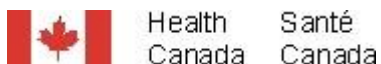


Book of Proceedings

Pest Resistance Management Workshop



February 19 - 20, 2008
Fairmont Chateau Laurier
Ottawa, Ontario



**Produced by
The Intersol Group**

The Pest Resistance Management Workshop was a collaborative effort between Health Canada's Pest Management Regulatory Agency and CropLife Canada. The planning and organizing committee:

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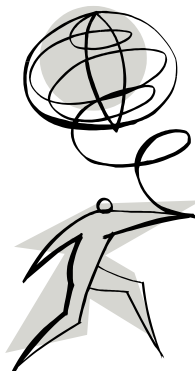


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B. EVENT SUMMARY

On February 19 – 20, pest management scientists, agricultural extension specialists and resistance management experts assembled to tackle the challenge of pesticide resistance and its management. The workshop was an opportunity for scientific experts and practitioners to discuss leading edge research results and share best practices for herbicide, insecticide and fungicide pest resistance management options from around the world.

The design of the workshop provided the opportunity to share knowledge, discuss applicability and to work collaboratively on some of the more promising resistance management opportunities within the three categories of herbicides, insecticides and fungicides.

The invited list of resistance management experts who shared their research work with the workshop participants:

Dr. Hugh Beckie
Research Scientist, Herbicide Resistant Plants
Agriculture and Agri-Food Canada

Dr. Galen Dively
Professor, Integrated Pest Management
University of Maryland

Professor Ulrich Gisi
Research Fellow
Syngenta Crop Protection AG

Professor David Wallace Onstad
Associate Professor, Natural Resources and Environmental Sciences
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Professor Steve Powles
Professor and Director School of Plant Biology
University of Western Australia

Dr. Dale Shaner
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Dr. Walt Stevenson
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Dr. Wayne Wilcox
Professor, Department of Plant Pathology
Cornell University

Dr. John Wise
Associate Professor
Michigan State University

C. AGENDA

FEBRUARY 19

8:30 Plenary Presentations

12:00 Lunch

1:00 Expert Breakout Sessions and Group Discussions

- Insecticides
- Herbicides
- Fungicides

4:30 Wrap Up

FEBRUARY 20

8:30 Expert Breakout Sessions and Group Presentations

- Insecticides
- Herbicides
- Fungicides

12:00 Lunch

1:00 Plenary Group Presentations and Discussion

2:30 Wrap Up and Closing Remarks

APPROACH

Over the course of the morning, six of the nine scientific experts presented to the workshop participants. The initial panel of three presenters shared their views on the options currently available for resistance management. The second panel discussed how to ensure the sustainability of pest management strategies.

After lunch, participants moved to separate breakout rooms which focused on one of the three resistance management categories; herbicides, insecticides or fungicides. These groups had the opportunity to hear from an additional scientific expert focused on that specific category as well as from a PMRA representative to better understand the regulatory process for and requirements for pesticides. The PMRA representatives were Mr. Pierre Beauchamp, Mr. Michael Downs and Ms Andrea Martin.

Following a group discussion, participants generated a list of resistance management opportunities based on the discussions and presentations they had during the day. Each table sub-group of participants was then able to spend time to discuss the specific resistance management opportunity. Specifically, each sub-group was asked to describe the specific opportunity they had chosen, its methodology/approach, risks and constraints, risk mitigations and finally, any specific recommendations regarding the opportunity

On day 2, sub-groups shared their respective results and then worked together to respond to the question "From a Canadian agriculture perspective, which resistance management strategies should we focus on and why?"

This book of proceedings captures the results of these breakout discussions. Copies of expert presentations are under a separate attachment.

D. BREAKOUT GROUP - INSECTICIDES

Resistance Management Experts: Dr. Galen Dively Andrea Martin Dr. John Wise Prof. David Wallace Onstad	Facilitator: Frank Van Gool
Risk Management Opportunities:	
<ol style="list-style-type: none"> 1. Enhanced definition of roles and responsibilities of stakeholders with respect to resistance management 2. Specific regional approach 3. Increase or maximize the number of modes of action to the grower 4. Monitoring to delay the onset of resistance 5. Improved awareness of the importance of IRM through education 6. Improve definition of rates by delivery method 7. Ensure end-users are aware of RM strategies and adopt them 	

GROUP 1: Enhanced definition of roles and responsibilities of stakeholders with respect to resistance management.

Methodology/Approach:

Clearly outline who the stakeholders are and what they need to do in order to develop/implement a RM strategy

Stakeholder Roles

Government (Federal/Provincial/Municipal):

- Harmonize product registration policies with resistance management strategies (ie/ register 2 new products in different chemical classes at same time to allow product rotation....particularly for those commodities/pests where product choices are few)
- Provide "incentives" for farmers, producer groups etc including incentives to industry to develop and implement RM strategies/tactics (ie/ grants, tax incentives, in-kind support etc)
- Provide grants and contributions for new research in RM
- Identify RM research as a priority in government S&I strategies
- Conduct "long-term" research in RM that private industry is unlikely to do due to long time frame and/or lack of ROI (research that the private sector can not do at a profit)
- ensure the results of the RM research are presented in a manner that can be easily understood and distributed to the end user
- provide support where possible for private/regional efforts to implement RM strategies/tactics
- Re-examine the "labeling" of pest control products such that an emphasis can be placed on user friendly instructions versus a "legal" label (ie/ user instruction sheet that includes RM practices etc that match up with provincial publications)

Industry:

- Continue to support research on RM through both in-house activities and through provision of research grants/contributions to the private sector, university or gov't research organizations
- Develop new chemistry that results in new products and new chemical classes to supplement existing products for rotation tactics and to reduce resistance selection pressure

- Partner with gov't, private, and university researchers to develop more effective RM strategies/tactics
- Collaborate with regulatory agencies (PMRA) in a re-examination of current pesticide labeling to provide better information for the user on pesticide use and RM.
- Continue leadership role in the Resistant Action Committees (RAC's)

Universities:

- Support research into RM by focusing on development of diagnostic tools, modeling, discovery (platform) research in RM.
- Provide undergrad and post grad training in RM as core course requirements in IPM curriculum
- Train graduate professionals (researchers) in RM
- Compete in RFP's in RM research calls
- Participate in RAC's with industry and gov't

Resistance Action Committees (RAC's):

- Take the lead on dissemination of information on RM by partnering with other organizations (provincial extension, university services, regulatory communications)
- Assist research providers in developing specific RM tactics for specific crop/pest complexes and products
- Take the lead in coordinating and integrating activities in resistance action committees by working with other organizations (local, regional, national) that are generating new knowledge and information on resistance management and sustainable pest management.

Grower/producer/commodity groups:

- Take the lead for regular direct communication with group members to provide, promote and instruct knowledge on RM tactics
- Support the concept of integrated crop management by promoting use of sustainable crop protection practices as provided in IPM programs
- Focus on long-term pest control issues versus short term (last season) concerns.
- Take a lead role in providing or partnering in educational activities with members (workshops, seminars, demonstration events etc) and emphasizing the collective commodity/producer group responsibility and rewards for practicing RM.

Farmers:

- Follow label directions in the use of pesticides
- Use sustainable pest control practices including IPM to reduce pesticide use
- Participate in development of an environmental farm plan and the use of BMP's for pest control
- Become knowledgeable about RM practices in relation to the crop and pest complex for their farm (implement available tactics for RM whenever possible)
- Support their producer/commodity group efforts in RM activities
- Be open and receptive to new techniques and approaches to pest control

GROUP 2: Specific Regional Approach

Methodology/Approach:

- Internationally harmonize the basic tools used to develop the RM strategy (i.e. use IRAC, or FAO, etc)
- Develop a range of RM strategies at the national level (i.e. PMRA) through a rationale/data
- Address specific regional needs at a local level through a 'working group' which includes provincial extension; growers groups, commodity groups, conservation groups; & industry. They will generate and implement a more specific plan based on the RM strategy range provided by PMRA

Risks and Constraints:

Risk/Constraint: submission of additional data will increase PMRA workload & require interpretation

How to Address: allow company to provide interpretation/summary of the data as opposed to another large data requirement

Risk/Constraint: what is the incentive/benefit for the grower's group to organize the working group?

How to Address: ???

Risk/Constraint: no membership to IRAC, FAO, etc.

How to Address: encourage Canadian companies to join/participate in IRAC, FAO, etc.

Risk/Constraint: regional level committee must maintain their link to IRAC, etc in order to have access to their database

How to Address: make industry IRAC rep a member of regional RM Strategy committee

Recommendations:

- Get Canadian industry involved in IRAC or FAO; etc
- Work with PMRA to help develop national RM strategy
- Develop regional RM Strategy

GROUP 3: Increase or Maximize the number of Modes of Action to the grower

Methodology/Approach:

- Research what chemistries are around the world and see if they can be brought into Canada
- Go directly to registrants to see what chemistries they have
- Use various search engines (CDMS, HOMOLOGO), may need growers and grower associations to fund the user pay search engines to aid in finding chemistries throughout the world
- Continue to maintain current chemistries MOA's (old or new)
- Growers and grower associations would be the ones that drive the needs
- Promotion of joint and global reviews (NAFTA, OECD)
- More scientists doing more testing and review (General / Registrants)
- Increase the number of employees to speed up registration process (PMRA)
- Perhaps force the registrants to take the advantages of joint or global registration

Risks and Constraints:**Pros:**

- Having more MOA's should delay the onset of resistance
- Allows several options for the grower to control pest problems
- A competitive market place is maintained
- New chemistries are very specific and targeted

Cons:

- Continue to use old (high risk) chemistries
- Possible trade issues with other countries, or consumer units
- Higher cost the registrant → Higher cost to the grower → Higher cost to the final consumer
- Lack of qualified people to do all this work
- Grower associations will have their own agenda (squeaky wheel gets the grease)
- Who sets the priority?
- New chemistries are very specific and targeted

Recommendations:

- Through higher wages and incentives have more qualified individuals work in government positions (PMRA)
- Have the reviews be done by private contracts (speedier / cheaper??)
- Strongly encourage registrants to go through global reviews from this point on
- Give the registrants an incentive to have their chemistry registered in Canada, especially if addresses transition strategy items

GROUP 4: Monitoring to delay the onset of resistance**Methodology/Approach:**

- Strong producer/grower network
- High value crop with key pest(s) having high potential (history) for resistance, low threshold for damage
- Method of information distribution (grower meetings, newsletters, reports with company approval); time sensitive
- Required (regulated?) baseline susceptibility data for novel active ingredients before registration w/standardized protocol
- Financial support (gov., company, grower group)
- Regional "hotspot" sites; annual/biannual sampling
- Establish action threshold for mitigation (constraint?)

Risks and Constraints:

Risk/Constraint: \$\$\$\$\$\$

How to Address: involve all stakeholders and demonstrate worth

Risk/Constraint: Coordination and allocation of responsibility

How to Address: Regulation (?); demonstration of worth; incentives to stakeholders

Recommendations:

- Baseline susceptibility of all new active ingredients for high risk pests be part of the registration requirements
- Follow-up monitoring be conducted on a pre-determined interval to detect shifts in susceptibility
- Methodology for testing be standardized
- Effective communication channels must be established to disseminate information on shift in susceptibility to growers and others
- Pesticide resistance management be a part of IPM

GROUP 5: Improved awareness of the importance of IRM through education**Methodology/Approach:**

- Improve labels
- Implement pilot/demonstration projects
- Add more IRM information to AAFC Crop Profiles
- Bring about IRM information flow from companies to distributors and grower groups

Risks and Constraints:

Risk/Constraint: Who will fund pilot projects? Who will carry them out?

How to Address: AAFC research branch and industry have some responsibility to fund/carry out such projects.

Risk/Constraint: How can label statements be enforced? Mandatory label statements require agreement from registrants.

How to Address: Canadian Horticulture Council and other grower groups can get information to growers. Registrants can be addressed through Crop Life.

Recommendations:

Improve labels

- Provide expanded, more specific wording on IRM language in resistance label statements.
- Update DIR99-06.
- Create a chart on IRAC website similar to the FRAC grid.
- Make resistance management labeling mandatory.

Implement pilot/demonstration projects

- Use experimental research permit process prior to registration to study IRM techniques.
- Do pilot projects with products that are already registered, e.g., experiment with refuge areas.

Expand AAFC Crop Profiles

- Create an IRM section for each crop profile.
- This may require additional expertise or input.

Flow of IRM information from companies to growers

- Registrants can discuss IRM and good stewardship at their meetings with grower groups.
- Discussion of IRM can go on Crop Life's agenda.
- Crop Life, as a united front, can promote good stewardship.
- Key influencers can encourage growers to practice IRM.

GROUP 6: Improve definition of rates by delivery method

Methodology/Approach:

As a technical cross-functional group, come to a consensus on most appropriate definition of "Effective Rate" by target and crop market (incorporate a safety factor that accounts for field variables i.e. robust rate where consistent performance is expected under a series of growing and environmental conditions, when label directions are followed)

Considerations:

Relevant expression of rate (examples)

- Foliar sprays (tree fruit and vegetable): g ai/ 100 L and limits on max amount of A.I. per ha (to ensure optimal coverage by crop stage)
- Transplant drenches: g ai/1000 transplants (accounts for density differences and ensures precision of rate per plant)
- Seed treatments: g ai/ 100 kg seed (again, accounts for density differences and ensures precision of rate per plant)
- In-furrow: g ai/100 meters of row
- Others: as appropriate to provide better directions of use to grower and avoid excessive residual control (i.e. season-long control) or ineffective or variable rates

Requirement for Baseline Susceptibility data prior to launch

- Tool for resistance/ cross-resistance risk assessment
- Tool for segregating/ defining effective rates by different geographies where resistance frequency may be higher
- It would be most helpful to create accessible database with documented cases of resistance by species, crop, and region (county?) – standardization to generate this reference database will likely be discussed by group working on “monitoring methods”

Explore how to enforce improved clarity in language on the label

- How to define and measure residual activity and implement enforcement
- Greater regulatory restrictions → greater workload? More costly? Not possible for smaller registrants? May impact speed of registration and or availability of new actives in specific markets?
- Resources at company level: expense, time, and need for additional data packages

Recommendations:

- Standardize definition of rates by delivery method and implement at label level
- Foundation for better directions for use and education based on understanding of how to best use each a.i.
- Restrict residual activity to acceptable levels based on IRM principles

GROUP 7: Ensure end-users are aware of RM strategies and adopt them**Methodology/Approach:**

- Identify key stakeholders
- Need to have a Working Group in place at the national level (built on existing PMRA Sustainable Pest Management Section)
- Identify high risk crops/pests/pesticides
- WG define scope of project, gather information from various sources leading to a specific detailed strategy
- Delivery to end-users
- Ensure adoption

Risks and Constraints:

Risk/Constraint: Priority setting for projects

How to Address: Use PMC forum and dedicate some time on each day

Risk/Constraint: Resources commitment

How to Address:

Risk/Constraint: Adoption by end-users

How to address: Repetition, consistency across all info delivery channels, enforcement, incentives, and penalties, regulation, prescription

Recommendations:

- Determine leadership
- Develop a process for priority selection
- Develop strategies
- Deliver as close as possible to decision point (end-user)

E BREAKOUT GROUP - HERBICIDES

Resistance Management Experts: Dr. Hugh Beckie Michael Downs Prof. Stephen Powles Dr. Dale Shaner	Facilitator: Raymonde D'Amour
Risk Management Opportunities:	
<ol style="list-style-type: none"> 1. Label statement / warning against reduced use rates / robust rates / effective rate (consider resistance management) / effective use rates 2. A total approach management system (IMM) Economics / agronomics and crop; Rotation / diversity of management practices 3. Evaluate resistance management and benefits and incorporate into the review process for new and existing products 	

GROUP 1: Label statement / warning against reduced use rates / robust rates / effective rate (consider resistance management) / effective use rates

- Optimum rates + varied agronomic practices can have a major effect on reducing the seed weed population and slowing the spread of resistance
- Resistance Management needs to be part of the process of determining label rates
- We need to stop the enrichment of the resistant weed population

Methodology/Approach:

- Label wording
- Public awareness campaigns
- Reduction in weed numbers – “stop experimentation around rates”
- Start Clean, Stay Clean
- Farmers are playing the rate game – how low can we go?
- Determine the # of Jugs purchased versus acres being sprayed
- Training of custom applicators
- We do not understand the adverse effects of resistance management
- Need to understand what is sustainable for the future
- Joint Industry and Government

Risks and Constraints:

Risk/Constraint: Credibility – who provides the message

How to Address: Trusted - Extension specialists, scientists and independent researchers

- Need to be like the antibiotic resistance campaign
- Grower themselves can carry the message
- Needs to be an industry wide initiative

Risk/Constraint: Carrot versus the Stick – which do you employ; what is the benefit?

How to Address: Benefit – need to have the data in regards to weed resistance management

- Stick – currently PMRA resources focused on higher risk non-compliance activities (only if use unregistered uses)
- No compliance in the use of lower rates – need to established - “the fear”

Risk/Constraint: Where do we find the resources

How to Address: Interest of both parties – CropLife and Government – easier to find resources

Risk/Constraint: What is the economic incentive

How to Address: Economic Incentive – low weed numbers, fewer wrecks, fewer complaints, continue to use products that fit their operations and more scrutiny in regards to registrants in giving product when there is a complaint when it is due to lower rates

Risk/Constraint: How do we measure success

How to Address: Fewer resistant weeds, reduced number of complaints, awareness before and after, less dockage

Risk/Constraint: Concerned about the issue of Big Government looking over your shoulders; PMRA doesn't want to be seen 'in bed' with CPC; What about the anti pesticide lobby

How to Address: No information provided

Recommendations:

- Joint public awareness campaign around the use of registered rates from the perspective of weed resistance (example of triple rinsing, chemical container disposal, and antibiotic resistance management). Successful campaigns are based on the messenger being trusted and the message being brought forth repeatedly.
- Low use rate warnings – label wording – poster child (weed)
- This needs to be done in conjunction with proper management practices (crop and herbicide rotation)

GROUP 2: A total approach management system (IMM) Economics / agronomics and crop; Rotation / diversity of management practices

Methodology/Approach:

- Package of info; use it to train the trainers; consistency of management of message; localize the information; cooperative work (demonstrations)
- More explicit explanation of why the label rates exist (on labels; in provincial guides)
- Better risk communication (something very visible on the box)
- Label and the farmer (who does farmer get info from?; this is the person to target)
- getting farmers to share their information - challenge
- "Model" farm approach – share information

Risks and Constraints:

Risk/Constraint: Consensus on main message (trainers, farmers implementing)

How to Address: Value of cooperation (eg. Meetings such as this)

- "model" farm – demonstrate the message
- All players must say the same thing
- Use a model like the soil conservation one – challenge: less extension to carry message

Risk/Constraint: Extension service less prevalent in the field

How to Address: CropLife the central group? Technical tools (ie. Internet; industry people)

Risk/Constraint: Farmer resentment to license requirements

How to Address: Farmer needs to see value (reward, rebates, tax refund, etc.)

Recommendations:

- CDN body (CropLife) to pull the consistent message
- Needs to be a positive message (make more \$\$)
- Companies (contributing \$ to “cause”) – farmers understand their place in the chain
- PMRA
 - can modify labels (this is where regulatory can influence)
 - Sustainability Division may be helpful
 - Give presentations keep up with the message

GROUP 3: Evaluate resistance management and benefits and incorporate into the review process for new and existing products

Methodology/Approach:

- Resistance management strategy as a data requirement resulting in label statements
- Develop resistance management guidance document (stakeholders)
- Develop policy to allow expedited review time (emergency minor use, new mode of action (MOAs), resistance management strategy) optional
- BMP – resistance labelling (specific)
- Strategy utilizes the database

Risks and Constraints:

Risk/Constraint: Increased costs (guidelines, data); Develop and maintain the database

How to Address: Expedited review – sooner to market; Longevity of the product

Risk/Constraint: Potentially increased liability

How to Address: Label statement – best management practices (recommendations)

Recommendations:

- Develop and maintain a national “resistant weed” database
- Publish a resistance management guidance document
- Seek policy approval for expedited review based on the resistance management strategy

GROUP 4: Educating growers and retailers on herbicide resistance management

Methodology/Approach:

- certification and licensing of farmers for pesticide application
 - Module on resistance management
 - Sprayer calibration clinics
- Awareness campaigns for stewardship practices
- Communicating the herbicide risk triangle
- Education on new technologies (GPS, GIS, etc.)

Risks and Constraints:

Risk/Constraint: Farmer resentment to license requirements

How to Address: Farmer needs to see value (reward, rebates, tax refund, etc.)

Risk/Constraint: Who will establish and enforce the education program

How to Address: Value to maintaining Canada's reputation of high quality, safe food. Federal and Provincial government should establish and enforce

Recommendations:

- Awareness campaigns
- Reward for farmer compliance
- Initiate F-P-T committee on pest resistance management
- Development of training module
- Development of reward system
- Enforcement through sale of product as farmer needs certificate to purchase

F. BREAKOUT GROUP - FUNGICIDES

Resistance Management Experts: Dr. Walt Stevenson Pierre Beauchamp Dr. Ulrich Gisi Prof. Wayne Wilcox	Facilitator: David Reid
Risk Management Opportunities:	
<ol style="list-style-type: none"> 1. In-depth provincial spray guidelines with more focus on resistance management 2. Adding more minor uses to old/new actives to gain more access to new MOAs 3. Encourage practices that will reduce disease pressure 4. Monitoring Resistance 5. Monitoring Resistance (2) 6. (A)Increase the opportunity to register tank mixes and (B)enhance the availability of control options of all kinds 7. Provide flexibility in registration for more robust application rates at initial product release; to minimize development of resistant pathogens. 	

GROUP 1: In-depth provincial spray guidelines with more focus on resistance management

Methodology/Approach:

- Get groups like Western Forum and CropLife involved
- Grower-friendly format
- Provincial guidelines, because different uses are recommended in different regions
- Ultimately, develop an expert system for crop solutions.

Risks and Constraints:

Risk/Constraint: Growers won't use the info if it's too long or complex.

How to Address: Expert system to provide a 'recipe', but opportunities to burrow down to look at alternatives.

Risk/Constraint: Expensive and difficult to keep updated, and to maintain accuracy in a simple format.

How to Address: Need a third party (e.g., WFPM) to pull existing info together.

GROUP 2: Adding more minor uses to old/new actives to gain more access to new MOAs

Methodology/Approach:

- Add incentive to registrants (data protection)
- Base on EPA/OECD reviews and have PMRA ID data gaps (workshare) and approve conditional registrations.
- Encourage pre-subs for all new Cat A (new actives) to identify minor use opportunities

Risks and Constraints:

Risk/Constraint: Getting data (MRL and efficacy)

How to Address: Start looking towards EU and greenhouse data to extrapolate to field data

Risk/Constraint: Marketing pressures/Cost vs returns, R&D budget, PMRA priorities

How to Address: PMRA hire new staff

GROUP 3: Encourage practices that will reduce disease pressure

Methodology/Approach:

- Science-based education (sprayer technology, such as how pesticides are mixed, how they are applied spray coverage)
- Sanitation practices, including appropriate rotational crops
- Understand biology of the pathogen (source of inoculum, etc)

Risks and Constraints:

Risk/Constraint: Lack of people to help with education-based approach

How to Address: Educate students; strengthen plant pathology programs

Risk/Constraint: Perceived time and cost for growers

How to Address: Encourage buy-in on part of growers with team approach

GROUP 4: Monitoring Resistance

Methodology/Approach:

- Define goals of monitoring for resistance (population studies; evaluate resistance management programs)
- Identify cooperators (extension / university researchers, etc.) to collect isolates
- Send isolates to industry or researchers for baseline sensitivity testing (goal: to increase number of isolates on w/c to conduct baseline sensitivity)

Risks and Constraints:

Risk/Constraint: Finding collaborators for the Project; funding; movement of isolates across borders; intellectual property issues

How to Address: Education: make sure everyone is on board; growers association; regulatory agencies; industry; federal organizations (stakeholders should share in the cost);

formal agreements between cooperators should be reached to address IP issues; Do testing “in-house or extract DNA and ship this material (if a molecular analysis tool is available to evaluate resistance)

Recommendations:

- Use results of baseline sensitivity studies to identify recommendations for growers
- Use knowledge of resistance development to develop resistance management strategy for the pathogen
- Target educational programs based on results of surveys
- Prioritize pathogen active ingredient combinations that will be included in these studies
- Provide more tools (i.e. fungicides with different MoAs; biologicals; resistant varieties) that will contribute to resistance management

GROUP 5: Monitoring Resistance (2)

Methodology/Approach:

- Monitoring shifts in baseline over time:
 - Targeted representative sample of growers based on several variables:
 - Geography, disease pressure, “Good” & “bad” growers, etc.
 - Purpose = Probabilistic predictions based on trends and/or at least educate growers based on knowledge gained.

Risks and Constraints:

Risk/Constraint: Establishing the “representative” sample so that predictions can be made is not easy (sampling issues)

How to Address: Need to think about how to select growers and frequency of sampling.

Risk/Constraint: Cost & resources

How to Address: Crop and pathogen specific: choose combinations that have impact and are at risk. Choose commodities based on availability of alternatives.

Risk/Constraint: Monitoring methodology is problematic

How to Address: Molecular = when mechanisms known; Bioassay = potentially more expensive but can handle “unknown” resistance mechanisms.

Recommendations:

- Make monitoring part of registration process
- Prioritize certain crop/pathogen complex
- Costs= registrant + government + commodity + processor for monitoring?
- Educate growers based on results
- Make regulatory adjustments during product life span based on monitoring results.

GROUP 6: (A) Increase the opportunity to register tank mixes and (B) enhance the availability of control options of all kinds

Methodology/Approach:

(A)

- Change regulatory requirements for tank-mixing, so that the test requirements are to show a lack of adverse effects when tank mixes are within currently registered uses for both actives
- The inclusion of tank-mix label instruction would allow increased discussion, and recommendation of such practice as a means of forestalling or overall reduction of resistance development
- If labeling is registered, company(s) bear burden of liability, and growers get firm instruction

(B)

- Define which options?
 1. Chemical
 2. Non-chemical
 3. Crop Management
 4. Genetic-(Plant Resistance)
 5. Education/Training/Extension
- Build compelling multi-stakeholder case for each option, with pro/con options, cost implications, value/benefit statements, including the following points:

Risks and Constraints:

Risk/Constraint: Companies reluctant to cooperate with tank mix partners

How to Address: Build economic argument of increased product longevity

Risk/Constraint: Grower reluctance to assume higher costs of label-rate tank mixes

How to Address: Need compelling cost/benefit arguments

Risk/Constraint: Constraint of regulatory changes needed

How to Address: Build case on need to address resistance, show how change will decrease pesticide use/risk EG reduced energy use, less exposure opportunities etc.

Recommendations:

- Determine who does what?
- Create a multi-stakeholder group to build a compelling argument at political level
- Need buy-in from all parties to show benefit to greater Canadian public for suite of suggestions
- Stakeholders should include representatives from:
 1. Growers
 2. Registrants
 3. Research community
 4. Regulatory officials
 5. NGOs
 6. General public

GROUP 7: Provide flexibility in registration for more robust application rates at initial product release; to minimize development of resistant pathogens.

Methodology/Approach:

- A need to have PMRA's philosophy reflect potential resistance development with respect to setting of the Lowest Effective Rate; ie more robust rates to reduce resistance risk. This taking into account pathogen types, environmental situations, historical data on pathogen and or similar chemistry
- Testing of isolates relative to sensitivity to provide for the range which could be expected in the field, thus providing a potential to link the field data which represents the broad spectrum of 'wild types' to the rate which would be appropriate to limiting the risk of resistance development

Risks and Constraints:

Risk/Constraint: Ability to test isolates and validate the results

How to Address: Higher costs involved

Risk/Constraint: Over estimation of the upper rate, thus putting too much product in the environment

How to Address: Need to be able to drop the upper level with ease once the full risk assessment on resistance has been determined; in case of over estimation

Risk/Constraint: May put the product in the "red" relative to environmental or health issues; including constraints to application numbers, timings, locations, buffer zones etc.

How to Address: Run risk assessment at different rates which would include 1x and 1.5x minimum effective rate to determine the risk of the more robust level.

Recommendations:

- see Risk and Constraints
- Establish a cross functional committee including the regulators, industry and research communities

G. PLENARY PRESENTATIONS

As a final task in the breakout groups, participants were asked to sum up their discussions on pesticide resistance management with the following question:

“From a Canadian agriculture perspective, which resistance management strategies should we focus on and why?”

Each breakout group prepared a short presentation in response to the question. They follow:

INSECTIDES:

Resistance Management Opportunities

- Specific Regional Approaches
- Define the Role/Responsibilities of the Stakeholders with regard to RM
- Increase or Maximize the number of Mode of Actions to the grower
- Improved awareness of the importance of IRM through education
- Ensure end-users are aware of RM strategies and adopt them
- Monitoring to delay the onset of resistance
- Improve definition of rates by delivery method
- Increase non-chemical management strategies
- Better understanding of pest biology

Areas to Focus

- Prepare a broad RM strategic framework that is led and supported by gov't (PMRA, AAFC)
- Create a National working group to identify priority/high risk situations (PMAC?)
- Strategy for education across the country
(utilize a database of contacts, certification of retailers)
- Non-chemical strategies

Areas to Focus (2)

- Develop solutions with a regional focus with stakeholder collaboration
- Initiate pilot projects to demonstrate feasibility of IRM approach
- Make RM a priority for Ministers (AAFC/HC)
- Encourage/incentivize global registrations
- Ensure RM is an essential component of IPM

Areas to Focus (3)

- Prioritize and target research needs for RM and including baseline monitoring
- More resources to the provincial extension level
- Update and revise Directive 99.06 to include our recommendations
- Consider management language for labels

HERBICIDES:

Strategy: To foster awareness and the use of best management practices through stakeholder education

- Education is all encompassing (growers, extension, consultants, agronomists etc)
- Focus on best agronomic practices and profitability
- We deliver a common “positive” message
- Encourages prevention
- *How?*
 - Certification of applicators and upgrading certification of agronomists
 - National database and modeling
 - One-stop information shop (web-site, web forum, web training)
 - Environmental farm stewardship planning
 - Case studies and scenarios
 - Right rate, right time
 - Diversity

Strategy: Incorporate pest resistant management principles into the value assessment process (regulatory)

- This is a top down approach that is driven by the regulator and crop protection companies
- This could accelerate the introduction of new management tools or facilitate the maintenance of old tools
- Could provide an “optional” approach for assessing value
- There is an opportunity for a more consistent message
 - Label wording pertaining to resistance management

FUNGICIDES:

Develop Tools

- Regulatory changes to facilitate:
 - Tank Mixes
 - Appropriate rates
 - More control options
- Application Technologies
- IPM strategies- all aspects!
- Educational/training materials (including web-based)
- Research into genetics for resistance, non-chemical controls, resistance strategies, etc.

Develop Means to Implement The Use of the ‘Tools’

- Develop and deliver ‘Expert Systems’

- Develop better Production Guides and grower educational opportunities
- Implement national approaches to things like Mandatory Grower Certification

After the 'Beginning'

- Ensure long term oversight of each approach to ensure they are current, and effective
- Have an available resistance monitoring network to keep track of the current status of all disease management tools
- Continue to review and update all guidelines and educational approaches
- Ensure a 'Systems Feedback' is in place

What Do 'We' Need To Do To Accomplish All of The Above?!

- Funding! Short, med. And long term commitments
- Training and educational materials, and delivery mechanisms
- Last, but MOST Important!
 - Buy-in and collaboration from: Growers, registrants, regulatory officials, delivery agencies, researchers, buyers (Retail, processors) NGOs, and 'The Public' .