vineland
RESEARCH & INNOVATION CENTRE

Harnessing Invasive Plant Chemistry

The situation

Invasive species make up 27 per cent of total vascular plants in Canada. This contributes to an estimated cost of $2.2 billion a year for the agriculture industry through reduced crop yield, increased pest management expenses and overall market loss[1].

Herbicides are a critical tool for land managers battling invasive and weedy plants. Novel herbicides with new modes of action (MOA) are in great demand since invasive and weedy plants are gaining a resistance to commercial herbicides and a new MOA has not been introduced in over 30 years[2].

Plants remain a largely untapped resource for new agrichemicals, particularly herbicides with novel MOAs, and research and development in this area could become a priority for plant scientists globally[3].

The project

Thanks to the support of Ontario Trillium Foundation's Seed Grant, an interdisciplinary team of researchers at Vineland Research and Innovation Centre (Vineland) investigated the feasibility of a new approach to the control and eradication of invasive plants.

The team tested natural methods of removing invasive species and assessed the feasibility of using the unique natural chemistry of invasive plant biomass.

The use of the invasive plant *Vincetoxicum rossicum* (Kleopov) Barbarich, commonly referred to as dog-strangling vine (DSV), allowed the team to uncover new information about the phytotoxic (toxic effect by a compound on plant growth) properties of invasive plants (see Picture 1 of DSV on page 2).

Vineland's team evaluated the different chemical compounds produced by DSV and assessed the influence those chemical compounds have on other plants to better understand how to control invasive plants and weeds.

[1] *Environment Canada, 2010. Invasive alien species partnership program report. https://ec.gc.ca/nature/default.asp?lang=En&n=B008265C-1 [Accessed: April 20, 2019]*

[2] *Duke, S., Stidman, M.A., Daynan, F. 2019. A novel genomic approach to herbicide and herbicide mode of action discovery. Pest Management Science. 75(2): 314-317.*

[3] *Martin, C. 2013. The plant science decadal vision. Plant Cell. 25: 4773–4774*

Picture 1: Dog-strangling vine is listed in the Ontario Ministry of Agriculture, Food and Rural Affairs Noxious Weeds list. It can be found growing in ravines, hillsides, waste areas, fence lines and hedges and as a result can be a challenge to manage for growers in Ontario.

Facts about dog-strangling vine

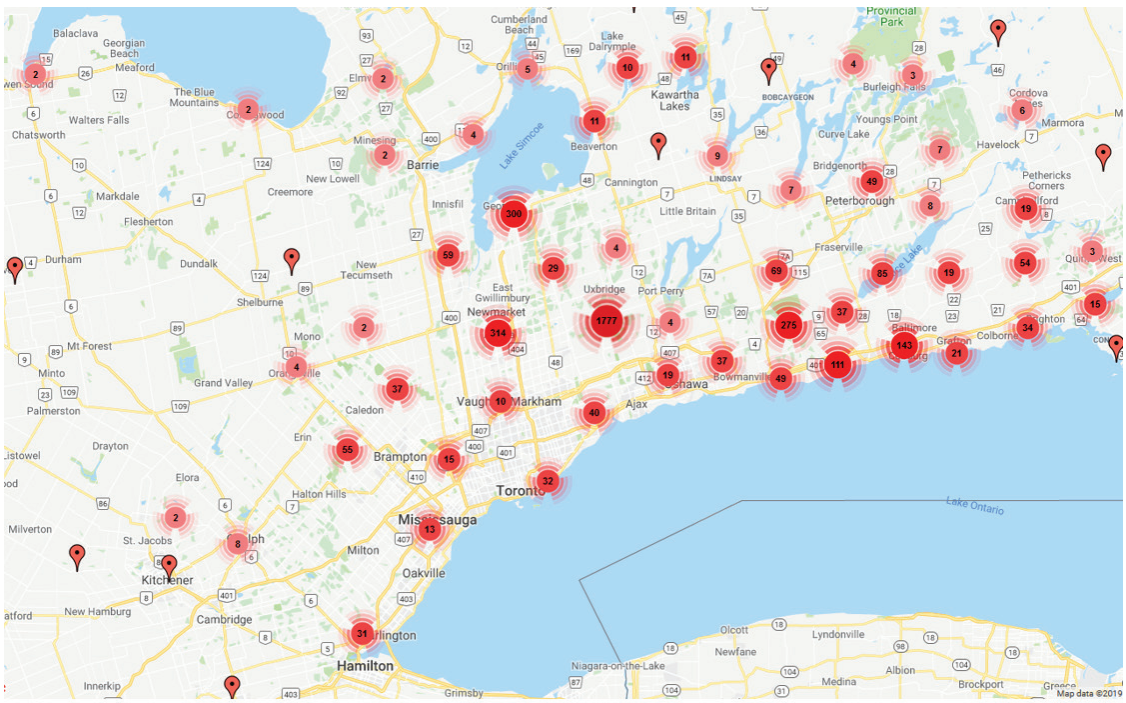
DSV is regulated as restricted under the Ontario Invasive Species Act.

It was originally brought into the northeastern United States in the mid-1880s and has since spread into Ontario and southern Quebec (see Picture 2).

Its extreme prolific characteristic is due in part to its high seed set and aggressive growth habit around other plants and trees.

Project findings

- Demonstrated that DSV contains phytotoxic properties when applied to other plants and also identified candidate herbicides that use the natural chemistry exclusive to DSV



Picture 2: Distribution of DSV in southern Ontario from EDDMapS. 2019. Early Detection & Distribution Mapping System. Available online at http://www.eddmaps.org/ [Accessed September 23, 2019].

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- Determined the locations within the plant where these chemicals accumulate
- Defined molecular targets in the corresponding metabolic pathways producing these compounds and focused on targets influencing the accumulation of defense-related chemicals
- Conducted a field study indicating that the chemical compounds were allelopathic (production of one or more biochemicals influencing the germination, growth, survival, and reproduction of other plants), found in all parts of the live DSV plant and leaf litter on the ground as well as act as a reservoir in soils in DSV invaded sites

Tips for land managers

- DSV phytotoxic chemicals are found everywhere in the plant (leaves, shoots, roots, dead biomass) and in the soil of sites invaded by DSV
- Extracts made from DSV biomass (live tissue of roots, leaves and shoots, as well as dead biomass) inhibit the growth of other plants (see Picture 3)
- Since phytotoxic chemicals are present in dead biomass, the DSV biomass found on restoration sites may inhibit restoration efforts
- Once DSV is removed from invaded sites, using an herbicide application, mowing, hand-pulling and solarization will not eliminate the phytotoxic chemicals in the soil. Those chemicals may inhibit the natural regeneration of native plants and the active restoration of sites (i.e. planting native species and sowing seeds)

Picture 3: Vineland's research team has found that chemical compounds from the extracts made from DSV inhibit the growth of other plants.

This project was supported by the Ontario Trillium Foundation (OTF). The Ontario Trillium Foundation is an agency of the Government of Ontario, and one of Canada's leading granting foundations. OTF awarded $108 million to 629 projects in 2018 to build healthy and vibrant communities in Ontario.

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