TEXAS A&M AGRILIFE EXTENSION

Choosing the Right Nozzle to Reduce Spray Drift

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Spray drift is the lateral movement of pesticide spray droplets away from the target area before reaching the plant or soil. This differs from vapor drift, which is the off-target movement of a pesticide as a vapor after reaching the plant or soil. Vapor drift is directly related to the formulation of the pesticide product and will not be discussed herein. Reducing spray drift of pesticides should be of utmost importance to applicators as they are legally liable for any damages to off-target plants. Additionally, any pesticide moving off-site is effectively reducing the pesticide rate applied to the intended area.

Spray drift is influenced by several environmental factors, including wind speed, air temperature, and relative humidity. These factors must be considered on a day-to-day or even an hour-to-hour basis, but there are additional important decisions in spray equipment setup that must be made well before reaching the field. Nozzle selection, operating pressure, and boom height are all controllable factors impacting the potential for spray drift to occur. Of these three, proper nozzle selection plays the largest role in reducing spray drift. Nozzle design and size directly influence the size of spray droplets. All spray droplets exit the nozzle at the same velocity, but smaller droplets lose velocity more rapidly and thus take longer to fall to the target. The longer a droplet takes to reach the target, the more susceptible it will be to drifting laterally.

Droplet Size Classification

When reading literature that accompanies most spray nozzles, one frequently finds tables providing the user with color-coded descriptions of spray droplet sizes for specific nozzles and operating pressures. Droplets are commonly measured in micrometers (µm), a very small unit of measure (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 droplet size (in µm) at which half of the spray volume is contained in droplets larger than the VMD, and half is contained in droplets 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

There are several different design features found on modern spray nozzles significantly influencing the size of spray droplets produced.

Many standard flat-fan nozzles such as the TeeJet (Wheaton, IL) Extended Range (XR) nozzle utilize a simple design with a single orifice. This single orifice both 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. An improvement on this design can be seen in the TeeJet Drift Guard (DG) nozzle. This nozzle utilizes a pre-orifice that regulates flow, while another orifice produces the spray pattern. This typically results in a significant reduction in spray drift while still providing excellent coverage.

Further improvements can be seen in the TeeJet Air Induction (AI) and Air Induction Extended Range (AIXR) nozzles. In addition to a pre-orifice, these nozzles utilize air inlet ports that draw air in to the spray solution. This additional disturbance to the spray solution results in an increase in droplet size. An additional increase in droplet size can be seen with nozzles such as the Turbo TeeJet Induction (TTI) nozzle. 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 Texas A&M AgriLife Extension Service in cooperation with USDA-ARS Aerial Application Technology Research Unit in College Station, TX has demonstrated the influence of the previously mentioned nozzle designs on spray droplet size. Extremely precise laser diffraction equipment was used to measure the droplet sizes of many pesticide sprays through different nozzle types. Although this research was conducted on TeeJet nozzles only, it should be noted that nozzles with similar properties are produced by manufacturers such as Greenleaf Technologies (Conington, LA), Pentair Hypro (New Brighton, MN), and Hardi International (Davenport, IA). Figure 1 below shows the effect of these nozzles operated at both 30 and 60 psi on VMD.

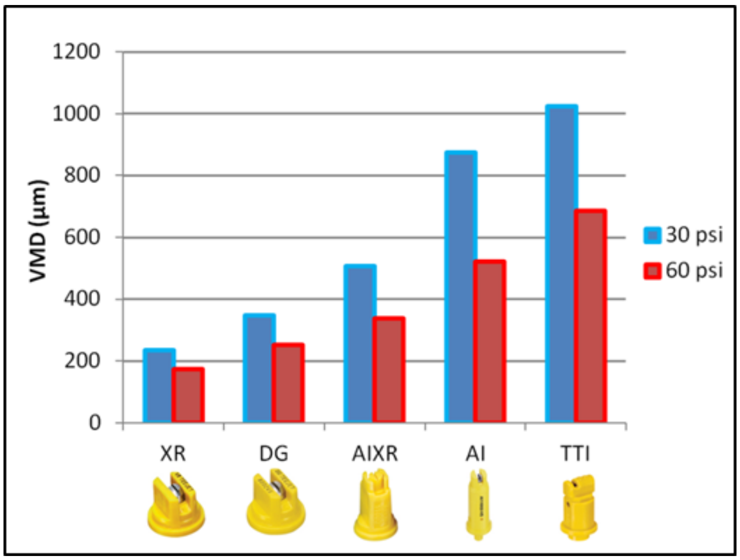

Figure 1. Effect of nozzles on VMD (*McGinty, J.A., Baumann, P.A., Hoffman, W.C., & Fritz, B.K. (2014) Unpublished data*).

As this figure shows, nozzle design plays a major role in determining the droplet sizes of the spray. For example, simply changing from an XR to a TTI nozzle results in a nearly 5-fold increase in droplet size when operating at 30 psi. Figure 1 also shows that droplet sizes are reduced as operating pressure increases.

Next, the "driftable" portion of these same sprays was analyzed. Figure 2 shows the percentage of the spray contained in droplets 100 µm or less in diameter, at pressures of 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 the drift-prone portion of a spray. This figure shows drift-prone droplets can be reduced by more than 50% simply by changing from a single-orifice nozzle (XR) to a pre-orifice nozzle such as the DG. Even greater reductions can be achieved by changing to a nozzle such as the TTI, where only a fraction of a percent of the spray is contained in drift-prone droplets. As expected, sprays produced at 60 psi resulted in the production of more drift-prone droplets than sprays at 30 psi.

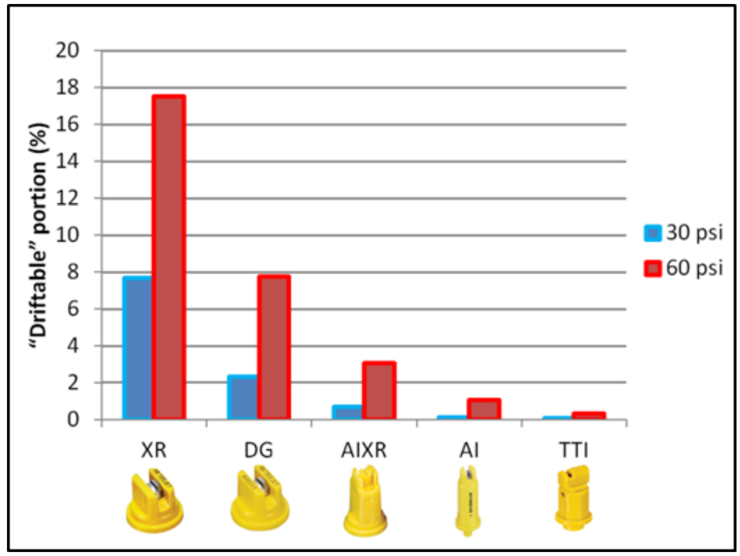

Figure 2. Effect of nozzles on drift-prone (≤100 µm) droplet production (*McGinty, J.A., Baumann, P.A., Hoffman, W.C., & Fritz, B.K. (2014) Unpublished data*).

Summary

Accurate and effective pesticide applications require the applicator do everything within their control to ensure the pesticide stays in the intended area. These results show proper nozzle selection is one of the most important decisions an applicator can make to reduce the potential for spray drift to occur. Finally, when higher nozzle output is desired, consider changing to nozzles with a larger orifice size rather than simply increasing operating pressure. This will help keep droplet sizes from decreasing as a result of increased pressure.

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