Drift reduction is the practice of reducing the “driftable fines” in a spray system which are the droplets less than 150 micrometers (um). These droplets can easily become buoyant and travel great distances, up to several miles from the sprayer, causing off-target drift and coating tree-lines. Reducing this number in a spray system will help reduce drift and problems associated with drift. Driftable fines are caused by many factors, but many of these factors can be controlled by choosing the right nozzle type and equipment settings (operating pressure, travel speed, tank mix and environmental conditions during operation). Each of these aspects are discussed as follows:

Nozzle Selection:

Nozzle selection is the best way to reduce driftable fines in a spray system and Figure 1 shows the different nozzles types and the percentage of driftable fines produced by each type of nozzle. Air induction (A.I.) nozzles produced the least amount of driftable fines, while XR and Cone Jets produced the most driftable fines. All other types of nozzles (Turbo Tees, 80-degree Flat Fans, D.G. [drift guard] Flat Fans, and Turbo Tee Twin, etc.) fell in-between these two types of nozzles. Therefore, A.I. Flat Fan type nozzles are preferred over all other nozzle types for drift control and most research indicates that these nozzles have adequate coverage for efficacy with systemic type herbicide (Roundup, etc.). In cases where more contact is needed, other nozzles maybe used, such as XR or Cone Jets for fungicide and insecticide work, or D.G. Flat Fans or Twin Turbo Tees for contact type herbicides. If maximum drift reduction is desired, A.I. Turbo Tees provided the most drift reduction of all nozzle types, but also had the coarsest droplet size, which may limit their use in some spraying situations.
NOZZLE TYPE AND DRIFT REDUCTION

Equipment Settings:

Equipment settings can greatly affect the number of driftable fines in a spray system. The following guidelines will help create a “safer” drift resistant system:

1) **Lower Boom Pressure**: Lowering the boom pressure and using a slightly larger nozzle size can help reduce the number of driftable fines in a spray system. In one case, research showed that a large XR flat fan nozzle, operated at a low boom pressure, had nearly the same drift reduction qualities as an A.I. Flat Fan. Sizing nozzles for drift reduction should include using slightly larger nozzle size with lower boom pressure to reduce drift.

2) **Travel speed**: Research has shown (Figure 2) that increasing travel and/or wind speeds across a boom can greatly increase the number of driftable fines in a spray system. In XR and Cone Jets, the driftable fines emitted into the open air increased by 6.5 times for each additional 1 mph of wind or travel speed across the boom, while A.I. type nozzles only had a 0.8-time increase. Remember that wind speed across a boom is equal to the driving speed plus the wind speed in a sprayer travelling in a head wind.

3) **Boom height**: Keep boom heights as low as possible. Typically, 18 to 20 inches above crop surface is the appropriate height for most nozzles. Overly high booms heights will for more time and wind to affect the spray pattern and “blow out” the fines that exist within the spray pattern.

4) **Sprayer shields**: Spray shields can greatly decrease the number of driftable fines emitted from a spray boom. These shields block the wind and allow smaller droplets to either impact the crop or collect inside the sprayer shield (falling as a big droplet in the field). Also, keep sprayer shields tight on the crop surface or winds can move through the opening and blow out fines from underneath the sprayer shield. Flexible skirts below the spray shield can help prevent this attribute.

![Figure 2: Chart of wind speed on a spray boom versus the amount of “driftable fines” released into the atmosphere (3 to 5 MPH) for different nozzle types.](image)
NOZZLE TYPE AND DRIFT REDUCTION

Environmental Conditions:

Environmental factors can play a large role in driftable fines and the following operating parameters guidelines can help reduce drift:

1) **Relative humidity:** Spraying in low humidity (R.H.) situations can greatly reduce the number of driftable fines traveling away from a sprayer. Research has shown that driftable fines leaving the field — instead of evaporating — can increase as much as 300 percent in some nozzles (XR and Cone Jets) for a relative humidity increase of 40 percent to 80 percent.

2) **Inversion layers:** Inversion layers trap driftable fines emitted from the sprayer and concentrate them in a layer in the atmosphere. This layer then moves off the field and deposits somewhere else in a thick chemical laden cloud (sometimes 10 to 50 miles away). Surface inversion layers most often occur when air temperatures is warmer above the ground than on the ground surface, but can also exist in low-wind and humid conditions. To prevent thermal layers from occurring, spraying should not be done too early in the morning, nor too late at night. Many states recommend waiting until the morning temperature rises 3 degrees above the morning low to spray, and then recommend ceasing spraying operations when the air temperatures fall more than 3 degrees from the daily high. Spraying when the winds are greater than 2 mph will help ensure that inversion layers do not exist.

3) **Wind conditions:** Spray when winds are between 2 and 10 MPH.

Additives:

Testing (Figure 3) has shown that most additives will reduce driftable fines in nozzles by up 60 percent over pure water. The biggest reduction in driftable fines was seen in nozzles that created the most driftable fines, such as XR and Cone Jets. No negative effects were seen in additives except in very cold and low humidity conditions. Additives and drift reduction agents are recommended for all sprayer operations and will reduce the droplet size 20 to 50 um (over pure water) while reducing drift (note that some chemicals may already contain a drift reduction agent).

Figure 3: Graphs of the effect of additives on spray drift for different nozzles. Most other additives had similar responses.
### NOZZLE TYPE AND DRIFT REDUCTION

Table 1 lists the recommended tips for different spraying operations.

**Table 1: Pesticide Mode of Action and Recommend Nozzle or Sprayer Tip Selection**

<table>
<thead>
<tr>
<th>Pesticide and Mode of Action</th>
<th>Tip or Nozzle Selection</th>
<th>Recommended Practices</th>
</tr>
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</table>
| Most Herbicides with Systemic Type Attributes – Coarse to Medium Droplets | A.I. Flat Fans and A.I. Turbo Tees (Air Induction) | - Use higher flow rates to ensure good coverage (although higher flow rates are not always necessary to attain good results).  
  - Spray when environmental conditions are optimum.  
  - Make sure a low-level inversion layer is not present (fog, heavy air, etc.).  
  - Make sure winds are between 2 and 10 mph (some winds are needed to insure a stable, non-inversion layer environment).  
  - Monitor back of sprayer and droplet evaporation.  
    - If you see a large amount misting behind sprayer, check system for over-pressurization or wrong tip selection and flow rate.  
  - Keep boom height at recommended distance from canopy (typically 18-20 inches from canopy surface).  
  - Use hooded sprayers to further aid in drift reduction.  
    - Make sure to run hood on the surface of the crop canopy. |
| Herbicides and Pesticides with Contact and/or Partially Systemic Attributes – Medium Droplet Size | Turbo Tee, DR and DG (Drift Reduction and Drift Guard), 80-degree Flat Fans | - Use higher flow rates to ensure good coverage (although higher flow rates are not always necessary to attain good results).  
  - Spray when environmental conditions are optimum.  
  - Make sure a low-level inversion layer is not present (fog, heavy air, etc.).  
  - Make sure winds are between 2 and 10 mph (some winds are needed to insure a stable, non-inversion layer environment).  
  - Monitor back of sprayer and droplet evaporation.  
    - If you see a large amount misting behind sprayer, check system for over-pressurization or wrong tip selection and flow rate.  
  - Keep boom height at recommended distance from canopy (typically 18-20 inches from canopy surface).  
  - Use hooded sprayers to further aid in drift reduction.  
    - Make sure to run hood on the surface of the crop canopy. |
| Fungicides – Medium to Fine Droplet Sizes  
Insecticides – Fine Droplet Size | Fungicide and Insecticides – DR/DG (Drift Reduction/Guard) and Hollow Cones or Equivalent | - Use higher flow rates to ensure good coverage (although higher flow rates are not always necessary to attain good results).  
  - Spray when environmental conditions are optimum.  
  - Make sure a low-level inversion layer is not present (fog, heavy air, etc.).  
  - Make sure winds are between 2 and 10 mph (some winds are needed to insure a stable, non-inversion layer environment).  
  - Monitor back of sprayer and droplet evaporation.  
    - If you see a large amount misting behind sprayer, check system for over-pressurization or wrong tip selection and flow rate.  
  - Keep boom height at recommended distance from canopy (typically 18-20 inches from canopy surface).  
  - Use hooded sprayers to further aid in drift reduction.  
    - Make sure to run hood on the surface of the crop canopy. |