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

PLANT SCIENCE SCAN

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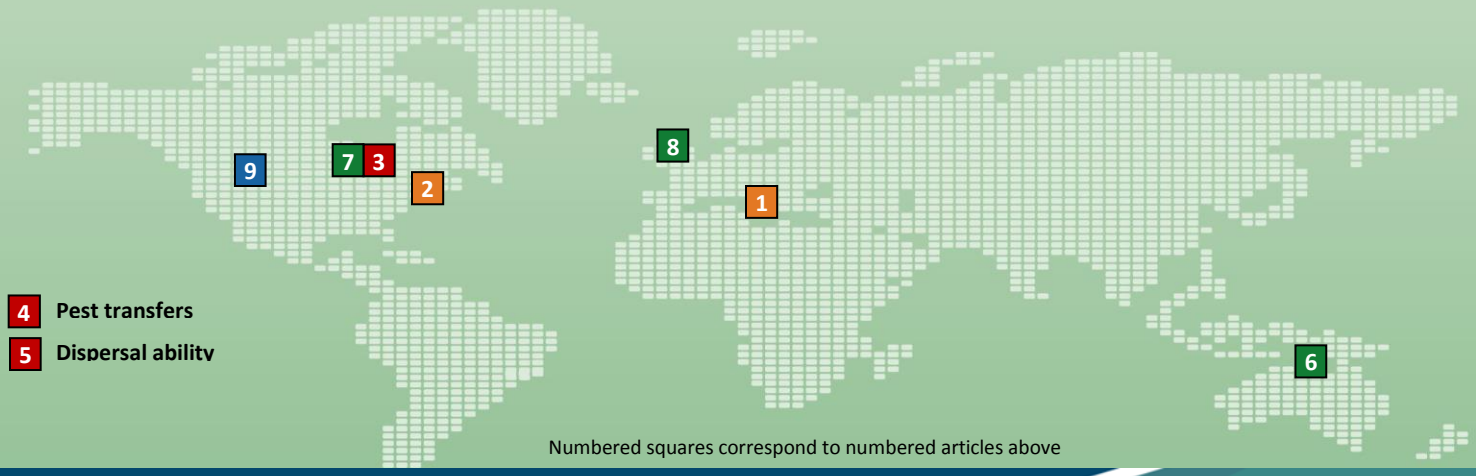
BACKGROUND: The Plant Health Science Directorate of the Canadian Food Inspection Agency routinely scans external sources to identify information that might be of possible regulatory significance or interest to Canada's national plant health. This Plant Science Scan report was prepared by the Canadian 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



Canada

Pathology

1 New pathogen, *Inonotus krawtzewii*, causing damage to oak in western Asia

For a few years, severe oak decline induced by canker trunk rots has been reported from the Zagros region of Iran on *Quercus brantii*. The causal organism was found to be the fungus *Inonotus krawtzewii* (Pilat) Pilat. The pathogen causes crown dieback, resulting in branches breaking and exposing bleached wood (Ghobad-Nejhad 2016).

This fungus was previously considered to be a little known species with a relatively restricted distribution in the Russian Far East, parts of central Europe (Ghobad-Nejhad 2016), and China (Farr and Rossman 2017). This is the first report of this species causing significant damage on oaks, and it is also the first report of it causing damage outside of its previously known locations. It is closely related to the pathogen *Inonotus andersonii*, a species known to cause significant trunk rot diseases in parts of North America (Ghobad-Nejhad 2016).

Inonotus krawtzewii currently is not regulated by the CFIA, and there are no reports of this fungus occurring in North America.

SOURCES: Farr, D.F. and A.Y. Rossman. 2017. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved August 15, 2017. https://nt.ars-grin.gov/fungaldatabases/

Ghobad-Nejhad, M. 2016. Inonotus krawtzewii causes noteworthy damage to oak stands in Zagros, western Asia, with a key to morphologically similar species worldwide. Nordic Journal of Botany. 34: 470-474.

2 First Report of the Apple Root-Knot Nematode (*Meloidogyne mali*) in North America

In a recent publication, the apple root-knot nematode (*Meloidogyne mali*) was detected in root samples from a declining hedge of Manhattan Euonymus (*Euonymus kiautschovicus* Loes.) growing at a private residence in Harrison, New York. This is the first report of this nematode in North America.

Meloidogyne mali was originally described in Japan from roots of an apple rootstock (*Malus prunifolia*). During 1995-98, this nematode was found on root samples of *Ulmus chenmoui* and *U. glabra* trees collected in Italy. The nematode was initially described as a new species, *Meloidogyne ulmi*, which was later synonymized with *M. mali*. These elm trees had been imported from the Netherlands as 3 year old plants. A few years later, this nematode was also found on roots of *Ulmus* trees in the Netherlands between 2012 and 2014.

Meloidogyne mali has a wide host range, including trees, shrubs and herbaceous plants of economic importance in horticulture and forestry. It induces large root galls ('bead-like' galls) on its host plants resulting in malformed root systems and retarded plant growth. However, no data is available on its current economic impact on apple production. Its impact on vegetable crops and other major forest trees remains to be clarified.

It is hypothesized that *M. mali* might have been introduced into Europe and North America with elm planting material within the framework of breeding programs against Dutch elm disease, therefore, this nematode may be more widespread than is currently known.

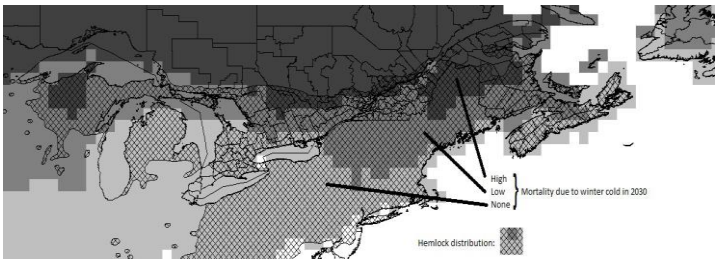
At present, *Meloidogyne mali* is not a regulated pest for Canada and the USA.

SOURCE: Ahmed, M., van de Vossenberg, B. T., Cornelisse, C. and Karssen, G. 2013. On the species status of the root-knot nematode Meloidogyne ulmi Palmisano & Ambrogioni, 2000 (Nematoda, Meloidogynidae). ZooKeys(362):1.

Entomology

3 Effect of cold on hemlock woolly adelgid

This study suggests that the adelgid will experience moderate mortality due to winter cold in Canada, and allows a projection of the approximate part of the range of hemlock that might be relieved of adelgid pressure by cold. Mapping minimum January temperature (projected to 2030, under a 'do-nothing' climate change scenario A2) suggests that moderate annual mortality in the northern part of the hemlock's range can be expected. Whether this moderate mortality is sufficient to reduce hemlock losses is uncertain, but a crude diagram to suggest where reduced mortality might be found is below: the hatched area is the distribution of hemlock, and the darkest gray values indicate areas of relatively high to relatively low cold-stress induced expected winter mortality.



SOURCE: Tobin, P. C., Turcotte, R. M., Blackburn, L. M., Juracko, J. A. and Simpson, B. T. 2017. The big chill: quantifying the effect of the 2014 North American cold wave on hemlock woolly adelgid populations in the central Appalachian Mountains. Population Ecology 59(3):251-258.

4 Assessing the probability of pest transfer from flowers and fruit

The model describes a process that is part of risk assessment: identifying the likelihood that a pest arriving on a commodity will successfully transfer to the environment. Plant health risk assessments at the CFIA are generally qualitative in nature; on occasion and when data permits, some of the risk elements are evaluated quantitatively. This model presents an outline that can be used in such cases, and suggests percentage probabilities that correspond to likelihoods normally expressed only qualitatively (unlikely, likely etc.). While these percentages do not need to be adopted, they provide a good starting point for the assessor to evaluate his or her own beliefs as to the likelihood of a particular event occurring. Even though qualitative methods arguably give a better impression of the relative risks being evaluated than qualitative modelling approaches, a transition to fully quantitative risk assessments is not likely to happen: their application will probably remain exclusive to those cases of extremely-well documented pests. However, the addition of quantitative evaluations to qualitative assessments will lead to more robust decision-making, and may lead to re-evaluations of past decisions. An added benefit is that models of pest transfer from commodity to environment can also identify the best nodes for the application of regulatory measures, where their effect may have the highest benefit related to their cost.

SOURCE: Holt, J., van der Gaag, D. J., Leach, A. W., Loomans, A. J. M. and Mumford, J. D. 2017. Model of the probability of pest transfer from imported fruit, cut flowers or vegetable produce. EPPO Bulletin 47(2):227-230.

5 Dispersal ability of Asian longhorned beetle

Tethered flight-mill studies allow tests of the flight endurance of an insect, that is, they suggest what the maximum flight range of an insect might be, all other conditions being optimal to encouraging linear travel. While these tend to greatly overestimate the actual distance the insect will disperse under normal conditions, the results do suggest that vigilance outside of a core quarantine area is required, perhaps especially as host plants are removed within the core zone. New infestations may start up to 8 km away from the generally-infested area, as well-fed beetles can make a trip of such a distance in the search of new hosts.

SOURCE: Lopez, V. M., Hoddle, M. S., Francese, J. A., Lance, D. R. and Ray, A. M. 2017. Assessing flight potential of the invasive Asian longhorned beetle (Coleoptera: Cerambycidae) with computerized flight mills. Journal of Economic Entomology 110(3):1070-1077.

Botany

6 New technologies for harvest weed seed control

The growing problem of herbicide resistance in weeds has prompted the development of new non-chemical technologies for weed control, in particular harvest weed seed control (HWSC) systems which target weed seeds that would typically be reintroduced into a field at harvest in chaff residue distributed by combine harvesters. The Harrington Seed Destructor is a new HWSC technology developed in Australia, consisting of a tow-behind machine that attaches to a combine and processes chaff through a cage mill to pulverize and devitalize weed seeds. Although extremely effective in Australian studies (>90% control for most weed species), adoption of the Harrington Seed Destructor has been slow due to its high cost and producers' reluctance to tow a large machine; development of smaller, more integrated and less expensive models is underway. A recent study tested the applicability of this technology in western Canada and found consistently high control under experimental conditions (>97% seed destruction) across a range of weed species, seed sizes, seed numbers, chaff loads and chaff type. This confirms that the Harrington Seed Destructor is highly effective on the seeds it processes, and the main limiting factor in weed control will be the extent to which it can collect and retain seeds of target weed species in the field, depending on height and maturity at the time of harvest. On-farm studies planned for spring wheat, canola and field pea in the upcoming year will test its efficacy in North American field situations.

SOURCES: Tidemann, B. D., Hall, L. M., Harker, K. N. and Beckie, H. J. 2017. Factors affecting weed seed devitalization with the Harrington Seed Destructor. Weed Science 65: 650-658. DOI: 610.1017/wsc.2017.1023.

7 Starry stonewort spreading in the Great Lakes region

Starry stonewort (*Nitellopsis obtusa* (N.A. Desvaux) J. Groves) is an invasive aquatic plant of the Characeae family (green algae) that appears to be spreading in the Great Lakes region. It is native to Europe and Asia, where it is considered beneficial and even endangered in some areas, but has become an aggressive invader in North America. Believed to have been first introduced via ballast water, it was reported in the St. Lawrence River in the 1970s and the Great Lakes system in the

1980s, but has been reported with increasing frequency in the last 10 years, occupying hundreds of inland lakes in Michigan and New York since about 2005, and Indiana, Minnesota, and Wisconsin since 2012. It was reported in Ontario in Presqu'ile Bay on the north shore of Lake Ontario in 2013. Starry stonewort grows rapidly and forms dense aquatic 'meadows' in ecologically sensitive littoral zones, affecting water quality and degrading native plant, fish and wildlife habitat. It also interferes with recreational activities such as boating, swimming and fishing. It reproduces vegetatively by fragmentation and overwintering bulbils, and like many aquatic weeds, is difficult to control. It is an interesting example of an introduced plant exhibiting a 'lag time' (30 yrs) between its initial introduction and subsequent population expansion. It has become a major management issue for conservation officials in the U.S., and presents an imminent threat to Canadian waters as well.

SOURCE: Associated Press 2017. Invasive aquatic weed, starry stonewort, creeps across Great Lakes region. Chicago Tribune. [Online] Available: http://www.chicagotribune.com/news/nationworld/midwest/ [Cited 2017].

Midwood, J. D., Darwin, A., Ho, Z.-Y., Rokitnicki-Wojcik, D. and Grabas, G. 2016. Environmental factors associated with the distribution of non-native starry stonewort (Nitellopsis obtusa) in a Lake Ontario coastal wetland. Journal of Great Lakes Research 42(2): 348-355. doi: 10.1016/j.jglr.2016.01.005.

8 Prioritization of invasive alien plants for pest risk analysis in the European Union (EU)

Using a modified prioritization process developed by the European and Mediterranean Plant Protection Organization (EPPO), the EU recently identified a new group of alien plant species that are high priority for pest risk analysis (PRA). The process comprises two stages, Stage 1: Preliminary risk assessment and Stage 2: Risk management. It is designed to exclude species unsuited for PRA due to factors such as uncertainty in taxonomy and nomenclature, lack of scientific information, lack of potential for spread and impacts, or lack of potential risk management measures. By excluding unsuitable candidates, the aim is to focus limited resources for full PRA on potentially significant invaders for which preventive actions or eradication measures are feasible. Through this process, a list of 37 alien plant species identified through horizon scanning exercises was reduced to 19 species which will undergo comprehensive PRA and may eventually be included on the list of EU concern.

Each of the stages of the prioritization process consists of a short series of questions in the form a decision tree. By the end of Stage 1, species are categorized into one of four lists: the EU List of Invasive Alien Plants, EU Observation List, EU List of Minor Concern and Residual List. Species categorized into the EU List of Invasive Alien Plants are those with the highest potential for spread and negative impacts on biodiversity or ecosystem services. Species on this list proceed to Stage 2, in which questions focus on the feasibility and cost-effectiveness of mitigating impacts through preventive actions and management measures. At the end of Stage 2, species are either included or not in a List of Priority Invasive Alien Plants for performing an EU level PRA.

Comprehensive PRA is resource-intensive and, as such, is not cost-effective for all species. The modified EPPO Prioritization Process provides a useful tool to narrow down lists of candidate species to those for which PRA makes the most sense. It is unlike many other prioritization processes in that it incorporates both risk assessment and risk management considerations prior to the initiation of a full PRA. Similar approaches may be beneficial for other National Plant Protection Organizations as a means of prioritizing long

lists of alien plants for PRA and documenting the decision making processes in doing so.

SOURCES: Tanner, R., Branquart, E., Brundu, G., Buholzer, S., Chapman, D., Ehret, P., Fried, G., Starfinger, U. and van Valkenburg, J. 2017. The prioritisation of a short list of alien plants for risk analysis within the framework of the Regulation (EU) No. 1143/2014. Neobiota 35: 87-118.

Biotechnology

9 Western bean cutworm – an increasing pest in Canadian corn fields

There's a new moth in a field near you. Western bean cutworm (WBC), *Striacosta albicosta* (Smith) (Lepidoptera: Noctuidae), has had increasing economic effects on Ontario corn production since 2008 when it was first identified in Ontario. WBC larval feeding reduces yield and increases subsequent mycotoxin contamination of grain, which negatively affects the health of humans and livestock that eat corn.

Transgenic corn hybrids that express *Bacillus thuringiensis* (Bt) insecticidal proteins are recommended for control of WBC by university extension personnel and industry. Some of these corn hybrids express the Bt protein Cry1F. Cry1F is expressed in corn line 1507 which was authorized for unconfined environmental release in Canada in 2002 (CFIA 2002). At that time, corn line 1507 was stated to protect corn against the European corn borer, corn earworm, fall armyworm, and black cutworm. Corn line 1507 was not developed to target WBC; however, the efficacy of Cry1F hybrids against WBC was discovered upon commercialization, and WBC has subsequently been included on some corn line 1507 labels.

The susceptibility of WBC to commercially approved Bt proteins is variable and not thoroughly quantified in its current range. Recently, a paper was published evaluating the susceptibility of WBC to the Bt protein Cry1F (Smith et al., 2017). To examine the efficacy of Cry1F on WBC, Smith et al. (2017) measured WBC damage to corn hybrids expressing the Cry1F protein for several years at multiple locations in small- and large-scale field plots following natural WBC infestation in Ontario. A naturally infested large strip trial was conducted in the last year of study. In 2015, WBC were collected in the field and tested for their susceptibility to Cry1F protein using an artificial diet bioassay in the laboratory. Results show that WBC in Ontario are not controlled by Cry1F-expressing corn hybrids and provide evidence that resistance to Cry1F has evolved.

Multiple factors may have contributed to the finding that Cry1F is no longer efficacious in Ontario against WBC including the inherent tolerance of Cry1F by WBC, multiple generations of exposure to Cry1F since the first cultivation of corn line 1507, the potential for cross-pollination, and extensive larval movement between plants with and without Cry1F expression within integrated refuges (Smith et al., 2017). It is difficult to determine the role each of these factors contributed because the baseline susceptibility of WBC to Cry1F was not established before commercialization and there was no population available for testing that definitively had no history of exposure to Cry1F.

Smith et al. (2017) suggest that the emergence of WBC emphasizes the need for considering insect resistance management strategies that manage the dynamics of multiple pests in the

corn production system. For control of WBC they recommend that growers use the following practices on most commercially available corn: monitoring moth flights, diligent scouting for egg masses and insecticide application. In the future, new transgenic products may become available and offer an alternative method of control.

SOURCES: Canadian Food Inspection Agency (CFIA). (2002). DD2002-41: Determination of the Safety of Dow AgroSciences Canada Inc. and Pioneer Hi-Bred International's Insect Resistant and Glufosinate – Ammonium Tolerant Corn (*Zea mays* L.) Line 1507. Available online: http://www.inspection.gc.ca/plants/plants-with-novel-traits/approved-under-review/decision-documents/eng/1303704378026/1303704484236 .

Smith, J. L., Lepping, M. D., Rule, D. M., Farhan, Y., & Schaafsma, A. W. (2017). Evidence for Field-Evolved Resistance of *Striacosta albicosta* (Lepidoptera: Noctuidae) to Cry1F Bacillus thuringiensis Protein and Transgenic Corn Hybrids in Ontario, Canada. *Journal of Economic Entomology*, tox228.

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