Cytological and morphological differences within Palaearctic Glyphina (Homoptera: Aphididae), and their taxonomic significance

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ABSTRACT. Karyotype variation within the genus Glyphina in Europe is described and correlated with morphological differences. G. pseudo-schrankiana sp. nov., on Betula pubescens in Europe and Japan, is separated from G. schrankiana Börner, on Alnus spp. in northern and central Europe, on the basis of differences in karyotype and morphology. G. jacutensis Mordvilko is synonymized with G. schrankiana. A key is provided to Palaearctic members of the genus.

Introduction

Glyphina is a small genus of birch- and alder-feeding aphids, with four species currently recognized: two in Europe and Asia, and two in North America. The two European species, G. betulac (L.) and G. schrankiana Börner, were thought to be difficult to tell apart until Szelegiewicz (1982) pointed out that the problem of distinguishing between them had been compounded by the supposition that each species was confined to a particular plant genus. According to Szelegiewicz, the apterous viviparous of G. betulac live only on Betula spp., and have a warty (denticulate) ornamentation of the dorsal cuticle, whereas those of G. schrankiana live on Alnus spp. but can also occur on Betula pubescens, and have a dorsal ornamentation composed of short wrinkles or incomplete reticulations. Szelegiewicz also noted that G. betulac has fewer and shorter hairs on the antennae and abdominal tergites than G. schrankiana, and its alatae have fewer secondary rhinaria on the third antennal segment.

Blackman (1980) noted a difference in chromosome number in European Glyphina. A population from Betula in Britain had 2n(male)=55, whereas Kuznetsova & Shaposhnikov (1973) had reported 2n(female)=10 for samples from both Betula and Alnus in the U.S.S.R. The aphids karyotyped as 2n=55 ran to G. betulac in Szelegiewicz's key, and it therefore seemed likely that both the 2n=10 samples examined by Kuznetsova & Shaposhnikov were G. schrankiana.

With the acquisition and karyotyping of more samples, however, it has become apparent that the situation is more complex, both cytologically and taxonomically.

Karyotypes

Four different karyotypes have now been found in European Glyphina (Fig. 1).

2n(female)=8. Two populations, one from Alnus incana in Rumania (coll. A. Czyluk, June 1984), and the other from A. glutinosa in Lithuania (coll. R. Rakauskas, May 1986), were found to have 2n=8 in female somatic cells (Fig. 1a). In prophase and prometaphase cells there often appeared to be two additional, dot-like chromosomes (Fig. 1b). This is because the X chromosomes have subterminal nucleolar organizing regions (NORs), and a terminal fragment

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of the X becomes separated from the remainder by the nucleolus in prophase cells.

2n(female)=10. Populations with this karyotype have so far been found in south-east England at Kew Gardens and Twickenham, London, in both cases on unidentified Betula spp. (not pendula), and at Jälla, Sweden, on B. pubescens. Two pairs of short, dot-like chromosomes are present, which seem too short to be equivalent in DNA content to one of the longer chromosomes of the 2n=8 form (Fig. 1c). Therefore the difference cannot be attributable to a single dissociation or fusion event, as is often the case when two closely related aphid species have different chromosome numbers (Blackman, 1980), but must be due to some more complex rearrangement. The X chromosomes have a similarly-placed NOR to those of the 2n=8 form, so that cells in prophase usually appear to have twelve separate elements, with three pairs of dot-like chromosomes.

Male embryos with an unpaired X chromosome (2n=9) were found in viviparous collected in June, and stages of spermatogenesis were obtained from preparations of the testes of immature males collected in July. Metaphase I spermatocytes had four bivalents and one univalent, the unpaired X chromosome (Fig. 1d).

2n(female)=56. Four samples with this karyotype have been obtained, all from B. pendula. Two were from England (Barnham Beeches, Bucks., coll. V. F. Eastop, July 1975; and Bewdley, Worecs., coll. M. W. Robinson, June 1985), and two from Lithuania (coll. R. Rakauskas, at Vilnius, May 1986; and at Povociai, August 1986). Males have 2n=55, with a single X chromosome. The 54 autosomes, presumably 27 pairs, were all dot-like and very small (Fig. 1f). Prophase cells revealed an unusual feature of the X chromosome: as in 2n=8 and 2n=10 forms, the nucleolar organizer region was not terminal, but in this case there were two NORs, placed equidistant from each end of the X chromosome (Fig. 1g).

2n(female)=28. A population from Betula pendula at Katowice, Poland (coll. A. Czylok, July 1984), was found to have male embryos with 2n=27, comprising 26 dot-like autosomes (presumably 13 pairs), and one long unpaired chromosome (Fig. 1e). Female somatic cells were not seen but presumably have 2n=8 with a pair of Xs. The long X chromosome has two NORs and is similar to that of the 2n=56 form.

**Morphology**

Morphological characters of apterous viviparous from karyotyped samples are compared in Table...
<table>
<thead>
<tr>
<th>Collection locality</th>
<th>Date</th>
<th>2n (female)</th>
<th>Dorsal ornamentation</th>
<th>Body length (mm)</th>
<th>Lengths of antennal segs (mean of two sides in mm)</th>
<th>Last tarsal seg. (meas. of two sides in mm)</th>
<th>Hind femur (mm)</th>
<th>Hair lengths (in µm) on:</th>
<th>Hair numbers on:</th>
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</thead>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>III</td>
<td>IV</td>
<td>V</td>
<td>Base</td>
<td>p.t.</td>
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<tr>
<td>8 Georgeni, Rumania</td>
<td>23.v.84</td>
<td>1.75</td>
<td>0.275</td>
<td>0.0     103.0</td>
<td>0.400</td>
<td>0.174</td>
<td>0.142</td>
<td>42</td>
<td>47</td>
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<td>27.v.84</td>
<td>1.79</td>
<td>0.306</td>
<td>0.127</td>
<td>0.041</td>
<td>0.175</td>
<td>0.149</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>8</td>
<td>11.v.84</td>
<td>1.78</td>
<td>0.264</td>
<td>0.119</td>
<td>0.041</td>
<td>0.164</td>
<td>0.142</td>
<td>48</td>
<td>52</td>
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<tr>
<td>8</td>
<td>28.v.87</td>
<td>1.68</td>
<td>0.240</td>
<td>0.197</td>
<td>0.037</td>
<td>0.157</td>
<td>0.134</td>
<td>44</td>
<td>52</td>
</tr>
<tr>
<td>8</td>
<td>28.v.84</td>
<td>1.69</td>
<td>0.254</td>
<td>0.193</td>
<td>0.037</td>
<td>0.187</td>
<td>0.126</td>
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<td>53</td>
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<tr>
<td>8</td>
<td>28.v.75</td>
<td>1.66</td>
<td>0.235</td>
<td>0.109</td>
<td>0.030</td>
<td>0.170</td>
<td>0.147</td>
<td>51</td>
<td>45</td>
</tr>
<tr>
<td>8</td>
<td>27.v.86</td>
<td>1.65</td>
<td>0.199</td>
<td>0.086</td>
<td>0.022</td>
<td>0.170</td>
<td>0.134</td>
<td>46</td>
<td>39</td>
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<tr>
<td>8</td>
<td>56</td>
<td>1.51</td>
<td>0.153</td>
<td>0.108</td>
<td>0.024</td>
<td>0.157</td>
<td>0.122</td>
<td>40</td>
<td>37</td>
</tr>
</tbody>
</table>

**Nomenclature**

*Gephyra schachani* Borkhaus is a replacement name for *Aphydra* sp. Schaub (see *Aphydra* de Geer), and should therefore be applied to an undescribed species, i.e., the 2n = 8 aphid. Another undescribed species, *Gephyra* sp., was described by Blackman (1927). The original description of *Gephyra* sp. is based on the following specimen: 1879, May, E. Africa. *Gephyra* sp. is a new species, and Blackman's 1927 voucher is a new species, *Gephyra* sp. (see above). The taxonomic separation of *Gephyra* sp. is based on the following specimen: 1897, May, E. Africa. *Gephyra* sp. is a new species, and Blackman's 1927 voucher is a new species, *Gephyra* sp. (see above).

**Polycaric Glypha**

1. Specimen with 2n = 8 and 2n = 10 have a predominantly warty and clavate, and 2n = 50, have a predominantly warty and clavate. According to the conception of *Gephyra* from the S. of A. sample, the 2n = 8 specimens were not possible to find any consistent morphological differences, as well as all other examined differences (see below) confirmed that the 2n = 8 form of *Gephyra* form the 8 segments from the 2n = 8 sample. Although the 2n = 8 samples were not possible to find any consistent morphological differences, as well as all other examined differences (see below) confirmed that the 2n = 8 form of *Gephyra* form the 8 segments from the 2n = 8 sample.
name is *G. jacutensis* Mordvilko (1931), the host plant of which is unknown. Mordvilko's description of this aphid refers to flat warty glands on the sides of the body, but no mention is made of their presence dorsally. Such structures are present all over the dorsum in *G. betulae*, and only on the sides of the thorax and abdomen in *G. schrankiana*. In the 2n=10 species they are absent, except sometimes on the head and thorax (see below). *G. jacutensis* can therefore be regarded as a synonym of *G. schrankiana* syn.n., and a new name is required for the 2n=10 species.

**Glyphina pseudoschrankiana** sp.nov. (Figs 3a, 3c, 3e)

Appearance in life. Adult aptera black with variably developed white markings, immature stages brown. Colonies are on young growing shoots, often on young trees, attended by ants.

Apterous virginopar. Mounted specimens in many respects resemble *G. schrankiana*, but have the following distinguishing characters:

Antennae with rather stout-based hairs which are almost parallel-sided for most of their length and taper abruptly to a point, like those on head and sides of body (Fig. 3a). (Antennal hairs of *G. schrankiana* are finer than body hairs, similar to tibial hairs, tapering gradually from the base and often with finely attenuate apices; Fig. 3b.) Third antennal segment dusky, only a little paler than other segments, whereas in *G. schrankiana* it is much paler and often contrasts markedly with the dark first, second, fourth and fifth segments. Base of fifth antennal segment relatively longer than in *G. schrankiana* (see Table 2), 1.00–1.29 times longer than second segment of hind tarsus (in *G. schrankiana* 0.71–1.00 times). Ultimate rostral segment relatively longer than in *G. schrankiana*; 1.11–1.51 times longer than second segment of hind tarsus (1.04–1.26 times longer in *G. schrankiana*). Second segment of hind tarsus relatively shorter than in *G. schrankiana*.

Ter gites sclerotized, pigmented, adorned with irregular wrinkles, more extensive and forming a partial reticulation in pleural areas; this sculpturing similar to that of *G. schrankiana*, but not...
becoming warty or denticulate on lateral and ventrolateral areas of the meso- and metathorax and abdomen, as is the tendency in that species (Figs 2a, b). The differences in cuticular sculpturing between the two species around the siphunculus are especially distinctive (Figs 3c, d). The only areas of denticulate ornamentation in *G. pseudoschrankiana* are on the head and prothorax.

Dorsal abdominal hairs rather thick, 52–75 µm long, a little longer than those of *schrankiana* (35–53 µm), and occasionally bifurcate, with the bifurcation sometimes quite near the base (Fig. 3e).

*Alate virginopara.* Very similar to *G. schrankiana*, but with more rhinaria on third antennal segment (8–9, compared with 4–7 in *G. schrankiana*), and similar differences in the relative lengths of base of fifth antennal segment, last segment of rostrum and second segment of hind tarsus to those noted for the apterous virginopara (Table 2). Dorsal abdominal sclerites are

<table>
<thead>
<tr>
<th>Table 2. Biometric comparison of <em>Glyphina pseudoschrankiana</em> sp.n. and <em>G. schrankiana</em> (all measurements in mm).</th>
</tr>
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<tr>
<td><strong>APTERAE:</strong> no. of specimens</td>
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<tr>
<td>Length of base of fifth antennal segment</td>
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<tr>
<td>Length of last rostral segment</td>
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<td>Length of second segment of hind tarsus</td>
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<td><strong>ALATAE:</strong> no. of specimens</td>
</tr>
<tr>
<td>Length of base of fifth antennal segment</td>
</tr>
<tr>
<td>Length of last rostral segment</td>
</tr>
<tr>
<td>Length of second segment of hind tarsus</td>
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</table>
mostly separate, showing less tendency to form transverse bars across the midline than in G. schrankiana.

Apterous ovipara. Appearance in life unknown; macerated specimens much less pigmented than apterous virginopara, but with the same pattern of dorsal ornamentation (wrinkles and some reticulation). Smaller than virginopara (body length 0.9–1.2 mm) and with much shorter legs, the hind tibiae not swollen and lacking discernible scent glands. Other characters as in apterous virginopara. Oviparae of G. schrankiana were not available for comparison.

Apterous male. The single specimen available has body length 1.07 mm, base of fifth antennal segment 0.109 mm, last rostral segment 0.138 mm, and second segment of hind tarsus 0.104 mm. Antennae, like those of G. betulae, lack secondary rhinaria. Dorsum with dark sclerotic transverse bands ornamented with wrinkles; very distinct from male G. betulae which have dorsal ornamentation comprising numerous small, almost circular warts. Males of schrankiana were not available for comparison.

Material examined

Type material. (Type status is reserved for karyotyped material.) HOLOTYPE. Apterous viviparous female, ENGLAND: London, Twickenham, from Betula sp., 8.vi.85 (Polaszek), RLB no.3326; embryos karyotyped as 2n=9 (male). PARATYPES. 39 apterous and 3 alate viviparae plus immatures, same collection data, karyotype (of embryos) and number as holotype; 5 apterae plus immatures, Betula sp., Surrey, Kew Gardens, 11.vii.84 (Polaszek), RLB no.3817. Paratype apterae have been sent to: Zoological Institute, Academy of Sciences, Leningrad; Academy of Sciences, Prague; Institut Pasteur, Paris; Zoological Institute, Lund, Sweden; collection of O. E. Heie, Copenhagen. Holotype and remaining paratypes in British Museum (Natural History).

Other material examined. JAPAN: Mount Teine, Hokkaido, 30.vii.80, Betula sp., 12 apterous viviparae + immatures. ENGLAND: Surrey, Elstead, 22.v.65, Betula sp., 4 apterae; same locality, 15.vi.65, Betula sp., 6 apterae; same locality, 21.vi.65, 5 apterae + 1 alata; Bedfordshire, Luton, 12.vi.70, B. pubescens, 6 apterae + immatures; Surrey, Kew Gardens, 23.vi.63, B. pumila, 1 alata; same locality, 3.vii.66, Betula sp., 34 apterae, 15 oviparae, 1 male; same locality, 2.viii.62, Betula sp., 3 apterae; same locality, 26.viii.62, B. pumila (with Lasius niger), 12 apterae + many immatures.

Key to palaeartic Glyphina species

1 Apterous viviparae ...........................................2
   – Alate viviparae...........................................4
2 Dorsal cuticle densely ornamented with numerous small warts or denticles, of irregular shape but often more-or-less circular. In life dark green to almost black with a pale spinal stripe, immatures green. On Betula spp., especially B. pendula, and occasionally on Alnus spp. Europe............. betulae
   – Dorsal abdominal cuticle with numerous short wrinkles, sometimes extending into a partial reticulation; closed 'warts' only ever present on head and thorax and on lateral and ventrolateral regions of abdomen ...........................................3
3 Base of fifth antennal segment longer (1.0–1.3 times) than second segment of hind tarsus. Hairs on third abdominal tergite longer than 50 μm. In life black with white markings, immatures brown. On Betula spp., especially B. pubescens and related 'downy' species (not on B. pendula). N.W. Europe and Japan................. pseudoschrankiana
   – Base of fifth antennal segment shorter (0.7–1.0 times) than second segment of hind tarsus. Hairs on third abdominal tergite shorter than 50 μm. In life brown, immatures pale brown. On Alnus spp. (A. incana, A. glandulosa) in central and northern Europe (not recorded from U.K.) ........ schrankiana
4 Third antennal segment with 8–15 hairs, but rarely with more than 12 on both antennae of the same individual .................................................... betulae
   – Third antennal segment with 13–23 hairs..............5
5 Third antennal segment with 8–9 rhinaria. Base of fifth antennal segment 1.1–1.3 times longer than second segment of hind tarsus, which is 0.73–0.79 of length of last segment of rostrum pseudoschrankiana
   – Third antennal segment with 4–7 rhinaria. Base of fifth antennal segment 0.8–1.0 times as long as second segment of hind tarsus, which is 0.78–0.95 of length of last segment of rostrum schrankiana

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References


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