Calibration
Tools Needed for Calibration

- Stopwatch
- Measuring tape
- Calibrated liquid container
- Scale
- Calculator
- Pressure gauge
- Flow meter
- Flagging tape
Dry Applicators

Information needed

- Travel speed
- Swath width
- Output rate
Dry Applicators

- **Travel speed**
  - Measure under working conditions (full tank)
  - Don’t use speedometer – slippage
  - Measure and time
Dry Applicators

Swath Width

- Operate equipment under field conditions
- Place cans, trays, etc. at even intervals across swath
- Run spreader across plastic
- If applicator applies bands, measure bands and add
- Swath width = width of band x number of bands
Dry Applicators

- **Output rate**
  - Measure granules applied to known area
    - Swath width x tarp length
    - Tarp width x tarp length
  - Collect granules over a known time period
    - Similar to collecting from nozzles
    - For applicators with multiple ports
  - Refill hopper after a measured time
Liquid Sprayers

- Calibrate Frequently
  - Pump wear – decreases amount and pressure
  - Nozzle wear – increases volume of output
- Information needed
  - Tank capacity
  - Travel Speed
  - Flow rate
  - Swath width
Liquid Sprayers

- **Tank Capacity**
  - Physically measure
    - Mfg may est. size
    - Calibrate sight gauge
    - Dipstick
- **Travel speed**
  - Measure under working conditions (full tank)
  - Don’t use speedometer – slippage
  - Measure and time
Liquid Sprayers

- **Flow Rate (low-pressure systems)**
  - Measure actual output from nozzles
  - Measure in GPM
  - Run agitators
  - If PTO driven pump, make sure RPM’s same as used in speed calibration
  - Make sure pressure is correct
  - Variation among nozzles – 5%
  - Recheck all nozzles when nozzles are replaced
Liquid Sprayers

- **Flow Rate (air blast or high-pressure systems)**
  - Move to level spot
  - Fill tank to a level you can duplicate
  - Run at normal speed and pressure
  - Record time
  - Measure amount needed to refill
  - Repeat several times
  - Calculate GPM
Liquid Sprayers

Swath Width

- Solid boom
  - Number of nozzles x nozzle spacing
  - Adjust boom - 30% overlap of spray from nozzles

- Banded application
  - Swath width = width of band x number of nozzles

- Air blast sprayer (orchard)
  - Swath width = distance between plant rows (2 sided)
  - Swath width = 1/2 distance between plant rows (1 sided)
Spray Drift Factors

1. Applicator attitude
2. Equipment set-up
3. Viscosity of spray
   - a liquid’s resistance to flow
4. Weather conditions
Spray Drift Factors

- **Applicator Attitude**
  - Assess what sensitive sites are near the application area
    - No-spray buffer necessary?
  - Assess weather conditions: air stability, wind direction and speed
  - Set up equipment with appropriate boom height, nozzles, and pressure
  - Make decision to spray or not to spray
Spray Drift Factors

- **Equipment Set Up**
  - **Nozzle size and pressure** set to give an appropriate size droplet to reduce drift
    - Use nozzles that produce **medium and coarse droplet sizes**
      - Smaller orifice = smaller droplet
    - Use lower pressures
      - except with certain nozzles
  - **Boom height** - drift potential increases as distances increase
### Driftable Droplets

<table>
<thead>
<tr>
<th>Nozzle Type</th>
<th>Approximate Percent of Spray Volume Less Than 206 Microns</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR TeeJet® 110°</td>
<td>14%</td>
</tr>
<tr>
<td>XR TeeJet® 80°</td>
<td>6%</td>
</tr>
<tr>
<td>DG TeeJet® 110°</td>
<td>N/A</td>
</tr>
<tr>
<td>DG TeeJet® 80°</td>
<td>7%</td>
</tr>
<tr>
<td>TT – Turbo TeeJet®</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>TF – Turbo FloodJet®</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>AI TeeJet® 110°</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Data obtained by spraying water at room temperature under laboratory conditions.

### TwinJet® (TJ)

<table>
<thead>
<tr>
<th>PSI</th>
<th>29</th>
<th>38</th>
<th>44</th>
<th>51</th>
<th>58</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJ60-8001 F VF VF VF VF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-8002 F F F F F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-8003 F F F F F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-8004 M M M M F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-8006 M M M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-8008 C C M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-11002 C C C M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-11003 F F VF VF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-11004 M F F F F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-11006 M M M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ60-11010 M M M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Turbo FloodJet® (TF)

<table>
<thead>
<tr>
<th>PSI</th>
<th>29</th>
<th>36</th>
<th>44</th>
<th>51</th>
<th>58</th>
</tr>
</thead>
<tbody>
<tr>
<td>TF-2</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
</tr>
<tr>
<td>TF-2.5</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
</tr>
<tr>
<td>TF-3</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
</tr>
<tr>
<td>TF-4</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
</tr>
<tr>
<td>TF-5</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
</tr>
<tr>
<td>TF-7.5</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
</tr>
<tr>
<td>TF-10</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
<td>XC</td>
</tr>
</tbody>
</table>

### DG TeeJet® (DG)

<table>
<thead>
<tr>
<th>PSI</th>
<th>29</th>
<th>36</th>
<th>44</th>
<th>51</th>
<th>58</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG80015 M M M M F F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG8002 C M M M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG8003 C C M M M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG8004 C C C C M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG8005 C C C C C M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG110015 M F F F F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG11002 C M M M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG11003 C C M M M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG11004 C C C C M M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG11005 C C C C C M M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Droplet size classifications are based on BCPC specifications and in accordance with ASAE Standard S-572 at the date of printing. Classifications are subject to change.*

[www.TeeJet.com]
Spray Drift Factors

- Viscosity of Spray Mix
  - Thickness of spray batch
  - Invert emulsions – thick like mayonnaise – low drift formulation
  - Water-based formulations affected by evaporation: temperature and humidity
  - Drift-reducing adjuvants may form an increased number of larger droplets
Spray Drift Factors

Weather Conditions – Read the Wind

- What’s downwind?
  Direction

- How far will it move?
  Speed
  - 0-3 mph: could be very stable with airflow, just not sure which direction the air is moving
  - 3-7 mph: manage for off-target movement downwind
  - >7 mph: carries more material off-target
Spray Drift Factors

Weather Conditions

- **Temperature** – droplet evaporates to smaller droplets as temperatures increase
- **Humidity** – droplets do not evaporate as humidity increases
The Larger the Spray Droplet Size

The Less Distance the Droplet Drifts
Liquid Sprayers
Changing Sprayer Output

- Change speed
- Change pressure
- Change nozzle size

After changing one or more of these, you must recalibrate your sprayer
Determine the pumping rate (GPA) - simple measurement method

- Chose speed, pressure and nozzles
- Fill tank and operate to fill plumbing
- Refill tank and spray a measured area
- Spray an area large enough to use at least 10% of tank capacity
- Measure water required to refill tank
- This is application rate per unit area
Determine the pumping rate (GPA) - simple measurement method

- Measure ½ acre
- Spray area
- Refill tank and measure amount to refill
- If 10 gallons required to refill:

\[
10 \text{ gallons} \div \frac{1}{2} \text{ acre} = 20 \text{ gpa}
\]
Determine the pumping rate (GPM) – arithmetic method

- Fill spray tank and sprayer plumbing
- Put vehicle in neutral at throttle setting (rpm) desired
- Open spray valve and pump for a set time
- Collect liquid (water only) from each nozzle
- Add amount collected from each nozzle
- Divide the number of gallons to refill by pumping time
Determine the pumping rate (GPM) – arithmetic method

If it takes 10 gallons to refill your spray tank after operating the pump for 5 minutes, what is your pumping rate?

Pumping rate = gallons/min

10 gallons ÷ 5 minutes = 2 gallons/minute
Determine the pumping rate (GPM) – alternative calculation

Your boom has 10 nozzles. You collect an average of 12.8 ounces per nozzle for 30 seconds. What is your gpm?

\[
\begin{align*}
10\text{ nozzles} \times 12.8 &= 128\text{ oz} \\
128\text{ oz} &= 1\text{ gallon} \\
1\text{ gallon} \div 0.5\text{ minutes} &= \\
2\text{ gallons/minute}
\end{align*}
\]
Determine gallons per acre (GPA) – arithmetic method

- Determine the number of feet the sprayer moves at the desired speed and throttle
- Measure the width of the sprayer boom
- Determine the pumping rate (gpm)
- Calculate the area that the sprayer covered in one minute (distance traveled x boom width)
Determine gallons per acre (GPA) – area treated

- Your sprayer with a 20 ft boom traveled 435 feet in one minute. How many square feet were treated?

435 feet/minute x 20 feet =

8700 sq ft / minute
Determine gallons per acre (GPA) – minutes to treat one acre

Minutes/acre = \frac{\text{sq ft / acre} \times \text{minutes / sq ft}}{8700\text{ sq ft}}

\frac{43,560\text{ sq ft}}{1\text{ acre}} \times \frac{1\text{ minute}}{8700\text{ sq ft}} = \frac{43,560\text{ minutes}}{8700\text{ acres}}

5\text{ minutes / acre}
Determine gallons per acre (GPA) – calculate GPA

- GPA = gal / minute x minutes / acre

2 gallons / minute  x  5 minutes / acre =

2 x 5 =

10 gallons / acre
What is the pumping rate?

15 gallons in 5 minutes
Speed = 6 mph
Swath width = 15 feet

15 gallons/5 minutes = 3 gpm
1b
How many sq. ft covered in 1 minute?

How many feet are we traveling?

6 miles/hr
X
1 hr/60 min
X
5280 ft/1 mile =

528 ft/1 min

How many sq ft covered?

528 ft/1 min
X
15 ft/ boom(swath) =

7920 sq ft/min
1c
How many minutes to cover one acre?

1 min/7920 sq ft
X
43,560 sq ft/acre =

5.5 min/acre
1c revisited
How many acres covered in one minute?

\[
7920 \text{ sq ft/minute} \times 1 \text{ acre/ 43,560 sq ft} = 0.18 \text{ acres/min}
\]
1d
How many gallons applied per acre?

From 2a: 3 gal/min
From 2c: 0.18 acres/min

3 gal/min
X
1 min/0.18 acres =
16.6 gpa

OR

From 2c: 5.5 min/acre

3 gal/min
X
5.5 min/acre =
16.6 gpa
Problem 2

- What do we need to know first???
2a
How many acres covered by one tank?

300 gallons spray solution/tank
30 gallons/acre

300 gallons/tank
x
1acre/30 gallons
or
300/30 = 10 acres/tank
2b
How much of pesticide A do you need?

Apply one quart of A/acre
From 1a: cover 10 acres/tank

\[
10 \text{ acres/tank} \times 1 \text{ quart/acre} = 10 \text{ quarts/tank}
\]
2c
How much of pesticide B do you need?

Apply five pounds of B/acre
From 1a: cover 10 acres/tank

\[ 10 \text{ acres/tank} \times 5 \text{ pounds/acre} = 50 \text{ pounds/tank} \]
How much of pesticide C do you need?

Apply one gallon of C/acre
From 1a: cover 10 acres/tank

10 acres/tank
x
1 gallon/acre =

10 gallons/tank
Add surfactant at $\frac{1}{2}$ percent by volume

300 gallons spray solution per tank

$5\% = 0.05$

$1\% = 0.01$

$\frac{1}{2} \% = 0.005$

300 gallons/tank

$\times$

0.005 =

1.5 gallons/tank
4a

How many pounds product/acre?

80% WP; want 4 pounds a.i./acre
Tank treats 10 acres
Want 4# a.i./acre
Have 80% (0.8#)

4#/80 = X#/100
80X = 400
X = 5 pounds

4# a.i./acre / 0.8# a.i/prod = 5 # product/acre
4b
How many pounds product per tank?

10 acres/tank
X
5#/acre =

50#/tank
5a

How many gallons product per acre?

Liquid 6# a.i./gal; want 4 pounds a.i./acre
Tank treats 10 acres
Want 4# a.i./acre
Have 6# a.i./gal

6#/1 gal = 4#/X gal

6X = 4

X = 4/6

4# a.i./acre /6# a.i./gal = X = 0.67 # product/acre
5b

How many gallons product per tank?

10 acres/tank
X
0.67 gal/acre =

6.7 gallons/tank
How many acres will be treated?

Rate = 20#/acre
30 inch rows; apply in 14 inch band
14”/30” = 0.46 (X100% = 46%)

200 acres x 0.46 =

92 acres treated in bands
How much product do you need to buy?

Want 20# product/acre

20#/acre x 92 acres = 1840#

or

20#/acre x 200 acres = 4000#
4000# x 0.46 = 1840#
What is the pumping rate?

10 gallons in 5 minutes
Speed = 5 mph
Swath width = 20 feet

10 gallons/5 minutes = 2 gpm
## How many sq. ft covered in 1 minute?

<table>
<thead>
<tr>
<th>How many feet are we traveling?</th>
<th>How many sq ft covered?</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 miles/hr X 1 hr/60 min X 5280 ft/1 mile =</td>
<td>440 ft/1 min X 20 ft/boom(swath) = 8800 sq ft/min</td>
</tr>
<tr>
<td>440 ft/1 min</td>
<td></td>
</tr>
</tbody>
</table>
How many acres covered in one minute?

8800 sq ft/minute

\[ \times \]

1 acre/ 43,560 sq ft =

0.20 acres/min
7c revisited
How many minutes to cover one acre?

1 min/8800 sq ft
X
43,560 sq ft/acre =

4.95 min/acre
7d
How many gallons applied per acre?

From 2a: 2 gal/min
From 2c: 0.20 acres/min

2 gal/min
X
1 min/0.2 acres =
10 gpa

OR

From 2c: 4.95 min/acre

2 gal/min
X
4.95 min/acre =
9.9 gpa
How many acres covered by one tank?

250 gallons spray solution/tank
10 gallons/acre

250 gallons/tank
x
1 acre/10 gallons

or

250/10 = 25 acres/tank
8b
How much of pesticide A do you need?

Apply 1.5 quart of A/acre
From 1a: cover 10 acres/tank

25 acres/tank
x
1.5 quart/acre =

37.5 quarts/tank
How much of pesticide B do you need?

Apply 2 pounds of B/acre

From 1a: cover 10 acres/tank

25 acres/tank

x

2 pounds/acre =

50 pounds/tank
8d
How much of pesticide C do you need?
Apply 3/4 gallon of C/acre
From 1a: cover 10 acres/tank

25 acres/tank
x
0.75 gallon/acre =

18.75 gallons/tank
Add surfactant at 3/4 percent by volume

250 gallons spray solution per tank

5% = 0.05
1% = 0.01
3/4% = 0.0075

250 gallons/tank

x

0.0075 = 1.875 gallons/tank
10a
How many pounds product/acre?

75% WP; want 0.5 pounds a.i./acre
Tank treats 10 acres
Want 0.5 a.i./acre
Have 75% (0.75#)

0.5#/75 = X#/100
75X = 50
X = 0.67 pounds

0.5# a.i./acre / 0.75# a.i/prod =
0.67 # product/acre
10b

How many pounds product per tank?

10 acres/tank
X
0.67#/acre =

6.7#/tank
11a
How many gallons product per acre?

Liquid 4# a.i./gal; want 1.5 pounds a.i./acre
Tank treats 20 acres
Want 1.5# a.i./acre
Have 4# a.i./gal

$\frac{4\#}{1\text{ gal}} = \frac{1.5\#}{X\text{ gal}}$

$4X = 1.5$

$X = \frac{1.5}{4}$

$1.5\# \text{ a.i./acre} \div 4\# \text{ a.i./gal} = 0.375 \# \text{ product/acre}$
11b
How many gallons product per tank?

20 acres/tank
X
0.375 gal/acre =

7.5 gallons/tank
12a
How many acres will be treated?

Rate = 5 #/acre
36 inch rows; apply in 14 inch band
12”/36” = 0.33 (X100% = 33%)

300 acres x 0.33 =

100 acres treated in bands
12b
How much product do you need to buy?

Want 5# product/acre

5#/acre x 100 acres = 500#

or

5#/acre x 300 acres = 1500#

1500# x 0.33 = 499.99#
Read the label carefully and often. It is a violation of Federal Law to misuse a pesticide.
It is YOUR Responsibility