

Lesson 28

Title of the Experiment: Study and calibration of knapsack sprayer
(Activity number of the GCE Advanced Level practical Guide – 40)

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Learning outcomes

At the end of this practical, students should be able to

- Identify the major parts of the lever operated knapsack sprayer
- Gain the skills to remove the parts of the knapsack sprayer and fit it again.
- To understand how a knapsack sprayer works
- calibrate a knapsack sprayer

Introduction

Pest management practices require modern equipment to apply a variety of pesticides. Selecting the right equipment for pesticide application is important for successful pest control. The correct usage of equipment and its proper maintenance are important factors which affect the ability to place pesticides on target more economically and effectively. Lever operated Knapsack sprayer is probably the most commonly used sprayer in the world. It is suitable for applying chemicals to several crops including rice. The operator carries the sprayer on his back and hence the name knapsack sprayer (figure 1).



Figure 1: Lever operated knapsack sprayer

Knapsack sprayer is composed of a tank (usually holding from one-half gallon to 3 gallons of liquid), a pump to compress air, and a discharge hose with a valve to control the discharge through a nozzle (figure 2).

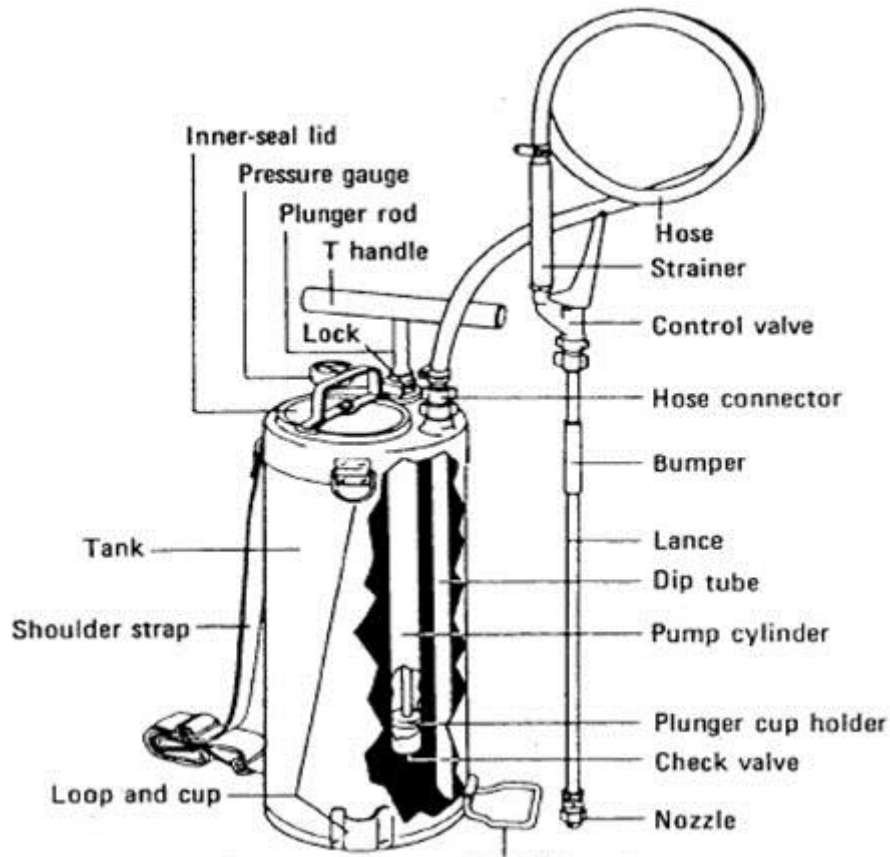


Figure 2: Parts of a typical spray pump
(from Pest and Vector Control; Cambridge University Press)

Most important advantages of knapsack sprayers are;

1. Useful to develop high pressure with less effort.
2. Light in weight and easy to carry on the back of the operator.
3. High work rate and economical.
4. Both left and right hand operation
6. Simple to spray chemicals and
7. Easy to maintain

However, it has following disadvantages

1. Constant pumping needed during application
2. Big influence of operators skills on results

Major parts of the Knapsack sprayer

Knapsack sprayer has following major parts.

1. Flat or bean-shaped tank of 10-15 litres capacity
2. Pump fitted inside/outside the tank
3. A handle to operate the pump
4. Agitator
5. Filter
6. Delivery hose
7. Spray gun with nozzle and
8. Flow control lever.

However, many designs are available and made in many contrasting materials. Types may vary by:

- Metal or rigid plastic tank
- Under-arm levered pump operation
- Over-arm levered pump operation
- Externally mounted pump
- Internally mounted pump
- Type of pump using piston or diaphragm mechanisms
- Location of pressure chamber

The airtight tank is made of either stainless steel or fiberglass. It has the capacity approximately 10-15 litres. The tank should have a large opening for easy filling and cleaning the tank. The tank is filled with chemical solution. Tank is filled approximately three-fourths of its capacity with a pesticide. The remaining space is utilized for the compressed air to be generated by the hand-powered plunger type cylinder within the tank.

The pump creates a flow of spray mixture from the tank to the nozzle. When the pump is operated, it draws the fluid through the suction hole and delivers it to the spray gun, when the cut off lever is pressed spraying is done through the nozzle as fine droplets. The pressure developed in these sprayers depends on the pump.

Agitators are used both for initial mixing of pesticides. Nozzles for sprayers are very important to proper pesticide application. There different types of nozzles are available. Regardless of the type, a nozzle has four major parts; body, cap, strainer (screen) and tip or orifice plate (figures 3 and 4).

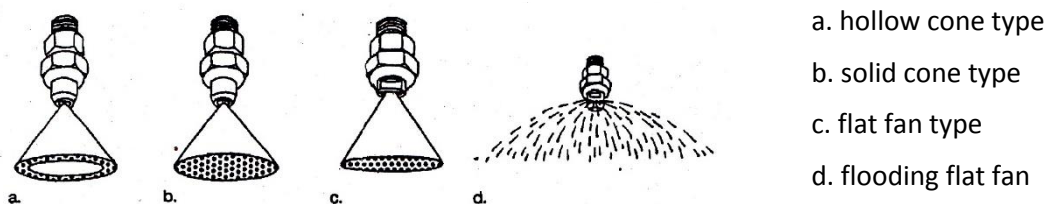


Figure 3: Different nozzle types



Figure 4: Parts of a nozzle

Functions of the Nozzle

- It is important to regulate the flow of the liquid
- It atomizes the liquid stream into droplets
- It spreads droplets in a specific pattern

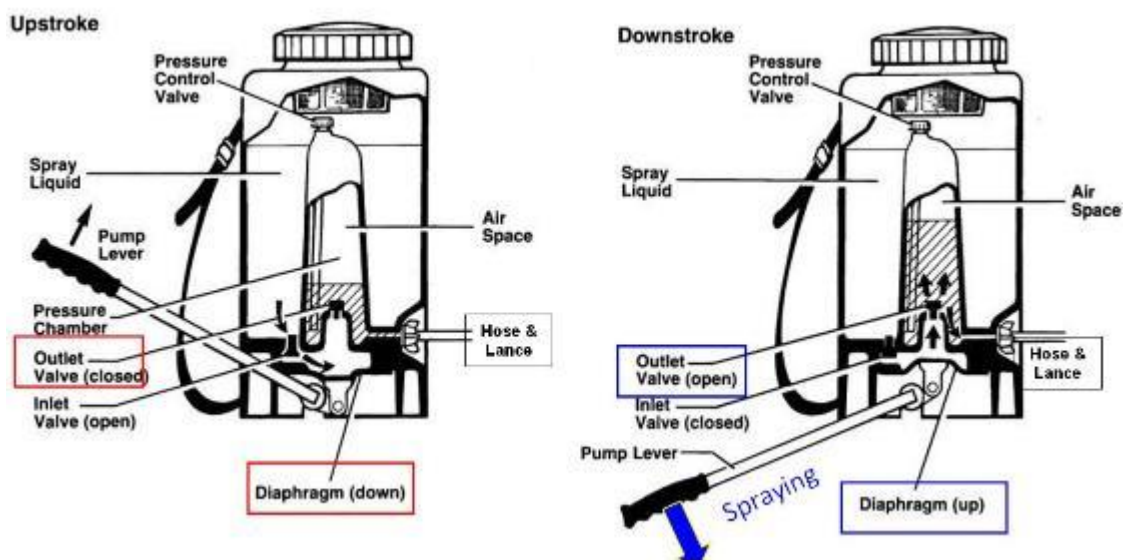


Figure 5: Lever operated knapsack sprayer: cross sectional drawings showing operation of diaphragm pump

(<http://www.stewardshipcommunity.com/best-spraying-practices/portable-spraying-equipment.html>)

Major steps to good knapsack spraying

- Check sprayer for leaks before use with clean water
- Calibrate sprayer output
- Ensure an even and uniform application
- Clean sprayer after each use

Calibration

Calibration is the process of determining sprayer output and adjusting the sprayer output by changing the speed of walking and/or nozzle size to match a specified sprayer output that is recommended for a particular pesticide on the pesticide label.

Calibrate sprayer output

- Read product label
- Follow calibration instructions
- Fit appropriate nozzle
- Measure swath width
- Adjust water volumes (l/ha) within recommended limits to your specific needs, such as stage of crop growth

The operation of the sprayer is as follows:

1. As the pump lever moves upwards the diaphragm is pulled downwards, thereby increasing the volume of the diaphragm chamber and reducing the internal pressure.
2. This low pressure causes liquid to flow from the tank to the diaphragm chamber through the inlet valve.
3. On the downstroke of the pump lever, the diaphragm moves upwards compressing the liquid in the diaphragm chamber causing the inlet valve to close and the outlet valve to open.
4. Liquid is forced into the pressure chamber, compressing the air present in the chamber.
5. This cycle is repeated with the lance trigger valve closed until sufficient pressure is generated in the pressure chamber. In sprayers with a pressure relief valve set to a given pressure, this is achieved when the pressure relief valve opens circulating excess liquid back to the tank.
6. The trigger valve is then opened and the air pressure in the pressure chamber causes the liquid to flow to the nozzle.
7. The operating pressure in the pressure chamber is maintained by regular lever strokes of about 30 per minute or approximately one every two paces.

<http://www.stewardshipcommunity.com/best-spraying-practices/portable-spraying-equipment.html>

Calibration of knapsack sprayer

1. Check the sprayer to make sure there are no leaks, nozzle is clear and the parts are in good condition.
2. Stake out a test area (10 m x 10 m) in the field.
3. Place 10 L of water into sprayer tank.
4. Establish the sprayer swath.
5. Enter the test area and make the test run, spraying the area at the recommended pressure and speed (figure 6).

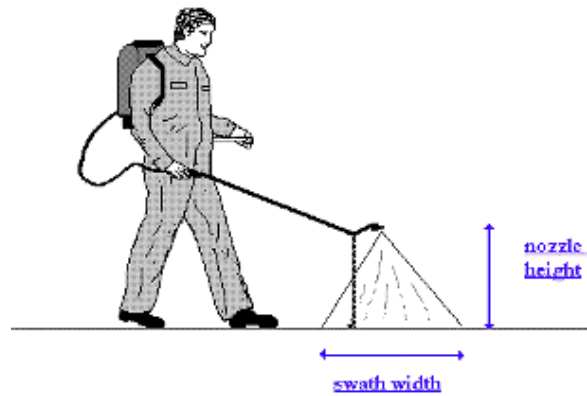


Figure 6: Test run by spraying water showing the nozzle height and swath width
(after <https://www.monsanto-ag.co.uk/>)

(N:B: Nozzle height is an important factor in accurate application of pesticides. Most are designed to work at 50cm above the target, but the swath width is dependent on this height and halving it will also halve the swath width and double the application rate.)

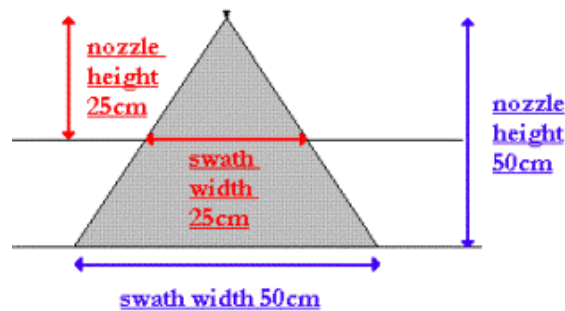


Figure 7: Swath width and nozzle height
(after <https://www.monsanto-ag.co.uk/>)

6. Measure the volume of water remaining in the tank.
7. Calculate the volume of pesticide per hectare as follows

$$\text{Volume needed for a hectare} = \frac{10 - \text{Volume of water remaining in tank}}{100} \times 10000$$

(1 hectare = 10000 m²)

8. Measure the volume of the tank
9. Calculate the number of sprayerloads per hectare as follows

Sprayer loads per hectare = Volume needed for a hectare/volume of the tank

(The ultimate application rate is a function of nozzle output, walking speed and swath width)

Activities

1. Study the major parts and the functions of the lever operated knapsack sprayer using given equipment. Fill the following table
- 2.

Part of the sprayer	Functions

3. Remove the different parts of the knapsack sprayer and fit it again as it was.
4. Operate the knapsack sprayer using water as a liquid
5. Calibrate the knapsack sprayer to given insecticide

