	Forest	Blackman and Eastop (1994)	KX631540	KX631471	KX631610	KX631652
	Macrosiphoniella	*kuwayamai*	Korea	Asterales	Forest	Blackman and Eastop (2006)	KX631539	KX631448	KX631611	KX631651
	Macrosiphoniella	*tanacetaria*	U.S.A	Asterales	Forest	Blackman and Eastop (2006)	_	_	DQ005171[2]	DQ005151[2]
	Macrosiphum	*hellebori*	Newzealand	Ranunculales	Forest	Blackman and Eastop (2006)	KX631509	KX631451	KX631595	_
	Macrosiphum	*rosae*	Newzealand	Rosales	Shrubland	Blackman and Eastop (2006)	KR574868[12]	_	KX631598	AY219736[11]

	Macrosiphum	*euphorbiae*	Newzealand	Rosales	Shrubland	Blackman and Eastop (2000)	KX631511	KX631452	KX631596	KX631637
	Macrosiphum	*perillae*	Korea	Lamiales	Forest	Blackman and Eastop (2006)	KX631560	KX631465	KX631599	KX631642
	Macrosiphum	*albifrons*	U.S.A	Fabales	Shrubland	Blackman and Eastop (2006)	KX631510	KX631491	KX631597	DQ005154[2]
	Macrosiphum	*aetheocornum*	U.S.A	Geraniales	Shrubland	Blackman and Eastop (2006)	_	_	DQ005184[2]	DQ005153[2]
	Matsumuraja	*rubifoliae*	Korea	Rosales	Forest	Blackman and Eastop (2006)	KX631552	KX631458	KX631623	_
	Megoura	*crassicauda*	Korea	Fabales	Forest	Blackman and Eastop (2000)	KX631516	KX631459	EU071339[5]	EU071349[5]
	Megoura	*brevipilosa*	Korea	Fabales	Forest	Blackman and Eastop (2006)	EU071326[5]	_	EU071346[5]	EU071356[5]
	Megoura	*lespedezae*	Korea	Fabales	Forest	Blackman and Eastop (2006)	EU071327[5]	_	EU071347[5]	EU071357[5]
	Megoura	*litoralis*	Korea	Fabales	Forest	Blackman and Eastop (2006)	EU071322[5]	_	EU071342[5]	EU071352[5]
	Megoura	*nigra*	Korea	Fabales	Forest	Blackman and Eastop (2000)	EU071324[5]	_	EU071344[5]	EU071354[5]
	Megoura	*viciae*	Korea	Fabales	Forest	Blackman and Eastop (2006)	EU071323[5]	_	EU071343[5]	EU071353[5]
	Megouroleucon	*codonopsicola*	Korea	unknown	unknown		KX631547	KX631468	KX631614	_
	Metopeurum	*fuscoviride*	India	Asterales	Forest	Blackman and Eastop (2006)	KX631538	_	DQ005176[2]	DQ005152[2]
	Metopolophium	*dirhodum*	Australlia, U.S.A	Rosales	Shrubland	Miyazaki (1971)	FN868599[6]	_	U41121[7]	DQ005156[2]
	Myzus	*ornatus*	Newzealand	Rosales	Forest	Blackman and Eastop (2000)	KX631524	KX631464	KX631587	KX631658
	Myzus	*cerasi*	Newzealand	Rosales	Forest	Blackman and Eastop (2006)	KX631548	KX631445	KX631586	KX631663
	Myzus	*mumecola*	India	Rosales	Forest	Blackman and Eastop (2006)	KX631554	_	_	KX631659
	Myzus	*siegesbeckiae*	Korea	Rosales	Forest	Miyazaki (1971)	KX631529	KX631475	KX631590	KX631657
	Myzus	*persicae*	Korea	Rosales	Forest	Lee (2002)	KX631542	KX631449	KX631588	KX631665
	Myzus	*varians*	Korea	Rosales	Forest	Blackman and Eastop (2006)	KX631507	KX631439	KX631585	KX631654
	Myzus	*philadelphi*	Korea	Cornales	Forest	Lee (2002)	KX631557	KX631476	KX631626	KX631672
	Nasonovia	*ribisnigri*	Canada	Saxifragales	Forest	Lee (2002)	KX631518	KX631447	KX631604	DQ005158[2]
	Neotoxoptera	*formosana*	Korea	Asparagales	Shrubland	Lee (2002)	KX631550	KX631446	KX631618	KX631668
	Obtusicauda	*coweni*	U.S.A	Asterales	Shrubland	Lee (2002)	EU701823[1]	_	DQ005168[2]	DQ005159[2]
	Ovatus	*malisuctus*	Korea	Rosales	Forest	Blackman and Eastop (2006)	KX631551	KX631481	KX631613	KX631660
	Semiaphis	*heraclei*	China	Dipsacales	Forest	Lee (2002)	KX631531	KX631473	KX631617	KX631669
	Sitobion	*ibarae*	Korea	Rosales	Shrubland	Blackman and Eastop (2006)	KX631528	_	KX631603	KX631643
	Sitobion	*avenae*	Korea	Poales	Shrubland	Blackman and Eastop (2006)	KX631517	_	KX631602	KX631644
	Tuberocephalus	*momonis*	Korea	Rosales	Forest	Blackman and Eastop (1994)	KX631546	_	KX631589	KX631656
	Uroleucon	*gobonis*	Korea	Asterales	Shrubland	Blackman and Eastop (1994)	KX631533	KX631440	KX631622	KX631649
	Uroleucon	*formosanum*	China	Asterales	Shrubland	Blackman and Eastop (1994)	KX631537	KX631453	KX631612	KX631650
	Uroleucon	*sonchi*	China	Asterales	Shrubland	Blackman and Eastop (2006)	KX631534	KX631442	DQ005187[2]	DQ005148[2]
	Uroleucon	*nigrotibium*	Canada	Asterales	Shrubland	Blackman and Eastop (1994)	KX631536	KX631441	KX631441	N
	Uroleucon	*gigantiphagum*	U.S.A	Asterales	Shrubland	Blackman and Eastop (1994)	KR031409[12]	_	DQ005187[2]	DQ005147[2]
	Uroleucon	*russellae*	U.S.A	Asterales	Shrubland	Blackman and Eastop (1994)	KR038460[12]	_	DQ005175[2]	DQ005149[2]
	Uroleucon	*tanaceti*	Germany	Asterales	Shrubland	Blackman and Eastop (1994)	DQ005177[2]	_	DQ005177[2]	DQ005150[2]
	Uroleucon	*eupatorifoliae*	Canada	Asterales	Shrubland	Blackman and Eastop (1994)	KX631535	KX631443	N	N
Pteorocomma group	*Capitophorus*	*elaegni*	Korea	Rosales	Wet area	Lee (2002)	KX631492	KX631436	KX631571	KX631673

	Capitophorus	*pakansus*	India	Rosales	Wet area	Blackman and Eastop (2006)	KX631493	_	KX631570	_
	Capitophorus	*hippophaeas*	Korea	Rosales	Wet area	Blackman and Eastop (2006)	MF830874[13]	KX631438	KX631573	KX631675
	Cavariella	*aegopodii*	Newzealand	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631503	KX631462	KX631581	KX631684
	Cavariella	*araliae*	China	Malpighiales	Wet area	SNU collection	KX631501	KX631463	KX631579	KX631683
	Cavariella	*digitata*	Korea	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631500	_	_	KX631678
	Cavariella	*heraclei*	Korea	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631497	_	KX631578	KX631680
	Cavariella	*japonica*	Korea	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631498	_	KX631577	KX631682
	Cavariella	*nipponica*	Korea	Malpighiales	Wet area	SNU collection	KX631496	KX631461	KX631575	KX631677
	Cavariella	*sapporoensis*	China	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631495	KX631460	KX631574	KX631676
	Cavariella	*salicicola*	China	Malpighiales	Wet area	SNU collection	KX631502	_	KX631580	KX631679
	Cavariella	*theobaldi*	Korea	Malpighiales	Wet area	SNU collection	KX631499	_	KX631576	KX631681
	Pleotrichophorus	*glandulosus*	Korea	Asterales	Forest	Lee (2006)	KX631494	KX631437	KX631572	KX631674
	Plocamaphis	*coreana*	Korea	Malpighiales	Wet area	Blackman and Eastop (1994)	KX631555	_	_	KX631689
	Plocamaphis	*flocculosa*	U.S.A	Malpighiales	Wet area	Blackman and Eastop (1994)	EU7018561[1]	_	_	_
	Pterocomma	*bicolor*	U.S.A	Malpighiales	Wet area	Blackman and Eastop (1994)	KX631505	KX631479	DQ005183[2]	DQ005139[2]
	Pterocomma	*pilosum*	China	Malpighiales	Wet area	Blackman and Eastop (1994)	KX631506	KX631480	KX631584	KX631686
	Pterocomma	*smithiae*	China	Malpighiales	Wet area	Blackman and Eastop (1994)	KX631504	_	KX631583	KX631687
	Pterocomma	*rufipes*	China	Malpighiales	Wet area	Blackman and Eastop (1994)	KX631505	KX631479	KX631582	KX631685
	Pterocomma	*jacksoni*	China	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631556	KX631483	KX631625	KX631688
	Vesiculaphis	*caricis*	Korea	Ericales	Forest	Lee (2002)	KX631553	_	_	KX631690
Aphidini	*Aphis*	*spiraecola*	Korea	Rosales	Forest	Lee (2002)	GQ904113[8]	_	EU358845[10]	EU358925[10]
	Hyalopterus	*pruni*	Korea	Rosales	Forest	Blackman and Eastop (2006)	GU457791[9]	_	EU358850[10]	EU358930[10]
	Rhopalosiphum	*padi*	Korea	Rosales	Forest	Blackman and Eastop (2006)	GU457795[9]	_	EU358856[10]	EU358936[10]
	Rhopalosiphum	*maidis*	Korea	Rosales	Forest	Blackman and Eastop (2006)	GU457793[9]	_	EU358854[10]	EU358934[10]
	Schizaphis	*graminum*	Korea	Poales	Shrubland	Blackman and Eastop (2006)	GQ904117[8]	_	EU358858[10]	EU358938[10]
Calaphidinae	*Tuberculatus*	*annulatus*	Newzealand	Fagales	Forest	Blackman and Eastop (2006)	KX631559	KX631488	KX631631	KX631694
	Eucallipterus	*tiliae*	Newzealand	Malvales	Forest	Blackman and Eastop (1994)	KX631561	KX631489	KX631633	KX631693
	Sarucallis	*kahawaluokalani*	Korea	Myrtales	Shrubland	Blackman and Eastop (2006)	KX631564	KX631490	KX631632	KX631695
Chaitophorinae	*Chaitophorus*	*saliniger*	Korea	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631565	KX631484	KX631484	KX631697
	Chaitophorus	*saliapterus*	Korea	Malpighiales	Wet area	Blackman and Eastop (2006)	KX631566	KX631485	KX631628	KX645789
	Periphyllus	*viridis*	Korea	Sapindales	Wet area	Blackman and Eastop (1994)	KX631568	KX631486	KX631629	KX631691
	Periphyllus	*allogenes*	Korea	Sapindales	Wet area	Blackman and Eastop (1994)	KX631569	KX631487	KX631634	KX631692
Eriosomatinae	*Aphidounguis*	*mali*	Korea	Rosales	Forest	Blackman and Eastop (2006)	KX631558	_	KX631630	_
Adelgidae	*Pineus*	sp.	Korea	Pinales	Forest	Blackman and Eastop (1994)	KX631567	_	KX631635	KX631696

Reference for 1~10 follow as:
[1], Foottit *et al*., 2008. Species identification of aphids (Insecta: Hemiptera: Aphididae) through DNA barcodes. Mol. Ecol. Resour. 8 (6), 1189-1201. [2], von Dohlen *et al*., 2006. A test of morphological hypotheses for tribal and subtribal relationships of Aphidinae (Insecta: Hemiptera: Aphididae) using DNA sequences. Mol. Phylogeny. Evolution. 38 (2), 316-329. [3], Desneux *et al*. Host phylogeny and host specialization in parasitoids. Unpublished. [4], Coeur d'acier *et al*., 2007. Molecular phylogeny and systematic in the genus *Brachycaudus* (Homoptera: Aphididae): insights from a combined analysis of nuclear and mitochondrial genes. Zool. Scr. 37 (2), 175-193. [5], Kim *et al*., 2008. Molecular systematics of the genus *Megoura* (Hemiptera: Aphididae) using mitochondrial and nuclear DNA sequences. Mol. Cells. 25 (4), 510. [6], Andrew King *et al*., 2011. Multiplex reactions for the molecular detection of predation on pest and nonpest invertebrates in agroecosystems. Mol. Ecol. Resour. 11 (2), 370-373. [7], Sunnucks *et al*., 1996. Numerous transposed sequences of mitochondrial cytochrome oxidase I-II in aphids of the genus *Sitobion* (Hemiptera: Aphididae). Mol. Biol. Evol. 13 (3), 510-524. [8], Kim *et al*., 2010. Molecular and morphological identification of the soybean aphid and other Aphis species on the primary host *Rhamnus davurica* in Asia. Ann. Entomol. Soc. Am. 103(4), 532-543. [9], Kim *et al*., 2011. Macroevolutionary patterns in the Aphidini aphids (Hemiptera: Aphididae): diversification, host association, and biogeographic origins. PloS One. 6 (9), e24749. [10], Kim *et al*., 2008. A molecular phylogeny of the tribe Aphidini (Insecta: Hemiptera: Aphididae) based on the mitochondrial tRNA/COII, 12S/16S and the nuclear EF1α genes." Syst. Entomol. 33 (4), 711-721. [11], von Dohlen *et al*., 2003. Phylogeny and Historical Biogeography of New Zealand Indigenous Aphidini Aphids (Hemiptera, Aphididae): An Hypothesis, Ann. Entomol. Soc. Am. 96(2), 107-116. [12], Gwiazdowski et al., 2015. The Hemiptera (Insecta) of Canada: constructing a reference library of DNA barcodes. PLoS One, 10(4), p.e0125635. [13], Blagoev *et al*., 2016. Untangling taxonomy: a DNA barcode reference library for C anadian spiders. Molecular Ecology Resources, 16(1), 325-341. [14], Hsieh *et al*. A universal mini-barcode pyrosequencing for a rapid species identification platform (unpublished data from NCBI). [15], Lee *et al*., 2013. Molecular and morphological characterization of two aphid genera, Acyrthosiphon and Aulacorthum (Hemiptera: Aphididae). J. Asia Pac. Entomol. 16(1) 29-35. [16], Zhu *et al*., 2017. DNA barcoding and species delimitation of Chaitophorinae (Hemiptera, Aphididae). Zookeys 656, 25-50. N, newly uploaded data in this thesis (deposited in Insect Biosystematics Laboratory, SNU). -. missing data.

Chapter 2.

Taxonomic review of two genera of Macrosiphini (Hemiptera: Aphididae)

Abstract

The aphid genera *Myzus* Passerini, 1860 and *Uroleucon* Mordvilko, 1914 (Hemiptera: Aphididae) are reviewed from the Korean Peninsula. In this study, I newly report three new species of *Myzus: M. pruni* **sp. nov.**, *M. asterale* **sp. nov.**, *M. raphani* **sp. nov**., and two new species and one new rocord of *Uroleucon*: *U. echinopsis* **sp. nov.**, *U. chrysanthemicola* **sp. nov.**, and *U. adenophora* (Matsumura, 1918).

Totally, twenty-two species of *Myzus* and twenty species of *Uroleucon* are described. Host plants, distributions, illustrations for alate and apterous viviparous females, and identification keys to species are presented.

Key words: *Myzus*, *Uroleucon*, Korean Peninsula.

Chapter 2-1.

Taxonomic review of genus *Myzus* (Hemiptera: Aphididae) in the Korean Peninsula

Abstract

The aphid genus *Myzus* Passerini, 1860 (Hemiptera: Aphididae) is reviewed from the Korean Peninsula. A total of twenty-one species of Korean *Myzus* are studied including three new species: *M*. (*Myzus*) *pruni* **sp. nov.**, collected on *Prunus* sp. (Rosaceae); *M*. (*Myzus*) *asterale* **sp. nov.**, collected on *Aster* sp. (Asteraceae); and *M*. (*Nectarosiphon*) *raphani* **sp. nov**., collected on *Raphanus sativus* L. (Brassicaceae). Those three new species are described with biometric measurements and illustrations. The identification keys to subgenera and species for the Korean *Myzus* including three new species are presented.

Key words: *Myzus*, Taxonomy, Korean Peninsula.

Introduction

The aphid genus *Myzus* Passerini, 1860 is Palearctic origin group belonging to the largest aphid tribe Macrosiphini (Hemiptera: Aphidinae) (Heie, 1994). Fifty-five described species are recorded in the world and the genus *Myzus* contains four subgenera, *Galiobium* Börner, 1933, nominotypical *Myzus* Passerini, 1860, *Nectarosiphon* Schouteden, 1901 and *Sciamyzus* Stroyan, 1954 (Favret, C. Aphid Species File. Version 5.0/5.0. [30. Mar. 2018]). This genus is associated with multiple life cycles, alternating woody plants (Rosaceae) and herbaceous plants (ca. 40 plant families) (heteroecious; Dixon, 1987; Blackman and Eastop, 1994, 2000), or host-specific (monoecious; Blackman and Eastop, 2006). Because of the broad host plants and various life cycles, some species have been regarding as severe agricultural pests. For example, peach-potato aphid (*Myzus persicae* (Sulzer, 1776)) is globally important, attacking numerous plant families.

The taxonomic position within *Myzus* has been problematic yet due to lack of morphological synapomorphies. Furthermore, 10 genera and 72 species in the tribe Macrosiphini are known as morphologically similar with *Myzus*, indicating *Myzus*-like aphids (*Eumyzus* Shinji, 1929, *Hyalomyzus* Richards, 1958, *Jacksonia* Theobald, 1923, *Neotoxoptera* Theobald, 1915, *Ovatomyzus* Hille Ris Lambers, 1947, *Ovatus* van der Goot, 1913, *Paramyzus* Börner, 1933, *Rhopalomyzus* Mordvilko, 1921, *Tubaphis* Hille Ris Lambers, 1947, *Tuberocephalus* Shinji, 1929) (Blackman and Eastop, 1994, 2006; Favret, 2018). More recently, phylogenetic studies implied polyphyletic of *Myzus* and some *Myzus* species made a clade with *Myzus*-like genera. For example, Nieto Nafría *et al*., (2013) revealed polyphyletic of *Myzus hemerocallis* Takahashi, 1921, and it nested with another Macrosiphini genus

Gibbomyzus Nieto Nafría *et al*., 2013. Moreover, Choi *et al*., 2018 used seven *Myzus* species and four *Myzus*-like genera in Macrosiphini phylogenetic study. It suggested that three *Myzus*-like genera, *Eumyzus*, *Tuberocephalus* and *Ovatus* are closely related with *Myzus*, although another *Myzus*-like genus, *Neotoxoptera* has been separated from the *Myzus* clade. Those results support the necessity of re-definition for the genus *Myzus* incorporating morphology and host preference with *Myzus*-like genera (see above), and further studies are required to determine the status with extended taxon sampling.

In the Korean Peninsula, Paik (1972) and Lee *et al*. (2002) had confirmed two subgenera, *Myzus s.str*., and *Nectarosiphon*. In this study, twenty-one species of Korean *Myzus* are studied, including three new species, *M*. (*Myzus*) *pruni* sp. nov., *M*. (*Myzus*) *asterale* sp. nov., and *M*. (*Nectarosiphon*) *raphani* sp. nov. The *M*. (*M*.) *pruni* sp. nov., is morphologically similar to *M*. (*M*.) *siegesbeckiae* Takahashi, 1965 but it has been distinguished by well-developed pigmented scleroites on abdomen, thick setae on antennal tubercles and dusky genital plate. *M*. (*M*.) *asterale* sp. nov., is morphologically similar to *M*. (*M*.) *mushaensis* Takahashi, 1931 but it has been distinguished by the parallel and cylindrical shaped siphunculi (SIPH), and ratio of SIPH/Body. *M*. (*N*.) *raphani* sp.nov. is morphologically similar to *M*. (*N*.) *lactucicola* Takahashi, 1934 but it has been distinguished by the more swollen SIPH, and ratio of SIPH/Cauda. Therefore, we have concluded the three species to new in the world based on those characteristic differences.

Korean species of North and South region collected by Seoul National University (SNU), Seoul, Korea and National institute of Agricultural

Sciences (NAS), Junju, Korea are observed for this study. Japanese specimens of Hokkaido University Insect Collection, Hokkaido, Japan and American specimens of NC State University Insect Museum, Raleigh, NC. USA are checked via loan and visiting by first author. Host plants, distributions, identification keys to all Korean species are presented. Three new species are described with biometric measurements, illustrations for apterous viviparous females.

Materials and methods

The fresh aphid samples were preserved in 80% alcohol, and slide-glass specimens were made on Canada balsam, following Blackman and Eastop (2000) and Martin's (1983) methods. Illustrations for each species were taken by digital camera (14.2 Color Mosaic, Diagnostic Instruments, Sterling Heights, MI, USA) attached to the microscope (DM 400B, Leica Microsystems, Wetzlar, Germany) at a resolution of 600 dpi. Measurements for each specimen are taken from the digital images by Image Laboratory v2.2.4.0 software (MCM Design Ltd, Hillerod, Denmark).

Major samples of this study are deposited in the College for Agriculture and Life Sciences, Seoul National University (CALS SNU, Korea), and the National Institute of Agricultural Sciences (NAS, Korea).

Abbreviations used for descriptions are as follows: al., alate viviparous female; ap., apterous viviparous female; ny., nymph; Ant., antennae; Ant.I, Ant.II, Ant.III, Ant.IV, Ant.V, Ant.VI and Ant.VIb, antennal segments I, II, III, IV, V, VI and base of VI, respectively; Ant.IIIBD, basal diameter of antennal segment III; AbdT.III, abdominal tergite III; BL, length of body; GP, genital plate, 2HT, second segment of hind tarsus; PT, processes terminals;

SIPH, siphunculi; URS, ultimate rostral segment (segment IV+V). For the localities of distribution, provincial abbreviations are also used: GB, Gyeongsangbuk-do; GN, Gyeongsangnam-do; GG, Gyeonggi-do; GW, Gangwon-do; JN, Jeollanam-do; JJ, Jeju-do.

Terminal taxa names with an asterisk (*) indicates a new record in the Korean Peninsula.

Systematic accounts

Hemiptera 노린재목

Infraorder Sternorrhyncha 진딧물아목

Family Aphididae 진딧물과

Subfamily Aphidinae 진딧물아과

Tribe Macrosiphini 수염진딧물족

Genus *Myzus* Passerini, 1860. 혹진딧물속

Myzus Passerini, 1860; Eastop, 1966; Basu, R.C. & D.N. Raychaudhuri, 1976; Eastop & Hille Ris Lambers, 1976; Smith, C.F. & Parron, 1978; Nieto Nafría *et al*., 2011.

Type species: *Aphis cerasi* Fabricius, 1775.

Diagnosis: Small to medium sized aphids (ca. 1.2-2.0mm). Body colors diverse. Head distinctly granulated. Antennal tubercles well developed with round and parallel shape. Median frontal tubercles rarely developed. Antennae mostly six segmented, rarely five segmented, shorter or as long as body (Heie, 1994). Absence of rhinaria on antennal third segment. Siphunculi cylindrical, swollen or narrow at distal half, with developed flange. Cauda triangular. Alatae usually have a dark central patch on abdomen. Primary host plant (woody plant) is typically plant genus *Prunus* L. (Rosaceae). However, recent phylogenetic study implies that not only *Prunus* but also plant subfamily Amygdaloideae (Rosaceae) are related forming a clade with three *Myzus*-like genera, *Eumyzus*, *Ovatus* and *Tuberocephalus* (Choi *et al*., 2018). Secondary host plants (herbs) are diverse associating over 40 plant families.

Key to the subgenera of *Myzus* (based on the apterous viviparous female) in the Korean Peninsula modified from Miyazaki (1971) and Heie (1994).

1. SIPH not swollen. Antennae reaching back to the SIPH.......…….................. ....Subgenus ***Myzus*** Passerini sensu stricto

- SIPH more or less swollen. Antennae reaching beyond the bases of SIPH...2

2. Dorsal cuticle strongly wrinkled or scaly. Cauda with slight basal constriction ……...……..……………….......Subgenus ***Sciamyzus*** Stroyan

- Without this combination of characters.. ....Subgenus ***Nectarosiphon*** Schouteden

Subgenus *Myzus* sensu stricto

Myzus Passerini, 1860.

Myzoides van der Goot, 1913.

Prunomyzus Hille Ris Lambers & Rogerson, 1946.

Type species: *Aphis cerasi* Fabricius, 1775.

Key to the species of subgenus *Myzus* in the Korean Peninsula (based on the apterous viviparous females) modified from Miyazaki (1971) and Heie (1994).

1. Brownish, blackish in life, but yellow or whitish in summer…...................2

- Body color in life yellowish or greenish, with or without dark spots…….....4

2. Abdominal tergites pigmented. SIPH stout. SIPH and cauda wholly black ……………………………………………….........*M. cerasi* (Fabricius)

- Abdominal tergites less pigmented, imbricated and wrinkled. SIPH rather parallel. SIPH and cauda dark brown……………………...……………......3

3. Dark marginal pigmented scleroites on abdomen and pigmented scleroites at the bases of dorsal setae. Central patch on thorax. Coxae dark. Genital plate dark dusky...............................……………………..…*M. pruni* **sp. nov**.

- No pigmented scleroites on abdomen. No central patch on thorax. Coxae pale. Genital plate pale.......................………... *M. siegesbeckiae* Takahashi

4. SIPH wholly black. Ant. I-II dark……………………………....……..…..5

- SIPH not wholly black. Ant. I-II pale ………………………………………6

5. Abdomen with transverse orange stripes in life. Whole antennae 0.88-1.09 × body. Head and coxae pale brown like genital plate……..…..*M. philadelphi* Takahashi

- No transverse orange stripes on abdomen in life. Whole antennae 0.53-0.57 × body. Head and coxae black…..….........

....*M. padellus* Hille Ris Lambers & Rogerson

6. SIPH bent outward at apex. On *Urtica* (Urticaceae)..........…*M. dycei* Carver

- SIPH not bent at apex………..................…………………....…………7

7. Genital plate strongly produced posteriorly. Green in life. On *Siegesbeckia* (Asteraceae)……………….……....….........*M. siegesbeckicola* Strand

- Genital plate not produced posteriorly…..………...8

8. URS 1.0-1.1 × 2HT. SIPH not darkened. Pale yellow or white in life……...……*M. hemerocallis Takahashi*

- URS 1.0-1.43 × 2HT. SIPH often dark apically or wholly……..................…9

9. SIPH 0.20-0.24 × body and 0.60-0.82 × hind femur. Pigmentation of distal half of SIPH and slightly narrowed shaped SIPH.. ....*M. mushaensis* Takahashi

- SIPH 0.12-0.17 × body and 0.55-0.72 × hind femur. Parallel and slightly curved SIPH at apex..…..….…*M. asterale* **sp**. **nov**.

10. SIPH jet-black apically. Ant. III-V black apically. Pale yellow or green in life..*M. varians* Davidson

- SIPH pale. Ant. III-V without black or weakly brown at apex…....…..…..11

11. Antennae 5 segmented.……..…………………….........*M. fataunae* Shinji

- Antennae 6 segmented.………………….……………….....……..…12

12. SIPH longer than 1.5 × Ant. III…….........…..…...…...*M. lythri* (Schrank)

- SIPH less than 1.5 × Ant. III…….........………………..……...……..13

13. Ant. III-V weakly brown at apex. White in life.. ....*M. boehmeriae* Takahashi

- Ant. III-V pale at apex. Pale yellow or pale green in life................................ ....*M. japonensis* Miyazaki

Subgenus *Nectarosiphon* Schouteden, 1901

Nectarosiphon Schouteden, 1901.

Amphorophora Baker, 1920.

Myzus (*Nectarosiphon*) Remaudière, G. & M. Remaudière. 1997.

Type spceis: *Aphis convolvuli* Kaltenbach, 1843.

Key to the species of subgenus *Nectarosiphon* in the Korean Peninsula (based on alate and apterous viviparous female) modified from Miyazaki (1971).

1. SIPH smooth and swollen. Yellowish green in life………………..….....…..2

- SIPH less or more granulated, elongated and swollen. Whitish, yellowish, greenish or reddish colors in life. On various plants..……...……....………..3

2. Cauda U-shaped. Whole antennae 0.48-0.56 times as long as body. PT 2.37-2.78 times as long as Ant.VIb (Al. SIPH generally pigmented, 12 secondary rhinaria on Ant.III). On *Aster* and *Kalimeris* (Asteraceae)………....
....*M. asteriae* Shinji

- Cauda distinctly constricted at middle (Al. basal and apex of SIPH pigmented, 29-31 secondary rhinaria on Ant.III, Abd.III and IV combined black patched) Green in life. On *Stellaria* sp. (Caryophyllaceae)......................
....……….*M. stellariae* (Strand)

3. Abdomen evenly pigmented…………………….....……………………...4

- Abdomen not pigmented. PT 2.8-4.5 times as long as Ant.VIb. URS 0.9-1.2 times as long as 2HT with 2-8 hairs (Al. dark dorsal abdominal patch, solid except for a small posterior window, 7-14 secondary rhinaria on ANT III only). On various plants…………..……………………..*M. persicae* (Sulzer)

4. SIPH slightly and modoreately swollen. Head color paler than abdomen. Body length 1.92-1.94 mm. SIPH 1.64-1.79 times as long as cauda. Shining brown-black and appendages pale yellow in life (Al. rhinaria on ANT III-IV or III-V). On *Lactuca* sp. and *Youngia* sp. (Asteraceae)...................................
.......………...………………*M. lactucicola* Takahashi

- SIPH more swollen. Head color darker than abdomen. Body length 1.27-1.77 mm. SIPH 2.11-2.45 times as long as cauda. On *Raphanus sativus* (Brassicaceae)……...….....…*M. raphani* **sp. nov.**

1. *Myzus* (*Nectarosiphon*) *asteriae* Shinji, 1941 해국혹진딧물

(Plate A1; Table A1)

Myzus asteriae Shinji, 1941; Miyazaki, 1971; Remaudière, G. & M. Remaudière, 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly dark. URS dark. Legs dark. Genital plate dark dusky. SIPH weakly dark and Cauda dark brown. ***Morphology.*** Body spindle-shaped, 1.52-1.77 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles rather low than other *Myzus* spceis. Antennae slight, 0.48-0.56 times longer than body length; Ant.I granulate with 2-4 setae; Ant.II granulate with 2-3 setae; Ant.III granulate with 5-10 setae, longest setae on Ant.III 0.21-0.25 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.93-1.17 times longer than 2HT, 0.87-1.15 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 2 on tergite VIII. SIPH slightly swollen, with reticulated cuticles, 1.90-2.03 times longer than cauda, 0.75-1.04 times longer than hind femur, developed flange. Cauda oblong triangular, with 6 hairs. Genital plate dusky, 2 median hairs, 8-12 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 4 secondary rhinaria in Ant.I; 2-3 in Ant. II; 15 in Ant.III. Cauda triangular, pointed at apex. SIPH slightly swollen, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 4 ap., Seogwipo-si, JJ, 25.iv.1971, on *Aster yomena*, col.#6181 (NAS).

Host plants. *Aster* sp., *Boltonia* sp., *Kalimeris* sp. (Asteraceae).

Distributions. East Siberia, Japan and Korea (South).

Remarks. Body 1.52-1.77 mm. Absence of secondary rhinaria on Ant.III (Al. 4 secondary rhinaria on Ant.III). Cauda with 6 hairs. The species is similar to *M. stellariae* but it can be distinguished by U-shaped cauda, generally paled SIPH and less short antennae.

2. ***Myzus*** **(*Myzus*)** ***boehmeriae*** Takahashi, 1923 모시풀흰수염진딧물

(Plate A2; Table A2)

Myzus boehmeriae Takahashi, 1923; G. Remaudière & M. Remaudière, 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly dark except Ant.II-III. URS dark. Legs pale except distal 1/3 of femora, and distal 1/5 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology.*** Body spindle-shaped, 1.52-1.95 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.02-1.13 times longer than body length; Ant.I smooth with 6-8 setae; Ant.II smooth with 3-6 setae; Ant.III 23-30 secondary rhinaria irregularly scattered with 18-26 setae, longest setae on Ant.III 0.53-0.66 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.59-2.12 times longer than 2HT, 1.16-1.55 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 9-10 on tergite III, 6-8 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.66-1.72 times longer than cauda, 0.87-0.93 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 15-18 hairs. Genital plate dusky, 2 median hairs, 10-13 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 44-46 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 14 ap., Seogwi-po, JJ, 10.vi.1971, on *Boemeria frutescens*, col.#6419; 2ap., Udo, Bukjeju, JJ, coll#. 000417-SH26 (NAS); 7 ap., 1 al., Cheonjiyeon falls, Seogwipo-si, JJ, 27.v.2004, on *Boehmeria nivea*, col.#040527-HJ-12, leg. Hyojoong Kim; 4 al., Tongyeong-si, GN, 11.v.2006, on *Boehmeria* sp., col.#060511-HJ-13, leg. Hyojoong Kim. (Preserved specimens in alcohol): GW, 14.vii.2010, on *Boehmeria* sp., col.#100714HR-7, leg. Hwalran Choi; GW, 14.vii.2010, on *Boehmeria* sp., col.#100714HR-8, leg. Hwalran Choi. (DNA preserved specimens): YMCA, JJ, 13.v.2003, on *Boehmeria nivea*, col.#030513SH-38, no.DNA15, experimenter Hwalran Choi.

Host plants. *Boehmeria* sp. (Asteraceae).

Distributions. Japan, Korea (South) and Taiwan.

Remarks. Body 1.52-1.95 mm. Absence of secondary rhinaria on Ant.III (Al. 27-38 secondary rhinaria on Ant.III). Cauda with 3-4 hairs. The species is similar to *M. japonensis* but it can be distinguished by weakly browned Ant. III-V at apex, and white color in life. It is known as monoecious holocyclic in Japan (Miyazaki, 1971).

3. ***Myzus* (*Myzus*) *cerasi*** (Fabricius, 1775) 매화혹진딧물

(Plate A3; Table A3)

Aphis cerasi Fabricius, 1775.

Myzus cerasi Eastop & Hille Ris Lambers, 1976; Smith, C.F. & Parron, 1978.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly dark except Ant.II-III. URS dark. Legs pale except distal 1/3 of femora, and distal 1/5 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology.*** Body spindle-shaped, 1.26-1.58 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.02-1.13 times longer than body length; Ant.I smooth with 6-8 setae; Ant.II smooth with 3-6 setae; Ant.III 23-30 secondary rhinaria irregularly scattered with 18-26 setae, longest setae on Ant.III 0.53-0.66 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.59-2.12 times longer than 2HT, 1.16-1.55 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 9-10 on tergite III, 6-8 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.66-1.72 times longer than cauda, 0.87-0.93 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 15-18 hairs. Genital plate dusky, 2 median hairs, 10-13 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 44-46 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 3ap., Mt. Yeogisan, Suwon-si, GG, leg. Seunghwan Lee, on *Prunus* sp., col.#000501-SH01 (NAS); 11 ap., 1 al., Hwengsung-gun, GW, 16.vii.2009, on *Prunus glandulosa*, col.#090716-HR-4, leg. Hwalran Choi. (Preserved specimens in alcohol): Mulhyanggi Arboretum, GG, 23.iv.2009, on *Prunus armeniaca*, 090423-HJ-16, leg. Hwalran Choi; Hwengsung-gun, GW, 16.vii.2009, on *Prunus glandulosa*, col.#090716-HR-4, leg. Hwalran Choi. (DNA preserved specimens): Newzealand, 20.xi.2010, on *Prunus avium*, col.#101120SH-24, no.DNA257, experimenter Hwalran Choi.

Host plants. Primary hosts: *Prunus avium*, *P. cerasus*, *P. americana* (Rosaceae), Secondary hosts: *Asperula* sp., *Galium* sp. (Rubiaceae). *Capsella* sp., *Cardamine* sp., *Coronopus* sp., *Lepidium* sp. (Brassicaceae). *Euphrasia* sp., *Rhinanthus* sp. (Orobanchaceae), *Veronica* sp. (Plantaginaceae).

Distributions. Australia, China, India, Japan, Korea (South), New Zealand, North America, Pakistan, Poland and Worldwide.

Remarks. Body 1.26-1.58 mm. Absence of secondary rhinaria on Ant.III (Al. 9-10 secondary rhinaria on Ant.III). Cauda with 4 hairs. Abdomen pigmented. Four subspecies of this species are confirmed in the world because of their host preference and morphological difference (Rakauskas *et* *al*., 2014; Takahashi, 1965; Zhang & Zhong, 1980). In Korea, there is one subspecies *M. cerasi umefoliae* is recorded.

Subspecies ***Myzus*** **(*Myzus*)** ***cerasi*** subsp. ***umefoliae*** (Shinji, 1924)
Akkaia umefoliae Shinji, 1924.
Myzus cerasi Miyazaki, 1971.
Myzus cerasi umefoliae Eastop & Hille Ris Lambers, 1976; Remaudière, G. & M. Remaudière, 1997.
Myzus umefoliae Basu, R.C. & D.N. Raychaudhuri, 1976.

Specimens examined. South Korea. 3 ap., Namyang, GG, 7.vi.1965, on *Artemisia* sp., col.#3714.
Host plants. Primary hosts: *Prunus ansu*, *P. mume* (Rosaceae). Secondary hosts: *Artemisia* sp. (Asteraceae).
Distributions. Europe, India, Japan, Korea (south), New Zealand, North America.
Remarks. In Korea, this species is collected in secondary host plant *Artemisia* sp., and in Japan, it occurs on *Prunus* (*Armeniaca*) *mume* and *Artemisia capillaris* (Takahashi 1965).

4. ***Myzus*** **(*Myzus*)** ***dycei*** Carver, 1961 비술나무혹진딧물

(Plate A4; Table A4)

Myzus dycei Carver, 1961; G. Remaudière & M. Remaudière, 1997.
Myzus urticae Tao, 1963.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly pale except Ant.I. URS dark. Legs pale except tarsus. Genital plate pale dusky. SIPH and Cauda pale brown. ***Morphology*.** Body spindle-shaped, 2.40-2.82 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.48-0.60 times longer than body length; Ant.I smooth with 2-5 setae; Ant.II smooth with 2-4 setae; Ant.III smooth with 8-15 setae without secondary rhinaria, longest setae on Ant.III 0.12-0.19 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-5 hairs; URS tongue shaped, 1.20-1.49 times longer than 2HT, 0.98-1.28 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with weakly developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 2 on tergite VIII. SIPH cylindrical, with distal part slightly curved outwards, 2.64-2.94 times longer than cauda, 0.74-0.92 times longer than hind femur. Cauda oblong triangular, basal 1/3 narrow slender, with 6-11 hairs. Genital plate dusky, 2 median hairs, 8-14 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite.

Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 22-27 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 8 ap., Suwon, GG, 7.v.1971, on *Ulmus pumila*, col.#6262 (NAS). (Preserved specimens in alcohol): Singil, China, 15.viii.2010, on *Urtica thunbergiana*, col.#100815sh-56, leg. Hwalran Choi. (DNA preserved specimens): Singil, China, 15.viii.2010, on *Urtica thunbergiana*, col.#100815sh-56, no.DNA206, experimenter Hwalran Choi.

Host plants. *Ulmus pumila*, *U.* sp. (Ulmaceae), *Hemiptelea davidii*, *H.* sp., *Girardinia* sp., *Laportea* sp., *Urtica* sp. (Urticaceae).

Distributions. China, east Siberia, India, Japan, Korea (South), Nepal.

Remarks. Body 2.40-2.82 mm. Absence of secondary rhinaria on Ant.III (Al. 22-27 secondary rhinaria on Ant.III). Cauda with 6-11 hairs. The species is similar to *M. siegesbeckicola* but it can be distinguished by shape of SIPH (*M. dycei*, SIPH bent outward at apex. *M. siegesbeckicola*, SIPH not bent at apex). The life cycle is unclear. Lee *et al*. (2002) suggested host alternation between Ulmaceae and Urticaceae but Favret (2018) considered these are probably alternative secondary hosts (Ulmaceae being allied to Urticaceae).

5. ***Myzus* (*Myzus*) *fataunae*** Shinji, 1924 뽕모시풀혹진딧물

Myzus fatouae Shinji, 1924.

Myzus fatouae Miyazaki. 1971.

Myzus (*Myzus*) *fataunae* Remaudière, G. & M. Remaudière. 1997.

Specimens examined. Japan. 4ap., *Myzus fatauna*, 31.vii.1957, Mt.Omine, Para, leg. M. sorin, on *Pilea hamaei*, Det. R. Takahashi.

Host plants. *Boehmeria* sp., *Parietaria* sp., *Pilea* sp. (Urticaceae), *Fatoua* sp. (Moraceae).

Distributions Japan and Korea.

Remark. The species has not been collected from first record of Paik (1972) until 2018 in Korea. Moreover, Miyazaki (1971) commented *M. fataunae* is morphologically problematic species to define because of uncertain characters.

6. ***Myzus* (*Myzus*) *hemerocallis*** Takahashi, 1921 원추리진딧물

(Plate A5; Table A5)

Myzus hemerocallis Takahashi, R. 1921; Remaudière, G. & M. Remaudière, 1997.

Myzus hemerocallidis Tao, 1963.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly pale. URS pale. Legs lightly pale brown except tarsus. Genital plate pale dusky. SIPH and Cauda pale brown. ***Morphology*.** Body spindle-shaped, 2.21-2.21 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle. Lateral frontal tubercles well developed. Antennae slight, 0.49-0.50 times longer than body length; Ant.I smooth with 2-4 setae; Ant.II smooth with 2 setae; Ant.III smooth with 6-10 setae without secondary rhinaria, longest setae on Ant.III 0.13 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-5 hairs; URS tongue shaped, 0.00-1.10 times longer than 2HT, 0.95-1.02 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with weakly developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 4 on tergite VIII. SIPH cylindrical, with distal part slightly curved outwards, 2.32-2.53 times longer than cauda, 0.72-0.81 times longer than hind femur. Cauda oblong triangular, basal 1/3 narrow slender, with 4 hairs. Genital plate dusky, 2 median hairs, 10 ciliated setae on posterior margin.

Specimens examined. South Korea. 1 ap., 1al., medicinal plant experiment station, Uiseong-gun, GB, 24.v.2000, on *Hemerocallis fulva*, col.#000522-SH-41, leg. Seunghwan Lee (NAS).

Host plants. *Agapanthus umbellatus* (Amaryllidaceae), *Hemerocallis* spp. (Asphodelaceae).

Distributions. America (Central, North and South), Australia, China, France, India, Indonesia, Kenya, Korea (South), Madeira, New Zealand, Pakistan, South Africa and Taiwan.

Remark. Body 2.21 mm. Absence of secondary rhinaria on Ant.III. Cauda with 4 hairs. In recent molecular data revealed that the *M. hemerocallis* is closely related to the genus *Gibbomyzus* (Nieto Nafría *et al*., 2013). The life cycle is unknown.

7. *Myzus* (*Myzus*) *isodonis* (Takahashi, 1965) 산박하진딧물

Metaphorodon isodonis Takahashi, R. 1965; Paik, 1972.
Myzus isodonis Miyazaki, 1971; Remaudière, G. & M. Remaudière, 1997.

Specimens examined. unknown.

Host plants. *Isodon* sp. (Lamiaceae).

Distributions. Japan and Korea.

Remarks. Paik (1972) described this spcies to *Metaphorodon isodinis* in Korea. After it, no more collection has been reported. Referring to Blackman and Eastop (2006), probably this is not the genus *Myzus*; it could be the secondary host form of a *Tuberocephalus*.

8. *Myzus* (*Myzus*) *japonensis* Miyazakia, 1968 일본혹진딧물

(Plate A6; Table A6)

Myzus japonensis Miyazaki, 1968; Remaudière, G. & M. Remaudière, 1997.

Description. Alate viviparous female. ***Color*** (macerated specimens): Head dark. Antenna entirely dark. Thorax dark. Abdomen pigmented with marginal scleroites. SIPH dark brown. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology*****.** Body spindle-shaped, 1.48-1.66 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed.

Antennae slight, 0.97-1.13 times longer than body length; Antenna with 11-18 secondary rhinaria in Ant.III; 5-11 in Ant. IV; 3-7 in Ant. V. Ant.I granulate with 2-4 setae; Ant.II granulate with 2-3 setae; granulate with 4-5 setae, longest setae on Ant.III 0.10-0.19 times long than the basal diameter of the segment, URS tongue shaped. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 5-8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with patch and marginal scleroite. SIPH cylindrical, smooth and flanged at apex, 3.42-4.98 times longer than cauda, 0.70-0.87 times longer than hind femur. Cauda triangular with 4-5 hairs. Genital plate dusky, 2 median hairs, 8-13 ciliated setae on posterior margin.

Specimens examined. South Korea. 5 al., Gageodo, Shinan, JN, 27.vi.1974, on undiscribed host (NAS).

Host plants. *Rosa rugosa* (Rosaceae).

Distributions. Japan, Korea (South).

Remark. Alatae had been collected in Korea (Al. Body 1.48-1.66 mm. secondary rhinaria 11-18 on Ant.III, 5-11 on Ant.IV, 3-7 on Ant.V. Cauda with 4-5 hairs). The species is only recorded in East Asian region (Japan, Korea). Oviparae and alate males were found in late October (Miyazaki 1968; Favret, 2018).

9. ***Myzus* (*Nectarosiphon*) *lactucicola*** Takahashi, 1934 씀바귀혹진딧물

(Plate A7; Table A7)

Myzus lactucicola Takahashi, 1934; Miyazaki. 1971; Remaudière, G. & M. Remaudière, 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna weakly darker than abdomen. URS dark. Legs weakly dark. Genital plate dark dusky. SIPH and Cauda pale brown and Cauda. ***Morphology.*** Body spindle-shaped, 1.92-1.94 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 0.85-0.89 times longer than body length; Ant.I smooth with 3-5 setae; Ant.II smooth with 3 setae; Ant.III smooth with 12-25 setae, longest setae on Ant.III 0.13-0.16 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.52-0.70 times longer than 2HT, 0.43-0.48 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 2 on tergite VIII. SIPH slightly swollen, imbricated and reticulated at apex, 1.64-1.79 times longer than cauda, 0.63-0.67 times longer than hind femur. Cauda oblong triangular, with 4-5 hairs. Genital plate dusky, 2 median hairs, 10 ciliated setae on posterior margin.

Specimens examined. South Korea. 4ap., Namhae, GN, 30.iii.1999, on *Hemistepta lyrata*, leg. Seunghwan Lee (NAS); 18 ap., Namhae, GN, 30.iii.1999, on *Taraxacum mongolicum*, leg. Seunghwan Lee (NAS); 10 ap., Namhae, GN, 30.iii.1999, on *Youngia sonchifolia*, leg. Seunghwan Lee (NAS); 2 ap., Jingyo-myeon, Hadong-gun, GW, 08.iv.2006, on *Ixeris dentate*, col.#060408-SH-4, leg. Seunghwan Lee; 5 ap., SNU, Seoul, 15.v.2012, on *Ixeris dentate*, col.#120515-HR-1, leg. Hwalran Choi; 10 al., SNU, Seoul, 2009.ix.17, on *Ixeridium dentaum*, 090617-HJ-018, leg. Hwalran Choi. Japan. 5ap., *Myzus lactucicola* 1.vi.1959, Iwami, Tottori, on *Lactuca*, coll. M. Sorin, Det. R. Takahashi. (Preserved specimens in alcohol): SNU, Seoul, 15.v.2012, on *Ixeris dentate*, col.#120515-HR-1, leg. Hwalran Choi; SNU, Seoul, 15.v.2012, on *Ixeris dentate* col.#120515-HR-2, leg. Hwalran Choi.

Host plants. *Crepidiastrum lanceolatum*, *Ixeris* spp., *Lactuca* spp., and *Youngia japonica* (Asteraceae).

Distributions. Japan, Korea (south).

Remarks. Body 1.92-1.94 mm. Absence of secondary rhinaria on Ant.III. Cauda with 4-5 hairs. The species is similar to *M. raphani* **sp. nov.** but it can be distinguished by shape of SIPH, pigmentation of head and ratio of SIPH/cauda (*M. lactucicola*, SIPH slightly and moderately swollen. Head color paler than abdomen. SIPH 1.64-1.79 × cauda. *M. siegesbeckicola*, SIPH more swollen. Head color darker than abdomen. SIPH 2.11-2.45 × cauda).

10. *Myzus* (*Myzus*) *lythri* (Schrank, 1801)

Aphis lythri Schrank, 1801.

Lythraphis lythri Amyot, 1847.

Myzus lythri Passerini, 1860.

Myzaphis lythri van der Goot, 1915.
Myzoides lythri Börner & Blunk, 1916.

Specimens examined. Unknown

Host plants. Primary hosts: *Prunus mahaleb* (Rosaceae), Secondary hosts: *Epilobium* spp. (Onagraceae), *Lythrum* spp. (Lythraceae), *Rhamnus pushiana* (Rhamnaceae).

Distributions. Africa (Central and South), Europe, Iran, Korea (South), Lebanon, North America and Tunisia.

Remarks. Boo *et al*. (2000) conducted ecological study for sex pheromone in the field and recorded sexual forms of *M. lythri* for the first time in Korea. However, it is in need of taxonomic confirmation because of lack of specimens.

11. *Myzus* (*Myzus*) *mushaensis* Takahashi, 1931 왕벚나무혹진딧물

(Plate A8; Table A8)

Myzus mushaensis Takahashi, 1931.
Prunomyzus mushaensis Tao, 1963.
Sarucallis zelkowae Tao, 1964.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen dark with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly dark. URS dark. Legs dark. Genital plate dark dusky. SIPH broadly dark with distal 1/3 deeply dark and Cauda deeply dark. ***Morphology.*** Body spindle-shaped, 1.52-1.85 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 1.52-1.85 times longer than body length; Ant.I granulate with 6-8 setae; Ant.II granulate with 3-6 setae; Ant.III granulate with 18-26 setae, longest setae on Ant.III 0.17-0.42 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.16-1.59 times longer than 2HT, 0.91-1.31 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 2 on tergite VIII. SIPH cylindrical, with strongly reticulated, 2.33-3.68 times longer than cauda, 0.60-0.82 times longer than hind femur. Cauda oblong triangular, with 4-6 hairs. Genital plate dusky, 2 median hairs, 6-9 ciliated setae on posterior margin.

Specimens examined. South Korea. 10 ap., Nandaerim-research, JJ, 07.v.2009, on *Prunus* sp., col.#090507-HJ-64, leg. Hyojoong Kim. (Preserved specimens in alcohol): JNU, JJ, 07.v.2009, on *Prunus serrulata*, col.# 090507-HJ-37; SNU, Seoul, 09.viii.2010, on *Prunus yedoensis*, col.#100809HR-1, leg. Hwalran Choi.

Host plants. Primary hosts: *Prunus* spp. (Rosaceae), Secondary hosts: *Plectranthus japonicas* (Lamiaceae).

Distributions. Japan, India, Korea (South) and Taiwan.

Remarks. Body 1.52-1.85 mm. Absence of secondary rhinaria on Ant.III. Cauda with 4-6 hairs. The species is similar to *M. asterale* **sp. nov.**, but it can be distinguished by pigmentation of distal half of SIPH and slightly narrowed shaped SIPH, and ratio of SIPH/Body. It is known to heteroecious holocyclic in Japan. Primary host plant is *Prunus* spp., and the secondary host is *Plectranthus* (=*Isodon*) *japonicas* (Favret, 2018).

12. ***Myzus*** **(*Myzus*)** ***padellus*** Hille Ris Lambers & Rogerson, 1946
백두혹진딧물

(Plate A9; Table A9)

Myzus padellus Hille Ris Lambers & Rogerson. 1946.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Ant. I-II dark. Ant. III-VI pale except distal 1/3 dark. URS dark. Legs wholly dark. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology.*** Body spindle-shaped, 2.43-2.53 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles rather low than other *Myzus* spceis. Antennae slight, 1.35-1.46 times longer than body length; Ant.I granulate with 3-5 setae; Ant.II granulate with 3-4 setae; Ant.III granulate with 10-13 setae, longest setae on Ant.III 0.40-0.54 times long than the basal diameter of the segment, Rostrum attaining between prothorax and mesothorax; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.37-1.49 times longer than 2HT, 0.96-1.05 times long than

Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 4-4 on tergite III, 4-4 on tergite VI between the SIPH, 2-2 on tergite VIII. SIPH cylindrical, with reticulated cuticles, 2.56-2.65 times longer than cauda, 0.63-1.04 times longer than hind femur. Cauda oblong triangular, with 4-6 hairs. Genital plate dusky, 2 median hairs, 10-15 ciliated setae on posterior margin.

Specimens examined. North Korea. 2 ap., Baektusan, on *Padus racemosa*, col.#SNU.

Host plants. Primary hosts: *Prunus padus (Rosaceae)*, Secondary hosts: *Brassica* sp. (Brassicaceae), *Galeopsis* spp.(Lamiaceae), *Pedicularis verticillata*, *Rhinanthus* sp. (Orobanchaceae).

Distributions. Austria, east Siberia, England, Finland, Georgia, Korea (North), Norway, Russia, Sweden, Switzerland and Turkey.

Remarks. Body 2.43-2.53 mm. Absence of secondary rhinaria on Ant.III. Cauda with 4-6 hairs. The species is similar to *M. philadelphi* but it can be distinguished by existence of abdominal stripes in life and ratio of whole antennae/body (*M. padellus*; No transverse orange stripes on abdomen in life, whole antennae 0.53-0.57 × body. *M. philadelphi*; Transverse orange stripes on abdomen in life, whole antennae 0.88-1.09 × body). This species is apparently known to heteroecious holocyclic, although host alternation has not been fully confirmed (Favret, 2018).

13. *Myzus* (*Nectarosiphon*) *persicae* (Sulzer, 1776) 복숭아혹진딧물

(Plate A10; Table A10)

Aphis persicae Sulzer, 1776.

Myzodes persicae Heinze, 1960.

Myzus persicae Smith, C.F. &Parron, 1978.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale brown. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly pale. URS dark. Legs pale brown. Genital plate pale dusky. SIPH and Cauda pale brown. ***Morphology*.** Body spindle-shaped, 2.13-2.26 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 0.67-0.83 times longer than body length; Ant.I granulate with 3-5 setae; Ant.II granulate with 3-4 setae; granulate with 13-14 setae, longest setae on Ant.III 0.28 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.94-1.20 times longer than 2HT, 0.84-0.99 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 2-4 on tergite III, 2-4 on tergite VI between the SIPH, 4 on tergite VIII. SIPH slightly swollen, imbricated and reticulated at apex, 1.94-2.42 times longer than cauda, 0.75-0.83 times longer than hind femur. Cauda oblong triangular, with 6 hairs. Genital plate dusky, 2 median hairs, 10-12 ciliated setae on posterior margin. **Alate viviparous female**. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale, with well developed scleroite and patch on Tergites III-VI, cross bands in front of and behind the patch.. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 9-15 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH slightly swollen, imbricated and reticulated at apex. Otherwise like apterous viviparous female. **Specimens examined**. South Korea. 2 ap., herbal testing center, hygn, GN, 21.iv.1999, col#99-0421-05, leg. Seunghwan Lee (NAS). 10 al., herbal testing center, hygn, GN, 21.iv.1999, on *Armoracia lapathifolia*, col.#99-0421-28, leg. Seunghwan Lee (NAS). 2 al., herbal testing center, hygn, GN, 21.iv.1999, on *Lysimachia barystachys* (NAS); 8 al., Geoncheon Service area, Gyeongsan, GB, 22.iv.1999, on *Brassica campestris*, col.#99-0421-55, leg. Seunghwan Lee (NAS). 7 al., herbal testing center, hygn, GN, 21.iv.1999, on *Sedum kamtschaticum*, col#99-0421-15, leg. Seunghwan Lee (NAS). 7 al., herbal testing center, hygn, GN, 21.iv.1999, on *Armoracia lapathifolia*, col.#99-0421-28, leg. Seunghwan Lee (NAS). 8 al., Seocheon**,** Namhae, GN, 30.iii.1999, on *Hemistepta lyrata*, leg. Seunghwan Lee (NAS); 7 al., 5 ap., Naju, JN, 14.v.1999, on *Prunus srrulata*, 99-0512-119SH, leg. Seunghwan Lee (NAS). 9 ap., 2 al., Gimcheon, GB, 12.v.1999, on *Eucommia ulmoides*, coll.#99-0512-27SH, leg. Seunghwan Lee (NAS). 20 ap., 1al., Euisung, herbal testing center, GB, 21.iv.1999, on *Pittosporum tobira*, coll.#99-0421-77, leg. Seunghwan Lee (NAS). 1al., Euisung, herbal testing center, GB, 22.iv.1999, on *Arilia continentalis*, coll.#99-0421-115, leg. Seunghwan Lee

(NAS). 10 ap., Ansung, GG, 29. iv.1999, on *Erigeron Canadensis*, coll#. 99-0429-01, leg. Seunghwan Lee (NAS). 4 al., 3 ap., Gapyeong, GG, 30.IV.1999, on *Galium spurium*, coll#.99-0429-30, leg. Seunghwan Lee (NAS). 5ap., Cheongwon, CB, 26.iv.2000, on *Goodyera schlechtendallana*, coll.#000425-TM09, leg. Seunghwan Lee (NAS). 7 ap., Sinpyeong, JJ, 19.iv.2000, on *Boehmeria nive*a, coll.#000417-sh54-1, leg. Seunghwan Lee (NAS). 5ap., Citrus lab, JJ, 19.IV.2000, on *Citrus unshlu*, coll.#000417-sh51, leg. Seunghwan Lee (NAS). 4 ap., Udo Island, JJ, 18.iv.2000, on *Euphorbia helloscopia*, coll.#000417-sh24, leg. Seunghwan Lee (NAS). 7 ap., 1 al., Marado, JJ, 24.v.2000, on *Spergularia rubra*, coll.000523-jy23, leg. J. Y. Choi. 8 ap., Jeonju, JB, 8.vi.2000, on *Nicotiana tabacum*, coll.#000607-jy26, leg. J. Y. Choi. 5 ap., Namwon, JB, coll#000607-JY09, leg. J. Y. Choi, 7.vi.2000, on *Nicotiana tabacum*; 3 al., 2 ap., KT&G lab. GG, 5.vi.2000, on *Nicotiana tabacum*, coll.#000605-jy02, leg. J. Y. Choi. 1 ap., Sangju, GB, 25.v.2000, on *Panax schinseng*, coll.#000522-GS70, leg. G. S. Lee. 2 ap., Sangju, GB, 25.v.2000, on *Paeonia lactiflora*, coll#000522-GS69, leg. G. S. Lee. 2 ap., Euisung, herbal testing center, GB, 24.v.2000, on *Lycium chinense*, coll#000522-GS58, leg. G. S. Lee. 2 al., Euisung, GB, 24.v.2000, on *Carthamus tinctorius*, coll.000522-GS45, leg. G. S. Lee. 2 ap., Eumseong, CB, 1.vi.2000, on *Arachis hypogaea*, coll#000531-GM19, leg. G. M. Kwon. 7 ap., 2 al., Korean Ginseng & Tobacco Research Institute, GG, 19.v.2000, on *Nicotiana tabacum*, #000519-TM01, leg. T. M. Han. 26 ap., Goesan, CB, 8.viiii.1998, on *Nicotiana tabacum*, leg. Seunghwan Lee (NAS). 2 al., 3 ny., Goyang, GG, 29.iii.2000, on *Malus pumila*, coll#.000329-GM10, leg. G. M. Kwon (NAS). 1 al., 6 ap., Buyeo, CN, 23.iii.2000, on *Lycopersicon esculentum*, coll#.000322-SH02, leg. Seunghwan Lee (NAS). 3 al., Ulleung, GB, 05.vi.2000, on Sasa borealis, coll#000605-sh96, GB, leg. Seunghwan Lee (NAS). 7 ap., herbal testing center, hygn, GN, , 20.vi.2000, on *Aster scaber*, coll#. 000620-SH35, leg. Seunghwan Lee (NAS). 8 ap., 3 al., SNU, Seoul, 02.v.2005, on *Rumex crispus*, col.#050502-HJ-4, leg. Hyojoong Kim. 1 al., Namgung, Yongin-si, GG, 17.v.2007, on *Brassica juncea*, col.#070517-IS-2, leg. Insu Kim. (Preserved specimens in alcohol): Broccoli farm, JJ, 07.v.2009, on Broccoli, col.# 090507-HR-14, leg. Hwalran Choi; Seopjikoji Beach, JJ, 07.v.2009, on *Brassica campestris*, col.# 090507-HR-27, leg. Hwalran Choi; Wonsan island, CN, 05.viii.2009, on *Prunus mume*, col.# 090805HR-3, leg. Hwalran Choi; Plum farm, JJ, 18.vi.2010, on *Prunus mume*, col.# 100618HR-8, leg. Hwalran Choi; CN, 14.iv.2011, on *Solanum lycopersicum*, col.# 110414HR-1, leg. Hwalran Choi; CN, 14.iv.2011, on *Solanum lycopersicum*, col.# 110414HR-2, leg. Hwalran Choi; CN, 14.iv.2011, on *Solanum lycopersicum*, col.# 110414HR-3, leg. Hwalran Choi; CN, 14.iv.2011, on *Solanum lycopersicum*, col.# 110414HR-4, leg. Hwalran Choi; Paprika brother's farm, Hwasun, JN, 12.iv.2012, on Paprika, col.# 20120412HR-5, leg. Hwalran Choi; Paprika brother's farm, Hwasun, JN, 06.iv.2012, on Paprika, col.# 20120412HR-6, leg. Hwalran Choi; Paprika brother's farm, Hwasun, JN, 08.iv.2012, on Paprika, col.# 20120412HR-8, leg. Hwalran Choi; Paprika brother's farm, Hwasun, JN, 09.iv.2012, on Paprika, col.# 20120412HR-9, leg. Hwalran Choi; SNU, Seoul, 15.v.2012, on *Galium spurium*, col.# 20120515HR-3, leg. Hwalran Choi; Greenhouse, Gwangyangsi, JN, 24.vii.2013, on Paprika, col.# 130724-HR-24, leg. Hwalran Choi. (DNA preserved specimens): Greenhouse, Gwangyangsi, JN, 24.vii.2013, on Paprika, col.# 130724-HR-24, no.DNA680, experimenter Hwalran Choi.

Host plants. Primary hosts: *Prunus persica*, *P. nigra*, Secondary hosts: wide ranges of host plants.

Distributions. Asia (Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, China, Gaza, Georgia, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Kazakhstan, Korea, Kyrgyzstan, Laos, Lebanon, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Syria, Taiwan, Thailand, Turkey, Turkmenistan, Uzbekistan, Vietnam, Yemen), Africa (Algeria, Angola, Benin, Burundi, Cameroon, Congo, Egypt, Ethiopia, Ghana, Kenya, Libya, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Nigeria, Réunion, Rwanda, Saint Helena, Seychelles, Sierra Leone, South Africa, Sudan, Tanzania, Tunisia, Uganda, Zambia, Zimbabwe), North America (Bermuda, Canada, Mexico, USA), Central America and Caribbean (Bahamas, Barbados, Costa Rica, Cuba, Dominican, El Salvador, Guatemala, Honduras, Jamaica, Panama, Puerto Rico), South America (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Suriname, Uruguay, Venezuela), Europe (Albania, Austria, Belarus, Belgium, Bosnia-Hercegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Czechoslovakia, Denmark, Finland, France, Germany, Gibraltar, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Macedonia, Malta, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, UK, Ukraine, Yugoslavia), Oceania (Australia, Fiji, New Caledonia, New Zealand, Northern Mariana Islands, Solomon Islands, Tonga).

Remarks. Body 2.13-2.26 mm. Absence of secondary rhinaria on Ant.III (Al. 12-14 secondary rhinaria on Ant.III). Cauda with 6 hairs. This species has world widely known to agricultural pest in various plants. It is heteroecious holocyclic, having secondary hosts in over 40 different plant families (Blackman & Eastop 2000). There are two subspecies recorded in the world (*M. persicae nicotianae* and *M. persicae dyslycialis* (Blackman & Eastop, 2006).

14. *Myzus* (*Myzus*) *philadelphi* Takahashi, 1965 고광나무혹진딧물

(Plate A11; Table A11)

Myzus philadelphi Takahashi, 1965; Miyazaki 1971; Remaudière, G. & M. Remaudière. 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly dark except basal part of Ant.III. URS dark. Legs dark except basal 1/3 of femora.. Genital plate dark dusky. SIPH black and Cauda dark brown. ***Morphology.*** Body spindle-shaped, 2.05-2.51 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 2.05-2.51 times longer than body length; Ant.I granulate with 3-4 setae; Ant.II granulate with 2-4 setae; Ant.III 23-30 with 12-25 setae, longest setae on Ant.III 0.13-0.33 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.85-1.33 times longer than 2HT, 0.55-0.89 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 2 on tergite VIII. SIPH cylindrical, with reticulated cuticles, 3.07-3.96 times longer than cauda, 0.69-0.94 times longer than hind femur, distal 1/3 reticulated apex. Cauda oblong triangular, with 4-8 hairs. Genital plate dusky, 2 median hairs, 8-10 ciliated setae on posterior margin.

Specimens examined. South Korea. 9 ap., Cheongwansan Recreational forest, Jangheung-gun, JN, 15.v.2009, on *Philadelphum schrenkii.*, col.#090515-SH-6, leg. Seunghwan Lee. (Preserved specimens in alcohol): Mulhyanggi Arboretum, GG, 09.vi.2009, on *Philadelphum schrenkii*, col.#090608-HR-13, leg. Hwalran Choi; Mulhyanggi Arboretum, GG, 10.vi.2011, on *Philadelphum schrenkii*, col.# 20110610hr-3, leg. Hwalran Choi. (DNA preserved specimens): Mulhyanggi Arboretum, GG, 09.vi.2009, on *Philadelphum schrenkii*, col.#090608-HR-13, no.DNA37, experimenter Hwalran Choi; Mulhyanggi Arboretum, GG, 10.vi.2011, on *Philadelphum schrenkii*, col.# 20110610hr-3, no.DNA422, experimenter Hwalran Choi.

Host plants. *Deutzia crenata*, *Hydrangea macrophylla*, *Philadelphus satsumi* (Hydrangeaceae).

Distributions. Japan and Korea (South).

Remarks. Body 2.05-2.51 mm. Absence of secondary rhinaria on Ant.III. Cauda with 4-8 hairs. The species has unique colors with a pattern of black and orange stripes in life, although those colors disappeared in preserved samples.

15. *Myzus* (*Myzus*) *pruni* sp. nov. 검은점혹진딧물*

(Plate A12; Table A12)

Etymology. The species name *pruni* is derived from the generic name of host plant *Prunus* sp.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head and antennal tubercles dark like SIPH and cauda (Fig. 1F). Thorax pale with dark patch between central prothorax and mesothorax (Fig. 1A). Metathorax with a low of pigmented scleroites. Abdomen pale with dark marginal pigmented scleroites on tergites I-VIII, irregular pigmented scleroites on tergites I-VIII, dense and rather bigger pigmented scleroites on the central tergites I-III (Fig. 1A). Antennae wholly dark except basal part of Ant.III., and granulated surface with several setae (Fig. 1C and D). URS pale like abdomen and trochanters (Fig. 1G). Legs pale but coxae dark like SIPH and cauda (Fig. 1B). Genital plate dark dusky (Fig. 1A). SIPH and Cauda dark (Fig. 1E and H). ***Morphology.*** Body oval-shaped, 1.69-2.18 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, roughly granulate on dorsum; 1-2 pair of setae on vertex and 3-4 more on inner side of each antennal tubercle; antennal tubercles well developed, median frontal tubercles rarely developed. Antennae slight, 0.57-0.66 times longer than body length; Ant.I granulate with 5-9 setae; Ant.II granulate with 3-4 setae; Ant.III granulate with 12-16 setae; longest setae on Ant.III 0.40-0.57 times longer than the basal diameter of the segment; without secondary rhinaria on Ant.III. Rostrum attaining the mesothorax; clypeus with 4 setae; mandibular laminae with 6-7 hairs; URS tongue shaped, 1.47-2.54 times longer than 2HT, 0.79-1.06 times longer than Ant.VIb.

Thorax: Prothorax with 4 spinal setae and one pair marginal seta; mesothorax with slightly separated mesoternal furca; metathorax with well-separated metasternal furca. Legs smooth with setae, hind coxae spinulate with 12 acute hairs; trochanter smooth; femur spinulate and longer than SIPH bearing short setae; hind tibia spinulate with irregular low of many setae; first segment of each tarsus smooth with about three setae at apex; 2HT imbricated with 4 setae. **Abdomen**: wrinkled cuticle like other *Myzus* species, *M. cerasi* and *M. sigesbeckiae* (Fig. 6 and 13). Abdominal tergites membranous with developed pigmented scleroites on tergites I-III with setae, scattered pigmented scleroites on tergites I-VIII. SIPH parallel, cylindrical, roughly imbricated, and flanged at apex (Fig. 1E). 2.02-2.50 times longer than cauda, 0.48-0.79 times longer than hind femur. Cauda triangular shaped with 4-5 hairs (Fig. 1H). Genital plate dusky surfaced with 2 median setae and 10-13 ciliated setae on posterior margin.

Specimens examined. Holotype. South Korea. 1 ap., Mungyeongseje, Mungyeong-eup, GB, 18.v.2005, on *Prunus* sp., col.#050518-SH-32, leg. Seunghwan Lee. Paratypes. 5 ap., same data as the holotype.

Host plants. *Prunus* sp. (Rosaceae).

Distributions. Korea (South).

Remarks. *M. pruni* **sp. nov.**, is collected on *Prunus* tree (Rosaceae: Amygdaloideae) and Many *Myzus* species have been known *Prunus*-feeding aphids in the world (Szelegiewicz, 1969, Medda & Chakrabarti 1986, Blackman and Eastop 1994, Favret, 2018). Among them, the species is morphologically similar to *M. asiaticus* (Szelegiewicz, 1969) and *M. siegesbeckiae* but it can be distinguished by dark pigmented scleroites on abdomen.

16. *Myzus* (*Myzus*) *asterale* sp. nov. 문경혹진딧물*

(Plate A13; Table A13)

Etymology. The species name *asterale* is derived from the host plant name *Aster* sp. and a Latin suffix -ale added to noun roots to form adjectives meaning "pertaining to".

Description. **Apterous viviparous female**. ***Color*** (macerated specimens): Head, abdomen and thorax pale as a same colored tone (Fig. 2A). Abdomen pale with dark marginal pigmented scleroites on tergites I-VIII. Antennae wholly pale except lightly browned Ant.VI ((Fig. 2C and D). URS pale (Fig. 2G). Legs pale brown like SIPH and cauda, but distal 1/5 of tibia and 2HT lightly dark (Fig. 2B). Genital plate pale dusky (Fig. 2A). SIPH and Cauda pale brown (Fig. 2E and H). ***Morphology.*** Body oblong-shaped, 1.59-2.07 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; 1-2 pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; antennal tubercles well developed. Median frontal tubercles rarely developed. Antennae slight, 0.51-0.61 times longer than body length; Ant.I granulate with 2-5 setae; Ant.II granulate with 2-4 setae; Ant.III granulate with 8-14 setae, longest setae on Ant.III 0.25-0.40 times longer than the basal diameter of the segment. Rostrum attaining the meso coxae; clypeus with 3-4 setae; mandibular laminae with 4-5 hairs; URS tongue shaped, 1.01-1.43 times longer than 2HT, 0.86-1.29 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 4 spinal setae and one pair marginal seta on each side of pronothum. Legs smooth. Hind coxa spinulate with 6-7 acute hairs; trochanter smooth;

femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. 2HT imbricated with 6 setae. **Abdomen**: Abdominal tergites smooth with spinulate, 4-5 setae on tergite III, 4-5 setae on tergite VI between the SIPH, 2 setae on tergite VIII. SIPH slightly curved outwards, imbricated and flanged at apex, 1.52-2.54 times longer than cauda, 0.55-0.72 times longer than hind femur (Fig. 2E). Cauda triangular shaped with 4-6 hairs (Fig. 2H). Genital plate dusky with 2 median hairs and 9-13 ciliated setae on posterior margin.

Specimens examined. Holotype. South Korea. 1 ap., Mungyeongseje, Mungyeong-eup, GB, 18.v.2005, on *Aster* sp., col.#050518-SH-65, leg. Seunghwan Lee. Paratypes. 9 ap., same data as the holotype.

Host plants. *Aster* sp. (Asteraceae).

Distributions. Korea (South).

Remarks. *M. asterale* **sp. nov.**, is collected on *Aster* (Asteraceae) and the plant genus *Aster* is one of secondary host in *Myzus* aphids, associating about four species (*M. asteriae*, *M. ornatus* Laing 1932, *M. persicae* and *M. siegesbeckicola*) in the world. Moreover, *M. asterale* **sp. nov.**, is morphologically very similar to *M. mushaensis* in Korea. However, *M. asterale* **sp. nov.**, is distinguished from the four above species by parallel and slightly curved SIPH at apex, and ratio of SIPH/body.

17. *Myzus* (*Nectarosiphon*) *raphani* 갯무혹진딧물*

(Plate A14; Table A14)

Etymology. The species name *raphani* is derived from generic name of host plant *Raphanus sativus*.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark (Fig. 3F). Thorax and abdomen dark but less than head, with marginal pigmented scleroites on tergites I-VIII (Fig. 3A). Antennae wholly pale except pigmented Ant.I, Ant.II, Ant.V and Ant.VI; Ant.I dark brown like head; Ant.II pale brown like distal half of femur and SIPH; Ant.III-IV pale; Ant.V-VI pale brown (Fig. 3A, C and D). URS pale yellow (Fig. 3G). Legs generally pale yellow but coxae, distal half of femur, tips of tibia, tarsus dark brown (Fig. 3A and B). Genital plate dark brown. SIPH pale yellow like Ant.III and base of femur but dark at apex (Fig. 3E). Cauda dark brown like genital plate (Fig. 3H). ***Morphology.*** Body oval-shaped, 1.27-1.77 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; two pair of hairs on vertex; antennal tubercles well developed. Antennae slight, 0.81-1.10 times longer than body length; Ant.I smooth with 3-6 setae; Ant.II smooth with 3-5 setae; Ant.III smooth with 8-13 setae, longest setae on Ant.III 0.15-0.24 times long than the basal diameter of the segment. Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4 hairs; URS tongue shaped, 0.69-0.85 times longer than 2HT, 0.44-0.54 times longer than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 2 spinal setae and one pair marginal seta on each side of pronothum. Hind coxae spinulate with 6 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. 2HT imbricated with 7 setae. **Abdomen**: Abdominal tergites smooth, wholly pigmented; 2 setae on tergite III, 2 on tergite VI between the

SIPH, 2 on tergite VIII. SIPH elongated, gently granulated, slightly swollen of distal half, imbricated and flanged at apex, 2.11-2.45 times longer than cauda, 0.69-0.79 times longer than hind femur (Fig. 3E). Cauda triangular shaped with 6 hairs (Fig. 3H). Genital plate dusky with 2 median hairs and 9-11 ciliated setae on posterior margin.

Specimens examined. Holotype. South Korea.1 ap., Jingyo-myeon, Hadong-gun, GN, 08.iv.2006, on *Raphanus sativus*, col.#060408-SH-4, leg. Seunghwan Lee. Paratypes. 6 ap., same data as the holotype.

Host plants. *Raphanus sativus* (Brassicaceae).

Distributions. Korea (South).

Remarks. About three polyphagous *Myzus* species have been known on the host plant *Raphanus sativus* (Brassicaceae) (ex. *M. ascalonicus* Doncaster 1946, *M. ornatus* and *M. persicae*) in the world (Blackman and Eastop, 2004; Favret, 2018) and we newly report *M. raphani* **sp. nov.**, on the list. *M. raphani* **sp. nov.**, is easily distinguished from the three polyphagous *Myzus* species by evenly pigmented abdomen. In Korea, *M. lactucicola* is morphologically closest species with *M. raphani* **sp. nov.**, but it can be distinguished by more swollen SIPH, dark head color and ratio of SIPH/cauda.

18. *Myzus* (*Myzus*) *siegesbeckiae* Takahashi, 1965 벗나무노랑혹진딧물

(Plate A15; Table A15)

Myzus siegesbeckiae Takahashi, 1965; Miyazaki 1971; Remaudière, G. & M. Remaudière, 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen dark with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly dark except Ant.III-IV. URS dark. Legs dark except basal 4/5 of femora.. Genital plate dark dusky. SIPH black and Cauda dark brown. ***Morphology*****.** Body spindle-shaped, 1.37-1.39 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 0.62-0.64 times longer than body length; Ant.I granulate with 4-7 setae; Ant.II granulate with 3-5 setae; Ant.III granulate with 6-10 setae, longest setae on Ant.III 0.28-0.33 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.42-2.03 times longer than 2HT, 1.19-1.44 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 4 on tergite III, 4 on tergite VI between the SIPH, 2 on tergite VIII. SIPH cylindrical, with strongly reticulated cuticles, 2.29-2.79 times longer than cauda, 0.74-0.86 times longer than hind femur, with distal part slightly curved outwards. Cauda oblong triangular, with 4-6 hairs. Genital plate dusky, 2 median hairs, 6 ciliated setae on posterior margin.

Specimens examined. South Korea. 4 ap., Horyonggoksan, Muii-do, Incheon, 08.vii.2009, on *Prunus serrulata*., col.#090708-HR-1, leg. Hwalran Choi.

(Preserved specimen in alcohol): Horyonggoksan, Muii-do, Incheon, 08.vii.2009, on Prunus serrulata, col.#090708-HR-1, leg. Hwalran Choi; China, 15.viii.2010, on *Siegesbeckia glabrescens*, col.# 100815SH-50, leg. Hwalran Choi; SNU, Seoul, 22.viii.2011, on *Prunus serrulata*, col.# 20110822hr-3, leg. Hwalran Choi; Taehwa mountain, GG, 15.vi.2013, on *Prunus serrulata*, col.# 130615HR-6, leg. Hwalran Choi. (DNA preserved specimens): Guesthouse, JJ, 07.v.2009, on *Prunus serrulata*, col.# 090507-HR-54, no.DNA366, experimenter Hwalran Choi.

Host plants. Primary hosts: *Prunus yedoensis*, *P. persica*, *P. mume*, *Prunus* spp. (Rosaceae), Secondary hosts: *Isodon* sp., *Plectranthus* sp., *Salvia nipponica* (Lamiaceae).

Distributions. China, India, Japan, Korea (South) and Taiwan.

Remarks. Body 1.37-1.39 mm. Absence of secondary rhinaria on Ant.III. Cauda with 4-6 hairs. Alive colors are variable from yellow to black, and are known to heteroecious holocyclic, migrating to Lamiaceae (*Isodon* sp., *Plectranthus* sp. and *Salvia nipponica*) (Favret, 2014).

19. ***Myzus* (*Myzus*) *siegesbeckicola*** Strand, 1929 진득찰혹진딧물

(Plate A16; Table A16)

Myzus siegesbeckicola Strand, 1929; Takahashi, 1937.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen dark with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark. URS dark. Legs dark. Genital plate dark dusky. SIPH dark and Cauda dark. ***Morphology.*** Body spindle-shaped, 1.26-1.40

mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 0.58-0.67 times longer than body length; Ant.I granulate with 3-5 setae; Ant.II granulate with 2-4 setae; Ant.III granulate with 6-12 setae, longest setae on Ant.III 0.13-0.32 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.36-1.70 times longer than 2HT, 1.41-1.64 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 2 on tergite VIII. SIPH cylindrical, with reticulated cuticles, 2.27-2.60 times longer than cauda, 0.80-1.05 times longer than hind femur. Cauda oblong triangular, with 4-5 hairs. Genital plate dusky, 2 median hairs, 10 ciliated setae on posterior margin.

Specimens examined. South Korea. 1 ap., Seoul, 1.ix.1963, on *Siegesbeckia globrescens*, col.#2189. 4 ap., Manripo, Taean-gun, CN, 20.viii.1963, on *Siegesbeckia globrescens*., col.#1689. 1 ap., Seoul, 1.ix.1963, on Siegesbeckia globrescens, col.#2189 (NAS). 4 ap., Manripo, Taean-gun, CN, 20.viii.1963, on *Siegesbeckia globrescens*, col.#1689 (NAS).

Host plants. *Artemisia* sp., *Aster* sp., *Chromolaena* sp., *Montanoa* sp., *Siegesbeckia* spp. (Asteraceae).

Distributions. East Siberia, India, Japan, Korea (South), Pakistan, Sumatra and Taiwan.

Remarks. Body 1.26-1.40 mm. Absence of secondary rhinaria on Ant.III. Cauda with 4-5 hairs. Genital plate is strongly produced posteriorly. The species is mostly recorded in Asia (east Siberia, India, Japan, Korea (South), Pakistan, Sumatra and Taiwan.). Previous taxonomic studies suggested that placing this species to the genus *Tuberocephalus* would be more correct (Blackman and Eastop, 2006; Favret, 2018).

20. ***Myzus* (*Nectarosiphon*) *stellariae*** Tao, 1963 **별꽃혹진딧물***

(Plate A17; Table A17)

Myzus stellariae Tao, 1963; Miyazaki, 1971; Eastop & Hille Ris Lambers, 1976; Remaudière, G. & M. Remaudière, 1997.

Description. Alate viviparous female. ***Color*** (macerated specimens): Head dark. Antenna entirely dark. Thorax dark. Abdomen pigmented with developed marginal scleroites. SIPH dark brown except middle part. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology.*** Body spindle-shaped, 2.32 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 0.92-0.95 times longer than body length; Antenna with 29-31 secondary rhinaria in Ant.III; 19-22 in Ant. IV; 7-10 in Ant. V. Ant.I granulate with 3-5 setae; Ant.II granulate with 1-2 setae; granulate with 1-2 setae, longest setae on Ant.III 0.20 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.69-1.72 times longer than 2HT, 0.64-0.71 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with large patch and marginal scleroite. SIPH slightly swollen from distal half part, pigmented at basal part and apex, smooth and flanged at apex, 3.27-3.56 times longer than cauda, 0.49-0.54 times longer than hind femur. Cauda oblong triangular, with 4 hairs. Genital plate dusky, 2 median hairs, 6 ciliated setae on posterior margin.

Specimens examined. South Korea. 3 al., Soheuksando Island, JN, 28.Jun.1974, on *Stellaria* sp., col.#657 (NAS); 4 ap., Mt. Yeogisan, Suwon-si, GG, 15.x.1998, on *Stellaria aquatic*, leg. Seunghwan Lee (NAS). Japan. 1 ap., 2 al., 1 ny., Tokyo, Japan, *Myzus stellariae*, 15.viii.1960, on *stellaria* sp., leg. R. Takahashi.

Host plants. *Stellaria aquatic*, *S.* spp. (Caryophyllaceae).

Distributions. Japan, Korea (South) and Taiwan.

Remarks. Alate viviparous female of Korean *M. stellariae* (Strand, 1920) had been trapped by British Museum of Natural History (London, UK.) for the first record in Korea (Blackman and Eastop, 2006; Favret, 2018). In this study, we newly have confirmed Korean *M. stellariae*.

21. *Myzus* (*Myzus*) *varians* Davison, 1912 검은마디혹진딧물

(Plate A18; Table A18)

Myzus varians Davidson, 1912; Miyazaki, 1971; Remaudière, G. & M. Remaudière. 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6. Antenna wholly pale except distal part. URS dark. Legs pale..Genital plate dark dusky. SIPH black with basal 1/3 pale. Cauda pale. ***Morphology.*** Body spindle-shaped, 1.72-1.98 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, granulate on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle; lateral frontal tubercles well developed. Antennae slight, 0.73-0.88 times longer than body length; Ant.I granulate with 4-9 setae; Ant.II granulate with 2-4 setae; Ant.III granulate with 10-19 setae, longest setae on Ant.III 0.21-0.55 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.01-1.58 times longer than 2HT, 0.91-1.20 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about three setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 2 on tergite III, 2 on tergite VI between the SIPH, 2 on tergite VIII. SIPH cylindrical, with reticulated cuticles, 2.31-2.91 times longer than cauda, 0.75-0.92 times longer than hind femur.. Cauda oblong triangular, with 6-9 hairs. Genital plate dusky, 2 median hairs, 9-13 ciliated setae on posterior margin.

Specimens examined. South Korea. 10 ap., Hwajeon-ri, Nam-myon, Hongcheon-gun, GW, 31.vii.2009, on *Prunus persicae*, col.#090731-HR-2, leg. Hwalran Choi. (Preserved specimen in alcohol): Chiak mountain, GW, 05.viii.2010, on *Prunus persicae*, col.# 100805HR-4, leg. Hwalran Choi; Taehwa mountain, GG, 16.vi.2012, on *Prunus persicae*, col.# 20120616HR-14, leg. Hwalran Choi.

(DNA preserved specimens): Wonsan island, CN, 05.viii.2009, on *Prunus persicae*, col.# 090805-HR-2, no.DNA653, experimenter Hwalran Choi.

Host plants. Primary hosts: *Prunus persica* (Rosaceae), Secondary hosts: *Clematis* spp. (Ranunculaceae).

Distributions. China, Europe, India, Japan, Korea (South), Taiwan, Thailand and Vietnam.

Remarks. The species is commonly occurring on peach farm in Korea, making pseudo gall on leave. It is known to heteroecious holocyclic and serious pest on peaches (Arzone & Alma, 1984). Body 1.72-1.98 mm. Absence of secondary rhinaria on Ant.III. Cauda with 6-9 hairs. Morphologically, this species can be easily distinguished by SIPH jet-black apically and Ant. III-V black apically.

Chapter 2-2.

Taxonomic review of genus *Uroleucon* (Hemiptera: Aphididae) in the Korean Peninsula

Abstract

The aphid genus *Uroleucon* Mordvilko, 1914 (Hemiptera: Aphididae) is recognized from the Korean Peninsula. A total of twenty species of Korean *Uroleucon* are confirmed including two new species: *U.* (*Uromelan*) *chrysanthemicola* **sp. nov.**, on *Chrysanthemum* sp. (Asteraceae) from Mt. Oseo, Korea and *U.* (*Uroleucon*) *echinopsis* **sp. nov.**, on *Echinops setifer* Iljin (Asteraceae) from Jeju Island, Korea. Two new species are described with biometric measurements, illustrations, and identification keys to subgenera and species are presented.

Key words: *Uroleucon*, Taxonomy, new species, Korean Peninsula.

Introduction

The aphid genus *Uroleucon* Mordvilko, 1914 is one of species-rich group in Aphididae, including 190 described species (Favret, C. Aphid Species File Version 5.0/5.0. [23.Mar.2018]). They contain six subgenera, nominotypical *Uroleucon* Mordvilko, 1914, *Uromelan* Mordvilko, 1914, *Lambersius* Olive, 1965, *Belochilum* Börner, 1932, *Divium* Pashchenko, 2000 and *Satula* Olive, 1963 in the world (Blackman and Eastop, 2006; Nieto Nafrìa *et al*., 2007). Among six subgenera, mainly three subgenera, *Uroleucon*, *Uromelan* and *Lambersius* consist of over 187 species. In the other hands, remained three minor subgenera, *Belochilum*, *Divium* and *Satula* have only 1 valid species each. *Uroleucon* had been belonging to the subgenus of the genus *Macrosiphum* Passerini, 1860, which is another genus of tribe Macrosiphini Wilson, 1910. Later, *Uroleucon* was erected as an own genus *Dactynotus* sensu Hille Ris Lambers (1939). After that, the former *Dactynotus* was regarded as current name, '*Uroleucon*' by Eastop & Hille Ris Lambers (1976). Taxonomic study of the *Uroleucon* has been studied through the world and accounts have been dealt with these regions: western Europe, UK, Ireland, Fennoscandia, Denmark, Russia, Siberia, Iran, Kazakhstan, Japan, Korea, China, India, South America, Argentina, Puerto Rico, Mexico and North America (Favret, C. Aphid Species File Version 5.0/5.0. [23. Mar. 2018]).

Uroleucon is host-specific (monoecious; Blackman and Eastop, 2006) aphids without host alternating, and is associated with herbaceous plant family Asteraceae mostly, although few species have been recorded from Campanulaceae or other plant families (Blackman & Eastop, 2006). For those plant host preference, Moran *et al*., (1999) conducted phylogenetic study and monophyly of *Uroleucon* had been revealed. Moreover, recent phylogenetic study agreed monophyly of the genus based on molecular data within two subgenera, *Uroleucon* and *Uromelan* (Choi *et al*., 2018).

In Korean Peninsula, three subgenera *Uroleucon*, *Uromelan* and *Lambersius* have been reviewed by following authors: Paik, 1972, Lee *et al*., 2002a; 2002b and Choi *et al*., 2012. In this study, twenty species of Korean *Uroleucon* are recognized, adding two new species, *U. chrysanthemicola* **sp. nov.**, and *U. echinopsis* **sp. nov.** The *U. chrysanthemicola* **sp. nov.**, was collected on *Chrysanthemum* sp. (Asteraceae) from Mt. Oseo, Korea. It is morphologically similar to *Uroleucon amamianum* (Takahashi, 1930). However, *U. chrysanthemicola* **sp. nov.**, is distinguished by triangular shaped cauda and ratio of body part such as ultimate rostral segment and second segment of hind tarsus, siphunculi and antennal segment III, and length of setae on abdomen. The *U. echinopsis* **sp. nov.**, was collected on *Echinops setifer* Iljin (Asteraceae) from Jeju Island, Korea. It is morphologically similar to *Uroleucon kikioense* (Shinji, 1942). However, *U. echinopsis* **sp. nov.**, has numerous and strongly prutuberant rhinaria distributed over its entire length on antennal segment III.

Korean species of North and South region collected by National institute of Agricultural Sciences (NAS), Junju, Korea and Seoul National University (SNU), Seoul, Korea are observed for this study. Japanese specimens of Hokkaido University Insect Collection, Japan and American specimens of NC State University Insect Museum, U.S.A are checked via loan and visiting by author. Host plants, distributions, identification keys to all Korean species are presented. Two new species are described with biometric measurements, illustrations for apterous viviparous females and keys to world species of genus *Uroleucon* compiled on host plants.

Materials and methods

The fresh aphid samples were preserved in 80% alcohol, and slide-glass specimens were made on Canada balsam, following Blackman and Eastop (2000) and Martin's (1983) methods. Illustrations for each species were taken by digital camera (14.2 Color Mosaic, Diagnostic Instruments, Sterling Heights, MI, USA) attached to the microscope (DM 400B, Leica Microsystems, Wetzlar, Germany) at a resolution of 600 dpi. Measurements for each specimen are taken from the digital images by Image Laboratory v2.2.4.0 software (MCM Design Ltd, Hillerod, Denmark).

Major samples of this study are deposited in the College for Agriculture and Life Sciences, Seoul National University (CALS SNU, Korea), and the National Institute of Agricultural Sciences (NAS, Korea).

Abbreviations used for descriptions are as follows: al., alate viviparous female; ap., apterous viviparous female; ny., nymph; Ant., antennae; Ant.I, Ant.II, Ant.III, Ant.IV, Ant.V, Ant.VI and Ant.VIb, antennal segments I, II, III, IV, V, VI and base of VI, respectively; Ant.IIIBD, basal diameter of antennal segment III; AbdT.III, abdominal tergite III; BL, length of body; GP, genital plate, 2HT, second segment of hind tarsus; PT, processes terminals; SIPH, siphunculi; URS, ultimate rostral segment (segment IV+V). For the localities of distribution, provincial abbreviations are also used: GB, Gyeongsangbuk-do; GN, Gyeongsangnam-do; GG, Gyeonggi-do; GW, Gangwon-do; HN, Hamgyeongnam-do; JB, Jeollabuk-do; JN, Jeollanam-do; JJ, Jeju-do; PN, Pyeongannam-do; RG, Ryanggangdo.

Terminal taxa names with an asterisk (*) indicates a new record in the Korean Peninsula.

Systematic accounts

Hemiptera 노린재목

Infraorder Sternorrhyncha 진딧물아목

Family Aphididae 진딧물과

Subfamily Aphidinae 진딧물아과

Tribe Macrosiphini 수염진딧물족

Genus *Uroleucon* Mordvilko, 1914 흰끝수염속진딧물

Macrosiphum (*Uroleucon*) Mordivilko, 1914.

Dactynotus Hille Ris Lambers, 1939.

Uroleucon Eastop & Hille Ris Lambers, 1976; Moran *et al*., 1999; Nieto Nafría *et al*., 2011.

Type species: *Aphis hieracium-paniculatum* Rafinesque, 1818

Diagnosis. *Uroleucon* is a medium to large sized aphids (ca. 2.3mm-4.3mm) with dark bronzy red or black in live (a few species are green in live). About 190 valid species are distributed in the world. They have usually distal band of polygonal reticulation on SIPH, and pigmented spots (scleroites) on abdomen are developed. Dominant host plants are Asteraceae, although some species prefer other plant families such as Campanulaceae.

Key to subgenera of *Uroleucon* in the Korean Peninsula (based on the apterous viviparous female) modified from Miyazaki (1971), Pashchenko (1988) and Lee *et al.*, (2002b).

1. Body green in life. Cauda pale and SIPH pale at least on basal 1/3. Abdominal tergum membranous without any pigmentation..............................
....….....…Subgenus *Lambersius* Olive

- Body dark red or black in life. Cauda dark or pale and SIPH dark and dusky. Abdominal tergum with many pigmented scleroites, at least with postsiphuncular scleroites……………..……2

2. Cauda pale or yellow, distinctly paler than SIPH..
....…Subgenus *Uroleucon* Mordvilko

- Cauda dark or concolorous with SIPH...
....……………....Subgenus *Uromelan* Mordivilko

Subgenus *Uroleucon* sensu stricto

Uroleucon Mordivilko, 1914; Moran *et al*., 1999; Nieto Nafría *et al*., 2011.
Eurythaphis Mordivilkko, 1914.
Megalosiphum Mordivilkko, 1914.
Tritogenaphis Oestlund, 1922.
Type species: *Aphis sonchi* Linne, 1767.

Key to species of subgenus *Uroleucon* in the Korean Peninsula (based on the apterous viviparous females) modified from Lee *et al.*, (2002b) (*U. exiguum* Lee, Holman & Havelka has been keyed for alate form because of original description).

1. Coxae pale like cauda. Numerous hairs on abdomen with less developed scleroites. Longest setae on AbdT.III 1.43-2.16 × Ant.IIIBD........................2

- Coxae pale yellow to black. If coxae pale yellow, longest setae on AbdT.III 0.91-1.78 × Ant.IIIBD. If coxae black colored, abdomen with distinctly developed scleroites……………..…..………..3

2. SIPH more than 1.8 × cauda. Cauda with less than 35 long hairs, number of secondary rhinaria on Ant.III less than 35, scattered over the whole length of segment. On *Aster ageratoides* var. *semiamplexicaulis*, *Aster maackii*, *Erigeron annuus*, *Erigeron acris*............…...............*U. monticola* (Takahashi)

- SIPH only a little longer than Cauda (1.1 times). Cauda with more than 35 setae. Ant.III with more than 20 rhinaria, confined to basal half, rarely over two-third of its length. On *Aster scaber*, *Lactuca raddeana*, *Cacalia hastata*, *Saussurea grandifolia*……...….*U. fuchuense* (Shinji)

3. URS shorter than 2HT. Scleroites on abdomen small or absent, with short setae, as long as or slightly longer than the middle width of Ant.III.......…...4

- URS as long as or usually longer than 2HT. Abdomen with distinct scleroites, if scleroites indistinct, the dorsal setae more than twice as long as the middle width of Ant.III………………………............……………..5

4. AbdT.III with at most 10 setae including marginal ones. SIPH at most 4.0 × basal width, shorter than Ant.III, 0.24-0.30 × body.....................................6

- AbdT.III with at least 12 setae. SIPH distinctly longer than Ant.III, more than 6.0 × basal width, 0.31-0.33 × body. Head pale brown. Middle of SIPH pale except basal and apex. On *Ixeris dentate*, *Sonchus* spp………...……*U. sonchi* (Linnaeus)

5. Ant.III as long as or longer than Ant. IV and Ant. V…………...……......7

- Ant. III distinctly shorter than Ant. IV and Ant. V......................………8

6. Whole antennae 0.91-0.96 × body. Head dark. URS reach to mesothorax. Ant. III with 6-18 rhinaria. On *Adenophora*, *Campanula*, *Platycodon* (Campanulaceae)…………………………..……...................*U. kikioense* (Shinji)

- Whole antennae 1.24-1.38 × body. Head as pale as cauda and basal portion of femur. URS reach to over metathorax. Ant. III with 84-107 rhinaria. On *Echinops setifer* (Asteraceae) ……………………...........*U. echinopsis* **sp. nov.**

7. URS more than 1.4 × 2HT. Abdomen with well pigmented scleroites at bases of dorsal setae. Ant.III slightly longer than Ant. IV and Ant. V together. On *Aster maackii*, *Centaurea*, *Lactuca indica*, *Ixeris dentate*, *Picris hieracioides* var. *Glabrescens*, *Sonchus* sp……...........…*U. picridis* (Fabricius)

- URS as long as or slightly longer than 2HT. Abdomen without black pigmented scleroites or with only pale scleroites at very base of dorsal setae. Ant.III more than 1.5 × Ant. IV and Ant. V together. On *Ixeris* spp, *Lactuca* spp, *Sonchus* spp., *Taxaxacum platycarpum*, *Youngia japonica*........................ ....*U. formosanum* (Takahashi)

8. Ant. III of alate viviparous female with 2-3 secondary rhinaria confined to basal half in a line. Cauda with 4 hairs. Primary rhinaria on Ant. V large, the longest diameter conspicuously (>1.5 times) longer than the middle width of the segment……….................................*U. exiguum* Lee, Holman & Havelka

- Ant. III of alate and apterous viviparous females with at least 20 secondary rhinaria, scattered through the segment. Cauda with at least 10 hairs. The longest diameter of primary rhinaria on Ant. V shorter than the middle width of the segment……………………….........................……………………...…9

9. Ant. III with less than 40 secondary rhinaria, confined to basal two- third. Ant. III-IV and tibia except at base and distal 1/5, pale, concolorous with abdomen, at most dusky, paler than Ant. I-II. SIPH as equal or slightly

shorter than hind femur, longer than Ant. III. Genital plate pale, dusky. Primary rhinaria on Ant. V nude. On *Aster scaber*, *A. koraiensis*……………..…….…...…*U. asteriae* Lee, Holman & Havelka

- Ant. III with more than 40 secondary rhinaria over the whole length of segment. Antennae and tibia black, basal half of tibia paler than the distal part, but not concolourous with abdomen. SIPH shorter than Ant.III. Genital plate well pigmented, dark brown. Primary rhinaria on Ant. V ciliate……...........10

10. AbdT.III including pleura with 13-15 hairs, and 4-5 hairs on tergite VI between SIPH. SIPH weakly spinulose on basal 1/2 with very small spinules. On *Leontopodium coreanum*……*U. leontopodiicola* Lee, Holman & Havelka

- AbdT.III including pleura with more than 20 dorsal hairs, 7-8 hairs on tergite VI between SIPH. SIPH denticulate on basal 1/2 with conspicuous strong single denticles. Polyphagous……….....…….…..…*U. cichorii* (Koch)

Subgenus *Uromelan* Mordvilko, 1914

Uromelan Mordvilko, 1914.

Type species: *Aphis jaceae* Linne, 1758.

Key to species of subgenus *Uromelan* in the Korean Peninsula (based on the apterous viviparous females) modified from Miyazaki (1971) and Pashchenko (1988).

1. Cauda with 40 or more hairs. SIPH smooth, only reticulated on apical 1/5. Tibia wholly black. On *Cirsium* spp........................*U. giganteum* (Matsumura)

- Cauda at most with 35 hairs. SIPH imbricated or spinulated, reticulated on more than apical 1/5. Tibiae pale at middle…………………....…...............2

2. Primary rhinaria of Ant.V strongly protuberant and larger 1.6-2.9 × secondary rhinaria 3

- Primary rhinaria of Ant.V small and flat, if protuberant then larger 0.6-1.1 × secondary rhinaria.........................……………....………………….5

3. SIPH less 1.9 × Cauda, reticulated on apical 1/3-2/5………......…......……4

- SIPH more 1.9 × Cauda, reticulated on apical 1/5-1/3..................................... ....*U. lactucicola* (Strand)

4. Coxae pale. Cauda tongue shaped. URS reach to mosothorax. URS 1.97-2.11 × 2HT. SIPH 0.88-0.98 × Ant.III. Setae on AbdT.III 1.11-1.32 × Ant.IIIBD..*U. amamianum* (Takahashi)

- Coxae dark. Cauda more triangular shaped. URS reach to metathorax. URS less 1.97 × 2HT. SIPH less 0.88 × Ant.III. Setae on AbdT.III more 2.45 × Ant.IIIBD…...…...*U. chrysanthemicola* **sp. nov.**

5. SIPH 1.12-1.29 × Cauda. Tergites II-IV each bearing 12-20 setae excluding marginal ones. URS 0.61-1.34 × 2HT. On *Adenophorae* sp. ……………………….....………….......*U. adenophora* (Matsumura, 1918)

- SIPH at least 1.4 × Cauda. Tergites II-IV each bearing 6-12 setae excluding marginal ones. URS 1.1-1.7 × 2HT………...........................……………...6

6. Cauda usually with more than 20 hairs. Ant.III bearing rhinaria on its basal 1/2-7/9…………………………………………..*U. cephalonopli* (Takahashi)

- Cauda with less than 20 hairs. Ant.III bearing rhinaria on its basal 3/4 to whole length…...…………....…..........………………*U. gobonis* (Matsumura)

Subgenus *Lambersius* Olive, 1965

Lambersius Olive, 1965.

Type species: *Siphonophora erigeronensis* Thomas, 1878**.**

1. *Uroleucon* (*Uromelan*) *adenophorae* (Matsumura, 1918)
잔대수염진딧물*

(Plate A19; Table A19)

Macrosiphum adenophora Matsumura, 1918.
Dactynotus adenophorae Miyazaki, 1971.
Uroleucon (*Uromelan*) *adenophorae* Holman, 1975; Remaudière, G. & M. Remaudière, 1997.

Description. Apterous viviparous female. *Color* (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark. URS attaining hind coxa. Legs dark except apex 1/2 of femora. Genital plate pale dusky. SIPH dark brown. Cauda dark except extreme base. ***Morphology.*** Body spindle-shaped, 2.71-3.38 mm long from antenna tubercle to end of cauda. **Head**: smooth with 4 pairs of acute dorsal hairs; one pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle. Antennae slight, 1.07-1.22 times longer than body length; Ant.I - Ant.II smooth with 2-6 setae; Ant.III 52-72 secondary rhinaria irregularly scattered with 13-24 setae, longest setae on Ant.III 0.92-1.38 times long than the basal diameter of the segment, Rostrum attaining the hind coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.61-1.34 times longer than 2HT, 0.60-1.00 times long than Ant.VIb with 2-5 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 13-24 on tergite III, 2-6 on tergite VI between the SIPH, 4-6 on tergite VIII. SIPH 1.12-1.29 times longer than cauda, 0.57-0.66 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/4 narrow slender, with 13-21 hairs. Genital plate dusky, 1-3 median hairs, 10-10 ciliated setae on posterior margin.

Specimens examined. South Korea: 7 ap., 9 ny., coll#.090524SH-1, Hoengsung-gun, GW, 24.v.2009, on *Adenophora* sp.

Host plants. *Adenophora* spp., *Adenophora triphylla* var. *japonica*, *Adenophora verticillata* var. *angustifolia*, *Adenophora coronopifolia* (Campanulaceae).

Distributions. Japan, Korea (South) and Mongolia.

Remarks. Body 2.71-3.38 mm. The species is easily discriminated by small and flat secondary rhinaria on Ant.V. 52-72 secondary rhinaria on Ant.III. SIPH less longer than cauda. Cauda with 13-21 hairs. According to Miyazaki (1971), the Ant.III of the alate viviparous female bears much more rhinaria (about 80-110) on Ant.III. It lives on the young leaves and shoots of the genus *Adenophora* spp. (Campanulacea).

2. ***Uroleucon*** **(*Uromelan*)** ***amamianum*** **(Takahashi, 1930)**

마타리수염진딧물

(Plate A20; Table A20)

Macrosiphum amamianum Takahashi, 1930.

Dactynotus (*Uromelan*) *amamianus* Takahashi, 1962.

Uroleucon (*Uromelan*) *amamianum* Remaudière, G. & M. Remaudière, 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly pale except Ant.VI. URS dark. Legs pale except distal 1/2 of femora, and distal 1/5 of tibiae. Genital plate dark dusky. SIPH and Cauda dark. ***Morphology.*** Body spindle-shaped, 3.36-3.37 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; two pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.96-1.01 times longer than body length; Ant.I smooth with 4-6 setae; Ant.II smooth with 3-4 setae; Ant.III 13-28 secondary rhinaria irregularly scattered with 16-21 setae, longest setae on Ant.III 0.84-0.86 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.97-2.11 times longer than 2HT, 0.92-1.17 times long than Ant.VIb with 6 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 10-12 on tergite III, 4-6 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.45-1.86 times longer than cauda, 0.64-0.70 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 12-14 hairs. Genital plate dusky, 2 median hairs, 12-14 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 30-33 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. North Korea. 1 al., coll#.85HA1068, Cheongryong-san, Pyongsong-si, PN, 20.vi.1985, on no recorded host; 2 apt., coll#.88HA2602, Mt. Kumgang-san, GW, 26.v.1988, on *Aster pinnatifidus*; 1 ap., coll#.88HA3679, Samjiyon, HB, 26.vi.1988, on *Aster maackii*.

Host plants. *Aster pinnatifidus*, *Aster maackii*, *Patrinia scabionsaefolia*, *Picris hieracioides*. *Solidago virga-aurea* var. *asiatica*, *Solidago virga-aurea* var. *gigantus* (Asteraceae).

Distributions. Japan and Korea (North).

Remarks. Body 3.36-3.37 mm. 13-28 secondary rhinaria on Ant.III (Al. 30-33 secondary rhinaria on Ant.III). Cauda with 12-14 hairs. The species differs from *U. chrysanthemicola* **sp. nov.** by distinctive morphological characters. (*U. amamianum*, URS 1.97-2.11 × 2HT, SIPH 0.88-0.98 × Ant.III, Setae on AbdT.III 1.11-1.32 × Ant.IIIBD; *U. chrysanthemicola* **sp. nov**, URS less 1.97 × 2HT, SIPH less 0.88 × Ant.III, Setae on AbdT.III more 2.45 × Ant.IIIBD).

3. *Uroleucon* (*Uroleucon*) *asteriae* Lee, Holman & Havelka, 2002 벌개미취수염진딧물

(Plate A21; Table A21)

Uroleucon asteriae Lee, Holman & Havelka 2002.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark except Ant.II-III. URS dark. Legs pale except distal 1/3 of femora, and distal 1/5 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology*****.** Body spindle-shaped, 2.87-3.33 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.02-1.13 times longer than body length; Ant.I smooth with 6-8 setae; Ant.II smooth with 3-6 setae; Ant.III 23-30 secondary rhinaria irregularly scattered with 18-26 setae, longest setae on Ant.III 0.53-0.66 times long than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.59-2.12 times longer than 2HT, 1.16-1.55 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 9-10 on tergite III, 6-8 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.66-1.72 times longer than cauda, 0.87-0.93 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 15-18 hairs. Genital plate dusky, 2 median hairs, 10-13 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 44-46 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 3 ap., 1 al., Ryongaksan, PN, 07.vii.1987, on *Cacalia hastate*, col.#NK-2212, leg. J. Havelka (NAS).

Host plants. *Aster koraiensis*, *A. scaber* and *Cacalia hastate* (Asteraceae).

Distributions. Korea (North).

Remarks. Body 2.87-3.33 mm. 23-30 secondary rhinaria on Ant.III (Al. 44-46 secondary rhinaria on Ant.III). Cauda with 15-18 hairs. The species has been confirmed in only North Korea. Morphologically, it is similar to *Uroleucon picridis* and *U. leontopodiicola*, but it can be distinguished by pale antennae with limited number (less than 40) of secondary rhinaria confined to basal 2/3 of Ant.III, and relatively short Ant. III, distinctly shorter (0.73-0.88x) than SIPH (Lee *et al*., 2002b).

4. ***Uroleucon* (*Uromelan*) *cephalonopli* (Takahashi, 1962)**

지칭개수염진딧물

(Plate A22; Table A22)

Dactynotus (*Uromelan*) *cephalonopli* Takahashi, 1962.

Uroleucon (*Uromelan*) *cephalonopli* G. Remaudière & M. Remaudière, 1997.

Description. **Apterous viviparous female**. Color (macerated specimens): Head dark. Thorax and Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark except basal part of Ant.III. URS dark. Legs pale except distal 1/2 of femora, and distal 1/4 of tibiae. Genital plate dark dusky. SIPH and Cauda dark. ***Morphology***. Body spindle-shaped, 3.48-4.18 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.82-0.96 times longer than body length; Ant.I smooth with 4-5 setae; Ant.II smooth with 3-4 setae; Ant.III 12-28 secondary rhinaria irregularly scattered with 20-35 setae, longest setae on Ant.III 0.54-0.96 times longer than the basal diameter of the segment, Rostrum attaining the hind coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.69-2.29 times longer than 2HT, 1.47-1.73 times long than Ant.VIb with 4-6 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 10-12 on tergite III, 5-6 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH cylindrical shape, 1.75-1.96 times longer than cauda, 0.91-1.03 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 16-21 hairs. Genital plate dusky, 2 median hairs, 11-12 ciliated setae on posterior margin.

Alate viviparous female. Color (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. Morphology. Antenna with 19-25 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. North Korean: 1 ap., coll#. NK-874, Konmingmyo, Kaesong Distr., HN, 1.vii.1985, on *Cirsium pendulum*; 2 al., coll#.NK-1369, Mupo, HN, 11.vii.1985, on *Adenophora curvidens*; 2 ap., coll#.NK-2258, Mupo, HN, 14.vii.1987, on *Saussurea pulohella*. South Korea: 1 ap., coll#.1340, Daegwalyong, GW, 12.viii.1963, on *C. maackii*; 5 ap., coll#.4737, Seoguipo, JJ, 5.x.1966, on *C. maackii*; 2 ap., coll#.5152. Mt. Chiri, JB, 9.vii.1969, on *C. maackii*; 1 ap., coll#.5191, Mt. Dokyou, JB, 29.vii.1969, host unknown; 5 ap., coll#.4314, Suwon-si, GG, 4.ix.1967, on *C. maackii*; 3 ap., coll#.6110, Suwon-si, GG, 2.ix.1970, on *Arctium lappa*; 5 ap., coll#.3629, Suwon-si, GG, 14.v.1965, on *C. leucanthum*; 4 ap., coll#.3892, Suwon-si, GG, 11.v.1965, on *Rumex japonicus*; 5 ap., coll#.040608-HJ-005, Uleung-gun, GB, on *Oenothera odorata*; 7 ap., coll#.050816-SH-015, Pyeongchan-gun, GW, 30.viii.2005, on *C. setidens*. Japan: 2ap., 1al., *Dactynotus giganteus*, 25.vii.1957, Aizankei, Hokkaido, on *Cirsium* sp., leg., S. Takagi; 2ap., *Uroleucon cephalonopli*, Sapporo, Hokkaido, 20.vi.1968, on *Cirsium* sp., leg., H. Torikura (Loaned specimens from Hokkaido University of Japan). (Preserved specimens in alcohol):Dalgang resort, GN, 13.v.2010, on *Hemistepta lyrata*, col.# 100513HR-1, leg. Hwalran Choi; Dalgang resort, GN, 13.v.2010, on *Hemistepta lyrata*, col.# 100513HR-2, leg. Hwalran Choi; Mushroom farm, GW, 13.v.2010, on Hemistepta lyrata, col.# 100513HR-5, leg. Hwalran Choi; Laoshan, China, 15.viii.2010, on *Breea segeta*, col.# 100815SH-28, leg. Hwalran Choi; Laoshan, China, 15.viii.2010, on *Breea segeta*, col.# 100815SH-29, leg. Hwalran Choi.

Host plants. *Adenophora curvidens* (Campanulaceae), *Breea setosa*, *Cirsium japonicum*, *C. kamtschaticum*, *C. maackii*, *C. leucanthum*, *C. pendulum*, *C. setidens*, *Hemistepta lyrata*, *Saussurea pulchella*, *Tanacetum boreale* (Asteraceae).

Distributions. Japan, Korea (North and South) and Taiwan.

Remarks. Body 3.48-4.18 mm. 12-28 secondary rhinaria on Ant.III (Al. 19-25 secondary rhinaria on Ant.III). Cauda with 16-21 hairs. The species is similar to *U. gobonis* but it can be distinguished by setae of cauda and rhinaria. (*U. cephalonopli*, cauda usually with more than 20 setae, Ant.III bearing rhinaria on its basal 1/2-7/9; *U. gobonis*, cauda with less than 20 setae, Ant.III bearing rhinaria on its basal 3/4 to whole length).

5. ***Uroleucon* (*Uromelan*) *chrysanthemicola* 오서산수염진딧물***

(Plate A23; Table A23)

Etymology. The species name *chrysanthemicola* is derived from host plant *Chrysanthemum* sp. and Latin suffix, -cola (dweller, inhabitant).

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head light brown like basal half of femur, and dorsally smooth (Fig. 1A and F). Thorax and abdomen pale with dark marginal pigmented scleroites on tergites II-VI and small pigmented scleroites at the bases of dorsal setae (Fig. 1A). Antennae wholly dark except basal and distal of Ant.III (Fig. 1C). URS dark (Fig. 1G). Legs pale except distal 1/2 of femora, and distal 1/5 of tibiae

(Fig. 1A and B). Coxae dark like SIPH and cauda (Fig. 1A). Genital plate dark dusky (Fig. 1A). SIPH and cauda dark (Fig. 1E and H). ***Morphology.*** Body spindle-shaped, 2.42-3.29 mm long from antenna tubercle to end of cauda (Table 1). **Head**: spinulose on whole surface of ventrum, smooth on dorsum; four pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.97-1.23 times longer than body length; Ant.I smooth with 4-8 setae; Ant.II smooth with 3-6 setae; Ant.III 18-34 secondary rhinaria irregularly scattered at middle part with 10-19 setae, longest setae on Ant.III 0.64-1.64 times longer than the basal diameter of the segment, Rostrum attaining the hind coxae; clypeus with 21-24 setae; mandibular laminae with 7-11 hairs; URS tongue shaped, reach to metathorax, 1.28-1.77 times longer than 2HT, 0.74-1.01 times long than Ant.VIb with 2 median setae. **Thorax**: Prothorax with 9-12 spinal setae and one pair marginal seta on each side of pronothum. Hind coxae spinulate with 6-9 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal segments membranous with well developed scleroites, 10-12 on tergite III, 3-6 on tergite VI between the SIPH, 3-6 on tergite VIII. SIPH trap shaped, 1.06-1.26 times longer than cauda (Fig. 1E), 0.50-0.70 times longer than hind femur, distal 1/3 polygonal reticulated apex. Cauda elongated and tapering, distal 1/3 narrow slender, with 8-15 hairs. Genital plate dusky and dark like head, 2 median hairs, 9-14 ciliated setae on posterior margin.

Specimens examined. Holotype. 1 ap., Mt. Oseo, Boryeong-si, CN, 09.x.2003, on *Chrysanthemum* sp., col.#031009-SH-7, leg., Seunghwan Lee. Paratypes. 12 ap., same data as the holotype.

Host plants. *Chrysanthemum* sp. (Asteraceae).

Distributions. Korea (South).

Remarks. Body 2.42-3.29 mm. 18-34 secondary rhinaria on Ant.III. Cauda with 8-15 hairs. The species is similar to *Uroleucon amamianum*. However, there are exclusively morphological difference following by coxae dark, cauda more triangular shaped, URS reach to metathorax, URS less 1.97 × 2HT, SIPH less 0.88 × Ant.III, Setae on AbdT.III more 2.45 × Ant.IIIBD (*U. amamianum*, coxae pale, cauda tongue shaped, URS reach to mosothorax, URS 1.97-2.11 × 2HT, SIPH 0.88-0.98 × Ant.III, setae on AbdT.III 1.11-1.32 × Ant.IIIBD). Additionally, we checked another *Uroleucon* species occurring on *Chrysanthemum* sp., in the World and nine species were keyed based on host lists and keys of Favret (2018). Among nine species, *U.* (*Uromelan*) *chrysanthemicola* **sp. nov.**, has been clarified with six species, *U.* (*Lambersius*) *erigeronense* (Thomas), *U.* (*Uroleucon*) *tanaceti* (L.), *U.* (*Uroleucon*) *formosanum* (Takahashi), *U.* (*Uroleucon*) *sonchi* (L.) and *U.* (*Uroleucon*) *ambrosiae* (Thomas) by morphological differences on subgenera status. Then, as same subgenus, *U.* (*Uromelan*) *compositae* (Theobald) and *U.* (*Uromelan*) *gobonis* (Matsumura) share dark colored cauda, which is morphological synapomorphy of subgenus *Uromelan*. It is, however, distinguished by ratio of SIPH and cauda, and number of hairs on cauda. Modified key to species of *Uroleucon* on *Chrysanthemum* sp. has been presented in this study.

Key to species of *Uroleucon* on *Chrysanthemum* sp. (Asteraceae) in the World modified from host lists and keys of Favret (Favret, C. Aphid Species File Version 5.0/5.0. [23. Mar. 2018]).

1. SIPH pale at least on basal 1/3, with polygonal reticulation over distal 0.3-0.4 of length. Cauda tapering almost to a point. Body green in life...*U.* (*Lambersius*) *erigeronense* (Thomas)

- SIPH mainly dark. Body dark red or black in life..….................................2

2. SIPH 1.7-3.2 × longer than the short. Cauda pale with 5-10 hairs.............3

- SIPH 0.6-2.3 × cauda, but if more than 1.7 × then cauda is long and finger-like and bears more than 10 hairs...…..........4

3. SIPH with polygonal reticulation on distal 0.17-0.25 of length, and usually with a paler middle section. URS 1.0-1.2 × 2HT...
....….*U.* (*Uroleucon*) *tanaceti* (L.)

- SIPH wholly dark, with polygonal reticulation on distal 0.25-0.38 of length. URS 1.2-1.4 × 2HT............................*U.* (*Uroleucon*) *pseudotanaceti* (Verma)

4. Cauda dark, like SIPH. Basal part of Ant.III pale. From India, Africa, Turkey, Réunion, Mauritius, Taiwan and South America (Brazil, Surinam)...*U.* (*Uromelan*) *compositae* (Theobald)

- Cauda pale, or much paler than SIPH...….6

5. Scleroites on abdomen densely developed. Antennae wholly black. SIPH 1.74-1.88 × cauda. Cauda with 22-26 hairs. From China, Japan, India, Korea (North, South), South East Asia and Taiwan..
....*U.* (*Uromelan*) *gobonis* (Matsumura)

- SIPH 1.06-1.26 × cauda. Cauda with 8-15 hairs...
....*U.* (*Uromelan*) *chrysanthemicola* **sp. nov.**

6. Ant.III very long, 1.5-2.1 × Ant.IV+V together, and bearing very numerous (96-135) strongly prutuberant rhinaria distributed over its entire length…...*U.* (*Uroleucon*) *formosanum* (Takahashi)

- Ant.III shorter than or about equal in length to Ant.IV+V together, and with 8-38 rhinaria extending over 0.35-0.65 of length...……7

7. Coxae black. SIPH 1.4-1.9 × cauda. Dorsal hairs mostly without dark basal scleroites…...*U.* (*Uroleucon*) *sonchi* (L.)

- Coxae pale. SIPH 1.1-1.5 × cauda. Many of dorsal hairs arising from dark scleroites..........................…...................*U.* (*Uroleucon*) *ambrosiae* (Thomas)

6. ***Uroleucon* (*Uroleucon*) *cichorii* (Koch, 1855)** 치커리수염진딧물

(Plate A24; Table A24)

Siphonophora cichorii Koch, 1855.

Dactynotus (*Dactynotus*) *cichorii* Hille Ris Lambers, 1939.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark. URS dark. Legs pale except distal 1/3 of femora. Genital plate dark dusky. SIPH dark and Cauda dark. ***Morphology.*** Body spindle-shaped, 3.73-3.78 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; two pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.16-1.17 times longer than body length; Ant.I smooth with 6-7 setae; Ant.II smooth with 6-8 setae; Ant.III 68-69 secondary rhinaria irregularly scattered with 18-20 setae, longest setae on Ant.III 0.51-0.66 times longer than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.54-1.69 times longer than 2HT, 1.41-1.76 times long than Ant.VIb with 8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 13-15 on tergite III, 4-7 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.33-1.41 times longer than cauda, 0.60-0.62 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 15-16 hairs. Genital plate dusky, 2 median hairs, 15 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 68-69 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. North Korea. 2 ap., 1 al., Samjiyon, HN, 26.vi.1988, on *Aster maackii*, col.#NK-3667, leg. J. Havelka.

Host plants. *Cichorium* sp., *Crepis* sp., *Hieracium* sp. *Lactuca* sp., *Lapsana* sp., *Leontodon* sp. (Asteraceae).

Distributions. Asia (central, south and west), east Siberia, Eritrea, Korea (north) and Mongolia.

Remarks. Body 3.73-3.78 mm. 68-69 secondary rhinaria on Ant.III (Al. 68-69 secondary rhinaria on Ant.III). Cauda with 15-16 hairs. The species is morphologically similar to *U. leontopodiicola* but it can be distinguished by tergite III including pleura with more than 20 dorsal hairs, 7-8 hairs on tergite VI between SIPH. SIPH is reticulated on basal 1/2 with conspicuous strong single polygonal reticulation. (*U. leontopodiicola*, tergite III including pleura with 13-15 hairs, and 4-5 hairs on tergite VI between SIPH, SIPH weakly spinulose on basal 1/2 with very small spinules).

7. ***Uroleucon* (*Uroleucon*) *echinopsis*** 절굿대수염진딧물*

(Plate A25; Table A25)

Etymology. The species name *echinopsis* is derived from host plant *Echinops setifer*.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale like cauda (Fig. 2A and F). Thorax and abdomen pale with dark marginal pigmented scleroites on tergites II-VI and small pigmented scleroites at the bases of dorsal setae (Fig. 2A). Antennae wholly dark except Ant.V-VI (Fig. 2C and D). URS dark (Fig. 2G). Legs pale except distal 1/2 of femora, and distal 1/5 of tibiae (Fig. 2A and B). Coxae pale like head. Genital plate weakly dusky. SIPH dark like Ant.I and II (Fig. 2E). Cauda pale (Fig. 2H). ***Morphology*.** Body spindle-shaped, 2.39-2.40 mm long from antenna tubercle to end of cauda (Table 2). **Head**: spinulose on whole surface of ventrum, smooth on dorsum; two pairs of hair on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.24-1.38 times longer than body length; Ant.I smooth with 5-6 setae; Ant.II smooth with 3-6 setae; Ant.III 84-107 prutuberant secondary rhinaria on entire length of Ant.III with 20-26 setae, longest setae on Ant.III 0.32-0.69 times longer than the basal diameter of the segment, Rostrum attaining the hind coxae; clypeus with 7 setae; mandibular laminae with 6 hairs; URS tongue shaped, 0.99-1.21 times longer than 2HT, 1.05-1.21 times longer than Ant.VIb with 2 median setae. **Thorax**: Prothorax with 10 spinal setae and one pair marginal seta on each side of pronothum. Hind coxae spinulate with 11 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal segments membranous with weakly developed scleroites, 8-10 on tergite III, 10-12 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.14-1.48 times longer than cauda, 0.60-0.63 times longer than hind femur, distal 1/3 polygonal reticulated apex. Cauda elongated and tapering, distal 1/3 narrow slender, with 18-20 hairs. Genital plate dusky, 2 median hairs, 12-14 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antennae entirely dark except Ant.V-VI. Thorax dark brown. Abdomen pale with weakly developed scleroites. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antennae with 111-123 secondary rhinaria on Ant.III (Table 2). Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. Holotype. South Korea. 1 ap., Halla Argoretum, Jeju-si, JJ, 27.v.2004, on *Echinops setifer*, col.#040527-HJ-21, leg. Hyojoong Kim. Paratypes. 2 ap., 2 al., 3ny, same data as the holotype.

Host plants. *Echinops setifer* (Asteraceae).

Distributions. Korea (South).

Remarks. Body 2.39 mm. 84-107 secondary rhinaria on Ant.III (Al. 111-123 secondary rhinaria on Ant.III). Cauda with 18-20 hairs. The species is collected from Jeju island where is the largest island and about 90 km far from the coast of Korean Peninsula. It is morphologically similar to *Uroleucon kikioense* but it can be easily distinguished by antennae 1.24-1.38 × body, Head pale, 84-107 rhinaria on Ant. III and URS reach to over metathorax. Additionally, we checked another *Uroleucon* species occurring on *Echinops* sp., in the World and three species were keyed based on host lists and keys of Favret. Among three species, *U.* (*Uroleucon*) *echinopsis* **sp.nov.**, has been clarified with *U.* (*Uromelan*) *echinatum* (Kulkarni) by morphological differences on subgenus status. Then, as same subgenus, *U.* (*Uroleucon*) *budhium* (H. Banerjee, A.K. Ghosh & Raychaudhuri, 1969) has been ranked with *U.* (*Uroleucon*) *echinopsis* **sp.nov.**, together. It is, however, easily distinguished by numerous and prutuberant secondary rhinaria on entire length of Ant.III. Modified key to species of *Uroleucon* on *Echinops* sp. has been presented in this study.

Key to species of *Uroleucon* on *Echinops* sp. (Asteraceae) in the World modified from host lists and keys of Favret (Favret, C. Aphid Species File Version 5.0/5.0. [23. Mar. 2018]).

1. Cauda pale..2

- Cauda black. URS 1.1-1.2 × 2HT. From India..
....*U.* (*Uromelan*) *echinatum* (Kulkarni)

2. 30-56 small secondary rhinaria on Ant.III, URS sharp and slender, 1.7-2.3 × 2HT. Scleroites on abdomen distinctly developed. Coxae black. Cauda pale. SIPH with reticulation on distal 0.14-0.17 of length. Anal plate pigmented. From India...
.............*U.* (*Uroleucon*) *budhium* (H. Banerjee, A.K. Ghosh & Raychaudhuri)

- 84-107 strongly prutuberant secondary rhinaria on entire length of Ant.III, URS tongue shaped. Scleroites on abdomen less developed. Coxae pale. SIPH with reticulation on distal 0.25-0.30 of length. Anal plate pale...*U.* (*Uroleucon*) *echinopsis* **sp.nov.**

8. ***Uroleucon*** **(*Lamersius*)** ***erigeronense*** **(Thomas, 1878) 망초수염진딧물**

(Plate A26; Table A26)

Siphonophora erigeronensis: Thomas, 1878.
Macrosiphum erigeronella Soliman, 1927.
Dactynotus behuhuri M.K. Raina & U. Raina, 1990.
Uroleucon (*Labersium*) *erigeronense* Remaudière, 1999.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale. Thorax and Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small setae at the basal part of Abdomen. Antenna wholly pale except distal part of Ant.III-V. URS dark. Legs pale except distal 1/3 of tibiae. Genital plate dark dusky. SIPH pale except distal part. Cauda pale. ***Morphology.*** Body spindle-shaped, 2.43-2.77 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.75-0.96 times longer than body length; Ant.I smooth with 2-5 setae; Ant.II smooth with 3-4 setae; Ant.III 12-21 secondary rhinaria irregularly scattered with 8-15 setae, longest setae on Ant.III 0.43-0.88 times longer than the basal diameter of the segment, Rostrum attaining between meso and hind coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.76-1.33 times longer than 2HT, 0.61-0.88 times long than Ant.VIb with 4-6 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with weak developed scleroite, 22-25 on tergite III, 14-15 on tergite VI between the SIPH, 5-7 on tergite VIII. SIPH cylindrical shape, 1.84-2.23 times longer than cauda, 0.89-1.06 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 7-9 hairs. Genital plate dusky, 2 median hairs, 6-11 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 29-33 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 8 ap., 3 al., Guksabong, Jinju-si, GN, 18.v.2005, on *Erigeron annuus*, col.#050518-SH-4, leg. Seunghwan Lee. (Preserved specimens in alcohol): Shiitakemushroom farm, JJ, 07.v.2009, on *Erigeron canadensis*, col.#090507-HR-52, leg. Hwalran Choi; SNU Suwon campus, GG, 20.ix.2009, on *Erigeron canadensis*, col.#090520-SH-6, leg. Hwalran Choi; Mushroom farm, GW, 08.vii.2010, on *Erigeron Canadensis*, col.# 100708HR-8, leg. Hwalran Choi.

(DNA preserved specimens): Mushroom farm, GW, 08.vii.2010, on *Erigeron Canadensis*, col.# 100708HR-8, no.DNA386, experimenter Hwalran Choi.

Host plants. *Aster* sp., *Baccharis* sp., *Conyza* spp., *Chrysothamnus nauseosus*, *C. lineare*, *Erigeron* spp., *Haplopappus* sp., *Heterotheca* sp., *Grindelia* sp., *Lactuca* sp. (Asteraceae).

Distributions. Algeria, America (Central, South), Australia, Europe, Kazakhstan, Korea (south), USA, Siberia.

Remarks. Apterae are yellowish green in alive. In recent, it is reported in Australia (Brumley & Watson 2017).

9. ***Uroleucon* (*Uroleucon*) *exiguum*** Lee, Holman & Havelka, 2002

꼬마흰끝수염진딧물

(Plate A27; Table A27)

Uroleucon (*Uroleucon*) *exiguum* Lee, Holman & Havelka, 2002

Description. Alate viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Wings pale with veins bordered by narrow dark pigmentations. Antenna wholly dark except Ant.III-IV. URS dark. Legs pale except distal 1/3 of femora. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology.*** Body spindle-shaped, 1.83 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; one pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle. Antennae slight, 0.93 times longer than body length; Ant.I smooth with 5-7 setae; Ant.II smooth with 3-6 setae; Ant.III 2-3 secondary rhinaria irregularly scattered with 6-7 setae, longest setae on Ant.III 0.28 times longer than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.12 times longer than 2HT, 0.68 times long than Ant.VIb with 2 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 6-8 on tergite III, 4-5 on tergite VI between the SIPH, 3-4 on tergite VIII. SIPH trap shaped, 2.00 times longer than cauda, 0.74-0.76 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 4 hairs. Genital plate dusky, 2 median hairs, 10 ciliated setae on posterior margin.

Specimens examined. South Korea. 1 al., Gaehwado, Buan-gun, JB, 15.viii.1975 on undscribed host.

Host plants. Unknown.

Distributions. Korea (South).

Remarks. So far, only alate form has been collected. Body 1.83 mm. 2-3 secondary rhinaria on Ant.III. Cauda with 4 hairs. Morphologically, it differs from other species of the genus *Uroleucon* in having only 2-3 secondary rhinaria on Ant.III, conspicuously large primary rhinarium on Ant.V and only 4 caudal hairs (Lee *et al*., 200b).

10. *Uroleucon* (*Uroleucon*) *formosanum* (Takahashi 1921)

대만수염진딧물

(Plate A28; Table A28)

Macrosiphum formosanum Takahashi, 1921.

Description. **Apterous viviparous female**. ***Color*** (macerated specimens): Head and Thorax dark. Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark. URS dark. Legs pale except distal 1/2 of femora, and distal 1/5 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology*****.** Body spindle-shaped, 3.27-3.33 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; two pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.96-1.08 times longer than body length; Ant.I smooth with 4-8 setae; Ant.II smooth with 3-4 setae; Ant.III 67-73 secondary rhinaria irregularly scattered with 25-28 setae, longest setae on Ant.III 0.56-0.82 times longer than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.83-1.24 times longer than 2HT, 0.96-1.00 times long than Ant.VIb with 6 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 7-8 on tergite III, 4-5 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.17-1.26 times longer than cauda, 0.63-0.71 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal

1/3 narrow slender, with 19-24 hairs. Genital plate dusky, 2 median hairs, 11-14 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 91-103 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 3 ap., Hwajeon-ri, Nam-myeon, Hongcheong-gun, GW, 31.vii.2009, on *Lactuca indica*, col.#090731-HR-5, leg. Hwalran Choi. 1 al., Anyang Arboretum, Anyang-si, GG, 03.vi.2005, on *Lactucal indica*, col.#050603-SH-6, leg. Seunghwan Lee.

(Preserved specimens in alcohol): Hwajeon-ri, Nam-myeon, Hongcheong-gun, GW, 31.vii.2009, on *Lactuca indica*, col.#090731-HR-5, leg. Hwalran Choi; Highway, GW, 02.vii.2010, on *Lactuca indica*, col.# 100702HR-1, leg. Hwalran Choi; Suanbo hotel, CB, 21.x.2010, on *Lactuca indica*, col.# 101021HR-2, leg. Hwalran Choi; Wolmi mountain, Incheon, 22.vi.2011, on *Crepidiastrum sonchifolium*, col.# 20110622HR-6, leg. Hwalran Choi; Taehwa mountain, GG, 22.vi.2011, on *Crepidiastrum sonchifolium*, col.# 130615HR-2, leg. Hwalran Choi.

(DNA preserved specimens): Hallapinemushroom farm, JJ, 28.x.2009, on *Lactuca indica*, col.# 091028SH-28, no.DNA54, experimenter Hwalran Choi; China, 15.viii.2010, on *Lactuca indica*, col.# 100815SH-7, no.DNA164, experimenter Hwalran Choi.

Host plants. *Lactuca* sp., *Youngia japonica* (Asteraceae).

Distributions. China, East Siberia, Japan, Korea (South) and Taiwan.

Remarks. Body 3.27-3.33 mm. 67-73 secondary rhinaria on Ant.III (Al. 91-103 secondary rhinaria on Ant.III). Cauda with 19-24 hairs. Two subspecies, *U. formosanum crepidis* Ghosh, Ghosh & Raychaudhuri, 1971 and *U. formosanum formosanum* (Takahashi, 1921) are recorded in India and Japan, respectively.

11. ***Uroleucon*** **(*Uroleucon*)** ***fuchuense*** **(Shinji, 1942)** 참취수염진딧물

(Plate A29; Table A29)

Macrosiphum fuchuensis Shinji, 1942.

Dactnotus (*Dactynotus*) *fuchuense* Takahashi, 1962.

Uroleucon (*Uroleucon*) *fuchuense* Remaudière, G. & M. Remaudière 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark. URS dark. Legs pale except distal 1/2 of femora, and distal 1/2 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology*****.** Body spindle-shaped, 3.39-4.30 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; two pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.89-1.13 times longer than body length; Ant.I smooth with 5-9 setae; Ant.II smooth with 3-8 setae; Ant.III 22-25 secondary rhinaria irregularly scattered with 17-29 setae, longest setae on Ant.III 0.80-0.84 times longer than the basal diameter of the segment, Rostrum attaining between meso and hind coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.01-1.39

times longer than 2HT, 0.78-1.04 times long than Ant.VIb with 2 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with weak developed scleroite, 8-10 on tergite III, 4-5 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH trap shaped, 1.13-1.25 times longer than cauda, 0.61-0.68 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 29-36 hairs. Genital plate dusky, 2 median hairs, 29-36 ciliated setae on posterior margin.

Specimens examined. South Korea. 6 ap., Chusan Nambu Reaserch forest, Ongyong-myeon, Gwangyang-si, JN, 16.vi.2009, on *Aster scaber*, col.#090616-HJ-1, leg. Hyojoong Kim.

Host plants. *Aster scaber*, *A*. spp., *Cacalia hastate*, *Pterocypsela raddeana*, *Saussurea grandifolia* (Asteraceae).

Distributions. East Siberia, Japan and Korea (South).

Remarks. Body 3.39-4.30 mm. 22-25 secondary rhinaria on Ant.III. Cauda with 29-36 hairs. The species is similar to *U. monticola* but it can be distinguished by ratio of SIPH and cauda, and hairs of cauda (*U. fuchuense*, SIPH only a little longer than cauda (1.1 ×), cauda with more than 35 hairs; *U. monticola*, SIPH more than 1.8 times as long as cauda, cauda with less than 35 long hairs).

12. *Uroleucon* (*Uromelan*) *giganteum* (Matsumura, 1918) 왕수염진딧물

Macrosiphum giganteum Matsumura, 1918.

Macrosiphum gigantea Shinji, 1941.
Dactynotus (*Uromelan*) *giganateus* Takahashi, 1962.
Uromelan giganteus Paik, 1972.
Uroleucon (*Uromelan*) *giganteum* Remaudière & Remaudière, 1997.

Specimens examined. Japan. 2 ap., 1al., Aizankei, Hokkaido, 25.vii.1957, on *Cirsium* spp. (Loaned specimens from Hokkaido University of Japan).

Host plants. *Chrysanthemum morifolium*, *Cirsium maackii*, *C. kamtschaticum*, *C. weyrichii*, *Hemistepta lyrata* and *Serratula wolffii* (Asteraceae).

Distributions. China, Japan, Korea (South) and Siberia.

Remarks. Large aphid. Apterae are dark reddish brown with almost black appendages. We confirmed Japanese specimen because of lack of Korean specimen.

13. ***Uroleucon* (*Uromelan*) *gobonis* (Matsumura, 1917) 우엉수염진딧물**

(Plate A30; Table A30)

Macrosiphum gobonis Matsumura, 1917.
Macrosiphum gobonis Okamoto & Takahashi, 1927.
Dactynotus (*Uromelan*) *gobonis* Takahashi, 1962.
Uromelan gobonis Tao, 1963.
Uroleucon (*Uromelan*) *gobonis* Remaudière & Remaudière, 1997.

Description. **Apterous viviparous female**. Color (macerated specimens): Head dark. Thorax and Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark. URS dark. Legs pale except distal 1/2 of femora, and distal 1/4 of tibiae. Genital plate dark dusky. SIPH and Cauda dark. ***Morphology***. Body spindle-shaped, 4.04-4.28 mm long from antenna tubercle to end of cauda. **Head**: Spinulose on whole surface of ventrum, smooth on dorsum; two pair of hairs on vertex and 1-2 more setae on Ant.III with 24-33 secondary rhinaria, 0.51-0.66 times longer than the basal diameter of the segment, Rostrum attaining the hind coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.54-1.69 times longer than 2HT, 1.41-1.76 times long than Ant.VIbsetae on Ant.III 0.51-0.66 times longer than the basal diameter of the segment, Rostrum attaining the hind coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.54-1.69 times longer than 2HT, 1.41-1.76 times long than Ant.VIb with 4-6 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 10-12 on tergite III, 7-8 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH cylindrical shape, 1.74-1.88 times longer than cauda, 0.89-0.96 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 22-26 hairs. Genital plate dusky, 2 median hairs, 13-14 ciliated setae on posterior margin.

Specimens examined. North Korea. 1 al., 1 ap., coll#.87HA2281, Mt1 al., 1 ap., coll#.87HA2281, Mt. Paektu-san, RG, 15.vii.1987, on *Senecio obatus*; 2 ap., coll#.88HA2752, Bot. Garden. Pyongyang-si, PN, 2.vi.1988, on *Arctiuim* *lappa*. South Korea: 2 ap., coll#.3807, Suwon-si, GG, 31.vii.1965, on *Saussurea japonica*; 2 ap., coll#.5989, Haenam-gun, JN, 21.v.1970, on *Cirsium maackii*; 1 ap., coll#.4025, Haenam-gun, JN, 1.vi.1966, on *Scrophularia buergeriana*; 1 ap., Sinhung Temple, JB, 7.viii.1958, on *Arctium lappa*; 1 ap., Cheongju-si, JB, 16.vi.1971, *Ixeris* sp.; 13 al., 1 ap., 9 ny., coll#.030625-SH-10, Pyeongchang-gun, GW, on *Atractylodes* sp. (Preserved specimens in alcohol): Seopjikoji Beach, JJ, 07.v.2009, on *Cirsium japonicum*, col.#090507-HR-15, leg. Hwalran Choi; Mushroom farm, GW, 24.vi.2010, on *Cirsium setidens*, col.#100624HR-4, leg. Hwalran Choi; Mushroom farm, GW, 24.vi.2010, on *Cirsium setidens*, col.#100624HR-7, leg. Hwalran Choi; Taepyeong, China, 15.viii.2010, on *Cirsium japonicum*, col.#100815SH-63, leg. Hwalran Choi; Chusan Nambu Reaserch forest, Ongyong-myeon, Gwangyang-si, JN, 15.vi.2011, on *Cirsium setidens*, col.#110615HR-1, leg. Hwalran Choi; Haman county, GN, 25.iv.2012, on *Cirsium setidens*, col.# 20120425SH-9, leg. Hwalran Choi. (DNA preserved specimens): Mushroom farm, GW, 24.vi.2010, on *Cirsium setidens*, col.#100624HR-7, no.DNA42, experimenter Hwalran Choi.

Host plants. *Adenophora curvidens* (Campanulaceae), *Aster maackii*, *Arctium lappa*, *Artemisia stenophylla*, *Atractylodes japonica*, *Cacalia auriculata*, *Carthamus tinctorius*, *Gnapholium uliginosum*, *Hemistepta lyrata*, *Saussurea japonica*, *S. pulchella*, *Senecio ovatus*, *Synurus deltoides*, *Taraxacum mongolicum* (Asteraceae).

Distributions. China, Japan, India, Korea (North, South), South East Asia and Taiwan.

Remarks. Body 4.04-4.28 mm. 24-33 secondary rhinaria on Ant.III. Cauda with 22-26 hairs. The species is similar to *U. cephalonopli* but it can be distinguished by setae of cauda and number of rhinaria. (*U. gobonis*, cauda with less than 20 hairs. Ant.III bearing rhinaria on its basal 3/4 to whole length; *U. cephalonopli*, cauda usually with more than 20 hairs. Ant.III bearing rhinaria on its basal 1/2-7/9).

14. ***Uroleucon*** **(*Uroleucon*)** ***kikioense*** **(Shinji, 1942) 도라지수염진딧물**

(Plate A31; Table A31)

Macrosiphum kikioensis Shinji, 1942.
Dactynotus (*Dactynotus*) *kikioense* Takahashi, 1962.
Dactynotus toragicolus Paik, 1965.
Uroleucon (*Uromelan*) *kikioense* Remaudière, G. & M. Remaudière, 1997
Uroleucon (*Uroleucon*) *kikioense* Pashtshenko, 2000.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark except Ant.III and basal part of Ant.IV. URS dark. Legs pale except distal 1/3 of femora, and distal 1/5 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology.*** Body spindle-shaped, 2.51-2.75 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; one pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.91-0.96 times longer than body length; Ant.I smooth with 4-5 setae; Ant.II smooth with 3-4 setae; Ant.III 6-18 secondary rhinaria irregularly scattered with 13-22 setae, longest setae on Ant.III 0.54-0.57 times longer than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.88-1.00 times longer than 2HT, 0.87-1.08 times long than Ant.VIb with 4-6 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with weak developed scleroite, 4-6 on tergite III, 4-5 on tergite VI between the SIPH, 2-3 on tergite VIII. SIPH trap shaped, 1.43-1.47 times longer than cauda, 0.69-0.77 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 9-16 hairs. Genital plate dusky, 2 median hairs, 12-13 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 23-28 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. South Korea. 2 ap., Daeya-ri, Hadong, Yeongwol-gun, GW, 30.vi.1999, on *Platycodon grandiflorum*, col.#990630-SH-8, leg. Seunghwan Lee. 1 al., medicinal plant experiment station, Jinan-gun, JB, 29.viii.2000, on *Platycodon grandiflorum*, col.#000829-TM-2, leg. T.M. Han.

Host plants. *Adenophora* sp., *Campanula* sp., *Platycodon grandiflorum*, *P.* sp. (Campanulaceae).

Distributions. East Siberia, Japan and Korea (South).

Remarks. Body 2.51-2.75 mm. 6-18 secondary rhinaria on Ant.III (Al. 23-28 secondary rhinaria on Ant.III). Cauda with 9-16 hairs. The species is morphologically similar to *Uroleucon echinopsis* **sp. nov.** but it can be easily distinguished by antennae 0.91-0.96 × body, Head dark. URS reach to mesothorax. Ant. III with 6-18 rhinaria.

15. ***Uroleucon* (*Uromelan*) *lactucicola* (Strand, 1929)** 씀바귀수염진딧물

(Plate A32; Table A32)

Macrosiphum lactucicola Strand, 1929.

Macrosiphum nipponicum Shinji, 1942.

Dactynotus (*Uromelan*) *lactucicola* Takahashi, 1962.

Uroleucon (*Uromelan*) *lactucicola* G. Remaudière & M. Remaudière, 1997.

Description. Alate viviparous female. ***Color*** (macerated specimens): Head and Thorax entirely dark. Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Wings pale with veins bordered by narrow dark pigmentations. Antenna wholly dark except basal part of Ant.III. URS dark. Legs dark except basal 1/2 of femora. Genital plate dark dusky. SIPH and Cauda dark. ***Morphology*****.** Body spindle-shaped, 3.37 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; two pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.01 times longer than body length; Ant.I smooth with 4 setae; Ant.II smooth with 4 setae; Ant.III 57-60 secondary rhinaria irregularly scattered with 16-18 setae, longest setae on Ant.III 0.44 times longer than the basal diameter of the segment, Rostrum attaining the hind coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.43-1.70 times longer than 2HT, 1.19 times long than Ant.VIb. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 17-20 on tergite III, 17-20 on tergite VI between the SIPH, 4-5 on tergite VIII. SIPH cylindrical shape, 1.90-1.96 times longer than cauda, 0.82-0.83 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 8 hairs. Genital plate dusky, 2 median hairs, 10 ciliated setae on posterior margin.

Specimens examined. North Korea: 1 al., coll#.NK-2342, Mt. Paecktu, HN, 14.vii.1987, on *Aster maackii*; Japan: 3ap., 1ny., Utukushigahara, Nagano, *Dactynotus lactucicola*, 26.vii.1961, on *Solidago virgaurea*, leg. R. Takahashi (Loaned specimens from Hokkaido University of Japan).

Host plants. *Artemisia princeps* var. *orientalis*, *Aster maackii*, *Cirsium maackii*, *Ixeris chinensis*, *I. dentata*, *Solidago virga-aurea* var. *asiatica*, *S. virga-aurea* var. *gigantus* (Asteraceae).

Distributions. China, Japan, Korea (North), Siberia and Sahalien, Taiwan.

Remarks. Alate form was confirmed in Korean Peninsula. Body 3.37 mm. 57-60 secondary rhinaria on Ant.III. Cauda with 8 hairs. SIPH is quit straight, and polygonal reticulation is well developed. The ratio of SIPH and cauda is relatively different with other species (*Uroleucon lactucicola*, SIPH more 1.9 × cauda, reticulated on apical 1/5-1/3).

16. *Uroleucon* (*Uroleucon*) *leontopodiicola* Lee, Holman & Havelka, 2002 솜다리꽃수염진딧물

(Plate A33; Table A33)

Uroleucon leontopodiicola Lee, Holman & Havelka, 2002.

Description. Alate viviparous female. ***Color*** (macerated specimens): Head and Thorax dark. Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Wings pale with veins bordered by narrow dark pigmentations. Antenna wholly dark. URS dark. Legs pale except basal 1/2 of femora. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology.*** Body spindle-shaped, 3.30 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; one pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.31 times longer than body length; Ant.I smooth with 6-7 setae; Ant.II smooth with 3 setae; Ant.III 45 secondary rhinaria irregularly scattered with 15 setae, longest setae on Ant.III 0.70 times longer than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.71-1.82 times longer than 2HT, 1.18 times long than Ant.VIb with 4 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 4-6 on tergite

III, 4-5 on tergite VI between the SIPH, 2-3 on tergite VIII. SIPH trap shaped, 1.81 times longer than cauda, 0.60 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 22 hairs. Genital plate dusky, 2 median hairs, 15 ciliated setae on posterior margin.

Specimens examined. North Korea. 2 ap., 1 al., col.#NK-2321, Mupo, HB, 14.vii.1987, on *Leontopodium coreanum*, leg. J. Havelka.

Host plants. *Leontopodium coreanum* (Asteraceae).

Distributions. Korea (North and South).

Remarks. Body 2.92-3.64 mm. 42-67 secondary rhinaria on Ant.III (Al. 45-78 secondary rhinaria on Ant.III). Cauda with 17-23 hairs. The species is distinguished from *U. picridis* by relatively short antennal segment III, apparently shorter than Ant.IV and Ant.V together (Lee *et al*., 2002b).

17. *Uroleucon* (*Uroleucon*) *monticola* (Takahashi, 1935) 산수염진딧물

(Plate A34; Table A34)

Macrosiphum monticolum Takahashi, 1935.

Dactynotus (*Dactynotus*) *monticola* Takahashi, 1962.

Uroleucon (*Uroleucon*) *monticola* Remaudière, G. & M. Remaudière, 1997.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale. Thorax and Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and numerous small setae at the basal part of Abdomen. Antenna wholly dark except Ant.I-II and basal 1/2 of Ant.III. URS dark. Legs pale except distal 1/3 of femora, and distal 1/5 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology.*** Body spindle-shaped, 3.09-3.42 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; three pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.05-1.13 times longer than body length; Ant.I smooth with 4-8 setae; Ant.II smooth with 3-5 setae; Ant.III 30-36 secondary rhinaria irregularly scattered with 19-27 setae, longest setae on Ant.III 0.61-0.99 times longer than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.01-1.42 times longer than 2HT, 0.69-0.96 times long than Ant.VIb with 4-6 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with weak developed scleroite, 13-15 on tergite III, 8-10 on tergite VI between the SIPH, 5-6 on tergite VIII. SIPH cylindrical shape, 1.85-1.99 times longer than cauda, 0.82-0.87 times longer than hind femur, distal 1/3 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 22-26 hairs. Genital plate dusky, 2 median hairs, 22-26 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 41-46 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. North Korea. 2 ap., Mt. Ryongak, Pyongyang-si, on *Cacalia hastate*, 7.vii.1987, coll.#87HA2204, leg. J. Havelka, (NAS). 2 ap., Mt. Kumkang, Kuryong-pokpo, GW, on *Erigeron acris*, 4.vi.1987, col.#87HA1664, leg. J. Havelka, (NAS); 3 ap., Mt. Ryongak, Pyongyang-si, on *Aster maackii*, 11.vi.1988, coll.#88HA2960, leg., J. Havelka (NAS); 1 al., Mt. Myohyang, PN, 26.vi.1987, on *Artemisia japonica*, col.#87HA3333, leg., J. Havelka (NAS). South Korea. 3 ap., 2 al., col.#050616-SH-1 Micheongol Recreational Forest, Yangyang-gun, GW, 16.v.2005, on *Aster* sp., leg. Seunghwan Lee.

Host plants. *Aster* sp., *A. ageratoides* var. *semiamplexicaulis*, *Erigeron* sp., *Meguroleucon longqishanensen* and *Viola verecunda* (Asteraceae).

Distributions. China, Japan, Korea (South), Taiwan.

Remarks. Body 3.09-3.42 mm. 30-36 secondary rhinaria on Ant.III (Al. 41-46 secondary rhinaria on Ant.III). Cauda with 22-26 hairs. Korean species have been collecting on both of *Aster* sp. and *Erigeron* sp. (Asteraceae), although Japanese species have been collected on only *Aster* sp. (Lee *et al*., 2002b; Favret, 2018).

18. ***Uroleucon* (*Uroleucon*) *picridis*** (Fabricius, 1775) 모련채수염진딧물

(Plate A35; Table A35)

Aphis picridis Fabricius, 1775.
Macrosiphum picridis van der Goot, 1915.
Dactynotus picridis His Ris Lambers, 1939.
Uroleucon picridis Paik, 1972; Eastop & Hille Ris Lambers, 1976.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head pale. Thorax and abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark. URS dark. Legs pale except distal 1/2 of femora, and distal 1/2 of tibiae. Genital plate dark dusky. SIPH dark and Cauda pale. ***Morphology*****.** Body spindle-shaped, 2.59 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; two pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 1.34-1.36 times longer than body length; Ant.I smooth with 5-11 setae; Ant.II smooth with 4 setae; Ant.III 83-88 secondary rhinaria irregularly scattered with 13-17 setae, longest setae on Ant.III 0.57 times longer than the basal diameter of the segment, Rostrum attaining the AbdT.III; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 1.70-1.79 times longer than 2HT, 1.55-1.62 times long than Ant.VIb with 2 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with well developed scleroite, 8-10 on tergite III, 8-10 on tergite VI between the SIPH, 5 on tergite VIII. SIPH trap shaped, 1.30-1.36 times longer than cauda, 0.71-0.75 times longer than hind femur, distal 1/3 polygonal reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 15 hairs. Genital plate dusky, 2 median hairs, 8 ciliated setae on posterior margin.

Alate viviparous female. ***Color*** (macerated specimens): Antenna entirely dark. Thorax dark brown. Abdomen pale with well developed scleroite. Wings pale with veins bordered by narrow dark pigmentations. ***Morphology***. Antenna with 78-82 secondary rhinaria in Ant.III. Cauda triangular, pointed at apex. SIPH cylindrical, imbricated and reticulated at apex. Otherwise like apterous viviparous female.

Specimens examined. North Korea. 4 ap., col.#NK-2352, Samjiyon, 13.vii.1987, on *Picris hieracioides*, leg., J. Havelka. South Korea. 1 ap., 2 al., Seoul, 15.vi.1965, on *Centaura monanthos*, coll.#3726 (NAS). 6 ap., col.#5405, Danyang-gun, CB, 24.viii.1969, on *Ixeris dentate*, 4 ap., col.#5376, Danyang-gun, CB, 24.viii.1967, on *Xanthium strumarium*. 8 ap., 5 al., Danyang, CB, 1.viii.1969, on anonymous plant, coll.#5287 (NAS).

Host plants. *Aster maackii*, *Centaurea* sp., *Hieracium umbellatum*, *Ixeris dentate*, *Lactuca indica*, *L. sativa*, *Picridis hieracioides* var. *glabrescens* and *Sonchus* sp. (Asteraceae).

Distributions. China, Europe, Japan, Korea (North and South) and Russia.

Remarks. Body 2.59 mm. 83-88 secondary rhinaria on Ant.III (Al. 78-82 secondary rhinaria on Ant.III). Cauda with 15 hairs. The species is similar to *U. formosanum* but it can be distinguished by ratio of URS and 2HT, and pigmented scleroites. (*U. picridis*, URS more 1.4 × 2HT. Abdominal tergum with well pigmented scleroites at bases of dorsal setae; *U. formosanum*, URS as long as or slightly longer than 2HT, Abdominal tergum without black pigmented scleroites or with only pale scleroites at very base of dorsal setae).

19. ***Uroleucon* (*Uroleucon*) *seneciocola*** **(Paik, 1965)**

솜방망이수염진딧물

Macrosiphum seneciocola Paik, 1965.
Uroleucon (*Uroleucon*) *seneciocola* Remaudière, G. & M. Remaudière, 1997.

Specimens examined. Unknown.

Host plants. *Senecio pierotii* (Asteraceae).

Distributions. Korea.

Remarks. Referring to Blackman Eastop (2006), this species is similar to *U. compositae* (or *U. gobonis*), but with less extensive rhinariation of Ant.III. Additionally, Paik (1965) described this spceis without detail information for type specimens, which is not available for the authors. After it, no more collection has been reported.

20. *Uroleucon* (*Uroleucon*) *sonchi* (Linnaeus, 1767)
방가지똥수염진딧물

(Plate A36; Table A36)

Aphis sonchi Linnaeus, 1767.
Macrosiphum sonchi, van der Goot, 1915.
Dactynotus sonchi, hille Ris Lambers, 1939.
Macrosiphum sonchicola Matsumura, 1917.
Dactynotus picridiphaga Takahashi, 1962.
Uroleucon sonchi Ripka, 2001.

Description. Apterous viviparous female. ***Color*** (macerated specimens): Head dark. Thorax and Abdomen pale with dark marginal pigmented scleroites on tergite 2-6 and small pigmented scleroites at the bases of dorsal setae. Antenna wholly dark except bases of Ant.III. URS dark. Legs pale except distal 1/3 of femora, and distal 1/6 of tibiae. Genital plate dark dusky. SIPH dark except the middle part. Cauda pale. ***Morphology.*** Body spindle-shaped, 3.18-3.74 mm long from antenna tubercle to end of cauda. **Head**: spinulose on whole surface of ventrum, smooth on dorsum; four pair of hairs on vertex and 1-2 more on inner side of each antennal tubercle, frons U-shaped. Antennae slight, 0.91-1.04 times longer than body length; Ant.I smooth with 6-8 setae; Ant.II smooth with 3-5 setae; Ant.III 12-17 secondary rhinaria irregularly scattered with 9-18 setae, longest setae on Ant.III 3.06-3.29 times longer than the basal diameter of the segment, Rostrum attaining the meso coxae; clypeus with 4 setae; mandibular laminae with 4-6 hairs; URS tongue shaped, 0.66-0.87 times longer than 2HT, 0.66-0.83 times long than Ant.VIb with 6-8 median setae. **Thorax**: Prothorax with 3 pairs spinal setae and one pair marginal seta on each side of pronothum. Hind coxa spinulate with 8 acute hairs; trochanter smooth; femur smooth and longer than SIPH bearing short setae; hind tibia smooth with many setae; first segment of each tarsus smooth with about five setae at apex. **Abdomen**: Abdominal tergites membranous with weak developed scleroite, 7-8 on tergite III, 3-5 on tergite VI between the SIPH, 4-6 on tergite VIII. SIPH cylindrical shape, 1.86-1.93 times longer than cauda, 0.83-0.99 times longer than hind femur, distal 1/4 reticulated apex. Cauda elongated and tapering, basal 1/3 narrow slender, with 23-30 hairs. Genital plate dusky, 2 median hairs, 9-12 ciliated setae on posterior margin.

Specimens examined. South Korea. 3 ap., Daebudo, Ansan-si, GG, 18.x.2000, on *Taraxacum mongolicum*, col.#001018-TM-20, leg. T.M.Han. **(**Preserved specimens in alcohol): Northeast Forestry University, China, 15.viii.2010, on *Sonchus oleraceus*, col.# 100815SH-4-1, leg. Hwalran Choi;

Northeast Forestry University, China, 15.viii.2010, on *Sonchus oleraceus*, col.# 100815SH-4-2, leg. Hwalran Choi; Laoshan, China, 15.viii.2010, on *Sonchus oleraceus*, col.# 100815SH-23, leg. Hwalran Choi. (DNA preserved specimens): Northeast Forestry University, China, 15.viii.2010, on *Sonchus oleraceus*, col.# 100815SH-4-1, no.DNA160, experimenter Hwalran Choi; Northeast Forestry University, China, 15.viii.2010, on *Sonchus oleraceus*, col.# 100815SH-4-2, no.DNA161, experimenter Hwalran Choi.

Host plants. *Cichorium* sp., *Hieracium* sp., *Ixeridium* sp., *Lactuca* sp., *Picris* sp., *Reichardia* sp. (Asteraceae).

Distributions. Afghanistan, Argentina, Australia, Europe, Japan, Kazakhstan, Nepal, Pakistan and Korea (South).

Remarks. Body 3.18-3.74 mm. 12-17 secondary rhinaria on Ant.III. Cauda with 23-30 hairs. In previous study of Lee *et al.*, (2002b), Korean specimen is relatively different with West Palearctic samples by pale SIPH (uniformly dark to black in West Palearctic samples of *U. sonchi*).

LITERATURE CITED

Amyot., 1847. Entomologie française. Rhynchotes (Suite) (1). Annales de la Société Entomologique de France Deuxième Série 5:453-506.

Arzone, A., Alma, A., 1984. Contributo alla conoscenza della biocenosi di *Myzus* varians. Boll. Zool. agr. Bachic. 18, 95-113.

Azuma, Y., Kumazawa, Y., Miya, M., Mabuchi, K., Nishida, N., 2008. Mitogenomic evaluation of the historical biogeography of cichlids toward reliable dating of teleostean divergences. BMC Evol. Biol. 8, 215.

Baker, A.C., 1920. Generic classification of the family Aphididae. Bull. US Dept. Agric. 826: 1-109.

Banerjee, H., Ghosh, A. K., Raychaudhuri, D. N. 1969. On a collection of aphids (Homoptera) from Kuti valley, West Himalaya. Oriental Insects, 3(3), 255-264.

Basu, R.C., Ghosh, M.R. & Raychaudhuri, D.N., 1976. Studies on the aphids from eastern India. XXXIV. (new genera, new subgenera, one new species and some new records from north-east India). Entomon (India) 1: 59-66.

Bergsten, J., Nilsson, A.N., Ronquist, F., 2013. Bayesian tests of topology hypotheses with an example from diving beetles. Syst. biol. 62, 660–673.

Börner, C., 1952. Europae centralis aphides, Weimarar Druck- und Verlagsanstalt Gebr. Knabe KG.

Börner, C., Heinze, K., 1957. Aphidina-Aphidoidea. In: Sorauer, P. (Ed.), Handbuch der Pflanzenkrankheiten, vol. B and 5. Paul Parey, Berlin.

Blackman, R.L., Esatop, V.F., 1994. Aphids on the World's trees: an identification and information guide. Wallingford, CAB International.

Blackman, R.L., Eastop, V.F., 2000. Aphids on the World's crops: an identification and information guide. Chichester, John Wiley & Sons Ltd.

Blackman, R.L, Eastop, V.F., 2006. Aphids on the World’s herbaceous plants and shrubs, vol. 2, The Aphids. Chichester: John Wiley & Sons Ltd.

Boo, K.S., Choi, M.Y., Chung, I.B., Eastop, V.F., Pickett, J.A., Wadhams, L.J. & Woodcock, C.M. (2000) Sex pheromone of the peach aphid, *Tuberocephalus momonis*, and optimal blends for trapping males and females in the field. Journal of Chemical Ecology 26: 601-609.

Börner, C., Blunk, 1916. Mitteilungen aus der Kaiserlichen. Biologischen Anstalt für Land- und Forstwirtschaft 16: 28-42.

Börner., 1933. Kleine Mitteilungen über Blattläuse. Selbstverlag. Naumburg p. 4.

Brumley, C., Watson, L., 2017. First records of *Uroleucon erigeronense* on *Conyza* (Asteraceae) from Australia, with descriptions of morphological variation, biological notes and an update for commonly used keys. Austral Ent. 56, 339-344.

Carver., 1961. Proceedings of the Royal Entomological Society of London Series B. Taxonomy, 30:69.

Chandler, G.T., Plunkett, G.M., 2004. Evolution in Apiales: nuclear and chloroplast markers together in (almost) perfect harmony. Bot. J. Linn. Soc. 144, 123–147.

Choi, H., Lee, W., Lee, S., 2012. Taxonomic review of the subgenus *Uroleucon* (Uromelan) (Hemiptera: Aphididae) in the Korean peninsula. J. Asia Pac. Entomol. 15 (1), 17–20.

Choi, H., Shin, S., Jung, S., Clarke, D. J., Lee, S., 2018. Molecular phylogeny of Macrosiphini (Hemiptera: Aphididae): An evolutionary hypothesis for the Pterocomma-group habitat adaptation. Mol. Phylogenet. Evol. 121, 12-22.

Clark, M.A., Moran, N.A., Baumann, P., 1999. Sequence evolution in bacterial endosymbionts having extreme base compositions. Mol. Biol. Evol. 16, 1586–1598.

Davidson., 1912. Aphid notes from California. Journal of Economic Entomology 5:401-413.

Dixon, A.F.G., 1987. The way of life of aphids: host specificity, speciation and distribution. In: Minks, A.K., Harrewijn, P. (Eds.), Aphids their biology, natural enemies and control, Vol A. Elsevier, Amsterdam, pp. 197–207.

Dixon, A.F.G. (Ed.), 1998. Aphid ecology. An optimization approach. Chapman & Hall, London.

Eastop, V.F., 1961. A study of the Aphididae of West Africa. BMNH, London, p. 19-22.

Eastop, V.F., 1966. A taxonomic study of Australian Aphidoidea. Austr. J. Zool. 14, 399-592.

Eastop, V.F., Hille Ris Lambers, D., 1976. Survey of the World's Aphids. W. Junk, The Hague 573 pp.

Eastop, V.F., Blackman, R.L. 2005. Some new synonyms in Aphididae. *Zootaxa* 1089: 1-36.

Eberle, J.J., Greenwood, D.R., 2012. Life at the top of the greenhouse Eocene world—A review of the Eocene flora and vertebrate fauna from Canada's High Arctic. GSA Bulletin. 124, 3–23.

Fabricius., 1775. Sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus. Systema Entomologiae 734.

Favret, C., 2005. A new non-destructive DNA extraction and specimen clearing technique for aphids (Hemiptera). Proc. Entomol. Soc. Wash. 107, 469–470.

Favret, C. Aphid species file. Version 5.0/5.0 [17. Sep. 2018]. <http://Aphid. SpeciesFile. org>.

Foottit, R. G., Maw, H. E. L., von Dohlen, C. D., Hebert, P. D. N., 2008. Species identification of aphids (Insecta: Hemiptera: Aphididae) through DNA barcodes. Mol. Ecol. Res. 8, 1189–120.

Guldemond, J.A., 1990. Host plant shift, host race formation and speciation in *Ctyptomyzus* (Homoptera, Aphididae). Acta Phytopathol. Entomol. Hung. 25, 89–96.

Heie, O.E., 1980. The Aphidoidea (Hemiptera) of Fennoscandia and Denmark. I. General part. The families Mindaridae, Hormaphididae, Thelaxidae, Anoeciidae, and Pemphigidae. Scandinavian science press Ltd., Klampenborg, Denmark.

Heie, O.E., 1994. The Aphidoidea of Fennoscandia and Denmark V. Aphidinae. Part 2 of Macrosiphini. Fauna entomologica scand. vol. 28, p. 242.

Heie, O.E., 1995. The Aphidoidea (Hemiptera) of Fennoscandia and Denmark. VI. Family Aphididae: Part 3 of the tribe Macrosiphini of subfamily Aphidinae, and Family Lachnidae. Fauna Entomologica Scandinavica 31: 43-80.

Heinze, K., 1960. Systematic der mitteleuropäischen Myzinae. Beitr. Ent. 10: 744-842.

Hille Ris Lambers, D., 1939. Contributions to a monograph of the Aphididae of Europe II. The genera *Dactynotus* Rafinesque, 1818; *Staticobium* Mordvilko, 1914; *Macrosiphum* Passerini, 1860; *Masonaphis* nov. gen.; *Pharalis* Leach, 1826. Temminckia 4, 1–134.

Hille Ris Lambers, D., 1946. A new British aphid from *Prunus padus* I., *Myzus padellus* sp. n. (Hemiptera: Aphididae). Proc. Roy. Ent. Soc. London. 15(9-10): 101-105.

Hille Ris Lambers, D., 1950. Hostplants and aphid classification. In: Proceedings of the 8th international congress of Entomology, Stockholm. 1948, pp. 141–144.

Jousselin, E., Genson, G., Coeur d'acier, A., 2010. Evolutionary lability of a complex life cycle in the aphid genus *Brachycaudus*. BMC Evol. Biol. 10, 295.

Karrenberg, S., Edwards, P.J., Kollmann, J., 2002. The life history of Salicaceae living in the active zone of floodplains. Freshwater Biol. 47, 733–748.

Katoh, K., Toh, H., 2008. Recent developments in the MAFFT multiple sequence alignment program. Brief. Bioinform. 9, 286–298.

Katoh, K., Misawa, K., Kuma, K., Miyata, T., 2002. MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. Nucleic Acids. Res. 30, 3059–3066.

Katoh, K., Misawa, K., Kuma, K., Miyata, T., 2005. MAFFT version 5: improvement in accuracy of multiple sequence alignment. Nucleic Acids. Res. 33, 511–518.

Kim, H., Lee, S., Jang, Y., 2011. Macroevolutionary patterns in the Aphidini aphids (Hemiptera: Aphididae): diversification, host association, and biogeographic Origins. PLoS ONE 6, e24749.

Kindlmann, P, Dixon, A.F.G., Michaud, J.P., 2010. Aphid biodiversity under environmental change. Patters and Processes. Dordrecht, Netherlands, Springer.

Knight, S., Gordon, D.P., Lavery, S.D., 2011. A multi-locus analysis of phylogenetic relationships within cheilostome bryozoans supports multiple origins of ascophoran frontal shields. Mol. Phylogenet. Evol. 61, 351–362.

Lavoué, S., Miya, M., Saitoh, K., Ishiguro, N.B., Nishida, M. 2007. Phylogenetic relationships among anchovies, sardines, herrings and their relatives (Clupeiformes), inferred from whole mitogenome sequences. Mol. Phylogenet. Evol. 43, 1096–1105.

Lear, C.H., Bailey, T.R., Pearson, P.N., Coxall, H.K., Rosenthal, Y., 2008. Cooling and ice growth across the Eocene-Oligocene transition. Geology 36, 251–254.

Leck, M.A., Schütz, W., 2005. Regeneration of Cyperaceae, with particular reference to seed ecology and seed banks. Perspect. Plant Ecol. Evol. Syst. 7, 95–133.

Lee, W., Seo, H., 1990. Systematic studies on aphids of Korea. 1. Tribe Macrosiphini. Korean J. Ent. 20(3):197-212.

Lee, S., Holman, J., Havelka, J., 2002a. Illustrated Catalogue of Aphididae in the Korean Peninsula. Part I, Subfamily Aphidinae (Hemiptera: Sternorrhyncha). Daejoen, Rep. of Korea: Korea Research Institute of Bioscience and Biotechnology. pp. 329.

Lee, S., Holman, J., Havelka, J., 2002b. The genus *Uroleucon* (Hemiptera: Aphididae) from the Korean Peninsula. Part I. The nominotypical subgenus *Uroleucon* with descriptions of three new species. Oriental insects 36, 59-77.

Lee, W., Lee, S., 2013. Molecular and morphological characterization of two aphid genera, *Acyrthosiphon* and *Aulacorthum* (Hemiptera: Aphididae). Journal of Asia-Pacific Entomology 16, 29-35.

Lichvar, R.W., Butterwick, M., Melvin, N.C., Kirchner, W.N., 2014. The National Wetland Plant List: 2014 wetland ratings. Phytoneuron 2014-41, 1–42.

Linnè, C., 1758. Systema Naturae 10th ed, p. 451-455.

Mackenzie, A., Dixon, A.F.G., 1990. Host alternation in aphids: constraint versus optimization. Amer. Nat. 136, 132–134.

Maddison, W.P., Maddison, D.R., 2014. Mesquite: a modular system for evolutionary analysis. Version 3.01 http://mesquiteproject.org.

Makowsky, R., Marshall, J.C., McVay, J., Chippindale, P.T., Rissler, L.J., 2010. Phylogeographic analysis and environmental niche modeling of the plainbellied water snake (*Nerodia erythrogaster*) reveals low levels of genetic and ecological differentiation. Mol. Phylogenet. Evol. 55, 985–995.

Marek, P.E., Bond, J.E., 2007. A reassessment of apheloriine millipede phylogeny: additional taxa, bayesian inference, and direct optimization (Polydesmida: Xystodesmidae). Zootaxa 1610, 27–39.

Martin, J.H., 1983. The identification of common aphid pests of tropical agriculture. Trop., Pest Manga. 29:395-411.

Matsumura, S. 1917, A list of the Aphididae of Japan, with description of new species and genera. Jour. Coll. Agr., Tohoku Imp. Univ. 7: 395.

Matsumura, S. 1918. New Aphidinae of Japan. Tran. Sapporo Nat. Hist. Soc. 7(1): 1-24.

Miller, M.A., Pfeiffer, W., Schwartz, T., 2010. Creating the CIPRES science gataway for inference of large phylogenetic trees in proceedings of the gateway computing environments workshop (GCE), 14 Nov. 2010, New orleans, LA pp 1–8.

Misof, B., Liu, S., Meusemann, K., Peters, R.S., Donath, A., Mayer, C., Frandsen, P. B., Ware, J., Flouri, T., Beutel, R.G., Niehuis, O., Petersen, M., Izquierdo-Carrasco, F., Wappler, T., Rust, J., Aberer, A.J., Aspock, U., Aspock, H., Bartel, D., Blanke, A., Berger, S., Bohm, A., Buckley, T.R., Calcott, B., Chen, J., Friedrich, F., Fukui, M., Fujita, M., Greve, C., Grobe, P., Gu, S., Huang, Y., Jermiin, L.S., Kawahara, A.Y., Krogmann, L., Kubiak, M., Lanfear, R., Letsch, H., Li, Y., Li, Z., Li, J., Lu, H., Machida, R., Mashimo, Y., Kapli, P., McKenna, D.D., Meng, G., Nakagaki, Y., Navarrete-Heredia, J.L., Ott, M., Ou, Y., Pass, G., Podsiadlowski, L., Pohl, H., von Reumont, B.M., Schutte, K., Sekiya, K., Shimizu, S., Slipinski, A., Stamatakis, A., Song, W., Su, X., Szucsich, N.U., Tan, M., Tan, X., Tang, M., Tang, J., Timelthaler, G., Tomizuka, S., Trautwein, M., Tong, X., Uchifune, T., Walzl, M.G., Wiegmann, B.M., Wilbrandt, J., Wipfler, B., Wong, T.K., Wu, Q., Wu, G., Xie, Y., Yang, S., Yang, Q., Yeates, D.K., Yoshizawa, K., Zhang, Q., Zhang, R., Zhang, W., Zhang, Y., Zhao, J., Zhou, C., Zhou, L., Ziesmann, T., Zou, S., Li, Y., Xu, X., Zhang, Y., Yang, H., Wang, J., Wang, J., Kjer, K.M., Zhou, X., 2014. Phylogenomics resolves the timing and pattern of insect evolution. Science 346, 763–767.

Miyazaki, M., 1968. On three aphids of Rosa rugosa occurring in Japan with description of a new species. Kontyû 36: 274-284.

Miyazaki, M., 1971. A revision of the the tribe Macrosiphini of Japan (Homoptera: Aphididae, Aphidinae). Insecta Matsumurana 34, 1–247.

Mondor, E.B., Roitberg, B.D., Stadler, B. 2002. Cornicle length in Macrosiphini aphids: a comparison of ecological traits. Ecol. Entomol. 27, 758–762.

Moran, N.A., 1992. The evolution of aphid life cycles. Annu. Rev. Entomol. 37, 321–348.

Moran, N. A., Kaplan, M.E., Gelsey, M.J., Murphy, T.G. & Scoles, E.A., 1999. Phylogenetics and evolution of *Uroleucon* based on mitochondrial and nuclear DNA sequences. Syst. Ent. 24, 85-93.

Mordvilko, A.K. 1914., Aphidodea I. Faune de la Russie (Insecta: Hemiptera). Insectes. Hmmiptères 1:236.

Mordvilko, A., 1921. Aphids of Graminea. Izv. sev. oblast. sta. Zashch. Rast. Vredit. 3, l-72. (In Russian: English translation by Uvarov, B.P. (1922) Bull.ent. Res. 13, 25-39).

Nault, L.R., Edward, L.J., Styer, W.E., 1973. Aphid alarm pheromones: secretion and reception. Environ. Entomol. 2, 101–105.

Nieto Nafría, J.M., Mier Durante, M.P., Ortego, J. & Seco Fernández, M.V., 2007. The genus *Uroleucon* (Hemiptera: Aphididae: Macrosiphini) in Argentina, with descriptions of five new species. The Can. Ent. 139(2), 154-178.

Nieto Nafría, J.M. Favret, C., 2011. Registers of family-group and genus-group taxa of Aphidoidea. Universidad de León, Área de Publicaciones.

Nováková, E., Hypša, V., Klein, J., Foottit, R.G., von Dohlen, C.D., Moran, N.A., 2013. Reconstructing the phylogeny of aphids (Hemiptera: Aphididae) using DNA of the obligate symbiont *Buchnera aphidicola*. Mol. Phylogenet. Evol. 68, 42–54.

Offenberg, J., 2001. Balancing between mutualism and exploitation: the symbiotic interaction between *Lasius* ants and aphids. Behav. Ecol. Sociobiol. 49, 304–310.

Okamoto, H., Takahashi, R., 1927. Some Aphididae from Corea. Ins. Mats. 1(3): 130-148.

Olive, A.T., 1963. The genus *Dactynotus* Rafinesque in North Carolina. Misc., Publ., Ent., Soc., Am. 4: 31-66.

Olive, A.T., 1965. Two new species of *Dactynotus* from eastern United States. Proc. Ent. Soc. Wash. 67, 41-45.

Ortiz-Rivas, B., and D. Martínez-Torres, 2010. Combination of molecular data support the existence of three main lineages in the phylogeny of aphids (Hemiptera: Aphididae) and the basal position of the subfamily Lachninae. Mol. Phylogenet. Evol. 55, 305–317.

Paik, W.H. 1965. A new species of aphid from Mt. Hanla. Korean Soc. Plant Prot. 10(2): 75-76.

Paik, W.H. 1972. Illustrated Encyclopedia of Fauna and Flora of Korea. Vol. 13. Insecta V. p. 751.

Parker, J.D.K., Bradley, B.A., Mooers, A.O., Quarmby, L.M., 2007. Phylogenetic analysis of the Neks reveals early diversification of ciliary-cell cycle kinases. PLoS ONE 2, e1076.

Pashtshenko, N.F., 1988. Suborder Aphidinea - aphids. Keys to Insects of the Far East of USSR (II) (ed. by P. A. Lehr). Nauka, Leningrad, p. 546-686.

Pashtshenko, N.F., 2000. Aphids of the genus *Uroleucon* Mordvilko, 1914 (Homoptera, Aphididae) from the Russiana Far East; A Key to the Subgenera and Species of the Nominotypical Subgenus and Descriptions of New Taxa. Entomological Review, 80(6), 659-672. Translated from Entomologicheskoe Obozrenie 79(4): 835-850.

Passerini., 1860. Gli afidi con un prospetto dei generi ed alcune specie nuove Italiane, Tipografia Carmignani, Parma, Italy 40 pp

Pavlicev, M., Werner Mayer, W. 2009. Fast radiation of the subfamily Lacertinae (Reptilia: Lacertidae): history or methodical artefact? Mol. Phylogenet. Evol. 52, 727–734.

Posada, D., Crandall, K.A., 1998. MODELTEST: testing the model of DNA substitution. Bioinformatics 14, 817–818.

Peccoud, J., Simon, J.C., von Dohlen, C., Coeur d'acier, A., Plantegenest, M., Vanlerberghe-Masutti, F., Jousselin, E. 2010. Evolutionary history of aphid-plant associations and their role in aphid diversification. C. R. Biol. 333, 474–487.

Pagel, M., Meade, A., Barker, D., 2004. Bayesian estimation of ancestral character states on phylogenies. Syst. Biol. 53, 673–684.

Pagel, M., Meade, A., 2007. BayesTraits, Version 1.0—Draft Manual. <http://www.evolution.rdg.ac.uk>.

Rakauskas, R., Havelka, J., Zaremba, A., Bernotienė, R., 2014. Mitochondrial COI and morphological evidence for host specificity of the black cherry aphids *Myzus* cerasi collected from different cherry tree species in Europe. ZooKeys 388, 1-16.

Remaudière G, 1951. Contribution à l'étude des Aphidoidea de la faune française. Description de quelques Aphididae nouveaux et addition a la liste des Myzinae et Dactynotinae. Revue de Pathologie Végétale et d'Entomologie Agricole de France 30: 125-144.

Remaudière, G., Remaudière, M., 1997. Catalogue des Aphididae du Monde. Homoptera Aphidoidea; Catalogue of the world's Aphididae. INRA, Paris, p. 473.

Richards, W.R., 1958. A New aphid genus (Homoptera: Aphididae). Florida Entomologist 41(4), 169-172.

Rindal, E., Soli, G.E.E., Lutz, B., 2009. Molecular phylogeny of the fungus gnat family Mycetophilidae (Diptera, Mycetophiliformia). Syst. entomol. 34, 524–532.

Ripka, G., 2001. New data to the knowledge of the aphid fauna of Hungary. Acta Phytopathol. Entomol. Hung. 36: 81-87.

Robinson, 1985. Annotated list of *Uroleucon* (*Uroleucon*, *Uromelan*, *Satula*) of America north of Mexico, with key. Can. Ent. 117: 1029-1054.

Ronquist, F., Huelsenbeck, J.P., 2003. MrBayes 3: Bayesian phylogenetic inference under mixed models. Bioinformatics 19, 1572–1574.

Sano, M., Akimoto, S., 2011. Morphological phylogeny of gall forming aphids of the tribe Eriosomatini (Aphididae: Eriosomatinae). Syst. Entomol. 36, 607–627.

Schouteden. 1901. Annales de la Société Entomologique de Belgique 45:112. Société entomologique de Belgique, p. 1864-1924.

Schrank., 1801. Schrank, F. v. P. 1801. Fauna Boica. Durchgedachte Geschichte der in Baiern einheimischen und zahmen Thiere 2, 1. Abt. Johann Wilhelm Krull, Ingostadt. Fauna Boica 2(1).

Shaposhnikov, G.K.H., Kuznetsova, V., Stekolshchikov, A., 1998. Evolutionary tendencies and system of Aphididae. In: Nieto Nafria, J.M., Dixon, A.F.G. (Eds.), Proceedings of the Aphids in natural and managed ecosystems, Universidad de Leon, Leon. Secretariado de Publications, London, pp. 481–487.

Shin, S., Jung, S., Menzel, F., Heller, K., Lee, H., Lee, S., 2013. Molecular phylogeny of black fungus gnats (Diptera: Sciaroidea: Sciaridae) and the evolution of larval habitats. Mol. Phylogenet. Evol. 66, 833–846.

Shinji, O., 1924. New aphid species from Morioka. Zool. Mag., Tokyo 36: 343-373.

Shinji, O., 1929. Some more new genera of Aphidides. Lansania 1(3), 39.

Shinji, O., 1941. *Monograph of Japanese Aphididae*. Shinkyo Sha Shoin, Tokyo, p. 1215.

Shinji, O ., 1942. 3 New species of *Macrosiphum* from Tokyo. Insect World 46(9): 258-262.

Smith, C.F., Parron, C.S., 1978. An annotated list of Aphididae of

North America. *Tech. Bull. N. Carolina agric. Exp. Stn* 255: 1-428.

Smith, C.F., Cermeli, M.M., 1979. An annotated list of Aphididae of the Caribbean Islands and South and Central America. Tech. Bull. N. Carol. Agric. Res. Stn., p. 259.

Stamatakis A. 2014. RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. Bioinformatics 30, 1312–1313.

Soliman, L.B.,1927. A comparative study of the structural characters used in the classification of the genus *Macrosiphum* with special reference to the species found in California. Univ. Calif. Publs. Ent. 4: 89-158.

Stireman, J.O., Greeney, H.F., Dyer, L.A., 2009. Species richness and host associations of Lepidoptera-attacking Tachinidae in the northeast Ecuadorian Andes. J. Insect. Sci., 9, 39.

Stireman, J.O., Devlin, H., Carr, T.G., Abbot, P., 2010. Evolutionary diversification of the gall midge genus *Asteromyia* (Cecidomyiidae) in a multitrophic ecological context. Mol. Phylogen. Evol. 54, 194–210.

Strand, E., 1929. Zoological and palaeontological nomenclatorial notes. Act., Univ., Latv. 20:1-29.

Stroyan., 1954. Proceedings of the Royal Entomological Society of London Series B, Taxonomy 23(1-2), 10.

Swofford, D.L., 2002. PAUP*: Phylogenetic Analysis Using Parsimony (*and Other Methods) computer program, version 4. Sinauer Associates, Sunderland, Massachusetts.

Takahashi, R., 1921. Aphididae of Formosa 1. Spec. Rep. Formosa agric. Exp. Stn. 20, 1-97.

Takahashi, R.,1923. Aphididae of Formosa 2. *Rep. Govt Res. Inst. Dep. Agric*, *Formosa* 4:1-173.

Takahashi, R., 1930. Some Aphididae of Loochoo. Trans. Nat. Hist. Soc. Formosa 20(111): 318.

Takahashi, R., 193l. Aphididae of Formosa 6. Rep. Govt. Res. Inst. Dep. Agric. Formosa 53: 1-127.

Takahashi, R., 1934. Aphids of Okinoshima. Fukuoka Nat. Hist. Jour. 1(3): 243-247.

Takahashi, R., 1937. Some oriental Aphididae II. Konowia 16: 90-96.

Takahashi, R., 1962. Key to Japanese species of *Dactynotus*, with descriptions of four new species (Aphididae, Homoptera). Kontyù 30(2): 73-81.

Takahashi, R., 1965. Some new and little-known Aphididae from Japan. Insecta matsum. 28: 19-61.

Tank, D.C., Olmstead, R.G., 2009. The evolutionary origin of a second radiation of annual *Castilleja* (Orobanchaceae) species in South America: the role of long distance dispersal and allopolyploidy. Am. J. Bot. 96, 1907–1921.

Tao, C.C., 1963. Revision of Chinese Macrosiphinae (Aphidae, Homoptera). Plant Protect. Bull. Taiwan 5(3), 162-205.

Tao, C.C., 1964. Revision of Chinese Drepanosiphinae. Q. J. Taiwan Mus. 17, 209-226.

Theobald, F.V., 1915. African Aphididae Part II. Bull. ent. Res. 6, 103-153.

Thomas, C. 1878. A list of the species of the tribe Aphidini, family

Aphididae, found in the United States, which have been named, with descriptions of some new sciences. Bull. III. State Lab. Natur. Hist. 2, 3-16.

van der Goot., 1913. Zur Systematic der Aphiden. Tijdschr. Ent. 56, 69–155.

van der Goot, P., 1915. Beiträge zur Kenntnis der Hollandischen Blattläuse. HD Tjeenk Willink & Zoon, Haarlem, p. 600.

von Dohlen, C.D., Moran, N.A., 2000. Molecular data support a rapid radiation of aphids in the Cretaceous and multiple origins of host alternation. Biol. J. Linn. Soc. 71, 689–717.

von Dohlen, C.D., Rowe, C.A., Heie, O.E., 2006. A test of morphological hypotheses for tribal and subtribal relationships of Aphidinae (Insecta: Hemiptera: Aphididae) using DNA sequences. Mol. Phylogen. Evol. 38, 316–329.

Wang, H., Moore, M.J., Soltis, P.S., Bell, C.D., Brockington, S.F., Alexandre, R., Davis, C.C., Latvis, M., Manchester, S.R., Soltis, D.E., 2009. Rosid radiation and the rapid rise of angiosperm-dominated forests. Proc. Nat. Acad. Sci. USA. 106, 3853–3858.

Verma, K.D, Das, S.M., 1992. The Aphididae of North West India (with special reference to aphids of Jammu and Kashmir state). Ahish Publ. House. New Delhi, p. 171.

Xie, W., Lewis, P.O., Fan, Y., Kuo, L., Chen, M.H., 2011. Improving marginal likelihood estimation for Bayesian phylogenetic model selection. Syst. Biol. 60, 150–160.

Yamanoue, Y., Miya, M., Matsuura, K., Katoh, M., Sakai, H., Nishida, M., 2008. A new perspective on phylogeny and evolution of tetraodontiform fishes (Pisces: Acanthopterygii) based on whole mitochondrial genome sequences: basal ecological diversification? BMC Evol. Biol. 8, 212.

Yang, B.B., Guo, X.G., Hu, X.S., Zhang, J.G., Liao, L., Chen, D.L., Chen, J.P., 2010. Species discrimination and phylogenetic inference of 17 Chinese *Leishmania* isolates based on internal transcribed spacer 1 (ITS1) sequences. Parasitol. Res. 107, 1049–1065.

Zhang, G., Zhong, T., 1980. New species and new subspecies of Chinese Macrosiphinae. I. Entomotaxonomia 2, 53-64.

Zhang, SD., Soltis, DE., Yang, Y., Li, DZ., Yi, TS., 2011. Multi-gene analysis provides a well-supported phylogeny of Rosales. Mol. Phylogenet. Evol. 60, 21–28.

APPENDIX

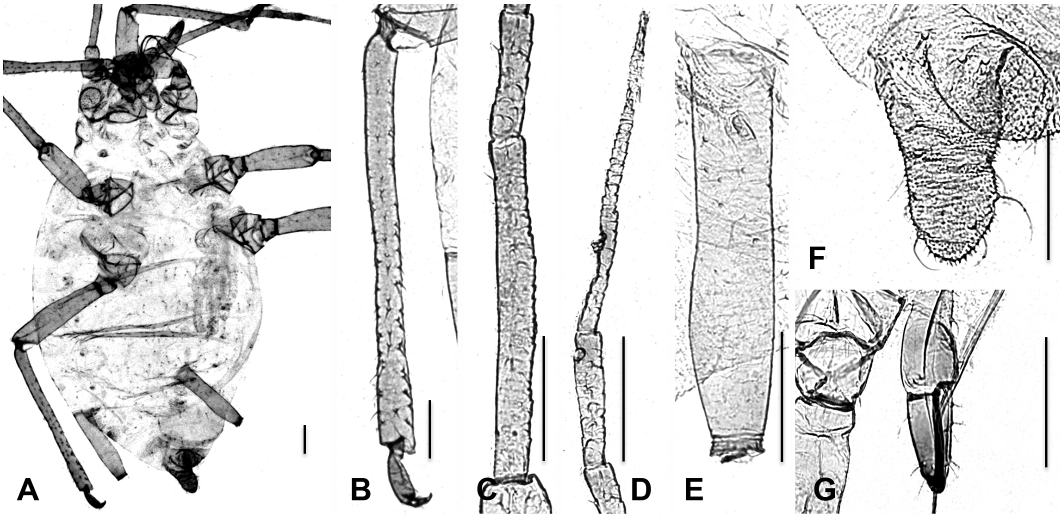


Plate 1. Apterous viviparous female (A-H) of *Myzus asteriae*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, cauda G, ultimate rostral segment. Scale bar means 0.1mm.

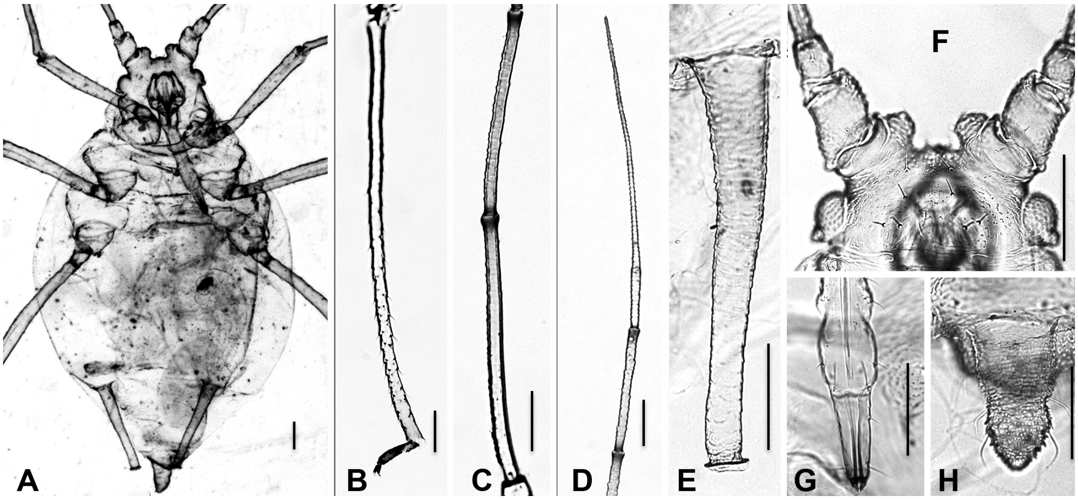


Plate 2. Apterous viviparous female (A-H) of *Myzus boehmeriae*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H,cauda. Scale bar means 0.1mm.

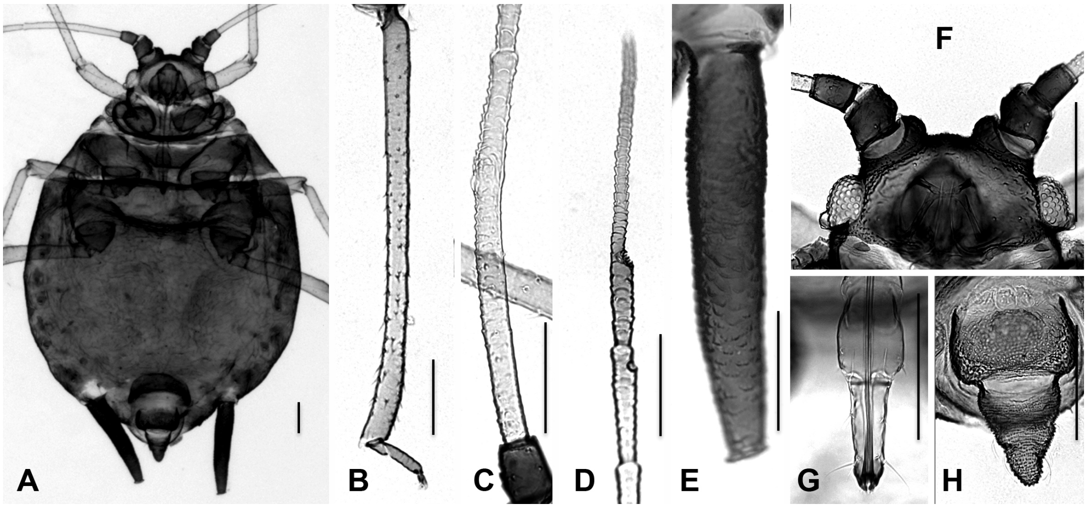


Plate 3. Apterous viviparous female (A-H) of *Myzus cerasi*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H,cauda. Scale bar means 0.1mm.

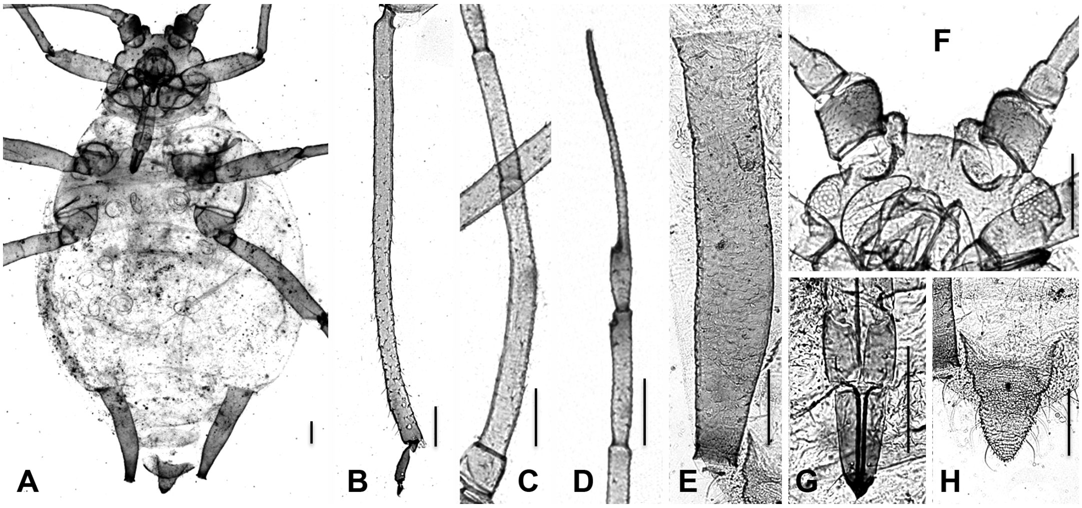


Plate 4. Apterous viviparous female (A-H) of *Myzus dycei*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

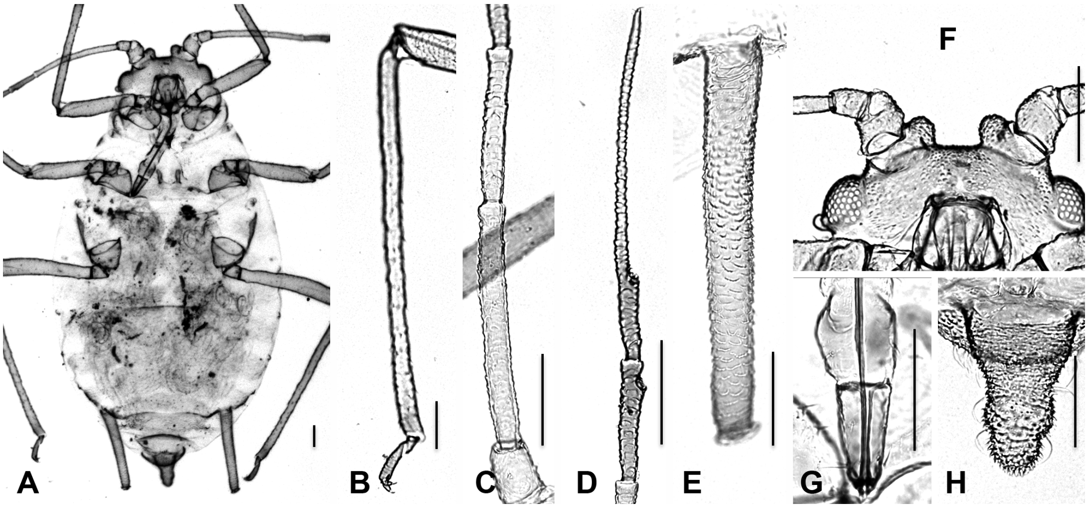


Plate 5. Apterous viviparous female (A-H) of *Myzus hemerocallis*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

Plate 6. Alate viviparous female (A-H) of *Myzus japonensis*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

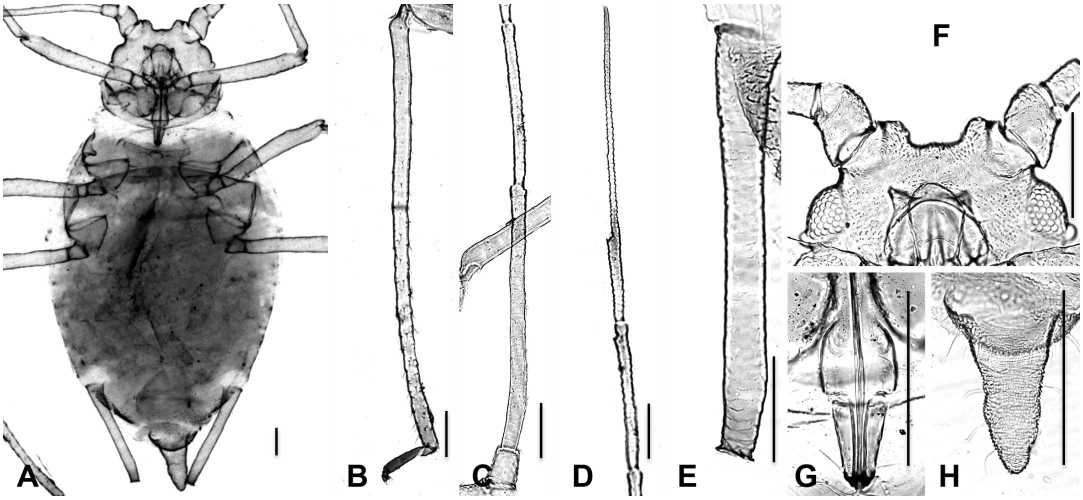


Plate 7. Apterous viviparous female (A-H) of *Myzus lactucicola*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

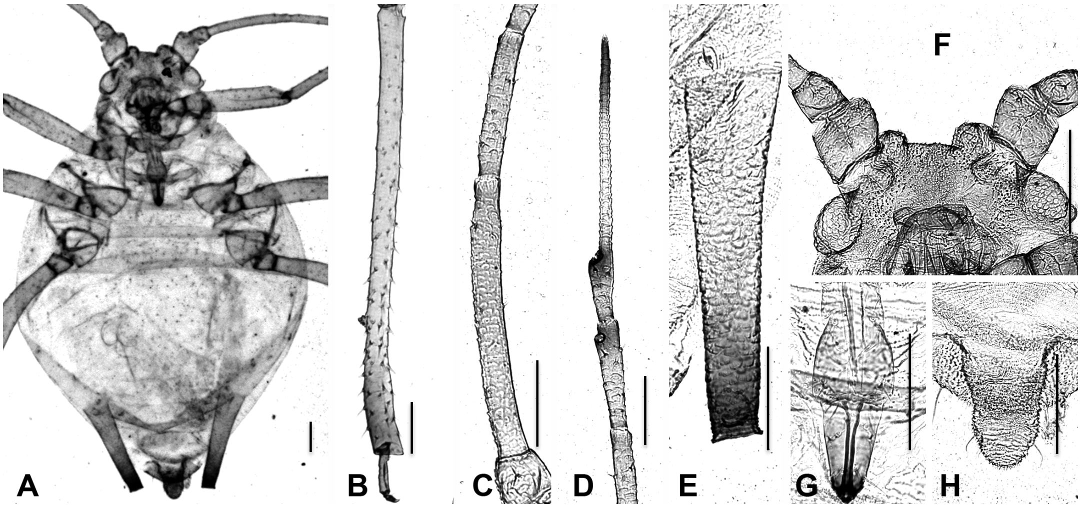


Plate 8. Apterous viviparous female (A-H) of *Myzus mushaensis*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

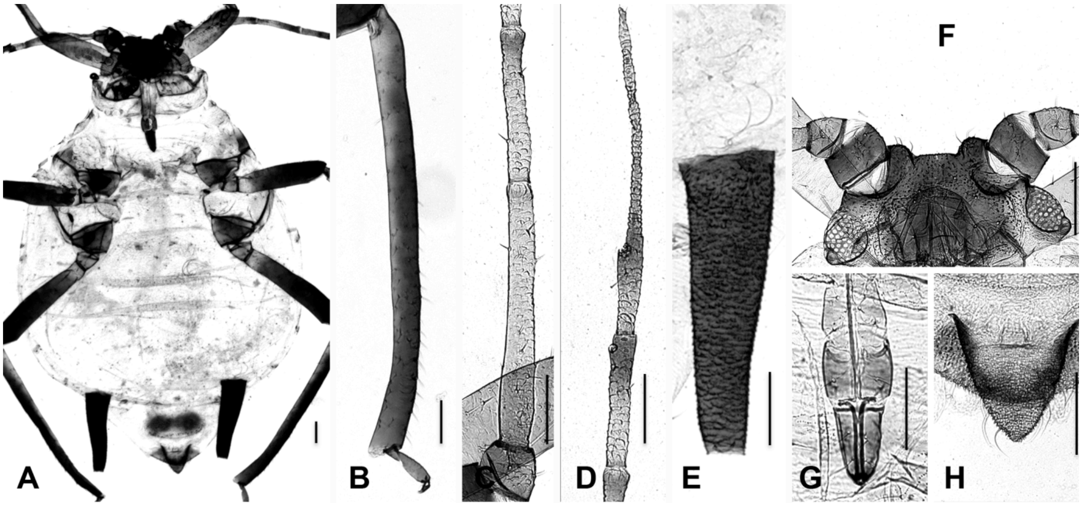


Plate 9. Apterous viviparous female (A-H) of *Myzus padellus*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

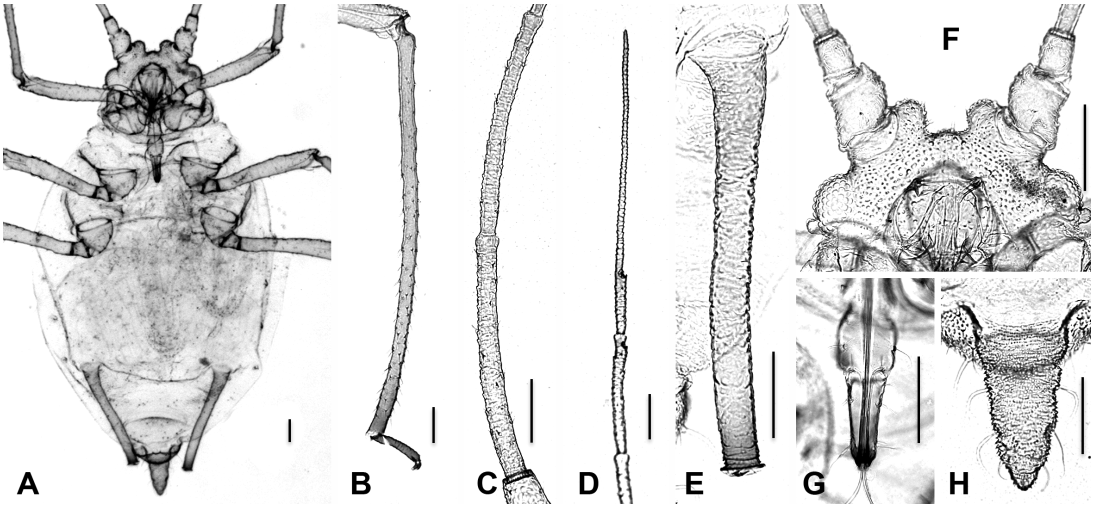


Plate 10. Apterous viviparous female (A-H) of *Myzus persicae*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

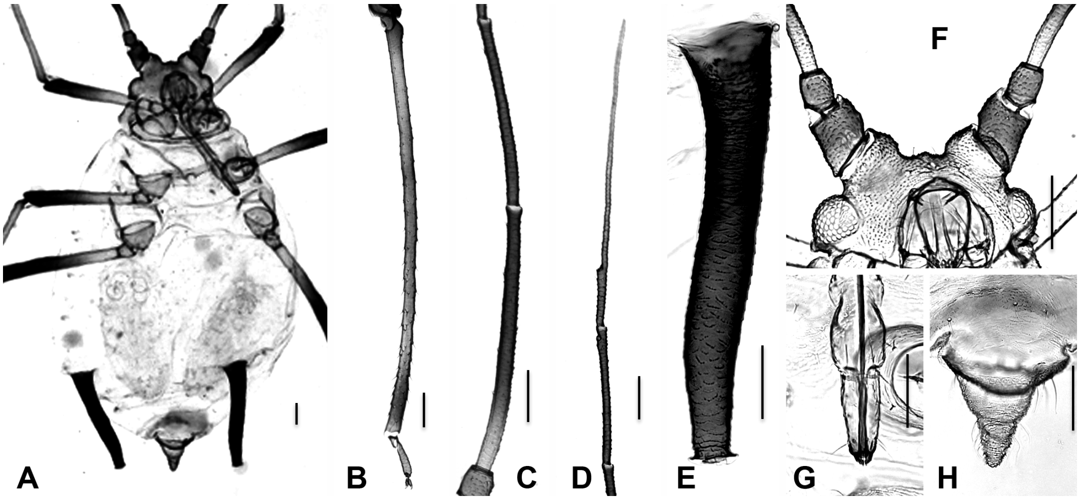


Plate 11. Apterous viviparous female (A-H) of *Myzus philadelphi*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

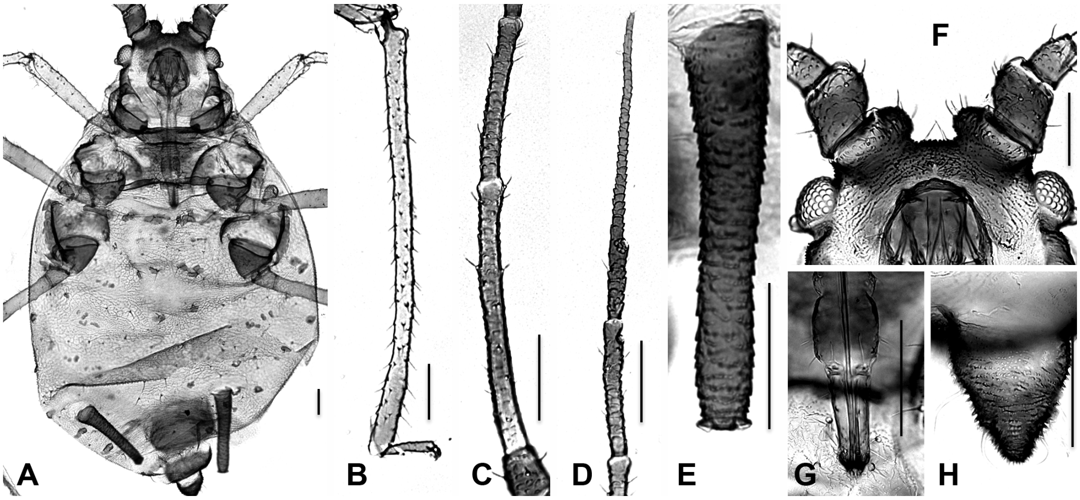


Plate 12. Apterous viviparous female (A-H) of *Myzus pruni* sp.nov. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

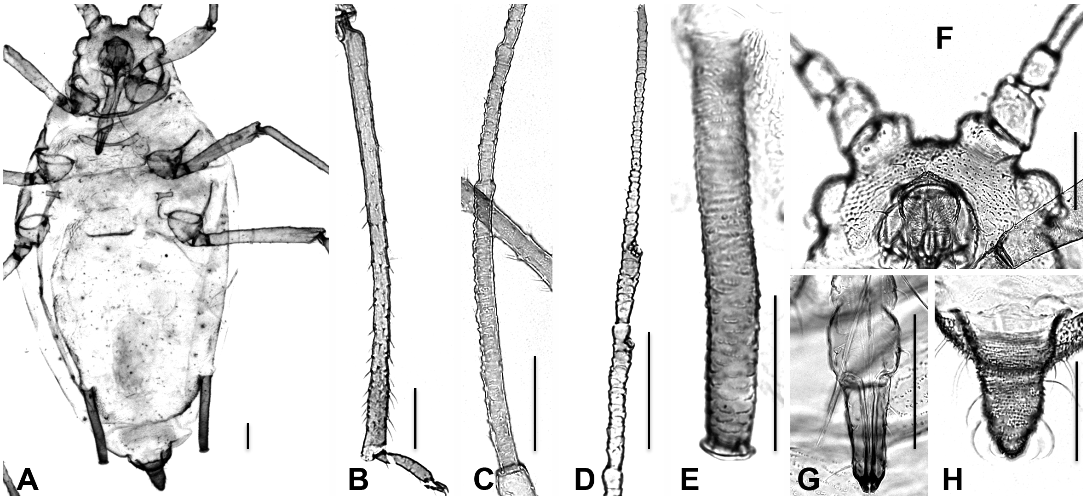


Plate 13. Apterous viviparous female (A-H) of *Myzus asterale* sp.nov. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

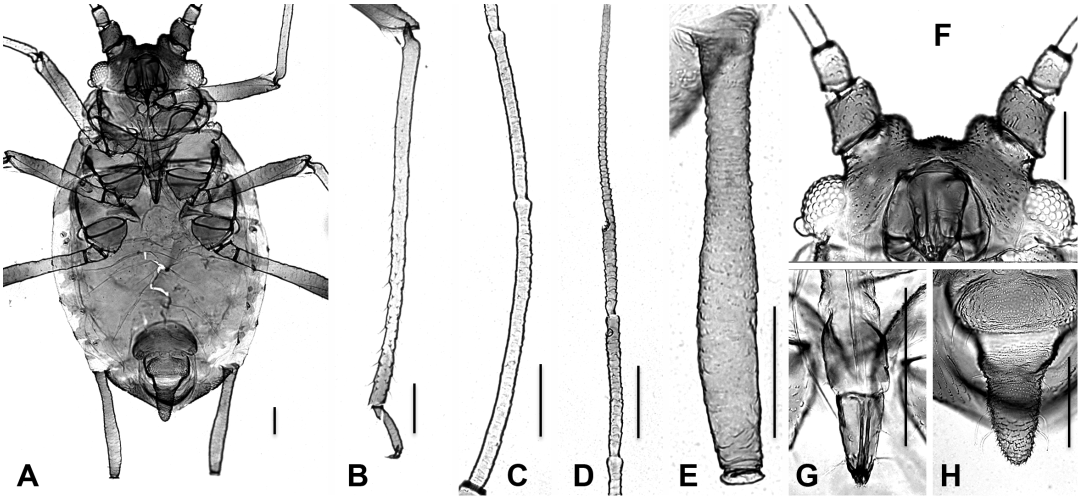


Plate 14. Apterous viviparous female (A-H) of *Myzus raphani* sp.nov. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

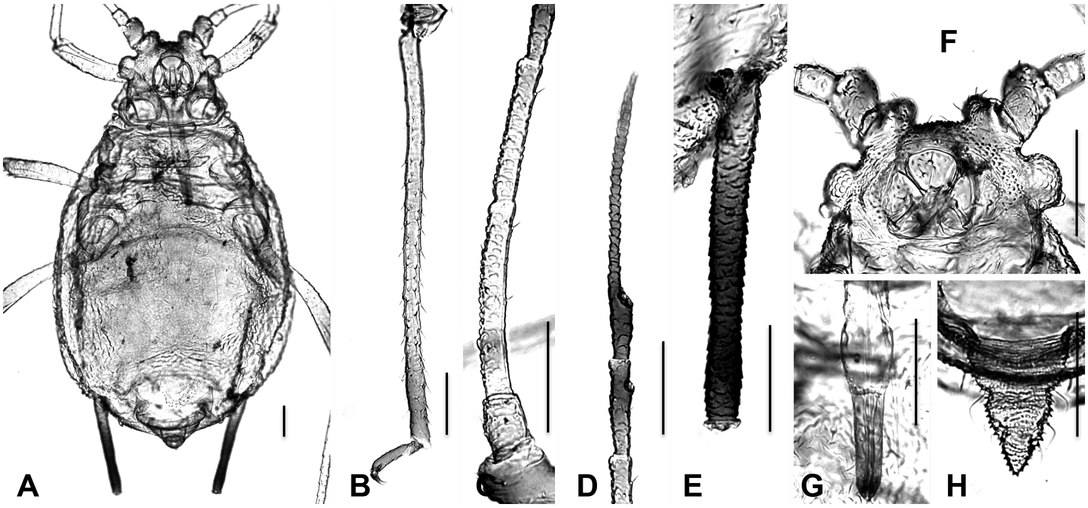


Plate 15. Apterous viviparous female (A-H) of *Myzus siegesbeckiae*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

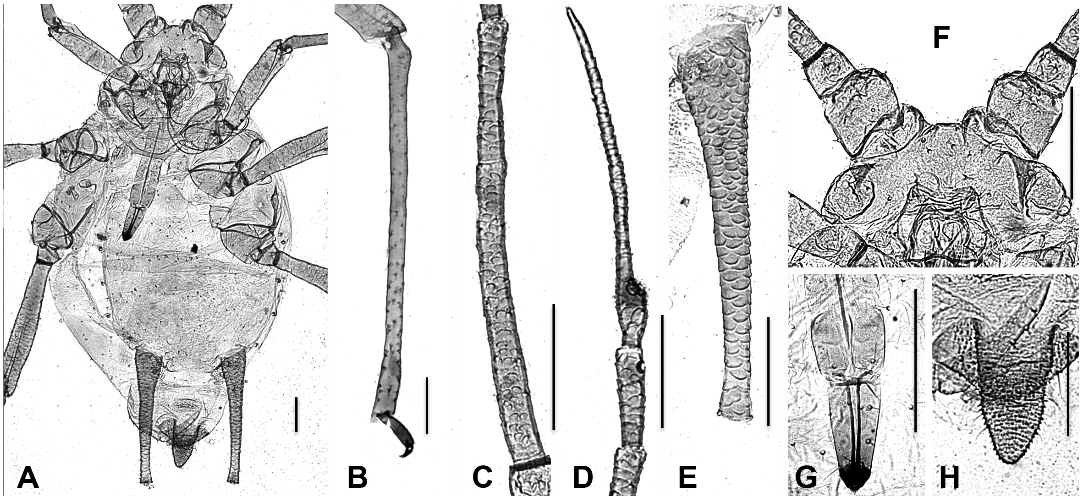


Plate 16. Apterous viviparous female (A-H) of *Myzus siegesbeckicola*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

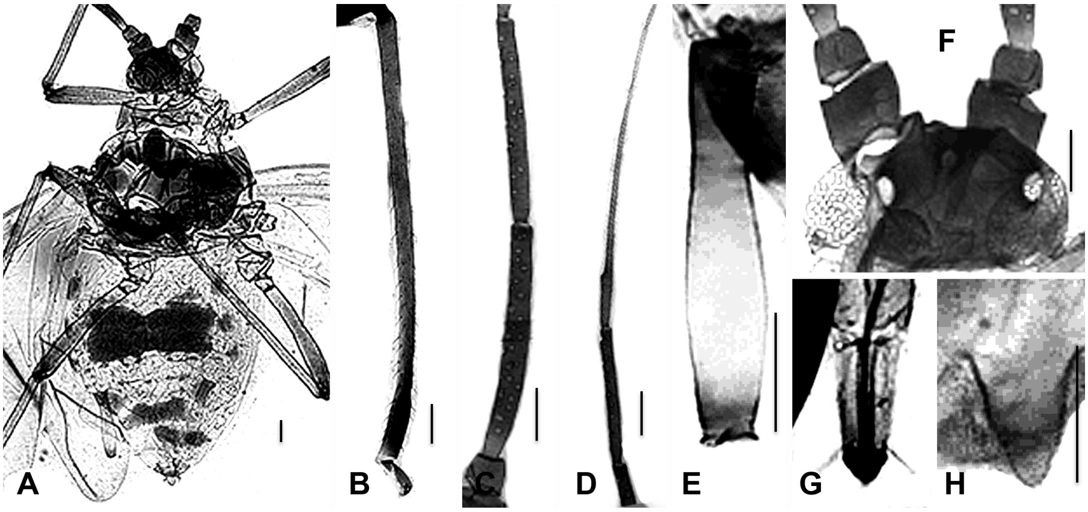


Plate 17. Alate viviparous female (A-H) of *Myzus stellariae*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm

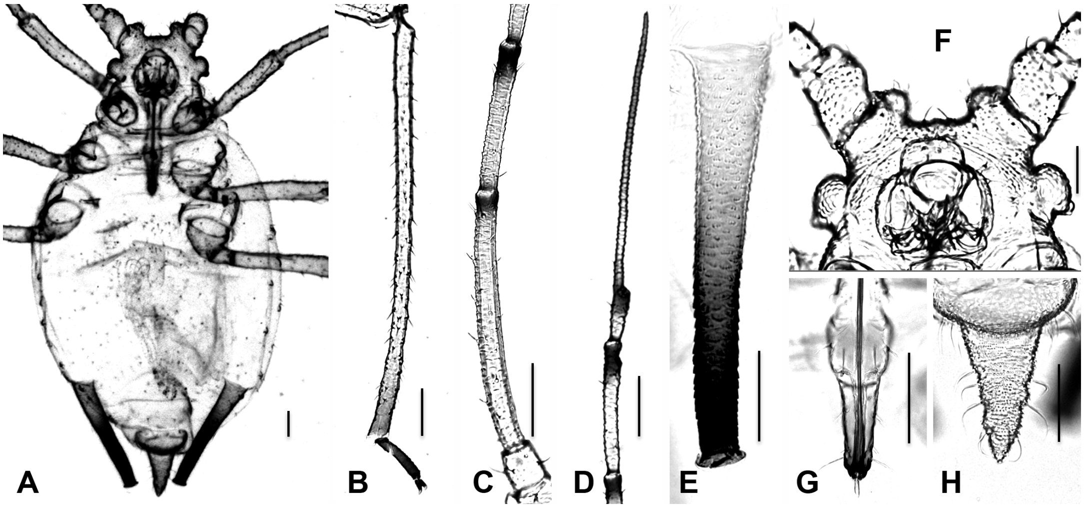


Plate 18. Apterous viviparous female (A-H) of *Myzus varians*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

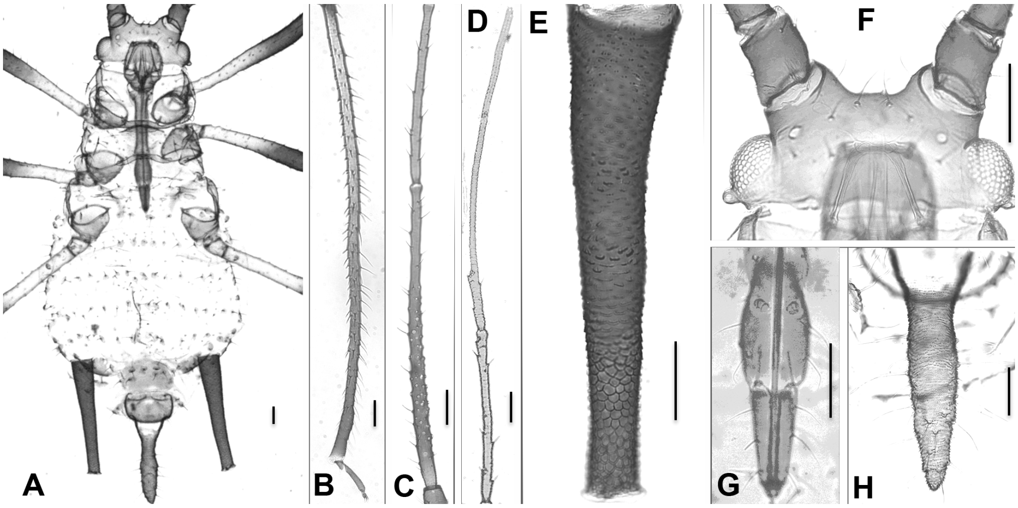


Plate 19. Apterous viviparous female (A-H) of *Uroleucon adenophorae*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

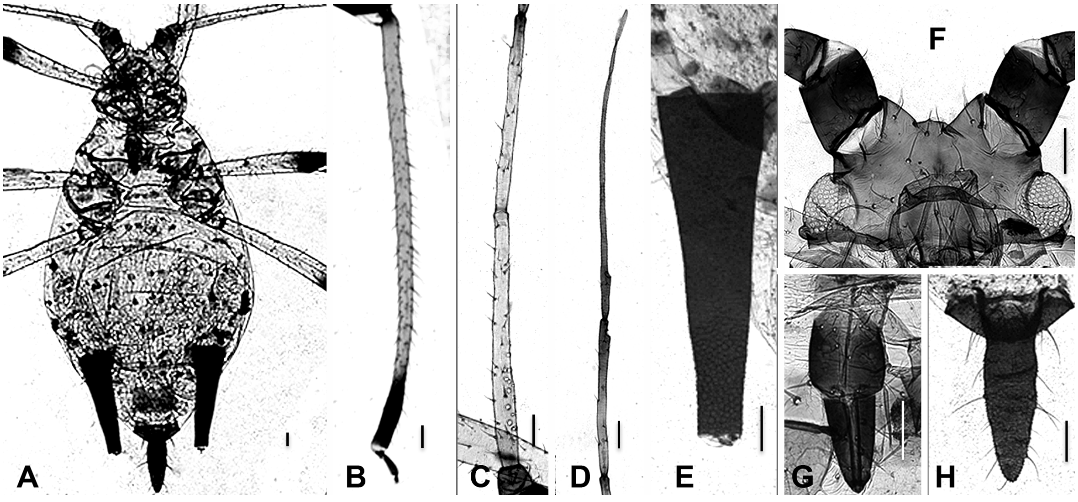


Plate 20. Apterous viviparous female (A-H) of *Uroleucon amamianum*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

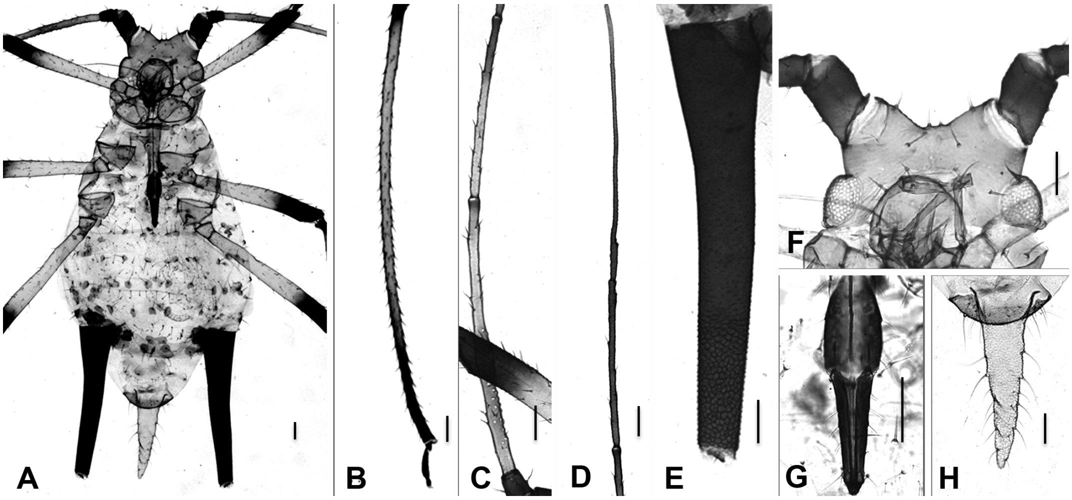


Plate 21. Apterous viviparous female (A-H) of *Uroleucon asteriae*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

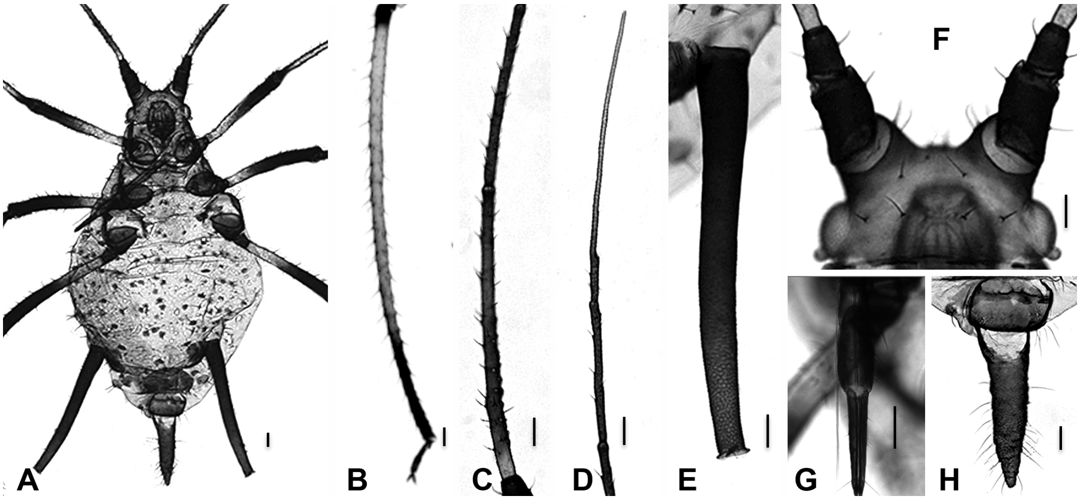


Plate 22. Apterous viviparous female (A-H) of *Uroleucon cephalonopli*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

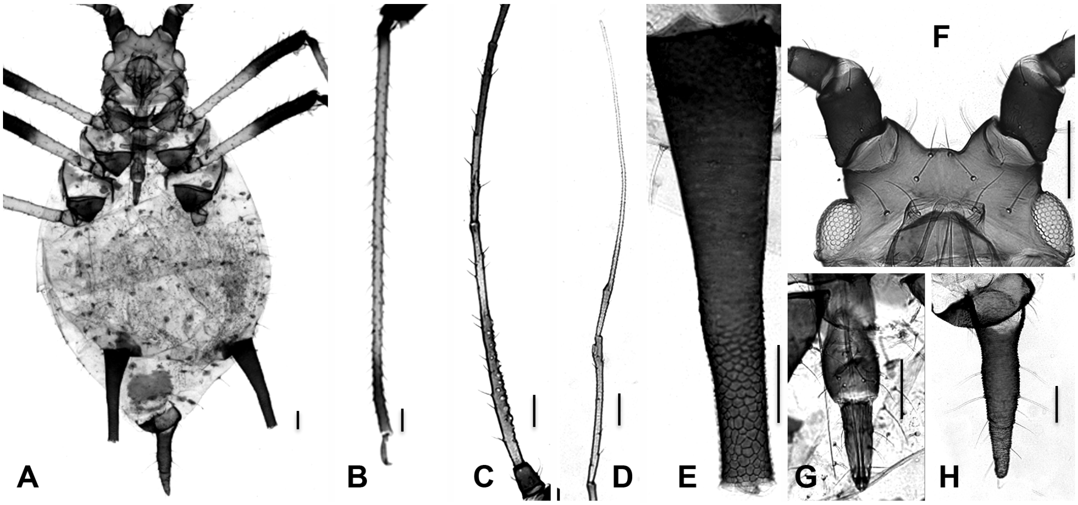


Plate 23. Apterous viviparous female (A-H) of *Uroleucon chrysanthemicola* sp.nov. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

Plate 24. Apterous viviparous female (A-H) of *Uroleucon cichorii*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

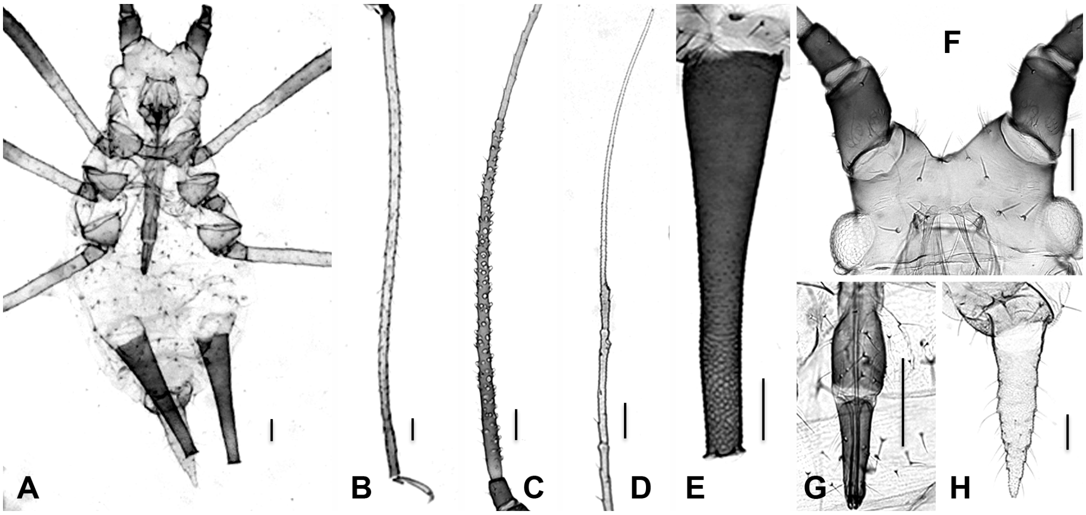


Plate 25. Apterous viviparous female (A-H) of *Uroleucon echinopsis* sp.nov. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

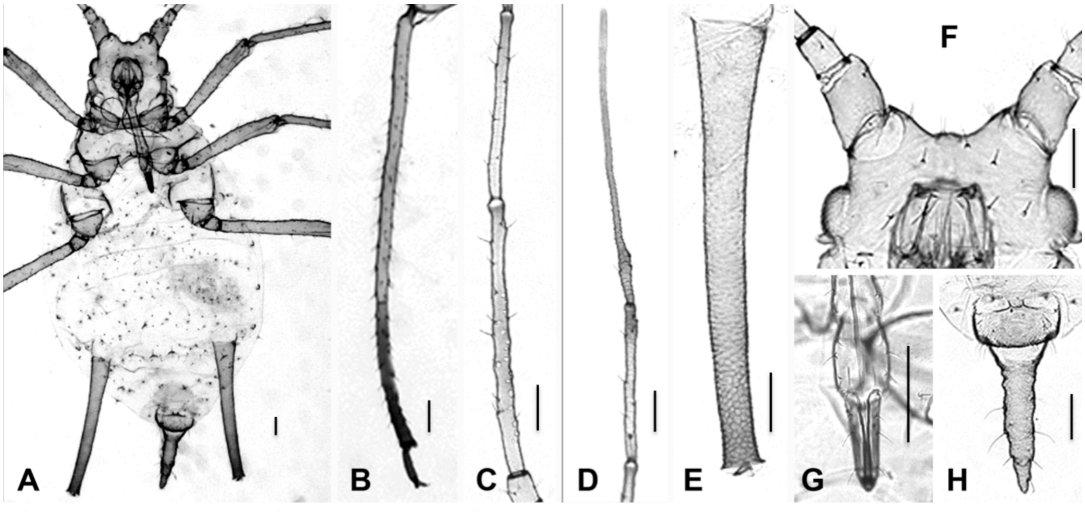


Plate 26. Apterous viviparous female (A-H) of *Uroleucon erigeronense*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

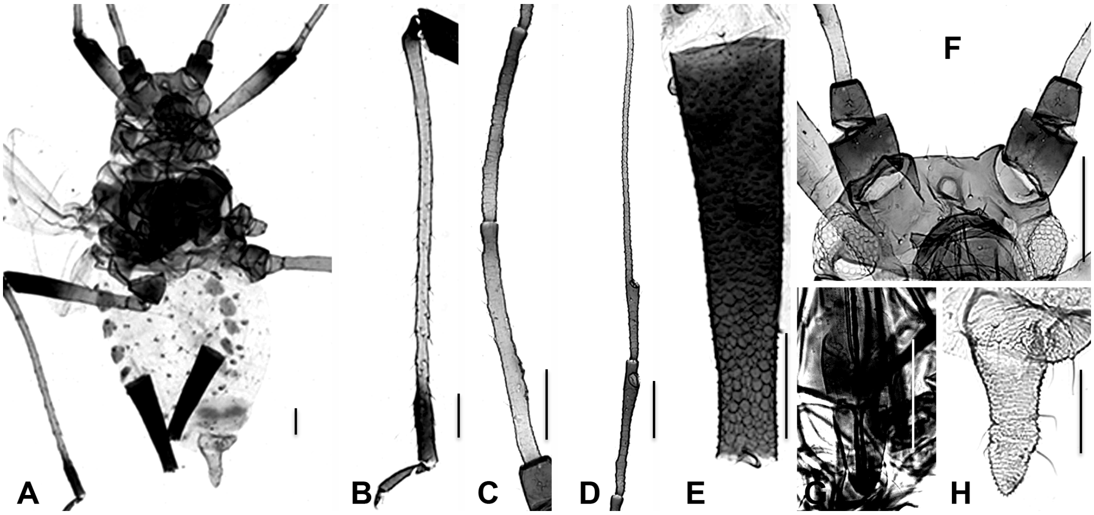


Plate 27. Apterous viviparous female (A-H) of *Uroleucon exiguum*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

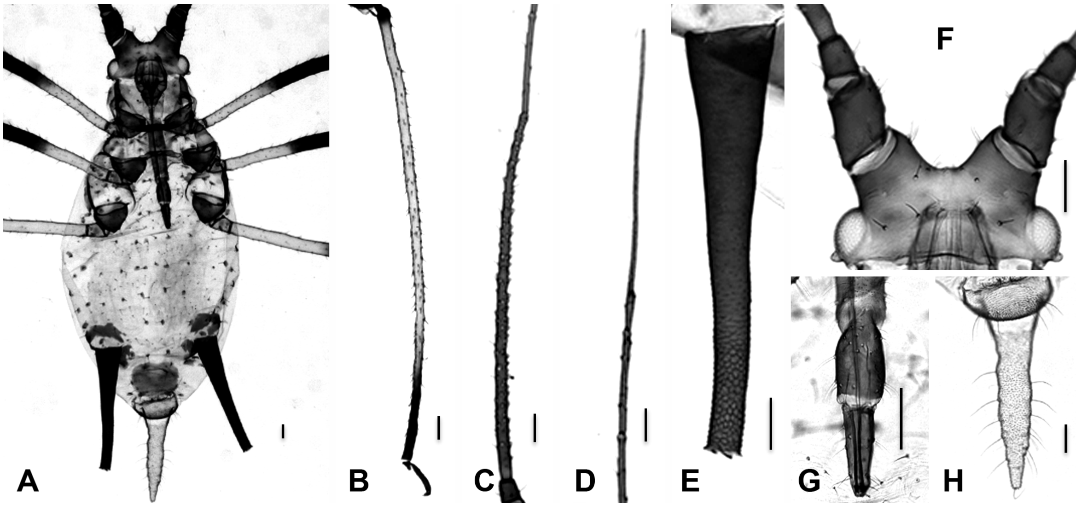


Plate 28. Apterous viviparous female (A-H) of *Uroleucon formosanum*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

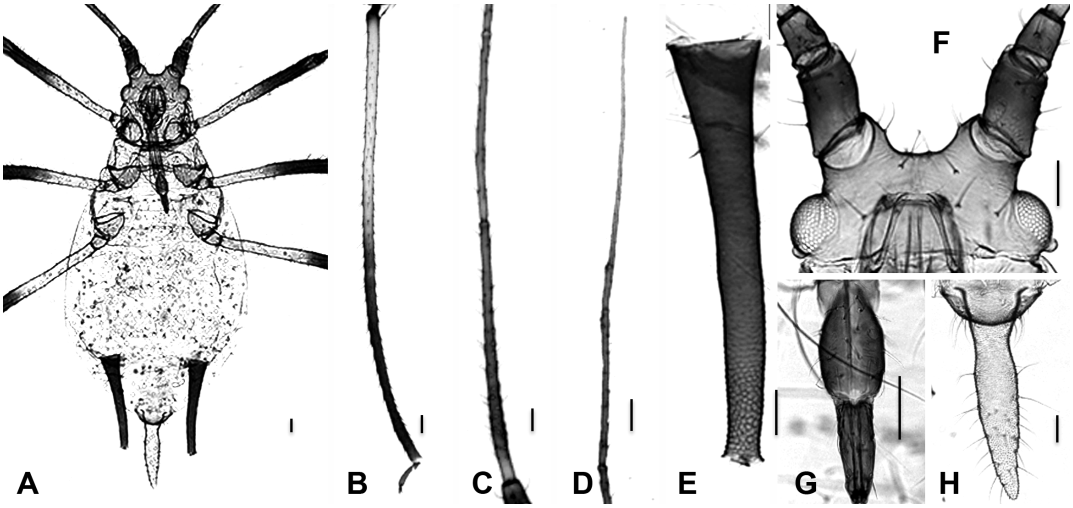


Plate 29. Apterous viviparous female (A-H) of *Uroleucon fuchuense*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

Plate 30. Apterous viviparous female (A-H) of *Uroleucon gobonis*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

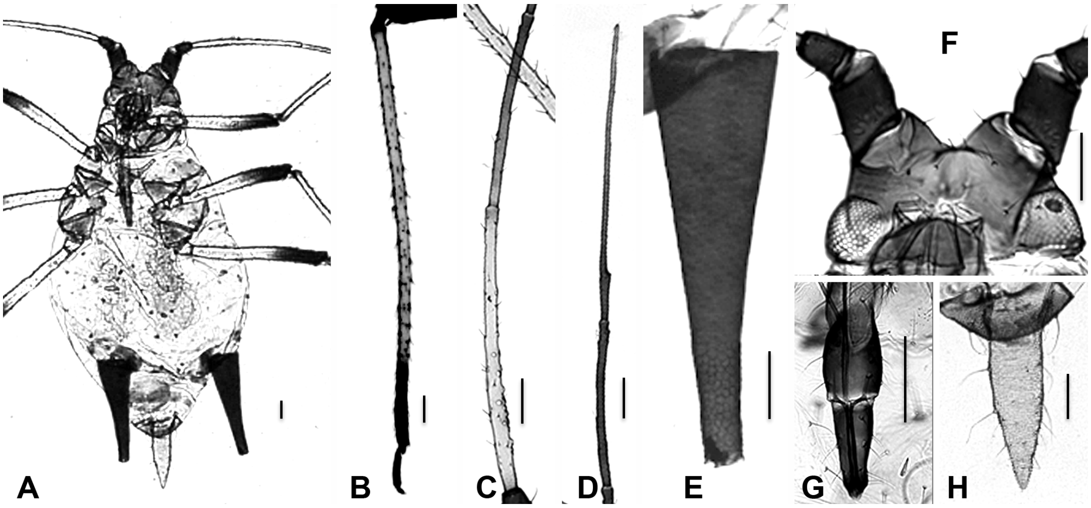


Plate 31. Apterous viviparous female (A-H) of *Uroleucon kikioense*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

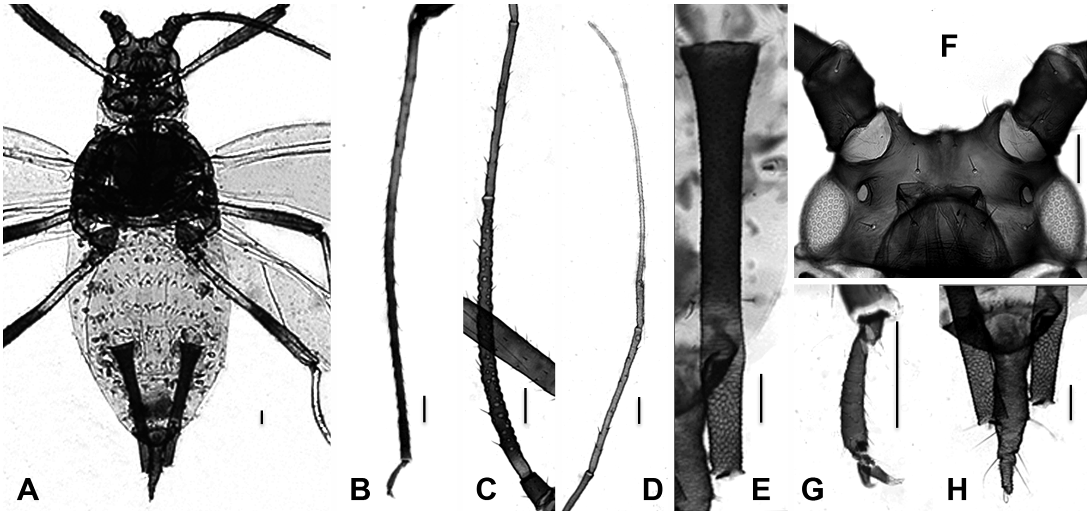


Plate 32. Alate viviparous female (A-H) of *Uroleucon lactucicola*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

Plate 33. Alate viviparous female (A-H) of *Uroleucon leontopodiicola*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

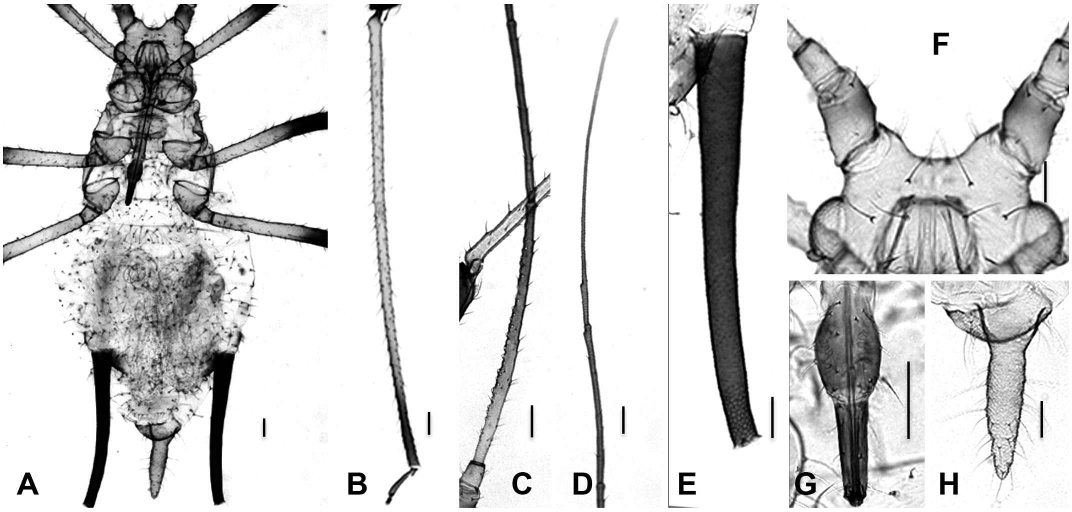


Plate 34. Apterous viviparous female (A-H) of *Uroleucon monticola*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

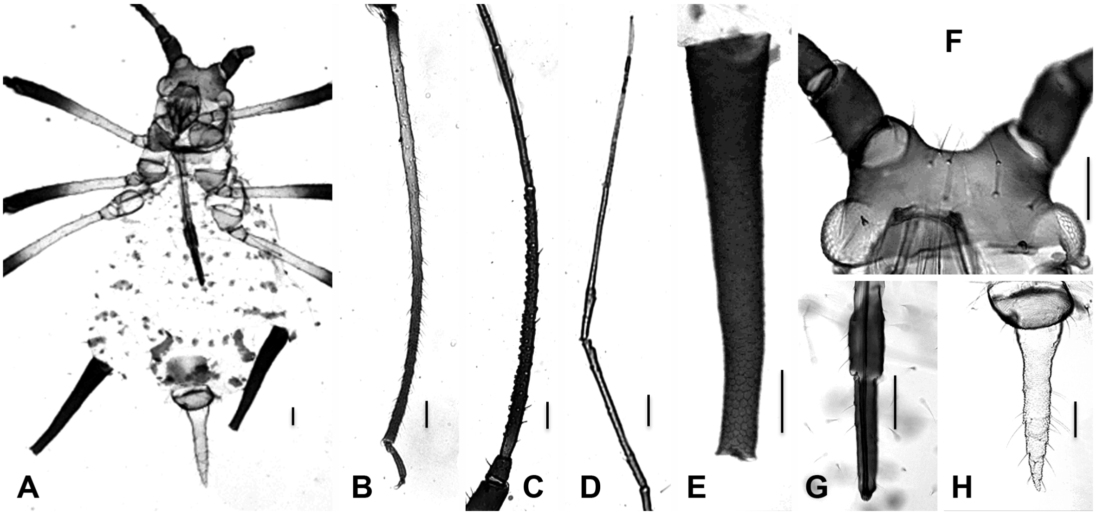


Plate 35. Apterous viviparous female (A-H) of *Uroleucon picridis*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

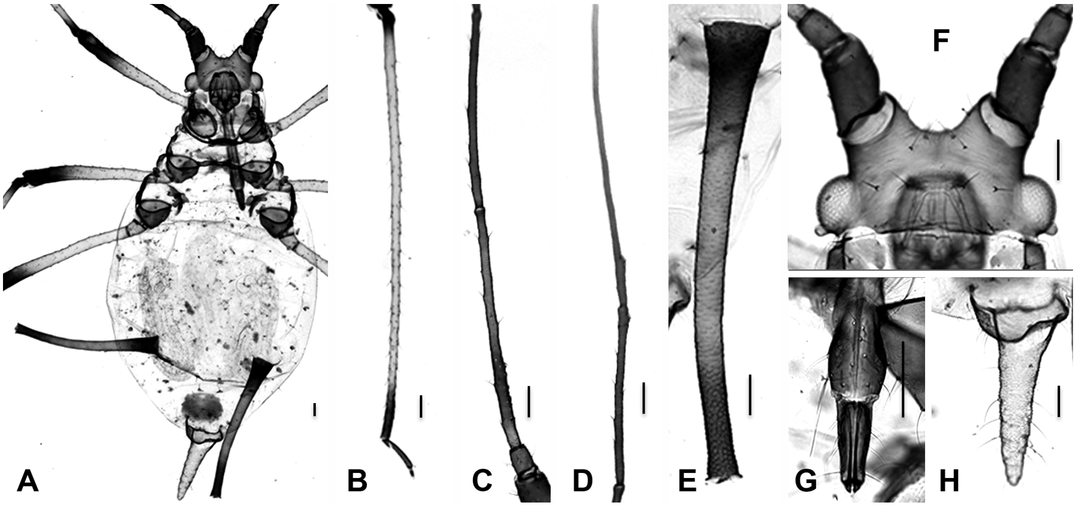


Plate 36. Apterous viviparous female (A-H) of *Uroleucon sonchi*. A, whole body. B, hind tibia and tarsus, C, antennal segments III-IV. D, antennal segments V-VI. E, siphunculus. F, head focused on dorsum. G, ultimate rostral segment. H, cauda. Scale bar means 0.1mm.

1. Biometric measurement of the apterous and alate viviparous females of *M. asteriae*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 3)		al. (n = 1)	
Length (mm)	Body	1.65	(1.52-1.77)	1.60	(1.60-1.60)
	Whole antennae	0.87	(0.83-0.93)	0.90	(0.90-0.91)
	Ant. I	0.04	(0.04-0.05)	0.04	(0.04-0.04)
	Ant.II	0.04	(0.03-0.05)	0.05	(0.05-0.05)
	Ant.III	0.26	(0.24-0.27)	0.33	(0.33-0.33)
	Ant.IV	0.11	(0.09-0.13)	0.16	(0.16-0.16)
	Ant.V	0.10	(0.10-0.11)	0.17	(0.17-0.17)
	Ant.VIb	0.08	(0.07-0.08)	0.08	(0.08-0.08)
	PT	0.20	(0.19-0.22)	0.04	(0.04-0.04)
	URS	0.07	(0.07-0.08)	0.08	(0.08-0.08)
	Hind femur	0.36	(0.30-0.41)	0.40	(0.39-0.42)
	Hind tibia	0.59	(0.55-0.65)	0.75	(0.75-0.75)
	2HT	0.07	(0.06-0.08)	0.07	(0.07-0.07)
	SIPH	0.30	(0.27-0.32)	0.20	(0.20-0.21)
	Cauda	0.15	(0.13-0.16)	0.13	(0.13-0.13)
	Setae on Ant.III	0.00	(0.00-0.00)	0.00	(0.00-0.00)
	Setae on AbdT.III	0.00	(0.00-0.00)	0.00	(0.00-0.00)
No. of hairs on	Ant.I	3	(2-4)	4	(4-4)
	Ant.II	3	(2-3)	3	(2-3)
	Ant.III	7	(5-10)	15	(15-15)
	URS	8	(8-8)	6	(6-6)
	AbdT.VII	3	(3-4)	4	(4-4)
	AbdT. VIII	2	(2-2)	2	(2-2)
	Median of GP	2	(2-2)	2	(2-2)
	Posterior margin of GP	10	(8-12)	12	(12-12)
	Cauda	6	(6-6)	6	(6-6)
No. of rhinaria	Ant.III	0	(0-0)	12	(12-12)
	Ant.IV	0	(0-0)	0	(0-0)
	Ant.V	1	(1-1)	1	(1-1)
Ratio (times)	Whole antennae / body	0.52	(0.48-0.56)	0.56	(0.56-0.56)
	PT / Ant.VIb	2.51	(2.37-2.78)	0.58	(0.58-0.58)
	PT / Ant.III	0.80	(0.74-0.86)	0.14	(0.14-0.14)
	URS / 2HT	1.06	(0.93-1.17)	1.00	(1.00-1.00)
	URS / Ant.VIb	0.96	(0.87-1.15)	0.96	(0.96-0.96)
	SIPH / body	0.18	(0.17-0.18)	0.13	(0.12-0.13)
	SIPH / Ant.III	1.15	(1.12-1.20)	0.62	(0.62-0.63)
	SIPH / hind femur	0.83	(0.75-1.04)	0.51	(0.49-0.53)
	SIPH / cauda	1.98	(1.90-2.03)	1.54	(1.53-1.56)
	Setae on Ant.III / Ant.IIIBD	0.23	(0.21-0.25)	0.18	(0.18-0.18)
	Setae on AbdT.III /	0.20	(0.13-0.24)	0.32	(0.32-0.32)

Table 2. Biometric measurement of the apterous and alate viviparous females of *M. boehmeriae*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 7)		al. (n = 4)	
Length (mm)	Body	1.78	(1.52-1.95)	1.40	(1.29-1.48)
	Whole antennae	1.88	(1.78-1.97)	1.42	(1.29-1.52)
	Ant. I	0.08	(0.06-0.09)	0.06	(0.05-0.07)
	Ant.II	0.05	(0.05-0.06)	0.05	(0.04-0.06)
	Ant.III	0.43	(0.37-0.49)	0.41	(0.38-0.43)
	Ant.IV	0.35	(0.30-0.39)	0.24	(0.19-0.27)
	Ant.V	0.28	(0.24-0.30)	0.16	(0.13-0.19)
	Ant.VIb	0.12	(0.11-0.14)	0.09	(0.07-0.11)
	PT	0.54	(0.52-0.58)	0.38	(0.35-0.43)
	URS	0.09	(0.08-0.10)	0.09	(0.08-0.10)
	Hind femur	0.54	(0.49-0.60)	0.48	(0.43-0.54)
	Hind tibia	0.97	(0.88-1.05)	0.97	(0.90-1.05)
	2HT	0.06	(0.03-0.07)	0.05	(0.03-0.07)
	SIPH	0.38	(0.33-0.42)	0.24	(0.22-0.27)
	Cauda	0.14	(0.12-0.17)	0.10	(0.09-0.11)
	Setae on Ant.III	0.01	(0.00-0.01)	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)	0.01	(0.00-0.01)
No. of hairs on	Ant.I	4	(3-5)	4	(2-7)
	Ant.II	3	(2-4)	3	(2-4)
	Ant.III	10	(6-12)	8	(6-11)
	URS	6	(4-8)	5	(2-7)
	AbdT.VII	2	(2-2)	2	(2-2)
	AbdT. VIII	2	(2-3)	2	(2-2)
	Median of GP	2	(2-2)	2	(2-2)
	Posterior margin of GP	9	(7-10)	8	(6-11)
	Cauda	4	(3-4)	4	(4-5)
No. of rhinaria on	Ant.III	0	(0-0)	33	(27-38)
	Ant.IV	0	(0-0)	15	(12-19)
	Ant.V	1	(1-1)	4	(2-6)
Ratio (times)	Whole antennae / body	1.06	(0.97-1.23)	1.01	(0.97-1.06)
	PT / Ant.VIb	4.31	(3.71-4.92)	3.98	(3.39-4.68)
	PT / Ant.III	1.25	(1.10-1.50)	0.92	(0.80-1.03)
	URS / 2HT	1.56	(1.18-2.67)	1.65	(1.15-2.54)
	URS / Ant.VIb	0.72	(0.61-0.85)	0.93	(0.76-1.20)
	SIPH / body	0.21	(0.19-0.23)	0.17	(0.16-0.18)
	SIPH / Ant.III	0.86	(0.78-0.94)	0.59	(0.53-0.65)
	SIPH / hind femur	0.69	(0.63-0.75)	0.50	(0.43-0.56)
	SIPH / cauda	2.72	(2.37-3.12)	2.42	(2.19-2.57)
	Setae on Ant.III / Ant.IIIBD	0.17	(0.09-0.34)	0.22	(0.10-0.34)
	Setae on AbdT.III / Ant.IIIBD	0.30	(0.20-0.43)	0.38	(0.24-0.57)

Table 3. Biometric measurement of the apterous and alate viviparous females of *M. cerasi*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 11)		al. (n = 1)	
Length (mm)	Body	1.40	(1.26-1.58)	1.32	(1.32-1.32)
	Whole antennae	0.89	(0.80-0.99)	1.14	(1.14-1.15)
	Ant. I	0.05	(0.05-0.07)	0.05	(0.04-0.05)
	Ant.II	0.05	(0.03-0.06)	0.04	(0.04-0.05)
	Ant.III	0.22	(0.19-0.27)	0.28	(0.28-0.29)
	Ant.IV	0.13	(0.10-0.16)	0.14	(0.11-0.17)
	Ant.V	0.11	(0.09-0.13)	0.13	(0.12-0.14)
	Ant.VIb	0.07	(0.06-0.08)	0.09	(0.08-0.10)
	PT	0.22	(0.20-0.26)	0.38	(0.35-0.41)
	URS	0.07	(0.06-0.09)	0.07	(0.07-0.07)
	Hind femur	0.32	(0.28-0.37)	0.31	(0.30-0.32)
	Hind tibia	0.58	(0.53-0.63)	0.65	(0.64-0.66)
	2HT	0.04	(0.03-0.06)	0.04	(0.04-0.04)
	SIPH	0.35	(0.32-0.38)	0.21	(0.21-0.21)
	Cauda	0.09	(0.08-0.11)	0.08	(0.08-0.08)
	Setae on Ant.III	0.01	(0.00-0.01)	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)	0.01	(0.00-0.01)
No. of hairs on	Ant.I	3	(2-4)	2	(2-3)
	Ant.II	2	(2-3)	2	(2-2)
	Ant.III	5	(3-7)	3	(3-3)
	URS	6	(4-8)	4	(4-4)
	AbdT.VII	2	(2-2)	2	(2-2)
	AbdT. VIII	2	(2-2)	2	(2-2)
	Median of GP	2	(2-2)	2	(2-2)
	Posterior margin of GP	8	(7-10)	8	(8-8)
	Cauda	4	(4-4)	5	(5-5)
No. of rhinaria on	Ant.III	0	(0-0)	9	(9-10)
	Ant.IV	0	(0-0)	0	(0-0)
	Ant.V	1	(1-1)	1	(0-1)
Ratio (times)	Whole antennae / body	0.63	(0.52-0.72)	0.86	(0.86-0.87)
	PT / Ant.VIb	3.00	(2.50-3.60)	4.08	(4.01-4.15)
	PT / Ant.III	1.01	(0.85-1.16)	1.34	(1.20-1.48)
	URS / 2HT	1.51	(1.10-2.01)	1.56	(1.45-1.67)
	URS / Ant.VIb	0.97	(0.77-1.27)	0.77	(0.69-0.85)
	SIPH / body	0.25	(0.21-0.28)	0.16	(0.15-0.16)
	SIPH / Ant.III	1.56	(1.30-1.80)	0.74	(0.72-0.76)
	SIPH / hind femur	1.07	(0.97-1.23)	0.68	(0.67-0.69)
	SIPH / cauda	3.55	(3.00-3.99)	2.66	(2.63-2.70)
	Setae on Ant.III / Ant.IIIBD	0.13	(0.10-0.21)	0.22	(0.22-0.22)
	Setae on AbdT.III / Ant.IIIBD	0.13	(0.09-0.15)	0.30	(0.30-0.30)

Table 4. Biometric measurement of the apterous and alate viviparous females of *M. dycei*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 6)		al. (n = 2)	
Length (mm)	Body	2.54	(2.40-2.82)	2.39	(2.32-2.47)
	Whole antennae	1.44	(1.37-1.54)	1.86	(1.81-1.89)
	Ant. I	0.09	(0.06-0.10)	0.07	(0.05-0.08)
	Ant.II	0.06	(0.05-0.08)	0.06	(0.04-0.07)
	Ant.III	0.45	(0.43-0.49)	0.58	(0.56-0.59)
	Ant.IV	0.23	(0.20-0.26)	0.31	(0.29-0.33)
	Ant.V	0.20	(0.17-0.22)	0.26	(0.24-0.27)
	Ant.VIb	0.09	(0.08-0.11)	0.12	(0.12-0.13)
	PT	0.29	(0.25-0.32)	0.43	(0.40-0.46)
	URS	0.11	(0.10-0.12)	0.11	(0.11-0.11)
	Hind femur	0.65	(0.59-0.73)	0.67	(0.65-0.68)
	Hind tibia	1.11	(1.02-1.21)	1.23	(1.23-1.23)
	2HT	0.08	(0.07-0.09)	0.06	(0.04-0.07)
	SIPH	0.55	(0.49-0.58)	0.38	(0.37-0.39)
	Cauda	0.19	(0.16-0.21)	0.15	(0.15-0.15)
	Setae on Ant.III	0.00	(0.00-0.00)	0.00	(0.00-0.00)
	Setae on AbdT.III	0.01	(0.00-0.02)	0.01	(0.01-0.01)
No. of hairs on	Ant.I	3	(2-5)	6	(3-7)
	Ant.II	3	(2-4)	4	(2-5)
	Ant.III	11	(8-15)	10	(4-14)
	URS	6	(5-9)	6	(6-6)
	AbdT.VII	2	(2-2)	4	(4-4)
	AbdT. VIII	2	(2-2)	4	(4-4)
	Median of GP	2	(2-2)	2	(2-2)
	Posterior margin of GP	11	(8-14)	13	(12-14)
	Cauda	9	(6-11)	6	(5-6)
No. of rhinaria on	Ant.III	0	(0-0)	25	(22-27)
	Ant.IV	0	(0-0)	2	(0-6)
	Ant.V	1	(1-1)	1	(1-1)
Ratio (times)	Whole antennae / body	0.56	(0.48-0.60)	0.77	(0.73-0.81)
	PT / Ant.VIb	2.96	(2.38-3.52)	3.39	(3.27-3.58)
	PT / Ant.III	0.64	(0.54-0.71)	0.74	(0.69-0.79)
	URS / 2HT	1.31	(1.20-1.49)	2.02	(1.62-2.51)
	URS / Ant.VIb	1.15	(0.98-1.28)	0.92	(0.89-0.96)
	SIPH / body	0.21	(0.17-0.23)	0.16	(0.15-0.17)
	SIPH / Ant.III	1.20	(1.00-1.29)	0.66	(0.62-0.67)
	SIPH / hind femur	0.83	(0.74-0.92)	0.57	(0.56-0.58)
	SIPH / cauda	2.80	(2.64-2.94)	2.52	(2.42-2.64)
	Setae on Ant.III / Ant.IIIBD	0.14	(0.12-0.19)	0.19	(0.18-0.21)
	Setae on AbdT.III / Ant.IIIBD	0.32	(0.18-0.41)	0.46	(0.32-0.59)

Table 5. Biometric measurement of the apterous viviparous females of *M. hemerocalis*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 1)	
Length (mm)	Body	2.21	(2.21-2.21)
	Whole antennae	1.10	(1.10-1.11)
	Ant. I	0.06	(0.06-0.07)
	Ant.II	0.05	(0.05-0.06)
	Ant.III	0.26	(0.25-0.27)
	Ant.IV	0.17	(0.16-0.18)
	Ant.V	0.12	(0.12-0.13)
	Ant.VIb	0.09	(0.08-0.09)
	PT	0.32	(0.30-0.33)
	URS	0.09	(0.09-0.09)
	Hind femur	0.54	(0.54-0.55)
	Hind tibia	0.87	(0.87-0.87)
	2HT	0.08	(0.08-0.09)
	SIPH	0.42	(0.40-0.44)
	Cauda	0.17	(0.17-0.17)
	Setae on Ant.III	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)
No. of hairs on	Ant.I	3	(2-4)
	Ant.II	2	(2-2)
	Ant.III	8	(6-10)
	URS	5	(5-5)
	AbdT.VII	2	(2-2)
	AbdT. VIII	4	(4-4)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(10-10)
	Cauda	4	(4-4)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.50	(0.49-0.50)
	PT / Ant.VIb	3.46	(3.19-3.73)
	PT / Ant.III	1.23	(1.14-1.33)
	URS / 2HT	1.05	(0.99-1.10)
	URS / Ant.VIb	0.99	(0.95-1.02)
	SIPH / body	0.19	(0.18-0.19)
	SIPH / Ant.III	1.62	(1.49-1.75)
	SIPH / hind femur	0.76	(0.72-0.81)
	SIPH / cauda	2.42	(2.32-2.53)
	Setae on Ant.III / Ant.IIIBD	0.13	(0.13-0.13)
	Setae on AbdT.III / Ant.IIIBD	0.17	(0.17-0.17)

Table 6. Biometric measurement of the alate viviparous females of *M. japonensis*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		al. (n = 5)	
Length (mm)	Body	1.57	(1.48-1.66)
	Whole antennae	1.66	(1.53-1.79)
	Ant. I	0.06	(0.04-0.07)
	Ant.II	0.05	(0.04-0.07)
	Ant.III	0.37	(0.32-0.40)
	Ant.IV	0.24	(0.21-0.28)
	Ant.V	0.22	(0.19-0.25)
	Ant.VIb	0.10	(0.08-0.11)
	PT	0.59	(0.57-0.62)
	URS		
	Hind femur	0.41	(0.36-0.48)
	Hind tibia	0.82	(0.79-0.92)
	2HT	0.05	(0.03-0.05)
	SIPH	0.31	(0.29-0.35)
	Cauda	0.07	(0.07-0.08)
	Setae on Ant.III	0.00	(0.00-0.00)
	Setae on AbdT.III	0.00	(0.00-0.00)
No. of hairs on	Ant.I	6	(4-8)
	Ant.II	4	(3-6)
	Ant.III	8	(6-10)
	URS	5	(4-6)
	AbdT.VII	2	(2-2)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(8-13)
	Cauda	5	(4-5)
No. of rhinaria on	Ant.III	15	(11-18)
	Ant.IV	7	(5-11)
	Ant.V	5	(3-7)
Ratio (times)	Whole antennae / body	1.05	(0.97-1.13)
	PT / Ant.VIb	5.92	(5.00-7.11)
	PT / Ant.III	1.61	(1.47-1.76)
	URS / 2HT		
	URS / Ant.VIb		
	SIPH / body	0.19	(0.18-0.21)
	SIPH / Ant.III	0.84	(0.78-0.93)
	SIPH / hind femur	0.75	(0.70-0.87)
	SIPH / cauda	3.96	(3.42-4.98)
	Setae on Ant.III / Ant.IIIBD	0.14	(0.10-0.19)
	Setae on AbdT.III / Ant.IIIBD	0.16	(0.11-0.23)

Table 7. Biometric measurement of the apterous viviparous females of *M. lactucicola*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 2)	
Length (mm)	Body	1.93	(1.92-1.94)
	Whole antennae	1.67	(1.63-1.71)
	Ant. I	0.07	(0.07-0.08)
	Ant.II	0.05	(0.04-0.05)
	Ant.III	0.48	(0.46-0.50)
	Ant.IV	0.28	(0.26-0.30)
	Ant.V	0.25	(0.24-0.27)
	Ant.VIb	0.12	(0.11-0.13)
	PT	0.38	(0.37-0.39)
	URS	0.05	(0.05-0.05)
	Hind femur	0.63	(0.62-0.63)
	Hind tibia	1.01	(0.99-1.04)
	2HT	0.09	(0.08-0.10)
	SIPH	0.41	(0.40-0.42)
	Cauda	0.24	(0.23-0.24)
	Setae on Ant.III	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)
No. of hairs on	Ant.I	4	(3-5)
	Ant.II	3	(3-3)
	Ant.III	13	(12-15)
	URS (subsidiary)	7	(7-7)
	AbdT.VII	2	(2-2)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(10-10)
	Cauda	5	(4-5)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.86	(0.85-0.89)
	PT / Ant.VIb	3.03	(2.80-3.30)
	PT / Ant.III	0.80	(0.77-0.83)
	URS / 2HT	0.63	(0.52-0.70)
	URS / Ant.VIb	0.45	(0.43-0.48)
	SIPH / body	0.21	(0.20-0.22)
	SIPH / Ant.III	0.86	(0.83-0.90)
	SIPH / hind femur	0.66	(0.63-0.67)
	SIPH / cauda	1.73	(1.64-1.79)
	Setae on Ant.III / Ant.IIIBD	0.14	(0.13-0.16)
	Setae on AbdT.III / Ant.IIIBD	0.21	(0.20-0.21)

Table 8. Biometric measurement of the apterous viviparous females of *M. mushaensis*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 10)	
Length (mm)	Body	1.68	(1.52-1.85)
	Whole antennae	1.21	(1.12-1.32)
	Ant. I	0.07	(0.06-0.08)
	Ant.II	0.05	(0.05-0.06)
	Ant.III	0.33	(0.27-0.39)
	Ant.IV	0.21	(0.18-0.25)
	Ant.V	0.15	(0.12-0.19)
	Ant.VIb	0.08	(0.07-0.10)
	PT	0.29	(0.26-0.32)
	URS	0.09	(0.08-0.10)
	Hind femur	0.56	(0.43-0.61)
	Hind tibia	0.90	(0.82-0.96)
	2HT	0.06	(0.05-0.07)
	SIPH	0.37	(0.35-0.40)
	Cauda	0.13	(0.09-0.15)
	Setae on Ant.III	0.01	(0.00-0.02)
	Setae on AbdT.III	0.01	(0.00-0.01)
No. of hairs on	Ant.I	4	(3-6)
	Ant.II	3	(2-4)
	Ant.III	10	(5-13)
	URS (subsidiary)	9	(6-10)
	AbdT.VII	2	(2-2)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	7	(6-9)
	Cauda	4	(4-6)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.72	(0.66-0.82)
	PT / Ant.VIb	3.40	(2.83-3.86)
	PT / Ant.III	0.88	(0.72-1.00)
	URS / 2HT	1.36	(1.16-1.59)
	URS / Ant.VIb	1.06	(0.91-1.31)
	SIPH / body	0.22	(0.20-0.24)
	SIPH / Ant.III	1.13	(1.01-1.34)
	SIPH / hind femur	0.67	(0.60-0.82)
	SIPH / cauda	2.90	(2.33-3.68)
	Setae on Ant.III / Ant.IIIBD	0.24	(0.17-0.42)
	Setae on AbdT.III / Ant.IIIBD	0.31	(0.10-0.54)

Table 9. Biometric measurement of the apterous viviparous females of *M. padellus*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 2)	
Length (mm)	Body	2.48	(2.43-2.53)
	Whole antennae	1.38	(1.35-1.46)
	Ant. I	0.07	(0.06-0.07)
	Ant.II	0.06	(0.06-0.07)
	Ant.III	0.39	(0.37-0.41)
	Ant.IV	0.23	(0.20-0.25)
	Ant.V	0.19	(0.17-0.21)
	Ant.VIb	0.10	(0.10-0.11)
	PT	0.32	(0.30-0.33)
	URS	0.11	(0.11-0.11)
	Hind femur	0.59	(0.40-0.66)
	Hind tibia	1.02	(1.00-1.03)
	2HT	0.07	(0.07-0.08)
	SIPH	0.42	(0.41-0.43)
	Cauda	0.16	(0.16-0.16)
	Setae on Ant.III	0.01	(0.01-0.01)
	Setae on AbdT.III	0.02	(0.02-0.02)
No. of hairs on	Ant.I	4	(3-5)
	Ant.II	4	(3-4)
	Ant.III	11	(10-13)
	URS (subsidiary)	4	(2-6)
	AbdT.VII	4	(4-4)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	13	(10-15)
	Cauda	5	(4-6)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.55	(0.53-0.57)
	PT / Ant.VIb	2.94	(2.73-3.23)
	PT / Ant.III	0.82	(0.75-0.88)
	URS / 2HT	1.42	(1.37-1.49)
	URS / Ant.VIb	1.01	(0.96-1.05)
	SIPH / body	0.17	(0.17-0.17)
	SIPH / Ant.III	1.09	(1.03-1.16)
	SIPH / hind femur	0.74	(0.63-1.04)
	SIPH / cauda	2.61	(2.56-2.65)
	Setae on Ant.III / Ant.IIIBD	0.47	(0.40-0.54)
	Setae on AbdT.III / Ant.IIIBD	0.85	(0.76-0.94)

Table 10. Biometric measurement of the apterous and alate viviparous females of *M. persicae*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 2)		al. (n = 2)	
Length (mm)	Body	2.19	(2.13-2.26)	2.08	(1.63-2.53)
	Whole antennae	1.71	(1.42-1.89)	2.10	(1.78-2.28)
	Ant. I	0.07	(0.06-0.08)	0.06	(0.04-0.08)
	Ant.II	0.06	(0.04-0.07)	0.05	(0.04-0.07)
	Ant.III	0.40	(0.32-0.43)	0.51	(0.42-0.57)
	Ant.IV	0.32	(0.27-0.35)	0.43	(0.33-0.48)
	Ant.V	0.26	(0.20-0.31)	0.34	(0.26-0.39)
	Ant.VIb	0.11	(0.09-0.13)	0.14	(0.10-0.16)
	PT	0.46	(0.39-0.51)	0.55	(0.54-0.57)
	URS	0.10	(0.09-0.11)	0.10	(0.10-0.10)
	Hind femur	0.63	(0.57-0.70)	0.63	(0.56-0.78)
	Hind tibia	1.09	(0.96-1.23)	1.24	(1.11-1.50)
	2HT	0.09	(0.08-0.11)	0.08	(0.07-0.10)
	SIPH	0.50	(0.44-0.58)	0.41	(0.37-0.44)
	Cauda	0.23	(0.22-0.24)	0.19	(0.19-0.19)
	Setae on Ant.III	0.01	(0.01-0.01)	0.01	(0.01-0.01)
	Setae on AbdT.III	0.00	(0.01-0.01)	0.01	(0.01-0.01)
No. of hairs on	Ant.I	4	(3-5)	4	(3-4)
	Ant.II	3	(3-4)	3	(2-5)
	Ant.III	13	(13-14)	13	(9-15)
	URS	8	(7-8)	8	(7-8)
	AbdT.VII	3	(2-4)	4	(4-4)
	AbdT. VIII	4	(4-4)	2	(2-2)
	Median of GP	2	(2-2)	2	(2-2)
	Posterior margin of GP	11	(10-12)	13	(12-13)
	Cauda	6	(6-6)	9	(7-10)
No. of rhinaria on	Ant.III	0	(0-0)	13	(12-14)
	Ant.IV	0	(0-0)	0	(0-0)
	Ant.V	1	(1-1)	1	(1-1)
Ratio (times)	Whole antennae / body	0.77	(0.67-0.83)	1.04	(0.89-1.28)
	PT / Ant.VIb	4.00	(3.85-4.25)	3.95	(3.35-5.23)
	PT / Ant.III	1.16	(1.12-1.21)	1.09	(0.94-1.29)
	URS / 2HT	1.08	(0.94-1.20)	1.23	(1.03-1.46)
	URS / Ant.VIb	0.91	(0.84-0.99)	0.75	(0.63-0.99)
	SIPH / body	0.23	(0.20-0.25)	0.20	(0.17-0.25)
	SIPH / Ant.III	1.27	(1.13-1.37)	0.82	(0.77-0.87)
	SIPH / hind femur	0.79	(0.75-0.83)	0.66	(0.55-0.73)
	SIPH / cauda	2.16	(1.94-2.42)	2.12	(1.91-2.26)
	Setae on Ant.III / Ant.IIIBD	0.28	(0.28-0.28)	0.31	(0.27-0.34)
	Setae on AbdT.III / Ant.IIIBD	0.26	(0.25-0.28)	0.33	(0.32-0.33)

Table 11. Biometric measurement of the apterous viviparous females of *M. philadelphi*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 10)	
Length (mm)	Body	2.32	(2.05-2.51)
	Whole antennae	2.24	(2.14-2.39)
	Ant. I	0.09	(0.08-0.11)
	Ant.II	0.07	(0.06-0.08)
	Ant.III	0.56	(0.53-0.60)
	Ant.IV	0.41	(0.37-0.47)
	Ant.V	0.35	(0.31-0.38)
	Ant.VIb	0.15	(0.14-0.17)
	PT	0.57	(0.49-0.64)
	URS	0.10	(0.08-0.12)
	Hind femur	0.79	(0.62-0.87)
	Hind tibia	1.32	(1.03-1.47)
	2HT	0.10	(0.08-0.12)
	SIPH	0.60	(0.56-0.65)
	Cauda	0.16	(0.15-0.18)
	Setae on Ant.III	0.00	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.01-0.02)
No. of hairs on	Ant.I	4	(3-4)
	Ant.II	3	(2-4)
	Ant.III	18	(12-25)
	URS (subsidiary)	10	(10-10)
	AbdT.VII	2	(2-2)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(8-10)
	Cauda	6	(4-8)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.96	(0.88-1.09)
	PT / Ant.VIb	3.74	(3.27-4.25)
	PT / Ant.III	1.01	(0.83-1.10)
	URS / 2HT	1.04	(0.85-1.33)
	URS / Ant.VIb	0.70	(0.55-0.89)
	SIPH / body	0.26	(0.23-0.28)
	SIPH / Ant.III	1.05	(0.95-1.20)
	SIPH / hind femur	0.76	(0.69-0.94)
	SIPH / cauda	3.63	(3.07-3.96)
	Setae on Ant.III / Ant.IIIBD	0.21	(0.13-0.33)
	Setae on AbdT.III / Ant.IIIBD	0.56	(0.40-0.82)

Table 12. Biometric measurement of the apterous viviparous females of *M. pruni* **sp. nov.** See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 6)	
Length (mm)	Body	1.96	(1.69-2.18)
	Whole antennae	1.20	(1.10-1.28)
	Ant. I	0.06	(0.05-0.07)
	Ant.II	0.04	(0.03-0.06)
	Ant.III	0.33	(0.28-0.37)
	Ant.IV	0.19	(0.15-0.21)
	Ant.V	0.17	(0.14-0.19)
	Ant.VIb	0.10	(0.08-0.12)
	PT	0.29	(0.25-0.32)
	URS	0.09	(0.09-0.09)
	Hind femur	0.50	(0.41-0.53)
	Hind tibia	0.75	(0.60-0.81)
	2HT	0.05	(0.03-0.06)
	SIPH	0.29	(0.26-0.32)
	Cauda	0.12	(0.12-0.13)
	Setae on Ant.III	0.01	(0.01-0.01)
	Setae on AbdT.III	0.03	(0.02-0.04)
No. of hairs	Ant.I	7	(5-9)
	Ant.II	4	(3-4)
	Ant.III	14	(12-16)
	URS	9	(8-10)
	AbdT.VII	4	(4-5)
	AbdT. VIII	5	(4-7)
	Median of GP	2	(2-2)
	Posterior margin of GP	11	(10-13)
	Cauda	4	(4-5)
No. of	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.61	(0.57-0.66)
	PT / Ant.VIb	2.91	(2.68-3.29)
	PT / Ant.III	0.87	(0.67-1.00)
	URS / 2HT	1.80	(1.47-2.54)
	URS / Ant.VIb	0.93	(0.79-1.06)
	SIPH / body	0.14	(0.13-0.16)
	SIPH / Ant.III	0.87	(0.79-0.94)
	SIPH / hind femur	0.58	(0.48-0.79)
	SIPH / cauda	2.27	(2.02-2.50)
	Setae on Ant.III / Ant.IIIBD	0.49	(0.40-0.57)
	Setae on AbdT.III / Ant.IIIBD	1.09	(0.92-1.47)

Table 13. Biometric measurement of the apterous viviparous females of *M. asterale* **sp. nov.** See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 10)	
Length (mm)	Body	1.84	(1.59-2.07)
	Whole antennae	1.03	(0.94-1.10)
	Ant. I	0.05	(0.04-0.05)
	Ant.II	0.04	(0.03-0.05)
	Ant.III	0.31	(0.27-0.34)
	Ant.IV	0.15	(0.12-0.17)
	Ant.V	0.12	(0.09-0.15)
	Ant.VIb	0.08	(0.06-0.09)
	PT	0.24	(0.22-0.26)
	URS	0.08	(0.07-0.08)
	Hind femur	0.42	(0.38-0.49)
	Hind tibia	0.68	(0.62-0.73)
	2HT	0.07	(0.05-0.07)
	SIPH	0.27	(0.21-0.32)
	Cauda	0.14	(0.12-0.16)
	Setae on Ant.III	0.01	(0.01-0.01)
	Setae on AbdT.III	0.01	(0.01-0.01)
No. of hairs on	Ant.I	4	(2-5)
	Ant.II	3	(2-4)
	Ant.III	10	(8-14)
	URS	7	(6-8)
	AbdT.VII	4	(4-5)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(9-13)
	Cauda	4	(4-6)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.55	(0.51-0.61)
	PT / Ant.VIb	3.10	(2.51-3.79)
	PT / Ant.III	0.79	(0.71-0.90)
	URS / 2HT	1.15	(1.01-1.43)
	URS / Ant.VIb	1.01	(0.86-1.29)
	SIPH / body	0.14	(0.12-0.17)
	SIPH / Ant.III	0.86	(0.75-0.97)
	SIPH / hind femur	0.64	(0.55-0.72)
	SIPH / cauda	1.93	(1.52-2.54)
	Setae on Ant.III / Ant.IIIBD	0.32	(0.25-0.40)
	Setae on AbdT.III / Ant.IIIBD	0.41	(0.30-0.54)

Table 14. Biometric measurement of the apterous viviparous females of *M. raphani* **sp. nov.** See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 7)	
Length (mm)	Body	1.58	(1.27-1.77)
	Whole antennae	1.47	(1.38-1.60)
	Ant. I	0.05	(0.05-0.06)
	Ant.II	0.04	(0.03-0.05)
	Ant.III	0.41	(0.39-0.45)
	Ant.IV	0.25	(0.23-0.29)
	Ant.V	0.20	(0.19-0.22)
	Ant.VIb	0.13	(0.12-0.14)
	PT	0.35	(0.30-0.40)
	URS	0.06	(0.06-0.06)
	Hind femur	0.47	(0.44-0.51)
	Hind tibia	0.82	(0.77-0.88)
	2HT	0.08	(0.07-0.09)
	SIPH	0.35	(0.33-0.37)
	Cauda	0.15	(0.14-0.17)
	Setae on Ant.III	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)
No. of hairs on	Ant.I	4	(3-6)
	Ant.II	4	(3-5)
	Ant.III	10	(8-13)
	URS	8	(7-8)
	AbdT.VII	2	(2-2)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(9-11)
	Cauda	6	(6-6)
No. of rhinaria	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.94	(0.81-1.10)
	PT / Ant.VIb	2.67	(2.30-2.96)
	PT / Ant.III	0.83	(0.75-0.89)
	URS / 2HT	0.79	(0.69-0.85)
	URS / Ant.VIb	0.48	(0.44-0.54)
	SIPH / body	0.22	(0.19-0.28)
	SIPH / Ant.III	0.85	(0.81-0.88)
	SIPH / hind femur	0.74	(0.69-0.79)
	SIPH / cauda	2.27	(2.11-2.45)
	Setae on Ant.III / Ant.IIIBD	0.18	(0.15-0.24)
	Setae on AbdT.III / Ant.IIIBD	0.22	(0.16-0.31)

Table 15. Biometric measurement of the apterous viviparous females of *M. siegesbeckiae*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 4)	
Length (mm)	Body	1.37	(1.37-1.39)
	Whole antennae	0.88	(0.87-0.89)
	Ant. I	0.06	(0.06-0.06)
	Ant.II	0.04	(0.04-0.04)
	Ant.III	0.19	(0.19-0.20)
	Ant.IV	0.14	(0.13-0.15)
	Ant.V	0.10	(0.09-0.11)
	Ant.VIb	0.07	(0.07-0.08)
	PT	0.25	(0.24-0.25)
	URS	0.10	(0.09-0.10)
	Hind femur	0.41	(0.38-0.45)
	Hind tibia	0.66	(0.60-0.71)
	2HT	0.06	(0.05-0.07)
	SIPH	0.32	(0.29-0.33)
	Cauda	0.12	(0.11-0.13)
	Setae on Ant.III	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)
No. of hairs on	Ant.I	5	(4-7)
	Ant.II	4	(3-5)
	Ant.III	8	(6-10)
	URS (subsidiary)	8	(8-8)
	AbdT.VII	4	(4-4)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	6	(6-6)
	Cauda	5	(4-6)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.64	(0.62-0.64)
	PT / Ant.VIb	3.26	(3.01-3.65)
	PT / Ant.III	1.28	(1.23-1.35)
	URS / 2HT	1.60	(1.42-2.03)
	URS / Ant.VIb	1.32	(1.19-1.44)
	SIPH / body	0.23	(0.20-0.24)
	SIPH / Ant.III	1.65	(1.46-1.77)
	SIPH / hind femur	0.78	(0.74-0.86)
	SIPH / cauda	2.57	(2.29-2.79)
	Setae on Ant.III / Ant.IIIBD	0.31	(0.28-0.33)
	Setae on AbdT.III / Ant.IIIBD	0.16	(0.12-0.23)

Table 16. Biometric measurement of the apterous viviparous females of *M. siegesbeckicola*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 5)	
Length (mm)	Body	1.35	(1.26-1.40)
	Whole antennae	0.86	(0.79-0.90)
	Ant. I	0.05	(0.04-0.06)
	Ant.II	0.04	(0.03-0.06)
	Ant.III+IV	0.36	(0.32-0.39)
	Ant.V	0.09	(0.07-0.10)
	Ant.VIb	0.05	(0.05-0.06)
	PT	0.23	(0.22-0.27)
	URS	0.08	(0.08-0.09)
	Hind femur	0.39	(0.33-0.43)
	Hind tibia	0.69	(0.65-0.71)
	2HT	0.05	(0.05-0.06)
	SIPH	0.35	(0.33-0.36)
	Cauda	0.14	(0.14-0.14)
	Setae on Ant.III	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)
No. of hairs on	Ant.I	4	(3-5)
	Ant.II	3	(2-4)
	Ant.III	10	(6-12)
	URS (subsidiary)	6	(5-8)
	AbdT.VII	2	(2-2)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(10-10)
	Cauda	4	(4-5)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.63	(0.58-0.67)
	PT / Ant.VIb	4.18	(3.70-4.81)
	PT / Ant.III	0.64	(0.57-0.74)
	URS / 2HT	1.50	(1.36-1.70)
	URS / Ant.VIb	1.53	(1.41-1.64)
	SIPH / body	0.26	(0.24-0.27)
	SIPH / Ant.III	0.96	(0.89-1.09)
	SIPH / hind femur	0.89	(0.80-1.05)
	SIPH / cauda	2.46	(2.27-2.60)
	Setae on Ant.III / Ant.IIIBD	0.20	(0.13-0.32)
	Setae on AbdT.III / Ant.IIIBD	0.20	(0.14-0.28)

Table 17. Biometric measurement of the alate viviparous females of *M. stellariae*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		al. (n = 1)	
Length (mm)	Body	2.32	(2.32-2.32)
	Whole antennae	2.18	(2.15-2.21)
	Ant. I	0.06	(0.05-0.06)
	Ant.II	0.06	(0.05-0.06)
	Ant.III	0.47	(0.46-0.48)
	Ant.IV	0.40	(0.40-0.41)
	Ant.V	0.34	(0.33-0.34)
	Ant.VIb	0.14	(0.13-0.14)
	PT	0.70	(0.67-0.72)
	URS	0.09	(0.09-0.09)
	Hind femur	0.65	(0.64-0.65)
	Hind tibia	1.25	(1.23-1.28)
	2HT	0.05	(0.05-0.05)
	SIPH	0.34	(0.32-0.35)
	Cauda	0.10	(0.10-0.10)
	Setae on Ant.III	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.01)
No. of hairs on	Ant.I	6	(5-7)
	Ant.II	4	(4-4)
	Ant.III	9	(7-10)
	URS	8	(8-8)
	AbdT.VII	6	(6-6)
	AbdT. VIII	6	(6-6)
	Median of GP	2	(2-2)
	Posterior margin of GP	6	(6-6)
	Cauda	4	(4-4)
No. of rhinaria on	Ant.III	30	(29-31)
	Ant.IV	20.5	(19-22)
	Ant.V	8.5	(7-10)
Ratio (times)	Whole antennae / body	0.94	(0.92-0.95)
	PT / Ant.VIb	4.98	(4.87-5.10)
	PT / Ant.III	1.48	(1.46-1.49)
	URS / 2HT	1.71	(1.69-1.72)
	URS / Ant.VIb	0.67	(0.64-0.71)
	SIPH / body	0.14	(0.14-0.15)
	SIPH / Ant.III	0.72	(0.67-0.77)
	SIPH / hind femur	0.52	(0.49-0.54)
	SIPH / cauda	3.41	(3.27-3.56)
	Setae on Ant.III / Ant.IIIBD	0.20	(0.20-0.20)
	Setae on AbdT.III / Ant.IIIBD	0.14	(0.14-0.14)

Table 18. Biometric measurement of the apterous viviparous females of *M. varians*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 10)	
Length (mm)	Body	1.84	(1.72-1.98)
	Whole antennae	1.51	(1.38-1.65)
	Ant. I	0.09	(0.07-0.12)
	Ant.II	0.05	(0.04-0.06)
	Ant.III	0.36	(0.30-0.39)
	Ant.IV	0.22	(0.18-0.25)
	Ant.V	0.21	(0.18-0.26)
	Ant.VIb	0.09	(0.08-0.10)
	PT	0.47	(0.44-0.50)
	URS	0.10	(0.09-0.11)
	Hind femur	0.56	(0.51-0.60)
	Hind tibia	0.92	(0.85-0.99)
	2HT	0.08	(0.06-0.09)
	SIPH	0.47	(0.41-0.52)
	Cauda	0.18	(0.16-0.19)
	Setae on Ant.III	0.01	(0.00-0.01)
	Setae on AbdT.III	0.01	(0.00-0.02)
No. of hairs on	Ant.I	7	(4-9)
	Ant.II	3	(2-4)
	Ant.III	14	(10-19)
	URS (subsidiary)	9	(8-10)
	AbdT.VII	2	(2-2)
	AbdT. VIII	2	(2-2)
	Median of GP	2	(2-2)
	Posterior margin of GP	11	(9-13)
	Cauda	7	(6-9)
No. of rhinaria on	Ant.III	0	(0-0)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.82	(0.73-0.88)
	PT / Ant.VIb	4.92	(4.18-5.90)
	PT / Ant.III	1.31	(1.15-1.52)
	URS / 2HT	1.26	(1.01-1.58)
	URS / Ant.VIb	1.07	(0.91-1.20)
	SIPH / body	0.25	(0.23-0.30)
	SIPH / Ant.III	1.32	(1.15-1.66)
	SIPH / hind femur	0.84	(0.75-0.92)
	SIPH / cauda	2.60	(2.31-2.90)
	Setae on Ant.III / Ant.IIIBD	0.43	(0.21-0.55)
	Setae on AbdT.III / Ant.IIIBD	0.52	(0.27-0.64)

Table 19. Biometric measurement of the apterous and alate viviparous females of *U. adenophorae*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 14)	
Length (mm)	Body	2.93	(2.71-3.38)
	Whole antennae	3.31	(3.11-3.70)
	Ant. I	0.11	(0.08-0.15)
	Ant.II	0.11	(0.07-0.14)
	Ant.III	0.96	(0.86-1.09)
	Ant.IV	0.55	(0.52-0.66)
	Ant.V	0.57	(0.53-0.62)
	Ant.VIb	0.20	(0.16-0.28)
	PT	0.85	(0.79-0.91)
	URS	0.16	(0.15-0.19)
	Hind femur	1.06	(0.99-1.26)
	Hind tibia	2.03	(1.89-2.21)
	2HT	0.19	(0.12-0.32)
	SIPH	0.64	(0.56-0.72)
	Cauda	0.52	(0.48-0.58)
	Setae on Ant.III	0.97	(0.86-1.09)
	Setae on AbdT.III	0.05	(0.02-0.07)
No. of hairs	Ant.I	4	(2-6)
	Ant.II	3	(2-4)
	Ant.III	19	(13-24)
	URS	3	(2-5)
	AbdT.VII	4	(2-6)
	AbdT. VIII	5	(4-6)
	Median of GP	2	(1-3)
	Posterior margin of GP	11	(10-12)
	Cauda	17	(13-21)
No. of rhinaria	Ant.III	65	(52-72)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	1.13	(1.07-1.22)
	PT / Ant.VIb	4.41	(3.26-5.48)
	PT / Ant.III	0.89	(0.78-0.95)
	URS / 2HT	0.95	(0.61-1.34)
	URS / Ant.VIb	0.83	(0.60-1.00)
	SIPH / body	0.22	(0.19-0.24)
	SIPH / Ant.III	0.67	(0.55-0.66)
	SIPH / hind femur	0.60	(0.57-0.66)
	SIPH / cauda	1.22	(1.22-1.29)
	Setae on Ant.III / Ant.IIIBD	1.09	(0.92-1.38)
	Setae on AbdT.III / Ant.IIIBD	1.76	(1.33-2.15)

Table 20. Biometric measurement of the apterous and alate viviparous females of *U. amamianum*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 2)		al. (n = 1)	
Length (mm)	Body	3.37	(3.36-3.37)	2.73	
	Whole antennae	3.33	(3.24-3.41)	3.33	(3.32-3.33)
	Ant. I	0.13	(0.13-0.14)	0.12	(0.11-0.14)
	Ant.II	0.09	(0.09-0.10)	0.10	(0.09-0.11)
	Ant.III	0.82	(0.77-0.86)	0.72	(0.72-0.73)
	Ant.IV	0.59	(0.59-0.60)	0.57	
	Ant.V	0.58	(0.57-0.59)	0.53	(0.52-0.54)
	Ant.VIb	0.15	(0.14-0.17)	0.15	(0.15-0.16)
	PT	0.96	(0.95-0.98)	1.13	
	URS	0.16	(0.15-0.16)	0.13	
	Hind femur	1.16	(1.13-1.18)	0.97	(0.96-0.98)
	Hind tibia	2.12	(2.06-2.14)	1.78	(1.67-1.89)
	2HT	0.08		0.09	(0.08-0.09)
	SIPH	0.76	(0.75-0.79)	0.69	
	Cauda	0.47	(0.43-0.52)	0.38	
	Setae on Ant.III	0.04		0.02	
	Setae on AbdT.III	0.06	(0.05-0.07)	0.04	
No. of hairs on	Ant.I	5	(4-6)	4	
	Ant.II	4	(3-4)	4	(3-4)
	Ant.III	19	(16-21)	17	(15-19)
	URS	6		6	
	AbdT.VII	5		6	
	AbdT. VIII	4	(4-5)	5	
	Median of GP	2		2	
	Posterior margin of GP	13	(12-14)	10	
	Cauda	13	(12-14)	10	
No. of rhinaria on	Ant.III	21	(13-28)	32	(30-33)
	Ant.IV	0		0	
	Ant.V	1		1	
Ratio (times)	Whole antennae / body	0.99	(0.96-1.01)	1.22	
	PT / Ant.VIb	6.36	(5.91-6.86)	7.29	(7.03-7.55)
	PT / Ant.III	1.18	(1.13-1.23)	1.56	(1.55-1.57)
	URS / 2HT	2.04	(1.97-2.11)	1.50	(1.40-1.60)
	URS / Ant.VIb	1.04	(0.92-1.17)	0.84	(0.81-0.87)
	SIPH / body	0.23	(0.22-0.23)	0.25	
	SIPH / Ant.III	0.94	(0.88-0.98)	0.95	(0.95-0.96)
	SIPH / hind femur	0.66	(0.64-0.70)	0.71	(0.71-0.72)
	SIPH / cauda	1.64	(1.45-1.86)	1.83	(1.83-1.84)
	Setae on Ant.III / Ant.IIIBD	0.85	(0.84-0.86)	0.52	
	Setae on AbdT.III / Ant.IIIBD	1.22	(1.11-1.32)	1.49	

Table 21. Biometric measurement of the apterous and alate viviparous females of *U. asteriae*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 4)		al.(n =1)	
Length (mm)	Body	3.03	(2.87-3.33)	3.45	
	Whole antennae	3.26	(3.09-3.44)	3.48	(3.43-3.54)
	Ant. I	0.14	(0.14-0.16)	0.15	(0.12-0.17)
	Ant.II	0.10	(0.08-0.12)	0.09	(0.08-0.11)
	Ant.III	0.87	(0.80-0.92)	0.97	(0.94-1.01)
	Ant.IV	0.62	(0.57-0.67)	0.63	(0.61-0.65)
	Ant.V	0.56	(0.53-0.57)	0.63	
	Ant.VIb	0.14	(0.12-0.14)	0.14	
	PT	0.83	(0.80-0.88)	0.88	
	URS	0.18	(0.16-0.21)	0.17	
	Hind femur	1.14	(1.06-1.21)	1.10	(1.05-1.14)
	Hind tibia	2.03	(1.92-2.14)	2.15	(2.08-2.21)
	2HT	0.10	(0.08-0.12)	0.10	
	SIPH	1.03	(0.95-1.12)	1.08	
	Cauda	0.61	(0.57-0.66)	0.54	
	Setae on Ant.III	0.02	(0.02-0.03)	0.02	
	Setae on AbdT.III	0.06	(0.06-0.07)	0.05	
No. of hairs on	Ant.I	8	(6-8)	7	(6-8)
	Ant.II	5	(3-6)	4	
	Ant.III	20	(18-26)	19	(17-20)
	URS	12	(10-13)	9	
	AbdT.VII	8	(7-9)	6	
	AbdT. VIII	4	(4-5)	4	
	Median of GP	2		2	
	Posterior margin of GP	12	(10-13)	13	
	Cauda	16	(15-18)	18	
No. of rhinaria on	Ant.III	25	(23-30)	45	(44-46)
	Ant.IV	0		0	
	Ant.V	1			
Ratio (times)	Whole antennae / body	1.08	(1.02-1.13)		(0.99-1.03)
	PT / Ant.VIb	6.18	(5.74-6.53)	1	
	PT / Ant.III	0.96	(0.90-1.02)	1.01	(0.87-0.94)
	URS / 2HT	1.83	(1.59-2.12)	1.58	
	URS / Ant.VIb	1.33	(1.16-1.55)	1.22	
	SIPH / body	0.34	(0.33-0.36)	0.31	
	SIPH / Ant.III	1.19	(1.11-1.22)	1.11	(1.08-1.15)
	SIPH / hind femur	0.91	(0.87-0.93)	0.99	(0.95-1.02)
	SIPH / cauda	1.69	(1.66-1.72)	1.98	(1.98-1.99)
	Setae on Ant.III / Ant.IIIBD	0.58	(0.53-0.66)	0.48	
	Setae on AbdT.III / Ant.IIIBD	1.59	(1.40-1.73)	1.21	

Table 22. Biometric measurement of the apterous and alate viviparous females of *U. cephalonopli*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 4)		al. (n = 3)	
Length (mm)	Body	3.91	(3.48-4.18)	2.81	(2.71-2.98)
	Whole antennae	3.50	(3.05-3.79)	3.24	(3.12-3.38)
	Ant. I	0.15	(0.12-0.17)	0.13	(0.11-0.14)
	Ant.II	0.09	(0.08-0.11)	0.08	(0.06-0.10)
	Ant.III	1.05	(0.89-1.14)	0.94	(0.86-1.05)
	Ant.IV	0.65	(0.55-0.74)	0.57	(0.53-0.60)
	Ant.V	0.52	(0.43-0.58)	0.50	(0.47-0.52)
	Ant.VIb	0.14	(0.13-0.16)	0.13	(0.12-0.14)
	PT	0.90	(0.79-0.98)	0.90	(0.88-0.93)
	URS	0.23	(0.22-0.24)	0.21	(0.21-0.22)
	Hind femur	1.30	(1.18-1.39)	1.08	(1.05-1.10)
	Hind tibia	2.35	(2.05-2.59)	2.11	(2.04-2.17)
	2HT	0.12	(0.10-0.14)	0.11	(0.10-0.12)
	SIPH	1.25	(1.15-1.32)	1.01	(0.96-1.05)
	Cauda	0.68	(0.62-0.72)	0.17	(0.16-0.18)
	Setae on Ant.III	0.03	(0.02-0.04)	0.03	
	Setae on AbdT.III	0.06	(0.05-0.07)	0.05	
No. of hairs on	Ant.I	4	(4-5)	5	(4-5)
	Ant.II	3	(3-4)	4	(3-5)
	Ant.III	25	(20-35)	21	(19-25)
	URS	9	(6-10)	8	
	AbdT.VII	6		6	
	AbdT. VIII	4		4	
	Median of GP	2		2	
	Posterior margin of GP	12	(11-12)	10	(10-11)
	Cauda	18	(16-21)	22	(19-24)
No. of rhinaria on	Ant.III	20	(12-28)	36	(32-39)
	Ant.IV	0		0	
	Ant.V	1		1	
Ratio (times)	Whole antennae / body	0.90	(0.82-0.96)	1.16	(1.08-1.25)
	PT / Ant.VIb	6.31	(5.18-7.19)	7.13	(6.44-7.53)
	PT / Ant.III	0.86	(0.79-0.99)	0.97	(0.86-1.03)
	URS / 2HT	1.99	(1.69-2.29)	1.90	(1.79-2.01)
	URS / Ant.VIb	1.61	(1.47-1.73)	1.68	(1.49-1.85)
	SIPH / body	0.32	(0.29-0.35)	0.36	(0.35-0.37)
	SIPH / Ant.III	1.20	(1.10-1.37)	1.09	(0.96-1.18)
	SIPH / hind femur	0.96	(0.91-1.03)	0.94	(0.88-0.98)
	SIPH / cauda	1.84	(1.75-1.96)	2.04	(1.81-2.24)
	Setae on Ant.III / Ant.IIIBD	0.70	(0.54-0.96)	0.76	(0.65-0.85)
	Setae on AbdT.III / Ant.IIIBD	1.48	(1.13-1.67)	1.25	(1.21-1.32)

Table 23. Biometric measurement of the apterous viviparous females of *U. chrysanthemicola* **sp. nov.** See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 13)	
Length (mm)	Body	2.92	(2.42-3.29)
	Whole antennae	3.15	(2.87-3.40)
	Ant. I	0.13	(0.11-0.16)
	Ant.II	0.08	(0.06-0.10)
	Ant.III	0.82	(0.74-0.93)
	Ant.IV	0.55	(0.49-0.65)
	Ant.V	0.51	(0.46-0.58)
	Ant.VIb	0.16	(0.13-0.20)
	PT	0.86	(0.75-0.99)
	URS	0.14	(0.13-0.16)
	Hind femur	1.03	(0.90-1.15)
	Hind tibia	1.94	(1.73-2.14)
	2HT	0.09	(0.08-0.11)
	SIPH	0.60	(0.52-0.68)
	Cauda	0.51	(0.45-0.57)
	Setae on Ant.III	0.03	(0.02-0.04)
	Setae on AbdT.III	0.10	(0.09-0.12)
No. of hairs on	Ant.I	6	(4-8)
	Ant.II	4	(3-6)
	Ant.III	16	(10-19)
	URS	10	(8-15)
	AbdT.VII	5	(4-6)
	AbdT. VIII	5	(3-6)
	Median of GP	2	(2-2)
	Posterior margin of GP	12	(9-14)
	Cauda	12	(8-15)
No. of rhinaria on	Ant.III	24	(18-34)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	1.08	(0.97-1.23)
	PT / Ant.VIb	5.29	(4.27-6.33)
	PT / Ant.III	1.05	(0.92-1.19)
	URS / 2HT	1.50	(1.28-1.77)
	URS / Ant.VIb	0.89	(0.74-1.01)
	SIPH / body	0.20	(0.18-0.22)
	SIPH / Ant.III	0.72	(0.65-0.80)
	SIPH / hind femur	0.58	(0.50-0.70)
	SIPH / cauda	1.16	(1.06-1.26)
	Setae on Ant.III / Ant.IIIBD	1.04	(0.64-1.64)
	Setae on AbdT.III / Ant.IIIBD	3.06	(2.45-4.15)

Table 24. Biometric measurement of the apterous and alate viviparous females of *U. cichorii*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 2)		al. (n = 1)	
Length (mm)	Body	3.75	(3.73-3.78)	3.73	
	Whole antennae	4.35	(4.34-4.36)	4.35	(4.34-4.36)
	Ant. I	0.18	(0.17-0.18)	0.18	(0.17-0.18)
	Ant.II	0.11	(0.10-0.12)	0.11	(0.10-0.12)
	Ant.III	1.27	(1.27-1.28)	1.27	(1.27-1.28)
	Ant.IV	0.84	(0.83-0.85)	0.84	(0.83-0.85)
	Ant.V	0.63	(0.60-0.65)	0.63	(0.60-0.65)
	Ant.VIb	0.15	(0.13-0.16)	0.15	(0.13-0.16)
	PT	1.17	(1.16-1.18)	1.17	(1.16-1.18)
	URS	0.21	(0.20-0.21)		
	Hind femur	1.35	(1.33-1.37)	1.35	(1.33-1.37)
	Hind tibia	2.44	(2.43-2.47)	2.44	
	2HT	0.11	(0.12-0.13)	0.11	
	SIPH	0.82	(0.79-0.84)	0.82	(0.79-0.84)
	Cauda	0.60	(0.69-0.71)	0.60	
	Setae on Ant.III	0.03	(0.02-0.04)	0.03	
	Setae on AbdT.III	0.07	(0.05-0.09)	0.07	
No. of hairs on	Ant.I	6	(6-7)	6	
	Ant.II	7	(6-8)	7	
	Ant.III	19	(18-20)	19	(18-20)
	URS	6	(4-8)	6	
	AbdT.VII	4	(4-5)	4	
	AbdT. VIII	4	(4-5)	4	
	Median of GP	2		2	
	Posterior margin of GP	15		15	
	Cauda	15	(15-16)	15	
No. of rhinaria on	Ant.III	69	(68-69)	69	(68-69)
	Ant.IV	0		0	
	Ant.V	1		1	
Ratio (times)	Whole antennae / body	1.17	(1.16-1.17)	1.17	(1.16-1.17)
	PT / Ant.VIb	8.00	(7.17-8.82)	8.00	(7.17-8.82)
	PT / Ant.III	0.92	(0.92-0.93)	0.92	(0.92-0.93)
	URS / 2HT	1.60	(1.54-1.69)		
	URS / Ant.VIb	1.64	(1.41-1.76)		
	SIPH / body	0.22	(0.21-0.23)	0.22	(0.21-0.23)
	SIPH / Ant.III	0.64	(0.62-0.66)	0.64	(0.62-0.66)
	SIPH / hind femur	0.61	(0.60-0.62)	0.61	(0.60-0.62)
	SIPH / cauda	1.37	(1.33-1.41)	1.37	(1.33-1.41)
	Setae on Ant.III / Ant.IIIBD	0.40	(0.51-0.66)	0.40	
	Setae on AbdT.III / Ant.IIIBD	0.85	(0.98-1.06)	0.85	

Table 25. Biometric measurement of the apterous and alate viviparous females of *U. echinopsis* **sp. nov.** See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n =4)		al. (n = 2)	
Length (mm)	Body	2.39	(2.39-2.39)	2.58	(2.52-2.64)
	Whole antennae	3.18	(2.98-3.32)	3.53	(3.42-3.65)
	Ant. I	0.12	(0.11-0.14)	0.12	(0.10-0.13)
	Ant.II	0.08	(0.07-0.08)	0.08	(0.07-0.10)
	Ant.III	1.28	(1.18-1.34)	1.44	(1.38-1.51)
	Ant.IV	0.39	(0.36-0.42)	0.43	(0.40-0.48)
	Ant.V	0.31	(0.29-0.33)	0.39	(0.36-0.41)
	Ant.VIb	0.11	(0.10-0.12)	0.13	(0.13-0.13)
	PT	0.85	(0.83-0.87)	0.91	(0.89-0.92)
	URS	0.12	(0.12-0.13)	0.16	(0.15-0.16)
	Hind femur	1.10	(1.05-1.15)	1.07	(1.01-1.10)
	Hind tibia	2.15	(2.10-2.21)	2.20	(2.19-2.22)
	2HT	0.11	(0.10-0.12)	0.10	(0.09-0.12)
	SIPH	0.68	(0.65-0.73)	0.64	(0.59-0.66)
	Cauda	0.52	(0.44-0.59)	0.40	(0.40-0.41)
	Setae on Ant.III	0.01	(0.01-0.02)	0.01	(0.01-0.02)
	Setae on AbdT.III	0.04	(0.04-0.05)	0.02	(0.02-0.03)
No. of hairs on	Ant.I	6	(5-6)	6	(5-7)
	Ant.II	4	(3-6)	4	(3-4)
	Ant.III	23	(20-26)	23	(21-26)
	URS	8	(6-10)	10	(10-10)
	AbdT.VII	6	(6-6)	4	(4-4)
	AbdT. VIII	6	(5-6)	5	(5-5)
	Median of GP	2	(2-2)	2	(2-2)
	Posterior margin of GP	12	(11-12)	13	(12-13)
	Cauda	19	(18-20)	18	(17-19)
No. of rhinaria on	Ant.III	97	(84-107)	117	(111-123)
	Ant.IV	0	(0-0)	0	(0-0)
	Ant.V	1	(1-1)	1	(1-1)
Ratio (times)	Whole antennae / body	1.32	(1.24-1.38)	1.36	(1.35-1.38)
	PT / Ant.VIb	7.52	(6.87-8.03)	6.71	(6.52-6.94)
	PT / Ant.III	0.66	(0.63-0.70)	0.63	(0.60-0.67)
	URS / 2HT	1.10	(0.99-1.21)	1.52	(1.28-1.65)
	URS / Ant.VIb	1.13	(1.05-1.21)	1.18	(1.14-1.21)
	SIPH / body	0.28	(0.27-0.30)	0.24	(0.23-0.25)
	SIPH / Ant.III	0.53	(0.50-0.55)	0.44	(0.42-0.46)
	SIPH / hind femur	0.62	(0.60-0.63)	0.60	(0.58-0.61)
	SIPH / cauda	1.32	(1.14-1.48)	1.57	(1.46-1.61)
	Setae on Ant.III / Ant.IIIBD	0.50	(0.32-0.69)	0.47	(0.45-0.50)
	Setae on AbdT.III / Ant.IIIBD	1.34	(0.91-1.78)	0.72	(0.52-0.91)

Table 26. Biometric measurement of the apterous and alate viviparous females of *U. erigeronense*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 9)		al. (n = 3)	
Length (mm)	Body	2.63	(2.43-2.77)	2.56	(2.53-2.58)
	Whole antennae	2.29	(2.06-2.53)	2.42	(2.38-2.46)
	Ant. I	0.10	(0.08-0.13)	0.10	(0.09-0.11)
	Ant.II	0.07	(0.05-0.09)	0.07	(0.06-0.07)
	Ant.III	0.59	(0.53-0.66)	0.62	(0.59-0.65)
	Ant.IV	0.42	(0.32-0.50)	0.45	(0.44-0.47)
	Ant.V	0.39	(0.33-0.43)	0.44	(0.42-0.47)
	Ant.VIb	0.14	(0.11-0.16)	0.14	(0.13-0.16)
	PT	0.57	(0.50-0.61)	0.59	(0.57-0.62)
	URS	0.10	(0.09-0.12)	0.10	
	Hind femur	0.77	(0.72-0.85)	0.74	(0.72-0.76)
	Hind tibia	1.49	(1.36-1.62)	1.50	(1.45-1.52)
	2HT	0.11	(0.09-0.13)	0.12	(0.10-0.14)
	SIPH	0.76	(0.69-0.84)	0.68	(0.65-0.70)
	Cauda	0.37	(0.34-0.40)	0.37	(0.32-0.47)
	Setae on Ant.III	0.02	(0.02-0.03)	0.02	
	Setae on AbdT.III	0.02	(0.02-0.03)	0.03	
No. of hairs on	Ant.I	3	(2-5)	3	
	Ant.II	3	(3-4)	3	(3-5)
	Ant.III	12	(8-15)	14	(13-16)
	URS	10		8	
	AbdT.VII	3	(2-4)	4	
	AbdT. VIII	4		4	
	Median of GP	3	(2-4)	2	
	Posterior margin of GP	7	(6-11)	6	
	Cauda	8	(7-9)	8	(8-9)
No. of rhinaria on	Ant.III	15	(12-21)	31	(29-33)
	Ant.IV	0		3	(3-5)
	Ant.V	1		1	
Ratio (times)	Whole antennae / body	0.87	(0.75-0.96)	0.95	(0.93-0.96)
	PT / Ant.VIb	4.21	(3.51-5.40)	4.16	(3.52-4.52)
	PT / Ant.III	0.96	(0.80-1.08)	0.95	(0.91-1.03)
	URS / 2HT	0.96	(0.76-1.33)	0.89	(0.73-1.02)
	URS / Ant.VIb	0.77	(0.61-0.88)	0.73	(0.64-0.77)
	SIPH / body	0.29	(0.25-0.32)	0.26	(0.26-0.28)
	SIPH / Ant.III	1.28	(1.17-1.40)	1.09	(1.02-1.18)
	SIPH / hind femur	0.99	(0.89-1.06)	0.91	(0.85-0.95)
	SIPH / cauda	2.07	(1.84-2.23)	1.87	(1.43-2.18)
	Setae on Ant.III / Ant.IIIBD	0.67	(0.48-0.88)	0.65	(0.60-0.69)
	Setae on AbdT.III / Ant.IIIBD	1.74	(0.45-1.03)	0.54	(0.47-0.65)

Table 27. Biometric measurement of the alate viviparous females of *U. exiguum*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		al. (n = 1)	
Length (mm)	Body	1.83	
	Whole antennae	1.70	(1.70-1.71)
	Ant. I	0.08	(0.06-0.09)
	Ant.II	0.05	(0.05-0.06)
	Ant.III	0.36	(0.35-0.37)
	Ant.IV	0.28	(0.28-0.28)
	Ant.V	0.26	(0.25-0.27)
	Ant.VIb	0.14	(0.13-0.14)
	PT	0.54	(0.53-0.55)
	URS	0.09	
	Hind femur	0.54	(0.53-0.55)
	Hind tibia	1.05	(0.96
	2HT	0.08	
	SIPH	0.40	
	Cauda	0.20	
	Setae on Ant.III	0.01	
	Setae on AbdT.III	0.02	
No. of hairs on	Ant.I	6	(5-7)
	Ant.II	5	(3-6)
	Ant.III	7	(6-7)
	URS	4	
	AbdT.VII	4	
	AbdT. VIII	4	
	Median of GP	2	
	Posterior margin of GP	10	
	Cauda	4	
No. of rhinaria on	Ant.III	3	(2-3)
	Ant.IV	0	
	Ant.V	1	
Ratio (times)	Whole antennae / body	0.93	
	PT / Ant.VIb	3.93	
	PT / Ant.III	1.52	(1.45-1.59)
	URS / 2HT	1.12	
	URS / Ant.VIb	0.68	(0.66-0.69)
	SIPH / body	0.22	
	SIPH / Ant.III	1.14	(1.10-1.17)
	SIPH / hind femur	0.75	(0.74-0.76)
	SIPH / cauda	2.00	
	Setae on Ant.III / Ant.IIIBD	0.28	
	Setae on AbdT.III / Ant.IIIBD	0.64	

Table 28. Biometric measurement of the apterous and alate viviparous females of *U. formosanum*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 3)		al. (n = 2)	
Length (mm)	Body	3.31	(3.27-3.33)	2.73	(2.41-3.05)
	Whole antennae	3.33	(3.15-3.60)	3.54	(3.44-3.58)
	Ant. I	0.14	(0.12-0.15)	0.13	(0.12-0.14)
	Ant.II	0.08	(0.06-0.10)	0.08	(0.07-0.09)
	Ant.III	1.48	(1.36-1.59)	1.47	(1.45-1.49)
	Ant.IV	0.39	(0.37-0.45)	0.43	(0.39-0.46)
	Ant.V	0.36	(0.31-0.40)	0.38	(0.32-0.42)
	Ant.VIb	0.13	(0.12-0.13)	0.14	(0.12-0.15)
	PT	0.75	(0.68-0.84)	0.91	(0.87-0.94)
	URS	0.14	(0.13-0.14)	0.13	
	Hind femur	1.23	(1.18-1.28)	1.13	(1.11-1.15)
	Hind tibia	2.26	(2.16-2.38)	2.22	(2.20-2.25)
	2HT	0.14	(0.11-0.15)	0.14	(0.12-0.17)
	SIPH	0.82	(0.78-0.86)	0.69	(0.68-0.70)
	Cauda	0.67	(0.65-0.68)	0.45	(0.43-0.47)
	Setae on Ant.III	0.03	(0.02-0.03)	0.02	(0.01-0.02)
	Setae on AbdT.III	0.05	(0.04-0.06)	0.03	
No. of hairs on	Ant.I	6	(4-8)	6	(5-7)
	Ant.II	4	(3-4)	4	
	Ant.III	27	(25-28)	21	(20-23)
	URS	13	(12-14)	9	(8-10)
	AbdT.VII	5	(4-6)	6	
	AbdT. VIII	4		4	
	Median of GP	2		2	
	Posterior margin of GP	13	(11-14)	9	
	Cauda	22	(19-24)	19	(18-19)
No. of rhinaria on	Ant.III	70	(67-73)	97	(91-103)
	Ant.IV	0		0	
	Ant.V	1		1	
Ratio (times)	Whole antennae / body	1.01	(0.96-1.08)	1.31	(1.17-1.48)
	PT / Ant.VIb	5.80	(5.50-6.34)	6.73	(5.63-7.74)
	PT / Ant.III	0.51	(0.48-0.55)	0.62	(0.59-0.64)
	URS / 2HT	1.01	(0.83-1.24)	0.97	(0.77-1.13)
	URS / Ant.VIb	1.06	(0.96-1.09)	0.99	(0.87-1.14)
	SIPH / body	0.25	(0.23-0.26)	0.26	(0.23-0.29)
	SIPH / Ant.III	0.56	(0.51-0.63)	0.47	(0.46-0.48)
	SIPH / hind femur	0.67	(0.63-0.71)	0.62	(0.60-0.63)
	SIPH / cauda	1.23	(1.17-1.26)	1.55	(1.47-1.64)
	Setae on Ant.III / Ant.IIIBD	0.70	(0.56-0.82)	0.41	(0.33-0.49)
	Setae on AbdT.III / Ant.IIIBD	1.28	(0.82-1.62)	0.81	(0.71-0.90)

Table 29. Biometric measurement of the apterous viviparous females of *U. fuchuense*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 6)	
Length (mm)	Body	4.00	(3.39-4.30)
	Whole antennae	3.84	(3.76-3.95)
	Ant. I	0.17	(0.14-0.20)
	Ant.II	0.11	(0.09-0.14)
	Ant.III	1.18	(1.16-1.23)
	Ant.IV	0.67	(0.65-0.69)
	Ant.V	0.54	(0.53-0.56)
	Ant.VIb	0.17	(0.16-0.19)
	PT	0.99	
	URS	0.16	0.14-0.18)
	Hind femur	1.48	(1.41-1.57)
	Hind tibia	2.77	(2.61-3.00)
	2HT	0.14	(0.13-0.15)
	SIPH	0.95	(0.87-1.03)
	Cauda	0.80	(0.74-0.88)
	Setae on Ant.III	0.04	
	Setae on AbdT.III	0.07	(0.06-0.08)
No. of hairs on	Ant.I	7	(5-9)
	Ant.II	5	(3-8)
	Ant.III	22	(17-29)
	URS	13	(8-15)
	AbdT.VII	7	(4-8)
	AbdT. VIII	4	(4-5)
	Median of GP	2	
	Posterior margin of GP	9	(7-11)
	Cauda	33	(29-36)
No. of rhinaria on	Ant.III	24	(22-25)
	Ant.IV	0	
	Ant.V	0	
Ratio (times)	Whole antennae / body	0.97	(0.89-1.13)
	PT / Ant.VIb	5.70	(5.15-6.35)
	PT / Ant.III	0.83	(0.80-0.85)
	URS / 2HT	1.18	(1.01-1.39)
	URS / Ant.VIb	0.93	(0.78-1.04)
	SIPH / body	0.24	(0.22-0.27)
	SIPH / Ant.III	0.81	(0.74-0.87)
	SIPH / hind femur	0.64	(0.61-0.68)
	SIPH / cauda	1.19	(1.13-1.25)
	Setae on Ant.III / Ant.IIIBD	0.82	(0.80-0.84)
	Setae on AbdT.III / Ant.IIIBD	1.64	(1.43-1.91)

Table 30. Biometric measurement of the apterous and alate viviparous females of *U. gobonis*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 2)	
Length (mm)	Body	4.16	(4.04-4.28)
	Whole antennae	3.66	(3.52-3.77)
	Ant. I	0.15	(0.14-0.17)
	Ant.II	0.10	(0.09-0.11)
	Ant.III	1.08	(1.05-1.10)
	Ant.IV	0.70	(0.66-0.73)
	Ant.V	0.58	(0.54-0.60)
	Ant.VIb	0.12	(0.11-0.14)
	PT	0.89	(0.73-1.02)
	URS	0.21	(0.20-0.21)
	Hind femur	1.36	(1.35-1.39)
	Hind tibia	2.45	(2.43-2.47)
	2HT	0.13	(0.12-0.13)
	SIPH	1.26	(1.22-1.30)
	Cauda	0.70	(0.69-0.71)
	Setae on Ant.III	0.02	(0.02-0.02)
	Setae on AbdT.III	0.04	(0.04-0.05)
No. of hairs on	Ant.I	7	(6-7)
	Ant.II	5	(4-6)
	Ant.III	29	(23-35)
	URS	10	(8-11)
	AbdT.VII	8	(7-9)
	AbdT. VIII	5	(4-5)
	Median of GP	2	(2-2)
	Posterior margin of GP	14	(13-14)
	Cauda	24	(22-26)
No. of rhinaria on	Ant.III	29	(24-33)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	0.88	(0.82-0.92)
	PT / Ant.VIb	7.02	(5.08-8.04)
	PT / Ant.III	0.82	(0.69-0.94)
	URS / 2HT	1.60	(1.54-1.69)
	URS / Ant.VIb	1.64	(1.41-1.76)
	SIPH / body	0.30	(0.28-0.31)
	SIPH / Ant.III	1.16	(1.14-1.17)
	SIPH / hind femur	0.92	(0.89-0.96)
	SIPH / cauda	1.79	(1.74-1.88)
	Setae on Ant.III / Ant.IIIBD	0.58	(0.51-0.66)
	Setae on AbdT.III / Ant.IIIBD	1.02	(0.98-1.06)

Table 31. Biometric measurement of the apterous and alate viviparous females of *U. kikioense*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 3)		al. (n = 1)	
Length (mm)	Body	2.63	(2.51-2.75)	2.15	
	Whole antennae	2.45	(2.27-2.63)	2.24	(2.11-2.37)
	Ant. I	0.12	(0.10-0.14)	0.11	(0.10-0.12)
	Ant.II	0.08	(0.06-0.10)	0.07	(0.06-0.07)
	Ant.III	0.68	(0.64-0.73)	0.67	(0.61-0.73)
	Ant.IV	0.43	(0.36-0.49)	0.44	(0.43-0.45)
	Ant.V	0.41	(0.36-0.44)	0.43	(0.39-0.46)
	Ant.VIb	0.11	(0.11-0.12)	0.12	(0.11-0.14)
	PT	0.62	(0.58-0.64)	0.41	
	URS	0.11	(0.11-0.12)	0.11	
	Hind femur	0.89	(0.87-0.93)	0.75	(0.74-0.76)
	Hind tibia	1.61	(1.51-1.70)	1.44	(1.42-1.47)
	2HT	0.12	(0.11-0.13)	0.11	(0.10-0.12)
	SIPH	0.64	(0.60-0.69)	0.57	(0.57-0.58)
	Cauda	0.44	(0.42-0.47)	0.34	
	Setae on Ant.III	0.02		0.02	
	Setae on AbdT.III	0.04		0.03	
No. of hairs on	Ant.I	5	(4-5)	4	(3-4)
	Ant.II	4	(3-4)	4	(3-4)
	Ant.III	17	(13-22)	15	(14-15)
	URS	8	(7-9)	6	
	AbdT.VII	5	(4-5)	6	
	AbdT. VIII	4	(4-5)	4	
	Median of GP	2		2	
	Posterior margin of GP	13	(12-13)	12	
	Cauda	13	(9-16)	13	
No. of rhinaria on	Ant.III	13	(6-18)	26	(23-28)
	Ant.IV	0		0	
	Ant.V	1		1	
Ratio (times)	Whole antennae / body	0.93	(0.91-0.96)	1.04	(0.98-1.10)
	PT / Ant.VIb	5.41	(4.79-5.75)	3.36	(2.93-3.78)
	PT / Ant.III	0.90	(0.86-0.96)	0.61	(0.55-0.67)
	URS / 2HT	0.95	(0.88-1.00)	0.98	(0.91-1.05)
	URS / Ant.VIb	0.98	(0.87-1.08)	0.89	(0.78-1.00)
	SIPH / body	0.24	(0.24-0.25)	0.27	
	SIPH / Ant.III	0.94	(0.93-0.95)	0.86	(0.78-0.95)
	SIPH / hind femur	0.72	(0.69-0.77)	0.76	(0.76-0.77)
	SIPH / cauda	1.45	(1.43-1.47)	1.70	(1.70-1.71)
	Setae on Ant.III / Ant.IIIBD	0.56	(0.54-0.57)	0.60	
	Setae on AbdT.III / Ant.IIIBD	1.29	(1.26-1.32)	0.76	

Table 32. Biometric measurement of the alate viviparous females of *U. lactucicola*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		al. (n = 1)	
Length (mm)	Body	3.37	(3.37-3.37)
	Whole antennae	3.42	(3.40-3.43)
	Ant. I	0.10	(0.09-0.11)
	Ant.II	0.09	(0.08-0.10)
	Ant.III	0.90	(0.90-0.91)
	Ant.IV	0.57	(0.57-0.57)
	Ant.V	0.56	(0.56-0.56)
	Ant.VIb	0.15	(0.15-0.15)
	PT	1.02	(1.02-1.02)
	URS	0.18	(0.18-0.18)
	Hind femur	1.07	(1.05-1.09)
	Hind tibia	1.91	(1.63-2.20)
	2HT	0.11	(0.10-0.12)
	SIPH	0.89	(0.87-0.90)
	Cauda	0.45	(0.45-0.45)
	Setae on Ant.III	0.01	(0.01-0.01)
	Setae on AbdT.III	0.04	(0.04-0.04)
No. of hairs on	Ant.I	4	(4-4)
	Ant.II	4	(4-4)
	Ant.III	17	(16-18)
	URS		
	AbdT.VII	6	(6-6)
	AbdT. VIII	4	(4-4)
	Median of GP	2	(2-2)
	Posterior margin of GP	10	(10-10)
	Cauda	8	(8-8)
No. of rhinaria on	Ant.III	59	(57-60)
	Ant.IV	0	(0-0)
	Ant.V	1	(1-1)
Ratio (times)	Whole antennae / body	1.01	
	PT / Ant.VIb	6.72	(6.72-6.72)
	PT / Ant.III	1.12	(1.11-1.12)
	URS / 2HT	1.56	(1.43-1.70)
	URS / Ant.VIb	1.19	(1.19-1.19)
	SIPH / body	0.26	(0.25-0.26)
	SIPH / Ant.III	0.97	(0.96-0.98)
	SIPH / hind femur	0.83	(0.82-0.83)
	SIPH / cauda	1.93	(1.90-1.96)
	Setae on Ant.III / Ant.IIIBD	0.44	(0.44-0.44)
	Setae on AbdT.III / Ant.IIIBD	1.02	(1.02-1.02)

Table 33. Biometric measurement of the apterous and alate viviparous females of *U. leontopodiicola*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		al. (n = 1)	
Length (mm)	Body	3.30	
	Whole antennae	4.36	
	Ant. I	0.13	(0.13-0.14)
	Ant.II	0.08	
	Ant.III	1.27	
	Ant.IV	0.84	
	Ant.V	0.69	
	Ant.VIb	0.17	
	PT	1.16	
	URS	0.20	
	Hind femur	1.23	(1.20-1.26)
	Hind tibia	2.29	
	2HT	0.11	(0.11-0.12)
	SIPH	0.74	(0.73-0.74)
	Cauda	0.41	
	Setae on Ant.III		
	Setae on AbdT.III	0.04	
No. of hairs on	Ant.I	7	(6-7)
	Ant.II	3	
	Ant.III	15	
	URS	9	
	AbdT.VII	4	
	AbdT. VIII	4	
	Median of GP	2	
	Posterior margin of GP	15	
	Cauda	22	
No. of rhinaria on	Ant.III	45	
	Ant.IV	0	
	Ant.V	1	
Ratio (times)	Whole antennae / body	1.32	
	PT / Ant.VIb	7.00	
	PT / Ant.III	0.92	
	URS / 2HT	1.76	(1.71-1.82)
	URS / Ant.VIb	1.18	
	SIPH / body	0.22	
	SIPH / Ant.III	0.58	
	SIPH / hind femur	0.60	
	SIPH / cauda	1.81	
	Setae on Ant.III / Ant.IIIBD	0.70	
	Setae on AbdT.III / Ant.IIIBD	1.59	

Table 34. Biometric measurement of the apterous and alate viviparous females of *U. monticola*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 3)		al. (n = 2)	
Length (mm)	Body	3.24	(3.09-3.42)	2.87	(2.79-2.94)
	Whole antennae	3.56	(3.42-3.71)	3.58	(3.33-3.69)
	Ant. I	0.12	(0.11-0.13)	0.10	(0.09-0.11)
	Ant.II	0.08	(0.07-0.09)	0.06	(0.06-0.07)
	Ant.III	0.90	(0.87-0.94)	0.87	(0.78-0.92)
	Ant.IV	0.65	(0.61-0.68)	0.65	(0.57-0.72)
	Ant.V	0.60	(0.56-0.63)	0.61	(0.52-0.66)
	Ant.VIb	0.16	(0.15-0.18)	0.15	(0.13-0.17)
	PT	1.06	(1.01-1.13)	1.14	(1.11-1.17)
	URS	0.13	(0.12-0.15)	0.12	
	Hind femur	1.18	(1.14-1.24)	1.07	(1.03-1.10)
	Hind tibia	2.22	(2.20-2.24)	2.10	(2.03-2.13)
	2HT	0.11	(0.10-0.13)	0.10	(0.08-0.12)
	SIPH	0.99	(0.95-1.05)	0.82	(0.80-0.84)
	Cauda	0.52	(0.50-0.54)	0.38	(0.35-0.41)
	Setae on Ant.III	0.03	(0.02-0.03)	0.03	(0.02-0.03)
	Setae on AbdT.III	0.07	(0.06-0.07)	0.06	(0.06-0.07)
No. of hairs on	Ant.I	6	(4-8)	5	
	Ant.II	4	(3-5)	3	
	Ant.III	23	(19-27)	23	(20-25)
	URS	9	(7-10)	10	
	AbdT.VII	6		6	
	AbdT. VIII	6		6	
	Median of GP	2		2	
	Posterior margin of GP	24	(22-26)	10	
	Cauda	24	(22-26)	14	
No. of rhinaria on	Ant.III	33	(30-36)	44	(41-46)
	Ant.IV	0		0	
	Ant.V	1		1	
Ratio (times)	Whole antennae / body	1.10	(1.05-1.13)	1.25	(1.13-1.32)
	PT / Ant.VIb	6.65	(5.87-7.30)	7.68	(6.66-8.41)
	PT / Ant.III	1.18	(1.16-1.20)	1.31	(1.21-1.44)
	URS / 2HT	1.15	(1.01-1.42)	1.25	(0.97-1.41)
	URS / Ant.VIb	0.82	(0.69-0.96)	0.81	(0.70-0.92)
	SIPH / body	0.31	(0.30-0.32)	0.29	(0.28-0.30)
	SIPH / Ant.III	1.11	(1.06-1.14)	0.95	(0.87-1.06)
	SIPH / hind femur	0.84	(0.82-0.87)	0.77	(0.74-0.79)
	SIPH / cauda	1.91	(1.85-1.99)	2.16	(2.00-2.36)
	Setae on Ant.III / Ant.IIIBD	0.79	(0.61-0.99)	0.84	(0.65-1.03)
	Setae on AbdT.III / Ant.IIIBD	1.92	(1.74-2.16)	2.02	(1.88-2.16)

Table 35. Biometric measurement of the apterous and alate viviparous females of *U. picridis*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 3)		al. (n = 3)	
Length (mm)	Body	2.59	(2.59-2.59)	2.65	(2.65-2.65)
	Whole antennae	3.52	(3.48-3.55)	3.35	(3.33-3.36)
	Ant. I	0.13	(0.12-0.14)	0.12	(0.11-0.13)
	Ant.II	0.07	(0.06-0.07)	0.07	(0.07-0.08)
	Ant.III	1.12	(1.09-1.16)	1.07	(1.04-1.10)
	Ant.IV	0.58	(0.57-0.6)	0.49	(0.49-0.49)
	Ant.V	0.53	(0.52-0.55)	0.50	(0.50-0.50)
	Ant.VIb	0.14	(0.14-0.15)	0.16	(0.16-0.16)
	PT	0.91	(0.91-0.91)	0.92	(0.92-0.92)
	URS	0.23	(0.23-0.23)	0.24	(0.24-0.24)
	Hind femur	0.94	(0.93-0.96)	0.92	(0.91-0.93)
	Hind tibia	1.81	(1.73-1.89)	1.89	(1.88-1.90)
	2HT	0.13	(0.13-0.13)	0.14	(0.13-0.15)
	SIPH	0.69	(0.68-0.71)	0.62	(0.62-0.62)
	Cauda	0.52	(0.52-0.52)	0.42	(0.42-0.42)
	Setae on Ant.III	0.02	(0.02-0.02)	0.02	(0.02-0.02)
	Setae on AbdT.III	0.05	(0.05-0.05)	0.03	(0.03-0.03)
No. of hairs on	Ant.I	8	(5-11)	6	(5-6)
	Ant.II	4	(4-4)	4	(4-4)
	Ant.III	15	(13-17)	15	(13-16)
	URS	8	(8-8)	8	(8-8)
	AbdT.VII	5	(5-5)	6	(6-6)
	AbdT. VIII	5	(5-5)	4	(4-4)
	Median of GP	2	(2-2)	2	(2-2)
	Posterior margin of GP	8	(8-8)	17	(17-17)
	Cauda	15	(15-15)	14	(14-14)
No. of rhinaria on	Ant.III	86	(83-88)	80	(78-82)
	Ant.IV	0	(0-0)	0	(0-0)
	Ant.V	1	(1-1)	1	(1-1)
Ratio (times)	Whole antennae / body	1.35	(1.34-1.36)	1.26	(1.25-1.26)
	PT / Ant.VIb	6.17	(6.05-6.30)	5.75	(5.75-5.75)
	PT / Ant.III	0.81	(0.78-0.83)	0.85	(0.83-0.87)
	URS / 2HT	1.74	(1.70-1.79)	1.67	(1.60-1.75)
	URS / Ant.VIb	1.58	(1.55-1.62)	1.51	(1.51-1.51)
	SIPH / body	0.26	(0.26-0.27)	0.23	(0.23-0.23)
	SIPH / Ant.III	0.61	(0.58-0.64)	0.58	(0.56-0.59)
	SIPH / hind femur	0.73	(0.71-0.75)	0.67	(0.67-0.68)
	SIPH / cauda	1.33	(1.30-1.36)	1.49	(1.49-1.49)
	Setae on Ant.III / Ant.IIIBD	0.57	(0.57-0.57)	0.56	(0.56-0.56)
	Setae on AbdT.III / Ant.IIIBD	1.60	(1.60-1.60)	0.81	(0.81-0.81)

Table 36. Biometric measurement of the apterous and alate viviparous females of *U. sonchi*. See the text for abbreviations of morphological characters. Values are means with min and max in parentheses. A blank cell in the range columns means that all measurements were identical.

Part		ap. (n = 4)	
Length (mm)	Body	3.46	(3.18-3.74)
	Whole antennae	3.33	(3.17-3.43)
	Ant. I	0.14	(0.12-0.15)
	Ant.II	0.08	(0.07-0.09)
	Ant.III	0.87	(0.83-0.91)
	Ant.IV	0.67	(0.64-0.70)
	Ant.V	0.59	(0.53-0.63)
	Ant.VIb	0.16	(0.15-0.18)
	PT	0.81	(0.79-0.83)
	URS	0.12	0.11-0.13)
	Hind femur	1.24	(1.16-1.36)
	Hind tibia	2.21	(2.12-2.38)
	2HT	0.16	(0.15-0.16)
	SIPH	1.10	(0.99-1.23)
	Cauda	0.58	(0.51-0.64)
	Setae on Ant.III	0.02	(0.02-0.03)
	Setae on AbdT.III	0.03	
No. of hairs on	Ant.I	7	(6-8)
	Ant.II	5	(3-5)
	Ant.III	13	(9-18)
	URS	12	(10-14)
	AbdT.VII	7	(6-7)
	AbdT. VIII	5	(4-5)
	Median of GP	2	
	Posterior margin of GP	11	(9-12)
	Cauda	27	(23-30)
No. of rhinaria on	Ant.III	15	(12-17)
	Ant.IV	0	
	Ant.V	1	
Ratio (times)	Whole antennae / body	0.97	(0.91-1.04)
	PT / Ant.VIb	5.06	(4.74-5.28)
	PT / Ant.III	0.93	(0.90-0.98)
	URS / 2HT	0.76	(0.66-0.87)
	URS / Ant.VIb	0.74	(0.66-0.83)
	SIPH / body	0.32	(0.31-0.33)
	SIPH / Ant.III	1.26	(1.14-1.38)
	SIPH / hind femur	0.89	(0.83-0.99)
	SIPH / cauda	1.91	(1.86-1.93)
	Setae on Ant.III / Ant.IIIBD	3.16	(3.06-3.29)
	Setae on AbdT.III / Ant.IIIBD	0.79	(0.73-0.85)

ABSTRACT IN KOREAN

수염진딧물족은 진딧물아과에 속하는 진딧물로서 곤충 계통 분류학적으로 논란이 많은 그룹이다. 이번 연구를 통해서, 본 연구자는 분류, 계통 및 진화적인 연구를 Chapter 1 과 Chapter 2 로 나누어 수행하였다. Chapter 1 에서는 계통학적 연구를 수행하였다. Macrosiphini 족 107 종과 그들에서 추출한 5 개의 유전자 (one nuclear gene (EF-1α) and four mitochondrial genes (COI, tRNA + COII, 16S), 2876bp 염기서열을 이용하여 분자계통연구를 하였고, 결과적으로 Macrosiphini 족의 단계통을 알수 있었고, 두개의 종속된 그룹(Macrosiphini *s.str* and the *Pterocomma*-group)이 형성됨이 밝혀졌다. 이중 *Pterocomma*-group 안에, 기존의 *Pterocomma* 종뿐만 아니라, *Capitophorus*, *Pleotrichophorus*, *Liosomaphis* 와 *Vesiculaphi*s 속에 속한 종들이 포진됨을 알 수 있었다. 또한 Macrosiphini 의 조상형질, 기주연관, 기주생태가 논의 되었다. 추가적으로 *Uroleucon* 속에 속하는 전세계에 분포하는 29 종을 포함하여 계통학적 연구를 하였다. 연구의 결과로, *Uroleucon* 속은 단계통을 이루는 속이나, 주요 3 아속들이 측계통을 이루는 결과를 보여주었다. 이는 분자학적 계통과 형태를 이용한 분류학적 연구가 일치하지 않음을 밝혔다. 그중 *Uromelan* 아속에 속하고, *Lambersius* 아속과 함께 분화가 된 신북구지역에서 서식하는 종들은 기존의 *Uroleucon* 에서 계통학적으로 분리됨을 강한 통계학적인 수치를 통해 입증하였다. 유럽과 아시아지역이 포함된 구북구지역에서 서식하는 종들은 일부 신북구지역 종들과 계통학적으로 함께 분화가 이루어 졌음을 확인하였다. 또한 기주의 근원지, 일부 형태학적 공통점들이 *Uroleucon* 계통에 연관이 있음을 확인하였다. Chapter 2 에서는 2-1 과 2-2 로 나누어 분류학적 연구를 수행하였다. 2-1 에서는 *Myzus* (혹진딧물속)의 분류학적 검토를 하였다. 연구의 결과로 *Myzus* 속에서 3 종의 신종 (*M. pruni* **sp. nov.**, *M. asterale* **sp. nov.**, *M. raphani* **sp. nov**.)을 밝혀 내었다. 2-2 에서는 *Uroleucon* (흰끝수염진딧물속) 의 분류학적 검토를 하였다. 연구의 결과로 *Uroleucon* 2 종의 신종(*U. echinopsis* **sp. nov.**, *U.*

chrysanthemicola **sp. nov.**)과 1 종의 국내 미기록종((*U. adenophora* (Matsumura, 1918))을 밝혀 내었다. 결과적으로 총 41 종의 진딧물종을 두 속에서 검토하였다.

검색어: 분류, 혹진딧물속, 흰끝수염진딧물속, 수염진딧물족, 서식지, 진화

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