Nozzle and equipment considerations for improved coverage in the soybean canopy: A summary of the work done in Ohio

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2006 National Rust Symposium
St. Louis, MO
Nov. 29 - Dec. 1, 2006
Effects of air-assisted and conventional spray delivery systems on management of Asian Soybean Rust

Objective:

• Evaluate the efficacy and deposition efficiency of various fungicide application methods to protect against infection that could result in soybean crop yield loss.
Measures of sprayer performance

- Spray coverage
- Spray deposit

- Lower canopy: 12 inches above ground
- Middle canopy: 24 inches above ground
- Fluorescent tracer (Brilliant Sulfadiazine)
- Metal deposition targets
- Water sensitive paper coverage targets
- 15 ft x 150 ft plots
- R5 stage treatment
Measures of sprayer performance

• Fungicide spray retention on foliage

  - Sampled several plants from each spray plot
    - Removed bottom of each plant
    - Divided plant into upper and lower zones
    - Removed top 4-6” of each plant
    - Separated leaves from stems

  - Headline (A.I.: Pyraclostrobin) residue analysis
    - Buffered QuEChERS method for extraction of pesticide
    - LC/MS analysis of prepared sample
### 2005 Asian Soybean Rust Field Trials: Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Sprayer</th>
<th>Nozzle</th>
<th>Pressure (psi)</th>
<th>Speed (mph)</th>
<th>Flow (gpm)</th>
<th>Spray Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacto air-assist sprayer</td>
<td>Jacto JA3</td>
<td></td>
<td>154</td>
<td>7</td>
<td>0.35</td>
<td>fine</td>
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<tr>
<td>Boom sprayer</td>
<td>XR8004</td>
<td></td>
<td>31</td>
<td>7</td>
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<td>Boom sprayer</td>
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<td>42</td>
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<td>Boom sprayer</td>
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<td>medium</td>
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<td>Boom sprayer</td>
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<td>0.35</td>
<td>medium</td>
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<tr>
<td>Boom sprayer with canopy opener</td>
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<td></td>
<td>31</td>
<td>7</td>
<td>0.35</td>
<td>medium</td>
</tr>
</tbody>
</table>

Application rate for all treatments: 15 gpa
2005 Sprayer Treatments

Jacto air-assist, JA3

Canopy opener, flat fan

Conventional broadcast, flat fan

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Wooster, OH
Percent Spray Volume deposited on artificial targets

Middle canopy (24 inches)

Bottom canopy (12 inches)

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Wooster, OH
Percent Spray Coverage on WSP targets

Middle canopy (24 inches)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Spray Coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air assist</td>
<td>a 7.3</td>
</tr>
<tr>
<td>Top Air</td>
<td>a 6.5</td>
</tr>
<tr>
<td>Opener</td>
<td>a 6.4</td>
</tr>
<tr>
<td>XR8004</td>
<td>b 3.7</td>
</tr>
<tr>
<td>XR8005</td>
<td>b 3.3</td>
</tr>
<tr>
<td>TwinJet</td>
<td>b 3.2</td>
</tr>
<tr>
<td>XR8002</td>
<td>c 2.4</td>
</tr>
<tr>
<td>Turbo</td>
<td>c 2.4</td>
</tr>
<tr>
<td>Hollow Cone</td>
<td>c 1.3</td>
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</tbody>
</table>

Bottom canopy (12 inches)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Spray Coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air assist</td>
<td>a 3.9</td>
</tr>
<tr>
<td>Opener</td>
<td>b 2.8</td>
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<tr>
<td>Top Air</td>
<td>c 1.4</td>
</tr>
<tr>
<td>XR8004</td>
<td>c 1.4</td>
</tr>
<tr>
<td>XR8005</td>
<td>c 1.2</td>
</tr>
<tr>
<td>Turbo</td>
<td>cd 0.9</td>
</tr>
<tr>
<td>TwinJet</td>
<td>cd 0.9</td>
</tr>
<tr>
<td>Hollow Cone</td>
<td>cd 0.7</td>
</tr>
<tr>
<td>XR8002</td>
<td>cd 0.5</td>
</tr>
</tbody>
</table>

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Wooster, OH
Results: 2005 Foliar deposits

2005 Foliar fungicide deposits

Concentration (ppb)

Upper Leaves

Treatment

Jacto JA3  XR8004  XR8002  XR8005  Turbo Duo  TwinJet  TX-18  Opener

A  B  BC  BC  BCD  DE  E

CDE

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Wooster, OH
Results: 2005 Foliar deposits

2005 Foliar fungicide deposits

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Concentration (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacto JA3</td>
<td>a</td>
</tr>
<tr>
<td>XR8004</td>
<td>bc</td>
</tr>
<tr>
<td>XR8002</td>
<td>bc</td>
</tr>
<tr>
<td>XR8005</td>
<td>c</td>
</tr>
<tr>
<td>Turbo Duo</td>
<td>c</td>
</tr>
<tr>
<td>TwinJet</td>
<td>c</td>
</tr>
<tr>
<td>TX-18</td>
<td>bc</td>
</tr>
<tr>
<td>Opener</td>
<td>ab</td>
</tr>
</tbody>
</table>

Lower Leaves
Results: 2005 Foliar deposits

2005 Foliar fungicide deposits

Concentration (ppb)

Treatment

Jacto JA3 XR8004 XR8002 XR8005 Turbo Duo TwinJet TX-18 Opener

Upper Leaves Lower Leaves

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Wooster, OH
2006 Asian Soybean Rust Field Trials: Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Sprayer</th>
<th>Nozzle</th>
<th>Pressure (psi)</th>
<th>Flow (gpm)</th>
<th>Rate (gpa)</th>
<th>Spray Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom sprayer</td>
<td>XR8004</td>
<td></td>
<td>34</td>
<td>0.35</td>
<td>15</td>
<td>medium</td>
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<td>Boom sprayer</td>
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<td>Jacto air-assist sprayer</td>
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<td>48</td>
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<td>Jacto air-assist sprayer</td>
<td>AXI11002</td>
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<td>118</td>
<td>0.35</td>
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<tr>
<td>Jacto air-assist sprayer</td>
<td>Jacto JA3</td>
<td></td>
<td>151</td>
<td>0.35</td>
<td>15</td>
<td>fine</td>
</tr>
</tbody>
</table>

Travel speed for all treatments: 7 mph
2006 Sprayer Treatments

- Jacto air-assist, flat fan AIX11002
- Conventional broadcast, TTJ60-11003
- Jacto air-assist, JA3

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Results: 2006 Foliar deposits

2006 Foliar Fungicide Deposits by Sprayer Type

Conventional

Air-Assist

Treatment

Concentration (ppb)

Upper Leaves

Lower Leaves

XR8004
15 gpa
XR8004
20 gpa
TTJ60-11003
15 gpa
AXI11002
10 gpa
AXI11002
15 gpa
JA3
15 gpa

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2005 & 2006 Comparisons

• Seed
  – 2005: Seed Consultants SC9284 (210,000 seeds/acre)
  – 2006: Pioneer 92B38 (200,000 seeds/acre)

• Canopy taller in 2005 than 2006
  – 44 inches vs. 41 inches
  – Larger area sampled for Upper/Lower canopy in 2005
  – More of the plant closer to nozzles was removed in 2005 compared to 2006
  – Spray more directed at Upper canopy area in 2006 than 2005

• Canopy more dense in 2005 than 2006
  – LAI: 6.4 vs. 3.4
Fungicide Residue and Artificial Tracer Comparisons

- Target area
  - Artificial tracer targets stationary
  - Larger foliar area sampled for fungicide residue
  - Middle tracer target (24 inches) may be better comparison with leaves from lower canopy
  - Trends for flat fan nozzle similar
2005 & 2006 Comparisons: Foliar deposits

Combined Year Comparison Conventional XR8004 & Jacto JA3 Cone

- Upper Leaves
- Lower Leaves

Treatment: XR8004
Concentration (ppb)

- A
- a

Treatment: Jacto JA3
Concentration (ppb)

- A
- a
Summary & Conclusions:

• Canopy differences affect deposition
  – Higher deposits found in shorter/less dense canopy
  – Coverage higher in shorter/less dense canopy
  – In taller/more dense canopy, single flat fan delivery treats lower canopy area better than dual-fan or cone nozzles

• ‘Medium’ quality sprays are recommended for conventional, broadcast applications
Summary & Conclusions:

• Based on all measures of performance, air-assisted delivery provides better canopy penetration

• Cone and flat fan nozzles performed similarly in air-assisted applications

• Bending over the top of the canopy helps improve spray penetration

• Unable to detect Headline on stems