Variable Rate Technology case study 2015

Bindi Isbister, Precision Agriculture Consultant, PrecisionAgriculture.com.au, Erin Cahill, Agronomist, Agvivo and David Isbister, Homewood Farms.

Purpose: Demonstrate variable rate technology on farm and how it can be applied to manage fertiliser use and to minimise nutrient enrichment or depletion that leads to poor soil health.

Location: Rowes Rd, Dandaragan

Soil Type: Yellow sandplain (Blackbutt and Sandplain Pear tree)

Soil Test Results: Paddock tested prior to seeding (data not presented), Plant tested 5/8/15

Rotation: Canola TT 2014, Wheat 2013, Wheat 2013, Pasture 2012

Growing Season Rainfall (April- October 2015): 303mm

BACKGROUND SUMMARY

Research has shown precision agriculture technologies such as variable rate technology and satellite imagery can be used to improve the efficiency of applying inputs. Local agronomists in the West Midlands area have noted over time nutrient levels such as phosphorus are declining in soils with high yield potential and increasing in low potential soils. Variable rate technology can assist replace P in the high zones and reduce P applied in the low performing zones reducing the risk of nutrient leaching and improving profitability for farmers. However there are still some barriers to adoption.

This case study aims to demonstrate the application of variable rate technology to adjust inputs as required based on soil test results and predicted yield potentials to reduce nutrient enrichment or depletion that leads to poor soil health.

Biomass imagery is a useful tool to map crop growth that is often closely related to soil type effects and reflects yield variability. This case study will also evaluate the usefulness of six meter satellite (new to the market in July) to improve the sustainable management of soils such as target areas for amelioration or strategic fertilizer application post seeding.

TRIAL DESIGN

The paddock was divided into three zones using yield data from 2013/14 post spading. The soil test points were overlaid and the average yield was calculated at the soil test points and used as the yield potential of the zones (Table1). The potential yields were run in soil nutrition models to determine P recommendations and set the fertilizer rates for the zone. Soil type varies from pale yellow sand in the low production zone, yellow sand in the medium production zone and yellow sand over gravel/clay in the high production zone.

Table 1: Zone area, target yields and variable rate application rates for the case study paddock

Rate	Area (ha)	Target Yield t/ha	Seeding Ktill MOP Blend kg/ha	1st app NS31 Kg/ha	2nd app UREA kg/ha
High	57	4.5	140	100	75
Medium	62	3.2	100	80	55
Low	28	2.7	70	60	35

Fertiliser test strips three times the width of the seeder have been applied across zones to evaluate varying compound fertilizer at seeding and the second application of nitrogen spreading width 24.22m. The John Deere software program APEX was used to generate prescription maps.

Crop type: Bass Barley

Seeding rate and date: 75kg/ha 29th May 2015

Machinery used: CaseIH Header, Ausplow DBS seeder, Ausplow multistream airseeder cart, Cat Tractor with JD guidance

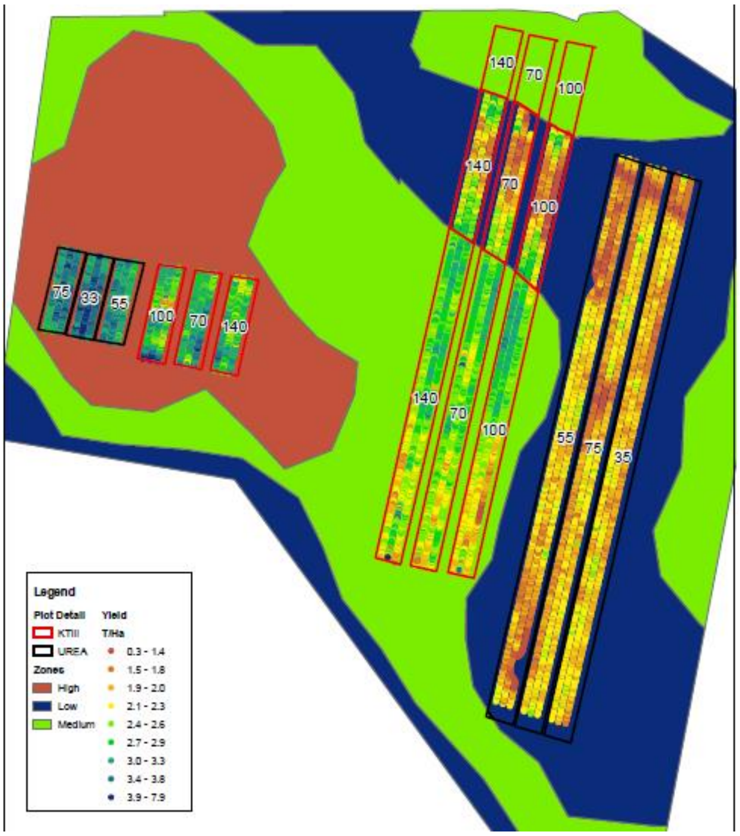
Herbicide rates and dates: glyphosate 1.5l oxyflufen 0.1l, ester 680 0.25l, Sprayseed 1l trifluralin 1.8l, metribuzin 0.08l, Paragon 0.05l, BROM MA 0.5l

Other applications/ treatment rates and dates: Insecticides chlorpyrifos 0.3l Fungicides Tilt 0.4 l Prosaro 0.15l

Treatment rates and dates: The paddock was deep ripped in March to 420mm. Seeding fertilizer KtillMOP blend (KTILL EXTRA 80%, MOP 11% and MAP 9%) with Flexi N 20L/ha Hi Load with flexi N = 150ml/ha applied as per rates in Table 1. 1st post emergent N application 80kg/ha NS 3:1 washed in on the 6/7/15. 2nd Urea application washed in 7/8/15.

Test strips were applied across the zones at seeding as per low medium and high rate compound rates. Post emergent nitrogen for the seeding test strips was 80kg/ha NS31 and 55kg/ha Urea. Another series of test strips was applied for the second nitrogen application at 75, 55 and 35 kg/ha of UREA.

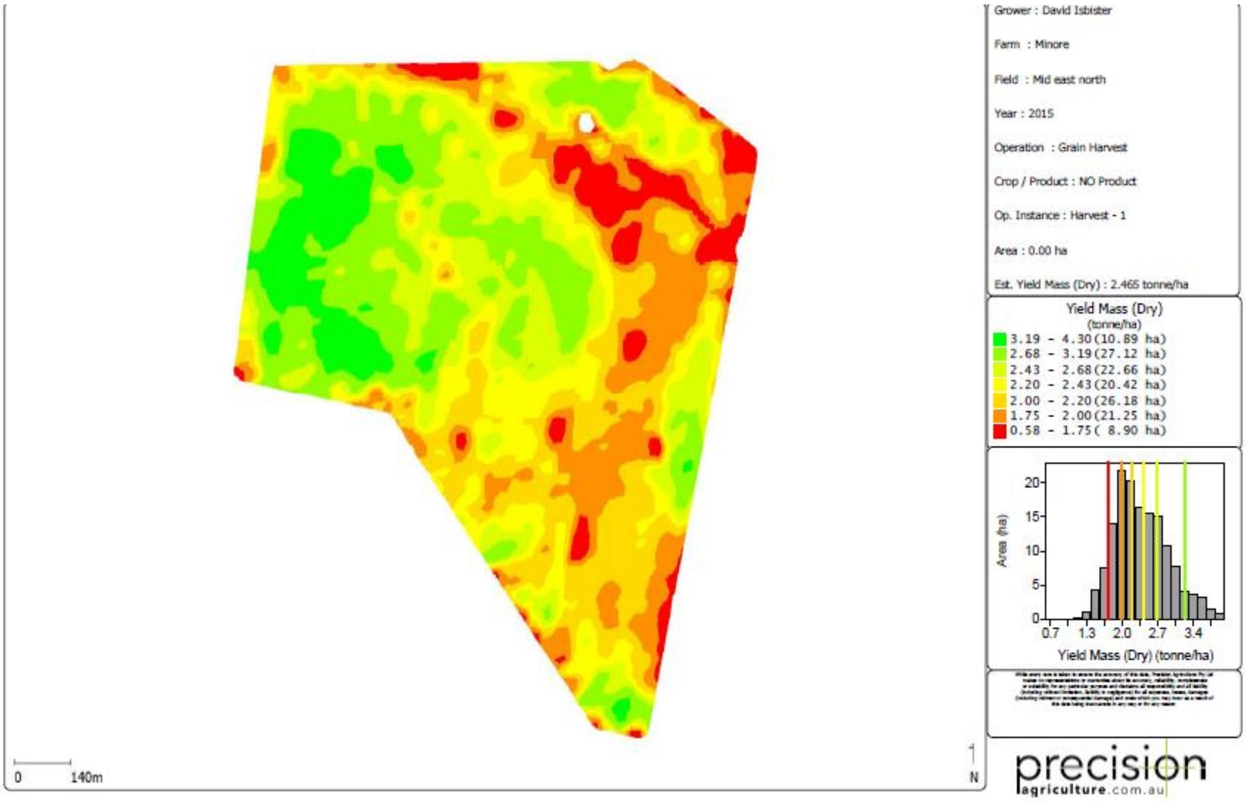
TRIAL LAYOUT



Zone map showing treatments applied and yield in each treatment strip

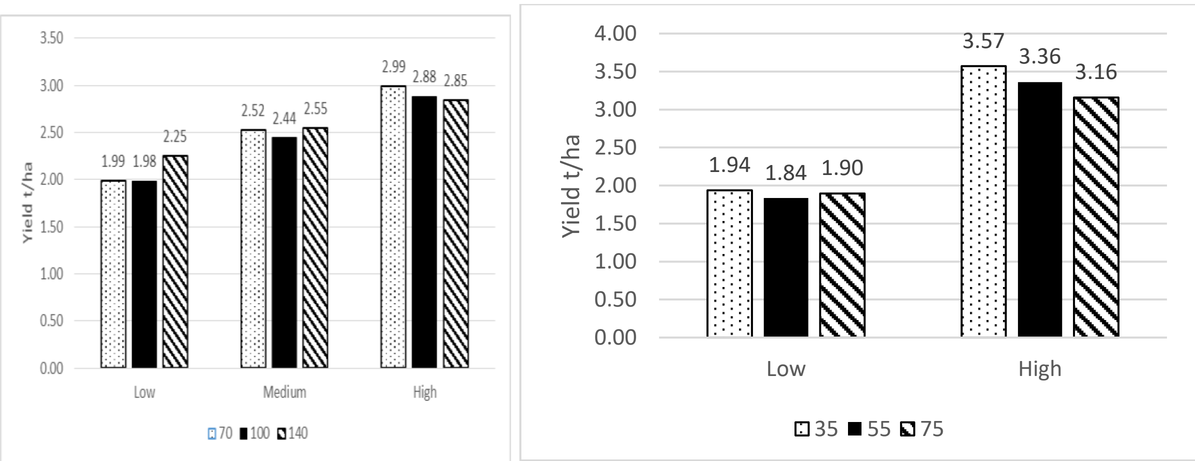
RESULTS/STATISTICS

The 2015 yield map generally reflected the identified paddock zones (see below).

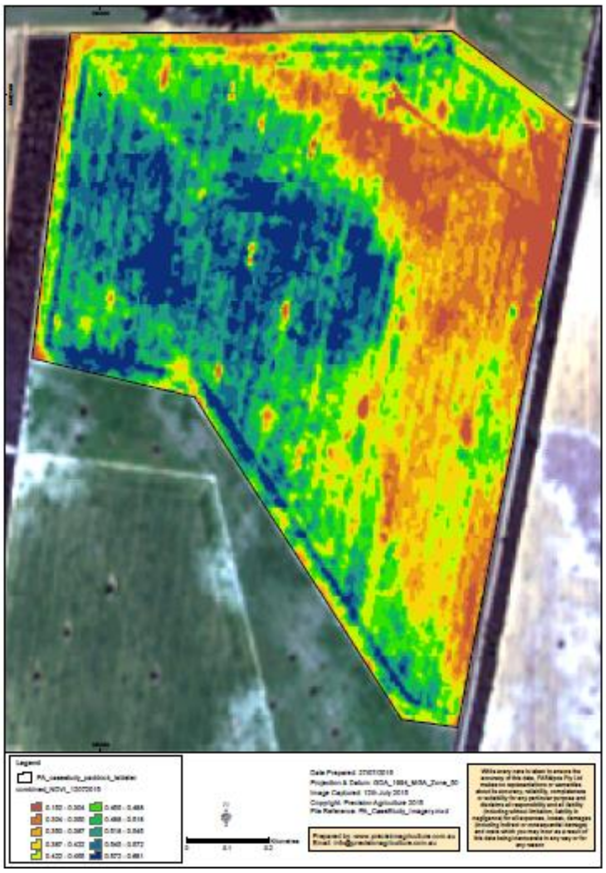


There was an increase in yield across the zones for both set of treatments applied confirming the three production potential zones in the paddock (Figure 1). There was no difference in yield in the low zone between post seeding nirtogen fertiliser rates. In the high zone the lowest fertiliser rate yielded the highest.

Figure 1: 2015 Barley yield from variable rate seeding fertiliser (KTILLMOP) (left) and second post nitrogen application (right)



The biomass imagery taken on the 12 July and 9 September reflect the management zones and yield map.



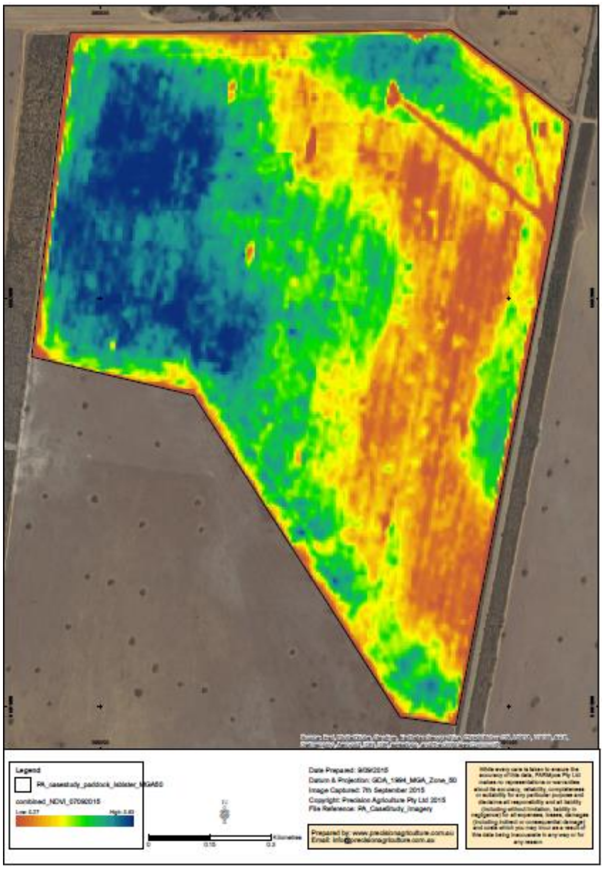
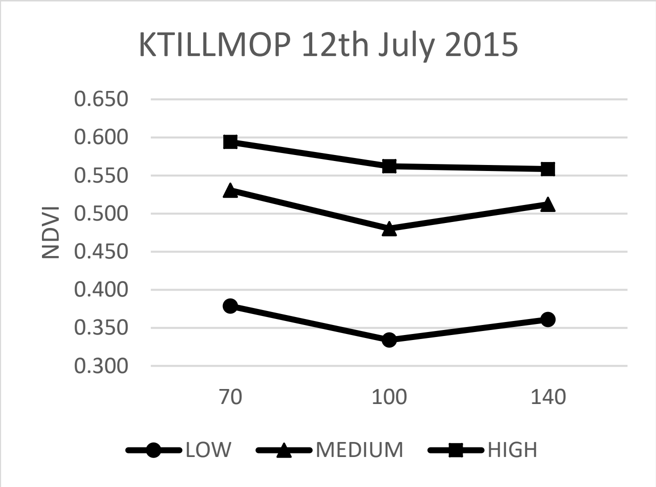


Photo NDVI imagery of the case study paddock 7 July 2015 (left) and 9 September 2015 (right).

Like yield there was clear difference in NDVI (amount of biomass) between zones with the low zone producing the lowest biomas for both image capture dates (Figure 3 and 4).

Figure 3: Average NDVI 12th July of each fertiliser treatments by zone KTILLMOP (Left) 2nd application nitrogen UREA (Right). UREA treatment had not been applied yet.



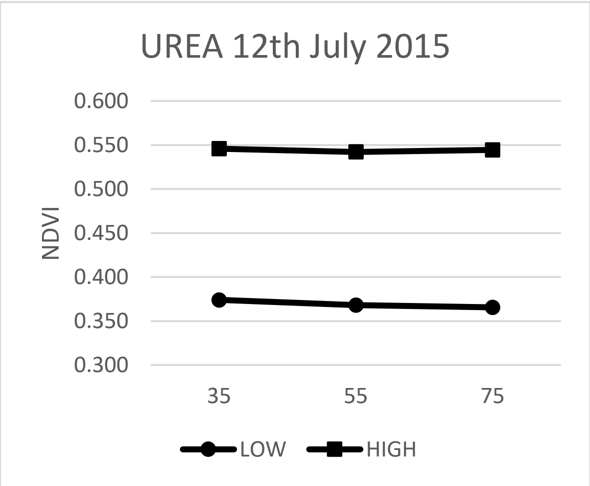
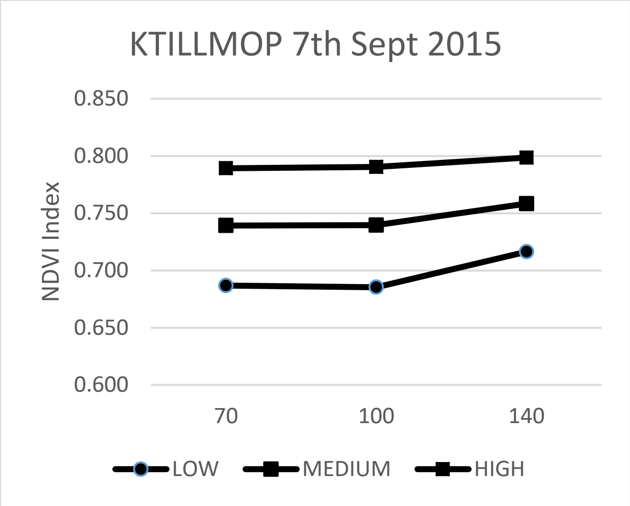
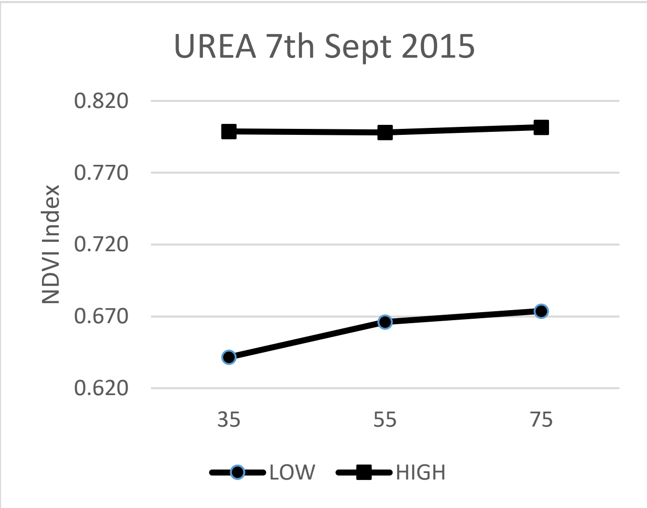


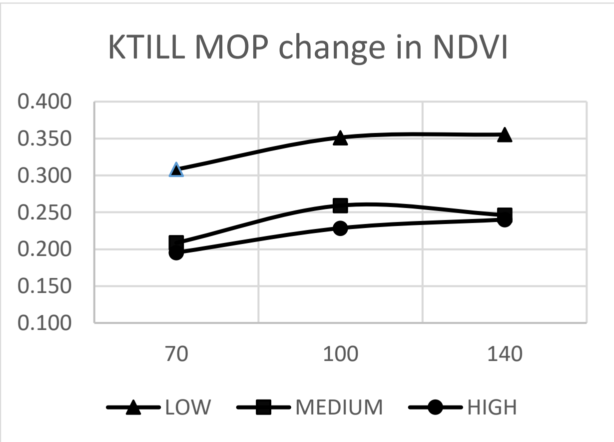
Figure 4: Average NDVI 6 September of each fertiliser treatments by zone KTILLMOP (left) 2nd application nitrogen UREA (right)

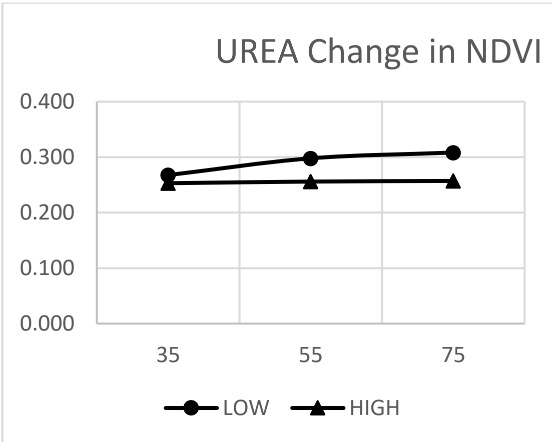




The change in average NDVI was the greater in the low zone compared to the medium and high zones between the 7 July and the 6 September (Figure 5). There was an increase in biomass in the low zone with post seeding UREA.

Figure 5: Change in NDVI from the 7 July to 6 Sept 2015 fertiliser treatments by zone





There was little difference in grain quality between the fertiliser rates applied post seeding on the low zone (Table 2). Screenings were very high reflecting the dry season.

Table 2: Grain Quality of the most eastern trial strips 35, 55 and 75 kg/ha UREA

Rate	35	55	75
Protein %	13.9	14	14.4
Moisture	11.2	11.2	11.1
Colour	56	57	56
HLWT kg/hl	58..42	59.41	59.75
Screenings	59.54	59.37	61.41
Grade	BFED1	BFED1	BFED1

FINANCIAL ANALYSIS OF RESULTS

The most economic treatment for the low zone was applying low fertilizer rate at seeding and the second UREA application (Table 3).

Table 3: Gross margin $/ha across the zones for applying variable rates of fertilizer at seeding and for the second application of post nitrogen. Cost fertilisers K Till Mix $703/T Flexi N at seeding $438/t NS 31 $478/t, UREA $567/t, Barley Feed 1 $213/t Farmgate, fixed input costs $292

KTILLMOP (kg/ha)	Low	Medium	High	UREA (kg/ha)	Low	High
70	19	126	214	**35**	28	311
100	-11	87	170	**55**	-10	255
140	13	83	126	**75**	-8	201

In this season applying the medium rate fertilizer across all zones was more economic than applying fertilizer according to zone potential (Table 4). The most economic strategy for applying fertilizer was to variable rate according to zone for seeding fertilizer and the second nitrogen application where the rate of the high zone was reduced to a low rate based on tissue tests showing nitrogen was adequate and seasonal conditions were dry. The high zone has a greater area than the low zone therefore the cost of over or under fertilising has a bigger impact on the paddock gross margins.

Table 4: Paddock income of applying fertilizer as an average rate or variable rate according to zone potential and season

Zone	Area of zone	Medium fertilizer rate income in $	Variable fertiliser according to zone $	Best strategy for season low rate 2nd UREA application $
Low	28	-294	356	643
Medium	62	5423	5429	
High	57	9681	7169	17716
total	147	14810	12948	

OBSERVATION/ DISCUSSION/ MEASUREMENTS

This year there was no big benefit from variable rate fertilizer in relation to yield. This is not unexpected given the dry season.

This trial gives some confidence that cutting fertilizer in particular P back on the low zone did not impact yield and had the best gross margin, therefore is a good strategy to reduce costs on the lower performing parts of the paddocks. This is consistent with current DAFWA and GRDC research findings that less phosphorus can be applied on soils with good P history without penalizing yield. Similarly it demonstrated the potential to reduce rates on the higher production zones depending on the season as tissue tests indicated adequate nitrogen just prior to the late N application. It is likely there was also more nitrogen available as a result of ripping increasing nitrogen mineralization and plant root access to water and nutrients. Reducing N applied after ripping is a recommended strategy to reduce the risk of the producing high biomass and the crop haying off early with a dry finish.

The estimated yield potential of the zones was not reached with the high zone about 1.5 t/ha below potential. This is consistent with farm observations that found there was a penalty of about 1 t/ha for crops sown later than 7 days from the 22nd May crops in this dry season.

High resolution six meter imagery was found to be very useful to identify management issues and map non-wetting soils, particularly the early July image which highlighted emergence issues. The non-wetting areas can be mapped and treated by ploughing those areas paddock not the whole reducing the cost of treatment. Ground-truthing showed the 6m resolution was high enough to identify problems with the bar such as running out of fertilizer. These are management issues that can be adjusted to improve efficiency and production to improve yield.

In the case study paddock the imagery has highlighted issues that were not evident from the yield maps such as residual compaction from old corners and where the ripper and spader lifted over a water pipe (the red line in the top north east corner). This paddock has been deep ripped twice but old compaction is still visible suggesting it is beyond the current ripping depth of 400mm. The late season imagery was too late to see any big differences in biomass. An optimal time to capture imagery appears to be mid-July.

Applying low fertilizer to the low production zone is both a good economic strategy to improve profitability and prevents over fertilizing that increases the risk of nutrient leaching in these pale sands that have limited capacity to store nutrients.

ACKNOWLEDGEMENTS/ THANKS

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