# NOZZLE TYPE AND DRIFT REDUCTION

Drift reduction is the practice of reducing the number of small droplets (typically less than 150 micrometers) in a spray system as these droplets can easily become buoyant and travel great distances (> ½ mile) from the sprayer. Control of these fines is as follows.

## Proper Nozzle Selection:

Nozzle type selection is one of the best ways to reduce driftable fines in the spray system. Figure 1 shows the different types of nozzles and the percentage of drift produced by each type. Air induction (A.I.) nozzles have the best drift reduction qualities and are recommended for most spraying operations, except for pulsed width modulated systems such as the AIM command, etc., which use larger than normal flat fan type nozzles. A.I. turbo tees produce very coarse droplets, which maybe too coarse for some spraying operations (note though that some pesticide labels require this type of nozzle), so A.I. flat fans may be a good choice for many spraying operations that require more droplets in the spray pattern as they have a medium to coarse droplet size (note that all A.I. nozzles have a very wide pressure range and are considered more safe to sprayer problems than other types of nozzles). XR and Cone Jets produce the most driftable fines but also may be needed for small droplet, high area contact coverage such as fungicide and insecticide treatments. All other types of nozzles - Turbo Tees, 80-degree Flat Fans, D.G. - drift guard Flat Fans, and Turbo Tee Twin - fall in between these sets of nozzles for drift reduction qualities. Picking a nozzle with a slightly larger orifice size than needed can also help reduce drift in ground-based sprayer systems.

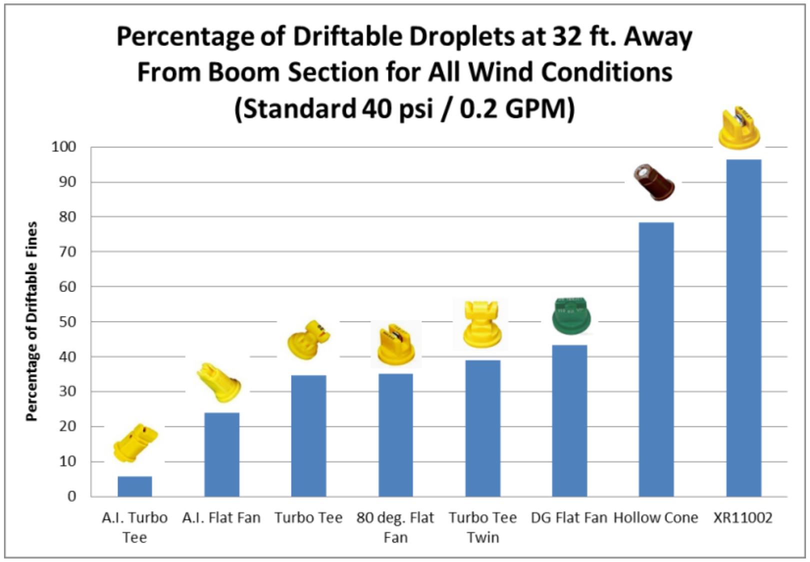


Figure 1: Percentage drift associated with each nozzle type operated in similar conditions.

## Equipment Settings:

Equipment settings can greatly affect the amount of driftable fines in a spray system. The following guidelines should be used to create a safer, more drift resistant system:

1) <u>Lower Boom Pressures</u>: Lowering the boom pressure and/or using a slightly larger nozzle orifice size can greatly help reduce the number of driftable fines in a spray system. Research has shown that a large XR flat fan nozzle combined with a lower boom pressure (< 40 psi) had nearly the same effect on drift reduction qualities as

an A.I. Flat Fan type nozzle. Sizing nozzles for drift reduction should include using slightly larger nozzle size with lower boom pressures in drift producing nozzles, or A.I. type nozzles.

2) Travel speed: Research has shown (Figure 2) that increased travel speed (and/or wind speeds across a boom) can greatly increase the number of driftable fines in a spray pattern. The number of driftable fines emitted by XR and Cone Jets increased by 6.5 times for each additional 1 mph of wind or travel speed across the boom. A.I. type nozzles only increased by a factor of 0.8 (or less) per MPH of increased wind or travel speed. For this reason, lower travel speeds are always recommended or reducing drift.
3) Boom height: Keep boom heights as low as possible. Nozzles are typically placed on booms at set distances to operate 18 to 20 inches above crop surface. Overly high booms allow more time for wind to affect the spray pattern and cause more inconsistent spray patterns.
4) Sprayer shields: Spray shields can greatly decrease the number of driftable fines emitted into the open environment by a sprayer system. These shields essentially block the wind and allow the smaller droplets to either collect on the crop or the hood surface (creating a larger droplet that falls in the field). Sprayer shields should be kept tight on the crop surface or high-speed winds can move through the opening and increasing drift - flexible skirts may be needed in this case but can damage crops.

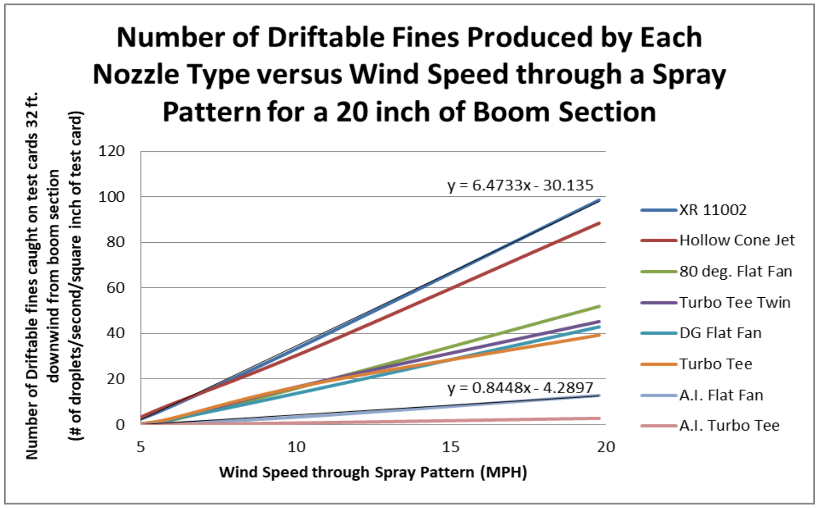


Figure 2: Graph of the amount of driftable fines released into the atmosphere versus wind or travel speed (5 to 20 MPH) across a boom for different types of nozzles.

## Environmental Conditions:

Environmental factors can play a large role in the amount of driftable fines released into the atmosphere.

1) Inversion layers: Inversion layers trap driftable fines emitted from the sprayer and concentrate them into a dense layer. This layer can then move off the field and deposits 0 to 50 miles away from that field. Inversion layers most often occur when air temperatures are warmer above the ground than on the ground surface but can also exist in low wind/humidity conditions. To prevent thermal layers from occurring, spraying should not be performed early in the morning or too late in the

afternoon. Some states recommend to not start spraying until the morning temperature rises 3 degrees above the morning low, and to cease spraying when the air temperature falls more than 3 degrees from the daily high. Also, spraying when winds are greater than 2 mph will help ensure that inversion layers do not exist.

2) Wind conditions: Spray when winds are between 2 and 10 mph.
3) Relative humidity: Spraying in lower humidity (R.H.) situations can greatly reduce the number of driftable fines as some research has shown that driftable fines may not evaporate and greatly increase in higher humidity conditions.

## Additives:

Additives are a good way to reduce drift and, in most cases (Figure 3), driftable fines were reduced by 60 percent over using pure water in most nozzles. The biggest reductions were seen in nozzles that created the most driftable fines, such as XR and Cone Jets, while the least effects were seen in A.I. type nozzles (only because they had very few driftable fines to begin with). Note that no negative effects were seen in any additives except in very cold or low humidity conditions (where small droplets did not evaporate and were carried further into the air stream).

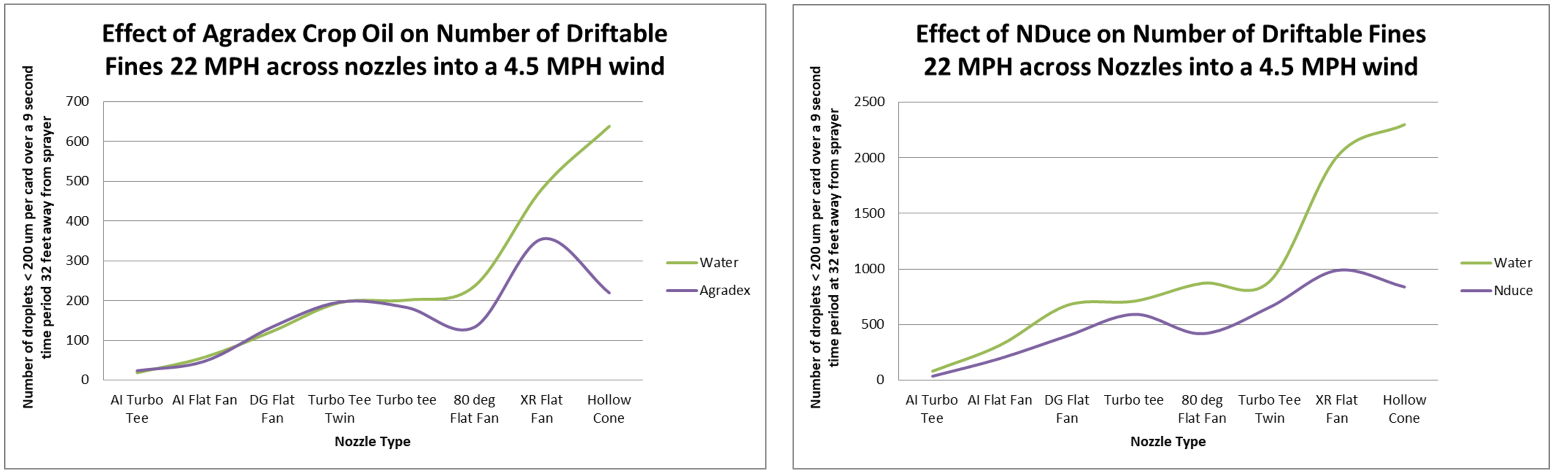

Figure 3: Graphs of several additives on spray drift for different nozzle types. Most other additives had similar responses.

Using these techniques, the number of driftable fines in a spray system can be reduced to create a safer spray system and less drift. A table of recommended nozzles per type of spray application and recommended spraying practices is given below:

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Table 1 lists the recommended tips for different spraying operations.

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

| Pesticide and Mode of Action | Nozzle or Tip Selection |
|---|---|
| Most Herbicides with Systemic Type Attributes – Coarse to Medium Droplets | A.I. (Air Induction) Flat Fan or Turbo Tee |
| 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 |
| Fungicides – Medium to Fine Droplet Sizes<br>Insecticides – Fine Droplet Size | Fungicide and Insecticides – DR/DG (Drift Reduction/Guard) and Hollow Cones or Equivalent |

**Recommended Practices**

- 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 for excessive drift.
    - 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 or near the crop surface to prevent a wind stream between the crop and hood surface.