Radial airblast sprayer optimization

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Why Optimize?

Video Courtesy of Steve Castagnoli
Why does it Matter

• Applying the correct amount –

• Overspraying could harm the plant and Environment

• Underspraying could promote pest resistance and further spraying may be need.

• Chemical Costs

• Liability Risks

• Compliant with Label (and your intent)
Why does it Matter

• Economic losses – could result from both over-spraying and under-spraying

• Potential fines due to law violations
Introduction:

- Airblast sprayer parts
- Sprayer calibration
  - Speed
  - Pressure
  - Nozzles
- Airflow
  - Direction
  - Volume
- Questions and Resources
Airblast Sprayers - Intro

• The basic airblast sprayer has several simple parts

- Fan Assembly
- Nozzle Body / Nozzle Area
- Spray Tank
- Pump / Valves
- Controls
Steps to Sprayer Optimization

1. Measure/Select speed and sprayer pressure (Calibration)
2. Adjust air direction
3. Match the air volume and speed to the canopy
4. Select nozzles with desired output
Calibration Factors

- Forward speed
- Nozzle size
- Spray pressure

The Spray Triangle

Airflow: Air Assist

GPM: Pressure * Nozzles

Speed: Tractor
Tools Needed for Calibration

- Measuring tape
- Stop watch with second hand
- Water source
- Measuring cup
- Pencil, paper, calculator
  - or Phone App
Six Steps to check output

1. Calibrate in the orchard or vineyard
2. Determine tractor speed
3. Determine your Gallons per Minute
4. Select nozzle sizes
5. Measure the output
6. Make adjustments as needed.
Measuring/Optimizing Speed

Why is speed important to spraying?

• We need to move slow enough to replace the air in the canopy.

• We need fast enough so that we don’t apply more than the desired rate
1. Find a Proper Place

• Work in the vineyard or orchard (or a place representative of the fields).

• Calibrating on a hard surface, concrete surface could lead to errors of up to 15% compared to when calibrated on a soft ground.
# 2. Calculate Forward Speed

<table>
<thead>
<tr>
<th>Manually:</th>
<th>Use a Tool:</th>
</tr>
</thead>
</table>
| In the field, mark a 100 foot path with two poles. With a stopwatch, record the time it takes for the front tire of the tractor to pass from one pole to the next. Use this formula to check the speed.  

\[
MPH = \frac{\text{feet traveled} \times 60}{\text{sec traveled} \times 88}
\]
| In the field, start the gps or app. Accelerate and drive down a row until you get to the desired speed (ex. 3.0 mph). Drive that speed for 10-15 seconds and then look at the device to determine accurate speed |
| Map My Ride iPhone App | GPS by TeeJet | eTrex hiking GPS |
Measuring Speed

• How to do you measure speed?
  • Manual Method

Supplies needed:
1) Distance measuring device (long tape measure at least 150 feet long)
2) Stop watch
3) Flagging/safety cone to mark stop and start marks
4) A tractor operator and a time keeper

Travel a known distance using a half full sprayer using the same tractor settings as spraying
Measuring Speed

- Calculating your ground speed:

\[ \text{Speed} = \frac{\text{Distance}}{\text{Time}} \text{ (answer will be in feet per second)} \]
\[ \text{Miles per hour} = 0.68182 \times \text{Feet per second} \]

Example
- Tractor covered 150 feet in 33 seconds.
  \[ \text{Speed} = \frac{\text{Distance}}{\text{Time}} \Rightarrow 150 \text{ feet}/33 \text{ seconds} = 4.545 \text{ Feet per second} \]
  \[ \text{Miles per hour} = (0.68182 \times 4.545 \text{ Feet per second}) = 3.098 \text{ Mph} \]
3. Determine Gallons Per Minute

<table>
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<th>Manually</th>
<th>Use a Tool</th>
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<tbody>
<tr>
<td>Desired gallons/acre (GPA) = __________</td>
<td></td>
</tr>
<tr>
<td>$GPM = \frac{GPA \times \text{mph} \times \text{row width (feet)}}{495}$</td>
<td></td>
</tr>
<tr>
<td>Next divide $GPM/2$ for each side</td>
<td></td>
</tr>
<tr>
<td>$GPM \text{ per side} = \frac{GPM}{2}$</td>
<td></td>
</tr>
</tbody>
</table>

![VineTech Equipment](image)
3. Determine Gallons Per Minute

• Desired gallons/acre (GPA) = 150

• GPM for the entire sprayer.

GPM = \frac{GPA (150) \times \text{mph (2.2)} \times \text{row width (12 feet)}}{495} = \frac{3960}{495} = 8

• GPM per Side

GPMS = \frac{GPM (8)}{2} = 4

• Nozzle output on one side must add up to be 4 GPM
4. Nozzle Selection – Expected Output

• Determine Pressure: ______PSI

• From nozzle catalog select nozzles with the correct output (GPM) for each nozzle and droplet size.
4. Nozzle Selection – Expected Output

Pull out the catalog!
5. Checking for Calibration Accuracy

- Test water output for each nozzle

- Add output of each nozzle for a total output and compare with calculated amount

- If not using a Flow meter will need to calculate ounces

Expected output per nozzle (OPM) = GPM per nozzle × 128
Nozzles – Fluid Flow

• How much fluid is coming out of the nozzles?

**Supplies needed:**
1) Collection device (large measuring cup)
2) Pipe / rubber fitting that goes over the Nozzle
3) Stop watch
4) A tractor operator and a time keeper

Measure fluid for a known amount of time.
6. Adjustments - Calibration for Speed and Volume is just the beginning!

- Optimization

- Distribute spray based on your tree shape, size and time of the year.
Airflow

Air moves atomized spray material from the machine to the target.

Air flow controls the height at which you apply material and is a major contributor to spray drift.

http://county.wsu.edu/chelan-douglas/agriculture/treefruit/Pages/Air-Blast_Sprayer.aspx
What we think a sprayer does
What a typical airblast sprayer actually does

- Air curves with rotation of fan!
Optimizing airflow

• Optimizing air flow is best done in the target crop canopy.

Supplies needed:
1) Flagging tape
2) Water Sensitive Papers
3) A tractor operator and a observer

• Step one: where is your fan blowing?
• Step two: is product catching in the canopy?
• Step three: how much air passes through the canopy?
Optimizing airflow

- Step one: where is your fan blowing?
  - Use fins to modify airflow
  - Turn off nozzles that are not pointed at the target!

**Supplies needed:**
1) Flagging tape
2) Wrenches
3) A tractor operator and a observer
A properly targeted sprayer....

Top: unadjusted Sprayer
High loss to Ground and drift

Bottom: nozzles turned off if not aimed at canopy, total spray volume reduced
Wind & Canopy
Where your spray release point is, affects drift risk

Windspeed relative to height above canopy

- high drift risk
- low drift risk
Optimizing airflow

Supplies needed:
1) Water Sensitive Papers
2) A tractor operator and a observer

• Step two: is product catching in the canopy?
  • Place Water Sensitive Papers in the canopy
  • Evaluate after one pass
Optimizing airflow

- Step three: how much air passes through the canopy?
  - Attach flagging to outside edge of canopy

Supplies needed:
1) Flagging
2) A tractor operator and a observer
Modifying Air Volume

- Ribbons blow straight out:
  - too much air
  - Solutions: reduce fan gear, drive faster,
  - plywood “donut”, cloth shroud,

- Ribbon doesn’t move:
  - too little air
  - Solutions: drive slower, increase rpm or fan gear
Air flow and Thin Canopies

Top: sprayer with high air, poor targeting, high losses

Bottom: air reduced, spray and drift contained
4. Select Nozzles and Desired Output

- Let’s assume
  - 200 GPA, 16’ Rows, and 3 mph
  - pressure=200PSI
- 7 nozzles per side remain open after step 2 and 3
- GPMS = 9.70 GPM
4. Select Nozzles and Desired Output

• Choose nozzles by density/structure of canopy zones
4. Select Nozzles and Desired Output

10%  N1 = 9.70 \times 0.1 = 0.97
60%  N2 = 9.70 \times 0.2 = 1.94
N3 = 9.70 \times 0.2 = 1.94
N4 = 9.70 \times 0.2 = 1.94
20%  N5 = 9.70 \times 0.1 = 0.97
N6 = 9.70 \times 0.1 = 0.97
10%  N7 = 9.70 \times 0.1 = 0.97

\text{TOTAL} = 9.70

- Select nozzles.
- 200 PSI
Maintain/Update Optimization

• Speed: Manually check tractor speed after new tire installation or when using on unfamiliar terrain

• Spray volume:
  • Visually inspect nozzles and gauges for wear and leaks before each application
  • Clean nozzles with a brush made for the task: using wire will change orifice size = uncalibrated sprayer
  • Check calibration 1-2 times per year (early Spring and Fall)
  • Check guage accuracy 1-2 times per year and/or install a secondary guage
  • Replace nozzles on a regular cycle or if they are > 5% from factory GPM

• Airflow:
  • Use ribbons to evaluate where air is directed for each canopy type on your farm –mark presets for wings or choose a happy medium
  • Evaluate spray deposition and wind penetration at multiple canopy stages and adjust air volume accordingly
Additional Resources

• Airblast 101: https://sprayers101.com/airblast101/
  • A book is also available.

• Ask your local extension educator to contact the national spray application work group if you are interested in more educational materials (SAWG)
  • https://projects.sare.org/project-reports/ew13-022/

Acknowledgements:

Project GREEEN

Michigan Cherry Committee

Michigan State Horticultural Society

USDA SCRI # 2011-01494
USDA SCRI # 2016-51181-25411