

IMPROVING IRRIGATION EFFICIENCY: IS THE LIMITING FACTOR THE DRIVER OR THE CAR?

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“If you cannot measure it, you cannot improve it”

“If you cannot measure it, you cannot improve it” (Lord Kelvin) is a wonderful quote which captures the essence of how we should think when it comes to improving the way we use water for irrigation on our farmland.

Farmers have a lot of questions about how to improve irrigation efficiency (or simply put - irrigating in a way that saves us time, money, water while maintaining or increasing production) and often the first thing one thinks is they must change their irrigation type to get improved results. While that may be the case in many situations this paper is about ‘backing up the truck’ and focusing on two areas regardless of your set up which will allow potential to be realised within the existing system.

Is it the driver or the car?

To make improvements in the way we irrigate first we must identify whether the limiting factor is

- The operator (the driver) or
- The irrigation system (the car)

Now of course everybody thinks they are good drivers so most people will automatically think it is the car (or the irrigation system) that is letting them down, right? Whether we want to admit it or not we all know deep down we have the ability to become better car drivers by adhering to the speed limit, not making that extra trip to town or doing more maintenance on our vehicles.

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Irrigation is no different and as operators huge potential exists to manage our irrigation smarter regardless of our system.

First step, improve my driving!

Scott Searle is a lower order sharemilker on Selwyn Dairies Ltd; a 315 ha, 1050 cow dairy farm located just north of the Rakaia River which is fully irrigated using travelling rotating boom irrigators. In 2009-10 Selwyn Dairies Ltd participated in a joint project between the farm owners Dairy Holdings Ltd, Dr Blair Miller, Streat Instruments and EECA (Energy Efficiency and Conservation Authority) to introduce on farm irrigation monitoring systems to improve water use efficiency on farm. Monitoring has continue on at the completion of this project and information presented in this paper is a combination of data gathered in the 2008-09 (pre project - no testing or monitoring), 2009-10 (project year - testing carried out and monitoring started) and 2010-11 (all monitoring equipment installed and data available) seasons.

What was done on farm?

1. Developed easy access to information to make more informed decisions on:
 - Water requirements and timing (through soil moisture & temperature monitoring)
 - Water and energy usage (water meters)
 - Performance of irrigation system (evaluation of irrigation system performance)
2. Staff training
 - Speeding up irrigation times so irrigators ran for less time with lower application rates
 - Adjusting timing so more irrigation occurred at night for lower electricity rate
 - Shutting off machines earlier at end of runs
3. End of season evaluation of results and recommendations for further development

What were the results?

Information on soil moisture information has become the basis for which all irrigation decisions for the farm are made especially in the shoulders of the season. And with watchful management this property has shown it is possible to improve efficiency of the application of Roto Rainer irrigators. They have become better drivers without the need to change the model of their car.

Soil moisture monitoring

The below charts show the data collected from the Aquaflex strips underground in paddock 17 on Selwyn Dairies Ltd. Figure 1 shows the soil moisture status and rainfall for the 2009-10 season (this is the first season technology was used), figure 2 is the same information but for the 2010-11 season. These two charts do a great job at illustrating the continual improvements being made on Selwyn Dairies to limit the soil moisture status exceeding field capacity.

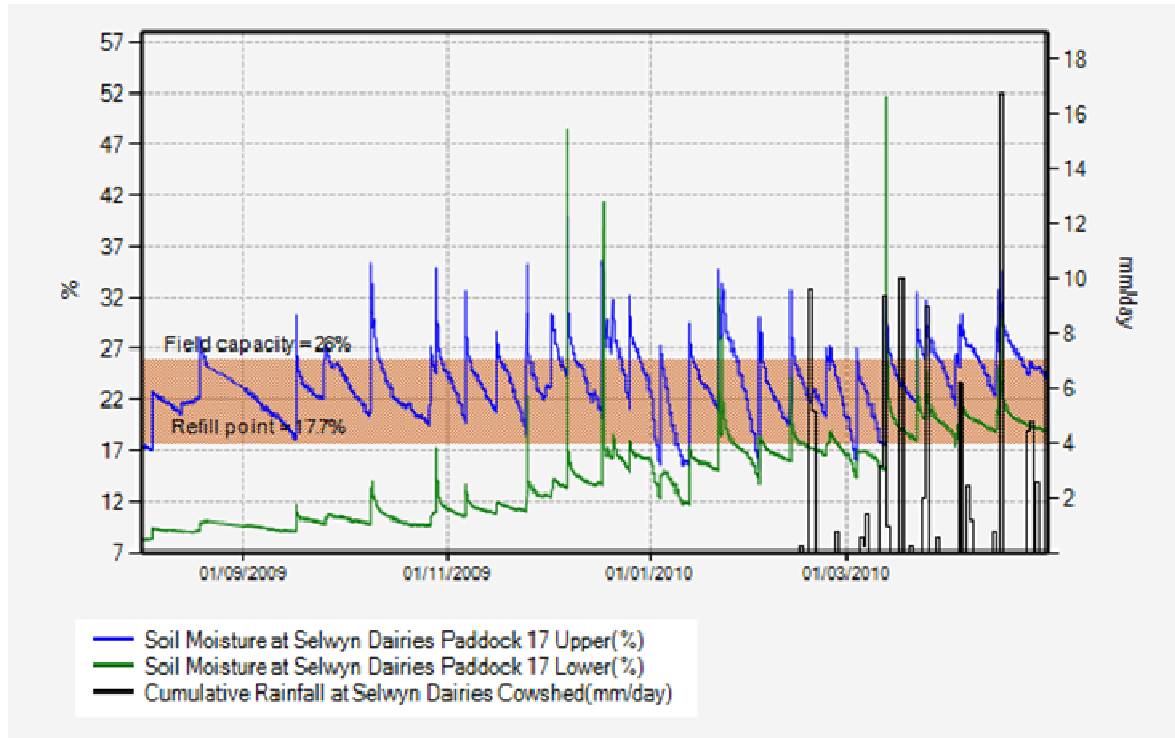


Figure 1: Soil moisture and rainfall status 2009-10 season

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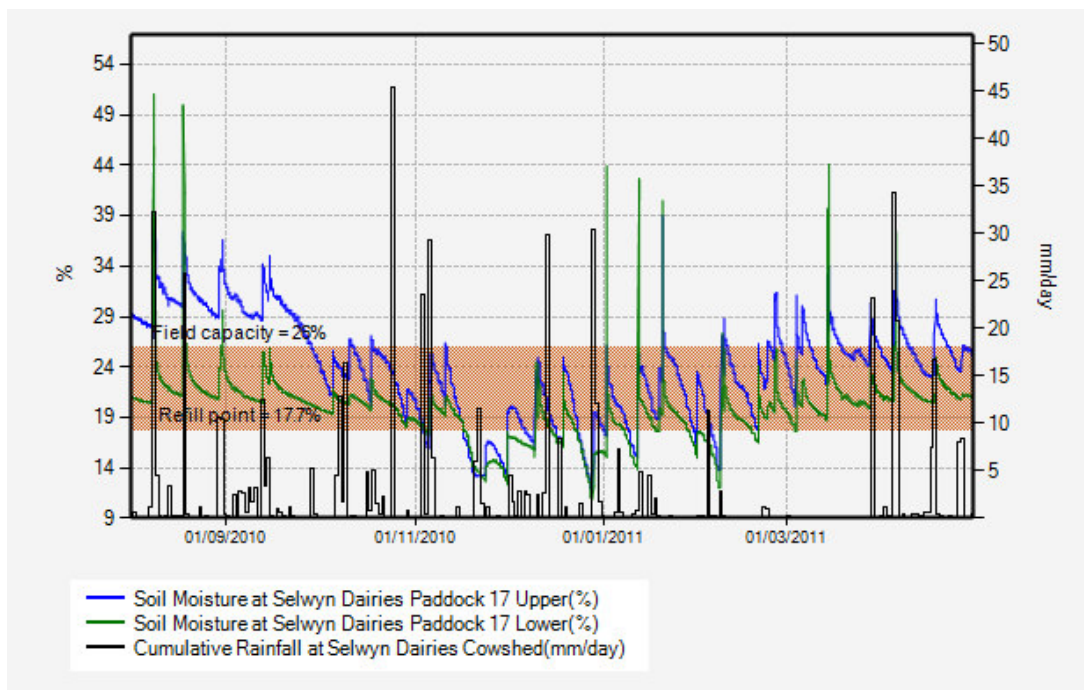


Figure 2: Soil moisture and rainfall status 2010-11 season

Water use

The volume of total water used in 2010-11 season was 21% less than in 2009-10 (these are the first two seasons total water used was recorded). Based on NIWA rainfall records, rainfall for the farm during the irrigation season (Sept – Apr) in 2009-10 was 287mm and 370mm in 2010-11.

Energy Use

Energy use is best compared using KWh used across the season rather than electricity cost as energy consumption rates vary from season to season. Figure 3 illustrates the differences in monthly energy consumption between seasons. Energy savings for the 2009-10 season were estimated to be 200,000KWh, meaning a total saving of \$11,000 for the season.

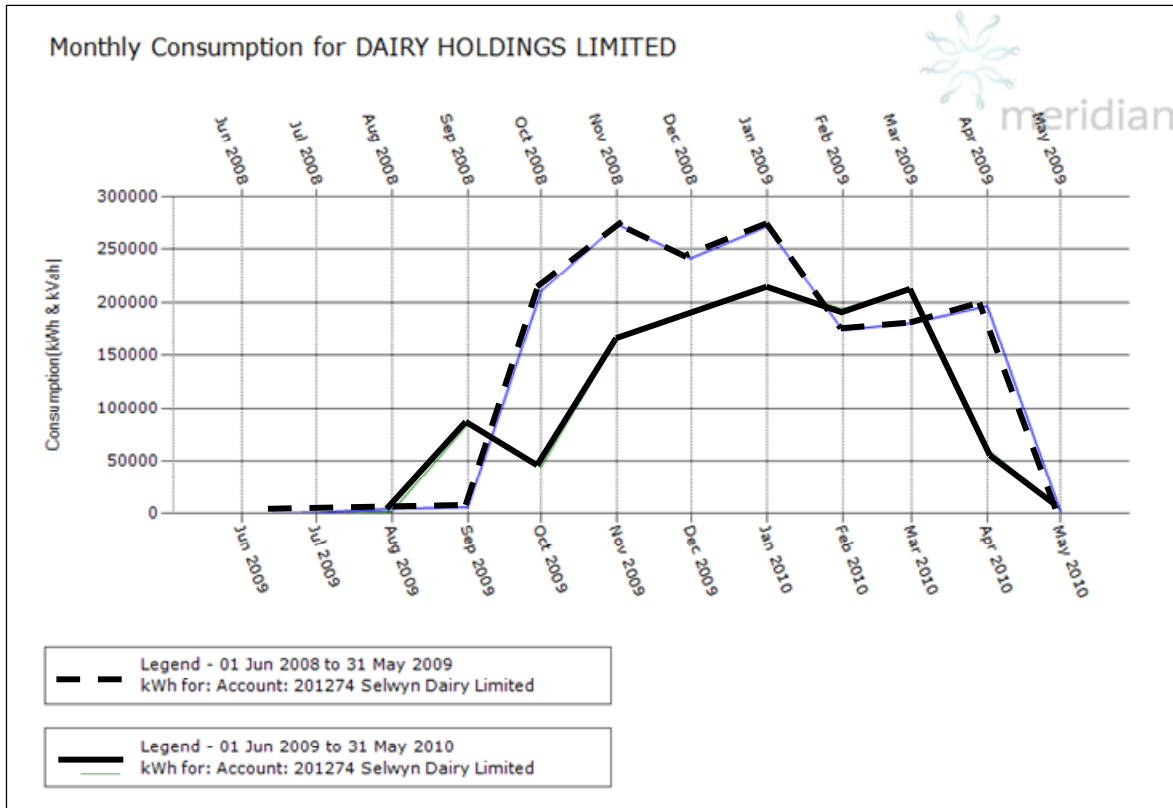


Figure 3: Monthly consumption for Selwyn Dairy Ltd.

Irrigation system performance evaluation

An irrigation system evaluation was carried out to find out how well the system was performing in relation to what it is specified or designed to do and identify where the opportunities were to improve. ‘Bucket tests’ were carried out to measure the application depths across the spans of the irrigators. The below graphs show the test results. A ‘bucket test’ is based on collecting irrigation water in strategically placed buckets and measuring what water is collected over a certain

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period of time. 'IRRIG8Quick' provides instructions for pivot, linear, traveller and sprayline irrigators to carry out this test. Go to www.pagebloomer.co.nz/resources/tools.

Initial results showed very poor uniformity of application. Pressure was not the problem so irrigator nozzles were inspected. Early tests confirmed that Distribution Uniformity (DU) was not satisfactory at 0.74 meaning some areas were receiving too much water and some areas not enough (perfect system DU = 1.0 meaning each plant would receive exactly the same amount of water).

Particular focus was given to the cross over points between runs where a lack of water was being applied. This is also where the Aquaflex monitors are located, so any readings would be misrepresentative as the middle of the runs would have higher soil moisture levels but management would be making irrigation decisions based on lower soil moisture readings which would result in overwatering large areas of the run.

Figure 4 illustrates the results found during the first tests. Each line represents a different irrigator and each point along the line is the reading from the collection bucket. Not only were there large variations between the individual Roto Rainers but also across the spans. The real concern was low application depths at either end of spans compared to the middle of the irrigator.

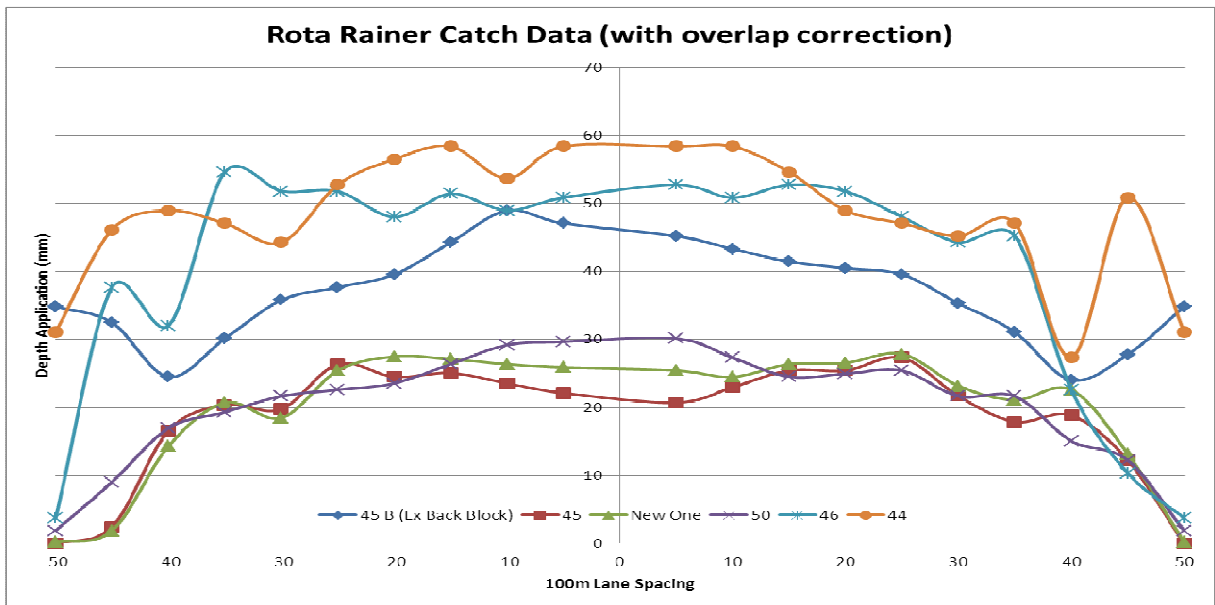


Figure 4: Initial bucket test results

Continual alterations to nozzles across the width of the irrigator spans reduced the variation in application depth to as little as 5mm (Figure 5). As a result farm staff bought the DU from 0.74 to 0.92 which is very good for this type of travelling irrigator.

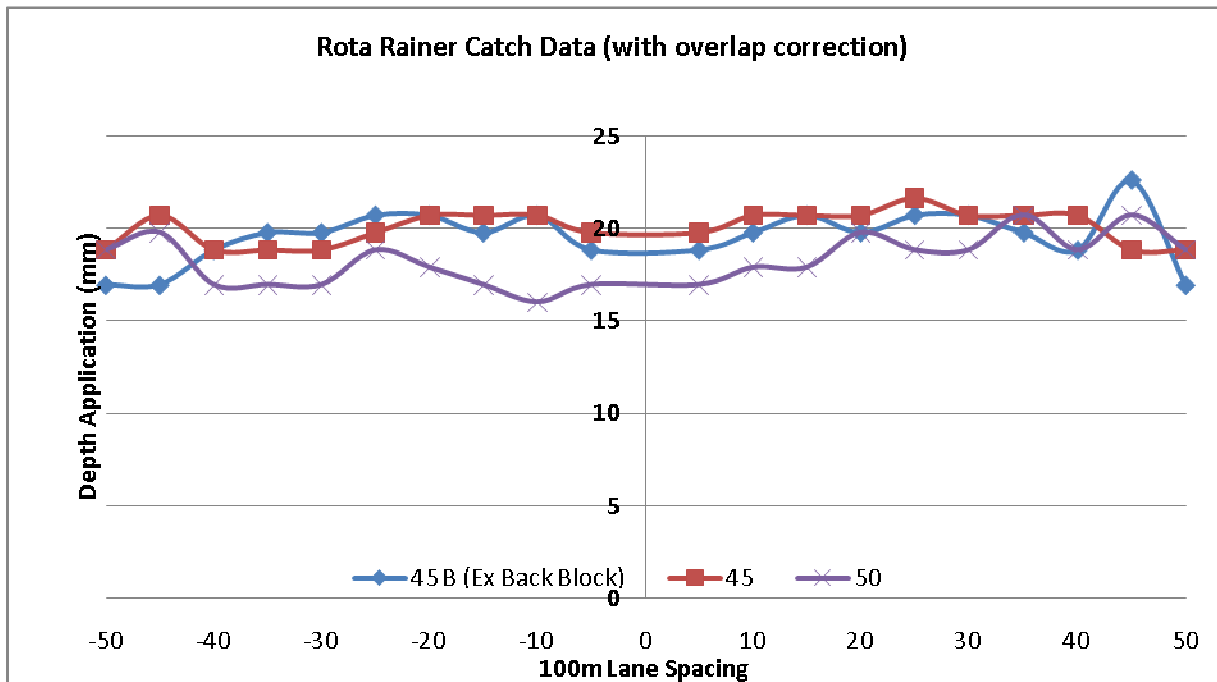


Figure 5: Final bucket test results

Where to from here?

Involvement in this project has provided Scott with huge insight into the opportunities which exist to be smarter about the way irrigation is managed and the savings and increased production which can be achieved. Scott has developed great enthusiasm for irrigation and is continuing to ensure his business can get the most from the resources involved. This includes more strategic

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application of nitrogen, more efficient sourcing of water and investigation of alternative irrigation type.

Want to find out more?

To find out more about what makes a good irrigation system and operator take a look at the DairyNZ 'Guide to Good Irrigation 1 & 2'.

References

McGregor G, Miller B, Herbison J. 2010, Final Report: Improved Irrigation Efficiency at Selwyn Dairies Ltd.