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Orchard Air-Blast Sprayer Calibration, Adjustment and Operation
Each season, you as a grower may apply materials worth from $100 to $600 per acre using an orchard air-blast sprayer. Many of these materials can bring great economic gains. However, you can also waste far more than the original cost of the material if the spray does not cover its target evenly.

To get the most out of a spray program, you need to adjust air-blast sprayers frequently to deal with differences in trees and purpose of spray application. Many people skip these adjustments because they consider sprayer calibration difficult and time consuming.

After evaluating sprayer operation in north central Washington, I estimate that most growers can save more than $1,000 per year in spray material costs alone by investing a few hours and dollars in maintaining and adjusting sprayers.

You can save on cost of materials and labor, and improve the effectiveness of your spray program by adopting the following steps.

**Step 1.**

**Determine the proper speed of travel for your sprayer.**

Driving too fast for orchard conditions is a major cause of poor coverage. Time spent figuring out proper sprayer speed can make the biggest improvement in both spray coverage and spray material performance. Matching sprayer output to tree surface that must be covered takes time. As the growing season progresses, and leaf and shoot growth add to the density of the trees, you may have to recalibrate. For any given sprayer, you will have to drive more slowly as the season progresses.
**How fast should you drive?**

There is no one proper speed to fit all conditions. You must drive slowly enough to obtain coverage in the upper central portion of the tree. For most sprayers, this means driving from 1.0 to 2.5 miles per hour (mph), depending on conditions.

**How can you tell when the speed is right?**

Spray at various speeds, using plain water as a test product, until a visual check shows that you have adequately covered the hard-to-reach areas of the tree. Write down the gear and revolutions per minute (rpm) used. Then measure the number of seconds it takes to drive 88 feet at this speed. Divide the seconds into 60. This measure gives you miles per hour. You will need this accurate measurement of mph to adjust the sprayer’s per acre application rate properly. Do not trust your tractor’s speedometer.

When using engine driven sprayers, you can adjust the speed relatively easily. For power take-off (pto) driven sprayers, select the speed based on the gear and rpm range that operate the sprayer. Choose the ground speed that both runs the sprayer at the correct pto rpm and provides adequate tree coverage. Although this speed may be slower than you would like to drive, proper coverage will save you more than you will spend on increased labor costs. Reducing your travel speed by 1/2 mph adds only 3 to 5 minutes to the time it takes to spray an acre of orchard. You may find that one hour’s labor cost has been added for a day when you applied $1,000 worth of spray materials.

After choosing a speed that will give you good coverage, you can set the sprayer to apply your preferred gallons per acre rate.

**Step 2. Adjust gallons applied per acre.**

The number of gallons of spray mixture you apply affects the type of coverage far more than the evenness. **Low volume applications** apply distinct droplets, while **high volume sprays** apply a sheet of water and material to tree surfaces. Some materials
must completely wet the fruit or leaf surface for best effect. Also, high volumes of water may be needed to move the material around once it contacts the tree, to reach pests protected behind bark scales. The amount of water needed to spray a tree at dilute (or to drip) depends on tree size and foliage thickness. In Washington you may need from 100 to 600 gallons per acre (gpa) for the spray to drip from all tree surfaces. If you assume 400 gpa is the proper amount without first calculating how much you need, you may waste spray material.

Adjust medium or low volume sprays (100 gpa or less) to the gallonage that covers the majority of the tree surface with distinct droplets but creates little movement of the spray material on foliage and fruit surfaces.

Avoid applying concentrated materials to trees at gallonages that allow material to run or dribble to the lower surface of the fruit. Evaporation of the water carrier could concentrate the resulting drip and cause fruit marking. Remember that when spraying large trees, amounts of spray material between 100 and 200 gpa tend to be most hazardous to the fruit.

To set up gallons per acre, first determine the gallons per minute (gpm) that each side of the sprayer must apply.

\[
gpm = \frac{\text{gpa desired} \times \text{mph} \times \text{spacing between rows (feet)}}{990} \]

Example: You wish to apply 80 gallons per acre at 1.8 miles per hour, and your orchard tree spacing is 18' x 9'.

\[
\frac{80 \times 1.8 \times 18}{990} = 2.62 \text{ gallons per side per minute}
\]

**Step 3.**

**Set up the sprayer nozzle manifold.**

Park your sprayer in a typical part of your orchard. While standing behind it, draw imaginary straight lines from the center of the fan through various parts
of the tree next to the sprayer (Figure 1).

Spray traveling in a straight line through the tree in the directions marked “A” and “D” in Figure 1 will need to cover much less surface than spray moving in the direction marked “B.” Spray traveling in direction “C” will have an intermediate amount of surface to cover. When arranging nozzles along the manifold, select and purchase a mixture of nozzle sizes that, when added together, put out the proper gallonage per minute for each side of the sprayer. Then place the nozzles on the manifold in relation to the tree size and shape. Place the largest nozzles in line with the thickest part of the tree, then arrange the medium and small-sized nozzles so that the gpa output tapers off on either end. If the sprayer has more than two manifolds, the rule remains the same. Keep output per minute highest along the part of the manifold that lines up with the bulk of the tree (Figure 2).

Figure 2. Possible nozzle arrangement for larger trees. S=small  M=medium  L=large nozzle
Example: 80 gpa, with 18 feet between rows and 1.8 mph driving speed calls for 2.62 gallons of spray per side per minute. Using a nozzle chart, choose nine nozzles producing a total output per minute close to this amount, that will place 2/3 of the output from the upper 1/2 of the manifold (Figure 3).

Nozzle maintenance.

Now that your sprayer is set up for your spraying conditions, write down the size and position of the nozzle discs, the core sizes, the speed of travel (gear and rpm for the tractor used), and the total gallon per minute output you measured by following the next exercise.

- Fill sprayer with water to overflowing.
- Without moving the sprayer, run both sides for 3 minutes at operating pressure (2 minutes if spraying dilute).
- Using a calibrated bucket, refill the sprayer to measure gallonage sprayed.
- Divide gallonage sprayed by 6 to determine output per side (divide by four if the sprayer was run for only 2 minutes).
• Compare actual sprayer output with calculated output (from Step 2). If necessary, alter pump pressure slightly to adjust sprayer output.

• Record pump and manifold pressure necessary to operate new nozzles and cores at the correct output per minute. Have you had the pressure gauges checked lately? They tend to become inaccurate after a few years.

• Recheck your gallons per minute output regularly. If the output rises by 5% at a constant pressure, the nozzles are wasting more money than it takes to replace them.

Nozzle wear occurs most rapidly when you apply wettable powders, flowables, or dispersible granules, especially at high nozzle pressures. Under these situations, choose tips and cores for the sprayer from hard, wear resistant materials. Abrasion resistant nozzle components cost more initially, but are quite cost-effective in the long term. Table 1 illustrates relative wear rate of various nozzle materials. Brass wears at a rate 10 to 15 times faster than hardened stainless steel. Table 2 shows that the more wear resistant nozzles cost more but are more cost effective.

Table 1. Relative wear rate of nozzle parts made of various materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Relative Durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brass</td>
<td>1</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>3-4</td>
</tr>
<tr>
<td>Hardened stainless steel</td>
<td>1-15</td>
</tr>
<tr>
<td>Tungsten carbide</td>
<td>120-150</td>
</tr>
</tbody>
</table>

Table 2. Approximate price of nozzle disc and core, initial price and cost per unit of wear.

<table>
<thead>
<tr>
<th>Material</th>
<th>Initial cost</th>
<th>Cost per unit of Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brass</td>
<td>$0.66</td>
<td>$0.66</td>
</tr>
<tr>
<td>Hardened stainless</td>
<td>$2.95</td>
<td>$0.24</td>
</tr>
<tr>
<td>Tungsten</td>
<td>$14.26</td>
<td>$0.07</td>
</tr>
</tbody>
</table>
Useful Calibration Formulas

A. To determine the number of gallons per minute (gpm) to spray from each side of the sprayer (Steps 1 and 2).

\[
gpm = \frac{\text{Desired gpa} \times \text{mph} \times \text{row spacing (ft)}}{990}
\]

B. If you know the gallons per minute output of the sprayer and have an accurate measurement of the speed of travel and wish to determine the gallons per acre output.

\[
gpa = \frac{\text{gpm (1 side) \times 990}}{\text{Tree row spacing \times mph}}
\]

C. If you know the gallons per minute output per side and the gallons per acre you wish to apply, then want to determine the speed to drive (note: check the coverage at that given speed!).

\[
\text{mph} = \frac{\text{gpm (1 side) \times 990}}{\text{Desired gpa \times tree row spacing}}
\]

D. To accurately determine your speed in mph, time equipment over an 88-foot length. Divide seconds elapsed into 60.

\[
\text{mph} = \frac{60}{\text{Seconds to drive 88 feet}}
\]

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Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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