

*Smarter Irrigation for Profit*

UNIVERSITY  
OF SOUTHERN  
QUEENSLAND



NCEA

National Centre for  
Engineering in Agriculture

# Centre Pivot System Capacity & Calculations

Dairy SA, Allendale  
31<sup>st</sup> August 2016



Dr Joseph FOLEY BEng(Agric), MEng(Mech), PhD MIEAust  
Agricultural Engineer - Water Engineering and Irrigation  
em: [foley@usq.edu.au](mailto:foley@usq.edu.au)



Dairy  
Australia

Rural Research and  
Development for Profit  
Keeping Australian farmers  
at the cutting edge



tia

TASMANIAN  
INSTITUTE OF  
AGRICULTURE



Australian Government

Department of Agriculture  
and Water Resources

# Centre Pivot System Capacity

- Measure of flowrate for irrigated area in mm/day
- Low system capacities have been responsible for more CP&LM “failures” than all other issues combined
- Single greatest reason for low uptake of CP&LMs
- Calculate by dividing your CP&LM flowrate, in Litres per day, by irrigated area in square metres
- Remember that 1 litre on 1 square metre = 1 mm
- CP&LMs are built to run 24 hrs a day, seven days a week – make sure they do through Dec-Jan

# System Capacity



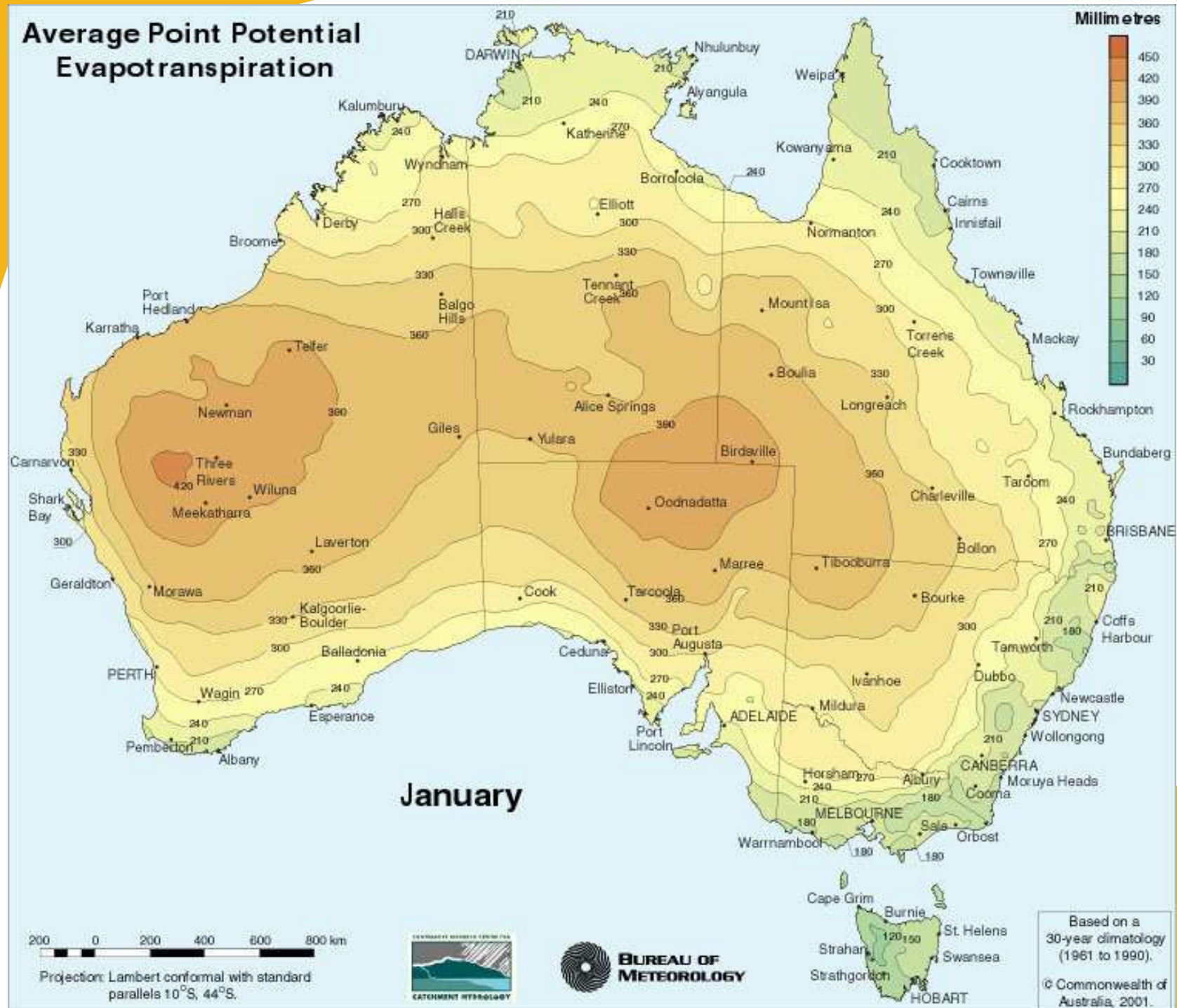
The system capacity is the maximum possible rate at which the machine can apply water to the irrigated field area

Expressed in mm/day

**NOT** the depth applied per pass (mm)

$$\text{System Capacity} = \frac{\text{Daily pump flow rate (L/day)}}{\text{Field irrigated area (m}^2\text{)}}$$

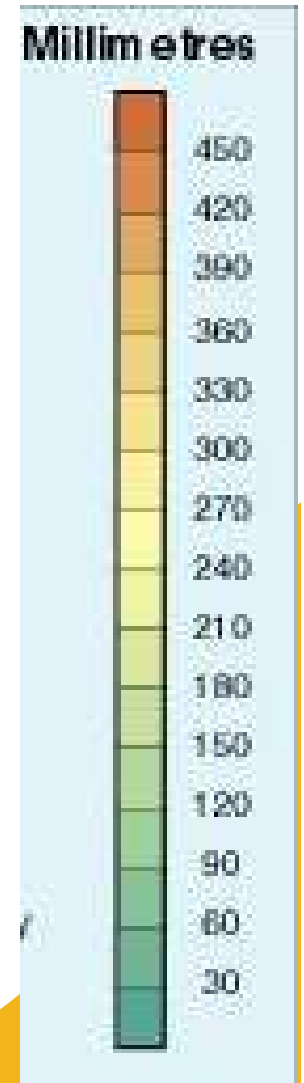
# Average Point Potential Evapotranspiration



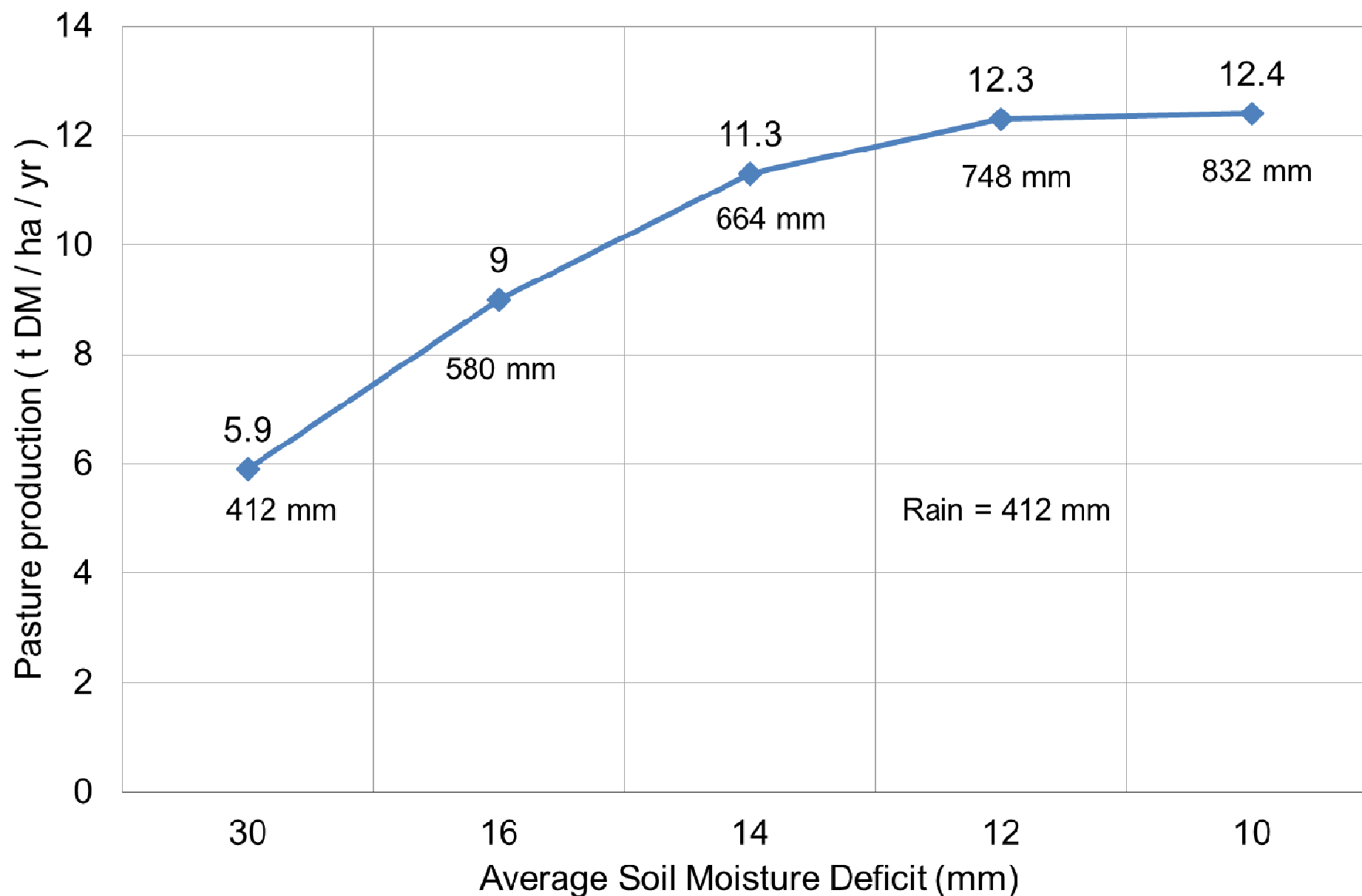
# System Capacity Recommendations

7.0 to 7.5 mm/day

8.0 to 8.5 mm/day



# Pasture prod'n with deficit

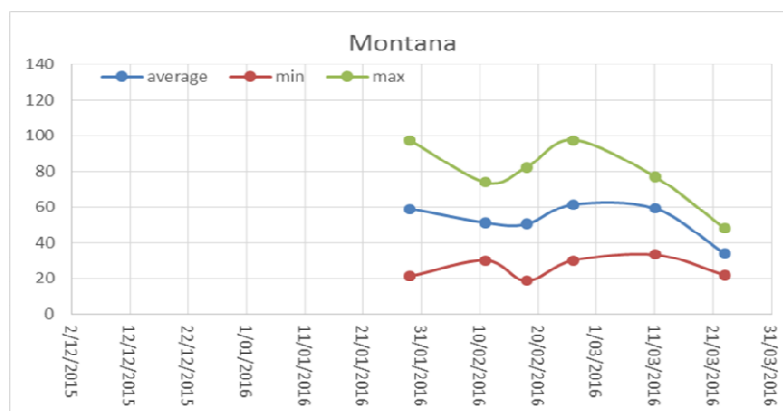
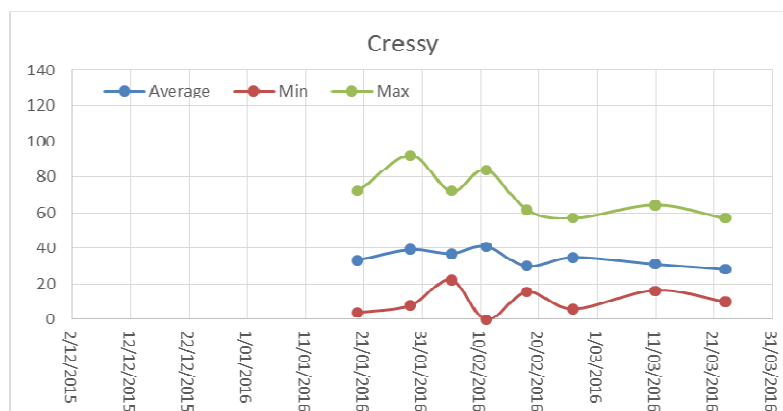




# Cressy site



# Pasture growth rates

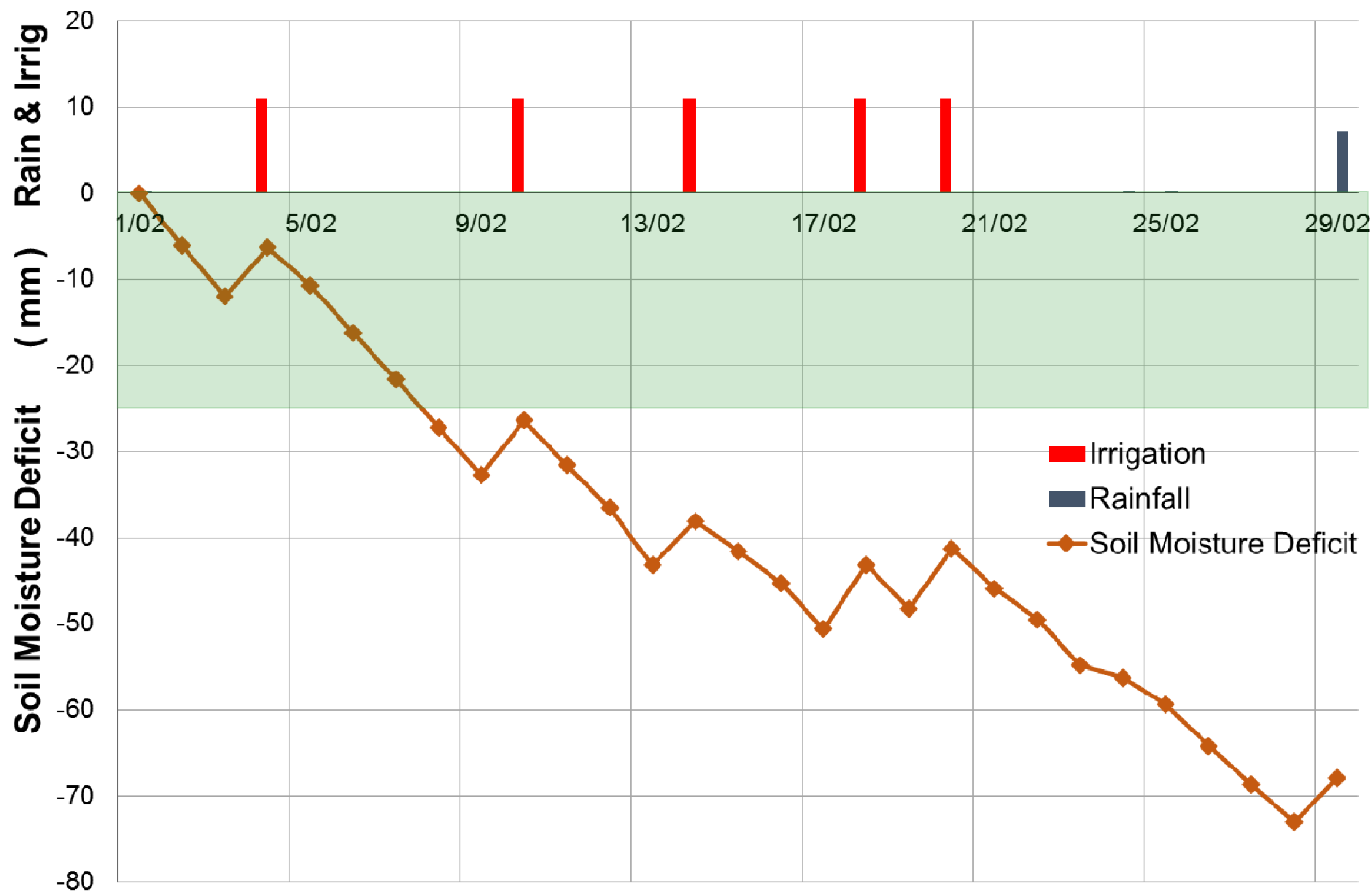


- Cressy averaged 40kg DM/ha/d
- Opportunity loss of 20kg DM/ha/d
- Opportunity loss of 210t pasture on 117ha pivot replaced with purchased grain
- \$200/t extra cost
- \$42000 extra cost over three months

Pasture growth rates (kg DM /ha/day)



# Cressy Pivot Water Balance



# Take home messages

- Need to understand system capacity and what this means in terms of the pivot operation
- Don't chase offpeak power if you don't have the managed system capacity to enable irrigation inputs to match crop water use – it could cost you significantly more than the energy cost savings

# Pasture productivity





# Rocky Cape site



# Sandy site

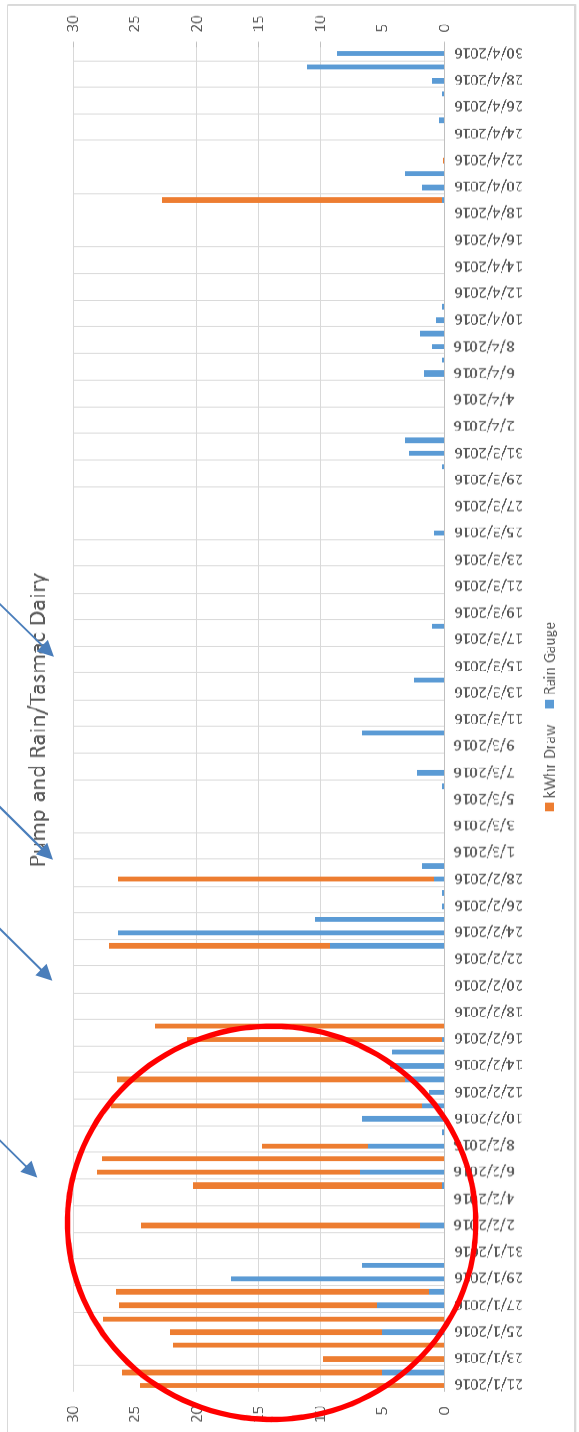
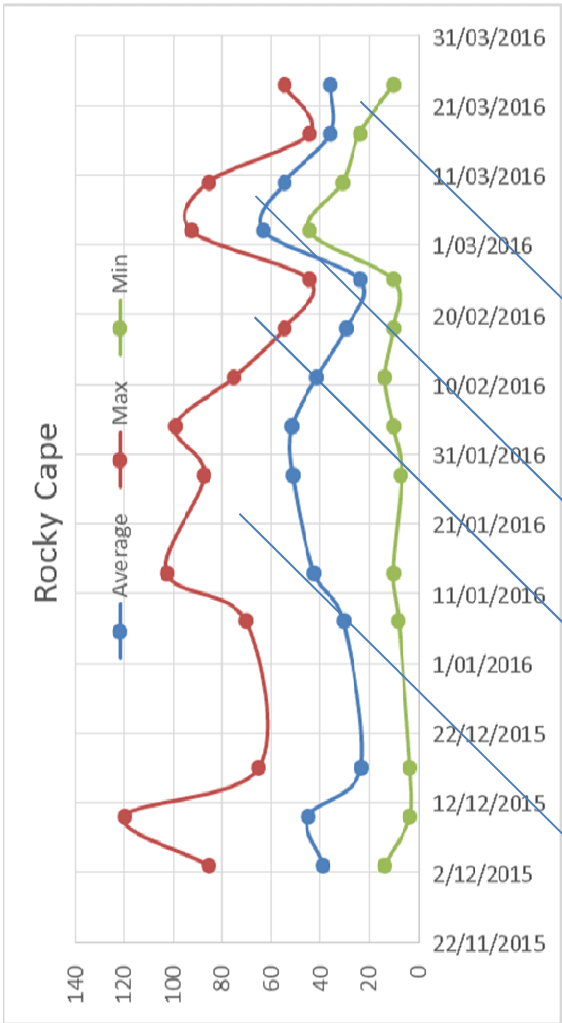


Ap	0-17 cm	Black (10YR2/1); sand; single grain structure; very weak consistence (moist); abundant very fine roots; sharp smooth boundary.
P2	17-23 cm	Very dark brown (10YR2/2); peat; moderately developed fine platy structure; moderately weak consistence (moist); many very fine roots; sharp smooth boundary.
2A	23-47 cm	Very dark grey (10YR3/1); slightly peaty loamy sand; massive parting to single grain structure; moderately weak consistence (slightly moist); common very fine roots; sharp wavy boundary.
2C1	47-105 cm	Very pale brown (10YR7/3); sand; single grain structure; very weak consistence (moist); very few fine prominent yellowish brown (10YR5/8) mottles; few very fine roots; sharp smooth boundary.
2C2 g	105- 120+cm	Dark grey (5Y4/1); sand; massive structure; very weak consistence (wet).



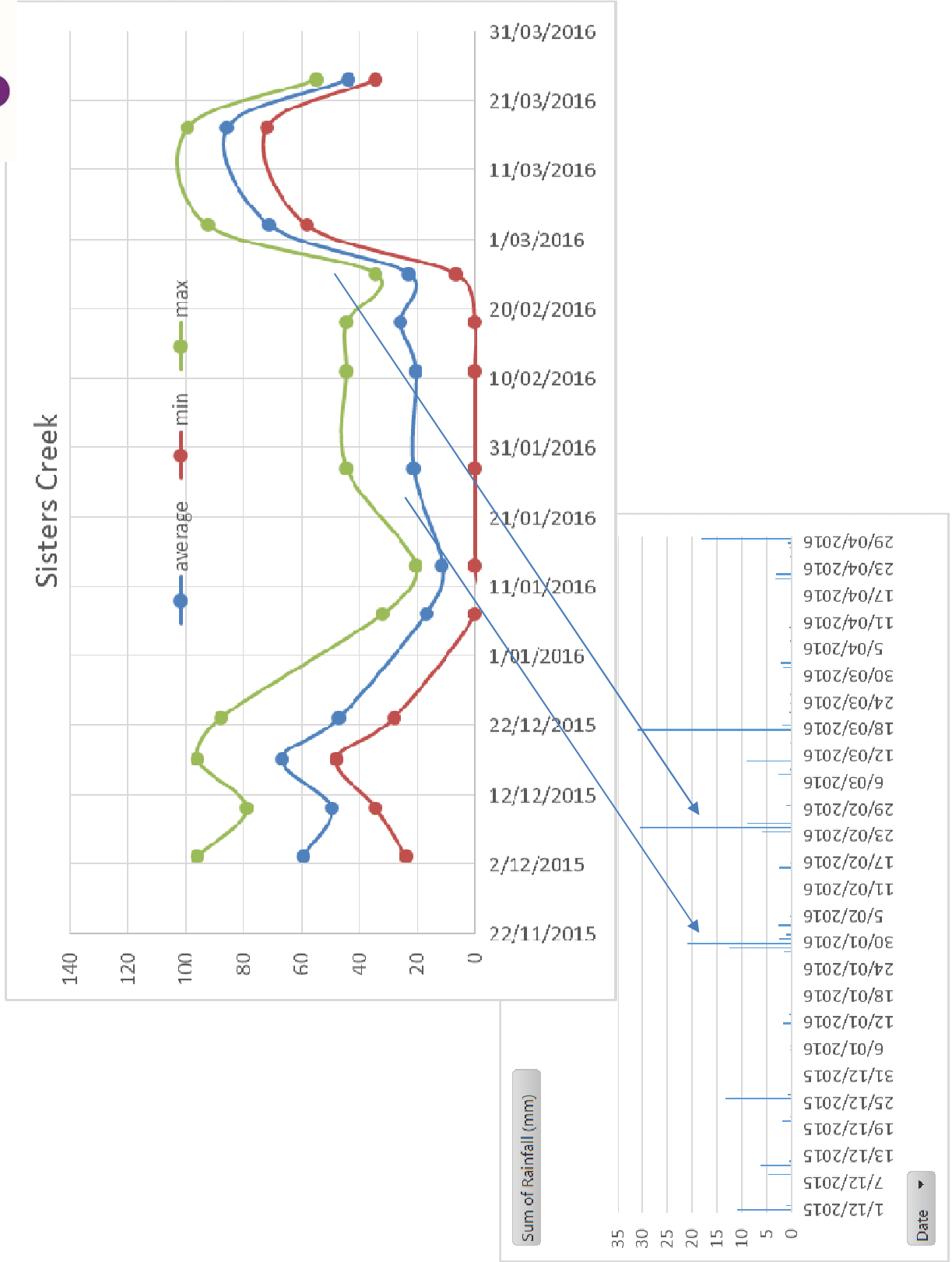
# Centre Pivot details

- 12 span machine with an end gun
- 600m in length and irrigates 60ha
- Dam water source
- 30KW motor close coupled with centrifugal pump
- Part circle (2/3)



# Sisters Creek site





# South Riana site

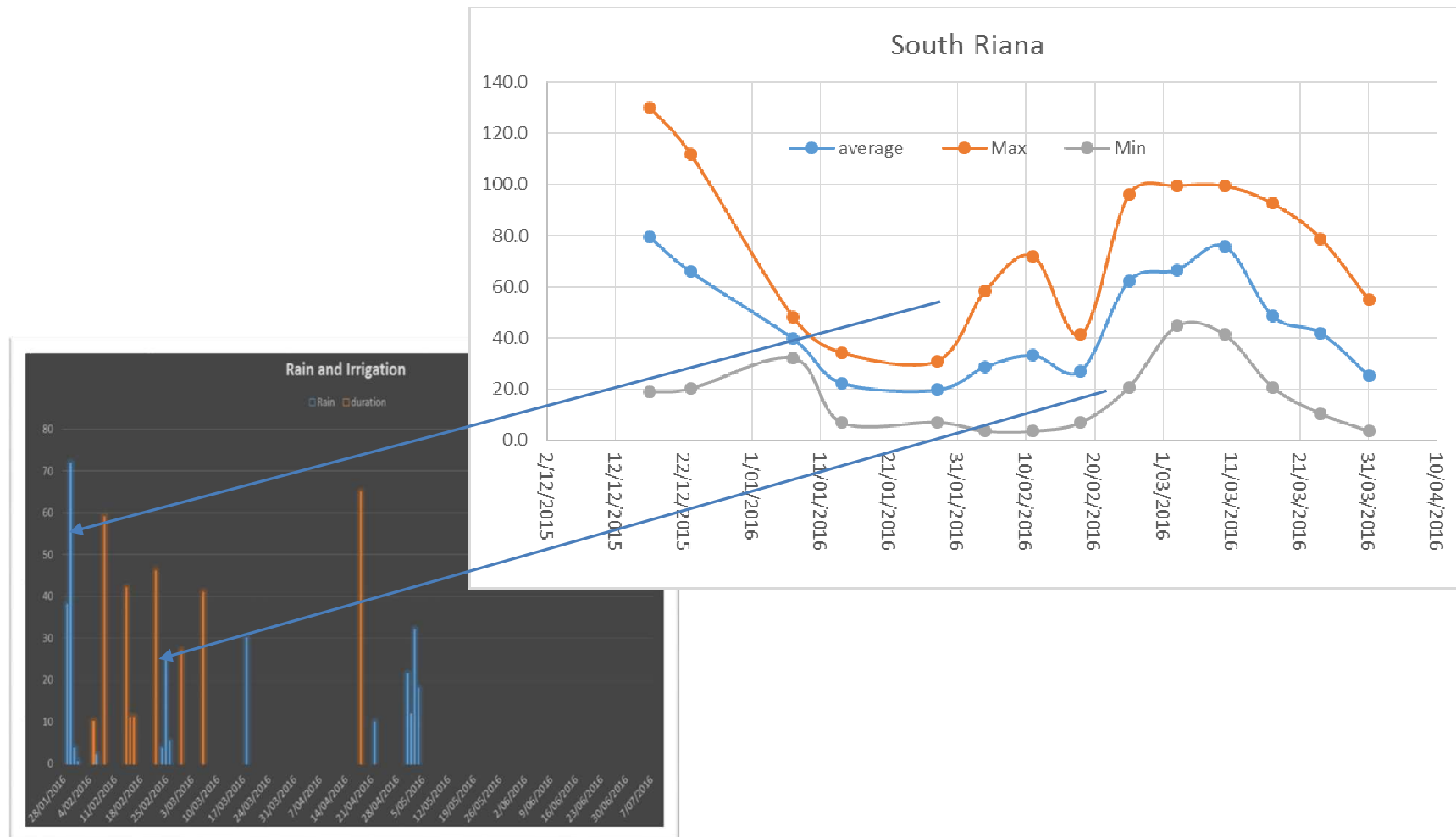




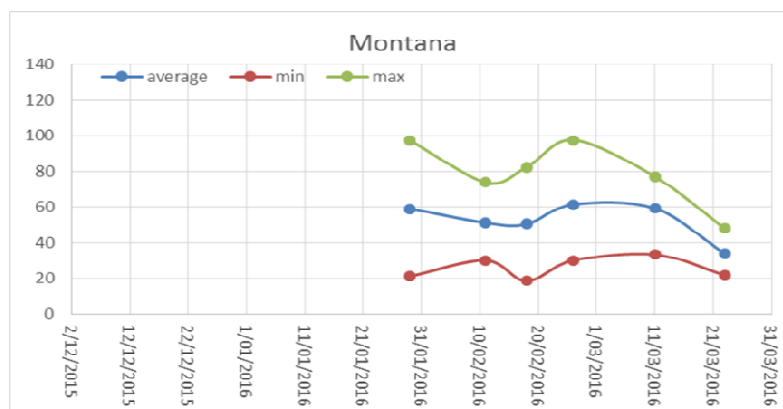
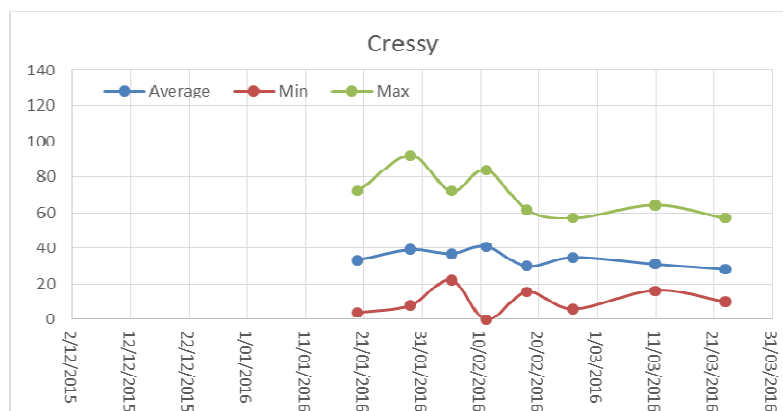
# Centre Pivot details

- 7 span machine with SR-75 0.65” end gun
- 360.9m in length and irrigates 46.17 hectares
- Dam Water source
- 45KW motor coupled with southern cross pump
- Full circle

# Pasture growth rates



# Pasture growth rates



- Cressy averaged 40kg DM/ha/d
- Opportunity loss of 20kg DM/ha/d
- Opportunity loss of 210t pasture on 117ha pivot replaced with purchased grain
- \$200/t extra cost
- \$42000 extra cost over three months

Pasture growth rates (kg DM /ha/day)

# Take home messages

- Pasture needs water to grow
- Regular watering required.....
  - Shallow roots 90% in top 30cm
  - Readily available water usually between 10 and 20mm
  - ETo over summer months usually between 4.5 and 6.5 mm
  - Irrigation interval without rain to achieve optimum growth 2-3 days
- Poor watering costs money