Australian Garlic Industry Association

Information Sheet

SPRAY APPLICATION

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Objective

Chemicals can play an important role in garlic production and are regularly used to control insect pests, diseases and weeds. When applying these chemicals the aim is to maximise the amount reaching the target and to minimise the amount reaching off-target areas. To achieve the best possible spray coverage you need to consider the following:

- ✓ Optimum spraying condition is when there is a slight breeze of about 7km/hr.
- ✓ When applying most chemicals aim for a water rate of 200 to 250 L/ha when the garlic is young
- ✓ Increase the water rate to 350 to 400 L/ha as the crop reaches maturity.
- ✓ Hollow cone nozzles are recommended and often used when applying insecticides and fungicides.
- ✓ Producing spray droplets in the "fine" classification can gives the best plant coverage.

Principles of Spray Application

The majority of chemicals used in garlic production are delivered in the form of droplets produced from different types of nozzles and spray booms. To maximise spray efficiency, spray droplets must be uniformly distributed on a target surface with minimum losses due to drift, evaporation or run-off. Poor spray application techniques will result in reduced control of pests, yield reduction, wasted chemicals and lower returns to the grower.

Droplet Size

Droplets are very small and usually measured in microns (µm) with one micron equalling 0.001mm. When operating at any given pressure, hydraulic nozzles produce a range of droplet sizes. The British Crop Protection Council (BCPC) has classified these ranges of droplet sizes into different classes. This classification is included in most nozzle catalogues and are a useful guide for assessing the suitability for any given spray job.

Table 1: BCPC classification and their application

BCPC Category	Droplet size	Description	Uses in agricultural spraying
Very Fine	< 150µm	Mist or fog	
Fine	150-250µm	Fine spray	Insecticides 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	Foliar fertilisers
Extremely coarse	> 550µm	Heavy rain	Foliar fertilisers

Note: Droplets smaller than 80µm cannot readily be seen by the naked eye.

When targeting the plant, spray droplets should be distributed uniformly over the entire plant, which include both sides of the leaves. To achieve this, 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 garlic leaves and onto the ground. When larger droplets are produced, there are much less of them, meaning there is less likelihood of them reaching the target.

Droplet Density

Droplets not only need to be uniformly distributed over the target area but the density also needs to be sufficient to achieve good results. Different types of chemicals require a different level of droplet density. Contact and protectant chemicals require a higher droplet density than systemic type chemicals. Table 2 gives a guide to the droplet densities required to ensure adequate levels of control.

Table 2 – Recommended droplet density

Product	droplets/cm^2
Systemic insecticide and fungicides	20-30
Contact insecticide and fungicides	50-70
Pre-emergent herbicide	20-30
Post-emergent herbicide	30-40
Foliar nutrients	20-30

Water Rates

Water rate as well as droplet size helps determine droplet density. If water rates are too low, it will lead to insufficient droplet density and poor coverage. If water rates are too high, it will lead to plants dripping with excess pesticide and environmental pollution. Good spray application aims at using a water rate that gives a uniform droplet distribution at the desired density.

When conducting a spray program for garlic with contact chemicals you need to aim for a droplet density of 50 to 70 /cm^2 throughout the entire canopy. To achieve a thorough coverage with a conventional boom, you need to use a water rate of about 200 to 250 L/ha when the plants are young. As the crop growth increases, water rates should also increase. Aim for a water rate of 350 to 400 L/ha by the time the garlic is fully matured.

Adjuvants

Spray retention on garlic 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 garlic's susceptibility to disease. Therefore only use adjuvants recommended for use in garlic. Research has shown that vegetable oil adjuvants are more suitable for use in alliums than mineral oils and leaf surfactants.

Water Quality

The quality of water used when spraying agricultural chemicals can have significant effects on chemical efficacy. It is always advisable to use clean rainwater where possible. This is not always possible and usually water has to be sourced from other places including bores, dams, channels and rivers. The quality of water available from these other sources can be variable and may cause significant application problems if the quality is too poor. It is preferred that the water is clear, colourless, odourless and neutral (pH 7.0). That is, not acid, alkaline or brackish.

Nozzle Selection

Nozzle selection is often based on achieving the required water rate at 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 a 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

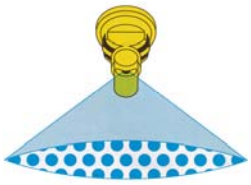
Solid cone nozzles have an extra hole in the centre of the swirl plate and produce higher flow rates than a similar size hollow cone nozzle. Not usually recommended for applying insecticides and fungicides as the increase in flow rate comes with an increase in droplet size. Solid cone nozzles are more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

Flat Fan Nozzles and Double 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 operate under various pressures with a wide range of droplet sizes. Double flat fan nozzles produce two spray swaths from the one nozzle body. These nozzles offer the advantage of the spray being directed from two different angles to improving coverage. These nozzles are suitable for applying insecticides and fungicides if the correct size and pressures are used.

Turbo and Double Turbo Fan Nozzles

Turbo types are also a common nozzle and suitable for broadcast spraying. These nozzles have a tapered edge to give a wide angle flat spray pattern. Uniform coverage is also achieved by overlapping each nozzle 30% with the nozzle each side of it. There are also many sizes of these nozzles that can be operated under various pressures to produce a wide range of droplet sizes. The double fan nozzles also produce two spray swaths from the one nozzle so the spray can be directed into the target from two different angles. These nozzles produce a larger droplet size than most other nozzle types when operated at the same pressure.



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.

Spraying Equipment

Hydraulic Spray Booms

Conventional spray booms with hydraulic nozzles are the most common method of applying chemicals in large paddocks of garlic. 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. The performance of this boom sprayer can be improved in some cropping situations by the addition of droppers. These are short lengths of semi-rigid plastic tubes attached to the boom with nozzles at the lower end and positioned between plant rows to direct spray from a lower angle, increasing spray penetration and coverage.

Knapsack sprayers

Knapsacks (or hand operated sprayers) are designed to be carried and operated manually by one person. They are suitable for treating small areas of garlic. These sprayers have a tank of up to 20 L capacity and are usually carried on the operators back. The nozzles used in knapsacks are the same as those used in conventional boom sprays. Often there is only one nozzle at the end of a wand but there may be more to increase water rate or spray width. Knapsacks can be pressurised by a leaver operated pump, motorised pump, battery operated pump or portable compressed air. Most knapsack sprayers operate at moderate to low pressure (200 to 400 kPa). Droplet size and flow rates can be regulated by adjusting the pressure.

Knapsack sprayer (photo: Astrid McCormick)