ENVIRONMENTAL MANAGEMENT GUIDELINES FOR GROWING CUT FLOWERS

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Preface

Spreading urban development in the Sydney region has put pressure on agricultural industries to make the most of the available land and, at the same time, reduce any negative impact on the environment. In 1993, NSW Agriculture initiated the development of the Strategic Plan for Sustainable Agriculture — Sydney Region. It was released in 1998 after extensive consultation. One of the major objectives of the Strategic Plan was to ensure that farmers, including cut flower growers, use best management practices for sustainable agriculture.

While these Guidelines focus on cut flower production in the Sydney region, they can be applied by growers throughout New South Wales.

These Guidelines were prepared by NSW Agriculture staff in cooperation with representatives from the cut flower industry. The Guidelines aim to help growers understand the impact of cut flower growing on the environment and be better environmental managers. They summarise good management and best farm operation practices that will reduce harmful environmental impacts and maximise sustainable economic production of high quality crops. Please refer to the NSW Agriculture companion publication *Environmental issues for commercial flower growers — sources of information and assistance* for additional information.

How the Guidelines will help growers:

These guidelines will help growers to:

- reduce or avoid adverse environmental effects as growers become more aware of possible problems and are able to deal with them
- achieve long-term productivity and viability of the farm and the industry as a whole
- save time and money by using chemicals and fertilisers responsibly.

These Guidelines are not intended or seen as definitive rules for cut flower growing and therefore should not be regarded as a policy planning document.

How the Guidelines were developed

NSW Agriculture developed a draft guideline document through extensive consultation at all levels of the cut flower industry. This involved regular meetings with a focus group of growers representing a range of flower crops and geographical locations. Government and private agencies, universities, flower grower associations and individual growers then gave comments on the draft. Most of them have been incorporated in these Guidelines and are gratefully acknowledged.

Cut flower industry in NSW 1

NSW Agriculture estimates the value of the cut flower industry in New South Wales to be up to $350 million per annum at farm gate, climbing to $800 million at retail level. Cut flower growing is an expanding industry, with over 700 established growers. The industry is mainly based in the Sydney region where the climate allows year-round production of a wide range of flowers. The estimate for this local production is $300 million per annum.

Most commercial cut flower production occurs in the area bordered by the Central Coast just north of Sydney, the Southern Highlands, the South Coast, and the Blue Mountains to the west.

Growing cut flowers close to metropolitan Sydney has a number of advantages including:

1. Consumers and florists are able to buy a wide variety of fresh flowers direct from the grower.
2. Flowers can be transported in water, which can enhance vase life and reduce damage associated with packaging.
3. Local marketing reduces the need for packaging (and its recycling) associated with transporting flowers long distances.
4. The industry can recycle urban and industrial waste products in the production cycle. This helps reduce the amount of waste products sent to landfills and treatment works.
5. The industry is part of a large horticultural/agricultural industry which enhances the scenic/aesthetic, as well as the amenity value and cultural diversity of Sydney's rural fringe, and provides green space.

Most of the flowers produced are sold through the Sydney Flower Market at Flemington, Sydney. The metropolitan location of farms allows efficient handling and transport of flowers destined for domestic and export markets. There are major flower exporters located in and around Sydney who target key markets in Japan, South-East Asia, Europe and North America.

Commercial flower growing is a labour intensive and technically challenging business. The industry has an important role in providing employment and recycling waste products from other industries such as poultry, dairy and mushroom production. About one third of crops are now grown in greenhouses while the balance is grown in the field. Investment in new growing technology is increasing with greenhouses and associated climate control, growing out-of-season crops and using hydroponic systems.

Most commercial cut flower production occurs in the area bordered by the Central Coast just north of Sydney, the Southern Highlands, the South Coast, and the Blue Mountains to the west.

Environmental management is the key

The way a farm is managed affects the environment and it is the health of the environment as a whole that determines the farm's productivity and efficiency. Environmental management is about efficient and sustainable management of the environment on which we depend and actually improving it for ourselves and for future generations. It is not only about regulations, avoiding prosecution and reducing pollution. NSW Agriculture and the cut flower industry support sustainable agricultural practices.

The key environmental issues of concern to the community and to government are:

- water quality
- soil degradation
- air quality
- natural habitats and
- the capacity of others to use or enjoy the environment.

These Guidelines aim to improve the sustainability of cut flower production, while protecting the environment. In short — the aim is environmentally friendly growing. The Guidelines are divided into 10 sections each providing environmental management recommendations for different aspects of production.

Setting up the farm

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Farming operations should be looked at as a whole, using a whole farm planning process* to form the basis of day-to-day management of the farm.

Best farm layout

Farm layout is a very important part of whole farm planning. Some thought and preparation now could ensure your long-term future in the cut flower industry. In the layout, consider:

- environmentally sensitive areas, such as wetlands or waterways
- position of production areas in relation to waterways, ground water and neighbours
- current and/or future requirements for buffer zones (see box opposite)
- location of screens and windbreaks
- location of the best agricultural soils
- suitability of soils for your purposes and for the irrigation methods you use
- aspect — production areas facing north-east receive maximum warmth and protection from the wind.
- steepness of sloping land
- location and suitability of soils for a dam — if there is enough space to build a dam on the property, the farm layout should include a dam at the lowest point to catch run-off water for reuse (see Chapter 7)

*Home study courses in farm management are available. For information contact the CB Alexander Agricultural College 'Tocal' of NSW Agriculture on 1800 025 520 or visit the website: www.tocal.nsw.edu.au.

- location of buildings you will need
- areas for storing fertilisers and pesticides
- locating structures such as packing sheds and pump houses in a convenient spot where they can stay permanently, while ensuring that they are unobtrusive and away from your neighbours.

The following chapters provide information to help guide growers in making decisions regarding the best farm layout to suit their individual circumstances and for a sustainable and profitable future in the cut flower industry.

Buffer zones

Buffer zones are areas of land that are located between the farm activity and environmentally sensitive areas. For example, a strip of uncleared native vegetation between a river or creek and your farm will intercept and filter farm run-off to protect water quality and may also provide habitat or sanctuary for wildlife.

Soil management

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Soil analysis

You need to understand the soils on your property in order to know how to best manage them. It is important to maintain and improve your soils to minimise the long-term environmental impacts of flower growing.

The soil must be suitable for the crop being grown. Suitable soils for horticulture are deep, well-drained sands, sandy loams, silty loams, clay loams and loams. Heavy clays are less suitable as they drain poorly and waterlog easily. If in doubt, have the soil tested to identify the soil type.

Soil texture and structure give an indication of the soil's ability to hold nutrients and water. You can have tests done to find out about your soil's physical characteristics — its texture, structure, stability and how water gets into and makes its way through the soil. These tests can determine if a soil is likely to suffer from erosion.

A more detailed soil analysis gives information about total soil fertility and pH, which is useful for planning fertiliser programs.

Soils must have the correct soil reaction (ie. whether the soil is acidic, neutral or alkaline) to be suitable to grow plants and promote desirable microorganisms. This is known as pH which measures the acidity or alkalinity of soil and runs from 0 (most acidic) to 14 (most alkaline) with 7 as neutral. The availability of plant nutrients is generally highest between pH 6.5 and 7.5. Biological activity is greatest at pH levels of around pH 7.0 at which the breakdown of soil organic matter and the release of nutrients to the plant is increased.

Remember, the practice of continually fertilising cut flowers usually acidifies the soil over a period of time. If this happens, it indicates that you are over-fertilising or not providing the right balance of nutrients. It is therefore important to test your soil's pH regularly. This will help you decide whether you need to neutralise soil acidity and

increase pH by adding a liming material. Alternatively, if your soil is alkaline bring the pH down to 7.0 (neutral) before planting a new crop.

Soil care for all crops

- Add organic matter to your soil. This will reduce leaching and help hold moisture and nutrients in the root zone.
- Do not cultivate the soil too much because this breaks down soil structure.
- Do not cultivate steep slopes as they are prone to erosion through excessive run-off.
- Disturb only the ground that you plan to use and do not run beds down slopes. Run beds across the slope and follow the contours of the hills. This will slow down the flow of water, even during storms, and channel run-off more safely to the lowest point on the property.
- Limit the use of rotary hoes because they damage the soil structure. Use tined and non-inverting implements instead of discs. However, a rotary hoe is useful to incorporate crop stubbles (or trash or residues).
- Try to get as many crops as possible out of your rows or beds before recultivating.
- Use herbicides instead of cultivation, where appropriate, to control weeds and preserve soil structure.

The NSW Environment Protection Authority (known as the EPA) defines steep slopes as those of more than 10%, or 10m in 100m.

There are many commercial laboratories that can carry out a range of tests on your soil or growing medium. Most offer a basic soil test for a small fee.

Soil organic matter

Soil organic matter is the residue or remains of living or dead animal or plant material. It is a natural store of nitrogen, phosphorus and sulphur. Organic matter provides compounds which are important in the formation of water stable soil particles. This reduces the erosion hazard.

Organic matter, when left on the surface of the soil, provides a mulch for the soil. The mulch reduces erosion, gives protection for soil microorganisms and reduces evaporation. This preserves soil moisture at greater depths, and maintains an even soil temperature — cooler in summer and warmer in winter.

Screen plants and windbreaks

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Some screening around production areas (especially greenhouses) is worthwhile. It reduces the visual impact of farm buildings on neighbours and road users and can also catch pesticide drift. Most councils now require screen plantings to be part of any new development. What you plant as a screen depends on the site and on how close the screen or windbreak is to production areas. Sometimes you can also harvest screen plants for cut foliage or other products.

Windbreaks reduce the impact of production in a number of ways, for example:

- They reduce the rate of water loss from the soil and the crop. Plants protected in this way use water more efficiently and are less likely to wilt under hot conditions. You can save up to 10% of irrigation water.
- Some sprinkler systems lose as much as 42% of applied water through evaporation and drift. Windbreak protection saves both water and pump fuel costs.
- Windbreaks may also provide a haven for beneficial species, particularly birds, which can reduce insect pest problems.

Planning for screens and windbreaks is an important part of achieving the best farm layout. Poorly located windbreaks can shade production areas too much and lead to competition for water and nutrients. There is more detailed information on how screens and windbreaks can aid in sustainable and profitable cut flower production, plus how and where to grow them, in the box opposite.

More on the benefits of windbreaks and screen plantings...*

Windbreaks serve to protect flower growing crops and structures from wind damage. A screen planting is used to block flower production areas from the view of neighbours and roads. A well-designed screen can act as an effective windbreak.

Windbreaks:

- *Improve field crop quality by minimising wind damage.*
- *Shelter structures like polyhouses.*
- *Reduce the rate of water evaporation from farm dams, the soil and the crop, thus saving water and pumping costs.*
- *Create microclimates with higher soil and air temperatures than surrounding areas, especially in spring.*
- *Reduce spray drift — Wind affects spray application, so wind protection means less risk of spray drift and environmental contamination. There is also better pest/disease control and less hazard to the spray operator. Some plants have features which make them quite effective as 'spray catchers'.*
- *Help prevent soil erosion.*
- *Provide a shelter for wildlife.*

How does a windbreak work?

A windbreak filters and breaks the force of the wind. Most suitable are windbreaks that let some wind pass through them. This forms a cushion of slow-moving air on both sides of the windbreak. This deflects the main volume of wind up and prevents it from descending for some distance downwind of the windbreak, giving a protected area for crops or structures. Most native species form this type of windbreak.

Dense windbreaks form a small area of still air immediately behind the trees, but further downwind there is a lot of turbulence. An example of a dense windbreak is one of pines or cypresses.

How do you establish a windbreak?

Make sure you design and maintain the windbreak properly, or it may actually increase crop damage, e.g., by creating turbulence.

- *Ideally, plant and establish the windbreak before planting the crop.*

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*This information is adapted from *Horticultural windbreaks*, by Lawrence Ullio (Nepean Trees on Farms Program) and *Designing windbreaks for farms*, no. 5 in the Farm Trees Series.

Wind affects spray application, so wind protection means less risk of spray drift and environmental contamination. There is also better pest/disease control and less hazard to the spray operator.

Windbreaks can shade production areas — minimise this by planting the windbreak in a north-south orientation.

The height of the windbreak determines the size of the sheltered area. The distance of maximum protection is usually 5 to 15 times the height of the windbreak.

- *For best results plant the windbreak at right angles to the winds from which protection is needed, e.g., from hot, drying winds from the west or north-west.*
- *Be aware that windbreaks planted across a slope or hill can block the downward flow of cold air in winter and create a frost pocket on the uphill side.*
- *Be aware that windbreaks can shade production areas — this is minimised by planting the windbreak in a north-south orientation.*
- *The height of the windbreak determines the size of the sheltered area. The distance of maximum protection is usually 5 to 15 times the height of the windbreak.*
- *The minimum length of a windbreak is 12 times greater than the mature height of the species chosen.*
- *Gaps in the windbreak, e.g., for a road, can encourage 'funnelling' of the wind.*
- *Use a single row windbreak only where space is very limited. Choose a species that retains foliage to the ground and has fairly dense growth, e.g., pines, casuarinas, wattles and melaleucas.*
- *Windbreaks of 3 to 5 rows are more effective. Include at least one row of bushy shrubs or small trees to reduce air movement close to the ground. Plant tall-growing species in the centre rows.*
- *Space the plants to allow free growth of side branches, e.g., in coastal areas allow 5 m between medium to tall tree species and 3 m between small trees or shrubs.*
- *Remove weeds from the area before planting the windbreak. Control weeds after planting with mulch, weedmatting or herbicides, especially for the first 2 years after planting.*
- *Some fertiliser application, at least during establishment, will be helpful and is recommended for exotic species.*
- *Provide irrigation to supplement rainfall, especially during dry periods.*
- *If necessary, train the plants while young, to a single stem (this depends on the tree species). Some windbreaks need to be hedged to maintain a narrow form and allow desirable air flows through them.*

What plants are suitable for a windbreak?

- *Choose species which will grow well in your area, grow to the required height and let some wind pass through them.*
- *Get advice for your local area from a commercial nursery or NSW Forests nurseries.*

- *Buy good quality plants from a commercial nursery or NSW Forests.*
- *Examples of exotic evergreen trees are pines like slash pine (*Pinus elliottii*). Examples of deciduous exotic trees are poplars, willows and alders.*
- *Examples of native species are: casuarinas (e.g.,* Casuarina cunninghamiana, C. glauca *and* C. littoralis*), acacias, hakeas and melaleucas.*

References

Grow What Where, *1990, The Australian Plant Study Group, Viking O'Neill, Penguin Books Ltd.*

Trees & Shrubs for Eastern Australia,*1980, Forestry Commission of NSW, University of NSW Press.*

Principles of spray drift management, *1998, NSW Agriculture.*

Establishing and managing cropping systems 5

Annual field crops

Annual field crops are normally grown in rows or beds and irrigated by overhead or low-pressure sprinkler systems. Some fertiliser is usually applied to the soil before planting. Additional fertiliser is supplied as needed during the growth cycle as a side-dressing or in a liquid feed. Controlled-release fertilisers are less likely to be leached than traditional soluble fertilisers.

- Use cultivation, fumigation or herbicides before planting to control weeds.
- Do not over-cultivate the soil as this destroys the soil structure.
- Cultivate and plant at the right moisture content (see box opposite).
- Cultivating when the soil is too dry will make it powdery, will slow water and air movement, and will restrict root growth. Cultivating when it is too wet will smear (glaze) and compact the soil, restricting water and air movement and root growth.
- Improve and revitalise soil between successive crops by adding organic matter or planting green manure crops, such as oats mixed with field peas or clover (for winter), or millet (for summer). Slash green manure crops before the seed matures. It is best to leave the trash on the surface, but you can lightly incorporate it into the topsoil. This improves soil structure and fertility.
- Minimise the use of rotary hoes and discs. Instead, use tined and non-inverting implements.
- Place drains to direct run-off to grassed areas or to a dam at the lowest point of the production area.

Perennial field crops

Follow the advice for annual field crops and also:

- Form beds and add weed mat or mulch quickly to stop soil loss from wind or heavy rain.

Hydroponic crops

Simply put, hydroponics is a technique of growing plants without soil, hence the alternative term 'soil-less culture'. Instead, the roots grow in air (which is kept humid), in water (which is well aerated) or in some solid, non-soil medium which is kept moist, e.g., sand, rockwool, perlite or potting mix. The water around the roots is supplied with a balanced mixture of nutrients for the plants.

Hydroponics helps crops make the best use of water and nutrients. It also allows excess water to be managed responsibly so that it does not pollute ground or surface water.

Good management is important to maintain production without adversely affecting the environment. There are two basic types of growing systems, closed systems and open systems.

Closed systems

Closed systems are also known as recirculating systems. This is where the nutrient solutions are reused. These systems are vulnerable to the spread of diseases and crop nutrition is more difficult to manage. Periodically, a quantity of nutrient solution has to be discharged.

Open systems

In open or 'flow-through' systems, the nutrient solution is not recirculated. A typical system is where plants are grown in containers and the nutrient solution is delivered via a drip system. Open systems greatly reduce the spread of disease and plant nutrition is easier to manage. In this type of system it is important to:

- Manage irrigation so that the run-off from containers is controlled to about 10% of the volume applied.
- Tailor irrigations to suit the crop because nutritional and water demands vary between crops.
- Regularly monitor the quantity and quality of the solution in both types of system and pay attention to any run-off.

How to manage run-off responsibly

- Collect run-off and return it to the hydroponic system after disinfesting and adjusting the nutrient balance.
- Dilute and use run-off as a weak fertiliser for field crops, farm trees, pastures and windbreaks.
- Remove nutrients by passing run-off through an artificial wetland.

Soil moisture content

There is an easy way to find out if your soil has the right moisture content for cultivation. Dig a hole to just below the depth of cultivation and take a sample of soil about the size of a golf ball. Try to roll it into a narrow rod or pencil (3 mm in diameter). If the soil can just be rolled into a crumbly rod, it is safe to cultivate. If you can easily make a rod it is too wet to cultivate. Sand or loam soil is too dry to cultivate if a rod cannot be rolled, but it is safe to cultivate a clay soil in this condition.

Greenhouses and other growing structures

Greenhouse production allows a greater value of production per given area, so that small areas are used economically while controlling the impact on the environment.

Growing under cover has many advantages for both the grower and the environment. These include:

Growing under cover has many advantages for both the grower and the environment.

- Greenhouse crops are less likely to be damaged by the weather.
- You can adjust growing conditions to minimise pest and disease problems and to control crop development.
- You can use integrated pest and disease management more effectively.
- You can supply water and fertiliser more efficiently.
- You can grow out-of-season crops.

How to safeguard your investment in greenhouse growing

- Obtain a building approval from your local council before erecting a new greenhouse and remember to include all relevant details in the Development Application (DA). For example, if lighting is required for your structure, include it in the DA.
- Screen greenhouses and shadehouses from the view of neighbours. Screening the property, especially with trees, prevents many complaints about farm activities and appearance (see Chapter 4).
- Keep greenhouses in good repair. Make sure the covers are tight and not flapping in the wind.
- Recycle old greenhouse covers where possible.
- Channel run-off from irrigation out of the greenhouse to a collection area for reuse or responsible disposal.

6 Irrigation

The aim of an irrigation system is to apply enough water to meet the needs of every plant in the time available. A well-designed and maintained irrigation system will:

- *Apply water evenly* by using a system that operates at the correct pressure with the correct pipe sizes and sprinklers or emitters.
- *Save money* in capital and running costs.
- *Save water* by applying the right amount of water often enough to meet crop needs. Learn about your crop's water requirements and adjust the water application according to weather conditions. You need some information on the evaporation rates and crop water use of the range of plants you intend growing, including water holding capacity of soil or media, and in some cases the types and sizes of the containers to be irrigated.
- *Help you manage your production and marketing schedules*. The time available for irrigation will need to allow for wind conditions, disease susceptibility of the crop, shipping times of flowers, any off-peak pumping times and limited water availability.

Good irrigation means profitable flower growing

Good irrigation methods are important for profitable flower growing. All flower crops will suffer if they are watered too much or not enough. One long irrigation cycle or several shorter ones can be used. Irrigation should maintain uniform soil moisture in the root zone with minimum run-off and leaching. This can be aided by scheduling irrigations.

Irrigation scheduling is applying the right amount of water at the right time according to weather conditions, soil or media type and plant growth stage.

You can measure the right amount of water applied to the soil in the field by using soil moisture sensors such as tensiometers. Tensiometers

measure tension or pressure to indicate the amount of water at different depths of soil.

Remember that not all crops have the same water needs. Excessive watering may increase the risk of plant disease.

Water can be applied to crops using many methods including overhead sprinklers or low-pressure irrigation systems. Low-pressure irrigation systems are generally more water efficient.

Choose the irrigation system that: suits the soil or media type as well as the crop; is easy to use and cost effective; doesn't waste water and; fits your farm management practices.

How to to ensure best irrigation practice

- Identify the soil type and its depth. Is it sandy or clayey? Does it have a crust? Some soils absorb and hold more water than others and some absorb water more quickly than others do.
- Use a rain gauge to record the amount of rainfall in your production area. This will help you to decide when and how long to irrigate.
- Use mini or low-pressure sprinklers (especially if you use town water). These allow more efficient use of (expensive) water.
- Check that the crop is uniformly watered. Pressure, nozzle size, sprinkler spacing and wind, all have an effect.
- Keep your irrigation system in good working condition. Check for leaky pipes and fittings, regularly clean filters and service pumps and check for sprinkler blockages.
- Time the length and frequency of irrigations using the soil moisture and crop needs, not the duration alone. Schedule the irrigation water. Make sure the soil does not get too dry or too wet. Watering for long periods will leach nutrients and fertiliser from the soil, which is a waste of money and may contribute to environmental problems.
- Avoid watering when there is the potential for a high level of water loss by evaporation, for example in the heat of the day, or in windy conditions.
- Regularly check the quality of the irrigation water, especially if using dams, rivers and creeks. For example, you need to know about any changes in salinity, pH, iron and suspended solids, as they may affect crops or damage irrigation fittings.
- Maintain dams, spillways and trickle pipes in good condition. Seal leaks promptly. Control weeds in and around dams.
- Keep a protective grass cover growing on the dam wall and spillway.
- If you rely on town water supplies, install a holding tank and pump. This will help ensure adequate pressure and volume during times of peak demand.

Avoid watering when there is the potential for a high level of water loss by evaporation, for example in the heat of the day, or in windy conditions.

- Use organic composted mulches and weed matting to reduce evaporation from beds and to help reduce weed growth. Surface mulch can also reduce run-off.

Planning a new irrigation system

You may be in the situation of installing a new irrigation system at your farm. Before you actually design the irrigation system, divide the farm into blocks that have similar water needs and management requirements. For example, these might be:

- seedling areas
- greenhouses
- plants grown in containers and
- plants grown in the ground.

Within these divisions there may also be other subdivisions of plant varieties, etc. which normally can be dealt with by block management.

Check the most suitable type of system that you can use for each area. Some examples are:

- misting or fog systems and separate controls for seedling areas
- trickle or drip irrigation and
- low application rate sprinklers with fine droplet sizes for certain varieties.

Overhead sprinklers and mini-sprinklers can be used to wet-up beds before planting, for newly planted stock and in very hot weather.

When selecting the sprinklers for overhead systems you will need to check:

- the layout and shape of each area so that you select the appropriate sprinkler spacing
- the type of sprinkler to be used
- the application rate to match soil or media absorption rate
- the diameter of coverage, distribution pattern and how high the sprinklers throw
- the wind conditions likely in each area
- the sprinkler pressure and discharge and
- the location of laterals, submains, riser pipes and valves so that they will not be damaged or cause obstruction.

You should then assess the type of water treatment that might be required and the level of automatic control equipment appropriate to your operation and/or budget.

Before you actually design the irrigation system, divide the farm into blocks that have similar water needs and management requirements.

Managing run-off

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Excess water, such as irrigation tailwater or stormwater running off cultivated areas, may contain contaminants or pollutants which have a harmful effect on waterways. Irrigation run-off should be contained so that it does not enter waters or the sewerage system. You should also prevent run-off containing contaminants from entering neighbours' properties.

It is an offence under the *Protection of the Environment Operations Act 1997* (POEO Act) to pollute any waters, or cause or permit any waters to be polluted. Waters include creeks, rivers, wetlands, dams or underground water, and pollution includes leaving material in a position where it is likely to pollute waters. Pollutants include soil, mud, earth and clay, but also fertilisers and chemicals such as pesticides (See Chapter 10).

Run-off can also cost you money in wasted water, fertiliser and soil.

It is not necessary to trap all water running off the farm, only water that contains nutrients or pollutants. However, it is important to capture the first flush of run-off which may contain most of the pollutants. Periodically monitor the nutrient content of run-off water, especially for nitrates and phosphates. You can do this quite easily yourself or by sending a sample to a commercial testing laboratory.

Some councils require growers to construct nutrient ponds within 50 metres of the greenhouse to trap any sub-soil drainage run-off. However, sub-soil run-off is very small when growing under cover using mini-sprinklers and drippers which give very precise irrigation water control with almost no tailwater and minimal deep percolation.

How to collect and contain run-off

- If there is enough space to build a dam on the property, the farm layout should include a dam at the lowest point to catch run-off water for reuse. The quality of the dam water will determine its potential use and you may need to consider a recycling system.
- Channel or direct all run-off to a dam or series of dams.
- In outdoor areas where overhead irrigation is used for starting a crop, excess water should be collected in a sediment trap before discharging into a dam.
- Plant moisture-loving crops or trees and shrubs that will catch and use run-off containing nutrients. Use native species of trees, shrubs or aquatic plants such as reeds. These plants may substitute for a dam in some situations. They can also mop up run-off in low-lying areas of the farm. Some plants suitable for this purpose can be picked for fillers and foliage. Artificial wetlands could also be used to catch and filter run-off. See box on p. 24.
- Stormwater can be passed over grassways. Plant grass in catchment drains and ditches to prevent loss of soil and to catch sediment and nutrients. Grassed drains need to have more capacity than unlined earthen drains.
- Use rock, concrete or plastic lined drains to collect run-off and minimise erosion of the drains.
- Ensure that the overflow area (spillway) of the dam is covered with grass to absorb water and nutrients, and to reduce erosion.
- After collecting and/or treating contaminated run-off, it can be passed over a grassed area or drain before release. Ensure that erosion is minimised.

Do-it-yourself run-off testing

A range of products is available to help growers check their run-off. These include various portable means to measure pH, electrical conductivity (EC), sodium, potassium, nitrate, nitrite, phosphate and chlorine. You can use these products to check your input water, nutrient solutions, run-off or leaf sap. At present the most affordable on-farm measuring devices are test strips which provide the dip and read method. These may not be as sensitive as those used in a testing laboratory, or mixing a sample with a reagent, but they will give you an indication of trends, or increases and decreases in levels of a particular nutrient. You may still need the services of a laboratory to give you an accurate analysis and to interpret the results for you.

Tips on how to collect water samples

Use a clean container. Do not get any dirt in the sample and do not smoke near it. If not testing immediately, put the sample in the refrigerator and test within three days.

If you plan to build a dam, check with the Department of Land and Water Conservation on your harvestable rights as your proposed dam may require a licence. You also may need approval from your local council.

Positive benefits of growing trees or shrubs in wet areas

- *They will help absorb and evaporate surplus ground water.*
- *Weeds that grow in wet areas such as reeds will be reduced.*

Examples of trees and shrubs that grow in water logged or badly drained sites:

Acacia floribunda, A. elongata

Allocasuarina lehmanniana

Callistemon citrinus, C. speciosus

Casuarina cunninghamiana, C. glauca

Eucalyptus botryoides, E. crenulata, E. gunnii, E. ovata, E. globulus

Melaleuca armillaris, M. bracteata, M. decora, M. ericifolia

Populus - *Poplars*

Examples of trees and shrubs that can use large volumes of water from the soil and can help to drain wet areas:

Agonis juniperina

Callistemon

Casuarina

Eucalyptus, e.g., E. botryoides, E. camaldulensis, E. crenulata, E. ovata

Hakea nodosa

Melaleuca, e.g., M. armillaris, M. ericifolia

Reference - Grow What Where, *1990, The Australian Plant Study Group, Viking O'Neill, Penguin Books Ltd.*

NSW Water Reforms

The NSW government is carrying out reform initiatives for water resource management that will affect irrigators. NSW Agriculture is assisting NSW farmers who irrigate to adjust to the Government Water Reforms (see the companion Agnote, ***Environmental issues for commercial flower growers — sources of information and assistance*** for more details).

8 Fertilisers

Inorganic fertilisers

Flower crops must be supplied with nutrients throughout their production cycle for maximum yields and quality.

The best method of applying fertiliser depends on the type of production system you are using.

Crops growing in soil need different management from those growing in artificial media such as potting mixes, or in hydroponic systems where the crop may be dependent on externally supplied nutrients.

How to make sure your crops use fertilisers efficiently

- Have the soil tested regularly to determine how much fertiliser to add. This will show the nutrients that are deficient and those that are adequate.
- Split fertiliser applications so that only part is used before planting. Supply the rest as side-dressings during the production period. Mix the pre-plant fertiliser thoroughly through the soil. Schedule irrigation to avoid excessive leaching and run-off.
- Provide side-dressings or liquid feeding based on crop needs.
- Use controlled-release fertilisers if suitable. Choose one with a release period suitable for the life of the crop. Some controlled-release fertilisers are heat-sensitive and can burn the crop in hot weather.
- Use liquid feeding (fertigation) to adjust the nutrients supplied for each crop. This method usually causes the least leaching.

Research has shown that during summer the release time of controlled-release fertilisers can be quicker than in winter.

Standards Australia have released a Standard AS 4454-1999 for composts, soil conditioners and mulches, which gives growers the minimum requirements for the physical, chemical, and biological properties of these products as well as for labelling and marking. This will encourage the beneficial recycling and use of organic materials with minimum adverse impact on environmental and public health.

Composts, soil conditioners and mulches must be prepared according to this Standard which sets out minimum requirements as well as 'best practice' procedures. By following these procedures, products of consistent quality can be produced. Compost produced to the Standard will not spread weeds and plant pathogens.

- Use regular soil and leaf tissue analyses to help fine-tune your fertiliser program.
- Using inorganic fertilisers can result in high concentrations of salts in soil (measured as electrical conductivity — EC) which can harm flower crops. Measure EC annually, so that you can take steps to minimise salt build-up if needed.

Organic fertilisers

Organic fertilisers supply organic matter and nutrients which are both important to sustain crop yields and improve soil condition. Organic fertilisers generally used in horticulture are composts, soil conditioners and mulches.

Using organic fertilisers

- Compost animal manure before use to control odour and to help reduce the spread of weeds and pathogens.
- Store and cover animal manure and compost it in a dry area so that it cannot be washed into waterways.
- The nutrient content of animal manures can vary, e.g., nitrogen levels in poultry manure can range from 1.5% to 4.0%. It is therefore wise to get a sample of the manure analysed before you use it. The manure analysis will determine the quantity needed to meet the nitrogen requirements of the crop.
- Manure can be safely applied to soils at rates below 10 to 15 dry tonnes per hectare; this gives adequate nitrogen while keeping salt build-up in soils low. At this rate, nitrate movement beyond the root zone is minimal, even if the crop receives excess water (*Feedlot Manual*, 1995, Section 7.13, NSW Agriculture).
- Applying poultry manure each year can lead to a build-up of salts in the soil and soil nutrient levels that are too high.

Reference: *Best practice guidelines for using poultry litter on pastures*. Neil Griffiths, July 1998,1st ed, Agnote DPI/212, NSW Agriculture.

9 Integrated pest and disease management (IPDM)

IPDM is a dynamic approach that uses all available methods to effectively control diseases, pests and weeds, while minimising hazards to the environment. These include:

- Biological control agents, e.g., predatory mites.
- Cultural methods, e.g., rotating crops.
- Genetic factors, e.g., disease-resistant varieties.
- Mechanical or physical methods, e.g., insect screens around greenhouse vents; sticky traps; hoeing weeds.
- Isolation, e.g., quarantine.
- Planned use of farm chemicals.

Growers use IPDM because they can no longer rely 100% on broad-spectrum chemicals for pest and disease control. IPDM makes good management sense because:

- Many pests and pathogens have developed resistance to chemicals
- Chemical residues have been found in produce and the environment
- Some effective chemicals have been withdrawn because of resistance problems
- There are public environmental concerns about the use of too many chemicals on the farm
- Pesticides are expensive.

Remember:

- Check your crops regularly.
- Release predators in sufficient numbers for the given crop area and type.
- Release predators well before economic damage is apparent.
- Do not use pesticides that harm predators just before or after predator release.

- Try not to let greenhouses become too hot and dry in summer when using predators.

Key references

Integrated Pest Management in Ornamentals: Information Guide Goodwin, S et al 2000, Agrilink Horticulture Series QAL0004

and the companion booklet;

Field Identification Guide to Pests, Diseases, Disorders and Beneficials in Ornamentals.

Publications available from NSW Agriculture Publications, Locked Bag 21, Orange, NSW, 2800. Telephone: (02) 6291 3458 or 1800 028 374

'Softer' insecticides such as petroleum spray oils (PSOs) and soaps (fatty acids) are usually more compatible with beneficial organisms. They also generally avoid spray residue problems associated with synthetic pesticides.

It is important to protect predators and beneficial insects as much as possible. These insects provide a means of natural biological control. They are not a total replacement for sprays or expected to work as quickly. Use them as part of your IPDM strategy. Avoid using broad-spectrum insecticides whenever possible.

10 Managing pests and diseases

Commercial flower growers continue to depend on the use of farm chemicals (pesticides) to control pests and diseases. The market demands 'perfect', blemish-free blooms; therefore, a planned approach to the use of farm chemicals is essential.

You can reduce environmental harm and save money by not spraying unnecessarily or ineffectively. Remember that you have a duty of care not only towards yourself, but also to your fellow workers, community and the environment.

Plan the use of farm chemicals

- Check crops regularly and thoroughly to detect pest and disease problems as early as possible.
- Only spray pest populations when they are present at a level which is likely to cause economic damage. There are alternative solutions to spraying (see Chapter 9).
- Identify the cause of the problem so that you can use the most appropriate control plan. A range of commercial diagnostic services and information sources are available to help you.

Attend a farm chemical training course. Several training programs are offered by a range of training providers throughout NSW. Completing a nationally accredited course is recommended. NSW Agriculture and TAFE NSW have jointly developed the SMARTtrain chemical training program to bring up-to-date chemical training to industry and the community in NSW. It provides a flexible response (offering a number of courses at different levels for various audiences) to the increasing pressure for chemical training. This need comes from the changing regulatory environment and the introduction of industry quality assurance schemes. The *Pesticides Act 1999*, administered by the NSW Environment Protection Authority, foreshadows the introduction of compulsory training for all pesticide users.

Always read the whole label before using a chemical.

Users of agricultural (or veterinary) chemical products must always read the label and any Permit, before using the product, and strictly comply with the directions on the label and the conditions of any Permit.

Safe and effective use of chemicals

- Use integrated pest and disease management (IPDM) wherever possible (see Chapter 9).
- Keep a diary of problems. Write down when they happened and how you tackled them.
- Use the correct farm chemical for the pest, weed or disease.
- Use an appropriate range of chemicals to stop insect pests, weeds and diseases developing resistance to common chemicals.
- Be aware of poison schedules and dangerous goods classifications of the chemicals you use. Less toxic alternatives may be available.
- Store farm chemicals in a designated, locked cupboard or shed.
- Dispense chemicals in a well-lit and ventilated area that you have set aside for this job. Have a water supply close by for making up sprays as well as for washing hands.
- Always read the whole label before using a chemical. *Users of agricultural (or veterinary) chemical products must always read the label and any Permit, before using the product, and strictly comply with the directions on the label and the conditions of any Permit.* You cannot use any reason as an excuse for not following directions on the label or conditions of the Permit.
- Use chemicals only for the purpose they are registered for.
- Do not use a chemical if it is unlabelled or if there is any doubt as to the identity of the product. If the label is unreadable get a new label from the reseller or the manufacturer.

Keep good records of farm chemical use. The records should cover:

- the time and date of chemical application
- the names of the chemicals used
- the rate used and quantity applied
- how the chemical was applied
- who applied the chemical
- the target pest or disease
- the crop, its location and area sprayed
- weather conditions at the time of spraying
- neighbours notified or involvement of any third parties
- any problems that occurred during spraying and how they were solved
- was the spraying a success?

- Use the right spray equipment for the job. If possible, have one spray unit for insecticides and fungicides and another for applying herbicides.
- Use the right nozzles and replace them regularly — worn nozzles give wrong rates and patterns of spray.
- Calibrate your equipment often to ensure that you are using the right amount of chemical.
- Always use appropriate personal protective equipment as recommended on the label. Wash it well after use and store in a clean area.

Protective equipment could include:

- washable or disposable overalls
- rubber or PVC gloves
- PVC apron
- washable hat
- rubber boots
- face mask
- a respirator and hood (if possible).

- Look after your face mask carefully and replace cartridges regularly. Store cartridges in an airtight container between uses.
- Do not store masks or cartridges in the chemical store.
- Avoid spraying in very gusty or very still conditions or when humidity is high as this affects drift droplet size and drift.
- Spray in the cool of the day to reduce risk of burning the crop.
- Mix up only enough spray for the job to avoid having any spray left over.
- Always keep pesticides in their original containers.
- At the end of each spray job thoroughly rinse the tank and hoses so that residual pesticides will not enter waterways.
- It is recommended that you use separate measuring equipment for different chemicals. If you use the same equipment for different chemicals, rinse containers thoroughly after each use.
- When a pesticide container is empty, rinse it three times. Do this immediately after emptying the container as residues on the walls are more difficult to remove when dry. This will remove most of the remaining chemical. Always ensure that the rinsed containers are drained and allowed to dry. After proper rinsing of steel containers, they should be drained, punctured and allowed to dry.
- Recycling schemes are now operating for properly rinsed metal containers and many 20L plastic drums (for example, drumMUSTER

Calibration is a method to help you calculate how much chemical your sprayer can put out. This allows you to spray the correct amount without wastage, saving you money and protecting the environment.

— products that qualify for this scheme will carry the drumMUSTER sticker). Contact your farm supplier or local council for information on recycling schemes. From time to time authorities such as local councils and the Sydney Water Corporation will advertise collection points for unwanted chemicals and empty containers.

- If you are worried about your health or feel sick during or after applying pesticide, see your doctor. Blood and urine tests are available for some chemicals to determine if your exposure has been harmful to your health. Consider having such tests done on an annual basis to monitor your health.
- Plant screening shrubs around production areas to catch any spray drift (see Chapter 4, and the section on spray drift below).

Container rinsing equipment is manufactured by several companies who also manufacture spray equipment. Contact your local Agsafe accredited supplier for details.

Using herbicides

Adequate weed control is necessary for productive, high quality crops. Weeds can compete with crops for space and nutrients and may harbour serious pests and diseases.

Soil fumigation can be used to reduce or eliminate certain pests, diseases or weeds from the soil before planting. Many fumigants need to be applied by a licensed operator.

Herbicides are used both for pre-emergence and post-emergence control of weeds. Great care must be exercised to prevent herbicide spray drift and/or contamination of waterways. In either case this can cause serious damage or destruction of valuable crops.

- You must read and follow all instructions on the herbicide label.
- Spray weeds when foliage is dry to avoid diluting chemicals with dew or rainwater. Some herbicides require a rainfree period of time after application to be fully effective.

Spray drift

This happens when the farm chemical moves beyond the target area during or after spraying. This can expose other people, neighbouring crops, animals and the environment to the chemical.

Spray drift onto neighbouring properties is an offence, especially if it is a result of negligence.

Spray drift onto neighbouring properties is an offence, especially if it is a result of negligence.

How to reduce spray drift:

- Control droplet size. Small droplets of less than 100 microns drift and stay in the air longer, but those greater than 300 microns may give poor coverage and require higher application rates. Droplet size is determined by spray pressure and nozzle type.
- Use a shield to reduce drift if appropriate.

- Have unsprayed buffer zones between crops and sensitive areas downwind.
- Avoid spraying when wind is blowing towards a sensitive area such as houses. Wait until conditions are right.
- Avoid spraying when conditions are very calm, hot and dry, or very windy.

For more information see: *Principles of Spray Drift Management*, 1998, NSW Agriculture.

❦ Have unsprayed buffer zones between crops and sensitive areas downwind.

Noise, odour and dust control

11

Noise

The EPA is responsible for the control of noise from premises scheduled under the *Protection of the Environment Operations Act 1997* (POEO Act). Farms are not scheduled. The responsible authority for control of noise from non-scheduled premises is your local council.

Be aware of the impact of noise on neighbours and try to operate at times of less concern. Maintain good relations and regular contact with neighbours. Try to inform them about the needs and benefits of agriculture.

- Avoid excess noise by maintaining your equipment in good working condition, e.g., pumps and sprayers. Enclose fixed equipment (e.g., compressors, pumps, and fans) in insulated housing to muffle noise.
- Electric pump systems are quieter than diesel systems and therefore more suitable when close to residential areas.
- Keep noisy equipment away from boundaries with neighbours.

Odour and dust control

Some products used in flower production (such as uncomposted animal manures and certain farm chemicals) may have an odour that some people find unacceptable.

- If possible, locate stockpiles of uncomposted manure well away from your neighbours.
- Avoid turning or disturbing the stockpiles at sensitive times or when wind blows in the wrong direction (e.g., towards houses).
- Mix manure and compost into the soil as soon as possible after applying it to prevent any odour or dust being blown by wind onto neighbouring properties.

A farm chemical that has a pungent odour can often be replaced with an alternative farm chemical with less odour.

12 Conclusion

These Guidelines will assist cut flower growers to be better environmental managers by following good management practices. The resulting cut flowers available to consumers will be of high quality. In addition, growers will benefit from savings made due to efficient production systems. Therefore, the NSW cut flower industry will be showing an active commitment to its long term environmental and economic future.

Notes