

Growing Plants in Hot Climates®

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INTRODUCTION

Hotter weather is one of the greatest challenges in a production or propagation nursery in Australia. Our earliest growers from Europe struggled with growing plants in Australian conditions because they were used to the cooler temperatures and lower light levels. It is very hard to grow or propagate plants well when it is so hot. This puts growers in hotter climates at a disadvantage that they need to overcome in order to compete with growers in cooler climates.

So, how do you grow and propagate plants well? What does summer mean to you in your nursery? And, what should you be doing to minimise climatic impact? It is very difficult to grow plants from climates that are so different to ours.

THE HOT CLIMATE IN MILDURA

Very hot climates like the Mildura region are conducive to growing good fruits and vegetables but present some significant challenges for the local plant producers. Not only is it hot here, but also it is also dry and evaporation is high.

Figures 1, 2, and 3 show the variation in temperatures and climatic features of Mildura relative to other Australian cities (source of data: Bureau of Meteorology).

WHY BE CONCERNED ABOUT THE HEAT?

It is simple to say that it is harder to grow temperate plants in the heat, but why is it so? This is not meant to be a plant biology lesson but a brief description will help. A plant is all about its leaves and roots. Plant leaves are thin and therefore heat up and cool down very fast. Plants transpire — it is their cooling system; water is brought up from the roots and evaporates from the leaves through the stomata. If the temperature gets too high or the humidity gets too low, the plant can't move enough water up from the roots to the leaves, so the stomata start to close to prevent further dehydration. This slows water uptake, which reduces nutrient uptake. When stomata close, plant growth virtually stops, so in hot periods, there is often very little growth and leaf and fruit cells start to collapse and die. This normally happens when the leaf temperature gets to 35 °C.

Heat also has the following direct and indirect impacts in the nursery:

- Can burn or scald plants, foliage, and flowers — caused by dehydration.
- Reduces moisture available to a plant in growth medium.
- If root temperatures get too high it will slow down plant growth. Plants in pots will heat up quickly. Ideal medium temperature is between 15–30 °C.
- Heat is often associated with hot winds that also increase transpiration.
- Seed germination and root initiation on cuttings are particularly susceptible to hot weather. The larger the root system the greater the plants ability to cope with hot weather.
- Makes it harder for your workers to perform at their peak.

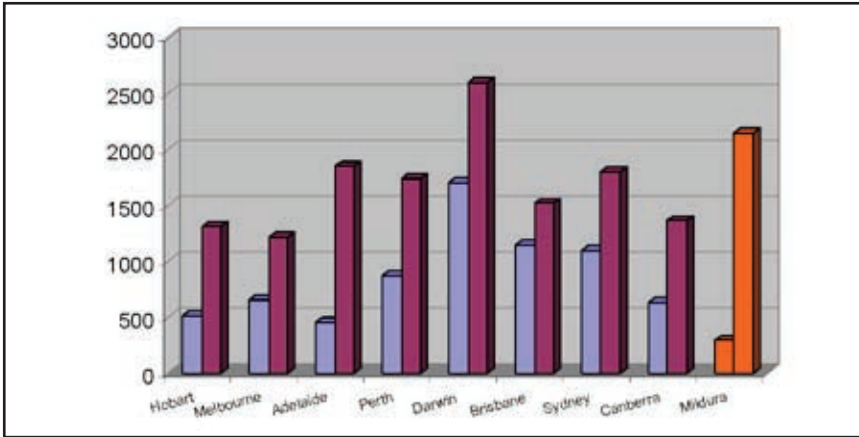


Figure 1. Annual rainfall in mm (left column) and evaporation in mm (right column) for each Australian capital city and Mildura.

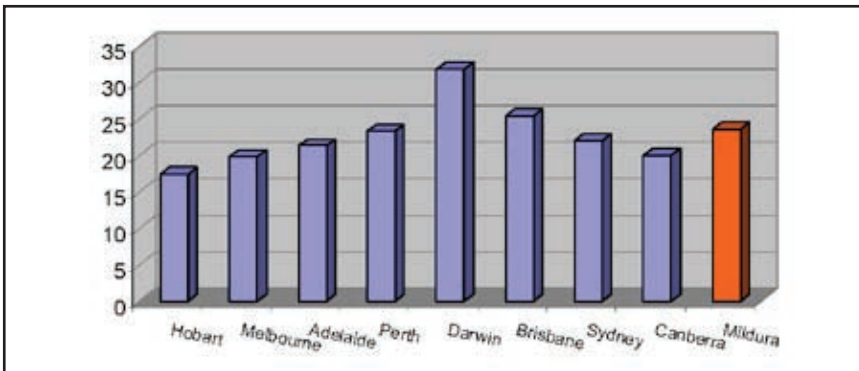


Figure 2. Average temperature (°C) in the Australian capital cities and Mildura.

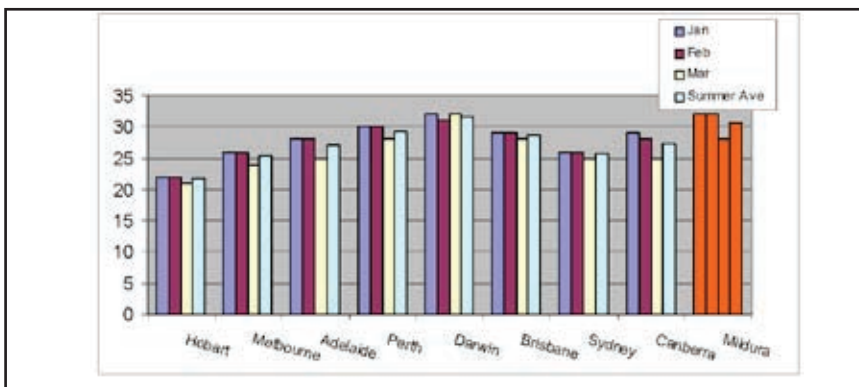


Figure 3. Average summer temperature (°C) in Australian capital cities and Mildura.

WORKING AND COPING WITH THE HEAT IN NURSERIES

So what are the mechanisms, coping actions, and other management systems you need to put in place in the hotter weather? I have outlined some strategies for you to consider in your nursery business.

Irrigation Systems. Sprinklers work to put water on plants and irrigation can be used for cooling down the plants on hotter days.

- Ensure that you have a well designed and correctly functioning sprinkler system. Concentrate on the potentially dry bits (corners, along the aisles, and northerly groups of plants).
- Ensure that all plants are getting watered, even on hotter windy days, and that water isn't being wasted.
- Plants in pots will die very quickly in summer and reduced growth rates due to water stress can be significant.
- If possible, group plants with similar water requirements in the same area to allow most flexibility in sprinkler run times and frequencies.
- Use pulse watering to cool plants outside.
- Precipitation rates of sprinklers should aim to match the ability of the potting mix to take the water up.
- Consider, drip, capillary matting, and flood and drain as superior water-saving systems.

Irrigation Cycles. Summer watering is quite different; in fact you should change your watering cycles regularly to match the season. Automatic irrigation systems are great in the nursery but the controllers that operate them do not know it is summer unless you tell them by changing their cycles. Plants require extra water in the hotter weather to cool down.

- Aim to water plants according to their needs.
- Normal watering should be finished before the sun comes up to minimise the losses due to wind and evaporation.
- Supplementary watering is often necessary but is time consuming and expensive.

Water Supply and Storage. Summer is the time when everybody else is using more water as well, but summer is not the time to consider this — it is too late. Planning for summer water needs is a job for the cooler months. In summer water availability is typically reduced and the flow from bores can also be lower. Be aware of the following factors regarding water supply over summer:

- Dams get lower and salt levels will increase in the water, which might harm plant tissue and cause nutrient imbalances.
- Flow levels in rivers, creeks, and aqueducts may be affected. The effects of this are compounded in periods of extended dry.
- Water supply might not be guaranteed in some areas most severely affected by heat (e.g., bushfires will reduce pressure, might cut off power, etc.).
- Plans should be made for the worst case scenario and now is probably a good time to think about long-term water needs, including recycling and treatment, if you are not already doing so.
- Always have an adequate amount of water in storage with good back-up systems.

Fertiliser and Nutrient Management. Plant nutrient requirements will also change in summer and this should be planned for. Plants need more water for cooling but not necessarily more of all the nutrients.

- Check your fertiliser regime in conjunction with your media and/or fertiliser manufacturer.
- Increased watering will increase the possibility of leaching of nutrient salts from your pots.
- Liquid feeding is more popular than ever — check your percentages and ratios, in particular those of the water-soluble nutrients.
- Urea-based fertilisers like isobutylenediurea (IBDU) are potentially dangerous in hotter weather if rates are not right.

Spraying and Chemical Applications. Whilst the hotter, drier weather will mean that generally you will have less pests and disease, mites do love the hot dry weather. In summer you may also have increased weed growth. Spraying is still required and you need to be aware of the implications of hotter weather on your pest management system. Spraying on hot days is a very risky business especially with volatile chemicals.

- More spray is lost due to evaporation and the northerly winds will increase potential for damaging drift. Ensure you don't spray on hot windy days.
- Try to limit sprays on hot days because the chemicals may damage the foliage or flowers on the plants by marking. Efficacy of chemicals can be increased in hotter weather. The potential for marking with adjuvants/stickers is increased.
- If you are using recycled or dam water then the pH of this may change over the summer period — this may have an impact on a chemicals efficacy
- Chemical stores can get too hot and vapours can be an OH&S issue — be aware of this.

Potting Media. If media is crucial to growing plants then be aware of the affects and variations that the heat might cause in production and propagation media.

- Increased temperatures can cause a premature release of the salts in fertilisers in potting mix, i.e., controlled-release fertilizer (CRF) dumping.
- If you do have to store the media for extended periods ensure that the mounds are kept low (less than ½ m in height) if they contain CRF. If salts do build up then make sure plants are thoroughly watered in.
- Don't allow the media to completely dry out as this can increase the risk of airborne particles. Wet it down to keep it cool as well.
- Temperate plants are more affected by release variations — leaching may be necessary.

Staff and Heat. Like plants, your staff can wilt under the pressure of the excessive heat in summer. Ensure that your staff is well protected.

- Ensure all staff wear adequate protective clothing and other personal protective equipment including, wide-brimmed hats, long sleeve shirts, and a sunblock with a high SPF.

- Consider extra breaks on the hottest days for extra drink breaks and relief from the hot sun.
- Consider the provision of temporary shade structures.
- Be aware of the signs of sunstroke and other heat related illness.
- Plan the working day so the tasks that are done in the sun or in hot greenhouses are done in the cooler parts of the day.
- Hot dry weather means that potting mix and other particles dry out and become more of a hazard. Staff should be particularly aware of dust from potting mix in hot, dry weather.

Growing Structures. Growing plants indoors successfully in hot climates is all about design. Good house design will allow you to grow plants in them regardless of temperatures outside — cold or hot. Air movement and ventilation are crucial. Ventilation can be natural (passive) or supplemental (forced air), both are utilised to cool things down in warmer weather.

- Natural ventilation — roof or sidewall vents allow hot air to escape. Typically the open area should be no less than 20% of the floor area, but 25% is optimum. High greenhouses ventilate much better than low ones and 4 m to the gutter is now common.
- Ventilation should be automatic, ideally based on thermostats, not time.
- Misting can be used to cool greenhouses as well.
- Utilise whitewash and shade cloth in the warmer months but do not forget to remove them when it starts cooling down. White shade cloth is better than black or green because it reflects more light, but still absorbs about 20% of the heat. Aluminium screens and other mechanical methods of shading work well and repay the capital investment quickly, achieving 6–7 °C variations under aluminium screens.
- Exhaust fans can be used when there is insufficient natural ventilation. Exhaust fans are cheaper to install than motorised vents, but they are noisier and use a lot more power.
- Exhaust fans should be sized to give 30–60 air changes per hour. Inlets for exhaust fans should be 1.5 times the area of the fan outlet.

Evaporative Cooling and Misting Growing Structures. Both systems are used, though misting is more common.

- Fog is much more common and can give a larger and more even drop in temperature of up to 14 °C on hot, dry days.
- Always have back-up systems (pumps and power) available for misting systems and check nozzles regularly to sure that they are not blocked.
- Effectiveness of cooling in houses is dependent on relative humidity.
- Using misters can increase humidity, which can be a negative side effect.
- Droplet size is crucial — not too big!
- Low-pressure misting systems are becoming more commonplace and are proving to be effective.

Stock Plants. In propagation, the best result comes from healthy stock plants and the best plants in pots come from healthy cuttings. Reducing stress levels of stock plants will give you the best results.

- Stock plants need to be well watered to maintain vigour.
- Reduce potential competition by removing weeds, mulching, or using a weed mat.
- Reduce stress levels by ensuring pests and diseases are well controlled.
- Sensitive stock plants can be grown in protected environments.
- Take cuttings in the cooler parts of the day and use immediately or cool down if storing (4 °C is ideal).
- Take wet towelling or wet paper into the field to wrap the cuttings. This allows evaporative cooling of the cuttings.

OTHER POINTS ON HOT WEATHER

Flower colour is often different in Australia to what you might see in Europe. They either wash or fade out faster, or are lighter as they fade in higher light levels.

Insect screens are desirable in greenhouses but do reduce ventilation.

Wind and air movement are good for plants and cooling. This often conflicts with some of the other things that we are trying to do with growing plants though. Too much wind can be a bad thing. Consider properly spaced windbreaks.

Despatch and transport in hot climates needs to be carefully planned. Plants in trucks or on tarmacs get very hot and can expire quickly. If you want your plants to arrive in good condition at your customers nursery then be aware of this and plan to avoid it!

Plants from hot climates grow better than plants from temperate or cold climates in hot places like Mildura. It is easier to grow plants that originate in hotter climates in these areas. Some taxa of the same genus and species will vary in their ability to cope with heat. Refer to the Diggers Heat Zone Map for details (<<http://www.diggers.com.au/GrowingGuides.htm>>). The map shows the various locations around Australia that are climatically similar (i.e., they have the same number of hot days above 30 °C). This will give us an indication of how you would expect Australian plants from the various climate zones to grow and cope with hotter weather.

CONCLUSION

Hot weather just happens; it seldom sneaks up on you. It comes at the same time every year. Be prepared and you will cope well. The hotter part of the year is inevitable; you can't stop it, but you can live with it and so can your plants.

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LITERATURE CITED

Bureau of Meteorology (Australia). Rainfall and climatic statistics. Web site: <www.bom.gov.au>.

Diggers Club. Heat zone map. Web site: <<http://www.diggers.com.au/GrowingGuides.htm>>.