

# New efficient spray technology for cotton crop

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*Cotton is an important kharif crop in Punjab as it was grown on 2.84 lakh ha (2018-19). The total production was 11.5 lakh bales with an average yield of 688.38 kg lint/ha. However, in India, total area was 122.38 lakh ha with average yield of 501.47 kg/ha. Although Bt cotton provides effective protection against cotton bollworms, but sucking pests namely whitefly, jassid, aphid and mealy bug are the most serious on Bt cotton and they cause maximum damage during July-September. Whitefly adults and nymphs suck sap from leaves and excrete honey dew on leaves which become sticky. Affected leaves and seed cotton turns black due to development of sooty mould on the plants. Regular monitoring of the crop is must for detection of whitefly incidence.*

**Keywords:** Bt cotton, Spray technology, Sprayer, Sucking pests

THE SEVERITY of whiteflies is seen after the cotton crop growth crosses 10 nodes on the main stem. Spraying against whitefly should be done when population reaches 6 adults per leaf on the upper canopy of the plants before 10 AM. Proper coverage of underside of leaves during the insecticidal sprays effectively reduces the whitefly population. Avoid tank mixing and use of readymade insecticidal mixtures. The incidence of insect pests increases with excessive use of nitrogenous fertilizers, hence use only recommended dose. Follow insecticide resistance management (IRM) strategy for effective management of insect pests. Different types of sprayers namely manually operated and tractor operated are available for spraying on cotton. Nozzle selection and efficient operation of sprayers is must for the better control of the whitefly on cotton crop.

The success of control over insect-pest, diseases and weed depends upon use of proper spraying technology (spray machine and spray method).

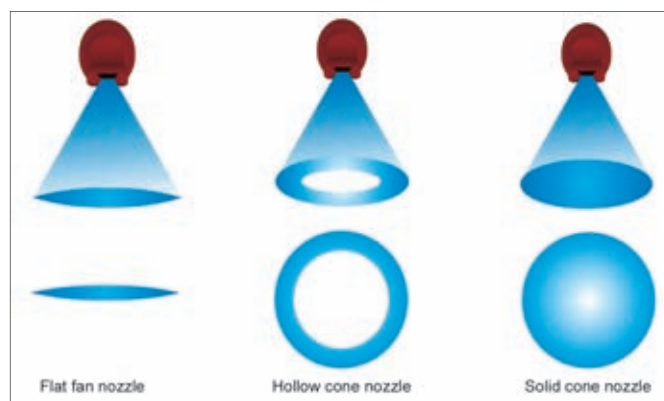
## Selection of nozzles

Flat fan nozzle is used for uniform coverage application such as for weed spraying. Hollow cone nozzles give a fine mist for complete coverage of plants being sprayed for insect control. Solid cone nozzles are used when a high pressure penetrating spray is required as for the control of whitefly in cotton. Use cone nozzle which discharges 600 ml of spray material per minute for efficient pest control. Nozzle performance changes as spray materials erode the nozzle tip. Brass tips show wear about one-third as fast as aluminium tip; stainless steel and some of the new plastic tips show wear only one-quarter as fast as brass. Nozzle wear is more significant in first 50 hours of use, depending on the abrasiveness of the spray material. Hence, nozzle performance should be periodically

tested for changes in flow rate and spraying pressures used and for changes in spray pattern owing to nozzle tip wear.

## PAU Multipurpose high clearance sprayer

A high clearance platform for 2-wheel drive tractors with spraying system was developed in Department of Farm Machinery and Power, PAU, Ludhiana in collaboration with the industry. It has three types of spraying arrangements namely auto rotate gun, boom type and drop up type nozzles which were operated by a single pump. The spray machine



Types of nozzle available



PAU multipurpose high clearance sprayer



Self propelled high clearance sprayer

consist of a hydraulic pump, spray tank (1,000 litre), pressure gauge and hydraulic assistance for controlling the boom. The pump can be operated at 800 rpm to develop desired pressure up to 35 kg/cm<sup>2</sup>.

Boom and drop-up nozzle mechanism consists of 14 hollow cone nozzles on boom and 13 hollow cone drop-up nozzles (Make: Teejet) mounted on foldable 9.8 m wide boom with 67.5 cm nozzle spacing. Boom nozzles are used for spraying on top side of plant canopy and other drop-up nozzles which were used to spray inside the crop canopy up to 65-75 cm below from the boom and within the row or underside of leaf through adjustable drop-up arrangement of nozzle to target whitefly residing locations. The height of boom can be adjusted up in the range of 30-250 cm according to the crop height with the help of a hydraulic assistance provided.

The auto rotate gun type attachment has two guns (Make: Teejet) placed at 9.40 m apart on each end of its boom and it has coverage radius of 10 m per nozzle at limiting pressure of 35 kg/cm<sup>2</sup>. This gun performs 120 degree of rotation to cover about 20 m of swath or working width. These guns can be operated independently if required. There is a provision for adjusting vertical height of boom from target which makes it suitable to spraying for different crops at different crop growth stage.

The auto rotate gun boom type nozzles and drop up nozzles performed better as 92-95% whitefly nymphs were killed by these spraying attachments as compared to knapsack sprayer. Auto rotate gun, drop-up

nozzles and boom type nozzle performed better as 65-75% whitefly adults were killed by these type of spraying attachments as compared to knapsack sprayer as control by which only 50-65% whitefly adults were killed. Droplet size (micron) is higher in knapsack sprayer (350-400) taken as control followed by high clearance boom type (320-380), drop up (200-320) and auto rotate gun type (250-330). High clearance is preferred by the farmer as it can work at all stages of the crop and saves time, labour and cost of operation as well as it reduces drudgery of the operation.

PAU Multipurpose high clearance sprayer is further modified to improve self propelled high clearance sprayer with four-wheel drive system having narrow width tyres and four-wheel steering system to facilitate the operation of these sprayers in other crops like rice, wheat etc. It has two types of spraying arrangements namely boom type and drop-up type nozzles which operated by a single pump. The spray machine consists of a hydraulic pump, spray tank capacity of 600 litre, pressure gauge and hydraulic assistance for controlling the boom. Boom mechanism consists of 13 each hollow cone, solid cone and flat fan type of nozzles on boom and drop-up nozzle consists of 14 drop-up hollow cone nozzles (Make: Teejet) mounted on foldable 9.8 m wide boom with 67.5 cm nozzle spacing.

#### Auto rotate gun type sprayer

An auto rotate gun type sprayer with two gun type nozzle (Make: Teejet) was developed in Department of Farm Machinery and Power, PAU, Ludhiana in collaboration with the

industry. It has frame mounted with guns, dc motor, hydraulic piston type pump and spray tank (600 litre). Spacing between the two guns is kept 9 m. Each gun rotates 120 degree of rotation to cover about 30 m of span or working width of sprayer at liquid pressure of 35-40 kg/cm<sup>2</sup>. These guns can be operated independently if required. There are two rotation settings (30 and 40 RPM) for each gun.

The auto rotate gun sprayer performed better as 85- 95% whitefly nymphs were killed by this spraying system as compared to knapsack sprayer as control.

Droplet size is higher in knapsack sprayer 350-400 micron taken as control as compared to auto rotate gun type having size 250-330 micron. Auto rotate gun type sprayer is preferred by the farmer as it can be used for effective spraying and saves time, labour and cost of operation as well as it reduces drudgery of the operation.

#### Back pack type air assisted electrostatic sprayer

Mobile back pack type (MBP) air assisted electrostatic sprayer powered by a 5 HP engine with an on-board compressor and spray gun can also be used for cotton crop. The engine power the air compressor and the compressor produces pressurized air which passes through conducting hose and used to atomize and propel the liquid spray. The electrostatic sprayer is equipped with a 15 litre tank which hangs on the operator's back. For charging the spray particles in the nozzle, two 9.0 V rechargeable batteries have been provided. Air and liquid enter separately at the outmost



Auto rotate gun type sprayer



Back-pack type air assisted electrostatic sprayer

of nozzle. Just before leaving the nozzle, the air hits the liquid stream to atomize it into spray droplets that passes through the charging ring. Spray deposition on the upper side and underside of leaves by electrostatic sprayer is 80 and 85% more than knapsack sprayer respectively. Average drift loss of electrostatic sprayer is approx. 50% lesser as compared to knapsack sprayer. Bio efficacy of the sprayer is given as percentage of insects killed by the operation of spraying. Overall bio-efficacy of electrostatic sprayers i.e. 68% is comparatively higher than hand operated knapsack sprayer i.e. 50%.

### Calibration of sprayers

Societal environmental concerns as well as economics require precision placement of only enough chemical to accomplish pest control. Conventional spraying technology depending on gravity and spray droplet inertial forces often achieves less than 50% deposit of the total spray on the plant targets and actual quantity reaching the insect or disease pest can be as low as 0.01% of the total spray volume. Hence, air-assisted with electrostatic technology is better to achieve more penetration of spray and more uniform deposit on the plant canopies, particularly on the undersides of leaves. Calibration of the sprayer is very important to determine the effectiveness of spraying and elimination of the over-spraying. Sprayer requires too much care in calibration as various parameters such as pressure and delivery of pump, speed of forward travel, height of boom, nozzle spacing and concentration of spray materials affect the eventual spray concentration per acre.

The insecticides recommended for control of sucking pests like whitefly, jassid etc. should be sprayed using 125-150 litres spray solution per acre with the manually operated knapsack sprayer or 75 litres per acre with the shoulder mounted power sprayer and tractor mounted sprayer. For calibration of a sprayer to control whitefly, let us suppose that dose of insecticides is recommended as 600 ml/acre. Measure the nozzle discharge by collecting the liquid coming out from each nozzle in ml/min. Calculate total volume collected from 18 nozzles, let it be 10 l/min. The sprayer travels at a forward speed of 4 km/h. When the sprayer nozzles are spaced 67.5 cm apart on the boom and carried 50 cm above the crop canopy, the application will be uniform. Field efficiency of the sprayer is to be low as 50%.

Application rate (l/acre) of spray can be calculated:

$$\frac{\text{Pump Discharge (l/min)} \times 4000}{\text{Forward speed (m/min)} \times \text{spacing between nozzles (m)} \times \text{No. of nozzles} \times \text{Efficiency}}$$

**Application:** The application rate calculated is 56 litre /acre, hence either 600 ml of insecticide should be dissolved in 56 litres of water to apply for one acre or decrease the forward speed up to 3.0 km/h or increase the pump discharge resulting decrease in nozzles discharge upto 14 l/min to apply 75 litres of water in an acre.

**Quantity of water required:** To estimate the quantity of water required for spraying, fill the spray tank with measured quantity of water and spray in field. After spraying, measure the area sprayed and record amount of water consumed in that

area. Calculate the quantity of water required per acre by the following formula:

Quantity of water required (l/acre) =

$$\frac{\text{Volume of water consumed (l)} \times 4000}{\text{Sprayed area (m}^2\text{)}}$$

### Precautions during spraying

- Clean the spray tank and nozzles with clean water before and after the spray by running for 2-3 minutes.
- Wear gloves for preparation of spray mix, full mask, full sleeve shirt and trousers during spraying.
- Spray should be done on calm days in straight bands/strips. Avoid spraying in heavy wind, dry (low humid) and hot environment condition as possible.
- Always use clean water for spraying to avoid clogging in the nozzles.
- If the discharge rate of the nozzle exceeds by 10-15% than the initial discharge rate, the nozzle is considered as worn out. Replace the worn out nozzle.
- Only 15 litres of water/acre is required for spraying with electrostatic sprayer.
- In case of backpack type electrostatic sprayer, electrostatic nozzle should not be lifted above shoulder height.
- Do not touches the nozzle tip while operating the backpack type air assisted electrostatic sprayer.
- Maintain the distance of the electro-static nozzle tip about 1 to 1.5 feet above/away from the crop canopy.

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