Variable yield maps: making the most of data
How can yield maps be used to improve enterprise profitability?

Variable yield maps

Yield maps are created from a cotton pickers yield monitor (that uses a series of sensors in the machine) and can give an indication of yield and its variance within a field.

Results should be considered indicative until they can be confirmed with ginned lint yields. Why? The monitors require manual calibration and the manufacturer suggests re-calibration for any change in field conditions. Also, the sensors (or calibrations) do not take into consideration factors that influence gin turn out.

Due to the many elements influencing yield, each field will naturally have variability. Factors include; soil characteristics, availability of nutrition, weed and pest pressure as well as topography and water availability. Many of these influences can be managed.

Yield maps can be used to inform field management and evaluate previous management (particularly from variable rate technology).

Using yield maps to improve enterprise profitability – a 3 step process

1. *Comparing the yields of highly productive and less productive areas to understand why the variability exists.*
    This process may include your advisor / agronomist and would be a good inclusion in your end of season review. At times there may be several obvious influencing factors and other times the variability may not be explainable.

2. *Consider if and how the issues in the lower yielding areas can be remediated*.
    Some management responses may include precision ag. More simply, a grid of management zones may be developed. And some issues may be beyond managements control.

3. *Analyse if a remediation is a good investment.*
    Partial budget analysis is a technique that considers if the change in costs outweigh the resulting change in revenue. If you don't have your own gross margins (GMs) the CottonInfo GMs are a great starting point and there is downloadable excel template.

Interpreting the yield maps

Yield maps are found in JD Ops Centre, Field Analyzer. The default legend displays relevant yield levels to the fields yield distribution. To easily compare yield results between fields, using a template for the legend is suggested. Unfortunately, the legend is limited to kg/ha (not bales/ha).

Your 'organisations preferences' should already be set to metric and the yield preference to weight (not volume).

The example (Figure 1) indicates 6% of the fields yield is over 3859 kg/ha, 15% of the field between 3632 and 3859 kg/ha etc. At the lower end, 2% of the field is between 33.8 kg and 2724 kg/ha.

Figure 1: Yield map legend
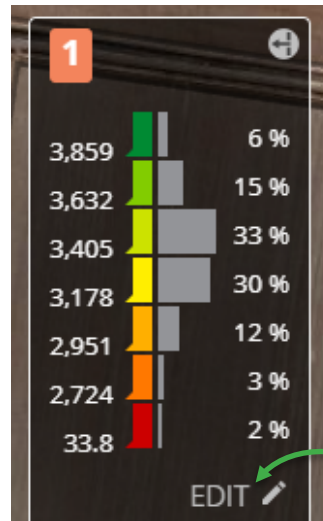
This map legend is in kg/ha and has been set to levels that reflect 12-17 bales/ha using the 'EDIT' button. Here you can also create or set a legend template.

Scenario 1: Drainage

The map displayed in Figure 2 (and legend enlarged in Figure 1), is from a 71 ha irrigated cotton field that achieved an impressive average yield of 14.5 bales/ha. The yield monitors were carefully calibrated and the ginned results reflected the displayed yield. The map legend indicates 6% of the field was over 17 bales/ha. Just 17% of the field achieved a yield under 14 bales/ha (3178 kg).

Figure 2: Irrigated cotton yield map with key as kg/ha
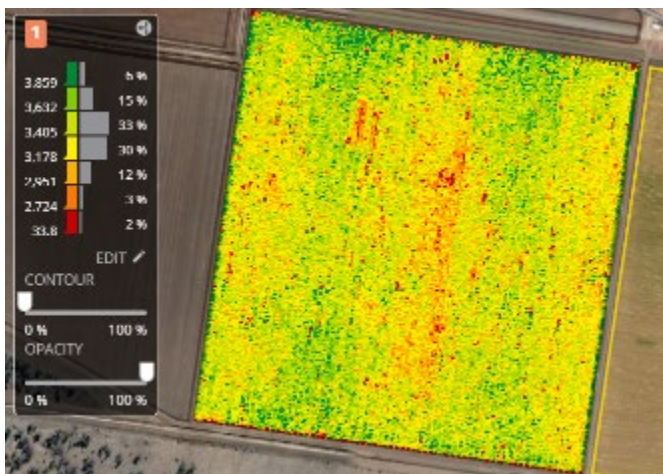
1. What is causing the variability?

Drainage was identified as an issue for the centre of this field, and the likely reason behind these lower yielding areas.

2. Remediation options

Laser leveling of the field?

3. Partial budget analysis

In this example we consider if the benefits of laser leveling will outweigh the costs. The yields in this field are firstly converted to a gross margin (GM) by conservatively applying the income of the lower yield in the range. For example 6% of the field was applied a yield of 3859 kg/ha, 15% 3632 kg/ha, 33% 3405 kg/ha etc. For the 2% at the bottom of the scale, due to the large range of potential yields, a yield of 908 kg/ha was applied.

Using the customisable CottonInfo GM template, with costs of production ($4523) and a lint price of $600 /ha. The total GM for the field was $344,048, with an average GM of $4846 /ha.

The GM for each yield point, the average and total field GMs can be seen in Figure 3.

Scenario 1 (Continued)

Once the current yield results were converted to a gross margin, the yield improvement from the suggested remediation was considered. The example scenario (Figure 4) shows the 17% 'lower' yielding areas improved to the average yield. This scenario resulted in an $18,000 improvement in gross margin. The yield improvement of the remediation (laser leveling) was calculated in this example to last for three cotton seasons, making a total benefit of $54,000.

This benefit estimate informs a potential maximum budget for remediation and can inform management decisions such as 'Do I laser the whole field, focus on the key problem areas, or is the issue not as bad as I thought?'

Alternatively, if there was a firm remediation cost, the required yield increase to cover those costs could be calculated, indicating if the investment was worth it.

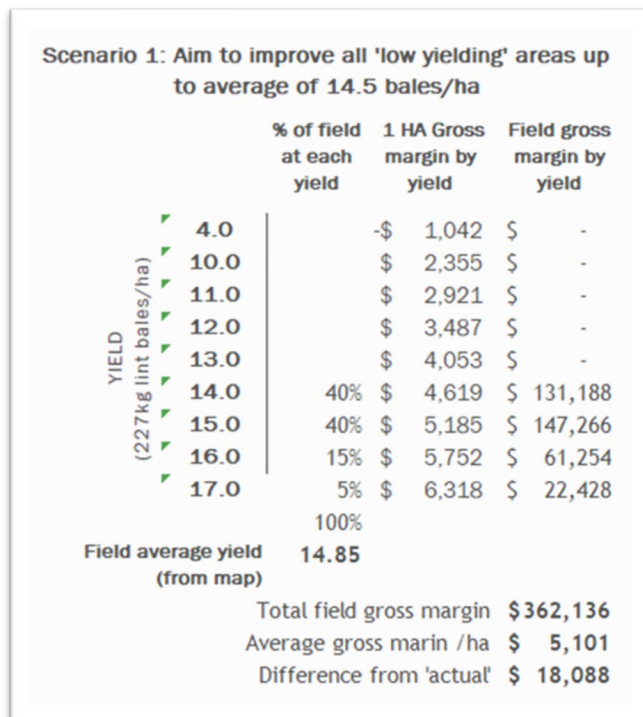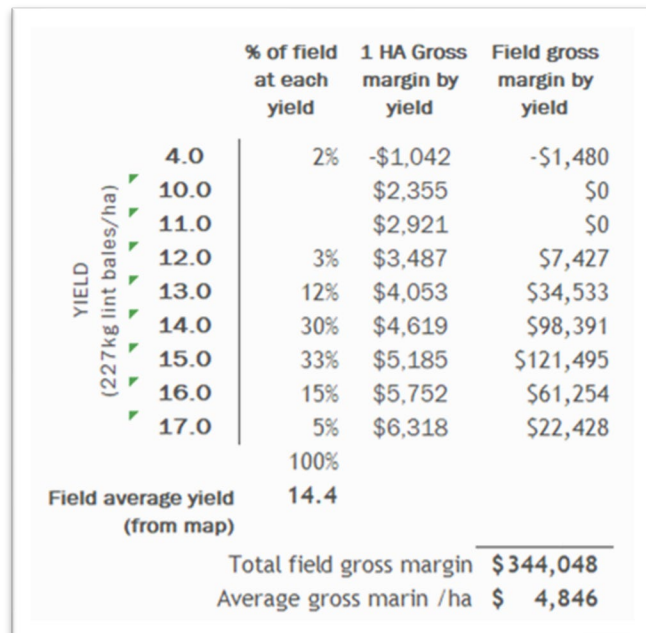*Figure 4: Scenario 1. Estimated yield improvement*

Scenario 1: Aim to improve all 'low yielding' areas up to average of 14.5 bales/ha

YIELD (227kg lint bales/ha)	% of field at each yield	1 HA Gross margin by yield	Field gross margin by yield
4.0		-$ 1,042	$ -
10.0		$ 2,355	$ -
11.0		$ 2,921	$ -
12.0		$ 3,487	$ -
13.0		$ 4,053	$ -
14.0	40%	$ 4,619	$ 131,188
15.0	40%	$ 5,185	$ 147,266
16.0	15%	$ 5,752	$ 61,254
17.0	5%	$ 6,318	$ 22,428
	100%		

Field average yield (from map)	14.85	
Total field gross margin		$362,136
Average gross marin /ha		$ 5,101
Difference from 'actual'		$ 18,088

Figure 3: Scenario 1. Gross margin by yield

YIELD (227kg lint bales/ha)	% of field at each yield	1 HA Gross margin by yield	Field gross margin by yield
4.0	2%	-$1,042	-$1,480
10.0		$2,355	$0
11.0		$2,921	$0
12.0	3%	$3,487	$7,427
13.0	12%	$4,053	$34,533
14.0	30%	$4,619	$98,391
15.0	33%	$5,185	$121,495
16.0	15%	$5,752	$61,254
17.0	5%	$6,318	$22,428
	100%		

Field average yield (from map)	14.4	
Total field gross margin		$344,048
Average gross marin /ha		$ 4,846

Within the analysis the results were sensitivity tested at different cotton pricing points to understand how the benefit may change. Sensitivity testing of scenario 1 (Figure 5) at $550 /bale and $650 /bale resulted in a change of +/- $1600 (9%). Lower yielding areas may be a result of multiple factors and a single remediation may not improve yields to that extent. Sensitivity testing showed that if only half of the lower yielding areas were improved. Benefits would be down 66% to $6000 for total field GM, $18,000 for three cotton crops (@$600/bale).

Figure 5: Sensitivity testing ($/bale & yield benefit). Scenario 1
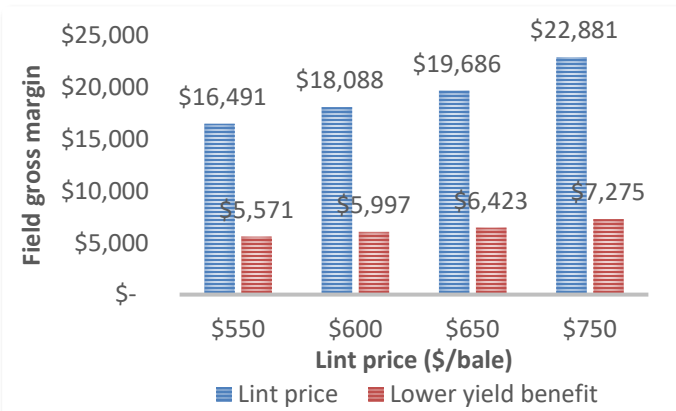
Scenario 2: Compaction & feral pigs

Yield maps can also be used to review implemented changes. The map displayed in Figure 5, is 26 ha irrigated cotton field that achieved an average yield of 14.29 bales/ha. The legend indicates 8% of the field to be over 17 bales/ha. 20% of the field achieved a yield under 14 bales/ha (3178 kg).

1. What is causing the variability?

Compaction was identified prior to the season as a key issue for the Western two thirds of this field. Deep ripping was conducted on the identified area (LHS of the dotted line) prior to the cotton season at a total cost of $120 /ha (variable and fixed costs). The yield map and moisture map (Figure 7) both clearly show the improved yield and moisture availability where the ripping occurred. Partial budget analysis using the yield maps can be used to estimate the benefit of ripping.

Additionally, the SW corner of the field had aprox. 2 hectares severely affected by feral pigs. Partial budget analysis can be used to estimate the cost of this damage.

Figure 6: Variable yield map #2: Irrigated cotton (kg/ha). Left of dotted line deep ripped. Right of dotted line not ripped
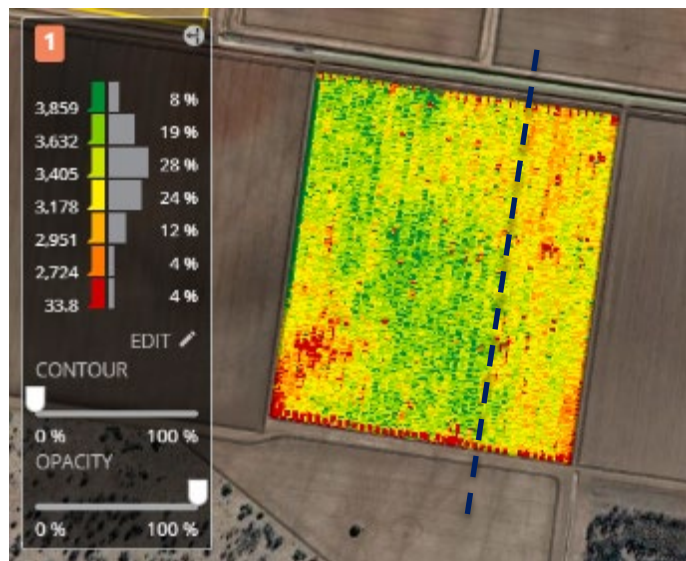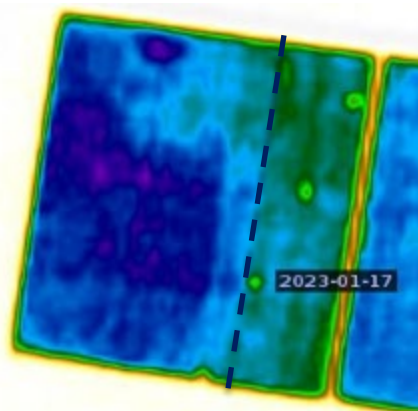

Figure 7: Moisture map (Satamap): Irrigated cotton #2

Figure 8: Scenario 2. Gross margin by yield

YIELD (227 kg lint bales/ha)	% of field at each yield	1 HA Gross margin by yield	Field gross margin by yield
4.0	4%	-$1,042	-$1,084
10.0		$2,355	$0
11.0		$2,921	$0
12.0	4%	$3,487	$3,626
13.0	13%	$4,053	$13,700
14.0	24%	$4,619	$28,824
15.0	28%	$5,185	$37,750
16.0	19%	$5,752	$28,413
17.0	8%	$6,318	$13,141
	100%		
Calculated field average yield	14.29		
		Total field gross margin	$ 124,370
		Average gross marin /ha	$ 4,783

2. Partial budget analysis

Converting the actual variable yields to a gross margin indicates a total field gross margin of $124,370, an average of $4,783 /ha (Figure 8). To review the benefits of the deep ripping, the yield differences were estimated by the grower as an average of 14.7 bales in the ripped section (18ha) and 13.4 bales in the area not ripped (8ha). Resulting in a GM $5,016 /ha and of $4,280 /ha respectively. Estimating that ripping the remaining 8 ha of the field would increase the average yield in that area to 14.4 bales/ha and the corresponding gross margin to $4,846. After ripping costs a net increase of $446 /ha.

Scenario 2: Compaction & feral pigs (continued)

Deep ripping is unlikely to achieve equivalent yield benefits annually and may not achieve equivalent results in other circumstances.

The damage caused by the feral pigs in two hectares of this field was estimated to have reduced the average yield from 14.7 bales /ha (GM $5,016) to 4 bales /ha (GM -$1,042) at a total income loss across the two ha of $12,116. Realising the scale of potential losses that feral pigs can cause, prompted the implementation of a co-ordinated feral pig management plan on this farm.

"We've started using the yield maps to inform the management decisions for our cotton operations. Apart from understanding the need for ripping our country, we're also using the yield maps to create variable application maps for gypsum. If we have the data, we may as well use it."

Namoi Valley Grower

Further factors for consideration

Some maps may not be suitable for analysis. If the map yields look questionable, don't use it to make management decisions. For example, some growers have found that yield monitors deliver higher results at night time and lower results in the morning. Without calibrating the machines multiple times during the day, the issue was unable to be fixed, removing the option of map analysis.

The visible stipes in the yield map image (Figure 9) clearly highlight this issue.

Where there are two or more pickers in a field or farm (or in a dryland scenario, a combination of pickers and strippers) differences in manual calibration will create varied yield results. This issue may also result in a stripey map like in Figure 9. These maps can be 'smoothed' in Field Analyzer using the edit button on the bottom right of the screen. This is also where you can calibrate the yield maps with actual ginned yield results.

For further information:
- **Visit www.cottoninfo.com.au**
- **Gross margins and customisable gross margin template**

Figure 9: Dryland cotton yield map not suitable for analysis