Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

PLANT SCIENCE SCAN

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BACKGROUND: The Plant Health Science Directorate of the Canadian Food Inspection Agency routinely scans external sources to identify information that might be of possible regulatory significance or interest to Canada's national plant health. This Plant Science Scan report was prepared by the Canadian Food Inspection Agency's staff as a mechanism to highlight potential items of interest, raise awareness and share significant new information related to plant health.

Index of Articles

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Canada

Pathology

1 First report of seed transmission of Tomato torrado virus (ToTV) in tomato

Tomato torrado virus (ToTV) is an emerging plant virus that causes stunting and necrosis of leaves, stems, and fruit of tomato (*Solanum lycopersicum*). This virus has been reported from Panama, Colombia, Spain, France, Italy, Hungary, Poland, South Africa, and Australia (Alfaro-Fernández et al. 2009; Alfaro-Fernández et al. 2008; Gambley et al. 2010; Herrera-Vasquez et al. 2009; Pospieszny et al. 2007; Verdin et al. 2009). Although ToTV is poorly transmitted mechanically, local spread of this virus has been linked to the occurrence of *Bemisia tabaci* and *Trialeurodes vaporariorum*, two whiteflies that are widespread in Canada. Until recently, the mechanism of long-distance dissemination of this virus was unknown.

A new study in Poland evaluated the seed transmissibility of ToTV in tomato. Seeds were collected from tomato plants infected with ToTV. Seedlings were grown in an insect-proof greenhouse, and molecular analyses were used to identify ToTV-infected seedlings. Among 17,985 plants, 69 were ToTV-positive (0.38%). Bioassays using indicator plants also confirmed the presence of infectious virus in the seedlings (Pospieszny et al. 2018). This is the first report of seed transmission of ToTV in tomato and may explain the recent rapid dispersion of this virus worldwide.

ToTV can cause serious economic losses and it was included on the 2015 United States Department of Agriculture- Animal and Plant Health Inspection Service (USDA-APHIS) Prioritized Offshore Pest List as a pest of concern. This virus is not known to occur in North America but its principal vectors are widespread on the continent. ToTV is not regulated by Canada. This report indicates that tomato seed may represent a potential pathway for the introduction of ToTV into Canada.

SOURCES: Alfaro-Fernández, A., Bese, G., Córdoba-Sellés, C., Cebrián, M., Herrera-Vásquez, J., Forray, A. and Jordá, C. 2009. First report of Tomato torrado virus infecting tomato in Hungary. Plant Disease 93(5):554-554.

Alfaro-Fernández, A., Córdoba-Sellés, C., Cebrián, M., Herrera-Vásquez, J., Sánchez-Navarro, J., Juárez, M., Espino, A., Martín, R. and Jordá, C. 2008. First report of Tomato torrado virus on weed hosts in Spain. Plant Disease 92(5):831-831.

Gambley, C., Thomas, J., Persley, D. and Hall, B. 2010. First report of Tomato torrado virus on tomato from Australia. Plant Disease 94(4):486-486.

Herrera-Vasquez, J., Alfaro-Fernández, A., Cordoba-Selles, M., Cebrian, M., Font, M. and Jorda, C. 2009. First report of Tomato torrado virus infecting tomato in single and mixed infections with Cucumber mosaic virus in Panama. Plant Disease 93(2):198-198.

Pospieszny, H., Borodynko-Filas, N., Hasiów-Jaroszewska, B., Rymelska, N. and Elena, S. F. 2018. Transmission rate of two Polish Tomato torrado virus isolates through tomato seeds. Journal of General Plant Pathology:1-7.

Pospieszny, H., Borodynko, N., Obrępalska-Stęplowska, A. and Hasiow, B. 2007. The first report of Tomato torrado virus in Poland. Plant Disease 91(10):1364-1364.

Verdin, E., Gognalons, P., Wipf-Scheibel, C., Bornard, I., Ridray, G., Schoen, L. and Lecoq, H. 2009. First report of Tomato torrado virus in tomato crops in France. Plant disease 93(12):1352-1352.

2 Composting to sanitize plant-based waste infected with Synchytrium endobioticum and Potato spindle tuber viroid

The potential for using the composting process to sanitize plant waste infected with *Synchytrium endobioticum* (potato wart) and

potato spindle tuber viroid (PSTVd) was investigated using bench-scale composting equipment. The results of this study showed that *S. endobioticum* could survive for up to 23 days in compost at ambient temperature as examined in the bioassay. When potato wart infected material was exposed to higher temperatures, generally 50 °C and above, for 24 h or longer, no wart symptoms were detected in any bioassay plants. Similarly, PSTVd was undetectable by bioassay and RNA-based PCR testing following exposure to compost for ≥28 days at ambient, ≥7 days at 50 °C and >7 days at 65 °C, regardless of the moisture content of compost. The main difference between moist and dry compost was seen at 65 °C, where the viroid was undetectable beyond 1 day in moist compost but was still detectable after 7 days in dry compost. The research also found considerable variability in measured susceptibility of the viroid to the composting process.

This research indicates that composting in a well-managed and monitored system may represent an effective and eco-friendly phytosanitary treatment method for plant wastes infected with *S. endobioticum* and PSTVd, two pests regulated by the CFIA. However, further studies would be required to validate the effectiveness of these time and temperature regimes under large composting systems.

SOURCES: Kerins, G., Blackburn, J., Nixon, T., Daly, M., Conyers, C., Pietravalle, S., Noble, R. and Henry, C. 2018. Composting to sanitize plant- based waste infected with organisms of plant health importance. Plant Pathology 67(2):411-417.

3 First report of *Pseudomonas syringae* pv. *aesculi*, the causal agent of bleeding canker of horse chestnut, in Slovenia

In December of 2016, extensive bleeding cankers consistent with *Pseudomonas syringae* pv. *aesculi* infection were observed on horse chestnut trees (*Aesculus hippocastanum*) in Ljubljana, Slovenia. The morphology of the bacterial colonies isolated from the bark and from exudate on the bark were similar to the pathotype strain of *P. syringae* pv. *aesculi.* Molecular analysis and pathogenicity tests confirmed that the causal agent of the disease was *P. syringae* pv. *aesculi.* This is the first report of this pathogen in Slovenia and expands on the known distribution of this pathogen in Europe.

Pseudomonas syringae pv. *aesculi* also infects other *Aesculus* species such as *A. indica* (Indian horse chestnut) and *A. flava* (sweet or yellow buckeye); it has been reported in parts of Europe and India. This pathogen is not known to occur in Canada and is regulated by the CFIA. Importation of *Aesculus spp*. plants for planting, including seed, from all countries except the United States is prohibited.

SOURCES Pirc, M., Jurc, D. and Dreo, T. 2018. First report of *Pseudomonas syringae* pv. *aesculi* as the causal agent of bleeding canker of horse chestnut in Slovenia. Plant Disease 102(10):2025.

4 Dispersal of Hymenoscyphus fraxineus airborne inoculum at different scales

Hymenoscyphus fraxineus, the causal agent of ash dieback, has devastated native ash populations in Europe. This pathogen has been reported in Asia and Europe but it is not known

to occur in North America; it is a regulated pest for Canada.

A recent study investigated the seasonal and spatial patterns of dispersal of *H. fraxineus* in France using spore-trapping and real-time PCR assay. The results of this study showed that the sporulation peak occurred from June to August and spores fall very close to their source and the dispersal gradient was steep at the local scale (i.e. traps were set up at distances ranging from 0 to 800 m from infected ashes and at locations evenly distributed across the sampling area). Most of inoculum remains within 50 m of infected ashes, even though spores can be detected by traps up to 500 m. At the regional scale, the spores were detected up to 50-100 km ahead of the disease front but the amount of spores rapidly declined within 20-30 km from an infested site. On average, spores of *H. fraxineus* spread at a distance of 1.4-2.6 km. The limited amount of far-dispersed ascospores is not necessarily associated with establishment and creation of new disease foci. However, when these spores establish a disease focus, they may have a disproportionate effect on disease spread.

The results of this study indicate that once introduced in a new area, control or eradication measures may have limited impact on reducing the spread of *H. fraxineus.*

SOURCES: Grosdidier, M., Ioos, R., Husson, C., Cael, O., Scordia, T. and Marçais, B. 2018. Tracking the invasion: dispersal of *Hymenoscyphus fraxineus* airborne inoculum at different scales. FEMS microbiology ecology 94(5):fiy049.

5 Beech leaf disease: an emerging epidemic in North America

Beginning in 2012, a new disease has been observed on American beech trees (*Fagus grandifolia*) in Ohio, New York, and Pennsylvania in the United States, and Ontario in Canada. Symptoms of the disease include dark green interveinal banding on leaves, which later become solidly darkened, shrunken, and crinkled. Affected buds are aborted and new leaves are no longer produced. The disease appears to be lethal to trees. The causal agent of this disease is not yet known, but given the variable climactic conditions in which it has been found, it is unlikely that it is an abiotic disorder. Efforts are ongoing to identify the causal agent of this disease. The symptomology could suggest that a virus or phytoplasma is the causal agent, but some information also suggests that it could be caused by a nematode. The disease is spreading rapidly in the areas in which it is known to occur – for example, in Lake County, Ohio, the disease covered 510 ha in 2013, and by 2016 covered 2525 ha.

The environmental and economic consequences of this disease could be devastating, as the maple-beech ecosystem is dominant across Eastern deciduous forests, and beech is a common landscape and urban tree. Additionally, it could have international impacts, as the disease has also been detected on other *Fagus* species, including European beech (*Fagus sylvatica*) and oriental beech (*Fagus orientalis*).

SOURCE: Ewing, C.J., Hausman, C.E., Pogacnik, J., Slot, J. and P. Bonello. 2018. Beech leaf disease: An emerging forest epidemic. Forest Pathology. E12488. https://doi.org/10.1111/efp.12488

6 Tomato brown rugose fruit virus, a new tobamovirus affecting greenhouse tomatoes

In 2016, a new tobamovirus, tomato brown rugose fruit virus (ToBRFV), was characterized in Jordan (Salem et al. 2016). Since then, outbreaks of ToBRFV have been reported on greenhouse tomatoes in Israel (Luria et al., 2017); Germany (Menzel et al. 2019), Italy (ProMED 2019), Mexico (Camacho-Beltran et al. 2019) and Palestine (Alkowni et al. 2019). This virus was also detected in greenhouse tomato plants in Santa Barbara County, California but the plants were destroyed (Chitambar 2018).

Tomato (*Solanum lycopersicum*) and pepper (*Capsicum annuum*) are the main hosts of ToBRFV, but tobacco (*Nicotiana* spp.), quinoa (*Chenopodium quinoa*), and petunia (*Petunia hybrida*) as well as some weed species were shown to be experimental hosts (Luria et al. 2017; Salem et al. 2016). Symptoms on tomato include chlorosis mosaic with dark green bulges and narrowing of the leaves. Affected fruit show crinkled brown or yellow spots, often concentrated around the calyx and occasional rugose symptoms. Affected fruit lose market value or are unmarketable.

ToBRFV is easily transmitted from plant to plant by mechanical means. Therefore, infections of ToBRFV most likely occur in protected environments such as greenhouses where favorable conditions for pathogen spread exist, as when seedlings are thinned, transplanted, or grafted.

There is evidence that ToBRFV is seed-transmitted. Therefore, infected seed and transplants are the main pathways for the introduction of ToBRFV into a new area. Currently, ToBRFV is not a regulated pest for Canada. The CFIA continues to monitor new information on this pest as it becomes available and is engaging with stakeholders to determine best practices to mitigate the pest risk.

SOURCES: Alkowni, R., Alabdallah, O. and Fadda, Z. 2019. Molecular identification of Tomato brown rugose fruit virus in tomato in Palestine. Journal of Plant Pathology:1-5.

Camacho-Beltran, E., Perez-Villarreal, A., Rodríguez-Negrete, E. A., Ceniceros-Ojeda, E. A., Leyva-López, N. E. and Mendez-Lozano, J. 2019. Occurrence of Tomato brown rugose fruit virus infecting tomato crops in Mexico. Plant Disease (Accepted for publication): https://doiorg/101094/PDIS-11-18-1974-PDN

Chitambar, J. 2018. California Pest Rating for Tomato Brown Rugose Fruit Virus. Available online: https://blogs.cdfa.ca.gov/Section3162/?p=5843.

Luria, N., Smith, E., Reingold, V., Bekelman, I., Lapidot, M., Levin, I., Elad, N., Tam, Y., Sela, N. and Abu-Ras, A. 2017. A new Israeli Tobamovirus isolate infects tomato plants harboring Tm-22 resistance genes. PloS one 12(1):e0170429.

Menzel, W., Knierim, D., Winter, S., Hamacher, J. and Heupel, M. 2019. First report of Tomato brown rugose fruit virus infecting tomato in Germany. New Disease Reports 39:1.

ProMED. 2019. Tomato brown rugose fruit virus - Germany: (NW) 1st report. Available online: http://www.seedquest.com/news.php?type=news&id_article=103775.

Salem, N., Mansour, A., Ciuffo, M., Falk, B. and Turina, M. 2016. A new Tobamovirus infecting tomato crops in Jordan. Archives of virology 161(2):503-506.

7 Remediation of *Phytophthora ramorum*-infested soil with biological control agent Trichoderma asperellum isolate 04-22

Disinfesting soil from *Phytophthora ramorum* in nurseries can be a complex and expensive task. Both laboratory and greenhouse studies have shown that the biological control agent *Trichoderma asperellum* isolate 04-22 (Ta 04-22) has the potential to remediate *P. ramorum*-infested soils. A new study further investigated

whether this isolate could disinfest soils under conditions that are common in commercial nurseries.

The study tested Ta 04-22 treatment on both inoculated and naturally-infested soils in a nursery setting, and compared its efficacy against two commercially-available biocontrol products and a fungicide. Results showed significant differences between the treatments, with Ta 04-22 showing the highest level of efficacy. When treated with Ta 04-22, no *P. ramorum* was detected in either inoculated or naturally-infected soils after 8 weeks and 5 weeks, respectively. Based on the negative test results from the nursery plots, the quarantine status of the commercial nursery was removed by the Animal and Plant Health Inspection Service of the United States Department of Agriculture.

Phytophthora ramorum is a regulated pest for Canada and it must be eradicated if identified in a nursery. Based on the information provided in this study, Ta 04-02 could have the potential for future use in *P. ramorum*-infested nurseries. However, the authors of the article noted that the detection method in the study does have some limitations, including a requirement for even pathogen distribution and sufficient sampling. They also caution that Ta 04-22 should be studied further in different soil types and environmental conditions.

SOURCE: Widmer, T.L., Johnson-Brousseau, S., Kosta, K., Ghosh, S., Schweigkofler, W., Sharma, S. and K. Suslow. 2018. Remediation of *Phytophthora ramorum*-infested soil with *Trichoderma asperellum* isolate 04-22 under ornamental nursery conditions. Biological Control. 118: 67-73.

Entomology

8 *Neosilba zadolicha* moving in trade with peppers

In the recent EPPO notifications of non-compliance is an unfamiliar name: *Neosilba zadolicha*. This is a fly in the family *Lonchaeidae*, and was intercepted in a consignment of fresh peppers from Brazil. The genus is restricted to the *Neotropics*, ranging from Mexico to Brazil, and contains up to 100 species (40 are described), of which some, including *N. zadolicha*, are of economic importance as polyphagous fruit pests. According to Gisloti et al (2017), *N. zadolicha* also attacks *Rubus*, *Psidium*, *Ziziphus*, and *Acca*, and passionfruits in Colombia (Wyckhuys et al. 2012), as well as oranges and mandarins (Suffert et al. 2016). Another species, *N. pendula* has been reported to attack green peppers and tomatoes in Chile (Koch-Klein and Waterhouse 2000).

Fresh peppers are currently prohibited entry to Canada from Brazil; however, Mexico, Chile, Peru and several Central American countries are authorized to export fresh peppers to Canada. While *N. zadolicha* could survive in greenhouse environments, it is unlikely to establish outdoors in Canada. The highest risk pathway for the entry of this insect to Canada is with imported fruit, particularly if the fruit is infested and handled or packaged in the vicinity of a pepper or tomato production greenhouse. Implementing biosecurity measures minimizes the risk of introducing pests, such as this one, to production greenhouses. The following page contains a link to the CFIA National Voluntary Farm-Level

Biosecurity Standard for the Greenhouse, Nursery and Floriculture Sectors: http://www.inspection.gc.ca/plants/plant-pests-invasive-species/biosecurity/eng/1323475203667/1323475279124

South Africa regulates *Neosilba zadolicha* (DAFF 2018) and the United States considers that both *Neosilba pendula* and *Neosilba zadolicha* meet the threshold to be identified as quarantine pests (see: https://www.federalregister.gov/documents/2018/02/06/2018-02382/supplemental-requirements-for-importation-of-fresh-citrus-from-colombia-into-the-united-states).

SOURCE: DAFF. 2018. Phytosanitary import requirements for fresh mango (*Mangifera indica*) fruit from Brazil to South Africa. Department of Agriculture, Forestry and Fisheries, Republic of South Africa, Pretoria, South Africa.
EPPO. 2019. EPPO reporting service, No. 11. Paris.

Gisloti, L., Uchoa, M. A. and Prado, A. 2017. New records of fruit trees as host for *Neosilba species* (Diptera, Lonchaeidae) in southeast Brazil. Biota Neotropica 17(1):DOI: 10.1590/1676-0611-bn-2016-0213.

Koch-Klein, C. and Waterhouse, D. F. 2000. The distribution and importance of arthropods associated with agriculture and forestry in Chile. ACIAR Monograph No. 68, 234 pp.

Suffert, M., Grousset, F., Petter, F., Steffen, K., Schrader, G. and Wilstermann, A. 2016. Work package 1. Pathways of introduction of fruit pests and pathogens Deliverable 1.3. PART 7-REPORT on Oranges and Mandarins-Fruit pathway and Alert List (Dropsa EU project number 613678).

Wyckhuys, K. A. G., Korytkowski, C., Martinez, J., Herrera, B., Rojas, M. and Ocampo, J. 2012. Species composition and seasonal occurrence of Diptera associated with passionfruit crops in Colombia. Crop Protection 32:90-98.

9 First report on establishment of *Laricobius osakensis* (Coleoptera: Derodontidae), a biological control agent for hemlock woolly adelgid, *Adelges tsugae* (Hemiptera: Adelgidae), in the eastern U.S.

The hemlock woolly adelgid, *Adelges tsugae* (Hemiptera: Adelgidae) originates from Japan, where it does not create serious problems because of the natural enemy complex which keeps the pest populations under control. Its introduction in North America, however, has led to the expression of invasive behaviour and significant tree mortality in the eastern United States. The search for biological control agents has been targeted at the area in Japan where the current adelgid strain found in eastern USA originated. *Laricobius osakensis* was approved as a biocontrol agent in 2010 and since then it has been released at 61 sites. Despite the unusually cold winters of 2014 and 2015, the beetle was able to survive, if in limited numbers. Its populations are slowly recovering and recovery rate seems to be positively correlated with adelgid density and plant hardiness zones; that is, establishment at several release sites seems to have been successful. This is the third predatory beetle successfully established in the USA as a biocontrol agent. The other two are *Laricobius nigricinus* and *Sasajiscymnus tsugae*, which are also established and are dispersing slowly (USDA Forest Service Northern Research Station 2017). *L. nigricinus* is doing well in southern areas of the USA, but shows some cold sensitivity (Mark Whitmore, Department of Natural Resources at Cornell University, presentation to the Forest Pest Management Forum, 4-6 December, 2018, Ottawa).

Laricobius osakensis is of interest to Canada, because it prefers to feed and oviposit on *A. tsugae* over other species and its ability to coexist with *L. nigricinus* and *L. rubidus* without hybridizing with them. Its establishment is confirmed at several release sites in Virginia, in plant hardiness zone 6b. The authors found a significant correlation between the beetle's dispersal rate and hardiness zone, showing the beetle`s preference for warmer climate.

Unlike *Laricobius* species, which feed in the winter and early spring, *Scymnus camptodromus* (Coleoptera: Coccinellidae) is an active predator of *A. tsugae* in the spring and summer, and could therefore cause additional pressure on *A. tsugae* populations. These beetles are voracious and abundant predators of HWA in China, have a broad geographic range and the ability to thrive in colder climates. The current problem with using this species as a biocontrol agent is the difficulty with laboratory rearing of it, due to an obligatory egg diapause. Research targeting the conditions necessary to break egg diapause and to develop mass rearing techniques for in order to begin releases is underway (USDA Forest Service Northern Research Station 2017).

SOURCES: USDA Forest Service Northern Research Station. 2017. Hemlock Woolly Adelgid. [Online] Available: https://www.nrs.fs.fed.us/disturbance/invasive_species/hwa/control_management/scymnus_camptodromus/ [13 Dec. 2018, 2018].

Toland, A., Brewster, C., Mooneyham, K. and Salom, S. 2018. First report on establishment of *Laricobius osakensis* (Coleoptera: Derodontidae), a biological control agent for hemlock woolly adelgid, *Adelges tsugae* (Hemiptera: Adelgidae), in the eastern U.S. Forests 9(8).

10 *Ips typographus* detected in the U.K.

An early science scan in 1997 reported a first finding of this regulated bark beetle in Wales, but this is the first official find of it in a natural setting. Compared to other sources, including from *Ips typographus*-infested parts of Europe, Canada's importations of conifer wood from the U.K. is minimal, so this is of interest mainly because it is the first long-distance movement of this beetle resulting in apparent establishment. Its biology, which includes the requirement for mass attack to overwhelm tree defences, is not conducive to long-distance migration, but this instance suggests that either a large amount of infested wood was brought to Europe, or, given that Kent is the closest county to mainland Europe, that it was blown over in a weather event.

Ips typgraphus is mentioned in the following CFIA regulatory documents:
D-02-12 - Import requirements of non-manufactured wood and other non-propagative wood products, except solid wood packaging material, from all areas other than the continental United States
D-01-12 - Phytosanitary Requirements for the Importation and Domestic Movement of Firewood
D-98-08 - Entry Requirements for Wood Packaging Materials Produced in All Areas Other Than the Continental United States

SOURCE Government of the U.K. press release, December 7, 2018.

11 A beneficial predatory insect, *Harmonia axyridis* (Coleoptera: Coccinellidae) as a pathway for the spread of hemlock woolly adelgid (Hemiptera: Adelgidae)

The hemlock woolly adelgid is a regulated quarantine pest in Canada. It is found in much of western Canada, where it is native and does not cause economic damage. In the eastern US, however, there was an introduction of a population of HWA which was believed to have originated from southern Japan in the 1950s. In Canada, HWA was found in two isolated instances in southern Ontario (in relative close proximity to infested sites in New York State) in the recent past and was promptly eradicated. But in 2017, it was detected in five counties in southwestern Nova Scotia.

The current report brings attention to the possibility that a predator-prey relationship (*H. axyridis*, the predator, *A. tsugae*, the prey) can inadvertently help the spread of the invasive species.

Harmonia axyridis is native to Asia and was introduced into many places around the world as a biological control agent. It is present in several Canadian provinces including Nova Scotia where HWA was recently detected. It is not known whether there is an overlap in the distribution of HWA and *H. axyridis* in the HWA-infested counties in Nova Scotia.

SOURCES: : Leppanen, C. & Simberloff, D. 2018. The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), disperses the hemlock woolly adelgid, *Adelges tsugae* (Annand) (Hemiptera: Adelgidae). Coleopterists Bulletin, 72(3): 612-613.

McClure, M.S. 1990. Role of wind, birds, deer, and humans in the dispersal of hemlock woolly adelgid (Homoptera: Adelgidae). Environmental Entomology, 19(1): 36-43.

12 Acoustic methods for detection of wood boring quarantine pests

In the past the limitations of the acoustic method were related mostly to the need of a soundproof case for the sample. Recent developments in the field allow separation of the target signal from the background noise. Specialized software distinguishes the sounds automatically and in some cases allows identification of the species by some characteristic sounds (e.g. red palm weevil and *Monochamus* longhorn beetles). A EUPHRESCO project “Q-detect” targeted at the development of rapid reliable test for early pest detection assessed and verified the acoustic methods effectiveness in detecting infestation by the red palm weevil, *Monochamus* longhorn beetles and Asian longhorn beetle (*Anoplophora glabripennis*).

Another EUPHRESCO project “ANOPLORISK I, II” focused on detection of *A. glabripennis* had been successfully tested on living trees. A sound library of more than 11 wood-boring pests has been established (among which *Agrilus planipennis, Anoplophora glabripennis*, *Anoplophora chinensis*, bark beetles and *Cossus cossus*). Two limiting factors for the acoustic methods remain. The first one is the lack of specialized software and the need for specific equipment, which are temporary obstacles. The second one is the necessity of the insect to be in an active stage in order to be detected.

The current development of the acoustic methods makes them more suitable for inspecting living plants in nurseries, trade and quarantine, while the inspection of wood products with other methods (X-ray, trained dogs, ``electronic nose`` and visual inspection) remains more efficient for the moment.

SOURCE: Starodubtseva, A. M. and Fedotova, A. G. 2017. Acoustic methods for detection of wood boring quarantine pests. Plant Health Research and Practice 2(20):39-41.

Botany

13 Whole angiosperm dispersal by gut passage through waterbirds

Birds are known dispersers of weeds and invasive plants, and can contribute to their spread into new areas. Most of the literature on bird dispersal of plants focuses on the passage of seeds through the gut (i.e., endozoochory). Small floating plants in the genera *Wolffia* and *Lemna* (*Araceae*) are also known to adhere to the feathers of waterbirds and may be dispersed externally (i.e., epizoochory). In a

recent study from southern Brazil, Silva et al. (2018) demonstrated for the first time that entire plants may be dispersed by gut passage through birds. The authors analyzed fresh droppings of the white-faced whistling duck (*Dendrocygna viduata*) and the coscoroba swan (*Coscoroba coscoroba*) and found intact, viable *Wolffia columbiana* plants in 16% and 32% of samples from the two species, respectively. They noted that dispersal of vegetative propagules such as plant fragments or whole floating plants by endozoochory "may be an important and overlooked process". Similarly, recent research has also shown that waterbirds can disperse viable moss fragments and fern spores by endozoochory.

When conducting weed risk assessments, the CFIA considers the potential for dispersal of plants by natural agents such as birds while evaluating the plant's potential to enter new areas and/or spread from existing populations. This research by Silva et al. (2018) provides a valuable contribution to our knowledge of avian endozoochory and also highlights the need for additional research in this area.

SOURCES: Silva, G. G., Green, A. J., Weber, V., Hoffman, P., Lovas-Kiss, Á., Stenert, C. and Maltchik, L. 2018. Whole angiosperms *Wolffia columbiana* disperse by gut passage through wildfowl in South America. Biology Letters 14. http://dx.doi.org/10.1098/rsbl.2018.0703

14 Framework for identifying future invasive alien species in Europe

The European Union (EU) recently passed legislation to regulate current invasive alien species (IAS), as well as undertake horizon scanning to develop a list of future IAS that may invade in the next 10 years. For the future threats, a systematic approach was used to identify species currently absent from the EU that could become important IAS. Experts were chosen for five thematic subgroups (e.g. freshwater invertebrates, marine species, terrestrial plants, terrestrial invertebrates and terrestrial vertebrates). Preliminary species lists were created by each expert, then discussed in their relevant subgroups and eventually combined through a consensus process to create a single list. List criteria included IAS pathways, establishment and spread potential, as well as negative impacts each species could have on biodiversity and ecosystem services. There were 66 species identified as absent from the EU at present but that pose either a medium, high or very high risk for the future. Out of the 66 species there were 6 freshwater invertebrates, 16 marine species, 18 terrestrial plants, 12 terrestrial invertebrates and 14 terrestrial vertebrates. Plants were deemed to present a greater than average threat. Many of the plants listed are native to Asia and South America and their primary entry pathway is escape from confinement (e.g. horticultural plants escaping from gardens). The overall goal of the list is to enable the EU to prioritize risk assessments for IAS that have not yet established.

This research by Roy et al. (2018) provides valuable insight on how to prioritize species using a framework that combines expert knowledge with evidenced-based literature review and impact assessment.

SOURCES: Roy, H. E., Bacher, S., Essl, F., Adriaens, T., Aldridge, D. C., Bishop, J. D. D., Blackburn, T. M., Branquart, E., Brodie, J., Carboneras, C. and others. 2018. Developing a list of invasive alien species likely to threaten biodiversity and ecosystems in the European Union. Global Change Biology http://dx.doi.org/10.1111/gcb.14527

Biotechnology

15 Canadian winter doesn't stop the western bean cutworm

Western bean cutworm (WBC), *Striacosta albicosta* (Smith) (Lepidoptera: Noctuidae), has been making a name for itself as an Ontario corn pest since 2008 when it was first identified in the province. WBC larval feeding reduces yield and increases subsequent mycotoxin contamination of grain, negatively affecting the health of humans and livestock that eat corn.

A study by Smith et al. (2018) documents the spread of WBC into Ontario, the ability of WBC to overwinter, and the resulting damage caused to corn. Findings show that WBC is an established perennial corn pest in the Great Lakes region due to its ability to overwinter and to cause crop damage. Authors suggest the lack of management options available make this pest the most important and problematic in the Great Lakes Region where it should be considered a primary pest.

Following the range expansion of WBC into the U.S. Corn Belt, pheromone trap monitoring in Ontario began in 2007 and led to the first capture in 2008. Trapping efforts documented increasing numbers of WBC from 2008 to 2012. Trapping confirmed that in Ontario, WBC undergoes one generation per year with peak flight usually occurring in late July. This information can inform when scouting and management of this pest will be effective.

Many moth pests migrate annually from the US but do not maintain a population in Canada – either emigrating or dying when temperatures drop. These pests often appear sporadically and are usually considered secondary pests. The study confirmed that WBC can complete its entire lifecycle in Canada, emerging from infested fields and overwintering experiments following winter. Multiple soil textures were infested with prepupae, and recovery was assessed throughout the winter. Soil temperatures at overwintering depths did not reach the supercooling point (that is, when the internal fluids freeze – for WBC prepupae it is around -13°C). Emergence cages were used to capture moths emerging from naturally-infested fields. Extrapolating from these results, emergence ranged from 100 to 38,000 moths per hectare.

WBC injury to corn in field plots increased in incidence, severity, and geographic range from 2010 to 2014. Transgenic corn hybrids that express *Bacillus thuringiensis* (Bt) insecticidal proteins may help control WBC. The Vip3A trait controls WBC and is expected to be used more in coming years while the efficacy of the Cry1F trait has decreased and it no longer provides effective control.

To maintain the efficacy of current and future products with activity against WBC, authors suggest that insect resistance management strategies are applied. The Canadian Food Inspection Agency typically requires insect resistance management plans to delay the development of insect resistance to plants expressing insecticidal proteins. New information about WBC biology can inform the development of resistance management strategies, including how monitoring moth flights, scouting for egg masses, insecticide applications, and refuge type may impact a strategies success.

SOURCES: Smith, J. L., et al. "Establishment of *Striacosta albicosta* (Lepidoptera: Noctuidae) as a primary pest of corn in the great lakes region." Journal of economic entomology 111.4 (2018): 1732-1744.

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