Case Study 5 – West Midlands Group, Evolving Soils Project.
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In this investigation a paddock that had been Mold boarded was compared to an untreated paddock.

It is to be noted that soil tests are only a guide to the nutrient status at the time samples are taken and can be used as a guide as to what the plant available nutrients are at any given time. There are many physical and environmental factors such as structure/type of soil, compaction, water infiltration/retention rates, temperature, and soil biology to name a few, that influence the plant and soil nutrient systems and how these interact with each other. Examples of parameters that may be highly variable are Ammonium Nitrate, Sulphur, and Chloride.

In this situation the Mold boarded paddock had been treated to 30 cm and 75 sub samples per depth were taken at 0 - 10, 10 - 30 cm and 30 - 60 cm.

Figure 1 P1 Mold board to 30 cm Soil Analysis –Graphical Results 0-10, and 10 – 30 and 30 – 60 cm

P1 Mold board Paddock Interpretation

- pH levels are fine across all depths.
- 0 - 10 cm has a higher CEC consistent with sandy loam and decreasing at depth, 2.01 to 1.56.
- P levels are all low.
- Most parameters are reduced as the depth increases except for Nitrate N which increases then decreases. This was surprising but possibly shows some time since moldboarding; allowing nutrients to settle through profile?
- PBI is on the low end of the scale across all depths however slightly higher at

the lower depth, indicating plant available P when applied (higher PBI soil binds P).

- Total P indicates P is available via microbial activity to plant also with more at depth.
- Potassium is sufficient in the top 0 - 10 cm reducing at depth.
- Magnesium is also sufficient on the surface reducing at depth.
- Calcium is also sufficient in the top 0 -10 cm and reducing at depth. The Ca:Mg ratio is ok with imbalance at depth due to dominating effect of Calcium.
- Sodium is excessive on the top, sufficient in middle profile and low at depth.
- Trace elements (Copper and Manganese) are low, and Zinc and Iron are sufficient however iron is high to excessive in the 0 - 10 cm sample. Zinc reduces in the middle profile.
- n the at sufficient levels in the top depths with Iron being very high, suspected due to the nature of the geology in the region.
- Boron is low at all depths.
- Nitrate Nitrogen is low in all depths. Very low C:N ratio indicates potential for sufficient N in the system if high organic matter is existing (low at 0.9 – 2.3). All soils in the wheatbelt have a typically low OM content so keep an eye on N. It also identifies potential soil structure issue. The balance of Nitrate to Ammonium Nitrogen is also out of balance with impact on mineralisation however improving at depth. Total Nitrogen levels are also looking quite good in the top 0 - 10 cm (1300) high. 800 – 450 reducing at depth which does show N in the system that could be utilised if more microbial activity occurred.
- With a low suspect C:N ratio and Calcium percentage is quite high (between 73.9%, 69.9 and 77.6%) using Calcium Ammonium Nitrate (CAN) in preference to SOA and treatments such as Gypsum may be useful.

The untreated paddock had 50 sub samples taken at each depth from 0 - 10, 10 - 20 and 20 - 30cm.

P2 Untreated Paddock Interpretation

- pH levels are fine in top 0 - 10 cm but are lower at depth.
- CEC is higher in the top layer and decrease at depth consistent with a transition to loamy sand to sand.
- P levels are sufficient in the 0 - 10 and 10 - 20 cm (although higher at mid-level) becoming more marginal at lower depth.
- All other parameters are reduced as the depth increases.
- PBI is on the low end of the scale indicating no issues with potential of P being locked up so there is plant available P (higher PBI soil binds P).

- Total P indicates P is available via microbial activity to plant also.
- Potassium is low and very low as depth increases.
- Sufficient Magnesium in the top 0 -10 cm, decreasing and low at depth.
- Calcium is also sufficient in the top 0 -10 cm. Low and very low at depth. The Ca:Mg ratio is ok at 5 - 8 in the top 0 - 20 cm and out of balance at depth with a dominating influence of Mg due to the low Ca levels.
- Sodium also excessive in the top 0-20 cm but low at depth.
- Trace elements (Copper and Manganese) are low with Zinc excessive at 0 - 10 cm and low at depth and Iron being excessive at 0 - 10 cm and sufficient at depth.
- Boron is low across all depths.
- Nitrate Nitrogen is low across all as is the C:N ratio of around 10 at all depths.
- C: N Ratio (under 12) can indicate a soil structure problem or poor aerobic/aeration considerations. Use Calcium Ammonium Nitrate (CAN) in preference to Sulphate of Ammonia. Cultivation may improve aeration and improve N mineralization.
- Total Nitrogen levels are quite good in the top 0 - 10 cm reducing at depth (1100, 570 and 400) demonstrating that there is N in the system however organic matter is low so it’s not being utilised.
- Due to high sodium in paddock use Sulphate of Potash in preference to Muriate of Potash in the future.
- Generally high sodium levels can be treated with Gypsum but considering the Exchangeable Sodium Percentage (ESP) is under 15% I wouldn’t bother at this point.

The topsoil to 10 cm was further compared over both areas.

P1 Moldboard Vs P2 Untreated Comparison (top 0 – 10 cm)

- pH levels are comparative in both.
- P levels are low in P1 compared to sufficient in P2.
- PBI is a little higher in P2, but both are characteristically low.
- Total P in both indicates P is available via microbial activity to plant also.
- Sufficient K in P1 and very low in P2.
- Sufficient Magnesium levels in both paddocks with P1 a little higher.
- Calcium is also sufficient in both. The Ca:Mg ratio is ok in both with the right balance of both Ca and Mg.
- Sodium also excessive in both paddocks in the top 0-10 cm.

- Trace elements (Copper and Manganese) are low with Zinc excessive in P2 top depths.
- Iron is very high in both.
- Boron is low in both paddocks. Sulphur also.
- Nitrate Nitrogen is low in both paddocks with no remarkable difference. C:N ratio of around 10 in both paddocks can identify potential soil structure issues.
- Total Nitrogen levels are quite good in both the top 0 – 10 cm reducing at depth (1300 and 1100) demonstrating that there is N in the system, organic matter is low so it's not really being utilised by microbiological activity. This is also verified by the imbalance of Nitrate N to Ammonium N showing low mineralisation.
- Both paddocks are characteristically similar, further questions I would have are in respect of history of fertiliser applications. Has more P been applied to the untreated paddock or has the action of moldboarding increased leaching? Similarly the high K on the untreated paddock, is this due to application.
- A slight increase in organic matter is detected in the Moldboard paddock versus untreated. No massive considerations jump out which is surprising so consider time since moldboarding etc.
- In this situation these comparisons are useful as for example you could only apply P to P 1 and only apply K to P2 with Cu and Mn to both.
- Watch things like fertiliser that can increase sodium more etc, SoP Vs MoP.
- Improving the balance over time will buffer impact of high Na if managed properly but monitor the situation.

Raw Lab Data

SampleName		PIM-PN-0-10-15	PIM-PN-30-60-16	PIM-PN-20-30-17	P2U-PN-0-10-18	P2U-PN-10-20-19	P2U-PN-20-30-20
SampleDepth		0-10	30-60	10-30	0-10	10-20	20-30
pH 1:5 water	pH units	6.22	6.31	6.14	6.31	5.87	5.55
pH CaCl2 (following 4A1)	pH units	5.51	5.43	5.27	5.66	4.89	4.58
Organic Carbon (W&B)	% (40°C)	1.33	0.54	0.78	1.18	0.61	0.42
MIR - Aus Soil Texture		Sandy loam	Sandy loam	Sand	Sandy loam	Sandy loam	Sand
Nitrate - N (2M KCl)	mg/kg	5	3.5	5.8	3	2	1
Ammonium - N (2M KCl)	mg/kg	4.9	1.6	3.3	5.4	2.1	1.2
Colwell Phosphorus	mg/kg	14	<5	8	18	21	11
PBI + Col P		18	29	17	20	18	25
Total Phosphorus	mg/kg	91	45	79	112	93	57
Colwell Potassium	mg/kg	84	27	69	50	30	<25
KCl Sulfur (S)	mg/kg	6.7	<2.5	3	7.9	3.5	4
Calcium (Ca) - NH4Cl/BaCl2	mg/kg	661	242	281	596	154	56
Magnesium (Mg) - NH4Cl/BaCl2	mg/kg	88	27	38	67	29	16
Potassium (K) - NH4Cl/BaCl2	mg/kg	90	27	66	57	24	17
Sodium (NH4Cl/BaCl2)	mg/kg	48.6	14.3	27.4	43.3	22.5	10.8
Calcium (Ca) - NH4Cl/BaCl2	cmol/kg	3.3	1.21	1.4	2.97	0.769	0.278
Magnesium (Mg) - NH4Cl/BaCl2	cmol/kg	0.725	0.218	0.316	0.551	0.236	0.133
Potassium (K) - NH4Cl/BaCl2	cmol/kg	0.231	0.068	0.168	0.147	0.062	0.044
Sodium (NH4Cl/BaCl2)	cmol/kg	0.211	0.062	0.119	0.188	0.098	0.047
Ca:Mg ratio		4.5	5.5	4.4	5.4	3.3	2.1
K:Mg ratio		0.32	0.31	0.53	0.27	0.26	0.33
GTRI		0.06	0.05	0.1	0.04	0.06	0.11
ECR	%	9.9	8.4	14	8.7	14	18
Exchangeable acidity	cmol/kg	<0.02	<0.02	<0.02	<0.02	0.08	0.16
Exchangeable aluminium	cmol/kg	<0.02	<0.02	<0.02	<0.02	<0.02	0.07
Exchangeable hydrogen	cmol/kg	<0.02	<0.02	<0.02	<0.02	0.06	0.09
ECEC	cmol/kg	4.46	1.56	2.01	3.86	1.24	0.66
Calcium	%	73.9	77.6	69.9	77	62	42
Magnesium	%	16.2	14	15.7	14.3	19	20.2
Potassium	%	5.2	4.4	8.4	3.8	5	6.7
Sodium	%	4.7	4	5.9	4.9	7.9	7.1
Aluminium	%	0	0	0	0	1	10
Hydrogen	%	0	0	0	0	5.1	14
Salinity EC 1:5	dS/m	0.1	0.034	0.068	0.096	0.045	0.026
Ece	dS/m	1.4	0.47	1.6	1.3	0.64	0.59
Boron	mg/kg	0.34	0.15	0.18	0.26	0.12	0.1
Iron (Fe)	mg/kg	55	28	44	56	45	36
Manganese (Mn)	mg/kg	2	0.4	0.7	3.6	0.7	0.6
Copper (Cu)	mg/kg	0.18	<0.08	0.11	0.36	0.25	0.2
Zinc (Zn)	mg/kg	0.94	0.08	0.29	3.4	0.55	0.19
Dumas Total Nitrogen	% dry wt	0.13	0.045	0.08	0.11	0.057	0.04
TDS	mg/L	65	22	44	61	29	16
MIR CaCO3 equiv	%	<1	<1	<1	<1	<1	<1
MIR Tot IC	%	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
Total Carbon	% dry wt	1.42	0.31	0.7	1.15	0.48	0.22