

## SUMMARY OF DOMESTIC AVOCADO IRRIGATION PRACTICES SURVEY

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### INTRODUCTION

The aim of this survey was to get a snapshot of current avocado irrigation practices in Australia and to identify issues in irrigation that producers are facing.

This survey is a component of the review of Australian avocado irrigation which is one of three Advanced Management Workshops in the industry extension project 'Avocado industry development and extension' (AV17005). Other components of the review include a comprehensive literature review of avocado irrigation from around the world, a look at the trends in avocado irrigation practices overseas and a summit with leading growers and consultants to debate the results of these investigations and to make recommendations for the industry.

### METHOD

In order to get 'quality not quantity' the survey was not sent to all producers. Instead, to cover the range of growers and levels of experience, producers perceived to be at different skill levels were selected from the eight major production regions of Australia and asked to complete the survey. The goal was to get six respondents comprising two 'advanced', two 'experienced' and two 'new' growers from each of the eight regions. Ideally 48 respondents were sought, in reality 37 growers completed the survey as follows. The response was considered to provide a good representation of industry practices.

Table 1. Survey respondents

| REGION               | ADVANCED | EXPERIENCED | NEW |    |
|----------------------|----------|-------------|-----|----|
| North Qld            | 2        | 2           | 2   | 6  |
| Central Qld          | 5        | -           | 2   | 7  |
| South Qld            | 2        | 2           | 1   | 5  |
| Sunshine Coast       | 1        | -           | 2   | 3  |
| NSW                  | -        | 2           | -   | 2  |
| Tristate             | 1        | 3           | -   | 4  |
| SW Western Australia | 2        | 3           | 2   | 7  |
| Perth & northwards   | 1        | -           | 2   | 3  |
|                      | 14       | 12          | 11  | 37 |

## RESULTS

### Rainfall

- Growers from the Tristate and WA receive most of their rain in winter whilst in the other regions most falls in summer.
- Annual rainfall ranges from 150-250mm amongst Tristate respondents to 800-3000mm on the Sunshine Coast.
- 73% felt that rainfall was changing, in WA 100% of respondents felt it was changing.

### Irrigation as a management issue

Irrigation is considered the top management issue for all regions except SW WA where it takes second place after root rot.

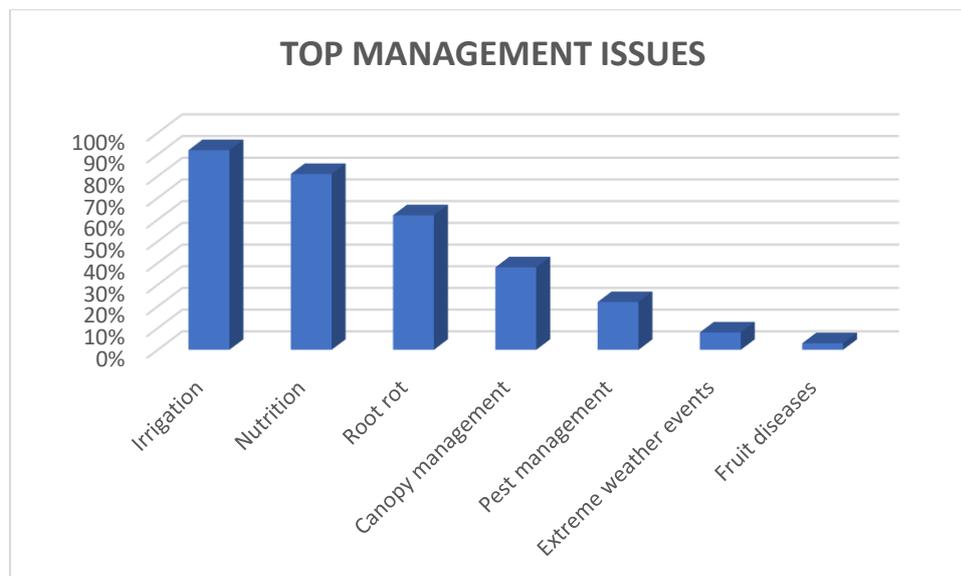


Figure 1.

### Soil types.

- Sandy loams: 35% of orchards
- Clay loams: 35%
- Sands: 16%
- Clays: 8%
- Loams: 5%

**Sources of irrigation water** (note: 46% of growers have more than one source of water):

- Dams 28%
- Irrigation schemes 26%
- Bores 24%
- Creeks 22%

### Depth of irrigation in summer

- Growers irrigate down to just 5cm to as deep as 120cm in summer, most irrigate to somewhere between 20cm and 60cm in depth. There is no clear correlation with soil type, but some of the growers on sands tend to irrigate to shallower depths.

### Time of day irrigated.

- 35% irrigate during the night only, 16% during the day only and 49% irrigate both at night and day.

### **Irrigation of sick or replant trees**

- 76% irrigate sick trees and replants differently from the other trees in the block. Those who don't said that it was too difficult to treat them differently, one said that the soil (a sand) was so well drained that it didn't matter.
- Methods used to irrigate these trees differently include:
  - Installing smaller sprinklers (3)
  - Cutting off water altogether (2)
  - Reducing the number of drippers
  - Reducing the number of sprinklers per tree

### **Use of consultants or experts**

- 46% use the services of a consultant or other expert to assist with irrigation decisions.

### **Automatic weather stations**

- 32% have automatic weather stations.

### **Water quality**

- 27% report issues with irrigation water quality. Every region except NQ and NSW are affected.
- Water conductivity ranges from 350 – 1560 microS/cm (current guideline is to use water with less than 600 microS/cm).
- The worst conductivity was found in the Perth region followed by Central Qld.
- Few growers were able to quote chloride levels, but these ranged from 67 – 210 mg/kg (current guideline is to use water with less than 80 mg/kg chloride).
- The worst areas for chloride were both regions of WA.

### **Flushing irrigations**

- Some growers interpreted this question to mean line flushing rather than flushing the salt out of the soil. Amongst those who understood the intention of this question approximately 32% use irrigations from time to time to flush salts from the root zone.

### **Readily Available Water (RAW) (mm of water that a plant can easily extract from its root zone)**

- Few were able to answer this question, but quoted levels ranged from 5 – 18mm. This is a concept not yet in common use.

### **Infiltration rate**

- Only three answered this question. Answers ranged from 1.2 – 25 mm/hour.

### **Mounds**

- 41% of growers have their trees planted on mounds/ridges. All growers in CQ used mounds whilst no respondents from the Tristate (expected) or Sunshine Coast (surprisingly) use them. Apart from the semi-arid region of Tristate, the relatively low % of growers using mounds is surprising given the widespread issue of Phytophthora root rot in Australia.

### **Mulch**

- 86% of growers reported using mulch, this is common across all production regions.

### **Tree density**

- Ranged from 83 – 417 trees/ha.

## **Fertigation**

- 89% of growers use fertigation.

## **Annual volume of irrigation applied**

This ranges from 1.5 (Sunshine Coast) to 18 ML/ha/yr (Perth). Low values corresponded to high rainfall areas, young orchards or limited water supply.

- NQ: 2.5 to 9 ML/ha/yr
- CQ: 4 to 15 ML/ha/yr (young to established trees respectively)
- SQ: 1.5 to 8 ML/ha/yr (most of respondents have very limited water supplies)
- S'shine Coast: 3 ML/ha/yr
- NSW: 8 ML/ha/yr
- Tristate: 10 to 13 ML/ha/yr
- SW WA: 4.3 to 17 ML/ha/yr (young to established trees respectively)
- Perth: 18 ML/ha/yr

## **Mini-sprinkler or drip irrigation**

- 92% currently use mini-sprinklers (several are experimenting with or changing to drip)

## **Number of sprinklers per tree**

- One sprinkler per tree: 65%
- Two sprinklers per tree: 32% (using multiple sprinklers give a larger wetted area)
- Three sprinklers per tree: 3%

## **Sprinkler rates**

- Excluding the one orchard that uses Mamkad ball drive sprinklers (260 L/hr) and a newly planted orchard (20 L/hr), individual sprinkler rates averaged between 62 – 123 L/ hr.
- When multiple sprinklers per tree were considered, the rates of water delivered per tree ranged from 83 – 209 L/ hr, with the highest rates in the Tristate and lowest in SW WA.

## **Proportion of orchard floor wetted when mini sprinklers are used**

- For mature orchards the proportion ranged from 35% to 100%, averaging about 64%.
- The Tristate stands out as having the largest proportion of the orchard floor wetted, averaging 89%, followed by SW WA with 72%. (Some growers in the Tristate like to irrigate the interrow to maintain a living grass sward to reduce temperatures in heat waves).

## **Drip irrigation**

- Only three respondents use drip irrigation, however, as the 'Changes being considered' question reveals later, 22% of growers are considering moving to drip irrigation or at least trying it
- Drip lines per tree row ranged from 1 to 3, the former where water is in very short supply.
- Irrigation delivery per tree/hr ranged from 18 – 50 L/hr.
- The trend to use lower rate emitters has not yet been adopted by two of the three users.

## **Solenoids**

- 76% of growers use automatic solenoids for switching irrigation on and off.

## **Remote controlled irrigation systems**

- 46% of growers are able to control their irrigation remotely.

### **Frequency of testing uniformity of irrigation systems**

- More than once per year: 27% of growers
- Annually: 40%
- Seldom: 22%
- Never: 11%

No correlation with grower experience levels.

### **Weather events monitored to help make irrigation decisions**

- Rainfall: 92% of growers
- Temperature: 92%
- Evaporation: 57%
- Wind: 57%
- Humidity: 46%

### **Factors on which irrigation decisions are based**

- Soil moisture: 97% of growers
- Tree appearance: 51%
- Stage of growth cycle: 43%
- Evaporation: 35%
- Calendar schedule: 27%
- Dendrometers: 14%

### **Soil moisture monitoring methods used**

- Dig and feel soil: 57% of growers
- Capacitance probes: 51%
- Tensiometers: 41%
- Gypsum blocks: 24%

41% of growers use two of these methods, 14% use three methods and 3% use all four. Thus 58% of growers employ more than one method.

**The primary soil moisture monitoring method used when more than one is employed** (also see pp 12)

- Capacitance probes: 45% of growers
- Dig and feel soil: 27%
- Tensiometers: 23%
- Gypsum blocks: 5%

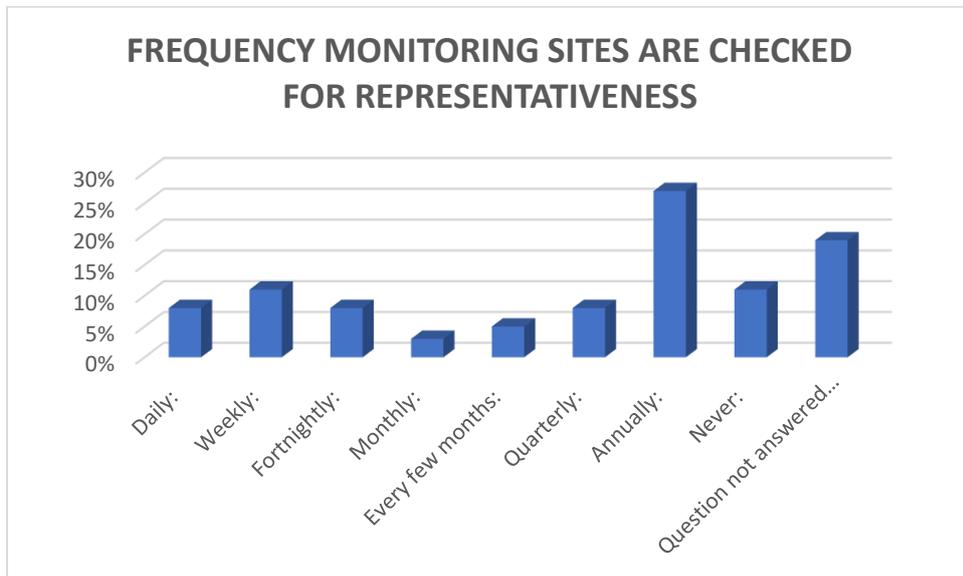
### **Shallow tensiometer reading that triggers irrigation**

- Ranged from 5cB (in Perth sands) to 40cB (in a sandy loam in South Qld)
- Most fell within the 15 to 20cB range

### **How the soil moisture monitoring system is read**

- Manually in the field: 53%
- Remotely and automatically: 39%
- Remotely: 8%

**How often a soil moisture monitoring station is checked to see if it is still representative of the trees it represents (also see pp 12)**



**Number of trees represented by a single soil moisture monitoring station**

Ranges between 130 to 15,000 trees per station (the latter in very uniform orchard conditions). Most fell in the range of 300 – 2,000 trees per station.

**Use of dendrometers**

- Currently used by 4 growers (11% of respondents)

**Frequency of reading soil monitoring devices during peak demand**

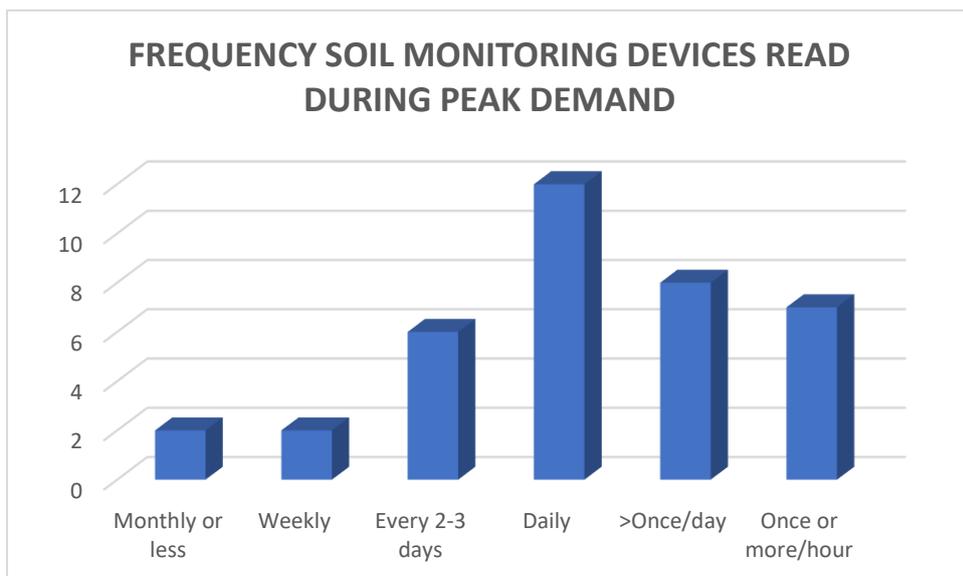


Figure 2

**Stage within the growth cycle that growers report extra water is used that is not in proportion to the evaporation rates**

During flowering & fruitset x8

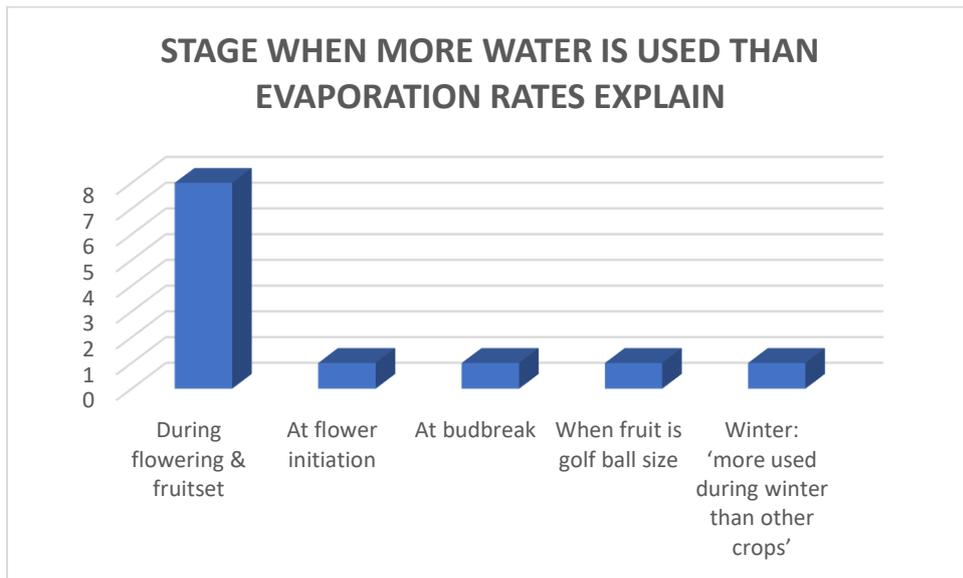
At flower initiation x1

At budbreak x1

When fruit is golf ball size x1

Winter: 'more used during winter than other crops' x1

In other words for example, eight growers report more water being used by the tree during flowering and fruitset than can be explained by a change in evaporation rates.



**Times that growers consider to be critical to irrigate**

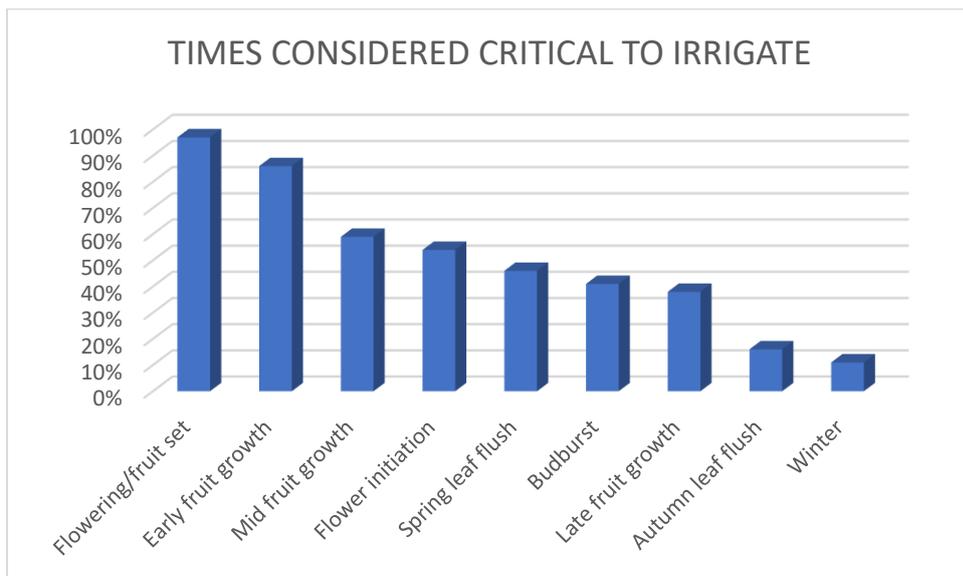


Figure 3

## Irrigation management challenges

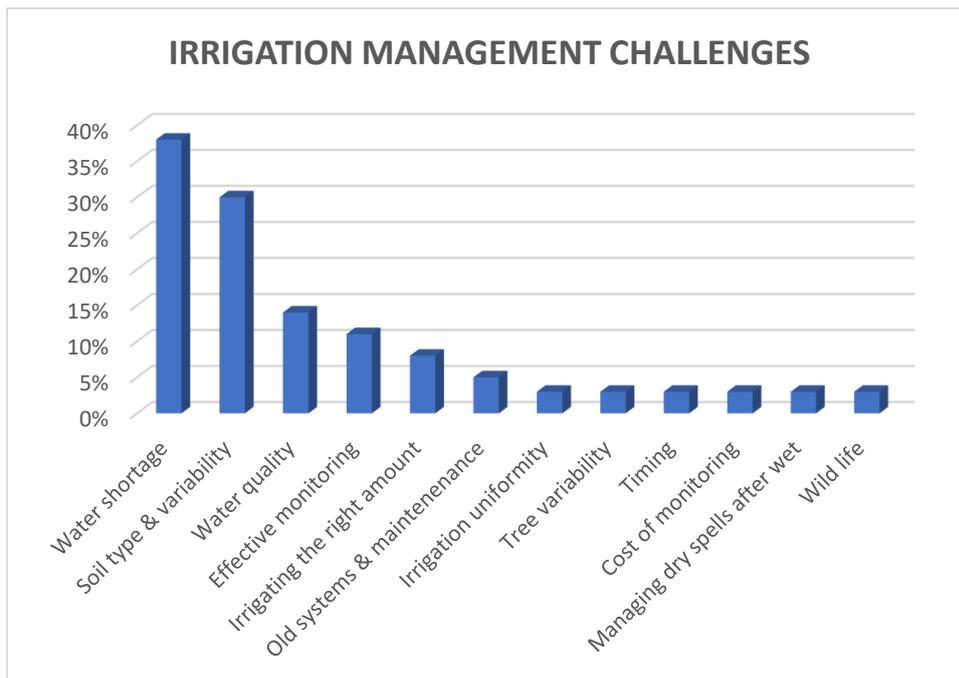


Figure 4

## Information, training, research, resource or technology that would lead to better irrigation decisions

- 11 votes: Soil moisture monitoring – better value, training, automation
- 7: Find out the most important stage(s) of growth cycle that trees need water
- 3: Better ways of monitoring tree
- 3: Use of remote sensing for sensing moisture status
- 3: Managing water quality especially chloride
- 3: Refill points of different soils
- 2: Information exchange and training
- 1: Movement of water and nutrients in tree
- 1: Subsurface drippers
- 1: Better water supply e.g. govt schemes
- 1: Better evaporation forecasts
- 1: Overcoming over irrigation
- 1: Affordable consultants for smaller growers

### Things you need to get right to irrigate effectively

- 13 votes: Scheduling application rates & intervals
- 10: Monitoring sites: well sited, monitored frequently (up to 3/times/day in peak period) & interpreted correctly
- 9: Timing for water and nutrient uptake
- 8: Good coverage of root zone, uniform distribution over wetted pattern
- 7: Checking sprinklers, system maintenance
- 5: Account for different soil types
- 5: Monitor weather, calculate evapotranspiration (evaporation & crop factor for stage)
- 4: System capacity
- 3: Suitable irrigation system design
- 2: Sufficient water for trees and salt flushing
- 2: Balancing soil moisture and soil aeration
- 1: Hand check soil moisture
- 1: Avoid tree stress
- 1: Responsible use of water resource
- 1: Automation

### Changes being considered

- 8 votes (22% of respondents): Trialling or moving to a drip system (one of them plans to install a dual drip/mini-sprinkler system)
- 5: More automation (of monitoring and/or irrigation), one planning for an automated fail-safe system. Another grower plans to introduce 'more technology'.
- 5: Planning to instal more monitoring devices (soil and plant) and paying more attention to the information they provide.
- 1: Overhead misting system for cooling
- 1: Install a booster pump
- 1: 'Using what we've got better'

### Irrigation philosophy

#### *NQ*

##### Advanced growers

- Irrigate often and wet up in advance of the critical times or before dry weather conditions.
- We were irrigating on demand but are re-looking at our whole irrigation scheduling.

##### Experienced growers

- Always get the timing right.
- Maintain the system. Auger soil. Irrigate often in small amounts while still maintaining uniformity.

##### New growers

- Irrigation is the number one priority.
- What it needs when it needs it.

#### *CQ*

##### Advanced growers

- Irrigation is the most important job on the farm... schedule water to soil type and apply what is needed when it is needed.

- Listen to the trees, listen to the soil. Watch the weather. Slow down the water to slightly stress the trees in winter to switch them over to a reproductive state, watch over the flowering fruit set stage, plenty of water then. The rest of the year is small amounts often and the weekly deep water.
- To keep the tree as happy as you can with moisture and grow as many roots as you can.
- Working towards accurate irrigation & fertigation.

#### New growers

- Use the auger and look for yourself.
- Maintain optimum moisture for the season.

### *SQ*

#### Advanced growers

- Keep topsoil moist.
- Keep soil water tension between 10 and 30 cB (30cm tensiometer) from panicle emergence to the 2nd fruit drop in December, and between 10 and 40cB the rest of the year. Try to keep the 60 cm tensiometer between 10 and 50 cB throughout the year.

#### Experienced growers

- Monitor & irrigate accordingly.

#### New grower

- Water is my greatest limitation; more water means more yield; I water whenever possible but maintain heavy inspections on bore water depth; I try to target the equivalent rainfall of 25 mm per week.

### *SC*

#### Advanced grower

- Keep the orchard moist, not over wet.

#### New growers

- Wish it would rain more. Work with what we got. Mulch. Tall grass in summer to reduce soil evaporation and over all tree temperature.
- Supplement rainfall because limited water supply especially in drought

### *NSW*

#### Experienced grower

- Regular irrigation - enough to wet root zone.

### *Tristate*

#### Advanced grower

- Do our best to meet the tree demands.

#### Experienced growers

- Keep trees healthy and stress free.
- Don't hold back.
- Try and provide enough water to keep the trees happy to give max production.

### *SW WA*

#### Advanced growers

- Get out in the field, don't rely on your phone to tell you when to water, make it a priority, don't water the same time each day as they don't require the same each day and simple methods are best.
- Irrigate to crop demand which is based off calculated evapotranspiration and crop factors. Monitor moisture probes (tensiometers and capacitance) regularly and feel the dirt regularly during peak irrigation periods.

#### Experienced growers

- Provide the best growing conditions for the trees combined with responsible use of the water resource.
- Unless it has rained, don't postpone or delay a scheduled irrigation cycle - the rain may not happen; get soil moisture levels topped right up before a hot/dry weather event (its too difficult to play catch-up); and finally, try to get it right.
- Don't get caught out by forgetting to check the monitoring devices.

#### New growers

- Check pipes and sprinklers every time.
- To run an efficient irrigation system which is based on the plant's needs, weather & soil conditions that avoids unnecessary overwatering and wastage of this commodity

#### *Perth WA*

##### Experienced grower

- Maximise water use efficiency in terms of productivity

##### New growers

- Correct balance on a weekly basis.
- Monitor daily in summer.

#### **Other comments**

- Benchmarking of water use by region would be useful to help improve overall industry yield
- Good irrigation = good fruit quality
- Government interest & support for water security for agriculture.
- To a great extent, irrigation design and scheduling should fit the soil water quality and climate (drip vs micro-sprinkler) of the farm. There is no one rule for all situations.
- Managing water in high rainfall area is only challenging in extended dry periods.
- Keep trees healthy and stress free.
- Provide enough water to keep the trees happy to give maximum production
- Meet tree demands
- Don't hold back.
- Mulch is a great buffer/blanket that can help iron out climatic effects on soil moisture levels.
- There is still an enormous amount of understanding to be done in terms of watering to climate and the ratio of water use by tree.

#### **DIFFERENCES BETWEEN ADVANCED, EXPERIENCED AND NEW GROWERS**

There were few standout differences between the three different grower experience levels. The following are those where some contrasts were apparent.

## Use of consultants

71% of 'Advanced' growers use a consultant or irrigation expert, whilst only 33% of 'Experienced' growers and 27% of 'New' growers use them. This is interesting because despite their greater knowledge and experience, it suggests that 'Advanced' growers consider it worthwhile to seek further advice and expertise on the subject of irrigation.

## Basis for making irrigation decisions

In this question growers were asked to identify which of the following are used to make irrigation decisions: calendar schedule, soil moisture monitoring, stage of growth cycle, evaporation, tree appearance, and dendrometers.

On average, 'Advanced' growers used 2.5 different items, 'Experienced' growers 3.1 and 'New' growers 2.

## Different soil moisture monitoring devices used

There is equal use of tensiometers across growers at all levels. The highest proportion of capacitance probe use and lowest use of gypsum block devices is amongst 'Advanced' growers.

|                           | Advanced growers | Experienced growers | New growers |
|---------------------------|------------------|---------------------|-------------|
| Tensiometer               | 26%              | 25%                 | 24%         |
| Capacitance probe         | 37%              | 25%                 | 18%         |
| Gypsum block (e.g. G dot) | 7%               | 25%                 | 12%         |
| Dig & feel soil           | 30%              | 25%                 | 47%         |

## Frequency of reading soil moisture monitoring devices

In general, 'Advanced' growers tend to read devices more frequently.

| Frequency of observations | Advanced growers | Experienced growers | New growers |
|---------------------------|------------------|---------------------|-------------|
| At least daily            | 79%              | 58%                 | 82%         |
| Several times per day     | 57%              | 17%                 | 45%         |
| At least hourly           | 29%              | 17%                 | 9%          |

## ACKNOWLEDGEMENTS

The project team would like to sincerely thank the 37 growers who generously gave their time to complete the survey. The information has provided the project team and the industry valuable insights into the current practices and issues amongst avocado irrigators in Australia. It will be used to provide direction for developing and promoting advances in avocado irrigation in Australia.

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