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Herbicide Application Techniques and Sprayer Calibrations

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Herbicide Application Techniques

Hand gun

Spot spray

Broadcast spray

Herbicide Application Volumes

- Pendulum
  - Labeled spray instructions suggest spray volumes of 10 to 200 gpa for ground applications
  - Aerial applications can be in 5 gpa
- Barricade
  - 20 gpa
- Surflan, Dimension
  - None
- Specticle
  - 10-20 gpa
- SureGuard
  - 10 (15) – 30 gpa (boom)
  - 100 gpa (backpack)

Herbicide Application Volumes

- Broadcast with boom sprayer
  - Spray swath is known
  - Distance determined by speed
- Hand gun
  - Spray swath is variable
  - Distance determined by speed or pace
- Spot sprayer
  - Spray swath is highly variable
  - Pace is highly variable, wandering path
  - Spray-to-wet or spray-to-runoff

Comparing Herbicide Application Volumes

- Desired product rate 2.0 qt/A = 1.0% solution (0.5 gal/50 gal)
- Backpack with boom sprayer (avg. 80 people)
  - Avg volume 41 gpa (10 – 100 gpa range) 5% - 0.5%
  - Avg 1.64 qt/A (0.4 – 4.0 qt/A range)
- Hand gun (avg. 80 people)
  - Avg volume 127 gpa (24 – 352 gpa range) 2% - 0.1%
  - Avg 5.2 qt/A (0.96 – 14.0 qt/A range)
- Spot sprayer (avg. 80 people)
  - Avg volume 628 gpa (80 – 1,560 gpa range) 0.6% - 0.03%
  - Avg 25.2 qt/A (3.2 – 63.6 qt/A range)

Bell, C. UC Weed Science Blog June 21, 2014

Summary

- Calibrate for all types of applications
  - Broadcast
  - Handgun
  - Backpack sprayer

Calibrating Boom Sprayers

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How to determine the amount of spray mix for an area

- Amount
  - Gallons per acre (gpa)
  - Gallons per 1000 ft^2
- Area
  - Acre = 43,560 ft^2

Determine the Area sprayed by the sprayer

- Boom width
  - Number of nozzles multiplied by spacing
  - Typically 20-inch spacing depends on spray tip angle
- Distance travelled
- Boom width x Distance travelled = Area

Determine the speed of the sprayer

- Measure a straight line distance
- Select gear and RPM (instead of mph)
- Measure the time in seconds to travel the straight line distance
- Distance per time = feet / second

$$\frac{X \text{ ft}}{Y \text{ sec}} \times \frac{\text{miles}}{5280 \text{ ft}} \times \frac{3600 \text{ sec}}{\text{hr}} = \frac{\text{miles}}{\text{hr}}$$

Determine the nozzle delivery flow rate

- Set a constant delivery pressure
- Use catch cans for each nozzle
- Volume per time =

  gallons / minute (GPM)

  ✓ Time = sprayer time per travelled distance
- Add total amount of water collected from all nozzles per time

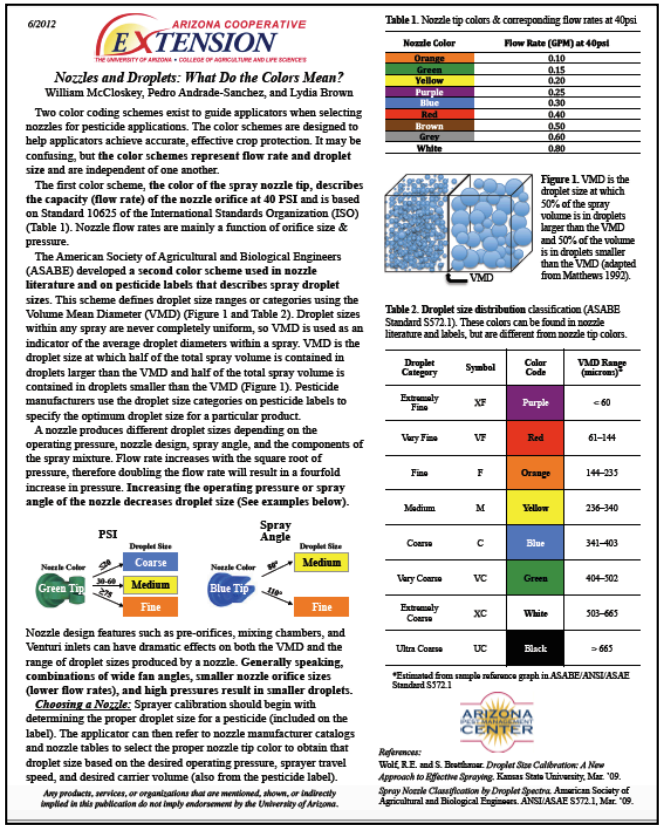
Nozzle Colors

2 color schemes used

Spray nozzle tip color describes the flow rate (gpm) of the nozzle orifice at 40 psi.

8002
80° angle
0.20 gpm

110025
110° angle
0.25 gpm



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Nozzles and Droplets: What Do the Colors Mean?

William McCloskey, Pedro Andrade-Sanchez, and Lydia Brown

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).**

PSI

Nozzle Color: Green Tip — 50 → Droplet Size: Coarse; 30-60 → Medium; 275 → Fine

Spray Angle

Nozzle Color: Blue Tip — 80° → Droplet Size: Medium; 110° → Fine

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).

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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

VMD

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. Bruthnaur. *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.

http://cals.arizona.edu/crop/cotton/files/ColorsofNozzles_Droplets.pdf

Nozzle Colors
2 color schemes used

ASABE color scheme for spray droplet size on pesticide labels

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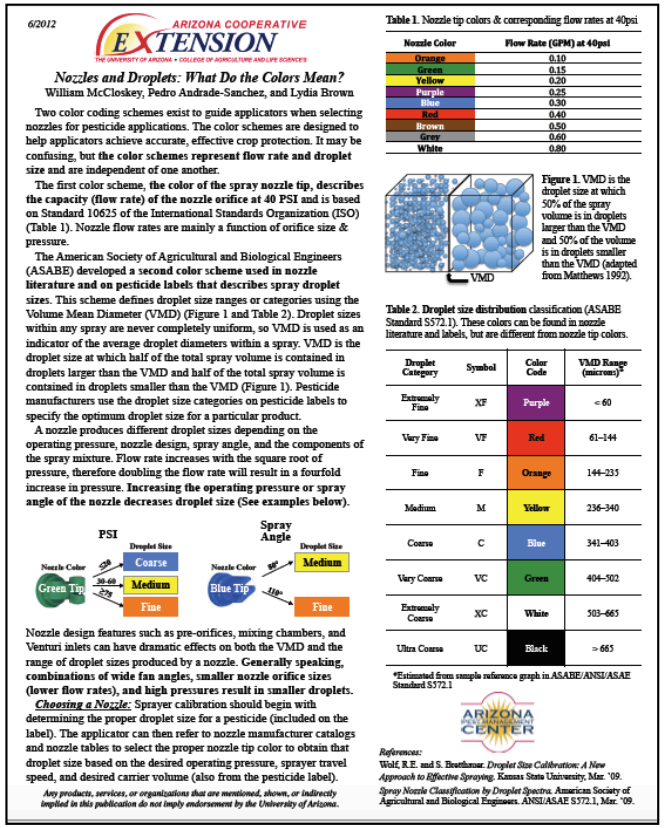
Fine droplets
- Higher psi
- Wider angle
- Small orifice

Coarse droplets
- Lower psi
- Narrow angle
- Large orifice



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PSI

Spray Angle

Nozzle Nozzle Color Droplet Size Coarse Medium Fine

Green Tip 30-60 Blue Tip Medium Fine

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Calculate the delivery rate

- Amount of spray per area
  - Gallons per acre (GPA)

$\frac{X \text{ gal collected in } Y \text{ sec}}{\text{Area = boom width' x distance'}} = \frac{? \text{ Gallon}}{43{,}560 \text{ ft}^2}$

Useful Conversions

1 gal = 4 qt = 8 pt = 128 oz = 3.78 L

1 pt = 16 oz = 473 mL

1 oz = 29.6 mL

1 lb = 16 oz = 454 gm

1 oz = 28.4 gm

1 acre = 43,560 ft^2

1 mile = 5,280 ft


Thank You
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