Air Assisted Spraying

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UC ANR Spray Training
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University of California
Cooperative Extension
Agriculture & Natural Resources
Objectives In Spraying

Slide concept: Dr. Ken Giles, UC Davis
• Review the role of sprayer generated air in pesticide movement/coverage.

• Review the range of sprayer designs (fan systems) available.

• Review current design challenges

• How might current designs be best adjusted to provide best coverage without excessive drift?
Air assist sprayer designs vary, depending on the farming system.
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Air assist sprayer designs vary, depending on the farming system.
Air is delivered via diverging, linear, or converging flow.
Air influences spray outcome in several ways.

1. Carries spray (pesticide) to the target.
2. Moves foliage to improve coverage
3. Aids deposition
4. Changes droplet size
5. Interacts w/ canopy to alter droplet spectrum.
Sprayer fan air carries pesticide further upwards than possible without fan.
Air assistance is not always needed.
Too much air for the stage of growth contributes to excessive drift.
Turbulent, low velocity air from the sprayer moves leaves, improving coverage.

Artist: David Kidd
From: The Safe and Effective Use of Pesticides. 2nd Ed. UC ANR pub 3324.
Droplet size and air velocity influence droplet deposition.
Air speed influences droplet size when droplets are released parallel to flow.

<table>
<thead>
<tr>
<th>Nozzle</th>
<th>Air speed (MPH)</th>
<th>VD\textsubscript{10}</th>
<th>VMD</th>
<th>VD\textsubscript{90}</th>
</tr>
</thead>
<tbody>
<tr>
<td>D4-45</td>
<td>50</td>
<td>162</td>
<td>292</td>
<td>467</td>
</tr>
<tr>
<td>D4-45</td>
<td>100</td>
<td>141</td>
<td>255</td>
<td>414</td>
</tr>
<tr>
<td>D4-45</td>
<td>150</td>
<td>133</td>
<td>214</td>
<td>303</td>
</tr>
</tbody>
</table>

Yates, et al., 1985
The angle of liquid release into airflow can further influence droplet size.

- Larger droplets
  - 0°
  - 45°
  - 90°

- Smaller droplets

100 MPH

D4/45

DV_{10} = 141\mu m

D4/45

DV_{10} = 131\mu m
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Objectives In Spraying

- Efficacy
- Off-site protection
- Productivity

Slide concept: Dr. Ken Giles, UC Davis
Cost effective alternatives/alterations to this technology exist.
Drift reducing and/or cost saving commercial units for vineyard spraying.
<table>
<thead>
<tr>
<th>Change</th>
<th>Savings/acre/spray</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 → 2 rows sprayed/pass</td>
<td>$9.60</td>
</tr>
<tr>
<td>Increase tractor speed (2 → 4 mph)</td>
<td>$4.50</td>
</tr>
<tr>
<td>Decrease spray volume (80 → 40 gpa)</td>
<td>$2.27</td>
</tr>
<tr>
<td>Tank size 200 gal → 500 gal</td>
<td>$1.40</td>
</tr>
</tbody>
</table>

Billing and Giles, UC Davis
Figure 7: Drift poles indicating spray drift from the conventional Kinkelder

Figure 8: Drift poles indicating spray drift from the modified Kinkelder

Landers & Gil, 2006
Objectives in Spraying

Efficacy

Off-site protection

Productivity

Slide concept: Dr. Ken Giles, UC Davis
Coverage and pest control suffers in tree tops.

Almond Spray Coverage Trial- 2012
NOW Infested nuts from Tree/level samples - NP
Sampled Aug 24

- AOF 2.5
- AOF 2.0
- Hollow
- Full
- Flat
- AOF 2 boom
- PA 150
- Control

Coverage and pest control suffers in tree tops.
Diverging air flow is partially deflected by the canopy, increasing drift.
Spray drift loss examples above citrus tree canopy from diverging (axial fan) sprayers.

M. Salyani, et al., 2007
Lateral air flow from tower sprayers reduces above canopy spray drift.
Tree canopies function as droplet filters.

<table>
<thead>
<tr>
<th>Sampling Location</th>
<th>( VD_{10} ) (µm)</th>
<th>( VMD_{50} ) (µm)</th>
<th>( VD_{90} ) (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Tree</td>
<td>133</td>
<td>215</td>
<td>351</td>
</tr>
<tr>
<td>Beyond Tree</td>
<td>15</td>
<td>31</td>
<td>64</td>
</tr>
</tbody>
</table>

Miller, et al., 2003
The canopy and air speed interact to produce different deposition patterns in the canopy.

![Graph showing the relationship between air velocity and average spray deposit on external and internal leaves.](Marucco, et al., 2008)
With diverging jets, air velocity decreases rapidly the further away from the outlet.
For the same fan settings, high volume, lower velocity air output (b) produces higher velocity air further from the sprayer than high initial velocity, lower volume output (a).
Tree canopies are a mixture of targets that alter air velocity and direction...
...making uniform spray coverage difficult.
Get a bigger hammer. More air volume + more nozzles sites = higher velocity & smaller droplets.

Twin 45” fans, 9.0 liter diesel engine (132 gallon fuel tank), 27-81 nozzles per bank.
Make sure enough air is getting through the canopy – but not too much. Petal fall in almonds. Tractors speed 3 MPH 36” fan, PTO axial fan sprayer
Hull split in almonds. Same tractor speed 3 MPH 36” fan, PTO axial fan sprayer
Hull split in almonds.
Tractors speed 1.5 MPH
36” fan, PTO axial fan sprayer
Hull split in less vigorous almonds.
Tractors speed 3.0 MPH
36” fan, PTO axial fan sprayer
• Review the role of sprayer generated air in pesticide movement/coverage.

• Review the range of sprayer designs available.

• Review current design challenges

• How can current designs be best adjusted to provide best coverage without excessive drift?
Current recommendation is for a max of 80% light interception in almond.
80% light interception leaves room for hedging to allow tower sprayer access.
Tower sprayers are commercially available.

B. Higbee, Paramount Farming Co.
Thank you

Questions?