CASE STUDY | AUGUST 2021

IRRIGATION SCHEDULING WITH IrriSAT

POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT

WHAT IS IT?

IrriSAT (https://irrisat-cloud.appspot.com/) is a free satellite-based irrigation scheduling app. It combines satellite images with weather data to estimate crop water use.

HOW DOES IT WORK?

Weekly satellite images of the crop are used to monitor growth changes through the Normalised Difference Vegetation Index (NDVI). A crop factor (K_c) is calculated and combined with weather data (temperature, wind, humidity) to estimate crop water use each day.

Crop water requirements can be predicted for up to seven days in advance, based on weather forecasts, helping to manage irrigation.

The IrriSAT system can also keep track of rainfall (automatically or via manual inputs from your rain gauge) and irrigation.

Information from IrriSAT can be combined with soil moisture probes installed within the crop. This can ground-truth estimates of crop requirements against actual soil moisture levels. The result is a soil water budget that can be used to answer the key questions about irrigation: when to irrigate and how much to apply.

WHAT PROBLEM DOES IT SOLVE?

Meeting crop water requirements

Potato crop water requirements change rapidly as the crop develops. For example, a potato crop may require less than 2mm/day during sprouting and emergence but increase to 8mm/day after only 2-3 weeks of vegetative growth.

Once the rows close over, weather becomes a major driver in daily water use. Hot, dry winds and high daily temperatures can increase daily water use to over 11mm/day, which is likely to push the limits of most irrigation systems.

Estimating crop water use is made more difficult by short periods of low temperatures and rain. Delaying irrigation for too long after rainfall is a common trap for many growers; this can result in soils drying down too low and irrigation needing to play catchup. This can be a problem under both pivots and laterals.

Identifying growth problems

Another issue for irrigators is that the area under a pivot can vary considerably in crop growth. This may be due to changes in soil type or structure, topography (high & low areas), a pest or disease outbreak or poor operation of individual sprinkler heads. However, identifying these areas from ground level can be difficult, especially if growers are running several concurrent pivots.

Hort Innovation

ahr applied horticultural research

This project has been funded by Hort Innovation, using the potato – fresh and potato – processing research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

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SHOW ME THE DATA.....

Meeting crop water requirements

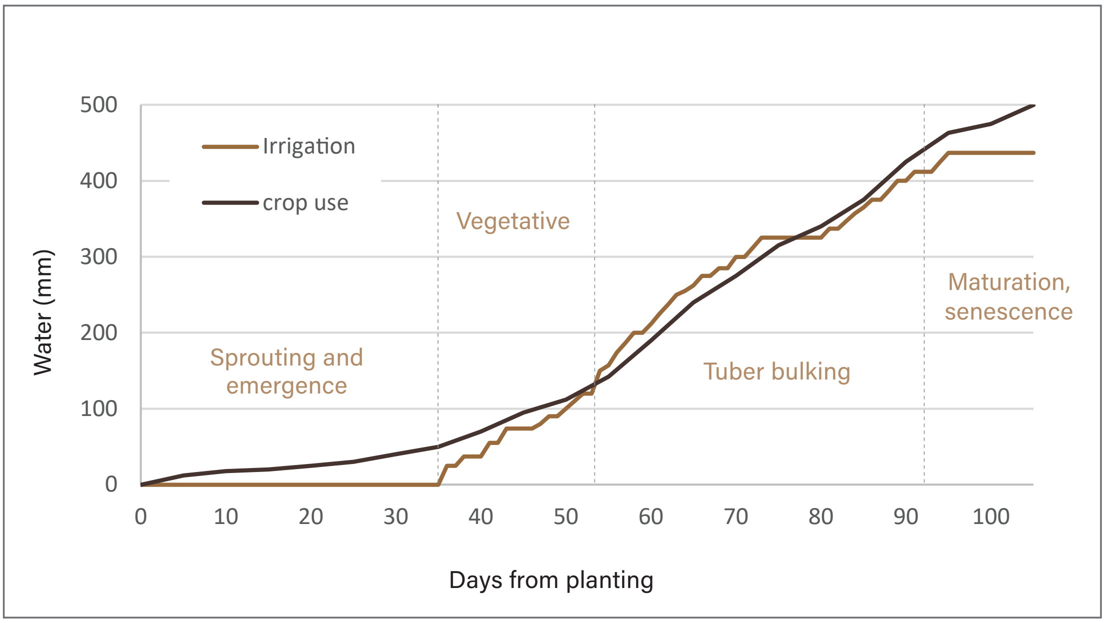
The IrriSAT system was used to monitor a NSW potato crop. Two soil moisture probes (WildEye™ Time Domain Reflectometry (TDR) system) were installed within the crop, with sensors at 20cm and 50cm depth. The half pivot was planted with cv. Snowden in October 2019. While the grower had access to information from IrriSAT, this was not used to schedule irrigation.

The data from IrriSAT demonstrates how water use by the crop changed during maturation (Figure 1). In this case, the grower generally matched demand well with irrigation.

However, a delay in re-starting irrigation after 9mm rain meant the crop entered the rapidly growing vegetative stage with a significant soil moisture deficit.

To overcome this deficit, the grower ran the pivot hard to refill the soil and keep up with crop development. This got the crop back on track in time for the tuber bulking stage.

A second, larger fall of rain some weeks later (mid-January) filled the soil to capacity. In this case, irrigation was not restarted for 7 days. Again, the moisture deficit increased, as strong demand by the crop combined with high daily temperatures (>35°C) reduced soil moisture below 10% VWC.



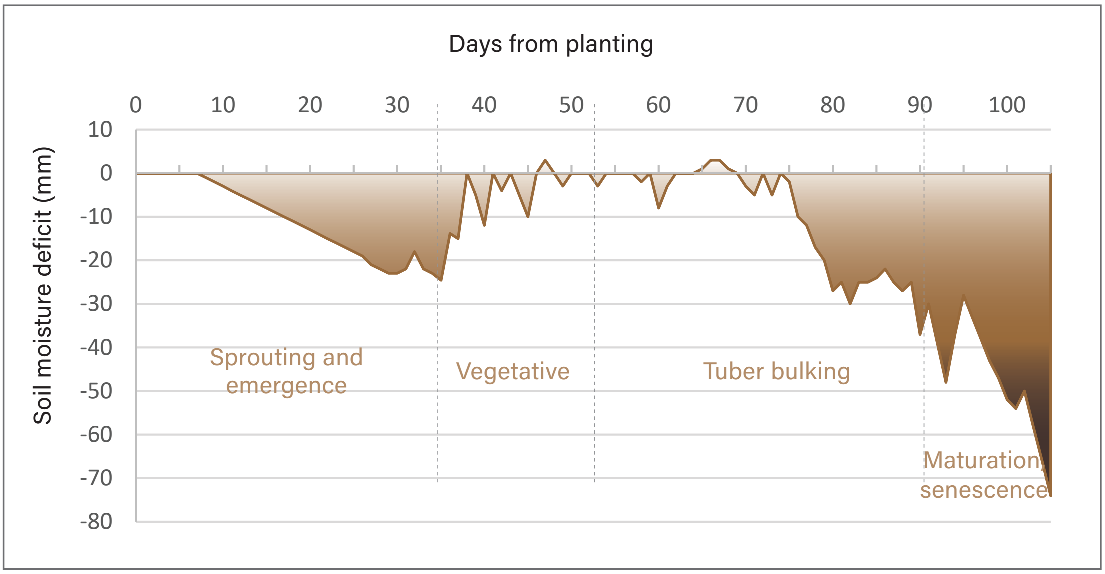


Figure 1. Irrigation applied combined with IrriSAT estimate of moisture requirements of the crop (top) and moisture deficit in the soil (bottom)

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When the crop was harvested after 105 days, tuber quality was excellent with no disease evident. However, yield was approximately 10% lower than expected. It is likely this was due to water stress during the late tuber bulking period, which likely caused premature senescence in marginal areas of the pivot.

Using the IrriSAT data would have helped the grower anticipate the water requirements of the crop, thereby avoiding moisture stress and increasing yield.

Varietal differences

In another study, potato varieties cv. 'Snowden' and 'Crop 77' were grown under a single pivot. Crop 77 is an indeterminate variety with a large, deep root system. As a result, it can access water from a deeper soil profile than the more determinate, shallow rooted Snowden. As evident from Figure 2, canopy coverage increased estimated crop water use in Crop 77 relative to Snowden.

As the IrriSAT system measures canopy coverage, it could estimate the differing irrigation needs of each variety. While in this case it was not possible to adjust irrigation precisely to the needs of each variety, it may be useful to consider this when planting future crops.

Identifying growth problems

The IrriSAT images can also show if a crop is not growing evenly. In the example shown in Figure 3, two rings of reduced growth were evident under spans two and three of the pivot. There was also an area of poor plant development at the bottom of the paddock. Investigation revealed that two of the sprinkler heads were not operating correctly, something not obvious at ground level.

The area of poor growth appeared affected by laser levelling activities which had removed the topsoil. While improving soil fertility is more difficult than fixing a sprinkler head, identifying the issue is the first step to remediation.

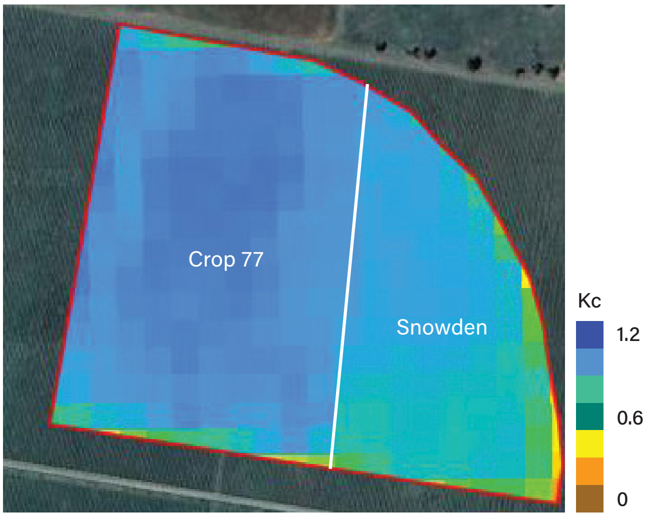
COSTS VS BENEFITS

Costs

IrriSAT information is FREE online. However it does require technical ability in terms of using the app tools and understanding the information provided. Also, it is best combined with soil moisture probes, which are likely to cost around $700 to $1,000 for a single location.

Benefits

Using IrriSAT to estimate crop water requirement could have enabled the grower to more closely track irrigation with crop growth. This could potentially have prevented the estimated 10% drop in overall yield that occurred due to moisture stress during tuber bulking.



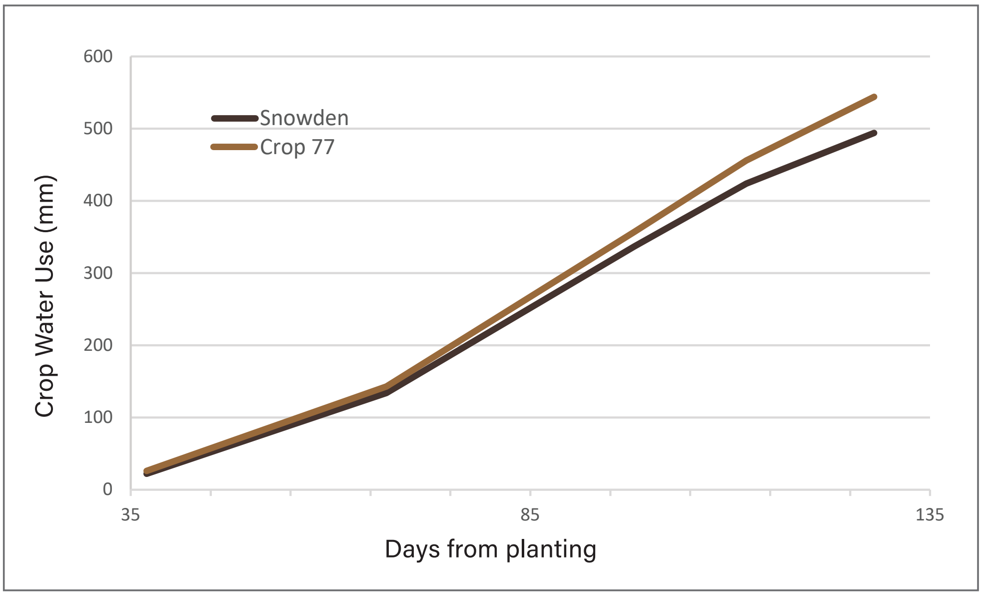


Figure 2. The IrriSAT image of a pivot planted with two different potato varieties clearly shows the difference in canopy coverage (top); this information can be used to estimate the irrigation requirement of each variety (bottom).

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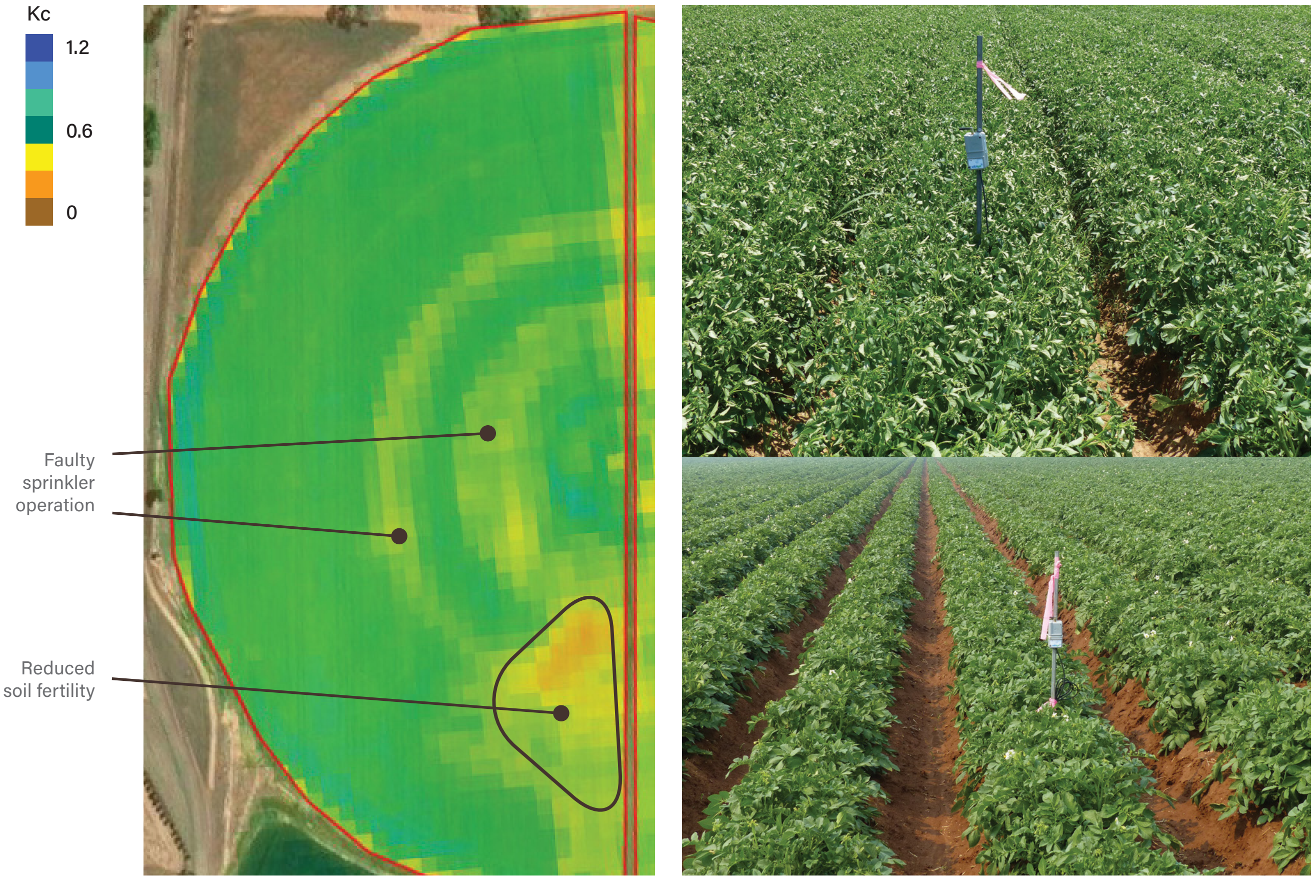

Figure 3. IrriSAT crop factor (Kc) image 49 days after planting, crop coverage is indicated ranging from full (blue) to nil (brown) as shown in the legend. Growth of the potato crop in a good (top) and reduced growth (bottom) areas

Figure 4. A faulty sprinkler head; for this crop, which was grown during hot weather, reduced irrigation limited growth and caused an estimated 10% drop in yield.

It was estimated that the issue with the two faulty sprinkler heads reduced the yield in a 3.1 ha zone by 17 tonnes, costing the grower between $4,800 – $6,800. Early identification of this issue using IrriSAT could have prevented this occurring.

The soil problem that was detected under the same pivot reduced yield by an estimated 27% over a 1 ha area. This reduced yield by 10 tonnes, potentially costing $2,800 – $4,000. However, the costs of remediating this area using compost, cover cropping etc need to be considered against the benefits.

Conclusion

There are clear benefits to using this system, if only to monitor crop performance visually over time. New, high resolution images are acquired every seven days, making it easy to check for crop health issues. Linking IrriSAT information to irrigation requires more technical skills. However, there are major benefits for both quality and yield from accurate application of irrigation.

A useful resource on using IrriSAT can be found at www.soilwealth.com.au/resources/articles-and-publications/reference-guide-for-irrisat/