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Potato Update

Issue 6

Effect of irrigation rates and timings on marketable tuber yield of Russet Burbank potatoes

Introduction

In Canterbury, irrigation is essential for maximising potato yields, as summer rainfall is often inadequate. Since all crops need irrigation during this period and water is a limited resource in most farming systems, it is helpful to know where water savings can be made for potato crops, without compromising yield. Additionally, excessive watering can risk drainage and leaching. This project investigated a range of irrigation amounts and timings to test their impact on tuber yield and quality.

Method

The research was undertaken on a commercial farm at Dorie, Mid Canterbury, using the processing cultivar 'Russet Burbank'. The soil type was a deep Templeton silt loam with storage to 50 cm depth of about 80 mm of crop-available water when full. The crop was planted on 30 September 2014 and received the same management and inputs that the grower used except for the water application. The trial was set up with four replicates of seven irrigation treatments and each plot was four rows by 10 m. Soil water content was monitored using time domain reflectometry (TDR) sensors, which were placed in the ridge to a depth of 50 cm and under the furrow to a depth of 25 cm. Water was applied weekly through drip irrigation set up along the top of the ridge.

The treatments were:

1. No irrigation (rain fed only).
2. Replace 33% of soil water deficit (SWD) weekly.
3. Replace 66% of SWD weekly.
4. Replace 100% of SWD weekly.
5. Replace 100% of SWD weekly until canopy closure, then replace 50% of SWD weekly.
6. Replace 50% of SWD weekly until canopy closure, then replace 100% of SWD weekly.
7. Replace 100% of SWD weekly, except once after canopy closure.

Final harvest was carried out for the middle two rows by 4 m of each plot and graded into three tuber size classes; 0-60 mm (reject) 60-90 mm and >90 mm.

Key points

- An irrigation trial (drip tape) with seven treatments ranging from no irrigation (rain fed) to 100% replacement of the soil water deficit was established in a commercial 'Russet Burbank' crop at Dorie, Mid Canterbury.
- Marketable yield was reduced from 79 t/ha to 40-60 t/ha when weekly irrigation fell below 66% of the soil water deficit.
- Irrigation reduced the amount of small (<60 mm) and medium (60-90 mm) sized tubers and increased the yield of large tubers (>90 mm).
- Replacing 66% of the soil water deficit weekly was the most water use efficient.
- Replacing only 50% of the soil water deficit after canopy closure gave a yield penalty of 10 t/ha.
- The treatment which applied only 50% of the deficit up until canopy closure, then 100% thereafter, had a similar size distribution and yield to the full irrigation treatments.
- Similarly, missing one week's irrigation at canopy closure did not influence marketable yield.

Results

Treatment 4 (fully irrigated) along with treatments 6 and 7 produced the highest marketable yields at 79 t/ha (Figure 1). Irrigation replacing less than 66% SWD reduced marketable yield by 40 t/ha for treatment 1 (rain fed) and 15 t/ha for treatment 2 (33% SWD replaced). There was no significant difference between full irrigation and only replacing 66% of SWD (76 t/ha vs 79 t/ha). Constant water stress after canopy closure (treatment 5) reduced yield to 69.5 t/ha. Stress before canopy closure (treatment 6) had no effect on yield.

Irrigation reduced the yield of small tubers (0-60 mm) from 2 t/ha under nil irrigation to 1 t/ha under all the other treatments (Figure 2). Similarly, irrigation reduced the yield of medium sized tubers from 21 t/ha under nil irrigation to between 12 and 14 t/ha under adequate irrigation (treatments 3, 4, 6 and 7). Conversely, the yield of large tubers of >90 mm increased when adequately irrigated (17 t/ha with no irrigation compared to about 65 t/ha for treatments 3, 4, 6 and 7). There was a similar marketable yield and tuber size distribution pattern for treatments 3 and 4 (66% and 100% SWD replacement).

Replacing 50% of SWD after canopy closure reduced the >90 mm tuber yield by 14 t/ha, compared to treatments 3, 4, 6 and 7. Reducing irrigation to 50% prior to canopy closure (treatment 6) did not influence the yield or size distribution of potatoes. Similarly missing a week's irrigation (e.g. irrigator breakdown) at canopy closure (treatment 7) did not influence yield or tuber size distribution.

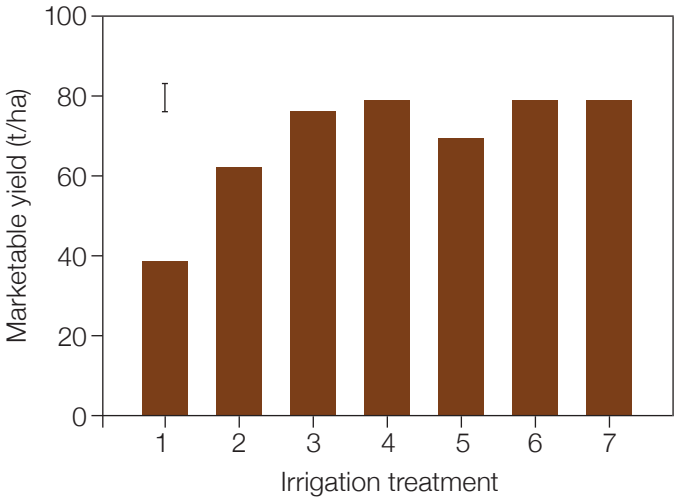

Figure 1. Marketable yield (t/ha) for 7 irrigation treatments, cv. 'Russet Burbank' at Dorie, Mid Canterbury. Bar represents LSD (p = 0.05, df=18).

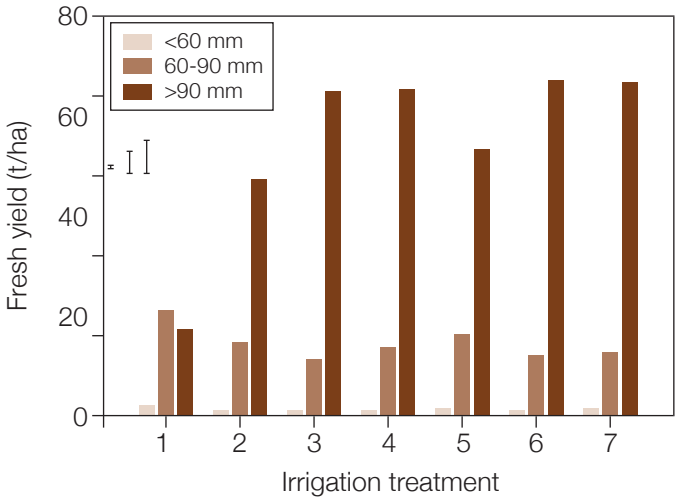

Figure 2. Distribution of tuber size in diameter <60 mm, 60-90 mm and >90 mm (fresh yield t/ha) for 7 irrigation treatments, cv. 'Russet Burbank' at Dorie, Mid Canterbury. Bars represents LSD (p = 0.05, df=18).

Discussion

In this situation (deep soil, drip irrigation), replacing 66% of SWD weekly yielded the same as 100% replacement, showing that matching water supply closely to crop needs can save water and reduce the risk of leaching and drainage. For 'Russet Burbank', early water stress had less impact on yield than did stress during the main period of tuber bulking. However, other cultivars may be more sensitive to early water stress during tuber initiation. As water infiltration and runoff patterns are likely to be different under sprinkler irrigation, growers should be wary of applying any of the 'optimum' irrigation regimes discussed here to sprinkler irrigated crops.

Acknowledgements

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