Trial 23

A 6 Tonne Per Hectare Wheat Crop
Sponsored By Pivot Agriculture

Aim: to work out what the limiting factors to production are on the sodic soils on the Tyrell land system

Method: at this site the major constraints to production were thought to be disease, weeds and nutrition. The treatments included:

- control
- predrill urea + topdressing urea as the season progressed (46 kg N + 2 x 32 kg N/ha)
- fumigation
- fumigation + predrill urea + topdressing as required (46 kg N + 2 x 32 kg N/ha)
- fumigation + predrill urea + Pivot Top Foliar spray (multiple nutrients) (46 kg N/ha)

Fumigated plots were treated with Basamid at 500kg/ha. All plots were sown with Ouyen wheat at 75 kg/ha with 7 kg N/ha as starter N, 22 kg P/ha and 2 kg Zn/ha On the specified plots urea was predrilled at 46 kg N/ha, and topdressed on two occasions (6 leaf and 1st node stage) with 32 kg N/ha each time, the foliar application was with Pivot Top Foliar which contains N, P, B, Cu, Mn, Mo and Zn, the fungicide applied was Folicur at the third node stage.

Results:

treatment	yield (t/ha)	protein % (at 11% moisture)
control	4.76	9.6
predrill + topdressed	4.49	11.2
fumigation	4.98	10.7
fumigation + predrill + topdressed	4.71	11.2
fumigation + predrill + foliar nutrients + fungicide	5.20	11.2
Significant difference	**NS**	**NS**

Interpretation:

It became clear during the season that the target of 6 tonne was not going to be achieved. Even though the inherent fertility of the site was excellent (148 kg N/ha at sowing as available nitrate nitrogen), the soil profile was full of water (125 mm of available water) and the growing season rainfall was plentiful (330mm between April and October) by flowering it was clear that something was not right. Establishment (germination) was good but the majority of plants only had one or two tillers (the expectation is to have 4 to 5 tillers by the end of tillering), so the crop was sparse with on average of around 400 potential number of heads at flowering. The problem was not associated with nutrition - plant analysis showed that all nutrients were adequate or in surplus. Disease levels were low (zero to very low levels of Take-all, CCN and Pratylenchus were recorded on the plant roots and associated soil in the fumigated plots, whereas in the non fumigated plots the levels were higher but still too low to affect yield). Soil tests were taken to depth on the suggestion of Dr Angus (CSIRO, Plant Industries). The results of these analysis showed two large problems in terms of plant growth:

Soil depth	Boron ppm	ESP % (exchangeable sodium percentage)
0 - 10 cm	2.5	1.6
10 - 20 cm	1.8	4.0
30 - 40 cm	10	23
50 - 60 cm	19	34
90 - 100 cm	17	33
120 - 130 cm	30	37

Boron levels in the soil above 15 ppm are thought to be toxic to plant growth, so somewhere between 30 and 40cm depth the soil is too high in boron to support good root growth. The exchangeable sodium percentage (ESP) is the amount of sodium in the soil as a percentage of all cations (calcium, magnesium etc) in the soil. ESP is a good measure of sodic conditions and at an ESP greater than 30% the saline conditions are such that root growth is inhibited.

It is highly likely that root growth is inhibited in this soil at 40 cm depth. This would severely restrict yield (through a reduction in water and nutrient uptake). It also means that boron tolerant varieties such as Frame are likely to perform well on this soil type (see the variety descriptions in this Manual for more details).

After harvest, soil samples were taken again to try and work out where the nitrogen was located in the soil. Samples were taken at 10 cm intervals down to 70 cm depth. We expected to find a bulge in soil nitrate at around 40 cm depth - the level at which boron and the ESP levels are very high. This did not occur and even under the high fertiliser regime in place (up to 110 kg N/ha as urea) there was little or no residual nitrogen in the soil to the depths we measured. It is possible that either:

a) the nitrate was leached out of the root zone (nitrate dissolves readily in water and can be leached). Because these soils are so sodic (high ESP) in the subsoil they are very well draining and water, together with the nitrate, could have leached beyond 70cm depth during this wet winter, or
b) the nitrate has been immobilised by soil bacteria and now forms part of the soil organic nitrogen pool

The results of the 6 tonne crop trial have raised more questions than we were able to answer. We know we can grow good crops but there is still something limiting production in the good seasons when the potential is much higher than average. The potential this year at the site was for a 7.0 tonne crop, the result of between 4.5 to 5.0 t/ha was not bad but not good enough. We will continue to work in this area over the next few years to really find out what is limiting production on our soil types, and what management systems, if any, can we have in place to take full opportunity of the next good season.