

Changing Fertiliser Rates within a Paddock: Decisions & Actions

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Introduction

The agricultural community – from manufacturers and service providers to farmers, research/education providers and agro-politicians – is not insulated in its operation from broad changes in general society. In its most general form, Precision Agriculture (PA) is merely proof of this truism. It is the embodiment, within the agricultural sector, of the Information Age that is sweeping through all facets of society.

In PA, the information that is now being provided to agriculture is used to improve the quantification of variability in production processes and refine management responses if necessary. Fertiliser rate changes to suit crop and soil requirements as they vary within a paddock are one of the more important management options because of the large contribution fertiliser makes to farm-wide variable costs. However, the ability to consider variability in more detail is being used in many animal and crop production enterprises to manage production (quantity, quality, health, risk), product tracking, value-adding chains and marketing.

And, as general society assimilates the benefits of information technology into everyday life, so PA will become inseparable from agriculture.

Observing Unique Fertiliser Responses within Paddocks

There are a number of methods becoming available which provide farmers with information for use in determining variable-rate fertiliser application rates. Most methods infer the responsiveness of different parts of a paddock from related data layers. An example is provided here where the response to Nitrogen fertiliser is tested directly within a paddock.

Nitrogen

Targeted deep soil nitrogen (DSN) sampling suggested that differences in yield response to N fertiliser could be expected within previously defined production classes in Paddock 44 Yarrowonga. A nitrogen response experiment was established in each class. (Figure 1a). The canola yield map for 2003 is shown in Figure 1b. Analysis of the yield response in each zone to applied urea is shown in Figure 2.

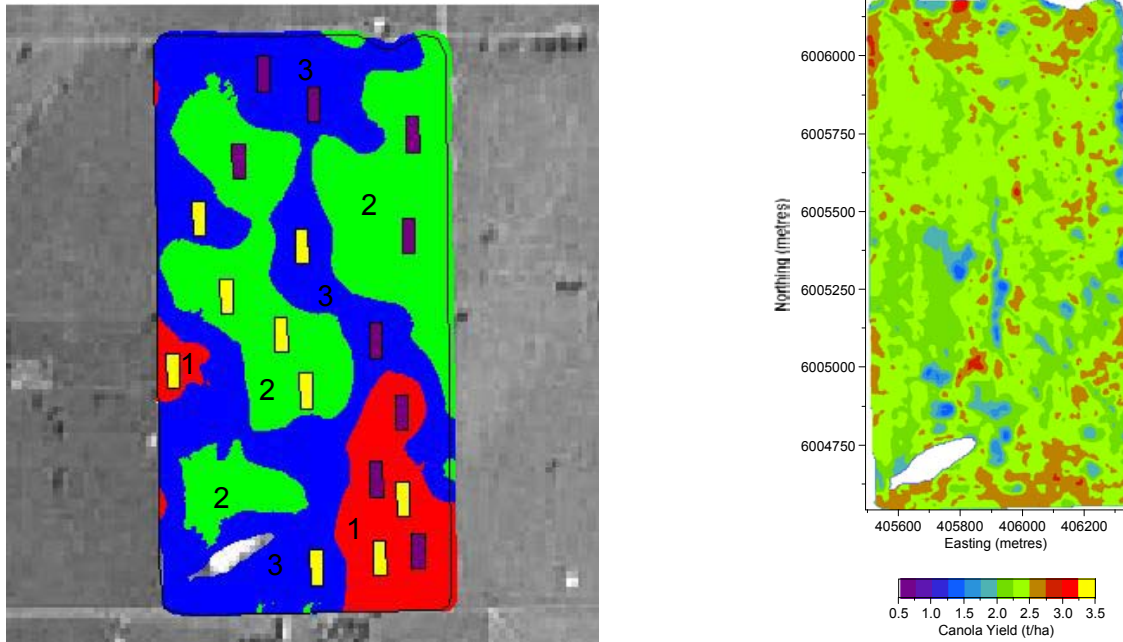


Figure 1. (a) Potential production classes (1,2,3) and the urea fertiliser application layout within each class– white plots received 0 kg/ha, dark plots received 200 kg/ha, rest of the paddock received 100 kg/ha. (b) canola yield map for 2003.

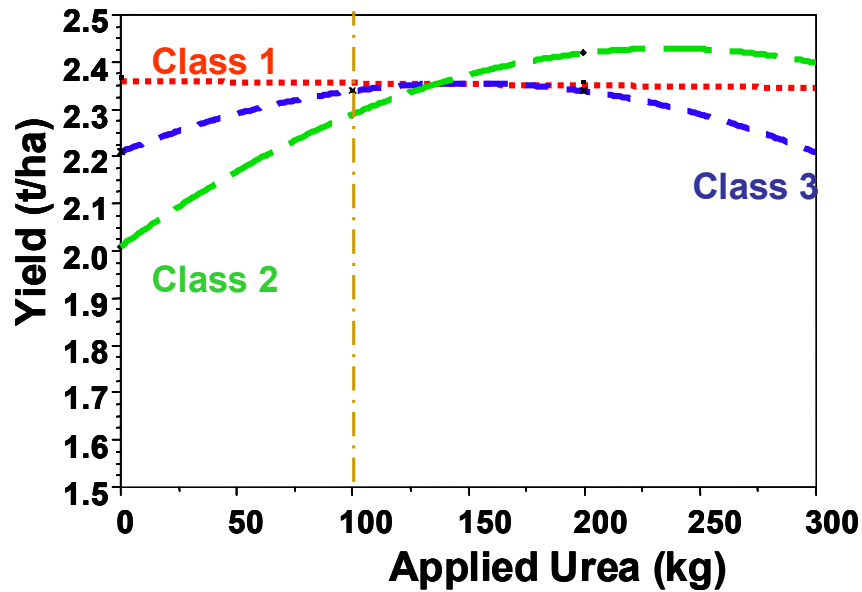


Figure 2. Yield response to applied urea in each potential management class. The paddock average of 100 kg/ha is shown to provide a relatively even yield across the classes, which is confirmed by the yield map.

The yield map is generally uniform across the paddock and this is reflected in the response function analysis. The majority of the paddock received 100kg/ha and the variation between the zones at this rate was calculated to be just 0.1 t/ha on average. However, an economic examination of the response data shows that the output from the different zones would have been optimised by applying different average rates in each. The urea rate for maximum yield and economic optimum urea rate for each zone using a marginal rate analysis is shown in Table 1.

	<i>Urea Rate for Maximum Returns (kg/ha)</i>	<i>Urea Rate for Maximum Yield (kg/ha)</i>
Class 1	0	0
Class 2	169	237
Class 3	72	151

Table 1. Urea rates to achieve maximum yield and economic optimum per potential management class.

Using these response functions it is possible to make a simple estimate of what gains or losses in gross margin would have been made if this information had been used to formulate fertiliser decisions at the beginning of the season. Table 2 documents a comparison with the paddock average treatment of 100 kg Urea/ha.

As can be seen in the breakdown, in 77ha of the paddock there was more fertiliser than required, and in 53ha of the paddock an extra application of 69 kg/ha would have brought in over 5 tonne more canola. The total waste in this scenario is \$3028 or \$23.29 per hectare.

But if this information was used at the beginning of the season, the 3.45 tonne of extra urea applied in Class 1 and 3 would not be removed from the paddock, it would have been distributed to Class 2, which would still require an additional 0.2 tonne of urea to be purchased. So the paddock would have actually used slightly more fertiliser than the traditional method. Class 3 would drop back in yield by a total of 1.18 t (\$472) and the cost of the extra fertiliser for Class 2 would have been \$80 for a gain of \$2120 in yield. The total of \$1568 (\$12.06/ha) in gross margin would have been gained over and above the marginal return from uniform application

<i>Fertiliser waste</i>	<i>ha x kg = t</i>	<i>x \$400/t =\$</i>
Class 1	18 x 100 = 1.8	720
Class 3	59 x 28 = 1.65	660
<i>Yield loss</i>		<i>x \$400/t =\$</i>
Class 2	53 x 100 = 5.3	2120
<i>Yield gain</i>		
Class 3	59 x 20 = 1.18	472
Total Loss		3028 (23.29/ha)

Table 3. Analysis of gross margin losses from fertilising at 100 kg/ha paddock average

So the actual increase, in financial accounting terms, from using this information would be \$12.06/ha. The true cost to the farm and the environment of not using the information is \$23.29/ha and so a very simplistic estimate of environmental cost from uniform management could be calculated as \$11.23/ha ($23.29 - 12.06$).

Options for Differentially Applying N Fertiliser

Regardless of the method by which the fertiliser requirements of different sections of a paddock are determined, there are a number of options for ensuring the application rates may be changed on-the-go. Map-based variable-rate technology (VRT) is well developed and available for spreaders, air seeders, planters and gas rigs.

There are also a number of ground-based, real-time sensing/application technologies that are commercially available for applying nutrients. The Greenseeker and the Yara (previously Hydro) N-Sensor. Correlations in Australia last season between the information gathered prior to anthesis by the N-sensor and final yield maps are promising.

