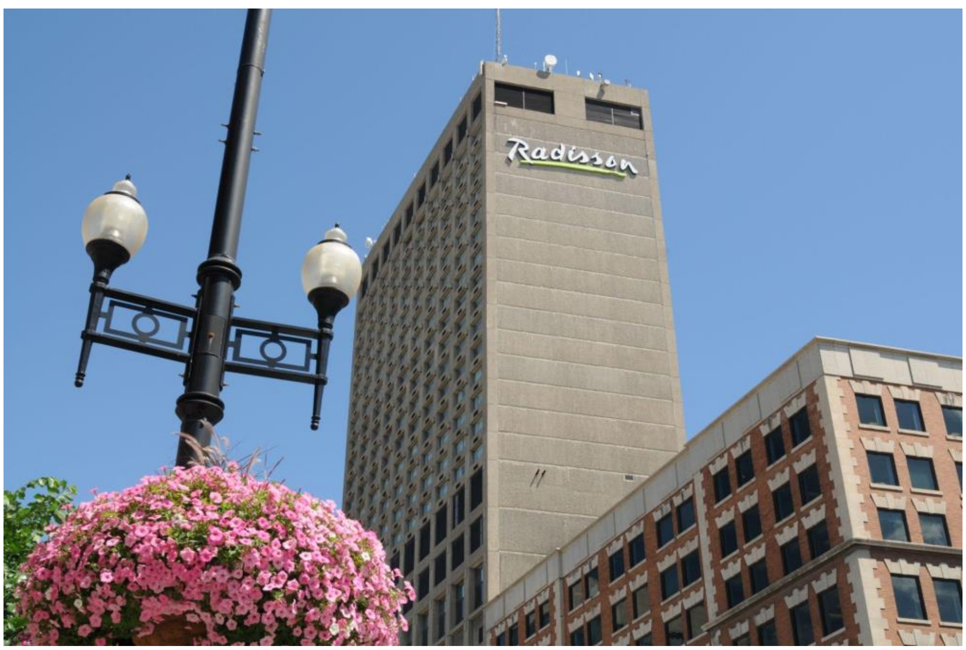
Canadian Weed Science Society
Société canadienne de malherbologie

77th Annual Meeting, November 20-23, 2023
Radisson Winnipeg Downtown, Winnipeg, MB

CWSS-SCM Annual Meeting
November 20th to 23rd 2023

Réunion annuelle

20 au 23 Novembre 2023



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2023 PLENARY SPEAKERS

Dr. Martin Laforest graduated from Laval University in 1999. Following his studies, he joined DNA LandMarks, a subsidiary of BASF Plant Science where he was in charge of SNP marker development in several different crops and contributed to the positional cloning of the fertility restorer gene Ogura in canola, amongst other things. During his 15 years at BASF, Martin collaborated on a number of projects related to weed science. He was thrilled to be able to continue in this field when he joined Agriculture and Agri-Food Canada in 2015. He then soon started collaborating with several members of the Canadian Weed Science Society to work on the characterization of herbicide resistant weeds found in Canada with the aim of elucidating mechanisms allowing weeds to survive herbicide application. To this end, Dr. Laforest and his colleagues are using molecular and genetic tools to study the simple and more complex cases of herbicide resistance. This information is used to develop genetic tests for the early detection of similar herbicide resistance cases, allowing growers to proactively apply mitigation strategies. He has also been working on the development of new weed control strategies.

Eric Patterson is an Assistant Professor in Weed Science in the Department of Plant, Soil, and Microbial Sciences at Michigan State University where he teaches weed science to Undergraduate and Graduates. His research focuses on more basic aspects of weed science including weed genomics, molecular biology of resistance mechanisms, rapid molecular weed diagnostics, and herbicide mode of action discovery. His lab is especially interested in how genome rearrangements (i.e. transposable elements and copy number variation) form and are utilized as novel sources of genetic variation for weed adaptation to abiotic stresses.

Dr. Breanne Tidemann is a research scientist with Agriculture and Agri-Food Canada in Lacombe. She completed all of her degrees at the University of Alberta, and holds a B.Sc in Biological Sciences, and an M.Sc. and a Ph.D. in Plant Sciences with projects focused on weed science and weed management. Breanne started with Agriculture and Agri-food Canada in 2016 as a Weed Scientist/ Field Agronomist. Her research program in Lacombe focuses on management of herbicide resistant weeds, integrated weed management strategies, and novel weed management practices.

Dr. Michael L Flessner is an associate professor and extension weed science specialist in the School of Plant and Environmental Sciences at Virginia Tech. He received his BS from the University of Tennessee. He obtained both his masters and doctoral degrees from Auburn University where he also served as research associate.

Michael has research and extension responsibilities for weed management in corn, soybean, small grains, and other crops as well as pastures and forages across Virginia. His research efforts focus on herbicides and herbicide resistance as well as cover crops and harvest weed seed control. To date, Michael is an author of 57 peer-reviewed publications in scientific journals, over 200 abstracts presented at professional meetings, and 21 extension publications. He has been awarded over $5.4 million in funding to his program. Michael has advised or co-advised 11 graduate students and currently chairs or serves on 8 student committees.

The Northeastern Weed Science Society recognized him with the Outstanding Researcher Award in 2019 and the Outstanding Educator Award in 2022. Additionally, the Southern Weed Science Society awarded him as Outstanding Young Weed Scientist, Academia in 2021-22. Michael currently serves on the Board of Directors for the Weed Science Society of America and the Executive Board of the Southern Weed Science Society in addition to providing leadership for GROW (Getting Rid of Weeds). Michael resides in Blacksburg, Virginia with his wife Chelsea and their two children, Davidson and Everett.

2023 CONFERENCE ORGANIZATIONAL COMMITTEES

For further information about the meeting please contact the Chair or a Local Arrangements Committee member as listed below:

Position	Name	Affiliation	Email
First Vice President (LAC Oversight)	Jeanette Gaultier	BASF	jeanette.gaultier@basf.com
Local Arrangements Committee	Rob Gulden (Co-Chair)	University of Manitoba	rob.gulden@umanitoba.ca
	Kim Brown-Livingston (Co-Chair)	MB Agriculture	kim.brown@gov.mb.ca
Registration	Breanne Tidemann	AAFC Lacombe	breanne.tidemann@agr.gc.ca
Plenary Session	Rob Gulden (Chair)	University of Manitoba	rob.gulden@umanitoba.ca
Hotel Liaison	Kim Brown-Livingston	MB Agriculture	kim.brown@gov.mb.ca
Crop Life Canada Representative	Matt Underwood (East)	Syngenta	matt.underwood.06@gmail.com
	Tyler Gullen (West)	NuFarm	tyler.Gullen@nufarm.com
Program Committee	Rob Nurse Breanne Tidemann Rob Gulden 2023 Section Chairs	AAFC Harrow AAFC Lacombe University of Manitoba	robert.nurse@agr.gc.ca breanne.tidemann@agr.gc.ca rob.gulden@umanitoba.ca
Graduate Student Presentations	Dilshan Benagarama	University of Manitoba	dilshan.benaragama@umanitoba.ca
Graduate Student Representative	William Kramer	Colorado State University	w.kramer@colostate.edu
Poster Session	Andrew McKenzie-Gopsill	AAFC Charlottetown	andrew.mckenzie-gopsill@agr.gc.ca
Scholarships and Awards Banquet	Leonardo Galindo Gonzales	CFIA	leonardo.galindogonzalez@inspection.gc.ca
Media and Publicity	Tasha Valente Breanne Tidemann	BASF AAFC Lacombe	tasha.valente@basf.com breanne.tidemann@agr.gc.ca
Sponsorship	Matt Underwood (east)	Syngenta	matt.underwood.06@gmail.com
	Tyler Gullen (west)	NuFarm	Tyler.Gullen@nufarm.com

CWSS-SCM CONCURRENT SECTION CHAIRS - 2023

Cereals, Oilseeds and Pulses Breanne Tidemann breanne.tidemann@agr.gc.ca	**Soybean, Corn and Edible Beans** Travis Goron travis.goron@corteva.com
Horticulture and Specialty Crops Jichul Bae jichul.bae@agr.gc.ca	**Weed Biology and Ecology / Invasive and Noxious Weeds** Martin Laforest martin.laforest@AGR.GC.CA
Provincial Reports / Regulatory Issues Kim Brown-Livingston kim.brown@gov.mb.ca	**Forage, Rangeland, Forestry / Industrial Vegetative Management** David Ralph extension@invasives.ca

CWSS-SCM 2023 Annual Meeting Agenda

Note that the abstracts for the individual presentations are listed by number in the Abstract section.

Date	Time	Topic/event	Room
Monday November 20	8:00 – 9:00	CWSS-SCM board meeting Breakfast	Ambassador H
	9:00 – 17:00	CWSS-SCM board meeting	13th Floor Exec Boardroom
	11:00 – 18:00	Commercial exhibits and poster set up	Terrace East and West
	12:00 – 17:00	Conference Registration	11th Floor Foyer
	17:00 – 17:30	Graduate Student Member Meet and Greet	Ambassador H
	17:30 – 18:30	Grad student meet and greet with BOD	Ambassador H
	18:30 – 22:00	Sponsorship Acknowledgement and Welcome Reception	Ambassador H

Date	Abstract #	Time	Topic/event	Speaker	Location
Tuesday November 21		7:00 – 17:00	Registration		11th Floor Foyer
		7:00 – 8:00	Continental Breakfast		Ambassador H
		8:00 – 8:15	Opening remarks – CWSS-SCM President		Ambassador A
		8:15 – 11:45	**Plenary Session: Managing Weeds with Seeds and Genes**		Ambassador A
	1	8:15 – 9:00	How Genomics is Contributing to our Understanding of Herbicide Resistance Evolution	Eric Patterson	Ambassador A
	2	9:00 – 9:45	So, You have a Weed's Genome Sequence	Martin Laforest	Ambassador A
		9:45 – 10:15	**Coffee Break**		11th Floor Foyer
	3	10:15 – 11:45	Harvest Weed Seed Control in North America: (Our best shot at) The Whole Story	Michael Flessner Breanne Tidemann	Ambassador A
		11:45 – 13:00	**Lunch**		Ambassador A

		13:00 – 15:00	**Grad student presentations**		Ambassador A
	4	13:00 – 13:15	The confirmation of 4-hydroxyphenylpyruvate dioxygenase (HPPD)-inhibitor resistance in redroot pigweed (*Amaranthus retroflexus*) from Ontario	Isabelle Aicklen	Ambassador A
	5	13:15 – 13:30	The effect of density and herbicide system on the Critical Weed Free Period in canola	Daniel Pouteau	Ambassador A
	6	13:30 – 13:45	Solar Corridor Cropping Systems: Effects of Row Spacing and Interseeded Cover Crops on Weeds and Corn Yield in Quebec	Laurence Durocher	Ambassador A
	7	13:45 – 14:00	Transcriptomic Approach to Understanding Metabolic Resistance to Imazamox in Feral Rye (*Secale cereale*)	William Kramer	Ambassador A
	8	14:00 – 14:15	Native and invasive plant growth trajectories across differing wildfire burn severities: preliminary observations from the McKay Creek Wildfire in St'at'imc territory	Virginia Oeggerli	Ambassador A
	9	14:15 – 14:30	Integrated Crop Management: A Holistic Approach for Weed Management in Wheat (*Triticum aestivum* L.)	Uthpala Ekanayake	Ambassador A
	10	14:30 – 14:45	Root elongation among 10 soybean genotypes at different temperatures	Joseph Zvomuya	Ambassador A

	11	14:45 – 15:00	Encapsulated formulation of saflufenacil/pyroxasulfone with potential tank mix partners applied postemergence in corn	Erica Nelson	Ambassador A
		15:00 – 15:30	**Afternoon Break**		11th Floor Foyer
		15:30 – 16:15	**Grad student presentations**		Ambassador A
	12	15:30 – 15:45	Evaluating the potential of a winter canola soybean relay intercrop system in Ontario	Marinda DeGier	Ambassador A
	13	15:45 – 16:00	Ecology and germination requirements of cow wheat (*Melampyrum lineare* Desr.) in wild blueberry (*Vaccinium angustifolium* Ait.) fields in Nova Scotia	Vanessa Deveau	Ambassador A
	14	16:00 – 16:15	Detecting Kochia (*Bassia scoparia*) at field scale using multi-temporal UAV imagery	Japjyot Sandhu	Ambassador A
		18:30	**CWSS-SCM President's dinner – by invitation only**		Off site
		18:30	**Dine around – Sign up to have supper at a restaurant with a group**		Off site

Date	**Abstract #**	**Time**	**Topic/event**	**Speaker**	**Room**
Wednesday November 22		7:00 – 17:00	Registration		11th Floor Foyer
		7:00 – 8:00	Continental Breakfast		Ambassador H
		8:00 – 9:00	**Corn, Soybean and Edible Beans**		Ambassador B
	15	8:00 – 8:15	Narrow-row spacing in soybean, edible bean and peas increases yield despite a lesser efficiency regarding weed control	Élise Smedbol	Ambassador B

	16	8:15 – 8:30	Weed communities after decades of fertilization and tillage treatments in a corn-soybean rotation	Marie-Josée Simard	Ambassador B
	17	8:30 – 8:45	Through fire and (hot) water: Evaluation of the potential of two alternative control methods for common waterhemp (*Amaranthus tuberculatus* (Moq.) J.D. Sauer)	Sandra Flores-Mejia	Ambassador B
	18	8:45 – 9:00	The economic impact of glyphosate-resistant weeds on major field crops grown in Ontario	Peter Sikkema	Ambassador B
		9:00 – 10:00	**Weed Biology, Ecology and Invasive Species**		Ambassador C
	19	9:00 – 9:15	P197L and W574L amino acid substitutions confer ALS inhibitor resistance in pale smartweed (*Persicaria lapathifolia*)	Gaganpreet Kaur Dhariwal	Ambassador C
	20	9:15 – 9:30	The genome and population genetics of wild mustard	Sara Martin	Ambassador C
	21	9:30 – 9:45	Policy, regulatory, and management failures leading to resistance of Reynoutria species to glyphosate in coastal British Columbia	Jennifer Grenz	Ambassador C
	22	9:45 – 10:00	Identifying Amaranthus species of concern through genome skimming, protein biotyping and CRISPR-Cas-based diagnostics	Leonardo Galindo Gonzalez	Ambassador C
		10:00 – 10:30	**Morning Break**		11th Floor Foyer
	23 - 38	**10:30 – 12:00**	**Poster Viewing (Authors Present)**		Terrace East and West

		12:00 – 13:00	**Lunch**		Ambassador A
		13:00 – 15:00	**Workshop:** Molecular Big Data - Getting acquainted with genomics data: How to take your first steps in the weeds of bioinformatics	Eric Patterson	Ambassador B
		13:00 – 15:00	**Workshop:** Publishing with Canadian Science Publishing	CSP	Ambassador C
		15:00 – 15:15	**Afternoon Break**		11th Floor Foyer
		15:15 – 17:30	**Cereals, Oilseeds and Pulses**		Ambassador B
	39	15:15 – 15:30	Discovery, molecular mechanism, and management of glyphosate-resistant downy brome (*Bromus tectorum*)	Charles Geddes	Ambassador B
	40	15:30 – 15:45	Talinor: new cereal broadleaf weed control option	Robert Klewchuk	Ambassador B
	41	15:45 – 16:00	Weed Management in Pea and Camelina Intercrops	Shaun Sharpe	Ambassador B
	42	16:00 – 16:15	What's New at the Winfield United Innovation Center	Gregory Dahl	Ambassador B
	43	16:15 – 16:30	Gene expression in wheat as a function of intraspecific interference.	Kidist Kibret	Ambassador B
	44	16:30 – 16:45	Discovering a new path of least resistance with Duplosan and Oxbow herbicide.	Tyler Gullen	Ambassador B
	45	16:45 – 17:00	The wild oat (*Avena fatua*) in the Bas-Saint-Laurent region: results of the 2022 scouting season and the foundation of community management in the region.	Sandra Flores-Mejia	Ambassador B

	46	17:00 – 17:15	Efficacy and crop safety of a preformulated mixture of halauxifen-methyl, florasulam and 2,4-D ester in cereal crops in Western Canada.	Rory Degenhardt	Ambassador B
		15:15 – 17:00	**Horticulture and Specialty Crops/ Provincial Reports and Regulatory Updates**		Ambassador C
	47	15:15 – 15:30	Effect of mowing height on flazasulfuron plus glufosinate efficacy on hair fescue in wild blueberry.	Scott White	Ambassador C
	48	15:30 – 15:45	Field horsetail (*Equisetum arvense*) management with an herbicide layering strategy in established cranberry fields	Jichul Bae	Ambassador C
	49	15:45 – 16:00	Plant Protection Update	Wendy Asbil	Ambassador C
	50	16:00 – 16:15	Manitoba Update	Kim Brown-Livingston	Ambassador C
		19:00 – 22:00	**CWSS-SCM Award Banquet**		Ambassador A

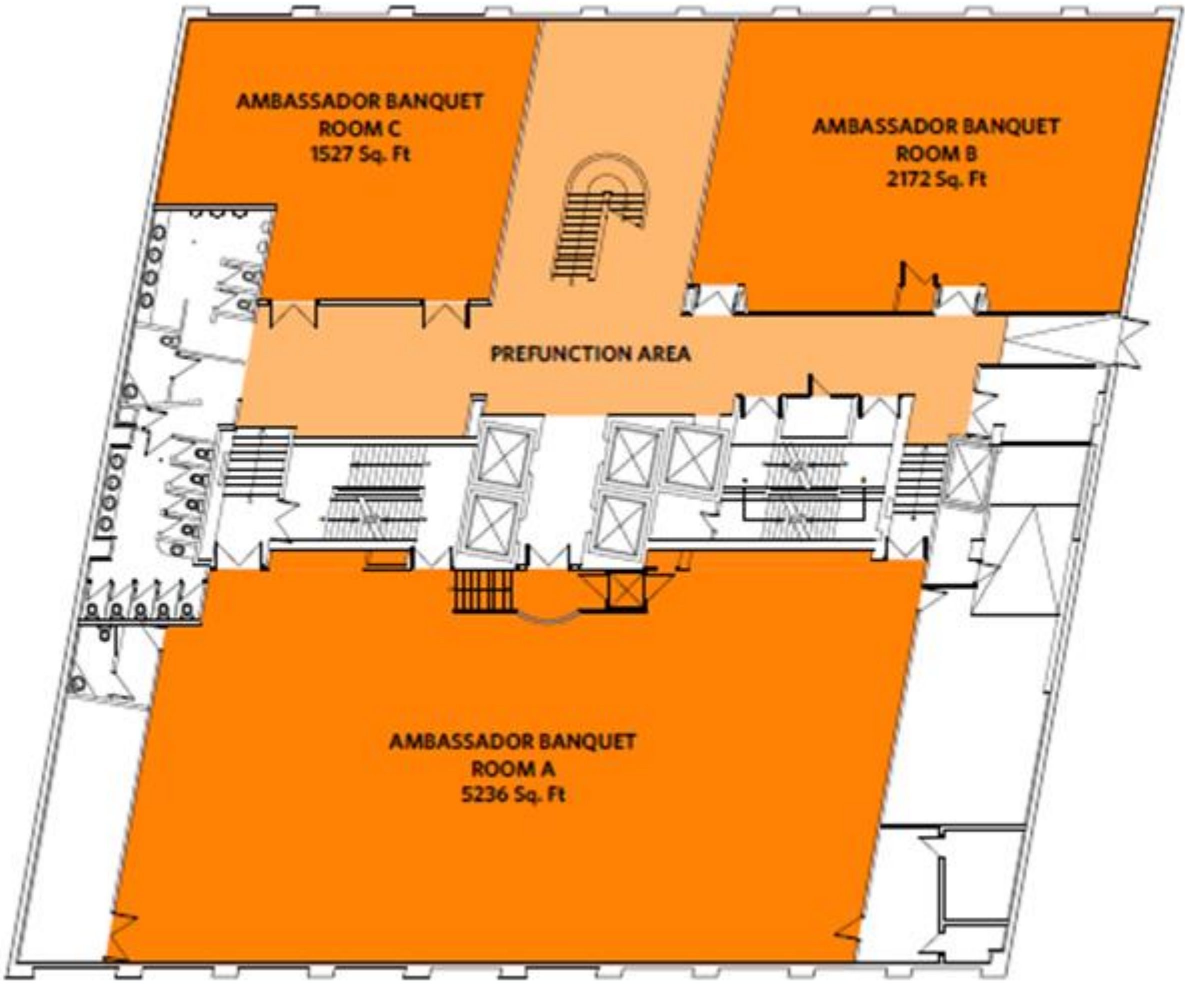
Date	**Abstract #**	**Time**	**Topic/event**	**Speaker**	**Room**
Thursday November 23		7:00 – 9:30	Breakfast and CWSS-SCM Annual General Meeting		Ambassador A
	51	9:30 – 11:00	**Workshop: PMRA – Preparing a registration package**	Scott Couture	Ambassador C
		9:30 – 11:00	**Rangeland, Forestry and Industrial Weed Management/ SaskPulse Kochia Summitt**		Ambassador B
		9:30 – 10:00	Kochia Research and Priorities	Charles Geddes	Ambassador B
		10:00 – 10:15	Remote Sensing of Kochia	Steve Shirtliffe	Ambassador B

	52	10:15 – 10:30	Rinskor™ active (Florpyrauxifen-benzyl) plus fluroxypyr for the management of kochia and other hard to control broadleaf weeds in rangeland, pastures and industrial areas	Kevin Falk	Ambassador B
	53	10:30 – 10:45	Protoporphyrinogen oxidase inhibitor (Group 14)-resistant kochia (*Bassia scoparia*)	Charles Geddes	Ambassador B
		10:45 – 11:00	Panel/ Discussion on Future Management of Kochia	SaskPulse	Ambassador B
		11:00 – 12:00	Commercial Exhibits Takedown		Terrace East and West
		12:00 – 17:30	CWSS-SCM Board Lunch and Meeting		13th Floor Exec Boardroom

Poster Session

Abstract #	Title	Author
23	Residual weed population shifts in Alberta - 1973 to 2023	Julia Leeson
24	Cultural impacts of invasive species on Indigenous value systems	Vanessa Jones
25	The potato vine crusher: a new tool for harvest weed seed control	Nicolle MacDonald
26	Digital imaging technology to classify herbicide-resistant and susceptible kochia (*Bassia scoparia*)	Charles Geddes
27	Weed suppression by integrating cultural tactics in western Canadian soybean production	Charles Geddes
28	Manitoba survey of herbicide-resistant weeds in 2022	Charles Geddes
29	Ile2041Asn substitution confers ACCase inhibitor resistance in foxtail barley (*Hordeum jubatum*)	Charles Geddes
30	Predicting Prairie Weed Community Emergence During Drought: A 1930's Dust Bowl Case Study	Shaun Sharpe
31	Investigating the 2014-2017 Prairie Herbicide Resistance Samples for False cleavers (*Galium spurium*) Response to Quinclorac	Breanne Tidemann
32	Selection Against Being Naked? The Genome and Population Biology of *Galium spurium*	Sara Martin
33	Identifying and Detecting Palmer amaranth (*Amaranthus palmeri* S. Watson) in Canada	Adele Julien
34	Is electricity a viable option for late season weed control and crop desiccation in dry bean?	Rob Nurse
35	Control of volunteer corn in soybean with clethodim and adjuvants	Nader Soltani
36	Control of weeds with tolpyralate and atrazine plus grass herbicides in corn	Nader Soltani
37	The Great Inventory of Quebec Weeds: Results from the Monteregie region (2021-2023)	Sandra Flores-Mejia
38	Revisiting the origins of glyphosate resistant giant ragweed (*Ambrosia trifida* L.) in Canada	Eric Page

11th Floor



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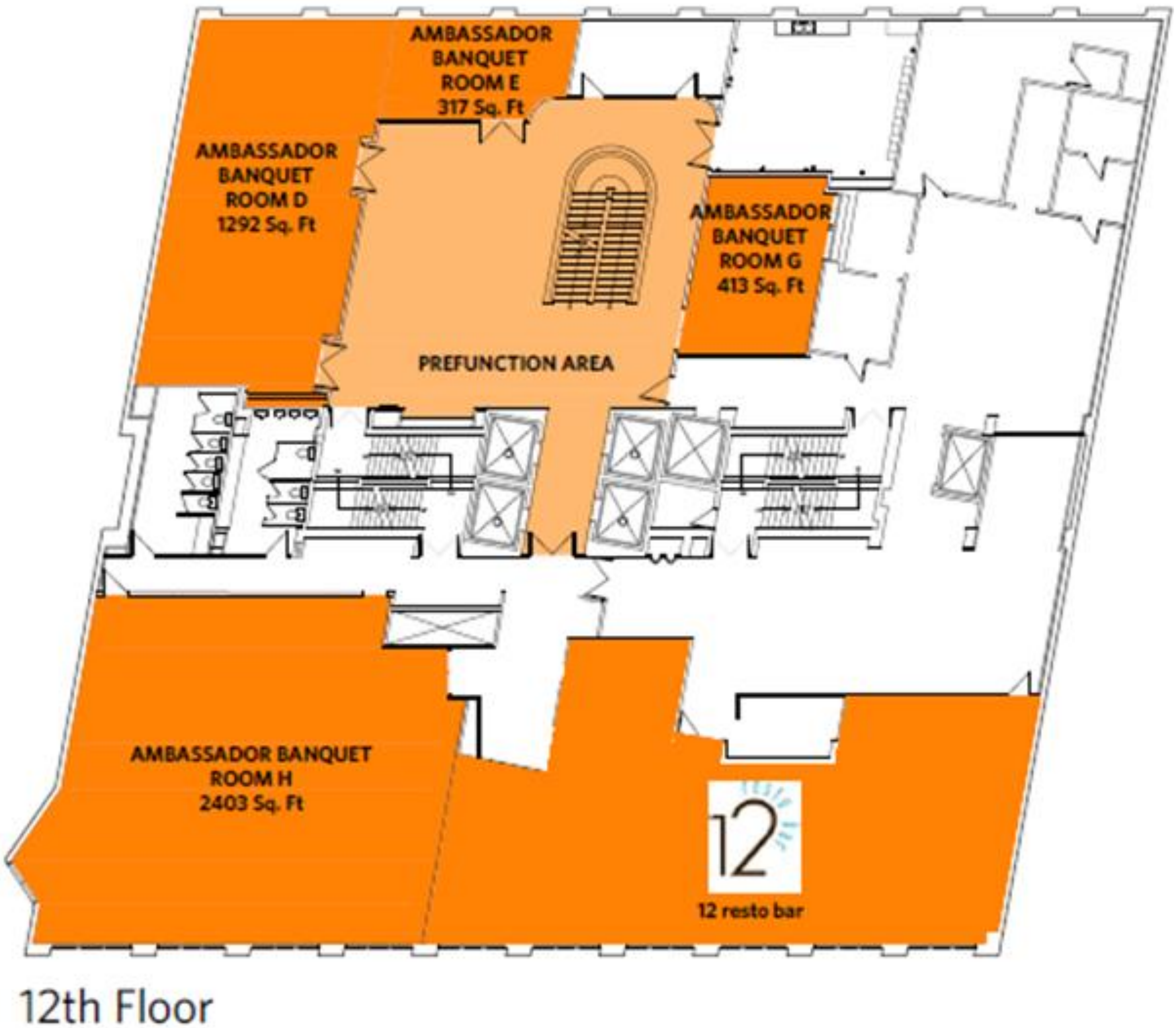
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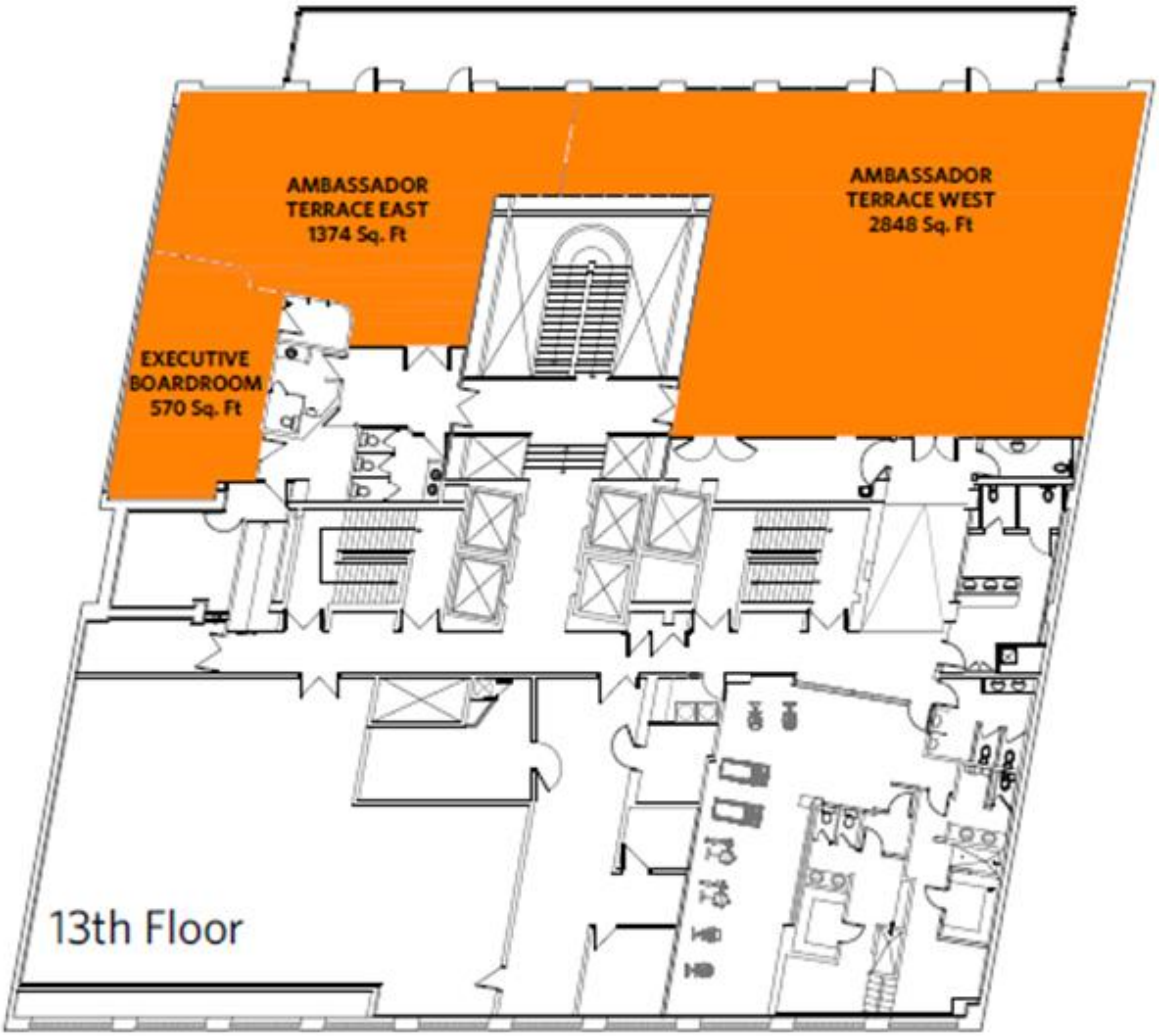

Abstracts

1

How Genomics is Contributing to our Understanding of Herbicide Resistance Evolution

Eric Patterson[1]

[1]Michigan State University

Genomics is an emerging tool for weed scientists and has led to several interesting discoveries that have subsequently changed our understanding of the origins of herbicide resistance traits. While reference genomes are critical for advanced genetics techniques such as RNAseq and Genome Wide Association Studies (GWAS), it has been new discoveries in genomic structural variation and transposable elements that have led to the most surprising results. With reference weed genomes, we have been able to discover the myriad of ways weeds duplicate EPSPS (the target of glyphosate), discovered transposable elements that generate new alleles for the targets of Auxin-mimics, and are beginning to understand the prevalence of novel transposable elements known as extra chromosomal circles (ECC). These discoveries are happening at a rapid rate and are not only unique to weed science but general plant biology as well. The International Weed Genomics Consortium has recently formed with the intent of generating these reference genomes and to facilitate working groups for certain weed genomes. This talk will focus on recent achievements in weed genome biology and how the IWGC is facilitating new discoveries.

2

So, You have a Weed's Genome Sequence

Martin Laforest[1], Eric Page[1], Sara Martin[1]

[1]Agriculture and Agri-Food Canada

Current agricultural production relies on tools introduced during the third agricultural revolution, including synthetic insecticides, fungicides, and herbicides. However, application of these chemicals has often resulted in changes to pests' biochemical pathways allowing them to escape our control. For example, worldwide, 515 weeds had evolved herbicide resistance by 2020. In some cases, the genetic change or changes that allow herbicide escape is known, but for a large number of instances, the genetic changes underlying the mechanisms of resistance remain elusive. More knowledge is required to better understand herbicide resistance to be able to detect rapidly and, eventually, exploit this knowledge to better control weeds. Here we present what we need to better understand the genetic basis of herbicide resistance, how these new genetic resources can be used, and present several examples of our early work, with a focus on the development of genetic resources for key Canadian weed species.

3	**Harvest Weed Seed Control in North America: (Our best shot at) The Whole Story** Michael Flessner[1], Breanne Tidemann[2] [1]Virginia Tech, [2]Agriculture and Agri-Food Canada Lacombe Harvest Weed Seed Control (HWSC) was developed in Australia in response to herbicide resistant weeds. HWSC manages weed seeds as they exit the combine harvester through collection, concentration, or destruction. For HWSC to work, weed seeds must be retained on the mother plant until harvest, be captured by the combine's header, and for some forms of HWSC, exit the combine in the chaff fraction. Research indicates that many important broadleaf weed species have significant seed retention at harvest, including >85% retention for *Amaranthus* spp. at soybean harvest, but grasses are not as conducive to HWSC, with up to 50% shatter in Urochloa platyphylla and >70% shatter for *Avena fatua*. Of seeds that enter the combine, ongoing work indicates >94% exit in the chaff fraction, as needed for HWSC. In preliminary chaff lining work, weed emergence is reduced with increasing chaff amount in wheat and soybean. In the year following wheat and soybean chaff lining, experiments observed a >43% decrease in emergence densities of multiple species compared to conventional harvest. Yields were similar or better for both wheat and soybean, except 1/12 site-years in wheat. Seed impact mills process chaff and weed seeds therein, killing >98% of most weeds tested to date in wheat, soybean, and canola chaff. Seed impact mills draw power from the combine and increase fuel consumption about ~15% in corn, ~15-33% in soybean, up to ~45% in wheat, but travel speed was not decreased on class 8 or higher combines. Despite many results showing high potential for HWSC in North America, there are some reasons to hesitate in adoption, including header losses, issues with high moisture causing plugging and harvest delays, and high initial cost investments. Best fit situations for HWSC across Canada and the US are being identified, and adoption is increasing.
4	**The confirmation of 4-hydroxyphenylpyruvate dioxygenase (HPPD)-inhibitor resistance in redroot pigweed (*Amaranthus retroflexus*) from Ontario** Isabelle Aicklen[1], Francois Tardif[1] [1]University of Guelph Herbicides are the most cost-effective method of weed control. Their high efficacy means however that they impose a strong selection pressure for resistance. To date, resistance to herbicides has evolved in over 269 weed species. While most cases of herbicide resistance are easily managed with alternative active ingredients, the propensity of many weed species to accumulate resistance

	mechanisms has led to numerous cases of multiple herbicide resistance (MHR). A population of *Amaranthus retroflexus* (redroot pigweed) from Chatham, Ontario is suspected of MHR as it survived field applications of herbicides inhibiting photosystem II (PSII)-(groups 5 and 6) and 4-hydroxyphenylpyruvate dioxygenase (HPPD) (group 27). The objective of this study was to confirm resistance and determine the pattern of multiple resistance within this redroot pigweed population. Initial screening indicated resistance to photosystem II-inhibiting and 4-hydroxyphenylpyruvate dioxygenase-inhibiting herbicides but not to acetolactate-synthase (ALS) inhibitors. The application of a discriminating rate of atrazine at 1000 g a.i. ha^{-1} resulted in 100% survival and significant biomass accumulation in the suspected MHR population confirming triazine resistance and prompting further investigation into the pattern of MHR. Dose response experiments were conducted to compare differences in survival and biomass accumulation between the MHR and a susceptible (S) population following treatment with the group 6 herbicide bromoxynil, and the group 27 herbicides topramezone, and mesotrione. Analysis of biomass and survival dose response curves confirmed that the MHR population is also 2.8-fold resistant to bromoxynil, and 1.8-fold resistant to mesotrione; however it was not resistant to topramezone. This population has therefore developed multiple resistance to PSII (groups 5 and 6) and HPPD (group 27) inhibitors and is the first redroot pigweed population in Ontario with resistance to these herbicides. Future studies will focus on determining the mechanisms of resistance in this population.
5	**The effect of density and herbicide system on the Critical Weed Free Period in canola** Daniel Pouteau[1], Rob Gulden[1] [1]University of Manitoba The critical weed free period (CWFP) is the end of the critical period of weed control which defines the period of the crop growth cycle during which interference with weeds reduces yield at unacceptable levels. Recruitment of weeds after the CWFP no longer causes yield losses that make weed management economical. Past research has shown that the critical period of weed control in canola ends between the 4 and 8 leaf stages, but what caused this range is not clear. This project focuses on the defining the CWFP of canola, in specific, how late herbicide applications are warranted to prevent yield loss in canola at three stand densities using the glyphosate- and glufosinate-resistant canola weed management systems. Glufosinate is a fast-acting herbicide while glyphosate is slower acting active ingredient. A fully balanced, two-way factorial, split-block RCBD experiment was used to generate the CWFP curves for all 6 treatment combinations and a mixed model approach will be used to compare the curve parameters of the CWFP among the three stand density and two herbicide systems. Results will be discussed.

6	**Solar Corridor Cropping Systems: Effects of Row Spacing and Interseeded Cover Crops on Weeds and Corn Yield in Quebec** Laurence Durocher[1], Yosra Menchari[1], Marie-Noëlle Thivierge[2], Samuel Gagné[1], Annie Brégard[1], Sébastien Angers[3], Jean-François Messier[4], Caroline Halde[1] [1]Université Laval, [2]Agriculture and Agri-Food Canada, [3]Ferme de l'Odyssée, [4]Entreprises JFMessier The solar corridor cropping system is a novel field crop production system in which row spacings are widened to optimize light reception by the plants. For Quebec field crop growers, it can be combined with interseeded cover crops to improve their establishment and weed control while maintaining optimum crop yield. The aim of this project was to assess the effect of cover crops and solar corridors on weed control and corn grain yield. A three-year field experiment was carried out in 2021 (corn), 2022 (corn), and 2023 (soybean) on two sites with contrasting soil textures (clay loam and sandy loam) under a cool, humid climate. Experimental units were arranged in a split-plot design, with four blocks. The main factor was row spacing, with two levels: 76 cm and 152 cm. The subplot factor was cover crop treatment, with three levels: pure stand of annual ryegrass, multi-species mixture, and no cover crop control. In corn, aboveground biomass of weeds and cover crops was higher with wider row spacing (795 kg ha-$^{-1}$ and 946 kg ha^{-1}, respectively) than with standard row spacing (260 kg ha^{-1} and 361 kg ha^{-1}, respectively). Across row spacings, weed biomass decreased between 2021 (623 kg ha^{-1}) and 2022 (431 kg ha^{-1}). Corn grain yield per unit area was lower with wider row spacing (8.7 Mg ha^{-1}) than with standard row spacing (10.2 Mg ha^{-1}). However, grain yield per corn plant was higher with wider row spacing (145 g plant^{-1}) than with standard row spacing (132 g plant^{-1}). These preliminary results show that solar corridors influence weed competition, cover crop biomass and corn yield. The legacy-effect of solar corridors will be evaluated in 2023. To complete the overall profitability of this system, an economical analysis and the measurement of several soil health indicators will be assessed.
7	**Transcriptomic Approach to Understanding Metabolic Resistance to Imazamox in Feral Rye (*Secale cereale*)** William Kramer[1], Todd Gaines[1], Franck Dayan[1], Neeta Soni[2] [1]Colorado State University, [2] Corteva Agriscience The introduction of imazamox-resistant Clearfield wheat varieties marked a significant shift in winter wheat weed management, with Group 2 acetolactate synthase (ALS) inhibiting herbicides playing a prominent role. Among the weeds posing challenges, feral rye (*Secale cereale*) has emerged as a substantial contributor to yield losses in winter wheat fields. Early detection of herbicide resistance is vital for proactive mitigation, prompting the need for herbicide resistance surveys. A multi-year survey across Colorado's Clearfield wheat fields identified feral rye populations with resistance to imazamox, confirmed through dose-response experiments. Populations that did not display ALS gene sequence variation were exposed to applications of the herbicide metabolism gene inhibitors, malathion. Such application resulted in resistance reversal and suggested the presence of a non-

	target site resistance mechanism related to differences in metabolism. Based on this evidence, this research aims to understand the molecular mechanism(s) underlying metabolic resistance in this population. To elucidate the transcriptomic response associated with metabolic resistance, segregating F_2 populations were developed via a biparental cross between imazamox-resistant and -susceptible individuals. Four confirmed resistant and four susceptible plants from the F_2 population were sprayed with a field rate of imazamox, and leaf-tissue was sampled 8-hours after application. Total RNA was extracted and used to generate paired-end cDNA Illumina libraries for sequencing. Preliminary differential gene expression results indicate that various herbicide detoxification genes respond to applications of imazamox. This study employs transcriptomics and will eventually utilize functional genomics to identify the specific gene(s) responsible for metabolic resistance. The overarching goal of this study is to enhance our understanding of the molecular basis of ALS herbicide resistance that will inform management practices in the short term and it aims to provide insights on herbicide discovery in the long term.
8	**Native and invasive plant growth trajectories across differing wildfire burn severities: preliminary observations from the McKay Creek Wildfire in St'at'imc territory** Virginia Oeggerli[1], Jennifer Grenz[1] [1]The University of British Columbia Increased wildfire intensity due to a changing climate and colonial history of fire suppression may not produce expected responses by invasive and native vegetation. In 2021, over 40,000ha of land burned in the McKay Creek wildfire in the Lillooet region of British Columbia. The McKay Creek Fire occurred within the traditional territory of the St'át'imc Nation who rely upon it for food, social, and ceremonial purposes. This area provides important habitat to blue listed species, wildlife, birds, as well as fish and is important to agricultural and recreational sectors within Lillooet. Little is known about vegetation responses to wildfire in each of the region's four biogeoclimatic (BEC) zones which endured varying burn intensities and contained infestations of multiple invasive plant species. This project set up 80 plots using stratified-preferential random sampling, completing vegetation monitoring for species diversity and cover throughout low, medium, and high burn severities. Within many high burn severity plots vegetation composition was reduced to dense monocultures of prickly lettuce, fireweed, and thistle. Preliminary findings demonstrate the resilience of berry bushes to low and medium burn severities. South facing slopes, no matter the burn severity, are seeing limited vegetation growth with large areas of burned bare ground 2 growing seasons post wildfire. This may be an indication that the changing climate and increasing temperature the south facing slopes heat exposure is becoming too harsh to support establishment of species regardless of burn severity. It is evident that there are areas within the post wildfire landscape that should be prioritized for restoration and invasive plant management to ensure that native plants are able to reestablish. This is vital as the forage value provide by native plants is required to support the local mule deer herds ensuring food systems and security is maintained for the St'át'imc Nation and local sectors.

9	**Integrated Crop Management: A Holistic Approach for Weed Management in Wheat (*Triticum aestivum* L.)** Uthpala Ekanayake[1], Rob Gulden[1], Chris Willenborg[2], Jonathan Rosset[1], Dilshan Benaragama[1] [1]University Of Manitoba, [2]University of Saskatchewan The integrated application of weed and nutrient management practices identified here as integrated crop management (ICM), has been less recognized as a tool for sustainable weed management. A field experiment was conducted in 2023 at the Carman research field in Manitoba, Canada, to evaluate the impact of the combined application of some weed and nutrient management strategies on weeds in a spring wheat (*Triticum aestivum* L.) crop. A factorial experiment was carried out with four factors, which consisted of two levels each: nitrogen fertilizer application timing (spring, fall), placement (broadcast, side-banding), rate (50%, 100%), weed management (IWM, standard) as a split-split plot design with four replicates. Integrated weed management consisted of narrow row spacing (6”), high crop density (400 plants m^{-2}), and early seeding, while the standard weed management was wide row spacing (12”), low density (200 plants m^{-2}), and late seeding. Crop biomass was significantly affected by the interaction of fertilizer application time, rate, placement, and weed management. The combination of fall application, side banding, and full rate with standard weed management had 3.6% greater crop biomass than spring application, broadcasting, 50% fertilization and IWM. Weed density was significantly affected by the interaction of fertilizer timing and weed management where the combination of fall application and IWM had 69% lower density compared to spring application with standard weed management. Weed biomass was significantly affected by the interaction of fertilizer time, placement, rate and weed management. The lowest weed biomass was observed from the combination of fall application, side banding, and half rate with IWM, which was about 48% lower than spring application, broadcasting, and full rate with standard weed management. The initial result of this study revealed that nutrient and weed management can interactively influence weeds in wheat thus, ICM can be a potential tool for sustainable weed management.
10	**Root elongation among 10 soybean genotypes at different temperatures** Joseph Zvomuya[1], Rob Gulden[1] [1]University of Manitoba Soybean [*Glycine max* (L) Merr.] has risen to be Manitoba’s third most-produced crop following wheat (*Triticum aestivum* L.) and canola (Brassica napus L.). This increased adoption is attributed to the development of short-season cultivars suited for Manitoba’s short, continental-climate growing season. Soybean, a sub-tropical crop, thrives when planted into warm soil conditions. Consequently, producers plant soybeans late, exposing them to interference from the better-adapted summer

	annual weeds. We conducted a growth chamber experiment to determine the base temperature for root growth of ten soybean cultivars. Seedlings in growth pouches had root images captured, measured, and analyzed to identify the differences in root elongation among the selected ten cultivars. An x-intercept method was used to calculate base temperatures for each cultivar. Some cultivars exhibited significantly low base temperatures, indicating their potential adaptability to cooler soil conditions, while others displayed the highest base temperature, indicating a preference for warmer temperatures. The change in root elongation was determined at 6 days after incubation (DAI) by determining the difference in root length between successive 5C temperature increments (15°C-20°C, 20°C-25°C and 25°C-30°C). Cultivars with lower base temperatures and greater root elongation under cooler conditions may be ideal choices for early-season planting, offering a potential competitive advantage against weeds. Field experiments are underway to test this hypothesis.
11	**Encapsulated formulation of saflufenacil/pyroxasulfone with potential tank mix partners applied postemergence in corn** Erica Nelson[1], Darren Robinson[1] [1]University of Guelph A new corn herbicide containing an encapsulated formulation of saflufenacil/pyroxasulfone has been developed by BASF. The new formulation improves crop safety and extends the window of application from preemergence (PRE) to early postemergence (ePOST). Combinations of saflufenacil/pyroxasulfone and POST tank mix partners were examined for their ability to control several common weed species with the hypothesis that weed control would improve with the addition of a tank mix partner. Six field studies were repeated, at three locations, in southwestern Ontario in 2022 and 2023 to determine if the addition of a tank mix partner, to the encapsulated saflufenacil/pyroxasulfone formulation, would improve weed control. All herbicide treatments were applied at the corn 3-leaf stage with encapsulated saflufenacil/pyroxasulfone applied alone, at either 146 or 245 g ai ha^{-1}, and with the following tank mix combinations, dicamba/diflufenzopyr/isoxadifen, mesotrione + atrazine, or topramazone/dimethenamid-p + atrazine. Crop phytotoxicity, weed control, and yield were assessed for all treatments. All saflufenacil/pyroxasulfone treatments had 1-4%, 0-1%, and 0% crop injury at 7, 14, and 28 days after treatment (DAT), respectively. All tank mix treatments performed similarly to the industry standard, S-metolachlor/atrazine/mesotrione/bicyclopyrone, for control of lambsquarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), and foxtail species (*Setaria* sp.). Based on 2022 data, yield for all herbicide treatments was the same. The addition of a tank mix partner to the encapsulated formulation of saflufenacil/pyroxasulfone provided more consistently improved control across all weed species assessed.

12	**Evaluating the potential of a winter canola soybean relay intercrop system in Ontario** Marinda DeGier[1, 2], Eric Page[1], François Tardif[2], Meghan Moran[3], Josh Nasielski[2] [1]Agriculture and Agri-Food Canada, [2]University of Guelph, [3]Ontario Ministry of Agriculture, Food, and Rural Affairs Winter canola has potential to enhance the sustainability of a cropping system by serving as a winter-hardy cash cover crop during the winter. A critical agronomic factor for its success lies in selecting the appropriate planting date, allowing sufficient time for development of a robust taproot that will contribute to successful overwintering. Seeding winter canola into soybeans may be a method for incorporating winter canola into the rotation, a practice known as relay intercropping, in order to achieve optimal development in the fall. The success of this relay intercrop system with winter canola and soybeans was evaluated by analyzing three planting date timings by seeding application methods through broadcast or planting of the winter canola seed. Four field experiments in Ontario were conducted over the 2022-2023 growing season near the locations of Elora, Woodstock, Harrow and Woodslee. Additionally, two separate studies at the Elora and Woodstock locations examined the impact of soybean plant population as an additional treatment. Evidence is provided on the effectiveness of the system through soybean light interception measurements, winter survival and yield of both soybean and winter canola. Initial findings indicate that soybean yield across the three planting dates were not significantly different. Winter canola establishment in the fall was greater when seeds were planted compared to broadcast. As the planting date was delayed, overwintering percentage decreased. In addition, similar trends were seen with winter canola yield, as the earliest planting date had the highest production with diminishing yields observed as planting dates were delayed.
13	**Ecology and germination requirements of cow wheat (*Melampyrum lineare* Desr.) in wild blueberry (*Vaccinium angustifolium* Ait.) fields in Nova Scotia** Vanessa Deveau[1], Scott White[1], Nancy McLean[1], Mason MacDonald[1] [1]Dalhousie University Cow wheat (*Melampyrum lineare* Desr.) is an annual hemiparasitic weed that is increasing in occurrence in lowbush blueberry fields in Nova Scotia. Knowledge of seed germination requirements, seedling emergence patterns, and parasitic root connections with wild blueberry rhizomes under field conditions, however, are lacking. The objectives of this research were to 1) determine the extent and timing of cow wheat seedling emergence in lowbush blueberry fields, 2) confirm the presence or absence of parasitic root connections between cow wheat and lowbush blueberry plants, and 3) identify factors regulating cow wheat seed dormancy and germination.

	Cow wheat seedlings emerged between April 18 to April 25 and 50% and 90% seedling emergence occurred by May 2 and May 26, respectively. The presence of haustoria connections between cow wheat roots and lowbush blueberry rhizomes was determined visually at 3 lowbush blueberry fields in 2023. Results suggest cow wheat has an affinity for Vaccinium spp., though specific resources obtained through parasitic connections with lowbush blueberry are unknown. There was a significant effect of cold moist stratification duration (CMSD) ($P < 0.0001$) but no significant effect of wild blueberry debris (WBD) ($P = 0.8297$) or the interaction between WBD X CMSD ($P = 0.8070$) on cow wheat seed germination. Cow wheat seeds did not germinate without cold moist stratification (CMS). CMSD for 4 and 8 weeks caused 20% and 27% cow wheat seed germination, respectively. Results suggest that CMS is an important factor affecting cow wheat seed dormancy and seed germination, but seeds may require exposure to additional conditions to maximize germination Future research should consider longer CMSD's, colder storage temperatures, and possibly the presence or absence of living lowbush blueberry roots to determine if this increases cow wheat seed germination.
14	**Detecting Kochia (*Bassia scoparia*) at field scale using multi-temporal UAV imagery** Steve Shirtliffe[1], Japjyot Sandhu[1], Seungbum Ryu[1], Thuan Ha[1] [1]University of Saskatchewan Kochia (*Bassia scoparia*) is becoming one of the problematic agronomic weeds in Canada. Kochia commonly grows around saline and acidic areas and in regions with meagre precipitation. Currently, controlling kochia in crops has become problematic due to its resistance to many herbicides, including those in Groups 9, 4, and 2. Due to this high level of resistance and kochia's ability to grow and mature at different times of the year, management strategies are limited, and farmers are unable to eliminate this weed from crops. Current kochia control methods include mowing the weed patches; this can rarely be done without damaging some cropped areas, leading to yield loss. Kochia control can be feasible if farmers are able to plan ahead and understand kochia spread throughout their fields over time. One way to plan and control kochia is by using UAV imagery. In this study, different vegetative indices were assessed to detect kochia using UAV imagery. This can help farmers understand how kochia is dispersing throughout the fields. Furthermore, the kochia detecting index can help farmers decide if the area should be cropped or controlled under different management practices. Moreover, a machine learning model will be trained to aid the government and researchers who want to identify the pattern of kochia spread over the years for surveys. If the government can estimate the spread of kochia and its impact on crop yield, they can set up new policies or subsidies for farmers whose fields are highly infested with kochia.

15	**Narrow-row spacing in soybean, edible bean and peas increases yield despite a lesser efficiency regarding weed control** Élise Smedbol[1], Maxime Lefebvre[1], Mick Wu[1], Maryse Leblanc[1] [1]Institut de recherche et de développement en agroenvironnement Inter-row mechanical weeding is routinely and efficiently performed in organic field crops, usually with row spacing of 20 to 30 inches, without damaging the crops. In narrow-row crops such as pea, inter-row mechanical weeding is usually not performed by fear of damaging the crops and reducing yields. The objective of this study was to propose a strategy for inter-row mechanical weeding in narrow-row soybean (Marula BIO + Turbo-N2), green bean (Caprice NT) and peas (Portage NT). The study was conducted at IRDA's organic agriculture innovative platform in the city of Saint-Bruno-de-Montarville (Qc, Canada), from 2019 to 2022. Different parameters were evaluated: weeding tools (goosefoot, flat or straight share), speed (4 and 6 km/h), crop growth stage, row spacing (7,5, 15 and 30 inches) and the addition of access routes for the tractor wheels in narrow-row crops. Crops were sown and weeded using RTK GPS. All crops were weeded at early growth stages using a Yetter rotary hoe. The inter-row weeding at later growth stages was performed using a camera guidance system. Yield, weeding efficiency and crop damage were measured. The results are indicating that later inter-row weeding could be performed in all three crops without reducing yields nor damaging crops, up to 5-6 internodes for pea, 2 and 3 trifoliate leaves for green bean and soybean, respectively. The weeding tools were equivalent regarding yields, but the goosefoot and flat shares were more efficient regarding weed control, at 6 km/h. Green bean and soybean had a higher yield when planted with a narrow-row spacing of 7,5 inches compared to a 30 inches row spacing, despite a higher weed pressure. This is probably due to a different tool adjustment in narrow-row crops, but mainly due to the difficulty of weeding on the row, which is the greatest challenge regarding mechanical weeding.
16	**Weed communities after decades of fertilization and tillage treatments in a corn-soybean rotation** Marie-Josée Simard[1], Noura Ziadi[1] [1]Agriculture and Agri-Food Canada Soil fertility and disturbance can potentially modify weed dynamics in a corn-soybean rotation. Knowing how added mineral fertilizers and tillage influence weed populations on the long term can provide insight on weed community shifts which may affect future weed management requirements. The first objective of this study was to evaluate the effect of 24-25 years of nitrogen and phosphorus fertilization treatments, and tillage (moldboard vs. no tillage) on weeds (density, biomass and composition) before and after herbicide applications in 2016/corn and 2017/soybean. The second objective was to evaluate the effect of the same treatments six years later following no post-emergence weed management in 2022/corn. Since the last evaluation performed in 2004, weeds

	increased in density, biomass, and diversity in this simple rotation of long-season crops where annual grasses are now ubiquitous. No fertilization effect was observed on managed weed communities. Both unmanaged weeds and corn benefitted from added fertilizer (2022/corn). Moldboard tilled plots had lower densities of dominant annual and perennial weeds. Weed species richness and diversity based on counts were equivalent between tillage regimes but total biomass was distributed between more species in no-till. The results of this study indicate that weed communities are not constrained by fertility in a corn-soybean rotation and that moldboard tillage lowered weed competition, especially from annual grasses.
17	**Through fire and (hot) water: Evaluation of the potential of two alternative control methods for common waterhemp (*Amaranthus tuberculatus* (Moq.) J.D. Sauer)** Sandra Flores-Mejia[1], Firmo Sousa[1], Gabriel Verret[1], Marie Bipfubusa[1], Stéphanie Mathieu[2], Yvan Faucher[2], Brigitte Duval[2], Annie Marcoux[3], Michel Dupuis[4], Élise Smédbol[5] [1]CÉROM, [2]MAPAQ, [3]LEDP-MAPAQ, [4]CSC, [5]IRDA Most studies addressing common waterhemp (AMATU) control are based on herbicide use. They have demonstrated that a combination of pre- (PRE) and post-emergence (POST) herbicides can be used to effectively control this species. However, relying solely on herbicides is unsustainable in the long term because of the rapid development of herbicide-resistant populations. Therefore, it is necessary to identify alternative control methods that could offer effective control of AMATU. For this reason, a pilot project was conducted, to explore the potential effectiveness of two thermal control methods against AMATU: a flame-weeder (Red Dragon, model VT 3-30 C) and a hot-water weeder (Oeliatec, model HOUAT 500). The efficacy of each method was tested to control AMATU plants at different growth stages (0-4 leaves, 4-6 leaves, and more than 10 cm) after 24 hours, as well as 2, 4, and 6 weeks after treatment. In the case of the flame-weeder, four rates of propane (0, 1, 2, and 4 grams per meter [g/m]) were tested. For the hot-water weeder, two variables were considered: the rate (6-8 or 12 liters per minute [L/min]) and the number of passes (0, 1, 2 or 3). The effect of hot-water treatments on the germination rate of AMATU seeds exposed to the treatments (rate x number of passes) at two different depths (on the surface or at 5 cm) was also evaluated. The results showed that flame-weeding is not an effective method for controlling AMATU plants as several plants were able to survive the treatment. In comparison, hot-water weeding has the potential to kill AMATU plants up to 10 cm in height with an application rate of 12 L/min. However, the effect of hot-water treatments on germination rate was inconclusive. Further testing is necessary to evaluate the feasibility and profitability of hot water-weeding control in the field.

18	**The economic impact of glyphosate-resistant weeds on major field crops grown in Ontario** Peter Sikkema[1], Nader Soltani[1] [1]University of Guelph Ridgetown Campus Limited information exists on the global economic impact of glyphosate-resistant (GR) weeds. The objective was to estimate the potential yield and economic loss from uncontrolled GR weeds in the major field crops grown in Ontario, Canada. The impact of GR weed interference on field crop yield was determined using an extensive database of field trials completed on commercial farms in southwestern Ontario between 2010 and 2021. Crop yield loss was estimated by expert opinion (weed scientists and Ontario government crop specialists) when research data were unavailable. This manuscript assumes that crop producers adjust their weed management programs to control GR weeds, which increases weed management costs but reduces crop yield loss from GR weed interference by 95%. GR volunteer corn, horseweed, waterhemp, giant ragweed, and common ragweed would cause an annual monetary loss of (in millions of Can$) $172, $104, $11, $3, and $0.3, respectively, for a total annual loss of $290 million if Ontario farmers did not adjust their weed management to control GR biotypes. The increased herbicide cost to control GR volunteer corn, horseweed, waterhemp, giant ragweed, and common ragweed in the major field crops in Ontario is estimated to be (in millions of Can$) $17, $9, $2, $0.1, and $0.02, respectively, for a total increase in herbicide expenditures of $28 million annually. Reduced GR weed interference with the adjusted weed management programs would reduce farm-gate monetary crop loss by 95% from $290 million to $15 million. This study estimates that GR weeds would reduce the farm-gate value of the major field crops produced in Ontario by Can$290 million annually if Ontario farmers did not adjust their weed management but with increased herbicide costs of Can$28 million and reduced crop yield loss of 95% the actual annual monetary loss in Ontario is estimated to be Can$43 million annually.
19	**P197L and W574L amino acid substitutions confer ALS inhibitor resistance in pale smartweed (*Persicaria lapathifolia*)** Gaganpreet K Dhariwal[1], Laura Kennedy[1], Mattea Pittman[1], Marianne Bessette[2], Martin Laforest[2], Charles Geddes[1] [1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB, Canada, [2]Agriculture and Agri-Food Canada, Saint-Jean-sur-Richelieu Research & Development Center, Saint-Jean-sur-Richelieu, QC, Canada Pale smartweed [*Persicaria lapathifolia* (L.) Delarbre] is a problematic annual weed in western Canada where it is capable of reducing crop yield and quality. This is especially so since resistance to acetolactate synthase (ALS)-inhibiting herbicides was reported in this species in 2009. While ALS inhibitor-resistant pale smartweed has occurred in western Canada for 15 years, the mechanism of ALS inhibitor resistance has not been reported globally. In this study, we identified and sequenced the pale smartweed acetolactate synthase (ALS) gene from two resistant and two susceptible pale

	smartweed accessions collected from Alberta, Canada in 2017. The sequencing revealed target site mutations resulting in two unique amino acid substitutions, P197L and W574L, present in separate resistant accessions. Whole-plant dose-response experiments revealed that the accession with the W574L substitution exhibited high-level resistance to imazethapyr (R/S 54-151), thifensulfuron + tribenuron (R/S 425-669), florasulam (R/S 71-109), flucarbazone (R/S 34-78), and thiencarbazone (R/S 237-249) based on biomass dry weight 28 days after treatment. The accession with the P197L substitution was highly resistant to thifensulfuron + tribenuron (R/S 285-449) and thiencarbazone (R/S 49-51), moderately resistant to flucarbazone (R/S 7-16) and imazethapyr (R/S 10-27), but susceptible to florasulam (R/S <4). These results show that two unique amino acid substitutions confer ALS inhibitor resistance in pale smartweed. In addition, the P197L substitution confers broad high-level resistance among ALS-inhibiting chemical families while the W574L substitution confers cross-resistance to the imidazolinone, sulfonylurea and triazolinone chemical families but not triazolopyrimidine - type 1. A PCR-based genetic test was developed to identify these target site mutations using pale smartweed leaf tissue. The rapid test allows for in-season detection of ALS inhibitor resistance in pale smartweed and also offers insight into which ALS-inhibiting herbicides may remain effective against the tested population(s).
20	**The genome and population genetics of wild mustard** Sara Martin [1], Elizabeth Sears[1], Tracey James[1] [1]Agriculture and Agri-Food Canada Wild Mustard (Brassicaceae) is a common weed found all across Canada and is widely introduced and naturalized in the world's temperate regions. The species has evolved herbicide resistance to ALS inhibitors, PSII inhibitors and auxin mimics in Canada and in other regions of the world. Here I will discuss the current taxonomic status of the species, progress on sequencing the species genome and summarize the results of small scale population genetics work.
21	**Policy, regulatory, and management failures leading to resistance of Reynoutria species to glyphosate in coastal British Columbia** Jichul Bae[1], Jennifer Grenz[2], Vanessa Jones[2] [1]Agriculture and Agri-Food Canada, [2]University of British Columbia Knotweed species (*Reynoutria* spp.), *Reynoutria japonica* and *Reynoutria bohemica*, are perennial invasive plant species that have had negative impacts to both infrastructure and ecosystems in the Pacific Northwest. For the past decade, active management campaigns have been underway in British Columbia to eradicate these species with the accepted best management practice for control being the use of systemic herbicides. Both provincial and federal regulatory restrictions on herbicide use have limited the choice of available active ingredients generally, further limiting control options to only glyphosate within close proximity to water bodies. Over the past 5 years, several populations

	exhibit symptoms of epinastic growth after multiple years of treatment using glyphosate products and eradication cannot be achieved. Dose-response assays were conducted on four *Reynoutria* populations using isopropylamine and potassium salt of glyphosate (Credit® Xtreme, 540 g L^{-1}, Nufarm Agriculture Inc. 5101, 333-96th Ave NE, Calgary, AB, Canada) at doses of 0, 0. 675, 1,350, 2,700, 5,400 and 10,800 g ai ha^{-1}. Thus far, the dose-response experiment confirmed that the P1 (Mission, BC) population was resistant to glyphosate. Dose-response assays for P2, P3 and P4 are currently underway with results expected by conference time. Results point to the contributions of regulatory, policy, and knowledge failures guiding invasive plant management programs to the development of herbicide resistance.
22	**Identifying Amaranthus species of concern through genome skimming, protein biotyping and CRISPR-Cas-based diagnostics** Andrée Ann Dupras[1], Max Murphy[1], Julia Hubert[1], Sarah Kyte[1], Irina Gymninova[1], Naana Duah[2], Chhaya Zala[3], Jesukhogie Williams-Ikhenoba[4], Leonardo Galindo-Gonzalez[1] [1]Canadian Food Inspection Agency, [2]University of Ottawa, [3]Algonquin College, [4]Carleton University Invasive and noxious plant species impact trade, crop production, human health and the environment. To control movement of these species it is key that we develop identification tools that are efficient, sensitive and reliable. We used plants from the genus *Amaranthus* to start developing these tools. Some species in this group are regulated in Canada (*A. tuberculatus*) or in the U.S. (*A. palmeri*), due to their invasiveness, herbicide resistance and impact on crops like corn and soybean. *A. palmeri* has been detected in small patches in Ontario and Manitoba, and will become a threat to Canadian crops as its range increases due to climate change. DNA barcoding is the go-to tool for molecular identification of many organisms but a universal DNA plant barcode is absent. We performed genome skimming (low pass sequencing to assemble high-copy regions from the genome) on 15 *Amaranthus* species, and assembled full chloroplast genomes, which allowed us to find 7 new barcodes with high species resolution. Then we adapted Matrix Assisted Laser Desorption/Ionization (MALDI) protein biotyping to see if single *Amaranthus* seeds would provide consistent and distinctive protein spectra for species classification. After generating a protein spectra database of 16 *Amaranthus* species, testing of two batches of blind samples resulted in 100% and 87% correct species identification. Finally, we adapted CRISPR-Cas12 gene editing technology to design a fluorescent assay that was able to distinguish *Amaranthus* spp. Our preliminary assays show that species-specific crRNA in complex with LbCas12a directed to polymorphic regions in species of this genus, results in fluorescent detection due to collateral cleavage of a small single-stranded DNA carrying a quencher and a fluorophore. The enzymatic assay provides results in less than 30 minutes, and we are currently working in a method that may streamline DNA extraction to fluorescent detection in under an hour.

23	**Residual weed population shifts in Alberta - 1973 to 2023** Julia Leeson[1], Shane Hladun[1], Charles Geddes[1], Chris Neeser[2], Breanne Tidemann[1] [1]Agriculture and Agri-Food Canada, [2]Alberta Agriculture and Irrigation The comparison of the relative abundance of weeds in Alberta in 2023 with results from previous provincial surveys enables the identification of recent shifts in species' ranks and relative abundance. In 2023, a total of 1121 fields of annual crops including spring wheat, canola, barley, field pea, durum, oat, and lentil were surveyed. These fields were selected using a stratified random sampling procedure based on ecodistricts. In each field, weeds were counted in 20 quadrats (50 by 50 cm) in late summer. Weed data are summarized using a relative abundance index based on frequency, field uniformity and density. The results from the 2023 survey are compared to results from surveys of 1232 fields in 2017, 1333 fields in 2009-2010, 1153 fields in 2001, 684 fields in 1997, 1086 fields in 1987-1989 and 3109 fields in 1973-1977. Chickweed (*Stellaria media* (L.) Vill.) was the most abundant weed 2023, as observed in the previous survey. Volunteer canola (*Brassica napus* L.) ranked second in 2023, moving into the top three most abundant weeds in Alberta for the first time. Wild buckwheat (*Fallopia convolvulus* (L.) Á. Löve) ranked third, followed by wild oats (*Avena fatua* L.), and lamb's-quarters (*Chenopodium* spp.). Annual bluegrass (*Poa annua* L.) and broad-leaved plantain (*Plantago major* L.), appeared in the top 25 for the first time in 2023. Kochia (*Bassia scoparia* (L.) A. J. Scott) has been steadily increasing since the first surveys and reached the top 10 for the first time in 2023. This species is dominant in the drier southern areas of Alberta. Other species that have continued to increase in relative abundance include spiny annual sow-thistle (*Sonchus asper* (L.) Hill) and volunteer barley (*Hordeum vulgare* L.).
24	**Cultural impacts of invasive species on Indigenous value systems** Vanessa Jones[1], Jennifer Grenz[1] [1]University of British Columbia Invasive species have become a recognized threat worldwide, causing both direct and indirect negative impacts to food system productivity, ecosystem health, and human livelihoods. Generally, economic and human health impacts are the main non-environmental targets of research and literature, with minimal mentions of impacts to Indigenous communities. However, as Indigenous communities continue to work toward self-governance, recognition of traditional stewardship practices and ecological knowledge, and food system reclamation, the impacts of invasive species to Indigenous value systems must also be determined. The purpose of this poster is to demonstrate the instances where this is seen globally as well as identify areas where further research is needed, as there is often a lack of literature regarding this topic. For instance, there is substantial literature available on Indigenous aquatic food systems of coastal First Nations in the Pacific Northwest

regarding the history of their management and current restoration. There is also extensive literature available about invasive species that infest the coastal Pacific waters such as the European green crab, the impacts of which to local ecosystems has been well studied. However, no studies have been done specifically investigating the impacts of an invasive species such as this to Indigenous aquatic food systems like clam gardens. This is just one example; the impacts of invasive species to both terrestrial and aquatic food systems, archaeology and cultural sites, and interpretive tourism and teaching opportunities must be investigated in order to continue reconciliation efforts and accurately represent the human and environmental impacts of invasive species in the literature. Invasive species can cause negative impacts to Indigenous value systems in various ways which ultimately leads to a lack of understanding of pre-colonial baselines, and more research is needed to overcome this.

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The potato vine crusher: a new tool for harvest weed seed control

Nicolle MacDonald[1], Andrew McKenzie-Gopsill[1]

[1]Agriculture and Agri-food Canada

Effective weed seedbank management is essential for long-term sustainable weed control. Advances in weed control strategies, including harvest weed seed control (HWSC), have been effective at reducing weed seedbank contributions and managing problematic weeds, including herbicide-resistant species. Tactics for HWSC include direct collection and removal of weed seeds from the field, as well as in-field devitalization. To date, HWSC tactics have been limited to combine-harvested crops, due to machinery requirements and the behaviour of weed species that retain their seeds until harvest. Other crops, such as potatoes, face similar weed challenges that cause significant yield losses. Nonetheless, HWSC has not been explored in these crops due to specialized harvesting equipment. This project focuses on evaluating the potential of the potato vine crusher (PVC), a roller-mill system originally designed for insect control, as an HWSC tool in Canadian potato production. Stationary testing was conducted to evaluate the impact of spring tension and roller speeds on controlling lambsquarters, the most problematic weed species in Canadian potato farming. Roller speed had minimal influence on lambsquarter control, while increased spring tension led to reduced control under controlled conditions. Under simulated field conditions, there was a notable reduction in lambsquarters emergence (53%) when using maximum spring tension. Encouragingly, high levels of control (65 - 94%) were observed for all other weed species under controlled conditions. During the simulated harvest scenario when testing different weed species with different seed sizes, we found that larger seeds had significantly reduced emergence when processed with the PVC, while smaller seeds were unaffected. This study not only demonstrates the potential of the PVC as a valuable HWSC tool for Canadian potato production systems but would also mark the first use of HWSC for a horticultural crop.

26	**Digital imaging technology to classify herbicide-resistant and susceptible kochia (*Bassia scoparia*)** Keshav Singh[1], Charles Geddes[1], Prabahar Ravichandran[1], Manoj Natarajan[1], Austin Jaster[1], Kamaljeet Gill[1] [1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre Kochia (*Bassia scoparia*) is an invasive tumbleweed that can cause high yield losses in field crops. Herbicides are the primary method used to control kochia. However, in recent decades kochia evolved resistance to up to five different herbicide modes of action. New techniques to recognize herbicide-resistant from susceptible plants could be highly useful for site-specific weed management. Digital imaging and artificial intelligence can perform various functions via utilizing advanced sensing systems and big data analytics. Imaging platforms using smart sensors facilitate more robust and efficient data collection than conventional practices. These platforms allow accurate, rapid, and nondestructive measurement of plant morphometrics and physiological parameters. By combining different sensing systems, it is possible to characterize weed growth parameters at high spatial, spectral, and temporal resolution. Two different sensors were evaluated simultaneously, including a high spectral resolution based hyperspectral system and high spatial resolution based low-cost Raspberry Pi (RPi) cameras. We assessed two different herbicides (glyphosate and fluroxypyr) applied to different kochia accessions with known herbicide resistance under controlled-environment. Hyperspectral imagery of the kochia plants was obtained immediately prior to herbicide treatment along with 1 and 3 days after treatment. These data were used to train classification models to identify resistant and susceptible kochia plants. The models classified the plants with an accuracy of 75.1% for glyphosate and 82.1% for fluroxypyr. An array of RPi computers was also deployed to continuously monitor plant characteristics. This setup was substantially less expensive and more automated than other alternatives. The quantitative traits extracted using RPi images included vegetation canopy cover, plant density and foliar greenness. Our results suggest that these imagery systems hold promise to discriminate resistant from susceptible kochia plants for site-specific weed management. We continue to train these models and validate them on diverse kochia populations collected from the Canadian Prairies.
27	**Weed suppression by integrating cultural tactics in western Canadian soybean production** Charles Geddes[1], Shamini Jayasekara[1, 2], Mallory Anderson[1], Robert Gulden[3], Chris Holzapfel[4] [1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, [2]University of Lethbridge, Faculty of Arts and Science, [3]University of Manitoba, Department of Plant Science, [4]Indian Head Agricultural Research Foundation Soybean [*Glycine max* (L.) Merr.] seeded area in western Canada has grown by 36% in the past decade. As a warm-season species, soybean is at a competitive disadvantage when growing with cool-

season weeds in this short-season environment. A strip-plot randomized complete block design field experiment was conducted near Lethbridge, AB in 2020 and 2021 and near Indian Head, SK and Carman, MB in 2021 and 2022 to determine the impact of integrating cultural weed management tactics on soybean yield, yield loss due to weeds, and weed biomass. The four cultural factors included presence vs. absence of a shoulder-season fall rye (*Secale cereale* L.) cover crop terminated before soybean planting, slender vs. bushy soybean cultivar, narrow (19-25 cm) vs. wide (61-76 cm) row spacing, and recommended (400,000 target plants ha^{-1}) vs. 1.5 times the recommended target density. The strip-plot factor included weedy vs. weed-free conditions. Among environments, the fall rye cover crop reduced weed biomass by 20% and reduced weed-free soybean yield by 4%. The bushy cultivar had 14% lower weed biomass and 5% greater weed-free yield than the slender cultivar. The narrow row spacing reduced weed biomass by 20%, increased weed-free yield by 11%, and reduced yield losses due to weeds by 4% compared with wide rows. The higher soybean target density reduced weed biomass by 15%, increased weed-free yield by 7% and reduced yield losses by 4% compared with recommended densities. When implemented together as part of a comprehensive integrated weed management program, planting a bushy soybean cultivar in narrow rows at higher densities into a terminated fall rye cover crop reduced weed biomass by 58%, increased weed-free soybean yield by 16% and reduced yield losses due to weed interference by 8% compared with a slender cultivar in wide rows at recommended target densities and without a cover crop.

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Manitoba survey of herbicide-resistant weeds in 2022

Charles Geddes[1], Mattea Pittman[1], Kim Brown-Livingston[2], Julia Leeson[3]

[1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, [2]Manitoba Agriculture, [3]Agriculture and Agri-Food Canada, Saskatoon Research and Development Centre

Herbicide-resistant weeds are a growing concern for Manitoba farmers. The percentage of annual-cropped fields occupied by herbicide-resistant weeds in Manitoba increased from 32% in 2002 to 48% in 2008 and 68% in 2016. Continued monitoring of the occurrence, distribution and impact of herbicide-resistant weeds is essential to understand how best to mitigate and manage this increasing threat to cropping systems. A randomized-stratified survey of 157 fields under annual crop production in Manitoba was conducted in 2022; twenty years after the baseline survey conducted in 2002. Fields consisted of randomly selected quarter sections stratified based on the area under crop production in each ecodistrict and the seeded area of crops in 2022. The fields were visited shortly before harvest and seeds were collected from all mature weed species visible from walking an inverted 'W' transect pattern. The seed samples were dried at ambient room temperature, cleaned under isolation, and left for a 4-month period of after-ripening to alleviate dormancy. The samples were planted under controlled-environment and the plants were treated with tier 1 acetyl-CoA carboxylase- and acetolactate synthase-inhibiting herbicides. Plant survival was evaluated 21 days after treatment.

	Overall 622 samples representing 44 different weed species were collected from the 157 fields. The majority of fields were seeded to canola (53 fields), followed by wheat (52), soybean (19), oat (12), corn (8), barley (6), field pea (4), pinto bean (2), and sunflower (1). Final data analyses remain in-process due to the time-consuming nature of screening 622 samples with multiple different herbicides. This poster will highlight the initial results of the Manitoba survey of herbicide-resistant weeds in 2022 and how the occurrence and impact of herbicide-resistant weeds in Manitoba has changed in the past two decades.
29	**Ile2041Asn substitution confers ACCase inhibitor resistance in foxtail barley (*Hordeum jubatum*)** Charles Geddes[1], Gaganpreet Dhariwal[1], Laura Kennedy[1], Mattea Pittman[1] [1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre Foxtail barley (*Hordeum jubatum* L.) is a perennial grass weed that is native to western North America and found throughout Canada. As a facultative halophyte, foxtail barley is commonly present in saline areas of western Canada, where it grows best on wet, fertile and non-alkaline soils. Few herbicides registered for foxtail barley control can cause overreliance on these products and greater selection pressure for herbicide resistance. To-date, however, herbicide-resistant foxtail barley is not known to occur globally. In 2022, lack of control of foxtail barley was observed following quizalofop treatment in three creeping red fescue (*Festuca rubra* L.) fields in the Peace Lowland ecoregion of northern Alberta, Canada. Single-dose screening with quizalofop applied at 70 g ai ha^{-1} resulted in 79%, 90%, and 4% survival of the foxtail barley seedlings derived from mature seeds collected from each of the three fields. In whole-plant dose-response bioassays, foxtail barley from two of the three fields were resistant to quizalofop while the third was susceptible. For example, one accession exhibited 17.3- to 29.0-fold resistance, the second accession exhibited 14.7- to 24.8-fold resistance, and the third remained susceptible (R/S ≤ 1.7) to quizalofop based on biomass dry weight 21 days after treatment compared with two susceptible control accessions. All three populations were susceptible to clethodim (R/S ≤ 1.5) based on biomass dry weight. Therefore, foxtail barley from two of the three fields represent the first known cases of acetyl-CoA carboxylase (ACCase) inhibitor-resistant foxtail barley globally. Sequencing of the *ACCase* gene revealed that the two resistant accessions were heterozygous for a target site mutation resulting in an amino acid substitution at position Ile2041Asn, while the third susceptible accession did not exhibit this substitution. Therefore, the Ile2041Asn substitution confers target site resistance to quizalofop but not clethodim in foxtail barley.

30	**Predicting Prairie Weed Community Emergence During Drought: A 1930's Dust Bowl Case Study** Shaun Sharpe[1], Japjyot Sandhu[1] [1]Agriculture and Agri-Food Canada Sustainable weed control for Prairie field crop farmers may be challenging with a changing climate. The Prairie provinces of Manitoba, Saskatchewan, and Alberta have areas located in a productive semi-arid steppe known as Palliser's Triangle which historically experienced reoccurring dry conditions and historic droughts. Climate change is anticipated to induce more frequent and severe drought conditions. Weed communities being naturalized, typically invasive populations contain greater genetic diversity to withstand diminishing environments such that infestations may increase with drought. Understanding how weeds emerge in drought conditions helps anticipate potential changes in management intervention timings. A literature review was conducted to gather weed emergence models for Prairie species using thermal and hydro-thermal considerations. Historical temperature and precipitation data from Swift Current during the 1930's dust bowl was used for simulations. Differences in hydrothermal and thermal time were evaluated to assess the impact of limited moisture on subsequent weed emergence. The predicted 50% emergence date for wild oat shifted by 52 days, kochia by 24 days, and volunteer wheat by 118 days. The predicted false cleavers emergence using hydrothermal time did not reach 50%. The difference in 20% emergence was 240 days with emergence onset in early November. Unfortunately, no hydrothermal time models were available for wild buckwheat, green foxtail, and volunteer canola. Drought may promote weed emergence later in the growing season after typical timings for chemical interventions have passed. Achieving good canopy closure at this time would be likely challenging due to limited moisture for the crop. Their ability to survive and reproduce would escalate management issues including resistance risk in subsequent years. Model availability for Prairie biotypes for some species are limited and additional research into thermal and hydrothermal responses to additional weeds both spatially and temporally is required.
31	**Investigating the 2014-2017 Prairie Herbicide Resistance Samples for False cleavers (*Galium spurium*) Response to Quinclorac** Breanne Tidemann[1], Charles Geddes[2], Shaun Sharpe[3] [1]Agriculture and Agri-Food Canada Lacombe, [2]Agriculture and Agri-Food Canada Lethbridge, [3]Agriculture and Agri-Food Canada Saskatoon A quinclorac resistant biotype of false cleavers was confirmed in Alberta in the 1990s. As a recessive gene, and a selfing species, spread of the biotype was expected to be limited, however, follow-up monitoring of this biotype was not conducted. Since that time, use of quinclorac has increased in western Canadian cropping systems due, in part, to the 2018 approval of maximum residue limits for

	quinclorac in canola crops. This study evaluated false cleavers samples collected from the 2014-2017 Prairie Herbicide Resistance Survey for survival to a discriminating dose of quinclorac of 400 g ai ha^{-1}, based on preliminary studies. Each population was seeded with a goal of achieving 50 plants per replicate, with 4 replicates per population and 2 repeats of the screening per population, or at least 3 replicates of a population if seed was limited. Populations that did not germinate over multiple replicates were discarded without screening. Populations were evaluated for survival after 4 weeks based on injury, survival and regrowth. Out of the 97 populations planted, 31 were screened. Only Alberta samples remained viable for screening. Susceptible populations made up the majority of those screened (65%), however, 35% of populations (11/31) showed low levels of survival when screened with 4x the registered rate. Populations showing low levels of survival should be investigated through dose response studies to confirm whether survival is due to resistance. These populations were collected prior to the increase in selection pressure from quinclorac use in canola. Investigation into survival of false cleavers populations collected after the increase in selection pressure is warranted.
32	**Selection Against Being Naked? The Genome and Population Biology of *Galium spurium*** Sara Martin[1], Shaun Sharpe[1], Elizabeth Sears[1], Tracey James[1], Breanne Tidemann[1] [1]Agriculture and Agri-Food Canada *Galium spurium* is an aggressive weed that has risen in abundance to be among the top ten weeds for the Canadian Prairies. Here we assemble a chromosome scale draft of its' genome, laying the foundations for determining the genetic basis of auxinic herbicide resistance and for systematic research into its' polyphyletic genus. The genome assembly covers approximately 85% of *G. spurium*'s expected 360Mbp genome size with 94% of BUSCO genes complete and most single copy (89%). Approximately 37% genome is repetitive elements and 35,540 genes were annotated using RNA-Seq data. This included homologs for 46 genes involved or potentially involved in herbicide resistance. The genome shows synteny with other members of the Rubiaceae such as *Coffea canephora*. Double digested RADseq data for the 19 populations from the Canadian Prairies indicate that *G. spurium* has high levels of population structure (F_{ST} = 0.5) and inbreeding (F_{IS} = 0.7). Variation in flowering time and seed weight largely overlapped among populations grown in the greenhouse and a redundancy analysis investigating a genotype-phenotype association showed the majority of highly loading SNPs were associated with mericarp hook density. Several genes of interest including CUL1, AXR1, and TMK are located in areas of the genome with evidence of selection and could be targets for further investigation into the genetic basis of auxinic herbicide resistance.

33	**Identifying and Detecting Palmer amaranth (*Amaranthus palmeri* S. Watson) in Canada** Adele Julien[1], Karen Castro[1] [1]Canadian Food Inspection Agency *Amaranthus palmeri* (Palmer amaranth) is a fast-growing annual plant that has emerged as a significant threat to crop production in North America. This plant is native to the southwestern United States and Mexico and has spread beyond its native range into the northeastern United States and to other parts of the world. Its rapid range expansion could be attributed to various factors such as its prolific seed production and the contamination of various agricultural products and equipment. This species presents a serious concern to the agriculture sector due to its ability to develop resistance to multiple herbicide groups resulting in major yield loss. Palmer amaranth can be challenging to distinguish from other pigweed species, making early detection of this invasive weed difficult. In Canada, there have been detections of *A. palmeri* in Ontario and Manitoba, but there are currently no known established populations. *A. palmeri* is not currently a regulated pest in Canada; however, it is regulated as a noxious weed in the province of Manitoba. With the ongoing northeastward expansion of *A. palmeri*, Canada's arable farmlands are at increasing risk, and vigilance in identifying this plant becomes crucial to prevent its establishment and spread. The Canadian Plant Health Council's Weeds Surveillance Community of Practice (WSCP) has focused on developing tools and resources to coordinate and facilitate national surveillance of *Amaranthus* species in Canada, including *A. palmeri.* These include harmonized monitoring protocols for adoption by the provinces, a *A. palmeri* pest ID card, and a contact list of provincial and federal weed specialists that should be notified in case of suspected sightings of this species in Canada.
34	**Is electricity a viable option for late season weed control and crop desiccation in dry bean?** Robert Nurse[1], Mike Cowbrough[2], Meghan Moran[2], Jamie Larsen[1], Elaine Lepp[1] [1]AAFC, [2]OMAFRA Dry beans, even at reproductive maturity are still able to stimulate new growth of green material. This makes harvesting problematic and the presence of any green plant material increases the likelihood that there will be staining on the beans. With the loss of glyphosate as a desiccant option, growers require the identification of novel pre-harvest desiccation methods. Electricity has recently re-emerged as a potential weed management tool in Canadian agriculture and its high efficacy of weed control provides the potential to also use the technology as a pre-harvest crop desiccant. Preliminary research at Harrow, ON (2021 and 2022) and St.Thomas, ON (2021) in navy and white kidney bean, respectively, demonstrated that the application of electricity at 90% pod colour change was an effective chemical desiccant replacement when compared to the herbicide saflufenacil +

	Merge (102 g ai/ha + 1 L/ha). Both treatments provided greater than 80% desiccation of the crop and late season weed control; however, bean plants did tend to have a higher level of regrowth in the saflufencil treatments. Also, only weeds that were above the crop canopy were effectively controlled by the electricity. We hypothesized that reducing tractor speed would further increase the efficacy of electricity; however, desiccation efficacy was similar for tractors speeds of 3 km/hr or 5 km/hr. Harvested beans of both market classes had similar or higher 100 seed weights (630g) when exposed to electricity in comparison to seed produced by plants sprayed with saflufenacil (575g). Finally, beans were checked for cracking and/or staining and no differences were observed among treatments. Based on these observations desiccation in dry bean using electricity may be a viable option for Canadian bean growers in the absence of effective registered herbicide options.
35	**Control of volunteer corn in soybean with clethodim and adjuvants** Nader Soltani[1], Christy Shropshire[1], Peter Sikkema[1] [1]University of Guelph Ridgetown Campus In Ontario, volunteer glyphosate-resistant (GR) corn is one the most common annual grass escapes in GR soybean sprayed with glyphosate. Six field experiments were established in southwestern Ontario to determine volunteer GR corn control in soybean with glyphosate (900 g ae ha^{-1}) + clethodim (45 g ai ha^{-1}) plus three adjuvants. At 1, 2, and 4 WAA, there was no visible soybean injury from the herbicide treatments evaluated. At 1 WAA, glyphosate + clethodim controlled volunteer GR corn 23%; the addition of the adjuvants Amigo®, Journey HSOC®, and StrikeLock® at 0.5% v/v improved control to 45 to 49%; there was no statistical difference in volunteer corn control among the adjuvants evaluated. At 2 WAA, glyphosate + clethodim controlled volunteer GR corn 23%; the addition of the adjuvants Amigo®, Journey HSOC®, and StrikeLock® at 0.5% v/v improved the control to 73 to 79%; there was no statistical difference in volunteer corn control among the adjuvants evaluated. At 4 WAA, glyphosate + clethodim controlled volunteer GR corn 16%; the addition of the adjuvants Amigo®, Journey HSOC®, and StrikeLock® at 0.5% v/v improved the control to 91 to 95%; there was no statistical difference in volunteer corn control among the adjuvants evaluated. Volunteer corn interference reduced soybean yield by up to 23% in this trial (highest yielding treatment compared to the non-treated control). Reduced volunteer corn interference with clethodim increased soybean yield 13%. Reduced volunteer corn interference with clethodim plus an adjuvant increased soybean yield 27 to 31%. This study concludes that the addition of Amigo®, Journey HSOC®, or StrikeLock® to clethodim improves volunteer GR corn control resulting in a concomitant increase in soybean yield.

36	**Control of weeds with tolpyralate and atrazine plus grass herbicides in corn** Nader Soltani[1], Christy Shropshire[1], Peter Sikkema[1] [1]University of Guelph Ridgetown Campus Six field experiments were established in southwestern Ontario in 2021 and 2022 to evaluate whether the addition of a grass herbicide (acetochlor, dimethenamid-p, flufenacet, pendimethalin, pyroxasulfone, or *S*-metolachlor) to tolpyralate + atrazine improves late-season weed control in corn. Tolpyralate + atrazine caused 12% and 5% corn injury at 1 and 4 wk after herbicide application (WAA); corn injury was not increased with the addition of a grass herbicide. Weed interference reduced corn yield 60%. The addition of a grass herbicide to tolpyralate + atrazine did not enhance velvetleaf control. The addition of acetochlor or dimethenamid-p to tolpyralate + atrazine enhanced pigweed species control 4% 4 WAA; the addition of other grass herbicides tested did not increase pigweed species control. The addition of acetochlor enhanced common ragweed control 5% at 4 WAA, and the addition of acetochlor or dimethenamid-p enhanced common ragweed control 8% at 8 WAA; the addition of other grass herbicides did not improve common ragweed control. The addition of acetochlor to tolpyralate + atrazine enhanced common lambsquarters control up to 4%; there was no enhancement in common lambsquarters control with the addition of the other grass herbicides. Tolpyralate + atrazine controlled barnyardgrass 90% and 78% at 4 and 8 WAA, respectively; the addition of a grass herbicide enhanced barnyardgrass control 9% to 10% and 21% at 4 and 8 WAA, respectively. Tolpyralate + atrazine controlled green or giant foxtail 80% and 69% at 4 and 8 WAA, respectively; the addition of a grass herbicide enhanced foxtail species control 15% to 19% and 24% to 29% at 4 and 8 WAA, respectively. This research shows that adding a grass herbicide to tolpyralate + atrazine mixture can improve weed control efficacy, especially increased annual grass control in corn production.
37	**The Great Inventory of Quebec Weeds: Results from the Monteregie region (2021-2023)** Sandra Flores-Mejia[1], Gabriel Verret[1], Firmo Sousa[1], Félix-Antoine Roy[1], Audrey-Anne Champagne[1], David Miville[2], Amélie Picard[2], Annie Marcoux[2], Bérenger Bourgeois[3], Yosra Menchari[3] [1]CÉROM, [2]LEDP-MAPAQ, [3]Université Laval In Quebec, the first inventory of weeds dates back to the early 1980's by the Quebec Ministry of Agriculture, Fisheries and Food (MAPAQ) in collaboration with Agriculture and Agri-Food Canada (AAFC). Since then, much has changed in the provincial agricultural landscape, mainly because of the widespread adoption of cultures with hybrid technological traits such as Roundup-Ready, Liberty Link, etc. More recently, the development and arrival of herbicide-resistant weeds, as well as a growing concern for the environment, has motivated some producers to change their agricultural practices, including the weed-management practices.

	All these changes in the agricultural practices, along with a changing climate could have an important impact in the presence, distribution, frequency and abundance of weeds. Thus, a new inventory of Quebec weeds is in progress to: a) determine the distribution and abundance of weeds in the main crops by administrative region; b) establish a link between the different agronomic practices and the weed populations; c) study the evolution of weeds in the province over the last 40 years. The Montérégie region was chosen as the first to be surveyed, as it is one of the main agricultural regions of Quebec. The inventory was conducted between 2021 and 2023, during the summer. A total of 423 fields were surveyed, including all the field and horticultural crops produced in this region. A total of 378 different weed species were listed in 42 different crops. The three most frequently encountered species (in the field and/or in the border of the field) were: dandelion (*Taraxacum officinale*, 96.4 % of fields), tufted vetch (*Vicia cracca*, 93.6%) and common lamb's-quarters (*Chenopodium album*, 89.6 %). The top three field- and horticultural-crops with the greater weed biodiversity were: field corn (160 weed species), soybean (157), meadows and pastures (150), mixed legumes (106), grape-vines (98) and blueberries (70).
38	**Revisiting the origins of glyphosate resistant giant ragweed (*Ambrosia trifida* L.) in Canada** <u>Eric Page</u>[1], Sara Martin[1], Sydney Meloche[1], Alyssa Thibodeau[1], Robert Nurse[1], Peter Sikkema[2], Mike Cowbrough[3], Francois Tardif[4], Martin Laforest[1] [1]Agriculture and Agri-Food Canada, [2]University of Guelph - Ridgetown, [3]Ontario Ministry of Agriculture, Food and Rural Affairs, [4]University of Guelph Glyphosate resistant giant ragweed (*Ambrosia trifida* L.) was first identified in Canada in 2008. Although early studies attributed resistance in this species to non-target site mechanisms, the presence of a proline to serine mutation at position 106 of EPSPS2 in common and giant ragweed has recently been reported. The objective of this research was to: i) determine if a P106S mutation is present in historical samples of giant ragweed collected from the site of the first report of glyphosate resistance, and ii) determine the frequency and distribution of P106S resistant and susceptible biotypes collected as a part of historical surveys throughout southwestern Ontario.
39	**Discovery, molecular mechanism, and management of glyphosate-resistant downy brome (*Bromus tectorum*)** <u>Charles Geddes</u>[1], Gaganpreet Dhariwal[1], Laura Kennedy[1], Mattea Pittman[1] [1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre Downy brome (*Bromus tectorum* L.) is a facultative winter-annual grass weed that is highly invasive in natural and ruderal areas, pastureland, and cropping systems of western North America. In 2021, lack of downy brome control was observed following four glyphosate treatments in a glyphosate-resistant canola (*Brassica napus* L.) field in southern Alberta, Canada. Mature downy brome seed collected

	from this population and two susceptible populations were planted under controlled-environment and the seedlings were subjected to whole-plant single-dose screening, dose-response bioassays, EPSPS gene sequencing and analysis of copy number variation, shikimate acid quantification, and bioassays assessing response to residual soil-applied preemergence herbicides and alternative foliar-applied postemergence herbicides. All seedlings from the downy brome population survived glyphosate applied at 900 g ae ha^{-1}, while the susceptible control plants did not. In dose-response bioassays, the putative glyphosate-resistant population exhibited up to 12-fold resistance to glyphosate 3 weeks after treatment (WAT) compared with two susceptible controls. No target site mutations were observed to cause viable amino acid substitutions. However, plants from the glyphosate-resistant population had 29-fold greater *EPSPS* gene copy number and substantially less shikimic acid present during the first eight days after glyphosate treatment compared with a susceptible control. Soil-applied mixtures of a protoporphyrinogen oxidase-inhibiting herbicide with the very long chain fatty acid elongase inhibitor pyroxasulfone at a rate ≥89 g ai ha^{-1} effectively controlled (≥80%) the glyphosate-resistant and susceptible downy brome 8 WAT. Foliar-applied quizalofop alone or in combination with imazamox, imazamox/imazethapyr, or imazamox + bentazon, and glufosinate mixed with either clethodim or tiafenacil effectively controlled (≥80%) both the glyphosate-resistant and susceptible downy brome 3 WAT. Therefore, glyphosate resistance in downy brome is conferred by *EPSPS* gene amplification. Integrating non-chemical tactics into weed control programs is warranted to maintain the efficacy of alternative herbicides for control of glyphosate-resistant and susceptible downy brome.
40	**Talinor: new cereal broadleaf weed control option** Robert Klewchuk[1] [1]Syngenta Canada Inc. Talinor™ is a new post-emergence cereal herbicide developed by Syngenta Canada Inc. Talinor is a liquid premixed formulation. This formulation combines both a Group 27 and Group 6 herbicide effectively delivering multiple modes of action. Bicylopyrone is a powerful, novel active ingredient in Western Canadian cereal crops. In combination with bromoxynil, Talinor assists growers by delivering excellent control of difficult broadleaf weeds, including those troublesome broadleaf weeds that have become resistant to ALS-Inhibitor, synthetic auxin, and glyphosate herbicides (Group 2, 4, & 9). Bicyclopyrone moves in both the xylem and phloem offering active ingredient throughout the plant for quick weed uptake and mortality. UK Syngenta scientists, in their studies, have deemed bicyclopyrone's chemical class (triketones) to be potent inhibitors of the HPPD enzyme in plants. This potency can have a longer lasting impact on the weed with control to follow. As weed resistance continues to expand, growers are faced with less effective tools. Talinor is an effective chemical management tool to be considered. Talinor research authorization trials across Western Canada in 2023, allowed growers to experience quick and effective broadleaf weed control on their farms.

41	**Weed Management in Pea and Camelina Intercrops** Shaun Sharpe[1], Christina Eynck[1], Leonard Chester[1], Kyle Rosvold[1], Lana Shaw[2], Michelle Hubbard[1] [1]Agriculture and Agri-Food Canada, [2]Southeast Research Farm Building resilient agroecosystems is critical for long-term farming sustainability. Intercropping builds a crop community with varying environmental tolerance and plasticity. Camelina has good tolerance for problematic canola pathogens and insects, and good competitiveness with weeds. Camelina's upright plant habit compliments the tall vine habit of field peas, a common Prairie pulse crop. The study objective was to evaluate integrating chemical and cultural techniques for weed management in pea and camelina intercrops. The experiment was conducted at the Saskatoon Research and Development farm in 2022. The experimental design was a three-factor factorial arranged as a randomized complete block. The first factor was ethalfluralin (yes/no), the second factor was cropping system (peas, camelina, or intercrop), and the third factor was planting date (standard/late). Peas and camelina were seeded to achieve 80 plants/m^2 and 550 plants/m^2, respectively. Camelina and pea stand densities were not affected by ethalfluralin application, planting date, or intercropping. Intercropping peas with camelina increased July canopy light interception by 20%. Weed densities were low throughout the trial (1 to 4 no./m^2). Ethalfluralin reduced weed densities by 50% and weed biomass by 95%. Intercropping reduced weed density from 3 to 2 plants/m^2. Camelina yield was affected by a planting date and cropping system, where delaying planting reduced yield from 129.8 to 95.8 g/m^2 while intercropping reduced yield from 122.4 to 103.2 g/m^2. Pea yield was affected by an interaction between planting date and intercropping, where highest yields were for peas monoculture at the first planting date (124.0 g/m^2), a reduction by pea monoculture at the second planting date (81.6 g/m^2), and reduced further by intercropping across both planting dates (29.7 to 31.8 g/m^2). Camelina was the dominant component of the intercrop during this experimental run and this run was characterized by a very dry growing season.
42	**What's New at the Winfield United Innovation Center** Gregory Dahl[1], Eric Spandl[1], Joshua Skelton[1], Steven Fredericks[1], Elizabeth Alonzi[1], Elizabeth Buescher[1], Cody Hoerning[1], Kassi Kosnicki[1], Annie Makepeace[1] [1]Winfield United The Winfield United Innovation Center in River Falls, Wisconsin opened in September 2017. It was designed and constructed to address research, size, capabilities, and support the business needs of Winfield United. We regularly conducted tours and meetings for people interested in herbicides, adjuvants, application methods, fertilizers, crops, and other topics. Many features and capabilities were incorporated into the Winfield United Innovation Center. Chemistry lab areas, equipment and chemists were increased to analyze, develop, optimize, and scale up manufacturing of products. Greenhouses and growth chambers were added to conduct year-round research and studies that are difficult to conduct in the field. Time-lapse imaging and use of new techniques were used to

	demonstrate spray deposition and coverage of spray mixtures. Wind tunnel spray analysis systems were created or reengineered to improve capabilities, visual and laser-based systems were involved in analyses, and imaging of spray droplets formation, characteristics, movement, and fate. A high throughput phenotyping system was installed that monitors and measures plant phenotypes over time in the presence of various products. Research and imaging that were recently conducted at the Winfield United Innovation Center included spray drift and deposition comparisons of tank mixtures such as dicamba and glyphosate, 2,4-D, and glyphosate and/or glufosinate, in a large, closed, wind-tunnel system using susceptible soybean plants and spray collectors. Other studies used plant phenotyping methods to evaluate control of broadleaf and grass plants treated with certain herbicides alone or plus adjuvants. High speed imaging equipment was used to observe droplet formation with Pulse Width Modulation (PWM), elevated wind speed, simulated aerial application conditions, and other demonstrations.
43	**Gene expression in wheat as a function of intraspecific interference** Kidist Kibret[1], Rob Gulden[1] [1]University of Manitoba As part of a large-scale study done in Manitoba, Canada, the effects of row spacing and seeding density were investigated in two wheat varieties. This experiment showed that the wheat cultivars responded positively to narrower row spacings. In these field studies, plant tissue was sampled at regular intervals from key organs. The transcriptome was determined using an RNAseq approach to identify key genes and/or gene expression ratios in these cultivars that are associated with changes in morphology and plant performance in response to intra-specific interference at different spatial arrangements. Factorial RNAseq analysis showed that although the largest number of differentially expressed genes were found to be solely due to varietal differences, indicating that the data are high quality and in line with the general trend that genetically diverse genotypes have a large difference in gene expression patterns. The variety-spacing interaction resulted in the next largest significantly differentially expressed genes. In addition, hundreds of genes up and downregulated at narrow spacing and high-density treatment significantly greater than the control (no neighbours) in all environments, tissues and timepoints tested. Conducting density by variety studies to optimize a variety's yield response by site is time consuming and laborious. This also hinders the opportunity to conduct QTL studies and Genome wide association studies to generate markers to incorporate to wheat breeding programs. RNAseq technology is beneficial to pinpoint the molecular mechanisms of this adaptation without large scale expensive field studies.

44	**Discovering a new path of least resistance with Duplosan and Oxbow herbicide** Tyler Gullen[1] [1]Nufarm Agriculture Inc Multiple herbicide-resistant kochia (*Bassia scoparia*) has become a widespread economic and agronomic concern to farmers across Western Canada. The synthetic auxin herbicides (WSSA group 4) that have traditionally been used to control kochia in the region such as dicamba, 2,4-D, and fluroxypyr are now ineffective in many geographies. Research in recent years has shown that Duplosan, a 'rediscovered' group 4 molecule remains effective on populations showing resistance to other such group 4 active ingredients. This has led to the registration of Oxbow herbicide in 2023, a novel combination of Duplosan and Bromoxynil. Oxbow herbicide is effective on kochia as well as many other problematic weeds in Canada and provides a new resistance management tool for farmers.
45	**The wild oat (*Avena fatua*) in the Bas-Saint-Laurent region: results of the 2022 scouting season and the foundation of community management in the region** Sandra Flores-Mejia[1], Firmo Sousa[1], Gabriel Verret[1], Ayitre Akpakouma[2], Jalinets Navarro[2], Marc Tétrault[3], Yann Gosselin[3], Éric Pagé[3], Michel Dupuis[4], Samuel Comtois[5], Mario Handfield[6], Salah Zoghlami[7] [1]CÉROM, [2]MAPAQ-BSL, [3]FUPA-BSL, [4]CSC, [5]Groupe PleineTerre, [6]UQAR, [7]PGQ The project aims to carry out the first inventory of wild oat (*A. fatua,* AVEFA) presence in the Bas-Saint-Laurent, BSL (Lower Saint-Lawrence) region of Quebec, and to use collaborative methods to develop and promote adoption of Integrated Weed Management Practices (IWMP) to control AVEFA. During 2022 season, 43 farms and 96 fields were scouted from all eight RCMs (regional county municipality) of the region. AVEFA was present in 74.4 % of the farms and 54.2 % of the surveyed fields. Certain distribution patterns were observed in fields with AVEFA (52), as this species could be found only inside the field (28.8 %), only in the border of the field (9.6 %) or both field and border (61.5%). The majority of the AVEFA plants were found in patches (61.5 %), randomly distributed in the field (19.2 %), as isolated plants (7.7 %) or in bands (1.9 %). The progression of AVEFA infestation within farms was extreme, either it was absent or it was present in all the scouted fields. Only three farms seemed to be in the beginning of infestation, with AVEFA in only some of the fields. Canola had the highest average infestation rate (33.5 AVEFA plants/m^2), followed by a mixture of wheat and oats (23.2), with other crops having significantly lower infestation rates. AVEFA seeds were collected from a total of 28 fields from 18 different farms to evaluate herbicide resistance to group 1 herbicides. These results will be available in the fall of 2023. Two workshops were carried out during the winter of 2022 with a total of 30 participants, including growers and agronomists. Three main needs from the growers were identified: information, training and support from their agronomist.

46	**Efficacy and crop safety of a preformulated mixture of halauxifen-methyl, florasulam and 2,4-D ester in cereal crops in Western Canada.** Kevin Falk[1], Travis Goron[1], Kris Guenette[1], Cody Chytyk[1], Rory Degenhardt[1] [1]Corteva Agriscience Awaiting legal approval.
47	**Effect of mowing height on flazasulfuron plus glufosinate efficacy on hair fescue in wild blueberry** Scott White[1] [1]Dalhousie University Faculty of Agriculture Hair fescue is a competitive, tuft-forming perennial grass that rapidly colonizes wild blueberry fields and reduces yield. Established tufts are suppressed with some POST herbicides but fall pronamide applications are generally required to reduce living tuft density. Recent research, however, determined that fall bearing year or spring non-bearing year flazasulfuron + glufosinate applications reduced living tuft density and may provide an alternative to pronamide for hair fescue management. Fall bearing year flazasulfuron + glufosinate applications are currently made after mowing, but growers are interested in applications before mowing to improve flexibility in application and mowing timing. Based on current mowing practices in wild blueberry, the objective of this experiment was to determine the effect of mowing height on flazasulfuron + glufosinate efficacy on hair fescue. The experiment was a 3 X 3 factorial arrangement of mowing height (none, high [10 cm], low [<5cm]) and herbicide treatment (none, flazasulfuron, flazasulfuron + glufosinate) arranged in a randomized complete block design with 5 blocks and 2m X 4m plot size. There was a significant effect of mowing height ($P \leq 0.0253$) and herbicide ($P \leq 0.0001$), but no mowing by herbicide interaction effect ($P \geq 0.3767$) on hair fescue flower tuft density and total tuft density. Reductions in non-bearing year flower tuft density were similar for flazasulfuron and flazasulfuron + glufosinate across mowing treatments. Flazasulfuron + glufosinate, however, gave the greatest reductions in bearing year flower tuft density. Flazasulfuron + glufosinate also gave greater reductions in non-bearing and bearing year total tuft density than flazasulfuron alone across mowing treatments. Herbicide treatments reduced wild blueberry stem height by about 15%. Wild blueberry flower buds per stem and yield, however, were markedly increased in the flazasulfuron + glufosinate treatments. Results suggest that wild blueberry growers are not restricted by mowing timing when using fall bearing year flazasulfuron + glufosinate applications for hair fescue management.

48	**Field horsetail (*Equisetum arvense*) management with an herbicide layering strategy in established cranberry field** Nathan Young[1], Miranda Elsby[2], Ryan Critchley[3], Jichul Bae[3] [1]Simon Fraser University, [2]Ocean Spray Canada, [3]Agriculture and Agri-Food Canada Field horsetail (HT; *Equisetum arvense*) is the most problematic creeping perennial weed (CPW) in cranberry production in British Columbia (BC). Due to their extensive underground root and shoot system, CPW are seldom controlled by a single herbicide application. This study aims to develop an effective herbicide layering strategy composed of broadcast applications of pre-emergent (PRE), post-emergent (POST) and/or post harvest (POST-H) herbicides to manage HT in established cranberry beds. The experiment was conducted at an established (~5 years old) cranberry farm in Pitt Meadows, BC, that was highly infested with HT. The herbicide treatments were timed with the phenological stages of the cranberry plant: 1) PRE of sulfentrazone (140.16 g ai ha^{-1}) at pre-bud break; 2) POST#1 of Clopyralid (102 g ai ha^{-1}) or mesotrione (100.8 g ai ha^{-1}) at bud break; 3) POST#2 of mesotrione (100.8 g ai ha^{-1}) in tank mix with sethoxydim (495 g ai ha^{-1}) at hook stage; and POST-H of dichlobenil (4400 g ai ha^{-1}) at dormant stage after harvest. Weed coverage assessments were conducted biweekly until harvest starting after the POST#2 application. Weed coverage was visually scored on a 0% (no coverage) to 100% (complete coverage) scale. This study demonstrated that excellent HT control (>95% control) was maintained until harvest (late September) when the POST-H treatment of dichlobenil was included, suggesting that the PRE herbicide application may not be necessary for HT control when a POST-H herbicide application of dichlobenil is included in the treatment. For example, the POST-H followed by POST treatments were as effective as the full layering treatments on HT control. Furthermore, the study demonstrates that POST-H herbicide of dichlobenil should be included for season-long HT management. Future studies should examine whether the POST-H application of dichlobenil can reduce the need for POST herbicides while providing excellent (>95%) season-long HT control.
49	**Plant Protection Update** Wendy Asbil[1] [1]Canadian Food Inspection Agency The Canadian Food Inspection Agency (CFIA) recognizes the risks associated with invasive plants to the Canadian environment and economy. The Invasive Plants Program aims to reduce the risk of introduction and spread of invasive plants via intentional and unintentional pathways. This presentation will provide an update on the CFIA's Invasive Plants Program; including examples of several domestic incursions, import challenges, and ongoing enhancements to our program.

50	**Manitoba Update** Kim Brown-Livingston
51	**PMRA Workshop: Benefits of a good Part 10 (Value) Package, and How to Create One** Scott Couture[1] [1]Health Canada Join PMRA evaluators for an interactive overview of the components and types of information that can be used to support the value assessment for registration of a new herbicide, or for the addition of new uses for a registered herbicide. Useful tips and tricks will be provided, as well as advice on how to avoid common pitfalls. Participants will gain in in-depth understanding of how to address value requirements and benefit from the opportunity to interact with evaluators who review the submissions.
52	**Rinskor™ active (Florpyrauxifen-benzyl) plus fluroxypyr for the management of kochia and other hard to control broadleaf weeds in rangeland, pastures and industrial areas** Laura Smith[1], Kevin Falk[1], Cody Chytyk[1], Kris Guenette[1], Rory Degenhardt[1] [1]Corteva Agriscience Awaiting legal approval.
53	**Protoporphyrinogen oxidase inhibitor (Group 14)-resistant kochia (*Bassia scoparia*)** Charles Geddes[1], Austin Jaster[1], Mattea Pittman[1] [1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre Kochia [*Bassia scoparia* (L.) A.J. Scott] is a halophytic summer-annual tumbleweed that can cause substantial yield losses in several major crops grown in western North America. Its abundance has grown in western Canada in recent decades due, in part, to rapid evolution and spread of herbicide resistance. Kochia populations are known to exhibit resistance to acetolactate synthase inhibitors [Herbicide Resistance Action Committee (HRAC) Group 2], auxin mimics (HRAC Group 4), photosystem II inhibitors (HRAC Group 5), and the 5-enolpyruvylshikimate-3-phosphate synthase inhibitor glyphosate (HRAC Group 9). Here we report the fifth herbicide mode of action to which kochia can exhibit resistance, the protoporphyrinogen oxidase (PPO) inhibitors (HRAC Group 14). In 2021, poor control of a kochia population was observed following treatment with pre-plant glyphosate + sulfentrazone + carfentrazone followed by post-plant pre-emergence glyphosate + carfentrazone + bromoxynil in a tame mustard field in west-central Saskatchewan. Since the field had been treated

	with sulfentrazone each of the two years prior, there was reason to suspect that the kochia was PPO inhibitor-resistant. Mature kochia seeds collected from the field were planted under controlled-environment, and the seedlings were treated with saflufenacil at 50 g ai ha^{-1}. Surviving kochia plants were grown in the greenhouse under isolation for one generation, in addition to two susceptible control accessions, to control for differences in maternal environment. The second generation accessions were subjected to separate whole-plant dose-response bioassays with a range of PPO inhibiting-herbicides including foliar-applied saflufenacil, tiafenacil, carfentrazone, pyraflufen-ethyl, and acifluorfen, and soil-applied sulfentrazone and flumioxazin. The accession from west-central Saskatchewan exhibited resistance to all of these PPO-inhibiting herbicides compared with two susceptible controls, with the exception of foliar-applied acifluorfen; the only active ingredient tested from the diphenyl ether family. Therefore, PPO inhibitor-resistant kochia exhibits broad cross-resistance to PPO-inhibiting herbicides with the likely exception of the diphenyl ethers.

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