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SIX NEW ALIEN PHYTOPHAGOUS INSECT SPECIES RECORDED IN SLOVENIA IN 2011

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Abstract - Six alien phytophagous insects found in 2011 in Slovenia for the first time are presented: *Dichromothrips corbetti* (Thysanoptera, Thripidae), *Aleuroclava aucubae* and *Pealius azaleae* (Hemiptera, Aleyrodidae), *Ceroplastes ceriferus* (Hemiptera, Coccidae), *Cydalima perspectalis* (Lepidoptera, Crambidae) and *Aproceros leucopoda* (Hymenoptera, Argidae). Pathways of their introduction and spread as well as their potential phytosanitary and environmental impacts are briefly discussed.

KEY WORDS: Slovenia, alien insects

Izvleček – ŠEST NOVIH TUJERODNIH RASTLINOJEDIH VRST ŽUŽELK, NAJDENIH V SLOVENIJI LETA 2011

Članek obravnava šest tujerodnih rastlinojedih žuželk, ki so bile v letu 2011 prvič najdene tudi v Sloveniji. To so: *Dichromothrips corbetti* (Thysanoptera, Thripidae), *Aleuroclava aucubae* in *Pealius azaleae* (Hemiptera, Aleyrodidae), *Ceroplastes ceriferus* (Hemiptera, Coccidae), *Cydalima perspectalis* (Lepidoptera, Crambidae) in *Aproceros leucopoda* (Hymenoptera, Argidae). Na kratko je obravnavan njihov vnos in širjenje ter možne fitosanitarne in okoljske posledice.

KLJUČNE BESEDE: Slovenija, tujerodne žuželke

Introduction

An increasing introduction and spread of alien insects into Slovenia has been reported recently (Seljak, 2011). This phenomenon by itself is not new and has been documented many times throughout Europe. The trend of exponential rise of the number of new alien species introduced into Europe as well as into Slovenia in recent time is,

however, of big concern. Considering only the phytophagous insects and mites more than 60 alien species have been recorded as new to Slovenia in the last decade. This is about twice as many as in the previous decade (1991-2000) and about six times as many as in the decade 1981-1990 (Seljak, 2011). This means that fauna of Slovenia has been "enriched" by roughly six new alien insects and mites each year. Also the last year, 2011, was no exception since six new phytophagous alien insect species were discovered to occur in the territory of Slovenia.

Material and methods

Introduction of new and already known non indigenous plant pests is systematically monitored by the phytosanitary inspection and public plant protection services, both coordinated by the Phytosanitary Administration of the Republic of Slovenia (PARS). Samples of unknown insects were sent to the authorised laboratory for entomological and acarological diagnostics at Agriculture and Forestry service Nova Gorica (Kmetijsko gozdarski zavod Nova Gorica – KGZ NG). However, in the present case the majority of the new alien species were discovered and sampled by the author himself. All samples were processed according to the standard entomological procedures for morphological diagnostics. If EPPO diagnostic protocol for the species involved exists, identification procedure is done according to this protocol. For species in respect of which special preparation techniques are required for a reliable identification, permanent slides were done. Voucher material of the majority of species being dealt with is deposited in the insect collection at the KGZ NG. In most cases, photographs of living specimens and/or injury symptoms were taken as well. Besides the topographic names of localities, their UTM squares are also given.

Results

***Dichromothrips corbetti* (Priesner, 1936) [Thysanoptera, Thripidae]** - vanda thrips, orchid thrips; SLO: orhidejev resar (Fig. 1-3)

Material examined: Nova Gorica (UL99), 16.5.2011 on *Phalaenopsis* spp. orchids.

The specimens of this species were picked up from pot orchids during a regular phytosanitary inspection of plant material on the market. Infested orchids were delivered from The Netherlands, while their exact origin is unknown.

D. corbetti is an almost cosmopolitan species that, however, originates in South-Eastern Asia. It has been widely introduced by the trade of ornamental orchids all over the world. In Europe, it has been repeatedly intercepted during phytosanitary inspections of imported orchids. Since it is a thermophilous tropical species, in temperate climate conditions it can only persist indoors, mostly in greenhouses. Its host plants are various ornamental orchids from the genera *Vanda, Phalaenopsis, Ascocenda* and some others. *D. corbetti* is a specialist orchid feeder causing injuries preferably to flowers. Injuries on flowers consist of innumerable punctures of minute discoloured areas on the surface, particularly obvious on dark coloured orchid species and varieties. The present phytosanitary status of *D. corbetti* in Slovenia could only be considered as an in-

Fig. 1: *Dichromothrips corbetti* - slide mounted female

Sl. 1: *Dichromothrips corbetti* - preparirana samica

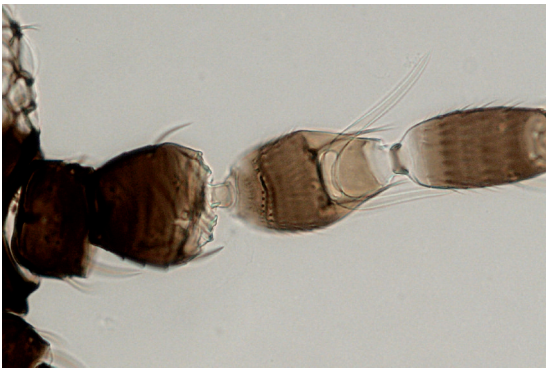

Fig. 2: *Dichromothrips corbetti* - forked sense cone on the third antennal segment

Sl. 2: *Dichromothrips corbetti* - viličast čutni stožec na tretjem členu tipalk

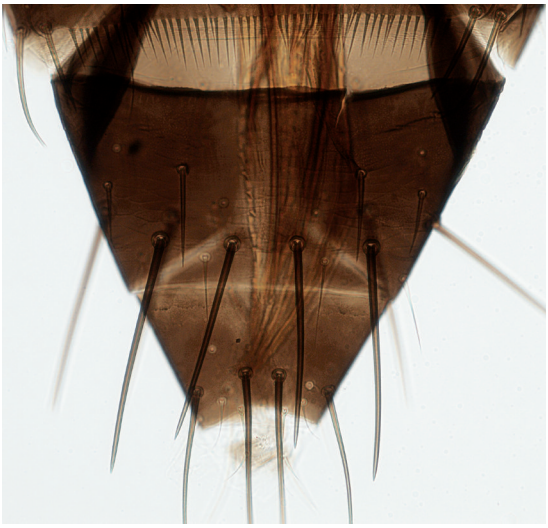

Fig. 3: *Dichromothrips corbetti* - abdominal segments 8, 9 and 10 with posteromarginal comb on segment 8

Sl. 3: *Dichromothrips corbetti* - 8., 9. in 10. zadkovi členi z resicami na zadnjem robu 8. člena

terception. However, it might become a threat to the large-scale production of pot orchids in greenhouses.

Besides the strict association with orchids as its host plant, the species can be recognised by the following combination of characters: female body length 1.4-1.6 mm, dark coloured, except tarsi, distal half of tibia and basal part of forewings, which are yellow (Fig. 1), only two pairs of ocellar setae present, first ante-ocellar pair (S_1) wanting, antennae 8-segmented, dark, forced sense cones on antennae segment 3 fairly long (Fig. 2), lack of long ante- and postero-marginal setae on pronotum, meso- and metasternal furca with well-developed spinula, posteromarginal comb on segment 8 complete, long and dense fringed (Fig. 3). An excellent identification key for this and other related species has been provided by zur Strassen (2003).

***Aleuroclava aucubae* (Kuwana, 1911) [Hemiptera, Aleyrodoidea, Aleyrodidae]** (Fig. 4-6)

Material examined: Solkan (UL99), 15.11.2011 on *Citrus limon;* Nova Gorica (UL99), 20.12.2011 on *Pittosporium tobira,* 24. 1. 2012 on *Ligustrum lucidum* and *Photinia fraseri*, 20. 3. 2012 on *Prunus lusitanica.*

The occurrence of this species in Slovenia was discovered merely by chance in a sample of lemon leaves brought by the grower himself, being interested in some growing problems of his lemon plants. Afterwards additional infested leaves were collected at the same place in order to provide enough voucher material and to prepare slide mounted specimens. The infestation of lemon plants was moderate, with mostly only 1 – 3 puparia per leaf, but there were also several leaves with more than ten puparia each. Further searching for puparia on potential host plants led to their discovery on the leaves of *Pittosporium tobira, Ligustrum lucidum, Photinia fraseri* and *Prunus lusitanica* in a park in the Nova Gorica town centre.

Puparia of *A. aucubae* are very small 0.72 - 0.84 mm in length, elliptical, deep black with characteristically ornamented surface (Fig. 4). However, a reliable identification is only possible on the basis of slide mounted puparia (Fig. 5, 6). A good key for identification of this species was provided by Takahashi (1952).

A. aucubae is an East Palaearctic whitefly species previously recorded in Japan, Taiwan and China and later introduced also into the USA - California (Evans, 2007). In Europe, it was first found in northern Italy in 2006 (Pellizzari et Šimala, 2007) but that publication wrongly identified this insect as *A. guyavae* (Takahashi, 1932) (Jon Martin, pers. comm.). Puparia were found on several evergreen plants in greenhouses (*Ficus sycomorus*, *Citrus limon*), but also on some plants growing outdoors during the whole season like apricot trees, *Pittosporium tobira* and *Photinia* spp. (Pellizzari et Šimala, 2007).

A. aucubae overwinters in the puparia stage. In the climatic conditions of northern Italy and south-western Slovenia, it certainly can survive the winter on host plants which usually are wheeled indoors during the winter (i.e. lemon plants). The occurrence of puparia on several evergreen shrubs in Nova Gorica in the open air during the winter time clearly suggests that the species is also able to overwinter outdoors but this has not been experimentally established yet. From the present knowledge *A. aucubae*

Fig. 4: *Aleuroclava aucubae* - puparia (life-size 0.7-0.8 mm)
Sl. 4: *Aleuroclava aucubae* - puparija (n. v. 0,7 - 0,8 mm)

does not apparently cause damage to cultivated plants (Pellizzari et Šimala, 2007). At most it might become a minor pest in citrus production in the Mediterranean countries.

***Pealius azaleae* (Baker et Moles, 1920) [Hemiptera, Aleyrodoidea, Aleyrodidae]** - Azalea whitefly; SLO: azalejev ščitkar (Fig. 7)

Material examined: Šempeter pri Gorici (UL98), 19.5.2011 on azalea (*Rhododendron indicum*) leaves.

A heavy infestation of azalea leaves was discovered in a private garden. The origin of these azalea plants could not be established as they have grown there for years. Light yellow puparia have been situated almost exclusively on the lower leaf sides (Fig. 7). A fine sooty mould has developed on infested leaves due to the honeydew excreting by the larval stages. As azalea bushes are growing continuously in the open air in

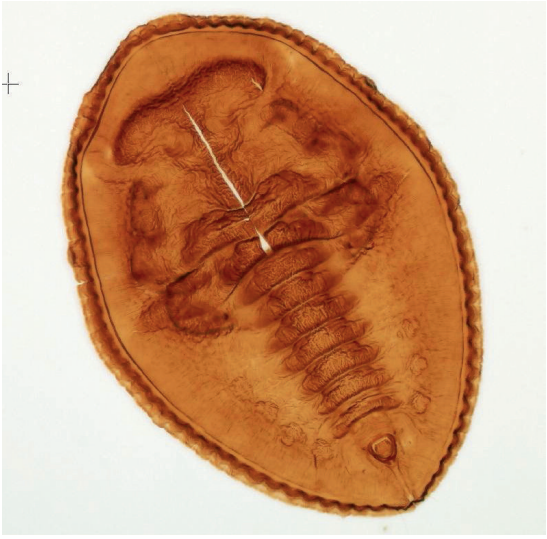

Fig. 5: *Aleuroclava aucubae* - slide mounted puparium
Sl. 5: *Aleuroclava aucubae* - prepariran puparij

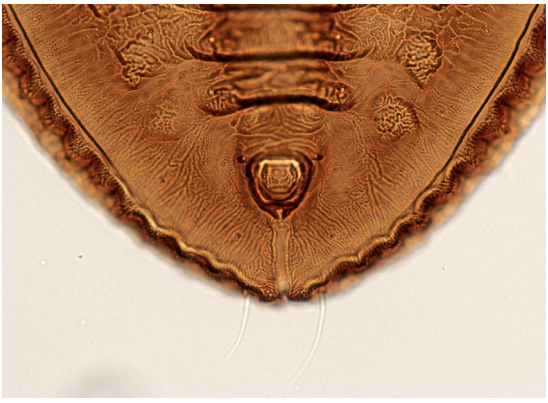

Fig. 6: *Aleuroclava aucubae* - vasiform orifice
Sl.6: *Aleuroclava aucubae* - zadnjična odprtina

this case, it is obvious that the species can successfully overcome the winter conditions of this region.

Puparia of *P. azaleae* are yellowish, elongate-oval, small sized - 0.7 - 0.8 mm, with long and stout caudal setae, also cephalic and 1st abdominal tergite setae are usually enlarged; transverse moulting suture does not reach the margin of puparia; vasiform orifice elongate cordate, operculum occupying about two-thirds of it, leaving ligula head ± free; caudal furrow present, about as long as vasiform orifice.

P. azaleae is likely to be an East-Palaearctic whitefly species (Japan, Korea, India). With azalea plants it has been introduced into many other parts of the world: USA, Belgium, England, Scotland, Netherlands, Russia, Iran, Australia, New Zealand (Evans, 2007), Czech Republic (Zahradnik, 1987) and Italy (Del Bene et al., 1991). This whitefly species is closely associated to the host plants of the genus *Rhododendron*, especially of the *Sciadorhodion* subg. and *Tsutsusi* subg., which are better known by their

common name 'azalea'. The following azalea species have been recorded as the host plants: *Rhododendron ponticum, Rh. indicum, Rh. mucronatum, Rh. schippenbachii* (Evans, 2007). *P. azaleae* is considered as a minor pest of ornamental azaleas, in particular those being kept indoors (Martin et al., 2000). The biology of this pest was studied in details by Del Bene and collaborators in Italy (Del Bene et al., 1991). According to these authors, *P. azaleae* develops two generations per year. It overwinters in the 4th larval stage passing into puparia stage in March. Adults of the first generation fly in May and June, those of the second generation from August to October. In our cursory observations in December 2011 larvae of the second and third developmental instars could still be found, while the majority of them have already been in the fourth developmental instar stage. Some adults have also been observed. At that time, the eggs were not found any more.

In addition, another alien whitefly species, *Massilieurodes chittendeni* (Laing), living on *Rhododendron* has been found to occur in Slovenia (i.e. Arboretum Volčji potok). As far as we know, it turns up very scattered and in small populations without causing any visible damages.

Fig. 7: *Pealius azaleae* - puparia on the lower side of an azalea leaf.
Sl. 7: *Pealius azaleae* - pupariji na spodnji strani lista azaleje

Fig. 8: *Ceroplastes ceriferus* - mature female (life-size 7-10 mm)
Sl. 8: *Ceroplastes ceriferus* - odrasla samica (n. v. 7 - 10 mm)

***Ceroplastes ceriferus* (Fabricius, 1798) [Hemiptera, Coccoidea, Coccidae] -** indian wax scale. SLO: stožčasti kapar (Fig. 8)

Material examined: Ljubljana - Črnuče (VM60), 23.11.2011 on *Acer palmatum*.

According to the grower's information, the infested plants of *A. palmatum* were purchased in Italy, but more precise data about the supplier and date of purchase were not provided. At the present knowledge, this finding is to be considered only as an interception. It is impossible to predict whether this species could survive winter conditions in the Central Slovenia. It can almost certainly survive in sub-Mediterranean climatic conditions of South-Western Slovenia. In this region, it may be a potential occasional pest of ornamental plants growing in parks and gardens. It requires very similar environmental conditions as its relative *Ceroplastes japonicus*, which is already widely spread and highly invasive all over the Primorska region (Jančar et al., 1999, Seljak, 2008). *C. ceriferus* can be easily recognised by the dorsal hornlike protrusion (Fig. 8) that lacks in other similar white waxy species occurring in Europe, like *C. sinensis* and *C. floridensis*.

C. ceriferus is most likely to be native to Asia, but it has already been widely distributed all over the world (Gimpel et al., 1974). In Europe, it has been intercepted several times at the imports of ornamental plants. In 2001, it was found to be already established in some areas in North Italy (Veneto - District Verona and Lombardia - District Bergamo) (Mori et al. 2001). Later it also spread into the adjacent areas of Emilia-Romagna. In this area, *C. ceriferus* is considered as established and to be the minor pest of various ornamental and wild plants (Pellizzari et al., 2004). Occasionally it has been even suppressed by the application of insecticides. The species is extremely polyphagous being found on host plants from at least 52 plant families. In Europe it was mostly found on woody plants like *Acer palmatum, Cornus, Desmodium penduliflorum, Deutzia, Laurus nobilis, Magnolia, Malus, Spirea, Camellia, Euonymus, Hedera, Pyracantha, Buxus* and many others (Mori et al. 2001).

C. ceriferus develops one generation per year. It overwinters in adult female stage. It reproduces almost exclusively parthenogeneticaly, as males do usually not occur or are seen only very seldom (Gimpel et al., 1974). Eggs are laid in May and June. Larvae hatch from the beginning of June to mid July. The development goes through 3 larval stages. Adult females appear again from mid August onwards (Pellizzari et al., 2004).

***Cydalima perspectalis* (Walker 1859) [Lepidoptera, Crambidae]** (syn.: *Diaphania perspectalis, Glyphodes perspectalis*) - box-tree pyralid, SLO: pušpanova vešča (Fig. 9-10).

Material examined: Ključarovci (WM85), 23.8.2011 on *Buxus sempervirens* (leg., coll. and det. Matjaž Ježˇ).

This species has not yet been seen alive by the author. He only saw pictures of heavy damaged bushes of *Buxus sempervirens* sent to him by an owner. On that basis, the presence of this species was supposed. Later on, Matjaž Ježˇ (Maribor) visited the infested site and confirmed the presence of this species. He collected some voucher ma-

Fig. 9: *Cydalima perspectalis* - adult moth

Sl. 9: *Cydalima perspectalis* - odrasel metulj (foto: Matjaž Ježˇ)

Fig. 10: *Cydalima perspectalis* - heavy damaged box tree bush

Sl. 10: *Cydalima perspectalis* - močno poškodovan grm pušpana (foto: Slavica Prelog)

Fig. 11: *Aproceros leucopoda* - elm leaf with the zigzag feeding trace of a young larva (right leaf) and damages made by elder larval instars (left leaf)

Sl. 11: *Aproceros leucopoda* - mlade pagosenice delajo cikcakaste poškodbe na brestovih listih (desni list); poškodbe pagosenic višjih razvojnih stopenj (levi list)

terial and took photos of adult moths and damaged bushes (Jež, 2012). It is still unknown, how the species arrived there, but most probably with infested *Buxus* plants for planting. According to unpublished records, a few specimens of this moth have already been caught by light traps since 2008 (Gomboc, pers. comm.)

C. perspectalis is native to Asia (Japan, Korea, China). In Europe, it was first found in Germany in 2007 (BBA/AGK/Bau/06/2007, Krüger, 2008), from where it has quickly spread throughout the Central Europe. Currently, it has been recorded in Germany (already widely spread), Austria and Lichtenstein (Rodeland, 2009), Switzerland (Käppeli, 2008), Netherlands (Muus et al., 2009), France (Feldtrauer et al., 2009), Italy (EPPO, 2011), Britain (Mitchell, 2009), and most recently also in Belgium (Casteels et al., 2011) and Hungary (Sáfián et Horváth, 2011). It is thought that most probably the species was introduced with imports from China.

Caterpillars of *C. perspectalis* feed on leaves and young shoots of *Buxus* spp. (*B. sempervirens, B. microphylla, B. sinica*), often causing severe defoliation (Fig. 10). It may be a serious pest threatening nurseries, natural boxwood stands, but especially the historical and decorative gardens and parks where boxwood is an important design plant. That's why it was put on the EPPO Alert list in 2008, although later removed and not recommended for regulation. There is still little knowledge about the biology of this pest in Europe. In China, it develops up to three generations per year and overwinters in the caterpillar stage (Zhou et al., 2005). A quite comprehensive presentation of this species with excellent photographs is given on the website http://www.lepiforum.de.

***Aproceros leucopoda* Takeuchi [Hymenoptera, Argidae]** - elm sawfly, SLO: brestova grizlica (Fig. 11)

Material examined: Rožna dolina (UL98), 25.9.2011; Nova Gorica (UL99), 28.9.2011; Kromberk (UL99), 9.10.2011.

The spread of *A. leucopoda* sawfly into Slovenia was expected, since its mass occurrence has been recorded in the neighbouring regions in Friuli-Venezia Giulia in Italy (Zandigiacomo et al., 2011). First signs of its presence were noticed in late September 2011 just close to the border with Italy in Rožna dolina near Nova Gorica. Later typical "zigzag" injuries on elm leaves were discovered at two other sites in and around Nova Gorica. In that late season, no larvae or adults could be found. At about the same time leaf injuries were also found on elms in the Botanical Garden in Ljubljana and in Arboretum Volčji potok. Also in these cases, no live animals could be found, but only a few empty cocoons on the lower sides of elm leaves (de Groot et al., 2012).

A. leucopoda is an East-Asiatic species, known to be indigenous in Japan, China and Far-East Russia (Blank et al., 2010, secondary citation). In Europe, it was first recorded in Hungary and Poland in 2003. Now it is present in Poland, Hungary, Austria, Slovakia, Romania, Ukraine (Blank et al., 2010), Italy (Zandigiacomo et al., 2011) and Germany (Kraus et al., 2011). Elm sawfly feeds on various *Ulmus* species, in Europe most frequently on *Ulmus minor* and *U. glabra*, but also on other indigenous and ornamental members of this genus (*U. laevis, U. davidiana, U. pumila, U. japonica,*

U. laciniata). Early instar larvae make typical zigzag feeding traces in leaves, while elder stages may devour the whole leaf tissue causing complete defoliation of the attacked trees. Therefore, it is considered as a very invasive and harmful pest of elm trees in Europe. Repeated heavy infestations may seriously weaken elm trees and increase the risk to be attacked by the extremely destructive Dutch elm disease (*Ophiostoma novo-ulmi*).

According to the observations in Friuli-Venezia Giulia, *A. leucopoda* may develop at least four generations per year. It overwinters in the last larval stage (nymph) in a cocoon mainly in the ground (Zandigiacomo et. al, 2011).

The larval development goes through six developmental stages. Larvae are completely green to yellowish green, but they have typical T-shaped dark brown or black markings on the second and third thoracic legs. Also the head is crossed by a dark stripe. Adult sawflies are black to dark brown with whitish or pale yellowish legs. A good key for identification of adults and larvae of this species has been provided by Blank (Blank et. al. 2010).

Discussion

The above presented newly discovered alien phytophagous insect species in Slovenia represent only a small sample, which, however, demonstrates very well the trend that has been followed in the last 20 years. Six new alien phytophagous insect species discovered in 2011 represent the exact yearly average of the last decade. This is the consequence of free and expanding markets as well as increasing quantities of transported goods, especially live material. Recently, an increased and very intensive import of live goods from China that had been for many decades of the previous century commercially isolated, is apparent. An enormous biotic potential of this country has been released within a quite short period, which is of particular concern in temperate zones with similar climate conditions, where organisms of these origins may easily be introduced and established.

Considering only plant material, import of ornamental plants is the most frequent pathway of introduction of new alien insects into Europe and Slovenia, although it is not necessarily the most important one. All above discussed species and their host plants may be considered as to belong to this group. While the finding of *Dichromothrips corbeti* on orchids in sale could be considered only as an interception, all other species have biotic potential to be wider-spread and established in the territory of Slovenia, especially in its south-western sub-Mediterranean part. *Aproceros leucopoda* and *Cydalima pespectalis* have even the potential to become very invasive species, with unpredictable consequences on the forest environment and cultivated landscape. An early discovery of new, potentially harmful organisms is of particular importance in order to stop their further spread at the population rate when eradication measures may still be feasible. A continuous surveillance carried out by phytosanitary services, plant health authorities and other stakeholders that are supported by qualified diagnostic laboratories and followed by rapid and appropriate phytosanitary measures seems to be the only good response to this globalisation mess.

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