Spray Drift Management
What You Need To Know

- What is spray drift.
- How weather affects spray drift.
- The effects of droplet size.
- How your decisions can affect spray drift.
This is Drift...

...so is this.
This is not drift…

…and neither is this.
Why Control Drift?

- Spotty pest control
- Wasted chemicals
- Off-target damage
- Result - higher costs-
- More wind?? (Timing)
- Environmental impact
  - Water and Air Quality
- Public more aware of pesticide concerns! (Negative)
- Spraying in more populated areas? (Suburbs)
Misapplication Facts

Source: Farmland Insurance 1996
Contributions to Drift

- Nozzle: 38%
- Applicator: 26%
- Physical: 13%
- Other: 23%
Types of Drift

- Vapor Drift – volatilization
- Particle Drift - movement of spray particles
Factors Affecting Drift

- Spray Characteristics
  - Chemical
  - Formulation
  - Additives
  - Drop size
  - Evaporation
Factors Continued

• Equipment & Application
  – Nozzle type
  – Nozzle size
  – Nozzle orientation
  – Nozzle pressure
  – Height of release
  – Technology
Factors Continued

• Weather, etc.
  – Air movement (direction and velocity)
  – Temperature & humidity
  – Air stability/inversions
  – Topography
Relationship of Drift to Drop Size

- Particle drift results by creating smaller drops.
- Spray droplets are measured in microns.

One micron ($\mu m$) = $1/25,000$ inch
Comparison of Micron Sizes for Various Items (approximate)

- 2000 μm  #2 Pencil lead
- 850 μm  paper clip
- 420 μm  staple
- 300 μm  toothbrush bristle
- 150 μm  sewing thread
- 100 μm  human hair
Droplet Size

• Large droplets have less potential to drift because they:
  – Fall more quickly
  – Evaporate more slowly
  – Are less affected by wind

• Small droplets often result from:
  – High spray pressure
  – Small nozzle tips
  – Wind shear across the nozzles
Secondary Break-Up

Droplet elongation and fracture produces small droplets
Sources of Spray Mist or Fines

Aerodynamic Effects

Air friction due to speed of the application vehicle causes additional production of small droplets
Sources of Spray Mist or Fines

Aerodynamic Effects

- Air friction due to speed of the application vehicle is dependent upon the nozzle orientation angle.
- $90^\circ$ produces the greatest number of small droplets.
Drift Potential is Influenced by

- Volume Median Diameter (VMD) 50%
- Droplet Spectrum (Range - big to small)

% Volume in droplets less than 200 microns in size
1/2 of spray **volume** = smaller droplets

1/2 of spray **volume** = larger droplets
Cutting Droplet Size in Half
Results in Eight Times the Number of Droplets
Cutting Droplet Size in Half

Results in Eight Times the Number of Droplets

2 500 Microns

= 2 more droplets fill in the sphere

2 250 Microns
# Evaporation and Deceleration of Various Size Droplets*

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

*Conditions assumed: 90 F, 36% R.H., 25 psi., 3.75% pesticide solution*
Low Drift Nozzle Types

- Flat-fan (Spraying Systems, Hardi, Delavan, Lurmark, others)
- Raindrop (Delavan)
- Drift Reduction Flat-fan (Several)
Low Drift Nozzle Types, cont:
• Turbo Flood (Spraying Systems)
• Turbo Flat-fan (Spraying Systems)
• TurboDrop
• AI Flat-fan
• SprayMaster Ultra
• Compact Venturi
## Dropsize Comparisons
(Data provided by Spraying Systems Co.)

<table>
<thead>
<tr>
<th>Nozzle type (all nozzles are Spraying Systems nozzles)</th>
<th>40 psi @ 0.2 gpm</th>
<th>40 psi @ 0.5 gpm</th>
<th>60 psi @ 0.5 gpm</th>
<th>% spray volume under 200 microns (0.5 gpm @ 40 psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR 80°</td>
<td>270*</td>
<td>370</td>
<td>300</td>
<td>11</td>
</tr>
<tr>
<td>XR 110°</td>
<td>224</td>
<td>310</td>
<td>250</td>
<td>22</td>
</tr>
<tr>
<td>Turbo Flat-fan</td>
<td>340</td>
<td>450</td>
<td>400</td>
<td>6</td>
</tr>
<tr>
<td>Drift Guard 110°</td>
<td>330</td>
<td>390</td>
<td>320</td>
<td>11</td>
</tr>
<tr>
<td>Flood</td>
<td>-</td>
<td>450</td>
<td>410</td>
<td>3</td>
</tr>
<tr>
<td>Turbo Flood</td>
<td>-</td>
<td>710</td>
<td>650</td>
<td>less than 1</td>
</tr>
</tbody>
</table>

*Numbers listed are in Microns (Dv.5)
Nozzle Dropsize Classification

Selection based on droplet size:

- Very Fine
- Fine
- Medium
- Coarse
- Very Coarse

- $< 119 \, \mu m$
- $119-216 \, \mu m$
- $217-353 \, \mu m$
- $354-464 \, \mu m$
- $> 464 \, \mu m$

Insecticides and Fungicides
Herbicides and Postemergence
Soil Applications of Herbicides
Tip Spray Selection by Drop Size

Turbo TeeJet Flat-fan

<table>
<thead>
<tr>
<th>Tip No.</th>
<th>Pressure in psi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
</tr>
<tr>
<td>TT11001</td>
<td>0.06</td>
</tr>
<tr>
<td>TT110015</td>
<td>0.09</td>
</tr>
<tr>
<td>TT11002</td>
<td>0.12</td>
</tr>
<tr>
<td>TT11003</td>
<td>0.18</td>
</tr>
<tr>
<td>TT11004</td>
<td>0.24</td>
</tr>
<tr>
<td>TT11005</td>
<td>0.31</td>
</tr>
</tbody>
</table>
Strategies to Reduce Drift

Increase flow rates - higher application volumes.
Use lower pressures. (AI nozzles?)
Use lower spray (boom) heights.
Avoid adverse weather conditions.
Consider using buffer zones.
Consider using new technologies:
  – drift reduction nozzles
  – drift reduction additives
Select nozzle to increase drop size.
Be aware that some products require relatively small droplets to ensure good coverage.
Adjuvants and Surfactants can increase the elasticity of big drops
Buffer Zone

• An area where pesticide is not directly applied
• Buffer zone designation may be contingent upon:
  – state regulations
  – pesticide product labels
  – prevailing weather conditions
  – sensitive/protected area(s)
Factors the Applicator can Control

• You can control…
  – The selection of the applicator/operator
  – Equipment selection and setup
  – Field conditions
  – The choice of the product

• You can’t control…
  – The weather
  – What is next to the field, unless you own it
Equipment Selection and Setup

- Good operating condition and is calibrated regularly.

- Should you select equipment to produce the largest droplet size possible?
Field Conditions

- What are the adjacent crops?
- Is the field close to houses or a town?
- Is this a preventive treatment or have pest thresholds been reached?
- Large, uniform fields are good candidates for aerial applications while small, irregular shaped fields suggest ground rigs.
Product Selection

• Of course you must control your target pest(s).
• You may have several options on products.
• Understand the product chemistry!
• Consider worker safety and restrictions.
• Consider the effect this product may have on homes and gardens near the application site.
• Consider environmental and wildlife safety.
Factors You Can’t Control

- Weather
  - Wind
      (speed & direction)
  - Temperature
  - Humidity

- Susceptible crops or other non-target areas of concern near your application site.
Wind

- Increasing wind speed = Drift potential
- Droplet size and boom height also influence drift.
- Use a wind gauge and avoid gusty conditions.
Wind

- Wind **direction** is very important
  - Know the location of sensitive areas - consider safe buffer zones.
  - Do not spray at any wind speed if it is blowing towards sensitive areas - all nozzles can drift.
  - Spray when breeze is gentle, steady, and blowing **away** from sensitive areas.
  - “Dead calm” conditions are **never** recommended.
However, Drift Potential May be High at Low Wind Speeds

• Because:
  – Light winds (0-3 mph) tend to be unpredictable and variable in direction.
  – Calm and low wind conditions may indicate presence of a temperature inversion.

• Drift potential is lowest at wind speeds between 3 and 10 mph (gentle but steady breeze) blowing in a safe direction.
Inversions

Under normal conditions air tends to rise and mix with the air above. Droplets will disperse and will usually not cause problems.
Temperature Inversions

Under these conditions the temperature increases as you move upward. This prevents air from mixing with the air above it. This causes small suspended droplets to form a concentrated cloud which can move in unpredictable directions.
Conditions Favoring Inversions

• The most common cause of surface inversions is radiant cooling of the ground.
• Clear skies favor radiant cooling and therefore favor the formation of surface inversions.

Conditions Not Favoring Inversions

• Low, heavy cloud cover
• Strong to moderate winds (greater than 5-6 mph). These winds will quickly dissipate an existing inversion.
• Bright sunshine
Recognizing Inversions

- Under clear to partly cloudy skies and light winds, a surface inversion can form as the sun sets.
- Under these conditions, a surface inversion will continue into the morning until the sun begins to heat the ground.
Drift Potential vs Inversions

• Inversions only affect small droplets that don’t settle quickly.
• Small droplets remain in a concentrated cloud until inversion dissipates or until the cloud moves out of the area where the inversion conditions exist.
• Minimizing the production of small droplets will minimize the potential for drift under inversion conditions.
Precautions for Inversions

- Be especially careful near sunset and an hour or so after sunrise, unless...
  - There is low heavy cloud cover.
  - The wind speed is greater than 5-6 mph at ground level.
  - 5 degree temp rise after sun-up.
- Use of a smoke bomb or smoke generator is recommended to identify inversion conditions.
Other Weather Related Problems

- **Temperature**
  - Affects the speed at which spray droplets evaporate.
  - Affects ability to get product down into dark canopy.

- **Humidity**
  - Also affects the speed of evaporation of sprays.
  - The higher the humidity, the slower the evaporation rate.
Evaporation of Droplets

- The lower the humidity, the faster droplets evaporate. As they evaporate they become smaller and more likely to drift.
- Evaporation is not as much a problem for large droplets. So minimize the number of small droplets to combat spray drift.
Some Other Things to Keep in Mind when Planning a Spray Application

Allow enough time for:

- Scheduling and planning the application.
  - Obtaining the products.
  - Setting up the application date.
  - Weather delays or maintenance problems, if necessary.

**AVOID RIGHT NOW!** Forcing a job under poor conditions almost always leads to drift or other errors.
In Conclusion

Minimizing spray drift is in the best interests of everyone. Do your part to keep chemical applications on target.