

**Morphometric analysis of European species of the genus *Aphis*
(Sternorrhyncha: Aphididae) inhabiting *Ribes***

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Abstract. A review of the literary data on the life cycles and host plant relationships of *Aphis grossulariae* Kaltenbach, *A. schneideri* (Börner) and *A. triglochinis* Theobald is presented. Morphometric analysis of the three species revealed insufficient discriminative value of the majority of characters commonly used in the keys. A modified key to fundatrices, apterous and alate viviparous females, gynoparous and oviparous females and males is presented.

INTRODUCTION

There are four species of the genus *Aphis* L. inhabiting currants and gooseberries (*Ribes* spp.) in the Palaearctic. *Aphis grossulariae* Kaltenbach, 1843 and *Aphis schneideri* (Börner, 1940) are well-known pests; *Aphis triglochinis* Theobald, 1926 is also not rare, at least in Europe (Blackman & Eastop, 1984; Heie, 1986; etc.). *Aphis popovi* Mordvilko, 1932 is a Siberian species, closely related to *A. schneideri*; its entire life cycle is not yet known (Rakauskas, 1996). *Aphis varians* Patch, 1914 is a Nearctic species (Robinson & Rojanavongse, 1976; Blackman & Eastop, 1984; etc.); Palaearctic references of this species (Shaposhnikov, 1964; Vereshchagina & Vereshchagin, 1969; Ivanovskaya, 1978; etc.) refer to *A. triglochinis* (Rupais, 1989; Rakauskas, 1993). *Aphis octotuberculata* Mamontova, 1955 is treated as younger synonym of *A. schneideri* (Eastop & Hille Ris Lambers, 1976).

References concerning life cycles and host plant relationships of the above mentioned species (even the pests) are rather controversial. The holocyclic species *A. grossulariae* is sometimes referred to as monoecious on *Ribes* spp. (Gusynina, 1963; Savzdarg & Ponomareva, 1978; etc.), and in other cases as obligatorily (Ossiannilsson, 1959; Stroyan, 1984; Heie, 1986; etc.) or facultatively (Heikinheimo, 1952; Karczewska, 1979; etc.) heteroecious between *Ribes* spp. and Onagraceae hosts (mainly *Epilobium* spp.). Some students exclude black currants (Gusynina, 1963; Karczewska, 1979; Blackman & Eastop, 1984; etc.) and red currants (Karczewska, 1979; Babenko, 1982) from the list of winter hosts of *A. grossulariae*. Hille Ris Lambers & Dicker (1965) and Stroyan (1984) indicate only red currants as winter hosts for *A. triglochinis*, while Gusynina (1963) and Babenko (1982) indicate only black currants. There are references excluding gooseberry (Börner & Heinze, 1957; Gusynina, 1963; Heie, 1986; etc.) and red currants (Karczewska, 1979; Rupais, 1989; etc.) from the winter hosts of *A. schneideri*. One of the possible explanations concerns diagnostic problems (Stroyan, 1984: 104; Blackman & Eastop, 1984: 234). The

aim of this study is to perform a morphometric analysis of the three common European species of the genus *Aphis* L. inhabiting *Ribes*: *A. grossulariae*, *A. schneideri*, and *A. triglochinis*.

MATERIAL AND METHODS

Thirty-two clones of three species of *Aphis* originating from Lithuania and Poland were used for field experiments in 1978–1989, each clone starting from the single fundatrix or fundatrigenia of the first generation. These experiments have been performed with the aim of studying the bionomics of European *Ribes*-inhabiting *Aphis* species. The list of clones and rearing methods have been published earlier (Rakauskas, 1993). The aphid material from the above mentioned study from different winter and summer hosts was used for obtaining morphometric data of various morphs for three species: *A. grossulariae* (holocyclic facultatively heteroecious between *Ribes* spp. and Onagraceae), *A. triglochinis* (holocyclic obligatorily heteroecious between *Ribes* spp. and various Brassicaceae, Boraginaceae and Asteraceae) and *A. schneideri* (holocyclic monoecious on *Ribes* spp.). Thirty morphological characters were measured or counted, preferably those commonly used in the keys. Measured were: length of antenna (abbreviated in the text as ant); length of antennal segments III, IV, and V (antIII, IV, V); articular width of antennal segment III (awantIII); lengths of the basal parts of antennal segments V (for fundatrices and oviparae) or VI (for other morphs) (baseV, VI); body including cauda; cauda; hind tibia; longest hair on antennal segment III (lhantIII); processus terminalis on antennal segments V (for fundatrices and oviparae) or VI (for other morphs) (prtV, VI); siphunculus (siphon); second segment of hind tarsus (tarsII); apical rostral segment (urs); and maximum width of antennal segment III (wantIII). Counted were: hairs on antennal segment III; hairs on cauda; hairs on abdominal segment VIII (tergum) (htergVIII); additional hairs on the apical rostral segment (hurs); marginal tubercles on abdominal segments II–VI (mtII–VI); marginal tubercles on abdominal segments I–VII; secondary rhinaria on antennal segments III, IV, V, and VI (rhantIII, IV, V, VI); and scent plaques on hind tibia of oviparae (sptibi). Percentages were calculated of: “grossularious” marginal tubercles (having basal width less than height) on abdominal segments I–VII; “schneiderious” marginal tubercles (having basal width not less than height) on abdominal segments I–VII; semi-erect hairs on antennal segment III; semi-recumbent hairs on antennal segment III. Many of the measured or counted characters are illustrated by Brown (1989).

Twenty-five ratios were calculated from these variables: antIII/lhantIII; antIII/prtV(VI); antIII/urs; ant/body; ant/lhantIII; lhantIII/awantIII; lhantIII/tarsII; lhantIII/wantIII; prtV(VI)/baseV(VI); prtV(VI)/body; prtV(VI)/lhantIII; rhantIII/hurs; rhantV/rhantIII; siphon/antIII; siphon/body; siphon/cauda; siphon/lhantIII; siphon/tarsII; siphon/prtV(VI); urs/cauda; urs/lhantIII; urs/tarsII; antIII/lhantIII : urs/tarsII; antIII/prtV(VI) : lhantIII/tarsII; lhantIII/wantIII : antIII/prtV(VI).

Descriptive statistics and correlation analyses were performed by the STATSOFT computer programme STATISTICA for WINDOWS, release 4.5.

RESULTS

Information on the morphological characters that are commonly used in the keys is summarized in Table 1. It is concluded that *A. triglochinis* is distinctly different morphologically from the other two species. Hurs is a good character for the separation of all morphs, although it may be confusing when discriminating between apterous viviparous females. Namely, hurs in *A. grossulariae* apterae is 4–11, while in *A. triglochinis* the range is 2–4 (Table 1). On the other hand, hurs is not usually visible in microscope slides, especially in alatae, when the rostrum is located beneath the highly sclerotised thorax. Additional characters discriminating *A. triglochinis* are htergVIII (for fundatrices), antIII/prtVI (for apterae), rhantIII, lhantIII/wantIII, (for alatae), rhantIII, rhantIV, lhantIII/wantIII, lhantIII/awantIII, siphon/body, urs/tarsII, antIII/prtVI, prtVI/baseVI, siphon/antIII, (for gynoparae), urs/tarsII, antIII/prtVI, siphon/antIII, mtII–VI (for males).

Another interesting conclusion from Table 1 is that none of the quantitative characters widely used in the keys is sufficient for correct discrimination between *A. schneideri* and *A. grossulariae*. There are, however, two qualitative characters for discriminating between *A. schneideri* and *A. grossulariae* that are sometimes used in the keys. The first is the antennal hairs (Gusynina, 1963; Blackman & Eastop, 1984; Stroyan, 1984; etc.): in *A. schneideri* on antennal segment III they are erect and very finely produced at the apex (Fig. 2), while those in *A. grossulariae* are semi-recumbent and abruptly tapering at the apex (Fig. 1). As can be seen from Table 1, semi-erect hairs can be present in *A. grossulariae*, and semi-recumbent in *A. schneideri*. There can be finely produced antennal hairs in *A. grossulariae* (Fig. 3), and relatively abruptly tapering hairs in *A. schneideri* (Fig. 4). The second character is the shape of the marginal tubercles (Shaposhnikov, 1964; etc.). In *A. schneideri*, their height usually does not exceed their basal width, as it is characteristic for *A. grossulariae*. Concerning this character, fundatrices of *A. grossulariae* may have 83–100% of *schneideri*-shaped tubercles on abdominal segments I–VII (Table 1). Generally, it would be better not to rely on any single morphological character when discriminating between *A. schneideri* and *A. grossulariae*.

TABLE 1. Key morphological characters of the Palaearctic species of the genus *Aphis* inhabiting *Ribes*, showing the number of the measured specimens, extreme values and mean in parentheses.

	<i>A. grossulariae</i>	<i>A. schneideri</i>	<i>A. triglochinis</i>
longest hair on antennal segment III / maximum width of antennal segment III			
fundatrices	19: 0.643–1.250 (0.88)	20: 1.000–1.767 (1.36)	20: 0.447–0.926 (0.70)
apterae I	105: 0.625–1.313 (0.91)	111: 1.273–2.000 (1.63)	56: 0.455–0.970 (0.64)
alatae I	100: 0.714–1.250 (0.90)	99: 1.119–2.030 (1.59)	37: 0.405–0.684 (0.51)
apterae II	20: 0.783–1.143 (0.89)	–	30: 0.480–1.000 (0.63)
alatae II	19: 0.714–1.152 (0.90)	–	31: 0.310–0.658 (0.44)
gynoparae	22: 0.667–1.121 (0.90)	–	20: 0.362–0.581 (0.46)
oviparae	21: 0.500–0.900 (0.74)	50: 0.964–1.818 (1.37)	20: 0.500–0.773 (0.61)
males	20: 0.667–1.088 (0.78)	13: 1.065–1.786 (1.44)	20: 0.468–0.676 (0.54)
longest hair on antennal segment III / articular width of antennal segment III			
fundatrices	19: 0.952–1.522 (1.18)	20: 1.429–2.938 (1.95)	20: 0.600–1.100 (0.89)
apterae I	106: 0.870–1.826 (1.24)	107: 1.727–3.100 (2.32)	38: 0.600–1.280 (0.88)
alatae I	100: 1.000–1.947 (1.39)	64: 1.826–3.043 (2.50)	20: 0.696–1.150 (0.84)
apterae II	19: 1.000–1.600 (1.27)	–	25: 0.106–1.000 (0.75)
alatae II	20: 1.167–1.947 (1.46)	–	25: 0.520–1.087 (0.79)
gynoparae	22: 1.111–1.750 (1.50)	–	14: 0.100–0.880 (0.77)
oviparae	21: 0.667–1.364 (1.10)	50: 1.89–2.500 (1.93)	18: 0.611–1.000 (0.81)
males	18: 1.174–1.650 (1.33)	10: 1.870–2.500 (2.28)	13: 0.800–1.150 (1.00)
siphunculus length / body length			
fundatrices	18: 0.103–0.148 (0.12)	20: 0.082–0.110 (0.09)	19: 0.079–0.107 (0.09)
apterae I	105: 0.124–0.246 (0.18)	111: 0.090–0.164 (0.13)	54: 0.092–0.160 (0.12)
alatae I	100: 0.124–0.249 (0.15)	101: 0.082–0.135 (0.11)	37: 0.079–0.140 (0.10)
apterae II	20: 0.139–0.220 (0.17)	–	28: 0.081–0.135 (0.10)
alatae II	19: 0.117–0.179 (0.14)	–	31: 0.064–0.110 (0.09)
gynoparae	22: 0.114–0.155 (0.13)	–	20: 0.081–0.112 (0.09)
oviparae	21: 0.067–0.116 (0.09)	48: 0.064–0.114 (0.08)	20: 0.047–0.074 (0.06)
males	20: 0.087–0.121 (0.11)	13: 0.063–0.097 (0.08)	20: 0.061–0.084 (0.07)

TABLE 1 (continued).

Morph	<i>A. grossulariae</i>	<i>A. schneideri</i>	<i>A. triglochinis</i>
siphunculus length / processus terminalis length			
fundatrices	18: 1.504–2.182 (1.73)	20: 1.236–2.500 (1.61)	19: 1.828–2.614 (2.08)
apterae I	106: 0.741–1.623 (1.40)	107: 0.793–1.478 (1.15)	55: 1.144–1.911 (1.55)
alatae I	98: 0.619–1.450 (0.83)	96: 0.591–0.988 (0.79)	37: 0.725–1.318 (1.05)
apterae II	19: 0.888–1.240 (1.11)	–	29: 0.764–1.513 (1.04)
alatae II	17: 0.596–0.978 (0.73)	–	31: 0.550–1.055 (0.77)
gynoparae	21: 0.575–0.741 (0.66)	–	20: 0.675–1.000 (0.87)
oviparae	19: 0.588–0.787 (0.71)	45: 0.585–0.960 (0.74)	20: 0.750–1.205 (0.95)
males	17: 0.368–0.534 (0.44)	13: 0.437–0.616 (0.52)	20: 0.454–0.610 (0.51)
apical rostral segment length / hind tarsal segment II length			
fundatrices	17: 1.400–1.633 (1.49)	17: 1.330–1.667 (1.49)	19: 1.170–1.379 (1.32)
apterae I	96: 1.416–1.807 (1.58)	101: 1.280–1.700 (1.46)	54: 1.137–1.400 (1.26)
alatae I	93: 1.330–1.985 (1.52)	98: 1.209–1.633 (1.39)	33: 0.973–1.270 (1.16)
apterae II	19: 1.430–1.663 (1.51)	–	28: 1.183–1.345 (1.26)
alatae II	18: 1.367–1.613 (1.46)	–	31: 0.936–1.690 (1.20)
gynoparae	19: 1.400–1.663 (1.50)	–	18: 1.064–1.233 (1.16)
oviparae	19: 1.446–1.746 (1.57)	44: 1.258–1.663 (1.47)	20: 1.137–1.375 (1.25)
males	20: 1.366–1.529 (1.43)	13: 1.323–1.563 (1.44)	19: 1.030–1.267 (1.17)
number of secondary rhinaria on antennal segment III			
alatae I	99: 7–16 (12.13)	100: 5–19 (10.92)	37: 19–42 (32.11)
alatae II	18: 8–14 (10.83)	–	31: 24–44 (35.94)
gynoparae	22: 7–17 (11.73)	–	19: 42–59 (50.32)
males	20: 20–32 (26.50)	12: 3–11 (6.00)	20: 23–74 (56.90)
antennal segment III length / processus terminalis length			
fundatrices	16: 1.308–1.909 (1.66)	20: 1.193–2.213 (1.53)	20: 2.075–2.928 (2.35)
apterae I	85: 0.514–1.189 (0.91)	79: 0.578–1.034 (0.77)	55: 1.394–2.168 (1.80)
alatae I	97: 0.618–1.415 (0.84)	97: 0.736–1.245 (0.95)	36: 1.383–2.025 (1.71)
apterae II	10: 0.535–0.863 (0.72)	–	24: 1.103–1.933 (1.47)
alatae II	17: 0.629–1.032 (0.79)	–	31: 1.300–1.894 (1.62)
gynoparae	21: 0.631–0.850 (0.76)	–	20: 1.567–2.087 (1.75)
oviparae	19: 0.718–1.054 (0.85)	8: 0.483–0.611 (0.54)	20: 1.427–2.162 (1.68)
males	17: 0.610–0.790 (0.70)	12: 0.644–0.963 (0.80)	20: 1.412–1.852 (1.62)
processus terminalis length / base of the ultimate antennal segment length			
fundatrices	19: 1.057–1.570 (1.32)	20: 1.020–1.354 (1.15)	20: 0.830–1.078 (0.99)
apterae I	100: 1.827–2.976 (2.27)	109: 1.458–2.443 (1.86)	55: 1.205–1.812 (1.43)
alatae I	96: 1.626–3.473 (2.58)	97: 1.650–2.593 (2.03)	37: 1.315–1.870 (1.54)
apterae II	19: 2.137–2.856 (2.53)	–	29: 1.300–1.670 (1.48)
alatae II	18: 2.314–3.370 (2.82)	–	31: 1.283–1.959 (1.65)
gynoparae	21: 2.441–3.608 (3.05)	–	20: 1.280–1.769 (1.56)
oviparae	19: 1.781–2.233 (1.95)	46: 1.250–2.043 (1.79)	20: 0.954–1.538 (1.20)
males	17: 2.727–3.579 (3.14)	13: 1.730–2.368 (1.96)	20: 1.485–2.050 (1.73)

TABLE 1 (continued).

Morph	<i>A. grossulariae</i>	<i>A. schneideri</i>	<i>A. triglochinis</i>
siphunculus length / cauda length			
fundatrices	18: 1.000–1.437 (1.24)	20: 0.826–1.275 (1.07)	19: 0.983–1.387 (1.14)
apterae I	105: 1.123–2.095 (1.65)	111: 0.982–1.485 (1.24)	54: 1.096–1.635 (1.31)
alatae I	100: 1.307–1.850 (1.53)	101: 0.828–1.497 (1.13)	37: 0.900–1.329 (1.17)
apterae II	20: 1.150–1.515 (1.37)	–	29: 0.699–1.329 (0.98)
alatae II	19: 1.144–1.694 (1.38)	–	31: 0.700–1.362 (0.91)
gynoparae	22: 1.225–1.557 (1.41)	–	20: 0.905–1.236 (1.08)
oviparae	21: 0.606–0.919 (0.73)	49: 0.654–1.308 (0.83)	19: 0.624–1.000 (0.82)
males	20: 1.136–1.617 (1.34)	13: 0.800–0.975 (0.88)	20: 0.909–1.268 (1.09)
number of additional hairs on apical rostral segment			
fundatrices	18: 5–7 (6.17)	19: 5–8 (6.11)	20: 2–2 (2.00)
apterae I	105: 4–11 (7.84)	109: 5–10 (7.06)	54: 2–4 (2.39)
alatae I	70: 6–13 (8.80)	60: 5–11 (6.88)	18: 2–3 (2.28)
apterae II	20: 6–8 (6.65)	–	27: 2–2 (2.00)
alatae II	12: 6–9 (7.25)	–	27: 2–2 (2.00)
gynoparae	15: 6–11 (8.20)	–	14: 2–3 (2.21)
oviparae	20: 5–9 (6.30)	45: 5–10 (7.09)	19: 2–2 (2.00)
males	13: 6–11 (7.85)	13: 7–11 (9.08)	14: 2–3 (2.14)
antennal length / body length			
fundatrices	19: 0.320–0.456 (0.37)	20: 0.256–0.401 (0.32)	20: 0.260–0.337 (0.29)
apterae I	100: 0.432–0.766 (0.55)	109: 0.329–0.565 (0.46)	53: 0.411–0.645 (0.48)
alatae I	99: 0.605–1.130 (0.71)	97: 0.475–0.732 (0.59)	37: 0.487–0.916 (0.61)
apterae II	19: 0.410–0.786 (0.56)	–	28: 0.440–0.604 (0.53)
alatae II	18: 0.591–0.875 (0.67)	–	31: 0.563–0.750 (0.65)
gynoparae	21: 0.614–0.798 (0.70)	–	20: 0.550–0.770 (0.63)
oviparae	20: 0.344–0.528 (0.41)	45: 0.325–0.493 (0.41)	20: 0.299–0.417 (0.34)
males	17: 0.757–0.914 (0.82)	13: 0.547–0.839 (0.67)	20: 0.734–0.915 (0.82)
number of hairs on cauda			
fundatrices	19: 8–16 (12.84)	20: 9–17 (13.20)	20: 10–13 (11.35)
apterae I	105: 6–22 (12.77)	113: 10–20 (14.79)	53: 6–14 (9.26)
alatae I	100: 9–18 (12.28)	102: 9–21 (13.98)	37: 5–13 (9.11)
apterae II	20: 8–14 (10.00)	–	27: 4–8 (5.85)
alatae II	20: 8–15 (10.50)	–	30: 5–10 (6.53)
gynoparae	22: 7–12 (9.36)	–	20: 6–10 (7.60)
oviparae	20: 8–15 (10.40)	49: 11–19 (15.02)	19: 7–10 (9.11)
males	19: 6–11 (8.26)	13: 10–15 (11.85)	18: 5–10 (6.56)
siphunculus length / antennal segment III length			
fundatrices	15: 0.921–1.271 (1.05)	20: 0.751–1.289 (1.07)	19: 0.753–1.000 (0.89)
apterae I	89: 1.174–1.735 (1.49)	78: 1.049–1.894 (1.51)	56: 0.651–1.176 (0.87)
alatae I	99: 0.808–1.203 (0.99)	100: 0.652–1.068 (0.84)	36: 0.478–0.748 (0.62)
apterae II	10: 1.244–1.766 (1.49)	–	25: 0.582–0.933 (0.72)
alatae II	17: 0.805–1.053 (0.94)	–	31: 0.317–0.597 (0.47)
gynoparae	22: 0.781–0.967 (0.87)	–	20: 0.399–0.561 (0.50)
oviparae	21: 0.679–1.000 (0.85)	8: 1.170–1.364 (1.26)	20: 0.474–0.680 (0.57)
males	20: 0.488–0.717 (0.63)	12: 0.571–0.759 (0.65)	20: 0.273–0.370 (0.32)

TABLE 1 (continued).

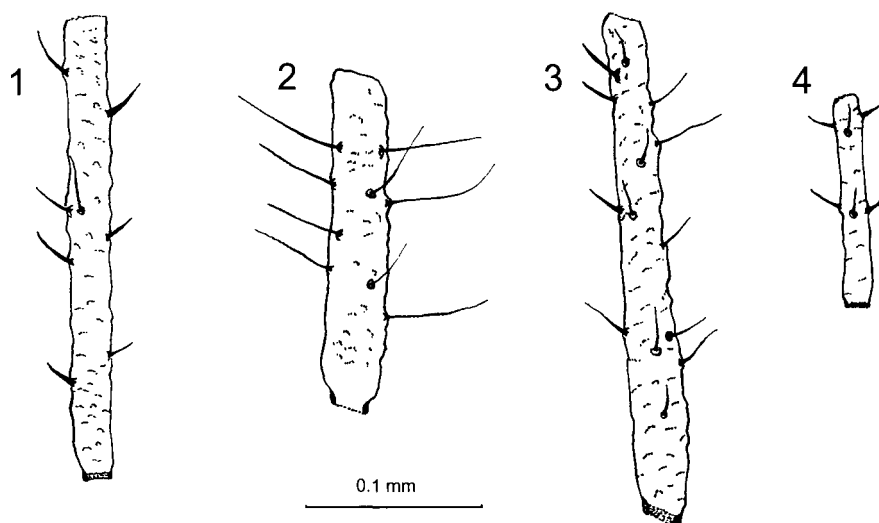
Morph	<i>A. grossulariae</i>	<i>A. schneideri</i>	<i>A. triglochinis</i>
number of hairs on abdominal segment VIII (tergum)			
fundatrices	19: 2–3 (2.47)	20: 2–2 (2.00)	17: 3–5 (3.88)
apterae I	105: 1–3 (2.06)	110: 2–4 (2.21)	53: 2–5 (2.93)
alatae I	100: 2–3 (2.04)	102: 2–4 (2.14)	36: 2–4 (2.75)
apterae II	20: 2–2 (2.00)	–	29: 2–5 (2.21)
alatae II	20: 2–2 (2.00)	–	30: 2–4 (2.20)
gynoparae	22: 2–4 (2.09)	–	20: 1–4 (2.30)
oviparae	21: 3–6 (5.10)	45: 3–5 (4.00)	19: 4–6 (4.73)
males	20: 2–2 (2.00)	13: 2–3 (2.23)	16: 2–3 (2.06)
number of marginal tubercles on abdominal segments II–VI			
fundatrices	18: 1–6 (3.722)	19: 1–10 (8.84)	18: 7–10 (9.17)
apterae I	101: 1–9 (4.90)	110: 5–10 (8.78)	53: 0–10 (2.79)
alatae I	94: 0–9 (4.87)	96: 0–10 (7.67)	36: 0–10 (3.53)
apterae II	20: 0–6 (2.65)	–	30: 0–0 (0)
alatae II	20: 0–8 (3.80)	–	28: 0–2 (0.11)
gynoparae	22: 0–8 (5.68)	–	20: 0–1 (0.05)
oviparae	21: 0–7 (2.38)	50: 7–10 (9.06)	20: 0–0 (0)
males	18: 3–10 (6.44)	13: 7–10 (8.69)	20: 0–1 (0.10)
percent of semi-erect hairs on antennal segment III			
fundatrices	16: 0.00–75.00 (36.88)	19: 33.33–100.00 (78.23)	
apterae I	103: 0.00–77.78 (30.90)	85: 37.50–100.00 (85.49)	
alatae I	100: 0.00–50.00 (7.64)	64: 12.50–100.00 (65.84)	
gynoparae	22: 0.00–50.00 (5.46)	–	
oviparae	21: 0.00–66.67 (12.62)	47: 50.00–100.00 (77.97)	
males	18: 0.00–30.77 (9.19)	10: 50.00–100.00 (79.57)	
percent of semi-recumbent hairs on antennal segment III			
fundatrices	16: 25.00–100.00 (63.13)	19: 0.00–66.67 (21.77)	
apterae I	103: 22.22–100.00 (69.10)	85: 0.00–100.00 (17.16)	
alatae I	100: 50.00–100.00 (92.36)	64: 0.00–87.50 (33.80)	
gynoparae	22: 50.00–100.00 (94.55)	–	
oviparae	21: 33.33–100.00 (87.38)	47: 0.00–50.00 (22.03)	
males	18: 69.23–100.00 (90.81)	10: 0.00–50.00 (20.43)	
% of <i>schneideri</i> -shaped marginal tubercles on abdominal segments I–VII			
fundatrices	18: 83.33–100.00 (98.46)	19: 84.62–100.00 (99.19)	
apterae I	93: 0.00–100.00 (84.67)	110: 60.00–100.00 (95.73)	
alatae I	76: 0.00–100.00 (40.36)	91: 50.00–100.00 (95.41)	
gynoparae	22: 11.11–100.00 (47.74)	–	
oviparae	21: 16.67–100.00 (82.66)	50: 57.14–100.00 (92.07)	
males	17: 42.86–100.00 (76.01)	12: 54.55–100.00 (78.01)	

TABLE 1 (continued).

Morph	<i>A. grossulariae</i>	<i>A. schneideri</i>	<i>A. triglochinis</i>
% of <i>grossulariae</i> -shaped marginal tubercles on abdominal segments I–VII			
fundatrices	18: 0.00–16.67 (1.543)	19: 0.00–15.39 (0.81)	
apterae I	93: 0.00–100.00 (15.33)	110: 0.00–40.00 (4.27)	
alatae I	76: 0.00–100.00 (59.64)	91: 0.00–50.00 (5.49)	
gynoparae	22: 0.00–88.89 (52.26)	–	
oviparae	21: 0.00–83.33 (17.34)	50: 0.00–42.86 (7.93)	
males	17: 0.00–57.14 (23.99)	12: 0.00–45.46 (21.49)	

Having recognized this, 23 additional characters were analyzed concerning their valuability to discriminate between *A. grossulariae* and *A. schneideri*. The most successful ones are presented in Table 2. The most promising character seems to be siphon/lhantIII, being effective for separation of fundatrices, apterae and alatae. Other valuable characters are antIII/lhantIII : urs/tarsII; antIII/lhantIII (for fundatrices), antIII/lhantIII; lhantIII/tarsII (for apterae). Oviparous females of *A. schneideri* can be easily distinguished by the lack of scent plaques on the hind tibiae; males of this species are apterous. Other characters separating oviparae and males of *A. schneideri* are lhantIII/awantIII; antIII/prtV; siphon/antIII; antIII/lhantIII; antIII/lhantIII : urs/tarsII; lhantIII/tarsII (for oviparae), prtVI/baseVI; siphon/cauda (for males).

After having evaluated various characters, the best have been selected for use in the key. When deciding about valuability of certain morphological features, the argumentation is as follows.



Figs 1–4. AntIII of *A. grossulariae* (1, 3) and *A. schneideri* (2, 4). 1 – Vilnius, 26.VI.1984, *R. rubrum*, aptera, 2 – Vilnius, 31.VI.1983, *R. rubrum*, aptera, 3 – Katowice, 15.VI.1987, *R. grossularia*, aptera, 4 – Katowice, 6.X.1987, *R. nigrum*, ovipara (an extreme “*grossulariae*-like” chaetotaxy in *A. schneideri*).

TABLE 2. Additional morphological characters of the Palaearctic species of the genus *Aphis* inhabiting *Ribes*, showing the number of measured specimens, extreme values and mean in parentheses.

Morph	<i>A. grossulariae</i>	<i>A. schneideri</i>	<i>A. triglochinis</i>
antennal segment III length / longest hair on antennal segment III length			
fundatrices	16: 7.229–13.000 (9.79)	20: 3.738–5.184 (4.56)	20: 8.636–15.923 (11.31)
apterae I	96: 4.783–12.400 (8.44)	85: 2.365–4.833 (3.22)	56: 9.880–18.944 (14.33)
alatae I	100: 5.595–11.233 (8.77)	102: 2.985–6.738 (4.43)	37: 11.500–20.200 (16.16)
apterae II	10: 5.944–9.870 (7.69)	–	27: 6.682–17.154 (13.58)
alatae II	20: 5.914–10.714 (8.39)	–	31: 13.600–26.154 (18.07)
gynoparae	2: 6.778–12.000 (8.64)	–	20: 15.680–21.941 (19.19)
oviparae	21: 6.667–14.000 (8.64)	8: 2.486–3.704 (3.04)	20: 9.412–14.882 (12.18)
males	20: 6.892–9.519 (8.22)	13: 2.974–4.349 (3.62)	20: 13.074–19.150 (15.40)
antIII/1hantIII : urs/tarsII			
fundatrices	14: 4.921–8.667 (6.58)	17: 2.691–3.615 (3.09)	19: 6.261–11.942 (8.64)
apterae I	93: 2.700–8.368 (5.38)	77: 1.675–3.189 (2.22)	54: 8.042–15.711 (11.38)
alatae I	93: 3.961–8.405 (5.79)	98: 2.114–5.183 (3.23)	33: 9.583–17.265 (13.942)
apterae II	9: 3.576–6.902 (5.14)	–	26: 5.345–14.503 (10.83)
alatae II	18: 4.136–7.507 (5.709)	–	31: 11.789–22.354 (15.11)
gynoparae	19: 4.432–7.159 (5.71)	–	18: 13.951–19.117 (16.51)
oviparae	20: 3.933–9.333 (5.53)	7: 1.864–2.677 (2.22)	20: 6.871–12.101 (9.77)
males	20: 5.012–6.461 (5.75)	13: 1.856–3.150 (2.515)	19: 11.660–18.592 (13.22)
longest hair on antennal segment III length / second segment of hind tarsus length			
fundatrices	17: 0.200–0.361 (0.26)	17: 0.345–0.534 (0.44)	19: 0.144–0.256 (0.22)
apterae I	103: 0.206–0.421 (0.28)	102: 0.422–0.667 (0.52)	55: 0.146–0.274 (0.20)
alatae I	96: 0.233–0.422 (0.32)	100: 0.382–0.691 (0.53)	35: 0.150–0.236 (0.19)
apterae II	19: 0.207–0.320 (0.27)	–	30: 0.133–0.275 (0.17)
alatae II	18: 0.270–0.411 (0.32)	–	31: 0.13–0.227 (0.169)
gynoparae	21: 0.253–0.381 (0.33)	–	19: 0.155–0.221 (0.18)
oviparae	20: 0.125–0.238 (0.19)	44: 0.287–0.482 (0.39)	20: 0.150–0.223 (0.18)
males	20: 0.289–0.398 (0.33)	13: 0.379–0.611 (0.51)	20: 0.200–0.294 (0.25)
siphunculus length / longest hair on antennal segment III length			
fundatrices	18: 6.657–13.650 (10.19)	20: 3.509–6.273 (4.86)	19: 8.130–15.154 (10.06)
apterae I	105: 7.273–16.950 (12.34)	111: 3.255–6.396 (4.75)	56: 8.344–15.533 (12.24)
alatae I	99: 5.676–11.321 (8.66)	100: 2.281–5.405 (3.69)	37: 7.778–12.000 (9.94)
apterae II	20: 9.000–14.053 (10.78)	–	30: 4.545–12.846 (9.78)
alatae II	19: 5.405–10.714 (7.84)	–	31: 4.529–14.846 (8.55)
gynoparae	22: 5.848–9.650 (7.47)	–	20: 7.824–12.176 (9.47)
oviparae	21: 5.294–11.700 (7.31)	49: 2.675–5.333 (3.69)	20: 4.882–8.467 (6.87)
males	20: 4.054–6.071 (5.18)	12: 1.940–2.939 (2.39)	20: 4.000–6.150 (4.90)
number of secondary rhinaria on antennal segment IV			
alatae I	98: 4–9 (6.29)	99: 2–14 (5.76)	35: 2–18 (8.11)
alatae II	18: 2–12 (5.33)	–	31: 6–19 (12.00)
gynoparae	22: 3–9 (5.59)	–	20: 18–27 (21.55)
males	20: 14–23 (17.50)	12: 7–15 (10.50)	20: 16–38 (29.15)
number of scent plaques on hind tibia			
oviparae	19: 43–116 (85.00)	50: 0–3 (0.10)	20: 56–83 (72.20)

TABLE 3. Results of the identification of aphid material with known life-cycle using the above key.

Reference and identification	Slide label data	Life cycle type	Morph & number of specimens	Our identification
Hille Ris Lambers & Dicker, 1965; <i>A. triglochinis</i>	Wageningen, 15.V.1965, transferred to <i>Ribes rubrum</i> from <i>Roripa</i>	<i>triglochinis</i>	apterae–2 alatae–6	<i>A. triglochinis</i>
Gusynina, 1963; <i>A. varians</i>	Novosibirsk, 21.VI.1960, <i>R. nigrum</i> ; No 4921 in Zool. Inst., Saint Petersburg, Russia	<i>triglochinis</i>	apterae–1	<i>A. triglochinis</i>
Gusynina, 1963; <i>A. schneideri</i>	Dubl'any, Lvov distr., 27.VI.1956, <i>R. nigrum</i> ; No 4920 in Zool. Inst., Saint Petersburg, Russia	<i>schneideri</i>	apterae–4	<i>A. schneideri</i>
Gusynina, 1963; <i>A. grossulariae</i>	Lvov, 06.VIII.1955, <i>R. aureum</i> ; No 4919 in Zool. Inst., Saint Petersburg, Russia	<i>schneideri</i>	apterae–4	<i>A. grossulariae</i>
Rakauskas, unpublished	Vilnius, 22.V.1988; E1xE2, <i>R. nigrum</i>	<i>grossulariae</i>	fundatrices–7	<i>A. grossulariae</i>
Rakauskas, unpublished	Vilnius, 27.V.1988; E1, <i>R. nigrum</i>	<i>grossulariae</i>	fundatrix–1	<i>A. grossulariae</i>
Rakauskas, unpublished	Vilnius, 21.V.1988; A1base, <i>R. nigrum</i>	<i>triglochinis</i>	fundatrices–3	<i>A. triglochinis</i>
Rakauskas, unpublished	Vilnius, 21.V.1988; A2 liek, <i>R. nigrum</i>	<i>triglochinis</i>	fundatrices–4	<i>A. triglochinis</i>
Rakauskas, unpublished	Zabrzeg (Poland), 16.V.1987; A, <i>R. nigrum</i>	<i>triglochinis</i>	fundatrices–2 apterae–5	<i>A. triglochinis</i>
Rakauskas, unpublished	Katowice (Poland), 12.V.1987; D=C2r, <i>R. nigrum</i>	<i>schneideri</i>	fundatrices–3	<i>A. schneideri</i>
Rakauskas, unpublished	Vilnius, 23.V.1988; C1n', <i>R. nigrum</i>	<i>schneideri</i>	fundatrices–4	<i>A. schneideri</i>
Rakauskas, unpublished; clone from Tajikistan	Vilnius, 26.V.1989; Č2base, <i>R. nigrum</i>	<i>grossulariae</i>	apterae–8 alatae–4	<i>A. grossulariae</i>
Rakauskas, unpublished; clone from Tajikistan	Vilnius, 26.V.1989; Č1base, <i>R. nigrum</i>	<i>grossulariae</i>	apterae–7 alatae–4	<i>A. grossulariae</i>
Rakauskas, unpublished	Dushanbe (Tajikistan), 8.V.1989; <i>R. aureum</i>	<i>grossulariae</i>	apterae–8	<i>A. grossulariae</i>
Rakauskas and Turčinavičienė, unpublished	Pilaite (Vilnius), 14.VI.1994, <i>R. nigrum</i>	<i>schneideri</i>	apterae–12	<i>A. schneideri</i>
Węgierek, unpublished	Buryatiya (Russia), 4.VIII.1987; <i>Ribes</i> sp.; No 91b in Silesian University (Katowice, Poland)	<i>schneideri</i>	apterae–5	<i>A. schneideri</i>

1. The character must be easily obtainable, that is, producing minimum problems when measuring, counting, etc. Pure measurements or counts were preferred over ratios.
2. Of all correlated characters, the longest (or the maximum if counted) was preferred to minimize the errors of measurement or counting.
3. Characters commonly used in keys were preferred, with the aim of not introducing new ones. Characters enabling discrimination of all morphs were preferred.
4. The most informative characters, having the greatest gaps between the species, were preferred in the case of correlation.

Thus, based on the above information on the morphology of the European species of *Aphis* inhabiting *Ribes*, the following key for identification of the morphs found on currants is proposed. One important point is that all three species can be found on various species of cultivated and ornamental currants and gooseberries. Therefore, the host plant species is of little discriminative value.

Key to the European *Ribes*-inhabiting species of the genus *Aphis*

Fundatrices

- 1 Hurs 2, or exceptionally 3 *triglochinis*
- Hurs 5–8 2
- 2 Ratio antIII/lhantIII more than 7. Ratio siphon/lhantIII more than 6.5. Antennal hairs usually semi-recumbent and abruptly tapering at the apex (Fig. 1) *grossulariae*
- Ratio antIII/lhantIII less than 6. Ratio siphon/lhantIII less than 6.4. Antennal hairs usually erect and finely produced at the apex (Fig. 2) *schneideri*

Apterous viviparous females

- 1 Ratio antIII/prtVI more than 1.3. Hurs usually less than 4 *triglochinis*
- Ratio antIII/prtVI less than 1.2*. Hurs usually more than 4 2
- 2 Ratio siphon/lhantIII more than 7. Ratio lhantIII/tarsII usually less than 0.42. Antennal hairs usually semi-recumbent and abruptly tapering at the apex (Fig. 1) *grossulariae*
- Ratio siphon/lhantIII less than 6.6. Ratio lhantIII/tarsII usually more than 0.42. Antennal hairs usually erect and finely produced at the apex (Fig. 2) *schneideri*

Alate viviparous females

- 1 Hurs 2, or exceptionally 3. RhantIII usually more than 19 *triglochinis*
- Hurs 5–13. RhantIII usually less than 19 2
- 2 Ratio siphon/lhantIII more than 5.5. Antennal hairs usually semi-recumbent and abruptly tapering at the apex (Fig. 1) *grossulariae*
- Ratio siphon/lhantIII less than 5.5. Antennal hairs usually erect and finely produced at the apex (Fig. 2) *schneideri*

Gynoparous females

- 1 Hurs 2, or exceptionally 3. RhantIII more than 40. Ratio prtVI/baseVI less than 1.9 *triglochinis*
- Hurs 6–11. RhantIII less than 20. Ratio prtVI/baseVI more than 2.3 *grossulariae*

* When calculating ratio antIII/lhantIII for apterous viviparous females and males, make sure that antennae are 6-segmented.

Oviparous females

- 1 Hurs 2. Ratio antIII/prtV 1.4–2.2 *triglochinis*
- Hurs 5–10. Ratio antIII/prtV 0.4–1.1 2
- 2 Sptibi 43–116. Ratio antIII/hantIII more than 6. Ratio antIII/prtV 0.7–1.1. Antennal hairs usually semi-recumbent and abruptly tapering at the apex (Fig. 1) *grossulariae*
- Sptibi 0–3. Ratio antIII/hantIII less than 4. Ratio antIII/prtV 0.4–0.6. Antennal hairs usually erect and finely produced at the apex (Fig. 2) *schneideri*

Males

- 1 Hurs 2, or exceptionally 3. Ratio antIII/hantIII more than 12*. Ratio prtVI/baseVI less than 2.1 *triglochinis*
- Hurs 6–11. Ratio antIII/hantIII less than 10*. Ratio prtVI/baseVI more than 2.6 *grossulariae*

The above key was used for the identification of aphid material from various places with the known life cycle (Table 3). It is evident that *A. varians* of Gusynina (1963) is *A. triglochinis*. However, it is possible that there may exist monoecious clones of *A. grossulariae*, because aphids that have been determined by Gusynina (1963) as non-migrating *A. grossulariae* are morphologically similar to *A. grossulariae* from our material.

CONCLUSIONS

The majority of the morphological features commonly used in the keys to discriminate between *A. grossulariae*, *A. schneideri* and *A. triglochinis* are unreliable. Even hurs can be confusing when separating apterous viviparous females of *A. triglochinis* from the other two species. When identifying European species of the genus *Aphis* on currants and gooseberries, it is necessary to use several morphological characters. All three species are capable (at least in Lithuania and Poland) to live on various species of currants and gooseberries. Therefore, winter host plant specificity is of little discriminative value.

Controversy in literary data concerning the life cycles and host plant relationships of *A. grossulariae*, *A. schneideri* and *A. triglochinis* may be caused by the diagnostic problems, but not necessarily. For example, Gusynina (1963) has reported *A. grossulariae* as monoecious holocyclic (which is characteristic for *A. schneideri*), and her aphids agree morphologically with *A. grossulariae* from Lithuania and Poland.

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