



Taxonomical implications of the comparative study of the genus *Drepanosiphum* Koch, 1855 (Hemiptera: Aphididae, Drepanosiphinae)

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ABSTRACT

The aim of the study was to review the sexual generation of the species of the aphid genus *Drepanosiphum* Koch. Oviparous females and males of *Drepanosiphum iranikum* Hille Ris Lambers are described and illustrated in detail. The poorly known sexuales of *D. acerinum* (Walker), *D. aceris* Koch, *D. braggii* Gillette, *D. dixonii* HRL, *D. oregonensis* Granovsky and *D. platanoidis* (Schrank) are re-described and illustrated in detail. Biometric data for the oviparous females and males are reported and keys for the sexual generation of the species that were studied are provided for the first time. The status of the closely related species *D. acerinum* and *D. caucasicum* as well as *D. platanoidis* and *D. iranikum* is discussed. The newly recognised species *D. latifemorum* sp. n., which is closely related to *D. oregonensis*, is described. Blackman and Eastop's general key to the species that are associated with *Acer* spp. is modified to include the new species. The most significant diagnostic characters of winged viviparous females of all of the known *Drepanosiphum* species are also provided and illustrated.

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1. Introduction

More than 5000 species of aphids (Hemiptera, Aphididae) (Favret, 2015) have been described to date. They are all characterised by apomictic parthenogenesis (clonal or asexual reproduction) as the primary or exclusive mode of reproduction. Despite being fairly rare in animals, aphids are among the organisms that exploit this method of reproduction to the greatest extent, i.e. this adaptation leads to higher population growth in a very short time and allows rapid niche exploitation in a changed habitat (Dixon, 1998). Therefore, the reproductive mode of aphids is one of the key components of the damage caused by these economically important pests. Asexual viviparous reproduction ensures a high increase in population during the growing season because natural selection gives the fittest genotypes a considerable demographic advantage due to their sustained clonality. Oviparous sexual reproduction, on the other hand, leads to the production of genetically recombined individuals, i.e. cold-resistant forms of the eggs, thus allowing aphid populations to resist harsh winters and to produce an array of new genotypic combinations each year (Simon et al., 2010). The parthenogenesis (viviparous females) is switched in sexual repro-

duction (sexuales – oviparous females and males) in almost all aphids. However, as sexual generation occurs for only a short period of time (usually in the autumn), sexuales – the key morphs in the life cycle of aphids are either unknown or have only been briefly described.

One example is the Holarctic genus *Drepanosiphum* Koch, 1855 (Drepanosiphinae), which comprises eight holocyclic species (*D. acerinum* (Walker, 1848), *D. aceris* Koch, 1855, *D. braggii* Gillette, 1907; *D. caucasicum* Dzhibladze, 1962; *D. dixonii* Hille Ris Lambers, 1971; *D. iranikum* Hille Ris Lambers, 1971; *Drepanosiphum oregonensis* Granovsky, 1939, *D. platanoidis* (Schrank, 1801)), which are trophically associated with plants from the genus *Acer* spp. (maples) (Holman, 2009). The unique character of this genus is the presence of winged morphs in parthenogenetic generation exclusively. The key morphological features of *Drepanosiphum* include long antennae with a very long processus terminalis, ciliated rhinaria, forelegs with enlarged femora, long cylindrical siphunculi and knobbed cauda. Although the viviparous generations are generally well known (Hille Ris Lambers, 1971; Stroyan, 1977; Heie, 1982; Nieto Nafría and Mier Durante, 1998), sexual morphs have never been properly described or have remained unknown (*D. iranikum*, *D. caucasicum*). As little is known about this generation of the genus, (1) we present a review of the sexual generation of *Drepanosiphum* species with the original keys to identifying oviparous females and males first. Furthermore, because

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Table 1Measurements (in mm) of main characters of oviparous females of the genus *Drepanosiphum*.

Character	<i>D. acerinum</i> n=4	<i>D. aceris</i> n=8	<i>D. braggii</i> n=7	<i>D. dixonii</i> n=1	<i>D. iranikum</i> n=10	<i>D. oregonensis</i> n=2	<i>D. platanoidis</i> n=10
BL	2.77–3.03	2.50–3.25	2.75–3.67	2.70	3.25–4.25	2.37	3.27–3.77
BW	1.15–1.25	0.51–0.66	1.00–1.37	1.15	1.20–1.70	0.90	1.12–1.47
HW	0.58–0.60	0.51–0.66	0.68–0.74	0.64	0.69–0.72	0.68	0.60–0.73
ANT	3.41–3.54	3.48–3.55	5.33–5.82	4.02–4.07	4.15–4.95	3.01–3.03	0.83–1.32
ANT III	0.83–0.94	1.00–1.02	1.10–1.30	1.00–1.02	1.12–1.52	0.69–0.70	0.83–1.32
ANT IV	0.65–0.82	0.70–0.74	1.00–1.25	0.91–0.95	0.90–1.20	0.57–0.60	0.63–0.92
ANT V	0.68–0.81	0.62–0.67	1.02–1.15	0.82–0.85	0.80–1.00	0.54–0.58	0.61–0.85
ANT VI	1.03–1.095	0.87–0.97	1.81–2.09	0.96–1.06	0.89–1.10	0.97–0.98	0.82–1.08
BASE	0.13–0.14	0.12–0.13	0.15–0.18	0.16	0.13–0.15	0.12–0.13	0.11–0.14
PT	0.90–0.96	0.75–0.85	1.65–1.92	0.80–0.90	0.76–0.95	0.84–0.86	0.71–0.94
ARS	0.10–0.11	0.14	0.14–0.18	0.14	0.16–0.17	0.10	0.14–0.15
FEMORA III	0.80–0.82	0.95–0.97	1.07–1.25	0.87–0.90	1.25–1.35	0.72–0.74	1.20–1.30
TIBIA III	1.30–1.42	1.65–1.72	2.05–2.37	1.65–1.70	2.17–2.45	1.20–1.22	2.20–2.40
HT II	0.15–0.16	0.18–0.19	0.16–0.18	0.14–0.15	0.17–0.21	0.15–0.16	0.14–0.20

Table 2Measurements (in mm) of main characters of males of the genus *Drepanosiphum*.

Character	<i>D. acerinum</i> n=3	<i>D. aceris</i> n=3	<i>D. braggii</i> n=2	<i>D. dixonii</i> n=1	<i>D. iranikum</i> n=4	<i>D. oregonensis</i> n=2	<i>D. platanoidis</i> n=10
BL	2.10–2.50	2.37–3.00	2.55–2.90	2.5	2.70–3.50	2.55–2.67	2.67–3.55
BW	0.75–0.72	0.95–1.00	0.75–0.82	1.00	0.75–1.02	0.75–0.80	1.00–1.10
HW	0.51–0.55	0.50–0.64	0.62–0.63	0.60	0.64–0.70	0.56–0.59	0.60–0.71
ANT	3.92–4.25	4.92–5.42	4.82–5.08	5.02–5.16	4.08–4.99	3.53–3.81	3.74–4.75
ANT III	1.02–1.20	1.27–1.32	1.10–1.12	1.32–1.35	1.52–1.62	0.95–1.01	1.00–1.45
ANT IV	0.70–0.87	1.05–1.15	0.90–0.95	1.02–1.05	1.05–1.20	0.71–0.72	0.80–1.07
ANT V	0.74–0.81	1.01–1.02	0.94–1.00	1.02–1.07	0.91–1.05	0.65–0.73	0.69–1.02
ANT VI	1.26	1.34–1.66	1.59–1.70	1.41–1.42	0.94–1.03	1.05–1.16	0.94–1.27
BASE	0.14	0.14	0.14–0.15	0.15–0.16	0.13–0.17	0.13–0.14	0.11–0.16
PT	1.12	1.20–1.52	1.45–1.55	1.25–1.27	0.79–0.90	0.92–1.02	0.82–1.12
ARS	0.09–0.10	0.14–0.15	0.14	0.14	0.15–0.16	0.10	0.13–0.15
FEMORA III	0.82–0.85	0.12–0.17	0.95–1.00	1.07–1.08	0.15–0.32	0.80–0.85	0.90–1.10
TIBIA III	1.45–1.60	2.27–2.50	1.95–2.12	1.20–2.00	2.20–2.35	1.52–1.57	1.90–2.15
HT II	0.13–0.14	0.14–0.15	0.16	0.14–0.15	0.16–0.18	0.15–0.16	0.17–0.19

Table 3Measurements (in mm) of main characters of viviparous females of *Drepanosiphum latifemorum* sp. n.

Character	<i>Drepanosiphum latifemorum</i> sp. n. (n=8)							
BL	3.15	2.96	2.90	2.67	2.55	2.48	3.21	2.40
BW	1.25	1.20	1.25	0.80	0.95	0.98	1.25	1.00
ANT	3.51	4.01	3.82	3.98	4.02	3.42	4.12	4.00
ANT III	1.20	1.13	1.20	1.20	1.16	1.05	1.08	1.24
ANT IV	0.94	0.89	0.81	0.95	0.85	0.73	0.86	0.95
ANT V	0.79	0.74	0.72	0.76	0.72	0.60	0.80	0.78
BASE	0.15	0.15	0.14	0.14	0.15	0.13	0.14	0.16
PT	0.76	0.89	0.95	0.75	0.80	0.75	0.95	0.75
ARS	0.13	0.12	0.12	0.13	0.12	0.13	0.13	0.12
FEMORA IL	1.05	1.00	0.90	0.97	0.95	0.85	1.00	1.00
FEMORA IV	0.21	0.20	0.21	0.20	0.20	0.20	0.20	0.20
FEMORA IIL	0.80	0.74	0.75	0.74	0.62	0.82	0.70	0.75
FEMORA IIW	0.14	0.13	0.14	0.13	0.12	0.12	0.13	0.13
FEMORA IIIL	1.00	0.90	0.95	0.87	0.87	0.85	0.92	0.87
TIBIA III	1.95	1.82	1.82	1.80	1.65	1.50	1.75	1.67
HT II	0.16	0.15	0.13	0.16	0.15	0.10	0.15	0.15
Siphunculus	0.79	0.72	0.77	0.64	0.70	0.62	0.74	0.75
Fore wings L	4.00	4.12	3.90	3.75	3.62	3.25	4.00	3.75
Fore wings W	1.35	1.35	1.25	1.20	1.15	1.00	1.40	1.17

the parthenogenetic generation consists solely of winged females that have a similar morphology, representatives from this genus are considered to be difficult to determine and the status of some species is questionable. In particular, [Blackman and Eastop \(1994\)](#) treated *D. caucasicum* and *D. iranikum* as good species based on the morphological characters and the different host relationship. In contrast, according to [Remaudière and Remaudière \(1997\)](#), *D. caucasicum* is a synonym of *D. acerinum* whereas *D. iranikum*, which was originally described as a subspecies of *D. platanoidis*, is its synonym. (2) Therefore, the second aim of this paper is the discussion of the status of mentioned taxa, which is based on a reinvestigation of the

type material of *D. caucasicum* and *D. iranikum*. We also present and illustrate the main diagnostic characters of the winged viviparous females of all of the known species of the genus. (3) Finally, based on the comparative study of winged viviparous females of the genus *Drepanosiphum*, a new species *Drepanosiphum latifemorum* sp. n., which was collected in Morocco, is described and illustrated in detail and an identification key to all of the species that belong to this genus is provided.

This paper is the third (after revision of the genera *Shenahweum* Hottes & Frison ([Wieczorek et al., 2013](#)) and *Drepanosiphoniella* Davatchi, Hille Ris Lambers & Remaudière ([Wieczorek et al., 2015](#)))

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