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EU-CANADA AGRICULTURE DIALOGUE WORKSHOP: **Sustainable Crop Protection** APRIL 25, 2023

OUTCOMES REPORT

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EXECUTIVE SUMMARY

This outcomes report is a summary of the final workshop in a series of five joint workshops between the European Union (EU) and Canada "to promote sustainability, environmental stewardship and climate action in agriculture, within the framework of the Agriculture Dialogue" under the Canada-EU Comprehensive Economic and Trade Agreement (CETA).[1] In total, 95 agricultural industry stakeholders from the EU and Canada participated in the Sustainable Crop Protection Workshop. Participants explored how farmers can get the most out of an Integrated Pest Management (IPM) plan and mitigate the risks of sustainable pesticide use while balancing the costs in a changing climate.

A final wrap-up conference will summarize the reports from the five workshops (i.e., soil health, greenhouse gas reduction in livestock production, organic production, sustainable use of fertilisers, and sustainable crop production).

Stakeholders highlighted the following information about the current state of the sector:

This report does not provide a comprehensive overview or in-depth analysis of Integrated Pest Management nor pesticide use. This report simply synthesizes what was heard at the Sustainable Crop Protection workshop. As a result of the focus in some discussions, certain subsections of the report provide more detail on the experiences in the European Union, while other subsections delve further into the Canadian context.

Sustainable crop protection: How do farmers get the most out of an Integrated Pest Management (IPM) plan?

- Numerous objectives and actions exist across the EU and Canada to encourage the use and uptake of IPM.
- Many farmers focus on pest prevention and monitoring to reduce the need for controls, biological or otherwise.
- Sharing research and results (both positive and negative, or non-results) is critical to ensure farmers continue to employ the most effective IPM practices. Demonstration of beneficial management practices (BMPs) can also help farmers adopt IPM practices.
- IPM plans need to account for climate change and the resulting uncertainty in pest and disease pressures.
- Long-term research is needed to understand how to improve IPM practices to be effective in the face of a changing climate.

Sustainable pesticide use: Mitigating the risks while balancing the costs in a changing climate

- Workshop participants highlighted the range of positive impacts and the risks associated with pesticide use. Levels of risk must be assessed when making decisions regarding the regulation and application of pesticides.
- Across Canada and the EU, BMPs are employed to support sustainable pesticide use.

1 Canada-European Union. (June 2021.) European Union-Canada Summit – Joint Statement, p. 3-4. Retrieved from https://pm.gc.ca/en/news/backgrounders/2021/06/15/canada-european-union-summit-joint-statement.

- The decision to use pesticides can be complicated for farmers depending on crop and regional considerations. The topic of sustainability must be approached from a holistic perspective.
- Research priorities should focus on crop protection strategies for pests for which limited or no control or treatment methods exist. Plant breeding to develop new, resistant varieties and hybrids is also crucial.

Overarching considerations across the breakout rooms

Several themes emerged that were consistent across both breakout topics. These themes are listed below.

- As growing conditions and pest pressures vary from year to year and region to region, a one-size-fits-all solution to sustainable crop protection does not exist and should not be attempted to be applied.
- Technology will play a critical role in the continued use of IPM. Technology can be leveraged to reduce the use of pesticides and/or increase the efficiency of crop protection products.
- Farmers need access to a range of IPM tools, including pesticides, to ensure a sustainable agricultural industry.
- Research is needed to examine how IPM strategies interact with one another.
- Multi-directional knowledge translation and transfer is necessary to encourage effective collaboration between farmers, researchers, industry advisors, and the public.
- Forecasting and monitoring tools should be a priority area for research and development to help farmers improve IPM plans.
- Researchers must take a systems approach to their work to study the entire production system and focus on integrated crop management to equip farmers in coping with future challenges.

As the EU and Canada continue their work on sustainable crop protection, they can consider the following 16 recommendations.

Recommendations for the scientific community

1. Prioritize a systems approach to research and development.
2. Prioritize research on pests with limited or no control or treatment methods.
3. Continue to support the development of specialized knowledge in sustainable crop protection, including:
    a. The development of accurate thresholds for pesticide application, and
    b. Plant breeding and genetics to enhance resilience to pests and develop resistant hybrids and varieties.

4. Publish negative or non-results and disseminate these findings to build industry knowledge of unsuccessful techniques to reduce crop protection inputs.

5. Develop long-term research projects to help improve IPM practices to understand how changing weather patterns affect pest lifecycles and what new pests may emerge in a changing climate over time.

Recommendations for policymakers and public authorities

6. Prioritize programs or initiatives that support the long-term development of knowledge and technology related to sustainable crop protection and IPM in a changing climate.

7. Provide opportunities for financial recognition or incentives for 'early adopters' of IPM practices and techniques to share information with the value-chain and scientific community.

8. Support programs, initiatives and research that have long-term time horizons.

9. Review the evaluation and approvals process, as well as the associated fees, related to crop protection product registration. Explore opportunities to determine if new products, in particular for biocontrol, can be brought to market in a shorter timeframe while still ensuring the safety and efficacy of the product.

10. Continue to support initiatives that build understanding of how agriculture impacts the environment and vice versa.

Recommendations for the value chain

11. Provide incentives or financial recognition for farmers trialling and adopting IPM practices and BMPs that reduce the use of certain crop protection products.

12. Exchange knowledge and best practices for sustainable crop protection with farmers regarding opportunities to try new IPM approaches.

Recommendations for all crop protection stakeholders

13. Facilitate knowledge transfer between farms with different characteristics and production systems to enhance information sharing in the sector (e.g., between organic and conventional production systems).

14. Collaborate to improve data collection related to IPM and sustainable crop protection.

15. Find opportunities to develop and disseminate consumer-friendly communication materials. Share knowledge about the importance of pest control, the challenges farmers face on this front, and the use of IPM.

16. Enhance communications between farmers, policymakers, and public authorities to identify shared goals and the best way forward to meet these goals.

CONTENTS

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INTRODUCTION

1. INTRODUCTION

1.1. EVENT AND REPORT CONTEXT

In June 2021, at the Canadian-European Union (EU) Leaders' Summit, the leaders committed to "launch a series of joint events to promote sustainability, environmental stewardship and climate action in agriculture, within the framework of the Agriculture Dialogue" under the Canada-EU Comprehensive Economic and Trade Agreement (CETA).[2]

A series of five events between 2021 and 2023 are exploring the policy context and showcasing beneficial practices, as well as the research and innovation taking place in Canada and the EU. This workshop, on Sustainable Crop Protection, was the final workshop in the series. The workshop was held online on April 25, 2023. A total of 95 individuals in the EU and Canada participated in the workshop. Attendees included researchers, academics, farmers, industry stakeholders, government officials, and not-for-profit representatives. The objectives of the Sustainable Crop Protection workshop were as follows:

- Enhance collaboration on sustainable crop protection between EU and Canadian stakeholders representing government, civil society, industry, and academia; and
- Foster shared learning with a particular emphasis on sustainable farming practices and IPM approaches.

To accomplish these objectives, the workshop included both plenary and breakout sessions. During the opening plenary session, Canadian and EU representatives participated in a roundtable discussion to explore the economic, environmental, and policy context. The panelists also discussed opportunities to foster further collaboration between industry stakeholders, better support farmers, and advance research and development.

EU-Canada CETA Agriculture Dialogue Sustainability Workshops

1) **Soil health (See the Outcomes Report)**
2) **Greenhouse gas reduction in livestock production (See the Outcomes Report)**
3) **Organic production (See the Outcomes Report)**
4) **Sustainable use of fertilisers (See the Outcomes Report)**
5) **Sustainable crop protection: Pesticide use in agriculture**

A final wrap-up conference will take stock of what has been achieved during the series of workshops.

For more information about these workshops, please visit the websites of the **European Commission** and the **Government of Canada.**

Next, workshop participants split into breakout rooms to do a deeper dive into one of two themes:

- Sustainable crop protection: How do farmers get the most out of an Integrated Pest Management plan?
- Sustainable pesticide use: Mitigating the risks while balancing the costs in a changing climate.

Finally, workshop participants returned to the main plenary session for a recap of the key findings from the breakout sessions. The rapporteurs from each breakout room, as well as Canadian and EU representatives, participated in a roundtable discussion to reflect on the ideas presented over the course of the workshop. (Please see Annex 6.1 for the full workshop agenda.)

This report summarizes what was heard during the workshop, beginning with a high-level overview of the agronomic, economic, environmental, and policy contexts of crop protection practices in Canada and the EU. Next, the report summarizes the findings from the breakout room discussions, presenting

2 Canada-European Union. (June 2021.) European Union-Canada Summit – Joint Statement, p. 3-4. Retrieved from https://pm.gc.ca/en/news/backgrounders/2021/06/15/canada-european-union-summit-joint-statement.

the current state of crop protection practices, followed by opportunities to advance efforts in these areas. As a result of the focus of some discussions, and the participants present in different breakout rooms, certain subsections of the report provide more detail on the experiences in the EU, while other subsections delve further into the situation in Canada. Finally, as an outcome of the workshop discussions, a series of recommendations are presented to enhance knowledge and adoption of practices that can help to increase the sustainability of crop protection products and practices. Ultimately, the implementation of these recommendations can help to better protect biodiversity, water quality, and soil health while maintaining farm profitability and feeding the world.

1.2. SUSTAINABLE CROP PROTECTION: SETTING THE CONTEXT

Pesticides are compounds used to manage pests (i.e., insects, fungi, bacteria, and weeds) in agricultural crops.[3] The term pesticide encompasses, among others, herbicides (to control unwanted vegetation),[4] insecticides (to kill or control insects), fungicides (to control pathogens), and bactericides (to control bacteria).[5]

Pesticides play an important role in the global food supply. Farmers use pesticides to protect crops from pests and diseases that impact crop yields and therefore influence how much food can be produced per acre or hectare of arable land. For example, recent research from the Food and Agriculture Organization (FAO) of the United Nations estimates that pests destroy up to 40% of crops globally, and that plant diseases and invasive insects are responsible for at least US$290 billion worth of losses annually.

The pest challenges are growing. In Canada and the EU, for example, the number of herbicide-resistant weeds is increasing. As a result, the cost of current pest management strategies is increasing while their effectiveness is decreasing. These challenges could be exacerbated by climate change. For example, changing temperatures could influence the geographic distribution of pests, the extent of their overwintering, and their populations.

While pesticides contribute to global food security, they are a notable crop input cost for farmers. Globally, it is estimated that pesticide expenditures are about US$40 billion per year.

The use of pesticides can have negative environmental impacts. For example, pesticide use can damage non-target organisms (e.g., beneficial insects), negatively impacting biodiversity. To minimise potential negative impacts and to protect biodiversity, water quality, and soil health, farmers should follow pesticide stewardship practices.

A crucial tool to support sustainable crop protection practices is the use of IPM.[6] IPM principles aim to manage pests in a holistic manner using a combination of preventative and curative methods and farming practices, such as crop rotation and resistant cultivars. Under IPM, non-chemical methods of

3 World Health Organization. (October 2020.) "Chemical Safety: Pesticides." Retrieved from: https://www.who.int/news-room/questions-and-answers/item/chemical-safety-pesticides.

4 Crop Life Canada. (2023.) "Facts and Figures: Herbicides." Retrieved from: https://croplife.ca/facts-figures/herbicides-in-canada/#:~:text=Herbicides%20are%20a%20type%20of,%2C%20space%2C%20water%20and%20sunlight.

5 Crop Life Canada. (2023.) "Facts and Figures: Herbicides." Retrieved from: https://croplife.ca/facts-figures/herbicides-in-canada/#:~:text=Herbicides%20are%20a%20type%20of,%2C%20space%2C%20water%20and%20sunlight.

6 Institute for European Environmental Policy. (May 2021.) "Event | Life on a Farm: Long-Term Sustainability Through Integrated Pest Management." Retrieved from: https://ieep.eu/news/event-life-on-a-farm-long-term-sustainability-through-integrated-pest-management/.

pest control are integrated as long as the pests are controlled appropriately.[7] Depending on farmer needs, the use of chemical pesticides to control pests can be seen as a last resort.[8]

Increasingly, farmers are leveraging alternative pest management solutions. For example, biopesticides are developed from natural sources such as bacteria, fungi, minerals, and plants.[9] Some robotic weeders are commercially available, and research and development are underway on other site-specific weed management technologies.[10]

Both economic and environmental considerations are contributing to a drive to optimise the use of pesticides, to reduce the risk from pesticides, and to increase the sustainability of crop protection practices across Canada and the EU.

7 European Commission. (n.d.) "Integrated Pest Management." Retrieved from: https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/integrated-pest-management-ipm_en.

8 Food and Agriculture Organization of the United Nations. (2023.) "How to Practice Integrated Pest Management." Retrieved from: https://www.fao.org/agriculture/crops/thematic-sitemap/theme/spi/scpi-home/managing-ecosystems/integrated-pest-management/ipm-how/en/.

9 Agriculture and Agri-Food Canada. (February 2021.) "Biopesticides." Retrieved from: https://agriculture.canada.ca/en/agricultural-production/agricultural-pest-management/biopesticides.

10 European Commission. (March 2020.) EIP-AGRI Focus Group: Non-chemical Weed Management in Arable Cropping Systems, p. 9. Retrieved from: https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_fg_non-chemical_weed_management_final_report_2020_en.pdf. And European Commission. (March 10, 2023.) "Integrated Weed Management: Practical Implementation and Solutions for Europe." Retrieved from: https://cordis.europa.eu/project/id/727321.

2

POLICY CONTEXT

2 . POLICY CONTEXT

2.1. EU POLICIES

The **European Commission**, the **European Food Safety Authority**, and **Member States** evaluate the safety of active substances, which are the components of pesticides that fight pests, before the substances can be used in pesticides.[11] Periodically, the approval of the active substance is reviewed. Member States authorize the sale and use of pesticides within their jurisdictions.[12]

In 2009, the European Commission adopted the **Sustainable Use of Pesticides Directive**, which seeks to reduce "the risks and impacts of pesticide use on human health and the environment."[13] The Directive prioritizes the use of IPM and alternative approaches to pest management (e.g., non-chemical alternatives). To support implementation of the Directive, each EU Member State adopted measurable National Action Plans, which are renewed every five years.[14]

In June 2022, the European Commission strengthened and updated this Directive through the adoption of a proposal for a new Regulation on the Sustainable Use of Plant Protection Products. The proposal provides a clear definition of IPM and includes legally binding targets for a 50% reduction in the use and risk of chemical pesticides and a 50% reduction in the use of more hazardous pesticides in the EU by 2030. This proposal stems from the **European Green Deal**, which charts a path to climate-neutrality by 2050, and the associated strategies:

- The **Farm to Fork strategy**, which aims to make "food systems fair, healthy, and environmentally-friendly;"[15] and
- The **Biodiversity strategy for 2030**, which "aims to put Europe's biodiversity on the path to recovery by 2030 for the benefit of people, climate and the planet."[16]

In May 2019, the European Commission adopted the use of harmonized risk indicators to estimate the trend in risk from pesticides.[17] These indicators measure the use and risk of pesticides, and the number of emergency authorizations.[18]

11 European Commission. (n.d.) "Approval of Active Substances." Retrieved from: https://food.ec.europa.eu/plants/pesticides/approval-active-substances_en.

12 European Commission. (n.d.) "Authorisation of Plant Protection Products." Retrieved from: https://food.ec.europa.eu/plants/pesticides/authorisation-plant-protection-products_en.

13 European Commission. (n.d.) "Sustainable Use of Pesticides." Retrieved from: https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides_en.

14 European Commission. (n.d.) "Main Actions." Retrieved from: https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/main-actions_en.

15 European Commission. (n.d.) "Farm to Fork Strategy." Retrieved from: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en.

16 European Commission. (n.d.) "Biodiversity Strategy for 2030." Retrieved from: https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en.

17 European Commission. (n.d.) "Harmonized Risk Indicators." Retrieved from: https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/harmonised-risk-indicators_en.

18 Emergency authorizations are granted in special circumstances to allow for the use of a pesticide for up to 120 days, "and for limited and controlled use… to control a serious danger that cannot be controlled by any other reasonable means." See European Commission. (n.d.) "Procedure to Apply for Authorization of a PPP." Retrieved from https://food.ec.europa.eu/plants/pesticides/authorisation-plant-protection-products/ppp-auth_en.

Additionally, the **new Common Agricultural Policy** (CAP), which spans from 2023-27, is committed to ensuring a sustainable future for European farmers. CAP "supports farmers in the sustainable use of pesticides" through measures including conditionality rules, rural development programs and eco-schemes.[19]

The EU Research Framework Programmes, Horizon 2020 and Horizon Europe, help to develop a wide range of tools for the prevention, early detection, monitoring, control and management of plant pests and diseases.[20] Horizon 2020 has already funded over 30 research and innovation projects with an investment of over €160 million to protect plant health and promote IPM (e.g., IPM Decisions, Novaterra, IPMWorks and PestNu). Knowledge and innovative solutions are available to advisors and farmers through Thematic Networks, including Innoseta, Smartprotect and Oper8.

The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) supports the development of innovations through Operational Groups; through these groups, relevant actors seek solutions to practical problems in a bottom-up manner. In total, 475 Operational Groups are working to find solutions for the sustainable use of pesticides.[21]

2.2. CANADIAN POLICIES

Health Canada's Pest Management Regulatory Agency (PMRA) is responsible for pest management regulation in Canada. Before pesticides can be sold in Canada, they undergo a rigorous science-based review by the PMRA to ensure their safety for consumers and the environment based on clear and tested evidence. As per the ***Pest Control Products Act***, Health Canada:

- Registers pesticide products using science-based criteria;
- Evaluates pesticides every 15 years to ensure products meet up-to-date standards; and
- Promotes sustainable pest management.

The PMRA has been consulting with stakeholders to inform the transformation of the Agency to more efficiently protect human health and the environment, and modernize risk assessment practices.[22] As an outgrowth of the PMRA consultations so far, the **Scientific Advisory Committee on Pest Control Products** was launched, with the role of "provid[ing] Health Canada with independent scientific advice to support evidence-based decision making on pesticide health and environmental risk and value assessments as well as development of risk management options."

Canada is now developing a **Sustainable Agriculture Strategy (SAS)**, which will "help set a shared direction for collective action to improve environmental performance in the sector over the long-term, support farmers' livelihoods and strengthen the business vitality of the Canadian agricultural industry." Among other benefits, the SAS will provide a framework to support the management of climate change impacts and help

19 European Commission. (n.d.) "Agriculture and Rural Development." Retrieved from: https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/low-input-farming/pesticides_en.

20 European Commission. (n.d.) "Plant Health." Retrieved from: https://research-and-innovation.ec.europa.eu/research-area/agriculture-forestry-and-rural-areas/plant-health_en. And European Commission. (May 18, 2021.) "Plant Health: Keeping Plants Healthy While Protecting the Environment." Retrieved from: https://cordis.europa.eu/article/id/429972-plant-health-keeping-plants-healthy-while-protecting-the-environment.

21 EIP-AGRI. (September 8, 2022.) "EIP-AGRI Activities Related to Sustainable Use of Pesticides." Retrieved from: https://ec.europa.eu/eip/agriculture/en/news/eip-agri-activities-related-sustainable-use.html.

22 Health Canada. (March 21, 2022). Discussion Document DIS2022-01, Further Strengthening Protection of Health and the Environment: Targeted Review of the Pest Control Products Act. Retrieved from: https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/public/consultations/discussion-documents/targeted-review-pest-control-products-act/document.html.

identify research priorities to support agri-environmental outcomes. The Discussion Document informing the consultations on the SAS includes biodiversity as one of five key themes and references considerations for pesticide impacts on biodiversity (e.g., large-scale pollinators) and water quality (e.g., risk of water contamination from climate-change induced demand for pesticide inputs).

Agriculture and Agri-Food Canada (AAFC) supports sustainable pesticide use through several initiatives, including:

- ✔ Providing cost-shared funding for BMPs for efficient pesticide use under the **Sustainable Canadian Agricultural Partnership** (Sustainable CAP), a five-year, $3.5-billion agreement between Canada's federal, provincial and territorial governments;
- ✔ Providing cost-shared funding for nature-based solutions via AAFC's **Agricultural Climate Solutions program**, including the $185-million 10-year **Living Labs** program to invest in on-farm research on BMPs to enhance climate resiliency; and
- ✔ Supporting research to develop innovative approaches to protect and enhance biodiversity through IPM approaches.

Canada's **Pest Management Centre** (PMC) works with the research community to conduct and facilitate scientific research to support the agricultural industry with BMP adoption related to pest management. The current scientific research priorities for the PMC include IPM solutions, minor use pesticide projects, and projects incorporating biopesticides. The minor use program, for example, is a collaboration between AAFC, the PMRA and the provinces to work together to identify crop and pest control combinations for low-risk products that do not warrant registration, thus accelerating the approval for such lower-risk products.

The **Agricultural Clean Technology (ACT) Program** supports research, innovation and adoption of clean technologies in agriculture. Technologies of focus include those that enhance precision agriculture (e.g., precision farming technologies for pesticide application, early warning systems, etc.) to improve the sustainability, efficiency, and productivity of farm operations.[23]

2.3. EU AND CANADA JOINT INITIATIVES AND EFFORTS

On December 19, 2022, participants at the **United Nations Biodiversity Conference** (COP15 nations), including Canada and the EU, agreed to the **Kunming-Montreal Global Biodiversity Framework**. This Framework includes four goals and 23 targets to achieve by 2030.[24] Target 7 is to "Reduce pollution risks and the negative impact of pollution from all sources, by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects, including: … reducing the overall risk from pesticides and highly hazardous chemicals by at least half including through integrated pest management, based on science, taking into account food security and livelihoods."

23 Agriculture and Agri-Food Canada. (n.d.) "Database: Agricultural Clean Technology Program Projects." Retrieved from: https://www.canada.ca/en/agriculture-agri-food/news/2022/02/the-government-of-canada-invests-in-clean-technology-to-support-sustainable-farming-practices.html#dataset-filter.

24 Convention on Biological Diversity. (December 19, 2022.) "COP15: Nations Adopt Four Goals, 23 Targets for 2030 in Landmark UN Biodiversity Agreement." Retrieved from: https://www.cbd.int/article/cop15-cbd-press-release-final-19dec2022.

3

THE CURRENT STATE OF SUSTAINABLE CROP PROTECTION IN CANADA AND THE EU

3. THE CURRENT STATE OF SUSTAINABLE CROP PROTECTION IN CANADA AND THE EU

3.1. SUSTAINABLE CROP PROTECTION: HOW DO FARMERS GET THE MOST OUT OF AN IPM PLAN?

CURRENT IPM INITIATIVES

Across the EU and Canada, farmers are employing IPM plans. Governments have created programs to support farmers in this endeavour. In the EU, the Farmer's Toolbox for Integrated Pest Management Pilot Project was conducted between December 2020 and November 2022. This project was designed to support the Europeans Commission's Farm to Fork Strategy and provides an overview of IPM BMPs and crop- or sector-specific guidelines to help farmers reduce their pesticide use. AAFC has a Pesticide Risk Reduction Team which supports projects to assist farmers in their effort to implement sustainable production practices.

Efforts to support practices that reduce the use of pesticides and/or maximise the efficiency of these products are underway in both the EU and Canada. The Prairie Pest Monitoring Network is an insect surveillance program that conducts insect monitoring and develops monitoring protocols for many field crop pests across the Canadian Prairies.[25] IPM works is a project across 16 European countries to promote the adoption of IPM strategies. This project includes peer-to-peer learning to demonstrate that IPM works.[26]

CURRENT IPM STRATEGIES

Monitoring pest pressures and populations is a key tool farmers use as part of IPM. Farmers focus on preventing and monitoring pests before introducing any form of controls, biological or otherwise. Public and private research on pest- and disease-resistant crop varieties and hybrids has helped farmers employ the genetic and cultural aspects of IPM.

Good soil health and crop management is also key for healthy crops that resist pests and diseases. With proper soil health management, plant-defense mechanisms are increased, and the crop can better resist pests.

Other strategies that farmers use include:

- **Dynamic action thresholds**: These thresholds focus on the impact on incomes of using pesticides, but also allow farmers to consider other control methods (e.g., biological control options) without incurring economic loss. For example, farmers trying to control soybean aphid also monitored the presence of beneficial insects (and those thresholds) to see if the biological control method would suffice prior to using a chemical control method. Farmers can use applications to help monitor both the pest and beneficial populations.
- **Crop staging**: If farmers understand what stage a crop is at, they can use this information to help with decision making about pesticide use. Once a crop has reached or surpassed a certain stage, the pest will not impact yield. Under these circumstances, the farmer does not need to use a chemical control method on the crop.
- **Record keeping**: This practice is strongly encouraged as part of IPM. If farmers keep good records, they can use this information to make decisions later in the IPM process. Farmers can also review records from previous years to understand what worked and what did not work. Challenges for producers

25 Prairie Pest Monitoring Network. (2023.) "About." Retrieved from: https://prairiepest.ca/about/.

26 IPM Works. (n.d.) "About the Project." Retrieved from: https://ipmworks.net/project/.

INDUSTRY ROLE IN IPM

Industry mindsets and experience can impact the implementation and use of IPM practices. For example, the mindset of defaulting to what has always been done on the farm can impact the uptake of new practices. Crop advisors, who are often agronomists, can play an important role in this regard by encouraging and supporting the adoption of new practices. Advisors can also help farmers understand the scientific aspect of IPM practices leading to more informed decision making. Additionally, advisors can help manage risks by explaining the business management components related to IPM; financial considerations can pose barriers when changing practices within a cropping system. Agronomists have an important role to play in encouraging knowledge sharing and supporting farmers in the implementation of IPM practices.

Workshop participants highlighted the importance of knowledge sharing between farmers and industry advisors involved in both conventional and organic production systems. For more information about the work being done in the organic sector in both the EU and Canada, see the Organic Production Outcomes Report.

IPM BARRIERS AND CHALLENGES

Although many farmers across Canada and the EU have adopted IPM, challenges to adoption still exist. For example, economic considerations can impact the adoption of IPM strategies. While crop rotations can help to manage pest pressures, economic considerations (i.e., commodity prices) could discourage a farmer from adopting this strategy. A farmer may instead decide to plant one crop continuously, or simply switch between two crops year after year. Weather patterns can also impact the adoption of IPM strategies. For example, a farmer might change their plans because of an extremely wet or dry planting season to ensure they plant a crop even if it does not follow the optimal crop rotation.

The human factor must also be considered when monitoring for pests. Although farmers are increasingly using technology, people often scout fields. People can make mistakes, such as incorrectly identifying pests and underestimating the amount of infection or the extent of damage. Finally, making in-field decisions on what IPM strategy to employ can be difficult. If a farmer waits to seek advice from a crop advisor, they could be delayed in protecting their crop. This delay could result in large economic losses.

Workshop participants highlighted that the labour shortages in both jurisdictions could impact the use of IPM practices, as field scouting can be labour intensive. Workshop participants said that new methods of scouting will be needed to help farmers manage labour shortages.

Incentives for the adoption and use of IPM can help to ensure farmers continue to employ IPM strategies. Farmers will choose to follow practices not only for environmental benefits but also for economic benefits. For example, a farmer may grow popular cultivars of apples that require additional pesticides, rather than less popular cultivars that are disease resistant. The farmer's decisions are shaped by market demand, and the consumer has little understanding of which varieties are disease resistant. Public information about optimising pesticide use and disease-resistant cultivars may help shift the market to embrace options that require fewer pesticides.

3.2. SUSTAINABLE PESTICIDE USE: MITIGATING THE RISKS WHILE BALANCING THE COSTS IN A CHANGING CLIMATE

WEIGHING THE IMPACTS OF PESTICIDES

Workshop participants acknowledged the range of potential impacts of pesticides (Table 1).

Table 1. Potential impacts of pesticides.

Potential positive impacts	Potential negative impacts
• Pest management • Helping to protect soil health and reduce the risk of soil erosion (e.g., the use of pesticides supports the current approach to no-till farming, which protects the topsoil) • Helping to protect crop quality and yield • Protecting global food security (e.g., where non-chemical control methods are not available/understood, pesticide use can safeguard the supply of key crops for food and feed)	• Exposure can create risks to farmer health (e.g., neurodegenerative diseases) • Risks to water quality • Risks to soil health • Risks to biodiversity • Risks for consumers

All the potential impacts, and the associated levels of risk, must be weighed up when making decisions regarding the regulation and application of pesticides, according to workshop participants.

MAINTAIN SUSTAINABLE APPROACH TO CROP PROTECTION

Industry stakeholders must collaborate to ensure the approach to crop protection considers all three pillars of sustainability (i.e., economic, environmental, and social). Farmers must be economically sustainable to continue to produce food and other commodities for their jurisdictions and for other parts of the world. Farms must also be economically sustainable to attract the next generation of farmers, and to support environmental and social sustainability.

EXISTING BMPS

Across Canada and the EU, many farmers already employ BMPs to support sustainable pesticide use. For example, farmers maintain required buffer zones between the pesticide application area and sensitive habitats.[27] Farmers also use cover crops to prevent weed growth after the harvest of one crop and before the planting of the next one.

Farmers continue to advance their own knowledge so they can apply BMPs on their farms. They also often work with industry advisors (e.g., agronomists or Certified Crop Advisors), who do field scouting. These "boots on

27 Government of Canada. (May 2020.) "Protecting Habitats from Spray Drift." Retrieved from: https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/growers-commercial-users/drift-mitigation/protecting-habitats-spray-drift.html.

the ground" are crucial to developing a clear understanding of the pest pressures, and to developing IPM programs to manage these pressures. Workshop participants acknowledged, however, that some farmers are reluctant to work with advisors, preferring to do the work themselves.

The application of these BMPs often brings both environmental and economic benefits; reducing the amount of pesticide applied also helps to manage crop input costs.

However, the application of these BMPs varies throughout the industry and by the BMP. For example, farmers with larger operations can see a faster return on investment with new technologies such as spot spraying systems than farmers with smaller operations. Relatedly, farmers and their employees must also learn how to use the new technology, which can pose another barrier to adoption. Costs can pose a barrier to the adoption of other BMPs. For example, it can be expensive to establish vegetative filter strips, especially in years with a lot of rainfall.

Workshop participants emphasized that growing conditions and pest pressures vary from year to year and region to region; a one-size-fits-all solution to sustainable crop protection does not exist. It can be challenging for farmers to choose the best methods to manage a particular pest, or combination of pests, within the unique conditions of the specific growing season. Farmers often have a short window of time to manage pests; they need to be able to make decisions quickly and have access to the technologies and techniques to enact the relevant controls within this timeframe. Weather conditions can further narrow windows of opportunity to manage pests. If it is too hot, for example, product applications could cause further stress or damage to crops. If it is raining or too wet, farmers or custom operators cannot enter the fields.

PEST MONITORING SYSTEMS AND MODELS

Pest monitoring systems and models are another tool that farmers and their advisors can use. These systems and models use drone and satellite imagery, among other technologies, to provide some foresight into what pest pressures farmers can expect in their fields in the short term (i.e., seven to 10 days).

This type of technology holds a lot of promise. It could help to decrease the amount of time needed for field scouting. This technology could also provide the maps of pest pressures needed to increase the adoption of spot-spray technology. However, the curation of the data to inform these systems and models remains a key bottleneck. As pest pressures are constantly evolving, these maps must be updated regularly to stay up to date. The current technology is not always user-friendly, which can also hinder adoption.

In Canada, the Prairie Pest Monitoring Network is an example of a successful collaborative initiative which provides weekly in-season updates regarding insect pests.

Knowledgeable farmers, staff, and agronomists walking the fields and checking pest traps remain crucial to assessing pest pressures and making informed crop protection decisions.

BIOPESTICIDES

Biopesticides are developed from natural sources such as bacteria, fungi, minerals, and plants.[28] They are useful tools in years with low pest pressures. In years with higher pest pressures, however, farmers may need to make multiple product applications. Biopesticides may offer environmental benefits, but industry stakeholders need a clear understanding of the potential trade-offs, which include increased greenhouse gas emissions (from the fuel needed for multiple product applications), increased input costs (e.g., fuel and biopesticides), and impacts on soil health (e.g., compaction).

28 Agriculture and Agri-Food Canada. (February 2021.) "Biopesticides." Retrieved from: https://agriculture.canada.ca/en/agricultural-production/agricultural-pest-management/biopesticides.

KNOWLEDGE TRANSLATION AND TRANSFER

Knowledge translation and transfer (KTT) is crucial to support sustainable pesticide use. Opportunities for farmers to gather and exchange knowledge, such as through tours of demonstration plots, are highly valued.

In Canada, government-supported extension services have declined. Increasingly, commodity commissions are using their levies from farmers to invest in research and KTT. During the winter, commodity commissions and retailers host farmer meetings to share research updates and highlight BMPs.

Industry-led initiatives are key to in helping to advance the sustainability of crop protection. In Canada, for example, the Canola Council of Canada, Cereals Canada, Pulse Canada, and the Prairie Oat Growers Association have collaborated to develop the Keep it Clean initiative. This initiative provides farmers and industry advisors with the resources and information needed to produce crops that meet the requirements of customers in Canada and abroad. Another strong example is the Western Grains Research Foundation's Field Heroes campaign, which helps farmers and agronomists increase their knowledge of beneficial insects and their role in pest management.

In the EU, the Horizon 2020 IPMWORKS project uses peer-to-peer learning and demonstration farms to encourage farmers to adopt IPM strategies. The IPM Toolbox project also created a database of many examples of IPM approaches and explored the drivers of, and barriers to, their uptake by farmers.

A challenge can exist in ensuring clear lines of communication and connection between university researchers and farmers; a workshop participant from Portugal, for example, noted that a disconnect can exist between these two groups. Given this disconnect, some farmers can be sceptical of the research results from universities.

DECISION-MAKING PROCESSES

As farmers make crop protection decisions, they must weigh up a range of short- and long-term considerations. Farmers want to protect their yields and their crop quality. Poor-quality crops can cause challenges for market access. For example, marketing options can be limited for wheat with deoxynivalenol, which is also known as DON or vomitoxin. Thresholds are a key consideration when making decisions about crop protection practices; farmers and their advisors weigh up the economic costs associated with pesticide applications against the economic losses (i.e., losses associated with yields or crop quality) that might result from leaving the pest untreated. Rather than applying a pesticide across an entire field, farmers and their advisors might decide to apply the pesticide on a smaller area. For example, farmers in Western Canada might opt to make a perimeter application of an insecticide on their headlands to control insects, rather than across the whole fields, to control aphids in lentils.

Farmers also recognize, appreciate, and assume their role as stewards of the land and strive to care for the soil and the water, as well as to protect biodiversity.

Farmers' individual perceptions of risk, as well as their risk tolerance thresholds, can impact their crop protection decisions. Some farmers may tend towards a "just in case" attitude, meaning that they are more proactive in applying pesticides to protect their crops from potential pest threats. For example, in Western Canada, crop rotations, and subsequently, weed control plans, are commonly planned in three- or four-year timeframes. IPM strategies, in contrast, require more of a focus on prevention and leveraging a "just in time" approach, in terms of use of chemical or mechanical control methods, to control pests. A "just in time" approach necessitates timely access to equipment and crop protection products. This timely access can be challenging, such as when farmers rely on custom applicators who have other customers with similar pest pressures.

Given the range of factors that influence each farmers' decision-making, the decision matrix can be complicated as farmers try to balance the various benefits, challenges, and risks.

As stakeholders collaborate to continue increasing the sustainability of the agricultural industry, they must approach the topic from a holistic point of view, considering the implications at a local, regional, and global level. For example, decisions made within one jurisdiction could lead to a de-intensification of production practices and lower crop yields, resulting in a decrease in the availability of a given commodity for the global market. A risk exists that another jurisdiction might clear more land or intensify its production to meet

the increased global demand. Farmers are mindful of maintaining their productivity to supply local and global markets in a world faced with increasing volatility from climate change. Several workshop participants highlighted the need to consider global food security when making decisions related to crop protection practices.

PRODUCT AVAILABILITY

As a result of increasing pest resistance and changing regulations, the availability of pesticides continues to evolve, which can be challenging for farmers. In the EU, for example, some stakeholders are concerned about the number of active substance approvals that will expire in the next four years. In Canada, some stakeholders are worried about the changing permissibility of various tank mix programs. Increasingly, farmers need to identify new ways to handle pests. Workshop participants also noted the challenge of differing regulations between jurisdictions, which can lead to an "uneven" playing field in international markets.

Other workshop participants highlighted that the impacts of pesticide bans are not as detrimental to the industry as is sometimes expected. For example, some people predicted that the increased regulations on neonicotinoids (known more commonly as neonics) in both Canada and the EU would hurt crop yields, but some workshop participants noted that the industry maintained yields after the new regulations were put into place.

PRODUCT REGISTRATION

Registration is crucial to ensure the safety and efficacy of products. The length of time needed to evaluate and approve new products, as well as the costs associated with this process, however, can hinder the commercialization of new products that can increase the sustainability of crop protection. Workshop participants underscored the value of reviewing the evaluation and approvals process, as well as the associated fees, to see if new products can be brought to market in a shorter time while still ensuring the safety and efficacy of the product.

MARKET INCENTIVES

The benefits of sustainable farming practices extend beyond the farm; sustainable practices also benefit society at large, such as by protecting biodiversity and water quality. As a result, workshop participants discussed the value of market incentives to help encourage farmers to increase the sustainability of their practices, and, particularly, to achieve impact reductions. Certification and labelling programs can be used to educate consumers about sustainably produced commodities. Farmers may be able to obtain a premium for such products.

However, workshop participants also stressed the need to find the right balance between supporting the sustainability of farming practices through market incentives and ensuring the continued affordability of food for consumers.

COMMUNICATING WITH THE PUBLIC

The public is often unfamiliar with the technical aspects of the agricultural industry, and some negative perspectives, particularly about pesticides, exist. For example, the term "pesticides" can have negative connotations in a public setting. Workshop participants are worried about the negative public views of agriculture and stressed the need to tell the industry's story in a better way. Workshop participants suggested that the phrases "medicine for plants" or "crop protection tools" might be more understandable or relatable amongst the public, as opposed to the term "pesticides."

Participants noted that telling the story about IPM can be challenging, as it is based on farmers' practices and not the impacts of this work. As a result, industry and governments must collaborate to develop clear, consistent, and impactful communications with the public about sustainable crop protection. This definition of sustainability should cover all three pillars – social, environmental, and economic. These communications should highlight the good work that is already underway, and the outcomes associated with this work.

Workshop participants also noted the importance of giving specific examples when telling the story about the good work underway. For example, an Alberta wetland monitoring program has consistently found the samples to be below the official thresholds for pesticides set by the PMRA. This finding shows the high level of stewardship practices on the farm, and the effectiveness of vegetative filter strips in reducing pesticide run-off into waterways.

Communication efforts should also note the range of pressures (e.g., market, environmental considerations, regulatory conditions, etc.) farmers face, and how many factors outside of their control impact their operations.

3.3. OVERARCHING CONSIDERATIONS

ENSURING THE AVAILABILITY OF A RANGE OF IPM TOOLS

The increased adoption of IPM is crucial to support the sustainability of crop protection, workshop participants said. They also recognized the importance of using a range of BMPs to manage pests, improve sustainability, and manage challenges such as increasing pest resistance to pesticides. Workshop participants underscored the need for pesticides to remain as an important tool in the toolbox to manage pests. The need to use such products will vary depending on the year (i.e., the level of pest pressures) and the advances in effective alternative management practices.

Workshop participants also stressed the important role crop advisors can play in ensuring a range of IPM tools are employed. In some cases, crop advisors may default to pesticides as the solution to pest pressures. While pesticides are important tools, crop advisors should consider all components of IPM and discuss options with farmers. If farmers continue to use a range of IPM tools, the risk of pesticide resistance will be lower.

In certain cases, workshop participants disagreed about BMPs or the effectiveness of different practices. Discussion between workshop participants highlighted how possible solutions can work differently depending on the jurisdiction. This was not only true between the EU and Canada, but even within Canada and the EU. For example, practices such as cover cropping are common and encouraged in Eastern Canada. Participants from Western Canada, in contrast, have mixed results with using cover crops as part of IPM.

Workshop participants highlighted that differences in topography, climate, and farm size can all have an impact on the effectiveness and popularity of IPM practices. Location-specific research is needed to instill confidence in farmers when selecting IPM practices to implement on their farms. Both researchers and industry must have a strong understanding of the climate in which they are working. Furthermore, industry stakeholders should collaborate to conduct on-farm research in differing climates to test how practices work across various locations.

ROLE OF TECHNOLOGY

Technology can play an important role in decision making as part of IPM. Applications for smartphones exist that help maintain records and identify pests. For example, the aphid advisor application helps growers determine whether control methods are needed for aphids in soybeans. The European Food Safety Authority also has many pesticide evaluation tools. GIS mapping can help farmers and industry advisors map the prevalence of pests and diseases based on crop scouting. Farmers and advisors can use these maps to evaluate pest pressures and make timely decisions on implementing preventative measures.

When applying pesticides, farmers use some combination of the following technologies:

- Improved sectional controls, which enable the operator to turn off individual nozzles as the operator travels across the field to avoid overlap in pesticide applications and applications outside of field boundaries (e.g., buffer zones)
- Low-drift nozzles to help decrease the chance of the pesticide moving off target
- Pulse-width modulated spray systems (PWM), which help to maintain a consistent spray pressure and consistent application rate regardless of travel speed
- Robotic weeders
- Spot spray systems, which only apply pesticides on targeted areas where they are needed to manage pests
- Weed destructors on combines to help with weed control

With the introduction of new technologies, concerns exist about data privacy and ownership. Agricultural technology companies will need to clearly document and communicate who owns and can access this data to ensure farmers are comfortable using these tools.

Artificial Intelligence (AI) and machine learning hold promise to help with IPM. Research is underway to determine how to use AI in IPM programs.[29]

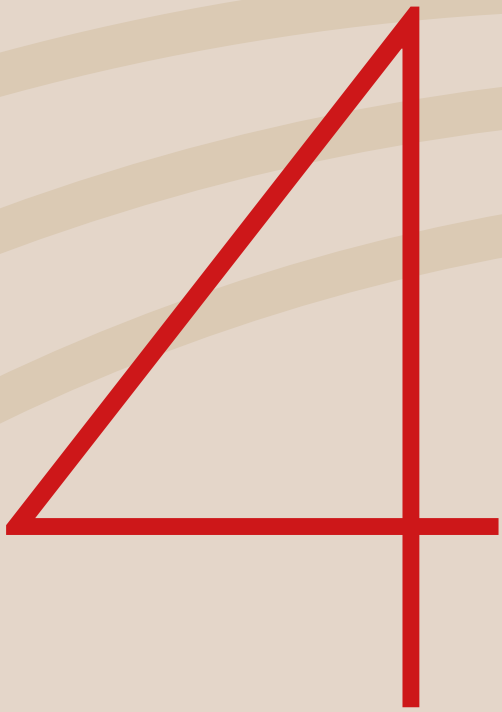
CURRENT RESEARCH

Researchers continue to study IPM. Workshop participants highlighted that research demonstrating the effectiveness of various IPM practices will increase the confidence of farmers and advisors in using non-chemical control solutions. Research on technologies that can assist in predicting pest pressures, monitoring fields, and precisely applying pesticides is also underway.

Farmers seek to understand how the range of IPM tools interact with one another. While the industry desires to reduce pesticide use, farmers and their advisors also need to understand how other IPM practices will impact the overall crop production system. For example, tillage is often suggested as a management technique for weeds, but tillage can negatively impact soil health. Research into the interaction of IPM practices and how to balance these practices as part of the larger crop production system is needed.

Workshop participants also want to see research on the return on investment of IPM practices. As the implementation of new practices often has financial implications, researchers must also consider economic impacts.

29 Josse De Baerdemaeker. (January 2023.) "Artificial intelligence in the agri-food sector: Applications, risks and impacts." European Parliamentary Research Service. Retrieved from: https://www.europarl.europa.eu/RegData/etudes/STUD/2023/734711/EPRS_STU(2023)734711_EN.pdf.



OPPORTUNITIES FOR SUSTAINABLE CROP PROTECTION PRODUCTS, TECHNOLOGIES AND PRACTICES IN CANADA AND THE EU

4. OPPORTUNITIES FOR SUSTAINABLE CROP PROTECTION PRODUCTS, TECHNOLOGIES AND PRACTICES IN CANADA AND THE EU

4.1. SUSTAINABLE CROP PROTECTION: HOW DO FARMERS GET THE MOST OUT OF AN IPM PLAN?

INCREASING IPM ADOPTION

Workshop participants discussed a measuring system called the "pestiscore" which could score fruit or vegetables at point of sale. This score would be based on the amount of pesticides required to produce that specific variety of fruit or vegetable. The assumption is that consumers would choose varieties that have lower pestiscores. If consumer demand shifts to crops with lower pestiscores, farmers will have an incentive to grow those specific crops. Workshop participants suggested that the adoption of a pestiscore display for end users may encourage increased adoption of IPM practices and principles.

While some workshop participants feel that information on return on investment exists to support IPM adoption, others feel that subsidies and programs to encourage IPM adoption may be most beneficial to encourage farmers to adopt BMPs for sustainable crop protection. Support programs to absorb some up-front risk or purchase new equipment may ease the transition for farmers.

Continued IPM research and knowledge translation and transfer is crucial to reach farmers who are hesitant to adopt new practices. The sharing of research results at demonstration farms, such as Living Labs, can showcase BMPs and non-chemical control options.

Further research is needed on resistant varieties and hybrids. More information on resistant varieties and hybrids, including crop production practices and yield data, would help farmers confidently choose those options.

TECHNOLOGY

Farmers will be better able to manage pests with improved technology. Workshop participants discussed many advances and tools for monitoring and protection that farmers and their advisors can use to help predict pest problems and understand issues in a timelier manner. Farmers must be able to make decisions quickly, and improved technologies can provide real-time results faster than traditional scouting and monitoring techniques.

Technology will have a large role to play in both surveillance and mapping, workshop participants said. Detailed field maps created with GIS software can allow for precision IPM. For example, farmers could make targeted pesticide applications solely in the areas of the field where infestation is above the economic threshold. These maps can be supported by information obtained from cameras mounted on tractors. These cameras could capture field images to analyse pest presence and pressure. Drones can also be used to help map fields and detect pests and diseases. Farmers and their advisors can use in-field smartphone applications when scouting fields to assist in mapping and reporting information. One workshop participant noted that some applications could include information on potential management solutions and opportunities to purchase control options. Farmers and their advisors can use this range of data to help in decision making and precision application of IPM methods.

IPM IN A CHANGING CLIMATE

Research suggests that IPM plans need to be updated to account for climate change. Farmers echo this sentiment based on in-field observations both in Canada and the EU. For example, workshop participants noted seeing pests that previously did not exist in their regions. These changes highlight a need to update IPM plans to reflect new concerns. One workshop participant referred to "weeds we haven't seen before," expressing a need for "more tools to get rid of them." Researchers need to be efficient and responsive in their work as changes continue to occur. Climate variability makes forecasting pests and diseases difficult, and any advances in this area will be extremely impactful. On-farm validation of new research is needed to reduce the potential for farmers' economic losses.

APPROACH TO RESEARCH AND DEVELOPMENT

Research and development are key for improving IPM practices and adoption. Workshop participants agreed that the industry needs to publish negative, or non-results. Researchers need to share findings indicating failure (or lack of response) of a given practice so that the scientific and agricultural communities understand what practices do not work. Researchers should focus on exploring potential solutions that have not been tried previously, and financial investments should support these projects.

Workshop participants also stressed the need for research on how combinations of IPM practices impact results and crop production. The industry needs a more holistic approach to understand IPM plans.

"When we have a negative result, we tend not to publish. By not reporting the (findings), we are wasting resources in repeating things which don't work."

- Workshop panellist

4.2. SUSTAINABLE PESTICIDE USE: MITIGATING THE RISKS WHILE BALANCING THE COSTS IN A CHANGING CLIMATE

INCREASE COMMUNICATION AND COLLABORATION AMONG FARMERS, POLICYMAKERS, AND PUBLIC AUTHORITIES

Farmers, policymakers, and public authorities face different types of challenges in their work. Farmers, for example, face increasing volatility in weather, which impacts growing conditions and pest pressures. Policymakers and public authorities seek ways to meet jurisdictional and global targets to protect the environment (e.g., biodiversity, soil health, reducing greenhouse gas emissions, etc). Some workshop participants expressed their concerns about the need to enhance communications between farmers, policymakers, and public authorities to identify shared goals and the best path forward to meet these goals. An opportunity exists to expand communication channels and collaboration.

PEST MONITORING SYSTEMS AND MODELS

Workshop participants acknowledged that we are in a transition phase; pest monitoring systems and modelling tools such as AI and mapping technologies continue to evolve. Stakeholders must find ways to streamline the data collection processes and increase the user-friendliness of these new tools. Stakeholders must also continue to check the accuracy and reliability of the tools compared to traditional scouting methods.

4.3. OVERARCHING OPPORTUNITIES

SYSTEMS APPROACH

Researchers must use a systems approach in their work. To support effective IPM, industry stakeholders need to better understand how to manage multiple pests at the same time. Researchers should explore the interactions between various IPM strategies. For example, researchers should study the interactions between various biological agents, workshop participants said.

Relatedly, researchers need to be studying the entire growing system, and integrated crop management, rather than focusing more narrowly on IPM. Integrated crop management includes such considerations as water, nutrient, and energy use. A systems approach is crucial to ensure that industry is ready to cope with future challenges, including those arising from climate change.

Increasing the resilience of the entire farming system, including increasing biodiversity and protecting soil health, will help to improve the sustainability of crop protection practices.

ROLE OF EXTENSION SERVICES

Workshop participants highlighted the differences in funding for crop advisors and extension services across the EU and Canada. The role farm advisors can play in offering advice and services also differs. These differences can make it difficult to properly disseminate accurate information to farmers. A more streamlined approach to farm service advisors, similar to the extension service in the United States, would help to ensure that all farmers have access to farm service providers who would provide non-biased research results in a timely manner. Additionally, these advisors could help farmers make timely decisions as to how to integrate IPM into their operations.

KNOWLEDGE TRANSLATION AND TRANSFER

Workshop participants highlighted the opportunity to improve communication between researchers, policy makers, and farmers. Farmers need to share information on what they see as working in their fields with researchers and policy makers. Policy makers and researchers must acknowledge and recognize farmers' knowledge of their farms and their production systems. Farmers, researchers, and industry advisors should seek opportunities to collaborate, as each group brings different knowledge and expertise to the table. Researchers can help to identify BMPs and products that address on-farm challenges and increase the sustainability of crop protection. Industry advisors can assist with this crucial knowledge translation and transfer. Independent advice (i.e., advice from experts who are not associated with crop input retailers nor equipment dealers) is important. Policy makers and researchers also need to share their findings with farmers to ensure that they have the most up-to date information. The information being shared needs to be presented in plain language so that all stakeholders understand.

Industry stakeholders should encourage opportunities for knowledge transfer between farms with different characteristics, including farms that:

- Produce different commodities
- Use different production systems (e.g., organic, regenerative, conventional)
- Operate at various scales (e.g., small acre farms, broad acre farms)

The industry must continue its efforts to train farmers on scouting and monitoring. Workshop participants support the idea that databases are critical first steps for timely and strategic decision making in IPM. If farmers are part of the data collection, it empowers them to detect challenges early while also making more

data available to researchers. One workshop participant highlighted a program in Spain where an award is given for the first spotter of downy mildew.

The availability of databases encourages information sharing, which helps farmers understand practices being used across states, provinces, and/or countries. Information technology professionals are needed to help create and maintain these databases and ensure that they are user-friendly. Allowing farmers to compare their operations with those of their peers, and see what practices other farmers are using, will reduce potential apprehension over data sharing. Having up-to-date data will ensure these databases remain relevant for users and ensure continued use.

Recognizing the efforts and knowledge of farmers who are early adopters of IPM is important. Most existing funding programs provide cost-sharing for farmers to implement new practices. As a result, the early adopters who already implement BMPs to reduce their use of crop protection products may be ineligible for funding support programs. Workshop participants suggested the benefits of a program for early adopters to showcase their practices with researchers and other farmers. This type of program would reward early adopters for their work while also supporting knowledge transfer.

Workshop participants emphasized that knowledge transfer should include sharing information with the public to educate consumers about IPM, how the industry uses it, and why it is important. Workshop participants suggested hosting demonstration days at farms, running educational programs, and providing information at the grocery store on how farmers are adopting IPM practices.

PRIORITY AREAS FOR RESEARCH AND DEVELOPMENT

Workshop participants highlighted several priority areas for research and development to support the implementation of IPM plans and more sustainable use of crop protection products. Workshop participants emphasised the need to involve farmers included in all steps of research, including determining priority areas for research and development.

Researchers need to be proactive and address future pest concerns, including the impact of climate change on IPM. Workshop participants believe that climate change will impact the types of pests that need to be managed within a given region, and the tools available for managing them. Some workshop participants are concerned that research into new tools and products to manage pests is reactive and only occurs once pests have caused economic damage. Workshop participants encouraged researchers to look at tools that can be proactive and provide farmers with information prior to the pests causing environmental or economic damage.

Research project design must consider the impact of climate change. For example, over the course of a given project, a lot of variability can exist (e.g., one year extremely wet, followed by a drought year). Research trials should consider this possibility in their design and focus on finding solutions that can take account of this variability and increase resilience in cropping systems.

Forecasting tools are helpful in creating proactive solutions to pest pressures. Ideally, these tools predict the timing and severity of pest infestations (e.g., when a certain insect will hatch or be in flight). If these tools are reliable, farmers and their advisors can use IPM to manage the pest. For example, if an insect is predicted to hatch within a certain window, farmers could change their planting timing to ensure their crop will not be in a vulnerable stage when the pest pressure is greatest. This change in planting timing would help to protect the crop and reduce the need for pesticide application. Farmers would benefit from further research and development of forecasting tools. The availability and ease of use of these tools is also important to ensure widespread uptake and use.

Workshop participants were particularly interested in the use of biological controls. Some workshop participants shared their concerns about the limited understanding of the potential impact of biological control agents on the environment. Further research is needed to understand the potential long-term impacts of using these types of products.

Researchers must strive to identify upcoming challenges for pest management and to identify solutions to these challenges as pest pressures evolve over time. For example, herbicides such as glyphosate supported the transition to no-till farming systems, as the pesticides could be used to kill the weeds in lieu of tillage. However, pests are becoming resistant to existing pesticides (e.g., glyphosate-resistant weeds). Industry stakeholders must find and implement alternative crop protection practices that do not impact the success of the no-till system.

Researchers must continue to prioritize plant breeding to develop new, resistant varieties and hybrids. Relatedly, the development of new breeding techniques could help to shorten the amount of time needed to bring these new varieties and hybrids to market.

Workshop participants underscored the importance of water and wetland monitoring projects to better understand the impacts of pesticides on the environment. Participants noted the costs associated with this work, advocating for support from policymakers and public authorities.

Workshop participants highlighted other areas for research, including:

- Validation of applications and new technology
- Prioritize finding crop protection strategies for pests for which limited or no control or treatment methods currently exist (e.g., Xylella fastidiosa in olive trees and black spot disease in citrus)
- RNA interference for insect control
- Incorporating IPM at different crop or pest lifecycle stages
- Combinations of solutions farmers employ to reduced pesticide use (i.e., what technology are they using to allow for a reduction in pesticides?)
- How plants "communicate." Ideally, researchers will find ways that plants can "tell" farmers whether they are experiencing sufficient levels of stress to require interventions to manage/control pests.

FOCUS ON OUTCOMES

Workshop participants underscored the need to ensure that industry stakeholders and governments continue to empower farmers to make the right decisions for their operations. Government policies and programs must recognize regional differences and focus on outcomes. Farmers should also have the flexibility to experiment to identify the best practices for their operations within their unique growing conditions.

5

CONCLUSIONS WITH RECOMMENDATIONS

5. CONCLUSIONS WITH RECOMMENDATIONS

Workshop participants explored the current state of IPM and pesticide usage, as well as opportunities for sustainable crop protection within a changing climate. Participants highlighted the pressures and challenges farmers face with pest management. Participants also noted the diversity of farms and pest pressures across the EU and Canada and stressed the need to find creative and adapted solutions to work in a variety of climates. All stakeholders prioritize balancing crop production and environmental concerns.

Technology will play an important role in IPM. Advances in technology will support improved surveying and monitoring of pests. These advances will help to ensure crop protection recommendations are fully informed by IPM best practices, and that the use of pesticides is warranted. Precision mapping could be integrated into IPM to allow for precision application of IPM solutions, including precise application of crop protection products.

Continued research is needed to ensure a range of tools and solutions is available to farmers and their advisors for managing ever-changing pest populations. Scientists should collaborate with farmers, leveraging their experience and knowledge, to ensure research projects align with their needs. Farmers must be supported in their work to manage crops in an economical and environmentally sustainable way.

Knowledge should be shared freely amongst all crop protection stakeholders, including the public, to ensure a shared understanding of current pressures and the work being done to manage pests. A more thoroughly defined approach for crop advisors and providers of extension services would be beneficial to ensure consistent messaging related to IPM and the sustainable use of crop protection products.

Stakeholders can leverage the following recommendations to help define a clear path forward. These recommendations aim to improve IPM plans and allow for the sustainable use of crop protection products in a changing climate.

RECOMMENDATIONS FOR THE SCIENTIFIC COMMUNITY

1. **Prioritize a systems approach to research and development.**
    - **a.** Leverage the expertise of scientists and economists to study and clearly document the agronomic, economic, and environmental impacts of existing and emerging IPM practices. Leverage the expertise of social scientists to best encourage farmer adoption of IPM.
    - **b.** Study the interaction between multiple IPM practices to understand optimal approaches to pest and disease pressures.
    - **c.** Study the interaction between IPM practices and the overall crop production system.
    - **d.** Increase collaboration between farmers and researchers, ensuring a two-way flow of information; involve farmers in the research priority-setting process.
2. **Prioritize a systems approach to research and development.**
3. **Continue to support the development of specialized knowledge in sustainable crop protection, including:**
    - **a.** The development of accurate thresholds for pesticide application, and
    - **b.** Plant breeding and genetics to enhance resilience to pests and develop resistant hybrids and varieties.
4. **Publish negative or non-results and disseminate these findings to build industry knowledge of unsuccessful techniques to reduce crop protection inputs.**
5. **Develop long-term research projects to help improve IPM practices to understand how changing weather patterns affect pest lifecycles and what new pests may emerge in a changing climate over time.**

RECOMMENDATIONS FOR POLICYMAKERS AND PUBLIC AUTHORITIES

6. **Prioritize programs or initiatives that support the long-term development of knowledge and technology related to sustainable crop protection and IPM in a changing climate.**
    a. Support the development of pest, disease, and weather forecasting and monitoring systems to improve the ability of the sector to detect crop protection challenges early and accurately in a changing climate.
    b. Ensure crop protection programming and initiatives have built-in resilience (e.g., safeguards are in place to enable researchers to adjust for climate variability).
    c. In recognition of regional differences, ensure that programs and incentives are focused on outcomes.
7. **Provide opportunities for financial recognition or incentives for 'early adopters' of IPM practices and techniques to share information with the value-chain and scientific community.**
8. **Support programs, initiatives and research that have long-term time horizons.**
    a. Consider opportunities for innovative approaches to research funding that enable long-term research. For example, exploring research funding that includes time-horizon milestones to determine whether further funding can be released.
9. **Review the evaluation and approvals process, as well as the associated fees, related to crop protection product registration. Explore opportunities to determine if new products, in particular for biocontrol, can be brought to market in a shorter timeframe while still ensuring the safety and efficacy of the product.**
10. **Continue to support initiatives that build understanding of how agriculture impacts the environment, and vice versa.**
    a. Support water and wetland monitoring programs to understand the impact of pesticides on the environment.

RECOMMENDATIONS FOR THE VALUE CHAIN

11. **Provide incentives or financial recognition for farmers trialling and adopting IPM practices and BMPs that reduce the use of certain crop protection products.**
12. **Exchange knowledge and best practices for sustainable crop protection with farmers regarding opportunities to try new IPM approaches.**
    a. Continue to support on-farm efforts to identify pests and estimates of infection or crop disease to improve response time and farmers' abilities to identify issues in the field.
    b. Help farmers understand the scientific aspect of IPM practices leading to more informed decisions on which practices to implement and when.
    c. Help farmers manage risks by explaining the business management considerations related to IPM.

RECOMMENDATIONS FOR ALL CROP PROTECTION STAKEHOLDERS

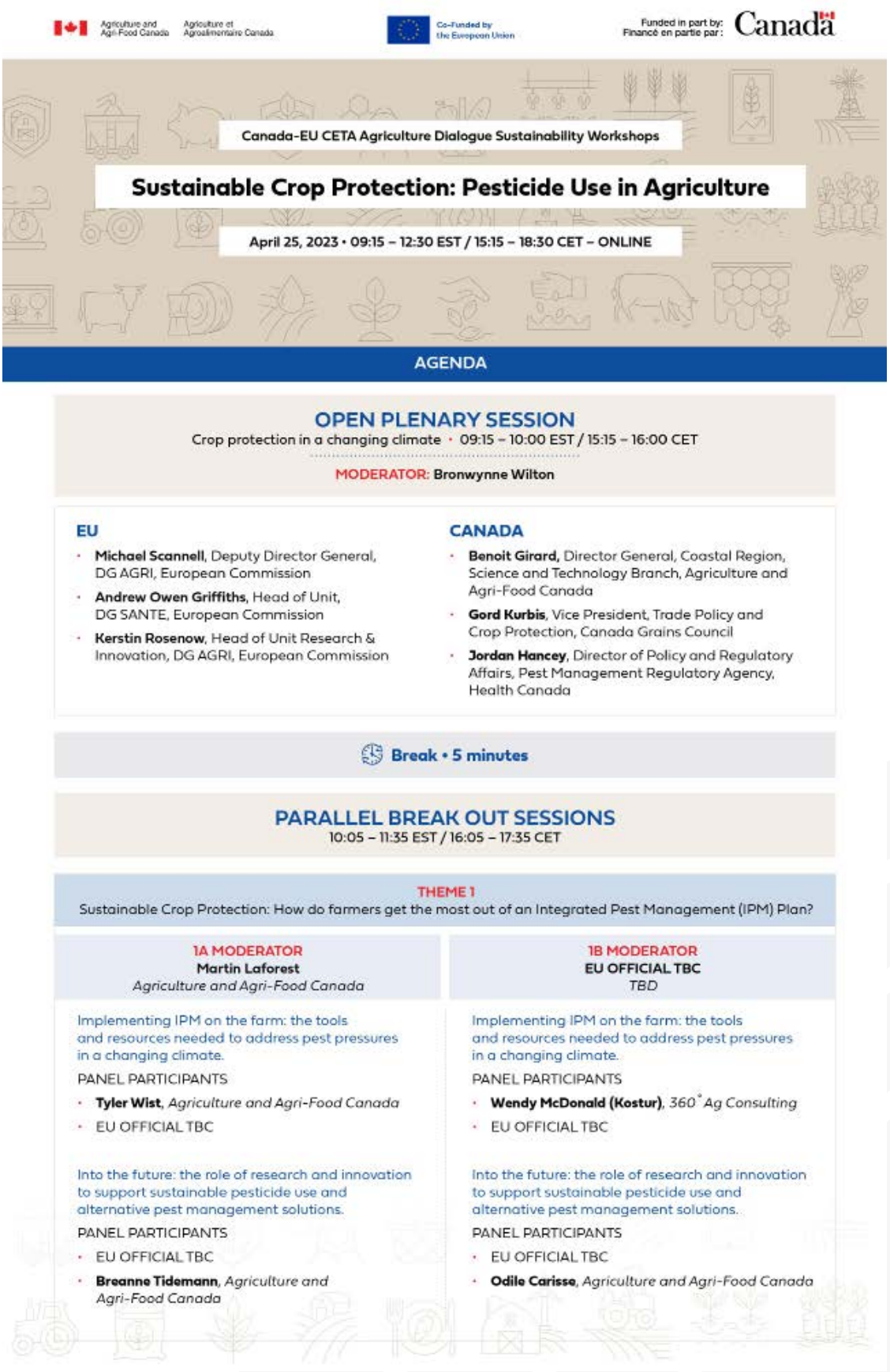
13. **Facilitate knowledge transfer between farms with different characteristics and production systems to enhance information sharing in the sector (e.g., between organic and conventional production systems).**
14. **Collaborate to improve data collection related to IPM and sustainable crop protection.**
    a. Support the development of robust databases to share information between farmers, policy makers, the value chain, and the scientific community.
    b. Ensure surveillance and monitoring data is accessible, easy to interpret, and has good data governance.
15. **Find opportunities to develop and disseminate consumer-friendly communication materials. Share knowledge about the importance of pest control, the challenges farmers face on this front, and the use of IPM.**
    a. Emphasize the efforts of the sector to reduce or optimize the use of crop protection products and increase the uptake of IPM practices.
    b. Develop public information about pesticide use and disease-resistant cultivars to help encourage the market to select options that require less pesticide use.
16. **Enhance communications between farmers, policymakers, and public authorities to identify shared goals and the best way forward to meet these goals.**

6

ANNEXES

6. ANNEXES

6.1. WORKSHOP AGENDA



Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

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Canada-EU CETA Agriculture Dialogue Sustainability Workshops

Sustainable Crop Protection: Pesticide Use in Agriculture

April 25, 2023 • 09:15 – 12:30 EST / 15:15 – 18:30 CET – ONLINE

AGENDA

OPEN PLENARY SESSION

Crop protection in a changing climate • 09:15 – 10:00 EST / 15:15 – 16:00 CET

MODERATOR: **Bronwynne Wilton**

EU

- **Michael Scannell**, Deputy Director General, DG AGRI, European Commission
- **Andrew Owen Griffiths**, Head of Unit, DG SANTE, European Commission
- **Kerstin Rosenow**, Head of Unit Research & Innovation, DG AGRI, European Commission

CANADA

- **Benoit Girard,** Director General, Coastal Region, Science and Technology Branch, Agriculture and Agri-Food Canada
- **Gord Kurbis**, Vice President, Trade Policy and Crop Protection, Canada Grains Council
- **Jordan Hancey**, Director of Policy and Regulatory Affairs, Pest Management Regulatory Agency, Health Canada

Break • 5 minutes

PARALLEL BREAK OUT SESSIONS

10:05 – 11:35 EST / 16:05 – 17:35 CET

THEME 1

Sustainable Crop Protection: How do farmers get the most out of an Integrated Pest Management (IPM) Plan?

1A MODERATOR
Martin Laforest
Agriculture and Agri-Food Canada

Implementing IPM on the farm: the tools and resources needed to address pest pressures in a changing climate.

PANEL PARTICIPANTS

- **Tyler Wist**, *Agriculture and Agri-Food Canada*
- EU OFFICIAL TBC

Into the future: the role of research and innovation to support sustainable pesticide use and alternative pest management solutions.

PANEL PARTICIPANTS

- EU OFFICIAL TBC
- **Breanne Tidemann**, *Agriculture and Agri-Food Canada*

1B MODERATOR
EU OFFICIAL TBC
TBD

Implementing IPM on the farm: the tools and resources needed to address pest pressures in a changing climate.

PANEL PARTICIPANTS

- **Wendy McDonald (Kostur)**, *360˚Ag Consulting*
- EU OFFICIAL TBC

Into the future: the role of research and innovation to support sustainable pesticide use and alternative pest management solutions.

PANEL PARTICIPANTS

- EU OFFICIAL TBC
- **Odile Carisse**, *Agriculture and Agri-Food Canada*

THEME 2
Sustainable Pesticide Use: Mitigating the risks while balancing the costs in a changing climate

2A MODERATOR
Curtis Cavers,
Agriculture and Agri-Food Canada

Mitigating the risks: stewardship practices to protect biodiversity, water and soil health while feeding the world

PANEL PARTICIPANTS

- **Nevin Rosaasen**, *Alberta Pulse Growers*
- EU OFFICIAL TBC

Balancing the costs: sustainable pesticide use while maintaining farm profitability in a changing climate over time.

PANEL PARTICIPANTS

- EU OFFICIAL TBC
- **Corey Loessin**, *Saskatchewan Pulse Growers and Aidra Farms Ltd.*

2B MODERATOR
Tassos Haniotis,
Directorate-General for Agriculture and Rural Development

Mitigating the risks: stewardship practices to protect biodiversity, water and soil health while feeding the world.

PANEL PARTICIPANTS

- **Tom Wolf**, *Agrimetrix Research & Training*
- EU OFFICIAL TBC

Balancing the costs: sustainable pesticide use while maintaining farm profitability in a changing climate over time.

PANEL PARTICIPANTS

- EU OFFICIAL TBC
- **Robert Stone**, *Stone Farms Inc.*

Break • 10 minutes (to transition)

CLOSING PLENARY SESSION
11:45 EST – 12:30 EST / 17:45 – 18:30 CET

MODERATOR: **Bronwynne Wilton**

Rapporteurs for BREAKOUT SESSIONS

1A Hossein Borhan
1B Gisela Quaglia
2A Kathryn Makela
2B Aymeric Berling

REACTIONS & CLOSING REMARKS

6.2. BIOGRAPHIES OF PANELLISTS, MODERATORS, AND RAPPORTEURS

SENIOR EXPERT AND WORKSHOP MODERATOR

Dr. Bronwynne Wilton is the Principal and Lead Consultant at Wilton Consulting Group in Fergus, Ontario, Canada. Bronwynne holds a PhD in rural studies and is experienced in managing comprehensive, full value-chain research and stakeholder engagement processes related to sustainability, innovation, strategic planning, regional agriculture, and food strategies. Bronwynne is the project lead for the development of the Canadian Agri-Food Sustainability Initiative (CASI).

OPENING PLENARY SESSION SPEAKERS

Margaret Bateson-Missen is the Head of Social Sustainability Unit in the Directorate General for Agriculture and Rural Development (DG AGRI) of the European Commission. This unit addresses such issues as plant health, plant protection products, and food labelling. Margaret is also the Equality Coordinator for DG AGRI. She joined the directorate-general in 1993.

Luis Carazo Jimenez is an Agricultural Engineer by training and a Master on International Trade. He had professional experience in the Spanish agri-food sector before joining the European Commission. For more than 25 years, Luis served in several market management units. He is currently the Head of the Unit in DG AGRI in charge of the Americas.

Dr. Benoit Girard is the Director General, Coastal Region in the Science and Technology Branch of Agriculture and Agri-Food Canada (AAFC). His mandate is to articulate the long-term vision and develop a collaborative strategy for a strong and competitive agricultural industry on the Atlantic and Pacific coasts. Benoit is a graduate of Laval University (B.Sc., food science and technology) and the University of British Columbia (M.Sc. and Ph.D.).

Andrew Owen Griffiths works for the European Commission's Directorate-General for Health and Food Safety. He is the Head of the Unit 'Plant and Organics,' which is responsible for audits in the areas of plant health, genetically modified organisms, organics, quality labelling schemes, and pesticides. The team is also responsible for the sustainable use of pesticides, including the ongoing review of the legislation in this area and reaching the ambitions of the Farm to Fork pesticide use and risk reduction targets.

Jordan Hancey is the Director of Policy and Regulatory Affairs at the Pest Management Regulatory Agency (PMRA) at Health Canada. He has nearly 25 years of public service working in PMRA, Transport Canada, AAFC, and Global Affairs Canada. He holds a master's degree in public administration from Carleton University and a master's degree in international affairs from the Norman Paterson School of International Affairs.

Gord Kurbis is Vice President of Trade Policy and Crop Protection at the Canada Grains Council, where he leads the development of policies and positions on domestic regulation and trade issues related to pesticide use and approvals. Gord has over 25 years of experience in the Canadian grain industry. He has also participated in senior roles at government/industry trade forums as well as technology-focused roles at the International Grain Trade Coalition and the International Agri-Food Network.

Kerstin Rosenow is the Head of the Research and Innovation unit in DG AGRI of the European Commission. She is responsible for programming, managing, and monitoring agricultural research under Horizon Europe and the European Innovation Partnership for Agricultural Productivity and Sustainability. Previously, she was Head of Unit in the European Commission Research Executive Agency, managing the implementation of the project portfolio for Horizon 2020 Societal Challenge 2.

PARALLEL BREAKOUT SESSION MODERATORS

Curtis Cavers is an Agronomist with AAFC located in Portage la Prairie, Manitoba. His interests and focus pertain to soil health, moisture management, landscape-based agriculture, crop productivity and sustainability. Prior to joining AAFC, Curtis worked for Manitoba Agriculture, Food & Rural Initiatives. There, he led programs pertaining to sustainable manure management, nutrient management, soil conservation, risk assessment of soils, water management, agronomy, and climate change.

Dr. Tassos Haniotis recently retired as Director for Strategy and Policy Analysis from DG AGRI of the European Commission. He is a member of the Scientific Advisory Board of two Horizon Research Projects. Tassos has an economics degree from the Athens University of Economics and Business and a masters and Ph.D. in agricultural economics from the University of Georgia.

Norman Jardine is a retired European Commission official, currently working in an Active Senior role. He is an experienced moderator and facilitator. As a senior member of the Commission's HR team, he has worked successfully in these roles with staff at all levels of the Commission and other institutions for the past 20 years.

Martin Laforest is a Weed Scientist at AAFC, located in Saint-Jean-sur-Richelieu, Quebec. He is studying herbicide resistance to understand the underlying mechanisms and provide diagnostic tests for early detection and rapid action. His research program also includes rapid weed identification using molecular barcoding, population genetic studies as well as novel weed control strategies.

RAPPORTEURS

Aymeric Berling is an Agricultural Engineer, specialised in crop protection. He worked several years in the French Plant Protection Service before joining the European Commission in 1995. Since then, he was active in several positions in both the plant health domain and the Common Agricultural Policy. Recently, he moved to the coordination of the Commission Directorate-General for Agriculture position on the pesticide files.

Dr. Hossein Borhan is a Research Scientist at AAFC's Research and Development Center in Saskatoon, Saskatchewan. He conducts genomic and molecular biology research on diseases of canola. He applies genetics, genomics, and molecular biology techniques to understand plant defense and pathogen virulence. Hossein graduated from the University of London, UK, in the field of molecular plant pathology.

Kathryn Makela is the Science Advisor for the Pest Management Centre (PMC) of AAFC, located in Ottawa, Ontario. Kathryn has over a decade of experience coordinating pesticide risk reduction strategies for a wide variety of crops. Prior to joining the PMC, Kathryn worked as a student and technician on numerous biological control projects in both Canada and at the CABI Centre in Delémont, Switzerland.

Gisela Quaglia is a Research Programme Officer at the European Commission. She contributes to the research and innovation agenda on plant health and plant protection in DG AGRI. Before joining this position in 2020, she was a Marie Sklodowska-Curie Ph.D. fellow (Horizon 2020) working on managing the environmental impacts of pesticides. Gisela is a chemical engineer with a Ph.D. in biosciences engineering from Ghent University.

PARALLEL BREAKOUT SESSION SPEAKERS

Sustainable crop protection: How do farmers get the most out of an IPM plan?

Dr. Odile Carisse is a Research Scientist, focused on plant pathology, at AAFC. She is based in Saint-Jean-sur-Richelieu, Quebec, and specializes in quantitative and molecular epidemiology. Using biovigilance as an approach, she develops alternative control methods to pesticides. Odile develops decision support tools based on state-of-the-art methods, including genomics, molecular biology, and modelling.

Felicidad de Herralde is a Researcher in the Fruit Production Program of the Institute of Agrifood Research and Technology (IRTA) in Catalonia, Spain. She has a Ph.D. in biology, and she is an expert on the ecophysiological responses of Mediterranean species to environmental – especially water – stresses. Her current research focuses on the study of the adaptation and mitigation of climate and global change of Mediterranean viticulture, from plant to vineyard to winegrowing region.

Wendy McDonald (Kostur) is an Independent Agronomist and Crop Consultant working with 360 Ag Consulting in Gilbert Plains, Manitoba. Wendy specializes in crop scouting, zone soil sampling, and variable rate fertilizer recommendations. Wendy has 24 years of agronomy experience working with Manitoba farmers and is a Professional Agrologist and a Certified Crop Advisor with a 4R Nutrient Management Specialist designation.

Nicolas Munier-Jolain is a Research Agronomist in the agroecology research unit at the Institut national de la recherche agronomique (INRAE) in Dijon, France. He has expertise in agricultural systems with low reliance on pesticides. He is coordinating the EU-funded IPMWORKS network of European farmers demonstrating cropping systems with low pesticide inputs. He is using a dataset describing details of IPM-based strategies in demonstration farms to produce knowledge on the cost efficiency of these strategies.

Laurent Oger is the Deputy Director General for CropLife Europe, and he also oversees regulatory affairs. After studying European law, Laurent worked for the French Agri Cooperative Association in Paris, then at the Brussels level. He joined the European Crop Protection Association in 2008, and the organization became CropLife Europe in January 2021.

Dr. Breanne Tidemann is a Research Scientist with AAAFC in Lacombe, Alberta. She holds a Master of Science and a Ph.D. in Plant Sciences, both from the University of Alberta. Breanne started with AAFC in 2016 as a Weed Scientist/Field Agronomist. Her research program focuses on the management of herbicide-resistant weeds, and integrated weed management strategies. She also has a few projects focused on the agronomic management of crops.

Judith Treis runs a farm in Germany. She studied agriculture at the University of Kassel and has gained a lot of practical experience in organic farming over the past 25 years. Judith grows cereals, legumes, potatoes, and vegetables. She is involved in agricultural European Innovation Partnership (EIP-AGRI) projects. Judith is also a member of the German government's dialogue network with the Ministry of Agriculture and Environment.

Dr. Tyler Wist is a Research Scientist with AAFC in Saskatoon, Saskatchewan. He holds a Ph.D. from the University of Alberta, and a bachelor of science and master of science in biology/entomology from the University of Saskatchewan. Tyler joined AAFC in 2016 as a Field Crop Entomologist. He works on many field crop insects. with most of his time spent on wheat midge, flea beetles and aster leafhoppers (in canola) and aphids (in cereals and peas).

Sustainable pesticide use: Mitigating the risks while balancing the costs in a changing climate

Pedro Ignacio Gallardo Barrena is a fourth-generation farmer in Andalucía, south of Spain. His farm business holds nearly 400 hectares, and his main crops are: sunflowers, rape seed, wheat, durum wheat and beans. He studied management at Cádiz University. Pedro is the Chair of Copa and Cogeca's Working Party on Pythosanitary Questions.

Johan Bremmer is a Project Manager and Senior Researcher with more than 25 years of experience. His research field is plant health economics with an emphasis on crop protection and phytosanitary policy and the development of methodology for the impact assessment of phytosanitary risks. He has led a research program on behalf of the Dutch Ministry of Agriculture in addition to several other international projects. Currently, he is coordinating the Horizon Europe research project SUPPORT.

Martin Dermine is the Executive Director of the Pesticide Action Network (PAN) Europe. Martin's expertise includes apidology, ecotoxicology, as well as pesticide regulatory science and alternatives to pesticides. Martin has a Ph.D. in pathology. Previously, Martin served as the Honey-bee Project Coordinator, and as a Health and Environmental Policy Officer.

David Doll moved to Portugal in 2018 to manage Rota Unica, a farming company in central Portugal. Here, he manages the field operations, finances, and general day-to-day tasks associated with growing tree nuts and other speciality crops. Previously, David served as an academic at the University of California, helping tree nut farmers.

Corey Loessin, his wife Joan and his son Aidan own and operate a 3500-acre grain farm in north central Saskatchewan near Saskatoon. The family grow spring wheat, canola, lentils, peas, barley, and oats. Corey holds a bachelor's degree from the University of Saskatchewan, and taught crop science at the University for 12 years. Corey is in his tenth year as a director on SaskPulse, as well as with Pulse Canada. Corey is also the past chair for both organizations.

Nevin Rosaasen is a fourth-generation farmer from eastern Saskatchewan where he continues to farm with his brother and parents. Nevin holds a Bachelor of Science in agriculture, agronomy with a minor in agricultural economics as well as a master of arts in international trade policy from the Middlebury Institute of International Studies at Monterey, California. Nevin works with Alberta Pulse Growers as their Sustainability and Government Relations Lead.

Rob Stone farms with his family near Davidson, Saskatchewan. They grow wheat, canola, and pulses in a no-till rotation. Rob is a farmer elected director on the board of the Sask Wheat Development Commission. This producer organization represents 25,000 wheat farmers in research, advocacy, and extension activities. Rob is active in his agricultural and local communities.

Tom Wolf lives in Saskatoon, Saskatchewan. Tom received his Ph.D. from Ohio State University. He has worked in spray stewardship research for 34 years, focusing on pesticide spray drift, efficacy, and waste management. He writes for and co-hosts the world's number-one sprayer website, Sprayers101.com.

6.3. NOTETAKERS

Name	Affiliation
Benjamin Vallin	Directorate-General for Agriculture and Rural Development
Betty Lee	Directorate-General for Agriculture and Rural Development
Kaara Smith	Agriculture and Agri-Food Canada
Ken Ellens	Agriculture and Agri-Food Canada
Mickaël Lepage	Agriculture and Agri-Food Canada
Mya Kidson	University of Manitoba
Neil Henry	Agriculture and Agri-Food Canada
Órla Ni Chuilleanain	Directorate-General for Health and Food Safety
Rex Horgan	Directorate-General for Health and Food Safety
Sierra Picard	Agriculture and Agri-Food Canada
Tim Mahler	Agriculture and Agri-Food Canada

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