

## **STOCK MAINTENANCE AND QUALITY CONTROL**

### **Aim**

Outline the importance of maintaining healthy stock and its relationship to maintaining a profitable business.

### **MANAGING PLANTS IN RETAIL NUSERIES**

In order for a nursery or garden centre to retain a good reputation it must offer healthy well-presented stock. In order to achieve this, stock must have a fast turn-around. Plants quickly outgrow their pots, look awful, and become attractive to pests and diseases. Garden centres stocking root bound, sick plants soon lose business. A good manager will know this and take the appropriate preventative steps.

A retail nursery needs to keep plants in peak condition at all times. Plants are bought into a retail nursery from a different environment, sometimes following a long trip on a truck. These things stress the plant, and it is only natural for a plant to deteriorate a little when it is first bought into a retail situation. This deterioration may only be mild, and it may take days or even weeks to become visible, depending on things such as the type of plant and time of year. Nurseries with a high turnover rate which quickly sell plants do not have such a problem with plants deteriorating. For other retail nurseries, it can be a constant battle to keep the plants looking good.

Routine jobs in a retail nursery or garden centre should include:

- Daily inspection of a selection of individual plants. Check for over watering or under watering, diseases, pests, leaf scorch, frost or wind damage, and any other adverse symptoms.
- Removing spent (dead) flowers.
- Removing damaged or marked leaves.
- Pruning to shape.
- Moving overcrowded pots to allow better ventilation and light penetration.
- Removing sick plants to an out of sight "hospital area".
- Rearranging plants to move the most attractive, healthiest plants, and those in flower, to a prominent position.
- Moving out of season stock away from sales areas.
- Moving seasonal stock into prominence.
- Moving plants into protected areas when weather changes.
- Potting up pot bound plants.
- Routine fertilising.
- Routine spraying for weeds, pests and diseases.
- Maintaining good hygiene/cleanliness.

### **PLANT BREEDERS' RIGHTS AND TRADEMARKS**

It is important for people working in the nursery industry to understand the legal, financial and moral obligations associated with plant variety ownership. Most new plant varieties sold by nurseries are registered with the Plant Breeder's Rights (PBR) scheme. PBR confers legal rights to the original breeder, and there are significant financial penalties for any person or organisation that infringes those rights.

The PBR scheme has been developed for two reasons:

1. To provide legal protection to the original breeder of a variety, ensuring other growers do not unfairly gain from the production or sale of the variety.
2. To encourage plant breeding and innovation through the grant of a limited commercial monopoly.

The PBR scheme confers exclusive commercial rights to a registered variety, including the right to:

- produce or reproduce the material
- condition the material for the purpose of propagation
- offer the material for sale
- sell the material
- import and export the material

In effect anyone wishing to propagate, purchase or sell a registered variety must obtain consent from the owner of the variety. The owner may be the original breeder or a license holder to whom the breeder has sold the rights to grow and sell the plant. The owner claims royalties from propagators, growers and dealers, as recompense for his/her work and the costs involved in breeding and developing the variety.

PBR protection is available in most of the major countries involved in horticultural and agricultural production. The criteria for registering a new variety varies from country to country, but the essential principles are similar and conform to the 1991 International Union for the Protection of New Varieties of Plants (the UPOV Convention). More than 50 countries have adopted the UPOV Convention.

The variety has to meet strict criteria of distinctiveness, uniformity and stability (DUS); it must be new and it must have a recognised breeder (or 'discoverer'). To meet the criteria of 'newness', the variety must not have been sold to others within the country more than 12 months before lodgement of the application, or more than four years for overseas sales (or six years for trees and vines).

It should be noted there are exceptions to the exclusive use of registered varieties. In keeping with the PBR scheme's aim of encouraging plant innovation, other breeders may use registered varieties in their breeding programs and researchers may use registered varieties for non-commercial experimental purposes. Farmers are permitted to save seed from registered varieties for the purpose of replanting on their own land.

Once granted, PBR is normally valid for 25 years for trees and vines and 20 years for all other plants. Once the PBR expires, the variety is in the public domain and is available to all.

#### *National and International PBR Registration*

The registration process takes at least two or more years for most varieties and involves the breeder carrying out comparative field trials, following UPOV guidelines, to demonstrate distinctiveness, uniformity and stability. The PBR office may also conduct field trials.

Breeders normally register a new variety in their own country. Members of the UPOV Convention have the opportunity for equivalent rights to be filed in foreign countries.

#### *Marketing PBR Plants*

Breeders may choose to propagate and market a PBR-registered plant themselves or they may license the variety to growers on the condition they pay a royalty on subsequent sales.

Increasingly plant breeding and marketing is taking place on an international scale, with the rights to a variety owned by a plant breeder in one country, who licences the plant to overseas growers. In these cases, the breeder appoints an agent to represent their interests both nationally and overseas. The agent might deal with such things as administering licenses, distributing material, monitoring sales and collecting royalties.

#### *Trademarks*

Before the introduction of PBR and PVR (Plant Variety Rights, the forerunner of PBR), breeders used trademarks to obtain legal protection. The trademark may be used as a promotional name but it cannot be used as a registered variety name.

#### *Patents*

Patents differ from PBR in that they are used to protect a process or the components of a variety; for example a technique of gene sequencing. PBR protects the end product, the plant variety, as a whole.

## **HOLDING STOCK**

Sometimes plants get to the point of being ready for sale before the market is ready to buy them. In these instances, the nursery manager is faced with the problem of keeping the plants alive and in peak condition without the plants growing any larger or becoming unmanageable.

There is a variety of things which can be done including:

- Slowing the growth rate by reducing fertiliser and water applications.
- Storing in a dormant state.
- Potting up and selling as a larger plant.
- Pruning back and allowing re-growth to occur.
- Dividing suckering or creeping plants.
- Developing the plant into a different product, such as a bonsai, topiary, basket or tub specimen.

### **Holding Dormant Plants**

Some plants, in particular bulbs, deciduous plants and many herbaceous perennials, go through a period of dormancy (usually over winter), when growth slows considerably, or stops. During this time, the plants are easy to move, and for that reason are often sold as balled or bare-rooted plants (without any soil).

Bare-rooted plants and bulbs are much easier and cheaper to transport and store in a dormant state, hence the costs involved in marketing are reduced. However, it is essential to understand the requirements of dormant or semi-dormant plants. When plant growth slows, the plants' ability to resist pest and disease problems is reduced. These plants will only remain dormant as long as environmental conditions are appropriate, and placing them in a warmer situation might stimulate growth and make the plants susceptible to damage through drying out or to physical damage when moved. They need to be sold, potted or planted out before dormancy breaks and growth begins.

Bare-rooted plants should be stored with their roots covered by a moist (but not waterlogged) organic material such as wood shavings or moss, or they can be heeled into a bed of soil (ie. the roots are covered by soil). The plants can be bunched together and do not need to be stood up, but be careful that plants rubbing against each other do not cause too many wounds.

Some varieties of herbaceous perennials, bulbs, corms, rhizomes and tubers can be stored dry on shelves in a dark, cool place over winter; while others must be kept moist, perhaps in containers covered with moist moss or shavings.

Nurseries that grow plants which go through a period of dormancy may need to build special storage facilities to hold plants for several months after digging as orders are received and processed.

## **CLEARING SURPLUS STOCK**

Stock which does not sell is taking up space which could otherwise be filled with stock which does sell. In this sense, surplus or old stock can be a very real liability in a garden centre. It can continue to cost you money in terms of both:

- a) Space it is occupying (which you are paying rent on but not getting a return from)
- b) Time and money it costs to maintain the stock; for example, plants require watering and feeding, while hardware cleaned or dusted.

It is often more economically sound to accept a financial loss on such stock, even selling at below cost, rather than retain the stock and continue to bare the ongoing costs.

Surplus stock might include any of the following:

- Stock which has not been selling.
- Seasonal lines which are out of season; for example, Christmas trees after Christmas.
- Lines which are no longer in production or available.
- Damaged or deteriorated stock; for example, out-of-date seed.

The way you deal with such stock will depend on the type of image the business is keen to promote:

- Some garden centres can put anything on special and sell it because they have the image of offering bargains.
- Other, up-market centres may need to be wary of promoting "bargains". This could damage their image of only dealing with "quality" stock. Such centres might be better selling surplus stock to other retailers and letting them do the selling; thus keeping their image intact.

### **Guidelines for Clearing Stock**

- Never try to sell second-rate plants. Sick plants should be dumped not sold! Even discount nurseries cannot afford to develop the reputation that all their plants die.
- Seasonal lines, such as Gloxinias or Cyclamen which have finished flowering, are a waste of time clearing out once the season has past. Clearance sales of seasonal lines should be at the end of the season, NOT AFTER THE SEASON. Seasonal lines generally need drastic reductions (perhaps half price) to ensure quick clearance. Most retailers just don't have the room to hold large numbers of out-of-season items.
- Clearance lines should be placed in a prominent position (near the cash register or exit is ideal) to catch the impulse buyer.
- Obsolescent lines need to be treated differently. Generally there are not enough items to make a significant display, so group them together on a discount table or bin.
- Call your clearance sale a birthday sale, spring sale, or anything you want; it doesn't need to be advertised as a clearance.
- Always keep sales short and snappy. They work best over one week or one weekend. Long sales lose impact and risk losing customer interest.
- Leave the original price on items and cross it out or put a sign up saying ...% off marked price. Sales work much better if the customer can see how much they are saving.

### **QUARANTINE ISSUES WHEN SELECTING STOCK**

Many plants are sourced from overseas growers, and this can be an excellent way for a nursery to introduce new varieties to the market. However, strict regulations apply to the import of seeds and plant material from overseas. In the past, too many deliberate introductions of ornamental plants from overseas resulted in environmental catastrophes, including weed invasions, altered natural ecosystems and the spread of exotic, detrimental pests and diseases. Quarantine laws are designed to prevent similar problems occurring in the future.

Most countries are aware of the problems caused by the unrestricted movement of plant material within and between countries and, on an international basis quarantine standards are becoming increasingly stringent. Certain protocols must be observed – always contact the quarantine authority in your own country and the country from which you wish to import the plants. The information is readily available on the internet and from government quarantine authorities.

Before bringing a new plant into the country, you must find out whether it has been cleared for importation into the country. Any plant deemed a weed risk will be denied for import. Endangered species protected by the Convention for International Trade in Endangered Species (CITES) may also be restricted for importation. If the plant has not been cleared, the quarantine authority may undertake an assessment, which can take some time as field and greenhouse trials may need to be carried out to evaluate its weed potential.

If the plant is currently permitted for entry, an import permit can be obtained from the quarantine authority; the permit will specify conditions and requirements that must be met such as pre and post dispatch treatments such as methyl bromide fumigation. Once plants arrive in the country, they are inspected by quarantine officers, treated and then quarantined for a period of time at a registered quarantine station.

### **Choosing, treating and shipping overseas stock**

- Select only healthy plants that are free of obvious diseases.
- Select plants with hardened growth rather than soft, new foliage.
- Ship perennial plants when they have died down.
- Ship deciduous plants just before they emerge from dormancy.

- Remove all traces of soil from the roots prior to shipping, otherwise the plant may be denied entry or will have to be cleaned by the quarantine authority. Sphagnum peat and perlite mixes are acceptable alternative media for imported/exported plants. Avoid using wet paper around bare roots as plants have
- Use new cartons. Ensure there is no free water in the package.
- Pack the bundles loosely and cover with protective packaging such as polystyrene to minimise bruising.
- Attach a copy of the import permit and other relevant shipping and invoice documents to the outside of the parcel.

## **HOW TO CONDUCT A PLANT INSPECTION**

It is particularly important to respond to problems detected in inspections IMMEDIATELY. When a plant becomes 'sick', the cause could be one or several things. More often than not, there are several factors involved; for example, minor diseases or environmental problems weaken the plant making it more susceptible to a more damaging (obvious) disorder.

When you inspect a plant for problems, you need to systematically consider all of the things which might possibly be going wrong.

### **First**

Systematically examine the plant and take note of any abnormalities.

Look at the leaves:

- Are there abnormal markings, swellings, distorted shapes, etc?
- Is there any discoloration?
- Are there dead patches or holes?

Look at the fruit and flowers:

- Are the flowers and fruit developing well?
- Is there any fruit drop?
- Is fruit undersized?

Look at the stems/branches:

- Are the growth tips lush and growing fast? A healthy plant will have lush, growing tips. If other parts are damaged but the tips are lush, this can indicate that the plant is recovering from a previous problem.
- Are there any abnormalities on the stems?

Look at the roots:

- Are the root tips fresh and healthy or black and rotting?
- Are the roots strong or is the plant loose in the ground?
- Are roots coming out of the surface of the ground? This may indicate the mix is low in fertiliser, dry deep down or has been eroded, hence the roots are coming up for water and nutrients.
- What parts of the plant are most damaged?

The parts which are most exposed to the problem will be most affected.

Frost damage occurs more on parts most exposed to frost.

Sun burn occurs more on parts exposed more to the sun, or on new soft growth.

Fruit rots may occur on branches close to the ground where disease spores can splash up from the soil.

Small animals tend to eat lush growth in preference to older tough foliage, while grazing animals will eat lower growth on shrubs and trees that is within their reach.

## **Second**

Examine the surroundings and note anything which may relate to abnormalities noticed when you examined the plant.

Soil:

- Is it wet or dry?
- Is it well drained?

Surrounding plants:

- Are they healthy or not?
- Do they have similar symptoms?

Environment:

- Consider exposure to wind, frost, sun etc.
- Has anything been changed since the problem arose (eg. a building or large tree which provided protection may have been removed)?
- Is the plant at the bottom of a hill or slope? Could something have washed down from further up the hill (eg. weedicide, disease from another plant)?

## **Third**

Decide, based on the information collected, which group you think the main problem comes from - pest, disease, nutrition, environment or weed.

Decide whether it is likely if there is more than one major problem. Eliminate the groups you can.

## **Fourth**

Select a suitable control method or methods.

### **If you are unsure:**

For anything you are uncertain of, devise a treatment which might be used and apply that treatment. You will be able to determine whether that was the problem or whether it was something else by whether or not the plant responds. The following table may also give you some clues to possible causes of plant disorders.

## DIAGNOSIS OF PLANT DISORDERS

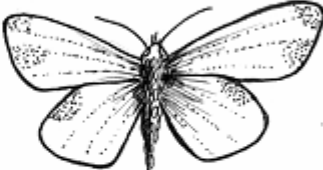
<b>SYMPTOM</b>	<b>POSSIBLE CAUSES</b>	<b>TREATMENT</b>
Spindly growth	Low light (eg: shade), excess water, high temperatures, plants too close together.	Improve light, cut watering, reduce night temperature in greenhouse by cooling or ventilation, reduce feeding increase spacing between plants
Growth reduced	Insufficient nutrient and/or water.	Feed more often but in low concentration. Water more often
Old or lower leaves yellowing	Nitrogen deficiency	Feed the plant/s with a fertiliser high in nitrogen. A highly soluble or liquid fertiliser will give quick results. This can be followed up with a slow release nitrogen fertiliser or further applications of highly soluble forms.
Young leaves yellowing between veins.	Iron deficiency	Similar treatment as for nitrogen above.
Purple leaves	Phosphorus deficiency	Similar treatment to nitrogen.
Root tips burnt or discoloured on container grown plants	Excess fertilizer or salts or toxic chemicals in soils or potting mixes (sometimes occurs when media is fresh)	Leach media thoroughly to wash away excess nutrient or toxin or repot into potting mix with low salt/toxin levels
Woody growth	Plants over hardened (ie: exposed to too tough conditions), or slow growing.	Increase feeding, if problem is excessive, also prune.
Stems very wet and decaying at base of the plant	Damping off disease caused by dirty conditions, high humidity and/or overcrowding	Thin out plants, Apply fungicide
Algae, moss or liverwort on surface of soils and potting mixes	Excess moisture and nutrient on surface. Doesn't harm plant initially but can impair flow of nutrient solution in the long term.	Reduce watering, increase ventilation, use better draining medium. Some chemicals (eg: Ferrous sulphate), can be used to kill algae and moss.
Poor root growth	Poor aeration or drainage in medium, low temperature in medium, toxic chemical in medium	Determine which of these is the problem and act accordingly

# PESTS

Cricket



White Butterfly Grub



White Butterfly

Aphis



Whitefly

Slug



Snail



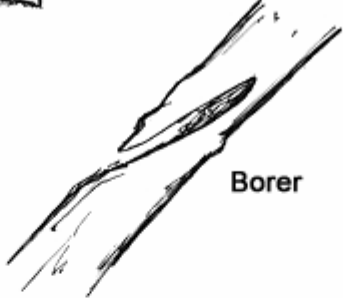
Scale



Red Spider Mite



Borer



Spitfire Caterpillars



Pear and Cherry Slug



Slater



Thrip



Mealy Bug



## ENVIRONMENTAL PROBLEMS

Heat, cold, wind, rain, frost, shade, pollution and other environmental problems can have disastrous effects on plants.

### Plants Have Varying Tolerance Levels

Every type of plant has a different level of tolerance to adverse environmental effects:

- There are certain environmental conditions which are preferred: e.g. most indoor plants prefer a temperatures between 22 - 30°C, and will grow best within that range
- There is a broader range of environmental conditions which are tolerated: e.g. most indoor plants will tolerate temperatures as low as 5 -10°C and as high as 40 - 45°C but below 15°C or above 35°C there is little, if any growth
- Outside of the tolerated range of environmental conditions the plant will suffer and perhaps die e.g. most indoor plants will die at temperatures below 5°C or above 45 °C

Wind, frost, pollution and all other environmental conditions affect all plants in the same way as the examples above: i.e. plants have preferred or tolerated and intolerable environmental conditions for growth.

## COMMON ENVIRONMENTAL PROBLEMS

### Air Pollution

- Symptoms are generally burning or discolouration of leaves and growth tips.
- The effects will be worse in badly polluted areas, so if you suspect pollution from a nearby factory, look at plants growing closer to the factory; they should show more dramatic signs of pollution.

### Burn of Foliage

#### a. Water-related

- In the case of some plants, wet foliage is likely to burn in direct sunlight
- Direct sunlight on African violet leaves (*Saintpaulia* spp.) often causes burn marks.
- Conifers which are watered on the foliage on a hot day commonly develop burn marks later.
- Generally plants with soft or fine foliage are most susceptible to this type of burn.
- Think about when the burn appeared. Was it straight after a hot day, and was the foliage wet then?
- The symptoms would occur on the parts which were wet and most exposed to the sun (except in severe cases, burn would only be on one side).

#### b. Sun Scorching

- Burn will be most severe on the tender growth (usually the young leaves or growth tips).
- Parts with the most exposure to the sun will be worst affected.
- Symptoms will show very quickly (perhaps the next day).

#### c. Pollutants

- Chemicals in the soil can cause a more generalized burn: growth tips or young foliage over the whole plant show burn: (compare with sun burn which might be on one side only).
- Consider whether the soil might have been polluted by a previous owner or if chemical toxins may have washed in from a neighbouring property

#### d. Pesticides

- Overuse of many types of insecticides or fungicides can burn foliage they are sprayed on.
- Spraying on a hot day can cause foliage burn.
- Look for the effect on the foliage most exposed to the chemicals.

#### e. Fertilizer

- Too much fertilizer can burn root tips, and in extreme situations, cause burn marks on foliage.
- Fertilizer burn is more likely in hot weather when many fertilizers become more soluble due to the higher temperatures

Treatment:

- Damaged foliage cannot be repaired. It can only be removed to prevent decomposing tissue spreading infection to healthy tissue.
- Feed damaged plants and look after them well so as to promote rapid rejuvenation.
- Avoid making the same mistake again: do not put susceptible plant varieties in places where the environment is hostile to them: take care when applying water, fertiliser and other chemicals

### **Drainage Problems**

- Too much water around roots encourages fungal root rots.
- Young root tips are white when healthy, but black or brown when not.
- Leaves often go yellow demonstrating a nitrogen deficiency induced by too much water around the roots: the plant is unable to absorb nitrogen from water-logged soil
- Too much soil water starves young roots for oxygen.

*Treatment:*

- Lay drainage pipes
- Use pots with a greater number of drainage holes
- Aerate the soil with an aeration fork
- Apply gypsum to break up the clay particles in the soil
- Plant susceptible plants on mounds or in raised beds

### **Frost**

- Frost burn generally appears as dead areas of foliage, and stems.
- Affected parts turn black, may go watery.
- Symptoms begin to show within hours of the frost occurring.
- Areas on the outside of the plant are most affected (Leaves closer to a wall or other plants are less affected).
- Can affect leaves, growth tips, fruit, flowers and buds.
- Frost damage to fruit buds or flowers can cause a great reduction of fruit from fruit trees.

*Treatment:*

- Do not remove burnt foliage until danger of further frosts has passed. (Dead damaged tissue should be cut off to prevent infection spreading as soon as frosts finish. Premature pruning will stimulate new shoots which will be particularly tender and vulnerable to frost damage).
- Cover with hessian or some other physical protection such as horticultural fleece.
- Create air movement to stop frost settling (e.g. in a frost prone greenhouse, a cheap fan might be left on overnight when there is a frost warning).
- Use a heat source (e.g. a kerosene fire or fan heater) on frost warning nights: even in the open, a small fire creates air movement which is often enough to prevent frost settling (there are inherent dangers with leaving unattended fires).
- Put sprinklers on for a few hours just before dawn when the chance of frost is greatest (i.e. the slightly higher temperature of the water is often enough to prevent frost damage).

### **Hail**

- Hail can damage fruit, flowers and foliage severely.
- The damage is obvious, causing denting and tearing of plant tissue.
- Damaged tissue cannot be repaired and is normally cut off, to prevent disease or rot affecting damaged tissue.

### **Shade**

- Areas of a garden can become increasingly shaded as trees grow, without obvious change
- Growth in the shaded area becomes elongated and less bushy as plants stretch toward the light
- Plant vigour and flowering can become reduced
- Soil dries out more-slowly in over shaded areas: conversely, soil shaded by trees will receive less rainfall penetration than that in open areas
- Algae or moss may grow on paths or lawns

#### *Treatment:*

- Remove some of the large trees.
- Thin out branches in the tree canopies of large trees to let more light penetrate.
- Replace some of the evergreen trees with deciduous trees to let more light in over winter.
- Replant under trees with plants more suited to shade (e.g. *Dichondra* sp. as a lawn, *Hosta* spp etc).

### **Temperature**

#### *a. Cold*

- Cold temperatures slow down growth and reduce flowering and fruit development:
- Extreme cold will kill parts or all of a plant very quickly

#### *b. Heat*

- The first symptom is slow growth, or no growth
- As heat increases, the plant will wilt: plants can wilt and recover again as the temperature cools, but there is a point beyond which recovery is impossible: this is known as the “permanent wilting point”
- In extreme heat parts or all of the plant will die quickly

#### *Treatment:*

- Mulching reduces temperature extremes in the soil.
- Shading can reduce temperature extremes:
- Watering deeply can help plants sustain high temperatures without wilting: avoid watering when the temperature is high (in emergencies it is important to get water to the plant, but avoid wetting the foliage)

### **Wind**

- Strong wind causes foliage to dry out faster than water can be taken up from the roots. This causes wilting, particularly with more susceptible newly-planted plants.
- Wind can cause drying out and death of the more tender and exposed parts of a plant.
- Damage will be worse on the more exposed side of the plant.
- Damage will be worse on growth tips and most tender foliage.
- Plants can literally blow over, in extreme cases, out of the ground.
- Wind-rock prevents roots becoming fully established in the soil and leads to weakened plants, susceptible to blowing over and which will ultimately die

#### *Treatment:*

- Erect or plant a windbreak.
- Use tree guards until the plant becomes established.
- Stake plants to stop them blowing over.

### **Cleanliness and hygiene**

If the area around plants is kept clean and free of pests and disease, there is less chance of your plants being affected. This can be achieved in such ways as:

- Being careful that you do not import soil that may be full of pests and diseases, weed seeds or other problems.
- When buying plants be careful that the soils and potting mixes that they are grown in don't have similar problems. Where possible obtain your soil and plants from a reputable supplier.
- Where possible don't leave plants or plant parts affected by pests or diseases near healthy plants.
- Use clean, sharp tools when working with plants. Regularly dip or rub over tools such as secateurs, handsaws, knives, etc. with an antiseptic such as methylated spirits, Dettol, etc. Keep cutting tools sharp to prevent tearing or ripping of plant material, which may make the plant more susceptible to attack.
- Ensure that any machinery (eg. planters, harvesters) used where pests, diseases or weeds are a problem are thoroughly cleaned before being used elsewhere.
- Keep a close eye on plants and do something about problems immediately they are noticed.
- Avoid having muddy areas. If possible, improve the drainage. Have drains take excess water away, and not just redistribute it elsewhere any diseases that might be in it.

Clear away any weeds which are near your crops. Many weeds will act as hosts to diseases and pests which affect your crops. Keep in mind that some pests, like aphids and leafhoppers, also spread viral and bacterial diseases as they suck sap and move from plant to plant.

## **WATERING**

All plants need water to grow, and to survive. The amount of water needed however, will vary from plant to plant. The two main things which affect how much water a plant needs are:

1. The variety of the plant. Some types of plants have the ability to retain water within their tissues for later use. Other plants are unable to do this.
2. The environment in which the plant is growing. If there is plenty of water available around the plant, then it is unlikely to suffer from a lack of water. Shaded, cool situations tend to remain more moist than exposed, windy, sunny situations.

Obviously plants can suffer from a lack of water. Plant can also suffer from an excessive amount of water. When you water a plant it is important to strike that delicate balance between too little and too much. Over watering can be just as bad as under watering.

### **Symptoms of Water Deficiency**

- The first symptom of water stress is wilting. Leaves and stems droop. If the plant is watered at this stage, it quickly recovers.
- The rate of growth slows.
- Stems become slender, leaves become smaller, flowers and fruit become smaller.
- If a plant which has a watery type of fruit (such as a tomato) is under watered, the plant can begin to take moisture out of the fruit (ie. the tomatoes begin to shrivel).
- In extreme water deficiency, the tips of the plant die back, leaves are dropped, and the plant does not recover even when watered.

### **Symptoms of Excess Water**

- Seedlings become leggy if they are planted close together in the nursery, and if there is too much moisture about.
- Plant tissue cells become enlarged and in extreme cases they might burst.
- Internodes become elongated (the spaces between two leaves on a stem become elongated).
- In extreme situations leaves become blackened, plant dies back or dies completely.

## **MAINTAINING APPROPRIATE WATER LEVELS**

- Consider the soil or potting mix the plant is growing in. If a plant is getting too much water, perhaps the soil or mix should be more freely draining. Coarse, free-draining material such as coarse sand or composted sawdust can be added to the soil or mix.
- If the plant is getting insufficient water, perhaps the soil should have a better capacity to retain moisture. Mulch can be spread over the garden bed or pot surface to assist water retention.
- Consider the frequency of watering. Maybe you need to water more often or less often.
- Consider water penetration. Does the water you apply get absorbed into the soil or does it run off the surface? Does it land on the leaves of plants and get deflected away from the soil? Does the sun or wind remove it before the plant gets to use it?
- Is the plant in a shaded situation? Is it in a very hot situation? How much natural rainfall has it been getting?

In a garden centre it is the wilting plants that a customer will often notice first over the lush green ones. If they see wilting plants, they will assume the rest of the plants have not been tended for as well.

In the heat of the day or if the wind has been strong, plants will wilt. Often this means hand watering to keep the soil hydrated. If possible, run the irrigation system during the day when no customers are near by to keep plants moist.

In cooler climates moisture may cause problems, by having the plants too wet which causes problems with fungal diseases. So it is vital to understand the water needs of the plants, the amount of light or shade they are receiving and how much water they really need.

## **NURSERY IRRIGATION**

All plants require water. How they are watered is dependent on how the plants are grown. Field-grown plants for example are most usually watered by travelling or fixed sprinklers and may or may not be watered daily depending on the prevailing climatic conditions. Container-grown plants in contrast usually need daily applications of water. This is due to the root restriction within the pot. The size of the root zone is often small when compared to the size of the plant and therefore water is rapidly taken up by the plant.

Three types of irrigation systems are most frequently used in the container nursery industry: overhead sprinklers, micro-irrigation and sub-irrigation. Overhead sprinklers may be fixed or travelling. Micro-irrigation may include the use of various types of drippers, micro-sprayers and misters. Sub-irrigation may involve periodic flooding of plants, or capillary mats. Occasionally there may also be a need for hand watering.

### **Overhead Watering**

There are many different types of sprinklers, from expensive metal pop-up types to simple plastic moulded nozzles which can be simply inserted into black polythene pipe hung above the plants.

Some sprinklers water in a full circle, others only in a part circle. To ensure adequate cover of water, it is often necessary to set sprinklers so the areas they water overlap. (The overlapped areas are watered doubly, and plants on these fringe zones tend to either be watered too much or not at all.) It is essential to calculate the area which a sprinkler will water, in order to space sprinklers properly and achieve complete coverage of the plants being watered. To do such calculations requires knowledge of the sprinklers being used, the number being placed on a sprinkler line, and the water pressure which you will use (at the time of day and year when water pressure is its lowest).

Some dry spots can appear no matter how well an irrigation system is designed. Proper management must include checking for such dry spots and either moving plants out of these areas, or hand watering these areas.

### **Micro- Irrigation**

In micro-irrigation water is delivered directly to the root zone of plants. This gives it an advantage over most other systems in specific applications. This is particularly beneficial for plants that are prone to fungal disease caused by wet foliage such as roses. Micro-irrigation systems are also suited where chemical application is done through the irrigation process (chemigation). There is less leaching and water runoff from pots that are micro-irrigated. This system is particularly suited to advanced plant production, particularly when plants are grouped together and are not moved for lengthy periods.

The micro-irrigation system provides a slow dripping of water at one point and is extremely efficient, with less than 10% of water applied being wasted. To evenly distribute water through large containers, more than one dripper may be required. Although the design of systems varies greatly, the basic components of all trickle systems include an automatic controlling device, a pressure regulator to ensure water pressure is even between drippers, system filters, control valves, and drippers or microsprays.

### **Sub Irrigation**

This involves water soaking up into the bottom of plant pots or trays. Such capillary watering supplies a constant supply of water to plants without needing to wet the foliage. The number of times water needs to be applied is reduced to how ever often the supply below the plants needs to be replenished. There are several ways in which water is supplied to pots through capillary irrigation.

### **Ebb and flow**

This system of irrigation is becoming a popular method, particularly in nurseries that produce flowering pot plants. Production rates are very high with thousands of pots all the one size and containing the same species and therefore water requirements can be reduced. The plants are set in shallow trays or basins that are periodically filled with a few centimetres of water for a set period of time.

### **Capillary mats**

Capillary mats are used by large-scale wholesale production nurseries. The mats are set into metal trays or beds that are irrigated by drip lines. Tensiometers are placed directly on the mats to monitor humidity.

## **Outdoor sand beds**

Outdoor sand bed irrigation is a simple manual, non-electric, system that was developed in the UK. Bed widths need to be narrow so that they can be reached from either side to prevent compaction caused by walking on wet beds.

## **AUTOMATIC SYSTEMS**

Irrigation can be controlled automatically by either sensing devices (which switch the watering on when it is needed) or by time clocks which switch the watering on at the time of day when you tell it to water...and for the length of time which you tell it to water for.

Automatic systems can require resetting as conditions change from time to time throughout the year. They can also break down, and watering might be missed without you noticing. It is important that you do not over rely on automatic systems. Check their operation and the way they are affecting the plants, frequently.

## **PRUNING**

Plants are pruned for all sorts of reasons, and the way to prune a plant depends both upon what you want from the plant and where you are. Roses, for instance, need to be pruned very hard in colder climates to achieve the best flowering, but similar treatment in the sub-tropics can result in a very poor crop of flowers.

Gardeners are less rigid today about the best method to prune a fruit tree, rose, shrub or tree than they were twenty years ago. In the past, many plants were pruned in the traditional shape of an inverted cone (particularly roses and fruit trees). Experiments have shown that other shapes can be just as productive and visually effective as this traditional shape.

With better watering, fertilising and weed control, plants are today able to carry a larger crop of flowers and fruit than they could a few decades ago. Consequently, the detailed heavy pruning of the past is not always now practised.

In the home garden, pruning is mainly done to shape the plant so that it fits into the general function and design of the overall garden.

### **Pruning Preparation**

Prior to pruning, look closely at the plant or tree and try to understand how it grows. What parts of the tree produce flowers and fruit, what shape do you want to achieve; do you want large flowers or fruit?

Deciduous trees and garden plants are usually pruned in winter as the plants are bare of leaves and it is easier at that time to see what you are cutting.

Note the size of the buds. Larger, plump buds are flower/fruit buds. Narrower buds are vegetative (vegetative buds give rise to leaves or green shoots). The number of flower buds will give an indication of the amount of fruit the tree is likely to bear (Note: On some types of trees, one bud can produce several fruit; on others one bud only produces one fruit.) You will notice that fruit buds are borne on particular parts of a tree. For example, peaches bear fruit on one-year old laterals; apples bear fruit on the tips of one-year-old laterals as well as in small clusters of compact growths called "spur systems".

The basis of your pruning should be to cut in a way that will encourage the development of the type of growth which will produce flowers, fruit and/or shape for future years, but at the same time leave enough buds to allow a reasonable crop (in the case of fruit or flowers) for the coming season.

When pruning consider the following:

- The vigour of the plant or shoot depends on the direction of growth and the amount of leaf surface (among other things). The more a shoot approaches the vertical position, the stronger its growth will be.
- The top or terminal bud of a shoot generally has the greatest amount of growth. The growth potential of the buds will gradually decrease as you come closer to the base of a shoot.
- The greater the leaf (ie. vegetative) growth, the lighter the crop, resulting in larger but poorer quality flowers or fruit.
- The fewer the number of buds on a shoot, the stronger will be the growth made by each individual shoot arising from these buds.
- All flowers and fruit should be removed from young plants for the first few years after planting, to allow the leaf and stem growth to better develop.

### **How to Prune**

Start by cutting out the dead wood and crossing limbs, then identify the bud that you wish to remain on the plant that is pointing in the direction in which you want growth to go. You will need to remove the excessive plant material above that bud.

Generally, an angled cut is made above the bud so that the high part of the cut is above the bud and the low part of the cut is on the other side of the stem. It is important not to cut too close to the bud otherwise the bud may die. If you cut too far away from the bud, the stem may suffer from dieback and may become prone to diseases.

### **Cutting Large Branches**

When large branches are to be pruned (referred to as tree surgery), the first objective is to remove most of the branches' weight. You can then make a clean final cut without the risk of the weight causing a tear.

Firstly, cut on the underside of the branch about a 50cm away from the intended final prune. This first cut is upwards into the limb about a quarter of the width. The second cut is made a little further away from the final cut, about 70cm along the limb. This cut is made downwards all the way through or until the branch falls off. The purpose of the first undercut is to prevent bark ripping off to the trunk. Now you should be left with a branch of about 70cm long which is easier to work with.

The final prune of a limb should be at the point where the limb naturally forms a swollen area at its junction with the trunk. This may be cut in any direction but always try to prevent bark ripping. Seal with a wound dressing.

It is wise wherever possible to use pruning! The best way is to compost the prunings. First however these will need to be shredded into smaller pieces to aid the decomposition process. Small amounts can be shredded using secateurs; for larger amounts, using a mechanical shredder. Large branches may be able to be used for landscaping as fences, retaining walls or garden furniture.

### **EXERCISE: NURSERY INSPECTION SHEET**

It can be a useful exercise to develop a checklist or inspection sheet for nursery staff to use when undertaking routine inspections for pest and disease problems.

Most nurseries are divided into several sections (eg. propagation area, shadehouse, greenhouse etc), and a separate inspection sheet is filled out for each section. The following is an example of one such sheet.

The nursery manager may decide to establish a procedure where this sheet is used daily or weekly to carry out an inspection of the nursery in order to determine whether any pest, disease or other problems are developing and need attention. This can be an excellent time saver for the manager, allowing a clear picture of the current status of the nursery to be determined quickly and efficiently.

## NURSERY INSPECTION SHEET

NURSERY NAME:

INSPECTION DATE:

INSPECTION CARRIED OUT BY:

NURSERY SECTION:

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### **Overall Condition Of Plants (Generally)**

Very Healthy  
Healthy  
Medium Health  
Sick  
Very Sick  
Dead

### **Condition of the Worst Plants (i.e. the worst plants that you are inspecting):**

Very Healthy  
Healthy  
Medium Health  
Sick  
Very Sick  
Dead

### **Root Inspection (Generally)**

Expose some of the roots on at least two different plants by either digging into the soil or part removing the plant from the pot.

#### *Root Tips*

White, healthy and growing  
Darkened or discoloured  
Rotting or dead  
Pot-bound, needing potting up  
Roots dry needing water  
Roots too wet  
Roots very hot  
Roots eaten, chewed or damaged by insects or other animals  
Roots or soil contains pests (give description: .....)  
Roots or soil contains fungal or some other growth (give description: .....)

### **Foliage (Generally)**

Growing Tips  
Lush, rapid growth  
Healthy but not lush  
Discoloured  
Looks sick  
Older Leaves  
Lush, very healthy  
Damaged  
Discoloured  
Has dead spots  
Some dropping

*General Foliage*

- Thick
- Sparse
- Hardened
- Soft/Tender
- Balanced shape
- Poor Shape

**Specific Problems Detected**

List the names of any insects, diseases or other specific problems detected:

.....

.....

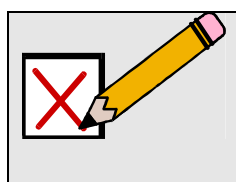
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**Recommended Treatments (if any)**

Plant Variety Concerned	Procedure	Urgent/Non Urgent
	Staking	
	Pruning	
	Relabel	
	Feeding	
	Move to Greenhouse	
	Move to Shadehouse	
	Watering	
	Move to .....	



**SELF ASSESSMENT**

Perform the self assessment test titled 'Self Assessment Test 3'  
If you answer incorrectly, review the notes and try the test again.

## SET READING

Research and read about anything you can find on maintenance in a nursery.

Refer to any reference material which you have access to, such as:

- Reference books in your possession
- Plant Catalogues or leaflets
- Books from a library
- Web Sites
- Magazines or Journals

Spend between 1 and 2 hours only doing this.

## SET TASKS

1. Visit a garden centre or retail nursery and judge the quality of plants for sale. Select four or five plants at random and study them carefully to assess their quality. Use the information from below to judge the quality of these container plants.

Assign points to the container plant according to the criteria listed below:

- a) Freedom from Blemishes or Damage: pest or disease damage, chemical, frost, sun or other burns or any other undesirable markings on plant. (Give a rating out of 20)
- b) Overall Lushness and General Quality: consider what is attainable with this particular variety, and how close this particular plant comes from towards reaching the very best overall appearance. (Give a rating out of 20)
- c) Floral or Foliage Display: for flowering plants consider the number, size and quality of flowers. For foliage plants consider the number, size and gloss of leaves. (Give a rating out of 25)
- d) Size of Plant: consider what is normal for this sized pot: too big can be as bad as too small: roots should not be coming out of the bottom of the pot. (Give a rating out of 20)
- e) Root System: for the following component, please ask for permission by the nursery. Do not proceed with this part without permission. Alternatively, look at a plant you have recently purchased.

Knock the plant from the pot and inspect the root system. It should be even throughout the root ball. The roots should not be rotting at any point. There should be no bugs or fungi growing in the soil. The soil should not smell strongly of anything (except perhaps fertiliser). The root tips should not be discoloured. The plant should not be pot bound. (Give a rating out of 15)

The Total of all of these rating will give you a score out of 100.

**Return to the same garden centre/nursery** every two (2) weeks for a two (2) month period. Each time you return; conduct an inspection, and record the results of that inspection. (ie. Keep a log book record of your observations.)

At the end of two months, submit the records of the inspections you carried out.

NOTE: You should submit the remainder of this lessons assignment when complete, and submit the log of your plant inspections with another assignment (when they are completed).

2. Visit a florist and try point scoring some of the cut flowers which are on sale.

The following is one way of scoring cut flowers:

- a) Condition of flowers: base on freedom from damage, bruising, marks to both blooms and stems, relative maturity of petals and uniformity of flowers in the bunch. (Give a rating out of 25)
- b) Form of plant: consider relative maturity of flower stem, shape and petal distribution on flower head, uniformity of flowers. (Give a rating out of 20)
- c) Stem and Foliage Characteristics: consider stem length and shape, size and proportion of foliage to stem, colour, substance, size and uniformity. (Give a rating out of 20)
- d) Colour of Flower: consider colour variations expected within that variety, trueness, intensity, clarity and uniformity. (Give a rating out of 20)
- e) Size of flower: consider stem, foliage and blooms. (Give a rating out of 15)



**ASSIGNMENT**

Download and do the assignment called 'Lesson 3 Assignment'.