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Orijinal araştırma (Original article)

Occurrence of an invasive alien species *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in Turkey

Türkiye'de yabancı istilacı bir tür, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae)

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Summary

Harmonia axyridis (Pallas) (Coleoptera: Coccinellidae) was detected, while studying on the species of Tingidae and their natural enemies between April and November in 2011-2013 in Tekirdağ. It is one of the most important biological control agent and well known invasive alien ladybird species. *H. axyridis* was recorded in Tekirdağ/Turkey and some knowledge on its distribution and economic importance were given.

Key words: *Harmonia axyridis*, Coccinellidae, new record, Turkey.

Özet

Tekirdağ İlinde, 2011-2013 yılları, Nisan-Kasım ayları arasında, Tingidae familyası türleri ve doğal düşmanları üzerinde yapılan çalışma esnasında *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) tespit edilmiştir. Önemli bir biyolojik savaş ajanı olan bu tür, istilacı uğur böceklerinden biri olarak bilinir. *H. axyridis* Tekirdağ/Türkiye'de kaydedilmiş ve türün yayılış ve ekonomik önemi hakkında bazı bilgiler verilmiştir.

Anahtar sözcükler: *Harmonia axyridis*, Coccinellidae, yeni kayıt, Türkiye.

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Introduction

The Harlequin ladybird, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) is native to Eastern Asia (Kuznetsov, 1997). The species has recently been recorded in other regions of the world, including South America (de Almeida & da Silva, 2002; Koch et al., 2006), Central America (Koch et al., 2006) and Africa (Ferran et al., 2000; Stals, 2008). It is an effective predator of aphids, coccids and other soft-bodied insects. It was introduced as a biological control agent of aphids and coccids in Europe. Use of *H. axyridis* has been successful in classical and augmentative biological control (Koch, 2003; Brown et al., 2008; Majerus et al., 2006; Brown et al., 2011b).

H. axyridis was first introduced as a biological control agent in 1982 in France, and between 1990 and 1997 field experiments and releases were carried out (Coutanceau, 2006). Mass production of *H. axyridis* in France began in 1992 and the first open-air commercial field releases were in 1995 (Kabiri, 2006). The species was released also in other European countries, such as Belgium, Czech Republic, France, Germany, Greece, Italy, Netherlands, Portugal, Spain and Switzerland, and it has been found in the wild without evidence of deliberate introduction in countries as Austria, Denmark, Great Britain and the Channel Islands, Liechtenstein, Luxembourg, Norway and Sweden (Brown et al., 2008).

Harmonia axyridis has been reported several negative impacts on the environment (biodiversity), human activity, fruit production and processing, biological control and native species in literature (Koch, 2003; Koch et al., 2006; Majerus et al., 2006; Evans & Oszako, 2007; Brown et al., 2008; Brown et al., 2011b). Especially this species was considered an invasive alien in Europe, North America (Brown et al., 2008) and South America (Koch et al., 2006) and the lack of dietary specificity for *H. axyridis* may lead to unintended adverse ecological effects through predation on native beneficial insects and other non-pest insects (Koch, 2003). *H. axyridis* larvae are able to reach the adult stage in the absence of aphids by feeding on alternative prey. The alternative food can be polen (Berkvens et al., 2008) or other aphidophagous predators such as *Coccinella septempunctata* L., *Adalia bipunctata* L., *Propylea quatuordecimpunctata* (L.) or *Episyrphus balteatus* (de Geer) (Phoofolo & Obrycki, 1998; Wells et al., 2010; Ingels & De Clercq, 2011). Brown (2003) indicated that the reduction in *C. septempunctata* abundance is correlated with the invasion of *H. axyridis* in apple orchards. It was concluded that it had wide host range, ability to establish and disperse, and direct and indirect effects on non-target species and there are no easy ways to mitigate or reduce the risk of *H. axyridis* and that it should not have been released in northwest Europe (van Lenteren et al., 2003).

This paper reports the first occurrence of *H. axyridis* in Tekirdağ-Turkey. Here, the potential impacts of distribution and economic importance of the species are assessed.

Material and Methods

The material for this study was collected from Malkara, Saray, Şarköy and Süleymanpaşa in Tekirdağ province between April and November in the years 2011-2013. During a field studies on the species of Tingidae and natural enemies, visual inspection and shaking method were used to collect the adults from woody plants as, apple, quince and pear. These insects were transported to the laboratory and sent for the identification after tagged. Identification of coccinellid species are made by Dr. Derya ŞENAL (Faculty of Agricultural Sciences and Technologies, Şeyh Edebali University, Bilecik) and Dr. Oldrich NEDVED (Faculty of Sciences, University of South Bohemia, and Institute of Entomology, Biology Center, Academy of Sciences of the Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic).

Results and Discussion

Harmonia axyridis (Pallas, 1773)

Material examined: 1 ♀, Tekirdağ: Malkara, Camiatik, N: 40°53.307', E: 26°54.425', 200 m, 10.VIII.2011, Coll: T. Aysal; 1 ♀, Malkara, Camiatik, N: 40°53.116', E: 26°54.854', 190 m, 07.IX.2012, Coll: T. Aysal; 1 ♀, Malkara, Evrenbey, N: 40°57.216', E: 27°01.645', 80 m, 09.VII.2011, Coll: T. Aysal; 2 ♀♀ Malkara, Evrenbey, N: 40°57.253', E: 27°01.580', 85 m, 18.VII.2012, Coll: T. Aysal; 1 ♀, 1 ♂, Malkara, Yenidibek, N: 40°46.067', E: 26°49.641', 131 m, 02.VIII.2012, Coll: T. Aysal; 1 ♀, Saray, Küçükyoncalı, N: 41°25.303', E: 27°57.163', 196 m, 29.IX.2012, Coll: T. Aysal; 1 ♀, Şarköy, Eriklice, N: 40°38.327', E: 27°11.125', 7 m, 10.IX.2012, Coll: T. Aysal; 1 ♀, Şarköy, İshaklı, N: 40°44.603', E: 27°05.654', 248 m, 29.IX.2011, Coll: T. Aysal; 3 ♀♀, 1 ♂, Şarköy, İshaklı, N: 40°44.634', E: 27°05.611', 267 m, 15.VIII.2012, Coll: T. Aysal; 2 ♀♀, 1 ♂, Şarköy, Palamutköy, N: 40°45.473', E: 27°09.427', 338 m, 15.VIII.2012, Coll: T. Aysal; 2 ♀♀, 1 ♂, Süleymanpaşa, N: 40°58.701', E: 27°33.086', 16m, 03.VIII.2011, Coll: T. Aysal; 1 ♀, Süleymanpaşa, N: 40°59.197', E: 27°34.748', 7 m, 06.X.2011, Coll: T. Aysal; 3 ♀♀, 2 ♂♂, Süleymanpaşa, N: 40°58.863', E: 27°34.254', 140 m, 29.X.2012, Coll: T. Aysal; 2 ♀♀, Süleymanpaşa, Değirmenaltı, N: 40°59.612', E: 27°34.782', 20 m, 30.VIII.2013, Coll: T. Aysal; 2 ♀♀, 1 ♂, Süleymanpaşa, Değirmenaltı, N: 40°59.612', E: 27°34.782', 20 m, 19.X.2013, Coll: T. Aysal; 1 ♀, Süleymanpaşa, Ferhadanlı, N: 40°59.686', E: 27°18.761', 208 m, 9.VIII.2012, Coll: T. Aysal; 1 ♀, Süleymanpaşa, Köseilyas, N: 41°00.054', E: 27°34.598', 50 m, 30.VIII.2012, Coll: T. Aysal; 1 ♀, Süleymanpaşa, Mermer, N: 40°51.546', E: 27°22.538', 272 m, 19.VII.2012, Coll: T. Aysal; 1 ♀, Süleymanpaşa, Naip, N: 40°52.749', E: 27°25.473', 21 m, 20.VII.2011, Coll: T. Aysal.

Distribution: *H. axyridis* has spread from Asia to other countries. Since 1988 it has established in 38 countries: three countries in North America, six in South America, 26 in Europe and three in Africa. In different continents the species has spread at rates estimated between 100 and 500 km year (Brown et al., 2011a).

It was found in Asia countries as Russia (Eastern, S. Siberia), Mongolia, China, Japan, Korea, Kazakhstan, Georgia and Caucasus (Brown et al., 2011a, Belyakova & Reznik, 2013).

In Europe, this species established range extends from Denmark in the north to southern France in the south, and from Czech Republic in the east to Great Britain in the west in Europe (Brown et al., 2008). It was been reported France, Greece, Germany, Belgium, Netherlands, England, Switzerland, Luxembourg, Czech Republic, Denmark, Austria, Norway, Poland, Wales, Spain, Liechtenstein, N. Ireland, Scotland, Sweden, Croatia, Hungary, Serbia, Slovakia, Slovenia, Ukraine, Bulgaria, Latvia, Romania, Bosnia and Herzegovina, Ireland, Belarus, Portugal in Europe (Brown et al., 2008; Brown et al., 2011a).

In North America, it was established in USA, Canada, Mexico (Brown et al., 2008; Brown, et al., 2011a); and in South America, in Argentina, Brazil, Chile, Peru, Paraguay, Uruguay, Colombia and Venezuela (Koch et al., 2006; Brown et al., 2011a; Solano & Arcaya, 2014).

It was detected in Egypt, Lesotho, Kenya, Tunisia in South Africa; and in Australia (Brown et al., 2011a).

It has spread rapidly, but not established formerly in Turkey. Recently, the species was found on apple, quince and pear trees near aphids and also found in buildings in Tekirdağ. Here it was a new record in Tekirdağ for the Turkish fauna.

Description and Brief Biology: Adults are oval and convex in shape, length, 4.81-7.47 mm; width, 3.90-5.89 mm (Chapin & Brou, 1991). They are highly color polymorphic with elytra ranging from pale yellow-orange to black bearing 0-19 spots (Figure 1). The head, antennae, and mouthparts are generally straw-yellow but sometimes tinged with black. The pronotum is similarly straw-yellow with up to five black spots or with lateral spots usually joined to form two curved lines, an M-shaped mark, or a solid trapezoid (Adriaens et al., 2003). The ventral surface can be yellow-orange to black. Legs are yellow-brown varying to black with posterior side of middle and hind legs and tarsi paler (Chapin & Brou, 1991).

Figure 1. *Harmonia axyridis* adults.

Eggs are oval shaped and about 1.2 mm long, freshly oviposited eggs are pale yellow in color and with time turn to a darker yellow, approximately 24 hours prior to hatching, the eggs become gray-black (El-Sebaey & El-Gantiry, 1999; He et al., 1994).

Larvae are elongate, somewhat flattened, and adorned with strong tubercles and spines. The mature larva is distinctively and strikingly colored. The overall ground colour is mostly black to dark bluish-grey, with a prominent bright yellow-orange patch extending over the dorsolateral lobes of abdominal segments 1-5 on each side (Adriaens et al., 2003).

Pupae are color polymorphic and pre-pupae have distinctive orange markings (Element, 2014).

H. axyridis is known to exist principally in shrubby and arboreal habitats (Brown, 2003). Additionally, it was determined feeding on field crops, as bean, corn, wheat and potato (Vandereycken et al., 2013). It is a multivoltine species. It has four generations in Greece (Katsoyannos et al., 1997), but they have two generations a year in GB (Anonymous, 2014). A female produces 1000-4000 eggs per life time, and the egg stage will take four to five days, the larval stage about three weeks a pupal stage one week in temperate regions (Anonymous, 2014). They hibernate as adults in large aggregations in diapause. Production of multiple generations would help to the rapid spread of *H. axyridis* in Europe.

Conclusions

The alien *H. axyridis* continues to expand its distribution around the world, since it's first introduction in USA and Europe. In autumn and winter, adults enter buildings for hibernating and can become a nuisance in some countries. They are larger than most other predators of aphids, and often consume the larval stages of other ladybirds. So they cause to reduce some native species. In addition, they can be harmful in apple and pear orchards and wineyards. In late summer and autumn aphids become scarce and the ladybirds feed on soft fruit causing blemishing and an associated reduction in market value. All these problems are not yet clear in Turkey. Surveys should be carried out to determine the spread of *H. axyridis*. Considering these risks, further studies on possible impacts and monitoring it's populations are necessary.

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References

Adriaens, T., E. Branquart & D. Maes, 2003. The multicoloured asian ladybird *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae), a threat for native aphid predators in Belgium? Belgian Journal of Zoology, 133 (2): 195-196.

Anonymous,2014. Harlequin ladybird,*Harmonia axyridis*. (Web sayfası: http://www.nonnativespecies.org/factsheet/downloadFactsheet.cfm?speciesId=1668) (Erişim tarihi: Haziran 2014).

Belyakova, N. A. & S. Ya. Reznik, 2013. First record of the Harlequin ladybird, *Harmonia axyridis* (Coleoptera: Coccinellidae) in the Caucasus. European Journal of Entomology, 110(4): 699-702.

Berkvens N., J. Bonte, D. Berkvens, K. Deforce, L. Tırry & P. de Clercq, 2008. Pollen as an alternative food for *Harmonia axyridis*. BioControl, 53: 201-210.

Brown, M. W., 2003. Intraguild responses of aphid predators on apple to the invasion of an exotic species, *Harmonia axyridis*. BioControl, 48: 141-153.

Brown, P. M. J., C. E. Thomas, E. Lombaert, D. L. Jeffries, A. Estoup & L. J. L. Handley, 2011a. The global spread of *Harmonia axyridis* (Coleoptera: Coccinellidae): distribution, dispersal and routes of invasion. BioControl, 56: 623-641.

Brown, P. M. J., R. Frost, J. Doberski, T. Sparks, R. Harrington & H. Roy, 2011b. Decline in native ladybirds in response to the arrival of *Harmonia axyridis*: early evidence from England. Ecological Entomology, 36: 231-240.

Brown, P. M. J., T. Adriaens, H. Bathon, J. Cuppen , A. Goldarazena, T. Hägg, M. Kenis, B. E. M. Klausnitzer, I. Kováf, A. J. M. Loomans, M. E. N. Majerus, O. Nedved, J. Pedersen, W. Rabitsch, H. E. Roy, V. Ternois, I. A. Zakharov & D. B. Roy, 2008. *Harmonia axyridis* in Europe: spread and distribution of a non-native coccinellid. BioControl, 53: 5-21.

Chapin J. B. & V. A. Brou, 1991. *Harmonia axyridis* (Pallas), the third species of the genus to be found in the United States (Coleoptera: Coccinellidae). Proceeding Entomological Society of Washington, 93(3): 630-635.

Coutanceau J. P., 2006. *Harmonia axyridis* (Pallas, 1773): une coccinelle asiatique introduite, acclimate´e et en extension en France. Bulletin de la Société Entomollogique de France, 111: 395-401.

de Almeida L. M. & V. B. da Silva, 2002. First record of *Harmonia axyridis* (Pallas) (Coleoptera, Coccinellidae): a lady beetle native to the Palaearctic region. Revista Brasileira de Zoologia, 19: 941-944.

Element, D., 2014. Beetles 16 – ladybirds 5 – Harlequin ladybirds. (Web sayfası: http://www.david.element.ukgateway.net/beetles16ladybirds5.htm), (Erişim tarihi: Kasım 2014)

El-Sebaey, I. I. A. & A. M. El-Gantiry, 1999. Biological aspects and description of different stages of *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae). Bulletin of the Faculty of Agriculture, Cairo University, 50: 87-97.

Evans, H. & T. Oszako, 2007. Alien Invasive Species and International Trade. Forest Research Institute, Warsaw, 119 p.

Ferran, A., S. A. El-Arnaouty, V. Beyssat-Arnaouty & H. Galal, 2000. Introduction and release of the coccinellid *Harmonia axyridis* Pallas for controlling *Aphis craccivora* Koch on faba beans in Egypt. Egyptian Journal of Biological Pest Control, 10: 129-136.

He, J. L., E. P., Ma, Y. C. Shen, W. L. Chen & X.Q. Sun, 1994. Observations of the biological characteristics of *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae). Journal of the Shanghai Agricultural College, 12: 119-124.

Ingels B. & P. De Clercq, 2011. Effect of size, extraguild prey and habitat complexity on intraguild interactions: a case study with the invasive ladybird *Harmonia axyridis* and the hoverfly *Episyrphus balteatus*. BioControl, 56: 871-882.

Kabiri, F., 2006. *Harmonia axyridis*: a problem or a distraction? REBECA Microbials Workshop meeting, Wageningen, Netherlands, 4–6 April 2006. (Web sayfası: http://www.rebeca-net.de/downloads/Risk%20assessment%20macrobials%20Kabiri.pdf) (Erişim tarihi: Haziran 2014).

Katsoyannos, P., D. C. Kontodimas, G. J. Stathas & C. T. Tsartsalis, 1997. Establishment of *Harmonia axyridis* on citrus and some data on its phenology in Greece. Phytoparasitica, 25: 183-191.

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., R. C. Venette & W. D. Hutchison, 2006. Invasions by *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in the Western Hemisphere: implications for South America. Neotropical Entomology, 35(4): 421-434.

Kuznetsov, V. N., 1997. Lady Beetles of The Russian Far East. Memoir No.1 Center for Systematic Entomology. T Gainesville, Sandhill Crane Press, Inc., Gainesville, 248 p.

Majerus, M., V. Strawson & H. Roy, 2006. The potential impacts of the arrival of the harlequin ladybird, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), in Britain. Ecological Entomology, 31: 207-215.

Phoofolo M. W. & J. J. Obrycki, 1998. Potential for intraguild predation and competition among predatory Coccinellidae and Chrysopidae. Entomologia Experimentalis et Applicata, 89: 47-55.

Solano, Y. & E. Arcaya, 2014. First record of *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) in Venezuella. Entomotropica, 29: 57-61.

Stals, R., 2008. Invasive ladybird spreading in South Africa. Biocontrol News and Information, 29: 24-26.

van Lenteren J. C., D. Babendreier, F. Bigler, G. Burgio, H. Hokkanen, S. Kuske, A. Loomans, I. Menzler- Hokkanen, P. van Rijn, M. Thomas, M. Tommassini & Q. Q. Zeng, 2003. Environmental risk assessment of exotic natural enemies used in inundative biological control. BioControl, 48: 3-38.

Vandereycken, A., Y. Brostaux, E. Joie, E. Haubruge & F. J. Verheggen, 2013. Occurrence of *Harmonia axyridis* (Coleoptera: Coccinellidae) in field crops. European Journal of Entomology, 110(2): 285-292.

Wells P. M., J. Baverstock, M. E. N. Majerus, F. M. Jiggins, H. Roy & J. K. Pell, 2010. Intraguild predation of non-coccinellid aphid natural enemies by *Harmonia axyridis*: prey range and factors influencing intraguild predation. IOBC/WPRS Bulletin 58: 185-192.