CHAPTER 11

Pesticide Application Procedures

This module will help you:

- Select appropriate application equipment and pesticide formulations
- Understand equipment components
- Determine pesticide application rates
- Choose drift reduction practices
Application Methods

- Broadcast
- Air, ground, boat
- Band
- Crack and crevice
Application Methods

- Spot
- Basal
- Space treatment
- Tree/stem injection
- Rope-wick or wiper treatment
Application Placement

- Foliar
- Soil injection
- Soil incorporation
- Tillage, rainfall, irrigation
Types of Safety Systems

- Closed mixing and loading systems
- Mechanical systems
- Water-soluble packets
- Enclosed cabs
- Pesticide Containment Pad
Closed Mixing and Loading Systems

- Prevent human contact with pesticides while mixing or loading

Benefits

- Increase human safety
- Reduce need for PPE
- Decrease likelihood of spilling
- Accurately measure pesticide
Closed Mixing and Loading Systems: Mechanical Systems

All in one system

- Remove pesticide product from container
  - by gravity or suction
- Rinse pesticide container
- Transfer pesticide and rinse solution to tank without being exposed to pesticide!
Closed Mixing and Loading Systems: Mechanical Systems

- Product specific
- Mini-bulk containers
  - 40-600 gallons
  - Pump, drive and meter units deliver accurate amount from mini-bulk container to sprayer
- Refill containers – eliminates waste
Closed Mixing and Loading Systems: Water-soluble packaging

- Easy system
- Unopened pesticide package is dropped into the mix tank
- Bag dissolves and pesticide is released into the tank
Enclosed Cabs

- May prevent exposure to pesticides if sealed correctly
- Supplement to PPE but not a replacement
- Consider cab contamination issues
Pesticide Containment System

Containment Pad

- Catch spills, leaks, overflows and wash water
- Prevent environmental contamination
- Impermeable material (sealed concrete, synthetic liners, glazed ceramic tile, etc.)
- System for recovering and removing material
Application Equipment

Hydraulic Sprayer

- Liquid
- Large power sprayers, small backpack and hand-held sprayers
Application Equipment

Air-blast sprayer

- Mist
- Uses air as the carrier

Ken Giles, UC Davis
Sprayer Components

- **Tank**
  - Non-corrosive and easily cleaned
  - Opening top and bottom for ease in filling and cleaning

- **Tank Agitator**
  - Provides continuous mixing of pesticide and carrier
Sprayer Components

- Pump
  - Provide pressure and volume to nozzles
  - Corrosion and abrasion resistant
  - Read manufacturer instructions

Roller pump
Sprayer Components

- Nozzle
  - Amount of material applied
  - Orifice size => droplet size
  - Distribution and droplet pattern

Coarse droplets
- minimize off-target drift

Fine droplets
- maximum surface coverage
Sprayer Components: Nozzles

- Material selection
  - Brass – don’t use with abrasive material
  - Plastic
  - Hardened Stainless Steel [Best if used with wettable powders and dry flowables]
  - Ceramic

Avoid application problems and replace all worn nozzles
Application Equipment

- Granular Applicators
  - Band or broadcast
  - Application rate affected by
    - Ground speed
    - Gate opening
    - Granule size, shape, and density
    - Terrain and weather conditions
Granular Applicators

Rotary Spreader
- Spinning disk or fan
- Heaviest granules thrown farther

Drop Spreader
- Gravity
- More precise application
Other Application Equipment

- Rubs, dipping vats
- Bait dispensers
- Foggers
- Dusters
- Chemigation
Equipment Calibration

What is meant by calibrating equipment?

Determine **volume applied per area**

- 18 gallons applied per 1 acre
- 13 ounces applied per 1,000 sq. ft
- Equivalent to:
  - 0.18 gals applied per 435.6 sq. ft
Equipment Calibration

Determine Application Rate (volume/area)

- Output = nozzles and pressure
- Sprayer speed
Equipment Calibration

1.6 feet x 100 feet
Nozzle spacing and calibration course length

Calibration = Volume applied per area

4 ounces per 160 ft²
Equipment Calibration

- Tools needed
  - Measuring tape, markers
  - Stopwatch
  - Scale or container with graduated volume
  - Tarp (granular)
Equipment Calibration

- Measure/mark a calibration area
- Apply using same technique when you will apply, time how long it takes
- Collect spray from one nozzle
- Multiply by number of nozzles
- Determine amount applied per area

15 feet x 200 feet
45 seconds

\[17 \text{ oz/nozzle} \times 10 = 170 \text{ oz per 3,000 square feet}\]
Calibration Formula

\[
\text{GPA} = \frac{5940 \times \text{nozzle output in GPM}}{\text{MPH} \times \text{nozzle spacing in INCHES}}
\]

- GPA – gallons per acre
- MPH – miles per hour
- GPM – gallons per minute

If using formulas, make sure you measure appropriate units.
Equipment Calibration

- Calibrate based on label rates
  - Acre
  - 1000 sq.ft.
  - 100 sq.ft.
- For accuracy, use the area stated
- Can use smaller unit area and covert, but you lose some accuracy
Equipment Calibration

Why is calibration important?

- Adjust equipment to get desired rate
- Achieve label rate for product delivery
  - Meet application volume requirements
- Effective pest control
- Does not waste money
- Personal and environmental safety
Equipment Calibration

How often should you calibrate?

- Periodically
- Any change in equipment set up
- Whenever change products

Calibration is important

Take the time to do it right and often
Oh no, Math!

- Equipment calibration and application requires basic math skills
- Remember, you can always refer to manuals for formulas but you need to know how to use the formulas
Area of Square/Rectangle

Area = Length x Width

125 ft × 40 ft = 5,000 sq.ft.

Area of Circle

Area = 3.14 × r²

r = 35 ft

3.14 × 35 ft × 35 ft = 3,846.5 sq.ft.
Triangular Areas

Area = \frac{\text{base} \times \text{height}}{2}

Area = \frac{20 \times 30}{2} = 300 \text{ sq. ft.}
Use a combination of shapes and add their areas:

Area = \( (B \times H \div 2) + (L_1 \times W_1) + (L_2 \times W_2) \)

\( (25 \times 25 \div 2) + (42 \times 30) + (31 \times 33) = 2,595 \text{ sq.ft.} \)
Irregularly Shaped Sites (from Univ. of Missouri – Lincoln)

How much of an acre is this area?

2,595 sq. ft. \( \div \) 43,560 sq. ft. = 0.06 Acres

REMEMBER:
43,560 square feet in 1 acre
Determining Application Rate

- Calibrated delivery rate of the sprayer is used to determine amount of pesticide concentrate you need and the amount of total spray mix needed

- READ THE LABEL!!!

- Don’t be proud, ask for help and have someone double check your calculations
Determining Application Rate

- Follow your units
  - 1000 square feet, acres
  - Gallons, quarts, pints, ounces
  - Ounces, pounds
  - Pounds of active ingredient

Read the Label and Watch Math Units!
Pesticide Math

You have a weed problem in a 40 ft. x 300 ft. turf area. The herbicide label says to apply 4 ounces of product per 1000 square feet. How many ounces of product do you need to comply with the label directions?

Area = 40 ft x 300 ft = 12,000 sq.ft.

12,000 sq.ft. ÷ 1,000 sq.ft. = 12 units

4 ounces x 12 units = 48 ounces needed
Pesticide Math

You have a sprayer calibrated to deliver 20 gallons per acre. Your sprayer has a 300 gallon tank. The label states to apply 2 quarts per acre. How many gallons of product do you need to fill the tank?

\[
\text{300 gallon tank} \div 20 \text{ GPA} = 15 \text{ acres covered} \\
15 \text{ acres} \times 2 \text{ quarts/acre} = 30 \text{ quarts} \\
30 \text{ quarts} \div 4 \text{ qts/gal} = 7.5 \text{ gallons}
\]
Pesticide Math: Cross multiplication

The label directs you to mix 1.5 quarts surfactant per 100 gallons of spray. How much surfactant do you need to make up 45 gallons of spray?

\[
\frac{1.5 \text{ quarts}}{100 \text{ gallons}} = \frac{? \text{ quarts}}{45 \text{ gallons}}
\]

\[
\frac{1.5 \text{ quarts}}{100 \text{ gallons}} = \frac{? \text{ quarts}}{45 \text{ gallons}} = \frac{1.5 \times 45 \text{ qts}}{100 \text{ gallons}} = ?
\]

\[
(1.5 \times 45) \div 100 = 0.675 \text{ quarts}
\]
Minimizing Drift

- Read the Label
- Volatility
- Equipment restrictions
- Droplet size restrictions
- New technology
- Buffers
- Wind direction/speed
- Temperature Inversions
Minimizing Drift

- Drift variables
  - Application equipment
    - Type of nozzle
    - Nozzle size and pressure
    - Sprayer speed – unstable boom
  - Distance from sprayer to target site
  - Drift adjuvants
  - Weather assessment

A. Felsot, WSU
WSDA
Minimizing Drift: Type of Nozzle

- Drift reduction nozzles
- Larger droplets are less likely to drift = larger orifice
- Read the label
Minimizing Drift: Spray Pressure

- Increase pressure 4 times to double the nozzle output – consider drift when changing pressure.
Minimizing Drift
Distance from target site

Reducing the distance a droplet must fall before hitting the target site, reduces drift potential.
Minimizing Drift
 Spray Adjuvants

- Several drift reduction adjuvants on the market
- Evaluate to ensure you get drift reduction
Lots of Decisions
Mistakes are Costly

- Target site and pest
- Pesticide choices and formulations
- PPE, closed systems
- Equipment selection set up, calibration
- Environment where application is to take place
Take the time to calibrate!

- Every sprayer needs to be calibrated
- Make sure applying correct amount of product
- Be a responsible pesticide applicator
Q1. Which of the following would contribute to minimizing drift potential?

1. Small nozzle orifice
2. 4 mph wind speed
3. High spray pressure
4. 1 ½ foot boom height

A. 1 and 3 only  
B. 2 and 4 only  
C. 1 and 4 only  
D. 3 and 2 only
Q2. Which type of application would you perform to treat a basement where there is evidence of a cockroach infestation?

A. Broadcast application
B. Dip
C. Basal application
D. Crack and crevice application
Q3. You need to treat a round golf green. The diameter of the golf green is 100 ft. The label rate is 3 oz. of product to 1,000 sq. ft. How much product do you need to treat the green? (area circle = $3.14 \times r^2$)

A. 23.5 ounces  
B. 47 ounces  
C. 94.2 ounces  
D. 62.7 ounces

\[
3.14 \times 50 \times 50 = 7,850 \\
3 \text{ oz} \times 7.85 = 23.5
\]
Acknowledgements

- Washington State University Urban IPM and Pesticide Safety Education Program authored this presentation

- Illustrations were provided by Kansas State University, University of Missouri-Lincoln, Virginia Tech., Washington State Dept. of Agriculture, Washington State University
Acknowledgements

- Presentation was reviewed by Beth Long, University of Tennessee; Ed Crow, Maryland Dept. of Agriculture; Jeanne Kasai, US EPA; and Susan Whitney King, University of Delaware

- Narration was provided by Carol Ramsay, Washington State University Urban IPM & Pesticide Safety Education
Support for this project was made possible through EPA Office of Pesticide Program cooperative agreements with the Council for Agricultural, Science and Technology, and the National Association of State Departments of Agriculture Research Foundation. The views expressed herein are those of the authors and do not necessarily represent the views and policies of the EPA.