Case Study 2 – West Midlands Group, Evolving Soils Project.

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Interpretation of lab data and graphical results for CB1 and CB2 Paddocks. Two sections of one paddock were tested to identify potential variances between production levels that had been noted. One section in particular; in CB1 has been outperforming CB2 for some unknown reason even though it is apparent CB1 (outside of this small area) is not a great performing area.

First paddock area CB1!

At the time of soil sampling CB1 paddock area (previously used for canola, now pasture) we planned to collect 0 - 10 cm, 10 – 20 cm and 20 – 30 cm samples (34 sub samples of each). . Due to the excessive rocky nature of the ground we also had to utilise handheld sampling gear and were unable to get enough soil from 10-20 cm depth for testing so potentially 20 -30cm is more reflective of the 10 - 20 cm depth.

The samples were collected in a grid pattern over entire area for optimal scientific representation of the average of the paddock, avoiding some of the excessive variability we often see within paddocks.

Figure 1 CB1 Area

Soil texture was sandy loam over sand. As mentioned, the paddock was extremely rocky (gravelly) and quite hard.

Figure 2 CP1 Area Data Graph

pH levels are fine at both depths. The 0-10 cm depth has a lower CEC (2.78) then 20 - 30 cm (4.05) conversely to lab soil texture guides specified as sandy loam over sand . We need to be aware that loading lots of cations into the soil (e.g., Calcium) shows elevated CEC - sand can have apparent CEC of 8 if lots of calcium in the soil. Perhaps in this situation a higher CEC at depth is due to excessive K cations or higher Ca and magnesium at depth.

Phosphorous (P) levels are very low at both depths. Low levels need to be improved.

Generally, across other farms, most parameters are reduced as the depth increases. But in this case K, Mg, Ca, Na, Zn, Fe, Mn, NO3 and S are higher in the lower depth reflecting the CEC and increased nutrient exchange and holding capacity in the lower depths.

PBI is on the very low to low end of the scale (16 – 61) indicating plant available P (higher PBI soil binds P). Total P indicates some P is available via microbial activity to plant also.

Potassium is sufficient in the top 0 – 10 cm and even higher at depth.

Low magnesium is apparent in the top 0 - 10 cm with good levels in the lower depths.

Calcium is also low in the top 0 -10 cm. Sufficient in the lower depth. The Ca:Mg ratio is little out of balance with more calcium then required (even though both are very low in the top 10 cm.

In this situation may be useful to improve the basic soil fertility/balance and productivity. Keep in mind long term use of Urea or Ammonia compounds, especially if combined with high concentrations of Sulphur not only increase acidity but at the same time reduce the active soil Calcium concentration.

Sodium also very low (0 – 10 cm) and low in the 20 – 30 cm. Trace elements are all generally low except for zinc which is sufficient in the topsoil and higher at depth.

Boron is low at both depths (0.19 and 0.29 respectively versus ideal range of 0.5 – 2 mg/kg).

Nitrate Nitrogen is low in the top depth and higher at depth. A low C:N ratio indicates sufficient N in the system if high organic matter is existing however organic matter is low to midrange. All soils in the wheatbelt have a typically low OM content so keep an eye on N levels. The balance of Nitrate to Ammonium Nitrogen (2.6:3.5 and 3.9:4) is out of balance with not enough Nitrate N in the system which does show little mineralisation is occurring. Total Nitrogen levels (0.089% - 0.11% Total N x 10 000 = 890 - 1100) are ok showing some N in system that can be utilised if microbiological activity is occurring.

The low C:N ratio can also indicate a soil structure problem, with field work also indicating very hard (and rocky) soil, potentially being an issue but not necessarily due to human induced compaction.

As Sodium is low at both depths there would be no issues using Muriate of Potash in the future (can exacerbate soils with high sodium but a more affordable option for K applications).

Sulphur is low (12) to adequate in the top depth but is very high (33) in the lower depth which can cause toxicity. I do suspect that is why there is a better performing area in the first section (CP1) as CP2 has what can be interpreted at nearly toxic levels in the top and lower depth. S is showing up as more acceptable at times in the graphs due to the lower concentrations of other parameters as we look at "balance".

Feedback from locals in the area have brought up the interesting considerations of tectonic plate fault lines in the region!

Second Paddock Area CB2!

Again, sampling to the three depths occurred with 34 sub samples taken at each of the 3 depths. This area is used for canola. In field observations over time have noted it is a lesser performing area then certain sections of CB1.

Figure 3 CB2 Data Graph

The pH levels are fine in all depths to 30 cm. CEC is quite good consistent with loam/sand ranging from sand on top to loamy sand at depth so acceptable/good nutrient holding ability.

An interesting point (Similar to CB1 but different per depth impacted) is that CEC at 0 – 10 cm is 5.94 but it is a sand and that's higher CEC then loamy sand at depth (4.27 and 5.38). Possibly excessive calcium in soil is acting as increased CEC.

P levels again are really low. Generally most parameters are reduced as the depth increases however in this situation, they seem to drop at depth but then increase in the lower depth again which is a great indication of the nutrient holding capacity increase with higher CEC and OM content at depth.

PBI is on the low end of the scale indicating potential of plant available P (higher PBI soil binds P).

Total P indicates some P is available via microbial activity to plant also if the system is functional.

Potassium is sufficient in all depths.

Magnesium is sufficient through the profile but lower at 10 – 20 cm.

Calcium is also quite high. The Ca:Mg ratio is generally out of balance with more calcium then required compared to Magnesium.

Sodium is sufficient in top depth lower at depth.

Trace elements are all low except for Zinc which is sufficient on the top and at depth. the region.

Boron is fine.

Nitrate Nitrogen is sufficient in the topsoil and lower at depth. A low C:N ratio indicates sufficient N in the system if high organic matter is existing. All soils in the wheatbelt have a typically low OM content so keep an eye on N levels as very volatile. The balance of Nitrate to Ammonium Nitrogen is surprisingly well balanced in the topsoil (8.1:3.6) indicating mineralisation is occurring. Total Nitrogen levels are also looking quite high (0.14 x 10 000 = 1400). The low C:N ratio can also indicate a soil structure problem, with field work also indicating very hard (and rocky) soil, potentially being an issue (less O2 circulation in pore spaces). Cultivation may improve aeration but would be difficult in this paddock due to the rocks.

Sufficient to low sodium levels through the depths.

All trace elements are low except for Zinc.

Sulphur is quite high (even though showing as green, 31 in the topsoil can potentially be causing some toxicity. Lower at 20 – 10 cm and again high at 20 – 30 cm.

Having a closer look at comparisons of CB1 and CB2 paddock areas (0-10 cm) results.

Similarity between these two sections of the paddock in the 0-10 cm depth, are the low P, sufficient K, low Cu, adequate Zn, low Fe.

Figure 4 CB1 Area VS CB2 0-10 cm results.

In general all major and trace elements are lower in the CB1 area that includes the better performing area.

I do suspect that excessive Calcium (can affect uptake of other nutrients) and Sulphur (S) in CB2 explains why there is a better performing area in the first section (CB1) as CB2 has what can be interpreted at nearly toxic levels in the top and lower depth. S is showing up as more acceptable at times in the graphs due to the lower concentrations of other parameters as we look at "balance".

Sulphur whilst illustrated as ok, 31 versus 12 in 0-10 from CB2 to CB1 is quite a bit higher, may indicate slight impact on performance with CB 1 having lower S in 0 - 10cm, main root zone? Sulphur in general is very high in this paddock, is it due to long term fertiliser applications or something to do with the fault lines in the region?

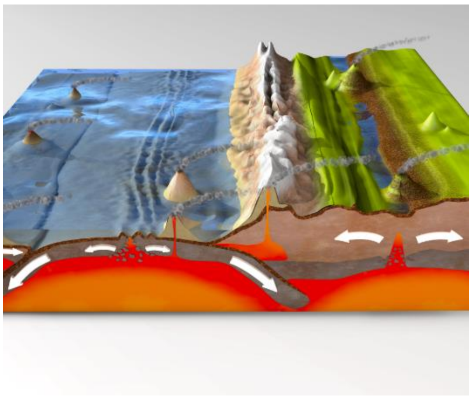

Figure 5 Image of fault lines

Overall, we received a significant amount of information from this initial testing program, it would be very useful to follow up with tissue tests within the season to confirm efficiencies/deficiencies and further soil testing in the next year. This allows us to assess changes and soil nutrient balance as we do have capacity to improve the system, impact soil structure and improve production at the same time as applying what fertilisers are needed (not applying what is not needed) and potentially in this economic climate saving quite a few $$$ whilst better managing the environmental health of our land.

Refer to table 2 to view full lab test results for case study 2 of WMG Evolving Soils Project.

Table 2: Lab Test Results for Case study 2

SampleName		CB1-0-10	CB1-20-30	CB2-0-10	CB2-10-20	CB2-20-30
pH 1:5 water	pH units	6.03	6.3	6.86	6.83	6.84
pH CaCl2 (following 4A1)	pH units	5.11	5.57	6.52	6.31	6.44
Organic Carbon (W&B)	% (40°C)	1.38	1.8	1.67	1.08	1.35
MIR - Aus Soil Texture		Sand	Sandy loam	Sand	Loamy sand	Loamy sand
Nitrate - N (2M KCl)	mg/kg	2.6	3.9	8.1	3.4	8
Ammonium - N (2M KCl)	mg/kg	3.5	4	3.6	2.3	2.2
Colwell Phosphorus	mg/kg	9	8	14	9	11
PBI + Col P		16	61	12	32	15
Total Phosphorus	mg/kg	73	94	104	79	94
Colwell Potassium	mg/kg	65	160	140	100	97
KCl Sulfur (S)	mg/kg	12	33	31	20	25
Calcium (Ca) - NH4Cl/BaCl2	mg/kg	439	574	998	719	909
Magnesium (Mg) - NH4Cl/BaCl2	mg/kg	46	74	62	49	60
Potassium (K) - NH4Cl/BaCl2	mg/kg	65	187	132	81	99
Sodium (NH4Cl/BaCl2)	mg/kg	10.8	22.5	24.7	17.5	21.5
Calcium (Ca) - NH4Cl/BaCl2	cmol/kg	2.19	2.87	4.98	3.59	4.54
Magnesium (Mg) - NH4Cl/BaCl2	cmol/kg	0.378	0.606	0.512	0.401	0.495
Potassium (K) - NH4Cl/BaCl2	cmol/kg	0.167	0.477	0.337	0.207	0.254
Sodium (NH4Cl/BaCl2)	cmol/kg	0.047	0.098	0.107	0.076	0.094
Ca:Mg ratio		5.8	4.7	9.7	9	9.2
K:Mg ratio		0.44	0.79	0.66	0.52	0.51
GTRI						
ECR	%	7.7	14	7.5	6.6	6.5
Exchangeable acidity	cmol/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium	cmol/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen	cmol/kg	<0.02	<0.02	<0.02	<0.02	<0.02
ECEC	cmol/kg	2.78	4.05	5.94	4.27	5.38
Calcium	%	78.7	70.8	83.9	84	84.3
Magnesium	%	13.6	15	8.6	9.4	9.2
Potassium	%	6	12	5.7	4.8	4.7
Sodium	%	1.7	2.4	1.8	1.8	1.7
Aluminium	%	0	0	0	0	0
Hydrogen	%	0	0	0	0	0
Salinity EC 1:5	dS/m	0.062	0.12	0.2	0.099	0.15
Ece	dS/m	1.4	1.7	4.6	2.3	3.4
Boron	mg/kg	0.19	0.29	0.48	0.34	0.34
Iron (Fe)	mg/kg	16	21	17	19	17
Manganese (Mn)	mg/kg	2.1	2.7	4.1	1.5	2.8
Copper (Cu)	mg/kg	0.32	0.19	0.56	0.23	0.46
Zinc (Zn)	mg/kg	0.92	5.5	1.4	0.48	0.98
Dumas Total Nitrogen	% dry wt	0.089	0.11	0.14	0.088	0.12
TDS	mg/L	40	79	130	63	95
MIR CaCO3 equiv	%	<1	<1	<1	<1	<1
MIR Tot IC	%	<0.12	<0.12	<0.12	<0.12	<0.12
Total Carbon	% dry wt	1.43	1.91	1.69	1.09	1.4