Best bet management of ameliorated non-wetting soils of the Geraldton Port Zone - Irwin

Debbie Gillam, Research & Development Manager, Mingenew Irwin Group

Key Messages

- The treatment plots with low or no potassium were observed to have less vigour (visual assessment) and plant density from emergence.
- High potassium treatments had lower screenings and higher yields independent of the rate of nitrogen applied.

Aim

To determine the best way to apply nutrients and increase nutrient uptake on non-wetting soils after amelioration in the Geraldton port zone.

Background

Soil water repellence is a significant soil constraint for growers in the Geraldton Port Zone. In the Regional Cropping Solutions Network (RCSN) initiated booklet 'Combatting non-wetting soils' it is noted that in the northern area of Western Australia, 1.1 million hectares or about 14 percent of agricultural soils are at a high risk of soil water repellence. A further 3.2 million hectares of agricultural soils are at moderate risk. The most affected soils in this region are the pale and coloured deep sands, sandy gravels and some sandy duplex soils. The most affected areas are in the western part of the zone, in medium rainfall areas where the deep low clay content sands are the dominant soil type.

The objective of this research is to identify the best bet options growers and advisors can employ when managing non-wetting soils that have been (or are about to be) ameliorated. It involves investigating the impact of cultivation on nutrient management at three sites across the Geraldton Port Zone at Eneabba, Marchagee and Irwin. The project team chose to select two nutrients, potassium (K) and nitrogen (N) which were applied in various forms; granular, banded, top-dressed and liquid. It was agreed that, to avoid the initial flush of nutrients after the first year of cultivation, that selected sites would have been ameliorated a minimum of two years prior to implementing the trial.

The site at Irwin (the focus of this report) was ploughed in 2015 with a John Shearer 5GP plough. Soils on the property include acidic sandplain and non-wetting soils and the plough is being used as a management tool for both.

Trial Details

Property	Kelly Family, Strawberry, Irwin
Plot size & replication	2m x 20m x 4 replications
Soil type	Christmas tree yellow/white sand
Soil pH ($CaCl_2$)	0-10cm: 5.5 10-20cm: 5.4 20-30cm: 5.5
EC (dS/m)	0-10cm: 0.042 10-20cm: 0.021 20-30cm: 0.011
Paddock rotation:	2016 Lupins 2015 Wheat 2014 Lupins 2013 Wheat
Sowing date	16/05/2017
Sowing rate	80 kg/ha Mace wheat
Fertiliser	16/05/2017: Seeding fertiliser as per treatment list 17/07/2017: 50 L/ha Flexi N
Herbicides, insecticides & fungicides	16/05/2017: 118 gm/ha Sakura, 1.5 L/ha Trifluralin, 200 ml/ha Lorsban, 200 ml/ha Dominex 17/07/2017: 800 ml/ha Jaguar
Growing season rainfall	213mm

Trial Layout

Table 1: Applied treatments and treatment cost, 2017

No.	Description	IBS (kg/ha)	Banded (L/ha)	Banded (kg/ha)	Z23 (L/ha)	N	P	K	Cost $/ha
1	Std N no K		54 Flexi N	85 Agstar Extra	50 Flexi N	56	12	0	100
2	Std N std K		50 Flexi N	100 K Till Extra	50 Flexi N	56	12	11	111
3	Liquid K		117 Flexi NK	85 Agstar Extra	50 Flexi N	56	12	11	114
4	Std N High K		50 Flexi N	100 K Till Extra/28 MOP	50 Flexi N	56	12	25	127
5	Low N, High K			62 Big Phos/51 MOP	50 Flexi N	21	12	25	84
6	Std N, high K		50 Flexi N	100 K Till Extra/28 MOP	50 Flexi N	56	12	25	127
7	Std N , high K		50 Flexi N	100 K Till Extra/28 MOP	50 Flexi N	56	12	25	127
8	Std N , no K		54 Flexi N	85 Agstar Extra	50 Flexi N	56	12	0	100
9	Very High K	200 MOP	54 Flexi N	85 Agstar Extra	50 Flexi N	56	12	99	214

The trial was sown immediately after a rainfall event but unfortunately infrequent rainfall after sowing delayed crop emergence and limited growth opportunities. The decision was then made not to apply late season nitrogen. It was felt that by the time the crop was ready for the application it was too late in the season for the nitrogen to be used by the plants. The outcome was that Treatments 7 and 8 (originally planned for high nitrogen) only received a standard nitrogen application and became the same as Treatments 6, 4 and 1 respectively.

Results

Low rainfall post seeding (less than 10ml in the following 30 days) impacted on the 2017 research. Establishment was delayed and due to the late timing of the season the decision was made not to apply the high nitrogen treatments to the trial. The result of this is that the original protocol of nine treatments was reduced to seven. A blanket nitrogen treatment was applied at Z23 to all treatments in error with the result that there was no longer a nil nitrogen treatment.

Analysis of soil samples taken at Irwin on the 21st April show that residual nitrogen was present in the soil (Table 2). With low season rainfall it is expected there was minimal loss of nitrogen through the profile and the yield results suggest nitrogen was not limiting yield at this Irwin.

Table 2. Soil test, sampled 21st April 2017

Depth	pH (CaCl2)	OC %	EC	NO_3	NH_4 N	Col P	Col K	PBI
0-10cm	5.5	0.65	0.042	12	2	10	<15	8
10-20cm	5.4	0.35	0.021	7	1	8	<15	8
20-30cm	5.5	0.12	0.011	3	1	5	<15	7
30-40cm	5.2		0.01	2	<1	9	<15	7
40-50cm	6.5		0.02	3	<1	13	<15	8

Organic Carbon percent (OC% - dertermined by Walkley-Black method), Electrical Conductivity ds/m (EC), Nitrate nitrogen (NO_3), Ammonium nitrogen (NH_4-N), Colwell Phosphorus (Col P), Colwell potassium (Col K)

Table 3: Yield and quality results from 2017

No.	Description	Plants /m²	Yield t/ha	Protein %	Weight kg/hl	Screenings %	Returns $/ha
1	Std N no K	46	0.45[d]	13.7[a]	69.5	8.7[a]	AGP1 $113
2	Std N std K	65	0.83[c]	13.8[a]	71.1	8.3[ab]	AUH2 $233
3	Liquid K	30	0.39[d]	13.9[a]	68.6	9.0[a]	AGP1 $98
4	Std N High K	50	0.90[bc]	12.6[c]	73	5.8[c]	AUH2 $225
5	Low N, High K	62	0.91[bc]	13.0[bc]	71.2	6.3[c]	AGP1 $228
6	Std N, high K	52	0.96[b]	13.4[ab]	68.9	6.9[bc]	AGP1 $240
7	StdN , high K	61	0.98[ab]	13.6[a]	69.4	6.8[bc]	AGP1 $245
8	Std N, no K	37	0.44[d]	13.7[a]	69.2	9.1[a]	AGP1 $110
9	Std N, very High K	65	1.08[a]	13.8[a]	71.1	6.4[c]	AUH2 $270
	LSD		*0.11*	*0.5*	*NS*	*1.5*	
	CV%		*9.4*	*2.3*		*13.4*	
	P value		*<0.001*	*0.025*	*NS*	*0.001*	

Notes: All prices net delivered Geraldton and GST exclusive
Results followed by the same letter do not significantly differ from each other (P= 0.05).
NS=Not significant.

Treatments with both banded K in the compound fertiliser and top dressed K yielded significantly higher than those treatments with no K, or banded liquid K. They were observed as more vigorous and higher in plant numbers throughout the season, irrespective of the rate of N used.

Results indicate the background N and basal applications of fertiliser were not limiting for both grain yield and protein, with no further N response observed at higher rates. Early dry conditions through the year resulting in low yield levels indicate that plants would have had little opportunity to use any additional nitrogen. High grain protein and screenings indicate a dry finish and haying off under water limited conditions

Table 4. Results of tissue analysis

No.	Description	IBS (kg/ha)	Banded (L/ha)	Banded (kg/ha)	Z23 (L/ha)	N %	K %
1	Std N no K		54 Flexi N	85 Agstar Extra	50 Flexi N	4.02	1.34
2	Std N std K		50 Flexi N	100 K Till Extra	50 Flexi N	3.03	1.08
3	Liquid K		117 Flexi NK	85 Agstar Extra	50 Flexi N	4.17	1.21
4	Std N High K		50 Flexi N	100 K Till Extra/28 MOP	50 Flexi N	2.76	1.55
5	Low N, High K			62 Big Phos/51 MOP	50 Flexi N	2.65	1.72
6	Std N, high K		50 Flexi N	100 K Till Extra/28 MOP	50 Flexi N	2.85	1.4
7	Std N , high K		50 Flexi N	100 K Till Extra/28 MOP	50 Flexi N	3.17	1.46
8	Std N , no K		54 Flexi N	85 Agstar Extra	50 Flexi N	3.73	1.1
9	Very High K	200 MOP	54 Flexi N	85 Agstar Extra	50 Flexi N	2.56	2.01

Tissue samples were taken on the 15th August. The trial was sown into wet soil in May but unfortunately infrequent rainfall post seeding meant the trial took a long time to establish and this date was the earliest opportunity to sample. A second set of samples were not taken as the weather continued to be warm after this date and there was not an opportunity to sample prior to head emergence.

Comments

2017 was a challenging season and more research in 2018 will be required to confirm the results received in 2017. Hopefully with a slightly higher rainfall, all nine treatments will be applied throughout the season.

In 2017 banded potassium was very important for crop development and was more critical than nitrogen due to the background soil N being more than enough for the season. The high background soil N is expected to be a result of the prior wheat/lupin rotation that has been implemented on this paddock.

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Contact
Debbie Gillam
Mingenew Irwin Group
Research & Development Manager
debbie@mig.org.au
0427 281 006