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Spray application in onions

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To achieve the best possible spray coverage consider the following guidelines:

- Optimum spraying condition is when there is a slight breeze of about 7 km/h.
- When applying most insecticides and fungicides to onions, aim for a water rate of 200 to 250 L/ha when the onion crop is at the early vegetative stage. Increase the water rate to 300 to 350 L/ha as the crop reaches maturity.
- Hollow cone nozzles are generally used when applying insecticides and fungicides.
- Producing spray droplets in the 'fine' classification is recommended for best plant coverage when applying most insecticides and fungicides.
- The efficacy of most chemicals can be enhanced by the use of an appropriate adjuvant.

Understanding the principles of spray application

Chemicals play an important role in onion production and are regularly used to control insect pests, diseases and weeds. The majority of chemicals used in onion production are delivered in the form of droplets produced from different types of nozzles and spray booms. Some agricultural chemicals need to have better penetration and coverage than others. Protective fungicides and contact insecticides require a more thorough coverage to the target area than systemic chemicals and residual herbicides.

Droplet size

Droplets are very small and usually measured in microns (μm) with one micron equalling 0.001 mm. When operating at any given pressure, hydraulic nozzles produce a range of droplet sizes. The British Crop Protection Council (BCPC) has classified these droplet sizes into different classes.

BCPC Category	Droplet size	Description	Uses
Very fine	< 150μm	Mist or fog	
Fine	150-250μm	Fine spray	Insecticides, fungicides and contact herbicides
Medium	250-350μm	Medium spray	Residual herbicides
Coarse	350-450μm	Very fine rain	Residual herbicides and foliar fertilisers
Very coarse	450-550μm	Fine rain	
Extremely coarse	> 550μm	Heavy rain	

Table 1. BCPC classes and their applications

Knowing the importance of droplet sizes, droplet density and water volume will help spray operators to get the best possible results. To achieve the most uniform coverage possible, droplets need to be small enough that they will swirl around as they are depositing onto the plant surface. Large droplets, being heavier, tend to fall straight down and are not usually deflected by air movement so their redistribution within the crop foliage is limited. Large droplets are also more difficult to retain on the leaf surface, tending to bounce or roll off, cascading down the foliage and onto the ground. When larger droplets are produced, there are fewer of them, meaning there is less likelihood of them reaching the target.

Water rates

Recent research has shown that a water rate of 200 to 250 L/ha is required to obtain 100 to 200 droplets/m^2 over the majority of the onions' surface area when the plants are small and at the pre-bulbing stage. A higher water rate of 250 to 350 L/ha is required when the plants are fully matured.

Adjuvants

Spray retention on onion leaves can be difficult because of the vertical nature of the plant and the waxy leaf surface. Spray retention can be improved by the use of a suitable spray adjuvant. Greater spray retention can result in an increase in the efficacy of foliar applied insecticides and fungicides.

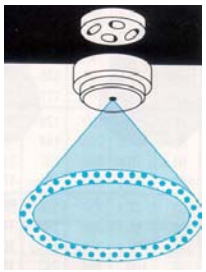
The waxy leaf surface of an onion is a natural barrier to disease infection. Some adjuvants will damage the waxy surface which can increase the onion's susceptibility to disease. Therefore only use adjuvants recommended for use in onions. Research at DPI&E Tasmania and QDPI&F has shown that vegetable oil adjuvants are more suitable for use in onions than mineral oils and leaf surfactants.

Selection of nozzle type

Nozzle selection is often based on achieving the desired droplet size. The following is a description of the most popular nozzles used for agricultural spraying.

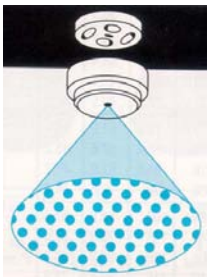
Hollow cone nozzles

Hollow cone nozzles are the most popular nozzle for applying insecticides and fungicides. They generally produce a smaller droplet size than most other nozzle types. The characteristic hollow cone shaped spray output is produced when the liquid is forced through slots in the swirl plate (within the nozzle body) then emitted through a narrow orifice.



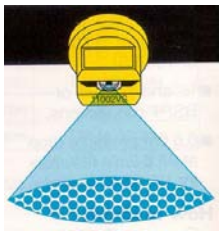
Solid cone nozzles

Solid cone nozzles have an extra hole in the centre of the swirl plate and produce higher flow rates than a similar size hollow cone nozzle. They are not usually recommended for applying insecticides and fungicides as the increase in flow rate comes with an increase in droplet size. Solid cone nozzles are more suitable for residual herbicides and foliar fertilisers.



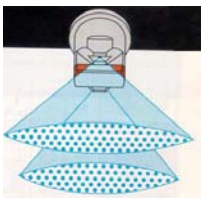
Flat fan nozzles

Flat fan nozzles are the most common type of nozzle and can be suitable for many different purposes. These nozzles have a rectangular or lens shaped orifice which produce a tapered distribution of droplets across the nozzle swath. Uniform coverage is achieved by overlapping each nozzle 30% with the nozzle each side of it. There are many sizes of flat fan nozzles that can be operated under various pressures with a wide range of droplet sizes. Flat fan nozzles can be suitable for applying insecticides and fungicides if the correct size and pressures are used.



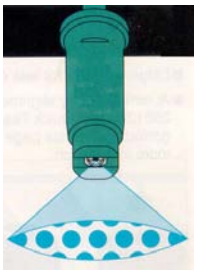
Double flat fan nozzles

Double flat fan nozzles produce two spray swaths from the one nozzle body. These nozzles offer the advantage of the spray being directed in from two different angles to improve coverage. The double flat fan nozzles produce a fine droplet and would be suitable for applying insecticides and fungicides.



Air induction nozzles

Air induction nozzles produce large air filled droplets. The air inclusion is usually by venturi action and produce large bubbly droplets. These droplets tend to shatter on impact, further distributing the smaller droplets into the canopy. The main advantage of these nozzles is to reduce drift and allow the operator to spray in windier conditions.



Selection of sprayer type

Hydraulic spray boom

Conventional spray booms with hydraulic nozzles are the most common method of applying chemicals. The best results are achieved when spraying in a light breeze at about 7 km/h. The wind will be beneficial by creating turbulence to assist in carrying the droplets into the crop canopy.

Figure 1. Hydraulic spray boom

Air assist boom

In its most common form, this sprayer is a conventional hydraulic spray boom with the addition of a high volume output fan mounted centrally above the boom with an air duct extending full length along both arms of the boom. The slotted outlet of the air duct produces a curtain of air adjacent to the spray nozzles. This air curtain directs the spray down into the crop canopy causing agitation of the plants and improves spray coverage on both sides of the leaves. Air assisted booms also have the potential to reduce spray drift and allow the operator to spray in conditions unsuitable for conventional booms.

Further reading

David White and Rod Eamens, *SMARTtrain reference manuals,* NSW Department of Primary Industries, 2000.

Glenn Geitz, *Efficient pesticide application in horticultural crops*, QLD Department of Primary Industries and Fisheries, 2002.

Acknowledgments

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