How Does Deep Ripping Affect Nitrogen Requirements?

Key Messages

- Deep ripping increased wheat yield by about 1 t/ha.
- Deep ripping did not reduce the response to nitrogen (N).
- After deep ripping, the high rate of N (100 L/ha Flexi-N) was most efficient when delayed until late tillering (Z30).

Aims

Deep ripping can lead to increased yield potential on soils constrained by sub surface compaction. This increases crop demand for N. However, the crop has more access to soil and fertiliser N due to potentially increased mineralisation of organic N and improved root access to N supplied by both the soil and fertiliser. An increase in soil mineralisation should reduce the need for fertiliser N at seeding and delaying applications until later in the season may reduce the risk of the crop running into moisture stress during grain fill.

The aim of this trial is to investigate the effects of deep ripping on the need for N fertiliser, and to compare the effectiveness of N applied at seeding compared to late tillering.

Soil Analysis

Depth (cm)	pH	EC	OC	Nit N	Amm N	P	PBI	K	S	Al
0-10	4.8	0.08	0.5	17	8	19	11	55	8	
10-20	4.2	0.03	0.4	6	2	17	15	43	4	4
20-30	4.3	0.03	0.3	6	2	16	17	47	5	7

Management

Seeding:	13 May	60kg/ha Mace wheat. Back half of site deep ripped to 30cm immediately after seeding.
Deep Ripping:	13 May	Immediately after seeding
Fertiliser:	13 May	80kg/ha Big Phos + 30 kg/ha MoP banded below the seed (basal)
	30 Jun	Flexi-N
Harvest:	30 Oct	

Rainfall: 253mm (Apr-Oct)

Trial Design

Trt	2015 Deep Ripped	Banded (L/ha)	Z30 (kg/ha)	N
1	-	-	-	0
2	-	50 Flexi-N	-	21
3	-	100 Flexi-N	-	42
4	-	-	50 Flexi-N	21
5	-	-	100 Flexi-N	42
6	-	50 Flexi-N	100 Flexi-N	63
7	+	-	-	0
8	+	50 Flexi-N	-	21
9	+	100 Flexi-N	-	42
10	+	-	50 Flexi-N	21
11	+	-	100 Flexi-N	42
12	+	50 Flexi-N	100 Flexi-N	63

Results

Crop Establishment

Establishment was worse in the deep ripping treatment at 98 plants/m^2, compared to 138 plants/m^2 in the unripped part of the trial. The deep ripping treatment improved early plant vigour, increased tillering and produced more biomass.

Penetrometer measurements

Penetrometer readings highlighted severe compaction (> 3 MPa) between 25 and 45cm, with a peak of 3.5 MPa.

Plant tissue test results

Plant testing at mid tillering (7 WAS) indicated no improvement in early N uptake as a result of deep ripping. Nitrogen appeared to be the only limiting nutrient.

Harvest

Yield responses to deep ripping were on average 1 t/ha across all treatments (Table 1).

The site was also very responsive to nitrogen (N) and deep ripping did not reduce the response to increasing rates.

Protein yields (yield * grain protein) showed that deep ripping improved crop access to N. There was an extra 20 kg N/ha recovered in the grain in the ripped section. This equates to an extra 27 kg N/ha taken up by the crop (assuming 75% retranslocation to the grain). Improved N recovery following deep ripping was most likely due to improved root development from July onwards and better access to nutrient reserves.

On the deep ripped section, there appeared to be a benefit from delaying the higher N inputs (100 L/ha Flexi-N) until late tillering where an extra 0.4 t/ha was produced.

Table 1. Wheat grain yields, protein, protein yield and nitrogen use efficiency (NUE) in response to Flexi-N applied at seeding and/or late tillering (Z30) on unripped and ripped soil.

	Treatments					Harvest			
Trt	2015 Deep Ripped	Banded (L/ha)	Z30 (kg/ha)	N	P	Yield (t/ha)	Protein (%)	Prot. Yield (kg/ha)	NUE* (%)
1	-	-	-	0	12	1.08	11.3	122	-
2	-	50 Flexi-N	-	21	12	1.30	12.0	156	37
3	-	100 Flexi-N	-	42	12	1.54	11.7	180	31
4	-	-	50 Flexi-N	21	12	1.39	11.6	161	44
5	-	-	100 Flexi-N	42	12	1.59	12.3	196	44
6	-	50 Flexi-N	100 Flexi-N	63	12	1.79	12.7	227	40
					Prob	<0.001	<0.01		
					LSD	0.18	0.52		
7	+	-	-	0	12	2.06	11.5	236	-
8	+	50 Flexi-N	-	21	12	2.32	11.7	271	43
9	+	100 Flexi-N	-	42	12	2.50	11.6	290	31
10	+	-	50 Flexi-N	21	12	2.28	11.4	259	32
11	+	-	100 Flexi-N	42	12	2.89	11.6	335	57
12	+	50 Flexi-N	100 Flexi-N	63	12	2.99	11.8	353	45
					Prob	0.009	0.38		
					LSD	0.30	ns		

* Nitrogen Use Efficiency (assumes 75% remobilisation of N from shoot to grains)

Economics

All Flexi-N treatments were profitable (Table 2).

The most profitable response to Flexi-N was on the deep ripped half of the trial where 100 L/ha Flexi-N was applied at late tillering.

Table 2. Economics of Flexi-N applied at seeding and/or late tillering (Z30) on unripped and ripped soil.

Treatments						Flexi-N Economics*		
Trt	2015 Deep Ripped	Banded (L/ha)	Z30 (kg/ha)	N	Yield (t/ha)	Returns ($/ha)	Cost ($/ha)	Profit ($/ha)
1	-	-	-	0	1.08	-	-	-
2	-	50 Flexi-N	-	21	1.30	56	34	21
3	-	100 Flexi-N	-	42	1.54	115	69	46
4	-	-	50 Flexi-N	21	1.39	79	39	40
5	-	-	100 Flexi-N	42	1.59	130	74	56
6	-	50 Flexi-N	100 Flexi-N	63	1.79	179	108	71
				Prob	<0.001			
				LSD	0.18			
7	+	-	-	0	2.06	-	-	-
8	+	50 Flexi-N	-	21	2.32	65	34	31
9	+	100 Flexi-N	-	42	2.50	112	69	43
10	+	-	50 Flexi-N	21	2.28	55	39	16
11	+	-	100 Flexi-N	42	2.89	209	74	136
12	+	50 Flexi-N	100 Flexi-N	63	2.99	234	108	126
				Prob	0.009			
				LSD	0.30			

*Assumes wheat $250/t; Flexi-N $520/t including freight

Grain protein in all treatments was between 11 and 12%.

Low rainfall and high temperatures recorded throughout September and October resulted in a quick finish, which probably contributed to high screenings (6-9%) on both ripped and unripped parts of the trial. Deep ripping appeared to improve hectolitre weights. They increased from 67-73 to 76-77 kg/hL with deep ripping.

Conclusions Deep ripping was very worthwhile at this site but had no effect on lowering crop requirements for N in this situation.

Nitrogen requirements may have been lower after deep ripping if there had been more organic N to mineralise (say after a lupin crop) and/or the soil had higher mineralised N levels that were subjected to more leaching pressure.

After deep ripping, high N inputs may be more effective delayed until late tillering.