CHAPTER-8

8.0 INSECTICIDE APPLICATION

8.1 Application Equipment

A number of application equipment is available for applying insecticides. But the type of application equipment used depends upon the following factors (Edward, 1975).

- Size of the area (mechanical equipment for large area while hand equipment for small area)
- Availability and the type of carrier (oil, water etc.)
- Availability of the workers
- Cost, availability and durability of equipment
- Type of insect and insecticide formulation
- Time, speed and accuracy of application equipment

8.1.1 Boom sprayer

8.1.1.1 Parts of Boom Sprayer

A number of insecticide formulations are sprayed by the sprayers so the material of sprayers should be such that it can withstand the effects of spraying material. Some of the insecticide formulations like wettable powders exhibited abrasive activity while other may have corrosive effects in contact with the sprayer material. Boom sprayer has following parts (FAO, 1994; Malik, 2012).

8.1.1.2 Pump

Pump produces the necessary pressure to facilitate the flow and atomization of spray material towards the nozzle. Different types of pumps are available in the market like roller, piston, diaphragm and centrifugal pumps. Piston and diaphragm pumps are more suitable to develop required amount of pressure for thorough plant coverage. Two things must be considered for choosing a good quality pump, one is the gallons per minute supplied by the pump and the other is the pressure range that can handle by it.

Figure 8.1 Pump of boom sprayer

8.1.1.3 Tank

Sprayers used water and other materials as diluents in addition to the insecticides. Spray tank is a necessary component to carry the spray material. The size of the tank should be large enough to avoid the frequent refilling. The size of the tank also depends upon the rate of application

and space available for its mounting. Tanks must be equipped with large upper and bottom opening. The large top opening with strainer helps in easy filling, inspecting and cleaning while the lower opening is used for draining. Both openings must be provided with water tight cover to avoid spillage. A good tank must have gauge to indicate the water level of the tank.

Spray tank can be made of different materials including steel, fiberglass, aluminum and polyethylene. Tanks made of fiberglass, polyethylene or stainless steel is more preferred because of their resistance towards corrosion and abrasion. In case of other materials tank should be coated with a protective lining to resistant the above activities.

Figure 8.2 Tank of boom sprayer

8.1.1.4 Spray Lance of boom

It is a horizontal pipe of varies length (1-15m) with two or several nozzles separated by 50cm apart. Usually long boom is used for tractor sprayers. It is more beneficial than spray lance because of its wide swath (Area covered by a single nozzle during spray) it covers in each trip. Width of swath can be adjusted to obtain three types of sprays.

- Directed spray
- Band spray
- Uniform spray

It contains 28-36 nozzles.

Figure 8.3 Spray Lance of Boom

8.1.1.5 Power source

It is the main requirement to operate the sprayer. Different power sources are operated now days including the manual, tractor or tractor with air craft engines, traction and motor.

8.1.1.6 Control Valve and gauge

It is valve which control flow of pesticide solution and gauge depicts pressure of solution which is being flowing.

8.1.1.7 Nozzles

Its main function is to convert the pressurized liquid into small droplets or mist for thorough application on the target site. It also controls the droplet size, amount of liquid and distribution pattern. Size of the droplet and flow rate is also dependent upon the pressure in addition to the design of the nozzle. Under high pressure and with small nozzle tip droplets of smaller size are produced and vice versa. Small droplet size provides thorough and even coverage while bigger size results in the reduction of off-target drift.

Nozzles can be available in different materials including brass, aluminum, stainless steel, ceramic, and plastic. Selection of nozzle material is quite dependent upon the type of formulation. Aluminum or brass can't be used for abrasive formulation (wettable powders and dry flowables). These materials wear down quickly. Selection of nozzle type consider many factor like coverage desired, target pest or area, method of application and potential for drift. A nozzle consists of nozzle body, a strainer, replaceable nozzle tip and a cap to hold it. Nozzles can be classified on the basis of droplet size and spray pattern (UK, 2016). A nozzle performs three important functions.

- Covert the spray able liquid into smaller droplets
- Spray and spread these droplets in a specific pattern
- Nozzles regulate the rate of release of the sprayer

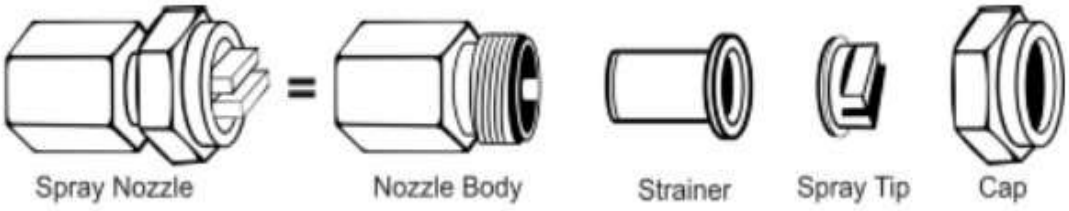

Figure 8.4 Parts of nozzle

8.1.1.7.1 Fan nozzle / Tee jet

These are used for banding sprays and produce a narrow, oval pattern with a sharp cutoff at the edge. These are available in different types like even flat fan, standard flat fan, low pressure, off center, and twin orifice flat fan nozzles. These are mostly used for applying herbicides. Nozzle spray angle and boom height effect the width of the spray. These are available in different colors depending upon the size of the orifice.

Figure 8.5 Fan nozzle

8.1.1.7.2 Hollow cone nozzle

These nozzles release a more uniform and fine spray particles than the solid cone nozzles. These are used for spraying agricultural crops with formulation of wettable powders, suspensions and flowables at higher pressure. These are usually used to apply fungicides or insecticides when complete coverage and foliage penetration is the priority. Spray drift is more than other nozzles. These are available in varying colors with different hole sizes.

Figure 8.6 Hollow cone nozzle

8.1.2 Knapsack sprayer

It is commonly used and small unit of sprayer which is operated by hand or engine. These are also manually operated and carry by operator on its back by a pair of mounting straps during application of insecticides. It is suitable for small lands up to some acres. The lever is used to push the liquid from spray tank to the air cylinder with the help of a piston. Air present in the cylinder creates pressure that releases the water through via cut-off valve. A plastic tank of 14-16 liters capacity is used with the sprayer. Hand level is usually operated at 15-20 strokes/ minute at the pressure of 40psi. However, applicator requires constant pumping to develop pressure. It requires good practice for thorough coverage of the area to be treated (McAuliffe & Gray, 2002).

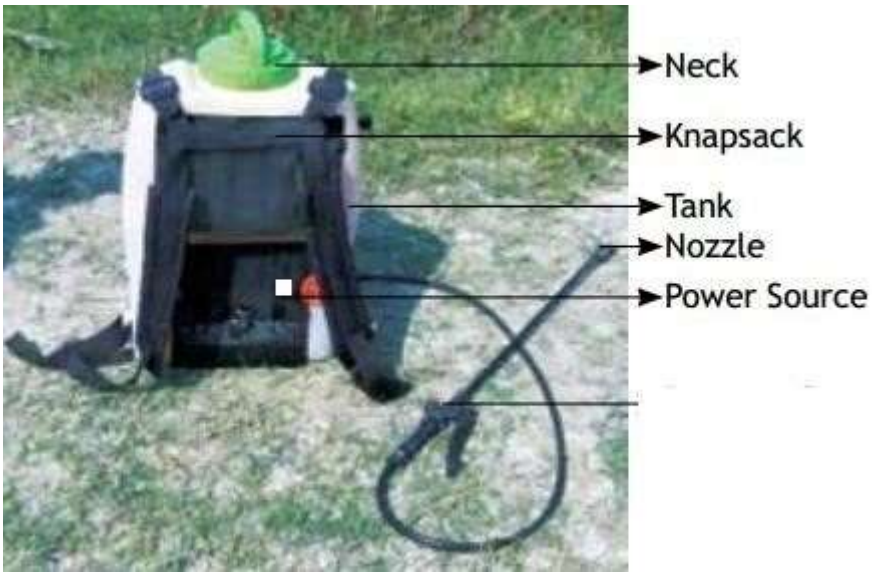

Figure 8.7 A Knapack sprayer

8.1.2.1 Parts of Knapsack Sprayer

8.1.2.1.1 Spray tank

This is main part of sprayer which is filled with pesticide solution being sprayed for control of different pests.

Figure 8.8 Spray tank

8.1.2.2 Spray lance

It is a long rod of 90cm in length made up of steel or brass. On one side it is attached to the delivery pipe and provided with a replaceable nozzle at the other end. At the hose side it is equipped with a trigger mechanism to regulate the flow of liquid and it bents at its nozzle end forming a goose neck. Sometimes a plastic shield is used to fix the spray lance to prevent chemical drifting.

Figure 8.9 Spray Lance

8.1.2.3 Control valves

Additional cutoff valves are provided between the pressure regulators and nozzle to provide the on/off function. These should be easily reachable by the spray person and should large and tight enough that does not hamper (when open) and release the liquid flow (when closed).

Figure 8.10 Control valve

8.1.2.4 Pressure regulators

Pressure regulators and gauges are provided to control and check the rate of pressure, respectively. It helps to maintain the operation at constant pressure. These also protect the sprayer parts to wear down due to excessive pressure. The type of regulators depends upon the type of pump. Likewise the type of pressure gauge depends upon the type of sprayer. High pressure gauge not provides the accurate readings for low pressure sprayer. These functions are sometimes performed by the cut-off valves of the sprayer.

Figure 8.11 Pressure regulator

8.1.2.5 Hose

These are used to deliver insecticides out of tank. These should be strong enough to resist the pressure and the effect of different formulations of insecticides. The inlet diameter of hoses should be greater or at least equal to the diameter of inside parts of the pump. Undersized hoses can reduce the pump capacity that can alter the pump pressure and ultimately results in uneven flow rate. The most effective materials used for the hoses are neoprene, plastic and rubber.

8.1.2.6 Pump

Pump is provided in a automatic sprayer which provide source to throw pesticide solution outside sprayer.

Figure 8.12 Pump of knapsack sprayer

8.1.2.7 Strainers

These are also called filters and are in the form of small mesh screen. These present at different places in the sprayers and help to filter the small particles present in the spray solution that may clog or damage the distribution system. Strainers of different sizes are present in the following places

- In the nozzle body to screen out the small particles to avoid the clogging of nozzle
- At the entrance of pump intake pipe (25-50 mesh size)
- In the way between the pressure regulator and boom (50-100 mesh size)

- For wettable powders all screens should be of 50 mesh size or coarser

Figure 8.13 Both are Strainer

8.1.2.8 Tank agitator

Spray material of an insecticide is a mixture different component (See chapter Formulations) including the insecticide and carrier. Agitator devices help to maintain the homogeneity of the spray material. Constant mixing is necessary for some of the formulations like dry flowables and wettable powders (suspension, emulsion). It will produces the uniform spraying material for even application. Agitation can be achieved by using paddles provided in the tank while jet agitation is another method for constant stirring the spray mixture.

In jet agitation, a nozzle is present inside the tank that continuously throws the stream of spray within the tank to keep it agitated constantly. Jet agitation is controlled by different ways. The amount of stream released depends upon the type of formulation and size of the tank. For the foam forming formulations, flow rate of liquid or agitation is reduced by using the control valve of the agitator.

8.1.3 Granule spreaders

These spreaders are used to apply uniformly coarse sized, dry particles of insecticides to water, soil and foliage. These are mostly used in broadcast and band applications. These are less likely used as a single unit because they are mostly attached with cultivating equipment (planters). It is usually operated by gravity (gravity feed) and has an adjustable opening to control the release of granules.

Two types of spreaders are commonly used including the rotary and drop spreader. Rotary spreader distributes the granules at the sides and front by using the rotating fan or disk while the drop spreaders differs by an opening at the bottom side which opens by means of a sliding gate that controls the flow of granules by gravity feed. Moat often drop spreaders are preferred over rotary spreaders when precise application is required (Roberson, 2017).

Advantages

These are simple, light weight and easy to calibrate and require no carrier.

Fig 8.14 Granular applicator

8.1.4 Pressurized cans (Aerosols)

These are in the form of pressurized disposable packaging or cans with the capacity of ≤ 1L. These are manually operated sprayers and mostly used for small land holdings such as green houses or for small land holdings. It consists of an air pump that develops pressure in the spray tank that slowly release the liquid droplets form nozzle. It provides less uniform coverage of the treated area.

Figure 8.15 Pressurized cans

8.1.5 Trigger pump sprayers (Gun)

These are non-pressurized sprayers because they do not use separate pressurized air source. The insecticide force through the nozzle under pressure created by the squeezing the trigger. These sprayers give an even application. They are mostly used for small areas.

Figure 8.16 Triger pump sprayer

8.1.6 Motorized / Power operated / Mechanical sprayers

Power driven sprayers have many advantages over conventional sprayers. These provide power and high pressure to operate the different parts of the sprayer. Power is provided by electric motors or engines. The sprayer under this heading may require high to low pressure depending upon the requirements of the pump or other components of the sprayers. These can be mounted on trucks, tractors and aircrafts. These are good for the large scale application in orchards and other crops (Edward, 1975; Malik, 2012; Anonymous, 2017).

8.1.6.1 Boom Sprayer

These are also mounted on trucks, trailers or tractors. These are also designed to apply the insecticides over large field areas in swaths. The application rate may vary from 50-500L/ha at the pressure of 50-500Kpa. The length of boom may be 6-10 meter long with the nozzle distance of 50100cm. these sprayers provide uniform and full coverage of large areas but they may not penetrate the dense foliage. These sprayers mostly use hydraulic sprayers that may cause problem with the wettable formulations.

Figure 8.17 Boom sprayer front and rear view

8.1.6.2 High-pressure / Hydraulic Sprayers

These sprayers are used for thick foliage, to the top of the trees and for the areas where high pressure is a necessary requirement for complete and uniform coverage. The sprayers work at a pressure of 7000Kpa. The design of the high-pressure sprayers is similar with the low pressure sprayers except the components are designed to withstand high pressure. The sprayer may be equipped with a boom, a hose, multiple nozzles or a handgun nozzle for spraying, shade trees,

orchards, building, ornamentals, livestock and commercial crops. They are also used mechanical agitators that well mix the wettable powders.

8.1.6.3 Air blast sprayers

These sprayers use a combination of water and air to deliver the insecticide to the target site. Insecticide is pushed through a nozzle or series of nozzle. A high speed fan or blower blows away the insecticide through nozzle in the form of an air blast. The high pressure air converts the insecticide solution into small droplets that moved away by an air blast. The pressure and volume of these sprayers can be adjustable according to the needs. The air blast may be carried 10-40 feet away from the sprayers. Capacity of tank is 500Ltr. These sprayers are used for tree spraying and spraying of agricultural crops (Malik, 2012).

Figure 8.18 Air blast sprayer front and rear view

8.1.6.4 Jeeto sprayer

It is of aluminum three-way valve enabled high efficiency sprayer. Its tank is made up of fiber glass with the capacity of 400 Liters. Its each disc of three stage turbine atomizes the chemical in small droplets (mist). It is mostly used for spraying orchard trees. Flow rate varies from 0.3 to 1.6L/ Min with the speed of 3-45KM/hr.

Figure 8.19 Jeeto Sprayer

8.1.7 Aerosol generators/ Foggers

These have a metallic container to withstand the pressure of liquefied propellant. The droplet size is very small (1-50µm) and these are suspended in the air for long period of time. These are mostly used to control the flying insects like mosquitoes and flies. Dispenser is fitted with a delivery tube and a propeller. The propeller forces the spray to leave through the delivery tube in the form of fine droplets. These are mostly available with the capacity of 300-400g of insecticide while 2-5kg sizes are also available. These are used at the rate of 7-14g per $100m^3$ of the area to be sprayed. On the other way compressed air, centrifugal energy and hot velocity air is also a source of energy (Malik, 2012; UK, 2016).

Figure 8.20 Aerosol generator

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