



Prepare and apply chemicals

AHCCHM303

By the end of this topic, you should be able to:

- Determine the need for chemical use and prepare a application plan
- Prepare chemical mixes
- Calibrate application equipment
- Apply chemicals
- Clean up equipment and complete records

- Plants are exposed to a range of organisms:
 - Beneficial organisms, which benefit the growing process (e.g. pollination, maintenance of soil health, controlling pests)
 - Pests, which affect plant health by consumption of plant tissues
- For example:

Beneficial organisms	Pests
• Beetles • Caterpillars • Some insects • Moths • Spiders	• Birds • Diseases • Some insects (e.g. aphids, dung beetles) • Mites • Weeds

Plant pests

- Examples of pests include:



African Black Beetles



Cowpea aphids



Cutworm



Fire ants



Fruit fly



Mealybugs



Rutherglen bug



Snails

Some pests are of such concern that you are legally required to report sightings to the Government

- The presence of pests can be seen in various ways:
 - Pests are visibly seen on plants (e.g. caterpillars)
 - Damage to plants
 - Curled or wilted leaves
 - Fruit have sting marks
 - Leaves are eaten
 - White covering on leaves and stems

Weed infestations

- Weeds affect a range of areas, including commercial crops, gardens, turf and natural areas.
- Some examples include:



Prickly acacia
Acacia pulchella

Affects natural areas



Nutgrass
Cyperus rotundus

Affects gardens and
turf



Barnyard grass
Echinochloa colona

Affects commercial
crops



Lantana
Lantana camara

Affects natural areas

Weed infestations

- Weeds affect a range of areas, including commercial crops, gardens, turf and natural areas.
- Some examples include:



Onion weed

*Nothoscordum
inodorum*

Affects gardens



Milk thistle

Silybum marianum

Affects natural areas



Bindii

Soliva sessilis

Affects gardens and
turf



Common sowthistle

Sonchus oleraceus

Affects commercial
crops

- Diseases in plants can be caused by micro-organisms, such as:

Bacteria	Fungi	Viruses	Nematodes
Causing: • Blights: Chlorosis, browning and death of plant tissues (e.g. leaves, branches, twigs or flowers) • Canker: Appearance of dead tissue • Galls: Swollen masses of abnormal tissue • Wilting: Loss of rigidity of non-woody parts of plants • Fruit rotting	Causing: • Canker: Appearance of dead tissue • Galls: Swollen masses of abnormal tissue • Ink spot: Causes blackening of leaves and flower stems • Mould/Mildew: White powdery spots • Rot: Decay roots, stems, wood flowers, and fruit • Rust: Brown pustules on the underside of leaves with yellow speckling on the upper leaf • Wilting: Loss of rigidity of non-woody parts of plants	Causing: • Canker: Appearance of dead tissue • Distortion: Irregularly shaped lesions • Scaling • Yellowing	Causing: • Visible nodules on plant roots May transmit and acquire viruses by feeding on infected roots

- When assessing pests, weed infestations and/or diseases, take note of the following details in your field notes:
 - Details of plant species affected
 - Signs and symptoms of pest/weed/disease displayed
 - Location, scope, size and severity
 - Identification of the pest, weed and/or disease
 - Beneficial organisms in the area
 - Environmental history in the area

Treatment options

- There are a variety of treatment methods for plant pests, weeds and diseases, including:

Treatment method	Definition
Biological	Makes use of the weed's naturally occurring enemies
Chemical	Includes: - Fungicides: Destroys fungus - Herbicides: Used to kill unwanted plants - Insecticides: Used for killing insects - Pesticides: Used to attract and then destroy/mitigate pests
Cultural	Involves manipulating farming practices to suppress weed growth and production, while promoting plant development
Mechanical	Uses physical barriers and traps to stop pests from reaching plants
Physical	Includes hand weeding, slashing, burning, cutting, ripping

The focus of this unit

Treatment options

- Integrated Pest Management (IPM) involves a range of methods to stop pests, weeds and diseases.
- Integrated Pest Management involves using more than one method to control a particular problem
 - The aim is to lower long term risks to the environment (e.g. chemical resistance)
 - Well considered IPM is generally more cost-effective in the long run as well

Control measures need to be selected in full consideration of
WHS and environmental implications

- It is not unusual to find the same chemical available in different formulations – each is suited to a particular use and will have its own hazards/risks:

Liquid type	Advantages	Disadvantages
Solutions and emulsifiable concentrates	- Easy to measure, handle, transport and store - Minimal wear on equipment	- May increase risk of skin irritation and absorption - May be highly flammable
Suspension concentrates	- Much less chance of nozzle or filter blockages than with wettable powders - No dust problem when measuring out	Suspension may settle in storage packs

- It is not unusual to find the same chemical available in different formulations – each is suited to a particular use and will have its own hazards/risks:

Solid type	Advantages	Disadvantages
Soluble powders	Easy to store and transport	- Need to avoid breathing in powder when measuring - Measuring can be difficult
Wettable powders	Convenient way of packing high concentrations of active constituent	- Constant agitation in spray vat required due to particle settlement - Suspended particles can block nozzles and filters

Treatment options

- It is not unusual to find the same chemical available in different formulations – each is suited to a particular use and will have its own hazards/risks:

Solid type	Advantages	Disadvantages
Water dispersible granules	- Can carry high concentrations of active constituent - Avoids dust generation - Easy to measure - No problems with blockages - Efficient to transport and store	A specific order of mixing may be required when more than one product is to be included in a spray solution
Granules	- Ready to use without mixing - No carrying water for application - Little or no dust	- More expensive - May require soil incorporation or follow-up rain before activating

Treatment options

- A primary consideration when deciding between various application options is the risk of spray drift
 - Spray drift is the physical movement of spray droplets through the air from the nozzle to a non- or off-target site at the time of application or soon thereafter
- The Australian Pesticides and Veterinary Medicines Authority (APVMA) outlines that when determining how far a drift deposit will reach and how much will be deposited, you need to consider:
 - Droplet size
 - Wind speed and direction
 - Release height
 - Humidity and temperature
 - Time of application
 - Surface temperature inversion conditions

Activity: Access the 'APVMA operating principles in relation to spray drift risk' document to read more about these factors

Preparing to apply chemicals

- When preparing to apply chemicals, you should undertake the following:
 - Be familiar with laws applicable to your workplace, such as:
 - Acts, such as:
 - *Work Health and Safety Act 2011 (Qld)* which outlines employers' and employees' safety responsibilities
 - *Agricultural Chemicals Distribution Control Act 1966 (Qld)* and *Pest Management Act 2001 (Qld)* which outline requirements when using chemicals (e.g. licensing and recordkeeping)
 - *Chemical Usage (Agricultural and Veterinary) Control Act 1988 (Qld)* which outlines requirements for the use of certain chemicals
 - Regulations, such as:
 - *Work Health and Safety Regulation 2011 (Qld)* which addresses the handling of hazardous substances
 - *Agricultural Chemicals Distribution Control Regulation 1998 (Qld)* and *Pest Management Regulation 2003 (Qld)* which outline requirements when using chemicals (e.g. licensing and recordkeeping)

- The use of horticultural chemicals (e.g. herbicides and pesticides) in Queensland is regulated.
 - If you distribute (spray, spread or disperse) herbicides using ground equipment (any machine or apparatus other than an aircraft), on land that you do not own or occupy (e.g. a commercial or work situation), you may require an *Agricultural Chemicals Distribution & Control (ACDC)* licence
 - Refer to the Department of Agriculture and Fisheries
 - If you apply pesticides to arthropods, birds, molluscs or rodents as part of a business activity, then a *Pest Management Technician (PMT)* licence may be required
 - Refer to the Department of Health

Preparing to apply chemicals

- When preparing to apply chemicals, you should undertake the following:
 - Familiarise yourself with the work area
 - Identify any WHS hazards and assess risks (e.g. manual handling injuries)
 - Identify environmental hazards (e.g. damage to flora/fauna, waste)
 - Collaborate with others, as necessary:
 - As required, ask questions and seek clarification – applying active listening
 - Report hazards to your supervisor within a timely fashion – especially emergency situations
 - Discuss your plans with neighbouring properties before applying chemicals to minimise conflict
 - The *Pest Management Regulation 2003* (Qld) requires information to be given to occupiers or others (s 13), identifying the technician's details (including licence number), the pesticide details, the area it is to be applied to and any precautions to be taken

Ensure that you are mindful of people's different backgrounds and abilities

Preparing to apply chemicals

- When preparing, handling, using and disposing of chemicals, refer to the following documents:
 - Product labels for active constituent details and application information
 - Safety Data Sheets (SDS) for hazard/risks and safe usage information (e.g. handling, transport, disposal, emergency and spill requirements)
- Be aware of signage/labels, such as:

Will display a number which reflects the Poisons Schedule



Acute toxicity



Corrosive



Flammable



Danger to human health



Warning

Preparing to transport, handle and store chemicals

- When preparing to transport, handle and store chemicals, you should undertake the following:
 - Be familiar with the Poisons Standard which outlines the requirements for storage, disposal and record keeping for poisons (and medicines)
 - The relevant schedules are **in bold** below

Schedule 1	<i>Not currently in use</i>	Schedule 6	Poison
Schedule 2	Pharmacy medicine	Schedule 7	Dangerous Poison
Schedule 3	Pharmacist only medicine	Schedule 8	Controlled drug
Schedule 4	Prescription only medicine or Prescription animal remedy	Schedule 9	Prohibited substance
Schedule 5	Caution	Schedule 10	Substances of such danger to health as to warrant prohibition of sale, supply and use

Preparing to apply chemicals

- When preparing to apply chemicals, you should prepare an application/spray plan, which considers:
 - Area to be sprayed
 - Considering the effects on neighbouring properties
 - Chemicals required
 - Quantity required for the area
 - Mix of chemicals required
 - Equipment requirements
 - Solid applicators may include: Dusters and granule applicators
 - Liquid applicators may include: Aerosols, Controlled droplet applicators (CDA), boom sprays, knapsacks and compression sprayers, handguns, air blast sprayers and foggers
 - Nozzle selection
 - Calibration requirements to avoid under-spraying or over-spraying
 - Operation of equipment and required output
 - Optimum spraying time and conditions
 - Potential hazards

Equipment types

- Nozzles need to be selected for the type of chemical applied.

ASAE category	Colour code	VMD of droplet cloud	Potential uses
Extremely fine (XF)	purple	< 60 µm (microns)	insecticide
Very fine (VF)	red	61–144 µm	insecticide
Fine (F)	orange	145–235 µm	fungicide
Medium (M)	yellow	236–340 µm	herbicide/insecticide
Coarse (C)	blue	341–403 µm	herbicide
Very coarse (VC)	green	404–502 µm	herbicide
Extremely coarse (XC)	white	503–665 µm	herbicide
Ultra coarse (UC)	black	> 500 µm	herbicide

- See the [Nursery Pesticide Application Best Practice Manual](#) for more detail

Equipment types

- Knapsacks/backpack sprayers are carried by the operator.



Advantages

- suitable for spot spraying
- for small operations
- a range of nozzles can be used for target and pesticide combinations

Disadvantages

- operator hazard—may leak, weight on back
- variable pressure (unless SMV used), variable flow rate
- must be calibrated for each operation

- See the [Nursery Pesticide Application Best Practice Manual](#) for more detail

Equipment types

- Vehicle-mounted boom sprayers can be used to treat larger areas.



Advantages

- quick to cover the target area
- greater uniformity in deposition than hand guns
- nozzles can be changed to suit situation

Disadvantages

- booms can be difficult to manoeuvre around the nursery (e.g. irrigation risers, building structures)
- nozzles wear and should be replaced regularly

- See the [Nursery Pesticide Application Best Practice Manual](#) for more detail

- When preparing chemical mixes, it is important to consider the following:

Efficacy	The mix of chemicals should be the most efficient for addressing the pest, weed and/or disease. Consider pest management effectiveness and the associated costs.
Mixing order	A specific order of mixing may be required when more than one product is to be included in a spray solution
Water quality	- Generally pesticides are most stable within a pH range of 4.5 – 7.0 (optimum is 5.0 – 6.0). The pH of water can reduce the effectiveness of some pesticides. - Insecticides are generally more severely affected by alkaline water than fungicides or herbicides.

- When preparing chemical mixes, it is important to consider the following:

Adjuvants

- These are added to a formulation or spray mix to improve its performance or stability. For example:
 - **Drift retardants**
 - **Sequestering agents** which can overcome problems caused by hard water containing excessive amounts of calcium and magnesium salts
 - **Synergists** which enhance the performance of the active constituent
 - **Buffers** which can alter and maintain the pH of carrier water
 - **Surfactants**, including:
 - **Wetting agents** which lower the surface tension of the liquid to produce an even film of liquid applied, rather than individual droplets
 - **Stickers** which help increase the rain-fastness of a spray, reducing the need for repeat treatments
 - **Anti-foaming agents** which can save time when recharging spray vats with high pressure water

Preparing to apply chemicals

- When preparing to apply chemicals, you should undertake the following:
 - Select and use PPE (e.g. face shield, gloves, goggles)
 - Refer to workplace policies and procedures, SDS and chemical product labels
 - Carry out pre-operational checks of application equipment
 - Refer to manufacturer's specifications
 - Identify and replace any damaged or worn components
 - Prepare application equipment for use
 - Follow training/manual for instructions on safe calibration and equipment use
 - The mixing area should contain a work surface, water supply and measuring equipment
 - The loading area can be part of the mixing area or it can be separate – it just has to be large enough to hold the largest sprayer.
 - The purpose of this area is to collect spills while loading and emptying – and to provide an area for washing down the sprayers after use.

- Equipment is calibrated in varying ways. For example:

Backpack sprayer

- Fill tank with water, closing caps taps and lids
- Pump the handle to pressurise the tank
- Look for leaks
- Check the spray stream, making adjustments as required to avoid spray drift

Boom spray

- Clean the filter/nozzles/tank
- Check the pump and pressure gauge
- Fill the tank with clean water and prime the spray unit
- Measure and perform calculations
 - Swath width
 - Liquid put out by single nozzle
 - Liquid put out by all nozzles combined
 - Time take to travel 100m
 - Spray application rate
- Calculate the amount of fertiliser you need to add to the tank

- When applying chemicals, you should follow environmental requirements:
 - Assess and record meteorological conditions and forecasts - assess whether chemical applications are able to proceed
 - Measure and record the weather conditions before and after the applications or as directed by the label. If you think they have changed, stop and measure them during the application as well.
 - Spray only in favourable weather conditions. Ideal wind speeds are between 3-15km/h.
 - During spraying, wind should be blowing steadily. Light and variable or gusty winds make it difficult to predict where spray will go.
 - Spraying should not be carried out under calm or still conditions. Under calm conditions, droplets are more likely to remain suspended in the air.
 - Ideally, wind should be blowing away from susceptible crops. If not, try leaving a buffer zone.
 - Avoid spraying in temperatures near or above 30°C and when humidity is low as spray droplet size may be reduced, increasing the risk of spray drift.
 - Do not spray when inversion conditions exist. Visual indicators include no wind, fog, dew, frost and smoke or dust hanging in the air or forming distinct layers. Inversion conditions are very prevalent in Australia.
 - Protect non-target plants with guards or shields
 - Substitute less toxic chemicals wherever possible

- When applying chemicals, you should undertake the following:
 - Apply chemicals in accordance with the application/spray plan
 - Follow the application requirements of the chemical labels
 - Observe re-entry periods
 - Workers who have not been involved in applying chemicals will not need health monitoring if re-entry periods have been observed and spraying has not been carried out near them
 - Obey withholding periods to ensure chemical product integrity is maintained

- Apart from eradicating weeds, treatments may have a range of other unwanted effects, including:
 - Unwanted consequences for humans and animals
 - Chemical spillage
 - Surface run-off
 - Changes in soil structure
 - Soil contamination
 - Leaching and contamination of the water table
 - Reduction in habitat
 - Spray drift and damage to off-target organisms/produce
 - Droplet drift: Direct airborne movement of liquid droplets away from intended target
 - Vapour drift: Airborne movement of vaporised chemicals from a sprayed area

Handling incidents

- If there are any incidents during the application process be sure to notify your supervisor and complete an incident report form
 - Incidents may include spills, emergencies (e.g. fire), medical emergency (swallowing, skin exposure)
- If poisoning occurs, contact the Poisons Information Centre on 13 11 26
- You may also be required to contact other organisations
 - For example, the local water authority if drains, streams and/or watercourses are contaminated

- Control methods should be monitored to determine their effectiveness
 - Refer to specified industry, WHS and enterprise standards to determine if treatments are functioning as expected
- Adjustments should be made to control measures, as necessary to meet enterprise specifications
 - As per IPM control measures, this may involve applying another control measure

- The law requires a number of records need to be kept when treating weeds, including:
 - Name of operator
 - Treatments applied
 - Date/time and location of application
 - Rate of application
 - Equipment settings
 - Weed numbers
 - Numbers of beneficial organisms
 - Accident and dangerous occurrence reports

Refer to the relevant legislation for your state.

For example, in Queensland refer to the *Agricultural Chemicals Distribution Control Act 1966* (Qld)

- As part of clean-up processes, you should:
 - Shut down, maintain, clean and store tools and equipment according to manufacturer's specifications
 - Rinse containers immediately after empty contents, following label instructions
 - Report identified hazards and faults within a timely fashion

- As part of clean-up processes, you should:
 - Store chemicals
 - Ensure chemicals and fuels are not stored together, as this may cause explosions
 - Ensure the storage area is well-ventilated to avoid the build up of fumes and gases
 - Lock up the storage area to avoid access by unauthorised persons

Under the *Work Health and Safety Regulation 2011* (Qld), a chemical can be decanted or transferred from its original container provided the new container is labelled (at a minimum) with:

- The product identifier
- A hazard pictogram or hazard statement consistent with the correct classification of the chemical

- As part of clean-up processes, you should:
 - Dispose of materials that cannot be reused or recycled
 - Ensure you implement environmentally safe practices
 - Follow Safety Data Sheet (SDS) requirements

- Containers may be rinsed in varying ways. For example:

Pressure rinsing

- Remove the cap from the container. Empty the contents into the tank and allow to drain.
- For piercing nozzles, insert the pressure nozzle by puncturing through the lower side of the container. For sucker-flusher probes, insert through the regular opening and do not invert the container (i.e. ignore next point).
- Hold the container upside down over the sprayer tank so the rinsate will run into the sprayer tank.
- Turn on the water and rinse until rinsate is clear.
- Rinse container cap and container thread.
- After thorough clean, leave container to dry then replace cap.

Triple-rinsing

- Remove the cap from the container. Empty the contents into the spray tank and allow the container to drain.
- Fill the container with water (i.e. 20-25% of its capacity). Replace the cap securely.
- Shake, rotate, roll or invert the container vigorously for at least 30 seconds.
- Remove the cap. Add the rinsate from the container into the sprayer tank.
- Repeat the above steps two or more times.
- Rinse container cap and container thread.
- After thorough clean, leave container to dry then replace cap.