# Vineyard air-assisted sprayers: selection and calibration

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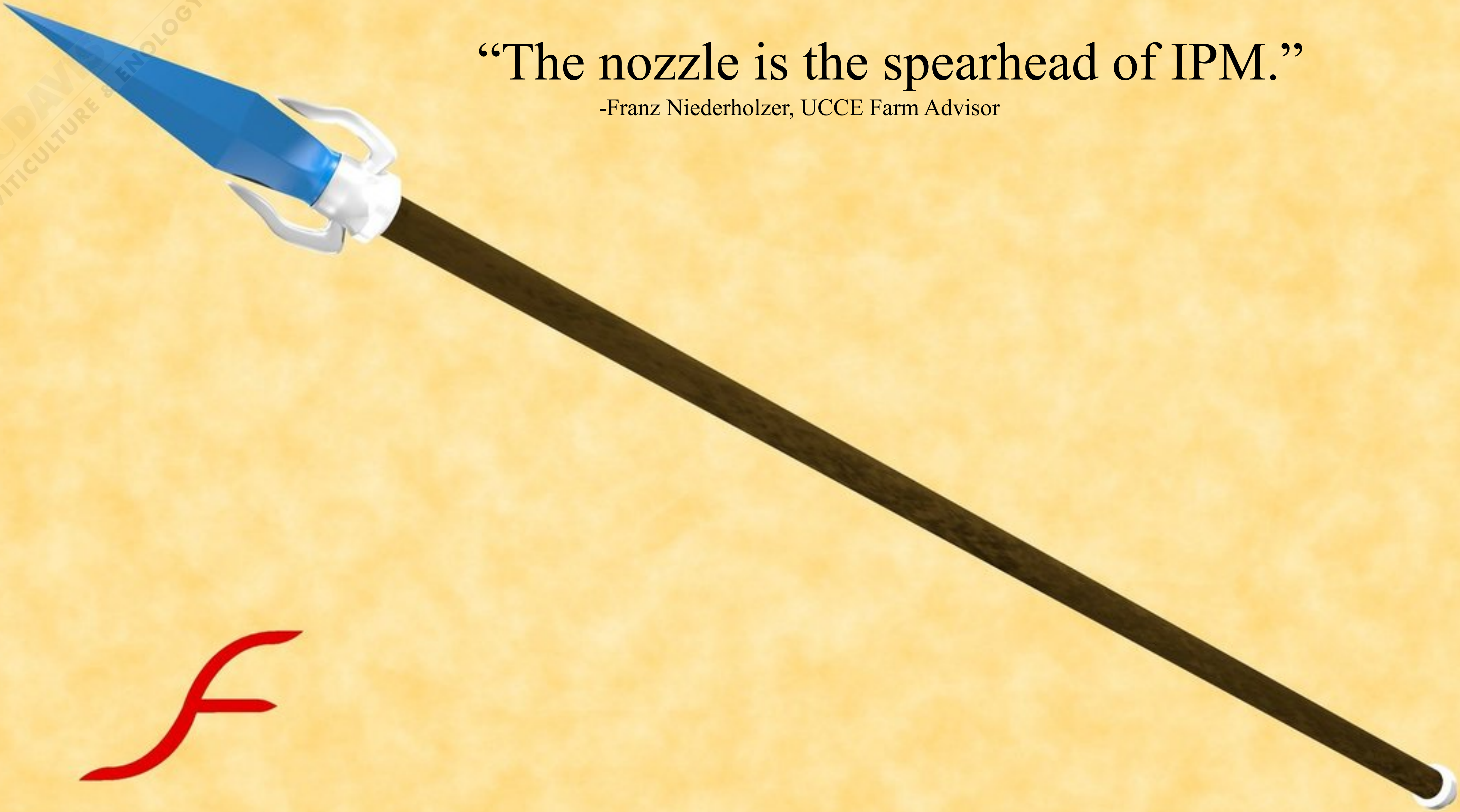
University of California Agriculture and Natural Resources

UCCE University of California Cooperative Extension

# “The nozzle is the spearhead of IPM.”

-Franz Niederholzer, UCCE Farm Advisor

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# Optimizing coverage: Is it Resistance or Something Else?

# What is calibration?

"the act of

**selecting,**

**establishing,**

**maintaining, and**

**verifying**

**sprayer operation parameters** which result in a

**known, desired and**

**uniform**

application rate of spray material".

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Basic spray formula:

$$\mathrm{GPA} = \frac{\text{Flow rate (gal/min)}}{\text{Land rate (ac/min)}}$$

This fundamental *relationship* works for all sprayers!

$$\textbf{GPA (gal/acre)} = \frac{\textbf{Flow rate-GPM (gal/min)}}{\textbf{Land rate (ac/min)}}$$

But what is "Land rate?"

# Land Rate: AREA covered in time

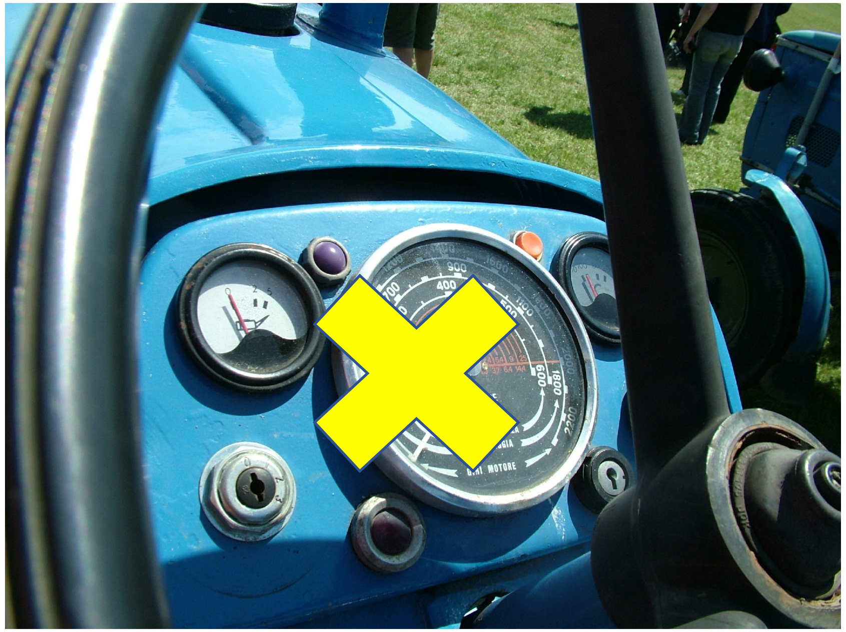
- <u>not</u> just tractor speed
- *Area* covered per unit time ($ft.^2/min$)

- **Speed (ft/min) x Swath width (ft.)**
- Convert $ft.^2/min$ to acres/min

# **Swath width** for vines is typically the row spacing width.


This can be easily measured with a tape. Distances of 5-10 feet are common swath widths for air assisted applications.

# Measuring speed

To measure speed:

Tank should be about ½ full.

**Terrain should be typical for the spray job.**

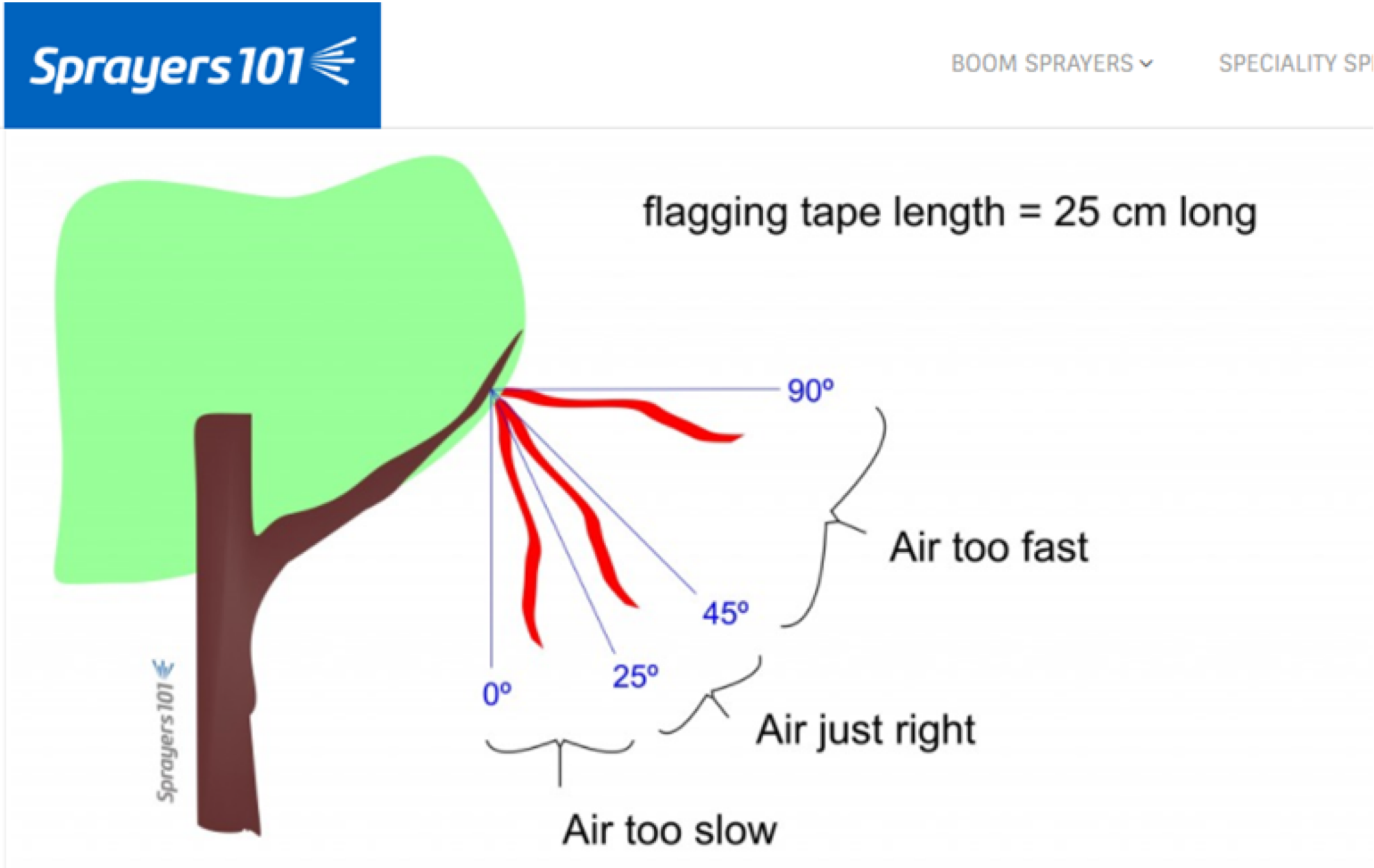
Measure time (convert to feet per minute) to travel at least 100 feet.

Note tractor gear and RPM.

Time multiple runs and take an average.

# How do we determine how fast to go?

Sprayers101.com



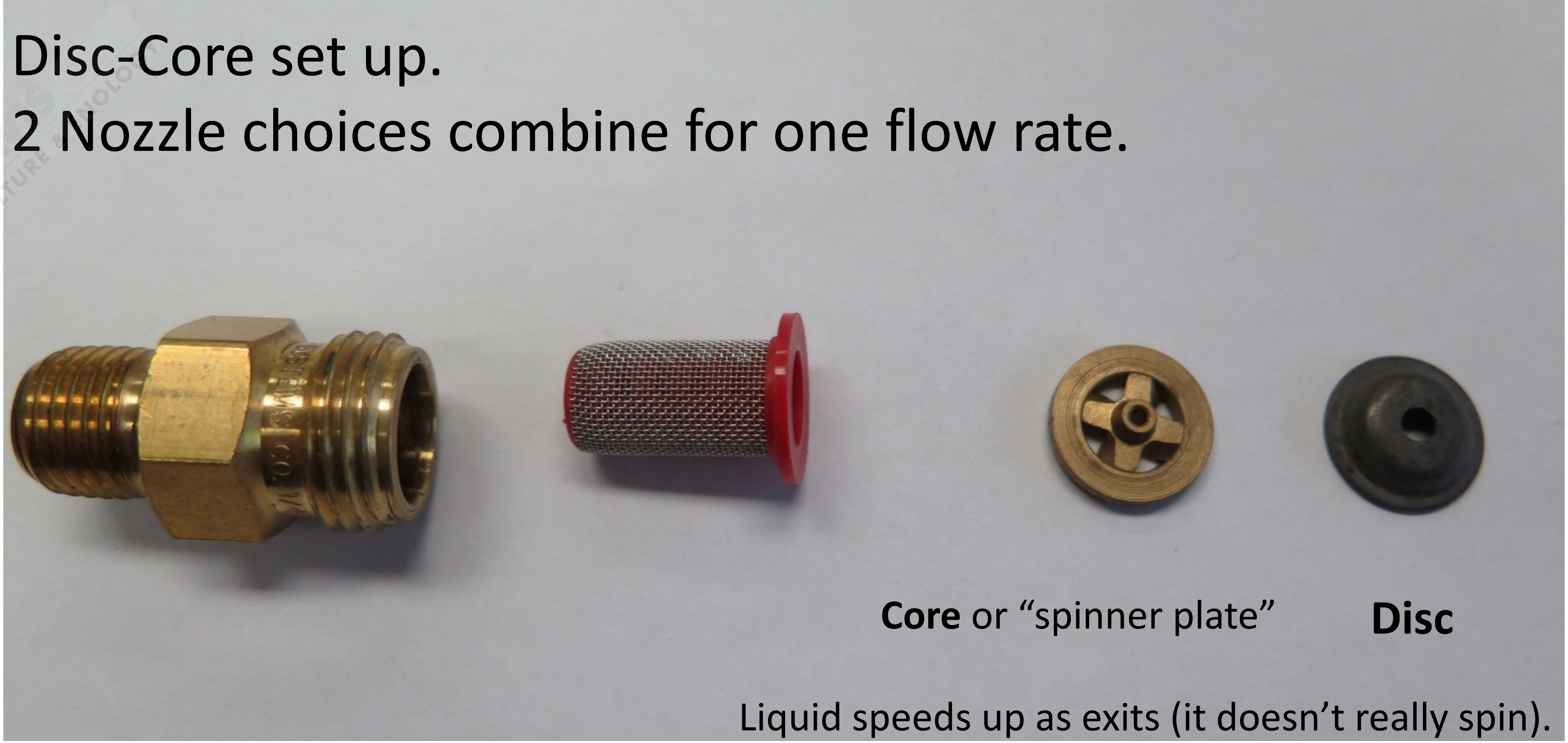

- Air is too fast: Increase ground speed, reduce rpm’s or lower fan gear
- Air is too slow: Reduce ground speed, increase rpm’s or raise fan gear

How to use the basic calibration formula for spraying

$$\text{GPA (gal/acre)} = \frac{\text{Flow rate-GPM (gal/min)}}{\text{Land rate (ac/min)}}$$


07/07/2016

# Disc-Core set up.
# 2 Nozzle choices combine for one flow rate.




L.R. Wunderlich

# What does the nozzle contribute to our spray application?





## 1. FLOW RATE: Volume/Time (Gallons/Min)

Nozzle flow rate is directly proportional to application rate (Gallons/acre)

Want a larger spray volume? Increase the flow rate by either:

Increase nozzle size (Larger droplets*)

* Except for VENTURI sprayers, where droplets are always fine.

Increase pressure (Smaller droplets)

## 2. DROPLET SIZE (COVERAGE/DRIFT)

Use the manufacturer’s catalog to see flow rates at a given pressure.

## Hollow Cone Type Spray Tips

www.teejet.com

| | | | GPM | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 10 PSI | 20 PSI | 30 PSI | 40 PSI | 60 PSI | 80 PSI | 100 PSI | 150 PSI | 200 PSI | 300 PSI | 20 PSI | 40 PSI | 80 PSI |
| D1 | DC13 | .031″ | — | — | .059 | .066 | .078 | .088 | .097 | .115 | .128 | .152 | — | 51° | 62° |
| D1.5 | DC13 | .036″ | — | .057 | .067 | .075 | .088 | .098 | .110 | .127 | .142 | .167 | 38° | 55° | 66° |
| D2 | DC13 | .041″ | — | .064 | .075 | .08 | .10 | .11 | .12 | .14 | .16 | .18 | 49° | 67° | 72° |
| D3 | DC13 | .047″ | — | .071 | .08 | .09 | .11 | .12 | .13 | .16 | .18 | .20 | 53° | 70° | 75° |
| D4 | DC13 | .063″ | .070 | .09 | .11 | .12 | .14 | .16 | .17 | .20 | .23 | .27 | 69° | 79° | 83° |
| D1 | DC23 | .031″ | — | — | .064 | .072 | .080 | .096 | .107 | .124 | .139 | .164 | — | 47° | 58° |
| D1.5 | DC23 | .036″ | — | .064 | .076 | .086 | .103 | .117 | .130 | .155 | .175 | .210 | 34° | 51° | 62° |
| D2 | DC23 | .041″ | — | .078 | .092 | .10 | .13 | .14 | .16 | .19 | .21 | .25 | 51° | 63° | 70° |
| D3 | DC23 | .047″ | .065 | .087 | .10 | .12 | .14 | .16 | .18 | .21 | .24 | .28 | 58° | 69° | 75° |
| D4 | DC23 | .063″ | .082 | .113 | .14 | .15 | .19 | .21 | .23 | .28 | .32 | .38 | 68° | 82° | 87° |
| D5 | DC23 | .078″ | .095 | .13 | .16 | .18 | .22 | .25 | .28 | .34 | .38 | .46 | 79° | 89° | 94° |
| D6 | DC23 | .094″ | .112 | .15 | .19 | .21 | .26 | .29 | .32 | .39 | .45 | .54 | 84° | 93° | 98° |
| D1 | DC25 | .031″ | — | — | .088 | .101 | .122 | .138 | .156 | .185 | .210 | .255 | — | 27° | 43° |
| D1.5 | DC25 | .036″ | — | — | .118 | .135 | .162 | .185 | .205 | .245 | .280 | .33 | — | 38° | 49° |
| D2 | DC25 | .041″ | — | .12 | .14 | .16 | .19 | .22 | .25 | .29 | .34 | .41 | 39° | 51° | 58° |
| D3 | DC25 | .047″ | .10 | .14 | .17 | .19 | .23 | .26 | .29 | .35 | .40 | .48 | 52° | 61° | 67° |
| D4 | DC25 | .063″ | .15 | .21 | .25 | .29 | .35 | .40 | .45 | .54 | .62 | .75 | 67° | 74° | 80° |
| D5 | DC25 | .078″ | .18 | .25 | .30 | .35 | .42 | .48 | .54 | .65 | .75 | .90 | 73° | 79° | 84° |
| D6 | DC25 | .094″ | .23 | .32 | .39 | .44 | .54 | .62 | .70 | .85 | .97 | 1.19 | 79° | 85° | 89° |
| D7 | DC25 | .109″ | .26 | .37 | .45 | .52 | .63 | .73 | .81 | .98 | 1.18 | 1.37 | 85° | 91° | 93° |
| D8 | DC25 | .125″ | .31 | .43 | .53 | .61 | .75 | .89 | .97 | 1.19 | 1.36 | 1.68 | 91° | 96° | 97° |
| D10 | DC25 | .156″ | .38 | .54 | .65 | .76 | .93 | 1.07 | 1.21 | 1.48 | 1.71 | 2.1 | 97° | 102° | 103° |
| D12 | DC25 | .188″ | .46 | .61 | .80 | .93 | 1.15 | 1.32 | 1.47 | 1.81 | 2.09 | 2.55 | 103° | 109° | 112° |
| D14 | DC25 | .219″ | .51 | .72 | .88 | 1.03 | 1.26 | 1.47 | 1.65 | 2.02 | 2.34 | 2.89 | 108° | 113° | 114° |
| D1 | DC45 | .031″ | — | — | — | .125 | .148 | .170 | .190 | .225 | .257 | .310 | — | 22° | 34° |
| D1.5 | DC45 | .036″ | — | — | .14 | .16 | .20 | .23 | .25 | .31 | .35 | .43 | — | 33° | 44° |
| D2 | DC45 | .041″ | — | .14 | .18 | .20 | .25 | .28 | .32 | .38 | .44 | .53 | 32° | 46° | 55° |
| D3 | DC45 | .047″ | — | .17 | .20 | .23 | .28 | .33 | .36 | .44 | .51 | .62 | 40° | 53° | 60° |
| D4 | DC45 | .063″ | .18 | .25 | .31 | .36 | .43 | .50 | .56 | .68 | .78 | .95 | 62° | 69° | 72° |

# Pressure gauge: an essential component

- Make sure it is operating properly and is maintained, is easy to read, and has a range that makes sense for the sprayer.

# TXR ConeJet® Hollow Cone Spray Tips

Teejet.com

| | | GPM | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 30 PSI | 40 PSI | 50 PSI | 60 PSI | 70 PSI | 80 PSI | 90 PSI | 100 PSI | 120 PSI | 140 PSI | 160 PSI | 180 PSI | 200 PSI | 220 PSI | 240 PSI | 260 PSI | 280 PSI | 300 PSI | 320 PSI | 340 PSI | 360 PSI |
| TXR800053VK | 100 | 0.046 | 0.053 | 0.059 | 0.064 | 0.069 | 0.073 | 0.077 | 0.081 | 0.089 | 0.095 | 0.101 | 0.107 | 0.113 | 0.118 | 0.123 | 0.127 | 0.132 | 0.136 | 0.140 | 0.144 | 0.148 |
| | | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR800071VK | 50 | 0.062 | 0.071 | 0.079 | 0.086 | 0.093 | 0.099 | 0.105 | 0.110 | 0.120 | 0.129 | 0.138 | 0.146 | 0.153 | 0.160 | 0.167 | 0.174 | 0.180 | 0.186 | 0.192 | 0.197 | 0.203 |
| | | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR8001VK | 50 | 0.087 | 0.100 | 0.111 | 0.121 | 0.131 | 0.139 | 0.147 | 0.155 | 0.169 | 0.182 | 0.194 | 0.205 | 0.216 | 0.226 | 0.235 | 0.245 | 0.253 | 0.262 | 0.270 | 0.278 | 0.286 |
| | | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR80013VK | 50 | 0.116 | 0.133 | 0.148 | 0.162 | 0.174 | 0.186 | 0.196 | 0.207 | 0.225 | 0.243 | 0.259 | 0.274 | 0.288 | 0.301 | 0.314 | 0.326 | 0.338 | 0.349 | 0.360 | 0.371 | 0.381 |
| | | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR80015VK | 50 | 0.131 | 0.150 | 0.167 | 0.182 | 0.196 | 0.209 | 0.221 | 0.232 | 0.254 | 0.273 | 0.291 | 0.308 | 0.324 | 0.339 | 0.353 | 0.367 | 0.380 | 0.393 | 0.405 | 0.417 | 0.429 |
| | | F | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR80017VK | 50 | 0.145 | 0.167 | 0.185 | 0.202 | 0.218 | 0.232 | 0.246 | 0.258 | 0.282 | 0.303 | 0.323 | 0.342 | 0.360 | 0.376 | 0.392 | 0.408 | 0.422 | 0.437 | 0.450 | 0.464 | 0.476 |
| | | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR8002VK | 50 | 0.174 | 0.200 | 0.223 | 0.243 | 0.261 | 0.279 | 0.295 | 0.310 | 0.338 | 0.364 | 0.388 | 0.410 | 0.432 | 0.452 | 0.471 | 0.489 | 0.507 | 0.524 | 0.540 | 0.556 | 0.572 |
| | | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR80028VK | 50 | 0.240 | 0.275 | 0.306 | 0.334 | 0.359 | 0.383 | 0.405 | 0.426 | 0.465 | 0.500 | 0.533 | 0.564 | 0.594 | 0.621 | 0.648 | 0.673 | 0.697 | 0.720 | 0.743 | 0.765 | 0.786 |
| | | F | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR8003VK | 50 | 0.260 | 0.300 | 0.335 | 0.367 | 0.396 | 0.423 | 0.449 | 0.473 | 0.517 | 0.558 | 0.597 | 0.633 | 0.667 | 0.699 | 0.730 | 0.759 | 0.788 | 0.815 | 0.841 | 0.867 | 0.892 |
| | | F | F | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR80036VK | 50 | 0.309 | 0.356 | 0.398 | 0.435 | 0.470 | 0.502 | 0.532 | 0.561 | 0.614 | 0.663 | 0.708 | 0.751 | 0.791 | 0.829 | 0.866 | 0.901 | 0.935 | 0.967 | 0.999 | 1.03 | 1.06 |
| | | F | F | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR8004VK | 50 | 0.347 | 0.400 | 0.447 | 0.489 | 0.528 | 0.564 | 0.598 | 0.630 | 0.690 | 0.745 | 0.796 | 0.843 | 0.889 | 0.932 | 0.973 | 1.01 | 1.05 | 1.09 | 1.12 | 1.16 | 1.19 |
| | | F | F | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |
| TXR80049VK | 50 | 0.423 | 0.488 | 0.545 | 0.597 | 0.644 | 0.688 | 0.730 | 0.769 | 0.842 | 0.909 | 0.971 | 1.03 | 1.09 | 1.14 | 1.19 | 1.24 | 1.28 | 1.33 | 1.37 | 1.41 | 1.45 |
| | | F | F | F | F | F | F | F | F | F | F | F | VF | VF | VF | VF | VF | VF | VF | VF | VF | VF |

**Note:** Always double check your application rates. Tabulations are based on spraying water at 70°F (21°C).
See pages 136–157 for drop size classification, useful formulas and other information.

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# Pneumatic sprayer, i.e. Low volume Venturi.

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PHONE (800) 833-3023
FAX (909) 548-4747
E-mail: sales@gearmore.com

GEARMORE INC.

13477 BENSON AVE.
CHINO, CA 91710
Website: www.Gearmore.com

# VENTURI AIR SPRAYER CALIBRATION CHART

## 4 YELLOW "*DIAL-A-RATE*" DISCS

### GALLONS PER MINUTE

| DISC SETTING | PRESSURE SETTING (PSI) | | | | | |
|---|---|---|---|---|---|---|
| | 16 | 22 | 25 | 28 | 33 | 36 |
| **1** | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 |
| **2** | 0.6 | 0.8 | 0.9 | 1.0 | 1.0 | 1.0 |
| **3** | 1.0 | 1.1 | 1.1 | 1.2 | 1.3 | 1.4 |
| **4** | 1.2 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 |
| **5** | 1.7 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 |
| **6** | 1.9 | 2.1 | 2.3 | 2.4 | 2.5 | 2.6 |
| **7** | 3.1 | 3.3 | 3.5 | 3.7 | 3.8 | 4.0 |
| **8** | 3.7 | 3.9 | 4.1 | 4.3 | 4.5 | 4.7 |
| **9** | 4.5 | 4.7 | 5.0 | 5.3 | 5.7 | 6.0 |
| **10** | 5.3 | 5.5 | 5.9 | 6.2 | 6.5 | 6.9 |
| **11** | 6.5 | 6.8 | 7.3 | 7.8 | 8.1 | 8.6 |
| **12** | 7.9 | 8.5 | 9.5 | 9.9 | 10.5 | 11.1 |
| **13** | 9.4 | 9.8 | 10.6 | 11.4 | 12.0 | 12.8 |
| **14** | 10.4 | 10.7 | 11.7 | 12.6 | 13.5 | 14.3 |
| **15** | 11.0 | 11.3 | 12.7 | 13.5 | 14.6 | 15.7 |

To determine the required pressure setting, you must *first* determine how many Gallons Per Minute will be required.

$$\text{Gallons Per Minute} = \frac{2 \times (\text{Miles Per Hour}) \times (\text{Gallons Per Acre}) \times (\text{Width of Area Treated})}{1000}$$

*NOTE for 3-Point Hitch Sprayer Users:*

The lower the sprayer pressure, the greater the agitation. Use the lowest possible pressure to achieve the desired G.P.M. For example, a Dial-A-Rate disc setting of #4 @ 36 P.S.I. and a disc setting of



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How to use the basic calibration formula for spraying

$$\text{GPA (gal/acre)} = \frac{\text{Flow rate-GPM (gal/min)}}{\text{Land rate (ac/min)}}$$

# Flow rate and land rate are the variables you need to check, no matter what formula or sprayer you use.

$$\textbf{GPA} = \frac{\text{Flow rate (gal/min)}}{\text{Land rate (ac/min)}} = \frac{\text{GPM}}{\text{Speed * swath width}}$$

$$\textbf{GPM} = \text{GPA} * \frac{\text{Miles/Hour * swath width (feet)}}{495}$$

# **First and Final Step: READ and FOLLOW the LABEL.** The label specifies the amount of pesticide, typically "per acre"

**SUPPLEMENTAL LABEL**

**NICHINO AMERICA, INC.**

| GROUP | 16 | INSECTICIDE |
|---|---|---|

**APPLAUD® 70DF INSECT GROWTH REGULATOR**
**For Use on Grapes in California and Arizona Only**

**EPA Reg. No. 71711-21**

**DIRECTIONS FOR USE**

**It is a violation of Federal law to use this product in a manner inconsistent with its labeling.**

**This labeling and the EPA approved container label must be in the possession of the user at the time of application.**

**New directions for use appear on this supplemental labeling that do not appear on the Section 3 container label. This supplemental label supersedes any previously approved supplemental label for use in grapes.**

NOTICE: Before using this product, read the First Aid, Precautionary Statements, Conditions of Sale and Warranty, and complete Directions for Use found on the container labeling. All applicable directions, restrictions, and precautions on the EPA registered label are to be followed.

| Crop | Pests Controlled | Formulated Product/A | Lbs a.i./A | Use Directions and Restrictions |
|---|---|---|---|---|
| **Grapes** | Mealybugs | 24.0 oz/A<br>(1.05 lb ai/A) | 1.05 lb a.i./A | **FOR USE IN CALIFORNIA AND ARIZONA ONLY**<br>USE RESTRICTIONS<br>• Apply by ground application using a minimum of 50 gallons of water per acre depending on the size of the grapevine canopy.<br>• Do not apply more than 24.0 oz (1.05 lb ai/A) per acre per growing season.<br>• Do not apply within 30 days of harvest.<br>RECOMMENDATIONS<br>• **Mealybug:** Apply at the beginning of crawler emergence.<br>• Good coverage is essential. Orient nozzles to assure good coverage. Use of a higher volume of water will assure better coverage, especially under adverse conditions, such as hot, dry weather and/or a dense canopy. |



030110

**NICHINO AMERICA, INC.**
4550 New Linden Hill Road, Suite 501
Wilmington, DE 19808
(302) 636-9001

For this example, the label recommended rate in grapes is **no more than 24 oz./acre per growing season to control mealybugs.** This label also states that good coverage is essential and to use higher volumes under adverse conditions or with dense canopies.

# How much pesticide in the tank? Determine how many acres your tank can spray at your calibrated rate.

In our example, say it is a 400 gallon tank.

The label for the spray job will provide a rate per acre, in our example we choose 12 oz. per acre.

We calibrate our sprayer to deliver 118 gallons per acre.

**Number of acres per tank**: 400 gallon tank/118 gallons per acre= **3.4 acres** can be sprayed with a full tank at this calibration.

**Amount of pesticide per tank:** 3.4 acres * 12 oz. per acre=

**41 ounces** of pesticide per tank in this example.

# Check for coverage to determine if your application rate is correct.

Water sensitive paper is one way to check for coverage


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# Kaolin Clay

# Visual check for coverage

# What does the nozzle contribute to our spray application?

## 1. FLOW RATE: Volume/Time (Gallons/Min)

Nozzle flow rate is directly proportional to application rate (Gallons/acre)

Want a larger spray volume? Increase the flow rate by either:

Increase nozzle size (Larger droplets*)

* Except for VENTURI sprayers, where droplets are always fine.

Increase pressure (Smaller droplets)

## 2. DROPLET SIZE (COVERAGE/DRIFT)

# Hydraulic nozzles produce a range of droplet sizes.


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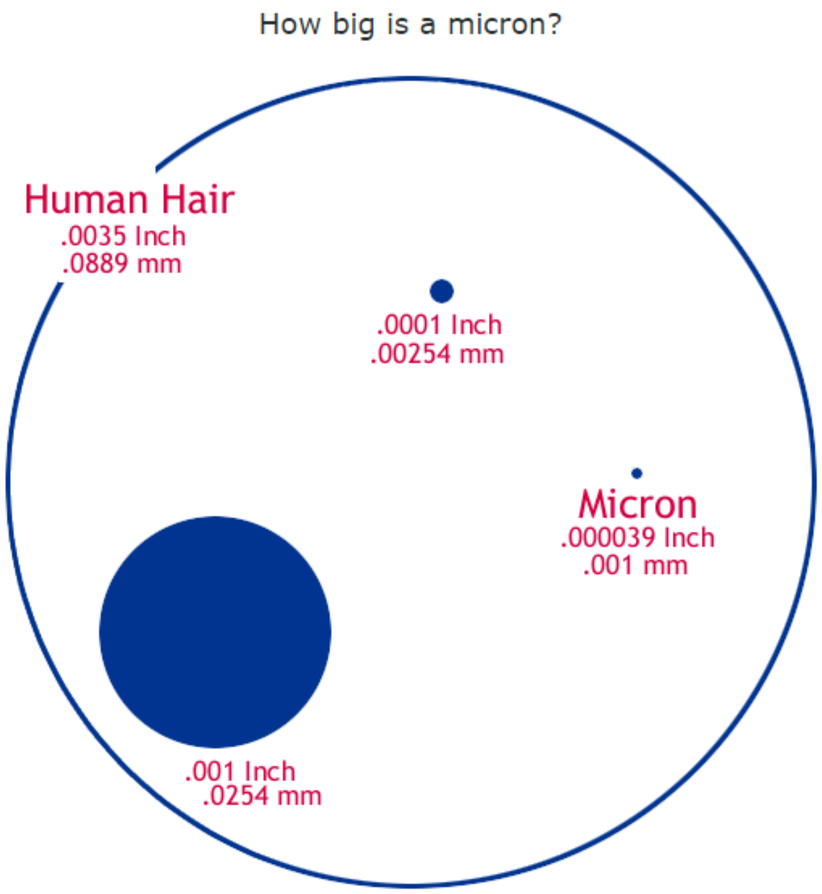
# Droplet size is measured in MICRONS (um).

1 um is about 39 millionths of an inch

"VMD 0.5" is Volume Median Diameter. Half of the droplets are larger, half are smaller.




Other measurements include:

DV 0.1 = 10% drops are smaller. Indicates drift potential. A larger DV 0.1 value indicates fewer driftable droplets.

DV 0.9= 90% of drops are smaller. If this number is large, too much of spray volume is taken up by large droplets. May not provide best coverage.

"Relative Span": range of droplet sizes.

$$\frac{(DV0.9-DV0.1)}{VMD\ 0.5}$$

Droplet size classification made easy: American Society of Agricultural and Biological Engineers (ASABE) color codes for droplet size.

Beware: these colors are not necessarily used for the nozzle itself, but refer to the manufacturer's nozzle chart indicating droplet size and related to pressure.

## Color Codes for Droplet Size

| Category | Symbol | Color Code | Approx. VMD Range (microns) |
|---|---|---|---|
| Extremely Fine | XF | Purple | <60 |
| Very Fine | VF | Red | 60-145 |
| Fine | F | Orange | 145-225 |
| Medium | M | Yellow | 226-325 |
| Coarse | C | Blue | 326-400 |
| Very Coarse | VC | Green | 401-500 |
| Extremely Coarse | EC | White | 501-650 |
| Ultra Coarse | UC | Black | >650 |

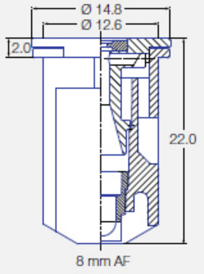

ATXA
8003
07/08/2016
L.R. Wunderlich

# Air-injector flat spray compact nozzles IDK 90

Very low-drift, compact air-injector flat spray nozzle.

**Advantages**
- 99/95/90/75/50 % drift reduction depending on nozzle size, pressure and country
- Most compact low-drift air injector flat spray nozzle
- Only 7 mm longer than TR hollow cone nozzle
- Large clog-resistant cross-sections
- Soiling on dosing orifice can be simply wiped off
- Breakage-resistant nozzle housing with beveled edges and reinforced walls

G 1834
G 1835
G 1886
G 1941




**IDK 90-01 C**
75 % drift reduction according to MABO dosage modell

Crop production

**Nozzle size**
0067 – 03

**Spray angle**
90°

**Material**
Ceramic

**Pressure range**
2 – **8** – **15** – 20 bar

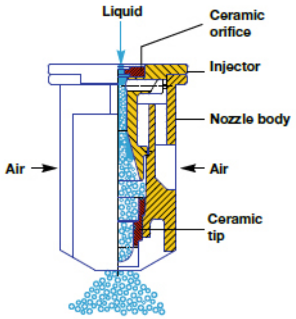
**Recommended filters**
60 M 0067 – 03

**Droplet size**
Very coarse – medium

**Width across flats**
8 mm

**Application areas**
- Plant protection products and growth regulators
- Plant protection in viticulture, orchard and specialty crops

Removable injector




**More detailed information**

ALBUZ



## AVI 80°

**APPLICATIONS**
- Particularly recommended for the orchard treatments of systemic and contact products.

**SPECIFIC CHARACTERISTICS**
- Recommended pressures : 10 bar for atomizer and 5 bar for face to face spraying
- Reduce dramatically the drift, while enhancing the number of "impacts" of the product on the target, ( excellent coverage of the treated zones)
- Anti-clogging design and double air-intake orifices.

**MAIN CHARACTERISTICS**
- Flow rate in accordance with international ISO standard colour codes
- Albuz durable pink ceramic allows high pressure spraying while maintaining nozzle performance and precision.
- Range of use of pressures from 10 bar to 20 bar.
- Standard design (length 28 mm) adapted to all booms and nozzle holders.

# This chart tells you something about spray "Quality" (DROPLET SIZE) TeeJet Catalog

**How to order:**
Specify tip number.
Example:
AITXA8001VK – Ceramic with VisiFlo color-coding

| | | GPM | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 60 PSI | 70 PSI | 80 PSI | 90 PSI | 100 PSI | 120 PSI | 140 PSI | 160 PSI | 180 PSI | 200 PSI | 220 PSI | 240 PSI | 260 PSI | 280 PSI | 300 PSI |
| AITX†8001VK | 50 | 0.121 | 0.130 | 0.138 | 0.146 | 0.154 | 0.168 | 0.181 | 0.192 | 0.203 | 0.214 | 0.224 | 0.233 | 0.242 | 0.251 | 0.260 |
| | | XC | XC | VC | VC | VC | C | C | C | C | C | C | C | M | M | M |
| AITX†80015VK | 50 | 0.181 | 0.195 | 0.209 | 0.221 | 0.233 | 0.255 | 0.275 | 0.294 | 0.312 | 0.328 | 0.344 | 0.359 | 0.374 | 0.388 | 0.401 |
| | | XC | XC | XC | VC | VC | C | C | C | C | C | C | C | M | M | M |
| AITX†8002VK | 50 | 0.247 | 0.195 | 0.286 | 0.303 | 0.320 | 0.351 | 0.379 | 0.405 | 0.430 | 0.453 | 0.476 | 0.497 | 0.517 | 0.537 | 0.556 |
| | | XC | XC | XC | XC | XC | VC | VC | VC | VC | C | C | C | C | C | C |
| AITX†80025VK | 50 | 0.300 | 0.324 | 0.347 | 0.368 | 0.387 | 0.424 | 0.458 | 0.490 | 0.519 | 0.548 | 0.574 | 0.600 | 0.624 | 0.648 | 0.670 |
| | | UC | UC | XC | XC | XC | XC | XC | XC | VC | VC | VC | VC | VC | VC | C |
| AITX†8003VK | 50 | 0.360 | 0.389 | 0.417 | 0.443 | 0.467 | 0.513 | 0.554 | 0.594 | 0.630 | 0.665 | 0.698 | 0.730 | 0.760 | 0.790 | 0.818 |
| | | UC | UC | XC | XC | XC | XC | XC | VC | VC | VC | VC | VC | C | C | C |
| AITX†8004VK | 50 | 0.480 | 0.519 | 0.556 | 0.590 | 0.623 | 0.684 | 0.740 | 0.792 | 0.841 | 0.887 | 0.931 | 0.974 | 1.01 | 1.05 | 1.09 |
| | | UC | UC | UC | UC | XC | XC | XC | XC | XC | VC | VC | VC | VC | VC | VC |

# CONSIDER DRIFT THE OPPOSITE OF COVERAGE: DROPLET SIZE MATTERS!

**Table 1. Movement of spray particles.**

| **Droplet diameter** (microns) | **Size classification** (ASAE* equivalent) | **Time required to fall 10 feet** | **Lateral movement in 3 mph wind** |
|---|---|---|---|
| 5 | Fog | 66 minutes | 3 miles |
| 20 | Very fine | 4.2 minutes | 1,100 feet |
| 100 | Very fine | 10 seconds | 44 feet |
| 240 | Fine/medium | 6 seconds | 28 feet |
| 400 | Coarse | 2 seconds | 8.5 feet |
| 1,000 | Extremely coarse | 1 second | 4.7 feet |

*American Society of Agricultural Engineers.
Source: Akesson and Yates, Annual Review of Entomology, 1964.

Larger droplets are less likely to become entrained in air flow streamlines around the target.

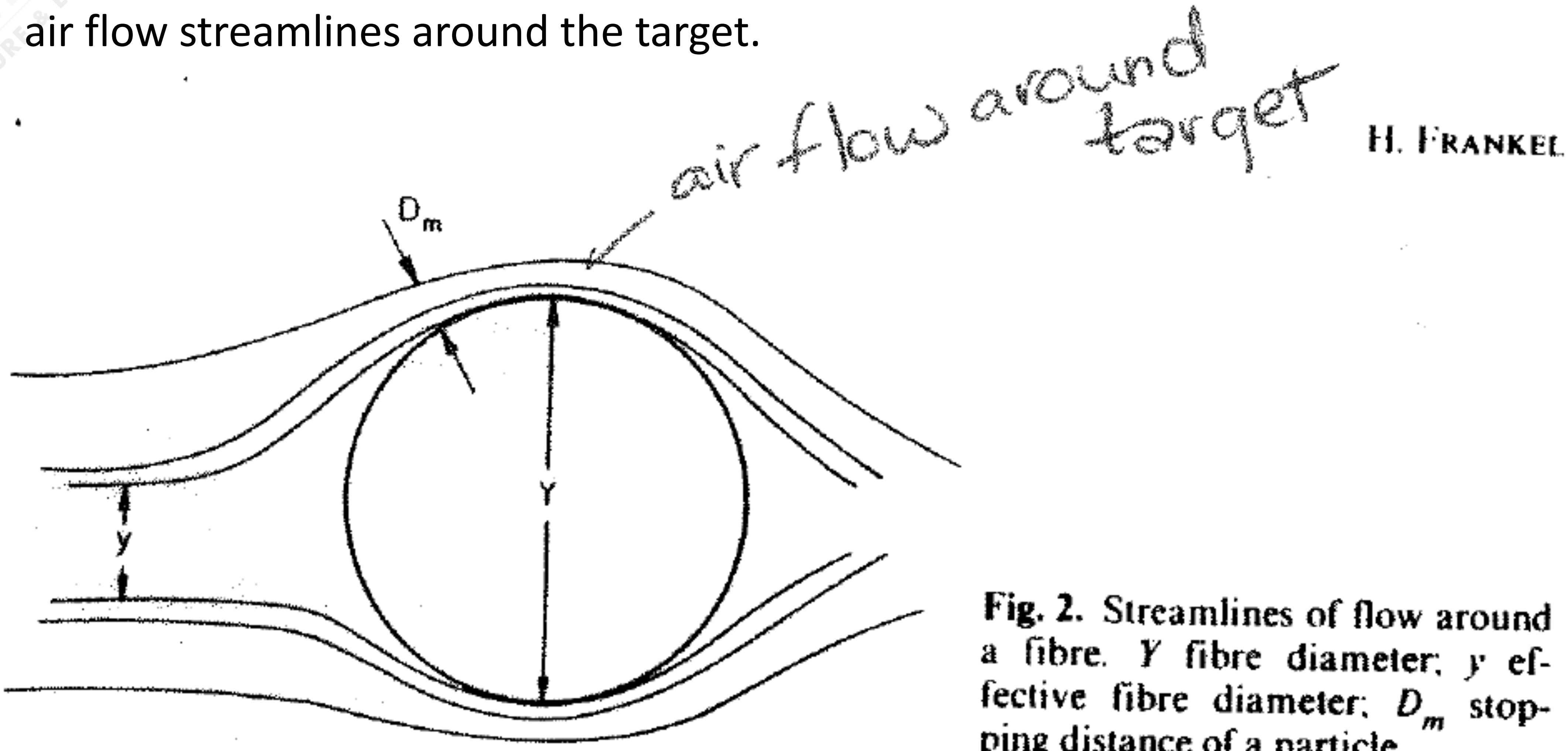



**Fig. 2.** Streamlines of flow around a fibre. $Y$ fibre diameter; $y$ effective fibre diameter; $D_m$ stopping distance of a particle



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# Selecting an air-assisted sprayer for your vineyard.

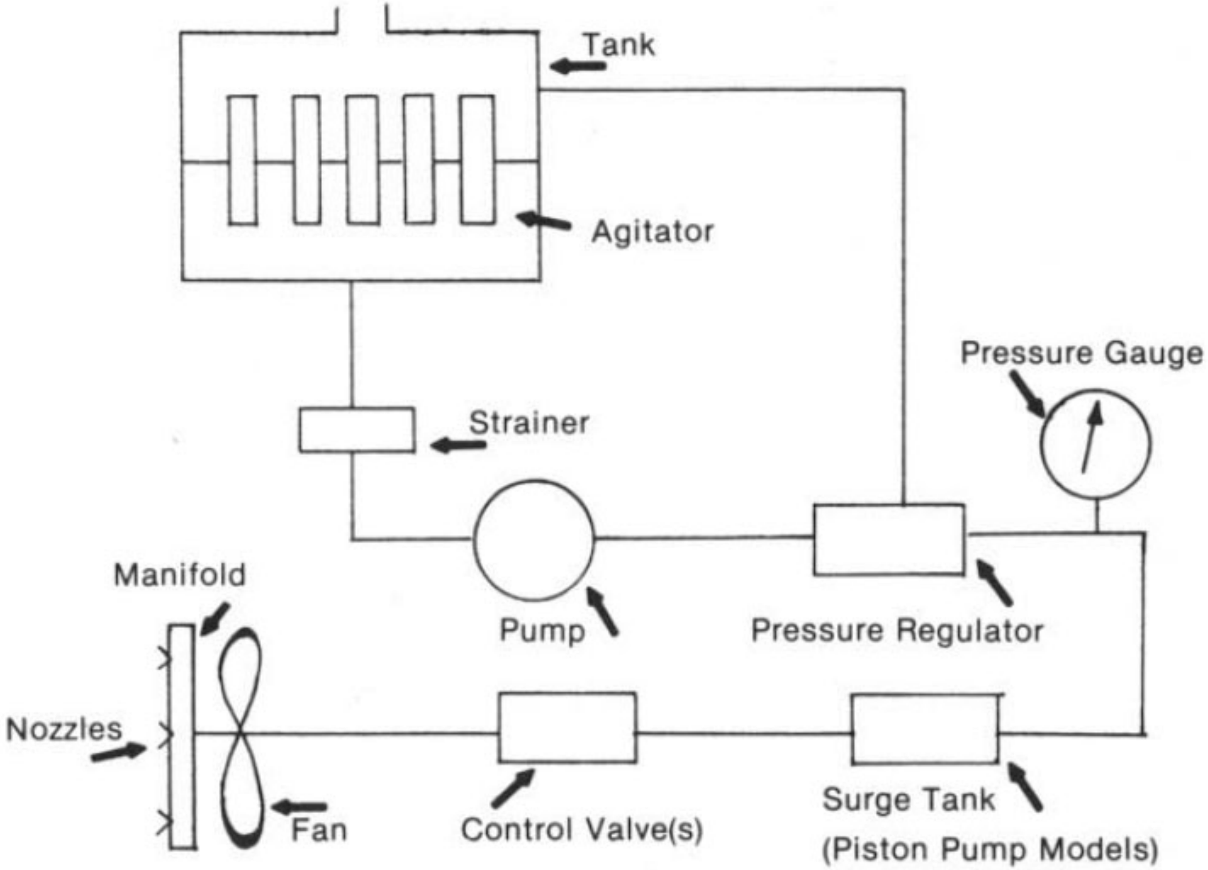
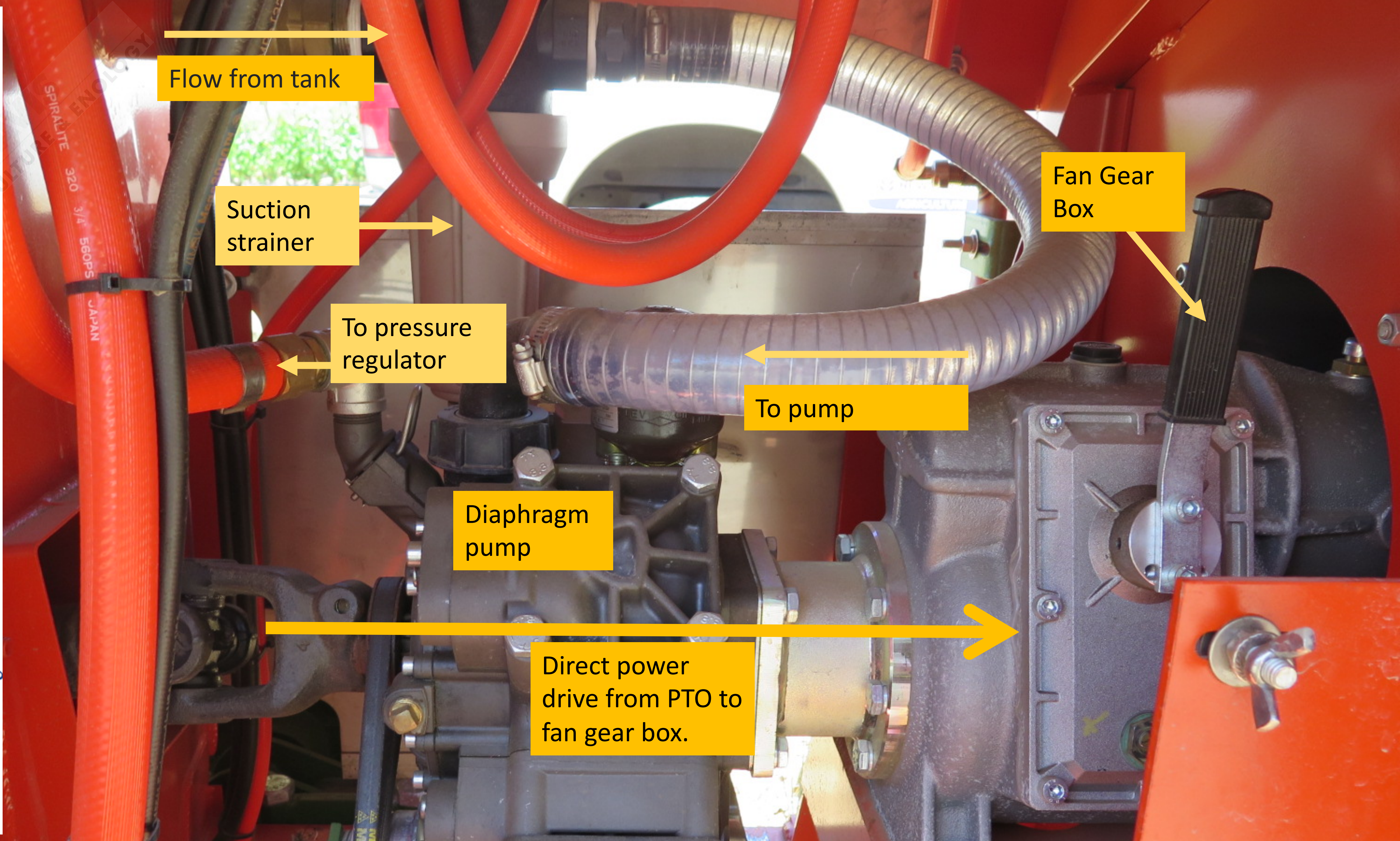



Figure 1. Basic Components of An Air Sprayer. (Adapted from Cromwell 1975.)

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Vine age, variety and r.s., health, site capacity and management affect canopy size.

**Sprayer should be matched to the canopy.**

*Some* adjustments can be made on *some* sprayers.



We see, generally, three types of sprayers working in vineyards.

Each has its fit.

Each spray job is unique.

*Canopy changes during the season.*

*Block to block changes.*

*Target pest.*

*Tank mix.*

*Weather that day, time.*

*Machine and set up.*

*People.*

Match the machine to the job as best as possible.

Airblast.
Axial fan (high volume)
High pressure
Disc-core or single piece (i.e. conejet) nozzles

Option: tower, mini-tower or "Trellis" modification


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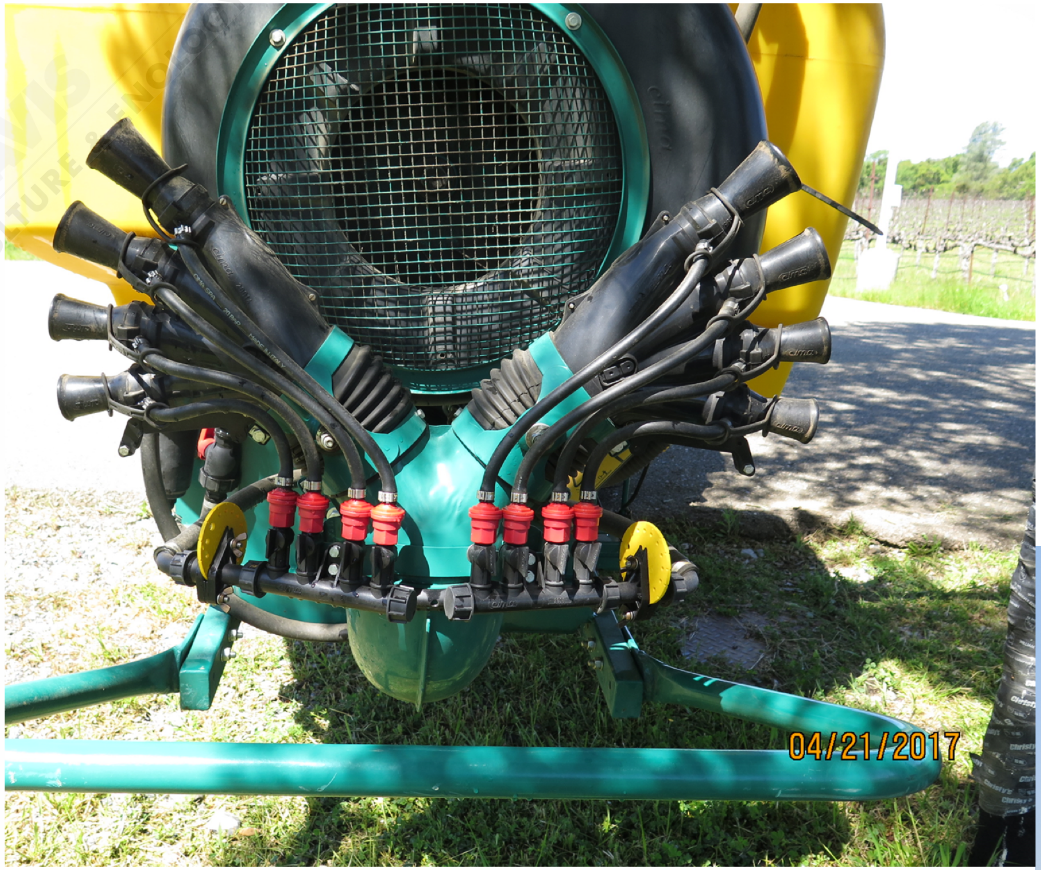


Low volume Venturi.

Centrifugal fan (lower volume, high speed)

Low pressure

Air-shear nozzle: dial a rate and outlet body


Option: over the row

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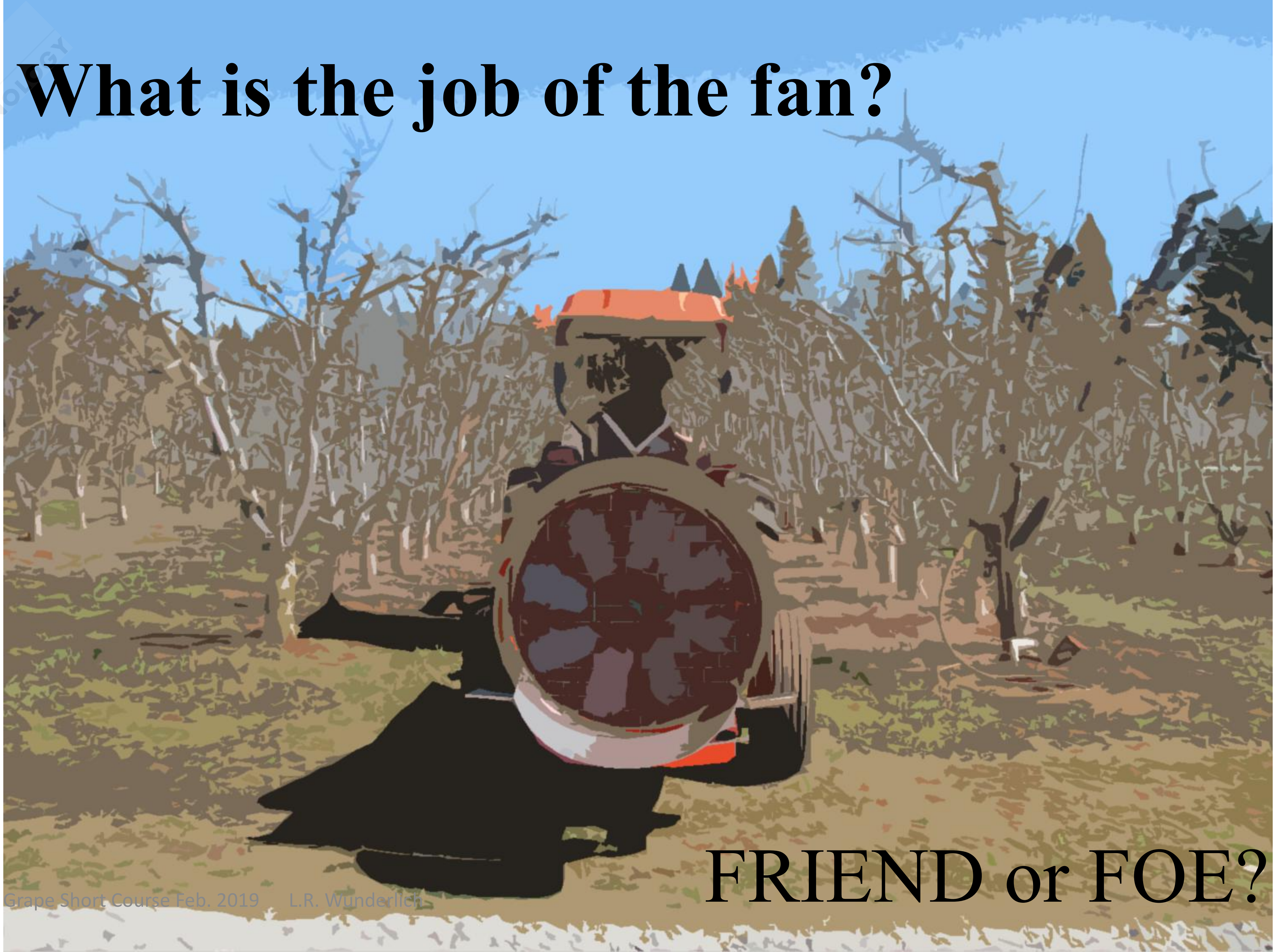
**Multi-function self propelled.**

**Harvesters fitted with attachments to increase their utility (spraying, thinning, pruning, etc.).**

**Can have either nozzle.**

# From Pellenc's website

# What is the job of the fan?



FRIEND or FOE?

# What is the job of the fan?

**Fan Essential Functions:**

Transport droplets to target.

Perturb canopy to increase penetration.

Improve deposition. Put air in motion so Force of Drag (friction again ambient air) works with us to move droplets to target.

Air-Shear: atomize droplets.

FRIEND

FOE

**Costs/Potential problems:**

Need POWER to move the fan. ($$)

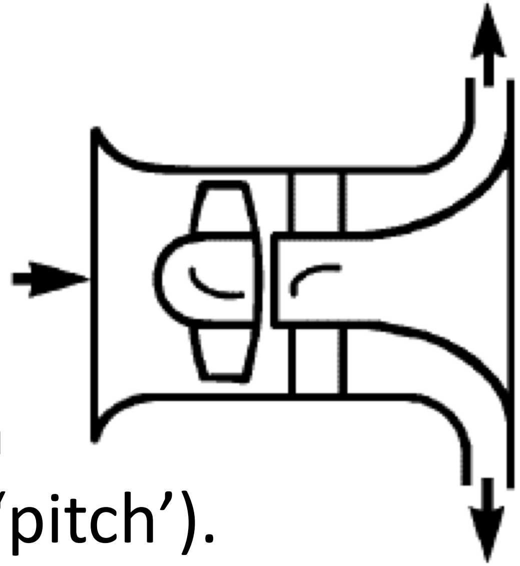
Air of fan will also be acted upon by Force of Drag-so velocity needs to be high at exit point.

Air of fan is diluted by ambient air (do the droplets reach the target?)

Can blast the droplets right through the canopy.

# Fan types:

## 1. Axial



HIGH air volume produced

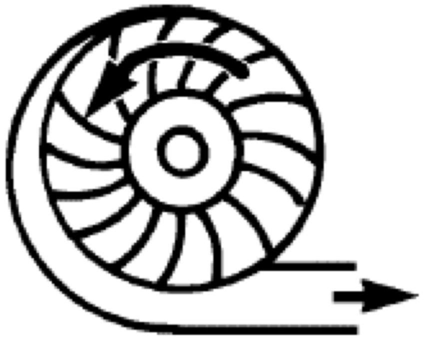
Low air speed

Low air pressure

Turbulent air moves canopy: spray penetration

Some axial fans have adjustable blade angles (‘pitch’).

## 2. Centrifugal



LOW air volume produced

High air speed

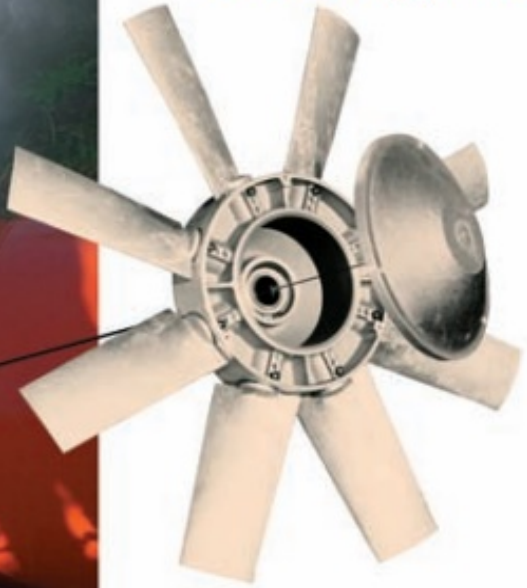
High air pressure

Typically has hoses attached to direct and localize air.

# Most important consideration: site specific CROP size

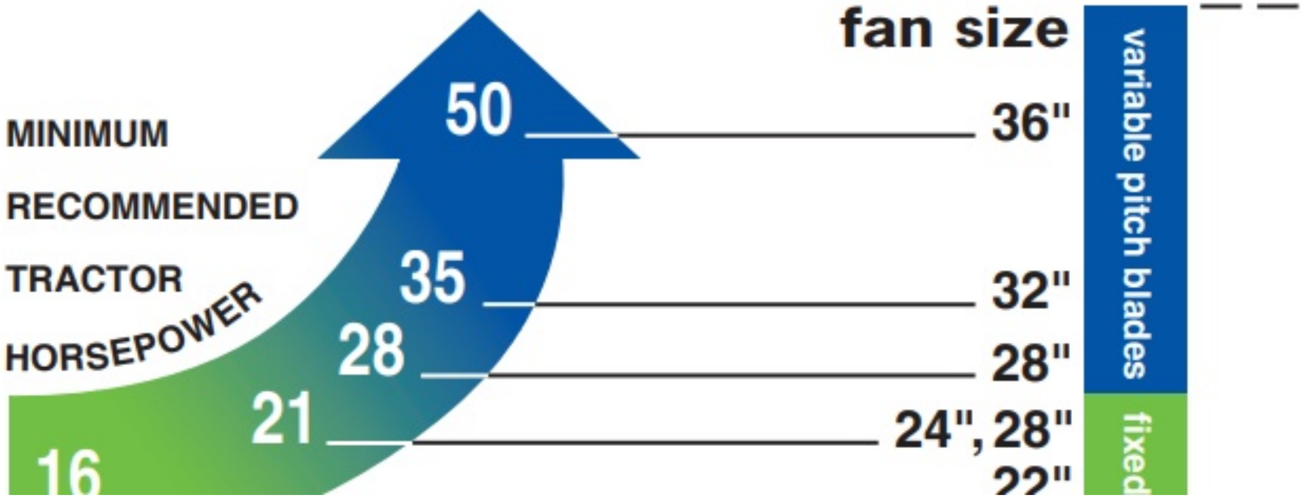
Rears Manufacturing Pul-blast literature

## selecting fan size.



The Pul-blast has a selection of a[…] flow fans ranging from 22"-36" […] fitted to its fan housing to produ[…] 22" and 24" diameter fans have six blades with a fixed pitch. 32" and 36" fans have 8 blades, each with a 3-position variable pitch. 28" diameter fans are available with 6 fixed blades or 8 variable pitch blades.

Louvered air straightening vanes are mounted in line with the fan to take the twist out of the air stream and equalize the velocity around the periphery of the air slot.



## Air volume

Volume is related to the aerodynamic characteristics of the blower housing and the rotation speed of the fan.

The theoretical volume ($m^3/h$) required for a given crop can be calculated:

$$\frac{1000 \times \text{speed (km/h)} \times \text{spray width (m)} \times \text{tree height (m)}}{3 \text{ (factor*)}} = \text{air volume } (m^3/h)$$

*For light foliage use factor 3.0 to 3.5, for dense foliage use factor 2.5 to 3.0

$m^3/h$

Source: Hardi Australia Mistblowing Technique

| Sprayer and fan type | Claimed Air Volume Output ($m^3/hr$) | 2.4 ft. * 3.25 ft.<br>Theoretical maximum speed to displace all air in 0.75m x 1.0m canopy (kph) | 5 ft. * 5 ft.<br>Theoretical maximum speed to displace all air in 1.5m x 1.5m canopy (kph) |
|---|---|---|---|
| Single row air shear, 500mm Turbine fan | 7550 | 4.7 | 1.6 |
| 2 Row air shear, 570mm Turbine fan 22.4 in. | 10300 6,059 $ft.^3/min$ | 6.4 3.9 mph | 2.2 1.4 mph |
| Single row ducted output 500mm Turbine | 7550 | 4.7 | 1.6 |
| 2 Row ducted 550mm Turbine | 14000 | 8.75 | 3.0 |
| Single row conventional air blast 900mm axial fan * 35.4 in | 85500 50,302 $ft.^3/min$ | 53.4 32 mph!! | 19.0 11.8 |
| 4 x 500mm boom -mounted fan heads per row, 2 entire rows sprayed | 96000 | 60.0 | 21.3 |

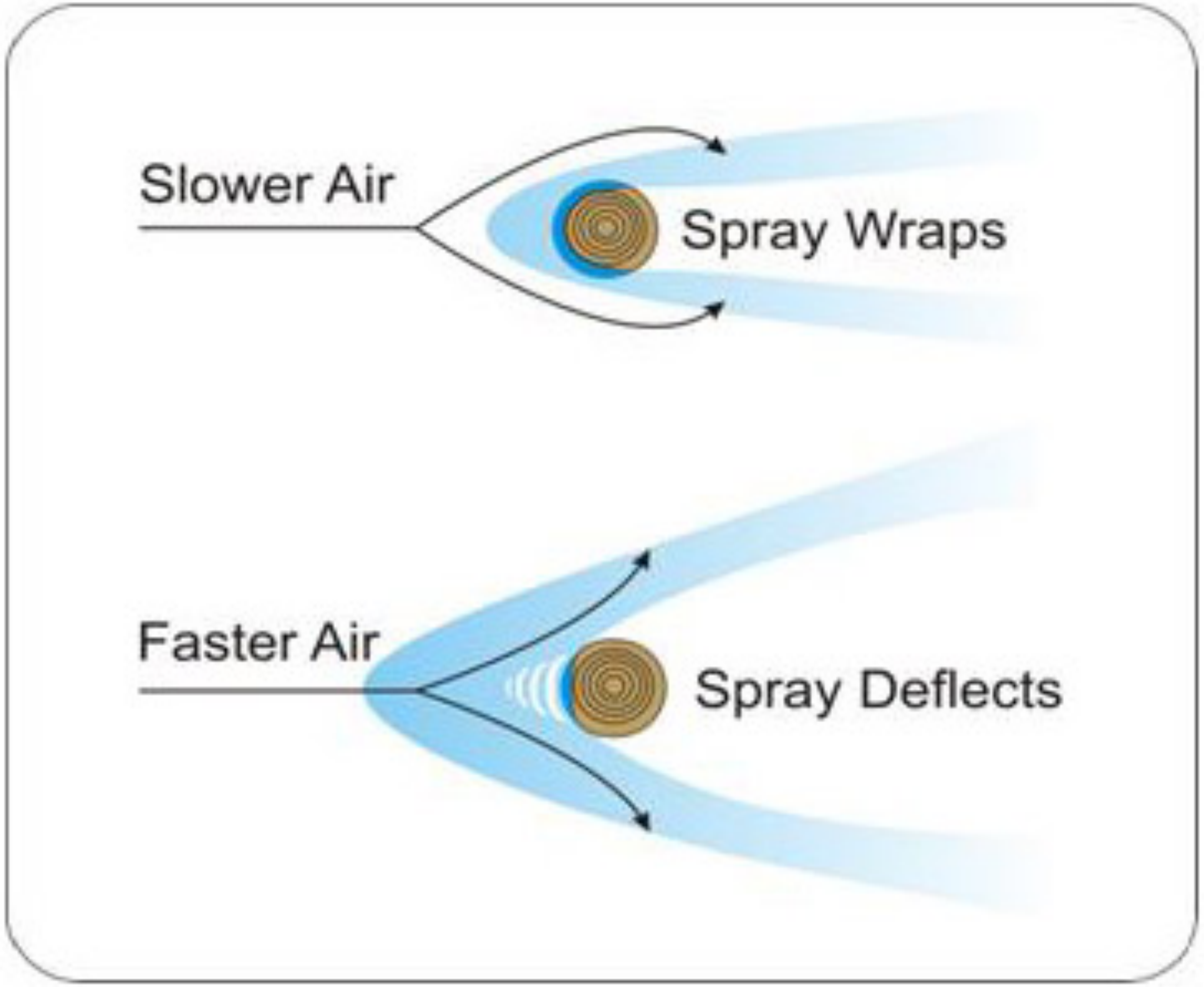
(* Assuming all air volume is directed at the canopy with veloutes)

**AIR volume needs to be considered in the context of the sprayer, the crop canopy AND the tractor speed.**

**There can be either too little or too much air-other adjustments may be necessary!**

From: Andrew Weeks and Adam Pietsch, CCW Co-operative Limited. 2011. Vineyard Spraying Principles

# SLOWER air can be desirable: better coverage on the "backside".



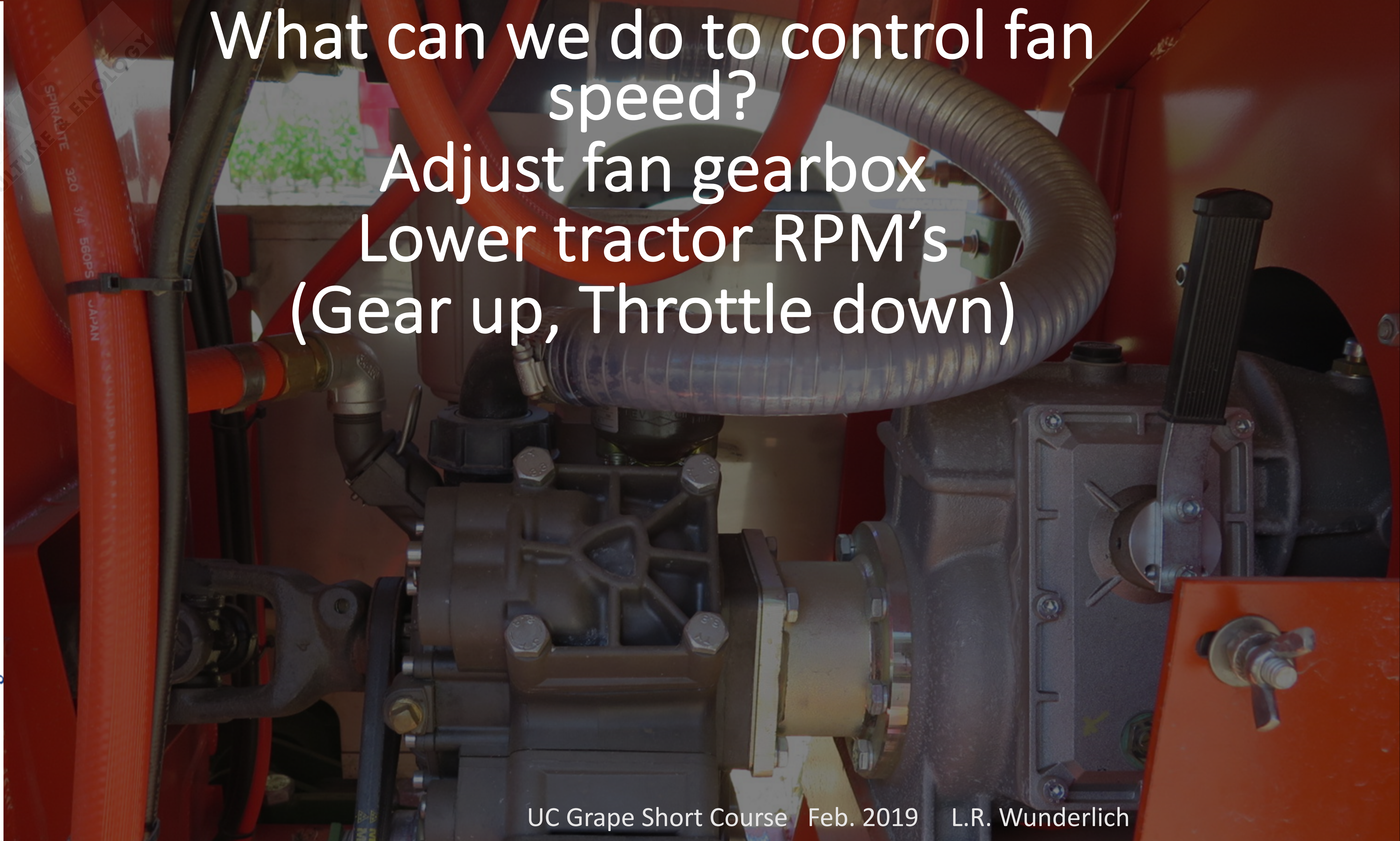

Credit: Jason S.T. Deveau - Application Technology Specialist/OMAFRA

# What can we do to control fan speed?

Adjust fan gearbox

Lower tractor RPM’s

(Gear up, Throttle down)





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# Early season sprays are a good time to look at using larger droplets, less fan.

# PUMPS: Typically Diaphragm or Piston (Positive displacement) or Centrifugal (Non-positive displacement). Make sure it can do your job!

<u>Use the following to determine pump capacity:</u>

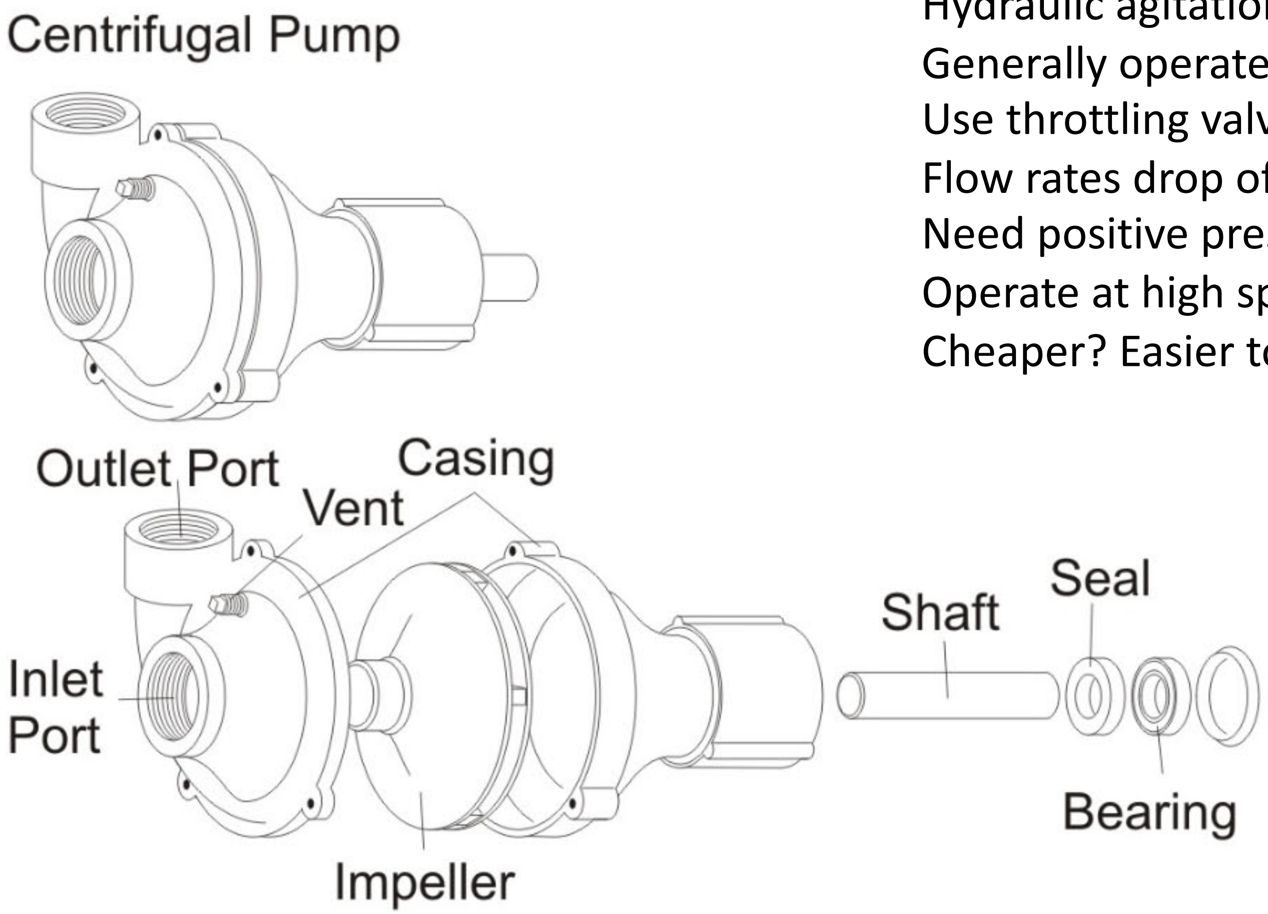
$$\text{Pump Capacity (gpm)} = \left( \begin{array}{l} \text{Boom Requirements (gpm)} + \\ \text{Agitation Requirements (gpm)} + \\ \text{Self Cleaning Strainers (gpm)} + \\ \text{Other Accessories (gpm)} + \\ \text{1 (gpm)} \end{array} \right) \times 1.2$$

Where:
Boom Requirements (gpm) = Number of nozzles x flow discharge per nozzle (gpm).
Agitation Requirements (gpm) = Use guidelines given
Self Cleaning Strainer (gpm) = Extra flow needed to clean strainer,
1 (gpm) = Extra flow to assure proper operation of the by-pass valve, and
1.2 = 20% extra capacity for pump wear.

From Grisso et.al. “Plumbing systems of agricultural sprayers”. Virginia Cooperative Extension Publication 442-452

**Design**

*Centrifugal Pumps*

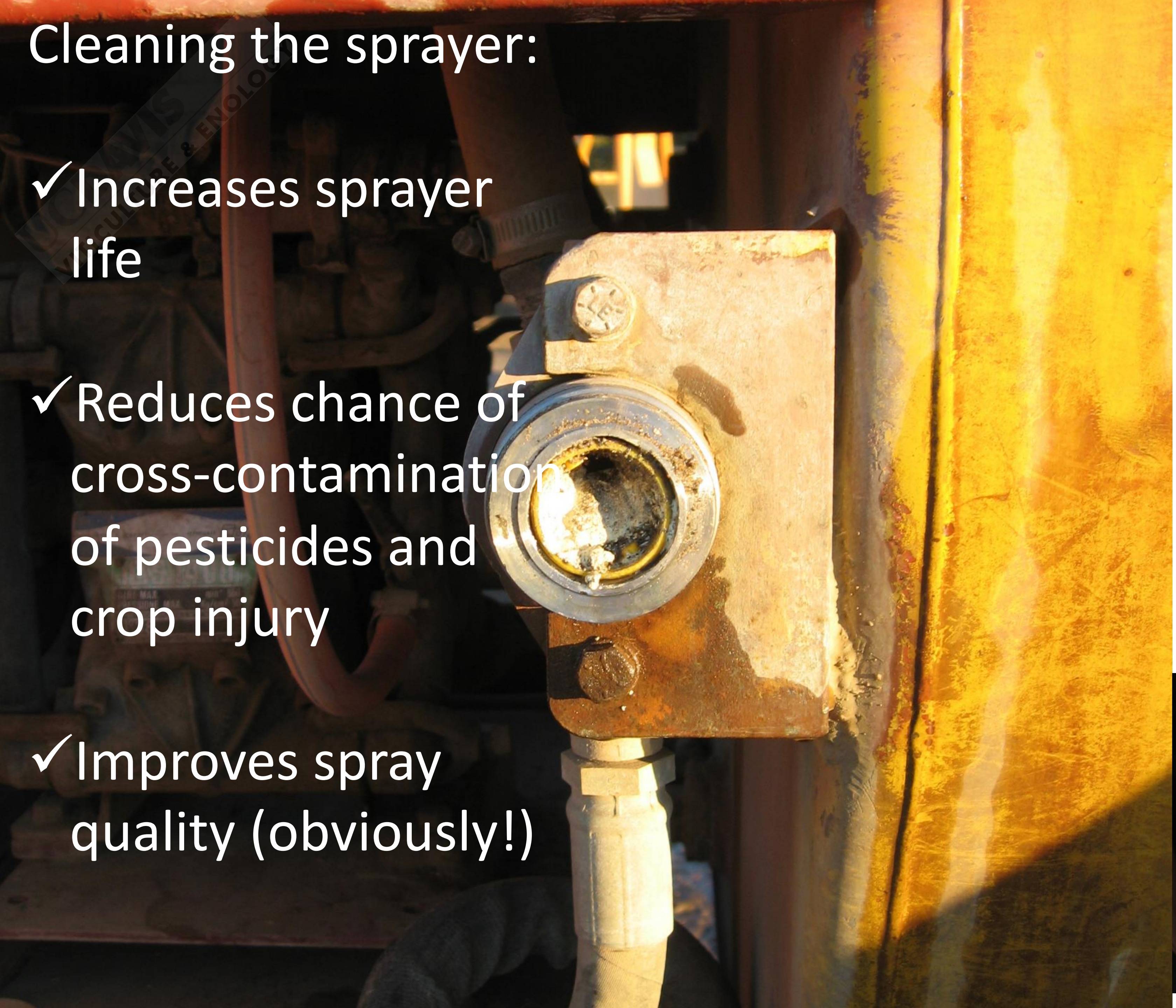



Centrifugal Pump – Exploded View.

- Handle “junk” well (wettable powders)
- HIGH flow rates
- Hydraulic agitation
- Generally operate at lower pressures (under 50 psi)
- Use throttling valve to regulate-not pressure relief valve
- Flow rates drop off with higher pressure
- Need positive pressure to prime-at “bottom” of sprayer
- Operate at high speeds-belts and pulleys, speed up gears
- Cheaper? Easier to maintain?

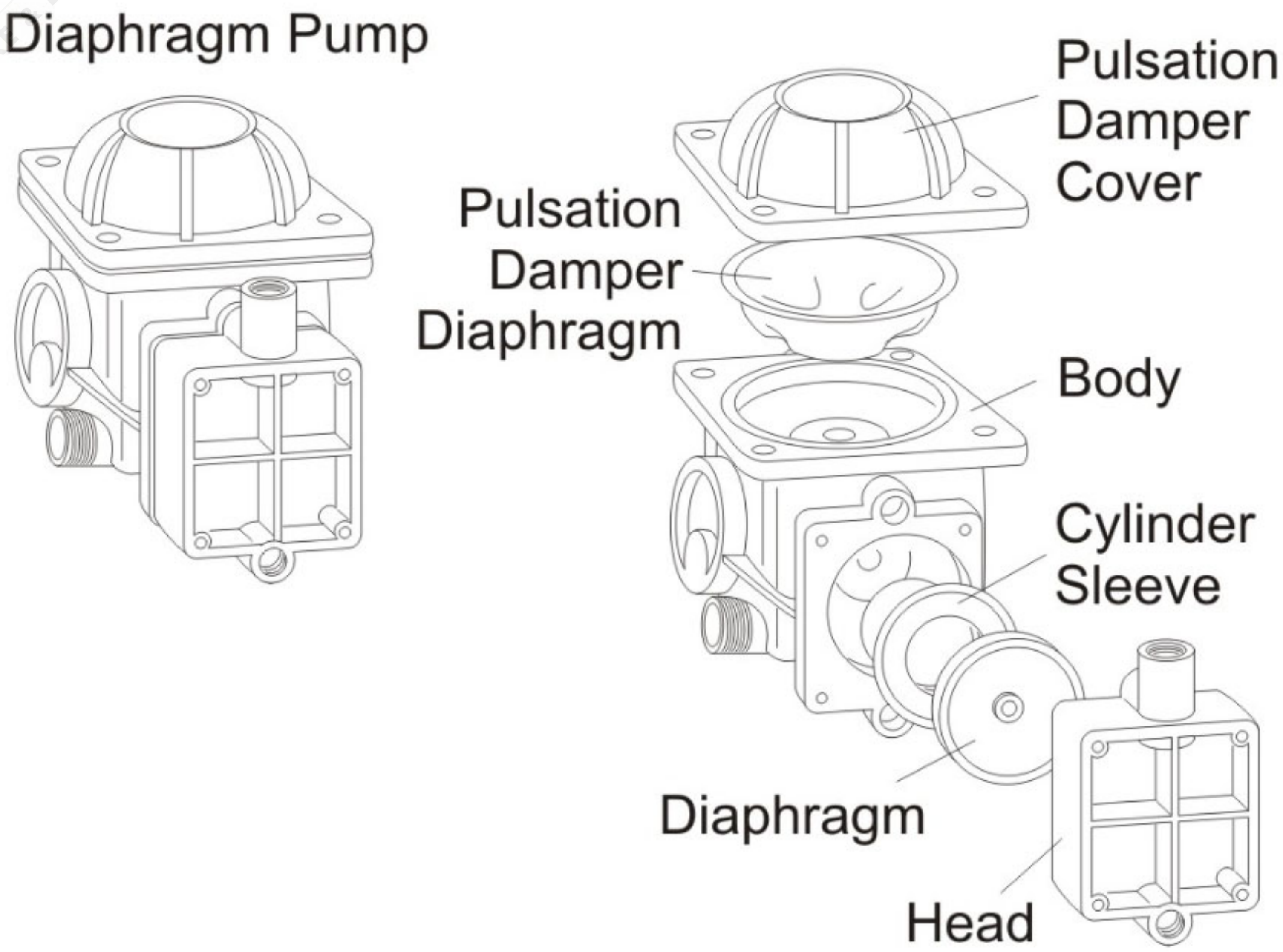
## Cleaning the sprayer:

- ✓ Increases sprayer life
- ✓ Reduces chance of cross-contamination of pesticides and crop injury
- ✓ Improves spray quality (obviously!)



SPRAY BASICS BOOM SPRAYERS SPECIALITY SPRAYERS MULTIMEDI






Diaphragm Pump – Exploded View.

"Positive Displacement" Pump (also piston, roller): flow output proportional to speed and independent of pressure.

High pressure capability
Good priming characteristics
Pressure relief valve
Pulse dampener

No matter what sprayer you choose, if you don't make adjustments to match the target and conditions, it won't work well.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# Spray Application Pest Management Alliance: Bringing Calibration Trainings to Northern California Applicators

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LoCA – The Wines of Lodi, CA

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