Unit D: Agricultural Equipment Systems

Lesson 5: Operating, Calibrating, and Maintaining Spraying Systems
Terms

- Air sparging
- Atomization
- Control valves
- Nozzles
- Pressure gauge
- Pump
- Relief valve
- Screens
- Strainers
Objective #1

What are the types of sprayers?
Types of sprayers

- Hand operated sprayers
  - Operate in 35 to 275 kPa range
  - Commonly used by home gardeners
  - 4 to 20 liters in size and simple in design
  - Pressure provided by hand operated air pump
  - Air is compressed in tank forces liquid out

- Knapsack or back-pack sprayers
  - Small piston or diaphragm pump that is powered by hand or small gasoline engine
Types of Sprayers

- **Low-pressure sprayers**
  - Most widely used type of field applicators
  - Operated in 140 to 350 kPa range
  - Applies 20 to 230 liters per hectare
  - Relatively inexpensive

- **Controlled droplet applicators**
  - Apply low volumes of pesticide mixtures
  - 3.5 to 11 liters of spray mix per hectare
Types of sprayers

- High pressure sprayers
  - Similar to low pressure except capable of working with pressures of up to 6900 kPa
  - Force spray through dense foliage or tops of trees
  - Single nozzle on a hand gun to large units with multiple nozzles

- Air carrier
  - High speed air stream carries pesticide to the surface being treated
  - Capacities range 1,500 to 18,000 cubic meters per minute
Types of sprayers

- Air-boom sprayers
  - Uses a blower to carry small spray droplets into the target
  - Lowers volume of carrier used to better coverage and reduce drift

- Foggers
  - Apply pesticides in very fine droplets
  - Commonly used in confined spaces for insecticides
Types of Sprayers

- Rope wick applicators
  - Apply liquid herbicides by wiping it onto the weeds
  - Pesticide is in a pipe and a rope acts as the wick bringing out chemical to plant

- Direct injection systems
  - Holds undiluted pesticide and carrier in separate tanks
  - Undiluted pesticide is metered into nozzle line by pumps for blending with carrier
  - Eliminates need to mix chemical in spray tank
Hand Operated Sprayer

Back-pack Sprayer

Air-boom Sprayer

Low-pressure Sprayer
Rope wick Applicator

Direct Injection System

Insect Fogger

Air Carrier Sprayer
Objective #2

How are sprayers selected and what are their components?
3 basic functions of sprayers

- Storage of chemicals prior to application in the field
- Meter the quantity of material being applied
- Distribution of material into desired pattern
Sprayer selection factors

- Chemical being applied
- Application rate
- Crop being treated
- Required accuracy
MAJOR COMPONENTS
OF A SPRAYER

- Nozzles
- Control Valves
- Pressure Gauge
- Pressure Regulator
- Pipes and Hoses
- Pump
- Agitation System
- Frame
Sprayer components

4 Sprayer tanks
   - Sufficient capacity
   - Easy to fill and clean
   - Be corrosive resistant
   - Shape suitable for mounting and agitation

4 Agitator
   - Maintain a uniform mixture
Agitation systems

- **Mechanical**
  - Propellers mounted on a shaft near bottom of tank

- **Hydraulic**
  - Returns a portion of the pump output to tank

- **Air sparging**
  - Agitation by bubbling air through the liquid
Sprayer components

- **Pump**
  - Moves liquid from the tank to the nozzles and creates pressure to produce droplets
SOME PUMPS USED IN SPRAYERS

DIAPHRAGM PUMP

PISTON PUMP

ROLLER PUMP

CENTRIFUGAL PUMP

(Courtesy, Interstate Publishers, Inc.)
Types of pumps

- Diaphragm pump
  - Flexible diaphragm that produces the pumping action

- Centrifugal pump
  - Creates a high speed impeller that forces liquid out of pump
  - Not self priming
Types of pumps

- **Piston pump**
  - Self-priming
  - Pistons travel inside cylinders and force liquid through one way valves

- **Metering pump**
  - Driven by ground wheel
  - Ground speed changes so does the pumping rate proportionately
Types of Pumps

- **Roller pump**
  - Cylindrical rollers that move in and out of slots in a spinning rotor
  - As rotor spins creates space for liquid during half its rotation
  - Liquid is discharged from pumping chamber during remainder rotation
  - Self-priming
  - Easy to repair
  - Operate efficiently on PTOs
Sprayer components

- **Relief valve**
  - Safety device that releases liquid when pressure exceeds a safe level

- **Pressure gauge**
  - Used to measure the pressure in the system and valuable diagnosing tool

- **Strainers and screens**
  - Used to remove particles from the system
Screen & strainer locations

- **Tank screens**
  - Removes foreign materials when filling tank

- **Line strainers**
  - Removes foreign materials from reaching the pump

- **Nozzle strainers**
  - Removes foreign material from clogging nozzles
Sprayer components

- Pipes and hoses
  - Convey the liquid through the sprayer system
- Sprayer frames
  - Must be strong and durable
  - Be able to attach the nozzles
- Control valves
  - Used to start and stop the flow of liquid to the nozzle
Sprayer components

- **Nozzles**
  - Meter the liquid, atomize the liquid stream into droplets, and disperse the droplets in a specified pattern

- **Atomization**
  - Liquid breakup caused by the tearing action of the air
Selection of nozzle type and size

- Nozzle determines
  - Amount of spray applied to the area
  - Uniformity of the application
  - The coverage of the sprayed surface
  - Amount of drift

- Flow rate depends on the effective size of the orifice and pressure

- Described according to the shape of the application pattern
Nozzle types

- **Flat-fan nozzles**
  - apply uniform coverage across the entire width of the spray pattern, and should only be used for banding pesticides over the row.

- **Extended-range flat-fan nozzles**
  - frequently used for soil and foliar applications when better coverage is required.
Nozzle types

- Wide angle flat fan nozzles
  - allow for application over a wider area.
- Even spray nozzles
  - provide consistent, uniform coverage over the area.
Nozzle types

- Hollow cone nozzles
  - produce coverage around a plant without actually covering the plant

- Full cone nozzles
  - produce large droplets over a wide range of pressures
FIGURE 1: Flat fan spray pattern

FIGURE 2: Extended range flat fan spray pattern

FIGURE 3: Wide angle flat fan spray pattern

FIGURE 4: Even spray pattern

Overlap broadacre pattern

Band spray application

FIGURE 5: Hollow cone spray pattern

FIGURE 6: Full cone spray pattern
## Nozzle guide for band and directed spraying.

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Objective #3
How are sprayers operated?
Guidelines to use when spraying

- Decide to use a pesticide and which one
- Adjust and set sprayer based on label
- Calibrate sprayer
- Load the sprayer
  - Quantity of pesticide & procedure to follow while mixing pesticide
- Transport loaded sprayers as little as possible
- Maintain constant ground speed & pressure
- Monitor for plugged nozzles and leaks
Guidelines to use when spraying

- Clean the sprayer after each different pesticide
- Store the sprayer in a dry, clean building
A. Wash sprayer with brush and soapy water. Wear protective clothing, boots, gloves, hat, and goggles.

B. Hose off the machine.

C. Wash the tires with a brush.

D. Pump soapy water through the nozzles.
Objective #4

What are the procedures to follow when calibrating sprayers?
Calibrating a sprayer

- Proper calibration helps insure area being sprayed receives right amount of chemical
- Variables
  - Nozzle flow rate
  - Ground speed
  - Width sprayed/nozzle
Calibrating a sprayer

- Determine amount of pesticide, add the pesticide to partially filled tank of carrier, then add the carrier to desired level with continuous agitation.
- Operate the sprayer at proper ground speed and pressure in tank.
- Check nozzle flow rate frequently.
Objective #5

How are sprayers maintained?
Maintaining a sprayer

- Preventative maintenance will reduce chances of breakage, repair bills, & loss of time
- Adequate and timely adjustment, repair, lubrication, and protection from weather adds life to the sprayer
- Clean thoroughly inside and outside after each use and always wear protective clothing when cleaning
Review

- What are the types of sprayers?
- How are sprayers selected and what are their components?
- How are sprayers operated?
- What are the procedures to follow when calibrating sprayers?
- How are sprayers maintained?