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Effect of Carrier Volume and Droplet Size on Coverage, Droplet Density, and Herbicide Efficacy in Peanut

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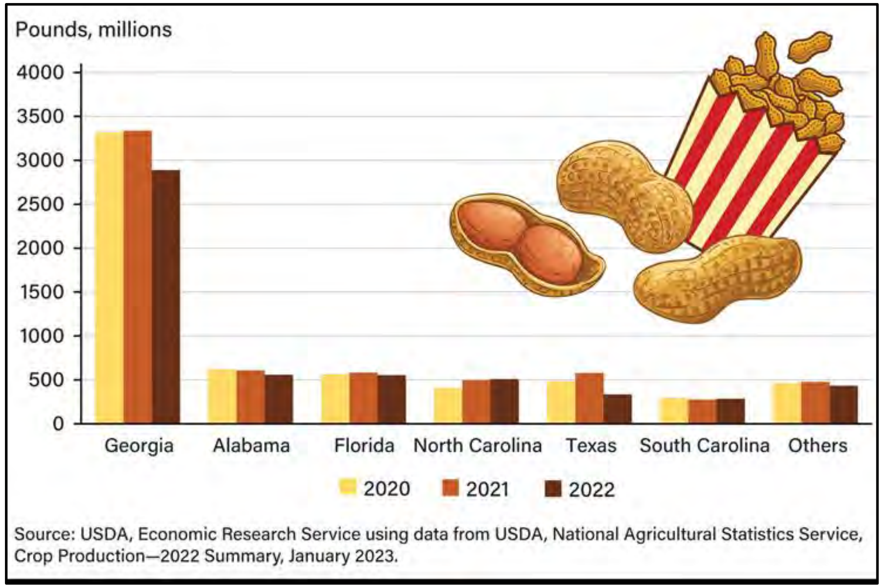
Introduction

- Peanut is an important row crop grown in the southeastern United States
- Peanut are used for peanut butter, peanut oil, confections, and direct consumption
- Georgia is the leading producer of peanut followed by Alabama, Florida, North Carolina, and Texas (USDA, 2022)



- Peanut production in the Southeast US is greatly affected by diseases and pests
- Heavy reliance on the use of pesticides to protect crop yield
- Timely and effective pesticide applications are critical

Leaf Spot

Thrips infestation

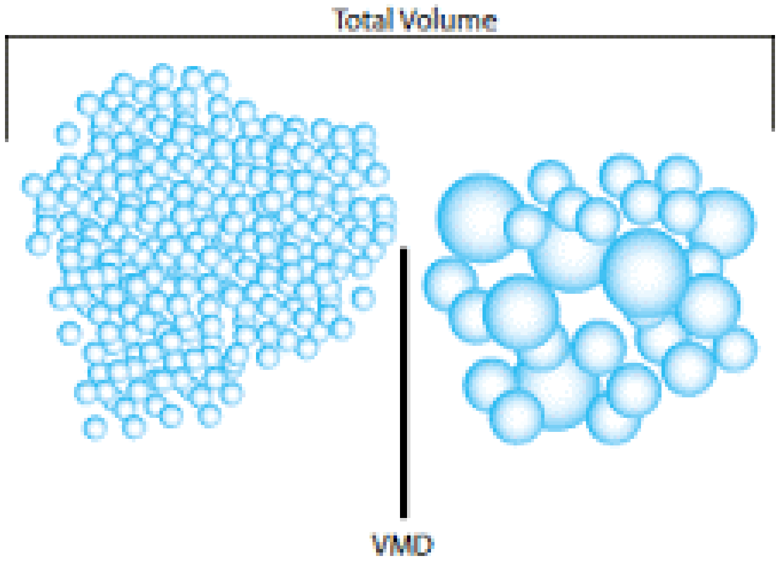
Palmer Amaranth

Spray Application Parameters

Ground Speed

Nozzle Selection

Droplet Size



Proper selection of these parameters is important to attain desired application volume, spray quality and efficacy for pesticide applications

Recent Trends in Pesticide Applications:

- **Lower Carrier Volumes** – using lower volumes to be more efficient and cover more acres

- **Larger Droplets** – Peanut grown in rotation with cotton where dicamba applications are common. Changing nozzles between crops is uncommon.

Hypothesis

Proper selection of carrier volume and droplet size will improve spray coverage and consequently the effectiveness of herbicide application

Objective

To assess the effect of carrier volume and droplet size on spray coverage, droplet density, and efficacy of herbicide application

Materials and Methods

Location

Sunbelt Ag Expo Farm in Moultrie, GA, USA (2021 and 2022)

Equipment

- 18-row commercial LMC boom sprayer
- Sprayer boom width (18.3 m), covering 18 peanut rows
- Calibrated at 345 kPa (50 psi) and ground speed of 16.1 km h^{-1} (10 mph) to deliver target carrier volumes

Treatments and Experimental Design

Study Treatments

Carrier Volumes: *(by varying nozzle size)*

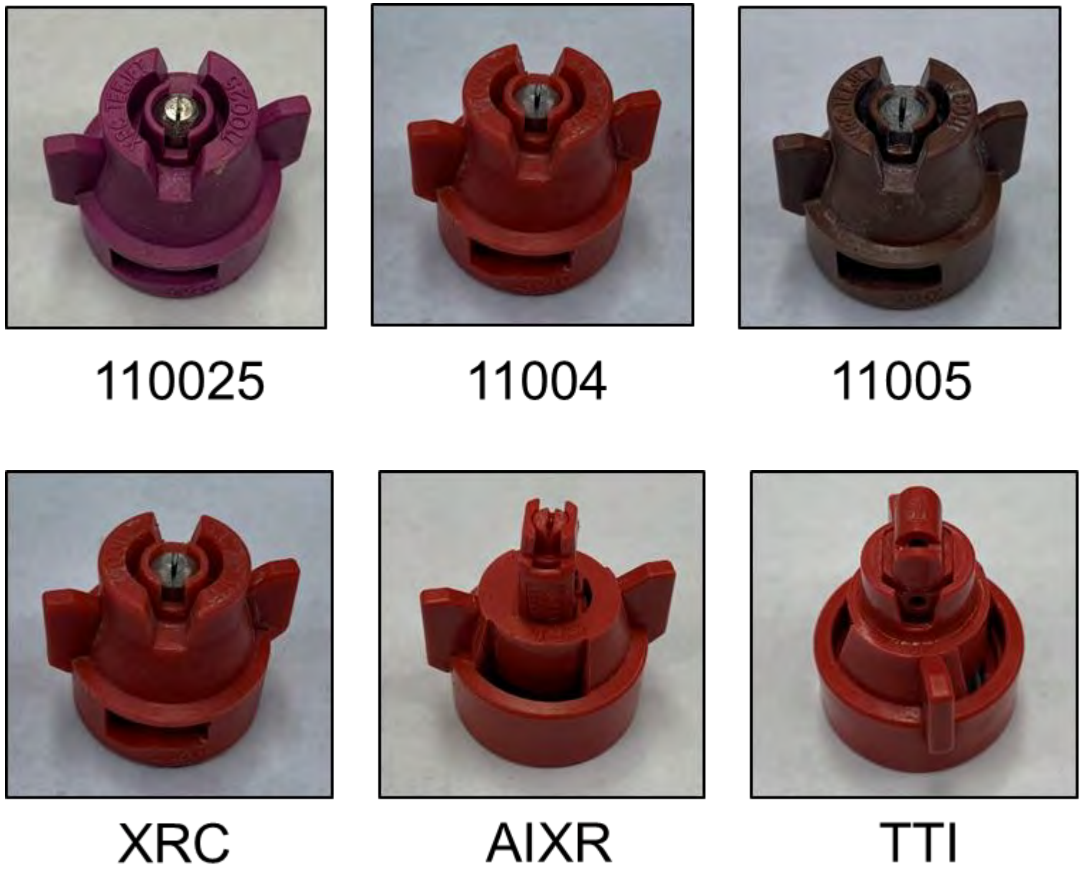
- 94 L ha^{-1}
- 117 L ha^{-1}
- 140 L ha^{-1}
- *187 L ha^{-1} (2022)*

Droplet sizes : *(by varying nozzle types)*

- Medium (M)
- Very coarse (VC)
- Ultra coarse (UC)

Design

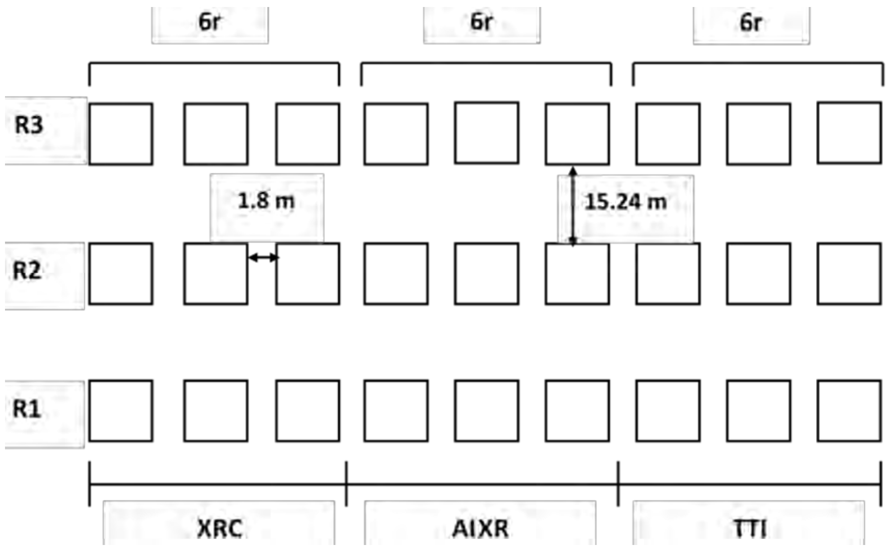
Split-plot with carrier volume as a whole plot and droplet size as a sub plot factor

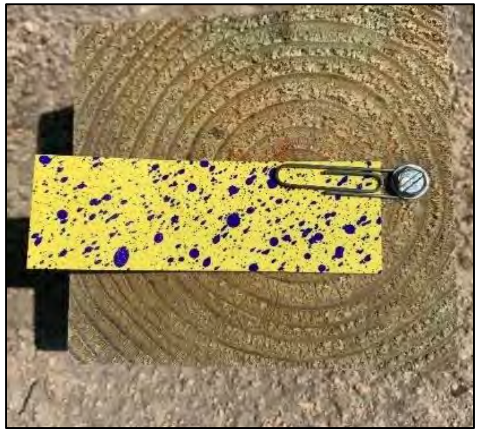


(Nozzle Droplet Size Classification based on ASABE S572.3, 2020)

Data Collection

- Two herbicide applications were made during both years:
  - o Pre-emergence application (PRE)
  - o Post-emergence application (POST)
- Water sensitive paper placed on the ground in a grid pattern (5.5 x 15.2 m)
- WSP were scanned in the lab for spray deposition and quality data
- **Visual weed rating** was performed approximately two weeks after PRE and POST in both years
- **Yield data** was collected by harvesting all six rows of each plot





Data Analysis

Analysed Area	23.91 cm²	Applied Volume on Paper	0.17 µl/cm²	Quantity of Drops	1367
Diameter Variation Coefficient	73.09%	VMD	297.31 µm	D0.9	468.89 µm
Largest Drop	647.55 µm	Average Diameter	120.88 µm	Covered Area	4.39%
Density	57.17 drops/cm²	Relative Amplitude	1.04	Drift Potential	2.93%
D0.1	161.07 µm	NMD	96.30 µm	Smallest Drop	24.34 µm
Droplet Size Classification	Medium				

- No Treatment x Application (PRE and POST) interaction was observed for all response variables during both years
- Analyzed separately for each year due to additional carrier volume in 2022
- ANOVA and means comparison using student t-test (*$p \leq 0.05$*)
- JMP® Pro 16 (SAS Institute, Cary, NC)

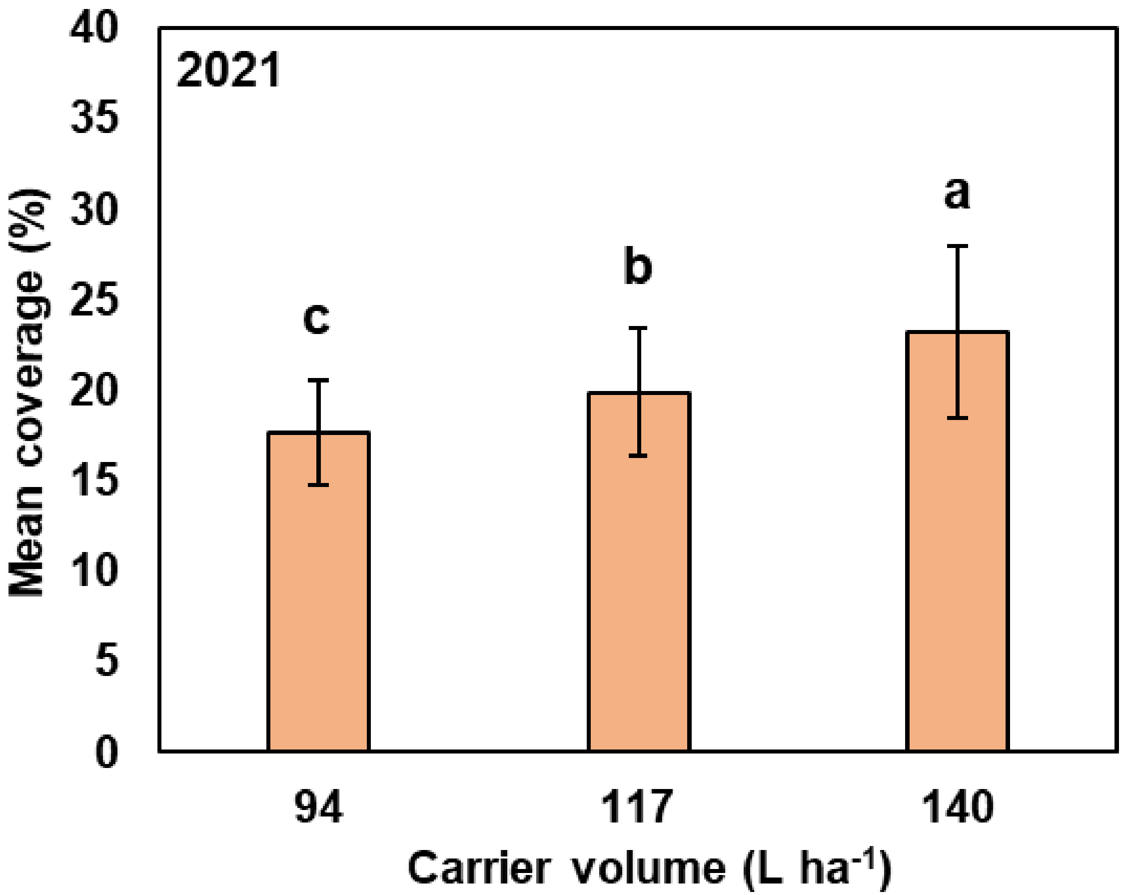
Results

ANOVA Analysis – Spray Coverage

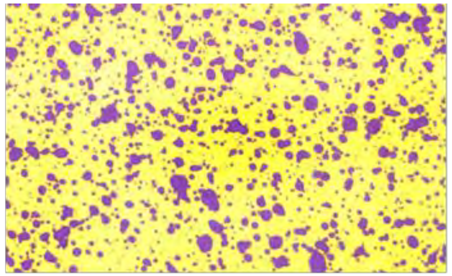
Effect	Spray coverage	
	2021	2022
Carrier volume	<0.0001*	<0.0001*
Droplet size	<0.0001*	<0.0001*
Carrier volume x Droplet size	NS	NS

Spray Coverage

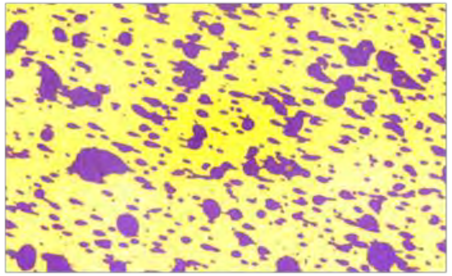
(Effect of Spray Volume)



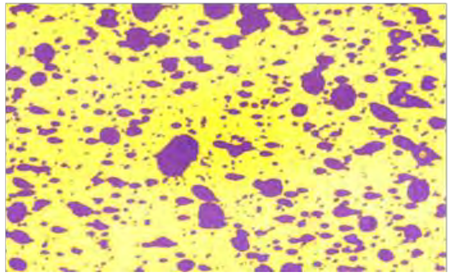
94 L ha-1



117 L ha-1

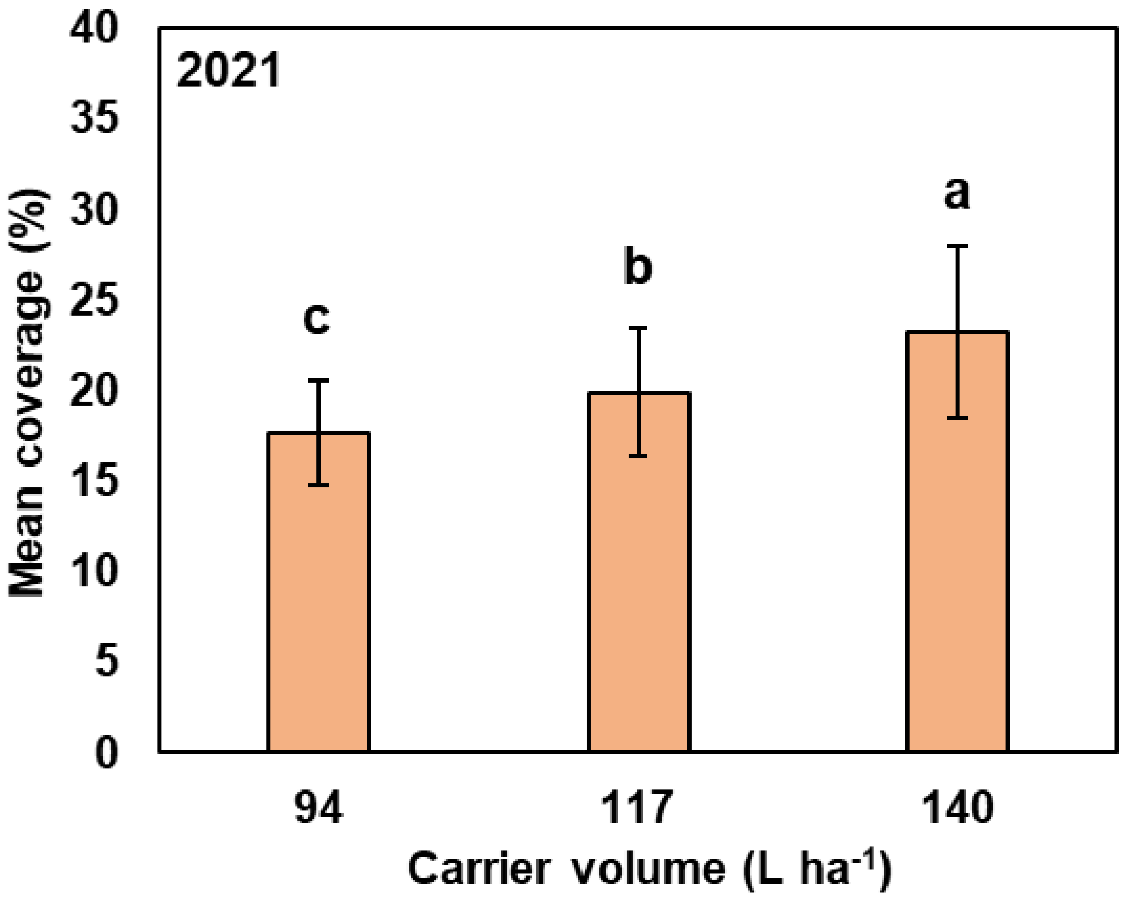


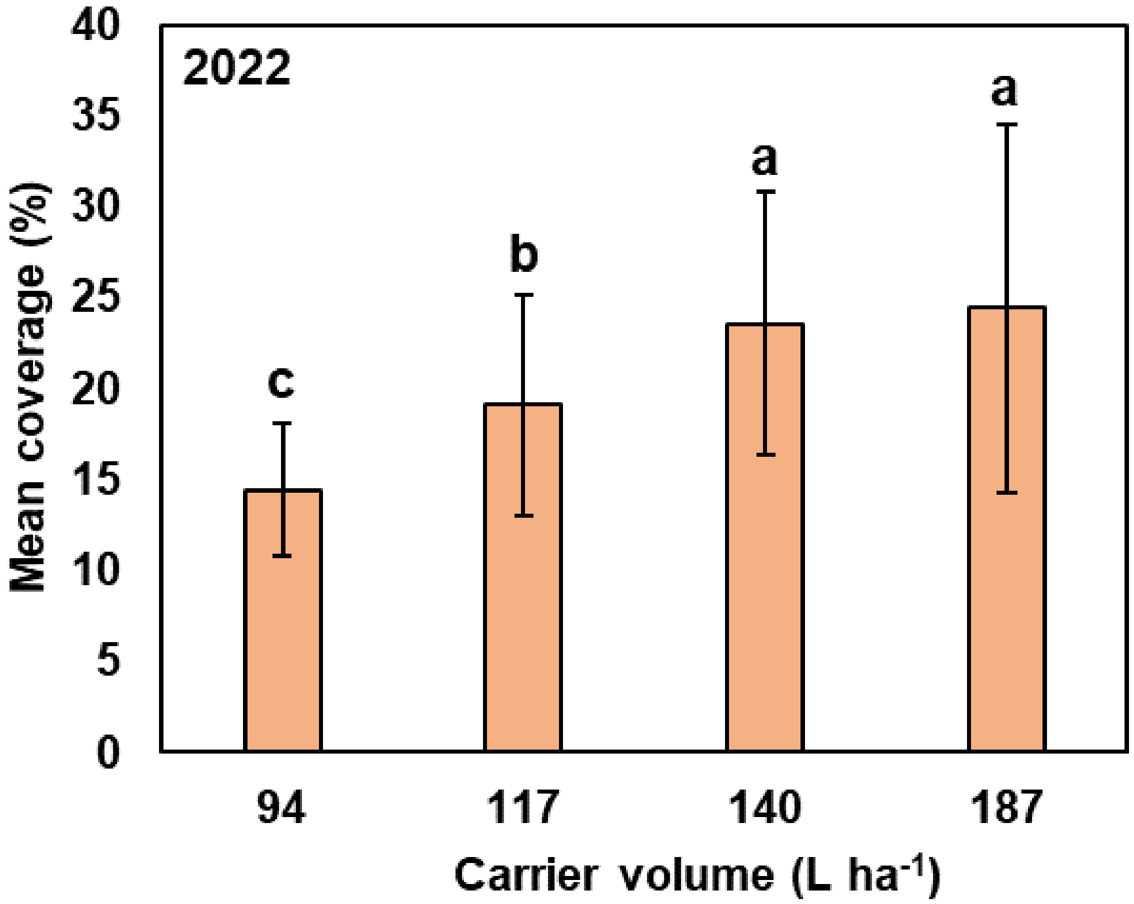
140 L ha-1



Spray Coverage

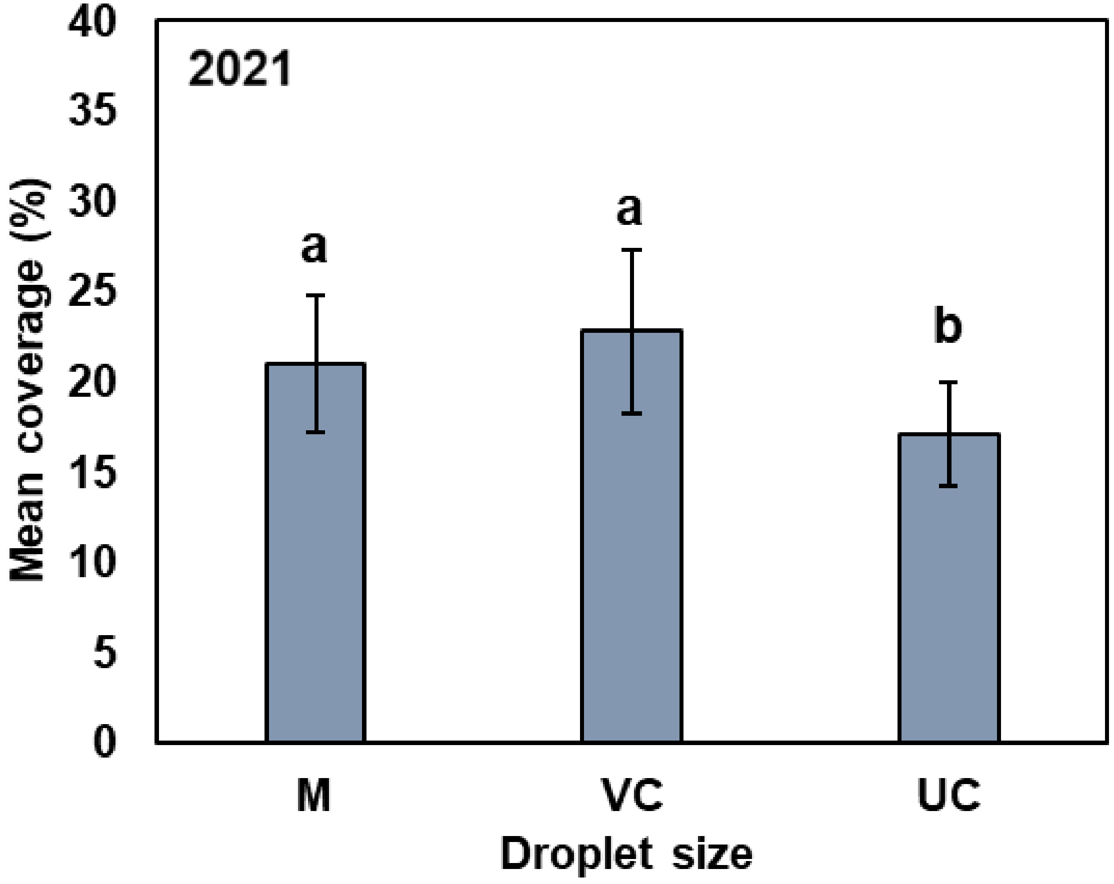
(Effect of Spray Volume)



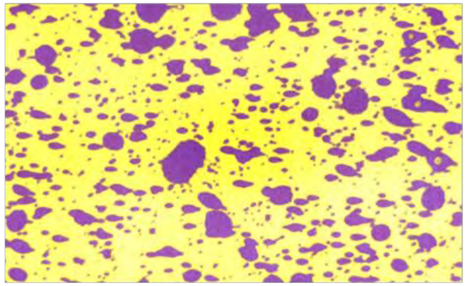


Spray Coverage

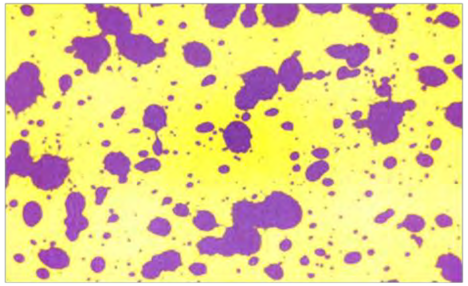
(Effect of Droplet Size)



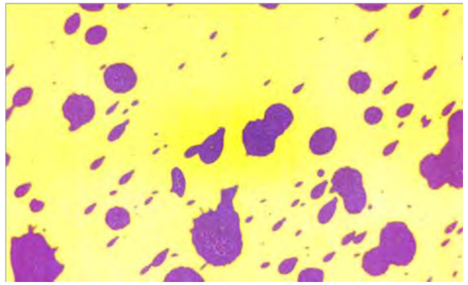
M



VC

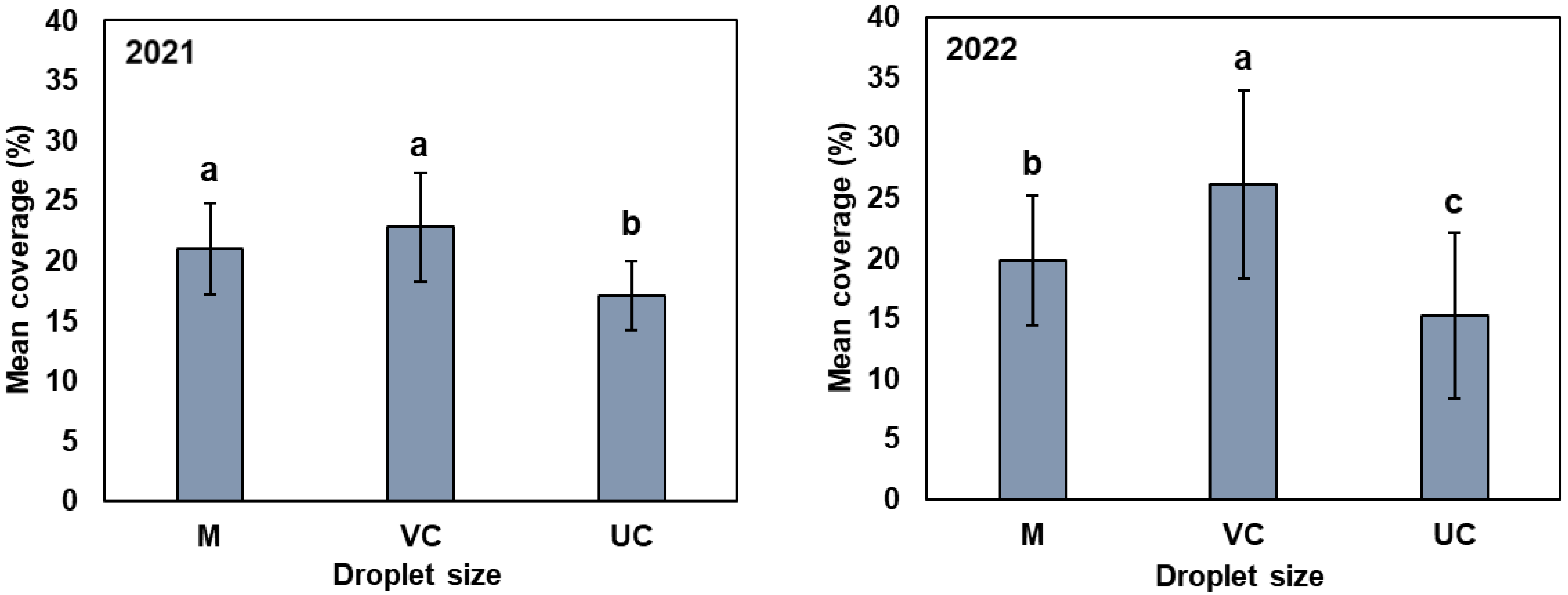


UC



Spray Coverage

(Effect of Droplet Size)



Droplet Density

ANOVA Analysis – Spray Coverage

Effect	**Droplet Density**	
	2021	**2022**
Carrier volume	NS	0.0125*
Droplet size	<.0001*	<0.0001*
Carrier volume x Droplet size	NS	0.0101*

Droplet Density

2021

Effect	Levels	Droplet Density (quantity of droplets per cm^2)
Carrier volume	94	93
	117	103
	140	107
Droplet size	M	164 a
	VC	104 b
	UC	36 c

2022

Carrier Volume ($L\ ha^{-1}$)	Droplet Size	Droplet Density (quantity of droplets per cm^2)
94	M	123 b
	VC	119 b
	UC	19 c
117	M	126 b
	VC	141 b
	UC	25 c
140	M	104 b
	VC	193 a
	UC	49 c
187	M	118 b
	VC	218 a
	UC	42 c

Herbicide Efficacy and Peanut Yield

Carrier Volume (L ha^{-1})	Droplet Size	Weed Density		Peanut Yield (kg ha^{-1})	
		2021	2022	2021	2022
94	M	1.1 b	0.2 b	6299	6186
	VC	0.5 b	0.3 b	6008	5540
	UC	1.6 b	0.4 b	5791	6700
117	M	1.8 b	0.1 b	6089	6077
	VC	2.1 b	0.1 b	6017	6458
	UC	0.6 b	0.3 b	5868	5842
140	M	1.3 b	0.2 b	5939	5633
	VC	1.1 b	0.1 b	6793	5566
	UC	0.6 b	0.2 b	6304	5328
187	M	-	0.1 b	-	6512
	VC	-	0.4 b	-	5874
	UC	-	0.4 b	-	6513
Check		14.9 a	19.2 a		

Conclusions

Spray Coverage

- Higher carrier volume improved spray coverage and droplet density (94<117<140 L ha^{-1})
- Increasing carrier volume beyond 140 L ha^{-1} in 2022 did not improve spray coverage
- Both M and VC droplet sizes provided comparable spray coverage and droplet density but spray coverage from UC droplet size was reduced in all cases.

Herbicide efficacy

- During both years, carrier volume and droplet size did not influence weed control and peanut yield

Thank You!

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Georgia Peanut Commission

National Peanut Board

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