HERBICIDE SPRAY DRIFT AND MANAGEMENT CONSIDERATIONS

CSUF Pesticides Class
Nov 1, 2016

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Application considerations:

- Weed sensitivity
- Treatment timing
- Application rate actually delivered
- Spray equipment and calibration
- Nozzles, volume, and coverage
- Environmental conditions
- Spray drift mitigation measures
- Crop safety
- Applicator skill and attitude
The goal during herbicide application is to...

deliver the spray mix (carrier, herbicide(s), and spray additives) to the target area accurately and uniformly.
Spray drift defined:

“The physical movement of a pesticide from an intended target area of application to an area where the pesticide is not intended.”
Spray drift occurs in 3 ways:

- **Droplet drift**: spray carrier droplets containing pesticide particles moves from the treatment site in the air and lands on an off-target area.

- **Particle drift**: spray carrier droplets evaporate, leaving concentrated pesticide particles to land on an off-target area.

- **Vapor drift**: pesticide evaporates from soil or plant surfaces, moves in the air, and lands on an off-target area.
Some implications of spray drift:

- damage to crops and other non-target plants
- potential food contamination
- environmental impact (surface water)
- Injury to people, livestock, and pets
- erratic control and waste of product
- public perception
- fines and litigation
- tighter application restrictions
Herbicide drift always leaves a mark:

- Shark
- Chateau
- Roundup + Goal
- 2,4-D
Results of drift on grapes:

- Roundup
- 2,4-D
- Roundup + 2,4-D
- Transline
- Raptor
- Clarity

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Spray drift incidents typically leave a pattern in the field

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The top 3 factors that affect spray drift potential are…

1. Spray droplet size
2. Environmental conditions
3. Spray height
1. Spray droplet size:

VMD (Volume Mean Diameter)

½ spray volume = smaller droplets

½ spray volume = larger droplets

1 micron (µm) = 1/25,000”
Human hair = 100 µm
# Spray droplet size classification:

(<200 µm are the most prone to drift)

<table>
<thead>
<tr>
<th>Droplet category</th>
<th>Symbol</th>
<th>VMD (microns)</th>
<th>Color code</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra Fine</td>
<td>XF</td>
<td>&lt;50</td>
<td></td>
<td>Dry fog</td>
</tr>
<tr>
<td>Very Fine</td>
<td>VF</td>
<td>&lt;136</td>
<td></td>
<td>Wet fog</td>
</tr>
<tr>
<td>Fine</td>
<td>F</td>
<td>136-177</td>
<td></td>
<td>Fine mist/drizzle</td>
</tr>
<tr>
<td>Medium</td>
<td>M</td>
<td>177-218</td>
<td></td>
<td>Very fine rain</td>
</tr>
<tr>
<td>Coarse</td>
<td>C</td>
<td>218-349</td>
<td></td>
<td>Fine rain</td>
</tr>
<tr>
<td>Very Coarse</td>
<td>VC</td>
<td>349-428</td>
<td></td>
<td>Light rain</td>
</tr>
<tr>
<td>Extremely Coarse</td>
<td>XC</td>
<td>428-622</td>
<td></td>
<td>Medium rain</td>
</tr>
<tr>
<td>Ultra Coarse</td>
<td>UC</td>
<td>&gt;622</td>
<td></td>
<td>Heavy rain</td>
</tr>
</tbody>
</table>

Spray droplet size classification:

(<200 µm are the most prone to drift)
Fine droplets vs. Medium droplets:

Fine
XR11002 at 30 psi

Medium
XR110004 at 30 psi
The smaller the droplets are, the lighter they are, so the more prone they are to drift:

<table>
<thead>
<tr>
<th></th>
<th>Droplet Diameter ($\mu$m)</th>
<th>Terminal Velocity (ft/sec)</th>
<th>Final Drop Diameter ($\mu$m)</th>
<th>Time to Evaporate (sec)</th>
<th>Deceleration Distance (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XF</td>
<td>20</td>
<td>.04</td>
<td>7</td>
<td>0.3</td>
<td>&lt;1</td>
</tr>
<tr>
<td>VF</td>
<td>50</td>
<td>.25</td>
<td>17</td>
<td>1.8</td>
<td>3</td>
</tr>
<tr>
<td>VF</td>
<td>100</td>
<td>.91</td>
<td>33</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>F</td>
<td>150</td>
<td>1.7</td>
<td>50</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>M</td>
<td>200</td>
<td>2.4</td>
<td>67</td>
<td>29</td>
<td>25</td>
</tr>
</tbody>
</table>

Kansas State University
Spray droplet distribution: (15 GPA)

- Very Fine
- Fine
- Medium
- Coarse
- Very Coarse
- Extremely Coarse
2. Environmental conditions:

- High Relative Humidity
- Low Temperature

- Low Relative Humidity
- High Temperature
3. Spray height:

Ohio State University
So then, what are some practical things we can do to help minimize spray drift while applying herbicides or other pesticides?
1. Follow the label guidelines

SENSITIVE CROP PRECAUTIONS

BANVEL may cause injury to desirable trees and plants, particularly beans, cotton, flowers, fruit trees, grapes, ornamentals, peas, potatoes, soybeans, sunflowers, tobacco, tomatoes, and other broadleaf plants when contacting their roots, stems or foliage. These plants are most sensitive to BANVEL during their development or growing stage. FOLLOW THE PRECAUTIONS LISTED BELOW WHEN USING BANVEL.

- Do not treat areas where either possible downward movement into the soil or surface washing may cause contact of BANVEL with the roots of desirable plants such as trees and shrubs.
- Avoid making applications when air currents may carry spray particles to areas where sensitive crops and plants are growing, or when temperature inversions exist. Do not spray near sensitive plants if wind is gusty or in excess of 5 mph and moving in the direction of adjacent sensitive crops. Leave an adequate buffer zone between area to be treated and sensitive plants. Coarse sprays are less likely to drift out of the target area than fine sprays.
- Use coarse sprays to avoid potential herbicide drift. Select nozzles, which are designed to produce minimal amounts of fine spray particles. Examples of nozzles designed to produce coarse sprays via ground application are Delavan Raindrops, Spraying Systems XR flat fans, or large capacity flood nozzles such as D10, TK10, or greater capacity tips. Keep the spray pressure at or below 20 psi and the spray volume at or above 20 GPA, unless otherwise required by the manufacturer of drift-reducing nozzles. Consult your spray nozzle supplier concerning the choice of drift-reducing nozzles.
- Agriculturally approved drift-reducing additives may be used.
- Do not apply BANVEL adjacent to sensitive crops when the temperature on the day of application is expected to exceed 85°F as drift is more likely to occur.
- To avoid injury to desirable plants, equipment used to apply BANVEL should be thoroughly cleaned (See PROCEDURE FOR CLEANING SPRAY EQUIPMENT) before reusing to apply any other chemicals.

All crop uses of BANVEL are intended for a normal growing interval between planting and harvest. No crop rotation restrictions exist if normal harvest of treated crop has occurred. If this interval is shortened, such as in cover crops that will be plowed under, do not follow up with the planting of a sensitive crop.

Crops growing under stress conditions such as drought, poor fertility, or foliar damage due to hail, wind or insects, can exhibit various injury symptoms that may be more pronounced if herbicides are applied.

Consult your local or state authorities for possible application restrictions and advice concerning these and other special local use situations. Tank mix recommendations are for use only in states where the tank mix product and application site are registered.
2. Spray under favorable conditions:

<table>
<thead>
<tr>
<th>Environmental condition</th>
<th>More likely to drift</th>
<th>Less likely to drift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind speed</td>
<td>0 to &lt;3 mph, and &gt;7 mph</td>
<td>3 to 7 mph</td>
</tr>
<tr>
<td>Air temperature</td>
<td>&gt;85° F</td>
<td>&lt;85° F</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Air stability</td>
<td>No vertical mixing, inversion layer</td>
<td>Vertical mixing</td>
</tr>
<tr>
<td>Herbicide volatility</td>
<td>Volatile</td>
<td>Non-volatile</td>
</tr>
</tbody>
</table>
3. Treat at the optimal timing

succulent → less foliage → better coverage → lower spray height → limits spray drift → better control and less crop injury

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4. Use spray shields
(reduces drift by 75% or more)
5. Use appropriate spray nozzles

*Spray nozzle choice affects:*  
- spray droplet size range  
- uniformity of coverage  
- flow rate  
- spray drift potential

*Which impacts:*  
- weed control  
- economics  
- environmental quality
Check the nozzles before and during treatment to make sure the spray pattern is uniform:

New

Damaged

Plugged
Make sure nozzle spacing, boom height, and spray overlap are correct for the nozzles used:

<table>
<thead>
<tr>
<th>Optimum Spray Height</th>
<th>80°</th>
<th>110°</th>
</tr>
</thead>
<tbody>
<tr>
<td>80°</td>
<td>30&quot;</td>
<td></td>
</tr>
<tr>
<td>110°</td>
<td>20&quot;</td>
<td></td>
</tr>
</tbody>
</table>
Pressure, spray angle, tip size, GPA, and coverage

1. It takes a 4X change in pressure to get a 2X change in GPA.

2. Change the tip size or speed to make a large change in GPA.

3. Consider droplet size as you make changes in tip size, GPA, angle, and spray pressure.
Rule of thumb when it comes to nozzle and spray pressure choice:

Use spray nozzles and an operating pressure that produces large enough spray droplets that minimize drift, while providing enough weed coverage for the herbicide type(s) being used.
Drift-reducing nozzle designs:

Extended Range design (XR)
<20% 200 µm; most are F-C

Chamber design (Turbo)
<6% 200 µm; most are M-VC

Venturi II design (Air Induction)
<3% 200 µm; most are VC-XC

Venturi I design (Turbo Induction)
<1% 200 µm; most are XC-UC
Spray nozzle trial in almonds
(Fresno County - 2008)

Herbicide: Rely 200 at 5 pt/acre    Volume: 26 gpa
Nozzles: XR, TTJ, AI                Speed: 4 mph
Pressure: 30 psi                    Weeds: up to 16” tall
Weed control rating
(28 DAT)

<table>
<thead>
<tr>
<th>Spray nozzle type</th>
<th>Horseweed</th>
<th>Hairy fleabane</th>
<th>Sowthistle</th>
<th>Barnyardgrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR11004 (M)</td>
<td>9.7 a</td>
<td>9.4 b</td>
<td>9.9 a</td>
<td>9.3 a</td>
</tr>
<tr>
<td>TTJ60-11004 (C)</td>
<td>9.8 a</td>
<td>9.9 a</td>
<td>10 a</td>
<td>9.5 a</td>
</tr>
<tr>
<td>AI11004 (XC)</td>
<td>7.5 b</td>
<td>5.0 c</td>
<td>8.6 b</td>
<td>5.0 b</td>
</tr>
<tr>
<td>CV (%)</td>
<td>1.46</td>
<td>1.05</td>
<td>0.50</td>
<td>1.37</td>
</tr>
<tr>
<td>LSD</td>
<td>0.37</td>
<td>0.26</td>
<td>0.12</td>
<td>0.81</td>
</tr>
</tbody>
</table>

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28 DAT

XR11004

TTJ60-11004

AI11004
25 GPA
Paraquat
(15 DAT)
Weed control trial in 2011:

XR11004
30 GPA

TT11004
30 GPA

TTJ60-11004
30 GPA

AI11004
30 GPA

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Extended Range (XR)

Turbo TeeJet (TT)

Air Induction (AI)

Air Induction Extended Range (AIXR)
Take-Home Points:

**The top 3 factors affecting drift:**
- spray droplet size (<200 µm)
- environmental conditions (wind, RH, temp)
- spray height

**Practical things we can do to help minimize drift:**
- follow label guidelines
- spray under favorable conditions (wind, humidity, temp)
- treat pest when most susceptible (small weeds)
- use spray shields (reduce drift by 75% or more)
- use appropriate nozzles (type, size, spray angle, pressure)
Weed Management

About my Program

Crop and non-crop areas alike are impacted by weed growth to one degree or another. Weeds affect crop production in several ways; weeds delay or reduce stand establishment, affect crop growth and development, reduce food quality and yield, compete for resources like water and soil nutrients, reduce irrigation uniformity and efficiency, harbor rodents and other destructive pests, increase the risk of frost hazard in temperature sensitive crops, and increase the cost of production. In non-crop settings, weeds may be poisonous to people and livestock, interfere with water recreation and water transport, cause potential traffic hazards, pose a fire hazard, are unsightly, and reduce land values.

To effectively manage weeds, one must be able to correctly identify the weeds present, develop a broad understanding of weed growth and survival, become familiar with the tools (both chemical and non-chemical) available, and implement a strategy that is both economically and environmentally sound. This is sometimes referred to as "Integrated Weed Management".

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