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Experiential Knowledge and Interdisciplinary Approaches to Address Herbicide Resistance: Insights from Theory and Practice

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Experiential Knowledge and Interdisciplinary Approaches to Address Herbicide Resistance: Insights from Theory and Practice

Proposed sequential contributed paper sessions for the 20th ICABR Conference: Transforming the Bioeconomy: Behavior, Innovation and Science, Ravello, Italy, June 26 - 29, 2015

Organizers: David Shaw, Mississippi State University and David Ervin, Portland State University

Session Abstract

The exponential increase in herbicide resistant weeds around the globe poses a “wicked problem” that resists solutions developed from disciplinary science (Ervin and Jussaume; Shaw). Traditional voluntary education and technical assistance approaches have failed to stem the advance of resistance. Scholars and practitioners recognize that improved understanding of human behavior leading to more resistant weeds must provide the foundation of knowledge for innovating more effective approaches. Principles to negotiate progress on wicked problems stress interdisciplinary approaches that integrate frontier social and natural science concepts with stakeholder experiences to discover novel approaches (Sayer et al). Standard templates to address the problem in varying biophysical and socioeconomic settings will not capture the heterogeneity of production agriculture conditions across countries. This session presents papers on innovating constructive approaches to herbicide resistance through improved understanding of human behavior. Leading scientists and practitioners present their experiences with interdisciplinary approaches to uncover key human behaviors that drive farmer decision making related to herbicide resistant weeds. The papers emphasize the integration of experiential and scientific knowledge bases by stakeholders informing science and practice. Accomplishing this integration is necessary to innovate more effective public and private approaches for managing herbicide resistance that jeopardizes progress on advancing the bioeconomy.

Moderator:

David Ervin

Professor Emeritus of Environmental Management and Economics

Senior Research Faculty, Institute for Sustainable Solutions

Portland State University

Session 1 – Advancing Theory on Herbicide Resistance Management

1. David Shaw

Vice President for Research and Economic Development

Mississippi State University

Past President, Weed Science Society of America

Title: Interdisciplinary Approaches to the Wicked Herbicide Resistance Problem

Abstract: Sociologists define a wicked problem as one without clear causes or solutions, and thus difficult or impossible to solve. Herbicide resistance is the epitome of a wicked problem:

the causes are convoluted by a myriad of biological and technological factors, and are fundamentally driven by the vagaries of human decision-making. Weed scientists for decades have conducted research and developed educational programs to prevent or mitigate evolution of herbicide resistance, yet resistance is more prevalent today than ever before. If we expect to achieve success in herbicide resistance management, different approaches will be essential. “Doing something different” in this case is bringing rural sociologists, agricultural economists, weed scientists, and crop consultants together to discuss the decision-making process itself, community-based approaches to resistance management, economics of resistance management, potential regulatory and incentive programs, new approaches to educational programs, and diversification of weed management practices.

2. John Miranowski (jmirski@iastate.edu)

Professor of Economics

Iowa State University

Title: Behavioral and Socioeconomic Perspectives on Policy Interventions to Encourage Adoption of Resistance Management Practices: Why we do not observe what traditional production economics would teach us to expect and what are more effective policy options?

Abstract: Many suggested policy interventions to encourage adoption of resistance management practices (RMPs) are designed to provide farmers with pest control information, label requirements, and incentives to encourage adoption of RMPs. Even though traditional economics indicates that RMPs may payoff in the long term, many farmers fail to adopt RMPs. We will identify behavioral and socioeconomic factors, including understanding information, motivation, implicit costs, and risk and uncertainty that may account for non-adoption based on field observations in Iowa and other Corn Belt states. Given behavioral and other socioeconomic factors, what policy interventions (including community-action) may be most successful in getting individual farmers to adopt RMPs?

3. Ray Jussaume (jussaume@msu.edu)

Professor and Chair of Sociology, Michigan State University

Title: Ideology and Herbicide Resistance: How Individualism and Faith in Technology Motivate Dependence on Chemical Weed Control

Abstract: Glyphosate has been the most widely used herbicide in the United States for almost 15 years, with an ability, up until recently, to kill weeds quickly, cheaply, and relatively safely. However, the increasing level of glyphosate use, along with other contributing factors, has led to a significant decrease in the effectiveness of glyphosate for weed control. Additionally, replacing glyphosate with other herbicides is likely to result in weeds that evolve multiple forms of resistances. Focus group data collected in 2015 from growers indicate that individualism and techno-optimism are key components of a farmer ideology that may prevent the conceptualization and utilization of more integrated weed management. Responses to an interdisciplinary survey will assess whether these findings apply to the U.S. farming population.

Audience discussion

Session 2 – Integrating Experience from the Field on Herbicide Resistance

1. Amy Asmus (amy@afschem.com)

Certified Crop Adviser and Principal
Asmus Farm Supply, Inc
Rake, Iowa

Title: Herbicide resistance management considerations in the execution of crop production.

Abstract: For a grower and advisor, applying scientifically proven best management practices for a specific production issue, like resistance management, is rarely as easy as it seems.

Growers, along with trusted advisors and other stakeholders in their operations, must weigh the agronomic, economic, and social benefits of that practice against the effect on their entire production system. Solutions or compromises must be found by working together to integrate the issue of resistance management with tangible and intangible issues of production agriculture while ultimately addressing the diverse goals of the many partners engaged in a grower's operation.

2. François Tardif (ftardif@uoguelph.ca)

Professor of Weed Science, Department of Plant Agriculture
University of Guelph
Ontario, Canada

Title: New Technologies, Integrated Weed Management and the Fight Against Herbicide Resistance

Abstract: Integrated Weed Management (IWM) involves the use of various approaches to manage weeds. This is done in order to reduce the environmental impact of a single weed control measure and to prevent management issues such as herbicide resistance. In modern agriculture this means reducing reliance on herbicides as the sole weed control method. In order to be adopted by practitioners, IWM approaches need to be efficient while causing as little disruption as possible. Various new technologies may have different impact on the adoption of IWM and resistance prevention. For example, herbicide resistant crops confer many immediate benefits to growers that make adopting IWM less appealing. However, the widening access to information technologies and robotics may facilitate growers' adoption of integrated practices.

3. Dr. Carl Reinhardt (dr.charlie.reinhardt@gmail.com)

Extraordinary Professor of Weed Science
Department of Integrated Plant and Soil Sciences
University of Pretoria
South Africa

Title: Lessons learnt from research in the “South African Herbicide Resistance Initiative

Abstract: Thirty populations of *Conyza bonariensis* occurring across the winter and summer rainfall regions of South Africa were subjected to a range of glyphosate dosages in a greenhouse. ED₅₀ values that were calculated from dose-response relationships varied significantly between populations. Glyphosate use history revealed that high frequency

of glyphosate use, application beyond the label-recommended growth stage, and lack of diversity in herbicide mechanisms of action employed were linked to either high tolerance or resistance. A major factor identified as probably contributing to the evolution of glyphosate-resistant weeds is variable growth stage of the target weed in a particular cropping system. Other factors include non-adherence to label recommendations, not following prescribed steps in resistance management strategies, high reliance on a single or a limited number of herbicide mechanisms of action, in particular under zero-tillage practice. Preliminary DNA sequence analysis showed very little sequence differences between the different populations. Evaluation of the genetic relationships among the different populations with the construction of a phylogenetic tree showed no clear clustering of resistant or sensitive traits, indicating that resistance have probably evolved and been selected for multiple times across different populations rather than a single event that spread across the country. In final analysis, more attention must be given to the effectiveness of all weed control methods, and not just to the use of herbicides, in particular as to how ineffective weed management may contribute to the risk of herbicide resistance evolution.

4. Dr. Harry J. Strek¹ (harry.stek@bayer.com), Guillaume Chancrin², Marc Verbiest³, Dirk Kerlen⁴, Roland Beffa¹

Title: The impact of field demonstration programs in changing farmer thinking and behavior for weed resistance management.

Abstract: Getting farmers to change their weed control practices before resistance flares up in a field is a key challenge for all of us involved in weed control. As a company offering weed control products, we investigate complaints resulting from a lack of expected efficacy where resistance is suspected by using field visits, bioassays in the greenhouse and in-depth assays in the laboratory. The knowledge gained from complaints has been the springboard to developing insights into resistance evolution and the measures to counter it. We follow up such cases with recommendations on how to achieve sustainable weed control using management programs that integrate chemical and non-chemical measures. We communicate through various programs about the need to change weed management programs lacking diversity before resistance evolves. The success of such efforts, although valuable, has clearly not been impactful enough. What is required is a fundamental change in the thinking and the behavior by farmers and their key influencers, including private advisors and those from retail outlets, university and government extension services and traditional chemical manufacturers. Education is recognized as indispensable means to achieving this goal. While analyses of the resistance status of individual fields is a valuable tool and service which works in many cases to effect a change in farmer behavior, all too often it alone is not enough. This analytical approach needs to be complemented with something more persuasive.

One of our most successful tactics at Bayer CropScience has been what we refer to as our “platform” studies. They are longer-term, generally 3 to 5-year, studies that compare and contrast weed population and resistance evolution in large-plot field trials that serve as demonstration platforms for the effectiveness of integrated management programs at sites with resistant weeds. They are carried out by country field development organizations with the support of the Weed Resistance Competence Center in Frankfurt, which provides comprehensive analyses of the resistance profile of a field over the multiple years of the study.

We also play an advisory role in the management of resistant weeds at the site. The platform studies have been a bit hit. Some farmers like to visit over several years and see for themselves the effects of the various tactics, and more importantly, how they work together in an integrated program to help manage weeds, reduce selection pressure for resistance and preserve the yield potential of their crops. We have conducted such trials in France and Belgium, and we are in the process of conducting one in Germany, and a new one in France. How the trials are conducted and shown will be presented, as well as their effect on weed control programs of farmers who have visited them.

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- 2 Bayer CropScience, Lyon, France
- 3 Bayer CropScience, Belgium
- 4 Bayer CropScience, Langenfeld, Germany

Audience discussion

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