Spray Deposition and Quality at Varying Ground Speeds for Two Rate Control Systems on Agricultural Sprayers

Madan Sapkota
Graduate Research Assistant
Texas A&M University

College of Agricultural & Environmental Sciences
UNIVERSITY OF GEORGIA

SOIL & CROP SCIENCES

- Ground speed variations are common and unavoidable during pesticide applications with agricultural sprayers
- Varying ground speeds results in actual rate being different (under or over) from the target application rate
- These speed variations also affect spray coverage and quality (droplet size)
- Maintaining a target application rate and spray quality is critical for precise and efficient pesticide applications

Spray Technologies for Precision Applications

Rate Controller

Pulse Width Modulation

Various precision spray technologies are currently available on agricultural sprayers for precision pesticide applications – application rate and spray quality

Hypothesis

Integrating precision spray technologies (rate controller and PWM) on agricultural sprayers will exhibit improved spray deposition and quality during pesticide applications over traditional sprayers without any technology.

Objective

To assess the influence of ground speed variations on spray deposition and quality for two different flow control systems (Rate Controller and PWM) on agricultural sprayers and compare it to conventional sprayer with no technology

Rate Control (RC) System:

Location

Southeast Georgia Research and Education Center, Midville, GA (2021 and 2022)

Equipment

- 18-row commercial Demco boom sprayer
  - 2021 - No rate controller (Conventional)
  - 2022 – with a rate controller (SRC)
- Sprayer boom (60 ft.) split into sections of two different nozzle types
  - XRC – Medium droplet (M)
  - TTI – Ultra Coarse droplet (UC)

XRC

TTI

Pulse Width Modulation (PWM) System:

Location

UGA Tifton Campus Research Farms (2023)

Equipment

- 6-row boom sprayer equipped with TeeJet DynaJet system (PWM)
- Sprayer boom (20ft.) split into sections with two different nozzle types
    - XRC – Medium droplet (M)
    - APTJ – Ultra Coarse droplet (UC)

XRC

APTJ

Treatments:

Varying Ground Speeds

- 6, 8, 10, 12, and 14 mph

(Both systems calibrated to deliver 20 GPA at 6 mph)

Design:

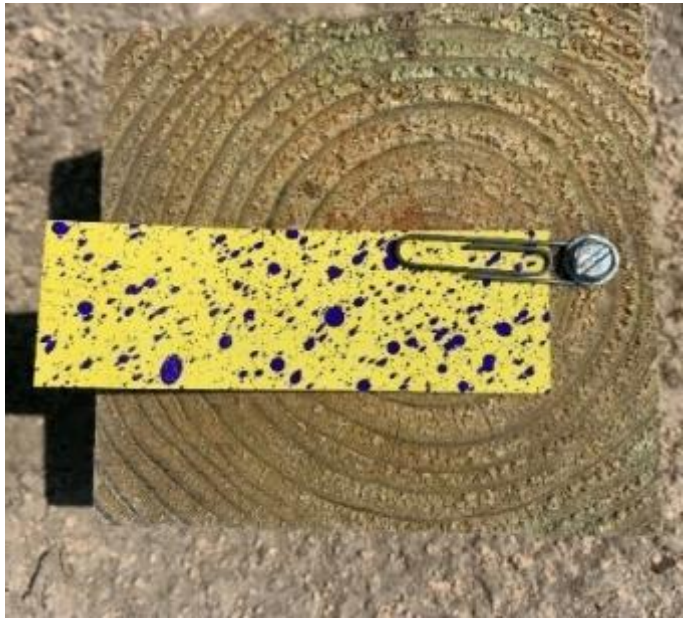
Split-plot with ground speed as a whole plot and nozzle type (droplet size) as a sub plot factor

Plot Size

6 rows wide (18 ft.) x length (100-200 ft.)

Data Collection

- Data was collected using water as a solution and prior to herbicide applications in peanut during both years
- Water-sensitive paper (WSP) were placed on wooden blocks in a grid pattern (5.5 x 15.2 m) before each sprayer pass
- WSP were scanned in the lab for spray deposition and quality data using DropScope

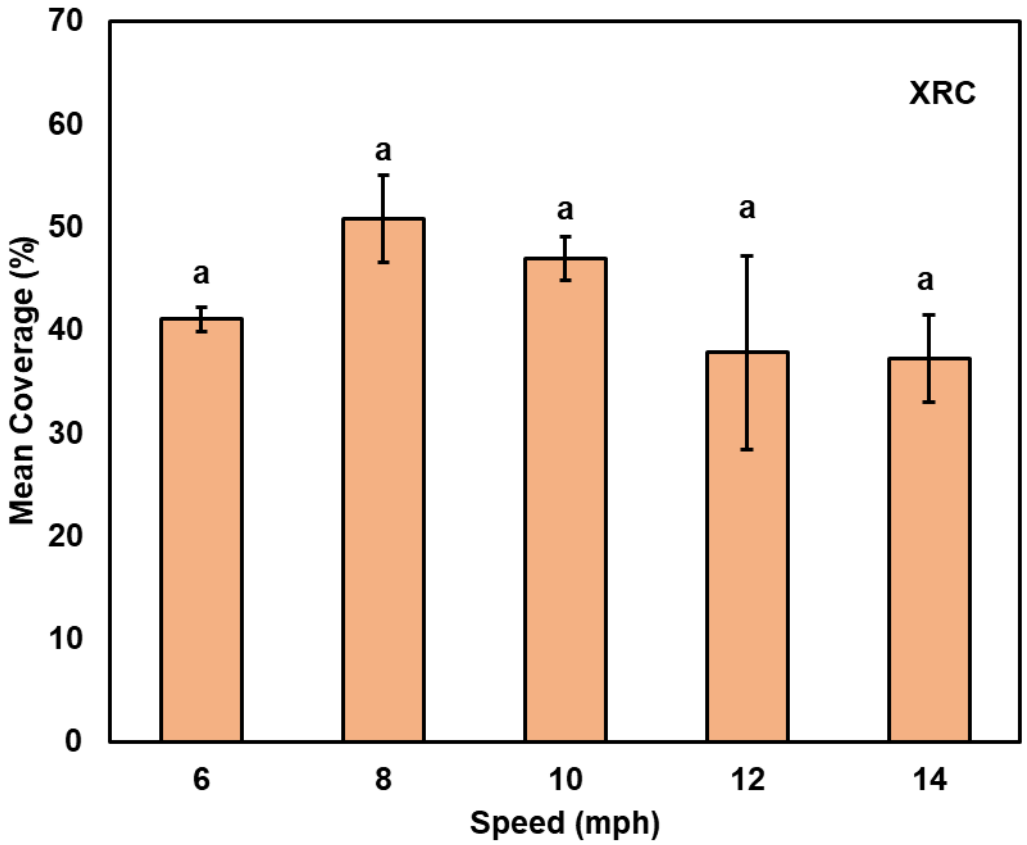


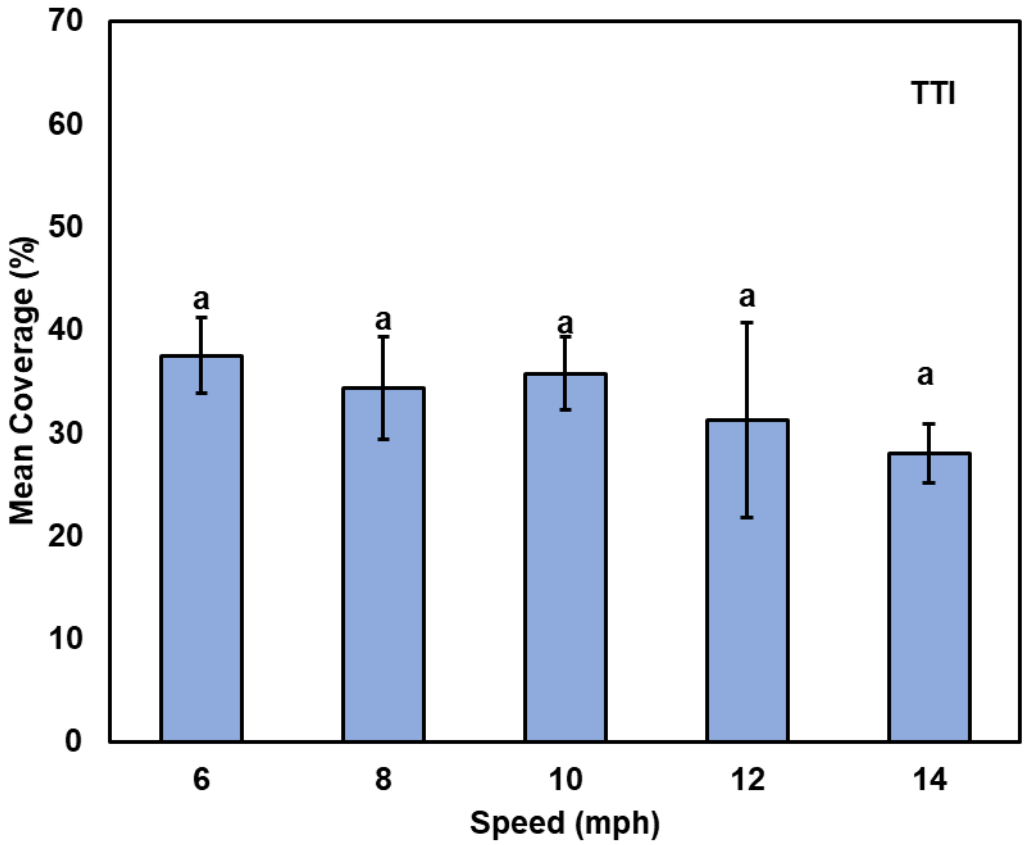
Data Analysis

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				

- Data analyzed separately for each year due to different sprayer setups
- ANOVA (alpha = 0.05) and means comparison using student t-test ($p \leq 0.05$)
- JMP® Pro 16 (SAS Institute, Cary, NC) was used for all statistical analysis.

Spray Deposition – No Rate Controller



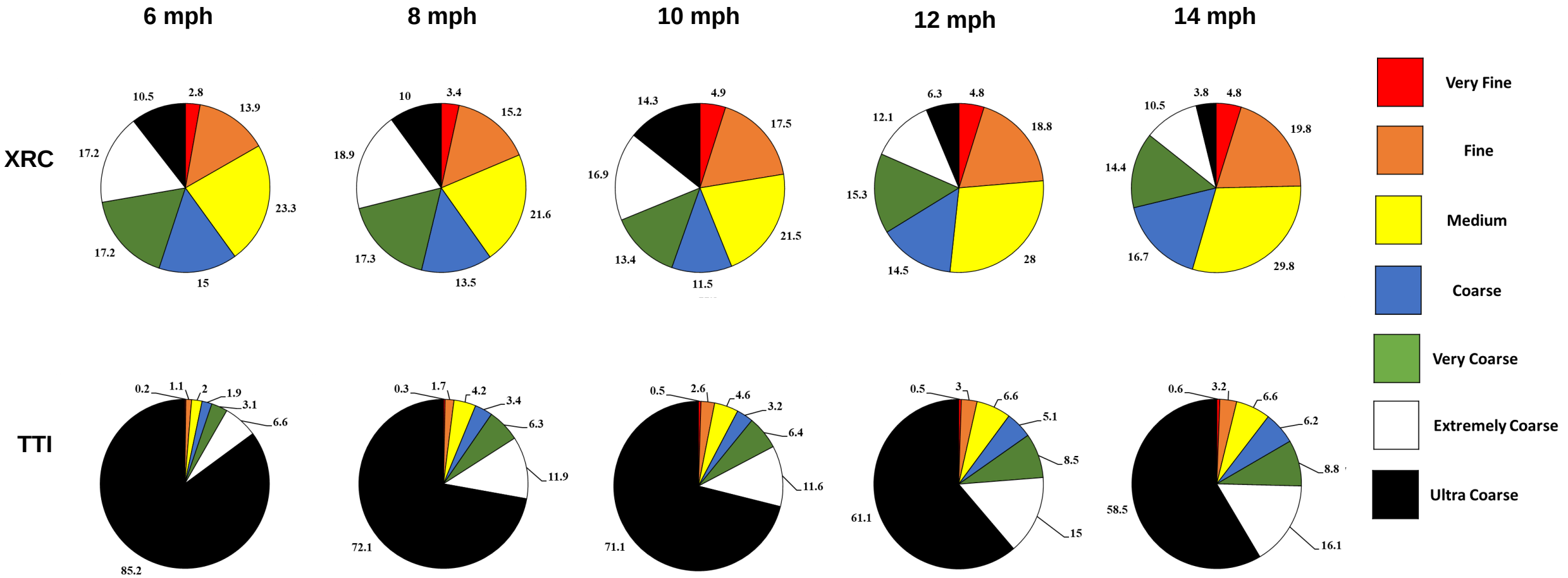


Droplet Density

(number of droplets/area)

Speed (MPH)	No Rate Controller		Rate Controller	
	XRC	TTI	XRC	TTI
6	5746 a	905 a	6845	1325
8	4933 ab	601 c	7893	1677
10	4589 b	404 bc	8626	2263
12	2819 c	604 b	7355	2092
14	2363 c	566 b	8218	2334

Spray Quality – Rate Controller

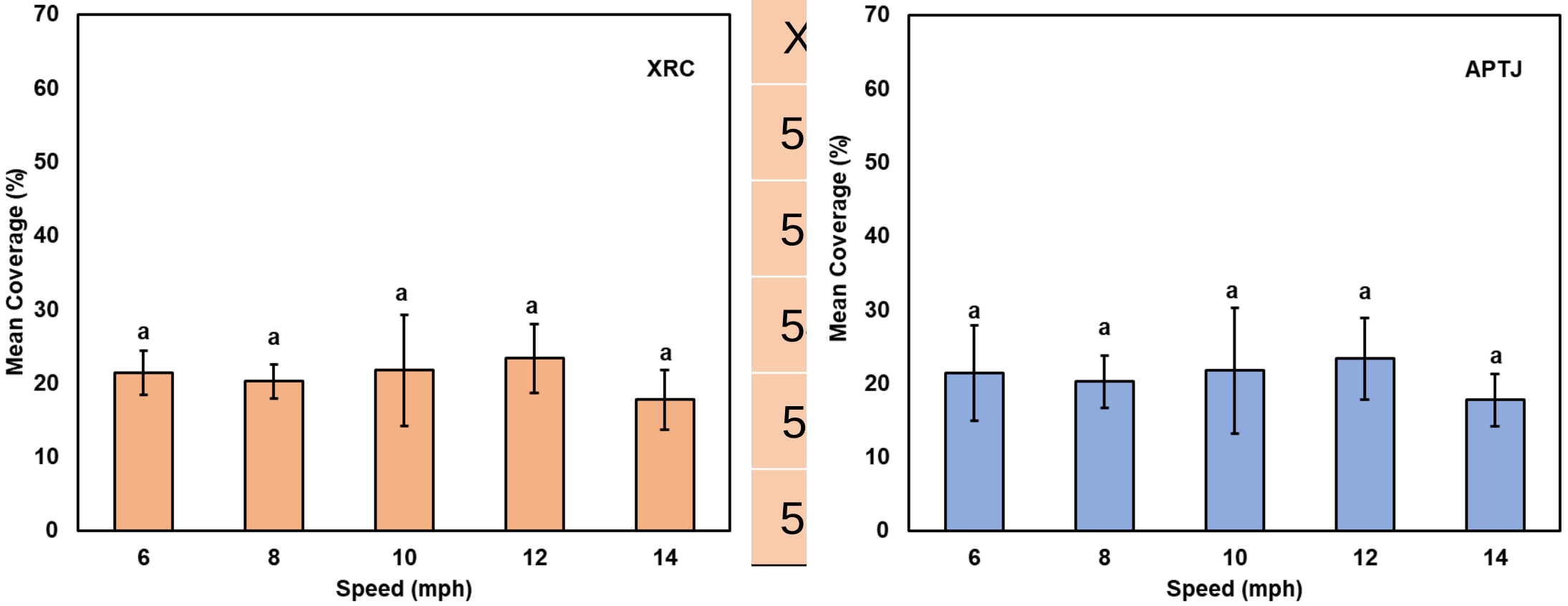


(ASABE S572.3, 2020)

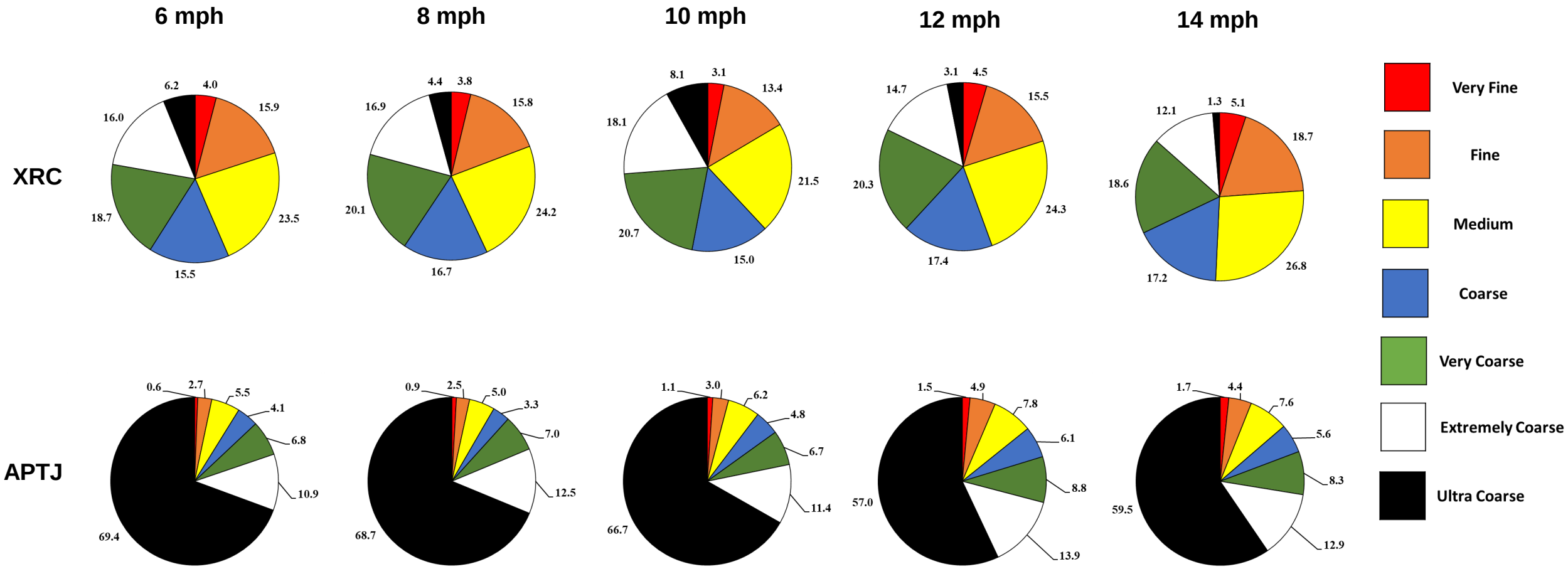
Droplet Density – PWM System

Spray Deposition - PWM System

PWM



Spray Quality - PWM System



(ASABE S572.3, 2020)

Rate Controller:

- Integrating a rate controller on the sprayer exhibited consistent spray deposition across varying ground speeds compared to conventional sprayer.
- Spray quality (droplet size) varied with ground speed for both sprayer setups, with greater variations for the sprayer with a rate controller due to changes in spray pressure.

PWM System:

- PWM system demonstrated consistent spray coverage and quality across varying ground speeds due to constant spray pressure.

Future Research: Investigate the effect of ground speed variations on pesticide efficacy and pest control with different rate control systems

Thank You!

Madan Sapkota
Graduate Research Assistant
Department of Soil and Crop Sciences
Email: Madan.Sapkota@tamu.edu

Georgia Peanut Commission

National Peanut Board®

UNIVERSITY OF GEORGIA
DIGITAL AG