Development of a Low Cost Vertical Patternator, Part 2

Funded by: Northeast SARE
(Sustainable Agricultural Research & Education Program)
&
Landey Vineyards

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Do you know where your spray is going?

- Only 55% of the spray hits the target
- 45% hits the ground or becomes airborne

  Reichard et al. 1979. Transactions of ASAE. 22:69-74

2012 SARE Patternator Project

Goals

- Test 2010 patternators for accuracy
- Develop a lower cost & simpler patternator
- Test ability to quantify spray pattern
- Statistical analysis of patternator's efficiency
- Develop software to quantify spray pattern

2012 SARE Patternator Project

- Modified Cornell patternator (from 2010)

  uses window screens

- SARE patternator (from 2010)

  uses painted plywood panels

- Paper patternator

  uses photograph printer paper
  or water sensitive paper - WSP

Modified
Cornell
Patternator

SARE
Patternator

Paper
Patternator

Testing Patternators

Berthoud MGP 360 sprayer – torex nozzles
PTO – 450 RPM
Pressure – 70 psi
3 nozzles open – left side
Water with no additives
Spray for one minute

Statistical Analysis

- Two-tailed t-test for independent samples for comparing modified Cornell & SARE patternators and paper patternators

- One-way analysis of variance (ANOVA)

Tukey's hsd test
5% and 1% level of significance

Utilized www.vassarstats.net

Total Output of Sprayer

Total Output of Sprayer

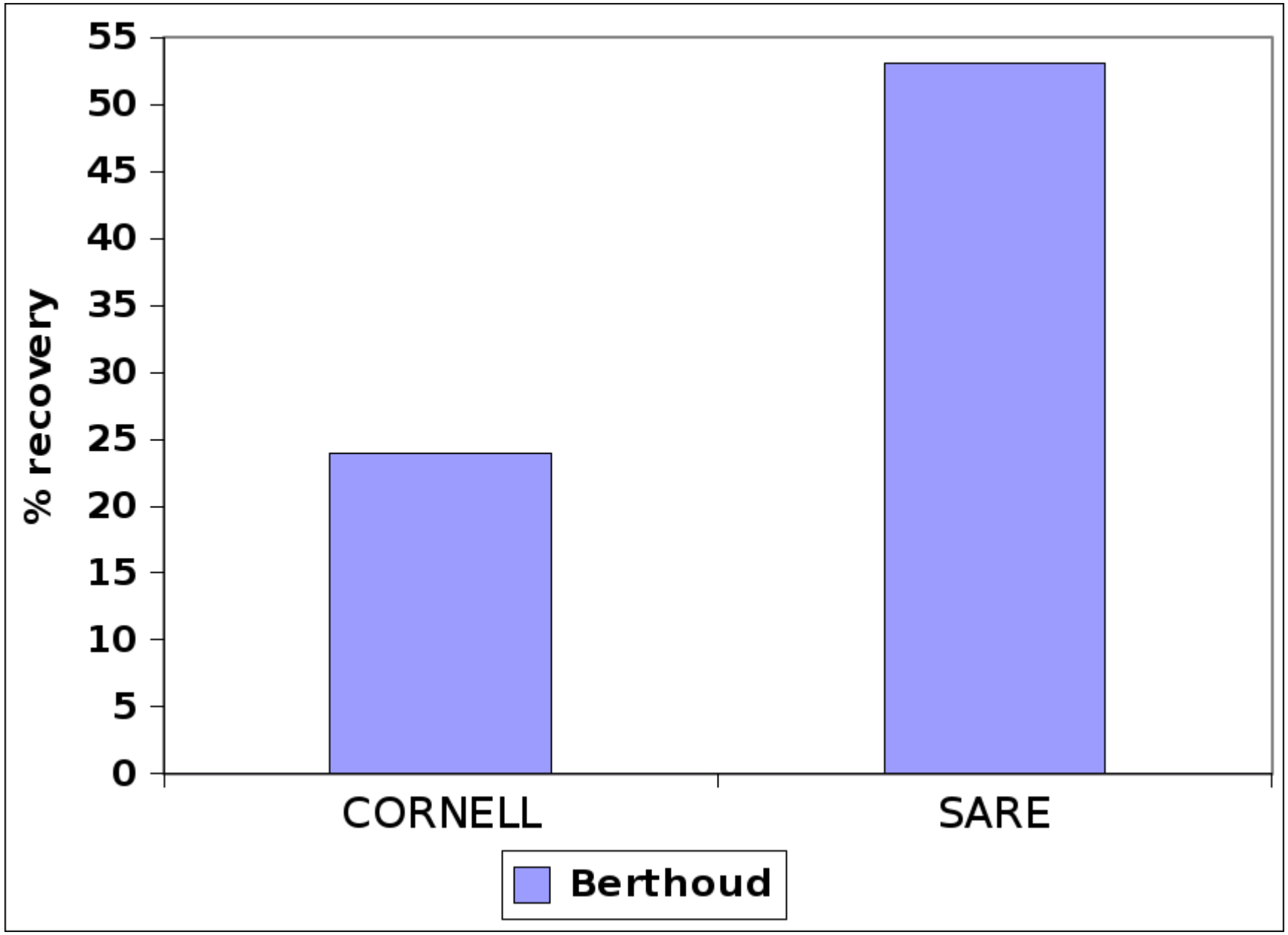
Total Output – Berthoud Saphirex 10 discs

4 replicates – left side

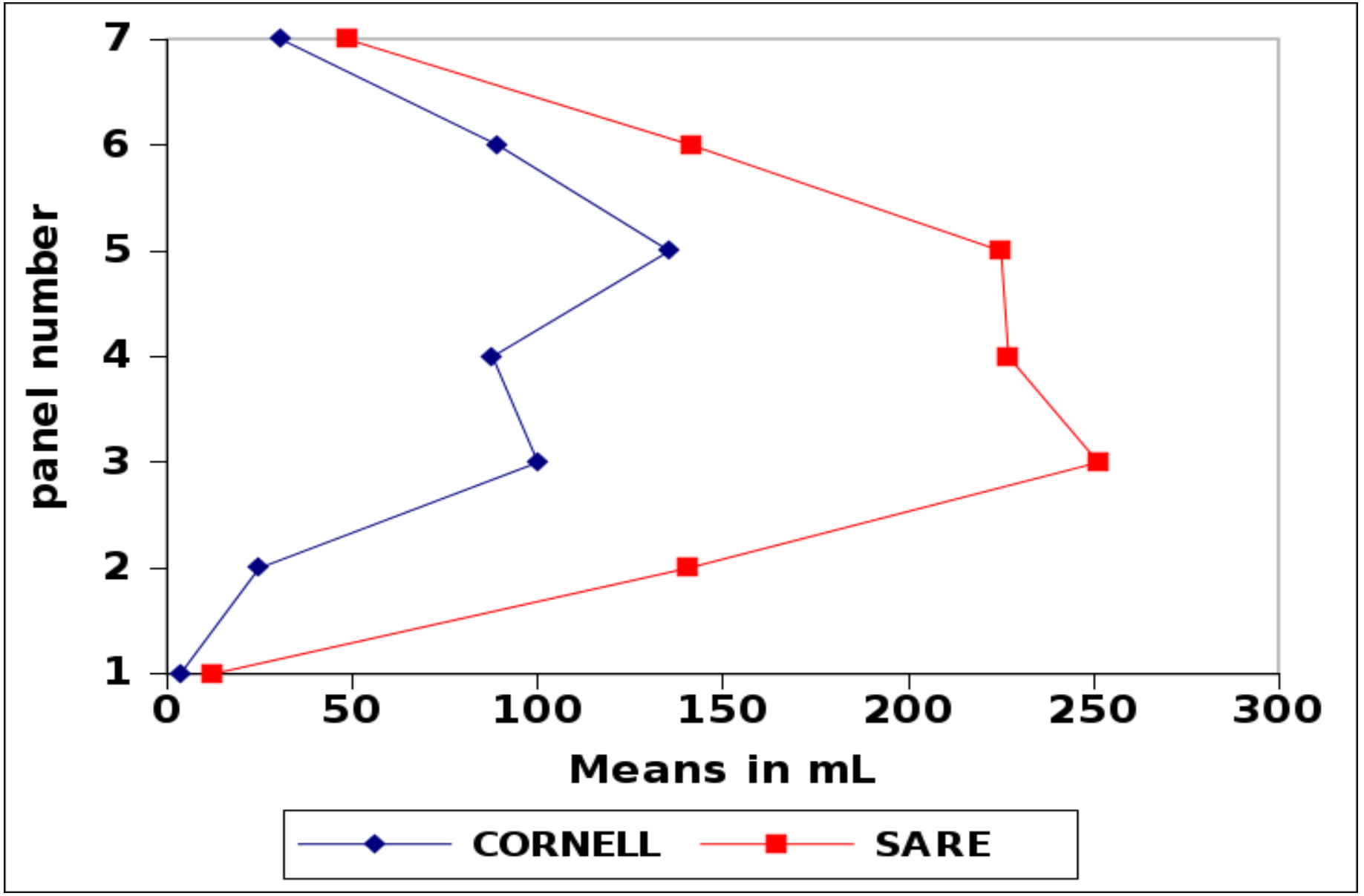
Treatment	Mean (ml)
top disc	664
middle disc	653
bottom disc	652

no statistical significance

Percentage of Total Spray Captured



Patternators with Berthoud Saphirex Discs



Patternators with Berthoud Saphirex Discs

- SARE – significantly more spray versus Cornell

  7^{th} panel – no significance

  6^{th} through 2^{nd} panels – significant at 1% level *

  1^{st} panel – no significance

* two-tailed t-test for independent samples
  4 replicates – left side

Patternators 2012

Need to know which patternator gives the most accurate representation of the actual spray material deposited on a leaf surface

Patternators 2012

A simple patternator can be constructed with a 2 X 4 and a strip of paper cash register tape. High droplet spread due to wicking.

Patternators 2012

Need only a few supplies
for a paper patternator

• 8 foot 2x4	2.78
• 4 foot metal t-post or pipe	4.88
• push pins	3.00
• rope or twine	
• photograph printer paper	13.79
• dye	20.00
Total Cost	$44.45

Patternators 2012

Test readily available photograph printer papers available at large office supply stores

Must have

- Good color retention
- Low spread factor

Paper patternators visualize spray that hits leaf surface

Photograph Printer Paper

Office Supply Stores

- Office Max store brand
- Staples store brand

Tested

- Glossy-professional 10 mil Office Max
- Semi-gloss professional 10 mil Office Max
- Matte-professional 10 mil Office Max
- HP Premium Matte 9 mil Hewlett Packard
- HP Everyday Glossy 8 mil Hewlett Packard

Dyes

To visualize the spray pattern a dye must be added to the spray tank

- Red Food Coloring

  Shank's or Butler's 40 ml/gal of water

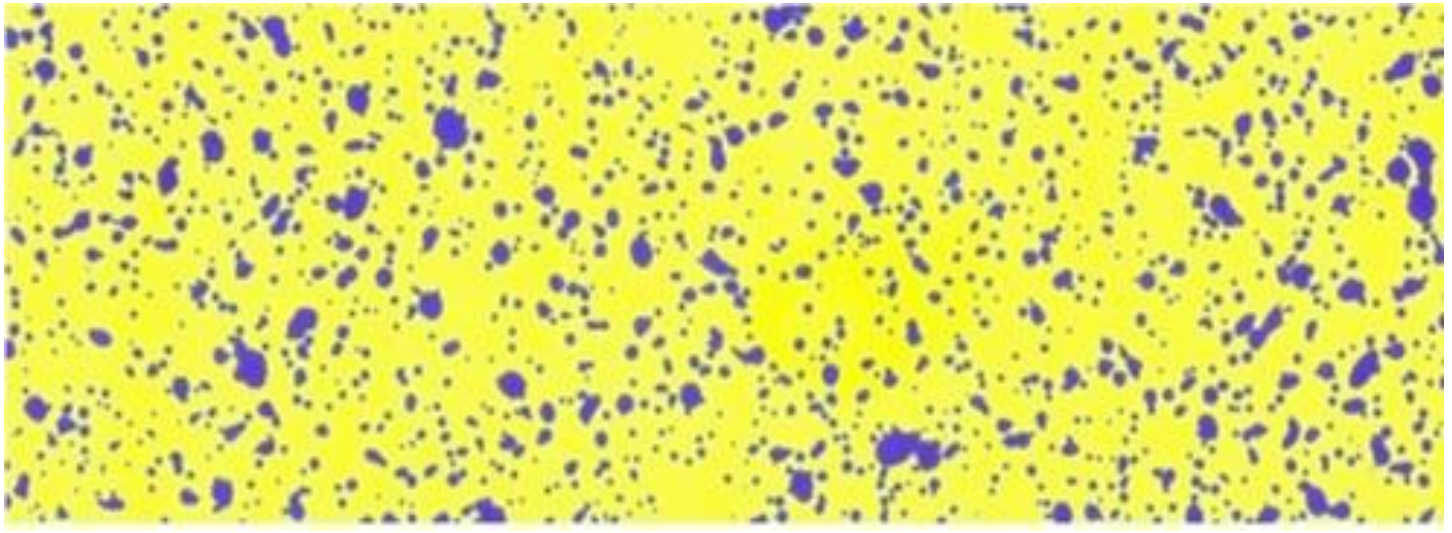
- Blue Spray Pattern Indicator for Turf

  Terramark SPI 20 ml/gal of water

Need sufficient water in sprayer so pressure does not fluctuate – 10 gallons

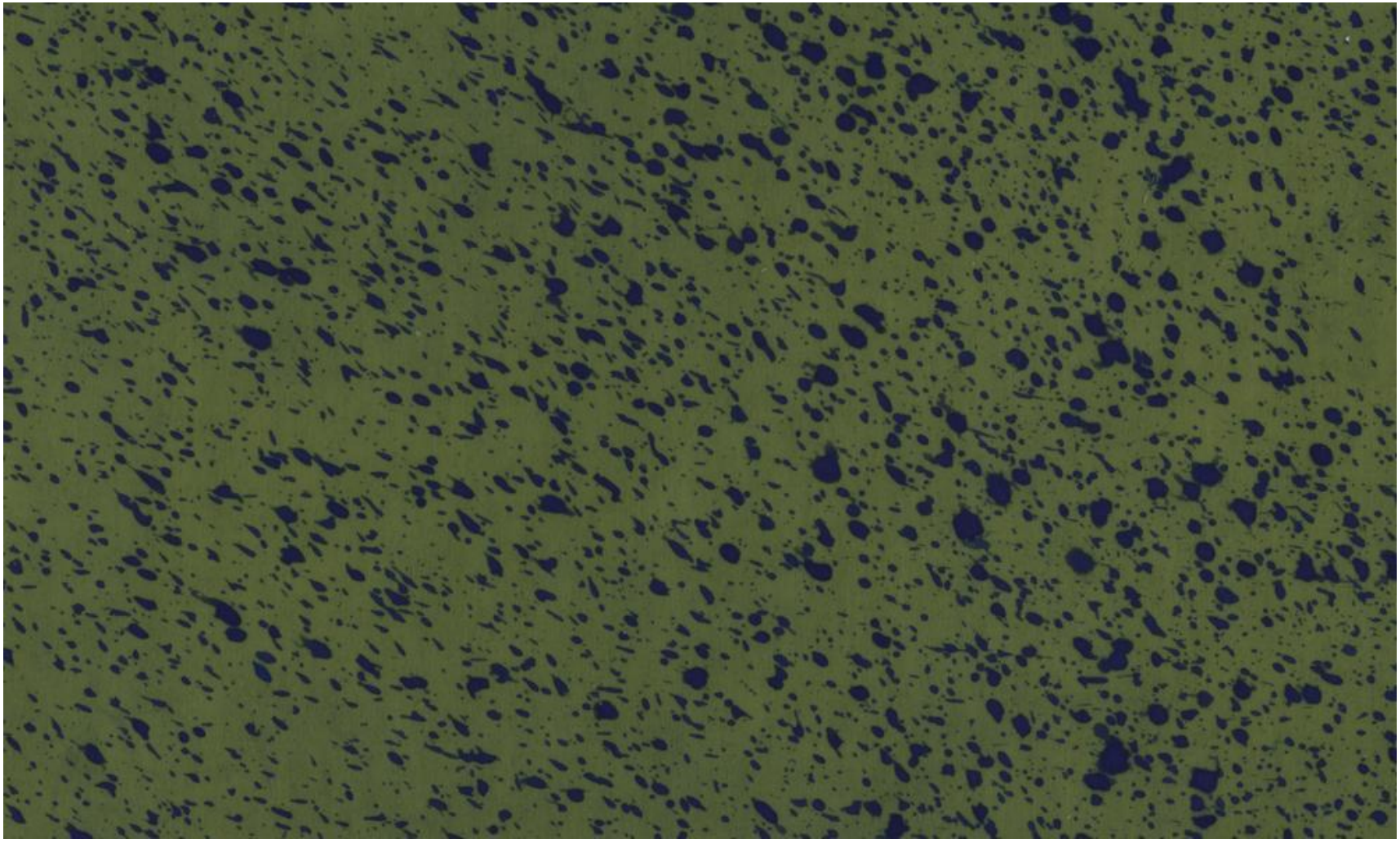
Water Sensitive Paper

- Reacts to water, changes color from yellow to blue
- In high humidity will change from yellow to green
- Must wear gloves, no moisture on plants
- Must keep in sealed bags and scan quickly after use



Water Sensitive Paper

NOT RECOMMENDED IN OUR AREA



Testing Paper Patternators

Berthoud MGP 360 sprayer
PTO – 450 RPM
3 nozzles open – left side
Water with dye added

Drive tractor at normal operating speed

Image Analysis Software

- NESARE NESareScan
- USDA DepositScan
  Available free at
  http://www.ars.usda.gov/Services/docs.htm?docid=18233
  was designed for use with water sensitive paper
- Commercial programs

  DropletScan
  Assess 2.0
  DropVision® - AG

Image Analysis Software

- NESARE NESareScan
- USDA DepositScan

Measure

- Droplet Density
- Droplet Size
- Percent Coverage

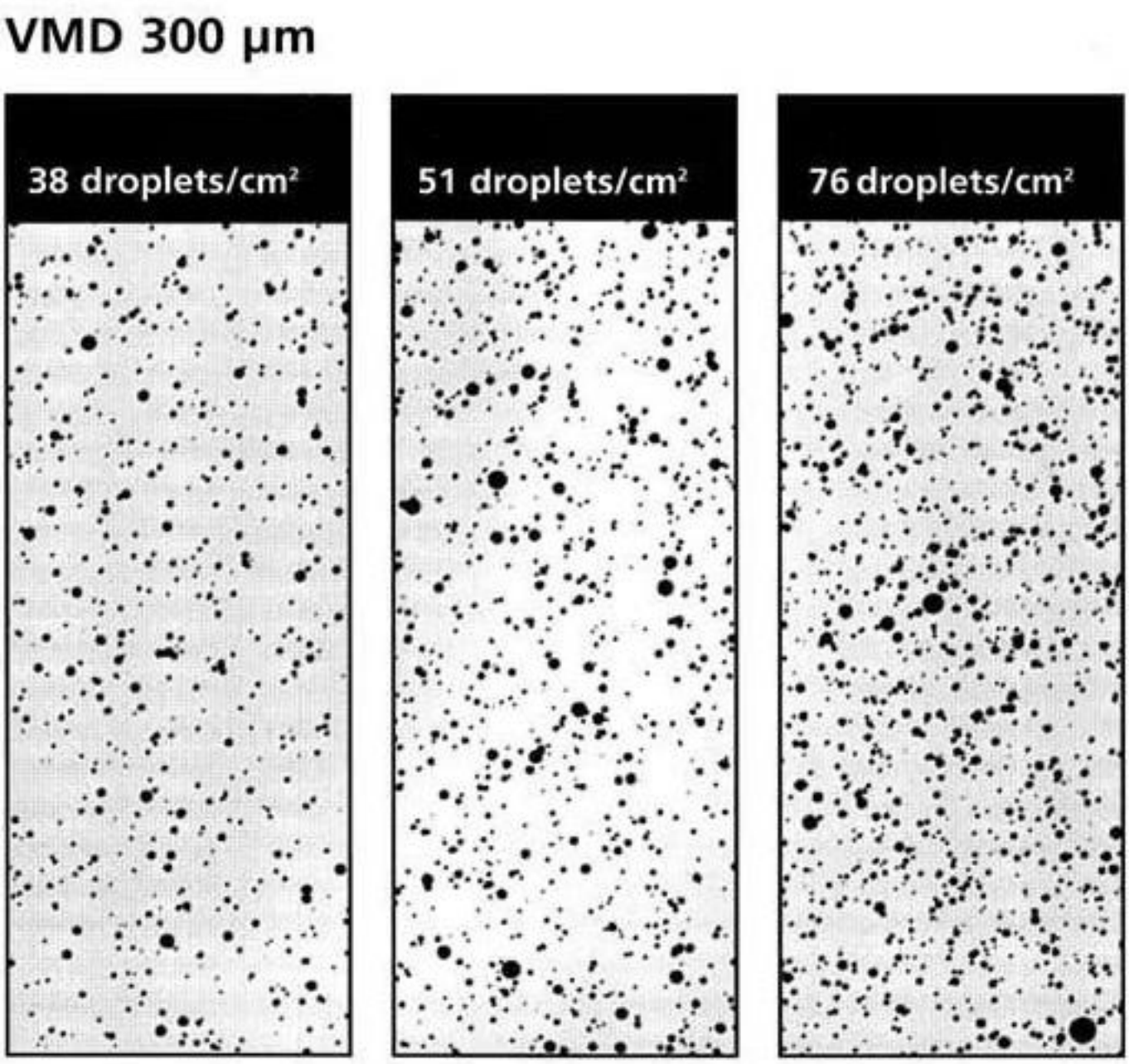
Droplet Density

Droplet density – measured in droplets/cm²

Recommended insecticides 20 – 30 droplets/cm²
fungicides 50 – 70 droplets/cm²

Usually higher when spraying grapevines

Droplet Density



Droplet Density

- Neither NESareScan or DepositScan is highly accurate with droplet density
- Must have a low droplet density – less than 30/cm^2 DepositScan is better than NESareScan

- DepositScan – type of paper is statistically significant

Droplet Size

- Nozzles produce a wide distribution of droplet sizes
  droplet spectrum

- Volume median diameter (VMD or Dv0.5)
  50% of volume is contained in larger droplets
  measured in microns or micrometers (µm)

- Number median diameter (NMD)
  50% of the droplets are larger
  measured in microns or micrometers (µm)

- With different size droplets the VMD is always larger than the NMD

Droplet Size

Nozzles can be classified by droplet size
for insecticides and fungicides applied to grapes
nozzles are usually fine or medium

No agreement on droplet size (microns)

- Fine VMD 100-175, 145-225, 180-220, 150-250 orange-charts

- Medium VMD 175-250, 226-325, 240-260, 250-350 yellow-charts

Measured at 43 psi or 3 bar

Droplet Size

- Size should be in the range of 150 to 300 microns

  Greater than 300 µm droplets might bounce off target

  Less than 150 µm droplets might drift away
  or less than 200 µm potential drift

- Half the diameter of a droplet – 8 times more droplets will cover twice the area

- Must balance volume and droplet size

- Droplet size depends on nozzle and pressure

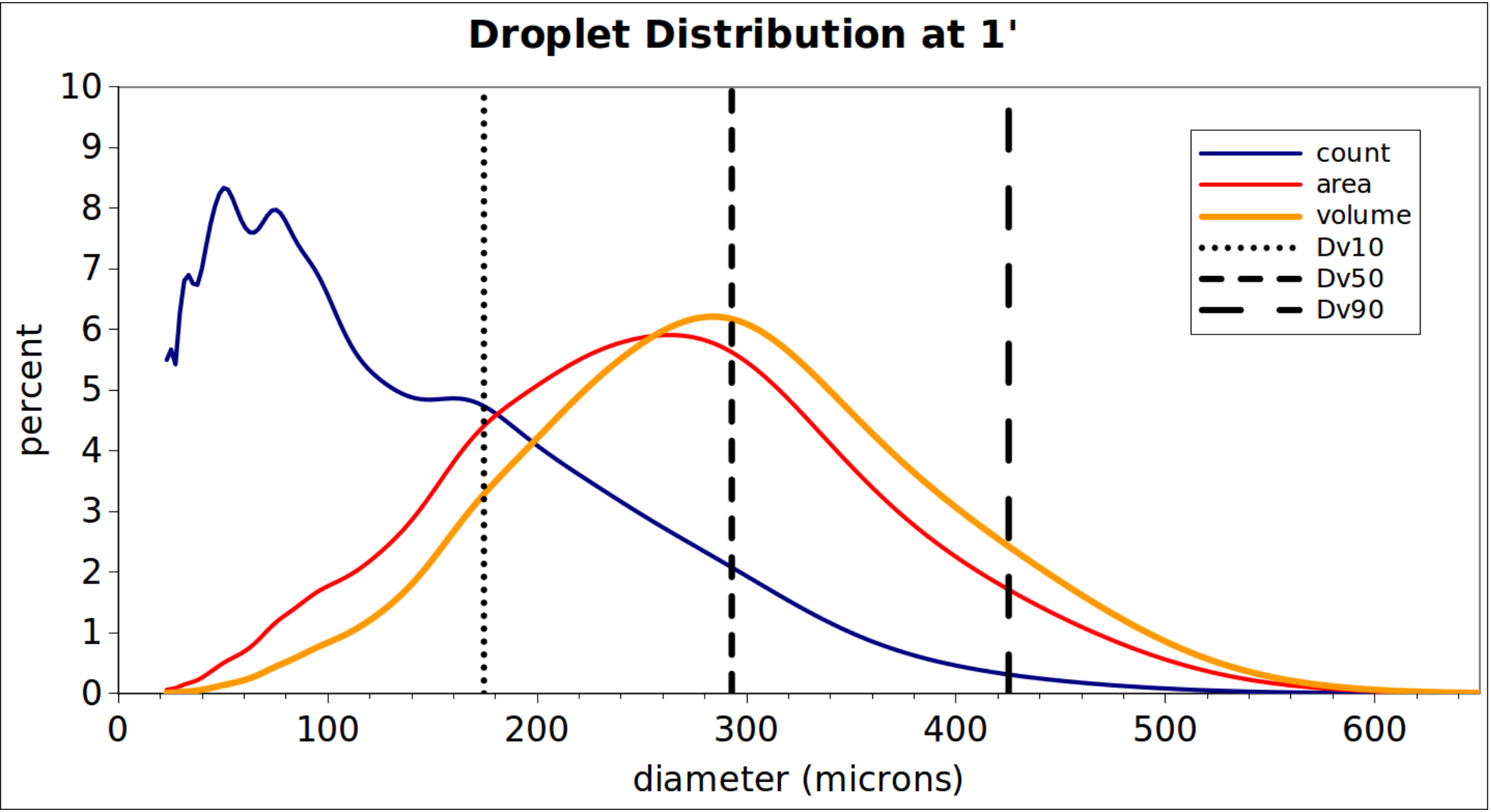
Droplet Size

- Calculated the Volume Median Diameter VMD or Dv0.5
- Difficult to measure if coverage is greater than 20%
- Most accurate at very low droplet density or coverage
- As coverage increases, droplet size increases in both NESareScan and DepositScan
- NESareScan values always lower than DepositScan
  rarely statistically significant

Droplet Size

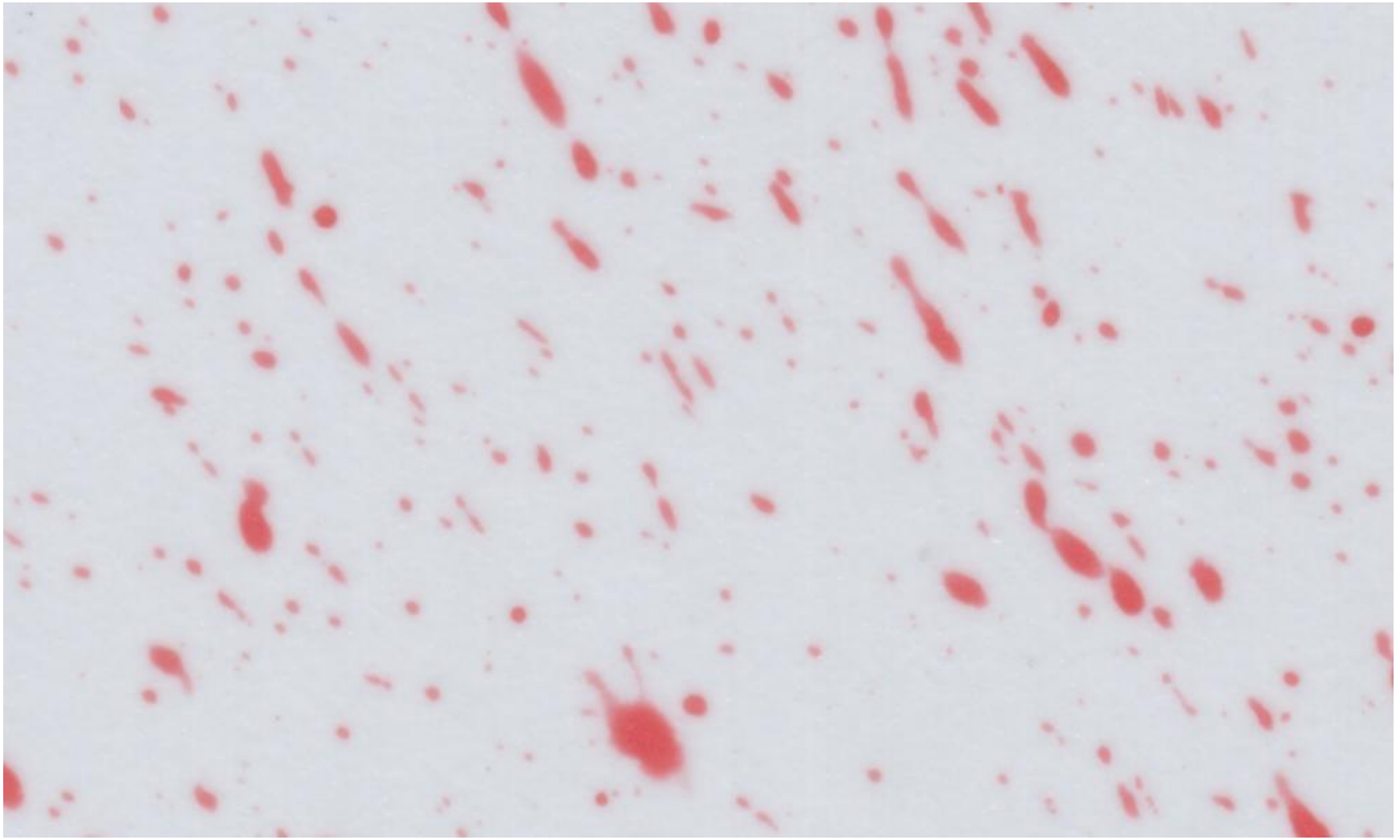
- Red Dye – no statistical significance with different papers
- Blue Dye – droplet size was significantly smaller with WSP than all other photographic papers
- Red dye had smaller droplet sizes than blue dye rarely statistically significant
- Water sensitive paper and matte paper gave the smallest droplet size but not statistically significant
- Volume Median Diameter - 257 to 327 microns
- Difficult to get good measurements with an air blast sprayer

Droplet Size



Droplet Size

Why it's difficult to determine droplet size and density



Percent Coverage

No information on what is considered adequate coverage

- Once coverage reaches 20% droplet size and droplet density is difficult to measure
- As coverage increases, more and more spray is deposited on areas already covered
- Most valuable information for adjusting nozzles

Percent Coverage

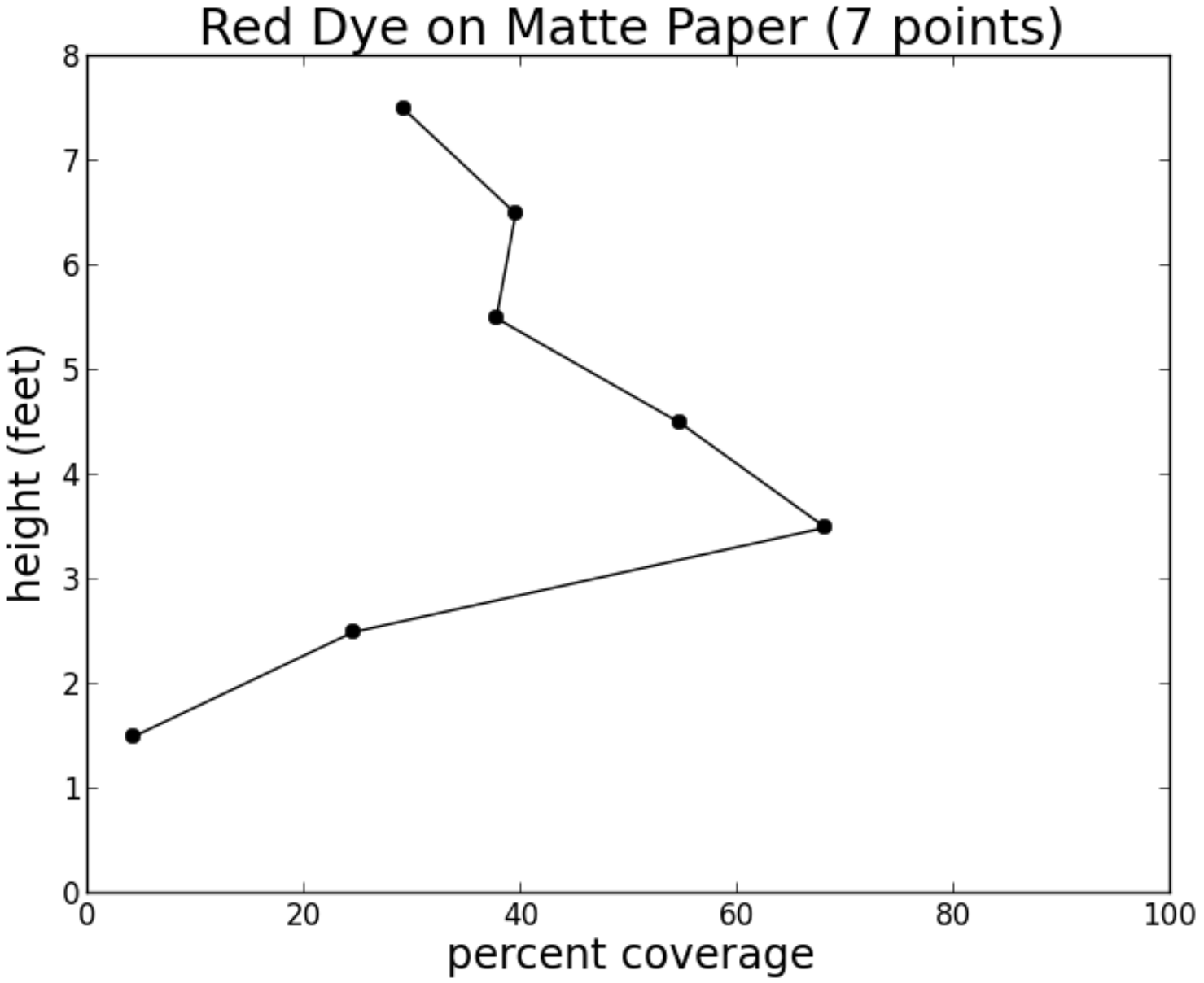
- Blue dye had significantly more coverage than red dye on all papers except WSP - usually 1% significance

- Blue dye had significantly higher coverage on all papers as compared to WSP – usually 1% significance

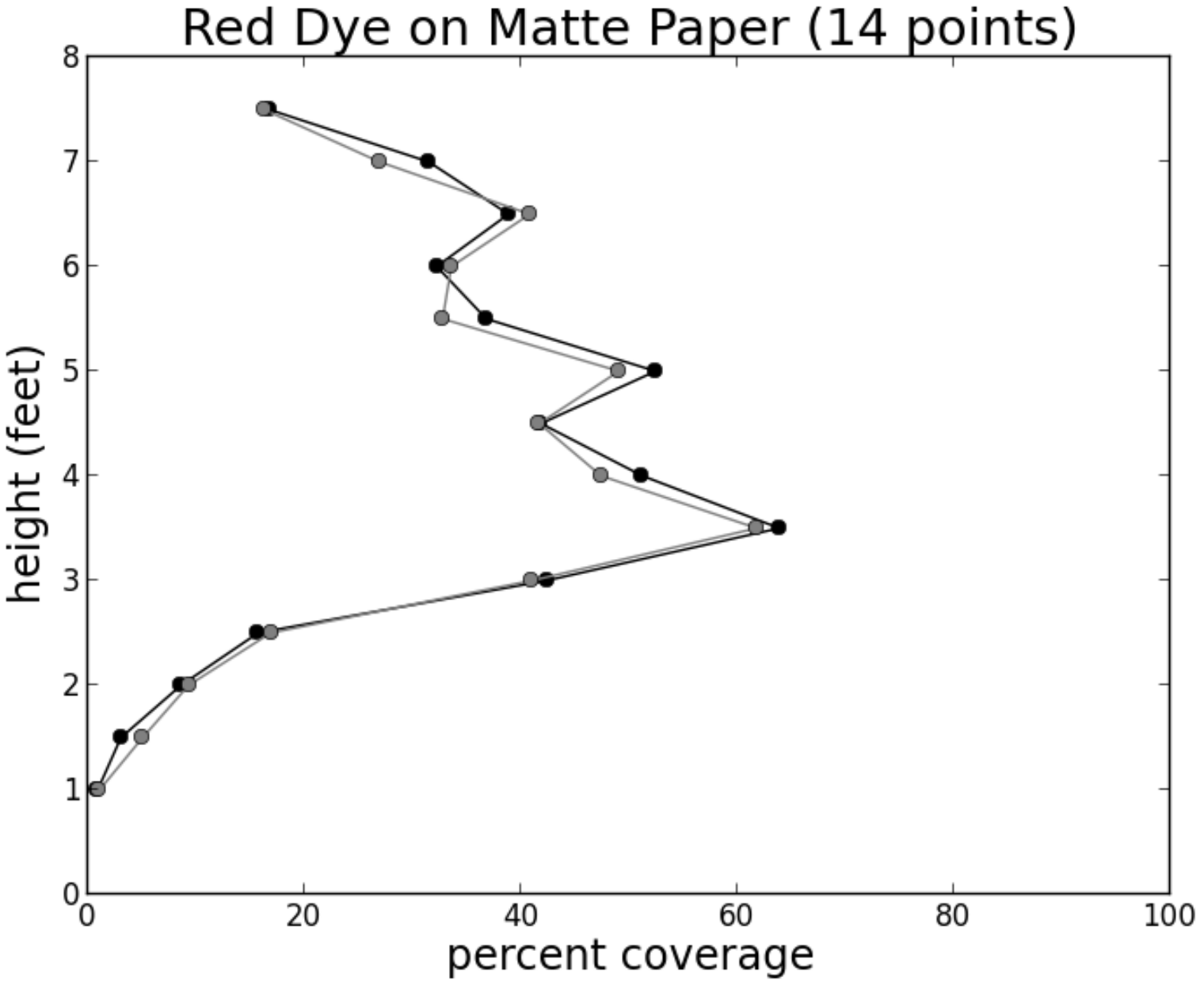
- Red dye rarely had a significant difference on the various papers

- Red dye rarely had a significant difference between NESareScan and DepositScan

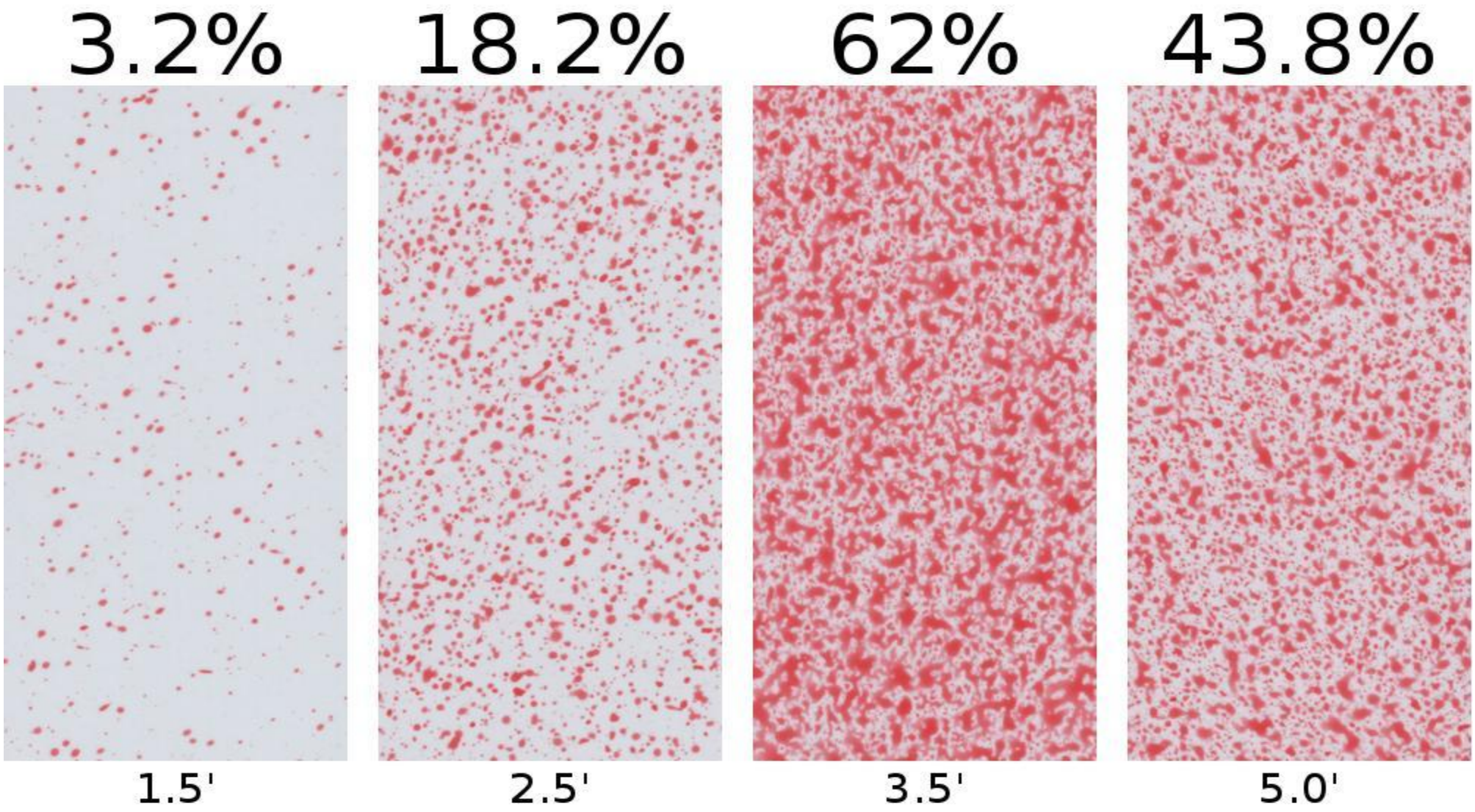
Percent Coverage



Percent Coverage



Percent Coverage



Conclusions

- Red food coloring is the best dye

- Photographic printer paper works well
  much easier to use than water sensitive paper

- No statistical significance between photographic papers
Matte paper might have a slight edge

- Use heavier grades of paper – 9 or 10 mil
  light weight paper will curl and writing on reverse side will show through when scanning

- Results from this year will added to 2010 information on www.patternator.com

Conclusions

- Use of a dye and photographic printer paper can be used with any sprayer – vertical or horizontal
  - Air blast
  - Tunnel
  - Boom
  - Backpack
- Photographic paper cards are easy to keep and maintain as a record of sprayer calibration