PEST RESISTANCE AND NEW REALITIES FOR SPRAY APPLICATIONS

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Goal Today

- Present some trends in agricultural pest management and reflect on their impact on equipment needs in the future
 - Herbicide resistant weeds
 - Insect resistance to Bt crops
 - Neonicotinoid insecticide impacts on pollinators
 - New biotech solutions coming
 - New machinery technologies
 - Tillage and cover crops

Adoption of genetically engineered crops in the United States, 1996-2013



Source: http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx



Corn Acres Treated with Insecticide as % of Planted Acres

- Steady at 25%-30% until 2004, why the big decline?
 - Rootworm Bt corn?
 - ECB suppression?
- What about rootworm Bt seed treatments?
 - 40% of 2010 acres were rootworm Bt corn with a neonicotinoid seed treatment



Source: USDA Ag Chemical Use Database and ARMS

Herbicide Use on Corn



Main Points

- Soil and foliar applied insecticide on corn decreased with adoption of Bt corn
 - ECB suppression, RW Bt substitute for insecticides
 - Neonicotinoid seed treatments
- Herbicides have shifted heavily to glyphosate
 - Eroded acreage share of atrazine on corn
 - Similar effect on soybeans to glyphosate
- Positive human health and environmental benefits
- Less pesticide spraying with traditional equipment
- Achilles Heels have appeared
 - Pest resistance
 - Pollinator impacts

Distribution of Herbicide Resistant Biotypes

Source: Dr. Ian Heap www.weedscience.com

Source: <u>http://ecodevoevo.blogspot.com/2010/05/rounded-up-no-varmints-got-away.html</u>

Pioneer's Map of Glyphosate Resistant Weeds

2002

2006

2008

Source: https://www.pioneer.com/home/site/us/agronomy/weed-mgmt-and-glyphosate-resis/

Syngenta's Dynamic Map Tool

THE SPREAD OVER TIME

Source: <u>http://www.resistancefighter.com/news.aspx</u>

Source: http://www.pfsscoop.com/2012/12/the-challenge-of-weed-resistance.html

It's not just a Glyphosate problem

- Weed populations have become resistant to multiple herbicide modes of action
- IL counties in <u>2003</u> with at least one waterhemp population with resistance to 1 or more herbicide modes-of-action

Source: http://agronomyday.cropsci.illinois.edu/2003/waterhemp/index.html

Tillage System Adoption Rates

USDA-ERS Farm Resource Regions

Source: USDA-ERS (2000). http://maps.ers.usda.gov/mapimages/ers_reg_color.jpg

Weed Resistance Management BMPs

- Scout fields before and after a herbicide application
- Start with clean fields using burndown herbicide applications or <u>tillage</u> Control weeds early when they are relatively small
 - Control weed escapes and prevent weeds from setting seeds
- <u>Clean equipment</u> before moving between fields to spread less weed seed Use new commercial seed that is as free from weed seed as possible
- → <u>Use multiple herbicides</u> with different modes of action during season
- Use tillage to supplement herbicide-based weed control
 - Use the recommended application rate from the herbicide label

Scouting is Changing

- Starting to use drones to scout crops
- Video and sensors recording sitespecific data
- Optical sensors can distinguish weeds by species, insects and/or insect damage
- Sprayers can have these sensors on board, scouting while spraying
- Create site-specific spray regimes

Main Point

- Weed resistant to herbicides is a real problem and it's spreading
- What can you do to help farmers manage herbicide resistant weeds?
- What can you do to help farmers manage herbicide resistance?

Thoughts on Implications for Equipment Needs

- Can your equipment track site-specific herbicide use history for fields?
- Optical sensors on sprayers that scout while spraying and record weeds by species
- Sprayers that receive scouting reports from drones or irrigation equipment
- Site-specific sprayers that change rates, switch or add herbicide modes of action on the fly
- Does your equipment inadvertently spread weed seeds?
- Is your equipment easy to clean of weed seed?
- What does more tillage mean for client sprayer needs?

Company Response: New Biotech Crops

- Dicamba and 2,4-D resistant or tolerant crops
- Herbicide drift will (again) become a concern
- Better sprayer calibration and control
- Could sprayer automatically connect to DriftWatch or databases and to wind-weather station?
 - To know wind/weather and if sensitive crops are nearby
- Can sprayer change droplet sizes on the fly to adjust for wind and nearness to sensitive crops?
- Can sprayer change herbicides on the fly to not spray near sensitive crops?

Company Response: BioDirect

- BioDirect: RNA interference (RNAi) uses small molecules that interfere with RNA replication (making enzymes)
- Link into very specific sequences of RNA, so very species-specific
- Apply it to herbicide resistant weeds, interferes with the mechanism used by weeds to be herbicide resistant
 - Weeds become susceptible to the herbicide again
- Delivery system? Will it be foliar sprays?
- Still years away

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Insect Resistance to Bt has Emerged

- Bt corn widely used, rootworm Bt commercialized in 2004, non-high dose products
- Performance problems in as little as three years of continual planting in one place
- Still debating science for confirmed "resistance"

VT Triple performance problem field in SE Minnesota. Note insecticide-protected refuge strips interspersed among lodged Bt-RW corn.

Source: http://www.nwroc.umn.edu/prod/groups/cfans/@pub/@cfans/@swroc/documents/asset/cfans_asset_404474.pdf

Location of Problem Fields in MN

 Field visits and calls in 2012 suggest increase in geographic scope, especially in SC and WC Minnesota and possible problems for more Bt-RW traits

 Scattered problem fields reported in "Broad Arc" from NW Illinois, NE Iowa, W
Wisconsin, SE Minnesota, SW
Minnesota, E South Dakota,
NW Iowa, NE Nebraska

Geography of Bt-RW problem fields 2009-12 (reported by 8/6/12).

Source: http://www.nwroc.umn.edu/prod/groups/cfans/@pub/@cfans/@swroc/documents/asset/cfans_asset_404474.pdf

Recommended Farmer Responses

- Rotate to non-corn crop
- Rotate Bt mode of action
- Use stacked/pyramided Bt traits
- Use soil insecticides
- Adult spray program
- Anecdotal Data: Actual Farmer Responses
- Combine RW-Bt corn with soil insecticides and/or adult spray program

Neonicotinoid Seed Treatments

- Neonicotinoids are a relatively new class of insecticides, EPA recognizes as reduced risk insecticides
- Quickly became popular as moved away from "hotter" chemistries (organphosphates, carbamates, pyrethroids)
- Seed treatments or in-ground applications become systemic in the plant tissues, like Bt
- All RW-Bt corn sold with a neonicotinoid seed treatment
- Soybeans have neonic seed treatments as well
- 2010-2012 average: 89% corn and 38% soybean acres had a neonic seed treatment

Source: http://water.usgs.gov/nawqa/pnsp/usage/maps/

Neonicotinoids In the News

- Connected to honey bee and pollinator deaths
 - Dust from corn seed treatments
 - Dust/spray drift onto flowers that bees using
- EU just banned several uses for 2 years
- Canada: some provinces considering bans
- USA: Misapplied neonic spray on parking lot trees in Oregon with killed 25,000 bees
- USDA report: neonics contribute in part to colony collapse disorder
- (New paper points to fungicides!)

- Trees netted to keep bumble bees off them
- Oregon banned dinotefuran (a neonicotinoid) for 6 months while they investigate the exact cause
- Still legal to sell them, just not use them!

Main Point

- Insect resistance to Bt and other insecticides is nothing new, it occurs for other crops and pests
- Insect resistance to Bt is a real problem and it's spreading
- Concern for pollinators: important for many crops
- Will see increased demand for traditional insecticides or older chemistries
 - More human health and environmental safety concerns
- Farmers, scouts, and applicators have gotten used to no insecticides and low risk insecticides in fields and will not like begin exposed again
 - Listen to (or read) the recent NPR news story: <u>http://www.npr.org/blogs/thesalt/2013/07/09/198051447/as-biotech-seed-falters-insecticide-use-surges-in-corn-belt</u>

Thoughts on Implications for Equipment Needs

- Expect pollinator-oriented controls / restrictions
 - Not just drift onto crops, but also non-crops (weeds)
- Greater demand for insecticides, including spray applications, and "hotter" chemistries
- Possibly liability concerns for applicators?
 - Data on what was sprayed when and where and rate
- Better sprayer calibration and control
- Can sprayer automatically connect to DriftWatch or databases and to wind-weather station?
- Can sprayer change droplet sizes on the fly to adjust for wind and nearness to sensitive areas?
- Can sprayer change insecticides on the fly to not spray near sensitive crops?

Cover Crops

Cover crops are becoming more popular

- Control erosion as more tillage for herbicide resistance
- Acreage expansion into more erosive land
- Drought and excessive rainfall events
- Enhanced soil health means higher yields, fewer inputs
- How and when do you seed them?
 - Before harvest, so aerial seeding, high boy seeders or seeding while spraying or side dressing N
 - Use herbicides to "slow down" a cover crop and let the crop establish and suppress the cover crop
 - Cover crop termination key for yield and crop insurance

Camera-Guided Weeders on pull-type equipment

Steketee ECO-Dan Camera Guided In Row Weeder Solutions (Northern Equipment Solutions Ontario, Canada)

Self-Guided Robotic Weeders

Source: http://abe-research.illinois.edu/Faculty/grift/Research/BiosystemsAutomation/AgRobots/AgRobots.html

Camera-Guided and Robotic Weeders

- Camera-guided spray equipment for ultra-site-specific herbicide or insecticide applications
 - Current applications focus on high-value crops
- Possible agronomic applications to improve sprayers
 - Follow-up to kill herbicide resistant weeds
 - Specific herbicides for specific weeds in specific places
 - Combine mechanical tillage with herbicide (tall weeds)
 - Auto-steer with speed based on drone scouting reports
- Self-guided robotic weeders with plant/crop sensors
 - Still seem far-fetched, but maybe some day!

Summary

- Presented some trends in agricultural pest management
- Reflected on their impact on future equipment needs
- Herbicide resistant weeds, insect resistance to Bt crops, neonicotinoid impacts on pollinators, possible new biotech solutions, cover crops, new machinery technologies
- Spray equipment will have to keep getting better:
 - Optical sensors, ultra-site-specific, drift reduction, apply multiple modes of action, combine tillage and herbicide for weed escapes, camera-guided equipment, communicate with drone-supplied and other databases
- Cover crops more popular: need new equipment to plant them in some situations

Questions? Comments?

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