Module 15

Spray Equipment and safe Handling

At the end of the module, the participant will be able to understand:

- Definition
- Principle of application equipment
- Selection of application equipment
- Equipment for anti-larval treatment
- Equipment for adulticide treatment
- Equipment for space spray, thermal fogging or ULV
- Safety precautions

Definition

An application equipment is a device made up of plastic/ metal for the application of larvicides/ adulticides to be applied with the desired discharge rate/ dosage on the surface of water or wall.

The mosquito vectors need to be targeted primarily at the aquatic/ larval stage. In urban situations, all the breeding potential areas/ spots are mapped and the area is calculated for the selection of appropriate larvicide.

The water bodies/ habitats with polluted water i.e. drains, seepage tanks, pits, and ponds contribute to the *Culex* breeding.

The water bodies/ habitats with clean water i.e. overhead tanks, cemented tanks, hoodies, construction sites, wells, underground tanks, coolers, fountains and water pools are favourable breeding places for Anopheles mosquitoes.

Aedes mosquito is a small container breeder and is found in earthen pots, cemented tanks, unused wells, tyres, coconut shells, flower pots, waste plastic cups and glasses.

Selection of Application Equipment

There are different types of equipment to be used for the control of mosquito vectors, which are as follows.

- Equipment for anti-larval treatment
- Equipment for adulticide treatment
- Equipment for space spray, thermal fogging or ULV

Selection of Spray Equipment

Insecticides will be effective only if applied precisely by the most efficient applicators. Equipment selection should be based on the type of pesticide to be applied and the size and scope of the spraying job involved. Five key factors should be considered when selecting application equipment.

1. Will it do the job? (Effectiveness)
2. Is it safe) (Safety)
3. Is it offensive? (Public relations aspects)
4. Is it expensive? (Cost)
5. Is it durable? (Durability)

An important consideration in the selection of spraying equipment is the size of droplets produced by the equipment during normal use. The type of spray depends on the droplet size, which is generally described by volume median diameter (VMD) expressed in micrometres (um). This is the number which divides the aerosol or sprays into two equal parts by volume, one half containing droplets smaller than this diameter and the other half containing the largest droplets.

Sprays may be classified according to droplet VMD as follows:

Aerosols	…….	50 um
Mists	……	50 - 100 um
Fine sprays	……	100 - 250 um
Medium sprays	……	250 - 400 um
Coarse sprays	……	400 um

The equipment for the production of fine and coarse sprays generally comprises nozzles and pumps. The knapsack sprayer, compression sprayers and stirrup pumps are most commonly used in vector control programmes.

The commonly used spray equipment varies according to the type of spray.

D. Types of Spray Equipment:

Type of Spray	Spray Equipment
Indoor residual spraying	Hand compression sprayers, and stirrup pumps.
Indoor space spraying	Mists blowers, power-operated mist blowers Aerosol generators
Exterior space spraying	ULV equipment, power-operated mist blowers, thermal, fogging equipment, and aerosol generators
Larviciding	Hand compression sprayers, knapsack sprayers, granule applicators, and dusters

The salient features of the different spray equipment are given in a nutshell below:

1.	Knapsack sprayer/ hand compression sprayer	A continuous type of sprayer with lightweight. The discharge rate is fairly constant and can be used by unskilled operators. Maintenance is usually simple.
2.	Stirrup pump	Less costly than hand compression sprayers. Any type of hydraulic nozzle can be used. The discharge rate is constant when constant pressure is maintained. Two spray men are required for each sprayer for its operation.
3.	Mist blowers	Simple manual and power-operated sprayers are available. The use of restrictors with small bores permits proper mist formation.
4.	ULV equipment	It is usually a two-stroke engine. The oil and petrol ratio is usually 1:24. The most milable oil is 30 SAE oil. Multigrade oil should never be used. The droplet size (VMD) needs to be 20 - 50 um. Useful and economical method of temporary control of mosquitoes.

5.	Thermal fogging equipment	Can be used both the indoor space spray and exterior space spray. Operating on a pulse jet system. The droplet size may be 10 - 50 um. Useful in urban and semi-urban areas. There is a fire hazard with some types of machines, hence greater care is needed.

The important factors that are to be considered while selecting the spray equipment are:

1) Effectiveness
2) Safety
3) Acceptability
4) Cost
5) Durability

While all attempts must be made to select the most effective equipment available in the country, safety should be the prime consideration to eliminate health hazards to the operators as well as to the general public. Defective non-standard equipment shall result in safety hazards and environmental pollution

Principle of Application Equipment

Hand/ Manually/ Hydraulic Energy Operated Pumps

Principle: Atomisation

Disintegration of insecticide formulation into small droplets.

This principle generally works in all pumps

- Energy used to automate liquid into droplets varies e.g. in the same it is “hand” generated-POWER operated
- These sprayers are both held and operated by hand
- Constructed of brass, steel, plastic
- Capacity may vary from 0.15 litre to 1.5 litres e.g. ordinary household sprayer or we call interim hint hand sprayer

Compression Hand Sprayer or Continuous Sprayer

- The container is filled 2/3rd of its capacity
- Air in the air space left is compressed by means of an in-built air pump or plunger-type
- When the air is sufficiently pressed, released the knob, the spray will come out through the outlet
- Similarly, you may come to a variety of hand-operated pumps for small-scale use of insecticides

Equipment for Anti-larval Treatment

Knapsack Sprayer

Knapsack means the way the pump is been on the back with a belt through both the arms and fully on the book with one hand moving the liver and the other deriding lance

- It is a non-pressurised sprayer. Actually, this is more like the stirrup pump-here the pump has a provision of TANK inside the body in place of a bucket out
- Mainly used for larvicide and not for adulticide

Composition

Consists of a large tank (9 litre) fitted with hand operated pump on the side, pressure chamber, outlet delivery tube, hose lance, nozzle etc.

At the bottom fitted with DIAPHRAGM, LEVER, and HANDLE.

Working

- Operated by hand lever-poisoned under the arm so that it can be moved up and down
- The tank is fully filled without leaving any air space
- Whether lever moved-liquid is drawn throughout inlet-flap-valve into pump chamber with 1st strike
- With the return of the lever-liquid in the pump chamber is forced past through another valve into a PRESSURE

Chamber

- The first valve gets closed during this operation to stop back entry of formulate
- Air is trapped in part of the pressure chamber and gets compressed as the liquid is forced into this chamber
- This compressed air will force the liquid outside through the outlet hose, lance and nozzle.

Discharge rate: @ 550 c.c.mt at /at.ma

Disadvantage/ Limitation

- To bear weight on the back and simultaneously to move both hands.

This is used for larvicide application and carried on the back. A shield is provided so that it does not come into actual contact with the back. A skirt is usually fitted to the bottom of the container to prevent direct contact with the ground. A knapsack sprayer is a continuous type of sprayer and the discharge rate is fairly constant.

Figure 43.Spray Pumps

Bucket & Mopping

The use of malarial larvicidal oil is being used with the bucket and mopping method. The larvicide is spilt over the breeding side with a mop after dipping into the larvicidal oil frequently.

Equipment for Adulticide Treatment

Stirrup Pump

This is hand operated bucket sprayer widely used for indoor residual spray in the house dwellings.

Composition

Metallic pump, having an inside piston-like cycle pump;

- At the upper end - DISCHARGE HOSE - Plastic pipe (5 m)
- It is connected with METALIC HOLLOW ROD - “LANCE”
- This, on one hand, has “CUT-OFF-DEVICE” - other end NOZZLE
- Before nozzle - GROSS NECK - a spray of the roof under cots tables
- Pump is provided with BRACKET & FOOT REST OR STIRRUP

- STIRRUP – Named - Iron ring suspended by strip from the saddle for footrest

These pumps are bucket sprayers as the container for the spray is a bucket. The stirrup pump is a traditional one being used in vector control and consists of a pump, attached discharge hose, spray lance with a bracket and footrest or stirrup. The spray discharge is continuous because an air chamber is incorporated into the pump system to maintain spraying pressure during suction stroke. Two persons are required during operation i.e. one for pumping and the other for holding spray lance. Relatively little skill is required to operate and maintain this pump as it works even with rough handling in the field. However, great care is required to avoid spillage of insecticide suspension from open buckets.

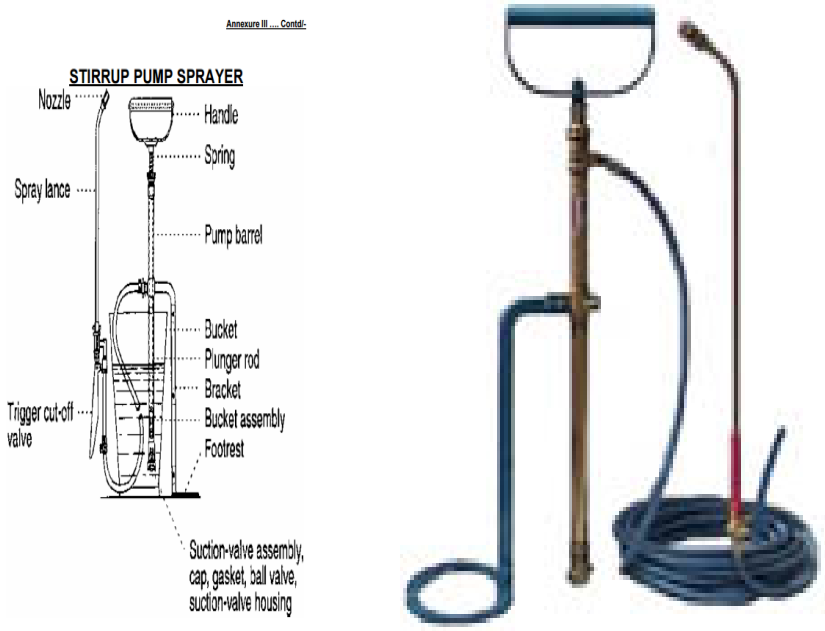

Figure 44.Parts of Stirrup Pump

Advantages

- Stirrup pumps for the IRS have been used under the programme since its inception
- Insecticide spray suspension is thick and requires continuous stirring to avoid settling of insecticide. Stirring is easy in a bucket & insecticide is not allowed to settle.
- The spray team and workers are tuned to use stirrup pumps during IRS.
- Pressure is maintained with continuous strokes
- The length of the hose of the stirrup pump is usually 5 meters which helps in reaching the long corners of the room.
- Two persons are needed, one to pump and one to direct the spray. The persons directing spray can move freely even in smaller rooms while the pump man is outside the house.
- Washing of pump is easy.

Issues

- Two persons are needed per pump hence more human resource is required.

Hand Compression Pump

The container of this pump acts as a pressurised air chamber and the air pressure impels the liquid. These pumps are fitted with pressure gauze and a safety device to release excess pressure. Compression pumps used for vector control are usually of 10-litre capacity. These are simple to use and save human resources as one person is required per pump. The only disadvantage of this pump is that pressure falls with the discharge of liquid. The control flow valve has been designed as a remedial measure but it can be fitted in a few branded pumps only. The most important thing to care about is to ensure that the material of the pump will withstand the pressure otherwise it may burst and harm the spray worker.

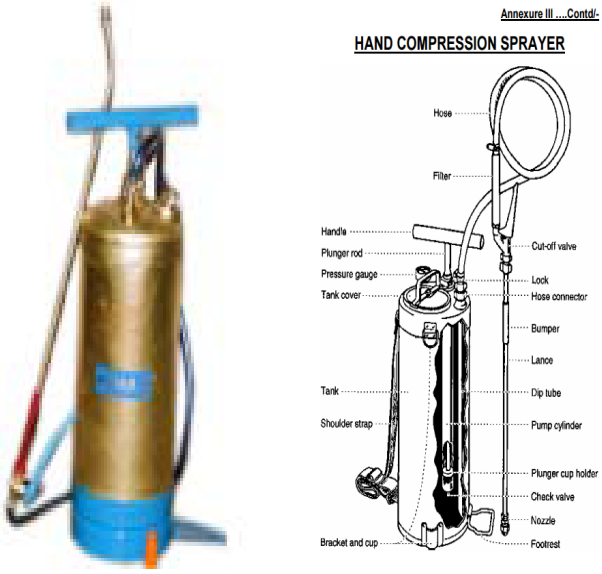

Figure 45.Parts of Hand Compressor Pump

Advantage

- One person is needed per pump hence less Human resource

Issues

- Carrying a pump with 10 ltrs of suspension becomes an issue due to its weight.
- Insecticide spray suspension is thick and requires continuous stirring to avoid settling of insecticide. Stirring in the pump is difficult & insecticide settles in pumps.
- Nozzle tips get choaked & hamper the spray
- Pressure gets diluted which affects the spray dose
- Washing /cleaning of pumps is required during spray which is difficult

Equipment for Space Spray or Thermal Fogging or ULV

Automiser

These are operated on the principle of a compression pump. The three-quarters of a container is filled with spray liquid and then air in the remaining space is compressed through a built-in air pump of plunger type. The trigger valve is used to release the spray. These are useful or small-scale larviciding or aerial sprays of liquid like pyrethrum extract etc.

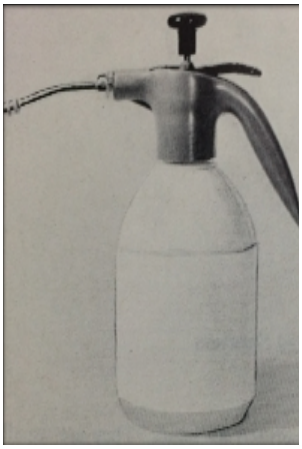

Figure 46. Ganesh Pump

Fogging Machine – Hand Operated

In such devices, insecticide is dissolved in an oil of suitably high flashpoint which is vaporised into a high-velocity stream of hot gas. When discharged into the atmosphere, the mixture containing insecticide condenses in the form of fog. Two basic methods are employed for the production of fog in the machines.

Figure 47.Manual Thermal Pulse Fogging Machine

In one type, the mixture is injected into the exhaust gas of a pulse-jet internal combustion engine at a point where it will be completely vapourised and then immediately discharged. This is used generally for hand-operated ones.

In the second method, petrol is burnt in a specially designed that is constantly supplied with a large volume of heated air at low pressure. The formulation is injected into a discharge tube through which air is passing and is emitted as dense fog. This is used in vehicle-mounted ones.

- Insecticide Solution: (5% MALATHION IN K.OIL OR DIESEL OIL)
- Vaporisation: This condenses to form a fine cloud of droplets on contact with the cooler air when it comes out of the chamber of the machine.
- High Temp: The insecticide solution is vaporised at a temperature of 1000 F.
- Dispersal: The dry fog made up of externally fine droplets (20-23 U) mixes with the wind and blows into all the places used by the vector species.

ULV

- Technical grade of insecticide
- 90% or more (96% in case of malathion) of the active ingredient.

Mechanical Force

- In ULV or cold aerosol generators, the insecticide is broken down into an aerosol alone, without the aid of heat.

Advantage

- Cole aerosol application is that it does not produce a dense fog which may pose a traffic hazard

Commonly Used

- To control the outbreaks of arboviral diseases like dengue/ DHF, JE, malaria etc. in the country.

Rate

- It is applied at about 500 ml per hectare area.