North East Farming Futures
growing our future

To Unlock the Soils Existing Bank of Phosphorous and Other Micro-Nutrients

NACC
Managing Natural Resources

Australian Government

National Landcare Programme

1.0 AIM

The long term aim of the demonstration is to economically rebuild many of the characteristics of a soil that will improve the viability of the farming system in this dry land cropping enterprise.

- Improve soil structure through the introduction of beneficial soil microbes and a necessary energy source for them**.** This will improve water use efficiencies, fertiliser performance and increase the buffering capacity of the soil against drought and chemical residues.
- Reduce the acidifying inputs into the farming practice. This helps to improve the habitability of the soil for beneficial biology and therefore build soil structure and related benefits.
- Develop a nutrient program to enhance crop health and performance. A healthier crop is more able to suppress pests and diseases, which in turn should help to reduce the dependence on chemical inputs.

2.0 BACKGROUND

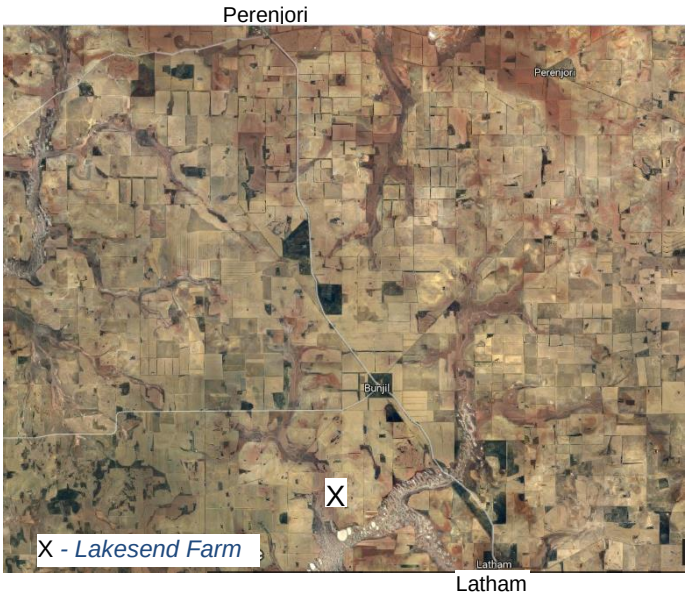
This trial was undertaken after interest was shown by Landholders in adding biological additives to cropping programs and stock enterprises in the Midwest. Reduced rainfall areas and degraded, marginal farmland have shown improved profit margins by introducing beneficial soil microbes and reducing fertiliser and chemical applications. The long term benefits of which are reductions in nutrient imbalances and chemical residues which improve soil health and sustainability, as well as financial benefits and seasonal risk reduction.

The Demonstration Site has a long term history of wheat on wheat cropping with Canola used a break crop once (3 years previously) in over 10 years. Lupins and other potential rotation strategies have not proved to be effective financially or beneficial to soil health on other paddocks on the farm. Chemical fallowing of paddocks can improve water retention for the next crop but this also contributes to increasing chemical residues in the soil.

Previous owners have not maintained stocking infrastructure and the increased capital required to reintroduce stock reduces the viability of utilising this as a rotation. Seasonal variability has also impacted the potential to maintain stock feed for a full 12 months which can increase the risk of selling stock at less optimal times and prices.

Given that the risk of drought or at least reduced and/or intermittent winter rainfall is rising in the north eastern cropping areas which can lead to reduced yields, strategies that reduce the financial outlay required for fertiliser and chemical inputs are necessary to maintain or improve profit margins. Although the short term profit may be reduced the risk of larger negative returns is also reduced.

The Demonstration is an opportunity to look at a long term strategy to reduce the annual financial risk of cropping whilst improving the soil structure to be economically and environmentally sustainable.



3.0 DEMONSTRATION SITE/S DETAILS

The demonstration site was on Lakesend Farm, owned by Phil and Bev Logue, 35km south of Perenjori between Bunjil and Latham. The site was selected due to the relative uniformity of the soil type to ensure that the results obtained from the trial were not affected by soil variations.

- Grey sand over gravel.
- Rotation has been wheat only 2014-15, canola 2013, wheat 2009-12
- This site is well drained and has had reasonably good yields in previous years

4.0 METHOD

	Farmer Practice Traditional	**Hi Tech Ag Program** Soil building
Seeding date	18/5/2016	18/5/2016
Variety	Justica wheat	Justica wheat
Seeding rate	60 kg/ha	60 kg/ha
Seed dressing	1L Veto/tonne seed fungicide	2kg VAM/tonne seed 5L Seed Gro Plus/tonne seed
Fertiliser		
- **At seeding**	70kg/ha KTill extra Units – 7N, 7P, 7K plus trace elements of Cu & Zn	70kg/ha Pro N Extra Units applied – 9.1N, 7P, 3.5K plus HiFulvic & HiHumic Coating
- **Post emergent**	**30/6/2016** (with Herbicides) 10 L/ha soluble urea (3 units of N) **3/7/2016** 30 L/ha soluble urea (8 units of N)	**30/6/2016** (with Herbicides) 10 L/ha soluble urea (3 units of N) **24/7/2016** 30L/ha Blu N (8 units of N) 3 L/ha Hi Pot
Herbicides		
- **Pre-emergent**	**18/5/2016** 1.5 L/ha Glyphosate 1.8 L/Ha Trifluralin Fulva Wet as wetter	**18/5/2016** 1.5 L/ha Glyphosate 1.8 L/Ha Trifluralin Fulva Wet as wetter
- **Post emergent**	**30/6/2016** 400 ml/ha Intervix 300 ml/ha LV ester Fulva Wet as wetter	**30/6/2016** 400 ml/ha Intervix 300 ml/ha LV ester Fulva Wet as wetter
Growing season Rainfall	244 ml	

	←330 m →
28m	Soil Building ← Seeding →
	VAM, Seed Gro Plus, Pro N Extra, Blu N, Hi Pot
42m	Traditional
	← Seeding →
	KTil Extra, Liquid Urea

Trial plots were 28m (2 Seeder widths) wide for HiTech & 42m (3 Seeder widths) wide for Farmer Practice, by 330 m long, replicated 10 times alternatively across the paddock. This was to ensure any subtle changes in soil type etc were minimized. The varied width of the trial plots allowed for any incursion of soil microbes from the HiTech applications into the adjacent Farmer Practice plots to be avoided at sampling.

Harvest samples were 18m (2 Harvester widths) wide by 330m long and each was replicated 10 times alternatively across the paddock. The plots were harvested using a conventional harvester with harvested grain measured using a weigh trailer.

The trial was to determine how the traditional Farmer Practice treatment compared to the soil building Hi-Tech treatment using averaged yield results as a standard comparison. Wheat protein, grain weight (HWT) and screenings were all tested at CBH. Root mass was measured by coring mid-row samples to retrieve roots which were then separated from the soils through shaking and washing.

Soil and Tissue testing was carried out by APAL laboratories, South Australia.

5.0 RESULTS

Trial results showed that the Farmer Practice treatment had a significant positive yield effect compared to Hi- Tech Ag with 160 kg/ha difference. Yield ranged from 1.5 t/ha to 1 t/ha in the Hi-Tech treatment with the Farmer Practice treatment ranging from 1.6 t/ha to 1.3 t/ha.

The pre-emergent and post emergent herbicide applications were the same for both treatments as this accommodated the size of the spraying machinery. It also ensured that weed burdens were not an issue in yield or quality results. Both treatments received Liquid Urea with 3 units of N in the herbicide application on the 30th June.

At seeding Farmer Practice plots were fertilised with 70kg/ha K-Till Extra which is a widely used district fertiliser with 7 units of N, P & K each plus trace elements of Cu & Zn with Veto seed dressing fungicide applied at 1 l/t seed. HiTech plots were fertilised with 70kg/ha Pro N Extra which is a DAP based fertiliser with 9.1 units of N, 7 units of P & 3.5 units of K, coated with humates & fulvates. Seed dressings applied for HiTech plots were VAM Gro Plus containing vesicular-arbuscular mycorrhizal (VAM) fungi and Seed Gro Plus containing trace elements and microbial stimulants.

Pro N Extra is a 'biologically enhanced granular fertiliser blend, containing a wide range of nutrients and other beneficial components to improve the soils natural release of resources'
http://hitechag.com.au/products/pro-n-extra-13-10-5/

There were 2 different foliar N applications in July, being liquid urea – Farmer Practice, with no additional products and Blu N – HiTech with Hi-Pot which had additional potassium and trace elements in zinc, copper and manganese. The results showed that these additional elements were not limiting factors to yield and to have had no yield advantage when compared to timing of application.

Timing of foliar N application had a significant yield difference. Farmer Practice treatment with Liquid Urea was applied 21 days before the HiTech Blu N treatment was applied. The Farmer Practice Liquid Urea application was applied as 8 units of N on the 3rd of July. This showed to have the greatest effect on the crop compared to the later application of HiTech Blu N on the 24th July.

The timing of the Farmer Practice Liquid Urea application of foliar N was based on normal district practice determined by the growth stages of the plants. Consultation with HiTech staff determined the timing of the HiTech Blu N foliar N who recommended that the application be delayed based on tissue testing results. The timing of N application around the wheatbelt is different and HiTech staff acknowledged that it was a mistake to wait this long to apply N in these circumstances.

Blu N is a 'non-acidifying concentrated liquid nitrogen source fortified with fulvic and amino acids'
http://hitechag.com.au/products/nitrogen/

Hi Pot is a 'high analysis citrated liquid potassium which is quick to be accepted and absorbed by living tissue' http://hitechag.com.au/products/hi-potassium-c30/

There were no significant grain quality differences between treatments in terms of protein, weight and screenings. There is no significant difference in any of the key indicators of crop nutrition or micro nutrient efficiencies in the soil tests

Post-harvest root biomass analysis showed that the Hi-Tech treatment had greater root bio mass compared to Farmer Practice. This result showed a significant difference of greater than 50% more root bio mass in the Hi-Tech treatment. This suggests that VAM Gro Plus and Seed Gro Plus had a major impact on the root structure.

There was a crop visual effect of staying greener for longer in the HiTech plots by 5-8 days in September but this has not resulted in better grain yield or in better or worse grain quality.

VAM Gro Plus is an inoculant which helps to 'build protect root structures, increase disease resistance, greater access to soil nutrients, overall improvement of plant function and the starting block to soil enhancement' http://hitechag.com.au/files/2015/11/VAM-Gro-Plus-1.pdf

Seed Gro Plus is a balanced blend of micro p and macro elements and natural amino acids for seed vigour and microbial stimulation' http://hitechag.com.au/files/2015/11/Seed-Gro-Plus-2.pdf

Weather conditions

Rainfall 311 ml for 2016
244 ml growing season rain

April	50 ml
May	32
June	42
July	57
Aug	41
Sept	17
Oct	6

Cold weather events

13 days below 3 degrees Celsius
Losses of up to 1 t/ha yield in the region was widespread

July	2 days	0.8ºC was the lowest
Aug	6 days	0.6ºC was the lowest
Sept	5 days	0.6ºC was the lowest

April 2016 Soil Tests

HiTech 0-100	Unit	Desired Level	Level Found	+ or -	Farmer Practice 0-100	Unit	Desired Level	Level Found
ECEC	c.mol/kg	May-25	2.54	0.05+	ECEC	c.mol/kg	May-25	2.59
Organic Carbon (W&B)	%	>0.5	0.7	0.08-	Organic Carbon (W&B)	%	>0.5	0.61
Total Nitrogen (Dumas)	%		NR		Total Nitrogen (Dumas)	%		NR
pH 1:5 (Water)		6.0 - 7.0	6.22	0.06-	pH 1:5 (Water)		6.0 - 7.0	6.28
pH 1:5 (CaCl2)		5.5 - 6.5	5.57	0.07-	pH 1:5 (CaCl2)		5.5 - 6.5	5.64
Nitrate – N	ppm	Oct-50	11.5	3.5-	Nitrate - N	ppm	Oct-50	14
Ammonium – N	ppm	-	5	1.4-	Ammonium - N	ppm	-	6.4
Colwell Phosphorus	ppm	25 - 35	46	9+	Colwell Phosphorus	ppm	25 - 35	37
Bray 2 Phosphorus	ppm	50 - 80	45	11-	Bray 2 Phosphorus	ppm	50 - 80	56
PBI + ColP		<100	30	4-	PBI + ColP		<100	34
Colwell K	ppm	40 - 80	86	5+	Colwell K	ppm	40 - 80	81
KCl Sulfur (S)	ppm	Oct-20	12.4	0.08+	KCl Sulfur (S)	ppm	Oct-20	13.2
Calcium (Ca)	ppm	900-1000	373	25-	Calcium (Ca)	ppm	900-1000	398
Magnesium (Mg)	ppm	150 - 175	48	4+	Magnesium (Mg)	ppm	150 - 175	44
Potassium (K)	ppm	> 100	58	3+	Potassium (K)	ppm	> 100	55
Sodium (Na)	ppm	< 70	17	5+	Sodium (Na)	ppm	< 70	12
Exch. Aluminium (Al)	c.mol/kg	< 0.5	<0.02		Exch. Aluminium (Al)	c.mol/kg	< 0.5	<0.02
Exch. Hydrogen	c.mol/kg	-	0.05	0.01+	Exch. Hydrogen	c.mol/kg	-	0.04
Chlorides (Cl)	ppm	<120	NR		Chlorides (Cl)	ppm	<120	NR
Salinity EC 1:5	dS/m	< 0.15	0.06	0.01-	Salinity EC 1:5	dS/m	< 0.15	0.07
Boron (B)	ppm	0.5 - 2.0	0.32	0.08-	Boron (B)	ppm	0.5 - 2.0	0.4
DTPA Iron (Fe)	ppm	Oct-70	25	0	DTPA Iron (Fe)	ppm	Oct-70	25
DTPA Manganese (Mn)	ppm	Apr-50	2.1	0.4+	DTPA Manganese (Mn)	ppm	Apr-50	1.7
DTPA Copper (Cu)	ppm	0.5 - 5.0	0.4	0.03-	DTPA Copper (Cu)	ppm	0.5 - 5.0	0.43
DTPA Zinc (Zn)	ppm	1.0 - 5.0	0.4	0.07+	DTPA Zinc (Zn)	ppm	1.0 - 5.0	0.33

March 2017 Soil Tests

HiTech 0-100	Unit	Desired Level	Level Found	+ or -	Farmer Practice 0-100	Unit	Desired Level	Level Found
ECEC	c.mol/kg	May-25	2.15	0.03+	ECEC	c.mol/kg	May-25	2.12
Organic Carbon (W&B)	%	>0.5	0.72	0.41-	Organic Carbon (W&B)	%	>0.5	1.13
Total Nitrogen (Dumas)	%		NR		Total Nitrogen (Dumas)	%		NR
pH 1:5 (Water)		6.0 - 7.0	6.02	0.37+	pH 1:5 (Water)		6.0 - 7.0	5.65
pH 1:5 (CaCl2)		5.5 - 6.5	5.2	0.34+	pH 1:5 (CaCl2)		5.5 - 6.5	4.86
Nitrate – N	ppm	Oct-50	7.5	0.8-	Nitrate - N	ppm	Oct-50	8.3
Ammonium – N	ppm	-	1.6	0.1-	Ammonium - N	ppm	-	1.7
Colwell Phosphorus	ppm	25 - 35	35	3+	Colwell Phosphorus	ppm	25 - 35	32
Bray 2 Phosphorus	ppm	50 - 80	43	4+	Bray 2 Phosphorus	ppm	50 - 80	39
PBI + ColP		<100	27	5-	PBI + ColP		<100	32
DGT Phosphorus	µg/L	67 - 100	57	22+	DGT Phosphorus	µg/L	67 - 100	35
KCl Sulfur (S)	ppm	Oct-20	9.5	3.1-	KCl Sulfur (S)	ppm	Oct-20	12.6
Calcium (Ca)	ppm	900-1000	321	24+	Calcium (Ca)	ppm	900-1000	297
Magnesium (Mg)	ppm	150 - 175	42	3+	Magnesium (Mg)	ppm	150 - 175	39
Potassium (K)	ppm	> 100	56	5-	Potassium (K)	ppm	> 100	61
Sodium (Na)	ppm	< 70	12	0	Sodium (Na)	ppm	< 70	12
Exch. Aluminium (Al)	c.mol/kg	< 0.5	NT		Exch. Aluminium (Al)	c.mol/kg	< 0.5	0.05
Exch. Hydrogen	c.mol/kg	-	NT		Exch. Hydrogen	c.mol/kg	-	0.06
Chlorides (Cl)	ppm	<120	NR		Chlorides (Cl)	ppm	<120	NR
Salinity EC 1:5	dS/m	< 0.15	0.05	0.02-	Salinity EC 1:5	dS/m	< 0.15	0.07
Boron (B)	ppm	0.5 - 2.0	0.31	0.03-	Boron (B)	ppm	0.5 - 2.0	0.34
DTPA Iron (Fe)	ppm	Oct-70	19	8-	DTPA Iron (Fe)	ppm	Oct-70	27
DTPA Manganese (Mn)	ppm	Apr-50	1.6	0.3-	DTPA Manganese (Mn)	ppm	Apr-50	1.9
DTPA Copper (Cu)	ppm	0.5 - 5.0	0.34	0.07-	DTPA Copper (Cu)	ppm	0.5 - 5.0	0.41
DTPA Zinc (Zn)	ppm	1.0 - 5.0	0.34	0.01-	DTPA Zinc (Zn)	ppm	1.0 - 5.0	0.35

Hi-Tech Ag plots

Trial row number	Sample number	Yield t/ha	HWT	Screening	Protein	Root Mass
3	1	1333.3	398	0.80%	10.3	
5	2	1484.8	387	1.08%	10.6	
7	3	1464.6	401	1.12%	10.4	
9	4	1461.3	397	1.33%	10.3	
11	5	1286.2	395	1.03%	10.3	
13	6	1020.2	400	0.94%	10.1	
15	7	1026.9				
17	8	1383.8				
19	9	1292.9				
21	10	1468.0				
Average		**1322.2**	**396**	**1.05%**	**10.3**	**97grams**

Farmer Practice plots

Trial row number	Sample number	Yield t/ha	HWT	Screening	Protein	Root Mass
2	1	1414.1	396	0.87%	10.3	
4	2	1552.2	400	1.10%	10.4	
6	3	1636.4	394	1.36%	10.2	
8	4	1636.4	397	1.48%	10.1	
10	5	1532.0	397	0.90%	10.2	
12	6	1471.4	399	0.87%	10.1	
14	7	1367.0				
16	8	1279.5				
18	9	1434.3				
20	10	1501.7				
Average		**1482.5**	**397**	**1.10%**	**10.2**	**46grams**

Average of the Hi-Tech Ag and Farmer Practice

	Yield t/ha	HWT	Screening	Protein	Root Mass
Hi Tech Ag	1322.2	396	1.05%	10.3	97g
Farmer Practice	1482.5	397	1.10%	10.2	46g
Difference	160.3 kg	0.8	0.05	0.1	51

6.0 CONCLUSION

This trial showed that timing of N application is critical to yield potential, this showed that early foliar N had greater significance than application of other nutrients like potassium and trace elements. The trial also showed that seed treatments can develop significantly greater root biomass than unapplied seed.

It was noted that the extra root bio mass did not translate into crop yield. Further trials in this area are needed. Similar timing of application of N will remove any distortion of the yield results which would ensure a direct comparison to treated and non treated seed. It will also show if increased root bio mass can translate to increased soil organic matter and how this may influence yield over time.

The timing of applied nitrogen has been done with the consultation of Hi Tech staff giving recommendations of timing on the HiTech plots where as the applied N on the farmer practice sites was on normal district practice based on wheat phenology.

The timing of N application around the wheatbelt is different and Hi Tech staff acknowledged this was a mistake to wait as long to apply the N.

There has been no detriment to crop yield or quality in using the soil health products supplied by HI-TECH in this cropping system but has not resulted in better financial results at this stage.

The nitrogen products supplied by HI-TECH have added benefit of being able to apply N post rain events without losing N efficiency. This has better agronomic benefits as you can spray post rain and eliminate spraying weeds when under moisture stress.

7.0 ACKNOWLEDGMENTS

- NACC
- National Landcare Programme
- Farmers, Phil & Bev Logue
- Hi Tech AG staff Wayne Challis, Luke Freeman, Oliver Kent and Phillip Lee.
- Perenjori Farming Forward

8.0 REFERENCES

If you have used any.

Not applicable.

‘To unlock the soils existing bank of phosphorous and other micro-nutrients’ was delivered by North East Farming Futures and Perenjori Farming Forward. It was supported by the Northern Agricultural Catchments Council through funding from the Australia Government’s National Landcare Programme.

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