Moving towards non-inversion

Pain or Pleasure?

Mike Harrington

Guiding Principles

How to create balance and trying to understand how soil functions, how it links into the system of growing crops, and to how to take it all into account.

A Plan for Soil?

Build organic matter – capture, store and make available free nitrogen

Minimize purchased Nitrogen

Maximise Nitrogen efficiency

And above all, understand what the plants needs are

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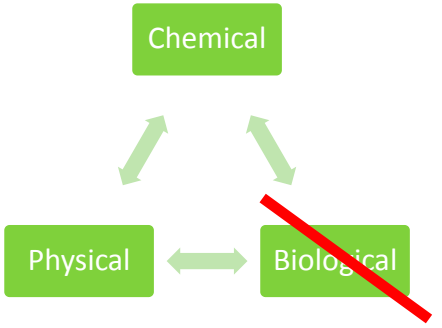
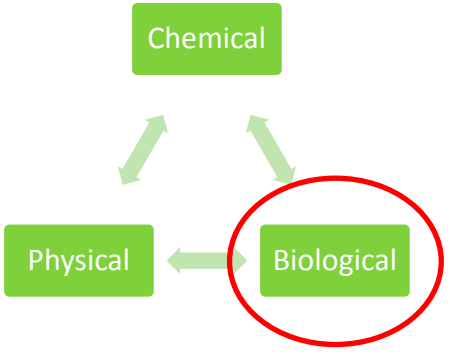
Biology makes a huge difference to soil management





Soil analysis – 22nd June 2010

Phosphorous – 26ppm (index 3.7)
Potassium – 230ppm (index 2.9)
Magnesium – 270ppm (index 5.1)

Analysis	Result	Guideline	Interpretation	Comments
pH	6.7	6.5	Normal	Adequate level.
Phosphorus (ppm)	40	26	Normal	(Index 3.7) Adequate Level.
Potassium (ppm)	230	241	Slightly Low	(Index 2.9) 0-25 kg/ha K2O (0-20 units/acre). Maintenance.
Magnesium (ppm)	270	50	High	(Index 5.1) Possible interference on availability of Potassium.
Calcium (UK) (ppm)	4722	1600	Normal	Adequate level.
Sulphur (ppm)	18	10	Normal	Adequate level.
Manganese (ppm)	22.0	55.0	Very Low	PRIORITY FOR TREATMENT.
Copper (ppm)	6.9	2.1	Normal	Adequate level.
Boron (ppm)	1.79	1.60	Normal	Adequate level.
Zinc (ppm)	8.3	2.1	Normal	Adequate level.
Molybdenum (ppm)	0.14	0.40	Very Low	Low priority on this crop. Other crops may be affected.
Iron (ppm)	1257	50	Normal	Adequate level.
Sodium (ppm)	29	90	Very Low	Not a problem for this crop.
C.E.C. (meq/100g)	22.0	15.0	Normal	Cation Exchange Capacity indicates a soil with a good nutrient holding ability.

Tissue analysis – 19th July 2010

Phosphorous - 53%
Potassium - 77%
Magnesium - 25%

Analysis	Result	Guideline	Interpretation	Comments
Nitrogen (%)	1.83	3.00	Low	PRIORITY FOR TREATMENT.
P[illegible]phorus (%)	0.14	0.30	Very Low	PRIORITY FOR TREATMENT.
Potassium (%)	0.67	3.00	Very Low	PRIORITY FOR TREATMENT.
Calcium (%)	0.81	1.00	Slightly Low	Low priority. See comments below.
Magnesium (%)	0.15	0.20	Slightly Low	Consider foliar applications of MAGNESIUM
Manganese (ppm)	12.4	25.0	Very Low	PRIORITY FOR TREATMENT.
Boron (ppm)	18.2	25.0	Low	PRIORITY FOR TREATMENT.
Zinc (ppm)	22.7	20.0	Normal	Adequate level.
Iron (ppm)	433	50	Normal	Adequate level.
Copper (ppm)	5.6	7.0	Slightly Low	Low priority. See comments below.
Molybdenum (ppm)	1.03	1.50	Low	Consider foliar applications of molybdenum.
Sulphur (%)	0.14	0.20	Low	PRIORITY FOR TREATMENT.

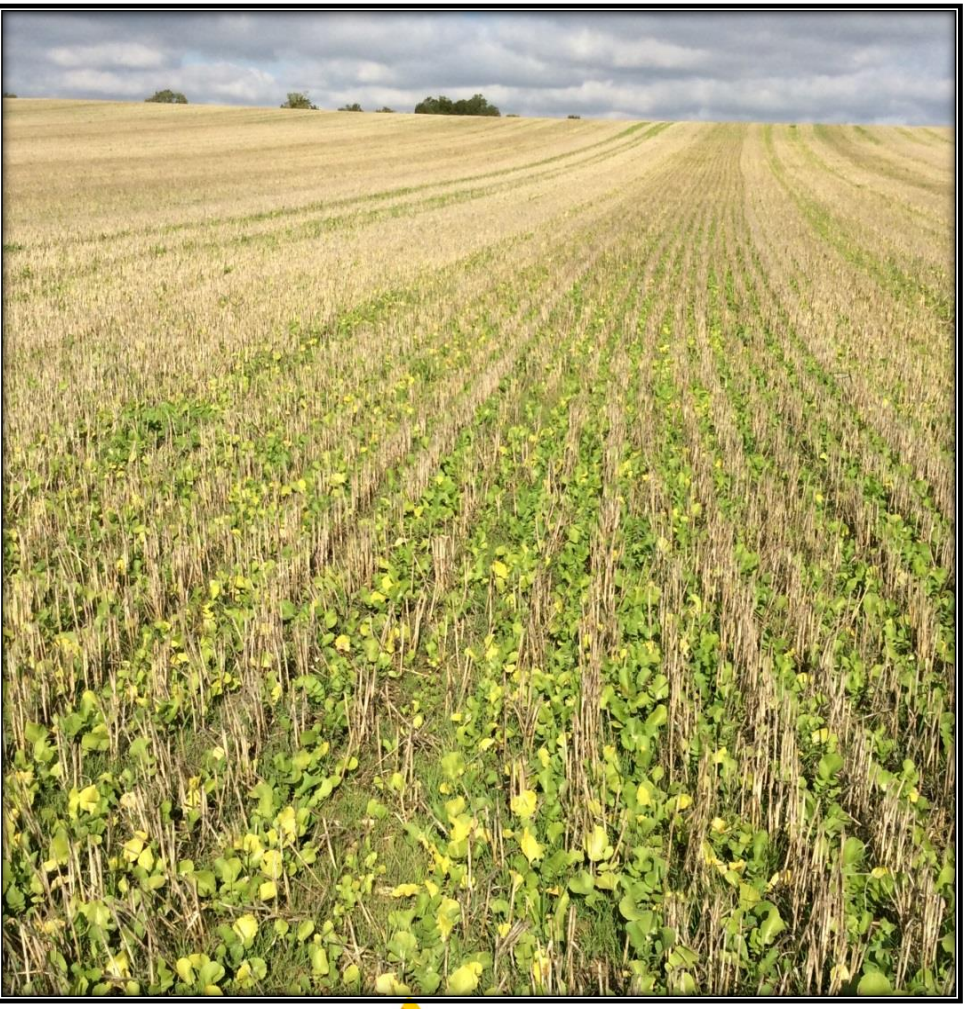
Functioning correctly, soil is a living entity, a constantly interacting, interdependent whole, operating a continuous cycle of expansion and contraction, digestion and mineralisation.

Basic principles first

Very first principle is AIR

A cover crop must offer 100% ground cover, otherwise weeds start to become part of the mix. i.e. Weeds quite often will do a better job as they are suited to the soil conditions. Unfortunately, it is the weeds that cause us issues later.

Limited nitrogen leads to limited growth and poor ground cover




Sprayed a week before drilling

Direct Drilling and Fallow Rotation


77 casts

Worms can make a big contribution to nu

- **5 times** as rich in the available nitrate nitr
- **7 times** as rich in available phosphorous
- **11 times** as rich in exchangeable potassi
- **Twice** as rich in exchangeable magnesiu
- **Increase** in structural stability
- **Increase** in Cation exchange capacity
- **Reduction** in bulk density

- **25 earthworms per cube foot = 1 million earth casts/year/acre**

Can we afford to ignore the contribution of natur

EARTHWORMS RENDER FUSARIUM HARMLESS

Earthworms, those most helpful of creatures for good farming, are a true digestive miracle: They not only eat their way through plant remains or carrion, but are even able to render phytopathogenal and toxic fungi harmless. This finding was confirmed by a working group from the Johann Heinrich von Thünen Institute and from the Julius-Kühn Institute in Braunschweig, together with the plant protection department from the Hanover chamber of agriculture. In one experiment they used loess loam soil, collected both types of earthworms, *Lumbricus terrestris* and *Aporrectodea caliginosa*, from the same site and artificially infected Tommi wheat with *Fusarium culmorum*. All other animal life found in the soil was removed by the four participating scientists to rule out the possibility of them influencing the experiment. Of the two types of earthworm, only *L. terrestris* was able to eliminate almost all of the Fusarium fungus and to reduce the concentration of the mycotoxin Deoxynivalenol (DON). In contrast, the *Aporrectodea* earthworm was not able to do this. This achievement really is remarkable: the content of fusarium protein was reduced by 98.8% in five weeks, while the DON content was reduced by 99.7%. ■

Big differences in above ground nutrient retention

Sample Name	Park - Good	Park - Poor
Sample ID	DM004	DM005
Moisture Removed (%)	88.96	86.59
Total Dry Weight per m^2 (g)	304.59	61.93
Total Dry weight per ha (Kg)	3045.94	619.28
Nitrogen (N) kg/ha	201.032 (half useable)	33.689 (half useable)
Sulphur (S) kg/ha	13.676	2.403
Phosphorous (P) kg/ha	30.277	4.155
Potassium (K) g/ha	131.280	28.797
Calcium (Ca) g/ha	27017	5673
Magnesium (Mg) g/ha	7097	904
Manganese (Mn) g/ha	118.79	21.67
Iron (Fe) g/ha	572.64	172.16
Copper (Cu) g/ha	36.25	8.92
Zinc (Zn) g/ha	184.28	34.87
Boron (B) g/ha	74.02	10.71

Tissue Analysis Report

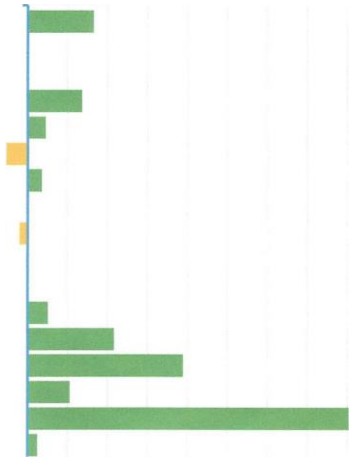
Standard Laboratory Values

Customer: RANDALL
Date: 14 June 2016
Sample: E207404/02
Field: TEMPLE PARK
Crop: Oats 32/37

Report - percent	Range	No Adjust	Results
Total Nitrogen	3.4 - 4	1.00	4.01

Report - percent	Range	No Adjust	Results
Phosphorous	0.3 - 0.56	0.28	0.47
Potassium	3.5 - 5	3.80	4.64
Magnesium	0.13-0.18	0.15	0.11
Calcium	0.3 - 1.2	0.40	0.47
Sodium	-	-	
Sulphur	0.28 - 0.35	0.30	0.27

Report - ppm	Range	No Adjust	Results
Manganese	26 - 60	35.00	43.8
Copper	4 - 10	5.00	10.4
Iron	40 - 150	35.00	103
Zinc	29 - 50	20.00	30.5
Molybdenum	0.09 - 0.2	0.15	0.96
Boron	6 - 10	5.00	5.6
Iodine	-	-	-
Cobalt	-	-	-
Selenium	-	-	-



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Plants can only grow to the extent of their most deficient element - we need to consider what is the biggest limiter to growth

Deficiency-Excess

-100 -50 0 50 100 150 200 250 300 350 400

Ratios	Desired		
N:P	6-18	:1	1
N: K	1.4-3	:1	4.3
N:S	14	:1	2.4
K: P	8-11	:	10.8
K:Mg			
K:Ca			

Ca: P	Results	<6	:
Ca:Mg	8.5		
Fe: Mn	0.9	>1	:1
Cu: Mo	14.9	5-30	:
	9.9		
	42.2		
	9.9		

Direct Drilled

Minimum Tilled


Direct Drilled
Minimum Tilled

Plant feeds the soil as much as the soil feeds the plant

Climax Climatic conditions – connection perfection!

In nature carbon drives all systems not nitrogen

A Plan for Soil?

Build organic matter using cover crops– capture, store and make available nitrogen and other elements

Minimize purchased Nitrogen – Legumes, biological nitrogen fixers, carbon cycling

Maximise Nitrogen efficiency – always add a carbon source, consider foliar applications, always evaluate need and consider balance

Understand what the plants and soils needs are

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1. Don't start with diversity, consider what limitations your soils has and look for species that will best manage those issues first. ie: Blackgrass and the bulk density of the soil.

2. A cover crop must offer 100% ground cover, otherwise weeds start to become part of the mix. ie: Weeds quite often will do a better job as they are suited to the soil conditions. Unfortunately, it is the weeds that cause us issues later. The cover crop must be in as early as possible and become dominant to out compete the weeds.

3. Do not drill species that are likely to seed as this may increase costs in the following year. ie: Drilling spring oats early in the summer or buckwheat in the autumn.

4. Do not drill into wet soil, ever.

5. The primary reason for cover cropping is carbon collection, nitrogen assimilation and containments of soil nutrients in the system. ie: If you are spring drilling, having cover crops that die out at the first frost means you will start to lose nutrients and nitrogen.

6. There must be scavenger species with nitrogen collectors to maintain nutrients over winter for use by the following spring crop.

7. Use enough seed, growing some of the easier components is a way of easing costs and supplementing seed rates.

8. Vertical architecture is as important as horizontal growth. ie: The tall growth of spring beans gives structure for vetch to climb upwards.

9. Drilling as early as possible is an absolute priority. If someone is harvesting and then taking straw off that two week delay in drilling could reduce biomass by at least 50%. The ultimate goal is to have the drill in the field with the combine.

10. Before destruction look down into the cover crop and if you see soil you may need to consider whether anything needs to change for the future. A cover crop does what it is called, it covers the ground.

11. A cover crop can collect and maintain very large levels of nutrients, these need to be assessed, measured and considered when creating a nutrient programme for the following crop. Otherwise, you run the risk of not adjusting to your new biological programme and your costs increasing.

12. Consider using the cover crops for manure, AD, slurry, compost applications, they are very good at sucking up soluble nutrients and maintaining them in their large structure for use later.

13. In the end, diversity is everything but not necessarily in the beginning. Assess and consider your starting point.

Find out more...

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Thank You

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