Evaluation of Spray Nozzles for Aerial Application of Biological Control Agents

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Evaluation of Aerial Application Systems to Release Liquid Formations

• Nozzle/atomizer setups
• Adjuvant mixes
• Weather conditions
• Spray release heights

Field and model studies
Quick Evaluations of

• In-swath deposition
• Off-target drift
• Canopy penetration
Nozzles of Aerial Application Systems

Davidon  CP  Accuflo  Micronair
CP-11TT Flat-Fan Nozzles Field Tests

In-Swath Deposition

Downwind Drift
Assessing Crop Injury Caused by Off-Target Drift of Aerially Applied Glyphosate
Davidon Tri-Set Nozzles In-Swath Deposition Test

- **Tank Mix**: Water, DRP-955 @35psi with 0.5 oz/gal
- 60 nozzles total (30 on each boom left and right)
- **Spray swath**: 65 ft  
  **Flight Speed**: 135 mph  
  **Spray altitude**: 12 ft  
  **Pressure**: 35 psi
- **WSP**: -32.5 ft, -21.67 ft, -10.83 ft, 0 ft, 10.83 ft, 21.67 ft, 32.5 ft (Number of Samples: 7 sampling stations x 3 nozzle deflections x 3 nozzle orifices x 4 reps = 252)
- **Kestrel 4500**: Wind speed, wind direction, air temperature, and relative humidity
<table>
<thead>
<tr>
<th>Deflection</th>
<th>Orifice</th>
<th>Reps</th>
<th>Run</th>
<th>Label Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 degree</td>
<td>Small</td>
<td>1-4</td>
<td>1</td>
<td>0S1-1, 0S4-1, 0S3-1, 0S4-1</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>1-4</td>
<td>2</td>
<td>0M1-2, 0M2-2, 0M3-2, 0M4-2</td>
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<tr>
<td></td>
<td>Large</td>
<td>1-4</td>
<td>3</td>
<td>0L1-3, 0L2-3, 0L3-3, 0L4-3</td>
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<tr>
<td>22.5 degree</td>
<td>Small</td>
<td>1-4</td>
<td>4</td>
<td>22S1-4, 22S2-4, 22S3-4, 22S4-4</td>
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<tr>
<td></td>
<td>Medium</td>
<td>1-4</td>
<td>5</td>
<td>22M1-5, 22M2-5, 22M3-5, 22M4-5</td>
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<tr>
<td></td>
<td>Large</td>
<td>1-4</td>
<td>6</td>
<td>22L1-6, 22L2-6, 22L3-6, 22L4-6</td>
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<tr>
<td>45 degree</td>
<td>Small</td>
<td>1-4</td>
<td>7</td>
<td>45S1-7, 45S2-7, 45S3-7, 45S4-7</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>1-4</td>
<td>8</td>
<td>45M1-8, 45M2-8, 45M3-8, 45M4-8</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>1-4</td>
<td>9</td>
<td>45L1-9, 45L2-9, 45L3-9, 45L4-9</td>
</tr>
</tbody>
</table>
**VMD (µm)**

- Sampling Position
  - 0 degree, small orifice
  - 0 degree, medium orifice
  - 0 degree, large orifice
  - 22 degree, small orifice
  - 22 degree, medium orifice
  - 22 degree, large orifice
  - 45 degree, small orifice
  - 45 degree, medium orifice
  - 45 degree, large orifice

**Relative Span**

- Sampling Position
  - 0 degree, small orifice
  - 0 degree, medium orifice
  - 0 degree, large orifice
  - 22 degree, small orifice
  - 22 degree, medium orifice
  - 22 degree, large orifice
  - 45 degree, small orifice
  - 45 degree, medium orifice
  - 45 degree, large orifice

**Coefficient of Variation (C.V.)**

- DVO.1
  - 0 degree, small orifice
  - 0 degree, medium orifice
  - 0 degree, large orifice
  - 22 degree, small orifice
  - 22 degree, medium orifice
  - 22 degree, large orifice
  - 45 degree, small orifice
  - 45 degree, medium orifice
  - 45 degree, large orifice

- DVO.5
  - 0 degree, small orifice
  - 0 degree, medium orifice
  - 0 degree, large orifice
  - 22 degree, small orifice
  - 22 degree, medium orifice
  - 22 degree, large orifice
  - 45 degree, small orifice
  - 45 degree, medium orifice
  - 45 degree, large orifice

- DVO.9
  - 0 degree, small orifice
  - 0 degree, medium orifice
  - 0 degree, large orifice
  - 22 degree, small orifice
  - 22 degree, medium orifice
  - 22 degree, large orifice
  - 45 degree, small orifice
  - 45 degree, medium orifice
  - 45 degree, large orifice
Developing Aerial Systems to Effectively Deliver Liquid Formulations of Non-Toxigenic Biological Agents to Control Mycotoxins in Corn

- Aflatoxin, a poisonous by product produced by the fungi *Aspergillus flavus* and *A. parasiticus*, negatively impacts marketing and utilization of corn.
- Release of non-toxigenic *A. flavus* into corn fields has shown promise as a biological control agent for aflatoxin producing strains of the fungus.
- In corn production systems, many producers use Afla-Guard®, a commercially available product containing non-toxigenic *A. flavus* as a biological control agent with crop consultants’ recommend applying it between the V10-V12 growth stages.
• For aerial application, there are obstacles that impede the adoption of Afla-Guard® and related products

• The application of a coarse granule to mature, 2 meter-tall corn is a challenge. Aerial applicators are often in high demand and applicators are not commonly prepared at that time to handle granular materials, particularly at the low use rates labeled for Afla-Guard®. Thus, there would be substantial advantages to a liquid formulation
• Water dispersible granule (WDG) formulations have several advantages over wettable powder, emulsifiable, oil or granular formulations. The development of WDG does not need solvents, and WDG formulations can greatly reduce the dust generated during application. Moreover, WDG has less long-term residual impact on our environment than oil or emulsifiable formulations.

• The development of WDG formulations has been increased in recent years (Jin et al., 2008 & 2009)
• Application efficacy from aerial platforms has been studied extensively

• However, more information is needed on the ability of aerial delivery systems to effectively apply biological agents, especially new specialized mixtures such as those described by Jin et al. (2013)

• One nozzle that could be considered for this application is the Accu-Flo™ nozzle (Bishop Equipment Mfg., Hatfield, PA). This nozzle finds extensive use in Forestry applications and was found to penetrate spray most effectively into soybean canopies (Thomson et al., 2007). It is unique in that it does not use pressure to shatter the spray into small droplets, and this non-shattering characteristic might also have significant advantages when applying relatively delicate biological products.
Thanks!