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2007/107 New data on quarantine pests and pests of the EPPO Alert List

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

- **New records**

Coconut lethal yellowing phytoplasma (EPPO A1 List) is reported for the first time on the Island of Nevis, St Kitts-Nevis (Myrie *et al.*, 2006). **Present, reported in 2005 on Nevis Island.**

The presence of *Cylindrocladium buxicola* (EPPO Alert List) is reported from Ireland and the Netherlands (Henricot, 2006). **Present, no details.**

Liriomyza sativae (Diptera: Agromyzidae – EPPO A2 List) occurs in Iran (Haghani *et al.*, 2007). The EPPO Secretariat had no previous data on the occurrence of this pest in Iran. **Present, no details.**

Rhagoletis cingulata (Diptera: Tephritidae – EPPO A2 List) was reported for the first time in 2006 in Hungary (Szeőke, 2006). **Present, no details.**

Xanthomonas axonopodis pv. *poinsettiicola* (EPPO Alert List) was detected for the first time in Taiwan in November 2005. The disease was observed on poinsettia (*Euphorbia pulcherrima*) plants growing in nurseries in the Taichung county (Lee *et al.*, 2006). **Present, first found in 2005 in Taichung county.**

From 2004 to 2005, samples of rice showing leaf blight symptoms were collected from different areas of the Guilan province, in Iran. Laboratory studies using morphological, physiological, biochemical, and molecular methods (PCR) confirmed the presence of *Xanthomonas oryzae* pv. *oryzae* (EPPO A1 List) in diseased samples (Kazempour *et al.*, 2006). **Present, first found in 2004/2005 in Guilan province.**

- **Detailed records**

In Japan, *Bemisia tabaci* (EPPO A2 List) biotypes B and Q were both detected (Ueda and Brown, 2006).

Clavibacter michiganensis subsp. *michiganensis* (EPPO A2 List) was found in 2005 in Baja California in Mexico (Holguín-Peña *et al.*, 2006).

In Greece, the presence of *Cucurbit yellow stunting disorder virus* (*Crinivirus* - EPPO A2 List) is reported from the islands of Crete and Rhodos, and from the prefecture of Arkadia in the Peloponnese (Boubourakas *et al.*, 2006).

In the USA, *Maconellicoccus hirsutus* (Homoptera: Pseudococcidae – EPPO A1 List) was reported for the first time in Louisiana in 2006 (Vitullo *et al.*, 2007).

In Poland, *Pepino mosaic virus* (*Potexvirus*, PepMV – EPPO Alert List) was reported once in 2002 and all affected plants were destroyed (EPPO RS 2003/043). PepMV isolates have now been divided into 3 strains: European tomato, Peruvian and US2. The Polish isolate detected in 2002 was found to be genetically similar to other European isolates (European tomato strain). In November 2005, in the western part of the Wielkopolska region, PepMV

was detected again. Molecular studies (RT-PCR, sequencing) showed that this Polish isolate was distinct from all other PepMV isolates reported so far (Pospieszny & Borodynko, 2006).

In a survey done in Colombia, Potato yellow vein virus (*Crinivirus* – EPPO A1 List) was detected in potato leaf samples collected from the Antioquia, Cundinamarca and Narino departments (Guzmán *et al.*, 2006).

In the Czech Republic, sporadic occurrence of Stolbur phytoplasma (EPPO A2 List) was detected on tomatoes in 2000-2001. Since 2004, the pathogen has been spreading to different hosts in southern Moravia. So far, it has been detected on potatoes (*Solanum tuberosum*), tomatoes (*Lycopersicon esculentum*), peppers (*Capsicum annuum*), aubergines (*Solanum melongena*), celery (*Apium graveolens*) and the weed *Solanum nigrum* (Linhartova *et al.*, 2006).

During studies done in Ethiopia, strains of *Ralstonia solanacearum* (EPPO A2 List) isolated from different host plants were characterized. Both race 1 (biovar 1) and race 3 (biovar 2) were detected (Lemessa, 2006).

In Malta, *Verticillium dahliae* (EPPO A2 List) was found for the first time on potato fields near Luqa in 2005. The low severity of symptoms observed by the growers in the fields, usually mistaken for normal dieback of aged plants, might explain why *V. dahliae* had never been reported before on potatoes in Malta (Pace-Lupi *et al.*, 2006).

- **Host plants**

Tomato ringspot virus (*Nepovirus* – EPPO A2 List) is reported for the first time on grapevine (*Vitis vinifera*) in Jordan. The virus was detected in approximately 6.5% of the tested grapevine samples (Salem *et al.*, 2006).

In November 2004, *Phytophthora ramorum* (EPPO Alert List) was detected in the United Kingdom on a *Parrotia persica* (Hamamelidaceae) tree which was showing necrotic leaf lesions and twig dieback. The affected tree was destroyed (Hughes *et al.*, 2006).

Source: Boubourakas IN, Avgelis AD, Kyriakopoulou PE, Katis NI (2006) Occurrence of yellowing viruses (*Beet pseudo-yellows virus, Cucurbit yellow stunting disorder virus* and *Cucurbit aphid-borne yellows virus*) affecting cucurbits in Greece. *Plant Pathology* **55**(2), 276-283.

Guzmán M, Ruiz E, Arciniegas N, Coutts RHA (2006) Occurrence and variability of *Potato yellow vein virus* in three departments of Colombia. *Journal of Phytopathology* **154**(11-12), 748-750.

Haghani M, Fathipour Y, Talebi AA, Baniameri V (2007) Thermal requirement and development of *Liriomyza sativae* (Diptera: Agromyzidae) on cucumber. *Journal of Economic Entomology* **100**(2), 350-356.

Henricot B (2006) Box blight rampages onwards. The Plantsman, September, 153-157.

Holguín-Peña RJ, Vázquez-Juárez RC, Rueda-Puente EO (2006) Bacterial canker caused by *Clavibacter michiganensis* subsp. *michiganensis* on tomato in the Baja California Peninsula of Mexico. *Plant Disease* **90**(12), p 1550.

Hughes KJD, Giltrap PM, Barton VC, Hobden E, Tomlinson JA, Barber P (2006) On-site real-time PCR detection of *Phytophthora ramorum* causing dieback of *Parrotia persica* in the UK. *Plant Pathology* **55**(6), p 813.

Kazempour MN, Ghasemie E, Padasht F (2006) Detection and identification of *Xanthomonas oryzae* pv. *oryzae* – the causal agent of bacterial blight in Iran. *Mitteilungen aus der Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* no. 400, p 350.

Lee YA, Wu PC, Liu HL (2006) First report of bacterial leaf spot of poinsettia caused

by *Xanthomonas axonopodis* pv. *poinsettiicola* in Taiwan. *Plant Pathology* **55**(6), p 823.

Lemessa F (2006) Physiological and pathogenic characterization of strains of bacterial wilt (*Ralstonia solanacearum*) from Ethiopia. *Mitteilungen aus der Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* no. 400, p 216.

Linhartova S, Cervena G, Rodova J (2006) The occurrence of potato stolbur phytoplama on different hosts in the Czech Republic. *Mitteilungen aus der Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* no. 400, p 456.

Myrie WA, Paulraj L, Dollet M, Wray D, Been BO, McLaughlin W (2006) First report of lethal yellowing disease of coconut palms caused by phytoplasma on Nevis Island. *Plant Disease* **90**(6), p 834.

Pace-Lupi TG, Porta-Puglia A, Ippolito A, Nigro F (2006) First record of *Verticillium dahliae* on potato in Malta. *Plant Disease* **90**(8), p 1108.

Pospieszny H, Borodynko N (2006) New Polish isolate of *Pepino mosaic virus* highly distinct from European Tomato, Peruvian and US2 strains. *Plant Disease* **90**(8), p 1106.

Salem N, Mansour A, Al-Musa A, Al-Nsour A (2006) Occurrence of *Tomato ringspot virus* on grapevines in Jordan. *Phytopathologia Mediterranea* **45**(2), 161-162.

Vitullo J, Wang S, Zhang A, Mannion C, Bergh JC (2007) Comparison of sex pheromone traps for monitoring pink hibiscus mealybug (Hemiptera: Pseudococcidae). *Journal of Economic Entomology* **100**(2), 405-410.

Szeőke K (2006) [First report about the occurrence of American eastern cherry fruit fly (*Rhagoletis cingulata* Loew.) in Hungary.]. *Növényvédelem* **42**(8), p 470 (in Hungarian).

Ueda, Brown JK (2006) First report of the Q biotype of *Bemisia tabaci* in Japan by mitochondrial cytochrome oxidase I sequence analysis. *Phytoparasitica* **34**(4), 405-411.

Additional key words: new records, detailed records, new host plants

Computer codes: BEMITA, CYLDBU, CYSDV, LIRISA, PEPMV0, PHENHI, PHYP56, PHYTRA, PYVV00, RHAGCI, TORSV0, VERTDA, XANTPN, CO, GB, GR, HU, IE, IR, JO, JP, KN, MT, NL, PL, TW, US

2007/108 Further details on the situation of *Erwinia amylovora* in Morocco

In Morocco, fireblight (*Erwinia amylovora* – EPPO A2 List) was first found in 2006 in the region of Meknes in one pear orchard (EPPO RS 2007/021). In May and June 2007, samples from other pear orchards showing symptoms of fireblight were collected and tested. As a result, *E. amylovora* was detected on 4 farms in the communes of Aïn Orma, Aït Ouallal and Dar Oum Soltane, all located in the prefecture of Meknes. Eradication measures will continue to be applied in this region of Morocco. All imported material will be officially inspected after plantation (twice during the growing season). A decree of compulsory control of fireblight in the prefecture of Meknes will soon be published and will include the following measures: all planting material must be tested for the presence of fireblight, movements of host plants and of bee hives from the infected area are prohibited. In addition, information campaigns for nurserymen, growers and technicians are being carried out.

Source: Achbani EH (2007) Feu bactérien sur Poirier au Maroc. Première apparition de cette brûlure bactérienne sur poirier dans la région de Meknès. *Phytoma – La Défense des Végétaux* no. 606, 26-28.

Additional key words: detailed record

Computer codes: ERWIAM, MA

2007/109 First report of *Aculops fuchsiae* in Jersey

Aculops fuchsiae (Acari: Eriophyidae – EPPO A1 List) was observed for the first time in 2006. The plants affected were mature fuchsia plantings at only one site. They were cut to ground level, and the foliage was burnt and treated with acaricides. On that site there has been no further occurrence of the pest so far. In 2007, 3 cases were found in private gardens. In all cases, fuchsia plants were small and all affected plants were destroyed. Surveys were carried out in all nurseries and garden centres, and no other cases were found in 2007.
The situation of *Aculops fuchsiae* in Jersey can be described as follows: **Present, first found in 2006 on few locations, under eradication.**

Source: NPPO of Jersey, 2007-07.

Additional key words: new record **Computer codes:** ACUPFU, JS

2007/110 First report of *Globodera rostochiensis* in Mallorca (Baleares, ES)

Potato (*Solanum tuberosum*) is one of the most important crops in the Islas Baleares (ES) covering 1,100 ha mainly around the city of Sa Pobla on the island of Mallorca. So far, only *Globodera pallida* (EPPO A2 List) was known to occur in the area of Sa Pobla*, where it can cause significant damage if not properly managed. In spring 2000, golden-coloured females were detected in several root samples of plant potatoes. From 2001 to 2003, soil and root samples were collected from 28 fields and analyzed (using the EPPO diagnostic protocol). Mixed populations of *G. pallida and G. rostochiensis* were found in 14 fields all around Sa Pobla, and *G. pallida* alone was detected in 2 fields. The proportion of *G. rostochiensis* in mixed populations was low, rarely exceeding 20%. According to the authors, this is the first report of *G. rostochiensis* in the Islas Baleares.

* The EPPO Secretariat had no previous data on the occurrence of *G. pallida* in Islas Baleares.

Source: Andrés MF, Alonso R, Alemany A (2006) First report of *Globodera rostochiensis* in Mallorca Island, Spain. *Plant Disease* **90**(9), p 1262.

Additional key words: detailed record **Computer codes:** HETDPA, HETDRO, ES

2007/111 Studies on strawberry pallidosis disease

Strawberry pallidosis disease was first recognized in Australia and the USA in 1957, but is considered indigenous to North America (infected Australian plants had been imported from the USA). Strawberry pallidosis does not occur in the EPPO region. Strawberry pallidosis is graft-transmissible and induces symptoms on *Fragaria virginiana* ('UC-10', 'UC-11') but not on *F. vesca* indicators. In most commercial cultivars, pallidosis remains latent. However, since 2000, decline symptoms have been observed in strawberries along the west coast of North America. It was suggested that pallidosis might play a role in this decline.
In earlier studies, it has been found that two viruses belonging to the genus *Crinivirus*, were associated with pallidosis disease: *Beet pseudo yellows virus* (BPYV) and Strawberry pallidosis-associated virus (SPaV). Further studies have showed that SPaV is transmitted by

Trialeurodes vaporariorum, but not by *T. abutilonea* and *Bemisia tabaci*. Pollen or seed transmission was not observed for SPaV. Testing for SPaV and BPYV was carried out in strawberry nurseries and fields of North America (USA: California, Florida, Oregon, Washington; Canada: British Columbia) to estimate the presence of both viruses and their importance in strawberry decline. Results showed that infection rates as high as 90% for SPaV and 60% for BPYV were observed when plants exhibiting decline symptoms were tested. California was the most affected state. In some areas (Washington, British Columbia), SPaV and BPYV were not detected in declining plants. Lower rates of infection of SPaV and BPYV were found in regions where whiteflies were absent or found in low numbers. Both viruses were detected in nurseries and efforts are being made to eliminate them from strawberry planting material. Research will continue to develop integrated pest management systems to minimize the incidence of the disease in areas where it still occurs.

Source: Tzanetakis IE, Wintermantel WM, Cortez AA, Barnes JE, Barrett SM, Bolda MP, Martin RR (2006) Epidemiology of strawberry pallidosis-associated virus and occurrence of pallidosis disease in North America. *Plant Disease* **90**(10), 1343-1346.

Additional key words: epidemiology **Computer codes:** US

2007/112 Blackberry chlorotic ringspot: a new virus of *Rubus*

Plants of blackberry (*Rubus* cv. 'Bedford Giant') showing diffuse chlorotic mottling and ringspots were observed during field trials carried out near the Scottish Crop Research Institute (GB). A new ilarvirus, tentatively called Blackberry chlorotic ringspot virus (BCRV) was isolated from these symptomatic plants. BCRV could be transmitted to several *Rubus* species and cultivars by grafting but most grafted plants remained symptomless (except *Rubus* cv. 'Himalaya Giant' and the hybrid Tayberry). Following this initial description in the United Kingdom, BCRV was also detected in the USA, on roses showing symptoms of rose rosette (Tzanetakis *et al.*, 2006) and on germplasm material of *Rubus occidentalis* cvs. 'Lowden' and 'New Logan' (Tzanetakis *et al.*, 2007). The host range, geographical distribution and impact of BCRV on cultivated plants remain to be further studied.

Source: Jones AT, McGavin WJ, Gepp V, Zimmerman MT, Scott SW (2006) Purification and properties of blackberry chlorotic ringspot, a new virus species in subgroup 1 of the genus *Ilarvirus* found naturally infecting blackberry in the UK. *Annals of Applied Biology* **149**(2), 125-135.

Tzanetakis IE, Gergerich RC, Martin RR (2006) A new *Ilarvirus* found in rose. *Plant Pathology* **55**(4), 568–568.

Tzanetakis IE, Postman JD, Martin RR (2007) First report of Blackberry chlorotic ringspot virus in *Rubus* sp. in the United States. *Plant Disease* **91**(4), p 463.

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

2007/113 Blackberry yellow vein associated virus: a new virus of *Rubus*

In the USA during the last five years a new disease of blackberry (*Rubus* spp.) has emerged in Arkansas, North Carolina and South Carolina. Affected plants show leaf distortion, vein banding, mottling and in some cases they die. Molecular studies have revealed the presence of a new *Crinivirus* tentatively called Blackberry yellow vein associated virus (BYVaV). Molecular and immunological assays have been developed for the detection of BYVaV, and the examination of symptomatic plants has shown a close association of disease symptoms with the presence of BYVaV although the virus was also detected in symptomless plants. Efforts are being made to identify a potential vector of this virus.

Source: Susaimuthu J, Tzanetakis IE, Gergerich RC, Martin RR (2006) Yellow vein-affected blackberries and the presence of a novel *Crinivirus*. *Plant Pathology* **55**(5), 607-613.

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

2007/114 Potato rough dwarf virus and Potato virus P are two distinct strains of the same virus species

Two putative members of the genus *Carlavirus* have been reported infecting potatoes in South America (see EPPO RS 1999/027): Potato rough dwarf virus (in Argentina) and Potato virus P (in Brazil). Studies have recently been done to characterize those two viruses using nucleotide sequence analysis, serology and bioassays. They strongly suggest that Potato rough dwarf virus and Potato virus P are two distinct strains of the same virus species which belongs to the genus *Carlavirus*.

Source: Nisbet C, Butzonitch I, Colavita M, Daniels J, Martin J, Burns R, George E, Akhond MAY, Mulholland V, Jeffries CJ (2006) Characterization of Potato rough dwarf virus and Potato virus P: distinct strains of the same viral species in the genus *Carlavirus*. *Plant Pathology* **55**(6), 803-812.

Additional key words: taxonomy **Computer codes:** PRDV00

2007/115 Further studies on *Tomato apical stunt viroid*

In Israel, *Tomato apical stunt viroid* (*Pospiviroid*, TASVd – EPPO Alert List) is reported to cause a severe disease of glasshouse tomatoes. Studies have showed that TASVd is not transmitted by *Myzus persicae* or *Bemisia tabaci*, but by bumble bees. It was also found that the viroid is seed-transmitted. TASVd was detected in embryonic tissues of tomato seeds originating from TASVd-infected plants. Transmission rates through seeds could reach 80 % when plants were infected at an early stage. It is suggested that seeds play a major role in the viroid transmission within tomato crops, followed by mechanical contact which is enhanced by workers and pollination activities of bumble bees.

Source: Antignus Y, Pearlsman M, Lachman O, Feigelson F (2006) *Tomato apical stunt viroid* (TASVd), a pathogen of greenhouse tomatoes in Israel is seedborne and transmitted by bumble bees. *Phytoparasitica* **34**(3), 306-307.

Additional key words: biology **Computer codes:** TASVD0, IL

2007/116 Description of new subspecies of *Xylella fastidiosa*

Xylella fastidiosa (EPPO A1 List) induces distinct diseases on its numerous host plants (e.g. Pierce disease on grapevine, variegated chlorosis on citrus, leaf scorch on various tree species). Several molecular studies on the different strains of *X. fastidiosa* suggested that they could be grouped into subspecies. So far, the following 4 subspecies have been proposed:

Subspecies	Strains
X. fastidiosa subsp. *fastidiosa*	*Vitis vinifera* (grapevine) *Medicago sativa* (alfalfa) *Acer* (maple) *Prunus dulcis* (almond) Several weeds
X. fastidiosa subsp. *multiplex*	*Prunus persica* (peach) *Ulmus* (elm) *Prunus domestica* (plum) *Vitis aestivalis* *Prunus dulcis* (almond) *Platanus occidentalis* (sycamore) Other shade trees
X. fastidiosa subsp. *pauca*	*Citrus sinensis* Most probably also strains from *Coffea arabica* (coffee)
X. fastidiosa subsp. *sandyi*	*Nerium oleander* (oleander)

Source: Hernandez-Martinez R, Costa HS, Dumenyo CK, Cooksey DA (2006) Differentiation of strains of *Xylella fastidiosa* infecting grape, almonds, and oleander using a multiprimer PCR assay. *Plant Disease* **90**(11), 1382-1388.

Schaad NW, Postnikova E, Lacy G, Barek-Fatmi M, Chang CJ (2004) *Xylella fastidiosa* subspecies: *X. fastidiosa* subsp. *piercei* [corrected subsp. *fastidiosa*] subsp. nov., *X. fastidiosa* subsp. *multiplex* subsp. nov., and *X. fastidiosa* subsp. *pauca* subsp. nov. *Systematic and Applied Microbiology* **27**(3), 290-300.

Schuenzel EL, Scally M, Stouthamer R, Nunney L (2005) A multigene phylogenetic study of clonal diversity and divergence in North American strains of the plant pathogen *Xylella fastidiosa*. *Applied and Environmental Microbiology* **71**(7), 3832-3839.

Additional key words: taxonomy **Computer codes:** XYLEFA

2007/117 Studies on bacterial leaf spot of poinsettia in China

Bacterial leaf spot of poinsettia, caused by *Xanthomonas axonopodis* pv. *poinsettiicola* (EPPO Alert List) was first reported in India in the 1950s and was then reported in other parts of the world. In China, a bacterial leaf spot disease was initially observed on poinsettia in the Xiaoshan district of Zhejiang Province, which is one of the major poinsettia-growing regions. On the basis of biochemical and physiological characteristics, the causal agent was ascribed to *Xanthomonas campestris* pv. *poinsetiicola*. The Chinese isolates of the bacterium were studied again to determine their position in the new classification of xanthomonads. Results showed that these Chinese isolates belonged to a pathovar of *Xanthomonas axonopodis* but presented some differences with other known isolates of *Xanthomonas axonopodis* pv. *poinsetiicola*.

Source: Li B, Xie GL, Zhang JZ, Janssens D, Swings J (2006) Identification of the bacterial leaf spot pathogen of poinsettia in China. *Journal of Phytopathology* **154**(11-12), 711-715.

Additional key words: detailed record **Computer codes:** XANTPN, CN

2007/118 A new PCR test to detect *Tilletia indica*

In many countries, the diagnostic of *Tilletia indica* (EPPO A1 List) involves the identification of spores on the basis of morphology, followed by a molecular analysis. In these protocols, the germination of spores is required for confirmation but implies a long delay of about two weeks. In order to speed up the diagnostic process, a new PCR test to detect *T. indica* has been developed in Australia. With this method, the fungus can be directly and rapidly detected on a very small number of spores (less than 10). In addition, this PCR test was found to be highly specific. It could clearly distinguish *T. indica* from other *Tilletia* species found on lots of wheat grain, as well as from the closely related species *T. walkeri*. The authors felt that this new PCR test could be particularly useful for quarantine purposes and surveillance programmes.

Source: Tan MK, Murray GM (2006) A molecular protocol using quenched FRET probes for the quarantine surveillance of *Tilletia indica*, the causal agent of Karnal bunt of wheat. *Mycological Research*, **110**(2), 203-210.

Additional key words: diagnostics **Computer codes:** NEOVIN

2007/119 New PCR assays to detect *Fusarium foetens*

Fusarium foetens (EPPO Alert List) is a new pathogen of *Begonia*. It is difficult to distinguish it morphologically from other *Fusarium* species and currently used identification methods require isolation and culture of the fungus which is time-consuming. A conventional PCR using specific primers and a real-time PCR were developed in the Netherlands. Both tests could specifically detect *F. foetens* in cultures as well as in infected *Begonia* tissues. Although these results are preliminary, it is considered that both methods have the potential to be used for the routine detection of *F. foetens*.

Source: de Weerdt M, Zijlstra C, van Brouwershaven IR, van Leeuwen GCM, de Gruyter J, Kox LFF (2006) Molecular detection of *Fusarium foetens* in Begonia. *Journal of Phytopathology* **154**(11-12), 694-700.

Additional key words: diagnostics **Computer codes:** FUSAFO

2007/120 Real-time PCR test for the identification and detection of *Deuterophoma tracheiphila*

Mal secco, caused by *Deuterophoma tracheiphila* (EPPO A2 List) is a severe disease of lemon (*Citrus limon*) and other citrus trees. A real-time PCR test using specific primers was developed in Italy and compared with conventional PCR. Both PCR tests successfully detected *D. tracheiphila* in woody samples of naturally infected lemon trees and artificially inoculated sour orange (*C. aurantium*) seedlings, but real-time PCR was 10 to 20-fold more sensitive than conventional PCR and allowed a quantitative monitoring of the fungus in plant tissues.

Source: Licciardello G, Grasso FM, Bella P, Cirvilleri G, Grimaldi V, Catara V (2006) Identification and detection of *Phoma tracheiphila*, causal agent of citrus mal secco disease, by real-time Polymerase Chain Reaction. *Plant Disease* **89**(12), 1523-1530.

Additional key words: diagnostics **Computer codes:** DEUTTR

2007/121 Identification key for Xyleborina beetles occurring in North America

Ambrosia-feeding scolytids in the Xyleborina tribe (Coleoptera: Curculionidae) can cause significant damage to forests. Since the last major review of the species occurring in North America, many exotic species have been discovered in Canada and the USA (e.g. *Xyleborus glabratus, X. similis, Euwallacea fornicatus*) or intercepted in trade (see EPPO RS 2006/208). To facilitate the identification of these ambrosia beetles, the following illustrated keys have recently been published. They are also available from the Internet: http://scolytide.msu.edu

- Genera of female Xyleborina in America North of Mexico
- Females of the species of *Ambrosiodmus*, North of Mexico
- Females of the species of *Euwallacea*, North of Mexico
- Females of the species of *Xyleborinus*, North of Mexico
- Females of the species of *Xyleborus*, North of Mexico
- Females of the species of *Xylosandrus*, North of Mexico

Source: Rabaglia RJ, Dole SA, Cognato AI (2006) Review of American Xyleborina (Coleoptera: Curculionidae: Scolytinae) occurring north of Mexico, with an illustrated key. *Annals of the Entomological Society of America* **99**(6), 1034-1056.

Additional key words: diagnostics **Computer codes:** 1CURCF

2007/122 Pathway analysis: production and processing of small seeds for birds

Bird seeds have been identified as a pathway for the introduction of invasive alien plants as contaminants. It is estimated that the market for bird seeds is increasing by 4% every year. This is linked to the increase of income and leisure time in industrialized countries. Until recently, the market for bird food was mainly concentrated in the industrialized countries of the northern hemisphere, however sales of bird food in Australia, Brazil, Indonesia, Japan, Malaysia and Mexico have increased substantially over the past five years. Bird food statistics are difficult to find as they are grouped under the general heading of "pet food". In the USA alone, 52 million people spend USD2.5 billion on bird food. The total northern European market has an estimated value of more than USD1 billion, mainly in Belgium, Luxembourg, the Netherlands, Norway, Sweden and the United Kingdom.
The global bird food market can roughly be divided into the following sectors: caged and companion birds, wild birds and pigeons.

Trends

Feeding of wild birds is predominantly a winter activity in northern Europe and North America and is done around houses. With the increased awareness of nature conservation and outdoor activities such as bird watching, wild bird feeding is now a major hobby and the number of bird food mixes, feeders and other accessories has tremendously increased.
Consumers have become more knowledgeable about which seeds are preferred by certain bird species. In order to attract certain species and discourage others into their gardens or balconies, consumers require more and more different types of seeds. The growing trend to treat companion animals as members of the family who deserve the best possible care may orientate the market towards organically grown food, GMO-free food, special treats and food containing exotic ingredients.

Origin of the production

Although many of the ingredients are of tropical or subtropical origin, most of them are also cultivated as large-scale agricultural crops in North-America. The major bird seed grown in the tropics is *Guizotia abyssinica* (Asteraceae), produced by order of importance in India, Nepal, Ethiopia and Myanmar.
Most of the grain crops used as ingredients in bird food have their main market in human or animal nutrition. This implies that components of bird food are often rejects from human or animal food or rejects from the seed industry.

Ingredients

There are about 30 different plants whose seeds are used as bird food. Seeds are given to a variety of domestic and caged birds such as: chickens, pigeons, parrots, budgerigars and canaries. Commercial mixtures of bird seed for these birds vary from one producer to another but the basic ingredients are usually the same. Many of the plants imported as seeds are grown in tropical countries for local consumption. Only a small proportion of the total production is used as bird food. Species used are the following:

Species	Comment
Arachis hypogaea (Fabaceae)	It is more popular in Europe, but its use is increasing in the USA. The total volume used is believed to be small.
Avena sativa (Poaceae)	
*Brassica napus** (Brassicaceae)	
Brassica rapa (Brassicaceae)	Seeds are sold in two colour varieties.
Camelina sativa (Brassicaceae)	Produced in Europe
Cannabis sativa (Cannabinaceae) Indian hemp	Grown in warm countries to produce fibre and narcotic resin. Often sold as sterile seed to prevent misuse of the plant as a narcotic drug.
Capsicum annuum (Solanaceae)	Produced in Spain
Carthamus tinctorius (Asteraceae)	Seeds are used as a bird food because of their high oil content. Global production is estimated to be 1.1 million tons. Produced in Australia, Argentina, Canada, China, Ethiopia (80 000 ha in this country), India, Mexico, the USA.
Carum carvi (Apiaceae)	Also introduced for culinary use.
Chenopodium quinoa (Chenopodiaceae)	Product of premium choice in health food stores and used in small quantities in bird food mixtures. Produced in South America, imported in the USA, Germany, the United Kingdom and the Netherlands.
Cicer arietinum (Fabaceae)	Has also a culinary use in Greek food.
Cichorium intybus (Asteraceae)	Frequent in the wild in the United Kingdom. Also cultivated in gardens and on an agricultural scale.
Cuminum cyminum (Apiaceae)	
Cuminum cyminum (Apiaceae)	Produced in Cyprus and other European countries.
Dipsacus sativus (Dipsacaceae)	Also cultivated for textile fibres. Produced in Europe.
Echinochloa crus-galli var. *frumentacea* (Poaceae)	Widely cultivated in the tropics and subtropics. There is no data on the production or trade for the bird food industry. However, it is often cited as an ingredient in companion bird food mixes, which indicates a global trading. It is grown in Australia (Queensland), China and USA mainly for grazing or hay.
Echinochloa utilis (Poaceae)	
*Eleusine coracana** (Poaceae)	
Fagopyrum esculentum (Polygonaceae)	Also used as game rearing. Produced in Europe
Guizotia abyssinica (Asteraceae)	A staple bird food included in many mixtures. Mainly produced in Ethiopia, India, Myanmar, Nepal, Bengladesh and countries of eastern and central Africa (by order of importance). In Ethiopia, it is mainly used for edible oil. In India, 75% are used for oil extraction, the rest is exported for bird food to USA and Europe. In 2003, the USA imported 49 542 tons having a total value of almost USD27.8 million. For export to the USA, seeds should be heat sterilized (60 °C) before shipment. This is done to eliminate possible contamination by *Cuscuta* spp.
Helianthus annuus (Asteraceae)	Used for parrots and also incorporated in food for small mammals such as gerbils. Between 1991 and 1993, the consumption of this species for bird food was 275 000 tons (USD170 million /year). Produced in Argentina, China, France, East African countries (Kenya, Uganda, Tanzania), Hungary, India, Romania, Russian Federation, Spain, Ukraine, the USA.
*Hordeum distichon** (Poaceae)	
Hordeum vulgare (Poaceae)	
Lactuca saligna (Asteraceae)	Also grown as a vegetable.
*Lactuca sativa** (Asteraceae)	Also grown as a vegetable.

Linum usitatissimum (Linaceae)	Escapes from agricultural cultivation. Produced in the Netherlands.
Oryza sativa (Poaceae)	Used as a bird food with the husk still protecting the seed. Produced in Italy and Argentina.
Panicum miliaceum (Poaceae)	Widely grown as a food crop for man and his livestock. A staple food for birds used in a number of different colour varieties. The global area sown with millets is relatively stable at around 38 million hectares. Only about 1% of world millet production is traded internationally, representing 200 000 to 300 000 tons or approximately 0.1% of the global cereal trade. Out of all the millets, *P. miliaceum* is the most important species being traded with a volume of 100 000 to 150 000 tons per year. It is predominantly produced in the USA, Australia and Argentina and is exported almost exclusively to other developed countries (European Union, Japan, Switzerland and Canada) for bird food.
Papaver somniferum (Papaveraceae)	Also used as a garden plant.
Phalaris canariensis (Poaceae)	Primarily produced as bird food, rarely grown for human consumption. An important species for cage birds, included in most commercial mixtures. The market is highly volatile. For example, world production varied from 300 000 tons in 1995 to 167 000 tons in 1997. Produced in Canada (75% of world production), the USA, Argentina (12%), Australia (3%), Hungary (2.5%), Mexico (2.5%), Greece, Turkey, Spain, Morocco, the Netherlands, England, Uruguay, Thailand. Most exports take place as bulk, unprocessed seed shipments and, to a lesser extent, as pre-packaged seed mixtures.
*Phaseolus aureus** (Fabaceae)	
Pimpinella anisum (Apiaceae)	Also introduced for culinary use.
*Pinus edulis** (Pinaceae)	
Pisum sativum (Fabaceae)	Sold as a pigeon food.
Poaceae are sold and include: *Echinochloa utilis*, *Zea mays, Hordeum distichon, Hordeum vulgare, Triticum aestivum, Secale cereale*.	Developing countries in Africa and Asia account for 94% of the global production of 28 million tonnes. India is the world's largest producer (40%).
Secale cereale (Poaceae)	
Setaria italica (Poaceae)	Widely grown and commonly used for human food, for fodder and brewing beer. Imported as ears for Budgerigars from Italy, France and China Loose grain sold under the misleading name "Panicum Millet" from USA, South-Africa, France, Australia and China.
Sorghum bicolor (Poaceae)	Used in wild bird food mixture. Also used for human and animal food. In recent years, its use in bird food seems to have declined.
Triticum aestivum (Poaceae)	
Vicia faba (Fabaceae)	Also cultivated in gardens and on agricultural land.
Vicia sativa Fabaceae)	
Zea mays (Poaceae)	Used both as bird food and in pet food for small mammals.

Legend: Species are quoted according to Lin, 2005 and to Hanson and Manson, 1985. Species in bold are quoted by both references. Species with an asterisk are only quoted by Hanson and Manson, 1985.

In addition to grain, fruits (banana, mango, papaya, coconut, almonds, pecans, sultanas), vitamin and mineral supplements, vegetable or fish oil and crushed shells are incorporated to bird food mixtures.

Processing and storage

Cleaning of seeds

Seed shipments first arrive in the importing country in sacks containing a large proportion of unwanted material such as husks, stalks, soil, stones, fragments of insects, weed seeds harvested with the crop, etc. The condition of seeds on arrival depends on the type of crop and the country of origin. Seeds are cleaned first by sieving to remove stones, soil and other large contaminants, and by blowing to remove dust and chaff. Seeds are then sorted using a revolving drum which is lined with indentations of the size and shape of the desired seed. This results in a fairly pure seed supply; the few contaminating seeds that escape the cleaning process are those that resemble the main seed most closely in size and shape.

Most of the birdseeds mentioned above can be cleaned by means of simple air/screen cleaners or by traditional methods such as hand threshing and winnowing. For most seeds, 98-99% purity is standard. It is also essential that bird seeds be shiny, look and smell fresh, be free of dead or live insects and noxious weeds and that the moisture content should not exceed 8-12%.

Guizotia abyssinica (Asteraceae) exported to the USA must undergo a heat treatment (60°C) before shipping to kill *Cuscuta* seeds that may be present.

The Birdcare Standards Association (BSA) in the United Kingdom has produced standards for wild bird feeding. Complying companies can carry the BSA logo.

Major players

Besides producers, others actors such as brokers, packers, and sellers participate in the bird seed pathway.

Brokers: commodity brokers are the link between producers and packagers or wholesalers. Major brokers are located in the USA (7) (in the High Plains, especially in Nebraska and Dakota, which are the main sunflower and millet growing areas), Australia (1), Belgium (1) and France (1).

Packers/wholesalers: they buy bird food ingredients from brokers or import them independently. The multi-national companies such as Nestlé, Proctor & Gamble, Mars, Heinz and Colgate-Palmolive are large players in the pet food industry. Major packers and wholesalers are based in the USA (7), the Netherlands (3), the United Kingdom (2), Belgium (2), Germany (1) and France (1).

Retailers: in the USA, large supermarket chains (Walmart, Winn Dixie, Kroger) retail large volumes of bird food. It is a high value/margin product and supermarkets account for about 50% of all bird food sales in the USA. The situation is different in Europe as bird food is retailed through garden centres and specialized pet shops rather than through large supermarket chains. During last years, the number of Internet-based bird food retailers has largely increased.

Cover crops for the creation of hunting and wildlife habitats

The use of cover crops to create wildlife habitats for hunting or conservation/observation is increasing in the USA and in Europe. Cover crop mixtures may contain: *Borago officinalis* (Borraginaceae), *Carthamus tinctorius* (Asteraceae), *Chamaecrista fasciculata* (Fabaceae), *Chenopodium quinoa* (Chenopodiaceae), *Cyperus esculentus* (Cyperaceae, EPPO List of IAP), *Dolichos lablab* (Fabaceae), *Echinochloa crus-galli* var. *frumentacea* (Poaceae), *Helianthus annuus* (Asteraceae), *Lespedeza cuneata* (Fabaceae), *Panicum miliaceum* (Poaceae), *Panicum ramosum* (Poaceae), *Paspalum notatum* (Poaceae), *Phalaris canariensis* (Poaceae), *Sesbania grandiflora* (Fabaceae), *Sorghum* spp. (Poaceae), *Sorghum vulgare rosburghii* (Poaceae), *Vicia faba* (Fanaceae), *Vigna* spp. (Vitaceae) and *Zea mays* (Poaceae).

Market trends
The bird seed market is very competitive and tries to be innovative by continuously finding new mixtures. For instance, a company added *Salvia columbariae* (Fabaceae) to its organic bird food as it is a "mythical" energy food of the Native American Indians. Most bird seed packagers are constantly seeking new sources or suppliers of raw material, both to diversify their product lines and to maintain a competitive price.

Source: BSA Birdcare Standards Association. http://www.birdcare.org.uk/whatisthebsa.htm

Edo Lin (2005) Production and processing of small seeds for birds. Food and agriculture organization of the United Nations, Rome. http://www.fao.org/docrep/008/y5831e/y5831e00.htm

Hanson CG, Mason JL (1985) Bird seed aliens in Britain. *Watsonia* **15**, 237-252 http://www.watsonia.org.uk/html/watsonia_15.html

Additional key words: invasive alien plants, bird seed **Computer codes: CYPES**

2007/123 Pathway analysis: alien plants introduced through the bird seed pathway

Studies were conducted in 1995 and again 2000 in England (UK) to determine which alien plant species may be introduced with commercial bird seed mixtures. Seed mixtures were sown and growing plants were identified, resulting in a list of species that may be introduced into the UK. Considering that these studies were done a few years ago and that the bird seed market is rapidly evolving, the list of plants presented below is not exhaustive but provides useful information on species which may be carried by this pathway.

This study reveals that despite the cleaning process of seeds (see "processing and cleaning" in EPPO RSE 2007/122), more than 450 plant species were found as contaminants of bird seeds. Among these 450 species, 120 are exotic for the whole EPPO region. For each of these 120 exotic species, their family, origin, and known invasive behaviour in the EPPO region are given (NOBANIS database and various other sources). The status of each species in the Global Compendium of Weeds (GCW) is given, to indicate their invasive behaviour elsewhere in the world.

Some of these species are particularly invasive and are listed in the EPPO List of Invasive Alien Plants: *Ambrosia artemisiifolia* (Asteraceae), *Bidens frondosa* (Asteraceae), *Cenchrus incertus* (Poaceae), *Helianthus tuberosus* (Asteraceae), *Sicyos angulatus* (Cucurbitaceae). Many other species introduced as bird seeds contaminants are common weeds in the EPPO region: *Abutilon theophrasti* (Amaranthaceae), *Amaranthus albus, A. blitoides, A. hybridus, A. retroflexus* (Amaranthaceae), *Bunias orientalis* (Brassicaceae), *Cuscuta campestris* (Convolvulaceae), *Eleusine indica* (Poaceae), *Paspalum dilatatum* (Poaceae), *Xanthium spinosum* (Asteraceae), etc.

From this study, potentially emerging invasive alien species for the EPPO region plants could be identified:
- *Dactyloctenium aegyptium* (Poaceae): this species is considered a common weed of open ground and waste places in the tropics and subtropics and is known to occur in Crete, Italy and Sicily (Flora Europaea). A Weed Risk Assessment conducted in the Pacific Islands and

concluded that this species represented a risk and should not be introduced (Pacific Island Ecosystems at Risk).
- *Diplachne uninervia* (Poaceae): according to a study on potential environmental weeds in Australia (Csurhes and Edwards, 1998) the plant thrives in areas along humid field edges, irrigation and drainage channels and is thought to have the potential to invade tidal and freshwater wetlands in temperate and sub-tropical zones. The plant is not known to occur in the EPPO region.
- *Eragrostis megastachya* (Poaceae): this plant is naturalized in tropical and warm temperate regions and is considered invasive in Ecuador, Hawaii, New Caledonia and New Zealand. It is not known to occur in the EPPO region and could only represent a risk in warmer places of the EPPO region.
- *Microstegium vimineum* (Poaceae): it is an annual grass native to Asia, invasive in the USA. Within the EPPO region, the plant is only reported in Turkey and its status there remains unknown (Global Invasive Species Database). It grows quickly, produces abundant seeds, and easily invades disturbed habitats. It occupies riparian habitats, lawns, woodland thickets, damp fields, and roadside ditches. The coldest winter temperature at which invasive populations occur is approximately -21° to -23° C. It spreads by rooting at nodes along the stem, and fruits and seeds are dispersed by water and animals. Fruits have been transported on cars and in hay and soil.
- *Physalis peruviana* (Solanaceae): the plant originates from South-America. It is considered invasive in Australia and New-Zealand (Pacific Island Ecosystems at Risk). It only reproduces by seeds. It is known as naturalized in Austria, Açores (PT), Czech Republic, Spain and Italy (Flora Europeae). It is also known to have escaped in the Islas Canarias (ES) (Martin Osoria, Victoria Eugenia & Wolfredo Wildpret, pers. com.). More information on the behaviour of this species is needed.
- *Senna obtusifolia* (Fabaceae): annual or perennial herb probably originating from the neotropic. Common as a weed of open disturbed areas in Hawaii, in arid lowlands in the Galápagos Islands, and in drainage channels, overgrazed pastures, and along rivers and flood plains in Australia. The plant reproduces by seeds; seeds are dispersed in mud adhering to vehicles, machinery, animal hooves and fur or as a contaminant of hay, fodder and pasture seeds. A Weed Risk Assessment was conducted in the Pacific Islands and concluded that this species represented a risk and should not be introduced (Pacific Island Ecosystems at Risk).
Some other species may be of concern such as *Achyranthes aspera* (Amaranthaceae), *Hordeum jubatum* (Poaceae) and *Navarretia squarrosa* (Polemoniaceae).

The EPPO Secretariat would greatly appreciate to receive any information about the occurrence and invasive behaviour in the EPPO countries of the species listed below and any additional information related to the bird seed pathway.

Species	Family	Origin	GCW	Known invasiveness in EPPO countries
Abutilon theophrasti	Malvaceae	W Asia	NW, EW	AT, DE, ES, NL, SE
Achyranthes aspera	Amaranthaceae	SW Asia	QW, NW, EW	
Amaranthus albus	Amaranthaceae	Americas	NW, EW	ES, IT, SE
Amaranthus blitoides	Amaranthaceae	N-Am.	Nat W, QW	ES, GR, IT, S
Amaranthus bouchonii	Amaranthaceae	Neotrop.	/	NL
Amaranthus capensis subsp. *uncinatus*	Amaranthaceae	Southern Af.	Nat W	

Species	Family	Origin	GCW	Known invasiveness in EPPO countries
Amaranthus caudatus	Amaranthaceae	Neotrop.	EW	IT
Amaranthus cruentus	Amaranthaceae	C. Am.	/	
Amaranthus graecizans	Amaranthaceae	Paleotrp	NW	ES
Amaranthus hybridus	Amaranthaceae	Neotrop.	/	ES, HU, IT, S
Amaranthus muricatus	Amaranthaceae	S-Am.	/	ES, IT
Amaranthus paniculatus	Amaranthaceae	trop Am.	/	
Amaranthus quitensis	Amaranthaceae	S-Am.	/	
Amaranthus retroflexus	Amaranthaceae	N-Am.	NW, EW	ES, HU, IT, LT, SE
Amaranthus scleropoides	Amaranthaceae	N-Am.	abs.	
Amaranthus standleyanus	Amaranthaceae	S-Am.	/	
Amaranthus thunbergii	Amaranthaceae	Africa	QW, Nat W	
Amaranthus viridis	Amaranthaceae	Neotrop.	EW	ES, IT
Ambrosia artemisiifolia	Asteraceae	N-Am.	NW, Nat W, EW	List of IAP, GIS Database
Amsinckia calycina	Boraginaceae	Americas	EW	
Amsinckia intermedia	Boraginaceae	Americas	/	
Amsinckia micrantha	Boraginaceae	N-Am.	abs	
Anoda cristata	Malvaceae	Americas	/	
Argemone mexicana	Papaveraceae	S-Am.	QW, NW, EW	
Arthraxon hispidus	Poaceae	Asia, Australia	/	
Atriplex nitens	Chenopodiaceae	SW Asia	abs	CZ, LT
Beckeropsis petiolaris	Poaceae	Africa	/	
Beckmannia syzigachne	Poaceae	China, Japan	/	
Bidens biternata	Asteraceae	E-Asia	/	
Bidens frondosa	Asteraceae	N-Am.	Nat W	List of IAP
Bidens pilosa	Asteraceae	trop Am.	EW	
Bidens tripartita	Asteraceae	Americas	/	
Brachiaria platyphylla	Poaceae	N-Am.	/	
Brassica carinata	Brassicaceae	Africa	/	
Bromus willdenowii	Poaceae	S-Am.	/	
Calceolaria chelidonioides	Scrophulariaceae	C&S Am.	abs	
Celosia argentea	Amaranthaceae	Pantrop.	W	
Cenchrus incertus	Poaceae	trop Am.	QW, NW	List of IAP
Cephalaria syriaca	Dipsacaceae	Africa, temp Asia	QW	
Chamomilla suaveolens	Asteraceae	N Am.	/	
Chenopodium ambrosioides	Chenopodiaceae	trop Am.	EW	
Chenopodium capitatum	Chenopodiaceae	N-Am.	/	
Chenopodium giganteum	Chenopodiaceae	perhaps Asia	/	
Chenopodium probstii	Chenopodiaceae	N. Am.	/	
Cosmos bipinnatus	Asteraceae	C-Am, W-India	EW	
Cuscuta campestris	Convolvulaceae	N-Am.	QW, NW, EW	CY, CZ, HU, LT, NL, SE, SL
Cynodon dactylon	Poaceae	trop. Af.	SW, NW, EW	
Dactyloctenium aegyptium	Poaceae	trop Af., Asia	EW	

Species	Family	Origin	GCW	Known invasiveness in EPPO countries
Datura stramonium	Solanaceae	trop. Am.?	QW, NW, EW	
Digitaria ciliaris	Poaceae	trop Am. Asia, Af.	Nat W	
Digitaria ternata	Poaceae	Asia, Africa	Nat W, EW	
Diplachne uninervia	Poaceae	SW N-Am.	QW, EW	
Dracocephalum parviflorum	Lamiaceae	N-Am.	NW	
Echinochloa colonum	Poaceae	India	EW	
Eleusine africana	Poaceae	Af.	QW	
Eleusine coracana	Poaceae	Af. Temp. Asia	/	
Eleusine indica	Poaceae	Af.	QW	EE, ES, GR, HU, IT, SE
Eleusine tristachya	Poaceae	S-Am.	QW	SE
Eragrostis megastachya	Poaceae	Af.	Nat W, EW	
Eragrostis neomexicana	Poaceae	SW Am.	/	
Eragrostis tef	Poaceae	Africa	/	
Eragrostis virescens	Poaceae	S-Am.	/	
Euphorbia hirta	Euphorbiaceae	trop & subtrop	/	
Euphorbia serpens	Euphorbiaceae	N-Am.	/	
Galinsoga ciliata	Asteraceae	S-Am.	/	
Glycine max	Fabaceae	Asia	/	
Glycine soja	Fabaceae	Asia	/	
Helianthus tuberosus	Asteraceae	Americas	NW, Nat W, EW	List of IAP
Hordeum jubatum	Poaceae	N-Am.	QW, NW, Nat W	
Ipomoea eriocarpa	Convolvulaceae	Madagascar	NW	
Ipomoea hederacea	Convolvulaceae	Americas	/	GR, LT
Ipomoea hederacea var. *integriuscula*	Convolvulaceae	Americas	/	
Ipomoea purpurea	Convolvulaceae	trop Am.	QW, NW, EW	ES, IT, LT, SE
Iva xanthifolia	Asteraceae	N-Am.	NW, Nat W	
Lepidium bonariense	Brassicaceae	S-Am.	EW	IT
Lepidium densiflorum	Brassicaceae	N-Am.	NW, Nat W, EW	
Lepidium divaricatum	Brassicaceae	Af.?	/	
Matricaria inodora	Asteraceae	Australia	EW	
Microstegium vimineum	Poaceae	Asia	EW	GIS Database
Navarretia squarrosa	Polemoniaceae	W N-Am.	EW	
Nicandra physalodes	Solanaceae	S-Am.	/	
Panicum capillare	Poaceae	N-Am.	/	
Panicum dichotomiflorum	Poaceae	N-Am.	NW, Nat W, EW	DE, LT, N
Panicum effusum	Poaceae	Australia	/	
Panicum laevifolium	Poaceae	C&S Af.	/	
Panicum subalbidum	Poaceae	Southern Af.	Nat W	
Paspalum dilatatum	Poaceae	S-Am.	EW	FR, IT, SE

Species	**Family**	**Origin**	**GCW**	**Known invasiveness in EPPO countries**
Pennisetum glabrum	Poaceae	Af.	abs	
Pennisetum nubicum	Poaceae	Af.	abs	
Persicaria glabra	Polygonaceae	Trop and subtrop Asia and Af.	/	
Persicaria pensylvanica	Polygonaceae	N-Am.	/	
Phaseolus angularis	Fabaceae	E Asia	/	
Phaseolus aureus	Fabaceae	Madagascar	/	
Physalis peruviana	Solanaceae	trop Am.	Nat W, EW	
Physalis philadelphica	Solanaceae	C & S Am.	/	
Polygonum nepalense	Polygonaceae	China, Japan, Korea, Himalaya	QW	
Potentilla norvegica	Rosaceae	N-Am.	NW, EW	
Psoralea corylifolia	Fabaceae	India	QW	
Rumex brownii	Polygonaceae	Australia	NW, EW	
Rumex triangulivalvis	Polygonaceae	N-Am.	/	
Salvia reflexa	Lamiaceae	N-Am.	NW, Nat W	
Senna obtusifolia	Caesalpiniaceae	trop Am.	QW, NW	
Sesamum capense	Pedaliaceae	S-Af.	abs	
Sesbania exalta	Fabaceae	N-Am.	/	
Setaria faberi	Poaceae	China, Japan	QW, NW	LT
Setaria geniculata	Poaceae	C & S Am.	/	
Setaria macrostachya	Poaceae	Americas	abs	
Setaria sphacelata	Poaceae	southern Af.	Nat W	
Sicyos angulatus	Cucurbitaceae	N Am.	NW, Nat W	List of IAP
Sida spinosa	Malvaceae	trop Am.	/	
Solanum cornutum	Solanaceae	N Am.	/	
Solanum physalifolium	Solanaceae	S Am.	EW	
Solanum pseudocapsicum	Solanaceae	S Am.	EW	
Solanum sarrachoides	Solanaceae	S Am.	QW	
Solanum sisymbriifolium	Solanaceae	S Am.	NW	
Spinacia oleracea	Chenopodiaceae	Iran	/	
Tetragonia tetragonioides	Tetragoniaceae	New Zealand	Nat W	
Trachyspermum ammi	Apiaceae	India	/	
Trigonella caerulea	Fabaceae	N Am.	/	
Triticum durum	Poaceae	China	abs	
Urochloa panicoides	Poaceae	southern Af.	NW, Nat W	
Verbesina encelioides	Asteraceae	N Am.	/	
Wedelia glauca	Asteraceae	S-Am.	QW	
Xanthium spinosum	Asteraceae	trop Am.	QW, NW, EW	

Species in bold are listed in the EPPO List of invasive alien plants.
* Abbreviations for the Global Compendium of Weeds column:
NW: noxious weed; Nat W: native weed; QW: quarantine weed; abs: not quoted in the GCW; /: no clear sign of invasiveness

Source: Csurhes S, Edwards R (1998) Potential Environmental Weeds in Australia - Candidate Species for Preventative Control National Weeds Program. Queensland Department of Natural Resources.
http://www.environment.gov.au/biodiversity/invasive/publications/weeds-potential/results-diplachne.html
Flora Europaea – Royal Botanic Garden Edinburg
http://rbg-web2.rbge.org.uk/FE/fe.html
Global Invasive Species Database – *Microstegium vimineum*
http://www.issg.org/database/species/ecology.asp?si=686&fr=1&sts=
Hanson CG, Mason JL (1985) Bird seed aliens in Britain. *Watsonia* **15**, 237-252
http://www.watsonia.org.uk/html/watsonia_15.html
Hanson CG (2000) Update on birdseed aliens(1985-1998) *Watsonia* **23**, 213-220
North European and Baltic Network on Invasive Alien Species (NOBANIS)
http://www.nobanis.org/
Pacific Island Ecosystems at Risk - *Dactyloctenium aegyptium*
http://www.hear.org/pier/species/dactyloctenium_aegyptium.htm
Pacific Island Ecosystems at Risk - *Eragrostis megastachya*
http://www.hear.org/pier/species/eragrostis_cilianensis.htm
Pacific Island Ecosystems at Risk - *Physalis peruviana*
http://www.hear.org/pier/species/physalis_peruviana.htm
Pacific Island Ecosystems at Risk – *Senna obtusifolia*
http://www.hear.org/pier/species/senna_obtusifolia.htm

Additional key words: invasive alien plants, bird seed **Computer codes:** AMBEL, BIDFR, CCHIN, HELTU, SIYAN, GB