

Satellite Imagery – Supporting Broadacre Crop Management

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Agricultural Reconnaissance Technologies Pty Ltd, trading as AGRECON, has been involved over the last ten years in research, development and deployment of satellite imagery to solve agricultural problems at national and regional down to farm, field and site level. For the last six years Agrecon has provided clients in the Australian cotton industry with yield variability maps and yield estimates at farm, field and site level. Agrecon is currently extending the application of satellite imagery to broadacre crop production.

Research and development for satellite products in the broadacre cropping industry has been underway for the past 18 months, with Agrecon already having invested over \$150,000 in this endeavour. The main focus has been on broadacre winter grains and oilseeds and more recently on sorghum in summer. One of the steps in the planned R&D program was that of collaboration with region specific grower groups. The purpose of this collaboration is to advance Agrecon's R&D by gaining access to collateral ground data, field observations, crop input and other agronomic information that only individual growers can provide. The Birchip Cropping Group (BCG) with its reputation for openness to innovation and willingness to trial new technology is an ideal collaborator with whom to form a working relationship.

Satellite Imagery – A brief explanation

Agrecon makes use of Landsat ETM+ satellite data acquired by the Landsat satellite which orbits the earth in such a way that the same geographic area on earth is imaged every 16 days. The satellite measures solar energy that is reflected from the earth's surface in a range of different and discrete wavelengths. The ETM+ sensor is able to measure the average reflectance from 25m by 25m patches of ground, referred to as a pixel. The strength of energy is recorded in 7 discrete wavelengths or spectral bands concurrently within a 256-step range. This information is telemetered as a digital stream back to earth where it is reconstituted as a grid covering an entire satellite image.

Three of the seven spectral bands lie within the visible part of the electromagnetic spectrum that can be seen by the human eye while the other four occupy different wavelengths within the infrared part of the spectrum that cannot be detected by the human eye. It is in the infrared part of the spectrum that inferences can be made about plant growth on the earth's surface. Actively growing crops tend to reflect a great deal of light in the infrared part of the spectrum. This diagnostic feature is used to estimate plant vigour and relate reflectance to final yield potential.

Agrecon's Experience in Cotton Production

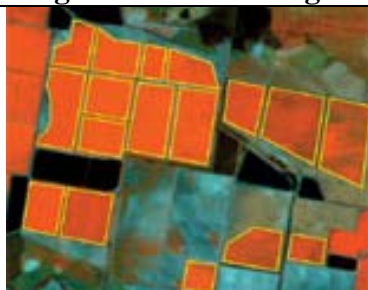

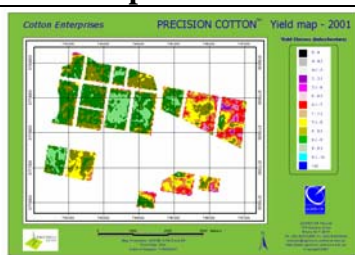
Agrecon acquires satellite imagery over the cotton industry twice during each growing season. An early season acquisition of imagery around Christmas is used to produce vigour maps for growers. The vigour maps are used as a mid-season management tool to monitor crop progress and decide on appropriate strategies to remedy problem areas that have been identified from the maps depicting within field spatial variance across the crop canopy. A second mid-season image acquisition is undertaken during the boll fill growth stage, some two months prior to harvest. This imagery is used to produce yield estimate maps and to generate an overall estimate of production likely to be realized from each field.

Agrecon's approach is to combine satellite imagery with paired ground data and to derive algorithms expressing yield potential as a function of inputs and spectral response. Growers can

access a national coverage of linked map and satellite image data through Agrecon's web site and use an on-screen cursor to record the location of field inspection sites. Agrecon uses grower's field estimates to calibrate yield maps to ensure high levels of accuracy are achieved for each field.

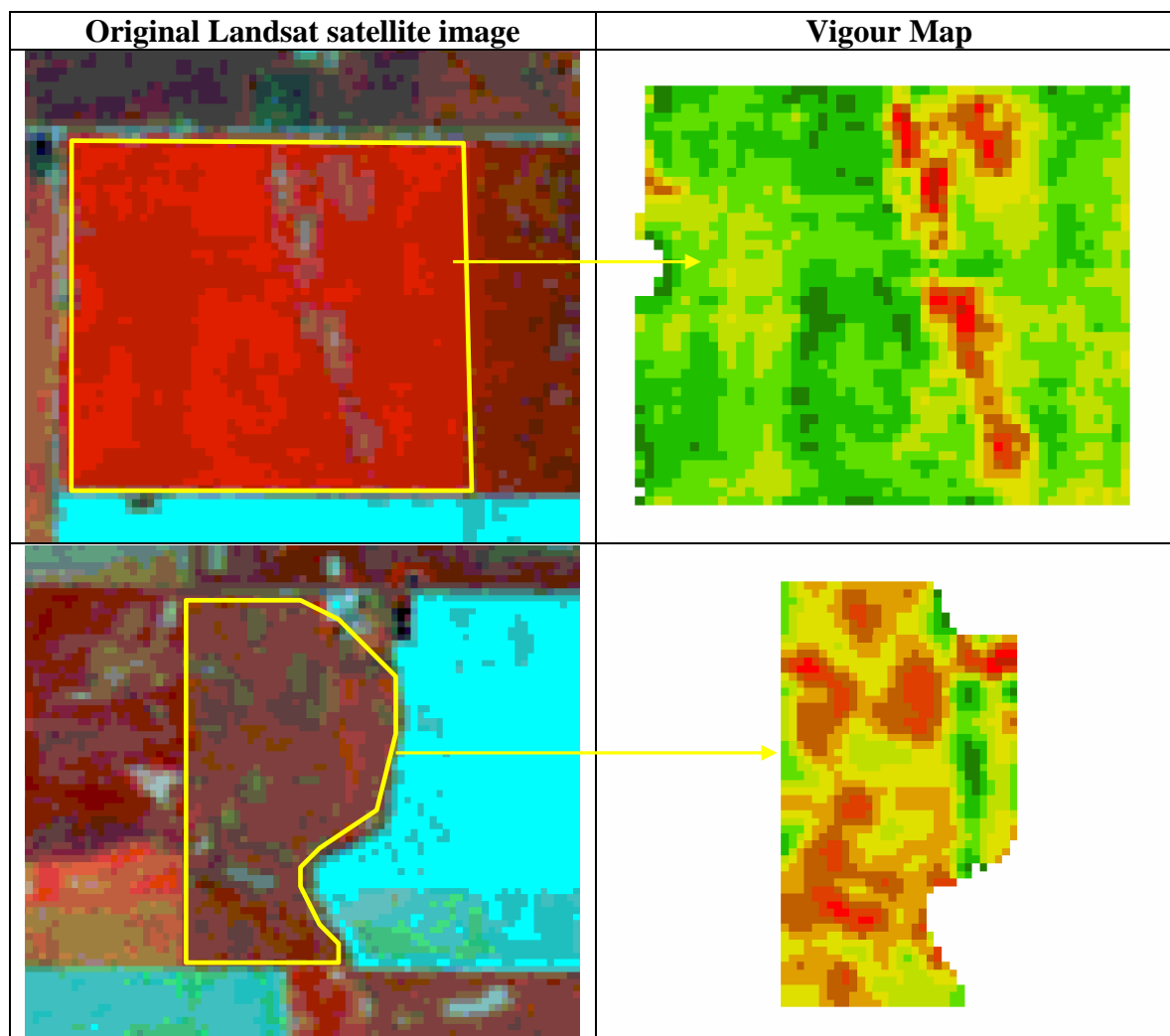
Vigour and yield maps offer growers the opportunity to use the map as a guide to locate areas of poor yield and visit these in the field to determine the underlying agronomic cause. These maps also enable growers to navigate themselves to sites that are broadly representative of the range of conditions within a single field. Yield maps are produced prior to defoliation and picking to enable growers to examine the growing plant as well as the soil for symptoms related to low yield areas identified from the imagery. The maps and average yield estimate per field are also used by growers to evaluate their likely performance in relation to contracts they may have entered and to decide what marketing strategy to adopt in relation to likely volumes of remaining unsold commodities.

The appearance of cotton fields on satellite imagery is shown below together with vigour and yield maps generated by processing the satellite data.

Original Landsat Image	Vigour Map	Yield Map
		
Superimposed field boundaries shown in yellow	Vigour maps produced as hardcopy and digital data	Yield maps produced as hardcopy and digital data

Vigour maps produced for the BCG

A Landsat ETM+ image acquired over the Birchip area on 28 September 2001 was used to produce vigour maps for paddocks nominated by the BCG. Vigour maps are derived by assessing the spectral reflectance properties of crops in the near infrared part of the spectrum. Factors such as leaf area, crop canopy density, plant and soil nutrient and water status all contribute to the reflectance measured by the satellite sensor. Computer algorithms are developed to highlight subtle differences in near infrared reflectance which may not be readily detected by the naked eye when viewing the unprocessed imagery. These differences are represented in shades of red (low crop vigour) to shades of green (high crop vigour) on the processed maps generated from the imagery. Examples of the original satellite imagery and derived vigour maps produced from the Landsat image are shown on the page below. The BCG is currently evaluating the vigour maps, comparing them with field based measurements and yield monitor data.



Forging links with the BCG

Agrecon intends to extend the use of satellite imagery for broadacre crops beyond vigour mapping to production of pre-harvest yield maps and protein content maps. Preliminary investigations in broadacre areas of NSW have demonstrated a strong positive correlation between satellite imagery and protein content in wheat and barley crops. Growers will have the advantage of being able to obtain a protein content map prior to harvest enabling them to plan harvesting strategies for segregating areas of high and low protein. This research is still in its infancy and requires close collaboration with regional groups such as the BCG. Agrecon entered into a working agreement with the BCG to obtain recorded yield, protein and rainfall data in the Birchip area in exchange for providing vigour maps at greatly reduced prices. The data from the BCG is being used to develop region specific yield and quality models that can be used in an operational mode during coming seasons.

Further Information

Agrecon looks forward to continuing its association with the BCG and welcomes all enquiries from the broadacre farming community. Agrecon can be contacted at:

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