

***HARMONIA AXYRIDIS* (PALLAS, 1773) (COLEOPTERA: COCCINELLIDAE), NEWLY RECORDED INVASIVE SPECIES FROM SAKARYA, TURKEY**

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ABSTRACT: The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), native to Asia, is one of the most important biological control agent and well known invasive alien ladybird species of the world. The harlequin ladybird was recorded for the first time on *Thuja orientalis pyramidalis aurea* (Cupressaceae) from Sakarya/Turkey in March, 2017. It has spread very rapidly and it is estimated that the prevalence and increase in Turkey will be continue. General information on this invasive species was given in the present paper.

KEY WORDS: *Harmonia axyridis*, invasive species, new record, *Thuja*, biodiversity

The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) is known the most invasive ladybird in the world. *H. axyridis* is native to central and eastern Asia, and has been introduced to at least five continents in Europe, North and South America, the Middle East, South Africa and Australia (Stals & Prinsloo, 2007; Brown et al., 2008; Smith & Fischer, 2008). The species has spread to other countries from the country of origin as a biological control agent as a predator of aphids and other soft-bodied insects. The species was first imported as a biological control agent from East Asia to America in 1916, and to Europe in the 1980`s (Sæthre et al., 2010). In Turkey, *H. axyridis* species that have recently entered our country and firstly recorded by Bukejs and Telnov (2015) in Cappadocia /Nevsehir (Göreme). This newly introduced pest has a high reproductive potential and a high dispersal capacity that allow it to rapidly colonize new locations in different part of Turkey. It is estimated that the dispersal capacity is around 50 to 100 km/year and causes a considerable increase in their distribution (Brown et al., 2008; Van- Lenteren et al., 2008). While *H. axyridis* is useful as a biological control agent, it is also known to cause adverse effects on native species due to intraguild predation, resource competition and intraspecific competition (Brown & Miller, 1998) impacts on non-target pests and fruit production (Koch, 2003; Koch et al., 2004), and impacts as a household pest and nuisance to humans (Kuznetsov, 1997; Kovach, 2004; Nalepa et al., 2004). It has recently been reported as a potential hazard to monarch butterflies developing in agricultural systems (Koch et al., 2003). For this reason, it is necessary to follow the expected further spread of *H. axyridis* in Turkey and to have more information about this invasive species. The aim of the present paper is to provide new information on the distribution of this species introduced in Turkey.

MATERIAL AND METHODS

Features of sampling place: Sakarya is located in the Marmara Region, in northwestern Turkey, between the Black Sea and Sapanca Lake as shown in Fig. 1. The land extending towards the Black Sea coast, on the two sides of the same named river which flows into this sea, is Sakarya, in the center of which lies the fertile plain of Adapazari. Arifiye is the district of Sakarya, and is located in the east of Lake Sapanca, and south of Sakarya. The distance from the Arifiye district to the center of Sakarya is 9 km, and the latitude and longitude of Arifiye (Sakarya) Turkey is: 40°42'47.77" N 30°21'40.61" E.

Features of host plant: *Thuja orientalis pyramidalis aurea* (Cupressaceae) grows in western regions of East Asia and North America. It is 5-6 m in length, usually in a pyramidal shape, with a thin pulsating outer shell and a fibrous inner shell as shown in Fig. 2. The branches are in a horizontal or vertical position. Immature leaves reciprocally arranged in the shoots are spindle-shaped. In contrast to the reddish or yellowish color of round male flower clusters formed at the tips of the individual branches, female flower clusters in very small structures are distinguished by their lilac green color.

Sampling method: Sampling was carried out during March 2017 on *Thuja* plants in Sakarya (Arifiye) province of Turkey. Two sampling methods were used: shaking the plants and visual inspections of the plants (Sæthre et al., 2010). The material collected was brought to the laboratory. The samples were separated individually and labelled for identification.

Identification of samples: The identification of the insects was made by Dr. Derya Senal (Seyh Edebalı University, Faculty of Agriculture Sciences and Technology, Plant Protection Department, Bilecik, Turkey).

RESULTS AND DISCUSSION

Observations of the harlequin ladybird in Sakarya (Arifiye), Turkey

The harlequin ladybird was found visually, while examining *Thuja* plants. Only 17 samples of lady beetle were taken for the collection. The samples collected were identified as *Harmonia axyridis* Pallas, 1773 (Coccinellidae).

Material examined: Arifiye/Sakarya, Turkey, 40 m, 14.III.2017, leg. Sevcan Oztemiz (1 specimen, 17 samples: 10 ♀♀; 7 ♂♂) as shown in Fig. 3. The specimens were deposited in the Duzce University, Faculty of Agriculture and Natural Science, Turkey.

Host Plant: *Thuja orientalis pyramidalis aurea* (Cupressaceae) as shown in Fig. 2. As it can be seen from the collection material and according to the author's observations, the harlequin ladybird, *Harmonia axyridis* (Pallas, 1773) was found for the first time on March 15 in 2017 in outdoor ornamental plants on *Thuja orientalis pyramidalis aurea* (Cupressaceae) in Sakarya (Arifiye) province, Turkey. The species was observed in greater numbers and in several forms of colour of imago (red, orange with or without spots and black with four big red spots). We found imago, egg, larvae and grubs on the plants as shown in Fig. 2 and Fig. 3.

Distribution: Central and Eastern Asia, Europe, North and South America, the Middle East, South Africa and Australia (Stals & Prinsloo, 2007; Brown et al., 2008; Smith & Fischer, 2008). In Turkey, since the first record in 2014, the species has been found at several locations in Turkey such as in Tekirdag (Malkara), Canakkale (Ayvacik, Bozcaada, Can, Eceabat, Geyikli) and Bartın (Inkum, Amasra, Bartın Center) (Aysal & Kivan, 2014; Bastug & Kasap, 2015;

Sobutay, 2016). In this study, a new one was added to the Coccinellidae fauna from Sakarya (Arifiye) province of Turkey. Together with this work so far, it is located in three different regions (Marmara, Central Anatolia and West Black Sea) of Turkey. *H. axyridis* has been found on imported cut flowers and fruits (Majerus et al., 2006). So, imports of ornamental plants pose a risk for the transport of *H. axyridis*. This species was introduced both intentionally and unintentionally to Europe, North and South America, the Middle East and South Africa (Stals & Prinsloo, 2007; Brown et al., 2008). *H. axyridis* has become a problematic invader species in many countries of the World as well as in Turkey.

Brief taxonomic history: *H. axyridis* belongs to the tribe Coccinellini of the family Coccinellidae (Kovář, 1996). This Coccinellid was initially described as *Coccinella axyridis*. It is highly polymorphic in colour pattern, eight junior synonyms, several subspecies and abnormal forms have been described (Korschefsky, 1932).

Taxonomic tree

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

Order: Coleoptera

Family: Coccinellidae

Genus: *Harmonia* Mulsant, 1846

Species: *Harmonia axyridis* (Pallas, 1773)

Description of *Harmonia axyridis* (Pallas, 1773)

Adults: The adults are 5-8 mm in length, oval shaped and convex, highly variable colouration and patterning (Fig. 3). Three colour forms are common: red or orange with zero to many black spots (f. *succinea*); black with four orange or red spots (f. *spectabilis*); and black with two orange or red spots (f. *conspicua*). The head is black and yellow markings. The pronotum is white with four black spots form an M-shaped. This structure is very important in the identification of species (Chapin & Brou, 1991; Kuznetsov, 1997; Majerus & Roy, 2005; Staverløkk et al., 2007).

Eggs: The eggs are approximately 1.2 mm in length, oval and yellow. The eggs turn gray or black close to hatching (Fig. 3).

Larvae: The larvae are black with orange colouration covered with scoli in three pronged on the dorsal surface of the abdomen and two on the dorsal-lateral surface (Fig. 3). The first-instar larvae are approximately 2 mm and darker than later instars reach to 7.5-10.5 mm in length (Sasaji, 1977; El-Sebaey & El-Gantiry, 1999).

Pupae: The pupae are orange and usually have an elongated dome shape (Fig. 3), attached to leaves (Sasaji, 1971; Hodek, 1996).

CONCLUSION

It would be necessary to carry out further research into the distribution of the species and monitoring of its population in Turkey to determine the spread of *H. axyridis* and have more information about this invasive species. Considering the biodiversity in the region, it is possible that the species will be found in different new locations of Turkey, and the number of species will be increase when more

detailed studies are carried out in this regard in future. In addition, the interactions between *H. axyridis* and other species within the aphidophagous community should be revealed.

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LITERATURE CITED

- Aysal, T. & Kivan, M. 2014. Occurrence of an invasive alien species *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in Turkey. *Plant Protection Bulletin*, 4: 141-146.
- Bastug, G. & Kasap, I. 2015. Faunistic studies on Coccinellidae (Coleoptera) family in the province of Canakkale. *Turkish Journal of Biological Control*, 6: 41-50.
- Brown, M. W. & Miller, S. S. 1998. Coccinellidae (Coleoptera) in apple orchards of eastern West Virginia and the impact of invasion by *Harmonia axyridis*. *Entomological News*, 109: 136-142.
- Brown, P. M. J., Roy, H. E., Rothery, P., Roy, D. B., Ware, R. L. & Majerus, Men. 2008. *Harmonia axyridis* in Great Britain: analysis of the spread and distribution of a non-native coccinellid. *BioControl* (Dordrecht), 53: 55-67.
- Bukejs, A. & Telnov, D. 2015. The first record of the invasive lady beetle *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) in Turkey. *Zoology and Ecology*, 25: 59-62. DOI: 10.1080/21658005.2014.984490.
- Chapin, J. B. & Brou, V. A. 1991. *Harmonia axyridis* (Pallas), the third species of the genus to be found in the United States (Coleoptera: Coccinellidae). *Proceedings of Entomological Society of Washington*, 93: 630-635.
- El-Sebaey, I. I. A. & El-Gantiry, A. M. 1999. Biological aspects and description of different stages of *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae). *Bulletin of the Faculty of Agriculture, Cairo Univ.*, 50: 87-97.
- Hodek, I. 1996. *Food Relationships*. In: Hodek I, Honek A, eds. *Ecology of Coccinellidae*, Dordrecht, Netherlands: Kluw. Academic Publ., pp. 143-238.
- Koch, R. L. 2003. The multicolored Asian lady beetle, *Harmonia axyridis*: a review of its biology, uses in biological control and non-target impacts. *Journal of Insect Science*, 3: 1-16.
- Koch, R. L., Hutchison, W. D., Venette, R. C. & Heimpel, G. E. 2003. Susceptibility of immature monarch butterfly, *Danaus plexippus* (Lepidoptera: Nymphalidae: Danaeinae), to predation by *Harmonia axyridis* (Coleoptera: Coccinellidae). *Biol Control*, 28: 265-270.
- Koch, R. L., Burkness, E. C., Burkness, S. J. & Hutchison, W. D. 2004. Phytophagous preferences of the multicolored Asian lady beetle (Coleoptera: Coccinellidae) to autumn ripening fruit. *Journal of Economic Entomology*, 97: 539-544.
- Korschefsky, R. 1932. Coccinellidae. En: Schlenkling S. Editor, *Coleopterorum Catalogus*, pp. 439-447, Berlin.
- Kovach, J. 2004. Impact of multicolored Asian ladybeetles as a pest of fruit and people. *American Entomology*, 50: 159-161.
- Kovář, I. 1996. Phylogeny, pp. 19-31, In: Hodek, I. & A. Honek 1996. *Ecology of Coccinellidae*, Kluw. Academic Publ. Holanda.
- Kuznetsov, V. N. 1997. Lady beetles of the Russian Far East. The Sandhill Crane Press, Inc., Gainesville.
- Majerus, M. & Roy, H. 2005. Scientific opportunities presented by the arrival of the harlequin ladybird, *Harmonia axyridis*, in Britain. *Bulletin of Royal Entomological Society (Antenna)*, 29: 196-208.
- Majerus, M., Strawson, V. & Roy, H. 2006. The potential impacts of the arrival of the harlequin ladybird, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in Britain. *Ecological Entomology*, 31: 207-215.
- Nalepa, C. A., Kennedy, G. G. & Brownie, C. 2004. Orientation of multicolored Asian lady beetles to buildings. *American Entomologist*, 50: 165-166.
- Sasaji, H. 1971. Fauna Japonica, Coccinellidae (Insecta: Coleoptera), Tokyo: Academic Press Japan.
- Sasaji, H. 1977. Larval characters of Asian Species of the Genus *Harmonia* Mulsant. *Memoir of the Faculty of Education Fukui University Series II Natural Science*, 27: 1-17.
- Sæthre, M. G., Staverløkk, A. & Hågvar, E. B. 2010. Stowaways in horticultural plants imported from the Netherlands, Germany and Denmark. *Norwegian Journal of Entomology*, 57: 25-35.
- Smith, B. & Fisher, D. 2008. Biosecurity risk - Asian lady beetle. *Wine Industry Newsletter*, 3.
- Sobotay, U. 2016. Coccinellidae (Insecta: Coleoptera) species in Bartın. University of Bartın, Graduate School of Natural and Applied Sciences, Forest Engineering, Bartın, MSc, 112 pp.
- Stals, R. & Prinsloo, G. 2007. Discovery of an alien invasive, predatory insect in South Africa: the multicoloured Asian ladybird beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae). *South African Journal of Science*, 103: 123-126.
- Staverløkk, A., Sæthre, M. G. & Hågvar, E. B. 2007. A review of the biology of the invasive harlequin ladybird *Harmonia axyridis* (Pallas, 1773) (Coleoptera, Coccinellidae). *Norwegian Journal of Entomology*, 54: 97-104.
- Van Lenteren, J. C., Loomans, A. J. M., Babendreier, D. & Bigler, F. 2008. *Harmonia axyridis*: an environmental risk assessment for Northwest Europe. *Biocontrol*, 53: 37-54.



Figure 1. Locality of *Harmonia axyridis* (Pallas) in the West Black Sea of Turkey: Sakarya (Arifiye).



Figure 2. Host plant of *Harmonia axyridis* (Pall.), *Thuja orientalis pyramidalis aurea* (Cupressaceae).



Figure 3. *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), a. Eggs, b. Larva, c. Pupa d. Adults.