Equipment

CHAPTER 21
Learning Objectives

- Understand and be able to describe application methods covered in this chapter
- Be able to describe components of each (i.e. nozzles for sprayers)
- Know how to select application method
- Describe how to use & store safely
Application methods

- **Band application** - strips
- **Basal application** – directed to lower portions of brush or small trees
- **Broadcast application** over entire field
- **Directed spray** to pest, avoid non-targets
- **Foliar application** – to leafy parts
- **Rope or wick** – wipes herbicide on weeds
- **Spot treatment** – to small distinct areas
- **Soil application** directly on soil
- **Soil incorporation** tillage, rainfall, irrigation
- **Soil injection** under pressure beneath soil surface
- **Tree injection** under the bark
- **Space treatment** small distinct areas
- **Crack and crevice** of buildings (i.e. baseboards, cabinets)
Sprayers

Most pesticides applied as liquids

Sprayer selection

- Formulation to apply
- Spray volume and pressure
- Size of area to treat
- Components: tank, pressure, nozzle
Sprayer Components

**Tanks**
- Size reasonable to limit refills
- Does not corrode and cleanable
- Drain to clean out
- Large top opening for filling, cleaning and inspecting
- Watertight cover
- Agitation

**Pump**
- Supplies pressure and volume to nozzle
- Must resist corrosion
- Operate at recommended pressures, not higher
- Depends on spray liquid for lubrication
Sprayer components

Nozzle functions:
- Control amount applied
- Control droplet formation & size
- Control distribution and pattern
- Size of nozzle opening
  - Coarse droplets to minimize drift
  - Fine droplets for maximum surface coverage
- Target pest type of application coverage desired, potential for drift, label instruction

Nozzle Spray Patterns:
- Flat spray – require overlapping, even fan for band applications.
- Flooding – fertilizers, herbicides, defoliants, less drift potential
- Hollow and solid cone – handguns and row crops for crop protectants, penetrate foliage
- Multi-pattern – adjustable to pin stream, flat fan, cone

Materials:
- Hardened stainless steel
- Ceramic
- Plastic and nylon
- Stainless steel
- Aluminum
- Brass
Sprayers for liquid solutions:

Describe uses, delivery, and advantages, disadvantages.

- **Low pressure boom sprayer** – roller or centrifugal pump – dilute pesticide mixes, low volume cover large area quickly, hydraulic agitator.
- **High pressure (Hydraulic) sprayers** 200-500 psi– piston pumps, mechanical agitation, heavy, drift potential
- **High pressure handgun**
- **Airblast** – fan helps deliver pesticide to target, high or low volume spray, good coverage, high drift potential
- **Hand operated sprayers** – compressed air, no agitation, small jobs
- **Backpack** – various pump types, to 100 psi
Sprayers for **granular** applications:

Describe uses, delivery, and advantages, disadvantages.

- **Gravity feed** with adjustable opening to adjust flow rate.
- **Band, in furrow, and broadcast** applications used in agriculture
- **Rotary and drop spreaders** (more precise) in turf and small areas
- **Airblast** granular spreader for aquatic areas
Other applicator equipment:

Describe uses, delivery, and advantages, disadvantages.

- Rubs, walk-through, dipping vats for animals
- Bait dispensers for rodents, insects
- Foggers for indoor pests, and outdoor (mosquitos)
- Chemigation
- Dusters
- Aerosol cans
Engineering controls:

Describe how they reduce applicator exposure?

- Low drift nozzles
- Enclosed cab – wear PPE specified on label, supplement to PPE, replacement?
- Check valves
- Multiple nozzle bodies – in case of plugging
- Tank rinse systems, clean water supply mounted to sprayer for in-field rinsing
Cleaning equipment:
Describe why and how?

- Can contaminate future applications
- Hazard for equipment maintenance
- PPE specified on label + eye protection
- Clean at application site
- Clean outside, fill tank 1/3 full with tank cleaning agents as per label
- Compressed air for blowing nozzles
Prepare equipment for storage: Describe why and how?

Review steps on page 174

- Clean
- Touch up paint
- Lubricate wheel bearings
- Remove and clean nozzles, store in baggie
- Plug nozzle outlets with cork
- Remove and clean filter screens, O-rings
- Loose lid
- Winterize pump and store sprayer inside.
Questions?
Calibration
Chapter 24

- Define Calibration
- Purpose of Calibration
- Why is it important?
  What are the consequences of incorrect calibration?
- Label information
- How to prepare
- Using equations provided, determine:
  - Spray rate of equipment
  - Amount of granules that should be applied to an area
  - Ground speed of equipment
  - Dimensions of a suitable test area
- What 3 things can you change to adjust your spray rate?
- List factors affecting flow rate. How?
- Why do you need to recalibrate granular application between products?
Calibration

- **Calibration** – the measurement of the delivery rate of your application equipment under controlled conditions

- **Purpose** – To apply correct amount uniformly

**Over-apply**
- Waste product ($)
- Damage treated surface
- Higher risk to human health & environment

**Under-apply**
- Inadequate control
- Reapply = more $ and time

**In Either Case: Violating Label**
Calibration equipment:

- Stopwatch
- Tape measure 100 Ft.
- Collection container
- Graduated cylinder to measure output
  - Scale to weigh dry formulation
- Paper/pencil
- Calculator

**Label info:** spray rate or application rate

**PPE:** sprayer is likely to contain residues
Calibration Prep:

1. Clean nozzles, screens, disc/whirls
2. **Use clean water!**
3. Check nozzle size and manufacturer specs
4. Check for uniform spray pattern – boom
5. Measure output for each nozzle over given time with flowmeter or measuring cup
6. Change nozzles off by 5% of average
7. Measure travel speed
Calibration – Methods

- Known area method: gallons per acre
  1. Mark out an acre: 43560 ft$^2$ (~209 x 209 ft)
  2. Fill tank & spray the area
  3. Measure how much you need to refill

This is the amount / acre

No information on individual nozzle wear, uniformity!
Boom Sprayer Calibration

- Determine nozzle spacing
- Determine travel course length *(Check chart pg 197)*
- Measure time required to travel course
- Sprayer standing still – set pressure and rpm, catch water from each nozzle for time it takes to travel course

\[
\text{Average nozzle output} = \frac{\text{Calibrated Spray Rate}}{\text{in GPA}}
\]

\[
\text{Average nozzle output per nozzle in fl oz.}
\]

**How does this work?**
- You sprayed 1/128 of an acre per nozzle
- 1 fl oz = 1/128 of a gallon

So applying 1 fl oz per 1/128 acre is the same as 1 gal per acre
Airblast sprayer calibration

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<th>Part 2:</th>
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<td><a href="https://www.youtube.com/watch?v=eAfELjwlg5HI">https://www.youtube.com/watch?v=eAfELjwlg5HI</a></td>
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Attach hoses over nozzles and collect into buckets for 60 seconds = **GPM (gal per minute)**

| Check travel speed (ft/s x 0.682) | 5 ft/s  
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<tbody>
<tr>
<td></td>
<td>= 3.41 MPH</td>
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Measure between row spacing  

| Gal/acre = | 1 x 495  
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<tr>
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<td>3.41 x 14</td>
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<tr>
<td></td>
<td>= 22.8 gal/A</td>
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</table>
Hand sprayer calibration

- Fill sprayer to known level
- Mark area and measure square feet (length x width) 20 x 50
- Spray uniform pattern at constant speed
- Measure amount of water needed to refill sprayer = gallons per 1000 ft²
Granular Applicator – size, shape, density of product

- USE PPE since using actual chemical
- Set up test run area on driveway that can be swept (tarp) or place a bag or catch pan under spreader
- Spread over test area at intended speed
- Measure area of spread
- Sweep up material and measure amount collected
  
  \[ \text{Flow rate} = \frac{\text{lb}}{\text{area of spread}}, \text{ convert to lb/100 ft}^2 \]

*Flow rate depends on size, shape, & density of material – recalibrate each time you change products*
Changing Delivery Rate

- **Pressure**
  - for small changes
  - need 4x pressure to double output

- **Speed**
  - for small changes
  - proportional decrease in spray rate
  - Double speed to decrease rate by 1/2

- **Nozzle size**
  - preferred method of change
  - Start all over with calibration
Questions?
Calculations
Chapter 25

- Give reasons why it is important to add the correct amount of product and carrier
- Given formulas, calculate
  - Total area of site
  - How much spray mix and/or product you need
  - How much carrier/product to add to a spray tank
  - Total area you can spray is a full or partial tank
  - How much pesticide product it takes to apply a specific amount of a.i. per acre
  - How much pesticide product and carrier are needed to make a given percentage spray
- Convert the amount of spray mix and product from per acre to per 1000 ft² and vice versa
Why do we need to get it right?

**Over-apply**
- Waste product ($)
- Damage treated surface
- Higher risk to human health & environment

**Under-apply**
- Inadequate control
- Reapply = more $ and time

In Either Case: Violating Label
Need to know:

- Calculate area of site, ft\(^2\) or acres
- Total spray mix/product needed for spray?
- How much product in the tank?
- How much carrier (water) in tank?
- Total area sprayed with full tank?
- How much product to apply ai/acre?
- How much product/carrier for % spray.
- Convert rate per acre to rate/1000 ft\(^2\)
Standard Measure

- 1 acre = 43560 ft²
- 1 gallon of water weighs = 8.3 lb.
- 1 gallon of kerosene = 6.6 lb
- 1 lb. = 16 oz.
- 1 pt = 16 fl oz.
- 1 qt. = 32 fl oz.
- 1 lb. WP per 100 gal = 1 Tablespoon/gal
- 1 pt. EC per 100 gal = 1 tsp/gal
Determine spray volume needed?

You have 20 acres to treat, your sprayer is calibrated to spray 40 gallons/acre. How much total spray needed?

20 acres X 40 gallons/acre = 800 gallons
Determine number of tanks needed?

- You have 20 acres to treat, your sprayer is calibrated to spray 40 gallons/acre. How much total spray needed?
- 20 acres $\times$ 40 gallons/acre = 800 gallons of spray
- 500 gallons per tank =
  - $800/500 = 1.6$ tanks

How many gallons in partial tank?
Determine acres sprayed by each tank?

- 500 gallons per tank = 40 gallons per acre
  - 12.5 acres
- 300 gallons of spray = 7.5 acres

Or

12.5 acres x 0.6 tank = 7.5 acres
Determine how much product?

- Total acres treated x amount per acre = product to buy
  20 acres x 3 lb/acre = 60 lb. product

- Amount per tank =
  7.5 acres x 3 lb = 22.5 lb product
  12.5 acres x 3 lb = 37.5 lb product
How much product per 1000 ft²

- Herbicide from hand sprayer at 2 gallons/1000 ft² on 6500 ft²

  Spray volume needed?

  Total ft² x 2 gallons/1000 ft² = Total Gals 1000 ft²

  6500/1000 x 2 = 13 gallons of spray

- Number of tankfuls? 3 gallons/tank

  Gallons needed/tank capacity = # tanks

  13 gallons needed/3 gal/tank = 4.33 tanks
How much area per 3 gallon tank?

- Herbicide from hand sprayer at 2 gallons/1000 ft\(^2\) on 6500 ft\(^2\)

\[
\text{Gallons in tank} \times 1000 \text{ft}^2 = \text{area by tank} \\
\text{Gals/1000 ft}^2 \\
3/2 \times 1000 = 1500 \text{ ft}^2
\]

- If 5 oz/1000 ft\(^2\), how much pesticide/tank?

\[
\text{ft}^2 \text{ per tank/1000} \times 5 \text{ oz./1000} = \\
1500 \text{ ft}^2/1000 \times 5 \text{ oz.} = 7.5 \text{ oz./tank} \\
6500 \text{ ft}^2/1000 \times 5 \text{ oz.} = 32.5 \text{ oz. (2.03 lb)}
\]
Label rate – pounds a.i. per acre?

Label calls for 1 lb a.i. per acre.  
Pesticide product has 8 lbs. a.i. per gallon.  
How much pesticide product is needed?

\[
\text{lbs a.i. per acre} / \text{lb a.i. per gallon of product} = \text{gallons of product per acre}
\]

\[
\frac{1}{8} = \frac{1}{8} \text{ gallon or } 1 \text{ pt.}
\]

How much product per spray tank (500 gallons for 12.5 acre)?

\[
12.5 \text{ acres} \times 1 \text{ pt/acre} = 12.5 \text{ pt, 6 qt 8 oz}
\]

500 gal tank – 1.56 gallons product = 498.4 gal \( \text{H}_2\text{O} \)
Label rate – percentage spray mix?
liquid formulation – look at label chart!

Volume spray wanted \times \text{% spray wanted} = \text{volume product} - 100\%

Label calls for 3\% spray and need 3 gallons water.
How much pesticide/water is needed?

\[3 \text{ gallons} \times 3\% / 100\% = 3 \times 0.03 = 0.09 \text{ gallons}\]

\[0.09 \text{ gallons} \times 128 \text{ fl oz/gal} = 11.5 \text{ fl oz product}\]

How much water?

3 gallons - 0.09 gallons = 2.91 gallons

2.91 gallons = 2 gallons and 116.5 fl oz.