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APPLICATION TECHNOLOGY: KNAPSACK SPRAYERS IN THE MANAGEMENT OF RUBBER NURSERY DISEASES

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Raising of quality assured planting material is vital for a sustainable rubber plantation industry. In fulfilling this requirement, crop protection plays an important role. Protecting the plants of nursery level is important especially since diseases reduce or weaken the plant's growth rate through out its life time. The health of nursery plant is one of the key indicators of quality planting material. Benefits of good quality planting material are always long-term as far as rubber is concerned. In a nursery, almost all the economically important diseases are evident. Hence RRISL recommends the prophylactic application of fungicides to protect the nursery plants from diseases.

Different plant protection sprayers are being used in the management of nursery diseases and the lever operated knapsack sprayer continues to be the most common application equipment amongst our stakeholders. The versatility in use with a variety of different chemical products and relative ease of operation make it well suited especially for small scale growers.

The knapsack sprayer (Fig.1) has a tank which stands erect on the ground and while using fits comfortably on the operators back. The tank is made of brass, galvanized iron, stainless steel or plastic moulded from polypropylene or high density polythene. The tank capacity ranges from 10 – 15 L. They are lever operated and the lever is connected to the pump assembly which is enclosed within the tank or fixed outside. Continuous operation of lever develops pressure in tank which forces out the spray through nozzle. No advance pressurizing is required in these sprayers. The lever operated knapsack sprayers may be of over arm or under arm lever and with piston or a diaphragm pump. The lever can be fixed on either side for the convenience of the operators. The spray is controlled by a cut off valve or a trigger fitted to the lance. The other end of the lance carries the nozzle.

The knapsack sprayer allows the pesticide to be directed to the biological target allowing the usage of minimum amounts of chemical making it more efficient and selective in chemical use. The relatively low cost, availability and the ease of operation are advantages compared to the other optional spraying equipment. However, the lack of pressure control is one of the limitations to the operation.

For accurate and quality chemical application, ability to calibrate a spray equipment is essential. Calibration itself depends on a measured and consistent flow rate and spray swath from the nozzle. Without a pressure regulating device, flow rate may be averaged per minute and can make consistent applications with even distribution of chemicals.

Fig. 1. A Knapsack sprayer

While spraying fungicides for comparatively larger extents, one has to be vigilant on the spray volume, to maintain the good coverage in order to save the time, pesticide, fuel, labour and even to avoid a large wastage of the active ingredient. Unless either your cost of producing a plant will rise unnecessarily or the diseases might not get controlled. However, there are limitations to this approach as the droplet size, is affected by the drift risk and meteorological factors *viz*. wind speed, relative humidity and rainfall. In order to achieve the dense and even covering of droplets without coalescence and to avoid many other disadvantages that may cause, a compromise must be reached between the volume and coverage. This is ultimately achieved by the calibration and proper use of the equipment.

Calibration of a sprayer

Step 1 – Before starting the calibration

- Clean the sprayer thoroughly
- Check the equipment for any leakages and functionality
- Check the nozzle filter – to ensure its free of residues
- Check the nozzles for its uniformity and maintenance

Step 2 – Check the flow rate of the nozzle

- Measure the flow rate of the nozzles (L/min.) at operating pressure.

(A graduated measuring cylinder can be used and the calculation of the average with 3 – 4 replicates of measurements is important).

Step 3 – Check the application speed

- Put two sticks in the field, in a distance of 30 meters (walking) and 60 meters (tractor).
- Path through the "start" and "end" markers
- Note the time (seconds) taken by the applicator – two replicates.
- Calculate the speed (km/h) using the following formula.

$$\text{Speed (km / h)} = \frac{\text{Test distance (m)} \times 3.6}{\text{Time (sec.)}}$$

Step 4 – Check nozzle distance (spray boom)/operating width of a single nozzle (cm)
Spray boom: note the distance between nozzles (cm) & control uniformity
Single nozzle: note operating width whilst continuously spraying in cm (preferably on dry ground – visibility of the spray pattern)

Step 5 – Calculate using the following formula:

$$\text{Spray volume (L / ha)} = \frac{\text{Nozzle flow rate (L/min)} \times 60000}{\text{Nozzle distance/swath width (cm)} \times \text{speed (km/h)}}$$

Variations in pressure are a result of a number of factors and have a detrimental effect on the consistency of spray pattern from the nozzle and subsequently on the overall quality of the chemical application.

Pressure fluctuations

As pressure varies at the nozzle, flow of the spray solution fluctuates significantly, resulting in an inconsistent dosage of the chemical applied. Inconsistent dosage and spray volumes reduce the biological and cost effectiveness of pesticide applications with knapsack sprayers. Depending on the nozzle type and size, the operating pressure of a sprayer can have a significant effect on spray angle. In addition to inconsistencies in flow rate, spray pattern and coverage of the target pest, crop or soil. When pressure increases with the downward stroke of the lever, the angle of the spray from the nozzle increases to cover a wider area. This is the spray swath width. Swath width declines as the pressure at the nozzle decreases, consequently the spray angle changes and variable spray patterns are created.

Pressure and spray drift

Inconsistencies in spray pressure result in inconsistencies in droplet size. The increase in pressure results in a significant increase in the percentage of extremely fine droplets which are considered drift prone. Due to the fact that the potential for

spray drift, the chance of off-target deposition increases. Furthermore, fine droplets of water have a very short lifetime due to evaporation which reduces the chemical efficacy. Concentrated droplets moving off-target can cause contamination of crops and the environment, particularly nearby water bodies.

Further, increasing the spray volume does not necessarily improve coverage, with a standard equipment, increasing the volume applied by increasing pressure will result in the aeration of more fines resulting higher drift potential. This can also lead to significant run off from the leaf surface.

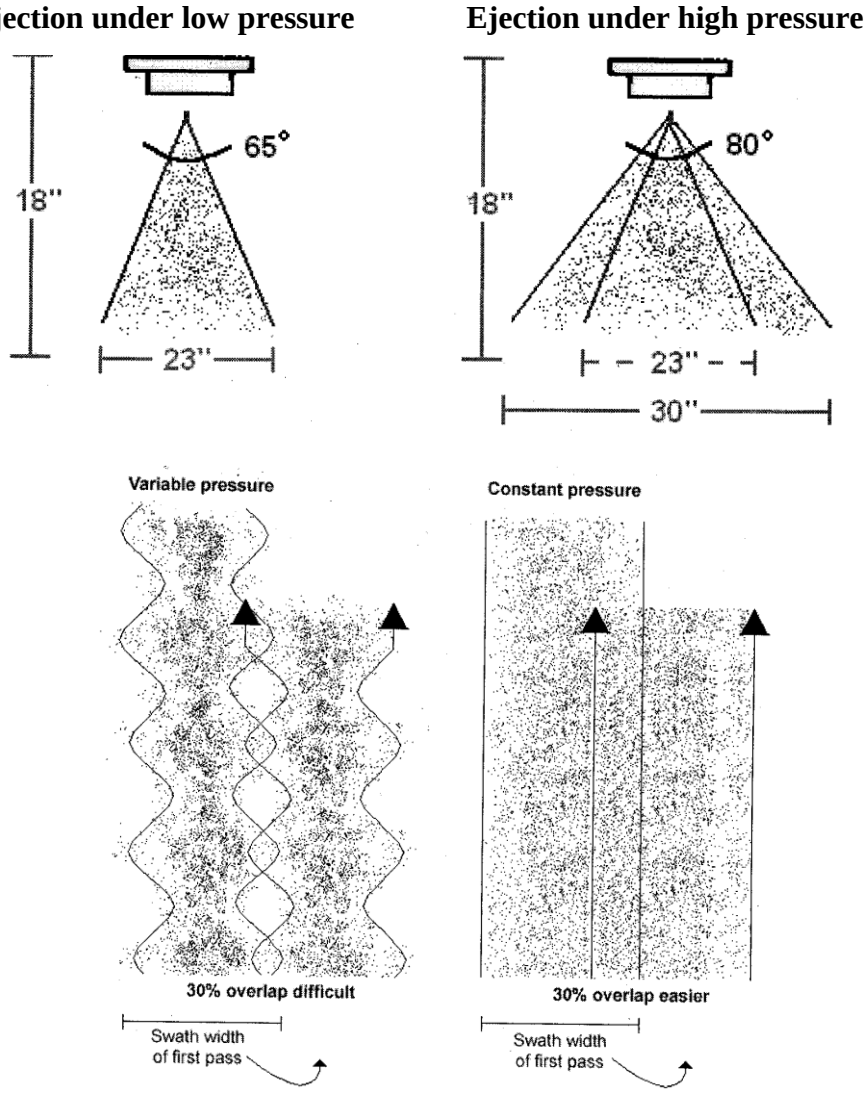

Fig. 2. Pressure fluctuations and its effect on spray angle & swath width

Requirements for optimum results of chemical application

- Selection of a suitable nozzle
- Calibration of the spraying equipment
- Spray at optimal conditions improves the efficiency e.g. weather factors
- Selection of the best time of the day for spraying – Disease forecasting based on epidemiological modeling may help to reduce the number of sprays
- High capacity allows to spray at best time

Maintenance of a knapsack sprayer

Plant protection machines in general are not well maintained regularly. Life of a machine depends entirely on its care and maintenance. Good and constant performance of machines can be obtained only when they are used and serviced periodically. Maintenance plays an important role in the quality of a chemical application. The maintenance of a machine involves proper care, operation, servicing, repair and keeping it in good working order.

- Cleaning the chemical tanks, hoses, valves and nozzles and flushing sufficiently to avoid pesticide residues which are corrosive.
- Cleaning of the machine equally well from outside also as it is contaminated due to leakage, spilling of pesticides.
- Lubricating suitably the pump parts like piston, cylinder, valves and other routing sliding and moving parts.
- Storage of the machine in a dry place duly protected from sun and rain.

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