Assessing Spray Droplet Spectra to Develop Spray Technologies for Precision Pesticide Applications

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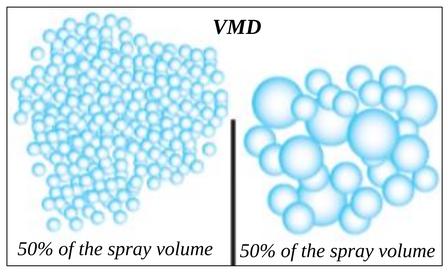
Introduction

- Achieving optimum coverage while keeping spray particle drift to a minimum is one of the biggest challenges facing pesticide applications today.
- Droplet size is a key factor for on-target pesticide applications as it directly affects spray coverage, drift and efficacy (Rodrigues et al., 2018).
- Current practice of nozzle selection for effective pesticide applications relies primarily on using droplet size based on the Volume Median Diameter (VMD), which does not account for droplet size variability present within a spray.
- Knowledge of spray droplet spectra can help in developing new methods and/or technologies that can effectively reduce spray particle drift and improve coverage, thus ensuring safe and precision pesticide applications.



	PSI	110°XR/XRC 15-60 PSI	TT 15-90 PSI	GPM	5 mph
03	20	M	VC	0.21	12.5
AI AIC AIXR	30	F	VC	0.26	15.4
AITTJ60 AI3070	40	F	C	0.30	17.8
TT TTI TTI60	50	F	M	0.34	20
XR XRC	60	F	M	0.37	22
(50)	70	—	M	0.40	24
TTJ60	80	—	M	0.42	25
(100)	90	—	F	0.45	27

Objective

To assess spray droplet spectra and quantify droplet size variability within a spray for six different droplet sizes commonly used for agricultural pesticide applications with a goal to understand how droplet spectra influences spray drift and coverage.

Material and Methods

Location: Plant Science Farm, University of Georgia, Tifton, GA

Spray Equipment: A 6-row test sprayer equipped with a TeeJet® Technologies:

- Rate Controller for regulating application rate (gallons per acre; GPA)
- Pulse Width Modulation (PWM) system for modulating spray droplet size

Treatments:

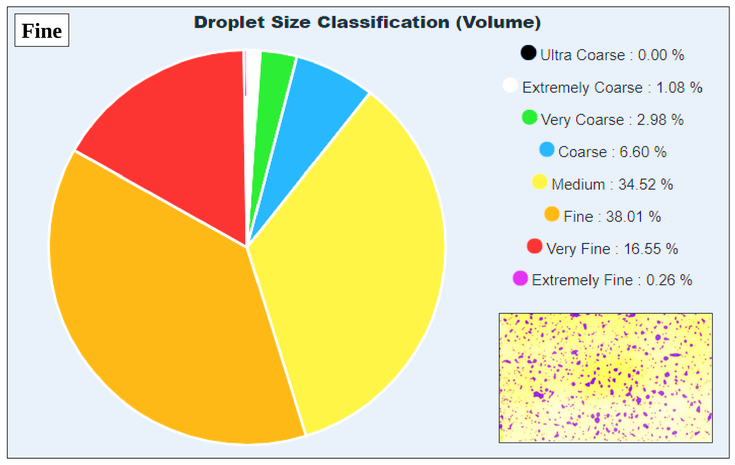
Six different nozzle types were used to attain different target droplet sizes, ranging from fine to ultra coarse, based on the VMD (ASABE S572.3). Applications were performed with water at 15 GPA and each droplet size was replicated three times.

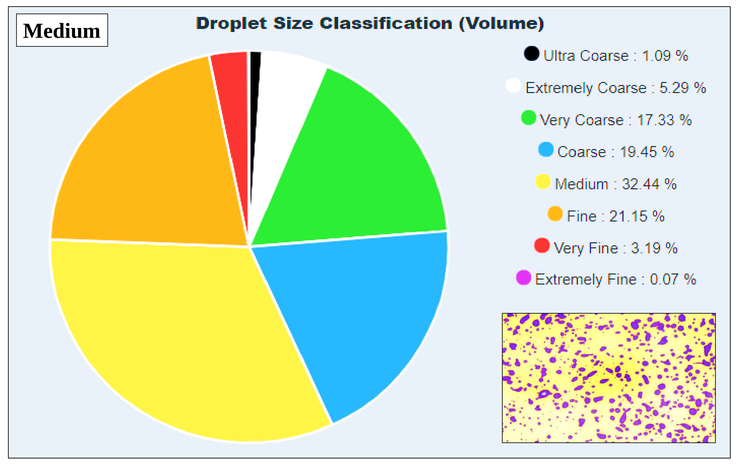
Droplet Size	VMD Range (Microns)	Coverage	Drift Potential
Fine	<60	Very Good	Very High
Medium	61-105	Good	High
Coarse	106-235	Moderate	Moderate
Very Coarse	341-403	Poor	Moderate
Extremely Coarse	404-502	Very Poor	Low
Ultra Coarse	>665	Very Poor	Very Low

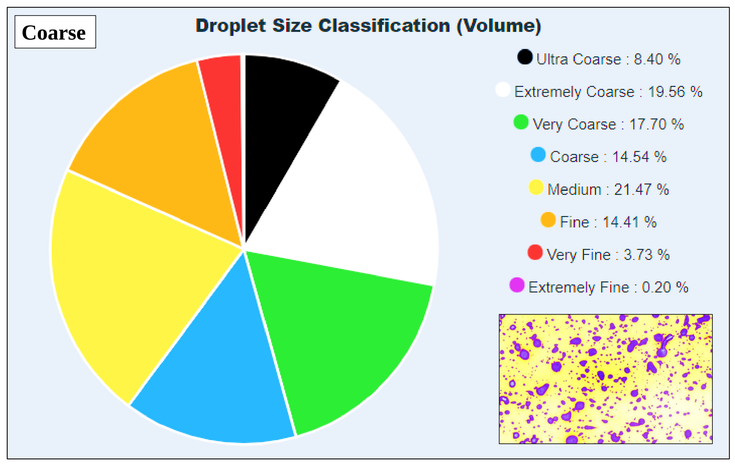
Data Collection & Analysis:

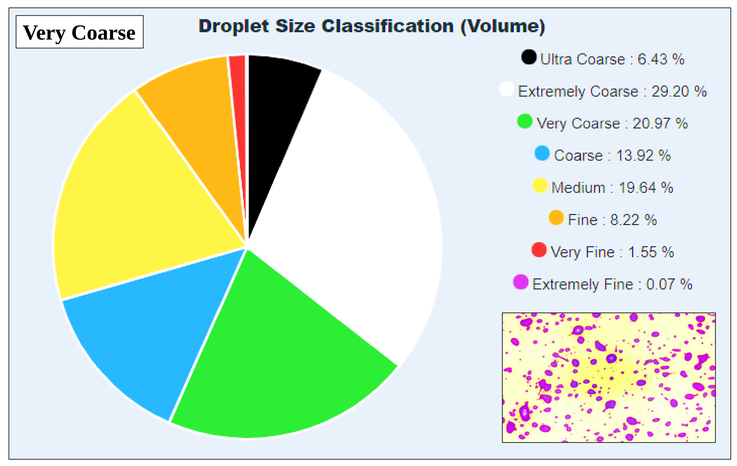
- Water sensitive paper, arranged in a 3m x 3m grid pattern, was used to collect spray deposition during each application.
- A wireless digital microscope (SprayX, São Carlos, Brazil) paired with a mobile app was used to spray quality data.
- Analysis included a detailed droplet size classification (droplet spectra) by volume for each droplet using DropScope 2.4.1.

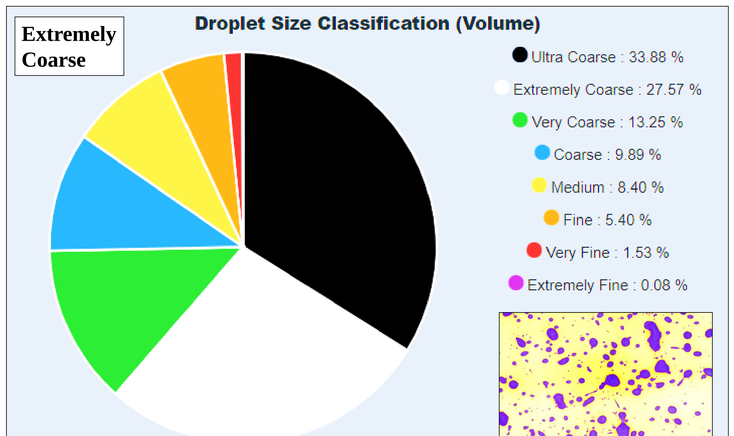
Results











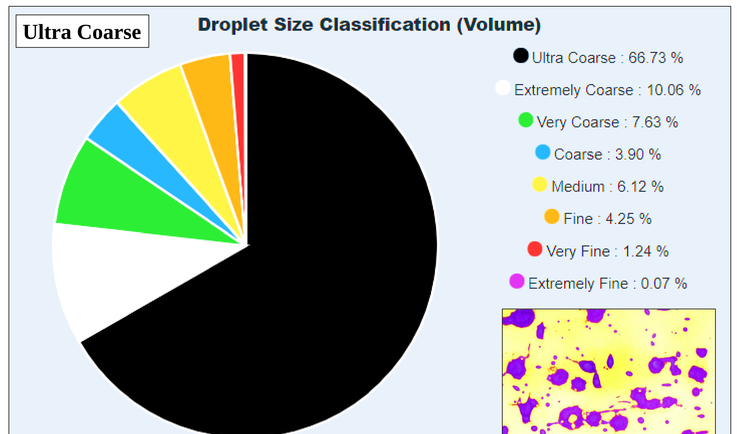


Figure 1. Graphs illustrating droplet spectra (droplet size classification by volume) and spray coverage (high-resolution image of water sensitive paper) for each target droplet size. Target droplet size is based on the VMD as defined in the ASABE Standard S572.3 and is listed on each illustration in the top left corner.

Conclusions

- Spray droplet spectra analysis indicated large droplet size variability within a spray for each target droplet size.
- Majority of the spray droplets within each droplet spectra were smaller or larger than the target droplet size, with the exception of ultra coarse droplet.
- Potential of spray drift and/or reduced coverage is still high when using nozzles selected based on the droplet size classification based on the VMD method.

Future Research

Investigate alternative droplet classification methods to accurately represent the target droplet size for spray nozzles and develop technologies that can effectively reduce selective spray particles for more efficient pesticide applications.

References

ASABE/ANSI. 2020. Spray Nozzle Classification by Droplet Spectra. Standard S572.3. American Society of Agricultural and Biological Engineers, St. Joseph, MI.

Rodrigues, A.O., L.G. Campos, C.F. Creech, B.K. Fritz, U.R. Antuniassi, and G.R. Kruger. 2018. Influence of Nozzle Type, Speed, Droplet Size and Weed Control from Gyphosate, Dicamba, and Glyphosate Plus Dicamba. Pesticide Formulation and Delivery Systems, 38:61-75.

Acknowledgements

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