

IMPROVING DAIRY IRRIGATION PRACTICES

Field day 23 April 2009

Summary of Irrigation Evaluation - Stu & Gayle Litchfield, Dunsandel - February 2009

Aqualinc Research Ltd completed an evaluation of this Roto-Rainer irrigation system to assess its overall performance, and to identify areas for potential improvements in efficiency. The evaluation was conducted as one component of Sustainable Farming Fund (SFF) project C07/004.

Farm Description

Size:	180 hectare, 173 effective
Irrigation:	3x Briggs Roto-Rainer M200 11 day rotation Ring-main
Water:	Groundwater (two bores) Using 105 l/s (consented 109 l/s)
Soils:	½ Chertsey and ½ Lismore Plant Available Water (PAW) of 75 mm/m (Lismore) ~ 95 mm/m (Chertsey)
Pasture:	Ryegrass (Bronsyn ARI), White Clover
Supplement:	250 – 300 kgDM / cow silage brought on, 395kgDM/cow feed barley
Cows in milk:	650
Milk solids:	1,800 kg / ha

Pressures and Flow Rates

Pressure and flow rate measurements show that the pumps are performing to specification, and that the irrigators are receiving more than enough pressure (getting at least 33 metres, when only 28 metres is required). There is potential to lower the mainline pressure, thus helping to reduce the total energy use of the system (1 m pressure \approx 1.5 kW \approx Total potential savings of \$700/yr).

System Capacity

Peak crop demand:	5.0 mm / day
Measured capacity:	5.0 mm / day
Effective capacity:	4.7 mm / day (<i>Effective = Measured value x Application efficiency</i>)

Because the effective system capacity is slightly lower than the peak crop demand, this system is expected to be able to keep up with plant water use in all but the driest months. Some plant stress is likely to occur during these periods, especially on the lighter Lismore soils.

Application Rate

Very little surface ponding was observed along the middle of the Roto-Rainer runs, indicating an effective average application rate.

However, significant ponding and runoff were noted at the ends of each run, where the machine operates in a stationary position for up to several hours. There is potential to reduce water use and

energy consumption by reducing end-of-run times. The automatic cut-offs recently installed will greatly help with this. (1 hr/day for all runs \approx \$30/day \approx Total potential savings of \$4,500/yr \approx 650 m³/day \approx 97,000 m³/yr).

Application Uniformity

Measured application uniformity within each paddock is relatively high, when compared to a typical Roto-Rainer system (see table below). This is a good result and means that water is being applied more evenly across the paddock than is usually expected.

	Measured	Typical Values
Average Application Uniformity (DU _{1q})	81 %	68 – 76 % *
Average Application Uniformity (CU _c)	87 %	80 – 85 % *
Potential application efficiency	94 %	90 – 93 % *

*Based on recommended uniformities reported in INZ's Design CoP for rotating boom irrigators.

Despite high uniformity, some significant watering onto the lanes was observed at the end of several runs. Adjusting the run stop positions to minimise this off-target irrigation will help to avoid erosion problems, and lead to further water and electricity savings (take 10 metres off all runs \approx 0.5 hr/day \approx \$15/day \approx Total potential savings of \$2,250/yr \approx 325 m³/day \approx 48,500 m³/yr).

Energy Efficiency

Total energy rating (2 pumps): 190 kW
 Energy per hectare: 1.1 kW / ha
 Energy per volume pumped: 490 kWh / 1,000 m³

Energy efficiency for this system is comparable to what would be theoretically expected based on typical pump efficiencies and the measured pressure and flow rate at the pumps.

Labour Efficiency

Labour required for operation: 1.5 hrs / day
 Labour required for maintenance: 4.0 hrs / month
 Total labour required: 245 hrs / yr
 1.4 hrs / ha / yr
 0.2 hrs / 1000 m³

There is not much room for improvement in labour efficiency for a Roto-Rainer system.

Operating Costs

	Cost Per Area (\$ / ha / yr)	Cost Per Volume Pumped (\$ / 1000 m ³)
Electricity for pumping	\$510	\$85
Labour for shifting	\$40	\$10
Maintenance *	\$20	\$5
Tractor operation	\$60	\$10
Total operating cost	\$630	\$110

*Includes 4 hrs / month in-house labour, plus \$2,500 / yr for full service of Roto-Rainers.

Energy costs for pumping account for more than 80% of irrigation operating costs on this farm, which serves to highlight the potential savings to be made by reducing energy consumption. The pumping costs calculated for this farm are generally comparable to costs calculated in a previous Aqualinc study (McIndoe 2003) for bores of a similar depth.

Other Notes

Keep flow meters in working order. Flow meter readings are pivotal to the calculation of many of the KPIs discussed earlier, and regular readings will give a good indication of the ongoing performance of an irrigation system and as an early warning of changes in irrigation efficiency.

Although there is no seasonal volume restriction imposed on this property yet, the current policy trend is moving in that direction, and the use of flow meters will become more important for irrigation managers in the near future. Regular monitoring of flow rates, in conjunction with soil moisture monitoring, will help to ensure enough water is still available later in the season, when it may be needed more critically.

Key Points

- Because measured pressures at the Roto-Rainers were higher than the manufacturer recommended pressures, there is potential to lower the mainline pressure without reducing performance. This will help reduce total energy use (1 m pressure \approx 1.5 kW \approx \$700/yr).
- This Roto-Rainer system is expected to be able to keep up with plant water use in all but the driest months, at which point it should be able to meet at least 90% of demand.
- The machines are sitting stationary for too long at the ends of runs, and causing surface runoff. There is potential to reduce water use and energy consumption by reducing end-of-run times (1 hr/day from all runs \approx \$30/day \approx \$4,500/yr \approx 650 m³/day \approx 97,000 m³/yr).
- Measured application uniformity is high compared to a “typical” Roto-Rainer system. This means that water is being applied more evenly than many other Roto Rainer systems.
- Some significant watering onto the lanes was observed at the end of several runs. Adjusting the run stop positions to minimise this off-target irrigation will help to avoid erosion problems, and lead to further water and electricity savings. (10 metres from all runs \approx 0.5 hr/day \approx \$15/day \approx \$2,250/yr \approx 325 m³/day \approx 48,500 m³/yr).
- Energy costs for pumping account for more than 80% of irrigation operating costs on this farm, which serves to further highlight potential savings to be made by reducing energy consumption.

Potential Energy & Water Savings (as identified by system evaluation)

	Energy Saving (\$ / day)	Energy Saving (\$ / year)	Water Saving (m ³ / day)	Water Saving (m ³ / year)
Reduce mainline pressure by up to 5 m (1 m \approx 1 ½ kW)	\$25	\$3,500	0	0
Reduce end-of-run irrigation by 1 hr/run (Avoids ponding at end of runs)	\$30	\$4,500	650	97,000
Shorten all runs by 10 m (Avoids watering lanes)	\$15	\$2,250	320	48,500
TOTAL	\$70	\$10,250	970	145,500

For project information contact:

Sue Cumberworth, The AgriBusiness Group, Mobile 027 628 6110, Email sue@agribusinessgroup.com

Geoff Dunham, The AgriBusiness Group, Mobile 0274 336 564, Email geoffdunham@agribusinessgroup.com