

Recent changes in aphid (*Hemiptera*, *Sternorrhyncha*: *Aphididae*) fauna of Lithuania: an effect of global warming?

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Two new (*Aphis oenotherae* and *Brachycaudus divaricatae*) and one rare (*Dysaphis pyri*) for Lithuania aphid species of southern origin were found in great numbers in southeastern Lithuania in 2002. Global warming, seasonal migrations and changes in the aphid life cycles are considered as possible reasons for the establishment of southern-born aphid species in Lithuania. *D. pyri* and *B. divaricatae* are potential orchard pests in this country.

Key words: aphids, *Aphis oenotherae*, *Brachycaudus divaricatae*, *Dysaphis pyri*, distribution areas, invasions, global warming, orchard pests

INTRODUCTION

Field studies of 2002 revealed several new and rare for the Lithuanian fauna aphid species (Rakauskas, in preparation). Three of them [*Aphis oenotherae* Oestl., *Brachycaudus divaricatae* Shap., *Dysaphis pyri* (B. de F.)] seem to be expanding northwards their distribution areas. The aim of this report is to inform on the status of these species in Lithuania and discuss the reasons for the recent changes in the aphid fauna of Lithuania.

MATERIAL AND METHODS

The aphid material has been collected in 2002 (from May till November) mainly in Vilnius and Vilnius region, a few samples originating from Varëna region and Druskininkai (eastern and southeastern Lithuania), using conventional methods of sampling (Eastop & Emden, 1972). Microscope slides were prepared using the Faure–Berlese mounting fluid (Blackman & Eastop, 2000). Most of the aphid material studied is deposited at the Department of Zoology of Vilnius University, several specimens have been sent to G. Lampel (Freiburg, Switzerland), G. Coccuza (Catania, Italy) and A. Andreev (Kishineu, Moldova). Host specificity and life cycles of aphids were investigated in Skirgiøkës (Vilnius region), employing methods described earlier (Rakauskas, 1993). Identification keys of R. L. Blackman & V. F. Eastop (2000) and Г. X. Шапошников (1988) were used when identifying species of the genus *Dysaphis* and of R. L. Blackman & V. F. Eastop (1994) and

R. L. Blackman & V. F. Eastop (2000) for identification of species of the genus *Brachycaudus* and *Aphis* (*grossulariae* group) respectively. The synonymy is in accordance with the Catalogue of the World's Aphididae (Remaudiere & Remaudiere, 1997).

RESULTS

Two new (*Aphis oenotherae* Oestlund, 1887 and *Brachycaudus divaricatae* Shaposhnikov, 1956) and one rare [*Dysaphis pyri* (Boyer de Fonscolombe, 1841)] for Lithuania aphid (*Hemiptera*, *Sternorrhyncha*: *Aphididae*) species were detected in 2002 in the southeastern and eastern parts of Lithuania. All three had been known as having south European and/or central Asian distribution prior to their findings in Lithuania.

Aphis oenotherae has been originally described from Minnesota (USA – Oestlund, 1887), later reported as widespread over the other states of the USA also (Palmer, 1952). It is supposed as being introduced to Europe at the end of the last century and has already been reported from Italy (Hille Ris Lambers, 1971; Barbagallo & Stroyan, 1982), Spain (Nieto Nafria & Mier Durante, 1985), United Kingdom (Martin, 2000), Germany (Müller, 1974), southern Poland (Szelegiewicz, 1976), also Czech Republic (Holman, 2000, personal communication). Because of the morphological similarity, *A. oenotherae* was synonymised with *A. neomexicana* Cockerell and Cockerell, 1901, *A. ribigillettei* Allen and Knowlton, 1939, and *A. sanborni* Patch, 1914 (Robinson & Rojanavongse, 1976; Remaudiere, 1993; Remaudiere &

Remaudiere, 1997). E. Patch (1927) provided an experimental evidence for *A. sanborni* being a holocyclic species, alternating between *Ribes* spp. (currants and gooseberries) and *Epilobium* herbs (Onagraceae, the same plant family that the genus *Oenothera* belongs to). Yet there is still no experimental evidence for the aphids from *Oenothera* being capable to colonize *Ribes* spp. The life cycle of *A. oenotherae* and its synonymy with *A. neomexicana* complex still needs an experimental confirmation therefore (Rakauskas, 2000; Blackman & Eastop, 2000). In Europe, *A. oenotherae* is known to be anholocyclic (having no bisexual reproduction), inhabiting various species of *Oenothera* in the field (Heie, 1986; Martin, 2000). F. P. Müller (1974) has reported on successful transfer experiments to other herbaceous hosts of the plant family Onagraceae (*Godezia*, *Gaura*, *Epilobium*, *Fuchsia*, *Chamaenerium* and *Clarkia*).

In Lithuania, we have found *A. oenotherae* heavily infesting *Oenothera biennis* in Vilnius and Vilnius region in 2002. Several samples originated from Varėna region and Druskininkai (southern Lithuania). The aphids caused severe leaf roll and deformation of the stem and inflorescences of their hosts. Up to 80% of *Oenothera biennis* plants were infested in some places. When given a choice (in pot cages) between *Oenothera biennis* (plant in poor condition) and *Epilobium adenocaulon* (thrifty specimen), aphids fed on the latter plant species for several parthenogenetic generations. Winged parthenogenetic females in September (supposed gynoparae) refused to accept cultivated black and red currants as a host plant. Winged males and apterous oviparous females appeared in the field and in the pot cages from the beginning of October, but no winter eggs were laid. Thus, *Aphis oenotherae* seems to be anholocyclic on *Oenothera biennis* (probably also on *Epilobium* spp.) in Lithuania, reproducing by parthenogenesis only, although having an abortive bisexual generation in some cases. Bisexual generation of *A. oenotherae* is hereby reported for the first time in Europe, whilst winged males are already known from the USA (Palmer, 1952). Overwintering egg is the most real possibility for aphids to thrive the winter in the climatic conditions of Lithuania in the field. There also exists an opportunity of overwintering in the stage of parthenogenetic female indoors, also on the root collars of the host plants "nested" by ants. *Aphis oenotherae* is closely dependent on ants in Lithuania, and we have found several cases where ants (*Lasius niger*, *Myrmica rubra*) were arranging "nests" over the first-year rosettes of *Oenothera biennis* infested by aphids. Yet, these possibilities for overwintering still need to be confirmed for *A. oenotherae* in Lithuania.

Brachycaudus divaricatae has been originally described from Turkmenia (Шапошников, 1956), later reported also from Crimea (Ukraine), northern Caucasus, Transcaucasia, Iran, Turkey (Шапошников, 1964; Андреев, Мамонтова, 1998; Blackman & Eastop, 2000). This species is reported as holocyclic facultatively alternating between *Prunus divaricata* (occasionally also *P. spinosa* and *P. domestica*) and some herbaceous plant species of the family Caryophyllaceae (*Melandrium album*, *Silene* spp.) (Шапошников, 1962, 1964; Андреев, Мамонтова, 1998). Three samples of this species were collected in Skirgiškės (Vilnius region) in June. Heavy infestation of *Prunus divaricata* was noted in each case. Observation of one infested plum tree evidenced the possibility of aphids to stay on the same tree till the end of September, but we failed to find any males or oviparous females. As the fundatrices of this species were not found either, it remains unclear whether findings of *B. divaricatae* in Lithuania represent just occasional cases (aphids might have been just recently introduced with the plant material), or this species has already established permanent populations in Lithuania. Concerning relatively harsh Lithuanian winters, *B. divaricatae* is expected to thrive the winter as a winter egg or by means of parthenogenetic females hiding on the root collar or roots of plum trees as reported for certain *Brachycaudus* species (Barbagallo et al., 1997; Blackman & Eastop, 2000). Finding places in Eastern Lithuania are approx. 2000 km northwest from the previously reported northernmost findings of *B. divaricatae*.

Dysaphis pyri is a common species throughout southern Europe, North Africa, Middle and Central Asia (Barbagallo et al., 1997; Blackman & Eastop, 2000), also recorded in Denmark, southern parts of Sweden and Norway (Heie, 1992), southern Poland (Szelegiewicz, 1966). Winter hosts of this species are cultivated and sometimes wild pears (Колесова, 1974), summer hosts being herbaceous plants of the genus *Galium*, also *Asperula cynanchica* and *Rubia peregrina* (Stroyan, 1957; Szelegiewicz, 1966). *D. pyri* has already been reported from southern Lithuania in 1994–1995 (Rakauskas, 1996). This temporary invasion appeared to be caused by summer immigration; there was no evidence to confirm permanent existence of this aphid species in Lithuania (Rakauskas, 2000a). A heavy infestation of cultivated pears by *D. pyri* was recorded in Vilnius and Vilnius region in June of 2002: farmers were enforced to use chemical pest treatment in certain cases. By the mid-July aphids were no longer available on pears due to the maturation of pear shoots and heavy entomophthorosis. Special searches for *D. pyri* on *Galium* spp. were unsuccessful. Winged parthenogenetic females of *D. pyri* refused to feed on *Ga-*

lium mollugo and *G. aparine* in pot cages [the same result has been received in transfer experiments in 1994–1995 (Rakauskas, 1996)]. No gynoparae, males or oviparous females of *D. pyri* were detected on pears in Vilnius in September and October 2002, despite the repetitive special search efforts. For the time being, the evidence for *D. pyri* as permanently established in Lithuania is still lacking.

DISCUSSION

The global warming is usually expected (and already documented) to cause a northwards shift of the distribution areas of plants and animals (Peters & Lovejoy, 1992; Palakevičiūtė & Palakevičius, 2001). The analysis of climatic fluctuations in Lithuania over the last two centuries revealed that winters and springs are gradually warming up, whilst the mean temperatures of summer and autumn remain more or less constant. General climate forecast predicts the growth of mean yearly temperatures in Lithuania by 1.5–1.7 °C till the midst of the 21st century (Bukantis, 2001). Southern-born species are expected to arrive to Lithuania in accordance with the above climatic tendencies. *A. oenotherae* might serve as a perfect example. Because of anholocycly (absence of bisexual reproduction), this species can thrive the mild winters only. Establishment of this aphid species in Lithuania is supposed to be possible due to the global warming, which makes Lithuanian winters softer. Nevertheless, this is not necessarily the case. Two other possibilities should also be considered.

1. Aphid species might be sometimes numerous, yet not established permanently in certain areas, because aphids are capable of traveling long distances carried by air currents (Dixon, 1971). The probable example is *D. pyri*: it does not hibernate in Lithuania, but is airborne here in some favourable summers. Similarly, *A. oenotherae* and *B. divaricatae* might be just an occasional airborne immigrant aphid species overwintering southwards in Europe.

2. Aphid species might expand their distribution areas due to the change of their life cycles. Once holocyclic (capable of producing fertilized eggs and thus to thrive harsh winters) clones of *A. oenotherae* should appear, the species would be capable of moving northwards. We have already found males and oviparous females of *A. oenotherae* in Lithuania (although as the abortive phase yet); this makes the holocyclic clones also possible to exist in this species.

Whatever the reasons of their invasion, the establishment of *D. pyri* and *B. divaricatae* in Lithuania (even as temporal summer populations) might cause problems in orchard pest management. *D. pyri*

has already presented itself as a pest of cultivated pears in Vilnius in 2002. So might appear *B. divaricatae*, because plums are rather common in Lithuanian orchards. *A. oenotherae* is expected to have little (if any) economic importance, because its main hosts, *Oenothera* spp., are rather weeds but not cultivated plants.

CONCLUSIONS

1. Two new (*Aphis oenotherae* and *Brachycaudus divaricatae*) and one rare (*Dysaphis pyri*) for Lithuania aphid species of southern origin were found in great numbers in southeastern Lithuania in 2002.

2. Global warming is not the only reason when explaining the establishment of southern-born aphid species in Lithuania. Seasonal migrations and changes in the aphid life cycles should also be considered.

3. *Dysaphis pyri* and *Brachycaudus divaricatae* might cause problems of orchard pest management in Lithuania, even if they appear to be just temporary airborne summer immigrants not capable of living here permanently.

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References

1. Barbagallo S., Cravedi P., Pasqualini E., Patti I. *Aphids of the principal fruit-bearing crops*. Milan: Bayer S.p.A. 1997. 123 p.
2. Barbagallo S., Stroyan H. L. G. Osservazioni biologiche, ecologiche e tassonomiche sull'afidofauna della Sicilia. *Frust. Entom. N. S.* 1982. Vol. 3. P. 1–182.
3. Blackman R. L., Eastop V. F. *Aphids on the World's Trees: An identification and information guide*. Wallingford: CAB INTERNATIONAL. 1994. 966 p.
4. Blackman R. L., Eastop V. F. *Aphids on the World's Crops: An Identification and Information Guide*. Chichester: John Wiley & Sons. 2000. 466 p.
5. Bukantis A. Climatic fluctuations in Lithuania against a background of global warming. *Acta Zool. Lituanica*. 2001. Vol. 11(2). P. 113–120.
6. Dixon A. F. G. Migration in aphids. *Sci. Prog. (Oxford)*. 1971. Vol. 59. P. 41–53.
7. Eastop V. F., Emden H. F. The insect material. *Aphid technology*. 1972. P. 1–47.

8. Heie O. E. *The Aphidoidea (Hemiptera) of Fennoscandia and Denmark. III. Fauna Entomologica Scandinavica 17*. Leiden–Copenhagen: E.J. Brill/Scandinavian Science Press. 1986. 316 p.
 9. Heie O. E. *The Aphidoidea (Hemiptera) of Fennoscandia and Denmark. IV. Fauna Entomologica Scandinavica 25*. Leiden–Copenhagen: E.J. Brill/Scandinavian Science Press. 1992. 189 p.
 10. Hille Ris Lambers D. Grensoverschrijdend verkeer van bladluizen. *Ent. Ber.* 1971. Vol. 31. P. 155–156.
 11. Martin J. H. Two new British aphid introductions in 1999, in the context of other additions over the preceding thirty years (Sternorrhyncha: Aphidoidea). *Entomologist's Gazette*. 2000. Vol. 51. P. 97–105.
 12. Müller F. P. Aphis oenotherae Oestlund, 1887, Erstfunde in Europa und als potentieller Zierpflanzenschadlig. *Entomol. Nachr.* 1974. Vol. 18. P. 129–133.
 13. Nieto Nafria J. M., Mier Durante M. P. Nuevas aportaciones a la afidofauna iberica (Hom. Aphididae). *Bolm. Soc. Port. Ent.* 1985. Vol. 3. P. 115–125.
 14. Oestlund O. W. Aphididae of Minnesota. *Geological and natural history survey of Minnesota*. 1887. Bull. No. 4. P. 1–99.
 15. Palmer M. A. *Aphids of the Rocky Mountain region*. Denver, Colorado: Thomas Say Foundation. 1952. 452 p.
 16. Patch E. M. Two currant aphids that migrate to willow-herbs. *Maine Agr. Expt. Sta. Bull.* 1927. No 336. P. 1–8.
 17. Peters R. L., Lovejoy T. E. (eds.). *Global Warming and Biological Diversity*. New Haven: Yale University Press, 1992. 386 p.
 18. Rakauskas R. On the Biology of the Ribes-infesting Aphis species in Central Europe. *Critical Issues in aphid biology. Proceedings of the 4th international Symposium on aphids*. 1993. P. 113–122.
 19. Rakauskas R. A new aphid on pears in Lithuania. *Aphids and other Homopterous insects (Warszawa)*. 1996. Vol. 5. P. 7–13.
 20. Rakauskas R. On the identity of Aphis neomexicana (W.P. and T.D.A. Cockerell, 1901). *Aphids and other Homopterous insects (Warszawa)*. 2000. Vol. 7. P. 7–14.
 21. Rakauskas R. *Lietuvos amarø (Hemiptera, Sternorrhyncha: Aphididae) biosistematiniai tyrimai*. Vilnius: VU leidykla, 2000a. 128 p.
 22. Remaudiere G. Pucerons nouveaux et peu connus du Mexique (12e note) Aphis (Bursaphis) solitaria (McVicar Baker) (Homoptera, Aphididae). *Revue fr. Ent. (N. S.)*. 1993. Vol. 15(3). P. 97–106.
 23. Remaudiere G., Remaudiere M. *Catalogue of the World's Aphididae*. Paris: INRA, 1997. 474 p.
 24. Robinson A. G., Rojanavongse V. A key to the Nearctic species of Aphis L. (Homoptera: Aphididae) on Ribes spp., with descriptions of two new species from Manitoba. *Can. Ent.* 1976. Vol. 108. P. 159–164.
 25. Stroyan H. L. G. *A revision of the British species of Sappaphis Matsumura. Part I*. London: H. M. S. Office, 1957. 59 p.
 26. Szelegiewicz H. Ergänzungen zur Blattlaus-fauna (Homoptera: Aphididae) von Ungarn. *Acta Zool. Acad. Sci. Hung.* 1966. Vol. 12. P. 181–192.
 27. Szelegiewicz H. Aphid species (Homoptera, Aphidoidea) new to the Polish fauna. *Ann. Zool.* 1976. Vol. 33(13). P. 217–227.
 28. Palakevièiūtė R., Palakevièius M. General aspects of the effect of climate and climate change on ecosystems and on the biology and ecology of the flora and fauna. *Acta Zool. Lituanica*. 2001. Vol. 11(2). P. 121–131.
 29. Андреев А. В., Мамонтова В. А. Тли рода Brachycaudus (Homoptera, Aphididae) в восточной Европе. *Вестник зоологии*. 1998. Т. 32(1–2). С. 65–75.
 30. Колесова Д. А. Грушевые тли рода Dysaphis С. В. (Homoptera, Aphididae) – двудомные виды. *Энтомологическое обозрение*. 1974. Т. 53(1). С. 38–53.
 31. Шапошников Г. Х. Филогенетическое обоснование системы короткохвостых тлей (Aparaphidina) с учетом их связей с растениями. *Тр. Зоол. ин-та АН СССР*. 1956. Т. 23. С. 215–320.
 32. Шапошников Г. Х. Тли с сокращенным жизненным циклом и летне-зимним диапаузированием. *Докл. на 11–14 ежег. чтен. пам. Н. А. Холодковского*. 1962. С. 79–95.
 33. Шапошников Г. Х. Тли (Aphidinea), повреждающие алычу и вишню. *Энтомологическое обозрение*. 1964. Т. 43(1). С. 145–151.
 34. Шапошников Г. Х. Ревизия группы тлей, сходных с Dysaphis tschildarensis (Homoptera, Aphididae). *Зоологический журнал*. 1988. Т. 47(1). С. 41–47.
- Rimantas Rakauskas**
- DABARTINIAI POKYÈIAI LIETUVOS AMARØ (HEMIPTERA, STERNORRHYNCHA: APHIDIDAE) FAUNOJE: GLOBALAUS ATÞILIMO PASEKMÈ?**
- S a n t r a u k a
- Dvi naujos (*Aphis oenotherae* ir *Brachycaudus divaricatae*) ir viena reta (*Dysaphis pyri*) Lietuvos faunai amarø (Hemiptera, Sternorrhyncha: Aphididae) rūðys uþregistruotos 2002 m. Pietryèiø Lietuvoje. Ðiø trijø pietiniø rūðiø atsiradimà Lietuvoje galima sieti su globalia klimato kaita, amarø vystymosi ciklø pokyèiais ir sezoninèmis amarø migracijomis. *D. pyri* ir *B. divaricatae* Lietuvoje gali tapti pavojingais kriaudiø ir slyvø kenkèjais.
- Raktaþodþiai:** amarai, *Aphis oenotherae*, *Brachycaudus divaricatae*, *Dysaphis pyri*, arealai, invazijos, globali klimato kaita, sodø kenkèjai