4.1: Sprayers and Dusters

Sprayers and dusters are plant protection equipment used to apply pesticides (insecticides, fungicides, herbicides) onto crops, either in liquid (spray) or dry powder (dust) form, to control pests, diseases, and weeds.

4.2 Sprayers

Sprayers apply pesticide as a liquid formulation, broken into droplets, and deposited on the target (crop foliage, pest, or soil).

Basic components of a sprayer:

1. Tank – Holds the spray liquid (pesticide solution/suspension mixed with water).

2. Pump – Creates the pressure needed to force liquid through the nozzle and break it into droplets. Common pump types: piston, diaphragm, roller/rotary, or centrifugal, depending on sprayer type.

3. Pressure regulator/relief valve – Maintains constant, safe operating pressure and diverts excess liquid back to the tank.

4. Agitator – Keeps the spray liquid (especially wettable powder formulations) uniformly mixed, preventing settling.

5. Hose and lance/boom – Carries the pressurized liquid from the pump to the nozzle(s).

6. Nozzle – Breaks the liquid into droplets and forms the spray pattern (cone, flat fan, etc.); nozzle type and size determine droplet size and coverage.

7. Strainer/filter – Prevents clogging of nozzles by removing debris/undissolved particles from the spray liquid.

Classification of sprayers by power source:

- Manually operated – hand compression sprayer, knapsack (backpack) sprayer, foot sprayer.

- Power-operated – engine or battery/motor-driven, including power sprayers, tractor-mounted sprayers (covered in detail in later chapters).

4.3 Dusters

Dusters apply pesticide in dry, finely powdered form, relying on an air blast to carry and deposit the dust onto the crop.

Basic components of a duster:

1. Hopper – Holds the dust formulation.

2. Metering mechanism – Controls the rate of dust flow from the hopper to the air stream (commonly an adjustable gate or agitator-fed opening).

3. Fan/blower – Generates the air stream that carries the metered dust through the delivery tube and disperses it onto the crop.

4. Delivery tube/nozzle – Directs the dust-air mixture onto the target crop.

5. Power source – Hand-cranked (manual duster) or engine/motor-driven (power duster).

4.4 Comparison – Sprayers vs Dusters

Aspect	Sprayers	Dusters
Formulation used	Liquid (solution/suspension/emulsion)	Dry powder
Water requirement	Yes (carrier is water)	No water needed
Coverage/deposition	Generally better foliage coverage/adhesion	Lower adhesion; more prone to drift
Drift risk	Moderate (droplet-size dependent)	Higher (very fine dry particles drift more with wind)
Common use	Most widely used method for insecticides, fungicides, herbicides	Limited use; mainly for certain fungicide/insecticide dust formulations
Equipment complexity	Pump, pressure system required	Simpler; blower-based

4.5 Advantages and Limitations (General)

Sprayers

Advantages: wide range of pesticide formulations usable; good foliage coverage and adhesion; adjustable droplet size/pattern via nozzle selection.

Limitations: requires water (can be a constraint in water-scarce areas); more equipment components (pump, pressure system) needing maintenance.

Dusters

Advantages: no water required, useful where water is scarce; simple construction; quick application.

Limitations: higher drift risk (affecting operator safety and non-target areas); lower deposition efficiency on foliage compared to sprays; limited pesticide formulations available in dust form.

5.1: Hydraulic Sprayers

A hydraulic sprayer is a type of sprayer in which the spray liquid itself is pressurized by a pump, and this hydraulic pressure forces the liquid through a nozzle to break it into droplets. This is the most common and widely used principle of spraying in agriculture, as distinguished from pneumatic (air-carrier) or centrifugal (rotary disc) spraying principles.

5.2 Principle of Hydraulic Spraying

- A pump raises the pressure of the spray liquid in the tank/hose system.

- The pressurized liquid is forced through a small nozzle orifice.

- As the liquid passes through the nozzle orifice under pressure, it breaks up into fine droplets, forming a defined spray pattern (cone, flat fan, etc.) depending on nozzle design.

- Droplet size is influenced mainly by the operating pressure and the nozzle orifice size/type — generally, higher pressure produces finer droplets.

5.3 Main Components of a Hydraulic Sprayer

1. Tank – Holds the spray liquid; may be made of plastic, stainless steel, or brass depending on the sprayer type.

2. Pump – Generates hydraulic pressure. Common types used in hydraulic sprayers:

- Piston pump – reciprocating type, generates high pressure; common in knapsack and power sprayers.

- Diaphragm pump – uses a flexible diaphragm; suitable for abrasive/corrosive formulations as fewer wear parts contact the liquid directly.

- Roller/rotary pump – simple, moderate pressure, common in some power sprayers.

3. Pressure chamber/air chamber – Smooths out pulsations from a reciprocating pump, providing a steadier flow and pressure at the nozzle.

4. Pressure regulator/relief valve – Maintains the set working pressure and bypasses excess liquid back to the tank, protecting the system from over-pressurization.

5. Agitator – Mechanical or hydraulic (jet-type) agitation keeps wettable powder formulations in suspension.

6. Lance/boom and hose – Deliver pressurized liquid from the pump to the nozzle(s); a lance is used for hand-directed spraying, while a boom (with multiple nozzles) is used for wide-swath field spraying.

7. Nozzle – Converts pressurized liquid into a spray of droplets in a defined pattern. Common types: cone nozzle (hollow/solid cone, for orchard/high-volume spraying), flat fan nozzle (for uniform boom spraying), and others.

8. Pressure gauge – Displays the operating pressure, allowing the operator to maintain the recommended pressure for the nozzle/formulation being used.

5.4 Types of Hydraulic Sprayers

1. Manually operated hydraulic sprayers:

- Hand compression sprayer – tank pressurized manually before spraying; pressure gradually drops during use, requiring repeated pumping.

- Knapsack (backpack) sprayer – carried on the operator's back; a hand lever continuously operates the pump during spraying, maintaining more consistent pressure.

- Bucket/foot sprayer – pump operated by hand or foot while the tank/bucket remains stationary on the ground.

2. Power-operated hydraulic sprayers:

- Power-operated knapsack sprayer – small engine drives the pump, reducing operator effort.

- Tractor-mounted/PTO-driven boom sprayer – large tank and boom with multiple nozzles, powered by the tractor PTO; used for large-area field spraying.

5.5 Advantages of Hydraulic Sprayers

1. Simple, well-understood technology; widely available and serviceable.

2. Suitable for a wide range of pesticide formulations (solutions, suspensions, emulsions).

3. Nozzle selection allows flexibility in droplet size and spray pattern for different crops/targets.

4. Boom-mounted versions allow efficient coverage of large field areas in row crops.

5.6 Limitations

- Relatively high water requirement (as a carrier), which can be a constraint in water-scarce regions.

- Droplet size distribution can be relatively wide (compared to some specialized systems like ULV sprayers), affecting spray efficiency and drift.

- Nozzles are prone to clogging if the spray liquid is not properly filtered.

- Regular maintenance (pump seals, nozzles, pressure regulator) needed for consistent performance.

6.1: Power Sprayers

A power sprayer is a hydraulic sprayer in which the pump is driven by an engine (petrol/diesel) or electric motor instead of manual effort. Power sprayers are used where higher pressure, larger spray volume, and greater field capacity are needed than manually operated sprayers can provide — for example, orchard spraying, plantation crops, and large field areas.

6.2 Need for Power Sprayers

1. Manual sprayers have limited pressure and capacity, restricting output and coverage, especially for tall trees/orchard crops needing higher pressure to reach the canopy top.

2. Reduces operator fatigue, since pumping effort is eliminated (engine/motor drives the pump).

3. Higher and more consistent operating pressure gives finer droplets and better coverage.

4. Enables spraying of larger areas in less time, improving timeliness of pest/disease control.

6.3 Main Components of a Power Sprayer

1. Engine/motor – Small petrol/diesel engine or electric motor that drives the pump; power typically ranges from about 2–5 HP for portable power sprayers.

2. Pump – Usually a reciprocating (piston) pump capable of generating high pressure (commonly 20–40 kg/cm² or more), driven by the engine through a crank/connecting-rod mechanism.

3. Pressure chamber/air vessel – Dampens pulsation from the reciprocating pump, ensuring steady pressure and flow at the nozzle/lance.

4. Tank – May be a separate stationary tank (for stretcher/trolley-mounted or tractor-mounted types) or carried on the sprayer frame.

5. Delivery hose and lance(s) – Carry pressurized liquid to hand-held lance(s); power sprayers often allow multiple lances to be operated simultaneously from one unit, enabling more than one worker to spray at once.

6. Pressure regulator and pressure gauge – Maintain and display working pressure.

7. Nozzle – Delivers the fine spray onto the target; nozzle selection depends on crop and target pest/disease.

6.4 Types of Power Sprayers (Based on Configuration/Mounting)

1. Portable/stretcher-mounted power sprayer – The engine-pump unit is mounted on a frame that can be carried by two persons (stretcher-type) or mounted on a small trolley; connected to hand-held lances via hoses. Commonly used in orchards and plantations.

2. Knapsack (backpack) power sprayer – A small engine/motor drives the pump; the entire unit (including tank) is carried on the operator's back, giving mobility with power-driven pressure.

3. Trolley/wheel-mounted power sprayer – Engine, pump, and tank mounted on a wheeled trolley; pulled or pushed manually across the field/orchard, with lances connected via hose.

4. Tractor-mounted power sprayer – Pump driven by the tractor's PTO or engine; tank mounted on the tractor or a trailed unit; used for large-scale field or orchard spraying with a boom or multiple lances.

6.5 Advantages of Power Sprayers

1. High, consistent operating pressure gives fine, uniform droplets and better canopy penetration (important for tall crops/orchards).

2. Greater field capacity and faster coverage compared to manual sprayers.

3. Reduces operator fatigue (no manual pumping required).

4. Multiple lance operation possible from a single unit, increasing overall spraying capacity with additional workers.

6.6 Limitations

- Higher initial cost compared to manual sprayers.

- Requires fuel (petrol/diesel) or electricity, adding to operating cost.

- Needs regular engine/pump maintenance.

- Heavier and less convenient for very small or scattered plots compared to simple manual sprayers.

- Noise and engine exhaust can be a concern for prolonged use.

7.1: Mist Blowers

A mist blower (also called an air-blast/mist sprayer) is a plant protection equipment that uses a high-velocity air stream, rather than only hydraulic pressure, to break the spray liquid into fine droplets (mist) and carry them to the target. This principle allows effective penetration into

dense canopy (orchards, plantation crops) and coverage of the underside of leaves, which hydraulic sprayers may not reach as effectively.

7.2 Principle of Operation

- A high-speed fan/blower generates a strong air stream.

- The spray liquid is introduced into this air stream at a metered rate (often at a point near the fan outlet, or atomized by a small nozzle assisted by the airflow).

- The air stream shears the liquid into very fine droplets (mist) and simultaneously carries/propels them over a considerable distance into the crop canopy.

- Because the air blast itself carries the droplets deep into the foliage and even turns leaves to expose their undersides, mist blowers achieve good coverage with relatively low liquid volume (low-volume spraying) compared to conventional hydraulic sprayers.

7.3 Main Components of a Mist Blower

1. Engine/motor – Powers the high-speed fan/blower; petrol engines are common in portable/knapsack mist blowers.

2. Fan/blower unit – Centrifugal or axial-flow fan that generates the high-velocity air stream responsible for atomizing and carrying the spray liquid.

3. Spray tank – Holds the spray liquid (often smaller volume than hydraulic sprayers, since mist blowing is a low-volume technique).

4. Liquid metering system – Meters spray liquid into the air stream at a controlled rate (may use gravity flow with a metering valve, or a small pump for more precise control).

5. Discharge nozzle/outlet duct – Directs the air-liquid mixture toward the target crop; some models have adjustable or directional outlets/nozzles for different canopy heights and spray angles.

6. Carrying frame/harness – For portable knapsack-type mist blowers, allows the operator to carry the unit on the back.

7.4 Types of Mist Blowers

1. Portable (knapsack) mist blower – Engine, fan, and tank carried on the operator's back; hand-held/adjustable discharge outlet directed at the crop; used in orchards, plantations, and vegetable crops.

2. Vehicle/tractor-mounted mist blower – Larger fan and tank mounted on a trailer or tractor-drawn unit, used for large-scale orchard or plantation spraying, giving much greater output and area coverage per hour.

3. Air-blast orchard sprayer – A specialized, larger version primarily used in orchards; produces a powerful directed air blast to penetrate tree canopies from ground level.

7.5 Advantages of Mist Blowers

1. Excellent penetration into dense canopy and coverage of leaf undersides, due to the carrying power of the air stream.

2. Low volume of spray liquid required per unit area (low-volume technique), saving water and reducing the number of tank refills.

3. Faster area coverage compared to hydraulic sprayers, since fewer refills are needed and the air blast covers a wide effective swath.

4. Well suited for orchards, plantation crops, and dense-canopy field crops.

7.6 Limitations

- Fine droplets produced are more prone to drift under windy conditions, posing risk to non-target areas/organisms.

- Higher initial cost compared to simple hydraulic knapsack sprayers.

- Requires careful calibration, since low-volume application means the concentration of pesticide in the tank mix is typically higher (requiring careful handling and dosage accuracy).

- Not as effective for ground-level/low-growing crops as it is for tall/dense canopy crops.

- Noise levels can be high due to the powerful fan/blower and engine.