

Energy

- **An unavoidable annual expense**
(Consumable)

Or

- **Investment in productivity**
(Return on investment critical)

Increasing the value of the energy \$

- Electricity cost in irrigation has almost doubled in the last few years
- Irrigation systems must be operated in the most efficient way for the highest possible return on investment
- Using less water for lower production may lower input cost but usually leads to falling gross income and a tightening profit margin

Daily management factors affect return on energy \$

- Primary crop production factor is water – Rain and **Irrigation**

How much – How often – How efficient

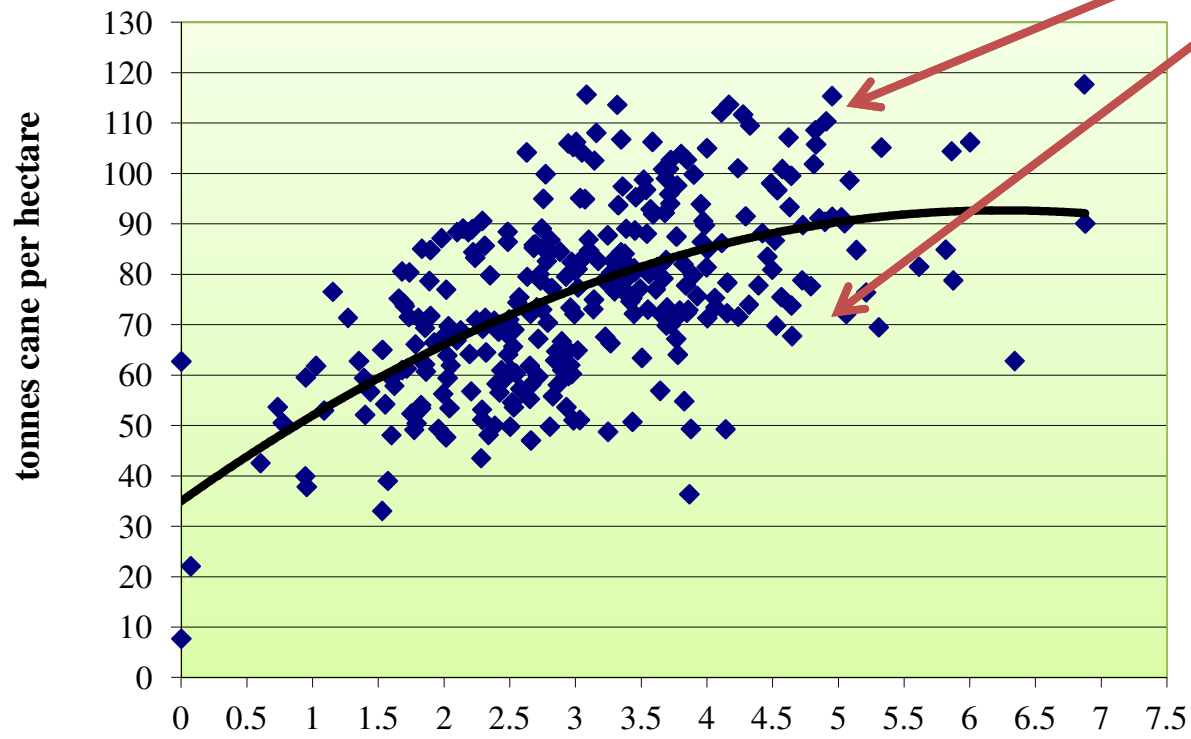
- Application efficiency (Joe Foley)
- Timing and demand
- Scheduling (matching application to soil type and crop need)

- Other factors (management issues)

- Crop class
- variety selection
- pest
- disease
- weed
- nutrient

YIELD AND WATER USE RELATIONSHIP

Bundaberg 2001



Yield
variation
for
5ML/ha

◆ tc/ha

— Poly. (tc/ha)

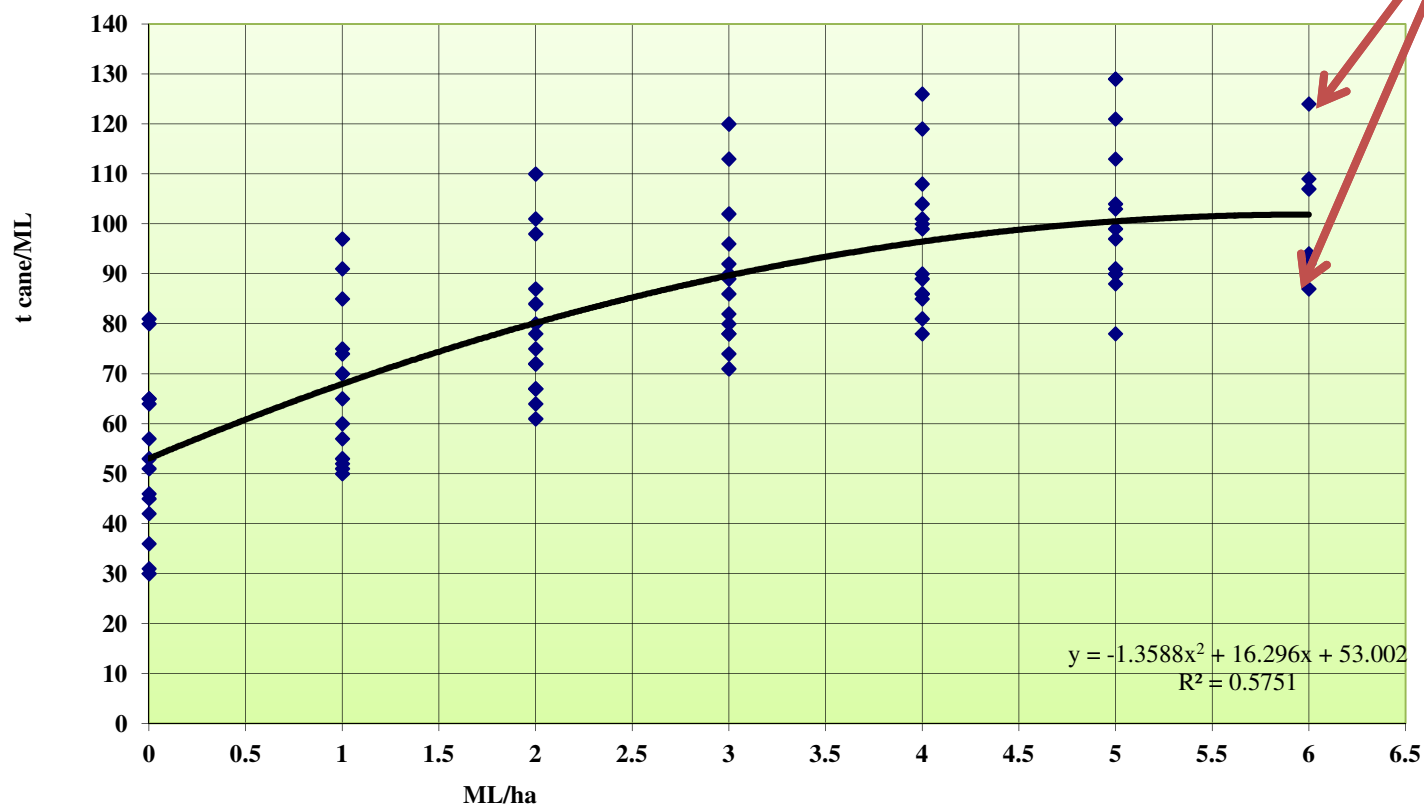
Average water use 3.07 ML/ha

Average yield 73 tc/ha



YIELD AND WATER USE RELATIONSHIP

Bundaberg 5 year average
(1998 – 2002)



◆ t cane/ML

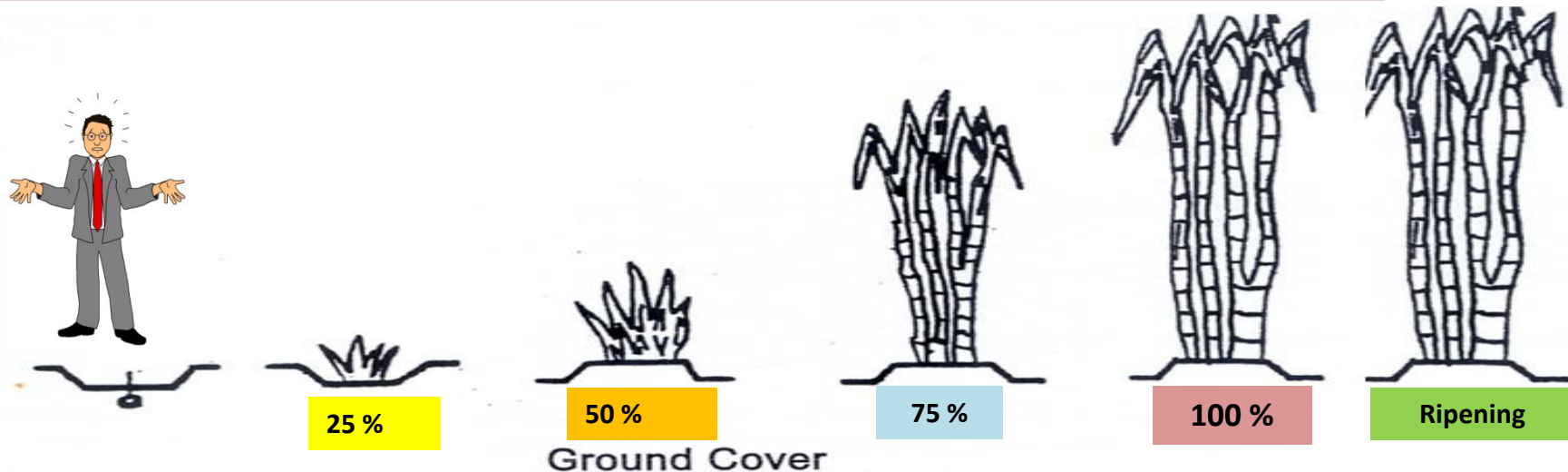
— Poly. (t cane/ML)

Return on energy investment (\$ / energy unit)

What if - Irrigation Scenario

Irrigated area	30ha
Irrigation system	Water winch
Flow rate	27 l/sec (97200 l/hr) – (21600 gal/hr)
Energy use	36 kW/hr
Gross volume applied	6.5 ML/ha
Total annual water applied	195 ML
Total energy units	72000 kWh
Scheduling	1.95 ML/day @ 43mm = 4.5ha/day
Irrigation cycle peak demand period	6.7 days (43mm – 6.00mm/day)
Pumping requirement	20 hrs/day for 100 days

Water – how often and how much does a Bundaberg sugarcane crop need ?



		J	A	S	O	N	D	J	F	M	A	M	J
Aut Plnt 10%	Cover %	25	25	50	75	100	100	100	100	100	Ripen	Ripen	Ripen
	mm/day	1.9	2.3	4.2	5.1	7.4	6.9	7.4	6.8	5.9	2.9	2.3	1.9
Early Rat 50%	Cover %	0	25	25	50	75	75	100	100	100	100	Ripen	Ripen
	mm/day	-	0.5	1.5	3.5	5.6	5.3	7.4	6.8	5.9	5.2	2.3	1.9
Sp Plnt 15%	Cover %	-	-	25	25	50	75	75	100	100	100	Ripen	Ripen
	mm/day	-	-	0.5	1.9	3.8	5.3	5.6	6.8	5.9	5.2	2.3	1.9
Late Rat 25%	Cover %	-	-	-	-	25	50	75	75	100	100	Ripen	Ripen
	mm/day	-	-	-	-	2.1	3.6	5.6	5.2	5.9	5.2	4.2	1.9

Water – how often and how much does a Bundaberg sugarcane crop need ?

200 days main irrigation period



Critical period 160 days



Long term data		Oct	Nov	Dec	Jan	Feb	Mar	April	May	Total
Median rain		68	100	127	149	135	86	41	52	758
Median rain	effective	51	75	95	112	101	65	31	39	569
Crop demand		108	140	153	154	194	179	151	86	1165
Soil moisture deficit		57	65	58	42	93	114	120	47	596

Irrigation cost per ML

Energy cost (best case scenario)

T66 = \$16,806

Cost per ML = \$93.36/ML

Yield variation noted at 6 ML/ha (1989-2002)

Maximum tc/ha = 125 tc/ha

Minimum tc/ha = 87 tc/ha

Differential = 38 tc/ha

Crop yield and gross value @ \$38/tc

Maximum 30 ha @ 125 tc/ha = 3,750 tc = \$142,500

Minimum 30 ha @ 87 tc/ha = 2,610 tc = \$ 99,180

Differential = 1,140 tc = \$ 43,320

Comparative Production costs

Electricity @ 125 tc/ha	= \$4.48 / tc
@ 87 tc/ha	= \$6.43 / tc
Harvesting @ \$7.50 for 125 tc/ha	= \$28,125
@ \$7.50 for 87 tc/ha	= \$19,575

Net \$ return

Maximum yield [$\$142,500 - (\$28,125 + \$14,540)$] = \$99,835

Minimum yield [$\$99,180 - (\$19,575 + \$14,540)$] = \$65,105

Return on energy input

Net Income per energy \$	@ 125 tc/ha	= \$6.88
	@ 87 tc/ha	= \$4.49

Monitoring systems help improve returns on energy inputs

Field monitored water balance



Computer generated water balance

IrrigWeb Scheduling Report for the week starting: 2014-11-07

Meteorological Site : **Bundaberg Aero**

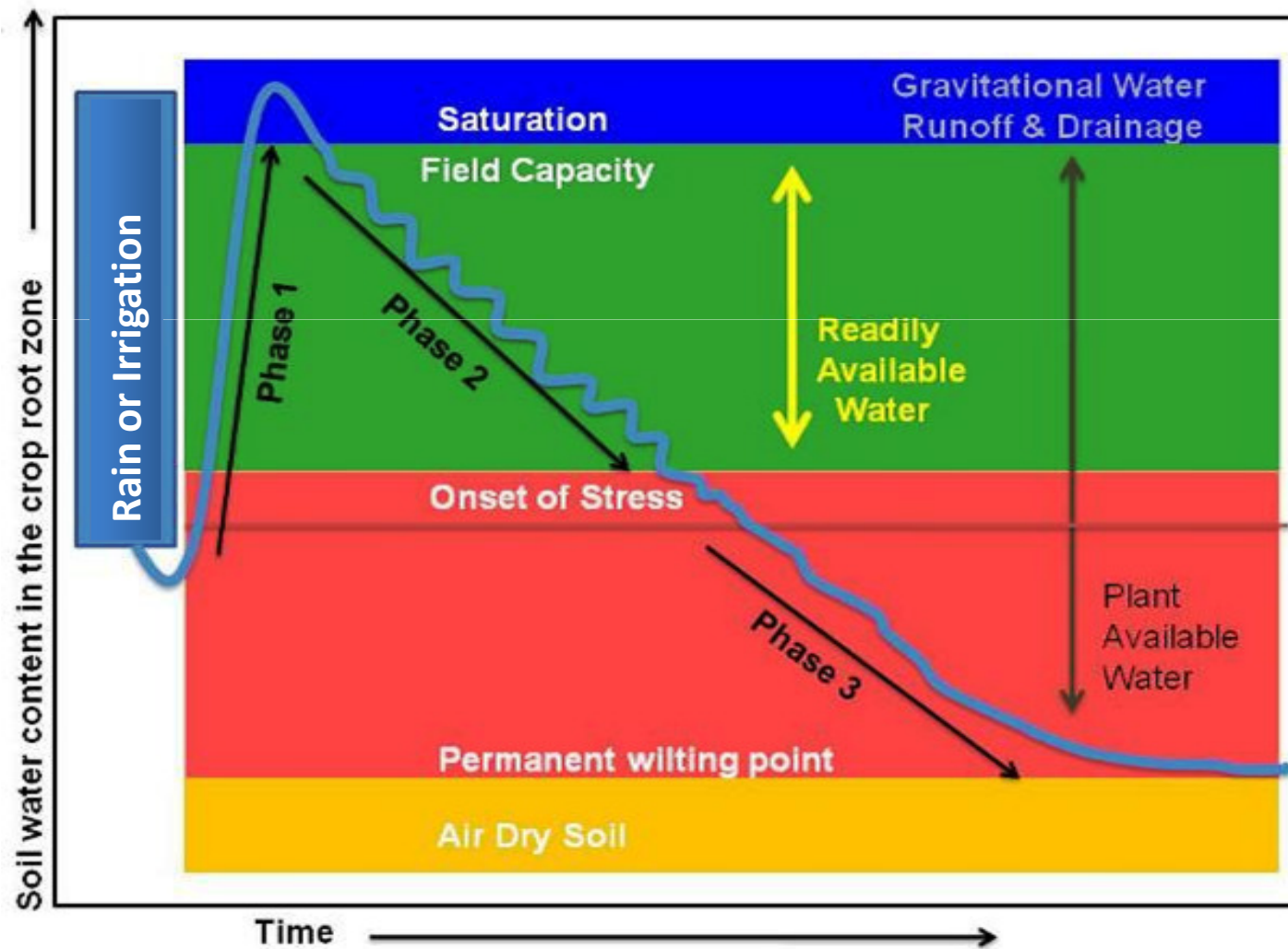
Soil Type : **Silty clay loam, PAWC = 152mm**

Irrig Rule	Field Name	Next irrig date	Current Deficit (mm)	Prev week CWU (mm/week)	Prev week canopy (%)	Next week CWU (mm/week)	Next week Irrig (mm)	Cum Irrig to-date (mm)	Cum Rain to-date (mm)	Cum Et to-date (mm)	Cane Yld to-date (t/ha)
Overhead 40mm @ 100% biom	R-Jun->Jun	10/11/14	-59	33	52	33	40	80	126	178	2
Overhead 40mm @ 100% biom	R-Jul->Jul	9/11/14	-68	19	40	28	40	40	107	137	1
Overhead 40mm @ 100% biom	R-Aug->Aug	> next 7 day	-40	22	34	21	0	40	103	93	0
Overhead 40mm @ 100% biom	R-Sep->Sep	> next 7 day	-44	13	14	15	0	40	37	45	0
Overhead 40mm @ 100% biom	P-May->Jul	11/11/14	-54	36	60	37	40	160	133	307	7
Overhead 40mm @ 100% biom	P-Sep->Sep	> next 7 day	-52	13	6	8	0	40	37	53	0

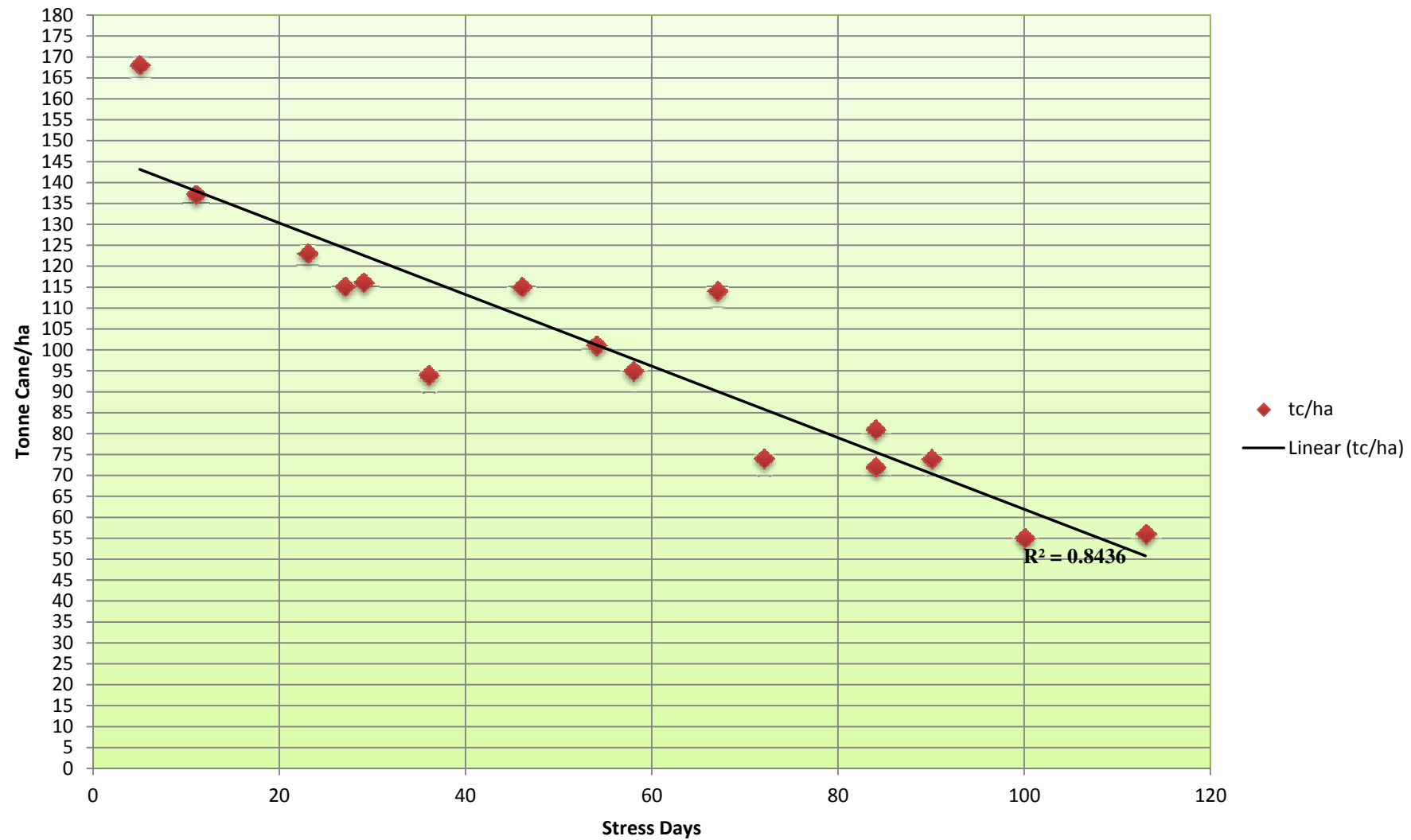
Stress days impact on final tc/ha

- The critical crop growth period in the Bundaberg region is late November to end of April (approx 160 days)
- Before and after this period – irrigation should supplement rain to establish or mature the crop
- During this peak growth period – irrigation should be used to manage the soil water balance for maximum growth of the crop
- Stress days should be minimised -the number of stress days in the peak growth period will strongly influence the final yield
- **Growth lost can not be made up**

Maintaining soil moisture in the Readily Available Water phase will maximise yield

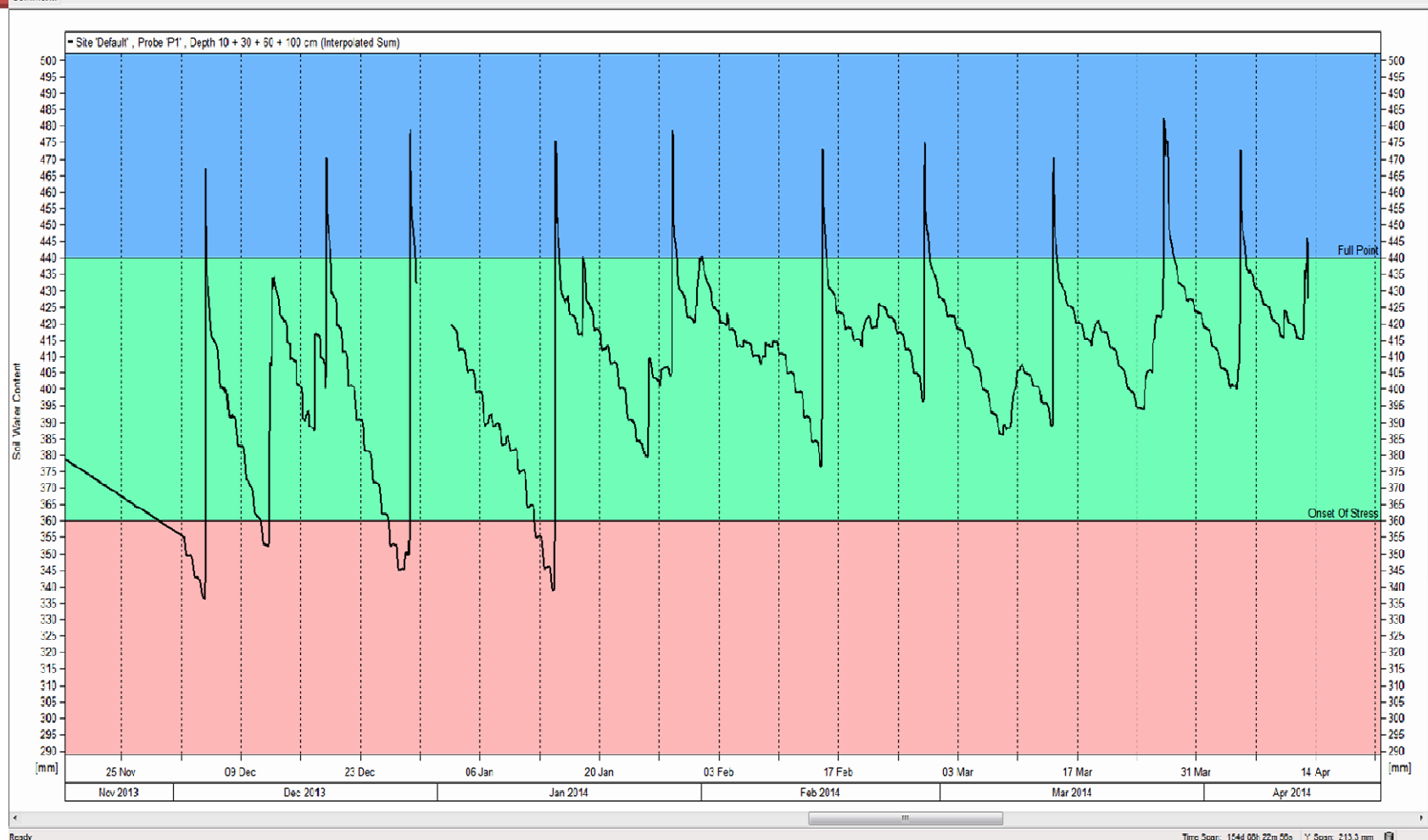


Potential yield loss to stress days = approx 0.8 tc/ha/day

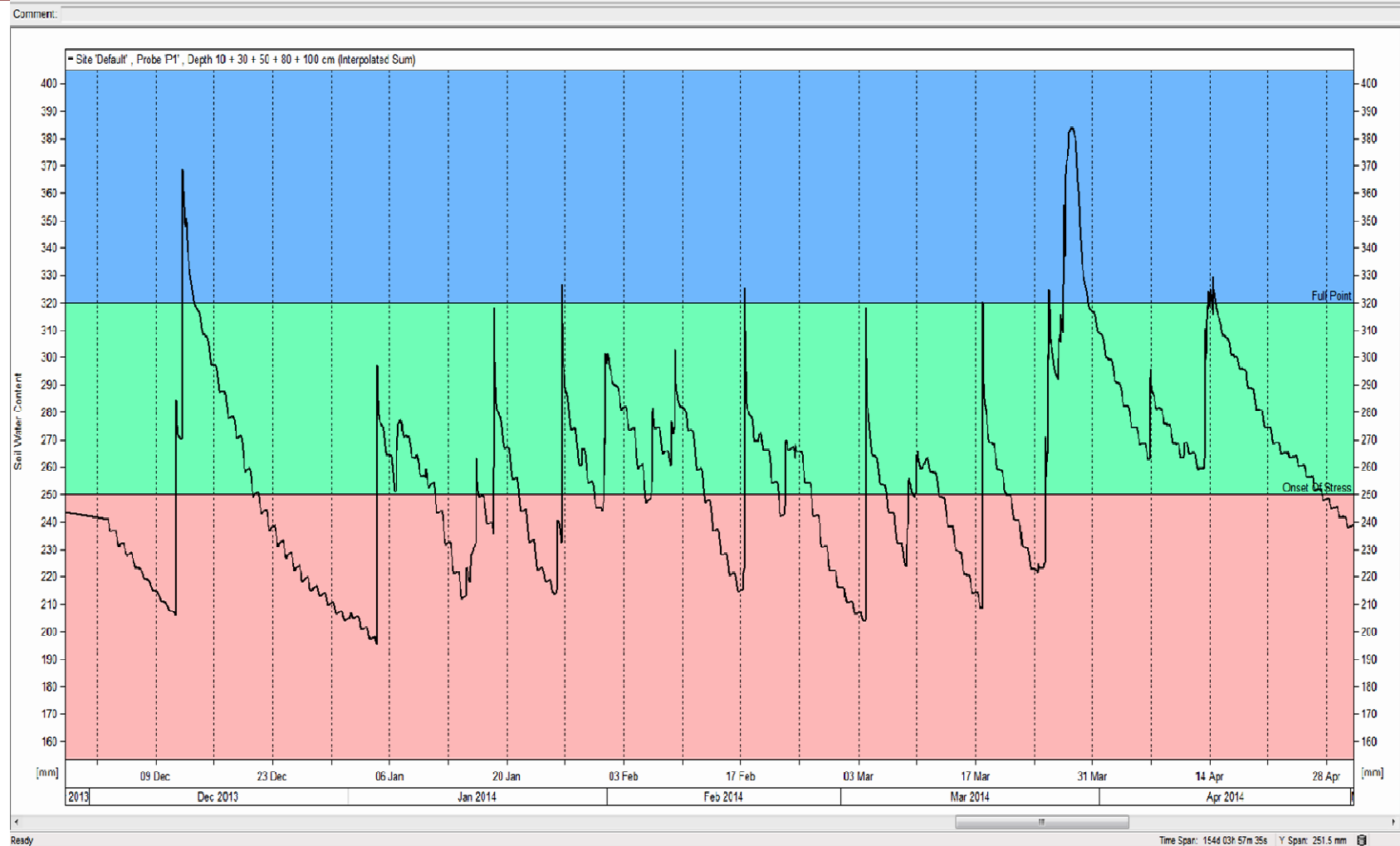


Stress days 11 – yield 137 tc/ha

Comment:

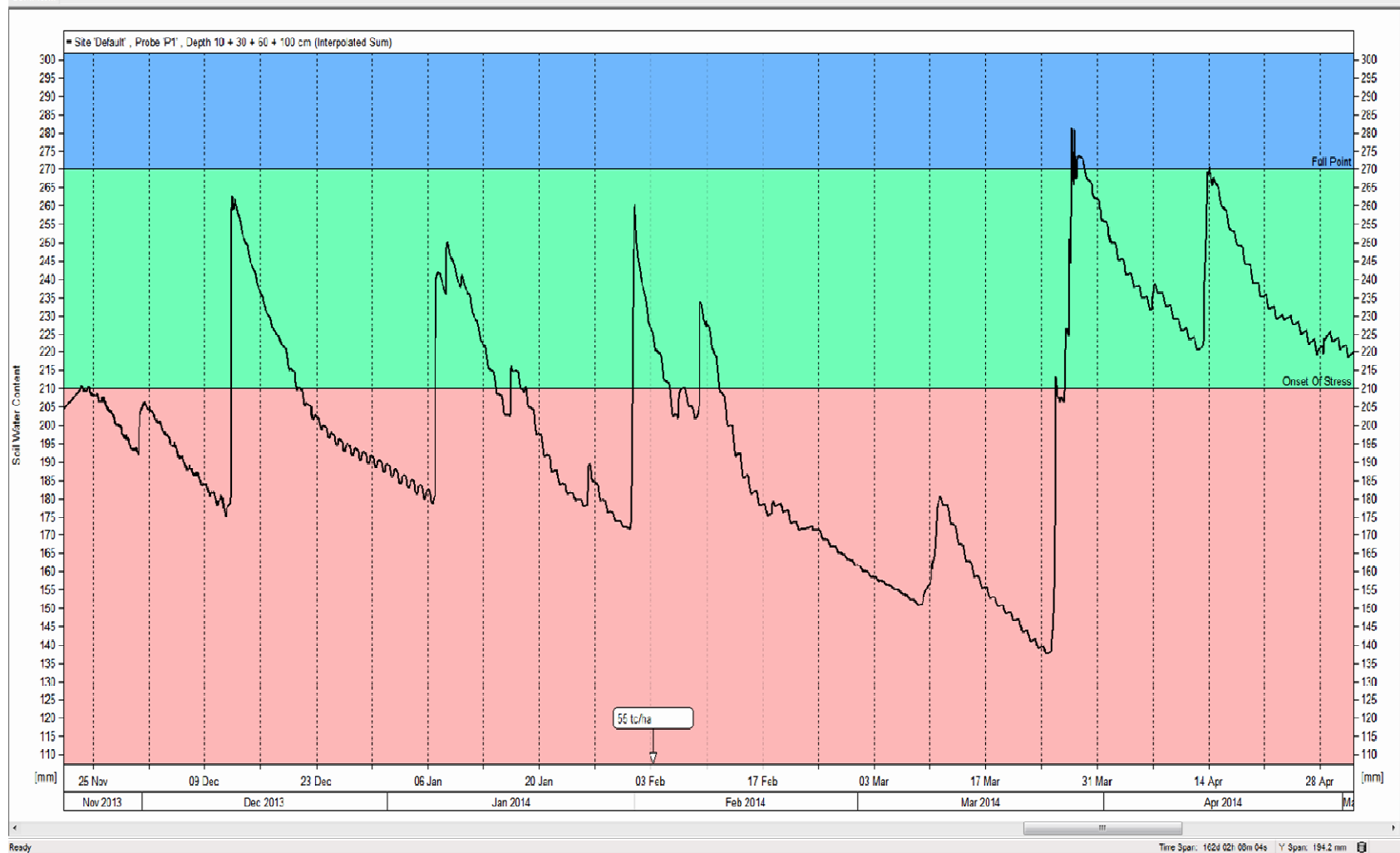


Stress days 72 – yield 74 tc/ha



Stress days 100 – yield 55 tc/ha

Comment:



Issues

- Right tariff
- Benefit of monitoring tools
- System capacity
 - Does the system have the ability to meet crop need?
- Stress days reduce yield
 - Lower return on energy investment
 - Impact on profitability
- System change
 - Will change reduce energy requirement?
 - Will change reduce stress days and increase yield?
 - What will be the pay back time?