

Gwydir Valley Irrigators Association Inc.

458 Frome St, PO Box 1451, Moree NSW 2400

Planting Configuration and Watering Regime Trial “Redbank”, Moree

“Less Crop but more Drops? Water use efficiency in limited water situations using different row spacings and irrigation strategies”

Trial Highlights

- We compared the yield and water use of partially irrigated systems using solid, single-skip and double skip configurations to a fully irrigated solid crop
- Irrigations were scheduled using NAWF with the aim to keep the crop in the partially irrigated system flowering as long as possible to take advantage of any in-crop rainfall where three irrigations were available or to finish the crop off where only one was planned
- The season was characterised by a very wet start and dry finish, with less ability for the partially irrigated treatments to capture rainfall than in a more typical year
- The solid, fully irrigated crop yielded over 12.5 bales/ha but the single-skip semi-irrigated had a respectable yield of 8.65 bales/ha with better irrigation water use efficiency
- Difficult to make conclusions about these systems from one year’s data but the single-skip semi-irrigated system may have potential in limited water situations

Aim

- (i) Compare the yield potential of different skip row configurations and partially irrigated treatments;
- (ii) establish the relationship between crop stress and yield in under these scenarios.

Method

Sicot 74BRF was used with 7 treatments with 3 replications of each. Solid plant spacings were 1 m spaced rows, single-skip (2 rows in, 1) and double skip (2 in, 2 out).

1. Solid – normal irrigation (full)
2. Solid – three irrigations (semi)
3. Single Skip – three irrigations (semi)
4. Double Skip – three irrigations (semi)
5. Solid – one irrigation (limited)
6. Single Skip – one irrigation (limited)
7. Double Skip – one irrigation (limited)



1 Figure 1 View of single skip replication next to solid.

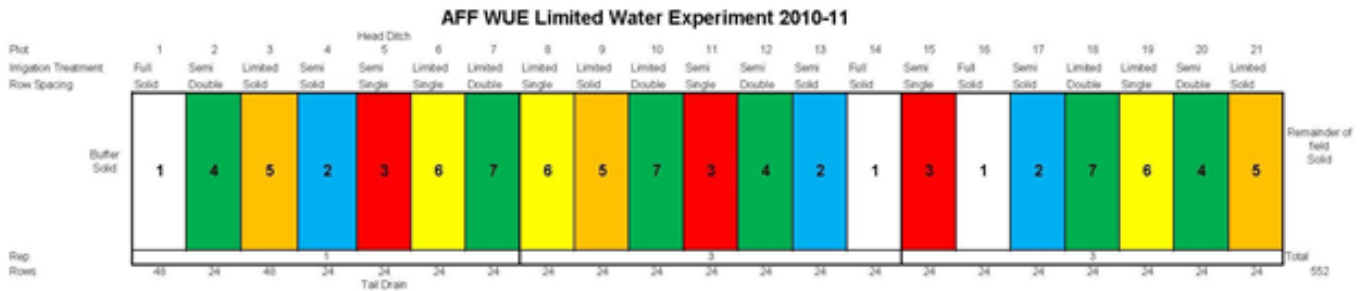


Figure 2. Trial design

Timing of irrigations

Normal – as per normal deficit (Scheduled by Mike Stone as per rest of field)

Semi - Three Irrigations – timed to keep crop developing at 7-6 NAWF. Irrigation to be considered if NAWF < 7, depending on climate, crop stress and fruit load.

Limited - One Irrigation – applied approaching cut-out (NAWF <5) to allow further growth and boll set or to mature and retain bolls already set.

Table 1: Irrigations applied.

Solid Full	Solid Semi (3)	Solid Limited (1)	Single Skip Semi (3)	Single Skip Limited (1)	Double Skip Semi (3)	Double Skip Limited (1)
22/12/2010						
31/12/2010	31/12/2010		31/12/2010		31/12/2010	
14/01/2011	14/01/2011	14/01/2011		14/01/2011		14/01/2011
23/01/2011			23/01/2011		23/01/2011	
31/01/2011						
7/02/2011	9/02/2011		9/02/2011		9/02/2011	
20/02/2011						
01/03/2011						

Data collection

- Capacitance probes and neutron moisture probes were installed in both the plant line and skip rows to monitor soil water.
- Plant mapping, nodes above white flower, heights, nodes, light interception, canopy cover and maturity were monitored at least weekly to determine differences in crop growth and development.
- Canopy temperature sensors (Smartcrop sensors) were installed above the crop to determine crop stress indicated by canopy temperature in each treatment.
- Two plots were monitored by CSIRO's irriSAT system.
- Water balance was also calculated during the season using a calibrated canopy coefficient (Kc) approach by estimating canopy cover.

Results and discussion

The 2010-11 season was cooler in terms of cumulative day degrees and characterised by above average rainfall up until Christmas followed by below average rainfall from January to March (Figure 3). This meant that all the treatments had a full profile of soil moisture until late November and developed in relatively mild conditions in the first part of the growth period.

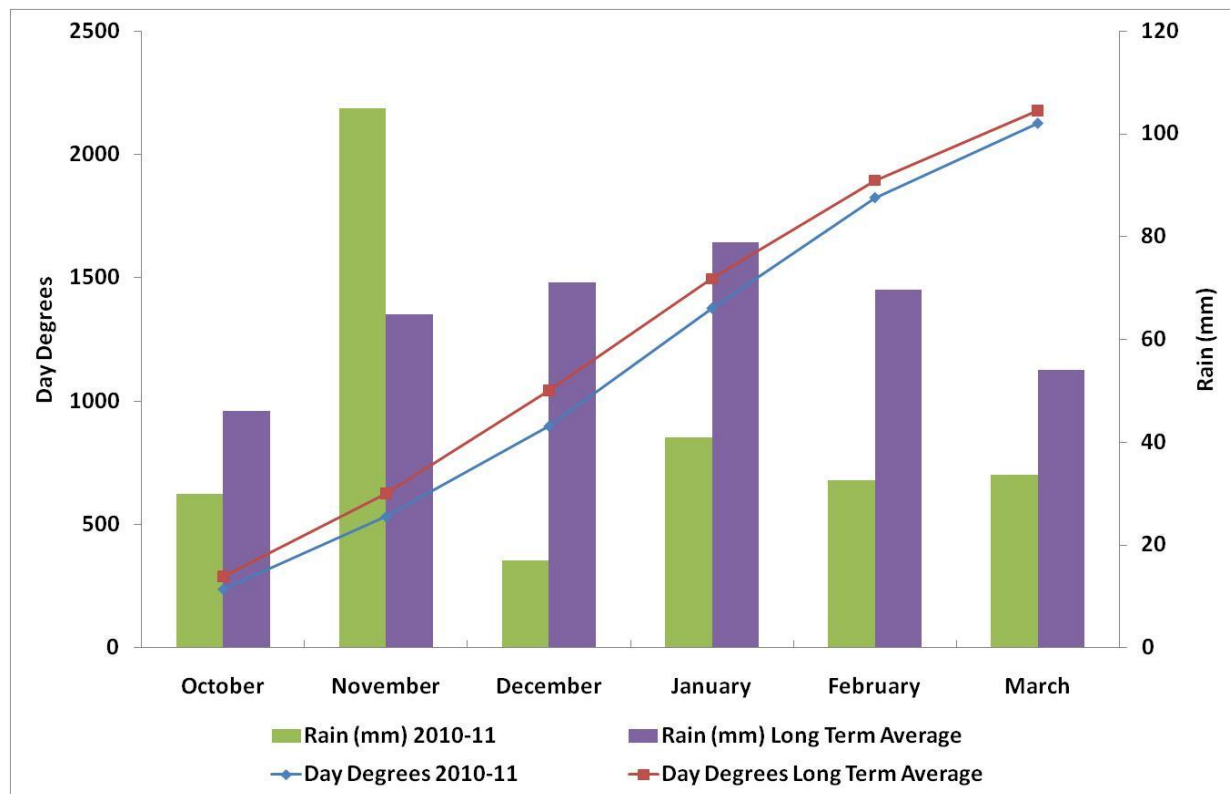


Figure 3. Day Degrees and Rainfall at Redbank Experiment 2010-11 compared with the long-term averages for Moree. Source: Cottassist Climate Analysis Tool

Estimating crop evapotranspiration (ET_c) using the chequer board method to calibrate it to the crop worked very well in the solid, fully irrigated and the semi-irrigated treatments, but this approach over-estimated water use in the limited irrigations and skip row treatments (Table 2). Comparing the water balance to actual soil moisture measurements the differences between the calculated ET_c in the partially and limited irrigated systems was due to the ET_c approach not accounting for declines in crop water use due to plant stress and over estimating the amount of water in the skip-rows.

Yields were highest in the solid, fully irrigated treatment, followed by the single-skip, semi irrigated treatment and the solid, semi irrigated treatment (Table 2). Water use however was higher in the solid, fully irrigated and solid, semi irrigated treatment when compared to the single-skip semi-irrigated treatment, which had the highest irrigation water use efficiency and higher total water use efficiency than any of the other partially irrigated treatments. The solid, fully irrigated treatments took longer to mature than the other treatments and rainfall in March led to the fully irrigated treatment having higher effective rainfall and more stored soil moisture remaining at the end of the season than the other treatments.

Evaluating these systems based on one season's data is not possible but the single-skip semi irrigated treatment had the highest irrigation water use efficiency and maintained reasonable yields (Table 2). It is important to note that very little in-crop rainfall fell during the later part of the season and differences between the solid planting and hence ability for the skip row treatments to capture

more rainfall than the fully solid treatments was less than would be expected in a more typical season (Figure 3).

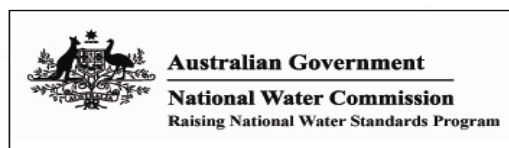
Table 2. Yield and Water Use in Redbank, Limited Water Experiment 2010-11

Treatments	Average Yield bales/Ha	Estimated Starting Soil Moisture 28/9/10	Irrigation Water Applied ML/Ha	Effective Rainfall ML/Ha	Ending Soil Moisture @ Defoliation ML/Ha	Total Available Water ML/Ha	Bales/ML Applied Irrigation Water	Bales/ML Total Water	Estimated ETc
Solid - Full	12.54	2.20	4.15	2.28	1.15	7.35	3.02	1.71	7.35
Solid - Semi	7.08	2.20	3.20	1.87	0.56	6.71	2.21	1.06	6.87
Solid - Limited	6.67	2.20	1.43	1.94	0.00	5.57	4.66	1.20	5.82
Single - Semi	8.65	2.20	2.64	1.61	0.57	5.76	3.28	1.50	7.32
Single - Limited	6.26	2.20	1.11	1.69	0.11	4.89	5.65	1.28	6.39
Double - Semi	6.81	2.20	2.28	1.53	0.61	5.24	2.99	1.30	7.52
Double - Limited	5.09	2.20	0.89	1.60	0.11	4.58	5.72	1.11	6.79

The semi-irrigated treatments required a significant amount of water in each of the three irrigations which needs to be considered when planning a partially-irrigated approach, i.e. three irrigations in a partially irrigated system is not necessarily equal to three in a fully-irrigated system. In hindsight we may have scheduled the final irrigation earlier in the semi-irrigated treatments to maintain fruit numbers, crop water use rapidly declined in the partially irrigated treatments before the final irrigation and the crop wasn't able to recover to fully utilise the final irrigation, evident by over 0.5 ML of stored soil moisture remaining in the profile in the semi-irrigated treatments. The efficiency gain in the single-skip irrigated treatment indicates that it may have a good fit in a limited water situation.

More research is needed to develop irrigation strategies for limited water situations, across a range of environments to understand the consequences of the timing and amount of irrigation applied on plant stress, yield and quality.

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