Plenary Sessions

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CWSS-SCM Annual Meeting
Morning Sessions

How Did We Get Here? A Historical Journey of Herbicide Use and the Rise of Resistance.



Eric Johnson, Retired, University of Saskatchewan, Agriculture and Agri-Food Canada

Eric Johnson is a retired weed scientist and agronomist whose career spanned more than four decades in agricultural research, extension, and producer collaboration. Beginning in 1982 with Saskatchewan Agriculture, he supported the adoption of zero-tillage and pulse crops before joining Agriculture and Agri-Food Canada's Research Farm at Scott, where he conducted research in weed management, agronomy, and new crop development. As Site Manager of the Pesticide Minor Use program, he contributed to 130 minor-use registrations across various crops and pests. He later joined the University of Saskatchewan's Department of Plant Science, working in weed science and agronomic crop imaging. Over his career, he co-authored 140 publications and mentored numerous young agronomists and researchers, earning recognition for connecting scientific research with practical solutions for producers. His achievements include the Saskatchewan Institute of Agrologists Distinguished Agrologist Award, the Canadian Weed Science Society's Excellence in Weed Science and Fellow awards, and the Saskatchewan Pulse Growers Pulse Promoter Award.

Abstract: The introduction of herbicides over the past 80 years has fundamentally changed agriculture worldwide, transforming weed management and crop production. On the Canadian Prairies, herbicides facilitated new cropping systems, shifting crop production from a traditional wheat–fallow rotation to diversified cropping systems that included oilseeds and pulses. The "Modern Era of Selective Herbicides" began in the 1940s with the introduction of 2,4-D. Rapidly and widely adopted, 2,4-D and related phenoxy herbicides remain useful tools for broadleaf weed resistance management. The 1960s saw the introduction of graminicides capable of selectively controlling wild oat in field crops, although early products often provided inconsistent control and undesirable crop injury. This changed in the 1980s with the introduction of highly selective and efficacious ACCase inhibitors. They were widely used, but their high efficacy was a double-edged sword: excellent weed control, but also high resistance selection pressure. ALS inhibitors, widely popular following their introduction in the 1980s, were also highly efficacious and suffered the same fate of high selection pressure. Glyphosate was introduced in 1974; however, its early use was largely limited to patch treatment of perennial weeds because of high application rates and cost. This changed with the adoption of zero-tillage, as lower rates effectively controlled annual weeds prior to seeding and its cost declined substantially. With the introduction of glyphosate-resistant crops, glyphosate use skyrocketed. Initially, the risk of evolved glyphosate resistance was considered low; however, widespread use and intense selection pressure resulted in the evolution of unique resistance mechanisms. The first herbicide-resistant weeds were reported in 1988 in western Canada. Since then, approximately two unique herbicide-resistant combinations, defined by weed species and herbicide site of action, have been identified annually in

Canada. Multiple resistance has been documented in several important weed species, including wild oat, kochia, cleavers and green foxtail. This presentation traces the historical development of herbicide use and resistance, with an emphasis on western Canada. It will examine how changes in herbicide technology, cropping systems, agronomic practices, climate and agricultural policies have influenced weed management and the evolution of resistance. Understanding this history provides important context for where we are today and the challenges ahead in managing multiple herbicide resistance.

New Tools, New Selection Pressures? Current Performance and Future Challenges in Specialty Crop Weed Management



Lynn Sosnoskie, Associate Professor and weed scientist at Cornell University

Dr. Lynn Sosnoskie is an Associate Professor and weed scientist at Cornell University whose research and extension program focuses on herbicide resistance, integrated weed management, and emerging weed-control technologies in specialty crops. Her work has included characterizing herbicide-resistant weed populations and developing strategies to reduce their spread and impact. She also evaluates electric and laser weeding, autonomous equipment, and precision spraying, with an interest in how these technologies can strengthen weed management programs while potentially creating new selective pressures on weed communities. Before joining Cornell, she worked at the University of Georgia, the University of California, Davis, UC Agriculture and Natural Resources, and Washington State University.

Abstract: Weed management in specialty crops is constrained by limited herbicide options, crop sensitivity, and costly hand labor, with herbicide resistance further narrowing growers' choices. This plenary talk will examine the performance of electric weeding, precision spraying, and laser weeding in high-value vegetable systems and consider their long-term consequences for weed management. These technologies provide alternative ways to control herbicide-resistant weeds and other escapes from chemical programs. By limiting crop exposure, precision spraying may also create opportunities to evaluate effective herbicides for future registration in crops where safety concerns currently restrict their use. Additional benefits may include improved crop safety, lower potential for herbicide residues, reduced off-target herbicide movement, and less worker exposure to herbicides and the dust, sun, and physical demands of manual weeding. Practical value depends on weed control efficacy, field capacity, cost, and how these tools complement existing practices. However, reduced herbicide use does not necessarily reduce selection pressure for resistance, and repeated reliance on vision-guided systems may favor weeds that escape detection. Drawing on specialty crop research, this talk will discuss how to integrate these tools into diversified programs that control escapes, prevent weed seed return, and remain effective as weed populations change.

Future Prospects in Herbicide Development



Franck Dayan, Professor, Department of Agricultural Biology, Colorado State University

Dr. Franck Dayan has been a Professor in the Department of Agricultural Biology at Colorado State University in Fort Collins, Colorado, since 2016. Prior to joining CSU, Dr. Dayan spent nearly two decades as a Research Plant Physiologist with the USDA Agricultural Research Service in Oxford, Mississippi, following a postdoctoral appointment at the Southern Weed Science Research Laboratory in Stoneville, Mississippi. As of January 2026, Dr. Dayan has authored 223 peer-reviewed research articles and 65 reviews and book chapters, and holds 46 issued patents, including 38 developed at Colorado State University. Their research has received more than 23,600 citations, with over 1,000 citations annually in the past five years, reflecting the significant impact of their co
Dr. Dayan is a Fellow of the Weed Science Society of America and has received WSSA's Outstanding Research Award. He has given keynote addresses around the world, including at the 2025 International Weed Science Congress and the European Weed Research Society.

Abstract: Over the past four decades, herbicide discovery has reached an impasse, with very few synthetic herbicides possessing new molecular targets or novel chemistries advancing to commercialization. Similarly, the development of bioherbicides, whether microbial or natural-product based, has achieved only limited commercial success. This growing need for innovative weed management solutions has stimulated the emergence of numerous start-up companies that are pursuing unconventional discovery platforms and technologies.
Most scientific innovation occurs incrementally, gradually expanding the boundaries of existing knowledge. Occasionally, however, transformative discoveries open entirely new fields of inquiry by revealing opportunities that were previously unrecognized that can be described as "unknown unknowns." In agriculture, the Green Revolution was not the result of a single breakthrough but rather the culmination of decades of advances in engineering, plant breeding, fertilizers, and crop protection chemistry, punctuated by several transformative innovations.
Looking ahead, artificial intelligence (AI) is poised to accelerate agricultural discovery by integrating vast and diverse datasets spanning mechanization, genetics, chemistry, and environmental sciences. AI-assisted research may identify more effective strategies for deploying autonomous machinery, robotics, drones, and hyperspectral imaging, enabling highly precise pest management while reducing labor requirements and environmental impacts. At the same time, AI-driven technologies are expected to accelerate the development of climate-resilient and pest-resistant crops through advanced gene editing and predictive breeding. Emerging non-chemical weed management approaches, such as RNA interference, peptide-based herbicides, PROTAC, also have the potential to provide highly targeted and sustainable crop protection. Together, these complementary technologies may redefine weed management by reducing reliance on conventional synthetic herbicides while improving agricultural productivity and environmental stewardship.