Horticulture

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July 2020 **Horticulture/Fruit/2020-01**

Calibrating Your Orchard Sprayer

Brent Black, USU Extension Fruit Specialist
Earl Seeley, Private Orchard Consultant

The costs of fungicides, miticides, insecticides, foliar nutrients, wetting agents and plant growth regulators continue to increase. For a full spray program on apples, for example, the cost of spray materials alone could cost $800 to $1700 per acre per year. A poorly calibrated sprayer applying an average of 10% more material than intended, directly increases production costs by $80 to $170 per acre. Nozzles on sprayers wear out over time, and flow rates increase as nozzles wear, with worn nozzles eventually increasing flow rates by 10% or more. Financially sound management requires carefully calibrating orchard sprayers to optimize the benefits from applying spray materials.

Further, materials such as plant growth regulators used for fruit thinning, fruit loosening, or stop drop have a narrow acceptable dose range. When growth regulators are applied at too low of a dose the plant response is inadequate. Alternatively, an overdose can result in harmful side effects that can affect not only the current season's crop but also the long-term health of the orchard. Wise management of orchard health also requires keeping spray equipment properly maintained and calibrated.

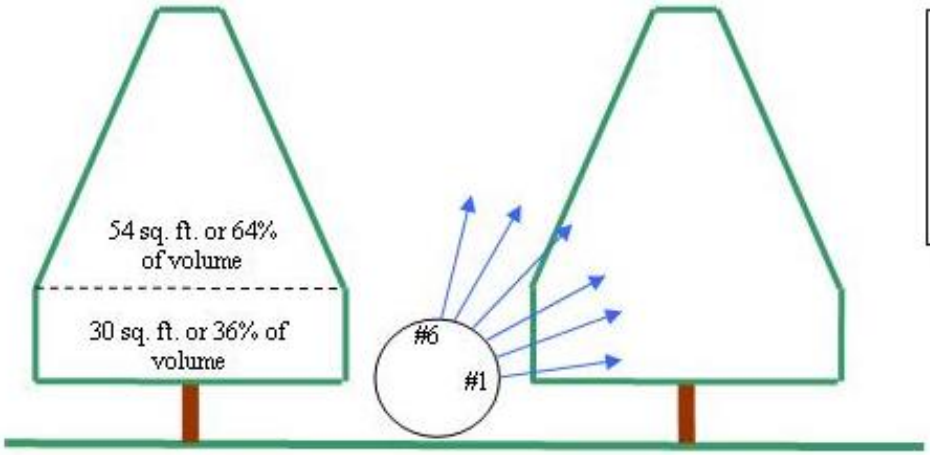
Calculations for proper spray calibration are not difficult, but can be confusing, with multiple opportunities for error. To minimize confusion and reduce the risk of error, an interactive computer spreadsheet has been developed to aid in sprayer calibration.

Users will need to input information specific to their orchard and equipment. User inputs are:

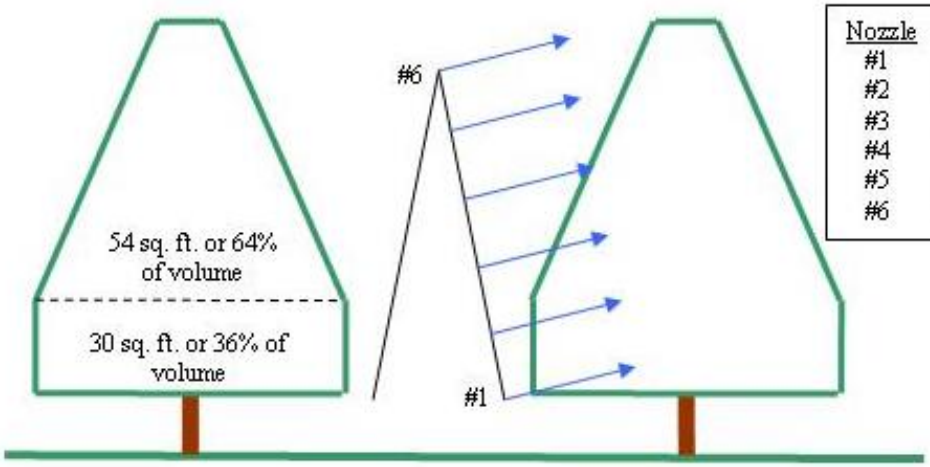
1. Ground speed (miles per hour)
2. Spacing between rows (feet)
3. Desired spray volume (gallons per acre)
4. Spray distribution pattern (fraction of the total spray to be discharged at each nozzle)

The spray distribution pattern is based on the type of sprayer to be used (round plenum vs. tower type), tree size, and the desired distribution of spray between the fruiting surfaces of the upper canopy, and the "heavy wood" and dense foliage areas in the lower canopy. Figure 1 illustrates examples of how this spray distribution pattern might be configured by varying the relative amount of spray through each spray nozzle in a round plenum and tower type sprayer.

Figure 1. Illustration of a 6 nozzle arrangement of round plenum and tower sprayers positioned in a 16-foot row spacing with trees that are 10 feet wide, trunk of approximately 2 feet and canopy extending up to 14 feet.



Nozzle	Percent
#1	25%
#2	10%
#3	20%
#4	20%
#5	15%
#6	10%



Nozzle	Amount
#1	24% (2/3 of 36%)
#2	18% (1/3 of 36% + 10% of 64%)
#3	14%
#4	12%
#5	10% (adjust to 16% for 'drip')
#6	10% (adjust to 16% for 'drip')

Above percentages are "target" and allow for greater volume at the bottom to cover 'heavy wood' and dense foliage areas, plus excess volume in the top 2 nozzles to allow for some 'downward' movement. In many blocks during the first part of the season nozzle #6 will be off, and volume added to Nozzle #5.

Companion Spreadsheet

To quickly calculate the target discharge rate for each nozzle, we have created a user input spreadsheet. Table 1 shows an example calculation from the spreadsheet (user input in red). Based on this calculated discharge rate, the spreadsheet specifies the core and disc required for the commonly-used TeeJet® hollow cone spray nozzles that would give the desired flow rate at operating pressures of 100 or 150 psi. The spreadsheet allows for up to 12 nozzles per side. Nozzles not in use for that specific spray are turned off.

Once the nozzles have been installed, the sprayer should be "static tested" according to the following instructions.

Static testing procedure
1. Fill the sprayer with water.
2. Park the sprayer on a level spot where the water sprayed will not cause any problems.
3. Bring the sprayer up to spraying rpm.
4. Open the nozzles and spray water for 10 minutes.
5. Measure total amount of water sprayed in the 10 minute period.
6. Divide the total gallons of water sprayed by 10 to determine actual the gallons per minute.
7. If the figure is close, but not correct, increase or decrease line pressure to raise or lower flow rate to the appropriate level.
8. After adjusting the pressure, repeat steps 1-6.

Table 1. An example of the spreadsheet interface. Values in red are the user inputs for designating target spray for the specific situation. Inputs are: ground speed, row spacing, gallons per acre, and the relative amount of spray to be discharged at each nozzle. The spreadsheet then calculates gallons per minute per nozzle, and selects a nozzle size based on commonly-used commercial nozzles.

Ground speed	**2.1**	mph	Feet per minute =	184.8
			Row feet per acre =	3630
Row spacing	**12**	feet	Minutes per acre =	19.6
			Gallons per minute =	5.09
Gallons per acre	**100**		GPM one side =	2.55

Spray Nozzle Arrangement

	Nozzle #	Fraction each nozzle	GPM per nozzle	Nozzle configuration for TeeJet®/Spray Systems nozzles 100 psi	150 psi
Top	12	**0.16**	0.407	D4/DC25	D3/DC25
	11	**0.00**	0.000	off	off
	10	**0.16**	0.407	D4/DC25	D3/DC25
	9	**0.00**	0.000	off	off
	8	**0.12**	0.305	D3/DC25	D2/DC25
	7	**0.00**	0.000	off	off
	6	**0.14**	0.356	D3/DC25	D3/DC25
	5	**0.00**	0.000	off	off
	4	**0.18**	0.458	D4/DC25	D3/DC45
	3	**0.00**	0.000	off	off
	2	**0.24**	0.611	D4/DC25	D4/DC25
Bottom	1	**0.00**	0.000	off	off
		Total 1.00	Total 2.55		

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