Lecture No –15/Ex. No.14 Plant Protection equipment's

Classification, types of spraying and types of dusting machines.
Study of Sprayers and Dusters

Sprayers: Sprayer is a machine to apply fluids in the form of droplets.

Sprayer is used for the following purposes:

1) **Application of herbicides to remove weeds.**
2) **Application of fungicides to minimize fungus discuses.**
3) **Application of insecticides to control insect pests.**
4) **Application of micronutrients on the plants.**

The main functions of sprayer are:

1. **To break the liquid into droplets of effective size.**
2. **To distribute them uniformly over the plants.**
3. **To regulate the amount of liquid to avoid excessive application.**

Desirable Quality of Sprayers:

a. **The sprayer should produce a steady stream of spray materials in the desired fineness of the particle so that the plants to be treated may be covered uniformly.**
b. **It should deliver the liquid at sufficient pressure so that it reaches all the foliage and spreads entirely over the sprayed surface.**
c. **It should be light in weight, sufficiently strong, easily workable and repairable.**

Basic Components of Sprayer: Components of a sprayer are as follows:

1. Nozzle body
2. Nozzle cap
3. Swirl plate
4. Spray gun
5. Spray boom
6. Filter
7. Over-Flow Pipe
8. Relief Valve
9. Pressure Regulator
10. Cut-off Valve
11. Nozzle Disc
12. Nozzle Boss
13. Nozzle tip
14. Spray lance

1. **Nozzle Body:** It is the main component on which other components of a nozzle fit.
2. **Nozzle Cap:** It is a component which retains the assembled parts in or on a nozzle body. The nozzle disc or tip may be integral with the cap.
3. **Swirl Plate:** It is the part of a cone nozzle which imparts rotation to liquid passing through it.
4. **Spray Gun:** It is a spray lance from which the spray is readily adjustable during the operation.
5. **Spray Boom:** It is a spray lance with spray nozzles fitted to a head, mounted at right angles to the lance.
6. **Filter:** It is a component to remove suspended matter larger than a predetermined size from fluid.

7. **Over-Flow Pipe:** It is a conduit through which excess fluid from a pump is by-passed by the action of a relief valve or pressure regulator.
8. **Relief Valve:** It is an automatic device which opens when the pressure of the fluid or gas reaches a predetermined valve.
9. **Pressure Regulator:** It is an automatic device to control the pressure of fluid or gas within a range of settings.
10. **Cut-off Valve**: It is a mechanism between the pump and the nozzle to control the flow of liquid from the sprayer. This is operated by hand.
11. **Nozzle Disc: It** is a component containing the final orifice of a nozzle usually a cone nozzle.
12. **Nozzle Boss: It** is a lug on spray boom or spray lance to which a nozzle body or cap is screwed.
13. **Nozzle Tip: It** is a component containing the final orifice of a nozzle usually a fen nozzle.
14. **Spray Lance: A** hand-held pipe through which the liquid reaches the nozzle mounted at the free end.

Types of Spray: Sprays may be: 1) High volume spray (more than 400 liters spray/ha), 2) Low volume spray (5 to 400 liters, per hectare), 3) Ultra low volume (ULV) Spray (less than 5 liters spray/ha.)

Spraying machines can be broadly classified into:

1. According to source of power:

1. **Hand Operated Machines: Suitable for small holdings, they are operated at the pressures ranging from 1 to7 kg/sq. cm.**
2. **Power Operated Machines: Suitable for treating a large area. They are operated at pressure from 20 to 55 kg/sq. cm.**
3. **Air planes: Suitable for large scale work.**

2. According to spray volume:

(i) High volume sprayer - More than 400 litres of spray liquid per hectare is used.

(ii) Low volume sprayer – Spray volume ranges between 5 to 400 liters' per hectare is used.

(iii) Ultra-Low volume sprayer – Spray volume less than 5 litres per hectare is used.

3. According to Energy conversion:

(i) Centrifugal (ii) Kinetic (iii) Hydraulic (iv) Gaseous

4. According to size of droplet:

(i) Aerosol- diameter below 50 *u* **(ii) Mist- 50 to 100 *u***

(iii) Fine- 100 to 400 *u* **(iv) Coarse- above 400 *u***

The selection of technique depends on type of vegetation, kind of pests and approach to the field.

1. **High Volume Spray:** The dilute liquids are applied by hydraulic machines. It consumers more time and labour.
2. **Low Volume Spray:** It uses air stream from a fan as a pesticide carrier with small quantities of liquid. There is saving of material and labour.
3. **Ultra-Lower Volume Spray:** ULV spraying can be defined as plant protection operation in which total volume of liquid applied amount to a few milliliters per acre. It is mainly used in air craft spraying.
4. **Foam Spraying:** In this system a foaming agent (chemical additive) is added to the spraying solution. The spray is passed through a special nozzle. This system is economical.

Ultra-Low Volume Sprayer:

The sprayer has a motor powered by 6 or12 volt battery. To the motor is attached a spinning disc, having grooves or teeth and rotates at a very high revolution per minutes (4000-9000). The spinning disc receives the concentrated chemical from a plastic container having a capacity of 1 liter (approx.). Average droplet size varies between 35 to100 microns. It is used for application of weedicide and for spraying small tress and crops.

Power Sprayer:

Power sprayers are operated usually with internal combustion engines. The prime mover capacity varies from 1 to 5 HP. The pressure pump is operated by a small power unit ensuring a constant steady pressure. They are operated at pressure from 20 to 55 kg/sq. cm. These machines are usually portable type. Sometimes, power sprayers are operated by the power take-off (PTO) shaft of the tractor besides being pulled by it. Some sprayers are tractor mounted and PTO operated also. A power sprayer essentially consists of: i) Prime mover ii) Tank iii) Agitator iv) Air-chamber v) Pressure gauge vi) Pressure regulator vii) Boom viii) Nozzles.

i. **Prime Mover:** Prime mover is needed to supply power to the power sprayer. It is usually internal combustion engine. The power generally varies from 1 to 5 H.P.
ii. **Tank:** Steel tank is widely used to prevent corrosion. Plastic tanks are also getting popular due to freedom from corrosion and ease of moulding into smooth shapes. A covered opening, fitted with a removable strainer is provided for easy filling, inspection and cleaning. A drain plug is there at the bottom of the tank for draining the liquid.
iii. **Agitator:** Agitators are needed to agitate the liquid of the tank. Propeller or paddle type mechanical agitators are provided for agitating the liquid. Horizontal shaft may be used with flat blades rotating at about 100 to 120 rev/ min. Paddle up speeds in excess of 2.5 m/see may cause foaming.
iv. **Air Chamber:** An air chamber is provided on the discharge line of the pump to level out the pulsations of the pump there by providing a constant nozzle pressure.
v. **Pressure Gauge:** The pressure gauge is provided on the discharge line to guide the operator regarding spray pressure. The spray pressure should be under specified limit.

vi. **Pressure Regulator:** It is meant for adjusting the pressure of the sprayer according to the requirement of the crops in the field.

vii. **Strainer:** A strainer is included in the suction line between the tank and the pump to remove dust, dirt and other foreign materials.

viii. **Boom:** Field sprayer to be driven by a tractor has a long boom in a horizontal place on which nozzles are fixed at specified spacing. The boom can be adjusted vertically to suit the height of plants in different fields.

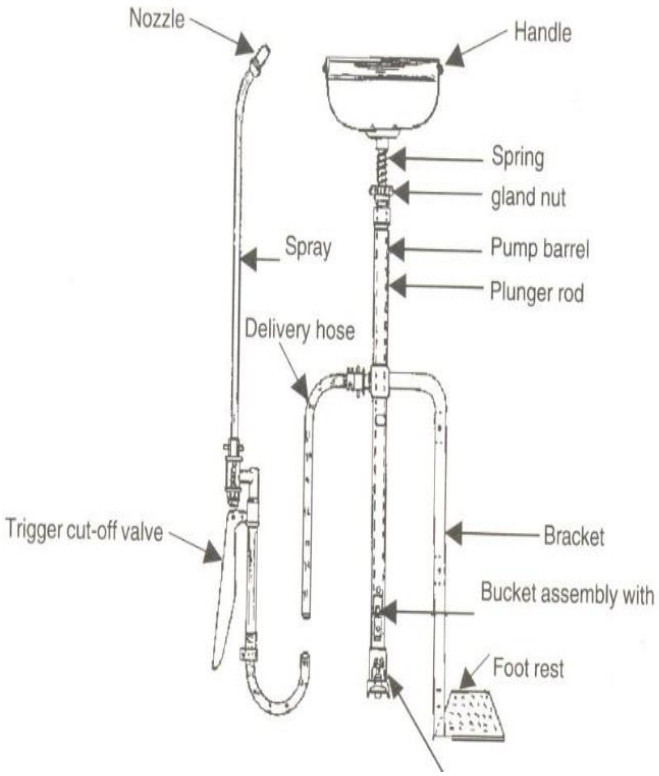
ix. **Nozzle:** It is used to break the liquid into the desired spray and deliver it to plants. A nozzle consists of: (a) body (b) Screw cap (c) Disc (d) Washer (e) Vortex plate (f) Strainer.

The body of the nozzle and the screw cap hold all the other parts in place. The disc has a number of holes including one hole in the centre and they are usually numbered from one to ten to denote the diameter of the hole. Each number usually denotes about 0.4 mm. The disc needs replacement, when the holes get enlarged due to constant use. The washer under the disc is provided to prevent leakage of the liquid.

Types of sprayers

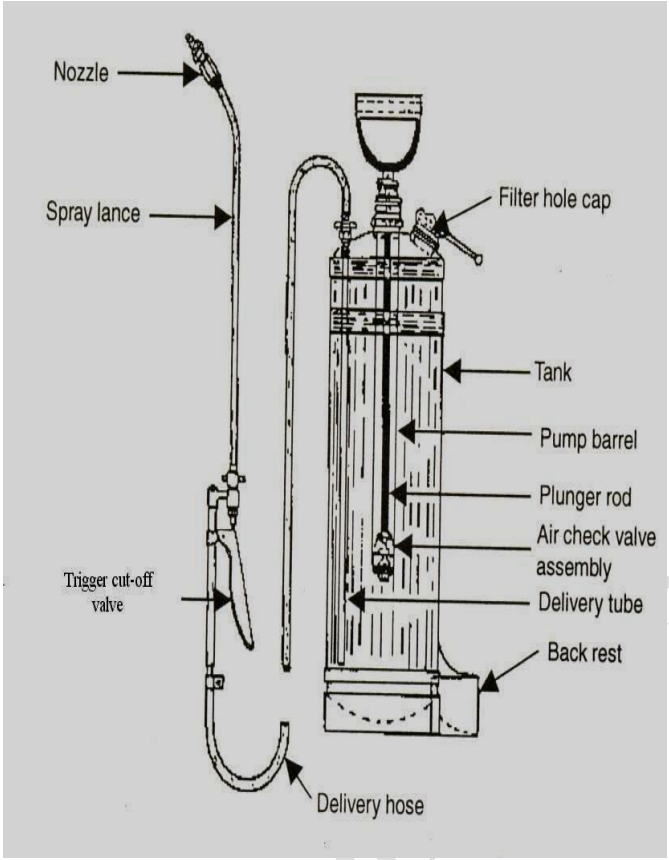
1. Bucket Type Sprayer

This equipment consists of a single or double pump which may be placed into any ordinary bucket containing spraying solution. It is very light and easily handled and development sufficient pressure to spray small gardens and low trees.



2. Knapsack Sprayer

The common type of knapsack sprayer is provided with a pump and large air chamber permanently mounted in a 9 to 22.5 liters tank. The apparatus is quite useful for spraying small trees, shrubs and row crops. One man can spray about 0.4 ha. in a day thus spraying about 90 liters of liquid.



3. Compression Sprayer

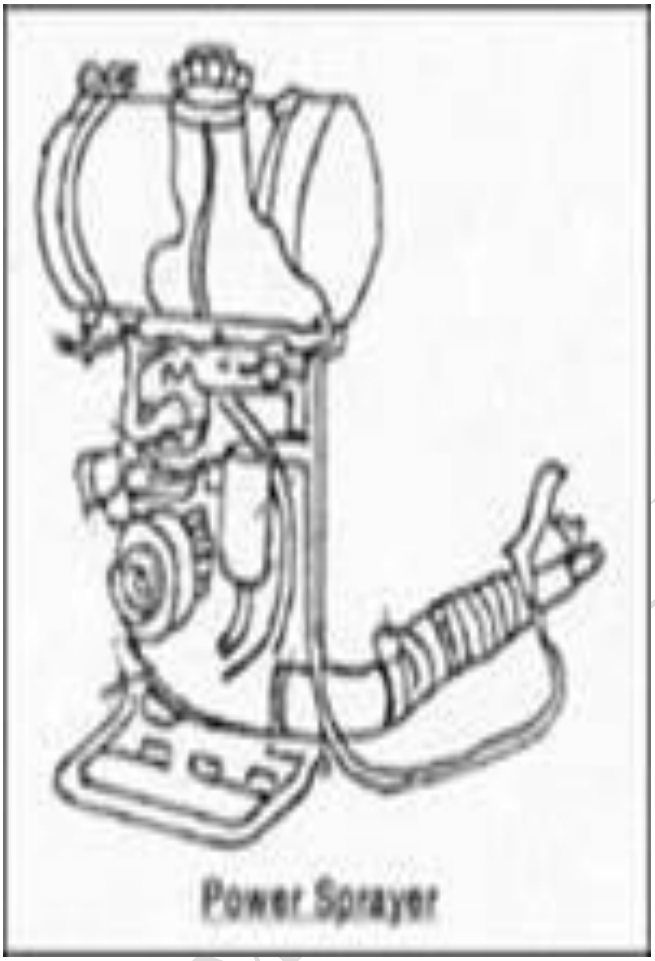
It consists of an air pump mounted in an air tight chamber which is filled (3/4)the with spraying material. The pressure is developed by pumping air into the tank and the spray is forced out under pressure. The tank capacity is usually 14 liters and frequently pumping is to be done to maintain the pressure.

4. Hand Atomizer

This is the smallest type of hand sprayer used to treat the plants in home garden or nursery and to apply fly spray in the house. In this instrument compressed air is allowed to pass over the end of tube of which the other end dips into the spray material. Blowing air sucks the material through the tube and blows it out of the nozzles as mist.

5. Engine Powered Sprayers

These machines are usually portable types. Since the sprayer pump is driven by an engine there is no variation in output, pressure and performance of the P.T.O. shaft of the tractor besides being pulled by it.



6. Air Plane Sprayers

Either centrifugal pump of a gear pump is used to force the spray liquid through the nozzles. These pumps work at the pressure of about 2.8 to 8.5 kg/cm^2. The pump sets its driven from a wind driven propeller having four to six bland. The tank capacity may range between 450 to 2550 liters.

Care and maintenance of sprayer:

(i) All washers and packings should be soaked in oil or water before use.

(ii) The ends of the nozzle should be unscrewed and cleaned before starting the work.

(iii) When spraying is over, the sprayer should be operated for sometime with clean water to remove sediments from the pressure vessel and the discharge tube.

(iv) Special attention has to be paid in case of power sprayers for the following:

(a) Lubricating oil of the engine should be changed for every 100 working hours unless otherwise advised by the manufacturers.

(b) Do not disturb the packing until a leak is observed.

(c) The spray pump should not be worked at more than recommended pressure.

(d) Oil level in the pump of the engine should be checked every time and all grease points should be greased once in a day.

(e) Recommended oils and fuels should always be used in the engine.

(f) Nozzle should be thoroughly cleaned after use by blowing air through it.

Dusters

Duster is a machine to apply chemical in dust form.

Dusters make use of air streams to carry pesticides in finely divided dry form on the plants. A duster essentially consists of a) Hopper b) Agitator c) Feed control d) Fan or blower and e) delivery nozzle.

Types of Duster:

There are several types of dusters in the common use, such as:

1) Plunger type 2) Knapsack type 3) Rotary type 4) Power operated duster.

1. Plunger Type:

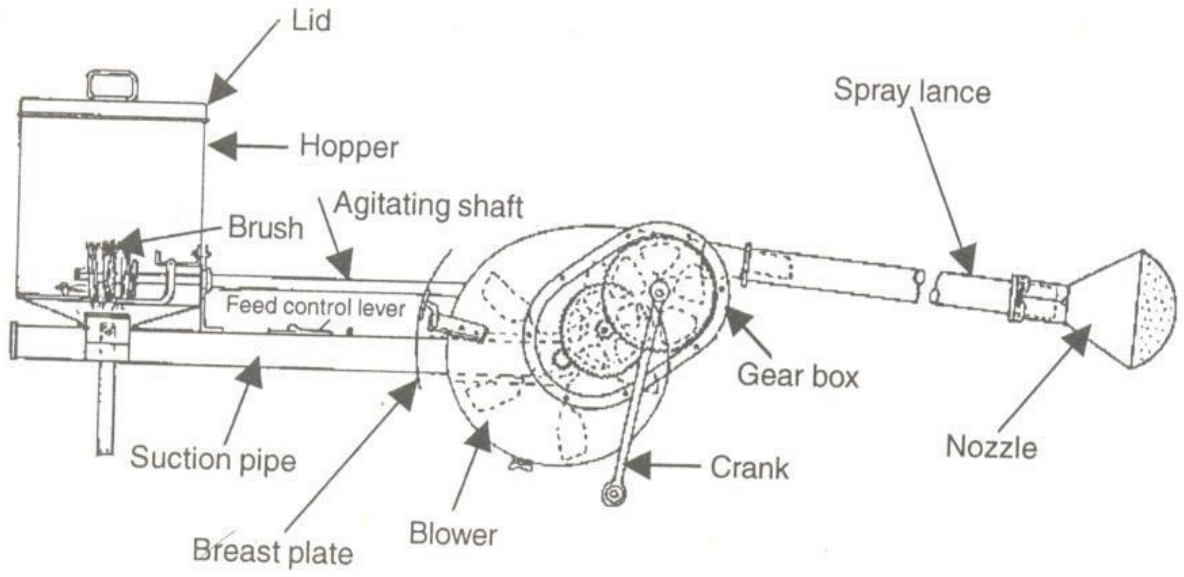
It is a simple duster with a small piston. The piston drives a current of air over the dust in the hopper. The dust is carried away through a delivery spout. Small hand pump dusters of this type are available and are suitable only where the area to be dusted is small like vegetable or flower garden.

2. Knapsack Type Duster:

It is a duster with the powder container on the back of the operator. Knapsack dusters have a hopper through which a current of air is blown to pick up the dust. The air current is produced by lever operated leather blows. Shoulder straps or carrying straps are generally provided in such dusters and they can be easily carried in the fields. These dusters are suited for small areas only.

3. Rotary Duster:

It is a duster with a hand-operated rotor in front of the operator. For spraying tall crops, more force of delivery is required, hence rotary dusters are preferred. Dust is fed from a hopper into a current of air produced by a rotary fan and is blown out through a delivery pipe. Most of the models have stirring device, actuated by the fan crank to ensure a steady flow of dust. The rate of delivery can be regulated by a valve below the hopper. The delivery force is controlled by controlling the speed of the fan.



4. Power Operated Duster:

Power operated duster mainly consists of a power-driven fan, a hopper and a delivery spout. The fan creates strong airflow, which causes the dust to blow off from the hopper to a considerable distance either vertically of horizontally. The direction of the dust is regulated by a movable delivery spout suitably fitted with the unit. These types of dusters are used for large areas.

Care and Maintenance of Dusters:

1. Duster should be thoroughly cleaned before and after use with suitable brush.
2. The hopper should be fitted with dust about half of its capacity.
3. The lid of the hopper should be closed during the operation.
4. In rotary dusters, handle should be cranked at 30 to 35 revolutions per minute for efficient performance.
5. Before storing the duster after use, the dust from the fan box, suction pipe and hopper should be thoroughly blown out and the agitation shaft should be profusely oiled while cranking.
6. Pieces of paper, sacking and other foreign materials should be prevented from getting into the hopper.
7. The agitator parts and dust feed should be occasionally checked for blockage by foreign matters.

Essential Spare Parts to Be Kept in Stock:

i) Agitator, ii) Feed control lever, iii) Feeding brush iv) Shaft for crank, v) Crank handle, vi) Hose couplings and clips, vii) Breast plate, viii) Nozzle, ix) Nuts and screws.

General Precautions for the Safe Use of Insecticides:

1. The name on container should be read carefully and manufacturer's instruction should be followed.
2. The pesticides should be kept always in container with proper name.
3. The pesticides should be stored in a safe and locked place so that children may not touch them.
4. The pesticides should never be placed near foodstuff or medicines.
5. Empty containers of dangerous pesticides should not be used for any alternative purpose.
6. Necessary protective clothing should be used while handling pesticides. The pesticide bags should not be torn but it should be cut with a knife.

Seed Dresser: It is a machine to apply coating of protective chemicals to seeds.

Fumigator: It is a machine to generate and distribute gases or smoke.

Flame Gun: It is an apparatus to kill weeds by a flame.

Power Sprayer cum Duster: It is a power operated sprayer, which can be converted as duster when desired.

Important Terms:

A. Suction capacity of power sprayer per plunger

$$Q = \frac{\Pi}{4} \times D^2 \times N \times L \times n \times 10^{-6}$$

Where, Q= theoretical suction capacity in litres/minute.

D= diameter of the plunger (mm)

N= number of revolutions per minute

n= no. of plungers

L= Stroke length (mm)

B. Volumetric efficiency

$$= \frac{Acual\ suction\ capacity}{Theoretical\ suction\ capacity}$$

C. Pump efficiency

$$= \frac{WHP}{SHP} = \frac{WATER\ HORSE\ POWR}{SHAFT\ HORASE\ POWER}$$

Water horse power is the power which is required only to deliver liquid from the pump.

$$Water\ horse\ power = \frac{Q \times H}{4500} = \frac{Q \times P}{450}$$

where, Q= suction capacity in liters/minute

H= head in metre (1 kg/cm^2 =10 m of water)

P= pressure in kg/cm^2

Problems

1. Taking pressure as 35 kg/cm2, the suction volume Q is 25 lit/min and pump efficiency is 85 per cent. Calculate shaft horse power

$$Water\ horse\ power = \frac{Q \times P}{450}$$

$$= \frac{25 \times 35}{450} = 1.95$$

$$Shaft\ horse\ power = \frac{WHP}{\eta} = \frac{1.95}{0.85} = 2.28$$

2. Find the suction capacity of power sprayer if diameter is 25 mm, speed is 1100 rpm, length of stroke is 22 mm, and number of plungers is 3.

$$Q = \frac{\Pi}{4} \times D^2 \times N \times L \times n \times 10^{-6}$$

$$= \frac{\Pi}{4} \times 25^2 \times 1100 \times 22 \times 3 \times 10^{-6}$$

$$= 35.6 lit / \min$$

3.Calculate water horse power which is required to discharge liquid @ 30 litres/min at 30 kg/cm^2 pressure.

Solution:

$$Water\ horse\ power = \frac{Q \times H}{4500} = \frac{Q \times P}{450}$$

$$= \frac{30 \times 30}{450} = 2$$