# Educating Applicators About Droplet Size

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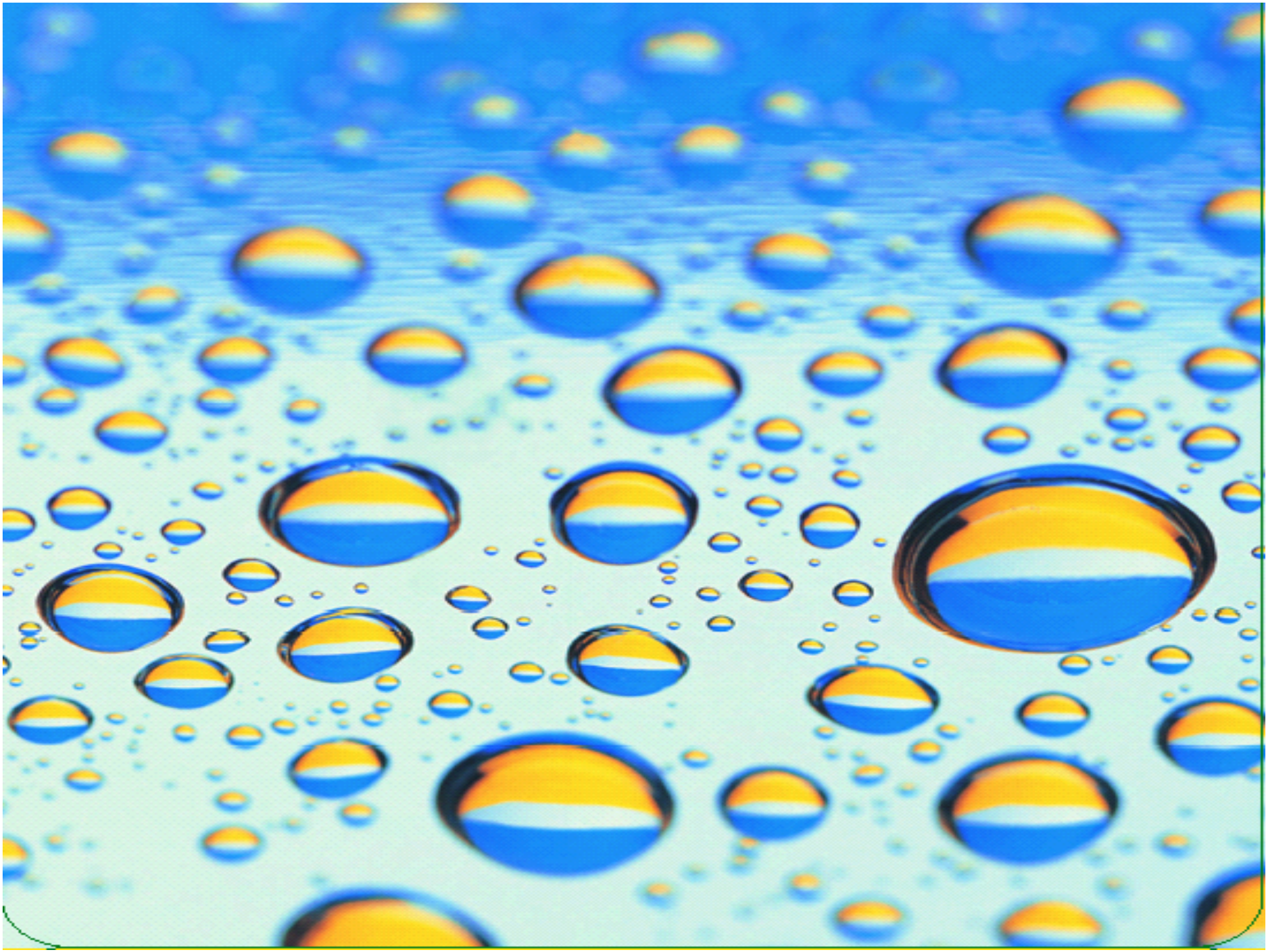


# Droplet Size
# μ - microns

- We typically use units of microns - micrometers (μ) to describe the size of drops produced by nozzles.

# Drop Size:


**One micron (μm) =1/25,000 inch**
**1/1000 millimeter**

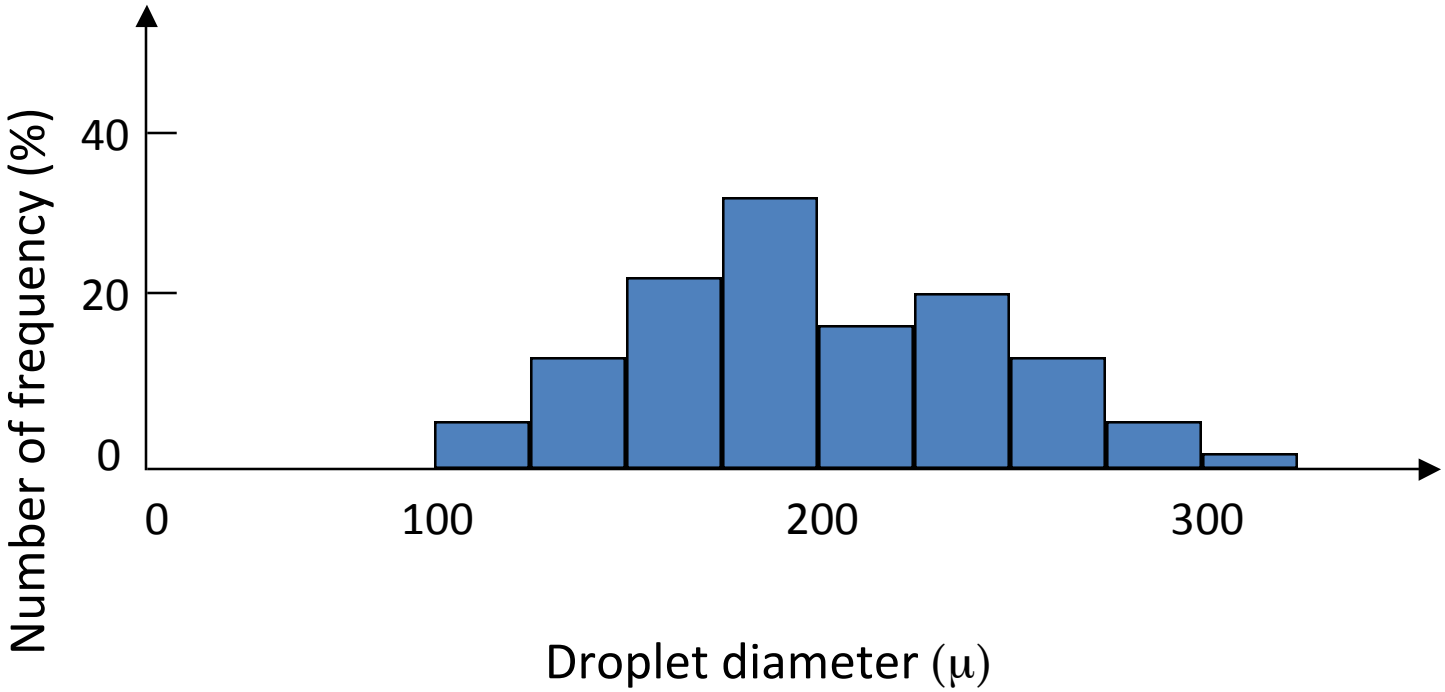
# Comparison of Micron Sizes for Various Items: (approximate values)

| | |
|---|---|
| • pencil lead | 2000 (μm) |
| • paper clip | 850 (μm) |
| • staple | 420 (μm) |
| • toothbrush bristle | 300 (μm) |
| • sewing thread | 150 (μm) |
| • human hair | 100 (μm) |

**150**

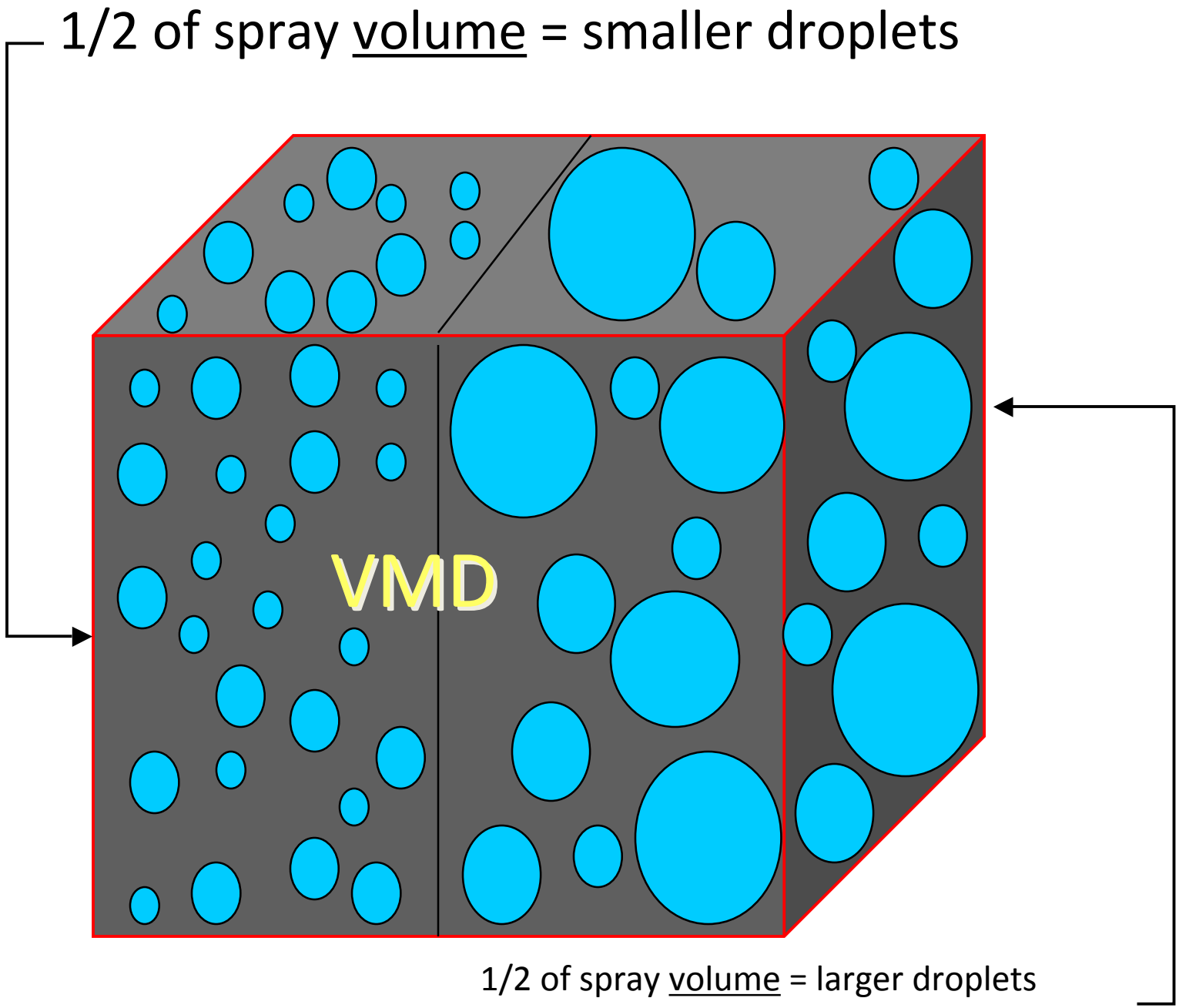
# Droplet Size Distributions

Droplet size data is generated by measuring the number of droplets within various size classes and preparing a statistical report.

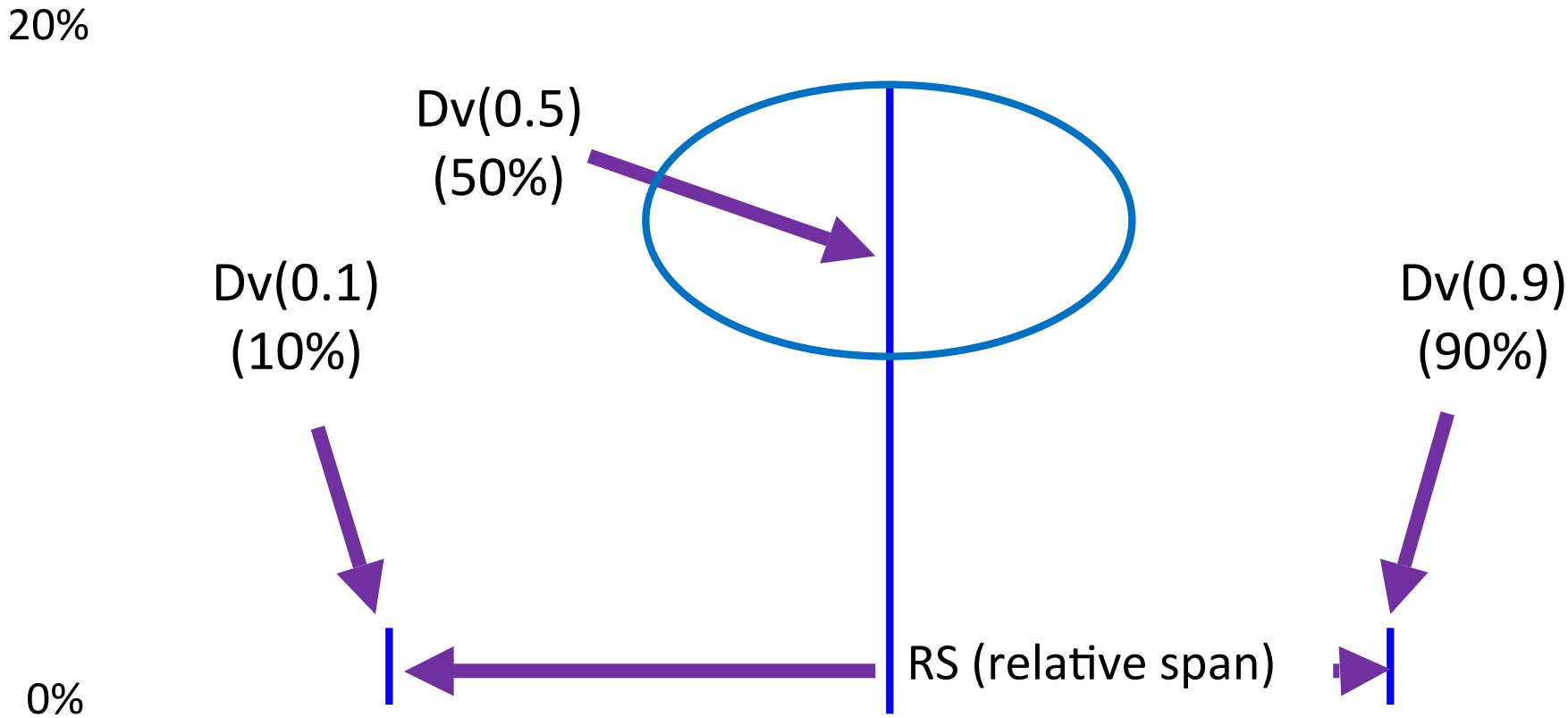


# VMD and NMD

- Dv0.5 (VMD) - volume median diameter:
  - Divides droplet spectrum so half the total volume of the spray are of lesser diameter and half of greater diameter.
- Dn0.5 (NMD) - number median diameter:
  - Divides droplet spectrum so half the total number of droplets are of lesser and half are of greater diameter.


1/2 of spray volume = smaller droplets
VMD
1/2 of spray volume = larger droplets

# Cumulative volume distribution



# Other droplet measurement terms

- Dv(0.1) – droplet diameter where 10% of spray volume is smaller (90% is greater)
- Dv(0.9) – droplet diameter where 90% of spray volume is smaller (10% is greater)
- Relative span (RS) – used to describe the "width" of the spectrum

$$RS = \frac{Dv(0.9) - Dv(0.1)}{Dv(0.5)\ VMD}$$

# Relative Span

$$RS = (Dv0.9 - Dv0.1)/VMD$$

$Dv0.9 = 400$, $VMD = 300$, $Dv0.1 = 100$

$Dv0.9 = 625$, $VMD = 300$, $Dv0.1 = 25$

# Droplet Size Classification for Agricultural Sprays

- Safe and efficient application requires a definition of an appropriate droplet size spectrum:
  - Maximize spray efficiency for transporting crop protection product to the target.
  - Minimize off-target losses via:
    - Spray drift
    - Applicator exposure
- Spray performance and drift minimization depends on droplet size.
- Because of a multitude of nozzle types - sprays should be classified according to droplet size.

# Origin Of Standardized Spray Droplet Size Categories - Europe

- 1985 – British Crop Protection Council (BCPC)
  - Spray classification system
    - Primarily designed to enhance efficacy
    - Originally for nozzles for ground spray applications
    - Other atomizers also included
  - Uses the term SPRAY QUALITY for droplet size categories.
- Quality of spray placed in five categories:
  - very fine, fine, medium, coarse, very coarse
- Recognized that droplet size spectra was different when measured by different instruments and techniques.
  - Laser diffraction, optical imaging, phase-Doppler
  - Sampling techniques with instrumentation

# Origin Of Standardized Spray Droplet Size Categories – United States

- 1999 – ASAE Standard  S572 (revised 2009-S572.1)
  - Defines droplet spectrum categories for the classification of spray nozzles.
  - Classified relative to specified reference nozzles discharging spray into static air so that no stream of air enhances atomization.
  - Droplet size classifications are primarily designed to indicate off-site spray drift potential.
  - Secondarily used for application efficacy.
- Standard is a means for relative nozzle comparisons only based on droplet size.
  - Does not address droplet trajectory, height, and velocity; air bubble inclusion; droplet evaporation; and impaction of target.

**ANSI/ASAE S572.1 MAR2009**
**Spray Nozzle Classification by Droplet Spectra**

**2009**

American Society of
Agricultural and Biological Engineers

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ASABE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA ph. 269-429-0300, fax 269-429-3852, hq@asabe.org

ASABE S-572.1 Droplet Size Standard

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> "Standards are essential for all human activity, but most people take them for granted. Only when products fail to work, or mishaps occur, does the average person think about standards. Even in business, where money is at stake, standards are often given a low priority. There is a clear need in the United States for greater attention to standards."
>
> "Global Standards: Building Blocks for the Future" Congress of the United States, OfficeofTechnologyAssessment (March 1992)

*ASABE recently signed a Memorandum of Understanding with the Irrigation Association to cooperate on irrigation standards*

ASTM INTERNATIONAL
Standards Worldwide - Home

# STANDARDS SEARCH

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a0276-08a

Refinements Applied:

None

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a0276-08a SEARCH

All Standards (102) | Active (95) | Historical (6) | Work Item (1)

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*No results were found for **droplet size**. Results shown are for **a0276-08a***

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*Active Standard (Latest Version)*

ASTM E1260-03(2009) Standard Test Method for Determining Liquid Drop Size Characteristics in a Spray Using Optical Nonimaging Light-Scattering Instruments

1.1 The purpose of this test method is to obtain data which characterize the sizes of liquid particles or drops such as are produced by a spray nozzle or similar device under specified conditions using a specified liquid. The drops will generally be in the size range from 5- x03BC; m to the order of 1 000- x03BC; m diameter; they will occur in sprays which may be as small as a few cubic ... More

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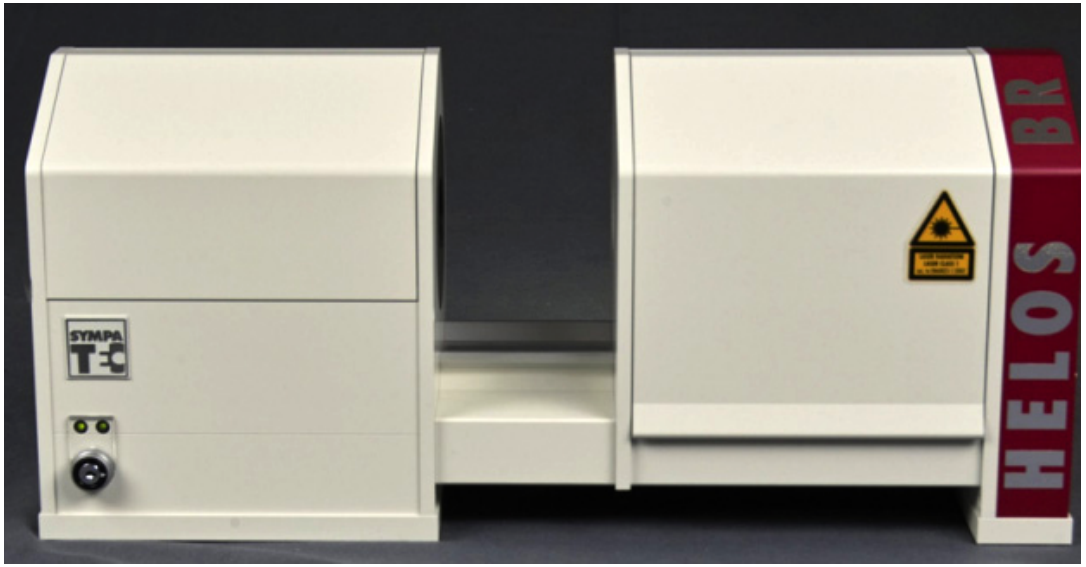
# Droplet Sizing

- Measured with a laser-based instrument.
  - Both reference and nozzles to be classified
- Commercial droplet sizing instruments typically use techniques with:
  - Laser diffraction
  - Laser imaging
  - Laser-based phase Doppler
- Verification and calibration to known standards essential.
- Nozzle oriented to scan the entire spray plume.
- Ensure a representative cross-sectional sample of the spray plume is obtained.


SYMPA
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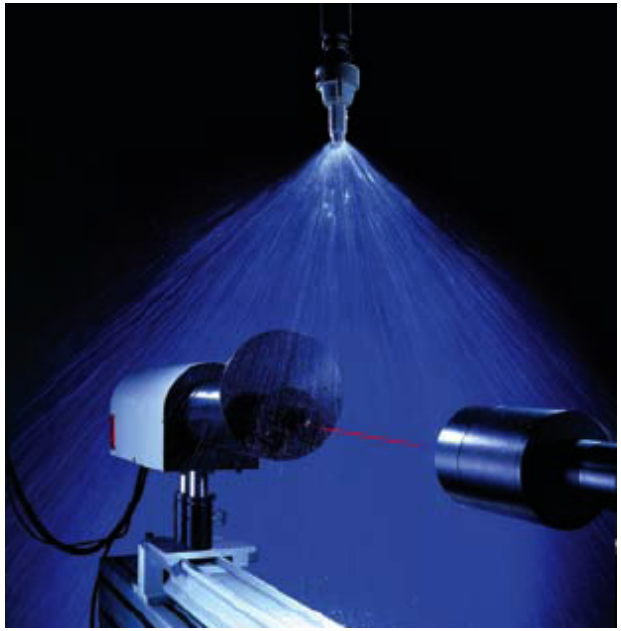
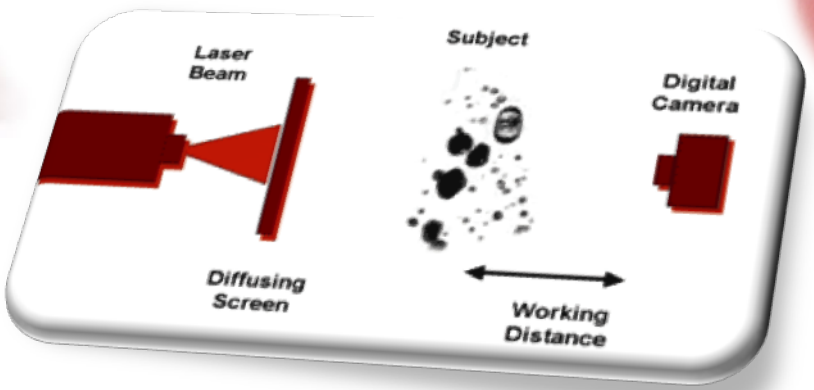



Sprayter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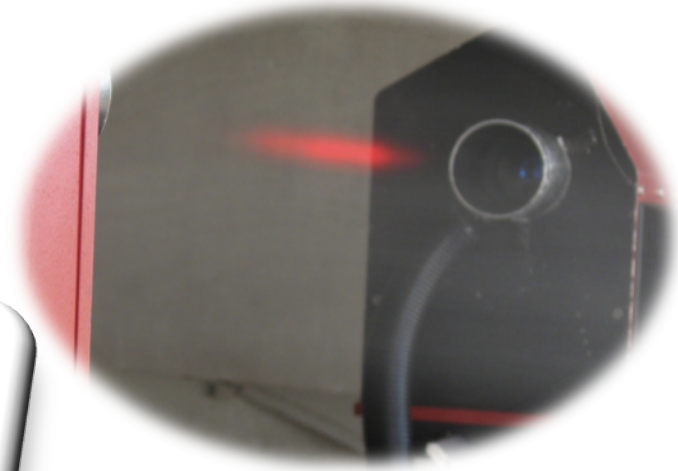

# Droplet Sizing

- Determine a reference graph from the reference nozzles.
- Create example reference graph by plotting droplet diameter (microns - µm) vs. the cumulative spray volume (fraction or %).
- Curves will define the classification thresholds between categories.

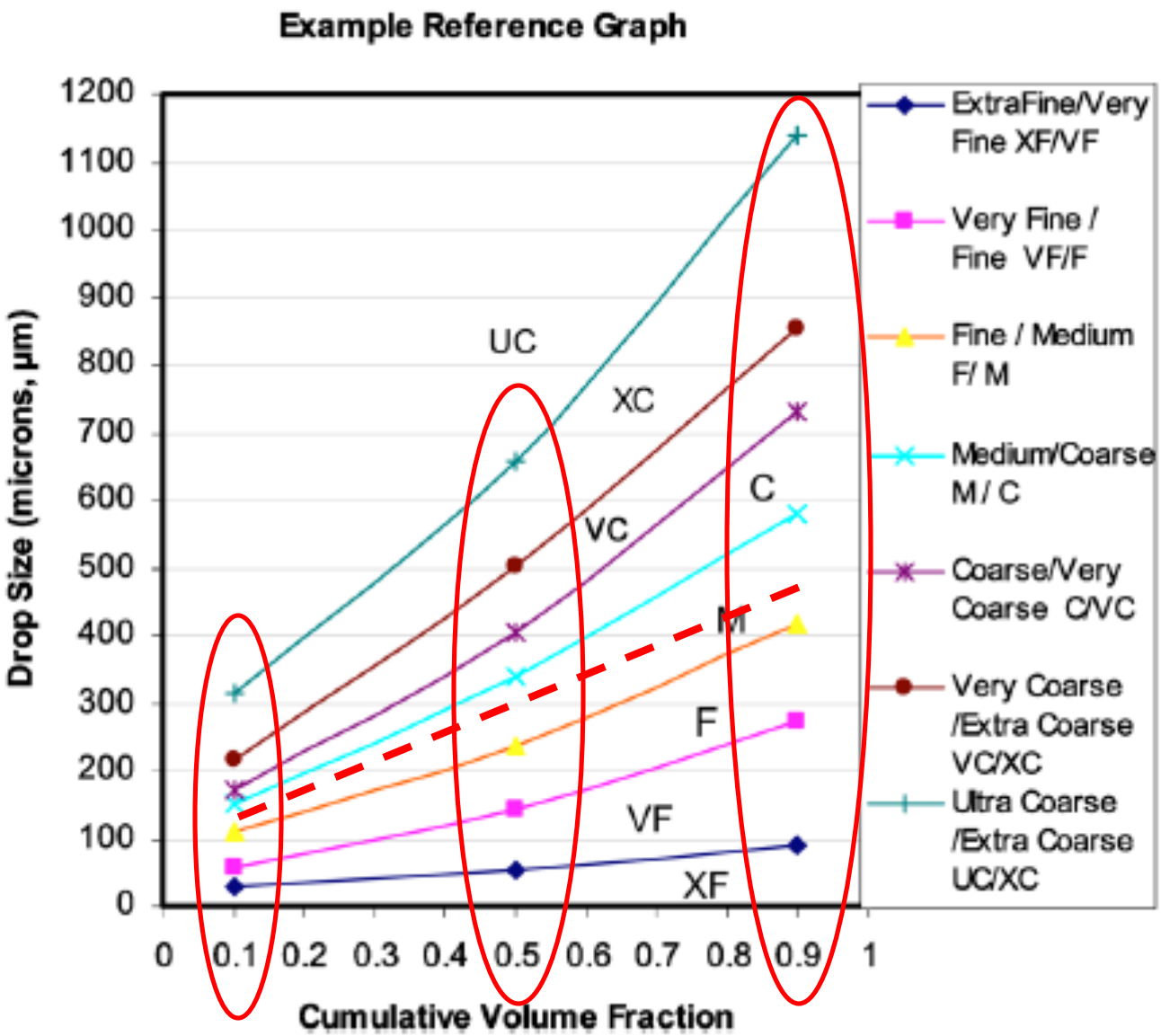


Figure 1 – Sample reference graph developed from measurements averaged from three types of laser instruments. NOTE: To view figure in color please go to http://www.asabe.org/standards/images/s572images.html

# Practical Uses for S-572.1

- Manufacturers can have their nozzles tested by a qualified technician using the proper equipment and techniques as outlined in S-572.1.
- Manufactures can do in-house testing provided they follow the specifications outlined in S-572.1.

THE CP® PRODUCTS COMPANY, INC.

*Spray Nozzles and Check Valves for Agriculture Applications*

## Aerial Products

- Product List
- Choosing Nozzles
- Set-up Calculations
- Droplet Calculations
- Check Valves

Boom configuration, orifice/deflector condition and many other factors may impact how close actu
It is extremely important that aircraft be pattern tested to verify deposition, droplet spectrum and tc

**For Fixed-Wing Aircraft:**

CP-03 Nozzle Model Fixed-Wing
CP-07 & 09 Nozzle Model Fixed-Wing
CP 40 Degree Flat Fan (Large Orifice) Nozzle Model Fixed-Wing
CP 40 Degree Flat Fan (Small Orifice) Nozzle Model Fixed-Wing
CP-80 Degree Flat Fan Nozzle Model Fixed-Wing
CP-11TT with Straight Stream Tips Model Fixed-Wing

**For Rotorcraft:**

CP-03 Nozzle Model Rotary-Wing
CP 40 Degree Flat Fan (Large Orifice) Nozzle Model Rotary-Wing
CP 40 Degree Flat Fan (Small Orifice) Nozzle Model Rotary-Wing
CP 80 Degree Flat Fan Nozzle Model Rotary-Wing
CP-80 Degree High Volume Tips for Rotor Craft
CP-110 Degree Flat Fan for Rotor Craft

418 S Price Road Tempe, Arizona 85281 Toll Free 866.303.0600

# APPLICATION PARAMETERS
# FOR 40-DEGREE FLAT FAN NOZZLE (SMALL ORIFICE)

USDA ARS AH-726
I. W. Kirk, ARS, USDA, College Station, Texas



ASAE, 2950 Niles Rd., St. Joseph, MI 49085-9659 USA
Voice: 616.429.0300 FAX: 616.429.3852

**Directions:** Enter CP nozzle parameters, pressure, and airspeed in the fields below.

| | Nozzle Tip Size | Nozzle Angle, Degrees | Pressure, PSI | Airspeed, MPH |
|---|---|---|---|---|
| Acceptable Range: | 2 to 10 | 0 to 90 | 20 to 60 | 100 to 160 |
| | 10 | 8 | 40 | 130 |

Results will appear in a new window.

Calculate! Clear Fields

| | | | |
|---|---|---|---|
| DV0.1 = | 154 | µm | = Droplet size such that 10% of the spray volume is in droplets smaller than DV0.1. |
| DV0.5 = | 349 | µm | = Volume median diameter |
| DV0.9 = | 574 | µm | = Droplet size such that 90% of the spray volume is in droplets smaller than DV0.9. |
| RS = | 1.20 | - | = Relative Span |
| %V<100µm = | 5.14 | % | = Percentage of spray volume in droplets smaller than 100 µm diameter. |
| %V<200µm = | 12.77 | % | = Percentage of spray volume in droplets smaller than 200 µm diameter. |
| DSCV0.1 = | MEDIUM | - | = Droplet Spectra Classification based on DV0.1. |
| DSCV0.5 = | MEDIUM | - | = Droplet Spectra Classification based on DV0.5. |
| DSCV0.9 = | MEDIUM | - | = Droplet Spectra Classification based on DV0.9. |
| DSC = | MEDIUM | - | = ASAE S572 AUG99 Droplet Spectra Classification |

**Another calculation? Just close this window,**
**change the numbers in the fields and click 'Calculate!'**

# USDA Aerial Nozzle Atomization Models

The models are implemented in Microsoft® Excel® computer spreadsheets and are available for download at:
**http://apmru.usda.gov/downloads/downloads.htm**

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Biology, Ecology and Management of the Boll Weevil

Aerial Application Technology For Crop Production And Protection

2002 ASAE/NAAA Technical Session Program

AERIAL SPRAY NOZZLE MODEL TABLES 2002 (Adobe PDF format)

AERIAL SPRAY NOZZLE MODELS (Technical Version) 2002 (Excel Spreadsheet)

AERIAL SPRAY NOZZLE MODELS (User Version) 2002 (Excel Spreadsheet)

# USDA Aerial Nozzle Atomization Models

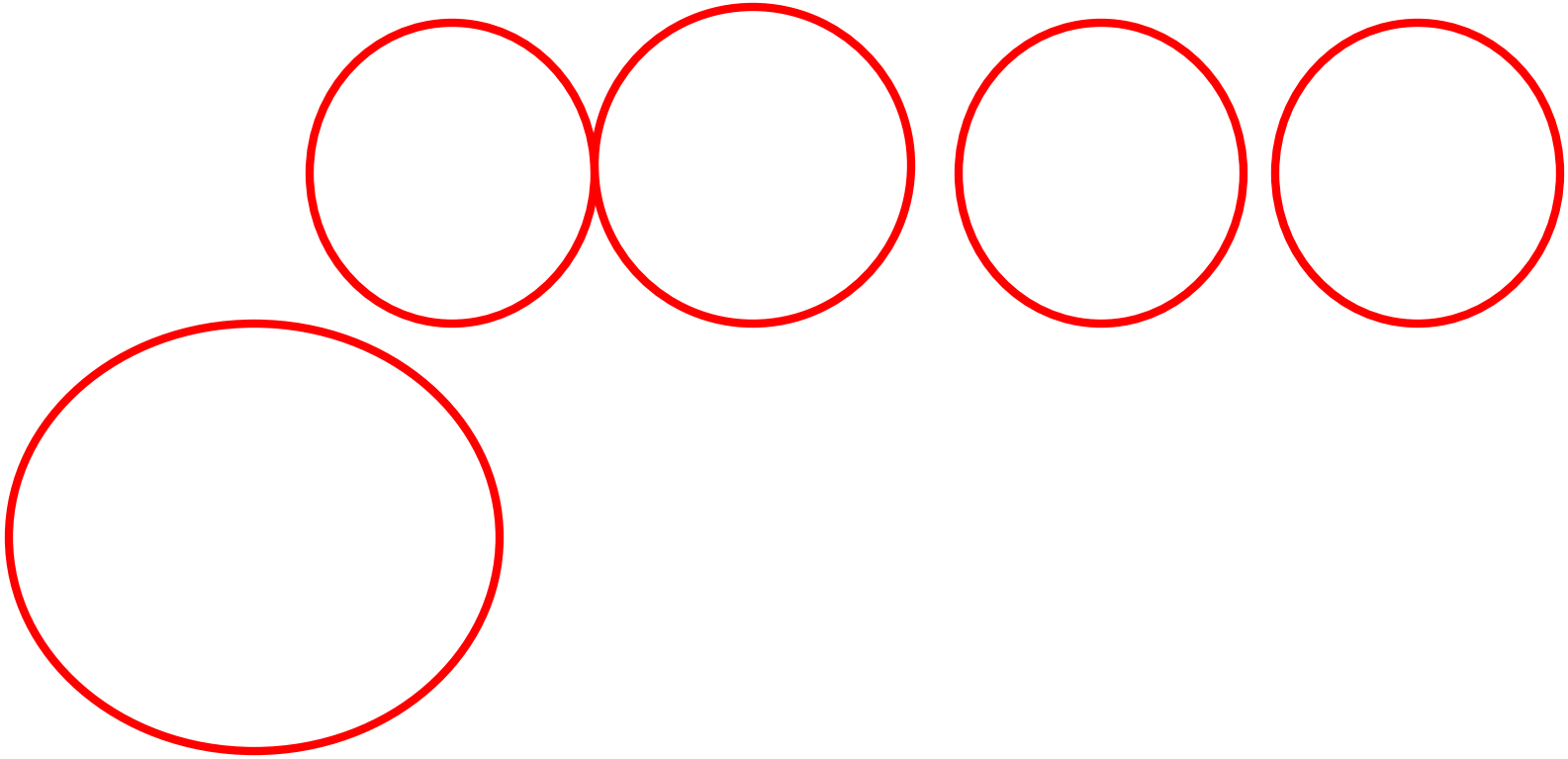
**FIXED-WING SPRAY NOZZLE MODELS**

40 DEGREE FLAT FAN (Large Orifice)
40 DEGREE FLAT FAN (Small Orifice)
80 DEGREE FLAT FAN
CP-03
CP-09
CP-11TT STRAIGHT STREAM
DISC ORIFICE 46 CORE
DISC ORIFICE 46 CORE CERAMIC
DISC ORIFICE 56 CORE
DISC ORIFICE STRAIGHT STREAM
LUND STRAIGHT STREAM

**Rotary-Wing SPRAY NOZZLE MODELS**

40 DEGREE FLAT FAN NOZZLE (large orifice)
40 DEGREE FLAT FAN NOZZLE (small orifice)
80 DEGREE FLAT FAN
ACCU-FLO DOUBLE ROW
ACCU-FLO SINGLE ROW
CP DR HIGH VOLUME FLAT FAN
CP HIGH VOLUME FLAT FAN
CP-03
DISC ORIFICE-46 CORE
DISC ORIFICE-STRAIGHT STREAM
RAINDROP RD

# USDA Aerial Nozzle Atomization Models



FIXED - WING

# CP-03 NOZZLE

## FOR USE ON FIXED-WING AIRCRAFT

AERIAL APPLICATORS SPRAY NOZZLE HANDBOOK
USDA ARS AGRICULTURAL HANDBOOK NO. XXX

I. W. Kirk, Agricultural Engineer, Arsenuide Pest Management Research Unit,
Southern Plains Agricultural Research Center, Agricultural Research Service, U. S. Department of Agriculture, 2771 F&B Road, College Station, TX 77845-4966, USA.

**Directions:** Enter CP 03 nozzle settings, pressure, and airspeed in the cells highlighted below.
(Atomization parameters are valid only with nozzle and operational settings specified in the Acceptable Range.)

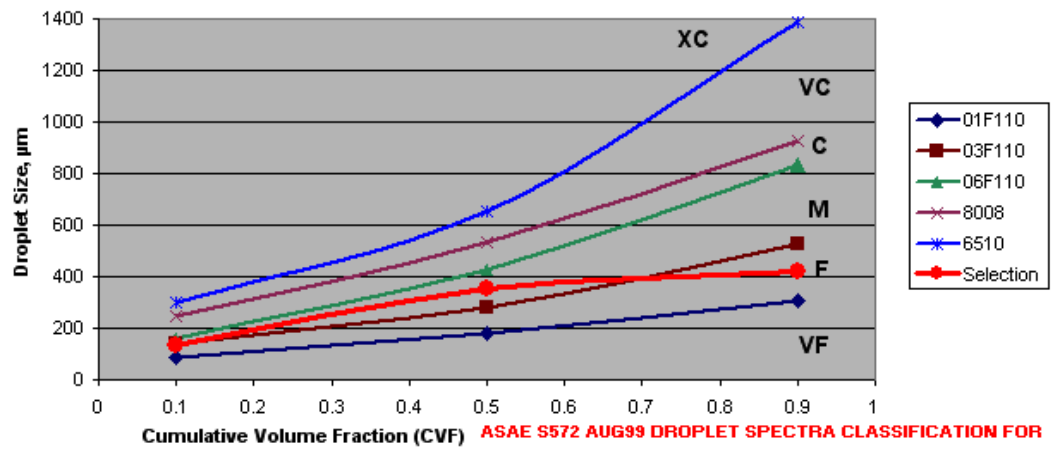
| | Orifice Size, inches | Deflector Angle, degrees | Pressure, psi | Airspeed, mph |
|---|---|---|---|---|
| Acceptable Range: | .061 to .171 | 30 to 90 | 20 to 60 | 100 to 160 |
| | 0.125 | 90 | 60 | 100 |

Atomization parameters are displayed in the box below.

**CAUTION: Do not enter or clear data in the cells in this box!**

| | | |
|---|---|---|
| $D_{V0.1}$ = | 131 µm | = Droplet size such that 10% of the spray volume is in droplets smaller than $D_{V0.1}$. |
| $D_{V0.5}$ = | 350 µm | = Volume median diameter |
| $D_{V0.9}$ = | 423 µm | = Droplet size such that 90% of the spray volume is in droplets smaller than $D_{V0.9}$. |
| RS = | 1.07 | = Relative Span |
| %V<100µm = | 8.01 % | = Percentage of spray volume in droplets smaller than 100 µm diameter. |
| %V<200µm = | 22.14 % | = Percentage of spray volume in droplets smaller than 200 µm diameter. |
| $DSC_{V0.1}$ = | FINE | = Droplet Spectra Classification based on $D_{V0.1}$. |
| $DSC_{V0.5}$ = | MEDIUM | = Droplet Spectra Classification based on $D_{V0.5}$. |
| $DSC_{V0.9}$ = | FINE | = Droplet Spectra Classification based on $D_{V0.9}$. |
| DSC = | FINE | = ASAE S572 AUG99 Droplet Spectra Classification |

**The Red Curve Shows Data for the Selected Nozzle Operation.**
**The Other Curves are for the ASAE S572 AUG99 Reference Nozzles.**




**ASAE S572 AUG99 DROPLET SPECTRA CLASSIFICATION FOR THE NOZZLE SELECTION IS THE FINER OF $CVF_{0.1}$, $CVF_{0.5}$, OR**

Values and classifications reported here are least-squares best-estimate predictions from experimental data collected in a wind tunnel.
Values reported from other laboratories may not yield the exact same values, but similar trends would be expected.
The ASAE droplet spectra classification category is based on droplet sizes in the mid-80% of the spectrum and not a single data point.

# Representative Settings for 270-300 Micron Applications*

## CP® Flat Fan Nozzles

## CP-11TT's

| CP-11TT Flat Fan Tips | 130 mph *** 113 knots | | | | | 140 mph *** 122.7 knots | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure | 30 psi | 40 psi | 50 psi | 55 psi | 60 psi | 30 psi | 40 psi | 50 psi | 55 psi | 60 psi |
| Tip # | VMD, Relative Span, Nozzle Angle (8° is the default angle built into the nozzle body) | | | | | VMD, Relative Span, Nozzle Angle (8° is the default angle built into the nozzle body) | | | | |
| 4004 | 300 1.10 15° | 295 1.15 30° | 297 1.16 30° | 297 1.16 30° | 296 1.16 30° | 272 1.12 8° | 282 1.12 8° | 290 1.12 8° | 293 1.11 8° | 295 1.10 8° |
| 4006 | 290 1.17 45° | 294 1.19 45° | 295 1.21 45° | 295 1.21 45° | 294 1.21 45° | 289 1.16 8° | 284 1.22 30° | 289 1.21 30° | 290 1.21 30° | 291 1.21 30° |
| 4008 | 298 1.18 45° | 275 1.23 60° | 276 1.25 60° | 275 1.25 60° | 274 1.26 60° | 294 1.21 15° | 292 1.24 30° | 299 1.23 30° | 277 .126 45° | 277 1.26 45° |
| 4010 | 299 1.15 30° | 282 1.15 45° | 286 1.17 45° | 286 1.20 45° | 286 1.22 45° | 289 1.16 15° | 282 1.17 30° | 288 1.19 30° | 290 1.22 30° | 291 1.25 30° |
| 4012 | 277 1.05 45° | 284 1.05 45° | 287 1.07 45° | 287 1.09 45° | 286 1.12 45° | 289 1.06 15° | 283 1.06 30° | 289 1.09 30° | 291 1.11 30° | 292 1.14 30° |
| 4015 | 279 0.92 45° | 285 0.92 45° | 289 0.94 45° | 289 0.97 45° | 288 0.99 45° | 290 0.94 15° | 284 0.93 30° | 290 0.96 30° | 292 0.98 30° | 293 1.01 30° |
| 4020 | 283 0.78 45° | 289 0.78 45° | 292 0.81 45° | 292 0.83 45° | 291 0.85 45° | 277 0.77 30° | 287 0.78 30° | 293 0.81 30° | 295 0.84 30° | 295 0.87 30° |
| 4025 | 287 0.74 45° | 293 0.74 45° | 296 0.76 45° | 296 0.78 45° | 295 0.81 45° | 281 0.71 30° | 290 0.73 30° | 296 0.76 30° | 276 0.72 45° | 275 0.75 45° |
| 4030 | 275 0.75 60° | 277 0.73 60° | 276 0.74 60° | 274 0.75 60° | 271 0.77 60° | 285 0.75 30° | 280 0.72 45° | 282 0.74 45° | 281 0.75 45° | 280 0.77 45° |
| | | | | | | | | | | |
| 8002 | | | | | | | | | | |
| 8004 | | | 285 1.18 8° | 290 1.17 8° | 289 1.14 15° | | | | | |
| 8005 | 281 1.13 8° | 290 1.16 8° | 285 1.14 30° | 288 1.13 30° | 284 1.11 45° | | | 276 1.21 8° | 283 1.20 8° | 290 1.18 8° |
| 8006 | 290 1.12 8° | 289 1.13 30° | 296 1.13 30° | 281 1.13 45° | 284 1.11 45° | | 272 1.21 8° | 286 1.20 8° | 294 1.19 8° | 295 1.15 15° |
| 8008 | 292 1.10 30° | 284 1.13 45° | 291 1.13 45° | 294 1.12 45° | 299 1.11 45° | | 280 1.20 8° | 297 1.19 8° | 299 1.16 15° | 293 1.13 30° |
| 8010 | 286 1.11 8° | 297 1.13 30° | 289 1.14 45° | 294 1.13 45° | 300 1.12 45° | | 275 1.21 8° | 294 1.20 8° | 297 1.17 15° | 292 1.14 30° |

# Fungicides

# Representative Settings for 285-365 Micron Applications*
# Relative Span under 1.20, VMD is ASABE Classification "Medium" or Larger
# CP® Flat Fan Nozzles
# CP-11TT's

| CP-11TT Flat Fan Tips | *130 mph *** 113 knots* | | | | *140 mph *** 122.7 knots* | | | |
|---|---|---|---|---|---|---|---|---|
| Pressure | 30 psi | *40 psi* | *50 psi* | *60 psi* | 30 psi | *40 psi* | *50 psi* | *60 psi* |
| Tip # | VMD, Relative Span, ASABE Classification (Dvo.1, Dvo.5, Dvo.9), Angle in Degrees | | | | VMD, Relative Span, ASABE Classification (Dvo.1, Dvo.5, Dvo.9), Angle in Degrees | | | |
| 4004 | | | | 318 1.09 MMF 8° | | | | |
| 4006 | 321 1.11 MMF 8° | 331 1.13 MMF 8° | 338 1.13 MMM 8° | 342 1.13 MMM 8° | | | | |
| 4008 | 332 1.15 MMM 8° | 344 1.16 MMM 8° | 353 1.17 MMM 8° | 358 1.17 CMM 8° | | | | |
| 4010 | 346 1.20 MMM 8° | | | | | | | |
| 4012 | 346 1.12 CMM 8° | 363 1.15 CMM 8° | 347 1.14 CMM 15° | 354 1.20 MMM 15° | 306 1.09 MMM 15° | 323 1.11 MMF 8° | 337 1.16 CMM 8° | |
| 4015 | 345 1.03 CMM 8° | 362 1.06 CMM 8° | 347 1.04 CMM 15° | 354 1.10 CMM 15° | 305 0.98 CMF 8° | 322 1.01 CMF 8° | 336 1.06 CMM 8° | 346 1.12 CMM 8° |
| 4020 | 343 0.94 CMM 8° | 361 0.97 CMM 8° | 347 0.94 CMM 15° | 353 1.00 CMM 15° | 305 0.85 CMF 8° | 322 0.89 CMF 8° | 335 0.94 CMM 8° | 344 1.01 CMM 8° |
| 4025 | 343 0.92 CMM 8° | 338 0.87 CMM 15° | 347 0.92 CMM 15° | 353 0.98 CMM 15° | 305 0.82 CMF 8° | 322 0.86 CMF 8° | 335 0.91 CMM 8° | 344 0.98 CMM 8° |
| 4030 | 342 0.97 CNN 8° | 359 1.01 CMM 8° | 348 0.96 CMM 15° | 354 1.02 CMM 15° | 306 0.87 CMF 8° | 322 0.90 CMF 8° | 335 0.95 CMM 8° | 344 1.02 CMM 8° |
| | | | | | | | | |
| 0008 | 352 1.08 CMM 20° | | | | 316 0.99 CMF 20° | 346 1.18 CMM 20° | | |
| 0010 | 358 1.13 CMM 20° | | | | 322 1.04 CMM 20° | | | |
| 0012 | 363 1.19 CMM 20° | | | | 326 1.09 CMM 20° | | | |
| 0015 | | | | | 330 1.16 CMM 20° | | | |
| 0020 | | | | | 311 1.11 CMM 8° | 329 1.20 CMM 8° | | |
| 0025 | | | | | 293 1.11 CMM 8° | 306 1.16 CMM 8° | 316 1.17 CMM 8° | 323 1.15 CMM 8° |

# Herbicides

CP-11TT
#25 40° Flat Fan
5 gpm
40 psi

CP-07 and CP-09
0.125 Orifice, 0 Deflection
5 gpm
40 psi

CP-03
0.125 Orifice, 30° Deflection
5 gpm
40 psi

## Percent of spray volume under 200 microns*

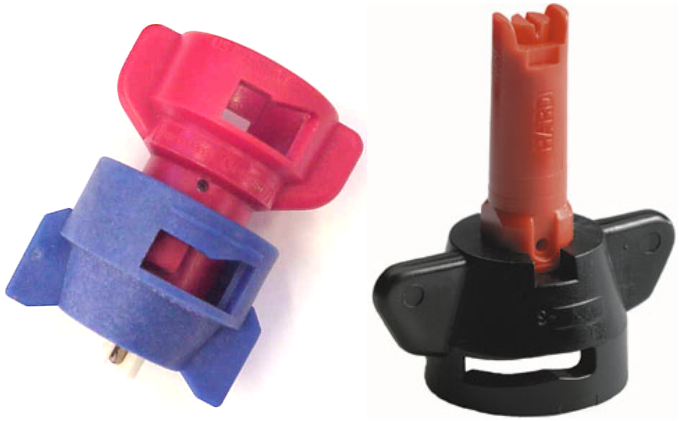
| | | | |
|---|---|---|---|
| 150 mph | 7.99% | 21.01% | 40.5% |
| 145 mph | 6.62 | 17.61 | 34.29 |
| 140 mph | 5.41 | 14.58 | 28.76 |
| 135 mph | 4.37 | 11.92 | 23.93 |
| 130 mph | 3.51 | 9.61 | 19.78 |
| 125 mph | 2.80 | 7.67 | 16.32 |
| 120 mph | 2.27 | 6.10 | 13.56 |

*Based on Spray Nozzle Models, USDA ARS AH-726, I. W. Kirk, Southern Plains Agricultural Research Center, College Station, TX

# Nozzle Types

# Nozzle Technology……

- Nozzles designed to reduce drift
- Improved drop size control
- Emphasis on ‘Spray Quality’



# Specimen Label

Dow AgroSciences

**Clincher®**

**CA**

**Herbicide**

®Trademark of Dow AgroSciences LLC

**For selective postemergence grass weed control in rice**

Active Ingredient(s):
cyhalofop: 2-[4-(4-cyano-2- fluorophenoxy) phenoxy] propanoic acid, butyl ester, (R)..... 29.6%
Other Ingredients ..... 70.4%
Total ..... 100.0%

Contains 2.38 lb of active ingredient per gallon.
Contains petroleum distillates.

EPA Reg. No. 62719-356

**Keep Out of Reach of Children**

**WARNING AVISO**

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Apply with medium to coarse droplet size as defined in the ASABE S-572 standard publication entitled "Spray Nozzle Classification by Droplet Spectra." Additional information on droplet guidelines can be obtained from the NAAA, USDA or nozzle manufacturer.

# Callisto® Xtra

syngenta.

## Herbicide

Postemergence Herbicide for use in Field Corn, Seed Corn, Silage Corn, Sweet Corn, Yellow Popcorn and Sugarcane.

**Active Ingredient*:**

| | |
|---|---|
| Atrazine** (CAS No. 1912-24-9) | 34.30% |
| Related Compounds | 0.70% |
| Mesotrione (CAS No. 104206-82-8) | 5.36% |
| Other Ingredients: | 59.64% |
| **Total:** | **100.00%** |

*This product contains 0.5 pounds of mesotrione pounds per gallon and 3.2 pounds of atrazine and related triazines per gallon.

**Atrazine with a maximum of 1.4% related triazines.

**CAUTION** **KEEP OUT OF REACH OF CHILDREN.**

See additional precautionary statements and directions for use inside booklet.

**EPA Reg. No. 100-1359 EPA Est. 39578-TX-1**

**SCP 1359A-L1 0110 305825**

Callisto Plant Technology®

**2.5 gallons**

**Net Contents**

# APPLICATION INFORMATION

## Ground Application

Spray nozzles should be uniformly spaced, the same size and type, and should provide accurate and uniform application. Use spray nozzles that deliver medium to coarse droplet size to provide good coverage and avoid drift. Good spray coverage is essential for optimum weed control. Boom height for broadcast over-the-top applications should be based on the height of the crop and according to the nozzle type, nozzle spacing and manufacturer's specifications.

Apply Callisto Xtra in a spray volume of 10-30 gallons/acre. Use a pump that can maintain adequate pressure at the nozzles to maintain an effective spray pattern and provide proper agitation within the tank to keep the product dispersed. Low pressures may be used with extended range or drift reduction nozzles but ensure a droplet size of medium to coarse. When weed foliage is dense, use a minimum of 15 gallons/acre.

Flat fan nozzles of 80° or 110° are recommended for optimum postemergence coverage. Do not use flood-jet nozzles or controlled droplet application equipment for postemergence applications. Nozzles may be angled forward 45° to enhance penetration of the crop and provide better coverage. Ensure that all in-line strainer and nozzle screens in the sprayer are 50-mesh or coarser.

Always ensure that agitation is maintained until spraying is completed, even if stopped for brief periods of time. If the agitation is stopped for more than 5 minutes, re-suspend the spray solution by running on full agitation prior to spraying.

## Aerial Application

Do not use aerial application to apply Callisto Xtra.

# SHARPEN®

## POWERED BY KIXOR® HERBICIDE

**A broadleaf herbicide for use in the following field and row agricultural crops: chickpea (garbanzo beans), corn (field, pop, silage), cotton, fallow and postharvest, field pea, small grains, sorghum (grain), soybean; and noncropland areas**

**Active Ingredient:**

saflufenacil: N'-[2-chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3, 6-dihydro-1(2H)-pyrimidinyl)benzoyl]-N-isopropyl-N-methylsulfamide . . . . . 29.74%

**Other Ingredients:** . . . . . 70.26%

**Total:** . . . . . 100.00%

Contains 2.85 pounds active ingredient saflufenacil per gallon formulated as a water-based suspension concentrate.

**EPA Reg. No. 7969-278** **EPA Est. No.**

**KEEP OUT OF REACH OF CHILDREN**

**CAUTION/PRECAUCION**

# Ground Application Requirements

The following measures must be followed to reduce the potential of spray drift to nontarget areas from ground applications:

1. Apply this product using nozzles which deliver **medium-to-coarse spray droplets** as defined by ASAE standard S-572 and as shown in nozzle manufacturer's catalogs. Flat-fan nozzles are recommended for burn-down applications while flood-jet type nozzles are recommended for residual soil surface applications. Nozzles that deliver coarse spray droplets may be used to reduce spray drift provided spray volume per acre (GPA) is increased to maintain coverage of target (i.e. weeds or soil surface). **DO NOT** use nozzles that produce fine (e.g. cone) spray droplets. In California,

Bayer CropScience

# Ignite® 280 SL HERBICIDE

**A non-selective herbicide for post emergence broadcast use on ca**
**designated as LibertyLink®. Ignite 280 SL Herbicide may b**
**cotton when applied with a hooded sprayer in-cro**
**broadcast burndown application before**
**transgenic variety of canola, co**

**ACTIVE INGRE** ..... **24.5%****

..... **75.5%**

**TOTAL 100.00%**

gredient per U.S. gallon.

**829**

**EPA Est. No. 264-MI-001**

**EPA Est. No. 407-IA-2**

- 15 GPA
- Generate MEDIUM spray droplets (ASABE S-572)
-Do not use nozzles and pressures that result in COARSE sprays

**Ground Application:** Ignite 280 SL Herbicide should be applied broadcast in a minimum of 15 gallons of water per acre. Under dense weed/crop canopies, 20 to 40 gallons of water per acre should be used so that thorough spray coverage will be obtained. Apply Ignite 280 SL Herbicide using nozzles and pressures that generate MEDIUM (about 250 to 350 microns) spray droplets category as reported by the nozzle manufacturer and in accordance to ASABE S 572. Do not use nozzles and pressures that result in COARSE sprays. FINE sprays should also be avoided to minimize spray drift risk. Boom height should be based on nozzle manufacturer recommendations. See the *Spray Drift Management* section of this label for additional information on proper application of Ignite 280 SL Herbicide.

**Aerial Application:** Poor coverage will result in reduced weed control. For optimal weed control, apply Ignite 280 SL Herbicide in a minimum of 10 gallons per acre. Apply Ignite 280 SL Herbicide using nozzles and pressures that generate MEDIUM (about 300 to 400 microns) spray droplets category as reported by the nozzle manufacturer and in accordance to ASABE S 572 based upon the selected air speed. Do not use nozzles and pressures that result in COARSE sprays. FINE sprays should also be avoided to minimize spray drift risk. See the *Spray Drift Management* section of this label for additional information on proper application of Ignite 280 SL Herbicide.

# ASABE Standard

| Symbol | Category | Code | Apx. VMD | Relative Size | Comparative Size | Atomization |
|---|---|---|---|---|---|---|
| VF | Very Fine | Red | >150 | | Point of Need | Fog |
| F | Fine | Orange | 151-250 | | Human Hair (100 Microns) | Fine Mist |
| M | Medium | Yellow | 251-350 | | Sewing Thread (150 Microns) | Fine Drizzle |
| C | Coarse | Blue | 351-450 | | | |
| VC | Very Coarse | Green | 451-550 | | Staple (420 Microns) | Light Rain |
| EC | Extremely Coarse | White | >551 | | #2 Pencil Lead (2000 Microns) | Thunderstorm |

Comparative Size

Fungicides/Insecticides

Herbicides

Source: Crop Life – July 2002

# ASABE Standard

## Comparative Size

| Symbol | Category | Code | Relative Size | Comparative Size | Atomization |
|---|---|---|---|---|---|
| VF | Very Fine | Red | | Point (Needle Points) | Fog |
| F | Fine | Orange | | Human Hair (100 Microns) | Fine Mist |
| M | Medium | Yellow | | Sewing Thread (150 Microns) | Fine Drizzle |
| C | Coarse | Blue | | | |
| VC | Very Coarse | Green | | Staple (420 Microns) | Light Rain |
| EC | Extremely Coarse | White | | #2 Pencil Lead (2000 Microns) | Thunderstorm |

Fungicides/Insecticides

Herbicides

Source: Crop Life – July 2002

| Spray Quality Categories | |
|---|---|
| **ASABE Standard S-572.1** | |
| **Category (symbol)** | **Color Code** |
| Extra Fine (XF) | Purple |
| Very Fine (VF) | Red |
| Fine (F) | Orange |
| Medium (M) | Yellow |
| Coarse (C) | Blue |
| Very Coarse (VC) | Green |
| Extra Coarse (XC) | White |
| Ultra Coarse (UC) | Black |

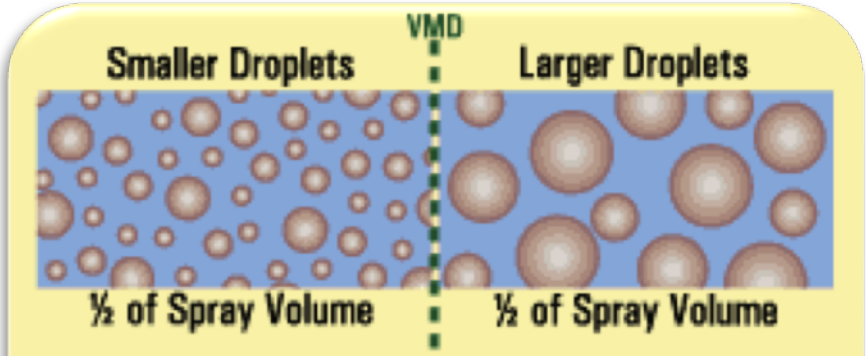
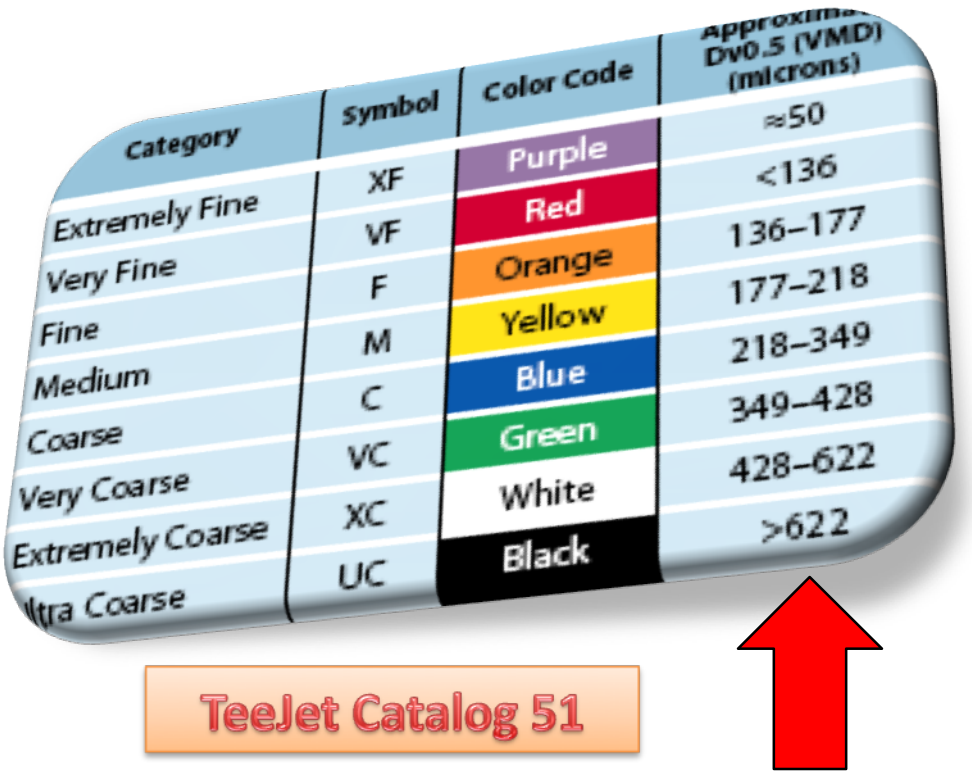



*Figure 1: Droplet size is generally given as VMD (Volume Median Diameter).*



| Category | Symbol | Color Code | Approximate Dv0.5 (VMD) (microns) |
|---|---|---|---|
| Extremely Fine | XF | Purple | ≈50 |
| Very Fine | VF | Red | <136 |
| Fine | F | Orange | 136–177 |
| Medium | M | Yellow | 177–218 |
| Coarse | C | Blue | 218–349 |
| Very Coarse | VC | Green | 349–428 |
| Extremely Coarse | XC | White | 428–622 |
| Ultra Coarse | UC | Black | >622 |

TeeJet Catalog 51

# How can the applicators use this standard for day to day applications?


See Page 136, TeeJet Catalog 51

## Drop Size Classification

Nozzle selection is often based upon droplet size. The droplet size from a nozzle becomes very 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 the nozzles used in agriculture can be classified as producing either fine, medium, coarse, or very coarse droplets. Nozzles that produce fine droplets are usually recommended for post-emergence applications, which require excellent coverage on the intended target area. The most common nozzles used in agriculture are those that produce medium-sized droplets. Nozzles producing medium- and coarse-sized droplets can be used for contact and systemic herbicides, pre-emergence surface-applied herbicides, insecticides and fungicides.

An important point to remember when choosing a spray nozzle that produces a droplet size in one of the six categories is that 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 the following tables to assist in choosing an appropriate spray tip.

| | |
|---|---|
| VF Very Fine | F Fine |
| M Medium | C Coarse |
| VC Very Coarse | XC Extremely Coarse |

Droplet size classifications are based on BCPC specifications and in accordance with ASAE Standard S-572 at the date of printing. Classifications are subject to change.

### Turbo TeeJet® (TT) and Turbo TeeJet® Duo (QJ90-2XTT)

| | PSI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 |
| TT1 1001 QJ90-2XTT11001 | C | M | M | M | M | M | F | F | F | F | F |
| TT1 10015 QJ90-2XTT110015 | C | C | M | M | M | M | M | M | F | F | F |
| TT1 1002 QJ90-2XTT11002 | C | C | C | M | M | M | M | M | M | M | F |
| TT1 10025 QJ90-2XTT110025 | VC | C | C | C | M | M | M | M | M | M | F |
| TT1 1003 QJ90-2XTT11003 | VC | VC | C | C | C | C | M | M | M | M | M |
| TT1 1004 QJ90-2XTT11004 | XC | VC | VC | C | C | C | C | C | M | M | M |
| TT1 1005 QJ90-2XTT11005 | XC | VC | VC | VC | VC | C | C | C | C | M | M |
| TT1 1006 QJ90-2XTT11006 | XC | XC | VC | VC | VC | C | C | C | C | C | M |
| TT1 1008 QJ90-2XTT11008 | XC | XC | VC | VC | VC | VC | C | C | C | C | M |

### AI TeeJet® (AI) and AIC TeeJet® (AIC)

| | PSI | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 70 | 80 | 90 | 100 | 115 |
| AI1 10015 | VC | VC | VC | VC | VC | C | C | C | C | C | C | C |
| AI1 1002 | VC | VC | VC | VC | VC | VC | VC | C | C | C | C | C |
| AI1 10025 | VC | VC | VC | VC | VC | VC | VC | VC | C | C | C | C |
| AI1 1003 | XC | XC | VC | VC | VC | VC | VC | VC | VC | C | C | C |
| AI1 1004 | XC | XC | XC | VC | VC | VC | VC | VC | VC | C | C | C |
| AI1 1005 | XC | XC | XC | VC | VC | VC | VC | VC | VC | VC | C | C |
| AI1 1006 | XC | XC | XC | XC | VC | VC | VC | VC | VC | VC | C | C |
| AI1 1008 | XC | XC | XC | XC | XC | VC | VC | VC | VC | VC | VC | C |
| AI1 1010 | XC | XC | XC | XC | XC | VC | VC | VC | VC | VC | VC | C |

### Turbo TwinJet® (TTJ60)

| | PSI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 |
| TTJ60-11002 | VC | C | C | C | C | C | M | M | M | M | M |
| TTJ60-110025 | XC | VC | C | C | C | C | C | C | M | M | M |
| TTJ60-11003 | XC | VC | C | C | C | C | C | C | C | M | M |
| TTJ60-11004 | XC | VC | C | C | C | C | C | C | C | C | M |
| TTJ60-11005 | XC | VC | C | C | C | C | C | C | C | C | C |
| TTJ60-11006 | XC | XC | VC | VC | C | C | C | C | C | C | C |

### Turbo TeeJet® Induction (TTI)

| | PSI | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| TTI1 10015 | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC |
| TTI1 1002 | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC |
| TTI1 10025 | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC |
| TTI1 1003 | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC |
| TTI1 1004 | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC |
| TTI1 1005 | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC |
| TTI1 1006 | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC | XC |

## XR TeeJet® (XR) and XRC TeeJet® (XRC)

| | PSI | | | | | | |
|---|---|---|---|---|---|---|---|
| | 15 | 20 | 25 | 30 | 40 | 50 | 60 |
| XR8001 | M | F | F | F | F | F | F |
| XR80015 | M | M | M | F | F | F | F |
| XR8002 | M | M | M | M | F | F | F |
| XR8003 | M | M | M | M | M | M | F |
| XR8004 | C | C | M | M | M | M | M |
| XR8005 | C | C | C | C | M | M | M |
| XR8006 | C | C | C | C | C | C | C |
| XR8008 | VC | VC | VC | C | C | C | C |
| XR11001 | F | F | F | F | F | VF | VF |
| XR110015 | F | F | F | F | F | F | F |
| XR11002 | M | F | F | F | F | F | F |
| XR110025 | M | M | F | F | F | F | F |
| XR11003 | M | M | M | F | F | F | F |
| XR11004 | M | M | M | M | M | F | F |
| XR11005 | M | M | M | M | M | M | F |
| XR11006 | C | C | M | M | M | M | M |
| XR11008 | C | C | C | C | C | M | M |

## Turbo TeeJet® (TT)

| | PSI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 |
| TT11001 | C | M | M | M | M | M | F | F | F | F | F |
| TT110015 | C | C | M | M | M | M | M | M | F | F | F |
| TT11002 | C | C | C | M | M | M | M | M | M | M | F |
| TT110025 | VC | C | C | C | M | M | M | M | M | M | F |
| TT11003 | VC | VC | C | C | C | C | M | M | M | M | M |
| TT11004 | XC | VC | VC | C | C | C | C | C | M | M | M |
| TT11005 | XC | VC | VC | VC | VC | C | C | C | C | M | M |
| TT11006 | XC | XC | VC | VC | VC | C | C | C | C | C | M |
| TT11008 | XC | XC | VC | VC | VC | VC | C | C | C | C | M |

## Turbo TwinJet® (TTJ60)

| | PSI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 |
| TTJ60-11002 | C | C | C | C | C | M | M | M | M | M |
| TTJ60-110025 | VC | C | C | C | C | C | C | M | M | M |
| TTJ60-11003 | VC | C | C | C | C | C | C | C | M | M |
| TTJ60-11004 | VC | C | C | C | C | C | C | C | C | M |
| TTJ60-11005 | VC | C | C | C | C | C | C | C | C | C |
| TTJ60-11006 | XC | VC | VC | C | C | C | C | C | C | C |

## AI TeeJet (AI) and AIC TeeJet (AIC)

| | PSI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 70 | 80 | 90 | 100 |
| AI110015 | UC | XC | XC | XC | XC | XC | VC | VC | VC | C | C |
| AI11002 | UC | UC | XC | XC | XC | XC | VC | VC | VC | VC | C |
| AI110025 | UC | UC | XC | XC | XC | XC | XC | VC | VC | VC | C |
| AI11003 | UC | UC | XC | XC | XC | XC | XC | VC | VC | VC | C |
| AI11004 | UC | UC | XC | XC | XC | XC | XC | VC | VC | VC | C |
| AI11005 | UC | UC | XC | XC | XC | XC | XC | VC | VC | VC | VC |
| AI11006 | UC | UC | UC | XC | XC | XC | XC | XC | VC | VC | VC |
| AI11008 | UC | UC | UC | UC | XC | XC | XC | XC | VC | VC | VC |
| AI11010 | UC | UC | UC | UC | XC | XC | XC | XC | XC | VC | VC |
| AI11015 | UC | UC | UC | UC | XC | XC | XC | XC | XC | VC | VC |

## Turbo TeeJet Induction (TTI)

| | PSI | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| TTI110015 | UC | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |
| TTI11002 | UC | UC | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC |
| TTI110025 | UC | UC | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC |
| TTI11003 | UC | UC | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC |
| TTI11004 | UC | UC | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC |
| TTI11005 | UC | UC | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC |
| TTI11006 | UC | UC | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC |

## AIXR TeeJet® (AIXR)

| | PSI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 |
| AIXR110015 | XC | XC | VC | C | C | C | C | M | M | M | M |
| AIXR11002 | XC | XC | XC | VC | VC | C | C | C | C | M | M |
| AIXR110025 | XC | XC | XC | XC | VC | VC | C | C | C | C | C |
| AIXR11003 | XC | XC | XC | XC | VC | VC | C | C | C | C | C |
| AIXR11004 | XC | XC | XC | XC | XC | XC | VC | VC | C | C | C |
| AIXR11005 | XC | XC | XC | XC | XC | XC | VC | VC | C | C | C |
| AIXR11006 | XC | XC | XC | XC | XC | XC | VC | VC | VC | C | C |

## Air Induction Turbo TwinJet (AITTJ60)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| AITTJ60-11002 | XC | XC | VC | VC | VC | C | C | C | C | C | M |
| AITTJ60-110025 | XC | XC | VC | VC | VC | C | C | C | C | C | M |
| AITTJ60-11003 | UC | XC | XC | XC | VC | VC | C | C | C | C | C |
| AITTJ60-11004 | UC | XC | XC | XC | VC | VC | C | C | C | C | C |
| AITTJ60-11005 | UC | XC | XC | XC | XC | VC | VC | C | C | C | C |
| AITTJ60-11006 | UC | XC | XC | XC | XC | VC | VC | C | C | C | C |

| | PSI | DROP SIZE | CAPACITY ONE NOZZLE IN GPM | CAPACITY ONE NOZZLE IN OZ./MIN. | 20" GPA 4 MPH | 5 MPH | 6 MPH | 8 MPH | 10 MPH | 12 MPH | 15 MPH | 20 MPH | GALLONS PER 1000 SQ. FT. 2 MPH | 3 MPH | 4 MPH | 5 MPH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT11001 (100) | 15 | C | 0.061 | 7.8 | 4.5 | 3.6 | 3.0 | 2.3 | 1.8 | 1.5 | 1.2 | 0.91 | 0.21 | 0.14 | 0.10 | 0.08 |
| | 20 | M | 0.071 | 9.1 | 5.3 | 4.2 | 3.5 | 2.6 | 2.1 | 1.8 | 1.4 | 1.1 | 0.24 | 0.16 | 0.12 | 0.10 |
| | 30 | M | 0.087 | 11 | 6.5 | 5.2 | 4.3 | 3.2 | 2.6 | 2.2 | 1.7 | 1.3 | 0.30 | 0.20 | 0.15 | 0.12 |
| | 40 | M | 0.10 | 13 | 7.4 | 5.9 | 5.0 | 3.7 | 3.0 | 2.5 | 2.0 | 1.5 | 0.34 | 0.23 | 0.17 | 0.14 |
| | 50 | F | 0.11 | 14 | 8.2 | 6.5 | 5.4 | 4.1 | 3.3 | 2.7 | 2.2 | 1.6 | 0.37 | 0.25 | 0.19 | 0.15 |
| | 60 | F | 0.12 | 15 | 8.9 | 7.1 | 5.9 | 4.5 | 3.6 | 3.0 | 2.4 | 1.8 | 0.41 | 0.27 | 0.20 | 0.16 |
| | 75 | F | 0.14 | 18 | 10.4 | 8.3 | 6.9 | 5.2 | 4.2 | 3.5 | 2.8 | 2.1 | 0.48 | 0.32 | 0.24 | 0.19 |
| | 90 | F | 0.15 | 19 | 11.1 | 8.9 | 7.4 | 5.6 | 4.5 | 3.7 | 3.0 | 2.2 | 0.51 | 0.34 | 0.26 | 0.20 |
| TT110015 (100) | 15 | C | 0.0962 | 12 | 6.8 | 5.5 | 4.6 | 3.4 | 2.7 | 2.3 | 1.8 | 1.4 | 0.31 | 0.21 | 0.16 | 0.13 |
| | 20 | C | 0.11 | 14 | 8.2 | 6.5 | 5.4 | 4.1 | 3.3 | 2.7 | 2.2 | 1.6 | 0.37 | 0.25 | 0.19 | 0.15 |
| | 30 | M | 0.13 | 17 | 9.7 | 7.7 | 6.4 | 4.8 | 3.9 | 3.2 | 2.6 | 1.9 | 0.44 | 0.29 | 0.22 | 0.18 |
| | 40 | M | 0.15 | 19 | 11.1 | 8.9 | 7.4 | 5.6 | 4.5 | 3.7 | 3.0 | 2.2 | 0.51 | 0.34 | 0.26 | 0.20 |
| | 50 | M | 0.17 | 22 | 12.6 | 10.1 | 8.4 | 6.3 | 5.0 | 4.2 | 3.4 | 2.5 | 0.58 | 0.39 | 0.29 | 0.23 |
| | 60 | M | 0.18 | 23 | 13.4 | 10.7 | 8.9 | 6.7 | 5.3 | 4.5 | 3.6 | 2.7 | 0.61 | 0.41 | 0.31 | 0.24 |
| | 75 | F | 0.21 | 27 | 15.6 | 12.5 | 10.4 | 7.8 | 6.2 | 5.2 | 4.2 | 3.1 | 0.71 | 0.48 | 0.36 | 0.29 |
| | 90 | F | 0.23 | 29 | 17.1 | 13.7 | 11.4 | 8.5 | 6.8 | 5.7 | 4.6 | 3.4 | 0.78 | 0.52 | 0.39 | 0.31 |
| TT11002 (50) | 15 | C | 0.12 | 15 | 8.9 | 7.1 | 5.9 | 4.5 | 3.6 | 3.0 | 2.4 | 1.8 | 0.41 | 0.27 | 0.20 | 0.16 |
| | 20 | C | 0.14 | 18 | 10.4 | 8.3 | 6.9 | 5.2 | 4.2 | 3.5 | 2.8 | 2.1 | 0.48 | 0.32 | 0.24 | 0.19 |
| | 30 | M | 0.17 | 22 | 12.6 | 10.1 | 8.4 | 6.3 | 5.0 | 4.2 | 3.4 | 2.5 | 0.58 | 0.39 | 0.29 | 0.23 |
| | 40 | M | 0.20 | 26 | 14.9 | 11.9 | 9.9 | 7.4 | 5.9 | 5.0 | 4.0 | 3.0 | 0.68 | 0.45 | 0.34 | 0.27 |
| | 50 | M | 0.22 | 28 | 16.3 | 13.1 | 10.9 | 8.2 | 6.5 | 5.4 | 4.4 | 3.3 | 0.75 | 0.50 | 0.37 | 0.30 |
| | 60 | M | 0.24 | 31 | 17.8 | 14.3 | 11.9 | 8.9 | 7.1 | 5.9 | 4.8 | 3.6 | 0.82 | 0.54 | 0.41 | 0.33 |
| | 75 | M | 0.27 | 35 | 20 | 16.0 | 13.4 | 10.0 | 8.0 | 6.7 | 5.3 | 4.0 | 0.92 | 0.61 | 0.46 | 0.37 |
| | 90 | F | 0.30 | 38 | 22 | 17.8 | 14.9 | 11.1 | 8.9 | 7.4 | 5.9 | 4.5 | 1.0 | 0.68 | 0.51 | 0.41 |
| TT110025 (50) | 15 | VC | 0.15 | 19 | 11.1 | 8.9 | 7.4 | 5.6 | 4.5 | 3.7 | 3.0 | 2.2 | 0.51 | 0.34 | 0.26 | 0.20 |
| | 20 | C | 0.18 | 23 | 13.4 | 10.7 | 8.9 | 6.7 | 5.3 | 4.5 | 3.6 | 2.7 | 0.61 | 0.41 | 0.31 | 0.24 |
| | 30 | C | 0.22 | 28 | 16.3 | 13.1 | 10.9 | 8.2 | 6.5 | 5.4 | 4.4 | 3.3 | 0.75 | 0.50 | 0.37 | 0.30 |
| | 40 | M | 0.25 | 32 | 18.6 | 14.9 | 12.4 | 9.3 | 7.4 | 6.2 | 5.0 | 3.7 | 0.85 | 0.57 | 0.43 | 0.34 |
| | 50 | M | 0.28 | 36 | 21 | 16.6 | 13.9 | 10.4 | 8.3 | 6.9 | 5.5 | 4.2 | 0.95 | 0.63 | 0.48 | 0.38 |
| | 60 | M | 0.31 | 40 | 23 | 18.4 | 15.3 | 11.5 | 9.2 | 7.7 | 6.1 | 4.6 | 1.1 | 0.70 | 0.53 | 0.42 |
| | 75 | M | 0.34 | 44 | 25 | 20 | 16.8 | 12.6 | 10.1 | 8.4 | 6.7 | 5.0 | 1.2 | 0.77 | 0.58 | 0.46 |
| | 90 | F | 0.38 | 49 | 28 | 23 | 18.8 | 14.1 | 11.3 | 9.4 | 7.5 | 5.6 | 1.3 | 0.86 | 0.65 | 0.52 |
| TT11003 (50) | 15 | VC | 0.18 | 23 | 13.4 | 10.7 | 8.9 | 6.7 | 5.3 | 4.5 | 3.6 | 2.7 | 0.61 | 0.41 | 0.31 | 0.24 |
| | 20 | VC | 0.21 | 27 | 15.6 | 12.5 | 10.4 | 7.8 | 6.2 | 5.2 | 4.2 | 3.1 | 0.71 | 0.48 | 0.36 | 0.29 |
| | 30 | C | 0.26 | 33 | 19.3 | 15.4 | 12.9 | 9.7 | 7.7 | 6.4 | 5.1 | 3.9 | 0.88 | 0.59 | 0.44 | 0.35 |
| | 40 | C | 0.30 | 38 | 22 | 17.8 | 14.9 | 11.1 | 8.9 | 7.4 | 5.9 | 4.5 | 1.0 | 0.68 | 0.51 | 0.41 |
| | 50 | M | 0.34 | 44 | 25 | 20 | 16.8 | 12.6 | 10.1 | 8.4 | 6.7 | 5.0 | 1.2 | 0.77 | 0.58 | 0.46 |
| | 60 | M | 0.37 | 47 | 27 | 22 | 18.3 | 13.7 | 11.0 | 9.2 | 7.3 | 5.5 | 1.3 | 0.84 | 0.63 | 0.50 |
| | 75 | M | 0.41 | 52 | 30 | 24 | 20 | 15.2 | 12.2 | 10.1 | 8.1 | 6.1 | 1.4 | 0.93 | 0.70 | 0.56 |
| | 90 | M | 0.45 | 58 | 33 | 27 | 22 | 16.7 | 13.4 | 11.1 | 8.9 | 6.7 | 1.5 | 1.0 | 0.77 | 0.61 |
| TT11004 (50) | 15 | XC | 0.24 | 31 | 17.8 | 14.3 | 11.9 | 8.9 | 7.1 | 5.9 | 4.8 | 3.6 | 0.82 | 0.54 | 0.41 | 0.33 |
| | 20 | VC | 0.28 | 36 | 21 | 16.6 | 13.9 | 10.4 | 8.3 | 6.9 | 5.5 | 4.2 | 0.95 | 0.63 | 0.48 | 0.38 |
| | 30 | C | 0.35 | 45 | 26 | 21 | 17.3 | 13.0 | 10.4 | 8.7 | 6.9 | 5.2 | 1.2 | 0.79 | 0.60 | 0.48 |
| | 40 | C | 0.40 | 51 | 30 | 24 | 19.8 | 14.9 | 11.9 | 9.9 | 7.9 | 5.9 | 1.4 | 0.91 | 0.68 | 0.54 |
| | 50 | C | 0.45 | 58 | 33 | 27 | 22 | 16.7 | 13.4 | 11.1 | 8.9 | 6.7 | 1.5 | 1.0 | 0.77 | 0.61 |
| | 60 | C | 0.49 | 63 | 36 | 29 | 24 | 18.2 | 14.6 | 12.1 | 9.7 | 7.3 | 1.7 | 1.1 | 0.83 | 0.67 |

# Example calculation:

Answer .30gpm

# Selecting The Proper Nozzle

Page 6

**TeeJet Catalog 51**

- Calculate GPM (formula)
- Look under GPM column
- Choose the size needed
- Match pressure(psi) and Droplet Classification
- Operate at given pressure and speed used in formula to achieve GPA and the desired droplet size

**0.30 GPM**

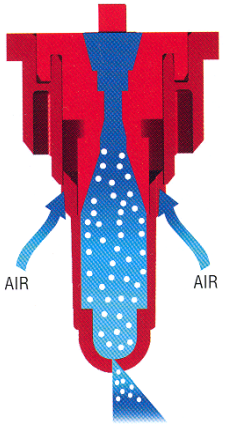
**7.5 GPA & 12 MPH**

| Tip No. (Strainer Screen Size) | Liquid Pressure in psi | Dropsize Category | Capacity 1 Nozzle in GPM | Gallons Per Acre - 20" Spacing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 4 mph | 5 mph | 6 mph | 8 mph | 10 mph | 12 mph | 15 mph | 20 mph |
| AIXR110015 (100 Mesh) Green | 15 | XC | 0.092 | 6.8 | 5.5 | 4.6 | 3.4 | 2.7 | 2.3 | 1.8 | 1.4 |
| | 20 | XC | 0.11 | 8. | | 5.4 | 4.1 | 3.3 | 2.7 | 2.2 | 1.6 |
| | 30 | C | 0.13 | 9 | | | 4.8 | 3.9 | 3.2 | 2.6 | 1.9 |
| | 40 | C | 0.15 | 1 | | | | | 3.7 | 3.0 | 2.2 |
| | 50 | C | 0.17 | | | | | | | 3.4 | 2.5 |
| | 60 | M | 0.18 | | | | | | | | |
| | 75 | M | 0.21 | | | | | | | | |
| | 90 | M | 0.23 | 17.1 | | | | | | | |
| AIXR11002 (50 Mesh) Yellow | 15 | XC | 0.12 | 8.9 | 7.1 | | | | | | |
| | 20 | XC | 0.14 | 10.4 | 8.3 | 6.9 | 5.2 | | | | |
| | 30 | VC | 0.17 | 12.6 | 10.1 | 8.4 | 6.3 | 5.0 | | | |
| | 40 | C | 0.20 | 14.9 | 11.9 | 9.9 | 7.4 | 5.9 | 5.0 | 4.0 | |
| | 50 | C | 0.22 | 16.3 | 13.1 | 10.9 | 8.2 | 6.5 | 5.4 | 4.4 | 3.3 |
| | 60 | C | 0.24 | 17.8 | 14.3 | 11.9 | 8.9 | 7.1 | 5.9 | 4.8 | 3.6 |
| | 75 | M | 0.27 | 20 | 16.0 | 13.4 | 10.0 | 8.0 | 6.7 | 5.3 | 4.0 |
| | 90 | M | 0.30 | 22 | | | | | | | 4.5 |
| AIXR110025 (50 Mesh) Violet | 15 | XC | 0.15 | 11.1 | | | | | | | 2.2 |
| | 20 | XC | 0.18 | 13.4 | | | | | | | 2.7 |
| | 30 | XC | 0.22 | 16.3 | | | | | | | 3.3 |
| | 40 | VC | 0.25 | 18.6 | | | | | | | 3.7 |
| | 50 | C | 0.28 | 21 | | | | | | | 4.2 |
| | 60 | C | 0.31 | 23 | | | | | | | 4.6 |
| | 75 | C | 0.34 | 25 | | | | | | | 5.0 |
| | 90 | C | 0.38 | 28 | | | | | | | 5.6 |
| AIXR11003 (50 Mesh) Blue | 15 | XC | 0.18 | 13.4 | | | | | | | 2.7 |
| | 20 | XC | 0.21 | 15.6 | | | | | | | 3.1 |
| | 30 | XC | 0.26 | 19.3 | | | | | | | 3.9 |
| | 40 | VC | 0.30 | 22 | | | | | | | 4.5 |
| | 50 | C | 0.34 | 25 | | | | | | | 5.0 |
| | 60 | C | 0.37 | 27 | 22 | 18.3 | 13.7 | 11.0 | 9.2 | 7.3 | 5.5 |
| | 75 | C | 0.41 | 30 | 24 | 20 | 15.2 | 12.2 | 10.1 | 8.1 | 6.1 |
| | 90 | C | 0.45 | 33 | 27 | 22 | 16.7 | 13.4 | 11.1 | 8.9 | 6.7 |
| AIXR11004 (50 Mesh) Red | 15 | XC | 0.24 | 17.8 | 14.3 | 11.9 | 8.9 | 7.1 | 5.9 | 4.8 | 3.6 |
| | 20 | XC | 0.28 | 21 | 16.6 | 13.9 | 10.4 | 8.3 | 6.9 | 5.5 | 4.2 |
| | 30 | XC | 0.35 | 26 | 21 | 17.3 | 13.0 | 10.4 | 8.7 | 6.9 | 5.2 |
| | 40 | XC | 0.40 | 30 | 24 | 19.8 | 14.9 | 11.9 | 9.9 | 7.9 | 5.9 |
| | 50 | VC | 0.45 | 33 | 27 | 22 | 16.7 | 13.4 | 11.1 | 8.9 | 6.7 |
| | 60 | VC | 0.49 | 36 | 29 | 24 | 18.2 | 14.6 | 12.1 | 9.7 | 7.3 |
| | 75 | C | 0.55 | 41 | 33 | 27 | 20 | 16.3 | 13.6 | 10.9 | 8.2 |

**MEDIUM**

# Hypro – GuardianAir Induction

- More consistent droplet
- All-in-one cap and screen
- Wide angle with 15 degree incline toward the rear
- Aim forward or rearword – alternate?






See Page 16, Hypro Spray Tip Guide

GuardianAir

| | 15 PSI | 20 PSI | 30 PSI | 40 PSI | 50 PSI | 60 PSI | 70 PSI | 80 PSI | 90 PSI | 100 PSI |
|---|---|---|---|---|---|---|---|---|---|---|
| GA110-015 | XC | XC | VC | C | C | C | M | M | M | M |
| GA110-02 | XC | XC | VC | C | C | C | M | M | M | M |
| GA110-025 | XC | XC | VC | C | C | C | C | C | M | M |
| GA110-03 | XC | XC | VC | C | C | C | C | C | M | M |
| GA110-035 | XC | XC | VC | C | C | C | C | C | M | M |
| GA110-04 | XC | XC | VC | C | C | C | C | C | M | M |
| GA110-05 | XC | XC | VC | C | C | C | C | C | M | M |

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SPRAY IT

SPRAY TIP SELECTION CALCULATOR

BROADCAST

www.hypropumps.com

Measurement Units: US Gallons per Acre

Tip Spacing: _____ inches

Speed: _____ mph

Application Rate: _____ gallons/acre

Solution Density: 8.34 lbs/gallon

Spray Quality: No Preference

Need Help?

Submit | Start Over

GREENLEAF TECHNOLOGIES

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TurboDrop® Variable Rate

Ignite

## Great News!

TurboDrop® and AirMix® are the ***only*** air induction nozzles recommended by Bayer for use with Ignite® Herbicide on LibertyLink® Crops!

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**NOZZLE CALCULATOR**

## TurboDrop® Twin Fan - TDTF


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Air Injection Technology

TurboDrop®
11003 @ 70psi

Extended Range
11004 @ 40 psi

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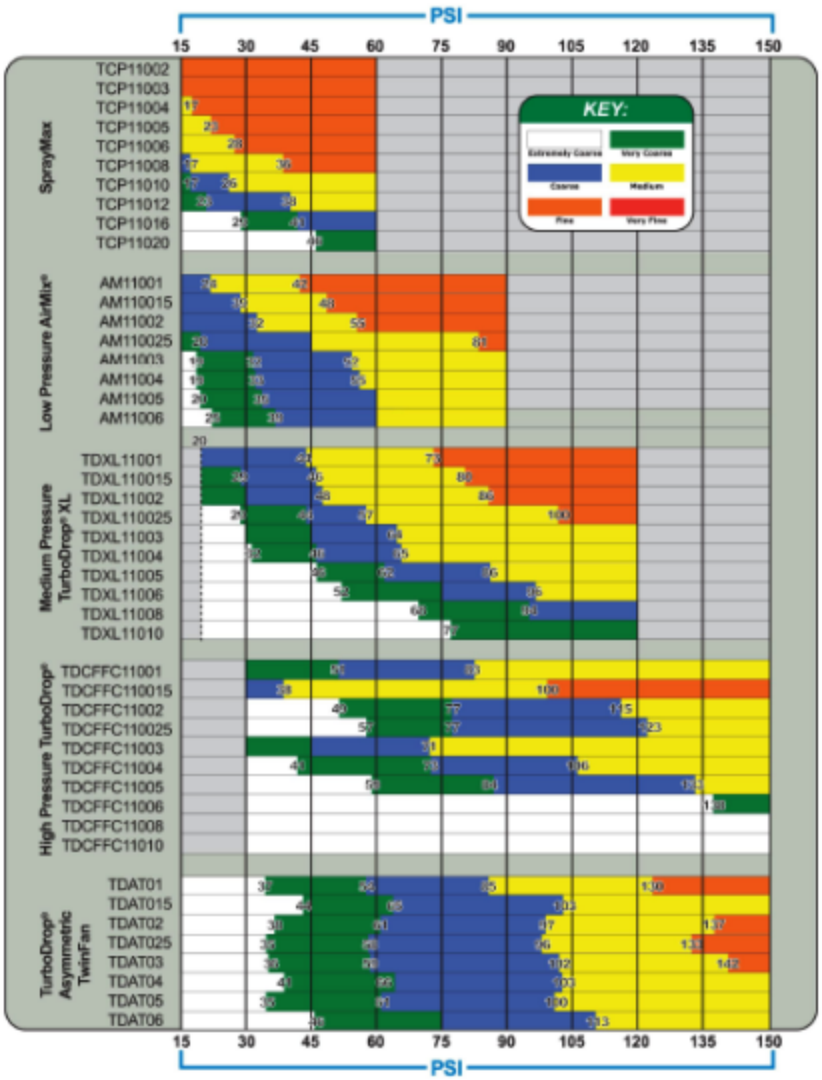
## Greenleaf Technologies - ASABE Droplet Size Categories




Droplet size classification scheme is based on BCPC specifications and in accordance with ASABE S-572 at the date of printing. Classifications are subject to change.

# Nozzle Calculator

**Please input your application rate:**

Application rate (gal/ac): 9 [-] [+] (5...100)

**Please input your speed (mph):**

Speed (mph): 6 [-] [+] (1,0...12,0)

Nozzle Spacing ("): 20

calculate

Flowrate (gal/min): **0.18**

| Nozzle Size (ISO) | -01 | -015 | -02 | -025 | -03 | -04 | -05 | -06 | -08 | -10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure (psi) | 129 | 57 | 32 | 21 | 14 | | | | | |
| SprayMax | | | | | | | | | | |
| AirMix® AM | | | | | | | | | | |
| TurboDrop® XL | | | | | | | | | | |
| TDCFFC® | | | | | | | | | | |

**Explication (droplet size):**

| | Droplet Size | Venturi Nozzle | Standard Nozzle |
|---|---|---|---|
| | Extremely Coarse | Systemic | Reduced Coverage |
| | Very Coarse | Systemic | Reduced Coverage |
| | Coarse | Systemic all Contact (higher GPA rates) | Systemic (higher GPA rates) |
| | Medium | Systemic; Contact | Systemic |
| | Fine | Drift Risk! | Systemic; Contact Drift Risk! |
| | Very Fine | Not Recommended | Not Recommended |

# The CP© Products Company Flow Rate Calculator for CP© Low Volume Sprayer Turbo Nozzles with Droplet Classifications

Enter your nozzle spacing and MPH in the row which matches the orifice and pressure you want to use. Then, click **Calculate** and read the GPA results in the same row.

Calculate

| Enter your nozzle spacing and MPH in the row which matches the orifice and pressure you want to use. Read the GPA results in the same row in column #6. | | | Enter your nozzle spacing in inches. | Enter your speed in Miles Per Hour | Column #6 Gallons Per Acre |
|---|---|---|---|---|---|
| **Orifice** | **PSI** | **GPM** | **Spacing** | **MPH** | **GPA** |
| #1.5 with #2 Tip | 60 | 0.18 | | | |
| | 50 | 0.17 | | | |
| | 40 | 0.15 | | | |
| | 35 | 0.14 | | | |
| | 30 | 0.13 | | | |

**CP®** Floater/Sprayer Nozzle Droplet Key

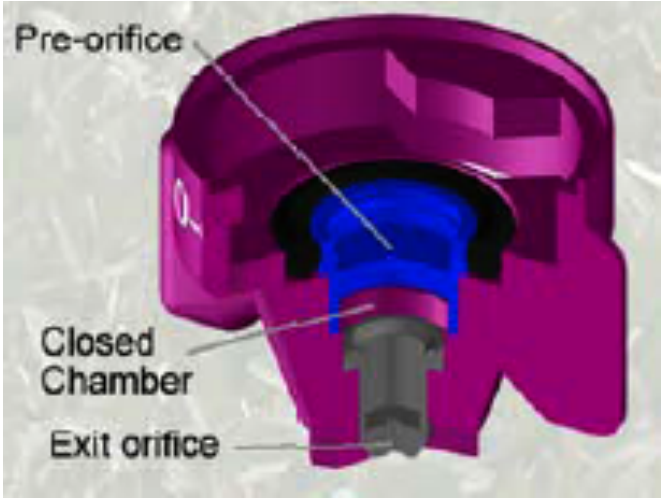
| Nozzle Classification* Category Threshold Values+ | Dv0.1 | Dv0.5 | Dv0.9 |
|---|---|---|---|
| Very Fine (VF) | ≤45.9µm | ≤108.1µm | ≤182.37µm |
| Fine (F) | ≤70.7µm | ≤166.96µm | ≤342.29µm |
| Medium (M) | ≤91.09µm | ≤245.74µm | ≤478.48µm |
| Coarse (C) | ≤108.82µm | ≤377.8µm | ≤708.12µm |
| Very Coarse (VC) | ≤129.22µm | ≤434.9µm | ≤1000.2µm |
| Extremely Coarse (XC) | ≥129.22µm | ≥434.9µm | ≥1000.2µm |

## CP® 65-T-S Standard Sprayer Turbo Nozzle

| Orifice ⇒ Def. Tip # PSI ⇓ | 3 #3 #7.5 #10 | 4 #3 #7.5 #10 | 5 #3 | 5 #7.5 #10 | 6 #3 | 6 #7.5 | 6 #10 | 8 #3 | 8 #7.5 | 8 #10 | 10 #3 | 10 #7.5 | 10 #10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | XC | XC | XC | XC | VC | XC | XC | VC | XC | XC | VC | XC | XC |
| 40 | XC | XC | VC | XC | VC | XC | XC | C | VC | XC | C | VC | XC |
| 50 | XC | XC | VC | XC | VC | VC | XC | C | VC | XC | C | VC | XC |
| 60 | XC | XC | VC | XC | VC | VC | XC | C | VC | XC | C | VC | XC |


# The Right Droplet Size
# The Right Spray Tip
# The Right Result





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**COMBO-JET® TIP-CAPS** - Here you'll find COMBO-JET® all-in-one Tip-Cap & Strainer, the product that has become the new industry standard for it's ease of use.

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**DOWN LOADS** - Product literature, nozzle performance charts, price lists, it's all here and easy to print.





Safer, Easier, More Effective, Spray Application

## Standard spray system
## Search a specific spray tip

An easy to use on-line computerized spray nozzle selector that helps you select the spray nozzle that is right for your application.

The TIP WIZARD "Search a specific spray tip" function can display tip performance specifications based on either application rate or sprayer speed. Please select or enter the following information.

1. Tip Number *COMBO-JET®* ER80-005 (Click arrow for list)

2. Nozzle Spacing 20 Inches

**Search by Application Rate**
To search for per tip performance specifications based on an application rate, enter the rate below.

Application Rate _____ US Gal/Acre

:: Show Spray Tip Specifications ::

**Search by Sprayer Speed**
To search for per tip performance specifications based on a sprayer speed, enter the speed below.

Sprayer Speed _____ MPH

:: Show Spray Tip Specifications ::

We recommend that you verify search results with our published Tip-Cap charts.

Spray tip output and droplet size are measured at 80 degrees F using clean water. Ambient temperatures and water condition may affect results.

We recommend that you refer to and follow the information and recommendations for the specific product you are applying.

If you want to search using different application units go to *Change Currency or Application Units*.

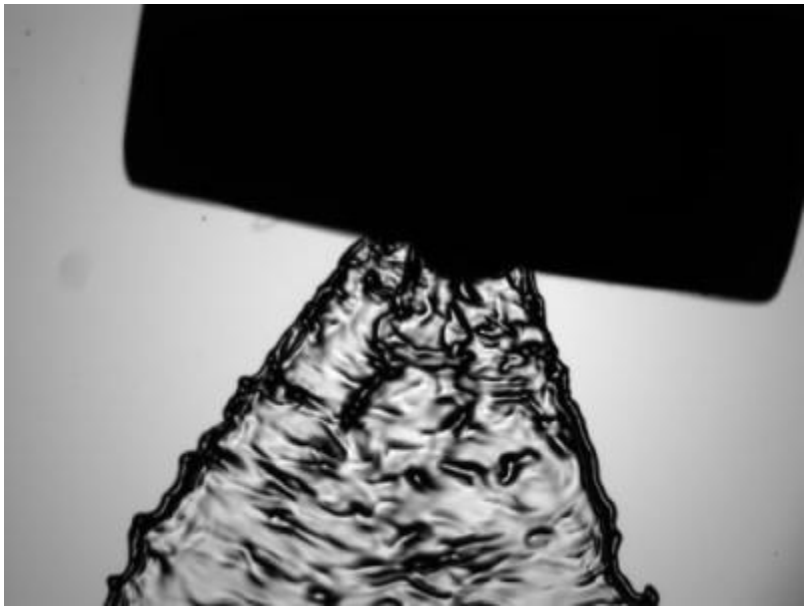
# Comparing Droplet Spectra – Example

| Nozzle | PSI | DSC | Nozzle | PSI | DSC | Nozzle | PSI | DSC |
|---|---|---|---|---|---|---|---|---|
| TT 11002 | 90 | F | AI 11002 | 90 | C | GA11002 | 90 | M |
| TT 110025 | 59 | M | AI 110025 | 59 | VC | GA110025 | 59 | C |
| TT 11003 | 40 | C | AI 11003 | 40 | VC | GA11003 | 40 | C |
| TT 11004 | 23 | VC | AM11002 | 90 | F | CP65T-SL (3-6) | 35 | XC |
| TTI 11002 | 90 | XC | AM100025 | 59 | M | CP65T-SL (3-4) | 40 | XC |
| TTI 110025 | 59 | XC | AM11003 | 40 | C | Wilger SR80-025 | 41 | M |
| XR 80025 | 40 | M | TDXL11002 | 90 | F | Wilger DR110-02 | 64 | M |
| XR 110025 | 59 | F | TDXL110025 | 59 | M C | Wilger SR110-03 | 28 | M |
| XR 8003 | 40 | M | TDXL11003 | 40 | VC | Wilger MR100-025 | 41 | M |
| XR 11003 | 40 | F | ULD12002 | 90 | M | | | |
| XR 8004 | 23 | C | ULD120025 | 59 | C | | | |
| XR 11004 | 23 | M | ULD12003 | 40 | C | | | |
| AIXR 11002 | 90 | M | | | | | | |
| AIXR 110025 | 59 | C | | | | | | |

0.30 gpm

MEDIUM

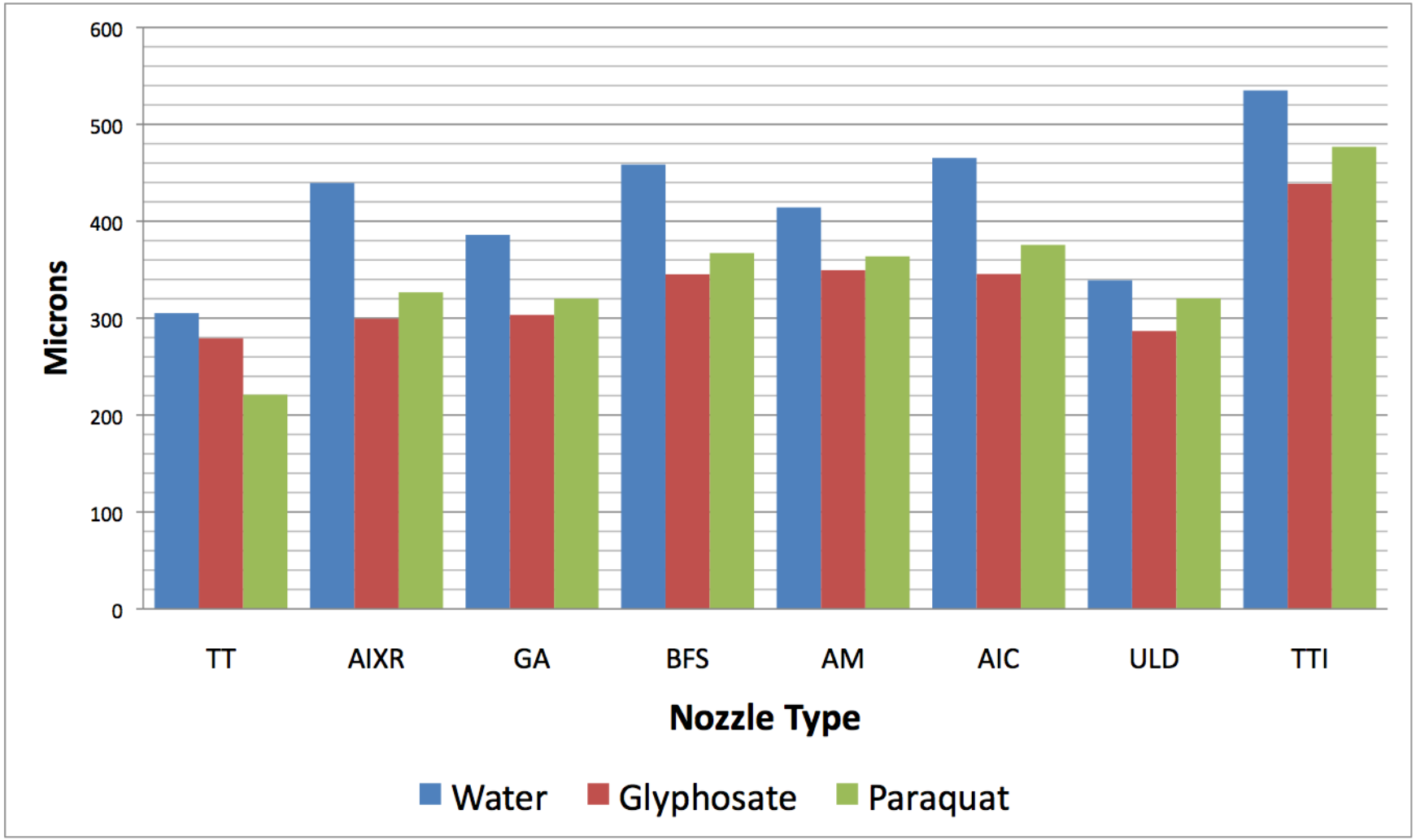
# New low speed wind tunnel:



No deposition aid

With deposition aid

# Solution Effect – College Station in the Wind Tunnel



# Doplet Spectra - Laser

| Nozzle Type | Droplet Spectra | VD0.5 Water + NIS + No Deposition Aid | VD 0.5 PowerMax + Clarity + AMS | VD 0.5 PowerMax + Clarity + AMS + Control | Water + NIS %<100 microns | Mix with No Dep Aid %<100 microns | Mix with Dep Aid %<100 microns |
|---|---|---|---|---|---|---|---|
| TT | coarse | 383.2 | 384.6 | 751.6 | 3.99 | 3.58 | 0.77 |
| TDTF | very coarse | 302.8 | 314.5 | 531.9 | 4.22 | 4.29 | 1.77 |
| TTI | extra coarse | 599.6 | 586.5 | 902.9 | 0.65 | 0.64 | 0.49 |
| AIXR | extra coarse | 415.5 | 418.0 | 908.6 | 1.73 | 1.71 | 0.18 |
| TTJ60 | coarse | 306.1 | 312.3 | 659.7 | 4.74 | 4.58 | 0.54 |
| CP-65T-SL | extra coarse | 496.2 | 439.1 | 1135.0 | 0.83 | 1.75 | 0.05 |
| XR11003 | Medium | 174.0 | 172.9 | 461.3 | 16.25 | 16.22 | 3.37 |

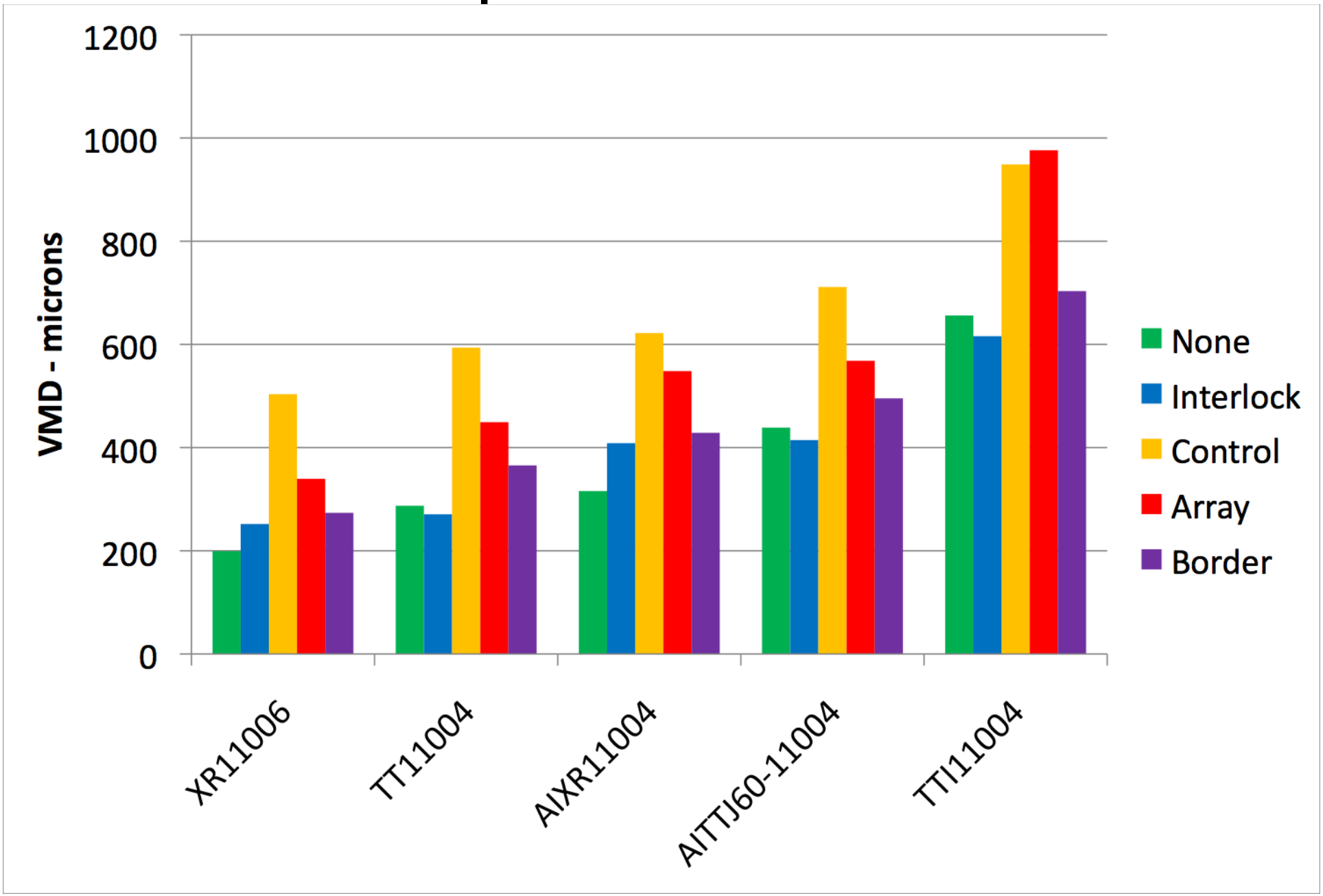
*Control at 2 ounces per 100 gallons (GarrCo Products, Inc)

# Droplet Spectra – Laser @ 10 GPA

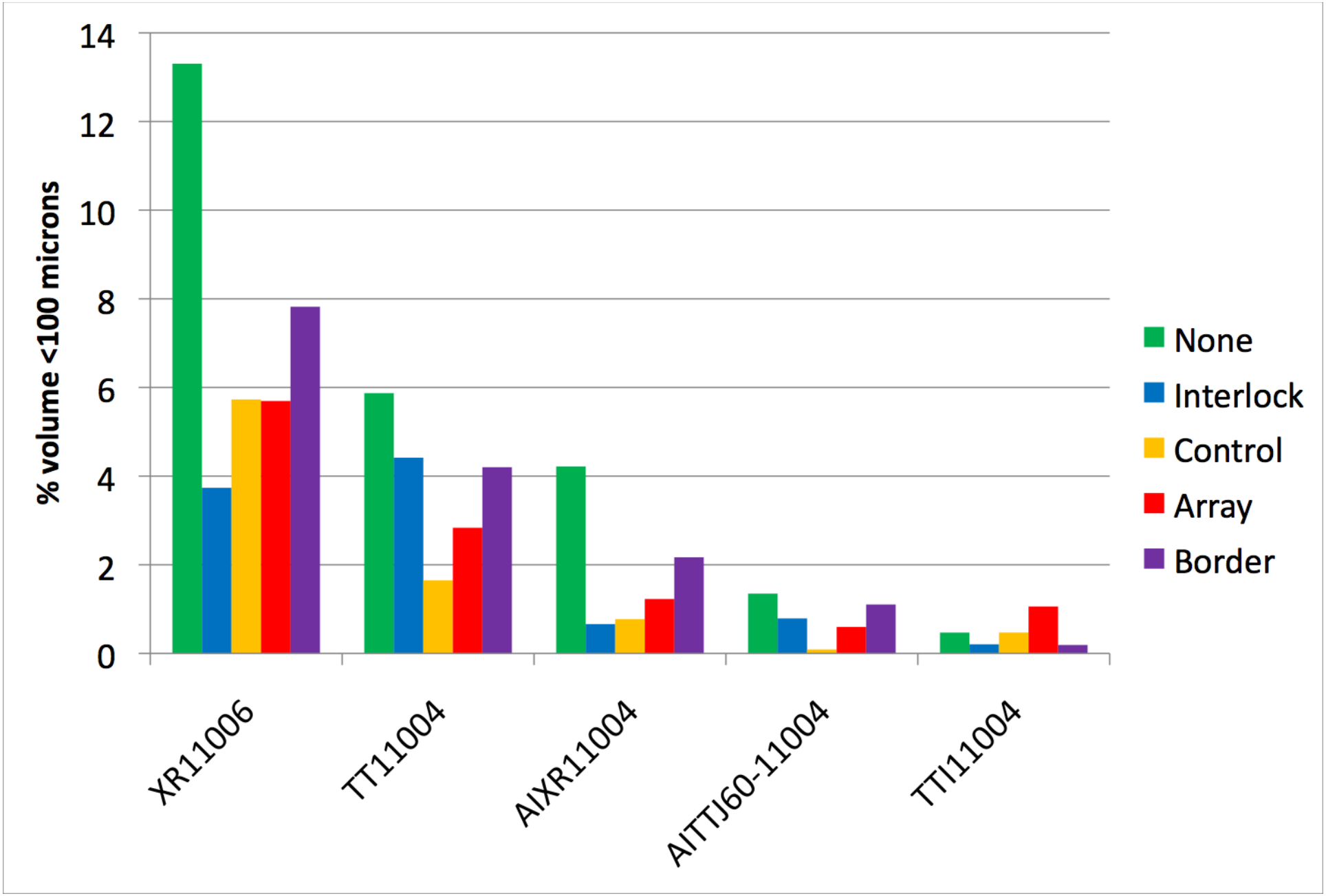
| Nozzle Type | Droplet Spectra | VD0.5 Water + NIS + No Deposition Aid | VD 0.5 Ignite + NPAK | VD 0.5 Ignite + Class Act + Interlock | Water + NIS %<100 microns | Mix with No Dep Aid %<100 microns | Mix with Dep Aid %<100 microns |
|---|---|---|---|---|---|---|---|
| XRI11003 | Fine | 174.7 | 167.3 | 180.2 | 14.9 | 17.3 | 11.9 |
| TT11002 | Medium | 241.0 | 219.9 | 243.3 | 7.3 | 9.0 | 5.8 |
| AIXR11002 | coarse | 314.8 | 289.8 | 323.2 | 3.3 | 4.9 | 1.9 |
| AI11003 | Very coarse | 452.4 | 399.4 | 443.6 | 1.2 | 2.4 | 0.8 |
| TTI11002 | extra coarse | 649.3 | 621.3 | 661.0 | 0.3 | 0.8 | 0.2 |
| XR11003 | Medium | 158.8 | 153.0 | 165.9 | 19.4 | 22.0 | 16.8 |
| | | | | | | | |

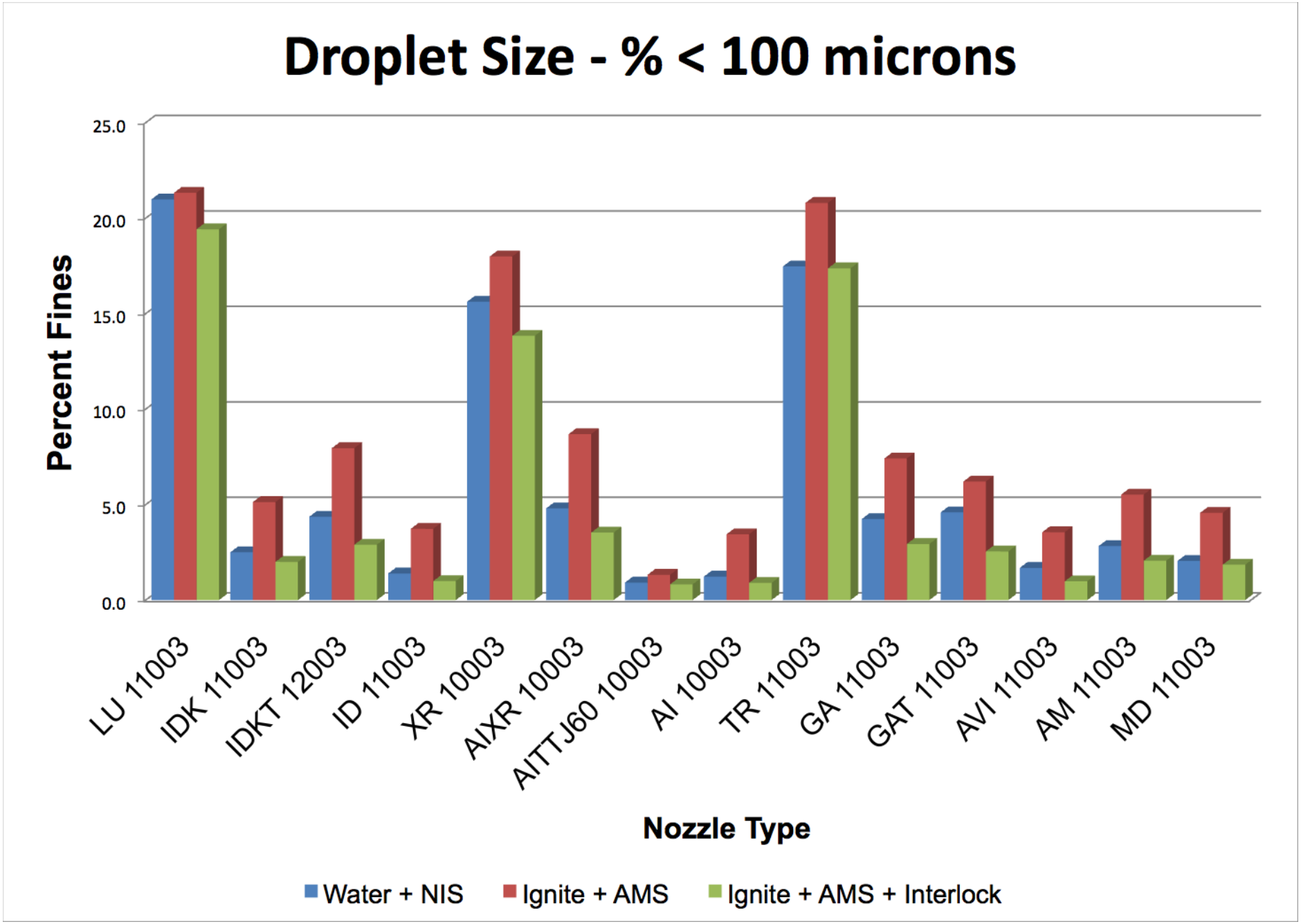
*Interlock at 2 ounces per acre (Winfield Solutions, Inc)

# Droplet size - VMD



# Droplet size - %V<100




Droplet Size - % < 100 microns
Percent Fines
25.0
20.0
15.0
10.0
5.0
0.0
LU 11003
IDK 11003
IDKT 12003
ID 11003
XR 10003
AIXR 10003
AITTJ60 10003
AI 10003
TR 11003
GA 11003
GAT 11003
AVI 11003
AM 11003
MD 11003
Nozzle Type
Water + NIS
Ignite + AMS
Ignite + AMS + Interlock

# Disclaimer:

- Brand names appearing in this presentation are for identification and illustration purposes only.
- No endorsement is intended, nor is criticism implied of similar products not mentioned.


What is the next step?