

Two aphid species newly introduced in Greece

J.T. MARGARITOPOULOS^{1*}, A.P. PAPAPANAGIOTOU², C.CH. VOUDOURIS^{1,3}, A. KATI⁴ AND R.L. BLACKMAN⁵

¹Department of Biochemistry and Biotechnology, University of Thessaly, 26 Ploutonos Str., 412 21 Larissa, Greece

²Department of Agronomy Technologists, Technological Educational Institute of Western Greece, Theodoropoulou Str., 272 00, Amaliada, Greece

³Institute of Molecular Biology and Biotechnology, Foundation for Research and Technology, 100 Nikolaou Plastira Str., 700 13, Heraklion, Crete, Greece

⁴Phytopathology Lab, School of Agriculture, Aristotle University of Thessaloniki, 541 24 Thessaloniki, Greece

⁵Division of Life Sciences, The Natural History Museum, London SW7 5BD, UK

ABSTRACT

In this paper we report two aphid species as new records for the Greek and the European aphid fauna. The species are *Aphis odinae* (van der Goot) and *Melanaphis sorghi* (Theobald) (Hemiptera: Aphididae). The former was found on *Pittosporum* spp. in Thessaloniki, northern Greece, and the latter on *Sorghum halepense* (L.) in Messolonghi, southern Greece, and also in Thessaloniki. Heavy infestations in *Pittosporum* trees by *A. odinae* have not been observed and *M. sorghi* was not detected in cultivated sorghum or maize in the few inspections we made. Thus, according to our inspections neither of these species is as yet of economic importance in Greece. These two species increase the number of aphid species recorded in Greece to 335.

KEY WORDS: Aphidoidea, aphid fauna, Greece.

Introduction

During the last two decades several studies have been conducted on the Greek aphid fauna (e.g. Kavallieratos et al. 2007, Tsitsipis et al. 2007, Papapanagiotou et al. 2012) and have raised the recorded aphid species to 333. However, the recorded aphid fauna in Greece is still lower than that in neighboring or other Mediterranean countries (see for example Patti and Barbagallo 1998, Kaygin et al. 2010, Barbagallo et al. 2011, Fauna Europaea 2012). The recent study of Papapanagiotou et al. (2012) on aphids from cultivated and wild plants in several regions of Greece added 18 new aphid species to the Greek fauna. This

suggests that the recorded number of aphid species could be substantially increased by similar studies, taking into account that Greece has diverse flora, climatic conditions and ecological habitats. Apart from aphid species native to European fauna, such surveys may also reveal alien (non-indigenous) aphids. In general, several studies have detected alien insects in Europe and some of these studies have clarified the routes of introduction [e.g., the western corn rootworm *Diabrotica virgifera virgifera* LeConte (Coleoptera: Chrysomelidae) (Miller et al. 2005)]. A notable example of a recent alien aphid species in Europe is the grapevine aphid,

*Corresponding author: johnmargaritopoulos@gmail.com

Aphis illinoisensis Shimer, a New World species that was recorded in Crete in 2005 (Tsitsipis et al. 2005), whence it has been spread to mainland Greece and other Balkan countries (Petrovic-Obradovic et al. 2010, Margaritopoulos unpublished data). It has been estimated that 102 alien species of Aphididae have been established in Europe which account for about 7% of the European aphid fauna (Coeur d'Acier et al. 2010).

In the present paper we report the presence of two species new to the Greek aphid fauna, and not previously recorded in the European literature.

Materials and Methods

Aphid samples were collected from *Sorghum halepense* (L.) (Poaceae) in Messolonghi, southern Greece in September 2008 and in the farm of the Aristotle University of Thessaloniki, Thessaloniki, northern Greece in August 2013. Aphids from *Pittosporum tobira* (Thunberg) and *Pittosporum* sp. (Pittosporaceae) were collected in Thessaloniki in May 2008, May 2012 and July 2013. Adult aphids from each sample were preserved in vials filled with two volumes of ethanol (95%) and one volume of lactic acid 75% (Eastop and van Emden 1972) until species identification. Permanent microscope slides of wingless females were prepared according to the method of Martin (1983). The identification of the aphid species was based initially on the keys of Blackman and Eastop (2006), and verified by comparison with specimens in the Natural History Museum (BMNH) collection. The permanent slides are kept in the aphid collection of the first author in the Department of Biochemistry & Biotechnology, University of Thessaly, Greece.

Results and Discussion

The aphids from *Pittosporum* spp. were identified as *Aphis odinae* (van der Goot) and those from *S. halepense* as *Melanaphis sorghi*

(Theobald). Putative colonies of *M. sorghi* were also observed on *S. halepense* in Messolonghi in 2006 by the second author, but we have not preserved specimens to validate the presence of the species in that year. Below we present some information about the two species.

Aphis (Aphis) odinae (van der Goot)
(Aphidinae: Aphidini - Aphidina)

Wingless females are usually grey-brown to reddish-brown, and feed on the undersides of leaves along the main veins, and also on young shoots. The colonies are ant-attended. This species is rather polyphagous and is found on shrubs and some trees of the families Anacardiaceae (*Anacardium*, *Mangifera*, *Rhus*), Araliaceae (*Aralia*, *Polyscias*, *Kalopanax*), Caprifoliaceae (*Viburnum*), Ericaceae (*Rhododendron*), Pittosporaceae (*Pittosporum*), Rubiaceae (*Coffea*, *Mussaenda*), and Rutaceae (*Citrus*). It can be distinguished from other aphids colonising these plants by its short dark siphunculi, only about half the length of the black, finger-like cauda. *A. odinae* is native to East and Southeast Asia but has become widespread in Africa south of the Sahara (Barbagallo and Santos 1989, Martin 1989, Millar 1994, as *Toxoptera odinae*). In almost all regions this species is anholocyclic, that is, it reproduces parthenogenetically throughout the year. However, it has recently been found to have a sexual phase on various hosts in Japan (Blackman et al. 2011). Particularly, males have been reported from *Viburnum erosum* Thunberg (Adoxaceae) and *Toxicodendron succedaneum* (L.) (synonym *Rhus succedanea* L.) (Anacardiaceae), sexual females (oviparae) from *Kalopanax septemlobus* (Thunberg) (Araliaceae) [synonym *Kalopanax pictus* (Thunberg)], *V. erosum* and *T. succedaneum*, and fundatrices (stem mothers) from *Juglans* sp. (Juglandaceae) and *T. succedaneum*.

Melanaphis sorghi (Theobald)
(Aphidinae: Aphidini - Rhopalosiphina)

Wingless females are white or yellow, but larger individuals may have a black dorsal abdominal patch. This aphid is found on Poaceae, especially on *Sorghum*, where it prefers to feed on the axils of the lower leaves, although large colonies may extend over the whole leaf. It can be distinguished from other aphids on *Sorghum* by its short dark siphunculi (0.7-0.9 of length of cauda). In other parts of the world it has sometimes been found on other Poaceae such as *Eleusine*, *Panicum*, *Saccharum* and *Zea*. *M. sorghi* occurs widely in Africa and the Middle East (including Cyprus and Israel), and in East and Southeast Asia but, unlike the sugarcane pest *Melanaphis sacchari* (Zehntner), it has not been introduced to the Americas. Like *A. odinae* it is anholocyclic almost everywhere, but cyclical parthenogenesis (holocycle) with a sexual generation on *Sorghum* has been observed in Japan (Setokuchi 1975). Sexual females have also been reported in north-west India (David 1977).

M. sorghi was distinguished from the sugarcane pest *M. sacchari* by Blackman et al. (1990), but is listed as a synonym of that species by Remaudière and Remaudière (1997) and in the online Aphid Species File [<http://aphid.speciesfile.org>, Favret (2013)]. The two species are closely related, but there is a reliable morphological discriminant that applies throughout both their ranges and has stood the test of time. The Greek wingless females from *Sorghum* all have hind tibiae more than twice as long as the antennal terminal process (range 2.05-2.34), within the range of values for this character found in *M. sorghi* (2.0-3.0), whereas the range of recorded values for *M. sacchari* is 1.4-2.2, with more than 95% of specimens in the range 1.75-2.0. The same discriminant can also be applied to winged females (2.0-3.2 in *sorghi*, 1.6-2.0 in *sacchari*). DNA evidence that might confirm the existence of two species is not yet available, but at this time it seems advisable to recognise that they are probably functioning as distinct taxonomic entities.

These two aphid species have already become established in Greece as they have

been collected in more than one year (both species) and in the case of *M. sorghi* in both southern and northern regions. We did not detect *A. odinae* on *Pittosporum* sp. in surveys in three other regions (Volos, Larissa and Kozani) which indicates that the distribution area of this species in Greece is rather restricted. According to our inspections neither of these species is as yet of economic importance. We have not observed heavy infestations in *Pittosporum* trees by *A. odinae*, which might indicate a regulation of the aphid populations by native natural enemies. *M. sorghi* was not detected in cultivated sorghum or maize in the few inspections that we made, although extensive and regular samplings are needed to determine whether the species is able to build populations in crops. In recent reviews for worldwide aphid pests on sorghum, tropical and subtropical fruit trees, Gerald J. Michels and Burd (2007) consider *M. sorghi* as an occasional pest of sorghum and Barbagallo et al. (2007) reports *A. odinae* as a minor pest of citrus and that it is occasionally injurious in tropical fruits (e.g., mango, cashew). However, *M. sorghi* could pose an indirect threat due to potential transmission of non-persistent plant-viruses to cereal crops. It is well known that non-colonizing aphid species contribute to increased virus spread of non-persistently transmitted viruses especially when they land in large numbers on the crops (e.g. Fereres 1993, Perez et al. 1995). Future research is needed on this topic, especially for *M. sorghi* in relation to cereal and maize aphid-transmitted plant-viruses.

Both aphid species are anholocyclic in almost all regions, and presumably the invading lineages in Greece are asexual. Asexual genotypes have some advantages, at least in the short term, in the first steps of invasion. They do not suffer from the two-fold reproductive disadvantage associated with sexual reproduction (Bulmer 1982), and do not need to find mates. However, Blackman et al. (2011) has shown that *A. odinae* in Japan is no less polyphagous in the hosts that it utilizes for sexual reproduction

compared to its parthenogenetic phase. This contrasts with host-alternating aphid species which are often very selective for the host for the sexual phase. Thus, the absence of a certain host(s) is not a limited factor for sexual populations of *A. odinae* to invade. Biological assays would clarify the life cycle category of the invaded populations in Greece.

The two newly recorded species increase the number of aphid species on the Greek list to 335. In addition, this is the first published record of *A. odinae* and *M. sorghi* in Europe as they are not listed in the Fauna Europaea project (Fauna Europaea 2012), although there are specimens of *M. sorghi* in the BMNH collection from Cyprus and Israel.

References

- Barbagallo, S. and L.A. Santos. 1989. *Toxoptera odinae* (V.D.G.) (Hom.: Aphididae), infesting (*Anacardium occidentale* L.) in Mozambique. [*Toxoptera odinae* (V.D.G.) (Hom.: Aphididae), uma nova praga do cajueiro (*Anacardium occidentale* L.) em Mocambique.] Phytophaga 3: 163-71.
- Barbagallo, S., G. Cocuzza, P. Cravedi and S. Komazaki. 2007. IPM Case Studies: Tropical and subtropical fruit trees. In: van Emden H.F. and R. Harrington (eds.). Aphids as Crop Pests. CAB, Wallingford, UK, pp. 663-676.
- Barbagallo, S., A. Binazzi, F. Pennacchio and A. Pollini. 2011. An annotated checklist of aphids surveyed in the Italian regions of Tuscany and Emilia Romagna. Redia 94: 59-96.
- Blackman, R.L. and V.F. Eastop. 2006. Aphids on the World's Herbaceous Plants and Shrubs. John Wiley & Sons, Ltd, Chichester, 1439 pp. (An updated version is available online at www.aphidsonworldsplants.info, last accessed December 2013).
- Blackman, R.L., V.F. Eastop and P.A. Brown. 1990. The biology and taxonomy of the aphids transmitting Barley Yellow Dwarf virus. In: Burnett, P.A. (ed.) World Perspectives on Barley Yellow Dwarf. CIMMYT, Mexico, D.F., Mexico: 197-214.
- Blackman, R.L., M. Sorin and M. Miyazaki. 2011. Sexual morphs and colour variants of *Aphis* (formerly *Toxoptera*) *odinae* (Hemiptera, Aphididae) in Japan. Zootaxa 3110: 53-60.
- Bulmer, M.G. 1982. Cyclical parthenogenesis and the cost of sex. J. Theor. Biol. 94: 197-207.
- Coeur d'Acier, A., N. Pérez Hidalgo and O. Petrović-Obradović. 2010. Aphids (Hemiptera, Aphididae). Chapter 9.2. In: Roques, A., M. Kenis, D. Lees, C. Lopez-Vaamonde, W. Rabitsch, J.-Y. Rasplus and D.B. Roy (eds.). Alien terrestrial arthropods in Europe. BioRisk 4: 435-474.
- David, S.K. 1977. Host-selection and speciation in some south Indian Aphids. In: Ananthakrishnan, T.N. (ed.). Insects and host-specificity. Madras: The Macmillan Company of India Ltd, Delhi, pp. 19-21.
- Eastop, V.F. and H.F. van Emden. 1972. The insect material. In: van Emden H.F. (ed.). Aphid Technology. Academic Press, London, pp. 1-45.
- Fauna Europaea 2012. Fauna Europaea version 2.5. Web Service available online at <http://www.fauaenr.org>.
- Favret, C. 2013. Aphid Species File. Version 5.0/5.0. [20/12/2013]. <<http://Aphid.SpeciesFile.org>>.
- Fereres, A. 1993. Transmission of Spanish pepper- and potato-PVY isolates by aphid (Homoptera: Aphididae) vectors: epidemiological implications. Environ. Entomol. 22: 1260-1265.
- Kavallieratos, N.G., Ž. Tomanović, G.P. Sarlis, B.J. Vayias, V., Žikić and N.E. Emmanouel. 2007. Aphids (Hemiptera: Aphidoidea) on cultivated and self-sown plants in Greece. Biologia 62: 335-344.

- Kaygin, A.T., G. Gorur and F. Cota. 2010. New records of aphid fauna in Turkey. *J. Insect Sci.* 10:5, 4pp.
- Martin, J.H. 1983. The identification of common aphid pests of tropical agriculture. *Trop. Pest Manag.* 29: 395-411.
- Martin, J.H. 1989. Identification, occurrence and pest status of *Toxoptera odinae* (van der Goot) (Hemiptera: Aphididae) in Africa. *Bull. Entomol. Res.* 79: 607-611.
- Millar, I.M. 1994. A catalogue of the aphids (Homoptera: Aphidoidea) of sub-Saharan Africa. Plant Protection Research Institute Handbook no. 4. Biosystematics Division, Plant Protection Research Institute, Pretoria, South Africa, 130 pp.
- Miller, N., A. Estoup, S. Toepfer, D. Bourguet, L. Lapchin, S. Derridj, K.S. Kim, P. Reynaud, L. Furlan and T. Guillemaud. 2005. Multiple transatlantic introductions of the western corn rootworm. *Science* 310: 992-992.
- Gerald, J. Michels, Jr. and J.D. Burd. 2007. IPM Case Studies: *Sorghum*. In: van Emden, H.F. and R. Harrington (eds.). *Aphids as crop pests*. CAB, Wallingford, UK, pp. 627-637.
- Papapanagiotou, A.P., M. Nathanailidou, M. Taylor, K.D. Zarpas, K. Voudouris, J.A. Tsitsipis and J.T. Margaritopoulos. 2012. New records of aphid species (Hemiptera: Aphididae) in Greece. *Entomol. Hell.* 21: 54-68.
- Patti, I. and S. Barbagallo. 1998. An approach to the knowledge on the Italian aphid fauna. In: Nafria, N. and J.M. Dixon (eds.). *Aphids in Natural and Managed Ecosystems*. Universidad de León, León, Spain, pp. 397-405.
- Perez, P., J. L. Collar, C. Avilla, M. Duque and A. Fereres. 1995. Estimation of vector propensity of potato virus Y in open-field pepper crops of central Spain. *J. Econ. Entomol.* 88: 986-991.
- Petrovic-Obradovic, O., Z. Tomanovic, L. Poljakovic-Pajnik, S. Hrnčić, A. Vucetic and S. Radonjic. 2010. New invasive species of aphids (Hemiptera, Aphididae) in Serbia and Montenegro. *Arch. Biol. Sci.* 62: 775-780.
- Remaudière, G. and M. Remaudière. 1997. *Catalogue des Aphididae du Monde (Catalogue of the world's Aphididae)* Homoptera, Aphidoidea. INRA editions, Paris. 473 pp.
- Setokuchi, O. 1975. The hibernation of *Longiunguis sacchari* (Zehentner) on sorghums. *Jpn. J. Appl. Entomol. Zool.* 19: 296-297.
- Tsitsipis, J.A., E. Angelakis, J.T. Margaritopoulos, K. Tsamandani and K.D. Zarpas. 2005. First record of the grapevine aphid *Aphis illinoisensis* in the island of Kriti, Greece. *OEPP/EPPO Bull.* 35: 541-542.
- Tsitsipis, J.A., N.I. Katis, J.T. Margaritopoulos, D.P. Lykouressis, A.D. Avgelis, I. Gargalianou, K.D. Zarpas, D.Ch. Perdakis and A. Papapanayotou. 2007. A contribution to the aphid fauna of Greece. *Bull. Insectol.* 60: 31-38.

Δύο νεοεισαχθέντα είδη αφίδων στην Ελλάδα

I.T. ΜΑΡΓΑΡΙΤΟΠΟΥΛΟΣ¹, Α.Π. ΠΑΠΑΠΑΝΑΓΙΩΤΟΥ², Κ.Χ. ΒΟΥΔΟΥΡΗΣ^{1,3}, Α. ΚΑΤΗ⁴ ΚΑΙ R.L. BLACKMAN⁵

¹Τμήμα Βιοχημείας και Βιοτεχνολογίας, Πανεπιστήμιο Θεσσαλίας,
Πλούτωνος 26, 412 21 Λάρισα

²Τμήμα Τεχνολόγων Γεωπόνων, ΤΕΙ Δυτικής Ελλάδας,
Θεοδωροπούλου, 272 00 Αμαλιάδα

³Ινστιτούτο Μοριακής Βιολογίας και Βιοτεχνολογίας, Ίδρυμα Τεχνολογίας Έρευνας, Νικολάου
Πλαστήρα 100, 700 13, Ηράκλειο, Κρήτη

⁴Εργαστήριο Φυτοπαθολογίας, Σχολή Γεωπονίας, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης,
541 24 Θεσσαλονίκη

⁵Division of Life Sciences, The Natural History Museum, London SW7 5BD, UK

ΠΕΡΙΛΗΨΗ

Στην παρούσα εργασία παρουσιάζονται δύο νέα είδη αφίδων για την Ελληνική και την Ευρωπαϊκή αφιδοπανίδα. Τα είδη είναι τα *Aphis odinae* (van der Goot) και *Melanaphis sorghi* (Theobald) (Hemiptera: Aphididae). Το πρώτο βρέθηκε σε *Pittosporum* spp. στη Θεσσαλονίκη και το δεύτερο σε *Sorghum halepense* (L.) στο Μεσολόγγι και στη Θεσσαλονίκη. Δεν παρατηρήθηκαν σημαντικές προσβολές στο *Pittosporum* από το *A. odinae* και το *M. sorghi* δεν βρέθηκε σε αγρούς καλαμποκιού και σόργου σε επισκοπήσεις που έγιναν. Τα δυο είδη δεν φαίνεται να έχουν οικονομική σημασία επί του παρόντος, δηλαδή να προκαλούν ζημιές. Τα δυο νέα είδη ανεβάζουν το αριθμό καταγεγραμμένων ειδών αφίδων στην Ελλάδα σε 335.