Nutrient waves dump yields

By Dave Eksteen, District Agronomist, DPI, Finley

It is well known that paddocks are not uniform and can often display a number of soil types within one paddock. In nutrition planning it has been the norm to treat different soil types separately. This is based on the assumption that each soil type is fairly homogeneous.

But recent GRDC-sponsored work and grower demonstration trials have shown that within soil types, paddocks are incredibly variable. The use of yield monitors has highlighted this with colourful maps being produced which show marked variation spatially in a paddock even across similar soil types.

This has made the analysis and interpretation of yield data very challenging.

This variability within paddocks is seen as a major constraint to crop production and often overrides the effects of applied treatments.

PADDOCK VARIABILITY

In 2003, a GRDC-sponsored project used satellite imagery to produce biomass images (Silverfox) for each of 12 paddocks in the Esperence area of Western Australia for the past three to five years.

These identified that, on average, 23 per cent of the paddocks showed low biomass production, 45 per cent average biomass production and 32 per cent above average biomass production.

Soil tests were then taken to compare nutrition between the 23 per cent low producing areas and the 32 per cent above average production areas.

The soil tests revealed that nutrition was one of the main factors limiting yield in these low biomass areas (Figure 1). The other factors found to be contributing to low yields were waterlogging and non-wetting sands, which affected plant population, sowing time and consequently, yield.

Figure 1 shows that potassium (K), calcium (Ca), magnesium (Mg) and manganese (Mn) were the main nutrients that were much lower in the low producing ar-

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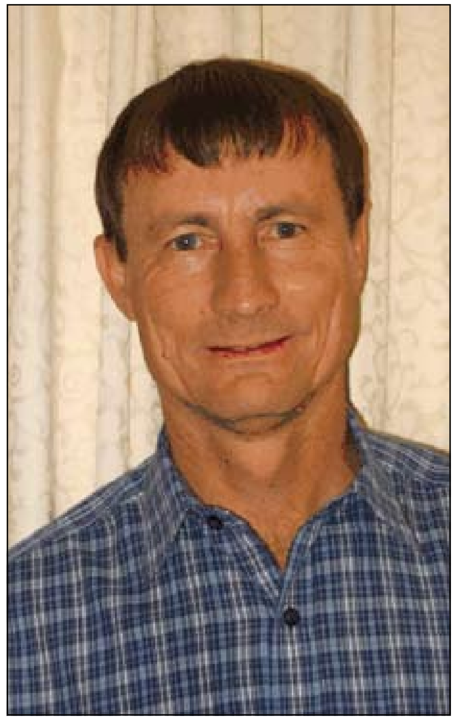

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◁3…VARIABILITY OF PADDOCKS

eas compared to the high producing areas. The sodium and salt levels were higher in the low producing areas compared to the high producing areas.

Strip trials were then conducted to see if trace elements deficiencies may be reducing yields on some of these paddocks.

The results produced an interesting trend where there were notable 'wave' effects in the paddock (Figure 2). It would appear that there are better strips in the paddock and poorer strips which affects yield and overrides the treatment effects.

Each treatment was one boomspray width (10 metres), with the control being 20 metres from the edge of the paddock. Each treatment was applied every 10 metres.

FIGURE 1: Low producing area as a percentage of high producing area

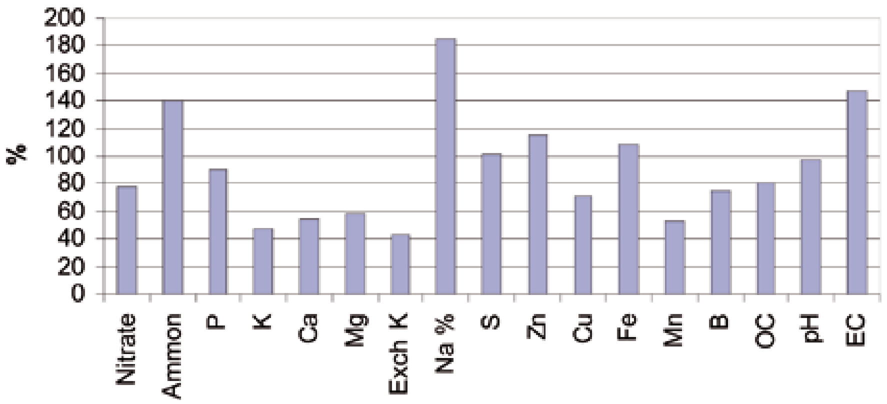


FIGURE 2: Nutrient demonstration trial (clay) – 2003

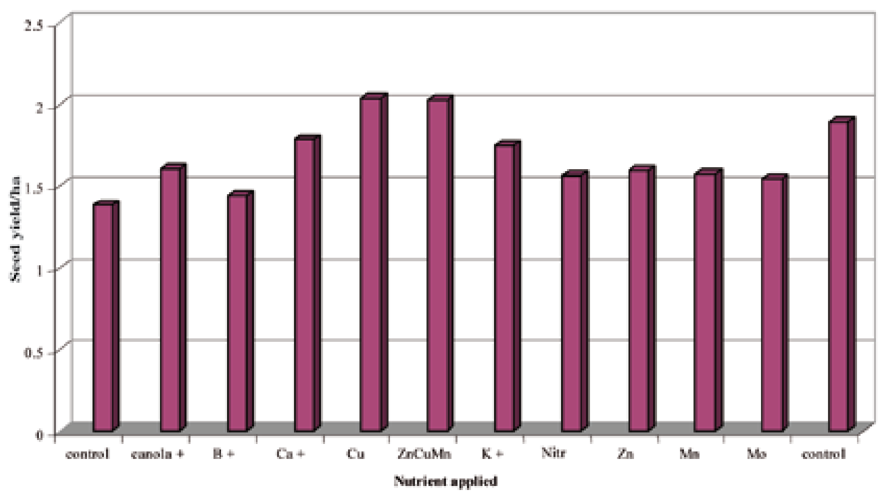


TABLE 1: Soil test results from samples taken every 10 metres in a linear line in a paddock

Site	Gravel %	Nitrate ppm	Ammonium ppm	P ppm	K ppm	S ppm	OC %	pH (water)	Exc Ca	Exch Mg	Yield (t/ha)
1	5-10	3	4	22	46	5.1	1.6	6.7	2.34	0.48	0.56
2	5-10	2	3	13	38	2.5	1.1	5.8	1.76	0.28	1.23
3	5-10	3	3	10	41	9.8	1.5	6.6	2.97	0.68	1.09
4	5-10	3	3	14	23	9.7	1.3	5.3	2.50	0.34	1.42
5	5-10	2	3	11	101	5.3	1.2	6.3	2.45	0.52	1.29
6	30-35	3	4	11	62	5.5	2.5	6.3	2.82	0.67	1.68
7	5-10	2	4	13	30	3.8	1.6	6.2	2.63	0.48	1.43
8	5-10	5	6	17	64	7.7	2.4	6.5	4.32	1.01	1.27
9	5-10	5	6	20	91	6.3	1.7	6.0	3.66	1.02	1.21
10	5-10	4	5	18	30	7.3	1.6	5.6	2.61	0.47	1.58

This wave effect has since been noted in a number of other trials. For example, when we spatially plotted data from a 2005 pasture trial in NSW, it showed a poor section in the trial from plots five to seven across all three replications – A, B and C (Figure 3).

To look at this variability more closely a paddock was selected and soil samples taken every 10 metres from one corner to the other corner. The results showed high levels of variability in the phosphorus and potash levels (Table 1). There was also a high variability in the above ground dry matter production at each of these sample sites.

A reason behind 'not significant'

This variability probably accounts for the reason many trials do not show statistical significances between treatments.

The variability is linked to the original natural vegetation of the paddock. Initially the landscape was not uniform and had clusters of shrubs and trees which would have had an effect on the nutrient deposition and accumulation in the soil.

During clearing, vegetation was pushed into piles and burnt. Then the farming practices of laser levelling, broadcasting of phosphates and nitrogen would have resulted in uneven application of nutrients.

Harvesting, windrowing and burning of windrows has added to this variability of nutrients.

A recent trial at Logie Brae near Finley, confirmed this problem of 'wave' effects (Figure 4). The Ventura wheat was sown as

FIGURE 3: Pasture trial – NSW, 2005

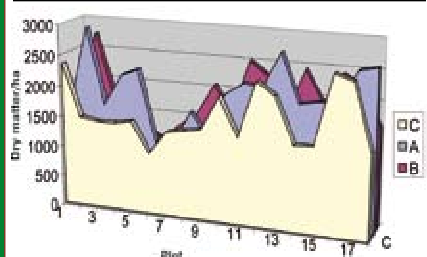
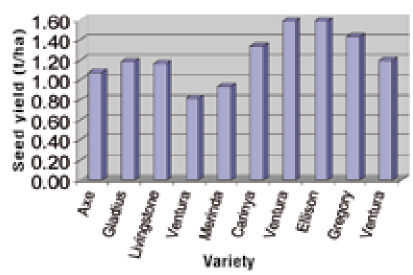


FIGURE 4: Cereal variety trial (plus fungicide) – Logie Brae, 2008



a control and its yield followed the trend of the 'wave' confirming that paddock variability has overridden the variety effect.

Identify and overcome constraints

One of the greatest challenges in improving crop production is to identify this variation within paddocks. We then need to develop strategies to overcome the low yields on these paddocks.

In the Logie Brae paddock there was no visual difference in crop, yet there was a significant yield difference.

In many paddocks around the Finley region there are visually huge differences (the wave effect) with these translating to huge losses to the grower.

We need to address this paddock variability across the entire Australian wheatbelt if we are to improve paddock yields and profitability.

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A wave effect on a cereal paddock near Finley in 2008.

IMPLICATIONS OF LOW INPUT CROPPING REGIMES

By Chris O'Callaghan, The Liebe Group

Chris O'Callaghan.

In the northern Western Australian wheatbelt, crop production has become the dominant enterprise over the past 20 years with crops providing more than 90 per cent of income on most farms. Many farmers have dismantled their stock infrastructure. Extensive farm consolidation has occurred and is expected to continue.

Sandplain soils in the region are naturally infertile and have relatively poor water holding capacity. But farmers have been very innovative in developing profitable farming systems based on wheat/lupins rotations, reduced tillage, timely sowing, herbicides and nitrogen. But new cost/price pressures are causing anxiety.

NEW PROJECT OUTLINE

In this new GRDC-supported project we aim to consider present options for maximising water use efficiency and to explore options that may provide opportunities for future increases.

The project is designed to cover different levels within the farming system:

- The crop;
- The cropping system; and,
- Issues at the whole farm level that impinge on crop management decisions.

Collaboration between CSIRO, Planfarm and three grower groups in the Northern Agricultural Region of WA (the Liebe Group, Mingenew-Irwin Group and North-East Farming Futures Group) will allow us to cover a substantial portion of a region in which water productivity is a key constraint.

The threat of climate change has come to the fore and, if the projected scenarios play out, the area could be one of the hardest hit in Australia. Nitrogen prices have risen in line with the increasing cost of fossil fuels. At present there are few alternative enterprises to annual crop production with wheat as the cornerstone enterprise.

Previous GRDC-supported research has identified water use efficiency (WUE) as one area worthy of further exploration to determine how productivity might be influenced by management practices centred around water use efficiency.

What are the longer-term implications of low inputs?

Results of the *Practice for Profit* project previously conducted by the Liebe Group, suggested that low input regimes gave the highest profit.

Whilst yields were reduced, this was more than offset by the reduced input costs. But it is necessary to consider the longer term implications of this strategy:

- Reduced fertiliser inputs can lead to the soil nutrient reserves being run down;
- Minimising weed control will lead to an increased seed bank; and so,
- Increased weed burden in subsequent crops.

In Mediterranean environments, productivity is influenced more by WUE than the total amount of water used. Conversely, water use efficiency is largely a result of good management, leading to high yield.

The level, timeliness and appropriateness of management are fundamental to high WUE and productivity. But this needs to be assessed in the context of profitability.

This project will improve the understanding of WUE and the range of management decisions that can alter WUE within this environment.

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