

RESULTS FROM DOMESTIC IRRIGATION PRACTICES SURVEY (part of the irrigation review in AV17005)

Simon Newett, March 2021

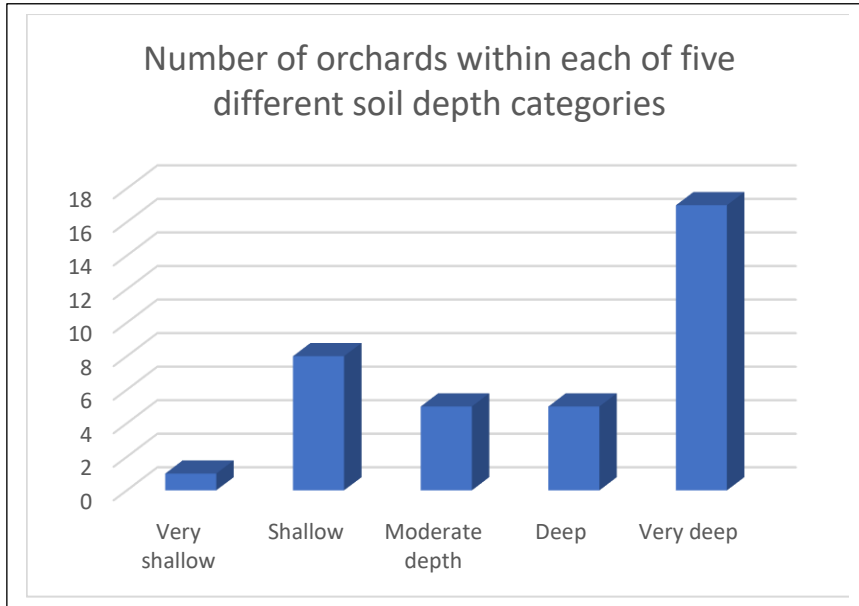
Table 1

REGION	GROWERS	ADVANCED/ EXPERIENCED/ BEGINNERS	RAIN/YR (mm)	MAIN RAINY SEASON	BELIEVE THAT RAINFALL IS CHANGING?	WATER SOURCE: BORE/CREEK/ DAM/SCHEME	IRRIGATION DEPTH IN SUMMER (cm)	TIME OF DAY IRRIGATED? Night/Day/Both	REPLANTS OR SICK TREES IRRIGATED SEPARATELY? ¹	USE CONSULTANT OR EXPERT ADVICE?
NQ	6	2 / 2 / 2	600-1500	Summer	3Y 3N	2B /2C /1D /3S	30-60	5N 0D 1B	6Y	3Y 3N
CQ	7	5 / - / 2	325-1200	Summer	5Y 2N	1B/1C /3D /5S	30-70	3N 0D 4B	6Y 1N	6Y 1N
SQ	5	2 / 2 / 1	200-1155	Summer	4Y 1N	4B /4C /3D /2S	20-60	2N 2D 1B	2Y 3N	2Y 3N
SC	3	1 / - / 2	800-3000	Summer	2Y 1N	0B /2C /2D /0S	20-50	0N 2D 2B	1Y 2N	1Y 2N
NSW	2	- / 2 / -	750-1300	Summer	1Y 1N	0B /2C /1D /0S	20-60	1N 0D 1B	1Y 1N	0Y 2N
Tristate	4	1 / 3 / -	150-250	Winter	3Y 1N	0B /0C /0D /4S	30-60	0N 0D 4B	2Y 2N	1Y 3N
SW WA	7	2 / 3 / 2	550-1100	Winter	7Y	2B /5C /2D /0S	5-120	1N 3D 3B	7Y	3Y 4N
Perth WA	3	1 / - / 2	500-800	Winter	2Y 1N	3B /0C /0D / 0S	20-70	1N 0D 2B	1Y 2N	1Y 2N
	37	14/12/11	150-3000		27Y 10N	13B /12C /15D /14S	5-120	13N 6D 18B	28Y 9N	17Y 20N
					73% Y				76% Y	46% Y

Table 2

REGION	GROWERS	USE AUTOMATIC WEATHER STATIONS?	SOIL TYPE Clay Clayloam Loam Sandyloam Sand	WATER QUALITY ISSUE?	WATER CONDUCTIVITY (microS/cm) Recommended <600microS/cm	USE SALT FLUSHING IRRIGAT'N?	CHLORIDE (PPM) Recommended <80mg/kg (only 4 responses)	R.A.W. ² mm (only 6 responses)	INFILTRAT'N RATE mm/hr (only 3 responses)
NQ	6	3Y 3N	1C 4CL 1S	6N		-			
CQ	7	2Y 5N	1C 3CL 1L 2SL	4Y 3N 57%	300-1000	3Y 4N 43%			
SQ	5	3Y 2N	2CL 1L 2SL	1Y 4N 20%	720	-		5-15	
SC	3	1Y 2N	2CL 1SL	1Y 2N 33%		-			
NSW	2	1Y 1N	1C 1SL	2N		-			1.2 – 6.5
Tristate	4	4N	3SL 1S	1Y 3N 25%	400-550	3Y 1N 75%		8	
SW WA	7	1Y 6N	2CL 3SL 2S	2Y 5N 29%	350-725	4Y 3N 57%	67-196	5-18	
Perth WA	3	1Y 2N	1SL 2S	1Y 2N	780-1560	2Y 1N 33%	120-210	10	25
	37	12Y 25N	3C 13CL 2L 13SL 6S	10Y 27N	300 - 1560	12Y 25N	67–210mg/kg	5-18mm	1-25mm/hr
				27% Y		32% Y			

Table 3



DEPTH OF WELL DRAINED SOIL (cm)

	Very shallow <40cm	Shallow 41-75cm	Moderate depth 76-100cm	Deep 101-150cm	Very deep >150cm
NQ		3			3
CQ	1	3		1	2
SQ				2	3
SC					3
NSW					2
TRISTATE			2	2	
SW WA		2	3		2
Perth WA			1		2
TOTAL	1	8	5	5	17

Table 4

REGION	GROWERS	TREES PLANTED ON MOUNDS?	TREES MULCHED?	TREE DENSITY PER HA	FERTIGATE?	TYPICAL VOL IRRIGATION APPLIED ML/ha/yr	MINISPKLR OR DRIP?	SPRINKL'S PER TREE	SPRINKLR EMITTER RATE (litres/hr)	RATE/TREE/HR (litres)	APPROX % OF ORCHARD FLOOR WETTED (by mini spkls in mature orchards)
NQ	6	2Y 4N	5Y 1N	83 - 237	6Y	2.5 - 9	6MS	6x1	80-260 ³	80-260 ³	57% (35-86%)
CQ	7	7Y	6Y 1N	159 - 278	7Y	4 - 15	6MS 1D	2x1 4x2	37-90	70-140	58% (46-77%)
SQ	5	5N	4Y 1N	83 - 200	4Y 1N	1.5 - 8	5MS	2x1 2x2 1x3	60-95	95-222	56% (36-67%)
SC	3	1Y 2N	3Y	202 - 400	2Y 1N	3	2MS 1D	2x1	100-145	100-145	100% (only one)
NSW	2	1Y 1N	2Y	208	1Y 1N	8	2MS	2x1	70-120	70-120	59% (59%)
Tristate	4	4N	4Y	250 - 417	4Y	10 - 13	3MS 1D	1x1 2x2	76-150	76-150	89% (83-100%)
SW WA	7	3Y 4N	5Y 2N	167-357	6Y 1N	4.3 - 17	7MS	3x1 3x2	20-90	40-180	72% (50-100%)
Perth WA	3	1Y 2N	3Y	250-408	3Y	18	3MS	2x1 1x2	74-100	95-148	51%
	37	15Y 22N	32Y 5N	83 - 417	33Y 4N	1.5 – 18 ML	34MS 3D	24x1 12x2 1x3	20 - 260	40-260	35 to 100%
		41%	86%		89%			65% 32% 3%			64%

Table 5

REGION	GROWERS	DRIPPER ARRANGEMENT				AUTOMATED SOLENOIDS?	SYSTEM CAN BE CONTROLLED REMOTELY?	IRRIGATION UNIFORMITY TESTING Frequent (more than once per year) Annual Seldom Never
		DRIPLINES PER TREE ROW	EMITTER INTERVAL (cm)	RATE PER EMITTER (L/hr)	RATE /TREE (L/hr)			
NQ	6					5Y 1N	3Y 3N	5A 1S
CQ	7	3	50cm	0.5	18	4Y 3N	3Y 3N	2F 3A 1S 1N
SQ	5					4Y 1N	5N	1F 3A 1S
SC	3	1	50cm	4	40	1Y 2N	3N	2F 1S
NSW	2					1Y 1N	1Y 1N	1A 1N
Tristate	4	3	75cm	2.5	50	4Y	4Y	1A 2S 1N
SW WA	7					6Y 1N	3Y 4N	5F 1A 1S
Perth WA	3					3Y	3Y	1A 1S 1N
	37					28Y 9N	17Y 19N	10F 15A 8S 4N
						76%	46%	27% Frequently 40% Annually 22% Seldom 11% Never

Table 6

REGION	GROWERS	WEATHER EVENTS MONITORED TO HELP MAKE IRRIGATION DECISIONS	DECISIONS TO IRRIGATE BASED ON Calendar schedule Soil moisture monitoring Growth cycle stage Evaporation or evapotranspiration Tree appearance Dendrometers
NQ	6	Rain 6 Evap 5 Temp 5 Humidity 2 Wind 2	2C 5S 4Gr 1Ev 2T
CQ	7	Rain 6 Evap 4 Temp 7 Humidity 5 Wind 1	2C 7S 3Gr 2Ev 3T 2D
SQ	5	Rain 5 Evap 1 Temp 4 Humidity 2 Wind 3	2C 5S 2Gr 1Ev 3T 1D
SC	3	Rain 2 Evap 0 Temp 3 Humidity 1 Wind 2	3S 1Gr 1Ev 1T
NSW	2	Rain 2 Evap 1 Temp 2 Humidity 0 Wind 2	2S 1Gr 1T
Tristate	4	Rain 3 Evap 4 Temp 3 Humidity 1 Wind 2	2C 4S 4Ev 2T 1D
SW WA	7	Rain 7 Evap 3 Temp 7 Humidity 3 Wind 7	2C 7S 3Gr 3Ev 4T 1D
Perth WA	3	Rain 3 Evap 3 Temp 3 Humidity 3 Wind 2	3S 2Gr 1Ev 2T
	37	RAIN 92% EVAP 57% TEMP 92% HUMIDITY 46% WIND 57%	27% CAL 97% SOIL 43% GR CYCLE 35% EVAP 51% TREE 14% DENDRO

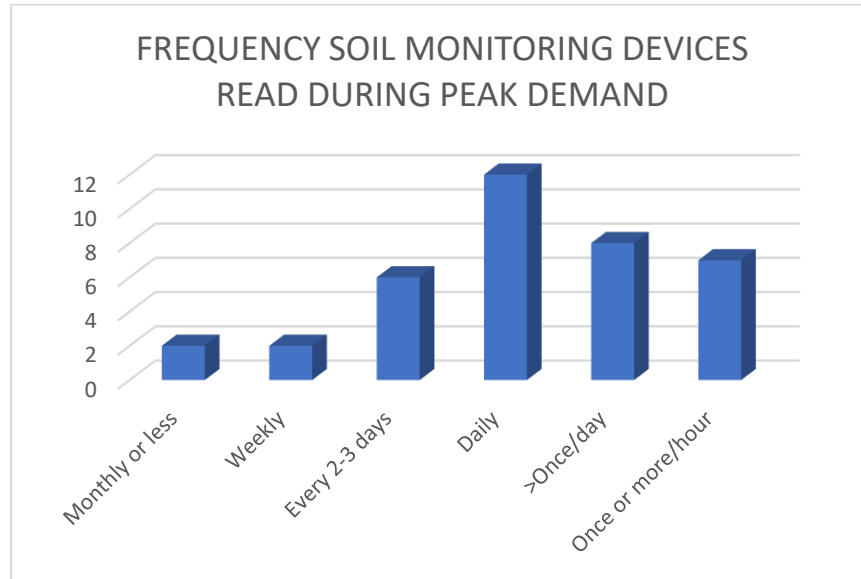
Table 7

REGION	GROWERS	SOIL MOISTURE MONITORING DEVICES USED					SHALLOW TENSIO-METER READING THAT TRIGGERS IRRIGATION	HOW IS SOIL MONITORING DEVICE READ? Manually in field Remotely Remotely & Automatically	
		TENSIO-METER T	CAPACITANCE PROBES C	GYPSUM BLOCKS G	DIG & FEEL SOIL S	<i>Number of growers that use 2 or more of these methods⁴</i>			Primary method used if >1 method used
NQ	6	2	3	2	5	4	1T 1C 2S	20cB	3M 3RA
CQ	7	1	5	2	5	6	1T 4C 1S	25cB	2M 5RA
SQ	5	3	1	1	2	2	1T 1S	15 - 40cB	4M 1R
SC	3	1	1		1	1	1S		1M 1R 1n/a
NSW	2			1		0		20cB	2M
Tristate	4	1	4	2	3	3	3C	20cB	1M 1R 2RA
SW WA	7	4	2	1	4	3	2T 1G 1S	5 - 15cB	5M 2RA
Perth WA	3	2	2		1	2	2C	5 - 10cB	1M 2RA
TOTALS		15	19	9	21	21	5T 10C 1G 6S	5 - 40cB	19M 3R 14RA 1n/a
	37	41%	51%	24%	57%	57%	23% 45% 5% 27%		53% M 8% R 39% R&A

Table 8

REGION	GROWERS	NUMBER OF TREES REPRESENTED BY A SINGLE SOIL MONITORING STATION	FREQUENCY OF CHECKING THAT MONITORING SITES ARE REPRESENTATIVE OF BLOCK		DENDRO-METERS USED?	STAGE WHEN THERE IS EXTRA USE OF WATER NOT EXPLAINED BY EVAPORATION RATE
			Never Annually Quarterly MM every few months ? not answered	Monthly Fortnightly Weekly Daily n/a		
NQ	6	700 - 2,000	1N 3A	1W 1n/a	1	Flower initiation, flowering, when fruit reach golf ball size
CQ	7	300 - 1,500	1N 1A 1Q 1MM 1FT 1D 1?		2	
SQ	5	130 - 500	1N 1A	1W 1D 1?		Bud break, 2x flowering, 2x fruitset
SC	3	400 - 500	1MM	2?		
NSW	2	300	1A 1M			
Tristate	4	200 - 1,500	1N 2A	1FT	1	More in winter than other crops. Flowering
SW WA	7	300 - 15,000	2A 1Q	1FT 1W 1D 1?		2x Flowering
Perth WA	3	2,000	1Q	1W 1?		
	37	130 - 15,000	4N 10A 3Q 2MM 1M 3FT 4W 3D 1n/a 6?		4	Flowering and fruitset x 8, Flower initiation x 1, budbreak x 1, fruit golf ball size x1, more used in winter than other crops x1

Table 9



FREQUENCY SOIL MONITORING DEVICES READ DURING PEAK DEMAND

	Monthly or less	Weekly	Every 2-3 days	Daily	>Once/day	1 or more/hour
NQ	1		2	1		2
CQ			1	3	2	1
SQ			2	2	1	
SC			1	2		
NSW		1		1		
TRISTATE		1		1		2
SW WA	1			2	3	1
Perth WA					2	1
TOTAL	2	2	6	12	8	7

Table 10

REGION	GROWERS	WHAT CONSIDERED MOST CRITICAL TIME OF THE CYCLE TO IRRIGATE (arranged in the order of the cycle)								
		FLOWER INITIATION	WINTER	BUDBURST	FLOWERING /FRUITSET	SPRING LEAF FLUSH	EARLY FRUIT GROWTH	MID FRUIT GROWTH	LATE FRUIT GROWTH	AUTUMN LEAF FLUSH
NQ	6	5	1	3	6	3	6	4	3	1
CQ	7	3		2	7	3	6	6	4	1
SQ	5	3		3	5	2	5	2	1	
SC	3	2	1	2	2	2	3	2	2	1
NSW	2	1		1	2	1	2	1		
Tristate	4	1	2	1	4	1	2	2	1	2
SW WA	7	3		2	7	3	6	4	2	
Perth WA	3	2		1	3	2	2	1	1	1
TOTALS		20	4	15	36	17	32	22	14	6
	37	54%	11%	41%	97%	46%	86%	59%	38%	16%

Table 11

REGION	GROWERS	TOP THREE MANAGEMENT ISSUES						
		IRRIGATION	NUTRITION	PHYTOPHTHORA ROOT ROT	CANOPY MANAGEMENT	PEST MANAGEMENT	EXTREME WEATHER EVENTS	FRUIT DISEASES
NQ	6	6	5	4	0	3	0	0
CQ	7	7	7	4	4	3	0	0
SQ	5	5	4	3	1	1	1	0
SC	3	2	2	1	2	0	0	0
NSW	2	2	2	1	0	1	0	0
Tristate	4	4	4	1	2	0	1	0
SW WA	7	6	5	7	3	0	0	0
Perth WA	3	2	1	2	2	0	1	1
TOTALS		34	30	23	14	8	3	1
	37	92%	81%	62%	38%	22%	8%	3%

Table 12

REGION	GROWERS	BIGGEST IRRIGATION MANAGEMENT CHALLENGES							
		WATER SHORTAGE	SOIL VARIABILITY & SOIL TYPE	POOR WATER QUALITY	EFFECTIVE MONITORING	GETTING THE RIGHT AMOUNT OF WATER ON	OLD IRRIGATION SYSTEM & MAINTENANCE	IRRIGATION UNIFORMITY	OTHER
NQ	6	2				1	1	1	
CQ	7	2	3	1	2				
SQ	5	4	1						
SC	3	2				1			Wild life e.g. deer Managing dry spells after extended wet periods
NSW	2	1	1						Timing
Tristate	4	1	3				1		Tree variability
SW WA	7	2	3	2	2	1			Cost of monitoring
Perth WA	3			2					Watering next to windbreaks
TOTALS		14	11	5	4	3	2	1	
	37	38%	30%	14%	11%	8%	5%	3%	

Table 15

REGION	CHANGES BEING CONSIDERED	
NQ	Use what we've got better Consider overhead misting for cooling at peak flowering Monitoring equipment.	Consider drip irrigation if water shortage. Change to drip irrigation Installing more water monitoring devices
CQ	More dendrometers Change to drip irrigation	More emphasis on irrigating according to soil monitoring devices
SQ	Change to drip irrigation	Possibly change to drip irrigation
SC	Install a booster pump	
NSW	Automation	
Tristate	Consider Phytech sensors	
SW WA	Automation Install remote monitoring system and automatic weather station Change to drip irrigation	Automation based on monitoring as a failsafe Automate monitoring & irrigation. Trial drip irrigation.
Perth WA	Dual drip/minisprinkler system	More technology

Table 16

REGION	IRRIGATION PHILOSOPHY	
NQ	<p>Irrigate often and wet up in advance of the critical times or before dry weather conditions. Always get the timing right. Irrigation is the number one priority. What it needs when it needs it.</p>	<p>We were irrigating on demand but are re-looking at our whole irrigation scheduling. Maintain the system. Auger soil. Irrigate often in small amounts while still maintaining uniformity.</p>
CQ	<p>Irrigation is the most important job on the farm... schedule water to soil type and apply what is needed when it is needed. To keep that tree as happy as you can with moisture and grow as many roots as you can. Working towards accurate irrigation & fertigation. Use the auger and look for yourself. Maintain optimum moisture for the season.</p>	<p>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.</p>
SQ	<p>Keep topsoil moist. 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. Monitor & irrigate accordingly.</p>	<p>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.</p>
SC	<p>Keep the orchard moist, not over wet. Wish it would rain more, work with what we got; mulch. Tall grass in summer to reduce soil evaporation and over all tree temperature.</p>	<p>Supplement rainfall because limited water supply especially in drought.</p>
NSW	<p>Regular irrigation - enough to wet root zone.</p>	
Tristate	<p>Keep trees healthy and stress free. Do our best to meet the tree demands. Don't hold back.</p>	<p>Try and provide enough water to keep the trees happy to give max production.</p>
SW WA	<p>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. 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</p>	<p>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. Don't get caught out by forgetting to check the monitoring devices. 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.</p>
Perth WA	<p>Maximise water use efficiency in terms of productivity Correct balance on a weekly basis.</p>	<p>Monitor daily in summer.</p>

Table 17

REGION	ANY OTHER COMMENTS?
NQ	
CQ	Benchmarking of water use by region would be useful to help improve overall industry yield Good irrigation = good fruit quality.
SQ	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.
SC	Managing water in high rainfall area is only challenging in extended dry periods.
NSW	
Tristate	Keep trees healthy and stress free. Provide enough water to keep the trees happy to give max production Meet tree demands Don't hold back
SW WA	Mulch is a great buffer/blanket that can help iron out climatic effects on soil moisture levels.
Perth WA	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.

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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FOOT NOTES

1. Reasons for not irrigating sick or replant trees

- Logistically difficult. Issues with not changing back as tree grows.
- Inject sick trees and more mulch on replants.
- Difficult to change (x3)
- Too hard (x2)
- Soil is well drained

How growers manage different rates to sick or replant trees

- Cut water off altogether (x2) or install smaller sprinkler jet (x2)
- Reduce number of drippers
- Reduce number of sprinklers per tree (e.g. from 2 to 1) x2
- Lower volume and less sprinklers

2. RAW . . . Readily Available Water = the mm of water that a plant can readily extract from its root zone

3. Dan Ball drive sprinklers (now known as Mamkad). This one delivers about 260 L/hr.



4. 15 growers use one method, 15 use two methods, 5 use three methods and 1 uses all four.

Soil organic matter/organic carbon

Soil organic matter was requested but results are not quoted here because of the uncertainty of the sampling depth and whether or not mulch was brushed aside before taking soil sample, which were not stipulated in the question.

Overhead sprinklers

Only three of the growers surveyed have an overhead sprinkler system for cooling the tree canopy during heatwaves. All of these are in the Tristate. Two of the three believe that this system also contributes to soil moisture.