Controlling Problem
Weeds in Eastern KS

Doug Shoup
Dallas Peterson
Department of Agronomy
K-State Research & Extension
Current Weed Control Issues

- New Herbicide Technologies
- New Trait Technologies
- Herbicide Resistance
Autumn Super (Bayer)

Autumn Super contains 6% Iodosulfuron-methyl (Autumn) + 45% thiencarbazone-methyl

Apply 0.5 oz product with COC or MSO at 1% v/v and UAN at 1.5 to 2 qt/a or AMS at 1.5 to 3 lb/a

- Fall applied up to 1 month before corn planting
- Fall applied up to 2 months before soybean planting
- Three months before wheat planting
- DO NOT USE if intending to plant any other crop
  - 9 to 18 mo. Restriction + 15 to 30” rainfall required
“Q” products (DuPont) for Corn

- Q indicates a safener has been added
- Accent Q, Steadfast Q, Require Q
- New Resolve Q, Realm Q
Basis Blend (DuPont) for Field Corn only

* *Basis Blend* contains: 20% rimsulfuron (*Resolve SG*) + 10% thifensulfuron-methyl (*Harmony SG*)

**Use rate is 0.825 to 2.5 oz/a**

- Apply 1.25 oz as fallow treatment in the spring or fall to emerged actively growing weeds less than 3” tall. Apply 1.25-1.5 oz (up to 2.5 oz) preplant or preemergence to corn
- Apply 0.825 oz to field corn in the spike through the two collar stage of growth
  - Do not apply to corn having 3 collars or corn 6” tall.
Resolve Q (DuPont) for Field Corn only

Resolve Q contains: 18.4% rimsulfuron (Resolve SG) + 4% thifensulfuron-methyl (Harmony SG)+Safener

Use rate is 1.25 to 2.5 oz/a
- Apply PRE 1.25 to 2.5 oz
- Apply POST 1.25 oz to corn up to 7 collar or 20 inch tall which ever is most restrictive
- Apply to 1 to 2 inch grass weeds and less than 5 inch broadleaf weeds for best control
**Realm Q (DuPont) for Field Corn only**

- **Realm Q** contains: 7.5% rimsulfuron *(Resolve)* + 31.25% mesotrione *(Callisto)* + Safener
- **Use rate is 4 oz/a**
  - = to 1.2 oz Resolve + 2.5 fl oz Callisto
  - Apply Early POST to corn up to 7 collar or 20 inch tall which ever is most restrictive
  - Apply to 1 to 2 inch grass weeds and less than 5 inch broadleaf weeds for best control
Evaluation of PRE applied herbicides in corn, Kansas Rivervalley 2011. (Thompson and Adee).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate</th>
<th>App</th>
<th>Crgr</th>
<th>Imgy</th>
<th>Paam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis+atra</td>
<td>0.5 oz + 1qt</td>
<td>PRE</td>
<td>95</td>
<td>92</td>
<td>99</td>
</tr>
<tr>
<td>Prequel+atra</td>
<td>1.66 oz + 1qt</td>
<td>PRE</td>
<td>92</td>
<td>91</td>
<td>99</td>
</tr>
<tr>
<td>Cinch ATZ</td>
<td>1 qt</td>
<td>PRE</td>
<td>100</td>
<td>92</td>
<td>99</td>
</tr>
<tr>
<td>SureStart</td>
<td>1.75 pt</td>
<td>PRE</td>
<td>94</td>
<td>82</td>
<td>100</td>
</tr>
<tr>
<td>SureSt+atra</td>
<td>1.75 pt+1 qt</td>
<td>PRE</td>
<td>97</td>
<td>97</td>
<td>100</td>
</tr>
<tr>
<td>Lexar</td>
<td>3 qt</td>
<td>PRE</td>
<td>100</td>
<td>97</td>
<td>100</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td></td>
<td></td>
<td>9</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

Evaluation 3 weeks after treatment, just prior to early post post treatments.
Dow AgroSciences DHT Corn

DHT = Dow AgroSciences Herbicide Tolerant

GMO trait –

- Gene confers resistance to 2,4-D
- Same gene confers resistance to aryloxfenoxy propionic acids (FOPS)
- A premix of 2,4-D (new formulation with glyphosate) will be used

Earliest would be 2013 for limited introduction
Fierce

Premix from Valent containing 33.5% flumioxazin (Valor) and 42.5% pyroxasulfone (Zidua) WDG.

Timing: Fall, EPP through preemergence.

Application rate: 3 to 4.5 oz/acre

3 oz Fierce = 2 oz Valor + 1.5 oz KIH 485

Preemergence control of grass and broadleaf weeds, including pigweeds.
Zidua

- New product from BASF containing 85% pyroxasulfone.
- Preplant through preemergence, and postemergence in corn and soybeans.
- Rates: 2 to 2.5 oz/a?
- Weeds: preemergence control of annual grass and broadleaf weeds, including pigweeds.
Anthem

- New premix from FMC containing pyroxasulfone and Cadet.
- Preplant, preemergence in corn and soybeans.
- Rates: 5 - 7 fl oz/a?
- Weeds: annual grass and broadleaf weeds, including pigweeds.
Eastern KS 2011

[Image of a green field with trees in the background]
Management or Resistance?
Introduction

- Increase in no-till cropping systems throughout central and eastern Kansas
- This change in cropping system has caused new challenges in weed control
- A major weed problem in no-till wheat and soybean is achieving effective control of marestail
**Introduction**

Marestail is a winter annual weed that overwinters in the rosette stage and bolts in the spring.

- Multiple flushes can occur in the fall, spring, summer
  - Northern areas fall germination more common
  - Southern areas spring germination more common

**Seedling**  **Rosette**  **Bolting**  **Seed head**
Introduction

Marestail can produce up to 200,000 seeds/plant

Mechanism of seed dispersal is by wind
- Can spread up to 1,475 ft from its original seed source

Not much competition research has been done with marestail
- Study in Michigan where soy yield reduced >80%
  - MI study may be an overestimate of yield loss w/ marestail
Marestail has developed herbicide resistance to five herbicide modes of action across 16 states including Kansas:

- Glyphosate
- Paraquat
- Atrazine
- ALS-inhibiting herbicides
- Diuron
Glyphosate Resistant Marestail in KS

Sumner Co. →

Miami Co. →

Check →

Glyphosate Rate:  1 pt  1 qt  1.5 qt  0
Glyphosate Resistant Marestail in KS

Sumner Co. →

Miami Co. →

Check →

Glyphosate Rate:  1 pt  1 qt  1.5 qt  0
Marestail Control

- Marestail is fairly easy to control when plants are a rosette with systemic herbicides
  - Glyphosate, 2,4-D, SU herbicides, FirstRate
- When plants bolt, effective control with herbicides is greatly reduced
  - Glyphosate and 2,4-D are still important to include in tank mixes for bolted marestail if possible
  - Contact herbicides seem to work better on bolted marestail than rosette
    - Growing point exposure
# Marestail Control in Wheat (Winfield)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate</th>
<th>Application Stage</th>
<th>% Control on May 19th</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rosette (Dec-21)</td>
<td>Bolted (April-8)</td>
</tr>
<tr>
<td>Banvel</td>
<td>8 floz</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Huskie</td>
<td>15 floz</td>
<td>84</td>
<td>100</td>
</tr>
<tr>
<td>Aim</td>
<td>1 floz</td>
<td>34</td>
<td>5</td>
</tr>
<tr>
<td>Finesse</td>
<td>0.4 oz</td>
<td>90</td>
<td>88</td>
</tr>
<tr>
<td>Powerflex</td>
<td>3.5 oz</td>
<td>55</td>
<td>80</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td></td>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>

Shoup, Zimmerman, & Peterson, 2010
Marestail Control Ahead of Soybean (Hillsboro)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate</th>
<th>Application Stage</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rosette (Mar-29)</td>
<td>Bolted (May-5)</td>
<td>% Control 5WAT</td>
</tr>
<tr>
<td>Roundup PMax</td>
<td>22 floz</td>
<td>84</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>2,4-D amine</td>
<td>32 floz</td>
<td>95</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>Ignite</td>
<td>22 floz</td>
<td>77</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>First Rate</td>
<td>0.7 oz</td>
<td>71</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Gramoxone</td>
<td>32 floz</td>
<td>6</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>LSD (5%)</td>
<td></td>
<td>16</td>
<td>7</td>
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</table>

Shoup, Roberts, & Peterson, 2010
# Marestail Control Ahead of Soybean (Osage County)

<table>
<thead>
<tr>
<th>Treatment (Sprayed 4/20)</th>
<th>Rate</th>
<th>Fall Germ</th>
<th>Spring Germ</th>
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<tbody>
<tr>
<td>RuPM</td>
<td>22oz</td>
<td>77</td>
<td>75</td>
</tr>
<tr>
<td>2,4-D</td>
<td>16oz</td>
<td>87</td>
<td>95</td>
</tr>
<tr>
<td>RuPM+2,4-D</td>
<td>22oz + 16oz</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>AuthFirst+RuPM+2,4-D</td>
<td>3oz + 22oz + 16oz</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>Sharpen+RuPM</td>
<td>1oz + 22oz</td>
<td>79</td>
<td>100</td>
</tr>
<tr>
<td>Sharpen+RuPM+Ignite</td>
<td>1oz + 22oz + 29oz</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td><strong>LSD (5%)</strong></td>
<td></td>
<td><strong>14</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

Shoup, 2011
## Marestail Control in Soybean (Manhattan)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate</th>
<th>1WAT</th>
<th>5 WAT</th>
<th>10 WAT</th>
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<tbody>
<tr>
<td>Roundup PMax</td>
<td>22 oz</td>
<td>30</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Roundup PMax</td>
<td>44 oz</td>
<td>37</td>
<td>60</td>
<td>57</td>
</tr>
<tr>
<td>Cadet</td>
<td>0.9 oz</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RU PMax + Cadet</td>
<td>22+0.9 oz</td>
<td>50</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>FirstRate</td>
<td>0.3 oz</td>
<td>47</td>
<td>73</td>
<td>63</td>
</tr>
<tr>
<td>RU PMax + FirstRate</td>
<td>22+0.3 oz</td>
<td>47</td>
<td>87</td>
<td>95</td>
</tr>
<tr>
<td>Classic</td>
<td>0.5 oz</td>
<td>53</td>
<td>53</td>
<td>40</td>
</tr>
<tr>
<td>RU PMax + Classic</td>
<td>22+0.5 oz</td>
<td>53</td>
<td>73</td>
<td>77</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td></td>
<td>6</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

Peterson and Thompson, 2009
Marestail Control

- Several herbicide options in wheat and corn
  - Wheat: 2,4-D, Dicamba, Huskie, Finesse
  - Corn: Atrazine, Callisto, Laudis, Status, SU herbicides

- Fall or early spring applications are the best management practice for controlling marestail ahead of soybean
  - Tank mixes of glyphosate, 2,4-D, dicamba, ALS on rosette
  - Tank mixes of glyphosate, 2,4-D, dicamba, Ignite, Sharpen, FirstRate on bolted marestail

- Marestail control in soybean with Glyphosate + FirstRate
  - Second herbicide option Glyphosate + Classic
  - Ignite in Liberty Link soybeans
Waterhemp
Herbicide Resistance

-waterhemp has developed resistance across SIX herbicide MOA (Heap 2011)
-ALS Resistance
-Triazine Resistance
-PPO Resistance
-Glyphosate Resistance
-HPPD Resistance
-2,4-D

-WERE RUNNING OUT OF HERBICIDES!!
Pigweed Pollination and Genetic Diversity

- Redroot pigweed, smooth pigweed, and prostrate pigweed are monoecious
  - Male and female parts on same plant

- Palmer amaranth and common waterhemp are dioecious plants
  - Male and female parts on separate plants

![Prostrate pigweed](image1)

![Common waterhemp](image2)
Pollination and Multi-Gene Resistance

Monoecious resistance

Dioecious resistance

Gene a

Gene b

Progeny have a+b genes
Single vs. Multiple Gene Resistance

- Male and female (dioecious) pigweed species
  - Quick development of single gene resistance
    - Genetic diversity
  - Quick stacking of multiple gene resistance
    - Cross pollination
Gyphosate Resistant Waterhemp Control

- **Foundation preemergence herbicides**
  - Soybeans: Prefix, Authority, Valor, Fierce, Intrro
  - Corn: Atrazine premixes, Lexar/Lumax, Balance Flexx, Corvus, Verdict, Sharpen

- **Postemergence herbicide options**
  - Soybean – Flexstar, Cobra, Ultra Blazer
  - Corn – Callisto, Laudis, Capreno, Impact, Status

- **Liberty Link programs**
## Glyphosate resistant waterhemp control at Ottawa, KS in 2011 (Peterson, Shoup, and Putman).

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Rate</th>
<th>Waterhemp Control</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>(oz/a)</td>
<td>6/28</td>
</tr>
<tr>
<td>Roundup Power Max</td>
<td>22</td>
<td>-</td>
</tr>
<tr>
<td>Valor XLT/ RUPM</td>
<td>4/22</td>
<td>91</td>
</tr>
<tr>
<td>Valor XLT/RUPM+Flexstar</td>
<td>6.5/22+20</td>
<td>89</td>
</tr>
<tr>
<td>Auth XL/RUPM+Flexstar</td>
<td>6.5/22+20</td>
<td>98</td>
</tr>
<tr>
<td>Auth First/RUPM+Flexstar</td>
<td>6.5/22+20</td>
<td>90</td>
</tr>
<tr>
<td>Fierce/RUPM+Flexstar</td>
<td>4.5/22+20</td>
<td>100</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td>7</td>
<td>4</td>
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</table>
Roundup Power Max
Fierce/Roundup PM+Flexstar
Broadleaf weed control at Manhattan, KS in 2010 with good activation (Peterson and Thompson).

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Rate</th>
<th>Paam</th>
<th>Vele</th>
<th>Ilmg</th>
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<tbody>
<tr>
<td>Valor XLT</td>
<td>3 oz</td>
<td>96</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td>Fierce</td>
<td>3 oz</td>
<td>99</td>
<td>99</td>
<td>87</td>
</tr>
<tr>
<td>Authority First/Sonic</td>
<td>3.2 oz</td>
<td>97</td>
<td>100</td>
<td>87</td>
</tr>
<tr>
<td>Authority XL</td>
<td>4 oz</td>
<td>98</td>
<td>93</td>
<td>90</td>
</tr>
<tr>
<td>Prefix</td>
<td>2 pt</td>
<td>100</td>
<td>53</td>
<td>50</td>
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<tr>
<td>OpTill</td>
<td>2 oz</td>
<td>89</td>
<td>100</td>
<td>83</td>
</tr>
<tr>
<td>Prowl H2O</td>
<td>2.5 pt</td>
<td>50</td>
<td>83</td>
<td>27</td>
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<tr>
<td>LSD (5%)</td>
<td>7</td>
<td>4</td>
<td>5</td>
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Broadleaf weed control at Manhattan, KS in 2010 with delayed activation (Peterson and Thompson).

<table>
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<tr>
<th>Herbicide</th>
<th>Rate (oz/a)</th>
<th>Paam (%)</th>
<th>Vele (%)</th>
<th>Ilmg (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valor XLT</td>
<td>3.5</td>
<td>99</td>
<td>87</td>
<td>73</td>
</tr>
<tr>
<td>Authority First</td>
<td>3.2</td>
<td>75</td>
<td>70</td>
<td>77</td>
</tr>
<tr>
<td>Authority XL</td>
<td>4</td>
<td>63</td>
<td>63</td>
<td>73</td>
</tr>
<tr>
<td>Authority Assist</td>
<td>5</td>
<td>80</td>
<td>67</td>
<td>80</td>
</tr>
<tr>
<td>Fierce</td>
<td>3</td>
<td>98</td>
<td>100</td>
<td>73</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td>8</td>
<td>13</td>
<td>12</td>
<td></td>
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</tbody>
</table>
Future for Weed Management

Dicamba resistant soybeans from Monsanto – 2014?
- Metabolism based resistance, stacked with Roundup Ready trait
- Monsanto and BASF developing new lower volatility formulation of dicamba

DHT (Enlist) resistant soybeans from Dow AS – 2015?
- Resistance to 2,4-D, stacked with glyphosate resistance
- Metabolism based resistance
- Dow developing new low volatility formulation of 2,4-D that will be pre-mixed with glyphosate called Enlist Duo.
Future for Weed Management

- HPPD resistant soybeans – 2016?
  - Syngenta and Bayer collaboration
    - Gene from oat
    - Stacked with glufosinate
    - Tolerance to Balance or Callisto
      - Preemergence injury at high rates (4x) 10-15%
      - Some postemergence injury
  - Bayer and MS Technologies collaboration
    - Gene from bacteria (Pseudomonas fluorescence)
    - Stacked with glufosinate
    - Tolerance to Balance or Callisto (not to Laudis)
      - Similar injury to previous event