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CONTENTS ***Pests & Diseases***

Invasive Plants

21 Bld Richard Lenoir
75011 Paris

Tel: 33 1 45 20 77 94
Fax: 33 1 70 76 65 47

E-mail: hq@eppo.int
Web: www.eppo.int

2015/089 First report of *Erwinia amylovora* in the Republic of Korea

In early May 2015, the presence of *Erwinia amylovora* (EPPO A2 List) was detected for the first time in the Republic of Korea on pear trees (*Pyrus* sp.). The bacterium was found in 3 adjacent pear orchards in the cities of Anseong and Cheonan. A delimiting survey was immediately conducted within a radius of 5 km around the infected site. As of 2015-05-29, 6 pear trees in Anseong city (3 orchards) were confirmed to be infected by *E. amylovora*. 330 pear trees from 14 orchards (13 orchards in Anseong city and 1 orchard in Cheonan city) are still under test. All infected pear trees have been destroyed, as well as all host plants located within a radius of 100 m around infected trees. Official control measures, including chemical sprays, prohibition to move host plants and bee hives, and specific surveys, are being implemented within a buffer zone of 5 km radius.
The pest status of *Erwinia amylovora* in the Republic of Korea is officially declared as: **Transient, actionable, under eradication.**

Source: IPPC website (2015-05-29) First outbreak of *Erwinia amylovora* in Rep. of Korea. https://www.ippc.int/en/countries/republic-of-korea/pestreports/2015/05/first-outbreak-of-erwinia-amylovora-in-rep-of-korea/

Additional key words: new record **Computer codes:** ERWIAM, KR

2015/090 First report of *Pseudomonas syringae* pv. *actinidiae* in Greece

The presence of *Pseudomonas syringae* pv. *actinidiae* (EPPO A2 List) is reported for the first time in Greece. In mid-March 2014, a sample of shoots (canes and leaders) of *Actinidia deliciosa* cv. 'Summer kiwi', showing red-rusty cankers and brown discoloration of the vascular tissues underneath the bark, was sent by a grower for examination to the Benaki Phytopathological Institute. This sample originated from a kiwifruit orchard (1 ha planted with 5-year-old plants) located in the area of Drosero (Pella prefecture, Northern Greece). It was also noted that, in this orchard, almost all plants exhibited symptoms. Laboratory and pathogenicity tests confirmed the presence of the bacterium in the studied sample. A nationwide survey is underway to determine the extent of the affected area.
The situation of *Pseudomonas syringae* pv. *actinidiae* in Greece can be described as follows: **Present, first found in 2014 in one sample collected from Northern Greece.**

Source: Holeva MC, Glynos PE, Karafla CD (2015) First report of bacterial canker of kiwifruit caused by *Pseudomonas syringae* pv. *actinidiae* in Greece. *Plant Disease* **99**(5), p 723.

Additional key words: new record **Computer codes:** PSCMAK, GR

2015/091 Survey of *'Candidatus* Liberibacter solanacearum' in carrot crops in Norway

In Norway, '*Candidatus* Liberibacter solanacearum' (EPPO A1 List – Solanaceae haplotypes) was detected for the first time in 2011 on carrots (*Daucus carota*, Apiaceae) in the Southeastern part of the country (see EPPO RS 2012/120). This bacterium is transmitted by the carrot psyllid, *Trioza apicalis*. A survey was carried out in the main carrot-growing regions in 2011 and 2012 to determine the occurrence of '*Ca*. L. solanacearum' in carrot plants and in psyllids, based on PCR tests. Carrot plants were collected from 30

commercial and research fields in 9 municipalities located in the counties of Akershus, Hedmark, Oppland, Østfold, Vestfold, (Southeastern Norway) and in the county of Rogaland (Southwestern Norway). In studied fields, the rate of symptomatic plants (showing leaf curling, discoloration) ranged from 10 to 100%. Carrot psyllids were collected with sweep nets and sticky traps from 10 commercial carrot fields in the municipalities of Rygge (Østfold county) and Larvik (Vestfold county). '*Ca*. L. solanacearum' could be detected in carrot plants and in *T. apicalis* from all municipalities surveyed in 2011 and 2012, except in samples collected from Rogaland county. The infection rate ranged from 33% to 100% in symptomatic carrot plants and from 21% to 56% in psyllid specimens. These results showed that '*Ca*. L. solanacearum' is widespread in several counties in Southeastern Norway, where most carrot crops are grown.

Source: Munyaneza JE, Sengoda VG, Sundheim L, Meadow R (2014) Survey of *'Candidatus* Liberibacter solanacearum' in carrot crops affected by the psyllid *Trioza apicalis* (Hemiptera: Triozidae) in Norway. *Journal of Plant Pathology* **96**(2), 397-402.

Additional key words: detailed record **Computer codes:** LIBEPS, TRIZAP, NO

2015/092 Situation of *Ceratocystis platani* in Greece

In Greece, *Ceratocystis platani* (EPPO A2 List) was first detected in 2003 in Messenia prefecture and gradually invaded the neighbouring prefectures of Ilia and Arcadia (see EPPO RS 2004/009). In 2009, the disease was observed in the Achaia prefecture. As of 2010, the disease had already killed thousands of oriental plane (*Platanus orientalis*) trees of all ages and sizes in these infected areas of Peloponnese. In 2010, *C. platani* was also found for the first time in the region of Epirus (Northwestern Greece, close to the border with Albania). In the region of Epirus, the disease was found near Tyria, in the Ioannina prefecture, as well as along the Kalamas river in the Thesprotia prefecture. Considering the number of infected trees, it is estimated that *C. platani* has been present in the region of Epirus since 2005-2006. It is suspected that the fungus has been transferred to the Epirus region with machinery used during the construction of a new highway. The spread of *C. platani* is considered to be a serious threat to oriental plane trees in Greece.
The situation of *Ceratocystis platani* in Greece can be described as: **Present, several foci in Peloponnese and Epirus regions.**

Source: Tsopelas P, Soulioti N (2014) Invasion of the fungus *Ceratocystis platani* in Epirus: a potential threat of an environmental disaster in the natural ecosystems of plane trees. Abstract of a paper presented at the 15th Hellenic Phytopathological Congress (Corfu, GR, 2010-10-05/10). *Phytopathologia Mediterranea* **53**(2), 340-376.

Additional key words: detailed record **Computer codes:** CERAFP, GR

2015/093 Grapevine red blotch-associated virus: addition to the EPPO Alert List

Why: Grapevine red blotch-associated virus (GRBaV) is a newly identified virus of grapevine (*Vitis vinifera*) and a putative member of a new genus (which remains to be characterized) within the family Geminiviridae. This virus is associated with red blotch disease that was first reported in California in 2008, and then found in the major grape-growing areas in North America. As GRBaV causes an emerging disease which affects the

profitability of vineyards by substantially reducing fruit quality and ripening, the EPPO Panel on Phytosanitary Measures suggested its addition to the EPPO Alert List.

Where: for the moment, GRBaV has only been reported from North America. Although, reported recently, it is thought that GRBaV has been present in North American vineyards for a long time. The symptom similarity to leafroll viruses probably explains the delay in recognizing and characterizing the causal agent of red blotch disease.
EPPO region: absent.
North America: Canada (Ontario), USA (Arizona, Arkansas, California, Georgia, Idaho, Maryland, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Texas, Virginia, Washington).

On which plants: grapevine (*Vitis vinifera*). The disease affects red cultivars (e.g. Cabernet franc, Cabernet sauvignon, Malbec, Merlot, Mourvèdre, Petit Verdot, Petite Syrah, Pinot Noir, Zinfandel), white cultivars (e.g. Chardonnay, Riesling), as well as table grapes and some rootstocks. GRBaV has been detected in grapevine collections, nursery stock and established vineyards.

Damage: in red grapevine cultivars, foliar symptoms consist of red blotches, marginal reddening, and red veins. In white cultivars, foliar disease symptoms are less conspicuous and generally involve irregular chlorotic areas that may become necrotic late in the season. Some white cultivars, such as Sauvignon Blanc may remain asymptomatic. Foliar symptoms first appear on older leaves at the base of the canopy in June and July and progressively move toward the top of the canopy in later months. Symptoms caused by GRBaV resemble those of leafroll viruses, but GRBaV does not cause leaf rolling, the red discolouration remains blotchy and irregular, and the smaller veins become red instead of remaining green. In addition to foliar symptoms, GRBaV affects fruit quality by delaying fruit ripening and reducing sugar content at harvest (i.e. grapes are slow to develop sugar levels sufficient for winemaking and some never fully mature).

Transmission: GRBaV is graft-transmissible and the most likely source of contamination of new vineyards is infected plant material. Although spread of GRBaV by a vector has not been confirmed, the patchy distribution of infected vines in vineyards and the increase in the number of diseased vines over time suggests that a vector is involved in disease spread. Glasshouse experiments have shown that GRBaV could be transmitted by *Erythroneura ziczac* (Hemiptera: Cicadellidae - Virginia creeper leafhopper) from infected to healthy vines. However, further studies are needed to understand how the virus is spread under field conditions and determine the role of the leafhopper(s) in disease epidemiology.

Pathway: plants for planting of grapevine from countries where GRBaV occurs.

Possible risks: grapevine is a crop of major economic importance in the EPPO region. GRBaV has been shown to negatively affect grapevine production and in particular, the quality of the berries. As the epidemiology of red blotch disease remains to be clarified, and in particular the role of possible vectors, the main control measures rely on the use of healthy planting material, and in some cases on the elimination of diseased plants. At present, the presence of GRBaV has been confirmed only in North America. However, in a study conducted in the National Clonal Germplasm Repository (NCGR) in California, grapevine accessions originating from countries outside North America (including European countries) tested positive for the virus. It cannot be concluded from these results that the virus occurs in those countries, but it seems wise that grapevine-growing countries verify

the presence or absence of GRBaV in their crops, and eventually include this new virus in certification schemes to prevent its spread.

Sources

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Additional key words: Alert List **Computer codes:** GRBAV0, CA, US

2015/094 *Grapevine vein clearing virus*: a new virus of grapevine

Grapevine vein clearing virus (GVCV) is a new badnavirus that is closely associated with an emerging disease of grapevine (*Vitis vinifera*) in the Midwest region of the USA. This disease has been observed for several decades in vineyards, but symptoms have probably been attributed to *Grapevine fanleaf virus*, thus delaying the identification of a new virus. In early spring, infected vines show a narrow strip of chlorotic tissues along the major and minor veins of fully expanded leaves of young shoots. Chlorotic veins are translucent when symptomatic leaves are held against sunlight (a characteristic symptom of the disease). Young shoots have short internodes with zigzag growth. Mature leaves are of reduced size, deformed, and display various patterns of chlorotic to yellowish tissues, as well as rolled margins. In advanced stages of infection the vines become dwarfed, bear fewer bunches and may show decline symptoms. GVCV has been detected in several grapevine cultivars (e.g. Cabernet franc, Cabernet sauvignon, Cayuga white, Chardonel, Chardonnay, Corot noir, Merlot, Muscat, Riesling, Traminette, Valvin, Vidal blanc, Zinfandel), as well as in a few plants of wild *Vitis* spp. growing near commercial vineyards. According to preliminary experiments, the cultivar 'Chambourcin' seems to be resistant. GVCV is a graft-transmitted virus, and it is assumed that the propagation of infected material is the main

pathway for spreading the disease. The fact that the disease has been frequently observed in Midwest vineyards in recent years, may suggest that GVCV is slowly spread from vine to vine by arthropod vectors. Although, no vector has been identified for the moment, it can be recalled that some badnavirus are transmitted by pseudococcid mealybugs. Further studies are needed to better understand the biology, epidemiology, geographical distribution and economic impact of GVCV.

Source: Guo Q, Honesty S, Xu ML, Zhang Y, Schoelz J, Qiu WP (2014) Genetic diversity and tissue and host specificity of *Grapevine vein clearing virus*. *Phytopathology* **104**(5), 539-547.

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National Clean Plant Network. Grapevine Vein Clearing and Vine Decline Disease. http://ucanr.edu/sites/NCPNGrapes/files/171630.pdf

Zhang Y, Singh K, Kaur R, Qiu WP (2011) Association of a novel DNA virus with the grapevine vein-clearing and vine decline syndrome. *Phytopathology* **101**(9), 1081-1090.

Additional key words: new pest **Computer codes:** GVCV00, US

2015/095 Situation of Grapevine Pinot gris virus in Italy

Since 2003, the presence of a new syndrome characterized by symptoms of stunting, chlorotic mottling, leaf deformation, reduced yields and quality has been reported in grapevine (*Vitis vinifera*) in Trentino-Alto Adige (EPPO RS 2014/006). In 2012, molecular analysis (deep-sequencing) of 2 plants (*V. vinifera* cv. Pinot gris – 1 symptomatic and 1 asymptomatic) led to the identification of a new virus tentatively called Grapevine Pinot gris virus (*Trichovirus*, GPGV). Subsequent studies could also detect the virus in other Northern regions of Italy (Emilia-Romagna, Friuli-Venezia Giulia, Lombardia, Veneto), as well as in other European countries (Czech Republic, France, Slovakia, Slovenia) and in the Republic of Korea (see EPPO RS 2014/208, 2015/055).

In Friuli-Venezia Giulia, the Plant Protection Service initiated a large-scale survey of GPGV from 2012 to 2014. In this region, Pinot gris, Traminer, Friulano (tokay) and Glera (Prosecco) are the most affected cultivars. Samples (1294 in total) were collected from symptomatic and asymptomatic plants in vineyards and nurseries, and tested in the laboratory (PCR tests). Results showed that GPGV was present in approximately 95% of the tested symptomatic samples and in 61-87% of the asymptomatic samples (depending on the year studied). Field observations indicated a widespread occurrence of this syndrome in Friuli-Venezia Giulia, although the percentage of affected vine was generally limited. A progressive increase of the symptomatic vines (from 14.7 to 33.9%) was also observed during the studied period. It is concluded that although these results show that GPGV is widespread in Friuli-Venezia Giulia and plays a role in the observed syndrome, the virus presence in asymptomatic grapevine plants still remains to be explained.

Finally, GPGV was also detected in Southern Italy during spring 2014. The virus was found in 2 distinct areas of Puglia region in table grapes (*V. vinifera* cvs. 'Black Magic' and 'Supernova').

Source: Beber R, de Lillo E, Malagnini V, Gualandri V, Poggi Pollini C, Ratti C, Saldarelli P, Valenzano D, Vernile P, Terlizzi F (2013) Transmission trials of Grapevine Pinot gris virus by the eriophyid mite *Colomerus vitis*. *Journal of Plant Pathology* **95**(4S), S4.36.

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Raiola A, Scopel C, Ferrigo D, Taglietti F, Duso C, Causin R (2013) First report of Grapevine Pinot gris virus infecting cv. Glera in the Conegliano-Valdobbiadene area. *Journal of Plant Pathology* **95**(4S), S4.58.

Additional key words: detailed record **Computer codes:** GPGV00, IT

2015/096 First report of Grapevine Pinot gris in Greece

In a recent review about virus and virus-like diseases of grapevine, the presence of Grapevine Pinot gris virus (*Trichovirus*, GPGV) in Greece is reported without any further details.

Source: Martelli GP (ed) (2014) Minor viruses and virus diseases. *Journal of Plant Pathology* **96** (1S), 105-120.

Additional key words: new record **Computer codes:** GPGV00, GR

2015/097 Studies on potential vectors of '*Candidatus* phytoplasma phoenicium' in Lebanon

In Lebanon, almond witches' broom (associated with '*Candidatus* Phytoplasma phoenicium' - formerly EPPO Alert List) is a lethal disease of almond (*Prunus dulcis*), peach (*P. persica*) and nectarine (*P. persica* var*. nucipersica*). The disease has rapidly spread from coastal areas to altitudes above 1200 m, killing more than 150 000 trees during the last 20 years. Transmission experiments have recently shown that the leafhopper, *Asymmetrasca decedens* (Hemiptera: Cicadellidae) is a vector of the disease. During these studies, it has also been found that the incubation period of the disease in plants could exceed one year. It is noted that further research is needed on the mode of transmission of '*Ca*. P. phoenicium' by *A. decedens*, and more generally on the epidemiology of the disease (e.g. to investigate the existence of other vectors). It is also concluded that international cooperation and IPM strategies are needed to contain this lethal disease of fruit trees (Abou-Jawdah *et al*., 2014).

In another survey about potential vectors of '*Ca*. P. phoenicium' conducted in Lebanon from 2011 to 2013, preliminary transmission experiments have shown that some *Tachycixius* species, *T. viperinus* and *T. cf cypricus* (Hemiptera: Cixiidae), could transmit the phytoplasma to healthy peach plants. It is stated that further studies are needed to clarify the taxonomic status and biology of these insects, as well as their potential role in disease transmission (Tedeschi *et al.*, 2015).

Source: Abou-Jawdah Y, Abdel Sater A, Jawhari M, Sobh H, Abdul-Nour H, Bianco PA, Molino Lova M, Alma A (2014) *Asymmetrasca decedens* (Cicadellicae, Typhlocybinae) ,a natural vector of '*Candidatus* Phytoplasma phoenicium'. *Annals of Applied Biology* **165**(3), 395-403.

Tedeschi R, Picciau L, Quaglino F, Abou-Jawdah Y, Molino Lova M, Jawhari M, Casati P, Cominetti A, Choueiri E, Abdul-Nour H, Bianco PA, Alma A (2015) A cixiid survey for natural potential vectors of *'Candidatus* Phytoplasma phoenicium' in Lebanon and preliminary transmission trials. *Annals of Applied Biology* **166**(3), 372-388.

Additional key words: epidemiology **Computer codes:** EMPODC, PHYPPH, TACXCY, TACXVI, LB

2015/098 *Orientus ishidae*: a potential phytoplasma vector spreading in the EPPO region

During the last decades several invasive Auchenorrhyncha species have been introduced into the EPPO region, such as *Metcalfa pruinosa* (Hemiptera: Flatidae) and *Scaphoideus titanus* (Hemiptera: Cicadellidae - vector of grapevine flavescence dorée). Another species originating from Asia, *Orientus ishidae* (Hemiptera: Cicadellidae) has now been reported from several European countries and is currently spreading in the EPPO region. This species has also been introduced in North America (Canada and USA) during the last century. It was first recorded in 1919 in New Jersey (US) on *Aralia spinosa*. At that time, it had been suspected that it had been introduced with nursery stock imported from Japan. Recent taxonomic studies have revealed that the taxon previously referred to as *O. ishidae* comprises two distinct species: specimens examined from Japan, USA and European countries belonged to *O. ishidae*, but those from China (Liaoning) and the Eastern Maritime region of Russia (Amur) corresponded to a new species, *Orientus amurensis*. *O. ishidae* is a highly polyphagous species which has been observed in association with many woody plants and deciduous trees (e.g. *Acer, Aralia, Betula, Carpinus, Corylus, Fagus, Hedera, Gleditsia Malus, Populus, Prunus, Salix, Tilia*), as well as some herbaceous plants (e.g. *Urtica*). *O. ishidae* is a sap-feeder, although some damage (i.e. uniform browning of apple and hazel foliage) has occasionally been reported in the USA, it is not considered to be a major pest of cultivated plants. The main concern raised by the introduction of *O. ishidae* in the EPPO region is the possible transmission of phytoplasma diseases. Experiments conducted in the 1970s in the USA have showed that *O. ishidae* could transmit Peach X disease (associated with '*Candidatus* Phytoplasma pruni') to celery plants. Recent studies conducted in Italy, Slovenia and Switzerland detected the presence of Grapevine flavescence dorée in specimens of *O. ishidae* collected from diseased vineyards. However, more research is needed to verify the capacity of *O. ishidae* to transmit the pathogen, and evaluate its potential role in the phytoplasma disease epidemiology.

From the literature, the spread of *O. ishidae* in the EPPO region could be retraced as indicated below. In most cases, specimens were found in urban or suburban environments (often caught in light or yellow sticky traps), and sometimes found along rivers and woodland margins.

- **Italy (1998):** the first specimens were collected in 1998/2002 in a residential area in Milano (Lombardia region). Additional specimens were collected in 2004 from a single weeping willow tree (*Salix babylonica*) near Lucca (Toscana region), and in 2011 in vineyards affected by flavescence dorée near Varese (Lombardia region).
- **Switzerland (2000):** *O. ishidae* was first recorded from Switzerland in 2000 (specimens were collected in a light trap in Basel). Its presence was also observed in vineyards in the Southern part of the country.

- **Germany (2002)**: the first specimens were found during summer 2002 in Weil am Rhein (Baden-Württemberg) and in the city of Dresden (Sachsen). *O. ishidae* then rapidly spread to several other German lander (Bayern, Berlin, Hessen, Nordrhein-Westfalen, Rheinland-Pfalz, Sachsen-Anhalt).
- **Slovenia (2002):** the first specimens were caught in 2002 on yellow sticky traps in Nova Gorica but could not be identified at that time. In July 2004, a substantial population of *O. ishidae* was found in Ljubljana on *Salix* spp. and Nova Gorica on various fruit trees (see EPPO RS 2006/160). Since its first detection, the insect has spread across the country.
- **Czech Republic (2004)**: the first specimens were collected in near Brno in 2004 (on the banks of a stream 'Leskava Brook'), and in the city of Prague in 2006 (in an apartment attracted by light).
- **Austria (2007):** the first specimen was collected in 2007 in Graz.
- **France (2009):** *O. ishidae* was first observed in Alsace in 2009 but it stated that the insect had probably been present prior to this.
- **Hungary (2010):** the first specimen was caught in 2010 in a private garden in the northwestern part of Budapest. In 2011, adults were caught in yellow sticky traps in a suburban area at the northwestern limits of Budapest. At this site, several specimens were caught by branch beating from *Betula* and *Quercus*. *O. ishidae* was also found on *Viburnum* spp. in the botanical garden of the Corvinus University of Budapest and in an apartment located in its close vicinity.
- **United Kindgom (2011):** it was first recorded in a park (Warwick Gardens, Peckham) in the London area in 2011.

Finally, several forums and blogs on the Internet indicate that *O. ishidae* is probably present in more European countries, such as:

Belgium (pictures taken in 2008)
http://www.cebe.be/technics/htm/invent.php?loc=p&id=4415
http://observations.be/soort/info/194988
http://www.natuur-forum.be/phpBB3/viewtopic.php?f=121&t=8926

Slovakia (picture taken in 2012)
http://www.biolib.cz/en/image/id260686/

Spain (pictures taken in 2012 and 2014)
http://www.biodiversidadvirtual.org/insectarium/Orientus-ishidae-%28Matsumura-1902%29-cat26685.html

Source:

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- British Bugs. *Orientus ishidae*.
http://www.britishbugs.org.uk/homoptera/Cicadellidae/Orientus_ishidae.html

- The GiGLer. The newsletter of Greenspace Information for Greater London. Hopping in Peckham by P Frith (dated 2012-02).
http://www.gigl.org.uk/GiGLer/?p=802

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Additional key words: new record, geographical distribution

Computer codes: ORIEIS, PHYP64, AT, CA, CH, CZ, DE, FR, GB, HU, IT, JP, SI, US

2015/099 New data on *Agrilus auroguttatus*

Agrilus auroguttatus (Coleoptera: Buprestidae – EPPO Alert List) is a wood borer which has recently been introduced into California (US), probably from Arizona (US). In California, *A. auroguttatus* is causing extensive tree mortality on native oak species (see EPPO RS 2013/058). Recent studies have been conducted in the USA and provide new information about this pest.

Determination of its area of origin in Arizona

In California, the development of a classical biological control program against *A. auroguttatus* is a high priority due the continuing ecological and economic damage caused by this insect since its introduction. In order to determine its area of origin, an analysis of the genetic relationships existing between and within populations of *A. auroguttatus* from Arizona and California has been conducted. Although the area of origin for the invasive population in California could not be firmly determined, results suggest that the Dragoon

Mountains (Cochise county in Arizona) could be a possible area of origin. Future surveys for natural enemies which might be used in the biological control of *A. auroguttatus* will be focussed on the Dragoon Mountains area (Lopez *et al.*, 2014b).

Flight performance
The flight performance of adults of *A. auroguttatus* under different age (old/young), mating (virgin/mated) and nutritional (fed/starved) status was assessed under controlled conditions using computerized flight mills. Adults were attached to flight mills for a 24 h period, and the total distance flown, flight times and velocities, number and duration of flight periods, body size and weight were measured. It was observed that nutrition, body size, and interactions between nutrition and age were important factors (gender and mating status had no influence), and that *A. auroguttatus* was only capable of flying relatively short distances during a 24 h period. The general results of these experiments indicate that *A. auroguttatus* is unable to fly long distances across habitats that lack suitable host plants. The authors concluded that their work supports the hypothesis that human-aided transportation (probably via infested oak firewood) from Southern Arizona across the Sonora desert has led to the introduction and subsequent spread of *A. aurogutattus* within the native oak woodlands of Southern California (Lopez *et al.*, 2014a).

Source: Lopez VM, McClanahan MN, Graham L, Hoddle MS (2014a) Assessing the flight capabilities of the goldspotted oak borer (Coleoptera: Buprestidae) with computerized flight mills. *Journal of Economic Entomology* **107**(3), 1127-1135.

Lopez VM, Rugman-Jones PF, Coleman TW, Hoddle MS, Stouthamer R (2014b) Population genetics of goldspotted oak borer, *Agrilus auroguttatus* Schaeffer (Coleoptera: Buprestidae): investigating the origin of an invasive pest of native oaks in California. *Biological Invasions* **16**(11), 2393-2402.

Additional key words: biology, genetics **Computer codes:** AGRLGT, US

2015/100 *Globodera ellingtonae*: a new potato cyst nematode

Globodera ellingtonae is a new cyst nematode which was described from Oregon (US) in 2012. A molecular diagnostic method has been developed to identify *G. ellingtonae* and differentiate it from other *Globodera* species. This new species was first found in soil samples collected in May 2008 at Powell Butte in Oregon, from a field in which potato (*Solanum tuberosum*) and other crops had been grown. In August/September 2008, *G. ellingtonae* was also detected in 2 agricultural fields in Idaho (Caribou and Teton counties) with unknown cropping history. The field host plant of *G. ellingonae* in Oregon and Idaho is still unknown. In 2014, *G. ellingtonae* was identified on roots of Andean potatoes collected from Northern Argentina (Salta region). During these studies, isolates of *Globodera* sp. from Antofagasta in Chile also showed a high degree of molecular similarity with the populations of *G. ellingtonae* from Argentina and the USA, suggesting that this nematode also occurs in Chile.
In the USA, eradication measures have been implemented in the infested fields. Preliminary experiments have demonstrated that potato and tomato (*S. lycopersicum*) can be host plants of *G. ellingtonae*, but the pathogenicity of the nematode to both crops remains to be studied. It is generally recognized that surveys should be made to evaluate the distribution of this new potato cyst nematode and estimate the possible damage it may cause to cultivated plants.

Source: Chronis D, Chen S, Skantar AM, Zasada IA, Wang X (2014) A new chorismate mutase gene identified from *Globodera ellingtonae* and its utility as a molecular diagnostic marker. *European Journal of Plant Pathology* **139**(2), 245-252.

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Skantar AM, Handoo ZA, Zasada IA, Ingham RE, Carta LK, Chitwood DJ (2011) Morphological and molecular characterization of *Globodera* populations from Oregon and Idaho. *Phytopathology* **101**(4), 480-491.

Zasada IA, Peetz A, Wade N, Navarre AR, Ingham RE (2013) Host status of different potato (*Solanum tuberosum*) varieties and hatching in root diffusates of *Globodera ellingtonae*. *Journal of Nematology* **45**(3), 195–201.

Additional key words: new pest **Computer codes:** GLOBEL, US

2015/101 New data on quarantine pests and pests of the EPPO Alert List

By searching through the literature, the EPPO Secretariat has extracted the following new data concerning quarantine pests and pests included on the EPPO Alert List, and indicated in bold the situation of the pest concerned using the terms of ISPM no. 8.

- **New records**

In autumn 2014, *Chilo partellus* (Lepidoptera: Crambidae – spotted stem borer) was detected for the first time in Turkey. It was found during a survey conducted in maize fields in the East Mediterranean region, in the provinces of Adana, Hatay and Osmaniye. *C. partellus* is a pest of maize (*Zea mays*), sorghum (*Sorghum vulgare*), sugarcane (*Saccharum officinarum*), rice (*Oryza sativa*) and millets (*Pennisetum* spp.). Larvae feed on leaves and tunnel within plant stalks, sometimes causing economic damage to crops. This is the second time that *C. partellus* is recorded in the EPPO region, as in 2011 its presence had been reported in Israel (EPPO RS 2011/197). **Present, first found in 2014 in the East Mediterranean region (Adana, Hatay, Osmaniye provinces).**

In November 2014, *Marchalina hellenica* (Hemiptera: Margarodidae – formerly EPPO Alert List) was detected for the first time in Australia. The pest was found in Melbourne and Adelaide (Victoria state) on *Pinus halepensis* (Aleppo pine), *P. pinea* (Italian stone pine), and *P. radiata* (Monterey pine). Phytosanitary measures are being implemented to prevent any further spread of the pest (DEPI, 2015). **Present, first found in 2014 in Victoria state, under official control.**

The presence of *Scaphoideus titanus* (Hemiptera: Cicadellidae), the main vector of flavescence dorée, is reported for the first time from Slovakia. During a survey carried out in 2013-2014, the pest was commonly found in vineyards in Eastern Slovakia, but was rare in South and Central Slovakia. It was also found in many localities of Western Slovakia (Tóthová *et al*., 2015). **Present, locally distributed.**

- **Detailed records**

In Brazil, *Helicoverpa armigera* (Lepidoptera: Noctuidae – EPPO A2 List) was first found in 2012 in the state of Bahia in cotton and soybean crops. During the 2012/2013 harvest, yield losses reaching up to 35% were observed and economic losses of 1 billion USD were reported in Western Bahia, triggering a state of phytosanitary crisis. The pest was then found in other Brazilian states: Goiás, and Mato Grosso. In July 2013, *H. armigera* was detected in Roraima on soybean and maize crops. In addition, genetic studies using molecular tools have shown that *H. armigera* also occurs in Maranhão, Mato Grosso do Sul, and Piauí (Leite *et al*., 2014; Mastrangelo *et al*., 2014).

In the USA, *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae – EPPO A2 List) was detected in Hawaii in 1983, and in California in 1999. Populations are now well established in California, Florida and Hawaii. In addition to these established populations, infested plants have been detected in Alabama and Oklahoma (2005), Louisiana (2006), New York and Texas (2007), Georgia (2008), North Carolina and South Carolina (2009), and Tennessee (2014) (Chong *et al*., 2015).

- **Diagnostic**

A new molecular diagnostic method (PCR-RFLP) has been developed in the USA to distinguish *Drosophila suzukii* (Diptera: Drosophilidae – EPPO A2 List) from other *Drosophila* species associated with fruit. This technique can identify field-collected specimens, adults and immature stages (Kim *et al*., 2014).

- **New host plants**

Recent observations made in Ohio (US) have shown that *Agrilus planipennis* (Coleoptera: Buprestidae – EPPO A2 List) can attack and complete its development on *Chionanthus virginicus* (Oleaceae – white fringetree). *C. virginicus* is a small tree which originates from Eastern USA and which is also planted for ornamental purposes (Cipollini, 2015).

- **Epidemiology**

Field experiments conducted in Italy from 2011 to 2013 showed that *Pseudomonas syringae* pv. *actinidiae* (EPPO A2 List) could be transmitted to healthy plants of *Actinidia deliciosa* cv. 'Hayward' via infected pollen. Although further pollination experiments are needed to confirm this preliminary study, the results obtained strongly support the hypothesis that infected pollen can be a pathway for introducing and spreading the disease (Tontou *et al.*, 2014).

Source: Bayram A, Tonğa A (2015) First report of *Chilo partellus* in Turkey, a new invasive maize pest for Europe. *Journal of Applied Entomology*. doi: 10.1111/jen.12232 (via PestLens).

Chong JH, Aristizábal LF, Arthurs S (2015) Biology and management of *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae) on ornamental plants. *Journal of Integrated Pest Management* **6**(1). doi: 10.1093/jipm/pmv004

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insects-and-mites/giant-pine-scale

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Mastrangelo T, Paulo DF, Bergamo LW, Morais EGF, Silva M, Bezerra-Silva G, Azeredo-Espin AMI (2014) Detection and genetic diversity of a Heliothine invader (Lepidoptera: Noctuidae) from North and Northeast of Brazil. *Journal of Economic Entomology* **107**(3), 970-980.

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Tóthová M, Bokor P, Cagan L (2015) The first detection of leafhopper *Scaphoideus titanus* Ball (Hemiptera, Cicadellidae) in Slovakia. *Plant Protection Science* **51**(2), 88-93.

Additional key words: new record, detailed record, diagnostic, epidemiology, new host plant

Computer codes: AGRLPL, CHILZO, DROSSU, HELIAR, MARCHE, PHENHI, PSDMAK, SCAPLI, AU, BR, SK, TR, US

2015/102 New BBCH growth stage keys

The BBCH* growth stage keys aimed to provide a standard and uniform description of the visible growth stages of plants, using a two-digit decimal code. This system has been developed for many important crops, such as cereals, rice, maize, rape, potato, fruit trees, small fruits, vegetables (see EPPO RS 2011/119). In 1997, the BBCH growth stage keys were recommended by the EPPO Working Party on Plant Protection Products and by Council for use in EPPO countries, thus replacing the previously recommended EPPO growth stage keys. The following new BBCH scales have recently been published to describe the growth stages of:

- *Asparagus officinalis* (edible asparagus) (Feller *et al*., 2012).
- *Camellia japonica* (camellia) (Vela *et al*., 2013).
- *Carthamus tinctorius* (safflower) (Flemmer *et al*., 2013).
- *Capparis spinosa* (caper plant) (Legua *et al*., 2013).
- *Elaeis guineensis* (African oil palm) (Forero *et al*., 2011).
- *Silybum marianum* (Martinelli *et al*., 2015).
- *Solanum muricatum* (pepino) (Herraiz *et al*., 2015).
- *Xanthostemon chrysanthus* (golden penda tree) (Ahmad Nazurudin *et al*., 2012).
- *Ziziphus jujube* (jujube tree) (Hernández *et al*., 2015).

* The abbreviation BBCH derives from the first letters of the German names of ***B***iologische Bundesanstalt (Federal Biological Research Centre), ***B***undessortenamt (Federal Plant Variety Office) and ***Ch***emical industry.

Source: Ahmad Nazurudin Mr, Tsan FY, Normaniza O, Adzmi Y (2012) Phenological growth stages of the golden penda tree (*Xanthostemon chrysanthus*). *Annals of Applied Biology* **161**(12), 12-15.

Feller C, Richter E, Smolders T, Wichura A (2012) Phenological growth stages of edible asparagus (*Asparagus officinalis*): codification and description according to the BBCH scale. *Annals of Applied Biology* **160**(2), 174-180.

Flemmer AC, Franchini MC, Lindström LI (2015) Description of safflower (*Carthamus tinctorius*) phenological growth stages according to the extended BBCH scale. *Annals of Applied Biology* **166**(2), 331-339.

Forero DC, Hormaza P, Romero HM (2011) Phenological growth stages of African oil palm (*Elaeis guineensis*). *Annals of Applied Biology* **160**(1), 56-65.

Hernández FCA, Legua P, Melgarejo P, Martínez R, Martínez JJ (2015) Phenological growth stages of jujube tree (*Ziziphus jujube*): codification and description according to the BBCH scale. *Annals of Applied Biology* **166**(1), 136-142.

Herraiz FJ, Vilanova S, Plazas M, Gramazio P, Andújar I, Rodríguez-Burruezo A, Fita A, Anderson GJ, Prohens J (2015) Phenological growth stages of pepino (*Solanum muricatum*) according to the BBCH scale. *Scientia Horticulturae* **183**, 1-7 (abst.).

Legua P, Martínez JJ, Melgarejo P, Martínez R, Hernandez F (2013) Phenological growth stages of caper plant (*Capparis spinosa* L.) according to the Biologische Bundesanstalt, Bundessortenamt and CHemical scale. *Annals of Applied Biology* **163**, 135-141.

Liu K, Li H, Yuan C, Huang Y, Chen Y, Liu J (2014) Identification of phenological growth stages of sugar apple (*Annona squamosa* L.) using the extended BBCH-scale. *Scientia Horticulturae* **181**, 76-80 (abst.).

Martinelli T, Andrzejewska J, Salis M, Sulas L (2015) Phenological growth stages of *Silybum marianum* according to the extended BBCH scale. *Annals of Applied Biology* **166**(1), 53-66.

Vela P, Salinero C, Sainz MJ (2013) Phenological growth stages of *Camellia japonica*. *Annals of Applied Biology* **162**(2), 182-190.

Additional key words: publications, growth stage keys

2015/103 *Impatiens edgeworthii* in the EPPO region: addition to the EPPO Alert List

Why
Impatiens edgeworthii (Balsaminaceae) is an annual species native to the Western Himalayas and currently has a limited distribution in the EPPO region. The species is present in the wild in Germany where it has shown invasive behaviour in forests in Central Germany. Due to the invasive nature of this species in the area described, *I. edgeworthii* can be considered an emerging invader within the EPPO region.

Geographical distribution
Impatiens edgeworthii is native to the Western Himalayas where the species is found in high altitude valleys in India, Nepal and Pakistan.
EPPO region: Germany.
Asia: India (Himachal Pradesh), Nepal, Pakistan.

Morphology
Impatiens edgeworthii as an annual herb which is recorded to grow between 25-60 cm tall in its native range. The stem is erect and branched and leaves are approximately 40-180 x 15-75 mm, elliptic-ovate. Petioles are 15-50 mm long. Flowers are yellow with red streaks in the throat, 25-36 mm long. Morgan (2007) details that there is also a pale lilac flower variety. Capsules are 20-30 mm in length, linear and erect. Seeds are oblong in shape and approximately 3 mm in length. In Germany, the plant is recorded to grow taller compared to populations in the native range – up to up to 180 cm tall (Baade and Gutte, 2008). There is also more variation in flower colour from samples described by Baade and Gutte (2008), and by Weiss (2013). In Germany, the flower colour can vary from yellow, yellow-white, white and pale violet, where yellow and brown specks are seen in the throat of the flower for the violet and yellow coloured flowers, respectively, and the white flowered variety shows red to brown specks.

Biology and ecology
The genus *Impatiens* contains approximately 1 200 species of annual and perennial herbs mainly distributed in the montane areas of tropical and subtropical Asia and Africa. In the native range, *I. edgeworthii* flowers from July to September and the plant is killed by the first autumnal frosts. Seedlings, however, can survive several degrees below zero (Weiss, 2015). Germination requires a period of cold stratification and moisture, but not necessarily frost, as plants in Germany germinate normally after a winter without frost (Weiss, 2015). *I. edgeworthii* is a good source of nectar for pollinators, in particular for honey bees, bumblebees and *Antophora* spp. in the late summer and early autumn (Weiss, 2013).

Habitats
In the native range *I. edgeworthii* occurs in damp shady montane habitats often growing along gullies and streams from 1800-3000m above sea level (a.s.l.). The plant can form dense stands along roadsides where the ground is irrigated by ditches. In Germany, *I. edgeworthii* occurs in similar damp shaded habitats (Weiss, 2013). The species has successfully invaded forests in Central Germany and is found to extend outwards along tracks and forest edges (Weiss, 2013). In undisturbed woodland, *I. edgeworthii* does not seem to be able to establish as it does in woodland areas where there has been some level of disturbance.

Pathways
Natural dispersal is by seed. Seeds are encased in explosive seed pods, which upon ripening project seeds some distance from the paternal plant. When the plant grows near water

ways, seeds are incorporated into the water body and transported downstream. *Impatiens edgeworthii* is traded as an ornamental species. As the species is an annual, the plant is traded by seed, mainly through mail order on the internet. As the species has an explosive seed mechanism, escape from gardens into the wild is a pathway for its spread.

Impacts
In Germany *I. edgeworthii* is reported to outcompete its close relative – *Impatiens parviflora*. However, *I. edgeworthii* has not been shown to outcompete the native, *I. noli-tangere* (Weiss, 2013). *I. edgeworthii* has been shown to compete with the commonly occurring *Urtica dioica* L. Because of scarce information on its impacts, the plant is listed on the Grey List of potentially invasive species (Lauterbach and Nehring 2013). In Germany *I. edgeworthii* has been shown to change plant community structure in invaded woodlands (Weiss, 2013).

Control
Any methods to control *I. edgeworthii* should be conducted before the plant sets seed. As with most annual *Impatiens* species, the root system is relatively shallow and therefore manual control, in the form of hand pulling can be effective to remove discrete populations of the plant. However, hand pulling should take place early in the season before the plant sets flowers/seed. Strimming or severing the stem is potentially effective with annual *Impatiens* species, though this must be conducted below the first node to prevent re-sprouting. Plants completely mown in June sprouted and flowered in September (Weiss, 2013).

Source: Baade H, Gutte P (2008) *Impatiens edgeworthii* HOOK. F. – Ein Für Deutschland neues Springkraut. *Braunschweiger Geobotanische Arbeiten* **9**, 55–63
Lauterbach D, Nehring S (2013) Naturschutzfachliche Invasivitätsbewertung *Impatiens edgeworthii – Buntes Springkraut. BfN Skripten* **352**, 110-111
Morgan R (2007) Impatiens: The Vibrant World of Busy Lizzies, Balsams, and Touch-Me-Nots. Portland, USA. Timber Press.
Weiss V (2013) Zur Ökologie von Impatiens edgeworthii HOOK. F. in Mitteldeutschland. *Mitteilungen zur floristischen Kartierung in Sachsen-Anhalt* **18**, 15–29.
Weiss V (2015) Die rote Pest aus grüner Sicht: Springkräuter – von Imkern geschätzt, von Naturschützern bekämpft. Stocker Verlag, Graz, Stuttgart, 160 pp.

Additional key words: invasive alien plants, alert list **Computer codes:** IPAED

2015/104 Invasive potential of *Miscanthus sacchariflorus* and *Miscanthus sinensis*

Perennial grass species from the genus *Miscanthus* have been widely planted for both ornamental and industrial (biofuels) purposes. However, some species within this genus pose a threat to the EPPO region due to their invasive behaviour. *Miscanthus sacchariflorus* and *M. sinensis* (EPPO Alert List) are both native to Asia and were introduced into Europe in the late 1800s. The hybrid *M.* x *giganteus* was introduced into Europe in the mid-1930s. In the present study the authors obtained 215 records (81 for *M. sinensis*, 122 for *M. sacchariflorus* and 11 for M. x *giganteus*) from Europe. Most records were from western European countries though several records did exist from Mediterranean areas and eastern European countries. In these countries most escaped populations occur in grassland sites, along rivers and in ruderal habitats such as extraction sites, roadside sites and habitats near urban gardens. When comparing escaped populations in the USA and Europe there are two main similarities (1) the populations are small and are not spreading rapidly, and (2) for *M. sinensis* and *M. sacchariflorus* both species show similar climatic preferences.

Compared to the USA however, the establishment of both species seems less advanced in Europe – which may be due to the shorter history of introduction and a lower frequency of planting for both horticulture and biofuels. The author concludes that the invasion potential of *Miscanthus* species needs to be carefully tested and current escaped populations in both the USA and Europe should be carefully monitored.

Source: Schnitzler A, Essl F (2015) From horticulture and biofuel to invasion: the spread of Miscanthus taxa in the USA and Europe. *Weed Research* DOI: 10.1111/wre.12141

Additional key words: invasive alien plants, biofuels **Computer codes:** MISSA, MISSI

2015/105 Negative impacts of *Solidago canadensis* on native plant and pollinator communities

Former arable land may support farmland biodiversity as the initial stages of succession take place, and over time their conservation value increases if they are left out of production. However, these old fields are prone to invasion by non-native alien plant species. In Romania large-scale abandonment of arable fields has taken place over recent decades and in many areas *Solidago canadensis* (EPPO List of Invasive Alien Plants), a rhizomatous member of the Asteraceae – native to North America - has colonised these fields. In the present study the authors assessed the succession of vegetation and the pollinator community in 36 fields ranging from 1-20 years post abandonment. The results of the study showed that *S. canadensis* reduced plant species richness and this was more prominent in older fields. The invasion of *S. canadensis* had a negative impact on the abundance of bees irrespective of the age of the field, and pollinator visitation rates to native flowers were reduced due to the presence of *S. canadensis*.

Source: Fenesi A, Vágási CI, Beldean M, Földesi R, Kolcsár LP, Shapiro JT, Török E, Kovács-Hostyánszki A (2015) *Solidago canadensis* impacts on native plant and pollinator communities in different-aged old fields. *Basic and Applied Ecology* **16**, 335-346.

Additional key words: invasive alien plants, impacts **Computer codes:** SOOCA

2015/106 *Galenia pubescens* in the EPPO region: addition to the EPPO Alert List

Why

Galenia pubescens is a perennial woody herb native to South Africa. The species currently has a limited distribution in the EPPO region where it is present in Israel and Spain. *G. pubescens* has invaded coastal sand dunes in Spain where the species can form dense monocultures which have a negative impact on local biodiversity.

Geographical distribution

EPPO region: Israel (Sharon Plain – rare; Negev Highlands – very rare), Spain.
Africa: South Africa (Eastern Cape, Free State, North West, Northern Cape, Transvaal, Western Cape).
North America: USA (California).
South America: Chile (Central).
Oceania: Australia.

Morphology

Galenia pubescens is a prostrate to decumbent semi woody perennial herb. The stem is cylindrical up to 1.5 mm in diameter. Leaves are ovate to spatulate and up to 35 mm in

length and 15 mm wide. The inflorescence is a leafy cyme with axillary flowers. Flowers are bisexual, radial and approximately 4-5 mm wide. Flower colour is either pink or whitish pink. Seeds are contained in capsules 3 mm in length. Seeds are 1-2 mm in length, shiny and black. The plant is mat forming. In Australia, the plant can grow up to 60 cm in height and 1.6 m wide. *G. pubescens* has an extensive tap root that can reach depths of 2 m (Hartmann, 2002).

Biology and ecology

Galenia pubescens is an opportunistic species colonising highly disturbed ground (García-de-Lomas *et al.*, 2010) which can outcompete native plant species. In Spain the species forms dense prostrate mats in wetlands and dunes. García-de-Lomas *et al.*, (2010) showed that *G. pubescens* will flower throughout the year with maximum flower density recorded in spring. Annual seed production was estimated between 95 300 and 100 200 seeds per m^2. In Israel, *G. pubescens* flowers in March, April and May. Bees seem to be attracted to *G. pubescens*, however, even though it may be a good nectar source, honey produced by this species is recorded as being foul tasting (Geelong Beekeepers Club Inc, 2015).

Habitats

In South Africa, *G. pubescens* colonises inland locations with karoo vegetation, and coastal areas at altitudes of 15-1 830 m a.s.l (Arnold and De Wet, 1993). In Australia, *G. pubescens* is present in semi-arid and sub-tropical environments where it is commonly found in highly disturbed sites such as mines, waste areas, coastal regions, roadsides, parks, footpaths and lawns. In southern Spain, *G. pubescens* is invasive in the Cadiz Bay Natural Park where it invades coastal areas and salty wetlands (García-de-Lomas *et al.*, 2010). The species is also found growing along road edges and other disturbed habitats (García-de-Lomas *et al.*, 2009). In Australia, *G. pubescens* is found growing in coastal regions, pasture land and grasslands.

Pathways for movement

Galenia pubescens spreads naturally by seed. Seeds are small and can be blown short distances on wind currents. As the species grows in coastal regions further natural spread may be facilitated by wave and sand movement. Additionally, the plant may be spread by livestock that ingest the seeds. Spread may be facilitated by transport of machinery, i.e. mowers or vehicles tyres.

Impacts

Galenia pubescens has been shown to decrease native species richness and diversity in invaded plots in Spain (García-de-Lomas *et al.*, 2010). Plant functional types were significantly altered in invaded plots where perennial species were replaced by annual ruderal grasses or forbs (García -de-Lomas *et al.*, 2010). The change in plant species composition within invaded stands can act to alter the structural composition of vegetation which can have an impact on ecosystem services. García-de-Lomas *et al.* (2010) suggests that increased soil humidity, plant litter accumulation and soil nutrient composition may all be altered as a result of dense mats of *G. pubescens*. Shading caused by mat formation may modify germination requirements for native plant species and thus prevent restoration of native plant community. By stabilizing sand dunes, *G. pubescens* alters the natural disturbance regimes of these habitats. Stabilization can enhance the persistence of the invasive population and the establishment of new populations (D'Antonio and Meyerson, 2002). There is some evidence that *G. pubescens* is toxic to domesticated animals. The plant can produce high levels of nitrates and oxalates that can cause death in animals when eaten (Williams, 1979).

Control
Mechanical removal and follow-up spraying is the most effective way to control and manage invasive populations of *G. pubescens.* Control trials in Southern Spain using glyphosate spraying have shown a high efficiency against *G. pubescens*.

Source: Arnold TH, De Wet BC (1993) Plants of Southern Africa: Names and Distribution. Memoirs of the Botanical survey of South Africa No. 62. National Botanical Institute, Pretoria.
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Additional key words: invasive alien plants, alert list **Computer codes:** GAJPU

2015/107 Waterbirds as pathways for the movement of aquatic alien invasive species

Waterbirds are sometimes cited as dispersing aquatic invasive alien species though to-date there has been little evidence based on scientific evaluation to quantify this. In the present study the authors reviewed the available literature and confirmed that only a small number of studies (14 studies) assessed dispersal by waterbirds. The authors describe dispersal as a three stage movement of organisms that comprises the following (1) emigration or uptake; (2) movement and transport; and (3) immigration or introduction. Uptake can take place either by ingestion or adhering to feet or feathers. A number of alien invasive plants have been found in faecal samples of waterbirds including large amounts of reproductive tissue of *Azolla filiculoides* (EPPO Observation List of Invasive Alien Plants) in Australia. The movement of plant propagules via entanglement in feathers or on feet may facilitate the establishment of new populations especially as many aquatic plants reproduce asexually. Coughlan *et al*. (2014) showed that *Lemna minuta* is readily transported between the feathers of waterbirds; with little effect on the viability of propagules.

Source: Coughlan NE, Kelly TC, Jansen MAK (2014) Mallard duck (*Anas platyrhynchos*) – mediated dispersal of Lemnaceae: a contributing factor in the spread of invasive *Lemna minuta*? *Plant Biology* **17**, 108-114.
Reynolds C, Miranda NAF, Cumming GS (2015) The role of waterbirds in the dispersal of aquatic alien and invasive species. Diversity and Distributions DOI:10.1111/ddi.12334

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