COMBINING AERIAL SURVEY AND GROUND TRUTHING TO ESTABLISH PLANT HEALTH OF COTTON CROP

How Technology is playing an Important Role in Identifying Nutrient Need

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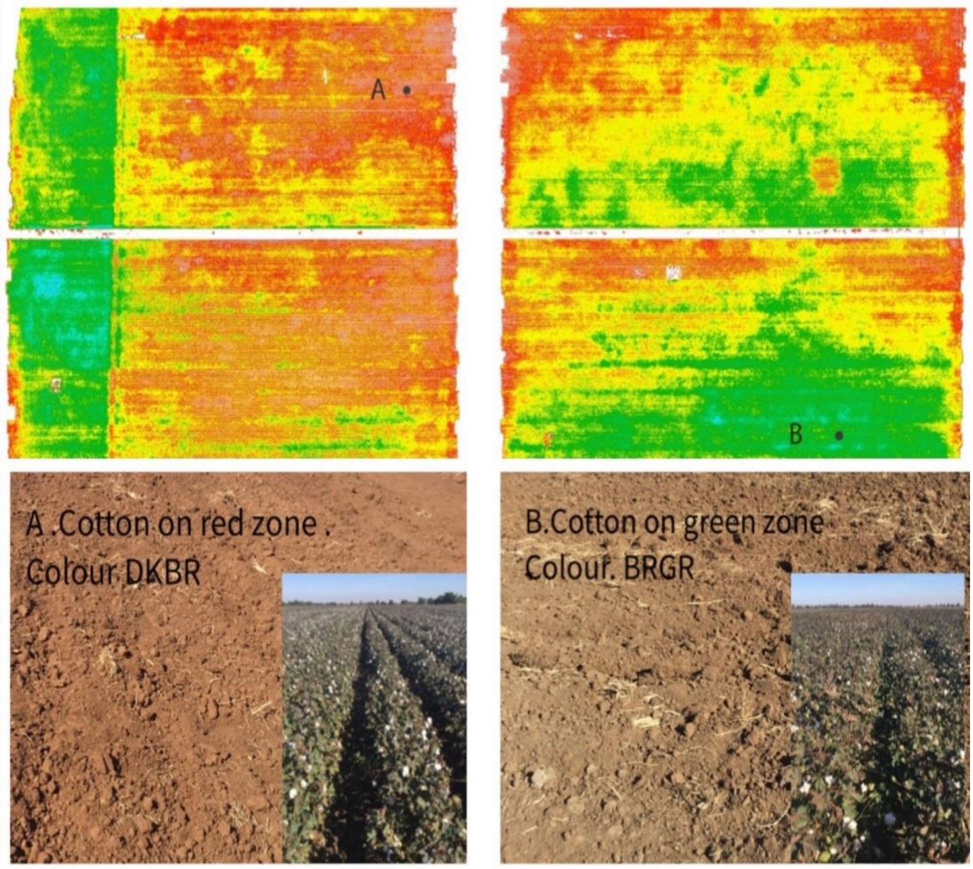
What's in this Insight

This IN discusses the results of a recent collaborative case study between Richard Stone, RLF's NSW Field Operations Manager, and Peter Borella, Director Agaerial Imaging. A drone was used to identify the health of a cotton crop at Griffith, NSW Australia.

Details of the Case Study

This was conducted during March 2019. The technology used to create the detailed mapping images in this article is called Normalised Difference Vegetation Index (or NDVI), and the images were created using a fixed wing drone flying at 400 feet.



Richard Stone then conducted a ground truthing investigation to establish the cause of the poor growth as indicated by the NDVI map above.

As can be seen in the image, the red area A corresponds to the colour (DKBR) of the soil and resultant cotton growth. The green area corresponds to soil colour (BRGR) and plant growth. Soil samples were taken from both A and B zones to establish nutrient levels as a basis for identifying the reasons why cotton growth was different.

What is NDVI?

Normalised Vegetation Index (NDVI) quantifies vegetation indices by measuring the difference between near-infrared light (which vegetation strongly reflects) and red light (which vegetation absorbs). Healthy vegetation contains chlorophyll and as such reflects more near-infrared and green light as opposed to other wave-lengths. But, it absorbs more red and blue light making this the reason why we see vegetation as the colour green.

So overall, **NDVI** is a standardised way to measure the health of vegetation. When the **NDVI** indices are high (0.8 – 1.00), the crops are healthier. When the **NDVI** indices are low (0.3 - 0.5), the crops are adversely effected.

By visiting the varied colour and NDVI indices's values reasons for poor growth can be established.

What is Ground Truthing?

Ground truthing is the process of collating and interpreting the information that was collected from the aerial imaging. It enables the image data to be related to ground features, and this is becoming an important diagnostic tool for the site-specific management of crops. The reflected light images are useful for detecting crop stress – often whilst there is still time to correct the problem. If you want more information about Ground Truthing contact rstone@rlf.com.au.

The Ground Truthing Summary for the Cotton

Soil tests taken from both the good and the poor performance growth areas are as follows:

Soil Test Results	A. Red Zone	B. Green Zone
Ammonium nitrogen mg/kg	4	1
Nitrate Nitrogen mg/kg	2	4
Phosphorous colwell mg/kg	67	64
Potassium colwell	280	342
Sulphur mg/kg	8.8	9.5
Organic Carbon %	0.59	0.79
Conductivity dS/m	0.064	0.080
pH level CaCl2	6.3	6.2
pH level H20	7.5	7.3
DTPA Copper mg/kg	2.17	2.23
DTPA Iron mg/kg	34.34	44.24
DTPA Manganese mg/kg	9.29	11.69
DTPA Zinc mg/kg	0.79	0.80
Exc Al. meq/100g	0.150	0.161
Exc. Calcium meq/100g	8.54	12.62
Exc. Mg meq/100g	6.94	7.43
Exc. K meq/100g	0.74	0.91
Exc. Sodium meq/100g	0.87	0.49
Boron Hot CaCl	1.28	1.19

Dr Nassery Overview

Contrasting parameters in soil tests:

1. Organic carbon is 33% higher in green zone compared to red zone.
2. Ca/Mg ratio is 1.2 (well below desired level) in red zone and is 1.69 in green zone which is higher than red zone but yet below desired level.
3. Exchangeable K/Na ratio is higher in green zone than red zone (1.8 versus 0.85).
4. Nitrate to ammonium ratio is 0.5 in red zone and 4 in green zone idicating more gas spaces in green soil than red soil supporting nitrifying bacteria.
5. Colwell potassium is near optimum range for cotton but is higher in green zone than red zone.
6. Interestingly, sulphur, phosphorus and trace element differences in red and green zone are negligible as to have any impact on crop performance.
7. Digital photos of the green zone shows more plant residues on the soil surface than the red zone reflecting crop growth differences.
8. It would be interesting, and necessary, to see how deeper soil profile differs in above parameters in red and green zone.
9. Tissue analysis is required to ascertain crop nutrient deficiencies and to recommend most suitable treatment.

Concluding Remarks on Soil Analyses

The soil colour and nutrient analysis of the zones shows that the green and red zone may have resulted from different rock sources, or have been exposed variably due to landscape and lasering or leveling. The higher Ca/Mg ratio and K/Na ratio in green than red zone, seems to have been the primary reasons causing larger and deeper root growth in green zone due to reduced soil resistance. This has over time, resulted in more soil organic matter helping moisture retention and mineralisation in the green zone with cumulative impact of plant-deposited organic matter.

The soil variation forcing biological changes in soil has resulted in the current mosaic soil pattern with different potential for plant growth.

Recommendations

Long-term strategy for improving soil structure:

- Try gypsum application rates to work out economical rates for gypsum response.
- Practice minimum till in cropping to increase soil organic matter.
- Pasture rotation also increases soil organic matter and productivity.
- Adding animal or plant waste and compost will also improve soil structure and productivity.

Short-term approach:

- When cropping, use **BSN** Seed Priming to increase root proliferation and set higher yield potential from the start of germination (cotton seeds are not suitable for priming due to the hard seed coat).

- Apply (inject) **Caltro** in seeding row at sowing at 20L/h to improve soil structure in the soil volume neighbouring roots.

- Use RLF acid products such as **Broadacre Plus**, **Plasma Fusion** or **Tetrachel**, having phosphorus and trace elements to stimulate sugar transport, photosynthesis and rhizosphere exudation of organic acids. This unlocks phosphorus and trace elements in rhizosphere thus creating a dual benefit of supplying nutrients through the leaf and the root.

- Always use nitrogen as foliar as much as possible (as UAN or Urea or **Power N** products) in tank mix with RLF acid foliar. Rates of 5 to 10kg of low biuret Urea/ha can be considered for cotton and all cereals to achieve a bigger impact of root growth and exudation. Shifting nitrogen from soil to foliar will have a big bearing on root growth and buildup of organic matter in soil.

- Foliar uptake of nutrients uses half, or less than half of the energy used in nutrient uptake by root. The saved energy is used by plant in increasing yield.

- In the current cotton crop or in future planting in similar conditions, foliar spray of potassium is required to increase yield. This can be inferred from the potassium differences of red and green zones that can cause deficient status in leaves, especially during drought. The red zone soil with poorer water storing capacity is more susceptible to potassium deficiency. Use **KC30** at dilution rate of 30X on its own, or tank mixed with RLF acid foliar and nitrogen.

- Use the balance of nitrogen to match crop yield potential through soil. Nitrogen used in fertigation along with **Power NS** increases nitrogen use efficiency since it slows down ammonia formation and nitrate leaching.