

MONITORING PASTURE GROWTH

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Objective

The objective of this trial was to provide data for two Crop & Food Research projects:

1. To provide commercial pasture production data to compare with rain shelter production data,
2. To provide pasture production data to include in the data set to develop an irrigation calculator for use on other dairy farms.

Methods

Pasture growth measurements were taken on three paddocks, N7, N11, and S8 by AgResearch staff from September 2005 to May 2008. The paddocks were selected to represent low (N7 on Eyre shallow silt loam over gravel), medium (N11 on Templeton deep silt loam over gravel) and high (S8 on Wakanui deep silt loam over clay) water holding capacity. N7 and N11 were irrigated by the North Block centre pivot, and S8 by the South Block centre pivot. The farm manager informed us that the two pivots applied the same amount of water each season.

Measurements were made at around monthly intervals using a cage technique. Three areas were trimmed with a mower after grazing, then protected from stock and mown after the next grazing in that paddock.

HydroServices took neutron probe soil moisture measurements to c.1m depth in the same paddocks at 2-3 week intervals. They also collated the irrigation and rainfall data.

Results

N11 was ploughed up in the summer of 2007 and so only two full year's data was collected from that paddock. HydroServices ceased soil moisture measurements on LUDF in December 2007.

Rainfall

Seasonal rainfall was 223 mm for 2005-6, 426 mm for 2006-7 and 332 mm for 2007-8.

Irrigation applied

Total irrigation applied was 588 mm for 2005-6, 360 mm for 2006-7 and 504 mm for 2007-8.

Soil moisture

Details of the soil moisture parameters used by HydroServices and their calculated irrigation and rainfall amounts and effectiveness are given in Table 1. Note that the root zone depth was changed in Table 1 after the first season, and that rainfall is lower for N11 in the final season because measurements ceased three weeks earlier in that paddock.

Graphs supplied by HydroServices shows that soil moisture content fell below the refill point only occasionally and briefly, so, according to their data, growth in the paddocks should not have been limited by soil moisture.

Table 1 Soil moisture characteristics and irrigation and water efficiencies (supplied by HydroServices).

Paddock	Year			Sep 05-Mar 06			Sep 06-May 07			Oct 07-Dec 07		
	N7	N11	S8	N7	N11	S8	N7	N11	S8	N7	N11	S8
Root zone (cm)	60	60	60	80	60	80	80	60	80	80	60	80
Full point (mm)	191	185	208	239	185	276	239	185	276	239	185	276
Refill point (mm)	143	111	153	187	111	205	187	111	205	187	111	205
Freely available water (mm)	48	74	55	52	74	71	52	74	71	52	74	71
Irrigation water applied (mm)	588	588	594	360	360	360	360	360	360	209	131	209
Irrigation effective water applied (mm)	588	588	594	360	360	339	360	360	339	209	131	194
Irrigation efficiency (%)	100	100	100	100	100	94	100	100	94	100	100	93
Number of irrigation events	98	98	99	61	61	61	35	22	35	35	22	35
Rainfall (mm)	223	253	223	426	426	426	88	46	88	88	46	88
Effective rainfall (mm)	184	199	184	304	247	275	74	38	60	74	38	60
Rainfall efficiency (%)	82	79	83	71	58	64	84	84	68	84	84	68
Number of rain events	34	39	34	55	55	55	18	10	18	18	10	18
Total water applied	811	841	817	786	786	786	297	177	297	297	177	297
Effective total water applied (mm)	712	787	778	664	607	614	283	169	254	283	169	254
Total water applied efficiency (%)	95	94	95	84	77	78	95	96	85	95	96	85
Number of water applications	132	137	133	116	116	116	53	32	53	53	32	53

Pasture Yield

Yield data supplied by AgResearch show that N11 grew more dry matter (DM) in the 2005-6 season compared to the other seasons, N7 more in the 2006-7 season, whereas S8 had similar yields in all three seasons (Figure 1).

N11 and S8 grew more DM than N7 in 2005-6 but not in 2006-7. S8 grew more dry matter than N7 in 2007-8.

These yield differences between paddocks and seasons could be partly due to differences in grazing management between the three paddocks and also to the shallower soil under N7 compared to the other two paddocks.

There was a close relationship between yield and potential evapotranspiration (PET), the driver of growth in well watered pasture (Figure 2). PET was calculated using the Penman equation from meteorological data collected at the Broadfield Weather Station 3 km north east of the Dairy Farm. The slope of the lines for N11 and S8 were very similar averaging 18.4 kg DM/ mm PET, whereas N7 produced 20% less yield at 14.8 kg DM/mm PET.

Figure 1: Cumulative yields (kg DM/ha) for three paddocks, N11, N7 and S8 over three seasons at L Lincoln University Dairy Farm.

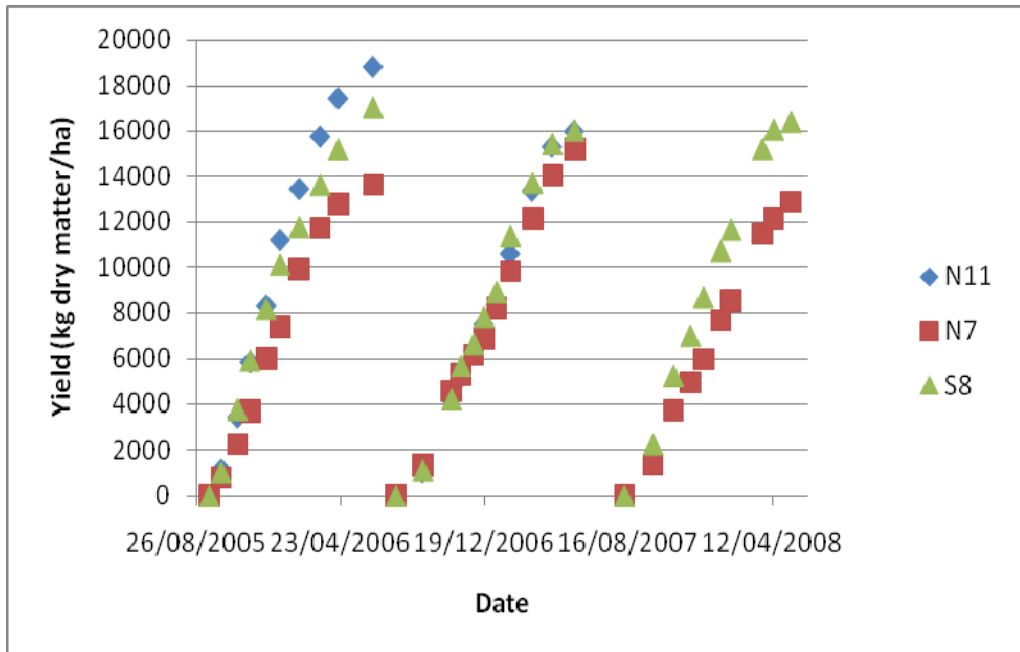
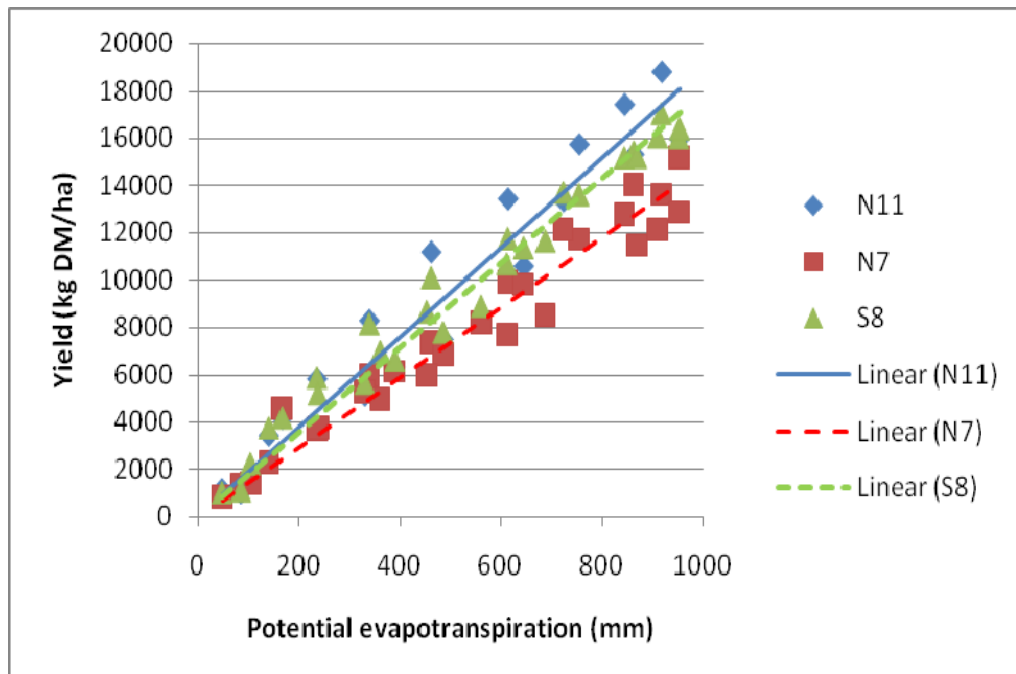


Figure 2: Cumulative yields (kg DM/ha) for three paddocks, N11, N7 and S8 over two (N11) or three seasons (N7 and S8) at Lincoln University Dairy Farm v potential evapotranspiration



Discussion

Pasture yields and their relationship to PET measured on the Lincoln University Dairy Farm were similar to those measured on other high pasture yielding dairy farms in Canterbury (Martin et al. 2006) and at the Plant & Food rain shelter 3 km north east of the Dairy Farm (Knight et al. 2007). The data have been used in the development of an Irrigation Calculator (Martin et al. 2006), and are currently being compared with ryegrass data in the rain shelter.

The irrigation appeared to be applied very efficiently, but the rainfall was utilised less efficiently, particularly in the wetter 2006-7 season when rainfall efficiencies were down to around 60% in the deeper paddocks (N11 and S8). This suggests that, in these two paddocks, the irrigation triggers could be drier than those used in this study to increase the efficient use of water without compromising yield.

Paddock N7 produced 20% less dry matter than the other two paddocks. This was on a shallower soil, and assuming that the Dairy Farm ensured that pasture growth was not restricted by soil fertility, then growth in this paddock was restricted by insufficient water. This suggests that pivot speeds and/or application rates on the North Block pivot should be adjusted to accommodate the different soil types under that irrigator in order to maximize pasture production without wasting water.

Acknowledgements

Westlea Clarke-Hill for taking the pasture cuts and HydroServices for soil moisture, irrigation and rainfall data. The project was funded from the Foundation for Research, Science and Technology Land Use Change and Intensification programme.

References

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