

Trial No: DM0607

Title: Investigation into irrigation practices and crop water use for Christmas Bush (*Ceratopetalum gummiferum*) at Nambour



Photo 1: Christmas Bush site at Nambour

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SUMMARY

Enviroscan soil monitoring equipment was installed in August 2007 in a 3m high crop of Christmas Bush at Nambour with the aim of finding information to assist the grower with the irrigation management of the crop. The weather conditions and irrigation management allowed observations on soil moisture to be made in both full soil profile and extremely dry soil conditions.

Under good soil moisture conditions the majority of crop water use (85%) was in the top 30cm of soil. As the top soil moisture became depleted the crop was able to utilize the soil moisture down to 70cm, however this was also associated with a significant drop in overall crop water use. Soil moisture data before and after irrigations show the irrigation water is going to the effective root zone with only 0-3% reaching the 70cm depth. The standard irrigation procedure of one hour irrigation twice per week appears to be sufficient to meet crop demand. Time of the year does not appear to be a significant factor for crop water use. Note however the crop was not harvested and remained as large trees for the whole monitoring period (August 2007- May 2008).

AIMS

1. To determine effective crop rooting depth and crop water use of Christmas Bush
2. To find where improvements in irrigation efficiency could be made

SITE DETAILS

Location: Palmwoods, Queensland

Sloping land – rows parallel to the slope

Crop

Variety: Alberly's Red

Age: Christmas Bush planted May 2001

Density: Planted into beds: 30-40cm ht; 1.7m wide; spacing of 3m.

Plant spacing along the bed: 1.25m.

Plant population: 2666 plants/ha

Crop Growth Stage August 2007: (see photo 1)

Budding with plant height of 3m and canopy width of 2.3m

Mulch: Nil

Harvest History: Crop was not harvested in 2007 – There was significant amount of “grow through” (50cm) in November. The branches in the inter row were pruned in January to allow access for machinery. At this time crop height was estimated to be approximately 4.5m

Soil Type

Brown Sandy loam

Irrigation

Normal Schedule: Twice per week with 1 hour per irrigation

Emitter output: 3L/hr

Emitter spacing 0.2m

Location: 2 lines, 20cm either side of the tree line (refer to Photo 2)

ASSESSMENT METHODS:

Soil Moisture Measurement: An Enviroscan logger with one probe, sensors at 10, 20, 30, 50, and 70cm, was installed on 9th August 2007. The probe was located between plants in the row and within 5cm of the drip tape.

Irrigation & Rainfall: Daily rainfall and irrigations were recorded.

RESULTS

Effective Rooting Depth

Soil moisture data at the various sensor depths Table 1&2 show that the majority of crop water used (87-90%) is in the top 30cm with good soil moisture levels in January 2008.

Table 1: Soil moisture sensor readings and calculated % crop water use for early January

Sensor Depth	12-Jan	13-Jan	Use mm/day	% by depth	14-Jan	Use mm/day	% by depth	15-Jan	Use mm/day	% by depth
10cm	28.3	27.4	0.9	20.93	25.89	1.51	29.09	24.34	1.55	24.49
20	22.77	21.37	1.4	32.56	20.01	1.36	26.20	18.29	1.72	27.17
30	27.56	26.1	1.46	33.95	24.46	1.64	31.60	22.14	2.32	36.65
50	20.11	19.72	0.39	9.07	19.27	0.45	8.67	18.8	0.47	7.42
70	24.82	24.67	0.15	3.49	24.44	0.23	4.43	24.17	0.27	4.27
Interpolated mm to 70cm	169.9	164.4	5.5	87.44*	157.8	6.6	86.90*	149.7	8.1	88.31*

Table 2: Soil moisture sensor readings and calculated % crop water use for early January

Depth	16-Jan	17-Jan	use	%	18-Jan	Use	%	19-Jan	use	%
10cm	28.09	26.22	1.87	28.64	24.74	1.48	25.56	22.62	2.12	24.37
20	21.23	19.65	1.58	24.20	18.05	1.6	27.63	15.43	2.62	30.11
30	23.35	20.94	2.41	36.91	18.87	2.07	35.75	16.03	2.84	32.64
50	18.83	18.36	0.47	7.20	17.95	0.41	7.08	17.16	0.79	9.08
70	24.08	23.88	0.2	3.06	23.65	0.23	3.97	23.32	0.33	3.79
Interp	158.1	149.8	8.3	89.74*	142.5	7.3	88.95*	131.4	11.1	87.13*

* = Sum of % crop water used in the 10 to 30cm soil depth

Interpolated = Calculated soil moisture for the total 70cm soil depth

Data from table 3 & 4 showing the crop increasing to use soil moisture from the 50-70cm zone as the soil moisture dries out above this.

Table 3

Sensor Depth	24-Jan	25-Jan	Use mm/Day	% by depth	26-Jan	use	%	27-Jan	Use	%	28-Jan	use	%	29-Jan	use	%
10cm	24.33	22.5	1.83	33.27	20.02	2.48	38.15	17.35	2.67	46.19	14.97	2.38	50.85	13.05	1.92	51.47
20	18.05	15.88	2.17	39.45	13.38	2.5	38.46	11.6	1.78	30.80	10.54	1.06	22.65	9.95	0.59	15.82
30	15.48	14.49	0.99	18.00	13.73	0.76	11.69	13.28	0.45	7.79	12.98	0.3	6.41	12.76	0.22	5.90
50	13.69	13.32	0.37	6.73	12.79	0.53	8.15	12.23	0.56	9.69	11.68	0.55	11.75	11.16	0.52	13.94
70	21.86	21.72	0.14	2.55	21.49	0.23	3.54	21.17	0.32	5.54	20.78	0.39	8.33	20.3	0.48	12.87
Interpolated	125.8	119.3	6.5	90.73	111.8	7.5	88.31	105.1	6.7	84.78	99.52	5.58	79.91	94.91	4.61	73.91

= Sum of % crop water used in the 10 to 30cm soil depth

Interpolated = Calculated soil moisture for the total 70cm soil depth

Table 4

Depth	24-Sep	25-Sep	Use	%	26-Sep	use	%	27-Sep	use	%	28-Sep	use	%
10cm	24.95	23.77	1.18	22.82	22.42	1.35	21.16	20.55	1.87	24.83	19.79	0.76	20.94
20	19.62	18.53	1.09	21.08	16.92	1.61	25.24	14.84	2.08	27.62	13.66	1.18	32.51
30	23.4	21.05	2.35	45.45	18.39	2.66	41.69	16.07	2.32	30.81	15.19	0.88	24.24
50	17.39	17.04	0.35	6.77	16.54	0.5	7.84	15.66	0.88	11.69	15.14	0.52	14.33
70	25.5	25.3	0.2	3.87	25.04	0.26	4.08	24.66	0.38	5.05	24.37	0.29	7.99
Interp	152.7	145.9	6.8	89.36	137.6	8.3	88.09	127.8	9.8	83.27	123.1	4.7	77.69

Crop water use (Table 5) becomes dominant at 70cm only with extremely low soil moisture in upper layers and is also associated with overall very low crop water use.

Table 5

Depth	24-Oct	26-Oct	use/day	%	Depth	26-Oct	28-Oct	use/day	%
10cm	11.16	10.12	0.52	24.94	10cm	10.12	9.76	0.18	19.25
20	9.3	8.71	0.295	14.15	20	8.71	8.56	0.075	8.02
30	12.07	11.44	0.315	15.11	30	11.44	11.3	0.07	7.49
50	9.89	9.15	0.37	17.75	50	9.15	8.91	0.12	12.83
70	17.23	16.06	0.585	28.06	70	16.06	15.08	0.49	52.41
Interp	84.18	78.38	2.9	54.2	Interp	78.38	75.71	1.34	34.76

Crop does not use soil moisture at 70cm with relatively low soil moisture but will access moisture from upper layers at similar soil moisture readings (Table 6).

Table 6

Depth	13-Nov	14-Nov	use	%	15-Nov	use	%	16-Nov	use	%	17-Nov	use	%	18-Nov	use	%
10cm	23.25	21.03	2.22	33.84	18.68	2.35	43.76	16.42	2.26	51.72	14.31	2.11	59.60	13.5	0.81	70.43
20	16.93	14.62	2.31	35.21	12.61	2.01	37.43	11.19	1.42	32.49	10.22	0.97	27.40	9.91	0.31	26.96
30	16.35	14.43	1.92	29.27	13.49	0.94	17.50	12.89	0.6	13.73	12.52	0.37	10.45	12.44	0.08	6.96
50	9.9	9.76	0.14	2.13	9.65	0.11	2.05	9.53	0.12	2.75	9.41	0.12	3.39	9.39	0.02	1.74
70	14.24	14.27	0.03	-0.46	14.31	0.04	-0.74	14.34	0.03	-0.69	14.37	0.03	-0.85	14.44	0.07	-6.09
Interp	105.9	98.23	7.67	98.32	92.28	5.95	98.7	87.52	4.76	97.94	83.68	3.84	97.41	82.51	1.17	100

Crop water use (Table 7) at the lowest soil moisture level show the crop will access moisture from the top soil (10cm) easier than lower depths (70cm) even with more moisture at the lower soil depth.

Table 7

Depth	26-Nov	27-Nov	use	%	28-Nov	use	%
10cm	11.12	10.59	0.53	84.13	10.14	0.45	54.22
20	8.77	8.76	0.01	1.59	8.68	0.08	9.64
30	11.6	11.56	0.04	6.35	11.45	0.11	13.25
50	8.92	8.91	0.01	1.59	8.84	0.07	8.43
70	14.08	14.04	0.04	6.35	13.92	0.12	14.46
Interp	76.27	75.56	0.71	92.06	74.55	1.01	77.11

Table 8: Comparison of crop water use at similar soil moisture levels at different times of the year

Depth	15-Sep	19-Sep	Use	%
10cm	21.43	13.86	1.89	23.41
20	18.98	11.58	1.85	22.88
30	24.42	14.7	2.43	30.06
50	22.65	17.96	1.17	14.50
70	29.56	26.6	0.74	9.15
Interp	166.7	123.3	10.85	76.35

Depth	18-Feb	22-Feb	use	%
10cm	27.83	19.88	1.99	27.77
20	21.3	13.86	1.86	25.99
30	25.31	16.16	2.29	31.96
50	20.43	18.5	0.48	6.74
70	27.47	25.31	0.54	7.54
Interp	169.2	132.9	9.08	85.71

Depth	12-Nov	15-Nov	Use	%
10cm	24.89	18.68	2.07	37.21
20	18.02	12.61	1.80	32.41
30	18.41	13.48	1.64	29.54
50	9.92	9.65	0.09	1.62
70	14.18	14.31	-0.04	-0.78
Interp	116.6	92.27	8.11	99.16

Depth	3-Apr	6-Apr	use	%
10cm	19.34	12.77	2.19	13.15
20	14.72	9.9	4.82	28.95
30	18.15	12.49	5.66	33.99
50	13.62	10.42	3.2	19.22
70	15.8	15.02	0.78	4.68
Interp	112.2	84.76	9.15	76.10

Table 9: Comparison using only the top 30cm

Depth	9-Sep	19-Sep	Use	Depth	14-Sep	19-Sep	use	Depth	18-Feb	24-Feb	use
10cm	28.7	15.16	1.35	10cm	22.59	15.16	1.49	10cm	27.83	14.91	2.15
20	25.02	12.55	1.25	20	20.18	12.55	1.53	20	21.3	11.03	1.71
30	32.46	15.78	1.67	30	26.08	15.78	2.06	30	25.31	13.71	1.93
Interp	86.18	43.49	4.27		68.85	43.49	5.07		74.44	39.64	5.80

Table 10: Rainfall 2007 mm

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1			2.5	3.5								28.5
2	9			2.5		2						
3		19		1		3			3			1.5
4	16		11									
5	16		4						68			5
6	6.5		38			43			38		20	6.5
7			14		2.5	33			37		25	
8			13		2				7	2.5	12	24
9	10		27		1.5					6.5		
10					1					7.5		
11	5				11					9		3
12		}		2.5	13.5					1	10	
13		} 119.5		2	3.5							17
14			5		6.5							4
15			1		1			2				
16	2	38.5										
17	2.5	10									}	
18	7.5	10									} 9	77.5
19	3	2										
20		10.5						28				
21		8			2			2				
22		48.5			3.5			48				
23			9.5				5.5	30.5	11	6.5	2	}
24		6	1			8	6.5	160			5.5	} 12.5
25						5.5		90				1
26	8.5		3		2	23.5		3		1.5		
27					20	19.5				3	1	3
28		11			39				3			18.5
29				6	8							10
30										22.5	2.5	
31			1									25.5
Totals	86	163.5	130	17.5	117	137.5	12	363.5	167	60	78	225

Table 11: Rainfall 2008 mm

Date	Jan	Feb	Mar	Apr	May
1	43.5	2			
2	31.5	33.5			
3	18	2	7		
4	54	41	5.5	}	
5	4	27.5		}	
6	1	39	1.5	}	
7		8.5		}	
8	1.5	14.5		}	
9	6.5			}	
10	38.5	21	10.5	}	
11	11		23	2.5}	
12	7	17		}	2
13		38.5		}	
14	4	31		}	
15	13	6		}	
16	4.5	}	3	}	
17	2	13}	1	}	
18		1	2		
19			2.5	5	
20				21	
21	28.5			6.5	
22					
23			6.5		
24	2.5		2.5		
25			1.5		
26		4			
27		16			
28			7.5		
29	1		20		
30	49				
31	11.5				
Totals	332.5	302.5	94	32.5	2

Rainfall - effect on soil moisture levels through the profile

Table 12: Results of rainfall penetration through the soil profile

10mm Rainfall 8th Nov 2007

Depth	8- Nov	8- Nov	mm Increase	%Increase
10	21.73	26.1	4.37	83.88
20	16.95	17.57	0.62	11.90
30	20.45	20.48	0.03	0.58
50	9.75	9.9	0.15	2.88
70	14.1	14.14	0.04	0.77
Interp	110	115.4	5.4	

22 mm Rainfall 29Oct 2007

Depth	29- Oct	30- Oct	mm Increase	%Increase
10	9.84	22.45	12.61	76.80
20	8.62	11.93	3.31	20.16
30	11.34	11.64	0.3	1.83
50	8.91	9.02	0.11	0.67
70	14.65	14.74	0.09	0.55
Interp	75.26	91.99	16.73	

28.5mm Rainfall 21st Jan 2008

Depth	21- Jan	22- Jan	Increase	%Increase
10	16.29	27.87	11.58	54.01
20	10.89	19.97	9.08	42.35
30	13.47	14.19	0.72	3.36
50	14.36	14.49	0.13	0.61
70	22.3	22.23	-0.07	-0.33
Interp	109.6	131.4	21.8	

57mm Rainfall 6th Nov 2007

Depth	6- Nov	8- Nov	Increase	%Increase
10	9.47	25.59	16.12	39.03
20	8.37	20.39	12.02	29.10
30	11.08	23.8	12.72	30.80
50	8.67	8.92	0.25	0.61
70	13.74	13.93	0.19	0.46
Interp	72.4	121.4	49	

28mm Rainfall 20August 2007

Depth	19-Aug	20-Aug	Increase	%Increase
10	18.6	25.59	6.99	38.58
20	17.66	24.31	6.65	36.70
30	22.79	27.29	4.5	24.83
50	20.04	20.15	0.11	0.61
70	25.8	25.67	-0.13	-0.72
Interp	149.2	173.8	24.6	

Irrigation Events

Table 13: Irrigation details

<u>Irrigation Details - 1/1/2008 - 14/05/2008</u>				
<u>Crop</u>	<u>Date of Irrigation</u>	<u>Amt. Irrigation (mins.)</u>	<u>Approx. Pressure (psi)</u>	<u>Amt.applied litres/tree(approx)</u>
Christmas Bush				
Alberys Red'	1/04/2008	45	8	21.5 l.
	25/04/2008	50	8	24 l.
	6/05/2008	60	8	29 l.
	10/05/2008	45	8	21.5 l.
	13/05/2008	45	8	21.5 l.
<u>Irrigation Details - 1/9/2007 - 31/12/2007</u>				
<u>Crop</u>	<u>Date of Irrigation</u>	<u>Amt. Irrigation (mins.)</u>	<u>Approx. Pressure (psi)</u>	<u>Amt.applied litres/tree(approx)</u>
Christmas Bush				
Alberys Red'	3/09/2007	40	5.5	13 l.
	4/09/2007	40	5.5	13 l.
	20/09/2007	45	7	19 l.
	21/09/2007	45	8	21.5 l.
	28/09/2007	45	8	21.5 l.
	29/09/2007	45	8	21.5 l.
	4/10/2007	45	8	21.5 l.
	5/10/2007	45	8	21.5 l.
	17/10/2007	45	8	21.5 l.
	18/10/2007	45	8	21.5 l.

Irrigation - effect on soil moisture levels through the profile

Table 14: Changes in soil moisture through the profile due to different amounts of irrigation

Irrigation early May (45 min)

Sensor Depth	10-May	11-May	Soil moisture Increase mm	%Increase
10	10.35	11.17	0.82	8.20
20	9.47	12.01	2.54	25.40
30	12.48	17.93	5.45	54.50
50	9.8	11	1.2	12.00
70	12.75	12.74	-0.01	-0.10
Interp	77.28	91.17	13.89	

Irrigation 25 April 2008 (50 min)

Depth	25-Apr	26-Apr	Increase	% increase
10	14.36	14.11	-0.25	-2.02
20	9.14	11.55	2.41	19.47
30	11.85	17.9	6.05	48.87
50	9.32	13.31	3.99	32.23
70	12.79	12.97	0.18	1.45
Interp	79.08	98.59	19.51	

Irrigation early May (60 min)

Depth	6-May	7-May	Increase	%Increase
10	9.49	10.76	1.27	8.36
20	8.32	11.43	3.11	20.46
30	11.18	17.62	6.44	42.37
50	8.87	12.79	3.92	25.79
70	12.31	12.77	0.46	3.03
Interp	70.78	93.35	22.57	

Total Irrigation 28-29 Sept (45 +45 min)

Depth	28-Sep	30-Sep	Increase	%Increase
10	19.65	23.37	3.72	16.08
20	13.43	20.05	6.62	28.62
30	15.02	26.45	11.43	49.42
50	15.06	17.03	1.97	8.52
70	24.29	23.68	-0.61	-2.64
Interp	122.2	152.7	30.5	

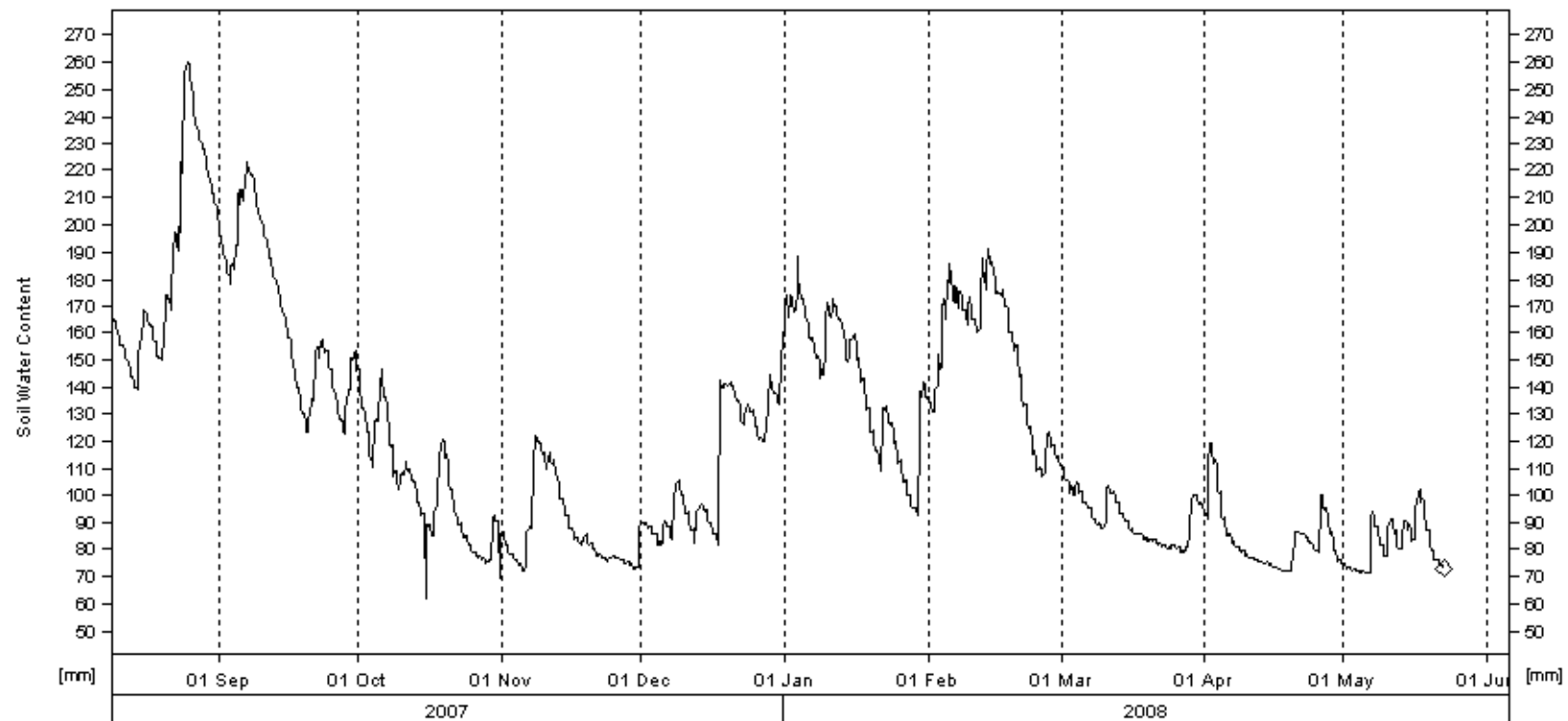
Total Irrigation 4-5 Oct 2007 (45 +45 min)

Depth	4-Oct	6-Oct	Increase	%Increase
10	16.29	20.63	4.34	16.33
20	11.99	19.7	7.71	29.01
30	14.19	26.33	12.14	45.67
50	13.48	16.46	2.98	11.21
70	22.65	22.06	-0.59	-2.22
Interp	110.5	145.8	35.3	

Enviroscan Graphs

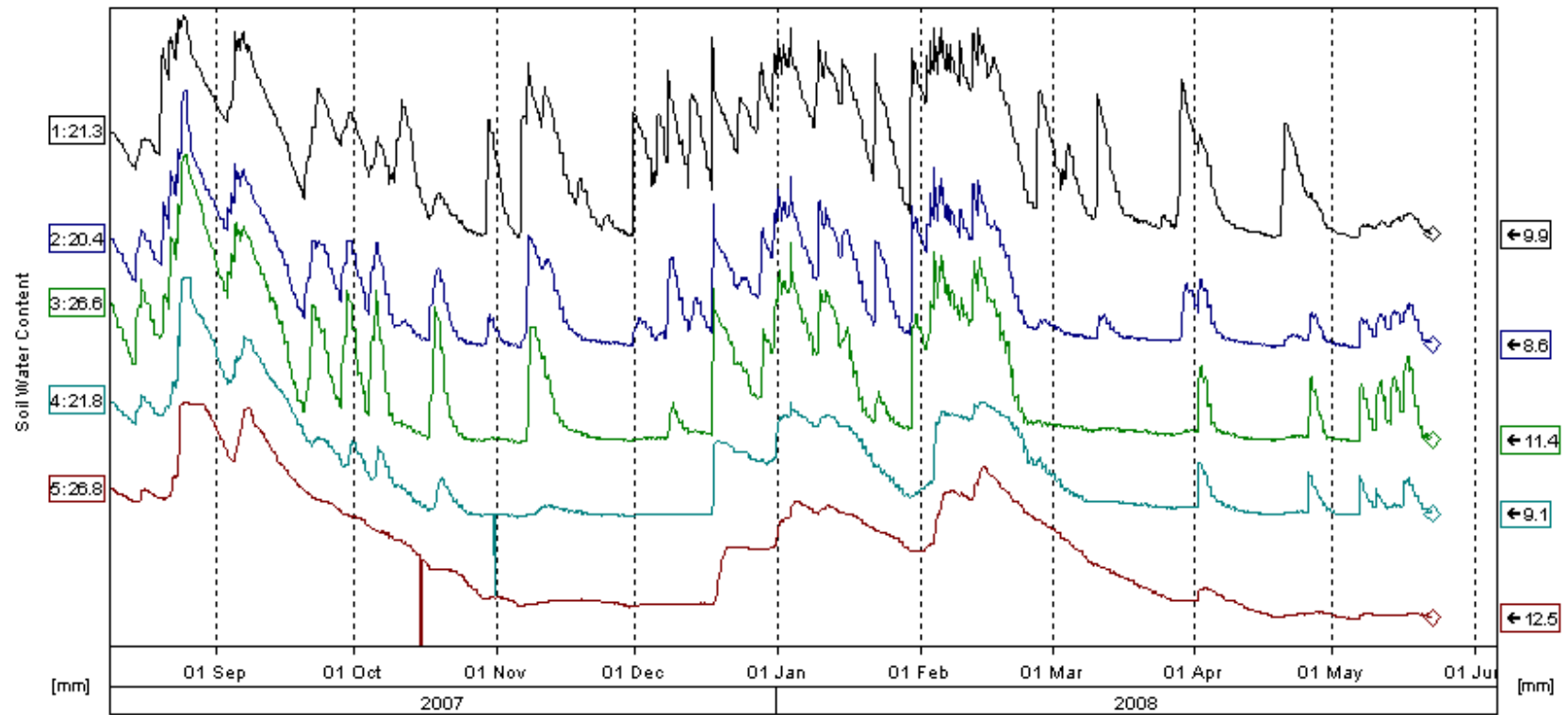
Graph 1: Interpolated summed graph for the whole period.

ImiMAX @ Summed Graph - Interpolated	Logger ID: K.Lamberton	Last Download: 22/05/2008 03:42:44 PM
— Site 'Lace' - Probe 'P11' - Depth 10 + 20 + 30 + 50 + 70 cm		
Comment: Interpolated summed graph from August 2007 to May 2008		



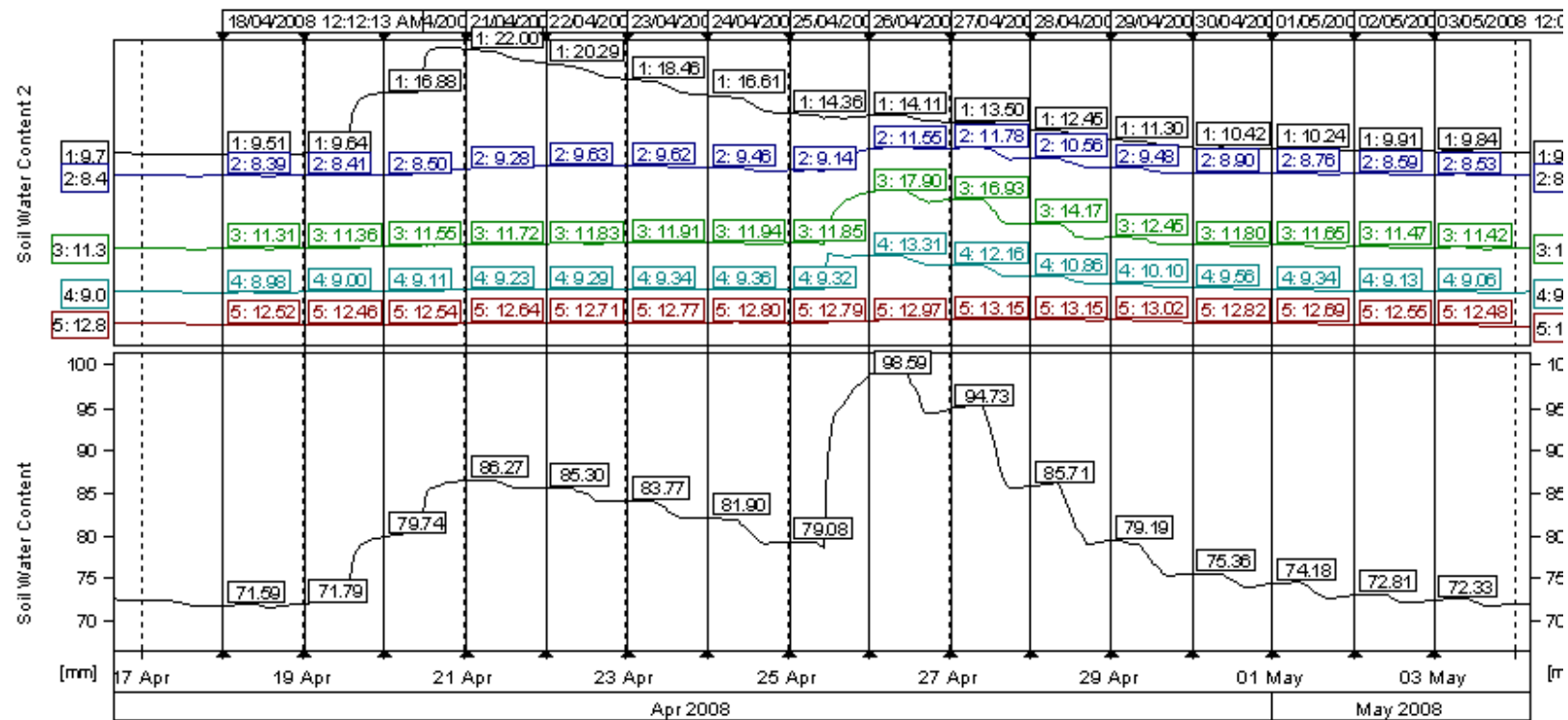
Enviroscan Graph 2: Stacked graph for the whole period

ImiMAX © Stacked Separate Graph	Logger ID: K.Lamberton	Last Download: 22/05/2008 03:42:44 PM
1: — Site 'Lace' - Probe 'P11' - 10 cm 2: — 20 cm 3: — 30 cm 4: — 50 cm 5: — 70 cm		
Comment: Stacked graph from August 2007 to May 2008		



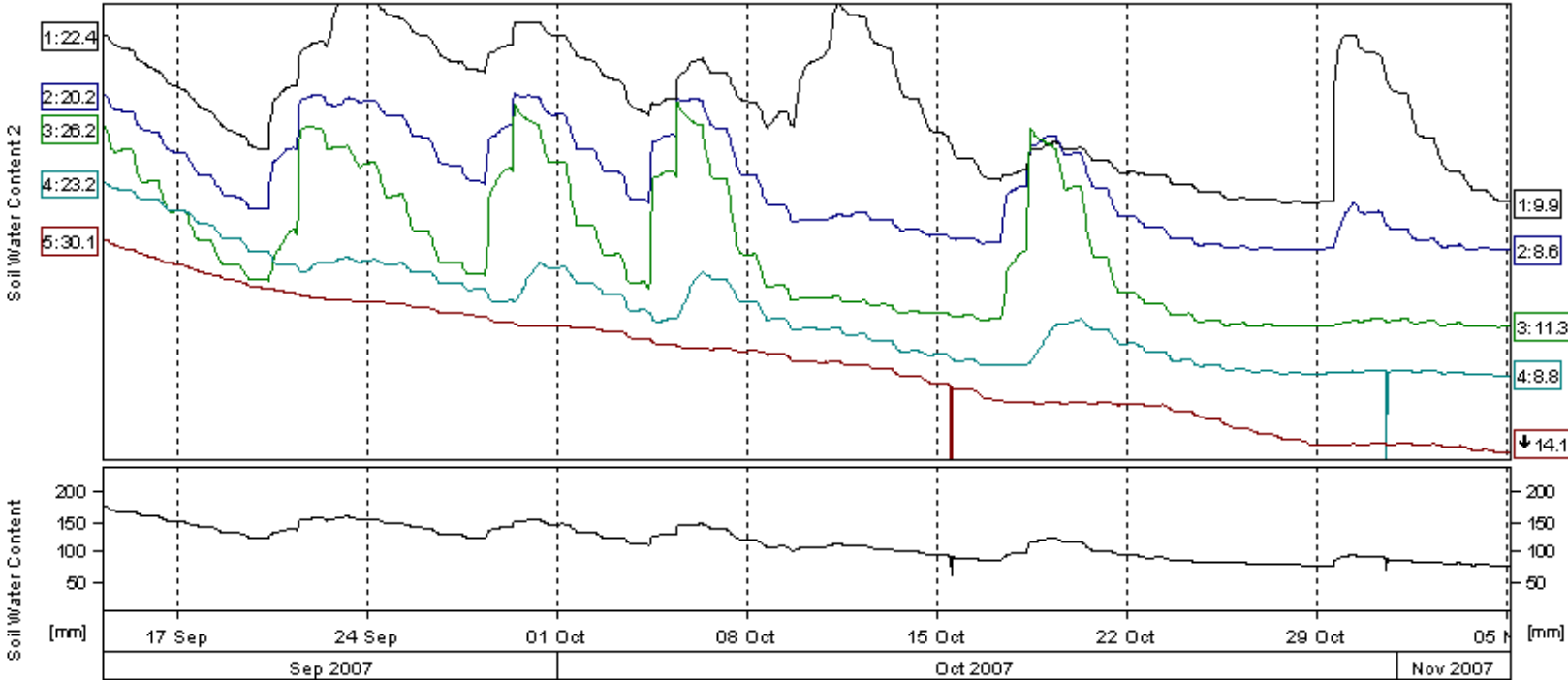
Enviroscan Graph 3: A comparison between the changes in soil moisture for an irrigation and a rainfall event.

ImiMAX © Summed Graph - Interpolated	Logger ID: K.Lamberton	Last Download: 22/05/2008 03:42:44 PM
Soil Water Content 2: 1: — Site 'Lace' - Probe 'P11' - 10 cm 2: — 20 cm 3: — 30 cm 4: — 50 cm 5: — 70 cm		
— Site 'Lace' - Probe 'P11' - Depth 10 + 20 + 30 + 50 + 70 cm		
Comment: 32mm Rainfall on 19-20April compared to irrigation on 25April 2008		



Enviroscan Graph 4: Shows the changes to soil moisture from irrigations and rainfall

ImiMAX @ Summed Graph - Interpolated	Logger ID: K.Lamberton	Last Download: 22/05/2008 03:42:44 PM
Soil Water Content 2: 1: — Site 'Lace' - Probe 'P11' - 10 cm 2: — 20 cm 3: — 30 cm 4: — 50 cm 5: — 70 cm		
— Site 'Lace' - Probe 'P11' - Depth 10 + 20 + 30 + 50 + 70 cm		
Comment: Irrigation 21+28 Sept and 4+18 Oct compared to rainfall on 9-12 Oct and 30 Oct		



DISCUSSION

Effective rooting depth

Enviroscan soil moisture readings indicate crop water use through the soil profile is dependent on the quantity of water at the various soil depths. When the soil moisture content is good throughout the soil profile the majority (85%) of crop water use comes from the top 30cm soil depth (Tables 1+2) with a use rate range of 6-11mm per day. As this becomes depleted the crop increases its extraction of soil moisture from the 50-70cm depth (Table 3+4), however the majority (74-77%) of the water use continues to come from the top 30cm. Crop water use becomes dominant (>50%) at the 50 to 70cm depths only when the upper soil moisture is severely depleted and this is also associated with very low overall crop water use (1-3mm/day).

In summary, the crop has a preference for utilizing the soil moisture in the upper 30cm. When this is depleted the crop can utilize moisture at 70cm, however access to these lower soil moisture reserves is associated with a significant drop in the overall daily crop water use.

It is possible that the crop was accessing soil moisture below the 70cm sensor depth. In future work with Christmas Bush the probes should have sensors to 1m depth.

Crop water use

The data presented in tables 3 to 9 indicate the crop water use is directly related to the quantity of soil moisture. Crop water use is high after good rainfall and gradually decreases as the soil moisture decreases in the upper profiles and the plant is forced to obtain moisture from lower soil depth. Irrigation replenishes the moisture in the top 30cm and crop water use after irrigation responds until this is depleted. The range of crop water use under reasonable to good soil moisture conditions was 6-11 mm/day. The time of the year did not have a significant influence on the crop water use (Table 8).

Effect of irrigation on soil moisture through the profile

Soil moisture data before and after irrigations show the irrigation water is going to the effective root zone with only 0-3% reaching the 70cm depth.

Photo 2: Location of the Enviroscan probe between the irrigation drip lines



Increases in soil moisture with irrigation were easily identified in the enviroscan graphs compared to rainfall events (refer to tables 12 and 13). Soil moisture readings after irrigations showed a substantial amount (50%) of the irrigation water being delivered to the 30cm depth and only small increases in the 10cm soil depth. Rainfall events always gave a substantial increase in the top soil moisture layer. The most logical reason for this is the bulb like pattern of drip irrigation combined with the location of the probe between the two drip lines.

In future crop monitoring for this type of drip irrigation setup, a further probe should be located on the outer edge of one of the drip lines.

Irrigation and crop demand (crop water use)

There were two periods where irrigation was used – April/May 2008 and September/October 2007. The irrigation information in Table 14 was calculated from data obtained from the enviroscan workspace.

Table 14: Increase in soil moisture due to irrigation and the daily crop water use after irrigation

Date of Irrigation	Time for the irrigation (min)	Soil moisture increase (mm)	Daily crop water use immediately after irrigation (mm)	Days of available soil moisture supplied per irrigation	Interpolated soil moisture reading after irrigation
10/5/08	45	14	5.76	2.4	91
25/4/08	50	20	6.33	3.2	99
6/5/08	60	23	5.36	4.2	93
28+29/9/08	45+45 Total 90	30	10.55	2.8	152
4+5/10/08	45+45 Total 90	35	12.5	2.8	145

The results are variable and make it difficult to formulate a suitable time for irrigation in terms of meeting crop demand for moisture. The variation comes from the crop water use pattern after the irrigation. Crop water use increases as the water available to the crop increases (refer to data and discussion on effective rooting depth). The irrigations in May 2008 were made to relatively low soil moisture content compared to the irrigations that were applied in September 2007 when soil moisture was good.

Unfortunately there was no crop growth rate measurement to compare with crop water use. The plants were 3m high at the commencement of monitoring in August 2007 and increased to 4.5m height by January 2008. However based on other crop monitoring and literature it can be concluded that crop growth is proportional to crop water use. With this assumption and an average crop water use during growth of 8mm/day, it would appear that the standard practice of one hour irrigation twice per week would be very close to meeting crop demand.

CONCLUSIONS

1. The majority (85%) of crop water use under good soil moisture conditions is in the top 30cm of soil. The crop has the ability to utilize soil moisture at 70cm when the upper layers of soil moisture have been depleted, however this is also associated with a significant drop in overall crop water use.
2. Soil moisture data before and after irrigations show the irrigation water is going to the effective root zone with only 0-3% reaching the 70cm depth.
3. The standard practice of one hour irrigation twice per week would be very close to meeting crop demand.