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Reduce Spray Drift by Choosing the Right Nozzle

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Spray drift is the lateral movement of pesticide droplets away from the target area before they reach the plant or soil. Reducing spray drift is vitally important because applicators are legally liable for any damage that drifting pesticide spray causes to off-target plants. Reducing drift is also important because drift effectively reduces the amount of pesticide that is applied to the intended area.

Do not confuse spray drift with vapor drift. Vapor drift occurs when a pesticide evaporates or volatilizes after it has reached the target plant or soil. This discussion focuses specifically on spray drift.

Spray drift is influenced by wind speed, air temperature, and relative humidity. You must consider these factors day-to-day or even hour-to-hour, however, spray equipment has to be selected and set up well before reaching the field. The nozzle, operating pressure, and boom height you chose can all potentially contribute to spray drift. Of these variables, nozzle selection is the most important factor in reducing spray drift.

Nozzle size and design directly influence the size of spray droplets. Though all spray droplets exit the nozzle at the same velocity, smaller droplets take longer to fall to the target because they lose velocity more quickly. The longer a droplet takes to reach the target, the more susceptible it is to lateral drift.

Droplet size

Manufacturers frequently provide color-coded tables with their products to describe the spray droplet sizes for specific nozzles and operating pressures. Droplets are commonly measured in micrometers (µm)—one µm equals 1/25,400 of an inch. This classification system uses the volume mean diameter (VMD) to define categories of droplet size. The VMD is the size (in µm) at which half of the spray volume droplets are larger than the VMD, and half are smaller than the VMD. This classification is shown in Table 1.

Table 1. ASABE S572.1 droplet size classification.

Category	Symbol and color code	Approximate VMD (µm)*
Extremely fine	XF	<60
Very fine	VF	61-144
Fine	F	145-235
Medium	M	236-340
Coarse	C	341-403
Very coarse	VC	404-502
Extremely coarse	XC	203-665
Ultra coarse	UC	>665

*Estimated from sample reference graph provided for ASABE S572.1 nozzle design

Nozzle design

Modern spray nozzles have several different design features that significantly influence the size of the spray droplets they produce.

Many standard flat-fan nozzles such as the TeeJet Extended Range (XR) nozzle use a simple design with a single orifice. This single orifice regulates the flow of the spray solution and produces the spray pattern. Nozzles like the XR can provide excellent coverage, but can also be quite drift-prone. The TeeJet Drift Guard (DG) nozzle is a an improvement over the single orifice design. This nozzle combines a pre-orifice to regulate the flow, with a second orifice to produce the spray pattern. This design significantly reduces spray drift while still providing excellent coverage.

The TeeJet Air Induction (AI) and Air Induction Extended Range (AIXR) nozzles incorporate further improvements. In addition to a pre-orifice, these nozzles have air inlet ports that draw air in to the spray solution. This additional disturbance to the spray solution causes the droplet size to increase. Nozzles such as the Turbo TeeJet Induction (TTI) nozzle increase the droplet size even more. This nozzle includes pre-orifice and air induction technology in addition to a turbulence chamber. This is simply a small chamber inside the nozzle body that helps absorb some of the energy of the spray solution by forcing it to change direction twice before exiting the nozzle.

Research conducted by the Texas A&M AgriLife Extension Service in cooperation with USDA-ARS Aerial Application Technology Research Unit in College Station, TX, has demonstrated how the nozzle designs mentioned above affect droplet size. Researchers used precision laser diffraction analysis to measure droplets of various pesticides produced by these different nozzles. Although this research tested only TeeJet nozzles, other manufacturers such as Greenleaf Technologies, Pentair Hypro, and Hardi International produce nozzles with similar features. Figure 1 shows the effect of these nozzles operated at both 30 and 60 pounds per square inch (psi) on VMD.

As Figure 1 shows, nozzle design plays a major role in determining the droplet sizes of the spray. For example, changing from an XR to a TTI nozzle at 30 psi causes a nearly 5-fold increase in droplet size. Note also that Figure 1 data shows that droplets get smaller as operating pressure increases.

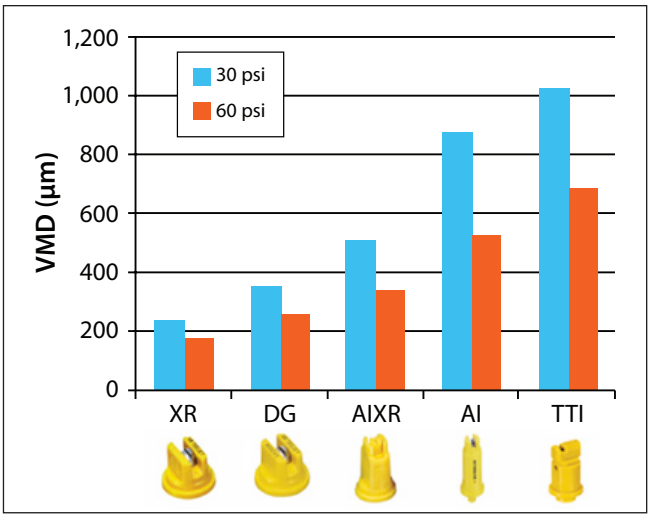

Figure 1. Effect of nozzles on VMD (McGinty, J.A., Baumann, P.A., Hoffman, W.C., & Fritz, B.K. (2014) Unpublished data).

Next, the researchers analyzed these same sprays to determine what portion was prone to drift. Figure 2 shows the percentage of spray droplets measuring 100 µm or less, at 30 and 60 psi. Droplets of 100 µm are roughly the same diameter as a human hair and can be used as a partial indicator of how much of the spray is likely to drift. This figure shows drift-prone droplets can be reduced by more than 50 percent

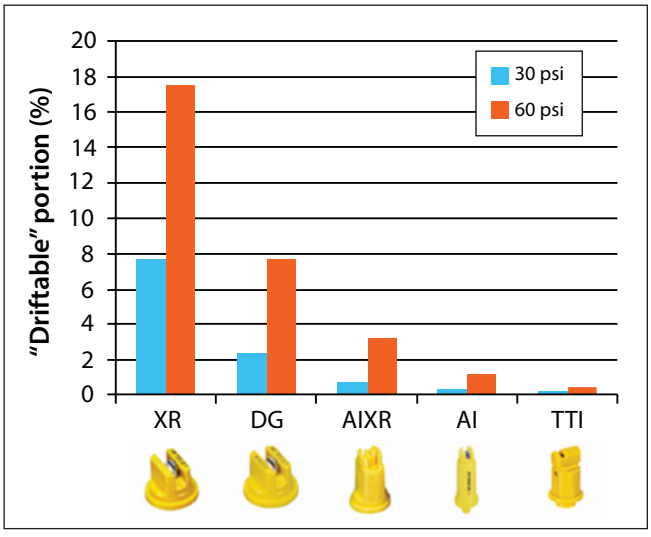

Figure 2. Effect of nozzles on drift-prone (≤100 µm) droplet production (McGinty, J.A., Baumann, P.A., Hoffman, W.C., & Fritz, B.K. (2014) Unpublished data).

by changing from a single-orifice nozzle (XR) to a pre-orifice nozzle such as the DG. You can reduce drift-prone spray even further by changing to a nozzle such as the TTI. Spray produced with his nozzle's pre-orifice and air induction technology contains only a fraction of a percent of drift-prone droplets. As expected, sprays produced at 60 psi contained more drift-prone droplets than sprays at 30 psi.

Summary

For pesticide applications to be accurate and effective, the applicator must do everything under his or her control to ensure that the pesticide stays in the intended area. Research shows that nozzle selection is one of the most important factors for reducing spray drift potential. Finally, if you require higher nozzle output, consider using nozzles with a larger orifice rather than increasing operating pressure. This will help reduce the number of smaller droplets that are caused by increased pressure.

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