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Irrigation and moisture monitoring in blueberries

P. Wilk
District Horticulturist, Alstonville

G. Carruthers
Environmental Systems Specialist, Wollongbar

C. Mansfield
Fruit Sub-project Manager, Tatura

V. Hood
Blueberry Industry Development Officer, Parkville

Introduction

The aim of this manual is to provide blueberry growers with practical information in order to manage irrigation and soil moisture more effectively in conventional orchards. Improved management will result in reduced production costs, better quality of fruit and conservation of limited resources.

This information has been developed by Blueberry Industry Development Officers in NSW and Victoria, using data from growers and researchers.

Fundamentals of irrigation

Water stress at critical times in the development of the blueberry crop can dramatically affect fruit yield and quality. However, blueberry plants under water stress may not show any visual signs of stress. Careful management of irrigation is a key factor in achieving good yields and plant performance, and in long-term plant health.

The main points for managing irrigation

There are some key points that must be considered for good management of irrigation. These points are:

- understanding the basic principles of plant water use
- establishing a good irrigation system
- applying effective irrigation
- effective monitoring
- using soil moisture-based monitoring methods
- using weather-based monitoring methods
- management to improve water use.

Understanding the basic principles of plant water use

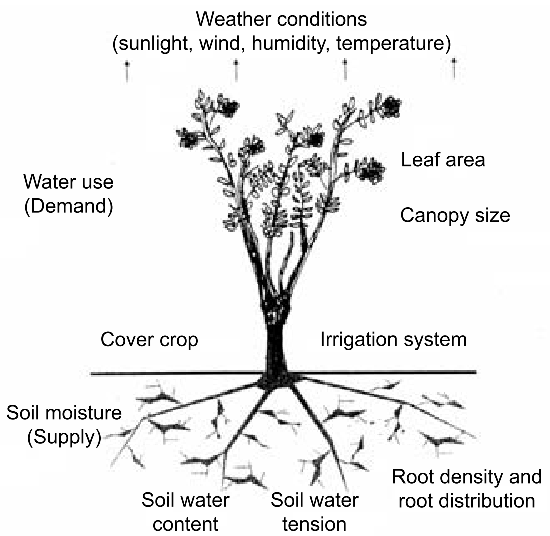
In order to correctly manage irrigation in any orchard, you need some basic background information. This includes knowledge of plant water use requirements, water balances, and your soil types. You also need to know how to recognise any problems associated with under-watering or over-watering.

Water balance

The water balance in plants results from a combination of factors. These include the weather conditions, the amount of water a plant uses each day and the amount of water available for plant uptake (see Figure 1).

If the plant water use exceeds the water the plant can take from the soil, then you will need to provide an alternative source of water. Smaller plants, with less canopy development will require less water than larger plants, for example. Similarly, if a cover crop is present, in general, less water will be lost from the soil due to evaporation and soil drying. All of these factors need to be taken into account when considering whether irrigation is necessary, and how much irrigation to apply.

Figure 1. Water balance in plants. Diagram supplied by Ian Goodwin, DPI Victoria.



Know your soil

Soil is a fundamental resource on which your crop production depends. Soil contains nutrients and stores water which will be available to plants between rainfall or irrigation events. The amount of water a soil will store is determined by the particular soil characteristics, so it is important to understand your soil type, for example, whether your soil is a loam or sandy clay loam or some other type. This knowledge will help you to determine how much water your soil will hold. In general, sandy soils are free draining and tend to hold less moisture than loams or clays.

Water infiltration

Water infiltrates the soil and is held in the spaces between soil particles. These spaces are called 'soil pores'. Once the soil has taken up enough water to fill all the pores, the soil is said to be at '**field capacity'**. There is no benefit in applying more water once the soil profile is at field capacity, as watering at this point will only cause saturation of the soil, resulting in runoff or subsoil drainage.

Roots remove water from the soil pores by creating suction. Water drains downwards in the soil due to gravity until a balance is reached, with soil pores holding the remaining water at field capacity. As plants remove water from soil pores, the remaining water is held more tightly in the smaller pores or adsorbed onto the soil particles. When the plant begins to have difficulty drawing up water, the '**refill point**' has been reached (see Figure 2). Irrigation 'permanent wilting point' occurs when the remaining water is held so tightly by the soil particles that plants cannot remove it.

Between the refill point and the permanent wilting point, plants can experience increasing water stress. Stressed plants use their energy to extract soil moisture at the expense of growth and fruit production.

Water stored in the soil is easiest for the plants to access when it lies between the field capacity and the refill point. This is called 'r**eadily available water**' (RAW) (see Table 1).

To improve water use efficiency, irrigators need to work with the RAW figures to maximise production. RAW is expressed in millimetres per metre of soil (mm/m) and indicates the depth of water held in each metre of soil that can be readily removed by the plant. RAW can be calculated for the total depth and texture of soil examined. However, for most irrigators it is more useful to calculate the RAW of the effective root zone For blueberries, on average, the effective root zone is 20–30cm from the soil surface. Growers should verify this on their own orchards by digging down into the mounds between two plants.

The best crop growth occurs when the soil water is in the range between the refill point and field capacity. If moisture levels fall below the refill point, blueberry fruit quality will be affected. Growers can

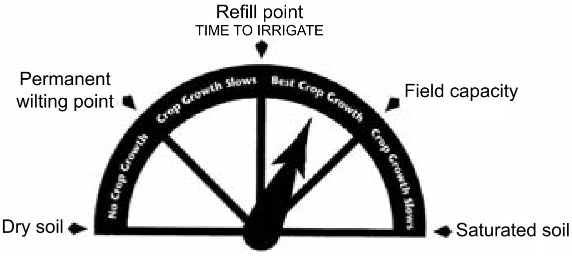


Figure 2. Soil: water 'fuel gauge'

monitor the refill point using moisture monitoring devices such as tensiometers or weather-based systems (see below). The refill point as measured by the vacuum gauge of the tensiometer will be in the 20–40 kPa range.

Under-watering

Several factors can create conditions where blueberry plants receive too little water. These include:

- Shallow rooting systems. Blueberry plants have a relatively shallow root system, with most roots in the top 20–30 cm of the soil surface.
- Mounding. Growing blueberries on mounds makes them susceptible to water stress as the mounds are free draining.
- Poor water penetration. Plastic covered mounds allow little natural rainfall penetration.
- Use of mulches. Woodchip mulches are difficult to re-wet if allowed to dry out.
- Delivery failure, e.g. blockages in drippers due to inadequate filters.

These factors make blueberries highly susceptible to water stress, which can result in reduced yields and quality. Also, reduced berry size can occur well before the plant shows any signs of wilting or obvious water stress.

Blueberry plants when mature require 2–3 ML/ha of irrigation per year. This may be in addition to natural rainfall as this only partially penetrates weedmat or plastic covered mounds from stem flow or seepage. If mulch dries out, it is very difficult to rewet. Therefore, if heavily mulched beds are allowed to dry out, they will only benefit from thorough soaking rainfall events.

Over-watering

A lack of knowledge of plant water requirements can contribute to over watering. Factors that create conditions where blueberries receive too much water include:

- Over-application of water. Mounds can become saturated if too much water is applied.

Table 1. Readily available water (RAW) and Available water (AW) for different soil textures

	Water tension in the soil				
	To 20 kPa	**To 40 kPa**	**To 60 kPa**	**To 100 kPa**	**To 1500 kPa**
	A	**B**	**C**	**D**	**E**
	Water sensitive crops such as vegetables and some tropical fruits.	Most fruit and table grapes, most tropical fruits (including blueberries).	Lucerne, most pasture, crops such as maize or soybeans.	Annual pastures and hardy crops such as cotton, sorghum and winter crops.	AW is the total water available in the soil. Plants stress before reaching this level.
Soil texture	**Readily available water RAW (mm/m)**				**AW (mm/m)**
Sand	35	35	35	40	60
Sandy loam	45	60	65	70	115
Loam	50	70	85	90	150
Clay loam	30	55	65	80	150
Light clay	25	45	55	70	150
Medium to heavy clay	25	45	55	65	140

Note: tension is 0 kPa at saturation point.
Taken from the NSW DPI publication *Waterwise on the farm*, Irrigation Management Course.

- Bad design. Poorly designed drip irrigation systems can mean water is delivered too quickly, or in too great a quantity for plants to take it up.
- Poor monitoring (or no monitoring). Poor monitoring to assess how quickly, or how much water is applied can lead to over-watering.

These factors reduce yield through reduced soil aeration, increased incidence of root diseases and root death from drowning, and will also reduce fruit quality. Plant death may also occur.

Importantly, over-watering also leaches fertiliser out of the root zone. This not only wastes fertiliser (adding unnecessarily to production costs), but also poses a serious environmental hazard, polluting groundwater with excessive amounts of nutrients, which contributes to soil acidification.

Excessive irrigation increases irrigation costs through unnecessary wear and tear on pumps and irrigation equipment.

Establishing a good irrigation system

Getting it right at the start is an efficient way to establish any good irrigation system. The following features need to be considered when establishing irrigation.

Design and layout

Drip systems are highly efficient at delivering water – consulting an irrigation professional early in the design phase may save time and money in the long term. The hydraulic design of a drip system is fairly complex and in order to achieve correct uniform water application a professional design is necessary. Employing professional help at the design phase will ensure that the pump size selected for irrigation delivery is adequate for the existing orchard and for future expansion.

Irrigation systems need to be designed correctly on steep lands so that plants at the bottom of a row are not waterlogged while the plants at the top are still dry.

Blueberry growers in both northern and southern Australia rarely use microjet sprinklers due to the increased humidity created in the crop resulting in a higher incidence of leaf diseases. These sprinklers are generally not recommended for blueberry growing.

Blueberry plants are usually fertilised via the irrigation system with liquid nutrients in a process known as fertigation. There are differences in the layouts of fertigation systems depending on location.

Both northern and southern systems aim to keep the mounds uniformly moist. **If there is only one emitter per plant, it is important that it is not placed near the centre of the crown.** Most of the feeder roots are away from the base of the plants, so placement near the crown will often lead to increases in root diseases such as phytophthora, and will not place water near the feeder roots.

Fig 3. Double irrigation line on woodchip

Fig 4. Single irrigation line suspended on wire in mulch in northern NSW

In NSW, fertigation is achieved via one or two driplines laid on mounds under either plastic mulch or wood chip mulch. This practice creates an added difficulty in growing blueberries as the mounds covered with weedmat are only partially permeable to natural rainfall. As a result, even during high rainfall events growers may still need to irrigate. This approach requires removal and reuse of the drip lines when raised beds are replanted and redeveloped.

In southern states, blueberry growers do not redevelop their farms often or change varieties as frequently so they use a single drip line suspended 30 cm above the beds on a trellis wire to fertigate plants.

Single or multiple irrigation lines?

Some growers use a single irrigation line while others use two. For sandier, well drained soils more frequent irrigation is needed. While raised beds allow for good drainage they also require more frequent irrigation. Using a double drip line in these circumstances (i.e. sandier soils and raised mounds) will help to keep the mound evenly moist. In red Krasnozen soils, often one drip line is sufficient to supply adequate water throughout the year. The drippers are then placed closer to the plants. Obviously the costs of double irrigation lines is greater than single lines but it also acts as insurance against blockages or under-watering with a single line.

The dripper spacing will be determined by the plant spacing. Many in-line drippers are spaced at 40 cm, 50 cm or 60 cm. If two irrigation lines are used, drippers need to be staggered so that the zone between the plants is kept evenly moist.

Growers on steep land should try to incorporate irrigation supply lines within cross-bank drains as secondary mains. This will divide whole irrigation blocks into smaller units and allow for more even uniform water application. Many growers already use pressure reduction devices that fit within the drip line. In the design phase it is far easier and economical to incorporate a secondary main in cross banks to give more even water distribution than putting pressure compensator valves within each of the drip lines. This will lead to both increased yield and larger berry size. Automatic self-flushing devices are also incorporated at the end of irrigation lines to help remove residual water.

Water quality

Blueberry production relies on a source of good quality water all year round for fertigation. To ensure such quality, it is important to test the water quality before initial use and then at regular intervals throughout the life of the orchard. Water quality can be monitored using a pH meter and an electrical conductivity (EC) meter. There are a number of NSW DPI Primefact information sheets dealing with farm water quality and its treatment (see the References section). Dam water quality will vary throughout the season but especially during droughts, when salinity levels may change dramatically.

High levels of naturally occurring chemicals such as iron may need to be removed from the irrigation water by aeration in the dam before use. This will minimise the build up of scum in the drip system which may lead to blockages. Controlling weeds in dams will ensure a maximum storage capacity available for irrigation purposes. Reedbed filter systems above dams will minimise the effects of algal blooms.

If growers are using recirculated water, especially if this water is draining from nearby orchards, chlorination of water prior to use will help to control soil-borne diseases such as phytophthora. Contact your nearest DPI office for chlorine application rates.

Ensure that captured water from the orchard is collected and cleaned by using silt traps before it leaves the property.

Filtration

Filtration will remove physical, chemical and biological materials that may cause blockages in irrigation lines. Pre-treatment of irrigation water may help in some situations. This may include pre-screening to remove twigs and leaves, usually by a strainer on the foot valve.

Never skimp on the cost of filtration systems as it will be more costly in the long term to correct blockages, repair damage to equipment and pay for increased maintenance time. The filtration system should form about 25% of the total costs of the irrigation system. The main filtration system can consist of a multiple plate type or graded sand filters. Ensure that enough filters are installed to allow back-flushing at the same time as the system supplies sufficient clean irrigation water to plants.

If the drip line is laid under plastic weedmat on top of blueberry mounds, it can be difficult to detect blockages. If filtration is inadequate and blockages have occurred often the only way a grower will know this has happened is when plants begin to wilt, but by then it is too late to correct the damage. Therefore preventing blockages is by far the more effective way to address these issues.

Applying effective irrigation

In northern NSW, the lowest rainfall and the greatest evaporation usually occur from August to December. Therefore, peak water demand for blueberries usually occurs in this period. Floral initiation for the following season's crop occurs in February and March. Inadequate irrigation at this critical time will result in wilting and dieback of tender shoots, and will lead to poor fruit set.

In southern Australia, the low rainfall period is usually from November to May. Peak water demand for many of the rabbiteye and highbush varieties is from November to March. During this time, monthly evaporation is greater than rainfall so supplementary irrigation is essential. Blueberries grown in this region display a winter dormancy where water demand is low. It is important to maintain moisture levels after harvest to allow floral initiation for next season's crop before the plant shuts down for winter.

Monitoring irrigation

Another essential requirement for efficient irrigation is a system to tell you how much water is needed and when it is needed by the crop. This is known as a monitoring and scheduling system. A uniform and adequate supply of moisture is essential for optimum growth. Blueberries, as a general rule, require 25–40 mm per week during their growing season. If this is not supplied by natural rainfall then the water must be supplied by irrigation. The demand for water is greatest from the time of fruit expansion until harvest. During the final stages of fruit filling, uniform soil moisture levels must be maintained to stop surges in moisture levels that cause fruit splitting. The importance of monitoring is confirmed by research which shows that water use can be reduced by up to 40% with monitoring, without affecting yield and fruit quality (see Reference *Waterwise: An introduction to irrigation management*). Monitoring ensures that enough water is applied at critical times. Monitoring of water use and water need in blueberries is usually achieved using a combination of soil-based and weather-based monitoring systems.

Soil moisture-based methods

Growers need to rely on soil-based equipment for monitoring soil moisture and scheduling, particularly where plastic mulches are used.

The most common types of soil-based monitoring equipment used are neutron soil probes, gypsum blocks, tensiometers and soil capacitance probes (such as Enviroscan®).the relative advantages and disadvantages of these various systems are shown in Table 2.

Table 2. Comparison of main soil moisture monitoring systems

System	Advantages	Disadvantages
Tensiometers	Relatively inexpensive Easy to install Can be read by growers themselves Monitor continuously	Labour intensive to collect data Require regular maintenance Can be inaccurate in dry soil Less accurate in top 10 cm of soil More difficult in sandy soils – these soils require a special type of tensiometer
Gypsum Blocks	Relatively inexpensive Easy to install Can be read by growers Monitor continuously Maintenance free	Inaccurate at higher tensions Very sensitive to temperature, salinity and high nitrogen fertilisers Have a limited life as gypsum dissolves slowly
Neutron probe	Portable and can be moved around site Very reliable	Not suitable for continuous monitoring Expensive Less accurate in top 10 cm of soil Less accurate in sandy soils
Capacitance probe	Monitor continuously Accurate at all depths and all soils Enables rapid reading and recording of results Very sensitive	Expensive Requires skill in interpreting data Difficult when redeveloping mounds every few years (as is common in northern NSW) Not accurate unless properly calibrated

Tensiometers

A tensiometer consists of four basic parts (see Figure 4):

- a hollow tube filled with water and algaecide
- a ceramic tip
- a water reservoir
- a vacuum gauge or a portable electronic reader which takes up to 50 readings.

In wet soils the vacuum gauge displays between 0 kPa and 5 kPa or centibars of negative pressure. As the soil dries out over several days, water moves from inside the instrument through the ceramic tip outside into the soil. The negative pressure steadily increases up to a maximum of 90 kPa. A wet soil will be in the 5 to 10 kPa range while a reading of 20–30 kPa indicates a need to irrigate on light textured soils. When the soil is rewetted after irrigation or rainfall, water moves from the soil back into the tensiometer and the gauge reading drops.

A minimum of 8 pairs of tensiometers are needed to correctly monitor soil moisture levels within the mounds for a block. However, this depends on the uniformity of the soil in the block and the slope, and on very variable blocks more pairs of tensiometers may be needed.

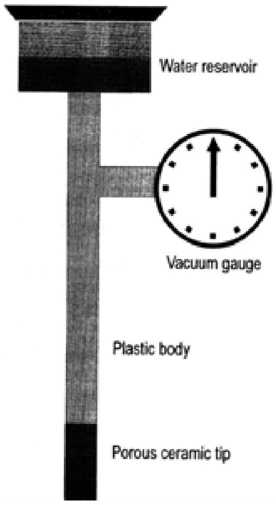


Figure 4. Standard parts of a tensiometer

Each pair of tensiometers should be placed close together in a blueberry mound. One should be placed at a depth of 15 cm, with the other at 30 cm. The deeper tensiometer will indicate if too much water is being applied by staying constantly low. The shallower tensiometer will dry out more quickly and indicates when to irrigate. If water is going past the root system and down into the lower parts of the mound then shorter, more frequent irrigation periods are required.

Figures 5 & 6. Sohan Atwal (blueberry grower from NSW) and Greig Ireland (NSW DPI) monitor tensiometers for irrigation scheduling

Pairs of tensiometers should be located at the top, middle and lower parts of the block. Tensiometers should be placed 15 cm away from trickle tubes and drippers to give a true reading of moisture levels within the mound.

For more information, see *Tensiometer Tips* on the NSW DPI website.

Gypsum blocks

Gypsum blocks measure soil water tension. This tension is a reflection of the force that a plant needs to extract water from the soil.

Each gypsum block has two electrodes embedded in it. Wires are joined onto each electrode and measure the resistance between the electrodes. The resistance between the two electrodes varies with the water content in the gypsum block, which will depend directly on the soil water tension. As the soil dries out, water is extracted from the gypsum block and the resistance increases. Conversely, as the soil wets, water is drawn back into the gypsum block and the resistance decreases. Gypsum blocks are measured either directly with a portable meter or remotely by a sophisticated irrigation controller linked to a computer.

For monitoring soil moisture in blueberries, growers will require at least 8 pairs of gypsum blocks per orchard block. The siting of gypsum blocks within blueberry mounds is very similar to that of tensiometers. Generally two gypsum blocks per site are needed, a shallow one in the root zone at 15 cm depth and another below the root zone at 30 cm. Again this is dependent on the uniformity of soil and the slope. For example, in northern NSW some growers have orchards with slopes of 10°–20°. In these situations, to get meaningful readings moisture probes need to be sited on the top, middle and lower parts of the orchard. As with tensiometers, the shallow block indicates when to water (as it will dry out first) and the deeper block indicates how much to irrigate.

Very little ongoing maintenance is needed with gypsum blocks but they do have a limited life of three to five years as the gypsum gradually dissolves.

Neutron probe

This is a very sophisticated device consisting of a probe containing a neutron source and a detector. A number of access holes are set up in the crop and the probe is brought to these sites at regular intervals during the season. When the probe is lowered into the access holes, neutrons from a radioactive source are emitted into the soil profile. When these fast neutrons collide with hydrogen atoms in water, they slow down dramatically and are deflected back to the detector which responds to slow neutrons only. If the soil is dry, the neutrons do not slow down and are therefore not detected. Readings are taken at various depths to provide an overall view of soil moisture within the profile.

As the probe is expensive, it is generally used only by consultants to monitor soil moisture as a basis for recommendations for watering. Although the neutron probe it is more sensitive than tensiometers, its value is dependent on how regularly the consultant visits and makes readings.

Capacitance probe (Enviroscan®)

This is a continuous moisture monitoring device based on capacitance sensors. Capacitance sensors measure the electric field between two poles. The electric field between the poles is affected by the content of moisture within the soil. Figure 7 shows a diagram of a typical capacitance probe.

The sensors are mounted on probes which have slots every 10 cm to accommodate the snap-in sensors. These probes are then placed within vertical PVC access tubes installed in the soil after the crop is established. The probes and tubes are left in place for the life of the crop. Sensors are positioned on the probes to provide readings at specific depths.

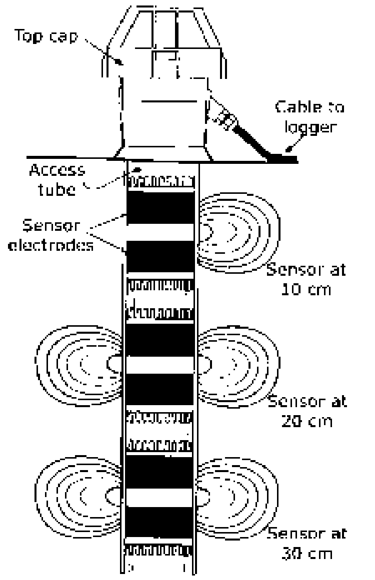


Figure 7. Construction of an Enviroscan® probe

Measurements from sensors are relayed at regular intervals via a cable to a data logger where data is recorded (see Figure 8). The data from the logger is downloaded manually to a computer every day or via mobile phone to a desktop computer to provide recommendations for irrigation scheduling.

For blueberries, a minimum of two probes is recommended for a block of plants. However, the number of sites again depends on the variability in the soil. The first probe should have sensors at 10, 20 and 30 cm while the second should have sensors at 10, 20, 30 and 50 cm (see Figure 9).

Figure 8. Enviroscan graph showing a typical wetting and drying cycle (note that the sensors 1 and 2 at 10 cm and 20 cm are much more active than the deeper sensors).

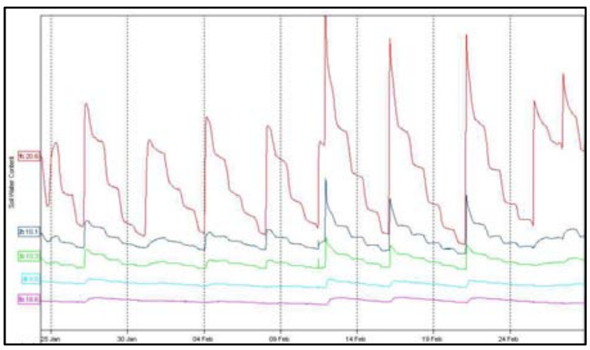


Figure 9. Enviroscan showing electronic sensors at various depths

These should be placed in the middle of the mounds but on different parts of the block to give a good representation of the soil moisture levels in the orchard.

The interpretation of the data requires some technical skill so it is recommended that the consultants who install the system provide at least the initial interpretation and advice.

Weather based monitoring methods

Weather-based monitoring models that use evapotranspiration are a useful tool for blueberry growers to increase awareness of when crop demands are high and when natural rainfall needs to be supplemented.

Weather-based methods of scheduling irrigation rely on growers measuring evaporation from a crop and calculating the amount of water that is still available in the soil root zone (RAW) of the crop.

The RAW values for various soil textures for blueberry plants have not yet been determined under Australian conditions but values in column B of Table 1 are close approximations based on USA data.

Designing an irrigation schedule

There are three main steps in scheduling irrigation.

Step 1. Determine the amount of water held in the root zone (RAW) of a blueberry plant to calculate how much to irrigate.

The best way to determine RAW for your blueberries is to dig some holes and get your hands dirty! The RAW stored within the effective root zone can be calculated by determining each soil texture type and measuring the thickness of each (in metres or parts of a metre), and then multiplying the thickness by the appropriate RAW value. In most cases, there will be only one soil type in a mound, but it is worth checking to make sure (see Table 1 for RAW values for various soil types).

Blueberries that have a well developed root system can exert a moderate to strong tension on the soil. Column B in Table 1 shows the relevant figures to use in calculating RAW values for blueberries. When calculating RAW value, use the effective root zone for blueberries, 0.2–0.3 m (20–30 cm).

For example, in the case of a clay loam soil, the RAW value from Column B is 55 mm. Multiply this by the effective root zone value of 0.2 (m). This gives a value of 11.0 mm (55 mm x 0.2 = 11.0 mm).

This means that 11 mm of water is readily available in the soil for the plant's use. Once this 11 mm of water has been used, then irrigation is required to refill the plant's effective root zone.

Remember that blueberries have only a shallow root zone, and applying more than the moisture holding capacity of a particular soil is wasteful and ineffective.

Step 2. Identify crop factors and the amount of evaporation to determine the amount of plant water use and frequency of irrigation.

You need to know how quickly water in the root zone is used. Knowing the crop factors and evaporation allows you to determine how much water a blueberry plant uses and when to irrigate.

In order to determine plant water use and frequency of irrigation you need to know evaporation figures and the crop factors.

Pan evaporation (Epan)

To determine how much water is lost from the crop we use pan evaporation figures. Pan evaporation is the amount of water lost from a standard Class A pan (see Figure 10). These figures can be obtained from the Bureau of Meteorology website for various locations around Australia (Table 4).

Crop factor

A crop factor is a value that represents plant water usage at a particular stage of growth. When multiplied by the amount of pan evaporation it will indicate the amount of water used by a plant.

For example, if the pan evaporation for a particular location is 10 mm and the crop factor is 0.3, plant water usage is 0.3 x 10 mm = 3 mm. A crop factor of 0.3 means that evaporation from the plant will be 30% of the evaporation that occurs from an open free water surface.

Figure 10. A class A pan measures evaporation

Crop factor figures have not yet been determined for blueberries in Australia but figures from North America can be used as a substitute. Crop factors in the Florida region of USA vary from 0.3 in winter to 0.70 in summer for mature Sharpe blue plants (Hazman 1997).

The crop factor will vary through the year depending on the plants' water demand and the weather conditions. The right crop factor for your orchard will need to be determined through trial and error. Begin with the starting values given in Table 3 and check the soil moisture before irrigation.

Remember!
1 mm applied water = 1 litre per m²

Step 3. Calculate the amount of water to apply based on the information from steps 1 and 2.

Soil moisture monitoring helps to check how much water to apply with each irrigation and when to irrigate. You will need to work out how much water to apply, taking into account that some will be lost through evaporation. The following formula illustrates how to calculate water use for an orchard.

Assume a planting square for blueberries is 1 metre × 1 metre = 1 m² (for ease of calculation)

Plant water use (mm) = blueberry crop factor × pan evaporation (Epan) mm × planting square (m²)

Putting all the steps together

From the example above, for a clay loam soil with an effective root zone of 0.2 m, we know that the RAW in this soil is 11 mm of moisture.

We also know that a blueberry plant in January uses 4.1 litres/day (from the circled figure in Column D in Table 3). Two drippers per plant each deliver 2 litres per hour (4 litres total). Therefore, in January it will take one hour to replace approximately 4 litres of water used by the blueberry plant.

Once the maximum irrigation to apply and the plant water use have been calculated you can then estimate how frequently the orchard or block will need to be irrigated. Since the soil we chose has a RAW of 11.0 mm, we have moisture reserves for less than three days for a blueberry plant using 4.1 litres per day. We therefore need to irrigate every second day to maintain soil and plant moisture levels in this situation in January.

Table 3. Calculating water usage of a mature blueberry plant

Month	Planting square 1×1 (m²) (A)	Crop Factor (B)	*Long-term average daily evaporation (mm/day) for Alstonville (C)	Average daily water use L/day per plant D = A × B × C
Jan	1	0.7	5.8	4.1
Feb	1	0.7	5.0	3.5
March	1	0.5	4.3	2.1
April	1	0.5	3.5	1.7
may	1	0.3	2.7	0.8
June	1	0.3	2.5	0.8
July	1	0.3	2.7	0.8
Aug	1	0.5	3.5	1.7
Sept	1	0.7	4.6	3.2
Oct	1	0.7	5.0	3.5
Nov	1	0.7	5.5	3.9
Dec	1	0.7	6.1	4.3

* Long-term average daily evaporation is taken from Bureau of Meteorology website.

Table 4. Climatic averages in major blueberry regions (mean rainfall and pan evaporation/month)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alstonville												
Mean rain (mm)	178	234	283	196	198	151	91	73	52	108	132	161
Pan evap. (mm)	179	140	133	105	84	75	84	108	138	158	165	189
Coffs Harbour												
Mean rain (mm)	180	215	246	179	167	112	74	78	60	80	129	136
Pan evap. (mm)	202	157	161	123	90	75	112	149	144	174	186	202
Tumbarumba												
Mean rain (mm)	77	56	59	90	92	90	112	118	101	102	77	74
Pan evap. (mm)	198	160	133	66	34	24	28	43	63	65	99	143
Moondarra												
Mean rain (mm)	60	38	96	99	79	88	91	94	102	112	95	87
Pan evap. (mm)	164	146	109	69	50	36	43	56	72	99	117	146

Information supplied by the Bureau of Meteorology.

Note.
Highlighted values in table indicate where evaporation exceeds natural rainfall and supplementary irrigation may be necessary.

Key points for blueberry irrigation

There are many simple steps you can take to improve water use in general to maximise blueberry production, but the key points are:

- Blueberries have a shallow root system 20–30 cm.
- Proper irrigation design is essential in the early phase of orchard development.
- It is important to effectively monitor irrigation to maximise blueberry production.

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