Spray Volumes For Air-Carrier Sprayers
Mark Mohr, Extension Specialist
University of Illinois Dept. of Agricultural Engineering

With the Tree Row Volume (TRV) method, the volume of dilute spray needed per acre can be calculated for each orchard based on the volume of foliage to be sprayed. TRV requires accurate measurement of the orchard.

PROCEDURE
Step 1. Determine the linear feet of tree row per acre (L).

\[ L = \frac{43,560 \text{ ft}^2 \text{ per acre}}{TS} \]

Where TS = row spacing

Step 2. Calculate the cubic feet of TRV (tree row volume) per acre.

\[ \text{TRV} = L \times H \times D \]

Where H = tree height; D = tree diameter

Step 3. Determine the spray volume the canopy can hold per 1000 ft³ of tree volume using previous experience or, an average tree may sprayed with water to determine the density factor (DF) for the tree...

The volume of a tree \( V = H \times D \times IS \)

Where IS = the in-row tree spacing.

\[ DF = \frac{1000 \times \text{gallons required}}{V} \]

Some estimates may be available though these may differ significantly from the actual gallons required.

Step 4. Calculate how much spray one acre will require (dilute).

\[ \text{TRV gallons} = \frac{\text{TRV} \times \text{DF}}{1000} \]

Step 5. Determine the amount of pesticide to apply per acre.

\[ \text{Pesticide per acre} = \frac{\text{pesticide per hundred gal} \times \text{TRV gallons}}{100 \text{ gal}} \]

Step 6. Determine the concentrate application volume.

\[ \text{Concentrate gal per acre} = \frac{\text{dilute gal per acre}}{\text{concentration}} \]

If the pesticide is formulated as a liquid include its volume in the total gallons per acre applied. 2 gal of pesticide applied in 100 gallons of spray per acre requires 98 gal of water.

EXAMPLE
An orchard has trees 12 in height (H), 14 feet in diameter (D), tree rows spaced 18 feet apart (TS), and 15 feet between trees in the row (IR). An average tree took 2 gallons to spray. The WP pesticide label calls for 12 ounces (0.75 pounds) per 100 gallons water for dilute application. A 6X application will be made.

Step 1. Determine the feet of row per acre.

\[ L = \frac{43,560 \text{ ft}^2 \text{ per acre}}{18 \text{ ft row spacing}} = 2420 \text{ linear feet of row per acre} \]

Step 2. Determine the TRV per acre.

\[ \text{TRV} = 2420 \times 12 \times 14 = 406,560 \text{ ft}^3 \text{ per acre} \]

Step 3. Determine the density factor.

\[ V = 12 \times 14 \times 15 = 2520 \text{ ft}^3 \]

It took 2 gallons to spray.

\[ DF = \frac{1000 \times 2 \text{ gallons}}{2520 \text{ ft}^3} = .79 \text{ gallons per 1000 ft}^3 \]

Step 4. Determine the TRV gallons (“1X” or dilute)

\[ \text{TRV gallons} = \frac{406,560 \text{ ft}^3 \times .79 \text{ gallons}}{1000 \text{ ft}^3} = 321 \text{ gallons per acre} \]

Step 5. Determine the proper rate of this fungicide.

\[ \frac{0.75 \text{ lbs} \times 321 \text{ gallons per acre}}{100 \text{ gallons}} = 2.4 \text{ lbs fungicide per acre} \]

Step 6. Determine the concentrate application rate.

\[ \frac{321 \text{ gallons per acre dilute}}{6 \text{X concentration}} = 53.5 \text{ gallons per acre} \]
IN THE ORCHARD
For your application measure and record the following:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row Spacing</td>
<td>TS =</td>
</tr>
<tr>
<td>Tree Height</td>
<td>H =</td>
</tr>
<tr>
<td>Tree Diameter</td>
<td>D =</td>
</tr>
<tr>
<td>In-Row Spacing</td>
<td>IS =</td>
</tr>
<tr>
<td>Pesticide Rate/100gal PER 100GAL</td>
<td>PER 100GAL</td>
</tr>
<tr>
<td>Concentrate Factor</td>
<td></td>
</tr>
</tbody>
</table>

Step 1.
\[ L = \frac{43,560 \text{ ft}^2 \text{ per acre}}{\text{TS}} = \text{ft of row per acre} \]

Step 2.
\[ \text{TRV} = L \times H \times D = \text{ft} \times \text{ft} \times \text{ft} = \text{ft}^3 \text{ per acre} \]

Step 3.
\[ V = H \times D \times IS = \text{ft} \times \text{ft} \times \text{ft} = \text{ft}^3 \text{ this tree} \]
\[ \text{DF} = \frac{1000 \times \text{gallons required}}{V} = \frac{1000 \times \text{gal}}{\text{ft}^3 \text{ per tree}} = \text{gal per 1000 ft}^3 \]

Step 4.
\[ \text{TRV gallons} = \frac{\text{TRV} \times \text{DF}}{1000} = \frac{\text{ft}^3 \text{ per acre} \times \text{gal per 1000 ft}^3}{1000} = \text{gal per acre} \]

Step 5. (You must keep track of the units of pesticide, i.e. ounces, pounds, etc.)
\[ \text{Pesticide per acre} = \frac{\text{pesticide per hundred gal} \times \text{TRV gal}}{\text{100 gal}} = \frac{\text{gal sprayed per acre}}{\text{100 gal}} = \text{pesticide per acre} \]

Step 6.
\[ \text{Concentrate gal per acre} = \frac{\text{dilute gal per acre}}{\text{concentration}} = \frac{\text{gal per acre}}{\text{X application}} = \text{concentrate gallons per acre} \]

IN THE VINYARD
If you are applying to grapes, or any other plant on a trellis, the TRV method can still be used. The difference is in step 3. Instead of calculating the gallons to treat one tree, you will want to calculate the gallons it takes to treat a pre-determined length of row, for instance, 20 feet. Spray twenty feet to the point of run-off.