POTATO CASE STUDY PART II
MAY 2020

SoilWealth NURTURING CROPS
Integrated Crop Protection PROTECTING CROPS

Irrigation monitoring in potatoes: Practical use of satellite information

The NSW case study has shown that IrriSAT satellite images, used to monitor irrigation, can also help potato growers identify soil and irrigation problems across the pivot. Fixing the problems identified in this case study would have increased yield and revenue by between $7,600 and $10,800 under this half pivot.

The key findings were:

- **Significant yield improvements**: An irrigation problem was identified that reduced the potato yield in a 3.1 ha zone by 17 tonnes and cost the grower between $4,800-$6,800.
- **Early detection of problems**: The problem was caused by poor sprinkler performance in span 2 and 3 and could be seen in the satellite images two months before harvest, allowing time for the problem to be corrected.
- **Soil problems identified**: A separate soil problem area, possibly caused by laser levelling, was also identified in the satellite images. This problem reduced yield by 27% over 1 ha of the pivot and cost the grower between $2,800-$4,000 by reducing yield by 10 tonnes.
- **Financial gains**: Fixing both issues could have increased the gross revenue by between $7,600 and $10,800 under this half pivot.

This case study looked at what extra information could be obtained from paddock satellite images used to monitor crop water use, and what value this can have for growers and advisers.

The 1,000 ha farm located at Billimari near Cowra, NSW, on sandy loam and loam soils, has been producing processing potatoes for nine years. The grower was interested in using IrriSAT to help schedule his irrigation. A side benefit of IrriSAT is that you also get good quality satellite images of your farm every seven days.

Marc Hinderager and Dr Kelvin Montagu from the AHR Soil Wealth team were interested in what other information they could get out of these satellite images.

IrriSAT satellite image

The IrriSAT satellite image is of the pivot-irritated potato crop at Cowra, captured on the 15th December 2019, 49 days after planting and just prior to row closure. The image shows two abnormal areas – the arcs under two of the irrigation spans and a patch at the bottom of the pivot. Both these areas have lower crop factors (Kc) indicating poorer crop growth (Figure 1). Details are provided in the Tech box below.

The NDVI image was zoned into three areas of crop growth: green=good growth, cream=moderate growth, and red=poor growth (Figure 2).

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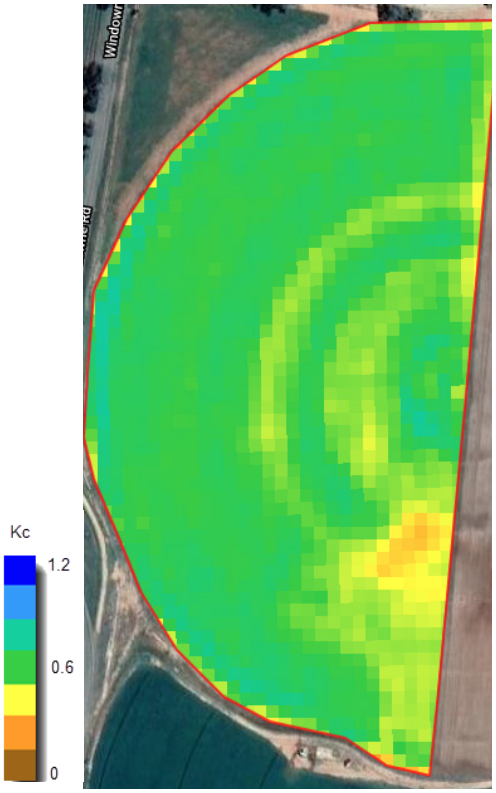

Figure 1. IrriSAT crop factor (Kc) image of the potato crop 49 days after planting and prior to row closure. Kc is calculated from NDVI. See Tech box for details.

Figure 2. The NDVI image simplified to three zones: green=good growth, cream=moderate growth, and red=poor growth

Figure 3. Potato crop 59 days after planting in the "poor" red area of paddock (top) and green "good" area of paddock (bottom) shown in Figure 2.

Irrigation issues identified in time to address the problems

The two rings under the spans show the potato crop has not grown well (yellow and light green areas in Figure 1; cream coloured areas in Figure 2), and is under-performing compared to the green areas in Figures 1 and 2. The yield in each of these three areas was then measured in the field when the crops were ready for harvest on the 15th February 2020.

The potato yield in the cream area (3.1 ha of the 13 ha half pivot) was reduced by 15%, compared to the good growth area.

In this half pivot alone, a total of 17 tonnes of potato yield was lost due to the reduced growth under spans 2 and 3, which cost the grower between $4,800-$6,800.

The cause of the yield reduction was that sprinklers on spans 2 and 3 were not delivering enough water to keep the crop growing well compared to the rest of the pivot. Potatoes in this 3 ha zone were slower to close canopy and were also under water stress during the critical tuber bulking up period.

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Importantly, the early identification of the sprinkler issue, two months before harvest, is early enough to fix it and reduce the potato yield loses.

Getting this identified in time to take corrective action is critical. The corrective action could have been as simple as checking that nozzles had been put back in the correct order after cleaning or the pivot performance may need to be checked and the sprinklers adjusted.

Soil issues identified

At the bottom of the pivot there was a poor performing area where yield was reduced by 27% across 1 ha of the pivot. This is the orange to yellow area in Figure 1 and the red area in Figure 2.

A total of 10 tonnes of potato yield was lost due to the reduced growth in the poor performing area, with an estimated value of between $2,800-$4,000.

The poor performing area appears to be due to soil issues. Laser levelling had removed the topsoil from this area, resulting in the crop effectively growing in the poorer subsoil. Correcting the soil structural issues is more difficult than fixing the pivot issue above, and could include some additional cultivation, compost and cover crop specific for the 1 ha area, based on the grower's knowledge of the area and experience of what he thinks will improve it.

The action that should be taken in this case is not as simple as in the irrigation example above. The cost and likely success of remediating this area of soil would have to be weighed against the benefits of making the improvements. What is known though, is that leaving the area as it is will be costing the grower 2,800-$4,000 for each potato crop.

Tech box

IrriSAT calculates crop factor (Kc, Figure 1) from the NDVI (Normalised Difference Vegetation Index) satellite image (Figure 2), which is acquired every 5-7 days. In this case study we took the NDVI image (also available in IrriSAT) and simplified it into three zones: green zone is good crop growth; cream is moderate crop growth and red is poor crop growth (Figure 2). The NDVI image was selected when the potato crop was growing rapidly (growth stage III) but before row closure. This was 49 days after planting. At this stage the differences in potato canopy growth will be greatest and has been shown to be the best time to correlate yield to NDVI.[i]

A relationship between NDVI and yield[i] was used to calculate the potato yield from the NDVI average in the three zones. The calculated yields were checked against field plot measurements in the green and red zone and commercial yields from the whole pivot. Calculated yields were within 10% of actual yields.

The value of the yield loss was calculated by multiplying the yield reduction, compared to the good area, by the area and applying a realistic price range for processing potatoes from 280 $/t[ii] to 400 $/t.[iii]

[i] Khalid A. Al-Gaadi, Abdalhaleem A. Hassaballa, ElKamil Tola, Ahmed G. Kayad, Rangaswamy Madugundu, Bander Alblewi, Fahad Assiri 2016. Prediction of Potato Crop Yield Using Precision Agriculture Techniques. PLoS ONE 11:16 pages.
[ii] Gross margin Budget – Potato processing 2013 www.dpi.nsw.gov.au/content/agriculture/gross-margin-budgets/vegetable
[iii] Gross margin for Potato Southern Queensland 2018 https://www.publications.qld.gov.au/dataset/agbiz-tools-plants-vegetables