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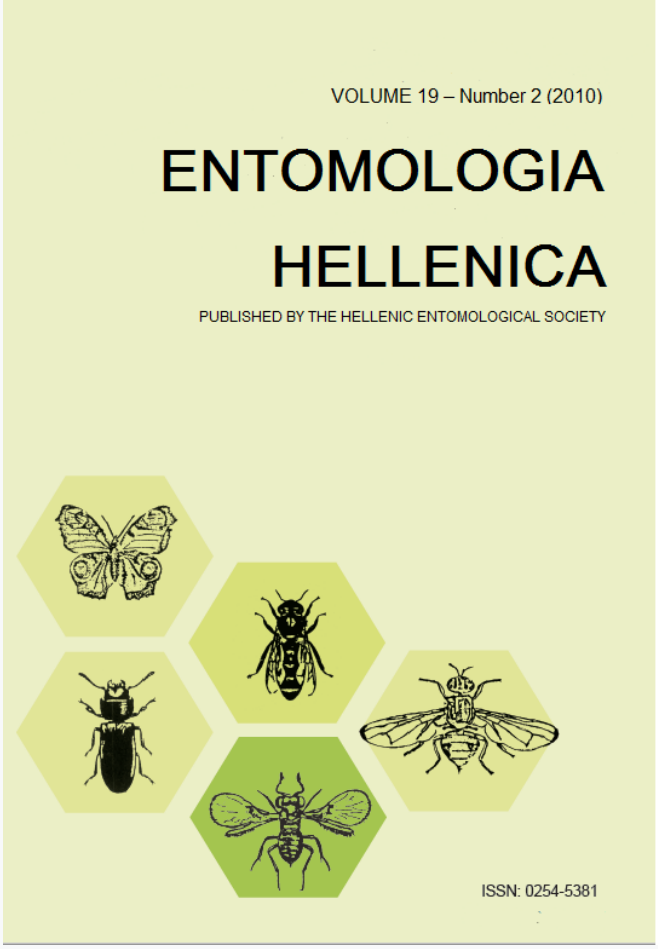

Επισκόπηση μη ιθαγενών ειδών κοκκοειδών εντόμων σε καλλωπιστικά φυτά στην Βουλγαρία και την Κίνα

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Non-indigenous scale insects on ornamental plants in Bulgaria and China: A survey

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ABSTRACT

A preliminary list of non-indigenous scale insect species on ornamental plants in Bulgaria and China is presented. The sampling was done between April and November, 2009, in the framework of the project "Invasive scale insects on ornamental plants in Bulgaria and China". The insects were collected in nurseries, parks, gardens, botanical collections and greenhouses. Representatives from four families have been identified in Bulgaria, the most numerous of which are the Diaspididae (eight species), Coccidae (four species), Pseudococcidae (two species) and Margarodidae (one species). Three species of non-indigenous scale insects associated with ornamental plants were collected in China, all belonging to the family Pseudococcidae. A list of alien scale insect species on ornamental plants is given, including the sampling sites, host plants on which they were found, origin and first report in both countries.

KEYWORDS: non-indigenous scale insects, Bulgaria, China, ornamental plants.

Introduction

There has been increased interest in recent years in the utilization of non-native ornamental plants in urban areas because of the beauty and diversity they lend to the landscape. However, the introduction of exotic ornamental plants to the urban landscape often results in the introduction of new pest and disease problems. Scale insects are notorious pests of ornamentals and are commonly transported with plant material and are frequent invasive species because of their small size and habit of feeding in concealed areas (Miller 2005). Due to the lack of natural enemies in their new habitat, and to their high fecundity and their protective covers and wax, effective control may be a major problem (Ben-Dov and Hodgson 1997). Information on the species composition of the scale insects fauna will allow us to predict possible pest problems and to make plans to manage them. In some cases, plants that are relatively immue to scale insect infestations could be selected while those especially susceptible could be avoided. Scale insects are frequent invaders. With 129 established species, they numerically represent one of the major group of insects alien to Europe (Pellizzari and Germain 2010).

Based on bibliographic sources, 34 species of scale insects are hypothesized by us as non-native on ornamental plants in Bulgaria (Tomov et al. 2009) and 73 in China (Wu unpublished work). The first list of Bulgarian scale insects was published by Tschorbadjiew (1938), who mentioned 23 species on 24 host plants.

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Since then there have been a few studies on scale insects on ornamentals, some of them quite old (Lazarov 1940, Stanev 1963, Tzalev 1968, Krusteva 1977, Staneva 1989, Pencheva 2007). The first published list of scales in China is that of Maskell (1897). Since then more than 1000 species were recorded in the country. Although there is some published work on the scale insects on ornamentals in China, the fauna is still poorly known (Tang 1977, 1992, Tang and Hao 1995).

The aim of this paper is to provide further information on the most common non-native scale insects that have been imported into both countries on exotic ornamentals via the plant trade.

Materials and Methods

The coccid samples were collected between April and November, 2009, mainly in nurseries, botanical collections and greenhouses, but also in gardens and parks, at the following sampling sites: BULGARIA**:** Varna, Sofia, Burgas, Troyan, Smolyan, Asenovgrad, Ravda, Plovdiv, Veliko Turnovo, Lovech, Kurdjali, Tzarevo, Nessebar, Sandanski, Kazanluk, Haskovo, Balchik (Fig. 1); CHINA: Beijing, Xinjiang, Guangdong (Fig. 2).

In the laboratory, the specimens were mounted on microscope slides according to the technique of Kosztarab and Kozár (1988) and identified using keys and illustrations of Kosztarab and Kozár (1988), Gill (1988) and Miller and Davidson (2005). Dry material and permanent slides have been deposited at University of Forestry, Plant Protection Department, Laboratory of Entomology, Sofia, Bulgaria and in Beijing Forestry University, Beijing, China. The term non-indigenous (alien) as used in this paper follows the definition of Nentwig and Josefsson (2009). The origin of the species is given according to Pellizzari and Germain (2010) and Miller et al. (2002). The nomenclature used here for the Coccoidea follows the ScaleNet database (Ben-Dov et al. 2010).

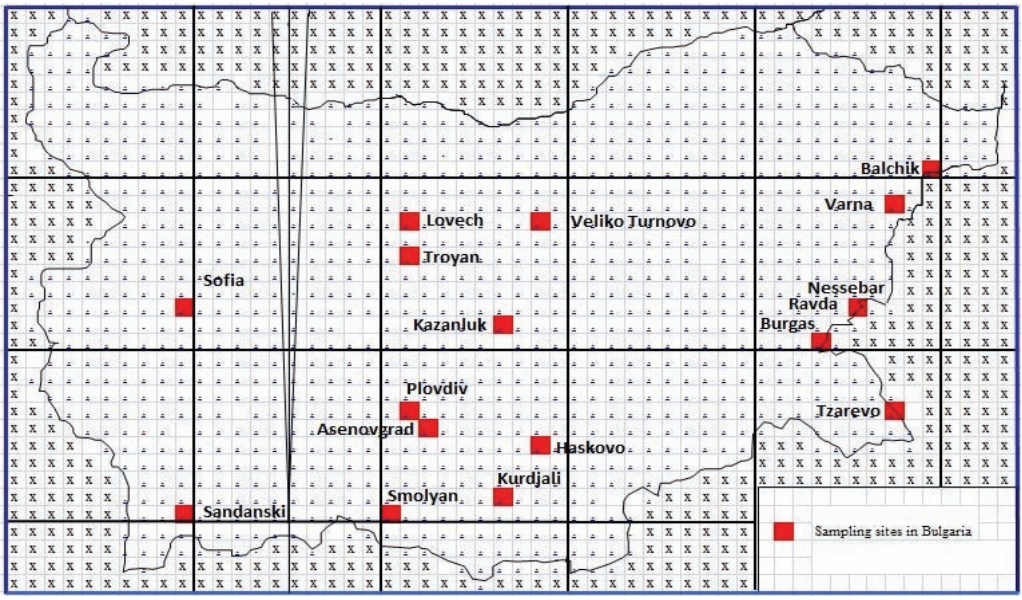

FIG.1. Sampling sites in Bulgaria (UTM map).

FIG. 2. Sampling sites in China.

Results and Discussion

The list of species collected is shown in Table 1, including the sampling sites, host plants, probable area of origin and the first report in both countries. During this short survey, a total of 15 coccoid species were collected in Bulgaria on 21 species of host plants and 3 species in China on 6 species of host plants. The most representative scale insect families in Bulgaria were Diaspididae, with eight species, and Coccidae, with four species. Three species of non-indigenous scale insects associated with ornamental plants were collected in China, all belonging to the family Pseudococcidae.

The most recent and interesting species collected in Bulgaria were the soft scale *Ceroplastes japonicus* Green and the diaspidid *Aulacaspis yasumatsui* Takagi. *C. japonicus* was recorded in Bulgaria for the first time in 2007 (Pencheva 2007) on an imported *Ilex aquifolium* L. and on *Hedera helix* L. According to Rainato and Pellizzari (2008), this species is a pest of ornamentals in urban environments in Italy, France, Slovenia and Croatia. To-date it has only been found indoors in Bulgaria but it is possible that with changes in climate, it might survive outside, at least in some years.

In Bulgaria, two species of *Aulacaspis* have been recorded: *A. rosae*, which is widely distributed and linked to Rosaceae, and the recently detected *A. yasumatsui*, recorded in July by Trencheva et al. (2009), on an imported *Cycas revoluta* Thunb., in a

TABLE 1. List of non-native species collected in Bulgaria and China, including the sampling sites, host plants on which they were found, area of origin and first report in both countries.

Family	Species	Host plant	Area of origin	Sampling sites	First record	Country
Coccidae	*Ceroplastes japonicus* Green	*Laurus nobilis* L.	Tropical Asia	Varna	Pencheva 2007	Bulgaria
	Coccus hesperidum Linnaeus	*Nerium oleander* L., *Citrus* sp., *Prunus laurocerasus* L.	Tropical, subtropical	Sofia, Varna, Burgas, Troyan, Smolyan, Asenovgrad	Tzalev 1968	Bulgaria
	Saissetia coffeae (Walker)	*Coffea arabica* L.	Afrotropical	Ravda, Sofia	Tschorbadjiew 1938	Bulgaria
	Saissetia oleae (Olivier)	*Olea europaea* L.	Afrotropical	Sofia, Plovdiv	Krusteva 1977	Bulgaria
Diaspididae	*Aspidiotus nerii* Bouché	*Strelitzia* sp., *Aulacubus* sp.	Afrotropical	Plovdiv, Veliko Turnovo, Smolyan	Tschorbadjiew 1938	Bulgaria
	Aulacaspis rosae (Bouche)	*Rosa* sp.	Asia	Sofia, Smolyan, Lovech, Kurdjali	Tschorbadjiew 1938	Bulgaria
	Aulacaspis yasumatsui Takagi	*Cycas revoluta* Thunb.	Asia	Tzarevo	Trencheva et al. 2009	Bulgaria
	Chrysomphalus aonidum (Linnaeus)	*Dracaena* sp.	Southern America	Nessebar	Tschorbadjiew 1938	Bulgaria
	Diaspidiotus perniciosus (Comstock)	*Cotoneaster* sp., *Crataegus* sp.	Asia	Petrich	Stanev 1963	Bulgaria
	Parlatoria oleae (Colvée)	*Pyrus sp., Malus sp.*	Asia	Petrich	Lazarov 1940	Bulgaria

TABLE 1 (continued). List of non-native species collected in Bulgaria and China**,** including the sampling sites, host plants on which they were found, area of origin and first report in both countries.

Family	Species	Host plant	Area of origin	Sampling sites	First record	Country
Diaspididae	*Pseudaulacaspis pentagona* (Targioni – Tozzetti)	*Morus alba* L., *Morus nigra* L., *Catalpa* sp., *Actinidia* sp.	Asia	Petrich, Sandanski, Kazanluk	Staneva 1989	Bulgaria
	Unaspis euonymi (Comstock)	*Euonymus* sp.	Asia	Sofia, Sandanski, Petrich, Burgas, Varna, Haskovo, Kurdjali, Lovech, Troyan, Nessebar, Ravda, Veliko Turnovo, Plovdiv, Asenovgrad, Smolyan	Tschorbadjiew 1938	Bulgaria
	Planococcus citri (Risso)	*Nerium oleander* L.	Asia	Balchik	Tschorbadjiew 1938	Bulgaria
	Pseudococcus longispinus (Targioni – Tozzetti)	*Coffea arabica* L.	Australia	Ravda	Tzalev 1968	Bulgaria
Pseudococcidae	*Phenacoccus solani* Ferris	*Euphorbia neriifolia var.cristata, Hylocereus undatus, Hoya carnosa, Schefflera macorostachya*	Nearctic Region	Beijing, Xinjiang	Chen et al. 2002	China

TABLE 1 (continued). List of non-native species collected in Bulgaria and China, including the sampling sites, host plants on which they were found, area of origin and first report in both countries.

Family	Species	Host plant	Area of origin	Sampling sites	First record	Country
Pseudococcidae	*Phenacoccus solenopsis* Tinsley	*Hibiscus rosa-sinensis* L.	Nearctic Region	Guangdong	Hodgson et al. 2008	China
	Pseudococcus philippinicus Williams	*Dracaena* spp.	Oriental Region	Beijing	Wang and Wu 2010	China
Margarodidae	*Icerya purchasi* Maskell	*Pittosporum tobira* Thunb.	Australasia	Plovdiv	Tzalev 1968	Bulgaria

garden center near to the town Tsarevo (Black sea). It is not clear from where the cycads plants were imported. Even if the cycad aulacaspis scale has been intercepted several times into Europe, it has not become established outdoors. In Bulgaria, *A. yasumatsui* may be a risk to cycads grown under glass and in botanical and private collections.

Other non-indigenous diaspidids that have been established in Bulgaria for a long time are *Diaspidiotus perniciosus, Parlatoria oleae, Pseudaulacaspis pentagona* and *Unaspis euonymi*. These species are present in both cultivated and natural habitats and are all polyphagous, except *Unaspis euonymi* which is monophagous on *Euonymus* sp.

Further non-native scales such as the coccids *Coccus hesperidum, Saissetia coffeae* and *Saissetia oleae*, the diaspidids *Aspidiotus nerii* and *Chrysomphalus aonidum,* the pseudococcids *Planococcus citri* and *Pseudococcus longispinus* and the monophlebid *Icerya purchasi* can only survive in Bulgaria in greenhouses, botanical collection or on house plants, which suggests that the climate is not appropriate for them to overwinter in the open.

All the species collected in China were found in greenhouses. *Phenacoccus solani* Ferris was reported for the first time by Chen et al. (2002) in Taiwan on 13 species of host plant, including *Lycoris aurea*, *Narcissus tazetta* and *Wedelia chinensis,* and by Wang and Wu (2009) in mainland China. It is a polyphagous species in greenhouses in north part of China and in open areas in southern China. *Phenacoccus solenopsis* Tinsley was reported for the first time by Hodgson et al. (2008) in Taiwan and by Wu and Zhang (2009) in mainland China. This species is now widely distributed in southern China. *Pseudococcus philippinicus* Williams was recorded recently in China on *Dracaena* spp. (Wang and Wu 2010). It was observed only in greenhouses, but perhaps could be found in open areas in southern China. However, for some species it is unclear how their impact and distribution will increase with climate changes. This list is a starting point for future investigation in both countries.

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Επισκόπηση μη ιθαγενών ειδών κοκκοειδών εντόμων σε καλλωπιστικά φυτά στην Βουλγαρία και την Κίνα

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ΠΕΡΙΛΗΨΗ

Παρουσιάζεται μια προκαταρκτική λίστα από μη ιθαγενή κοκκοειδή είδη σε καλλωπιστικά φυτά στην Βουλγαρία και την Κίνα. Η δειγματοληψία πραγματοποιήθηκε μεταξύ Απριλίου και Νοεμβρίου, 2009, στο πλαίσιο του προγράμματος "Επεκτατικά αλλόχθονα κοκκοειδή έντομα σε καλλωπιστικά φυτά στην Βουλγαρία και την Κίνα". Τα έντομα συλλέχθηκαν από φυτώρια, πάρκα, κήπους, βοτανικές συλλογές και θερμοκήπια. Είδη από 4 οικογένειες βρέθηκαν στην Βουλγαρία. Τα περισσότερα είδη ανήκουν στην οικογένεια Diaspididae (οκτώ είδη), στην οικογένεια Coccidae βρέθηκαν τέσσερα είδη, στην οικογένεια Pseudococcidae δύο είδη και στην οικογένεια Margarodidae ένα είδος. Τρία είδη μη ιθαγενών κοκκοειδών εντόμων σε καλλωπιστικά φυτά βρέθηκαν κατά τις δειγματοληψίες στην Κίνα. Τα τρία είδη ανήκουν στην οικογένεια Pseudococcidae.