April 5, 2017

Why are residuals needed in LibertyLink® and Roundup Xtend® herbicide traited technologies?

The most consistent weed control is obtained by employing multiple tactics such as narrow row spacing, bush type soybean cultivars that canopy fast to prevent light penetration to the soil surface, and residual herbicides that provide time under adverse conditions such as early planting where canopy does not occur rapidly to inhibit or control germinating weeds. I hope we have learned from past experience that overreliance on postemergence herbicides such as glyphosate can quickly lead to weed resistance issues that limit the value of these technologies. Current soybean herbicide traits allow use of herbicides that do not provide residual weed control which in turn puts intense selection pressure on these valuable tools when used alone. Anthem Brand herbicides and Authority Brand herbicides are vital components for preserving the herbicide technologies that we currently have.

Benefits of Residual Herbicides:

- Can be tank mixed with burndown and postemergence herbicides to provide extended windows of weed control
- Limit weed competition during the critical weed free period. For soybeans this may range from VE to V6 growth stages
- Residual herbicides allow timely in season postemergence herbicide applications by reducing the overall weed population density and size
- Provide insurance against weather events (wind, rain) that keep tractors out of the field for extended periods of time. The weeds do not quit growing when tractors are not running
- Reestablish utility of herbicide technologies in fields where glyphosate or other herbicide resistant weeds are present
- Reduce the selection pressure to preserve traited herbicide technologies

### RESIDUAL HERBICIDE PORTFOLIO

<table>
<thead>
<tr>
<th>Brand</th>
<th>Use</th>
<th>Soil Type Use Rates (oz./A)</th>
<th>Features and Benefits</th>
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</thead>
<tbody>
<tr>
<td>Anthem® herbicide</td>
<td>Pre and Post</td>
<td>Coarse: 4 - 7, Medium: 5 - 9, Fine: 6 - 10</td>
<td>Longest residual performance in class. Strong grass and small-seeded broadleaf control (pigweed and lambsquarter)</td>
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<tr>
<td>Anthem® MAXX herbicide</td>
<td>Pre and Post</td>
<td>Coarse: 2 - 3.25, Medium: 2.5 - 4.75, Fine: 3.5 - 5</td>
<td>Same benefits as Anthem herbicide at a 2x concentrated formulation for less jug handling and disposal</td>
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</table>
| Authority® MTZ DF herbicide | Pre Only | Coarse: 12 - 16, Medium: 14 - 18, Fine: 16 - 20 | • Excellent broadleaf herbicide with 2 effective modes of action (MOA) against pigweed  
  • Combine with Anthem Brand herbicides for superior season long weed control |
| Authority® Elite herbicide | Pre Only | Coarse: 19 - 25, Medium: 25 - 32, Fine: 25 - 32 | Great liquid formulation option for grasses and small seeded broadleaves (2 MOA for pigweed) |
| Authority® XL herbicide | Pre Only | Coarse: 4 - 6, Medium: 4 - 7, Fine: 4 - 8 | PPO and ALS combination product with excellent morning-glory activity |
| Authority® First DF herbicide | Pre Only | Coarse: 4 - 6.5, Medium: 4 - 6.5, Fine: 4 - 6.5 | Large and small seeded broadleaf option with no soil pH restrictions |
PRE Versus Pre fb POST Weed Control in LibertyLink® Soybean
Rating Interval: 55 DA PRE, 26 DA EPOST, 33 DA MPOST

Authority® and Anthem® Brand herbicides in LibertyLink Soybeans
Rating Interval: 55 DA PRE, 40 DA EPOST, 30 DA MPOST, 25 DA LPOST

- Palmer amaranth is the driver weed in the graph above.
- This reinforces the fact that no single Liberty herbicide application at any timing will provide adequate control of Palmer amaranth.
- Sequential applications of Liberty looks very good, but:
  1. It leads us down the path of overreliance that has led to the demise of so many herbicides before it. Glyphosate, ALS, triazines....
  2. 97% control of a Palmer plant that produced a conservative 250,000 seeds leaves 7,500 potential plants. If only 5% germinate that is still 375 plants to pull or hoe.
- Authority Brand herbicides and Anthem Brand herbicide treatments provided 3 good PRE fb POST options to achieve 100% control of Palmer amaranth.
- If Palmer amaranth is present, I would recommend Authority MTZ DF herbicide and Authority® Elite herbicide PRE fb Anthem Brand herbicides EPOST for over-lapping residuals with multiple effective modes of action.
- Authority® First DF herbicide and Authority® XL herbicide rely on a single known effective mode of action since most Palmer amaranth is safely assumed to be resistant to the ALS chemistry contained as the second mode of action.
Always read and follow label directions. NOTE REGARDING RESTRICTED USE PESTICIDES: Anthem ATZ herbicide, Athena insecticide, Brigade 2EC Insecticide/Miticide, Brigade WSB Insecticide/Miticide, Brigadier Insecticide Capture 3RIVE 3D insecticide, Capture LFR Insecticide, Declare insecticide, Hero Insecticide, Mustang Insecticide, Mustang Maxx Insecticide, Pounce 25WP Insecticide, Stallion Brand Insecticide, Temitry LFR Insecticide/Fungicide, Triple Crown Insecticide, Ethos XB Insecticide/Fungicide and Gladiator Insecticide/Miticide are Restricted Use Pesticides. NOTE FOR CALIFORNIA: Accurate Extra herbicide, Aim herbicide, Aim EC herbicide, Aim EW herbicide, Anthem herbicide, Anthem ATZ herbicide, Anthem Flex herbicide, Anthem MAXX herbicide, Authority Assist herbicide, Authority Elite herbicide, Authority First DF herbicide, Authority MAXX herbicide, Authority MTZ DF herbicide, Authority XL herbicide, Cadet herbicide, Chisum Herbicide, Command 3ME microencapsulated herbicide, Crusher Herbicide, Edition Broadspec herbicide, Edition Tankmix Herbicide, Marvel herbicide, Nimble Herbicide, Nuance Herbicide, Preemptor SC fungicide, Report Extra Herbicide, Solstice herbicide, Spartan 4F herbicide, Spartan Charge herbicide, Spartan Elite herbicide, Temitry LFR Insecticide/Fungicide, Topguard EQ fungicide, Zeus Prime X herbicide, Zeus XC herbicide, Capture 3RIVE 3D insecticide, Ethos XB Insecticide/Fungicide, Hero Insecticide, Mustang Maxx Insecticide, Display cotton harvest aid, Zoro Miticide and VGR Soil Amendment are not registered for sale or use in California. VGR Soil Amendment is not a pesticide. Beleaf and Carbine are trademarks of Ishihara Sangyo Kaisha, Ltd. Cercobin is a trademark of Nippon Soda Co., LTD. Sovran is a registered trademark of BASF. FMC, 3RIVE 3D, Accurate, Aim, Anthem, Athena, Authority, Brigade, Brigadier, Cadet, Capture, Chisum, Command, Crusher, Declare, Display, Edition, Ethos, Preemptor, Fracture, Fyfanon, Gladiator, Hero, Koverall, LFR, Marvel, Mustang, Nimble, Obey, Pounce, Report, Rhyme, Rovral, Shark, Solida, Solstice, Spartan, Stallion, Temitry, Topguard, Topguard Terra, VGR and Zeus are trademarks and HatchTrak and Investing in farming’s future are service marks of FMC Corporation or an affiliate. ©2016 FMC Corporation. All rights reserved. 11/16