

Case Study 4 - West Midlands Group, Evolving Soils Project.
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Interpretation of lab data and graphical results for two comparison paddocks (BP and CP) and comparison with an area of virgin bush (VB).

At the time of sampling BP, 68 sub samples were taken from 3 depths, 0 - 15, 15 - 30 and 30 - 70 cm. BP is a pasture/grazing paddock.



Figure 1 BP Graphical Results 0-15, 15 – 30 and 30 – 70cm

BP Interpretation

- pH levels are all ok through the depths getting slightly lower at 30 - 70 cm.
- BP has a low CEC through the depths consistent with sand (2.28, 2.36, 1.07).
- P levels are low to very low in all.
- Most parameters are reduced as the depth increases except for Mg and Ca which increase slightly at 15 - 30 cm and iron which reduces then increases at depth.
- PBI is on the very low end of the scale indicating plant available P when P applied (higher PBI soil binds P).
- Total P indicates some P is available via microbial activity to plant also.
- Potassium is low at all depths.
- Magnesium is also low at all depths.
- Calcium is also low.
- The Ca:Mg ratio is out of balance with dominating effect of calcium (even

though both are low).

- Sodium also low through all depths.
- Trace elements, Copper and Iron are low. Zinc is sufficient in the top two depths 0 - 30 cm and low at 30 - 70 cm. Manganese is sufficient in 0 - 15 cm and low at 15 - 30 cm, very low at 30 - 70 cm.
- Boron is low at 0.14, 0.11 and <0.1 at depth.
- Nitrate Nitrogen is low throughout the profile.
- A low C:N ratio indicates some 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.
- The balance of Nitrate to Ammonium Nitrogen is out of balance being 1.6:2.8, 1.4:2.8 and 1.1:1.7. This indicates little N mineralisation is occurring. Ideal ratio is 2:1. The low C:N ratio can also indicate a soil structure problem, low aerobic activity.
- Total N levels at 820, 1850 and 560 does indicate that there is useful N in the system available for increased microbiological activity.
- I would expect to see out of balance and low microbial activity in the biological tests carried out.

CP Paddock is also used for pasture/grazing and at the time of sampling 41 sub samples were collected from 3 depths also at 0 - 15, 15 - 30 and 30 - 70cm.



Figure 2 – CP Graphical Results 0-15, 15 – 30 and 30 – 70 cm

CP Interpretation

- pH levels are fine at all depths.
- The CEC at all depths is low consistent with sand.
- P levels are low and very low at depth.
- Most parameters are reduced as the depth increases except for Ca whilst low, increases in the 15 - 30 cm profile similarly to Nitrate N and Iron increases through the profile.
- PBI is on the very low end of the scale but slightly increases at depth



indicating some plant available P if applied but also potential for leaching (higher PBI soil binds P).

- Total P indicates small amount of P is available via microbial activity to plant also.
- Potassium is low to very low at all depths.
- Low to very low Magnesium through the profile.
- Calcium is also low.
- The Ca:Mg ratio is out of balance with more calcium then required (even though both are very low).
- Sodium also low.
- Trace elements (Copper, Iron and Manganese) are all low with Zinc sufficient through the 0 - 30 cm profiles.
- Boron is low through all at 0.24, 0.20 and <0.1).
- Nitrate Nitrogen is low,
- 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 organic matter is low, typically of the WA wheatbelt.
- The balance of Nitrate to Ammonium Nitrogen is out of balance with 1.7:3.8, 2.9:3.6 and 1.9:1.6. A good balance is 2:1. This indicates little mineralisation of N is occurring.
- Total N levels at 1100, 1000 and 480 does indicate that there is N in the system available for increased microbiological activity.
- Expect to see low and out of balance biological parameters but possibly a little more activity than Bush Paddock.

During sampling, samples were also collected from an area of bush from the 0-10 cm profile. It was of interest to compare results from the virgin bush to the two grazing paddocks.

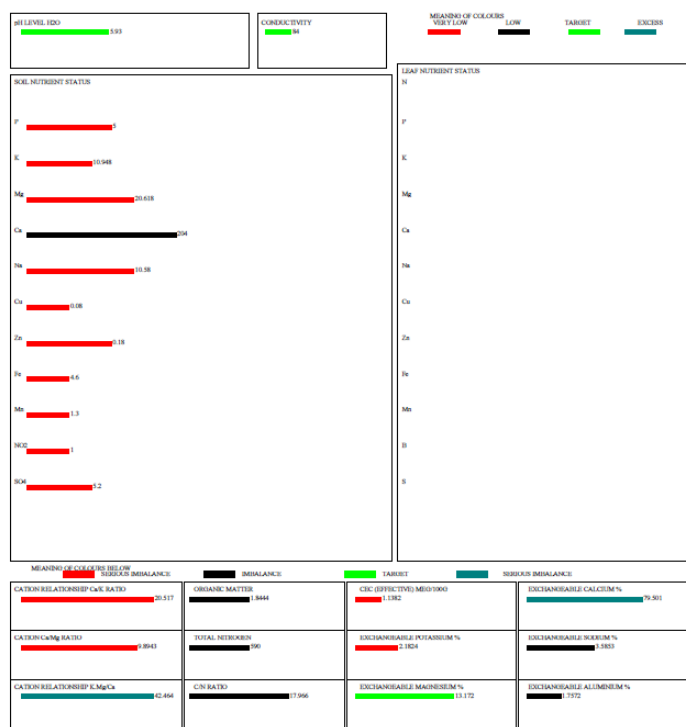


Figure 3 VB Graphical Results 0-10 cm



VB Interpretation

- pH level is fine.
- The CEC is low at 1.29.
- P level is very low.
- PBI is exceptionally low (higher PBI soil binds P).
- Total P indicates only incremental amount of P is available via microbial activity.
- Potassium is very low.
- Very low Magnesium through the top profile.
- Calcium is also low.
- The Ca:Mg ratio is out of balance with more calcium then required (even though both are very low).
- Sodium also very low.
- Trace elements are all very low.
- Boron is low at <0.1.
- Nitrate Nitrogen is very low,
- 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.
- The balance of Nitrate to Ammonium Nitrogen is out of balance with 1.0:1.2. A good balance is 2:1. This indicates little mineralisation of N is occurring.
- Total N level is low at 590 but does indicate that there is some N in the system available for increased microbiological activity.
- Expect to see low and out of balance biological parameters.

During this investigation we also compared the topsoil profiles of the three areas, see the results graphed below.

BP (0 – 15) Vs CP (0 – 15) Vs VB (0-10 cm) Soil Analysis Comparison Graph



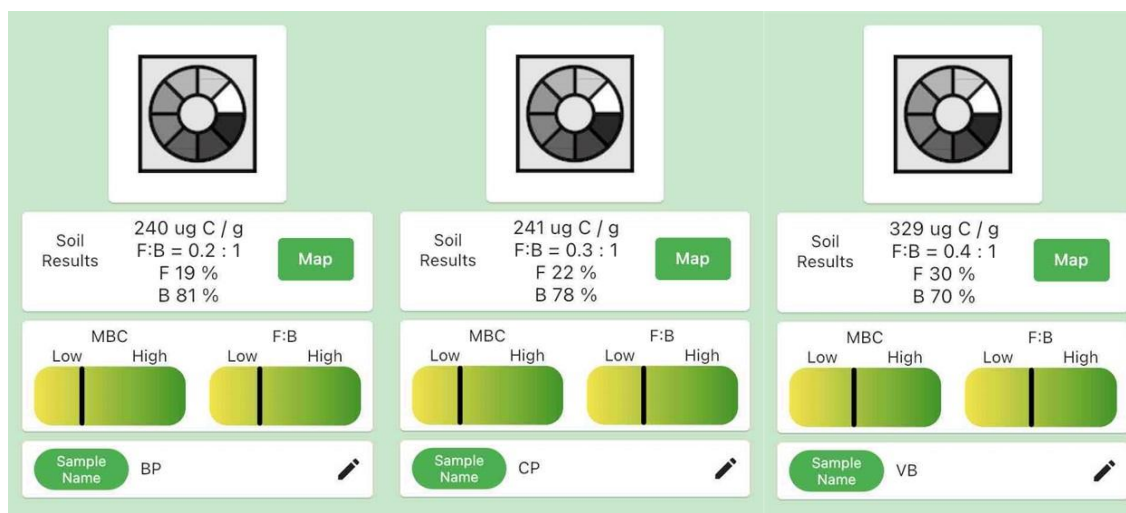
BP Vs CP Vs VB Comparison Interpretation (top profile)

- pH level is fine in all areas with the Virgin Bush (VB) being a little lower.
- The CEC is low in all locations however slightly lower in the Virgin Bush indicating potentially sandier soil, assuming to lack of smaller plants/root matter per m²?
- P level is very low in all but lowest in VB.
- PBI is exceptionally low in all but lowest and comparative in CP and VB paddock (higher PBI soil binds P).
- Total P indicates only incremental amount of P is available via microbial activity. Highest in CP and lowest in VB.
- Potassium is very low in all, highest in CP and lowest in VB.
- Very low Magnesium in all, highest in CP and lowest in VB.
- Calcium is also low in all, highest in CP and lowest in VB.
- The Ca:Mg ratio is out of balance in all.
- Sodium also very low in all, highest in BP and lowest in VB.
- Trace elements are all very low across all areas except for Zinc which is sufficient in BP and CP. This indicates Zn levels possible due to activity not geology.
- Boron is low in all, highest in CP and lowest in VB.
- Nitrate Nitrogen is very low in all.
- 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. All organic matter levels are low with Control paddock being the highest, then the Virgin Bush and the Bush Paddock.
- The balance of Nitrate to Ammonium Nitrogen is out of balance in all areas. This indicates little mineralisation of N is occurring. Interesting for the Virgin Bush section.
- Total N level is low across all but does indicate that there is some N in the system available for increased microbiological activity.
- Expect to see low and out of balance biological parameters across all.

In-field Biological Testing

In field microbiology tests were conducted using Micro Biometer. It is not surprising to see levels of Microbes and a low balance between Fungi and Bacteria.

Determining the F:B ratio in the soil will tell you if arbuscular mycorrhizal fungi (AMF) have colonized your plant making it more resistant to drought and pests. It is not surprising that the levels of both are slightly higher in the virgin Bush however the lab test do indicate a difference across biomass and diversity showing the VB to be actually lower. Refer to the results below.



Microbe wise Laboratory Testing Results BP, CP, and VB samples.

Bush Paddock

Potential for nutrient solubilisation rate is good, nutrient cycling rate is high, disease resistance is high, nutrient accessibility is lower (conductive with previous data), drought resistance is good and residue breakdown is high. Total microorganisms, bacteria and fungi are slightly lower than the guide but not bad. Actual microbial diversity showing as quite low. Low methane oxidisers (methanotrophs) oxidize methane to derive energy and carbon for biomass. In so doing, they play a key role in mitigating the flux of methane into the atmosphere. These are generally higher in aerobic soils again highlighting issue with anaerobic soils (less circulation of oxygen in soil). Higher true anaerobes also align with this lower)2 in soil. Lower fungi levels can be improved.

Control Paddock

Potential for nutrient solubilisation is good, nutrient cycling rate is high, disease resistance is high, nutrient accessibility is low (again reflective of low fungi levels), drought resistance is good and residue breakdown is high. Total microorganisms, bacteria and fungi are showing as higher than expected with actual microbial diversity showing as low. Fungi to bacteria ratio showing as ok. Again low methane oxidisers (methanotrophs) and higher True Anaerobes issue with anaerobic soils (less circulation of oxygen in soil).

Virgin Bush

Potential for nutrient solubilisation is much lower in VB showing as nearly in the red, nutrient cycling is high, disease resistance is mid-range, nutrient accessibility is low, drought resistance is low to mid-range and residue breakdown rate is high. Total microorganisms, bacteria and fungi are all lower than the guide showing less than the other paddocks. All bacteria groups are much lower and under guideline levels in the VB with similar higher True Anaerobes again illustrating issue with anaerobic soils (less circulation of oxygen in soil) which is aligned with the other paddocks and in the region.

Raw Lab Data

Sample Name		BP-MG-0-15-22	BP-MG-15-30-23	BP-MG-30-70-24	CP-MG-0-15-25	CP-MG-15-30-26	CP-MG-30-70-27	VB-MG-0-10-28
Sample Depth		0-15	15-30	30-50	0-15	15-30	30-50	0-10
pH 1:5 water	pH units	6.24	6.14	6.22	6.29	6.23	6.15	5.93
pH CaCl ₂ (following 4A1)	pH units	5.51	5.3	5.41	5.72	5.52	5.32	4.88
Organic Carbon (W&B)	% (40°C)	0.99	0.97	0.62	1.24	1.11	0.59	1.06
MIR - Aus Soil Texture		Sand	Sand	Sand	Sand	Sand	Sand	Loamy sand
Nitrate - N (2M KCl)	mg/kg	1.6	1.4	1.1	1.7	2.9	1.9	1
Ammonium - N (2M KCl)	mg/kg	2.8	2.8	1.7	3.8	3.6	1.6	2.2
Colwell Phosphorus	mg/kg	8	6	5	8	8	<5	<5
PBI + Col P		10	5	7	<2	4	11	<2
Total Phosphorus	mg/kg	58	54	32	75	68	33	15
Colwell Potassium	mg/kg	44	33	28	50	49	<25	<25
KCl Sulfur (S)	mg/kg	5.6	5.3	<2.5	8.9	8.8	3.8	5.2
Calcium (Ca) - NH ₄ Cl/BaCl ₂	mg/kg	368	387	171	409	431	151	203
Magnesium (Mg) - NH ₄ Cl/BaCl ₂	mg/kg	32	34	16	45	42	15	21
Potassium (K) - NH ₄ Cl/BaCl ₂	mg/kg	37	30	18	55	47	16	11
Sodium (NH ₄ Cl/BaCl ₂)	mg/kg	19.8	18.3	8.8	14.2	13.5	5	10.6
Calcium (Ca) - NH ₄ Cl/BaCl ₂	cmol/kg	1.84	1.93	0.854	2.04	2.15	0.752	1.02
Magnesium (Mg) - NH ₄ Cl/BaCl ₂	cmol/kg	0.263	0.276	0.129	0.366	0.347	0.123	0.169
Potassium (K) - NH ₄ Cl/BaCl ₂	cmol/kg	0.094	0.076	0.045	0.139	0.121	0.04	0.028
Sodium (NH ₄ Cl/BaCl ₂)	cmol/kg	0.086	0.08	0.038	0.062	0.059	0.022	0.046
Ca:Mg ratio		7	7	6.6	5.6	6.2	6.1	6
K:Mg ratio		0.36	0.27	0.35	0.38	0.35	0.33	0.16
GTRI		0.04	0.03	0.05	0.06	0.05	0.05	
ECR	%	7.9	6.6	7.8	7.7	6.7	6.6	5.9
Exchangeable acidity	cmol/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03
Exchangeable aluminium	cmol/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen	cmol/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03
ECEC	cmol/kg	2.28	2.36	1.07	2.61	2.68	0.94	1.29
Calcium	%	80.6	81.7	80.1	78.3	80.3	80.3	78.7
Magnesium	%	11.6	11.7	12.1	14	13	13.1	13.1
Potassium	%	4.1	3.2	4.2	5.3	4.5	4.3	2.2
Sodium	%	3.8	3.4	3.6	2.4	2.2	2.3	3.6
Aluminium	%	0	0	0	0	0	0	0.5
Hydrogen	%	0	0	0	0	0	0	1.9
Salinity EC 1:5	dS/m	0.061	0.049	0.032	0.072	0.06	0.027	0.028
Ece	dS/m	1.4	1.1	0.73	1.7	1.4	0.62	0.64
Boron	mg/kg	0.14	0.11	<0.1	0.24	0.2	<0.1	<0.1
Iron (Fe)	mg/kg	8.4	7.9	8.5	6.1	10	12	4.6
Manganese (Mn)	mg/kg	7	5.1	2.4	6.3	5.6	1.2	1.3
Copper (Cu)	mg/kg	0.38	0.29	0.15	0.49	0.5	0.15	<0.08
Zinc (Zn)	mg/kg	1.3	0.86	0.39	2.6	2	0.37	0.18
Dumas Total Nitrogen	% dry wt	0.082	0.085	0.056	0.11	0.1	0.048	0.059
TDS	mg/L	39	31	20	46	38	17	18
MIR CaCO ₃ equiv	%	<1	<1	<1	<1	<1	<1	<1
MIR Tot IC	%	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
Total Carbon	% dry wt	0.9	0.91	0.46	1.15	1.04	0.34	0.94