Provincial Report to the CWSS/SMC
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October 15, 2022

Legislation

Weed Control Act, R.S.O. 1990, c. W.5 https://www.ontario.ca/laws/statute/90w05

Ontario Schedule of Noxious Weeds (effective January 1, 2015)
http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm

A poster of Ontario's 25 noxious weeds has been created. For a PDF copy of this poster, please contact kristen.obeid@ontario.ca

Minor Use
Currently there is an emergency use registration (EUR) in place from May 1, 2022 – December 31, 2022 for the herbicide Tough 600 EC to control broadleaf weeds in carrots. This EUR was critical as there were regulatory and supply issues with the normal herbicide Linuron, relied on by growers.
In the coming weeks, growers and commodity associations will be asked to identify priority weeds and preferred solutions in preparation for the National Priority Setting Meeting.

New Extension Material – Publication 75 now in a searchable database

The Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has transformed the way crop protection information is provided to better serve clients through an online digital application called the Ontario Crop Protection Hub.

The Ontario Crop Protection Hub is now available and ready to access the latest crop protection information: Ontario.ca/CropProtection

The Ontario Crop Protection Hub is…

- accessible through any device (tablet, computer, smart phone),
- allows you to customize and find information based on your specific business needs, and
- replacing PDF and print crop protection publications, which can quickly become out of date.

There is a feedback form link at the top of the webpage and available here: **Feedback Form**
Questions? Contact the Agricultural Information Contact Centre by email at ag.info.omafra@ontario.ca or phone 1-877-424-1300

Current Herbicide Resistant Weeds in Ontario

Weed	WSSA Group	Weed	WSSA Group
barnyard grass	5	mustard, wild	5
Canada fleabane	2, 9, 22	nightshade, Eastern black	2, 22
carrot, wild	4	peppergrass, field	22
cocklebur	2	pigweed, green	2, 4, 5, 14
crabgrass, large	1	pigweed, redroot	2, 5, 6, 14
foxtail, green	2	pigweed, smooth	6
foxtail, giant	2	ragweed, common	2, 5, 9, 14

foxtail, yellow	5	ragweed, giant	2, 5, 9
goosefoot, late-flowering	5	ryegrass, Italian	9
groundsel, common	5	waterhemp	2, 5, 9, 14, 27
lamb's-quarters	5	witchgrass	5

22 resistant weed species, with the common trend of more species with multiple resistance

Herbicide Resistant Weed Testing

Completed by Harvest Genomics: www.harvestgenomics.ca

Project partners include: AAFC, AAFC-PMC, Bayer CropScience Inc., FMC Canada, FVGO, MAPAQ, OAG, OFVGA, OPVG and Syngenta Canada Inc.

Significant Results in 2022

- Waterhemp resistant to Groups 2, 5, 9, 14 and 27 in 7 counties in Ontario - Chatham-Kent, Essex, Lambton, Middlesex, Elgin, Northumberland and Stormont, Dundas and Glengarry.
- Waterhemp confirmed in 3 new Ontario counties in 2022 – Dufferin, Niagara and Ottawa. Bringing the total to 18 (Brant, Bruce, Chatham-Kent, Dufferin, Elgin, Essex, Haldimand, Huron, Lambton, Leeds and Grenville United Counties, Middlesex, Niagara, Norfolk, Northumberland, Ottawa, Stormont, Dundas and Glengarry, Wellington and Wentworth).
- Multiple resistant waterhemp confirmed in asparagus, peppers, corn, soybeans, sweet corn and white beans in Ontario.
- In 2022, greater than 95% of waterhemp confirmations were G14 resistant compared to 76% G9 resistant.
- Hybrid species of waterhemp and green pigweed or waterhemp and redroot pigweed are being found when confirmation of species is requested. Initial testing in Quebec has found that the seed of waterhemp and green pigweed hybrids are viable; however, G9 resistance was not carried forward to progeny. However, more testing is required.
- Multiple resistant pigweed species (green pigweed and redroot pigweed) are commonly found in many horticulture crops for example: G2/G5 in pumpkins, potatoes, soybeans, strawberries, sunflowers and tomatoes and G5/G14 in carrots.
- Continued documentation of Canada fleabane resistant to G9 in apples, grapes, blueberries, strawberries, carrots, onions and pumpkins.

Other New Resistant Species Confirmed Elsewhere

- New G14 resistant common ragweed found in soybeans in 2 locations in Prescott and Russell United counties. With several other locations yet to be confirmed in Ontario. Testing is being completed by MAPAQ. At this time, G14 resistant common ragweed has been found in 6 regional county municipalities in Quebec.
- New G4 (MCPA/MCPB) resistant green pigweed confirmed in processing peas (research completed by: Isabelle Aicklen, P. Smith, B. Metzger, T. Gaines, M. Jugulam, D. Robinson, P. Sikkema and F. Tardiff).

An online repository of all herbicide resistant weed testing results in Ontario will be available soon. Users will be able to search for herbicide resistant weed species and create distribution maps.

Canadian Plant Health Council – Weeds Surveillance Community of Practice (WSCP)
Co-Chairs Kristen Obeid and Sandra Flores-Mejia

Outcomes achieved by the WSCP To-Date

1. Poster presented at CWSS: Harmonized surveillance of common Waterhemp (Amaranthus tuberculatus): A model of national collaboration
2. Publication of harmonized protocols (bilingual, EN & FR) to guide monitoring for *Amaranthus* species. It features rapid genetic tests available to detect herbicide resistance, biosecurity protocols and other relevant resources, as well as contact information for reporting suspected cases.
3. Questionnaire to gather information on the distribution of Waterhemp and associated farming practices to inform the development of effective management programs.
4. Common repository for literature regarding *Amaranthus* species.

Robotic Weeding Trials (AgRobotics Working Group, OMAFRA and Haggerty Creek AgRobotics Company)

Several weeding robots promise to provide reduced soil compaction, a lower carbon footprint, reduced inputs (seed, herbicide, etc.), less labour requirements, scalable mechanical weeding, and ease of use. However, questions about their practicality and return on investment remain. To test these claims, three autonomous weeding robots were trialed and compared to conventional vegetable growing practices in Ontario, Canada. The Naïo Dino, Nexus La Chèvre or the Goat and FarmDroid FD20 were operated with side-by-side control comparison trials to collect and analyze metrics important for practical farming considerations, such as:

- Weed suppression (measured bi-weekly),
- Crop health (assessed bi-weekly), and
- Labour requirements (timesheets tracked weekly).

Robotics Technologies Tested:

1. **FarmDroid (Seeding and Weeding Sugar Beets and Rutabaga)** https://farmdroid.dk
- Solar-charged batteries
- 24-hours autonomous operation (sleep mode when batteries are low)
- Seeder, and inter- and intra-row mechanical weeder

2. **Naïo Dino (Weeding Carrots)** https://www.naio-technologies.com
- Rechargeable lithium batteries
- Up to 10 hours of autonomous operation
- Inter-row guidance and mechanical weeding

3. **Nexus Goat (Weeding Onions and Carrots)** https://nexusrobotics.ca
- Electric hybrid motor
- 24-hour autonomous operation
- Machine vision inter- and intra-row mechanical weed removal

Results

FarmDroid FD20

Sugar beets were seeded at a lower seeding density with the FD20 than the conventional unit (45,000 seeds/acre versus 53,000 seeds/ac, respectively). Although the FD20 seeded at a lower density, there were more sugar beets in the FD20 field. The FD20 seeded sugar beets were also more consistent in size and shape and had high sugar content. The producer commented that although the FD20 took longer to seed, it minimized seeding date risk, and precision seeding benefited the crop as it resulted in more consistent germination.

The rutabaga producer was hesitant to change from a traditional seeding density, however, after seeing the precision capability of the FD20, the producer will use the FD20 to complete their rutabaga seeding next season. The FD20's seeding/weeding proficiency was highlighted, noting improved crop development in the FD20 treatment while using the same seed and seeding date.

Naïo Dino

This robot worked reliably at cultivating in between rows of a 25 acre carrot field. This plot was traditionally minimally cultivated and unfortunately due to the heavy cultivation of the Dino, the producer requested to remove the robot.

Nexus Goat

The teams at Haggerty AgRobotics, Nexus and the Ontario Crops Research Centre - Bradford worked closely to operate the Goat in an onion plot, with unforeseen challenges and iterative weed identifying algorithms. The most advanced iteration was able to remove ~90% of weeds. After the weeds reached a certain height or diameter the Nexus was no longer able to remove them. Weed misclassification occurred ~1% of the time. This robot was removed after 6 weeks of operation because the onions were too large for the robot to continue without damaging the crop.

Conclusions

A large part of this pilot study was spent learning how to operate these autonomous tools, and although this data is greatly insightful for future studies and near-term operations, more research is needed. Conducting trials on commercial operations with high value crops was challenging. The Dino-carrot trial clearly showed grower apprehension to new, autonomous solutions compared to their conventional management methods. The rutabaga producers' apprehension to plant at a lower density was another example of this. Their openness to adopting the system after seeing the results highlights that there is a curve to adoption and a strong need for producers to see these technologies locally in Ontario, Canada production systems.

Critical considerations for future work are the need for producer designated test plots, and adjusted assessments based on weed pressure, field conditions, and resistant weeds. We are working together with our collaborators and innovative growers to de-risk these technologies and enable producers to utilize these technologies with confidence in the near future.

Acknowledgements

The authors greatly appreciate the support from The AgRobotics Working Group, Producers: Mark Srokosz, Karat King Inc., Exeter Produce and Mark Richards, OMAFRA staff Amanda Tracey and Ian McDonald. We'd also like to thank our industry collaborators at The Ontario Crops Research Centre - Bradford, RH Accelerator, The Western Fair Association, Vineland Research and Innovation Center, and sponsors at Tech Alliance, OMAFRA, and BioTalent Canada.

Challenges/Research Needs

1. Herbicide resistance in horticulture production systems in Ontario is expanding. As we continue to survey various cropping systems, more and more cases of herbicide resistant species are discovered. The newest trend is species resistant to multiple modes of action, which is making control very difficult in horticulture crops where there are species resistant to Group 2, 5, 9 and 14 herbicides. The majority of herbicides for postemergence control in horticulture crops are from herbicide Groups 1, 2, 5 and 14. These multiple resistant species severely limit the control

options producers have. The increased spread of Groups 2, 5, 9, 14 and 27 resistant waterhemp into various production systems is very concerning (asparagus, peppers, corn, soybeans, sweet corn and white beans).

2. There is a lack of post-emergence herbicides in fruit and vegetable crops to control resistant weeds when they occur in these cropping systems. Therefore, new registrations through the minor use system and further promotion of Integrated Weed Management (IWM) strategies including robots is imperative.
3. Continued occurrence of off-target movement of auxin herbicides onto highly sensitive horticulture crops such as: grapes, tomatoes, apples, peaches, and non-GMO/IP soybeans/beans. **Recommendation:** A one window reporting mechanism needs to be implemented to improve tracking of suspected cases and have more accurate data. This should include the PMRA, crop protection companies and provincial governments.