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Nozzles and Droplets: What Do the Colors Mean?

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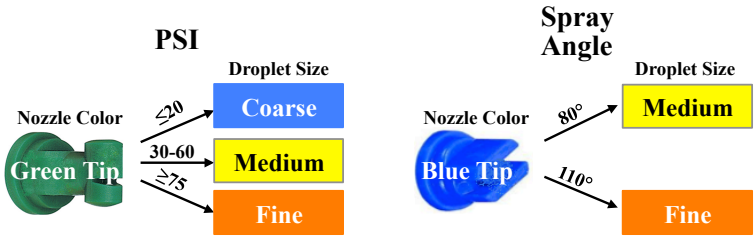
Two color coding schemes exist to guide applicators when selecting nozzles for pesticide applications. The color schemes are designed to help applicators achieve accurate, effective crop protection. It may be confusing, but **the color schemes represent flow rate and droplet size** and are independent of one another.

The first color scheme, **the color of the spray nozzle tip, describes the capacity (flow rate) of the nozzle orifice at 40 PSI** and is based on Standard 10625 of the International Standards Organization (ISO) (Table 1). Nozzle flow rates are mainly a function of orifice size & pressure.

The American Society of Agricultural and Biological Engineers (ASABE) developed **a second color scheme used in nozzle literature and on pesticide labels that describes spray droplet sizes**. This scheme defines droplet size ranges or categories using the Volume Mean Diameter (VMD) (Figure 1 and Table 2). Droplet sizes within any spray are never completely uniform, so VMD is used as an indicator of the average droplet diameters within a spray. VMD is the droplet size at which half of the total spray volume is contained in droplets larger than the VMD and half of the total spray volume is contained in droplets smaller than the VMD (Figure 1). Pesticide manufacturers use the droplet size categories on pesticide labels to specify the optimum droplet size for a particular product.

A nozzle produces different droplet sizes depending on the operating pressure, nozzle design, spray angle, and the components of the spray mixture. Flow rate increases with the square root of pressure, therefore doubling the flow rate will result in a fourfold increase in pressure. **Increasing the operating pressure or spray angle of the nozzle decreases droplet size (See examples below).**



Nozzle design features such as pre-orifices, mixing chambers, and Venturi inlets can have dramatic effects on both the VMD and the range of droplet sizes produced by a nozzle. **Generally speaking, combinations of wide fan angles, smaller nozzle orifice sizes (lower flow rates), and high pressures result in smaller droplets.**

Choosing a Nozzle: Sprayer calibration should begin with determining the proper droplet size for a pesticide (included on the label). The applicator can then refer to nozzle manufacturer catalogs and nozzle tables to select the proper nozzle tip color to obtain that droplet size based on the desired operating pressure, sprayer travel speed, and desired carrier volume (also from the pesticide label).

Table 1. Nozzle tip colors & corresponding flow rates at 40psi

Nozzle Color	Flow Rate (GPM) at 40psi
Orange	0.10
Green	0.15
Yellow	0.20
Purple	0.25
Blue	0.30
Red	0.40
Brown	0.50
Grey	0.60
White	0.80

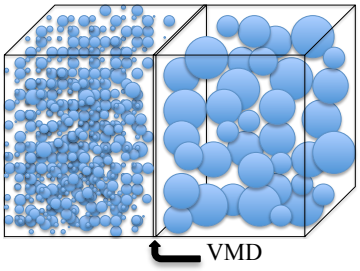


Figure 1. VMD is the droplet size at which 50% of the spray volume is in droplets larger than the VMD and 50% of the volume is in droplets smaller than the VMD (adapted from Matthews 1992).

Table 2. **Droplet size distribution** classification (ASABE Standard S572.1). These colors can be found in nozzle literature and labels, but are different from nozzle tip colors.

Droplet Category	Symbol	Color Code	VMD Range (microns)*
Extremely Fine	XF	Purple	< 60
Very Fine	VF	Red	61–144
Fine	F	Orange	144–235
Medium	M	Yellow	236–340
Coarse	C	Blue	341–403
Very Coarse	VC	Green	404–502
Extremely Coarse	XC	White	503–665
Ultra Coarse	UC	Black	> 665

*Estimated from sample reference graph in ASABE/ANSI/ASAE Standard S572.1

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References:

Wolf, R.E. and S. Bretthauer. *Droplet Size Calibration: A New Approach to Effective Spraying.* Kansas State University, Mar. '09.

Spray Nozzle Classification by Droplet Spectra. American Society of Agricultural and Biological Engineers. ANSI/ASAE S572.1, Mar. '09.