



Application
Technology Series

Guide to Spray Nozzle Tip Selection by Droplet Size

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A nozzle's spray pattern consists of numerous spray droplets of varying sizes. Droplet size refers to the diameter of an individual spray droplet. The drop sizes contained in the spray pattern can be classified into droplet size classes. These classes (extremely fine, very fine, fine, medium, coarse, very coarse, extremely coarse, and ultra coarse) can then be used to compare one nozzle to another.

Droplet sizes are usually measured in microns (micrometers). One micron equals 0.001 mm. The micron is a useful measurement because it is small enough that whole numbers can be used in droplet size measurement.

Nozzle tip selection is determined by the desired droplet size. The droplet size from a nozzle becomes important when the efficacy of a particular plant protection chemical is dependent on coverage or the prevention of spray leaving the target area is a priority. The majority of agricultural-use nozzles can be classified as producing droplets in the range of fine to ultra coarse droplets. Nozzles producing droplets in the finer to middle portion of the size range are usually recommended for postemergence contact applications. These applications — which may include herbicides, insecticides, and fungicides — require excellent coverage on the intended target. Nozzles producing droplets from the middle to coarser end of the range, while offering less thorough surface coverage, provide significantly improved drift control. These nozzles are commonly used for systemic and pre-emergence surface applied herbicides (Chart 1).

Remember one nozzle can produce different droplet size classifications at different pressures. A nozzle might produce medium droplets at low pressures, while producing fine droplets as pressure is increased. Droplet size classes are shown in Chart 2.

Many labels provide recommendations and requirements regarding droplet size, nozzle selection, and sprayer configuration. Research in application technology supports recommendations in nozzle-selection guides and directions on labels. In the absence of specific guidance, however, Charts 1 and 2 may serve as a starting point.

Droplets, Coverage, and Drift

Very fine droplets (VMD less than 145 microns) are collected efficiently by flying insects or needles on coniferous plants, but they tend to remain in the air stream, which carries them around the stem and leaves of weeds.

Fine and medium-size droplets (Volume Median Diameter, or VMD, between 145 and 325 microns) deposit efficiently on stems and narrow vertical leaves such as grasses if applied when there is some air movement.

Coarse (or larger) droplets (VMD more than 325 microns) deposit efficiently on large, flat surfaces such as the leaves of broadleaf weeds.

Insecticides, fungicides, and contact herbicides generally require smaller droplets (Chart 1) than systemic herbicides to obtain adequate coverage of the target. For foliar systemic herbicides, experimental results suggest that applications using droplet sizes in the coarse ranges do not significantly differ unless application volumes are extremely high or very low.

Summary

1. When selecting a nozzle, consider both flow rate and droplet size.
2. Base decisions on the properties of active ingredients applied and spray solution target.
3. Avoid using nozzles and pressures that produce a VMD of less than 225 microns (fine-very fine-extremely fine).
4. Always read the product label. Pesticide product labels may specify what droplet size to use and how much spray solution to apply to a given area. This information directs nozzle selection and in turn, affects spraying equipment configuration and calibration.

References and Additional Information

Strategies to Reduce Spray Drift, K-State Research and Extension publication MF2444. <http://www.bookstore.ksre.ksu.edu/pubs/MF2444.pdf>.

Calibrating a Sprayer with the "Ounce" Collection Method, K-State Research and Extension publication MF3174. <http://www.bookstore.ksre.ksu.edu/pubs/MF3174.pdf>

Agricultural Spray Nozzles: Selection and Sizing, K-State Research and Extension publication MF3178. <https://www.bookstore.ksre.ksu.edu/pubs/MF3178.pdf>.

Nozzles and Droplets: What Do the Colors Mean? Arizona Cooperative Extension. https://cals.arizona.edu/crop/cotton/files/ColorsofNozzles_Droplets.pdf



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Chart 1. Droplet range for application/pest control ¹.

Application	Droplet Category ²	Approximate VMD Range ³ (microns)
Fungicide		
Foliar protective or curative	Medium (M)	226–235
Insecticide		
Foliar contact	Medium (M)	226–235
Foliar systemic	Coarse (C)	326–400
Soil-applied systemic	Coarse (C)	326–400
	Very Coarse (VC)	401–500
	Extremely Coarse (XC)	500–650
	Ultra Coarse (UC)	>650
Herbicide		
Foliar/post-emerg contact	Medium (M)	226–325
Foliar/post-emerg systemic	Coarse (C)	326–400
	Coarse (C)	326–400
Soil-applied/pre-emerg systemic	Very Coarse (VC)	401–500
	Extremely Coarse (XC)	501–650
	Ultra Coarse (UC)	>650

1 Always read the label. Pesticide product labels may specify what droplet size to use, which will direct nozzle selection and in turn affect spraying equipment configuration and calibration.

2 ASABE (American Society of Agricultural & Biological Engineers) Standard 572.1. Color coding helps differentiate droplet sizes.

3 Reported VMD ranges vary widely, based on the type of laser analyzer used. VMD = Volume Median Diameter: a value where 50% of the total **volume** or mass of liquid sprayed consists of droplets **larger** than and 50% **smaller** than this value.

Chart 2. Droplet size classification chart.

Droplet Category ¹	Symbol	Color Code	Approximate VMD Range ² (microns)
Extremely Fine	XF	Purple	<60
Very Fine	VF	Red	60–145
Fine	F	Orange	146–225
Medium	M	Yellow	226–325
Coarse	C	Blue	326–400
Very Coarse	VC	Green	401–500
Extremely Coarse	XC	White	501–650
Ultra Coarse	UC	Black	>650

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John W. Slocombe and Dallas Peterson, *Guide to Spray Nozzle Tip Selection by Droplet Size*, Kansas State University, December 2015.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

MF3240

December 2015

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