VEGEnotes

Your levy @ work

Irrigation Management

Good irrigation management is vital to achieve efficient use of water combined with high yields and quality in vegetable crops. Irrigation also has a direct influence on factors such as pack out percentage, shelf life and aesthetic or visual appearance of the product.

Irrigation application rate and timing depends on the moisture content in the root zone and the rate of water losses (evapotranspiration) from the plant and soil.

Evaporation + Transpiration = Evapotranspiration (ET)

Soil texture and structure, root depth, crop characteristics and climate are the main factors influencing the amount of water available to the plant.

Therefore, effective irrigation is crucial to eliminating over or underwatering, which can both reduce the yield and cause salinity and waterlogging problems.

Why improve irrigation management?

There are many reasons for improving irrigation management including:

Growing better crops

Providing crops with optimum soil water reduces exposure to periods of waterlogging and dryness, thus maximising crop growth and fruit quality.

Too little water can be as problematic as overwatering. For example, moisture stress in lettuce during head formation can result in tip burn, while in tomatoes blossom end rot will result if the crop is stressed in early fruit set.

Too much water can cause root rot in most vegetables.

Reduce pest and disease problems

Maintaining optimum soil water aids crop performance and health. It can also assist with reducing pest and disease impacts.

For instance, strategic spray irrigation can reduce the effect of downy mildew in onion crops.

Reduce environmental impacts

Avoiding excess irrigation minimises waterlogging, salinity, leaching of nutrients and chemicals, and rising watertables. This preserves local biodiversity, enhances river systems and saves on production costs.

Protect the value of the farm

Salinity, high water-tables and soil degradation reduce productivity and the value of land.

Increase overall crop production

Improved irrigation efficiency may provide surplus irrigation water, which can be used to grow additional crops or sold to other enterprises.

Reduce production costs

Efficient irrigation means applying the right amount of water at the right time. Making sure the crop uses all water applied and avoiding system losses and wastage through run-off or drainage.

Furrow irrigation is best suited to heavier textured soils such as clay loams.

The Bottom line

- Use soil moisture monitoring
- Use an accredited designer for new irrigation systems
- Match irrigation rate with soil infiltration rate
- Ensure good drainage during rainfall
- Conduct a whole farm plan including irrigation infrastructure

To irrigate your crop effectively and profitably you need to know:

Crop Water Requirements - Understanding crop water needs at various stages of development is critical. In carrots, soils that remain too wet at early growth stages can result in damping off, whereas later in the growth cycle hairy roots will result if soil becomes too dry.

Readily available water (RAW) - Plants cannot use all water held in soil. For practical irrigation planning, irrigators must work with the water that is readily removed from the soil by the plant, the *readily available water* (RAW).

RAW is expressed in millimetres per metre (mm/m) and indicates the depth of water (mm) held in every metre (m) of soil, which can be readily used by the plant. RAW can be calculated for the total profile depth, or more usefully just down to the depth of the plant's effective root zone.

To achieve high yields without creating excess drainage you need to know the RAW for each crop and block.

Effective root zone - The area of the plant's root zone where the main mass of roots is found. Encourage root growth below the effective root zone by withholding irrigations early in the season, being careful not to cause stress, so the plant extracts water from a larger volume of soil.

Vegetables vary in root depth. Table 1 is a guide to root depth of selected crops (Allen et al., 1998).

When to irrigate (refill point) - After the RAW has been used, it becomes harder for plant roots to extract water from the soil, referred to as the refill point. The drier the soil, the more water needed to return to field capacity.

Irrigation should occur before the refill point is reached because the plant is already struggling.

Table 1. Root depth guide

Crop	Root Depth (m)
Tomato	0.5 - 1.5
Onion	0.3 - 0.6
Watermelon	0.8 - 1.5
Carrot	0.5 - 1.0
Lettuce	0.3 - 0.5
Broccoli	0.4 - 0.6
Cabbage	0.5 - 0.8

Infiltration rate - Is highly variable, both within and between fields. Soil texture and structure determine infiltration rate. Soils such as sands that have large pore spaces have a high infiltration rate. Water infiltrates a well-structured soil with air spaces and root channels more quickly than a compacted soil.

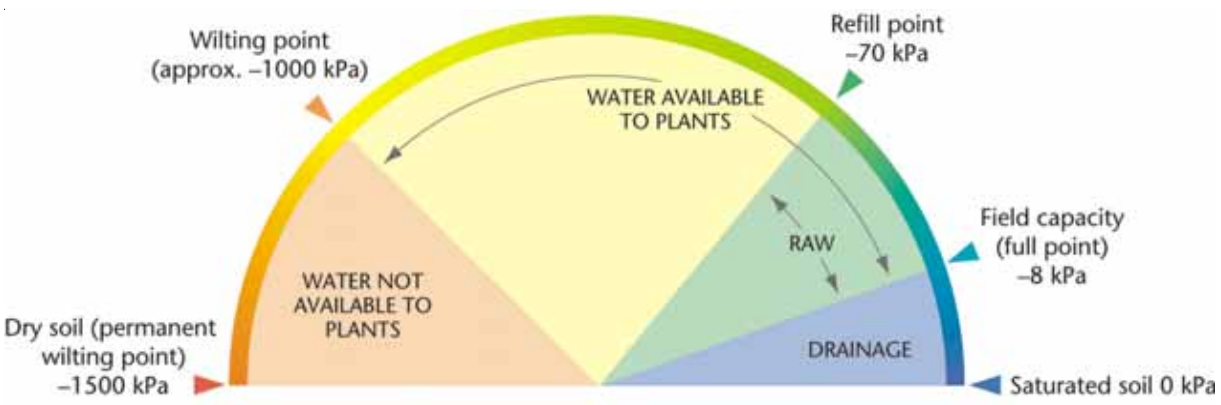
Infiltration can be improved by the following:

- open up the surface or break up crusts, hardpans and hard set layers
- use narrower beds
- add gypsum to sodic soils
- cultivate, core, spike or split to physically break compaction layers
- increase organic matter
- plant a pasture or cereal, such as rye grass or oats, over winter to increase levels of organic matter and allow roots to aerate the soil

Infiltration will be decreased by:

- exposing heavier subsoil during laser levelling
- working the soil when it is too wet
- using excessive cultivation

Figure 1. Different levels of soil moisture



Onions centre pivot - Irrigation application rates that exceed the infiltration rate can damage soil and produce excessive waterlogging and run-off.

Choosing the right irrigation system

It is wise to consider developing a whole farm plan to determine the best irrigation system for your situation.

Other considerations include:

- financial – detailed costing of the work and development stages
- farm management – development of fences and buildings etc
- engineering – sound design in hydraulic terms for automation, pressurised system design, re-use systems and on-farm storage
- environment – effect of surrounding landscape and watertable etc
- agronomy – crop types including rotations, soil types, paddock size and slope

Spray, drip or furrow irrigation?

Overhead spray irrigation is the most common form of irrigation used in vegetable crops in Australia. Spray irrigation:

- may be used on many soil types but is well suited to sandy, well-drained soils
- comes in many forms from fixed sprinklers, travelling guns and booms to centre pivot and linear move irrigators
- can be managed to minimise frost damage
- can be used with other crops in the rotation suited to spray irrigation
- is generally lower cost than drip
- allows more flexibility such as use on soils prone to crusting, regular irrigations to keep the surface soil moisture during plant emergence

Drip irrigation offers:

- better control of crop production
- less weed growth
- reduced risk of diseases such as fruit rots
- less labour (less hand weeding or moving the vines out of the furrow before irrigation)
- better control of the harvest schedule
- lower water use
- less drainage volume
- ability to use fertigation
- suitability to a variety of soils and landscapes

On the down side is the financial and environmental cost of disposing of drip tape, especially single-use tape, and black plastic, used to increase soil water. There is also a demand for better irrigation management, because the root volume is smaller (smaller margin for error).

Uniform wetting patterns of sub-surface drip is essential for even germination of crops.

As drip irrigation is expensive, rotations should comprise mainly high value crops. The other challenge for subsurface drip (buried drip tape) is bringing the water to the surface for crop emergance, while keeping the soil surface dry for the remainder of the season. Drip tape that is too shallow may keep the crown of the plant wet, encouraging disease.

A recent trial conducted by researchers at the Queensland Department of Primary Industries, Gatton, determined a lettuce crop yielding 4,150 cartons/ha could be grown using just 1.8 – 2.2Ml/ha of water (irrigation plus rainfall). This compares to 2.5 – 3 ML/ha budgeted by growers using well managed sprinkler systems.

Furrow irrigation is best suited to deep, moderately permeable soils with a uniform, relatively flat slope. Furrow irrigation:

- requires considerable skill, both in initial land grading and subsequent on-farm water management
- is viable on soils with good infiltration, such as self-mulching grey clays
- requires a good recycling system for efficient irrigation
- is cheaper to establish than drip, and so is suitable for long rotations, for example 1-in-4 years, or for growers who lease land for short periods
- requires little maintenance

Soil Moisture Monitoring

A recent study of irrigation in NSW vegetable crops revealed soil moisture monitoring is the most effective way to accurately meet vegetable crop water requirements.

By monitoring soil moisture, growers get a 'picture' of what is happening below the soil surface where the roots are exploring the soil and obtaining water vital for growth. The results provide information on the soil moisture changes after each irrigation.

There are several soil moisture monitoring devices available, which can be divided into two categories; soil moisture suction measuring (ie. tensiometers) and soil water content measuring (ie. Enviroscan®).

Whichever device is used, it is important to place it in a representative part of the paddock. Use sensors at different depths in the root zone (i.e. 15 and 30cms), in addition to a deep sensor (i.e. 50cms), which can monitor over-irrigation and watertable changes.

If the paddock is variable (ie. varies from clay on the flat rising to a sand hill) more monitoring sites may be required.

Many growers are already working towards better irrigation by taking these steps:

- developing a farm plan
- participating in an irrigation management course
- properly maintaining the irrigation system
- using a professionally designed irrigation system
- developing sound agronomic knowledge
- understanding soil and water relationships
- using soil water monitoring equipment
- determining irrigation and nutrient requirements

Further Reading

- "Best *management guidelines for irrigated vegetable crops*" (2004) M.Hickey et al, NSW Agriculture, Yanco (CD Rom and manuals)
- "*Managing yields and quality of lettuce cultivars*" (2003) Craig Henderson, Queensland Department of Primary Industries, Rural Water Use Efficiency Initiative.
- "*Irrigation scheduling for vegetable crops* : A growers guide" (2003) A.Qassim et al, Department of Natural Resources and Environment, Tatura, Victoria.
- *Crop evapotranspiration: guidelines for computing crop water requirements*" (1998) R.G Allen et al, FAO Irrigation and Drainage paper No 56, Rome
- "*Vegetable SoilPak*" (1998) B. McMullen, NSW Agriculture, Bathurst

Further Information

For further information on irrigation and water related issues in your state, contact your state Vegetable Industry Development Officer.

Acknowledgements

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