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PLANT SCIENCE SCAN

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BACKGROUND: The Plant Health Science Division 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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Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments
Canada

Pathology

1 Update: Recent outbreak and control of *Synchytrium endobioticum*, the causing agent of potato wart disease, in Denmark

Potato wart, a disease caused by a soil-borne fungus, *Synchytrium endobioticum*, has been discovered for the first time in three decades in Denmark. The source of the inoculum remains unknown. The outbreak was diagnosed in September 2014 using microscopy and PCR, and is isolated to four ware potato fields belonging to one grower in the town of Ikast. For more than a decade, the grower has been producing and delivering ware potatoes exclusively for one local starch producing factory. The grower has never produced potatoes for any purpose other than processing. Delimiting surveys by visual inspection of tubers have been completed. Soil sampling and analysis will continue within all relevant fields. The grower's harvest of this year is being destroyed by incineration or processing and the infested fields will be banned from future cropping until re-approved depending on survey results. A buffer zone is under consideration for future detection surveys and cropping restrictions.

Synchytrium endobioticum is a regulated pest in Canada. It attacks the growing points on the potato plant, such as eyes, buds and stolon tips. The fungus can remain dormant in the soil for several years or more as resting spores.

Source: IPPC. 2014. Isolated outbreak of *Synchytrium endobioticum* is being officially controlled, cf. DNK-15/3. [Online] Available: https://www.ippc.int/countries/denmark/basic-reporting/isolated-ourbreak-synchytrium-endobioticum-being-officially [Accessed November 6, 2014].

2 First Report: Asian brown rot, *Monilia polystroma,* in Italy

In July 2013, a survey for fungal postharvest pathogens detected brown rot symptoms on stored peaches (*Prunus persica*) in the Italian regions of Emilia Romagna and Sardinia. Typical decay spots were circular and brown, tending toward black and five percent of peaches presented a large number of yellowish or buff-colored stromata and firm decayed tissues. The pathogen was isolated and cultured, and the ribosomal ITS1-5.8S-ITS2 region of DNA obtained from the mycelium was PCR-amplified using ITS1 and ITS4 primers. A search in GenBank revealed the highest similarity (99%) to *Monilia polystroma* sequences.

This is the first report of the fungus *M. polystroma* on peach in Italy. *Monilia polystroma* is the causal agent of Asian brown rot in *Malus* spp. (apple), *Prunus* spp. (stone fruit), *Pyrus* spp. (pear) and *Cydonia* spp. (quince). It is also known to occur in Switzerland, the Czech Republic, Poland, Hungary, Serbia, China and Japan. *Monilia polystroma* is a regulated pest in Canada.

Source: Martini, C., Lantos, A., Di Francesco, A., Guidareli, M., D'Aquino, S. and Baraldi, E. 2014. First report of Asiatic brown rot caused by *Monilinia polystroma* on peach in Italy. Plant Disease 98(11): 1585.

3 First Report: *Phytophthora tentaculata* in the United States

A recent publication in the journal *Plant Disease* provides the first report of *Phytophthora tentaculata* in North America. This exotic pathogen was detected from nursery-grown sticky monkey flower plants (*Mimulus aurantiacus*) in California in October 2012. The plants were stunted and had dull, yellowish leaves. The roots and stem collars had necrotic, sunken lesions and few feeder roots. The source of the inoculum remains unknown. The nursery used seed and cuttings of *M. aurantiacus* from nearby native areas for propagation, and *P. tentaculata* was not found in neighbouring plant hosts or by baiting soil and water at the nursery. All infected *M. aurantiacus* material was destroyed.

Since the detection, this pathogen has been found on nursery stock in four counties in California,

including out-planted stock in restoration sites in Alameda. The USDA-APHIS, USDA Forest Service and California Department of Food and Agriculture are coordinating responses to detections and conducting surveys to determine the extent of introduced infestations. In 2010, the USDA-APHIS developed a set of pest response guidelines for *Phytophthora* species in the environment and nursery settings to guide their response to a detection of an exotic species of *Phytophthora* (USDA-APHIS 2010).

Phytophthora tentaculata is an emerging pest. It has been reported as a root and stalk rot pathogen of chrysanthemum, larkspur and verbena in Germany and the Netherlands; verbena, lavender and cotton lavender in Spain; chicory, oregano and African daisy in Italy; and Aucklandia and celery in China. The potential risk of this pathogen to Canadian nursery and forest industries remains unknown until further research is completed to determine its host range and other factors that would influence its importance.

Source: Rooney-Latham, S. and Blomquist, C. L. 2014. First Report of Root and Stem Rot Caused by *Phytophthora tentaculata* on *Mimulus aurantiacus* in North America. Plant Disease (98): 996.

Other cited material: USDA-APHIS. 2010. *Phytophthora* species in the Environment and Nursery Settings New Pest Response Guidelines. Technical Report, USDA Animal and Plant Health Inspection Services (APHIS), Riverdale, MD, USA.

4 Update: Polyphasic taxonomic study proposes revision of the *Ralstonia solanacearum* species complex

For more than a century, *Ralstonia solanacearum* species complex has been one of the most economically important phytopathogenic bacteria because of its lethality, complex host profile, worldwide distribution and persistent survival in soil and waterways. These bacteria cause vascular wilt in more than 200 plant species belonging to over 54 families in tropical and subtropical regions (Hayward 1991; Cellier and Prior 2010). *Ralstonia solanacearum* race 3 biovar 2 (R3Bv2) strains, which cause brown rot and bacterial wilt of potato, Southern wilt of geranium and bacterial wilt of tomato and other solanaceous crops, were classified as phylotype II sequevars 1 and 2 on the basis of phylogeny of endoglucanase gene sequences.

A recent study using a polyphasic taxonomic approach proposed a revision of the taxonomy of the *R. solanacearum* species complex and identified genotypic and phenotypic characteristics that differentiate the taxa. The following taxonomic proposals are made: emendation of the descriptions of *R. solanacearum* and *R. syzygii* and reclassification of *R. syzygii* subsp. nov. for the current *R. syzygii* strains, *R. syzygii* subsp. *indonesiensis* subsp. nov. for the current *R. solanacearum* phylotype IV strains, *R. syzygii* subsp. *celebesensis* subsp. nov. for the blood disease bacterium (BDB) strains and *R. pseudosolanacearum* sp. nov. for the strains of *R. solanacearum* phylotypes I and III.

In the new nomenclature, R3Bv2 strains remain as members of *R. solanacearum* genospecies. Unlike the other two genospecies, *R. syzygii* and *R. pseudosolanacearum*, *R. solanacearum* R3Bv2 strains have adapted to a temperate climate, and have caused significant losses to the potato industry throughout Europe during the last decade. Latently infected geranium cuttings from Kenya and Central America were believed to be the cause of substantial damage in greenhouse-grown crops in Belgium, Germany, the Netherlands and the United States (Swanson et al. 2005; Denny 2006). So far, the commercial movement of infected, generally asymptomatic, planting material represents the most significant route by which the pathogen has spread on a global scale. Eradication becomes difficult or impossible once the bacterium is established in local soil and irrigation systems. Strict quarantine regulations are applied in many countries for *R. solanacerum* R3Bv2. As a result, *R. solanacearum* R3Bv2 is considered to be a quarantine pathogen in Europe and Canada, and is listed as a select agent in the U.S. Agricultural

Bioterrorism Protection Act of 2002.

Source: Safni, I., Cleenwerck, I., De Vos, P., Fegan, M., Sly, L. and Kappler, U. 2014. Polyphasic taxonomic revision of the *Ralstonia solanacearum* species complex: proposal to emend the descriptions of *Ralstonia solanacearum* and *Ralstonia syzygii* and reclassify current *R. syzygii* strains as *Ralstonia syzygii* subsp. *syzygii* subsp. nov., *R. solanacearum* phylotype IV strains as *Ralstonia syzygii* subsp. *indonesiensis* subsp. nov., banana blood disease bacterium strains as *Ralstonia syzygii* subsp. *celebesensis* subsp. nov. and *R. solanacearum* phylotype I and III strains as *Ralstonia pseudosolanacearum* sp. nov. International Journal of Systematic and Evolutionary Microbiology 64: 3087-3103.

Other cited material: Cellier, G. and Prior, P. 2010. Deciphering phenotypic diversity of *Ralstonia solanacearum* strains pathogenic to potato. Phytopathology 100: 1250-1261.

Denny, T.P. 2006. Plant pathogenic *Ralstonia* species. Pages 573-644 *in* Plant-Associated Bacteria. S.S. Gnanamanickam (Ed.). Springer, University of Madras, Netherlands.

Hayward, A.C. 1991. Biology and epidemiology of bacterial wilt caused by *Pseudomonas solanacearum*. Annual Review of Phytopathology 29: 5-87.

Swanson, J.L., Yao, J., Tans-Kersten, J. and Allen, C. 2005. Behavior of *Ralstonia solanacearum* race 3 biovar 2 during latent and active infection of geranium. Phytopathology 95: 136-143.

5 New Treatment: Phytosanitary treatment of wood pallets by microwave

In April 2013, dielectric heating (microwave, radio frequency) was approved by the FAO as an effective phytosanitary treatment for wood packaging material. A study using pallet boards was carried out in order to set up a treatment program that would meet ISPM 15 requirements in terms of wood temperature and insect mortality. According to ISPM 15 (FAO 2009), target organisms are eradicated if a temperature higher than 60˚C is maintained for 60 s across the entire profile of the board. Using a 4 m-long industrial tunnel oven (maximum power of 28.8 kW), mean temperatures of 63.2˚C (*Populus* sp.) and 64.8˚C (*Pinus sylvestris*) were achieved on the upper surface of 22 mm-thick boards, enabling compliance with FAO requirements regardless of the moisture content, basic density and initial temperature of the wood (provided the latter exceeded 0˚C). Several decades after research dedicated to the possible use of microwaves was initiated, the findings of this study provide guidelines allowing for the transfer of this technology to the wood industry. This treatment now appears in the revised version of ISPM 15.

The most common method of heat treatment uses either conventional steam or a dry kiln heat chamber, in both cases requiring that a temperature of at least 56˚C be maintained across the entire profile of the wood for at least 30 minutes. The duration and reliance on a kiln heat chamber can cause delays in the production line. Alternatively, dielectric heating can be very useful due to the rapidity of the treatment and the comparatively small quantity of material required.

Source: Henin, J. M., Leyman, M., Bauduin, A., Jourez, B. and Hebert, J. 2014. Phytosanitary treatment of European pallets by microwave: developing a program to ensure compliance with ISPM 15 and monitoring its efficacy on the house longhorn beetle (*Hylotrupes bajulus* L.). European Journal of Wood and Wood Products 72(5): 623-633.

Other cited material: FAO. 2009. Regulation of wood packaging material in international trade. International Standards for Phytosanitary Measures No. 15 (ISPM 15) *in* Food and Agriculture Organization of the United Nations, Secretariat of the International Plant Protection Convention, Rome, Italy.

6 Tool Development: Adapting and evaluating a trapping system for the Asian longhorned beetle

This paper describes the development, deployment and evaluation of semiochemical-baited traps as part of a management plan to eradicate Asian longhorned beetle (ALHB), *Anoplophora glabripennis* (Coleoptera: Cerambycidae), in the greater Worcester area of Massachusetts. Intercept panel traps were deployed which were baited with three different families of lures exhibiting different rates of release of the male-produced *A. glabripennis* pheromone. The lures were tested alone and in combination with plant

volatiles. Over the four years of trap evaluation (2009 - 2012), 45 individual beetles were captured in 40 different traps. Beetles were found only in traps with lures. In several cases, trap catches led to the more rapid discovery and management of previously unknown areas of infestation in the Worcester county regulated area.

While this report is a step in the right direction for early detection of ALHB, a CFIA Survey Biologist (Troy Kimoto) opined that catching only 45 beetles in 40 traps between the 2009 and 2012 seasons is really too low for this method to be considered for operational use. The Worcester infestation, which was discovered in 2008, has close to 24,000 infested trees. By the time this research started in 2009, there should have been a large enough ALHB population to test attraction. The capture of low numbers of beetles in the presence of diverse lure combinations may also indicate that more work needs to be done on trap design, such as colour.

In North America, ALHB attacks and kills a wide range of deciduous tree species, and thus poses a high-risk to the urban and natural forests. Native to China and Korea, an established population of ALHB was discovered in 2003 in an industrial park in the Greater Toronto Area, on the border between Toronto and Vaughan, Ontario, Canada. This population was eradicated and Canada was declared free of ALHB in early 2013. However, a new detection was reported in an industrial area near Pearson International Airport, in Ontario, in late 2013. The CFIA has established a regulated area in Mississauga and Toronto as part of its plans to eliminate this pest. This insect was recently listed among the 100 most threatening invasive species worldwide.

Source: Nehme, M. E., Trotter, R. T., Keena, M. A., McFarland, C., Coop, J., Hull-Sanders, H. M., Meng, P., De Moraes, C. M., Mescher M. C. and Hoover, K. 2014. Development and evaluation of a trapping system for *Anoplophora glabripennis* (Coleoptera: Cerambycidae) in the United States. Environmental Entomology 43(4): 1034 - 1044.

7 First Report: Spotted lanternfly, *Lycorma delicatula,* in the United States

In September of 2014, the Pennsylvania Department of Agriculture and the Pennsylvania Game Commission confirmed the presence of the spotted lanternfly, *Lycorma delicatula* (Hemiptera: Fulgoridae), in Pennsylvania. This is the first report of *L. delicatula* in the United States. *Lycorma delicatula* primarily infests *Ailanthus altissima* (tree-of-heaven) but is also known to feed on many economically important plants, including *Vitis* spp. (grape), *Malus* spp. (apple) and *Prunus* spp. (stone fruit). Heavy feeding results in wilting, sooty mold accumulation around the plant base and sometimes plant death. An order of quarantine has been issued by the Commonwealth of Pennsylvania, regulating the movement of the insect, live plants of all species, brush and plant debris, firewood, stumps and wood packaging materials out of the quarantine area. The order also includes non-host items such as recreational vehicles and outdoor household articles including barbecue grills, lawn tractors and deck boards – essentially anything not stored indoors. All these items are considered possible carriers of eggs. As of late November 2014, District, Hereford, Pike, Rockland and Washington townships, including Bally and Bechtelsville boroughs, are quarantined. Subsequent to this report, a categorization was initiated in the Plant Health Risk Assessment Unit of the CFIA to determine whether this species poses a risk to Canada. In addition to this find in the United States, *L. delicatula* is known to occur in India, China, Vietnam, Korea and Japan. Until 2006 it was not thought able to survive in South Korea due to cold, but has now survived and spread, apparently aided by global climate change. It is possible that conditions in Canada's important fruit-growing areas are suitable for establishment of this pest, but this remains uncertain for the time being.

Source: Pennsylvania Department of Agriculture (PDA). 2014. Spotted lanternfly. Pennsylvania Department of Agriculture (PDA). Updated November 15, 2014. [Online] Available: http://www.agriculture.state.pa.us/portal/server.pt/gateway/PTAR

GS_0_2_24476_10297_0_43/AgWebsite/ProgramDetail.aspx?name=SPOTTED-LANTERNFLY&navid=12&parentnavid=0&palid=150& [Accessed November 25, 2014].

Botany

8 Update: *Lespedeza cuneata,* a potential rangeland concern for Canada

Chinese bush-clover, *Lespedeza cuneata*, is an aggressive, long lived perennial species of the legume family (Fabaceae). Native to Asia, it was introduced in the United States in the late 1800s for erosion control and forage. *Lespedeza cuneata* is adapted to a wide range of habitats, being found in open woodlands, rangelands, pastures, along roads, fence lines and drainage areas and in other disturbed areas (Stevens 2002). This species readily escapes from cultivation into native grasslands and agricultural areas and can seriously impact natural areas (Stevens 2002). A deep root system contributes to drought resistance and association with rhizobia allow this species to readily establish in poor (low N) soils. In the United States, this species is currently spreading and is known to move as a contaminant in hay and agricultural machinery but also via animals and water (Nebraska Invasive Species Council 2012). It is listed as a noxious weed in Colorado and Kansas (USDA-NRCS 2014). In the Midwestern United States, it is considered an invasive weed of rangelands and grasslands. When not managed, this species forms dense stands that effectively outcompete native species and negatively affect species richness and habitat structure. Allelopathic chemicals also reduce germination of native and desirable species (Stevens 2002).

A recent Nebraska weed risk assessment estimated that the potential range of *L. cuneata* would likely include rangeland regions in Southern British Columbia and Alberta as well as significant portions of cropland in Southern Ontario (Nebraska Invasive Species Council 2012). This species is listed as being present in Ontario but extremely rare (Newmaster et al. 1998; Brouillet et al. 2010+). The CFIA's Plant and Biotechnology Risk Assessment Unit is currently evaluating *L. cuneata* to determine if it would satisfy the definition of a quarantine pest for Canada.

Cited material: Brouillet, L., Coursol, F., Meades, S. J., Favreau, M., Anions, M., Bélisle, P. and Desmet, P. 2010+. VASCAN, the database of vascular plants of Canada. [Online] Available: http://data.canadensys.net/vascan/ [2014].

Nebraska Invasive Species Council. 2012. Weed Risk Assessment for *Lespedeza cuneata* G. Don (Fabaceae) – Chinese bush-clover. [Online] Available: http://www.nda.nebraska.gov/noxious_weed/chinese_bush_clover_risk_assessment.pdf

Newmaster, S. G., Lehela, A., Uhlig, P. W. C., McMurray, S. and Oldham, M. J. 1998. Ontario Plant List; Forest Research Information Paper No. 123. Ontario Forest Research Institute, Ontario Ministry of Natural Resources, Sault Ste. Marie, ON. 550 + appendices pp.

Stevens, S. 2002. Elements Stewardship Abstract for *Lespedeza cuneata* (Dumont – Cours.) G. Don Sericea Lespedeza, Chinese Bush Clover. The Nature Conservancy. [Online] Available: http://www.invasive.org/gist/esadocs/documnts/lespcun.pdf

USDA-NRCS. 2014. The PLANTS Database. [Online] Available: http://plants.usda.gov/core/profile?symbol=LECU

Biotechnology

9 Review: A comparative analysis of insertional effects in genetically engineered plants: Considerations for pre-market assessments

An interdepartmental working group, consisting of members from the CFIA Animal Feed Division, Plant Biosafety Office and Plant and Biotechnology Risk Assessment Unit as well as Health Canada's Food Directorate, developed a scientific paper that evaluates the nature of insertional effects in genetically engineered plants. Insertional effects are defined as the changes to the transformed plant's genome that result from the process of inserting DNA by genetic engineering. They include the insertion of the intended DNA, as well as

additional insertions, deletions and rearrangements at the site of insertion. The paper concludes that these insertional effects do not pose any greater risk than genetic changes that occur naturally in plants or through conventional plant breeding in the course of variety development and selection. A number of global science organizations have recently stated that genetic engineering poses no greater risk than conventional breeding, and this paper is the first to provide a structured, mechanistic analysis to support this statement.

The paper was peer-reviewed and subsequently published on October 26, 2014 in the journal *Transgenic Research*. In addition, key findings of the paper were presented at the *International Symposium on the Biosafety of Genetically Modified Organisms* (ISBGMO) in South Africa on November 10, 2014. The ISBGMO is held every two years and serves as the major world forum for scientists, regulators and the agricultural biotechnology industry to meet and discuss developments in the science of genetically engineered plants.

The conclusions of this paper will be used to inform the pre-market assessment of novel foods, novel feeds and plants with novel traits at the CFIA and Health Canada. In particular, the paper's conclusions will be especially relevant for "retransformants" – plants with identical genetic constructs as previously authorized plants of the same species. For example, vegetatively propagated plants, such as apple and potato, are difficult to breed. Consequently, developers generally prefer to use transformation techniques instead of using conventional plant breeding to introduce a novel trait into new varieties, which then triggers a pre-market safety assessment at the CFIA and Health Canada. Conducting pre-market assessments on multiple retransformants is resource intensive and can contribute to a backlog in the number of files awaiting pre-market assessment. In light of this, the CFIA and Health Canada are committed to exploring how the conclusions of the paper can be used to streamline the regulatory process for novel foods, novel feeds and plants with novel traits in Canada.

Source: Schnell, J., Steele, M., Bean, J., Neuspiel, M., Girard, C., Dormann, N., Pearson, C., Savoie, A., Bourbonnière, L. and Macdonald, P. 2014. A comparative analysis of insertional effects in genetically engineered plants: considerations for pre-market assessments. Transgenic Research: 1-17.

10 Update: The end of a myth – Bt (Cry1Ab) maize does not harm green lacewings

All currently authorized insect-resistant plants in Canada (*i.e.* Bt crops) express insecticidal proteins derived from the soil bacterium *Bacillus thuringiensis* (Bt). Bt sprays have been used in Canada for several decades and are still commonly used in organic farming. In 1996, plant-incorporated Bt corn was approved in Canada. As of March 24, 2014 there were 24 commercial Bt corn products registered for use in Canada (CCPC 2014) . Depending on the protein(s) involved, Canadian Bt corn products are effective against specific groups of lepidopterans (butterflies/moths) or coleopterans (beetles).

One of the main concerns regarding Bt plants is their potential to harm non-target organisms (NTOs), especially beneficial insects. This review article examines the scientific literature regarding the potential impact of Bt (Cry1Ab) maize on green lacewings (*Chrysoperla* spp.), a genus of beneficial, predatory NTOs associated with various natural and agro-ecosystems around the world. Early studies indicated that Cry1Ab harmed larvae of one species of green lacewing (*C. carnea)* but after an extensive review, the authors concluded that the weight of evidence is sufficient to conclude that Bt maize containing Cry1Ab protein does not harm green lacewings.

The article examined two hypotheses for how Bt maize could cause harm to green lacewings and reduce their biological control function: (1) that the production of Cry1Ab protein in Bt maize could

result in direct harm (e.g., harm through the ingestion of Cry proteins from Bt plants or prey exposed to Bt maize) or indirect harm (e.g., harm through the ingestion of prey with reduced nutritional quality due to exposure to Bt maize); and (2) that the genetic modification could result in an unpredictable and unintended negative effect on green lacewings. The authors, citing 92 sources in their assessment, determined that neither pathway to harm results in a decline in green lacewing populations and/or a loss of biological control from lacewings.

The authors of this peer-reviewed article work for national institutions in Switzerland, USA and China and have declared that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The CFIA and Health Canada are responsible for regulating the environmental release, livestock feed and human food uses of plants with novel traits (PNTs), including those with Bt insect-resistance. This review article supports the conclusions of previous safety assessments conducted by the CFIA and Health Canada regarding the safety of Cry1Ab Bt corn events, and is a resource that may prove useful for the safety assessments of future Bt corn products.

Source: Romeis, J., Meissle, M., Naranjo, S.E., Li, Y. and Bigler, F. 2014. The end of a myth – Bt (Cry1Ab) maize does not harm green lacewings. Frontiers in Plant Science (online) Doi10.3389/fpls.2014.00391. http://journal.frontiersin.org/Journal/10.3389/fpls.2014.00391/full

Other cited material: CCPC. 2014. Bt Corn Products/Traits Currently Available in Canada – As of March 2014 [Online] Available: http;//www.cornpest.ca/ccpcen/assets/File/Registered%20Bt%20events%20March%202014%20Final.pdf [Accessed November 18, 2014].

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