Soybean Crop Management Conference

Resistance Update and Detection of Herbicide Injury on Crops

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PPO Resistance

- Tennessee and Arkansas have made the headlines (again)
PPO Resistance

- Found resistance in 6 Missouri Counties in 2015
  - > 30% Survival in at least one field sample in these counties
• You don’t think we have a problem
  – I haven’t seen it yet

• You don’t think we need to be prepared for this problem
  – I’ll have plenty of time to prepare
It’s here!

100% Mortality

< 15% Survival

> 30% Survival
Small Palmer, Full rate of Reflex
PPO Resistance

Jim Heiser, Univ. of Missouri
PPO Resistance

- 13 of 27 samples
  - >30% Survivors

- 21 of 27
  - At least ONE plant out of ≈ 20 sprayed survived

- Only 6 of 27 samples displayed complete mortality 2 weeks after application
• Sending tissue samples to Illinois
• Quickly determines resistance
  – Initially developed for Waterhemp
  – Can sometimes miss
• Compare to greenhouse assay
PPO Resistance

• DISCLAIMER

• Seeded rather heavy

• Randomly thinned to 10 plants per pot
  – Some had poor germination and had less

• Two replications

• Same sprayer/mixture

• Two of the 27 had replications that were very different
  – but both had survivors
Observation of Injury Symptoms

- Where are we seeing the injury?
  - Entire Field
  - Whole Plants
  - Plant parts - leaf, root, stem, fruit

- Pattern or Random?
• Record any information you think will help you or others determine how incident occurred
  – Date of suspected application and when injury first observed
  – Herbicides applied to and nearby incident site
  – Climate information during applications
  – Application equipment – boom height, speed, pressure, etc.
  – Previous crop/herbicides in field
Alternative causes

• Eliminate possibilities
  – Disease, fertility, insects, carryover, weather

• Applicator error by you, your employee, or your custom applicator?

• Neighbor?

• Farther away?
Fitting the puzzle together

- Simple hand-drawn maps or color coding satellite images can help illustrate the relationship of damaged areas to surrounding fields.
- Showing injury and severity patterns along with weather and application information can help identify the source.
- Knowing herbicide injury symptoms and how quickly they may develop can verify the source of the incident.
Herbicide Injury influenced by

- Field Operations
  - Overlap
  - Compaction
  - Contamination
  - Improper mixing (rate, order, agitation)
  - Drift (physical, vapor)
  - Operator/guidance error

- External Factors
  - Carryover
  - Drift
  - Topography
  - Weather
  - Stress
  - Soil Moisture/Texture/O.M.
What is affected on the plants?

- Leaves
  - Upper
  - Lower
- Roots
- Grain/Fruit/Pod
- Mix of some or all
- Can help determine when and what caused the damage
• Symptoms on leaves
  – Deformation
    • Strapping, cupping, failure to fully emerge
  – Stunting
    • Node stacking, “drought” stressed
  – Discoloration
    • Necrosis
    • Chlorosis
    • Bleaching
    • Red/Purple
Root Injury

• Root injury symptoms
  – Deformation
    • Clubbed, bottle brush, thickened
  – Pruning
  – Proliferation

• Effects of root damage
  – “Drought Stress”
  – Lean/fall down
How do we Classify Herbicides?

• Plants controlled
  – Grass/broadleaf, genus/species activity
• How applied
  – PRE, POST, Soil, Foliar, Directed
• Tolerant Crops
  – Soybean, Rice, Corn, etc.
• Mobility
  – Contact/Systemic, Phloem/Xylem
• Chemical Family
  – Imidazolinone, sulfonylurea, Triazine, diphenyl ether…
• Mode of Action
  – ALS inhibitor, Synthetic Auxin, Inhibition of VLCFA’s…
Key to Herbicide Injury

1. Photosynthesis Inhibitors (PSII- Triazines, Ureas)
2. Membrane Disruptors (PPO/PS I- Diphenyl ethers, Bipyridiliums)
3. Pigment Inhibitors (inhibitors of 4-HPPD, DOXP, PDS,)
4. ALS inhibitors (IMIs, SUs)
5. Inhibition of EPSP (Glyphosate)
6. Inhibition of Glutamine Synthase (Glufosinate)
7. Lipid Synthesis Inhibition (ACCase-Fops, Dims; Non-ACCase-thiocarbamates)
8. Seedling Growth Inhibitors (inhibitors of microtubule assembly-DNA’s)
9. Seedling Shoot Inhibitors (VLCFA inhibitors- Chloroacetamides, Oxyacetamides)
10. Growth Regulators (Synthetic Auxins-Benzoic and Phenoxy-carboxylic Acids)
Classification by Mode of Action

• Can give clues to
  – Symptoms
  – Behavior
  – Crop Tolerance
  – Weed Spectrum Controlled
  – Application Timing

• Not every chemical fits the way we think it should
• When did the injury appear?

A. During or immediately after crop emergence (initial stand not uniform and/or plants lacked vigor)

B. After crop emergence (initial plant stand uniform and vigorous)
A. During or shortly after crop emergence

Where does the injury appear?

1. Plants stunted, leaves damaged, roots generally unaffected
2. Plants stunted, leaves damaged and roots injured
A.1. Plants stunted, leaves damage, roots generally unaffected

What type of injury?

a. **White or bleached leaves**
b. **Chlorotic leaf veins and margins**
c. **Deformed leaves**
• A.1.a White or bleached leaves
• Pigment inhibitor
• Ex: Callisto, Command, Brake, Balance
Now we know what to look for...

- Where do we look
  - Adjacent fields
  - Weeds present in field and surrounding areas
  - Sensitive species on turnrow, ditches, fencerows
  - Openings in fencerows
  - Shorter trees
What else can help?

- Some species not normally found in fields but in surrounding areas can be good indicators
  - Kudzu, trumpetcreeper, tree species
- Look for obstacles to movement
  - Openings or differences in height or density of these obstacles could allow penetration
Obstacle Example

- Suspected Drift Source
- Crop A
- Wind direction on day of suspected drift
- Crop B
- Injured Field

- Crop A
- Road
- Tree
- Crop B
- Injured Field

- Crop A
- Tree
- Crop B
- Injured Field
Anything else?

• Talk to everyone involved
  – Maybe I should say Listen

• Don’t place the blame
  – Not your job

• But do find the cause
  – Let the growers, insurance, or state decide who is at fault
  – “it looks like it was chemical “A”, applied around date “b” when the weather was “C” and the crop was at stage “D” is a good answer.
Why do I need to know this...

- New Technologies = growing pains
- You are probably already seeing some of these cases
- I’m afraid I won’t have enough time to walk all of the call in the next few years
New Technologies and Herbicides

• Dow – Enlist System utilizes 2,4-D (Growth Regulator)

• Monsanto – Roundup Ready Xtend uses Dicamba (Growth Regulator)

• NO CROSS TOLERANCE

• New formulations have better characteristics
  – Nothing is perfect
  – New technology costs $$$$$
What’s to like?

- Good to great Palmer and Marestail control
  - At correct plant size
- Very good crop safety
- Enlist is RR, LL, and 2,4-d resistant
- Xtend will probably have all three soon
- Both encouraging the use of PRE’s in a system
Labeling Issues

• Buffer zones not quite “Bubba Proof”
  – Not completely sure what they are going to be yet

• Nozzle requirements

• Tank mixing rules
  – Nothing except water unless tested

• Extensive cleanout procedures
Other Comments

• GRs good for early spring “burndown’’ operations
  – When few sensitive crops emerged

• No... more of a

• New formulations will be $$
  – Crop Prices ↓

• Must have residuals
  – But so do conventionals...
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I’m just the messenger...

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