

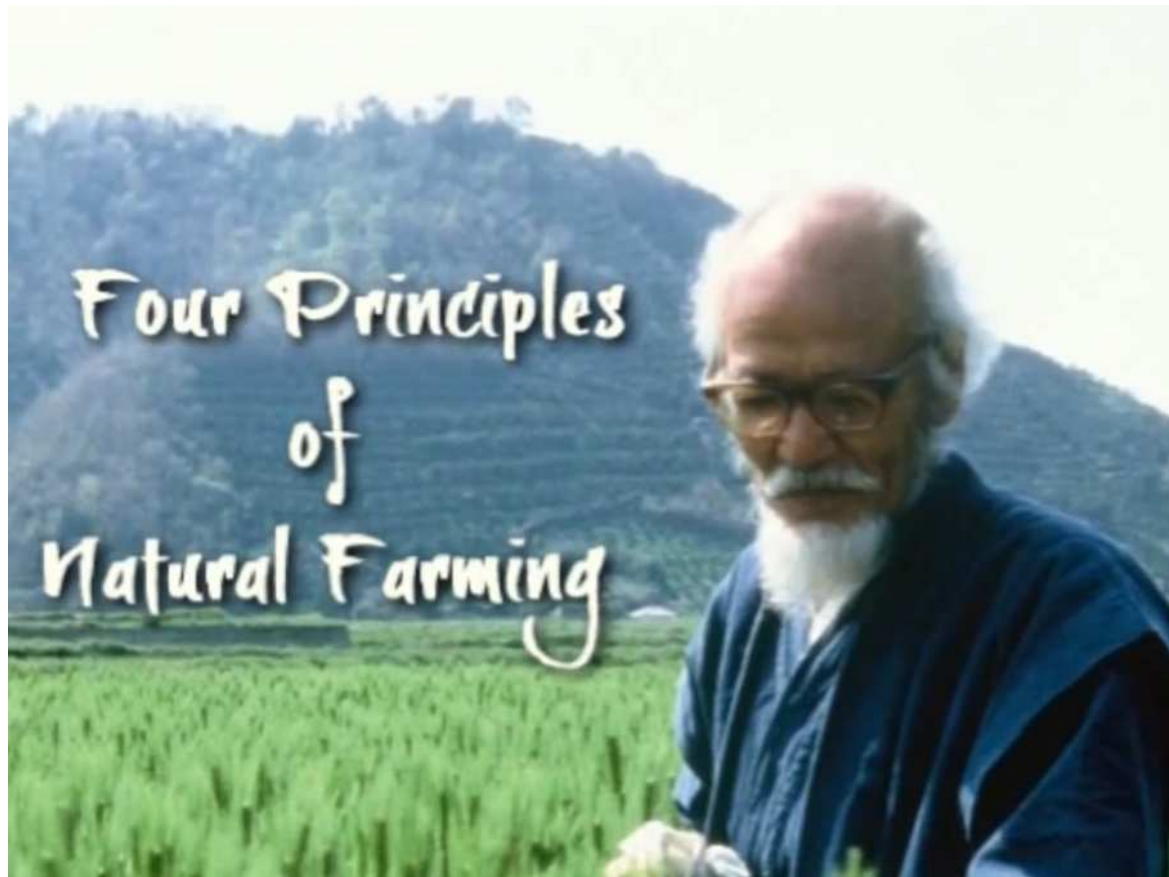
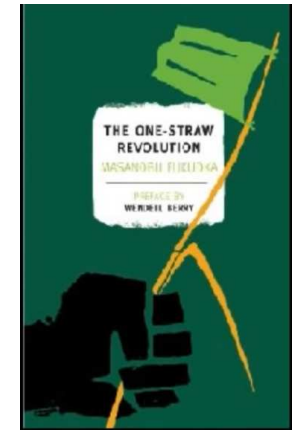
Soil Health Session 6

Soil Restoration

Approach & Application



One mans 30 year journey learning from nature – Masanobu Fukuoka



- 1) No Cultivation (Tilling)
- 2) No Fertilisers or prepared composts
- 3) No weeding by tillage or fertilisers
- 4) No dependence on chemicals

"At this farm, we practice

"do nothing" farming."
- Masanobu Fukuoka



Modern-day Examples:

- 'No till' broad acre grain and livestock farmers in Australia(Colin Seis) and US (Gabe Brown) who use root breakers, cover crops and plant residue to improve soil and provide fertility.
- Market Gardeners using gentle techniques such as broad-forking, hand tool like hoes and power harrow on walk behind tractor.
 - Look up: Elliot Coleman, Curtis Stone, J.M. Fortier

* None of these have all the right techniques or answers, neither do we. We can learn much from others experiences but we need to think for ourselves and seek all the counsel and wisdom the Lord gives.

How much land do we need to restore to live off?

How long does it take?

- Larry Korn: “In the old days a family of four in Japan could live and grow almost all the food and building materials they needed on ½ an acre (2000m²)” (and that was with a relaxed lifestyle)
- On a small backyard patch scale you can grow all your own herbs, greens and some veg on 25m² with fruit trees in extra space.
- If just starting out best to pick a small manageable bed or patch of a few m² and expand as needed.
- Restoring the Soil can get kick started in just months, be well on its way in a year or two and be optimal in several years.

Lets Make Soil Great Again

OUTLINE:

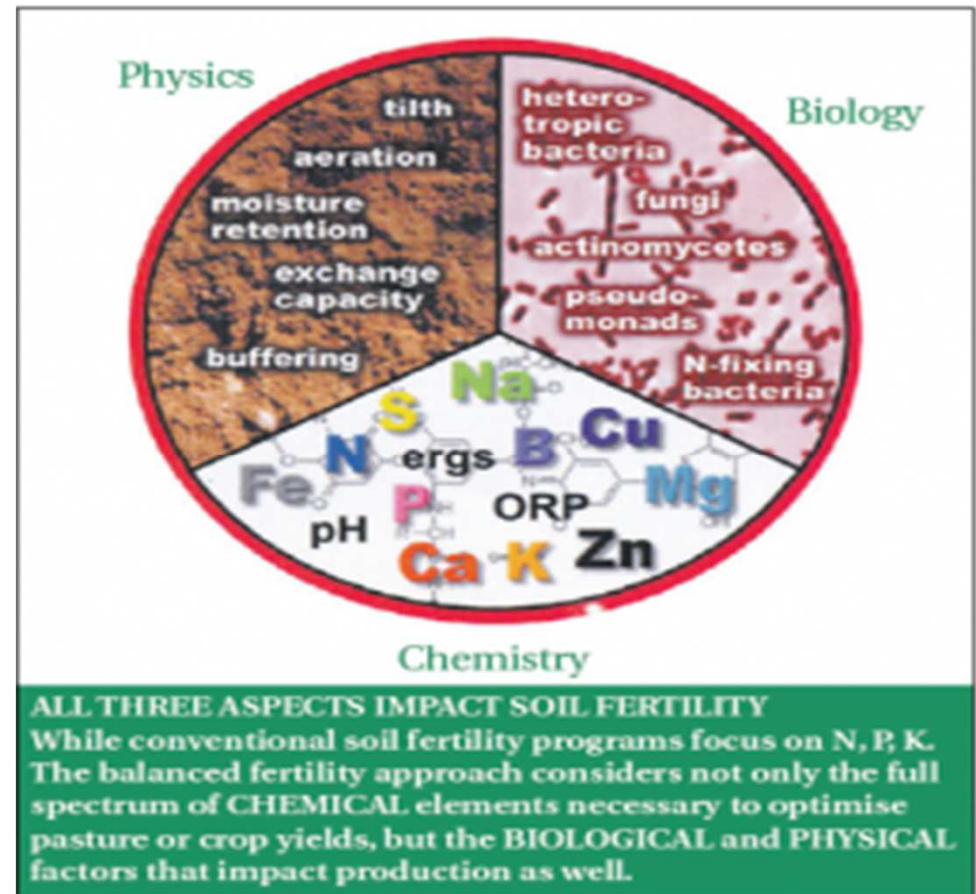


- 1) Current Soil Conditions (What are we up against)
- 2) Systems/Schools of alternative(natural) Agriculture:
- 3) Restoring the Character of the Soil (Physical, Biological, Chemistry)

Lets Make Soil Great Again

Bringing it all together in PRACTICE

We will teach you all the techniques we know of, gleaned from AdAgra pioneers, organic gardening pioneers and experts and try to keep it in the framework of Gods counsel based on true natural science.



Current Soil Conditions (What are we up against)

Rom 3:10 “*There is none righteous, no, not one*”

Q: What do you think may have shaped our soil condition today?

“Almost all Australian soils are low in one or more available nutrients”
(plantsinaction.science.uq.edu.au)

Whitmar McConnel – 30yrs soil consulting in the U.S., no soil without problems.

Out of 17 soil tests I recently did with others, all had major deficiencies and imbalances.

- In my vegetable patch and most others, we were low on 6 out of 7 trace elements tested!
- Major elements were way out of whack, all our base saturations needed correcting.
- We had major issues such as manganese deficiency, sodium excess, phosphorous excess.

Genesis 3:19 By..sweat ...you shall eat (sweating removes toxins from the body)

Genesis 3:17 “to Adam he said, Because ..(you sinned)

cursed is the ground for thy sake”!

Cursed?

- Uneven texture - Wrong Composition and STRUCTURE
- ***Unbalanced / Deficient Minerals***
- Erosion and **nutrient leaching** (weaker soil) - **Uneven weather** (hot and cold, too wet or dry)
- **Pests and diseases** (weaker plant health, natures recyclers start breaking down weak/sick tissue)

Ms13-1909 “You are not working alone, when you are tempted to be discouraged, remember this: *Angels of God are right around you. They will minister to the very ground of the earth, causing it to give forth its treasures.*”

Degradation points to the need for SALVATION!

"We should work the soil cheerfully, hopefully, gratefully, believing that **the earth holds in her bosom rich stores for the faithful worker to garner, richer than gold or silver.** The niggardliness laid to her charge is false witness. **With proper, intelligent cultivation the earth will yield her treasures for the benefit of man.**" (Special Testimonies to Ministers and Workers 4:18)

"**All these blessings** shall come upon you and overtake you because you obey the voice of the Lord your God...blessed shall you be in the country...blessed shall be the produce of your ground and....and...and....." (Deut 28:2-6)

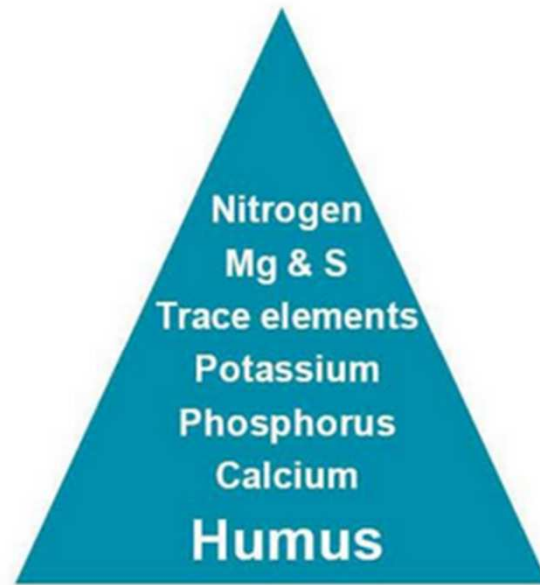
Schools of Thought in Agriculture:

Conventional Agriculture:

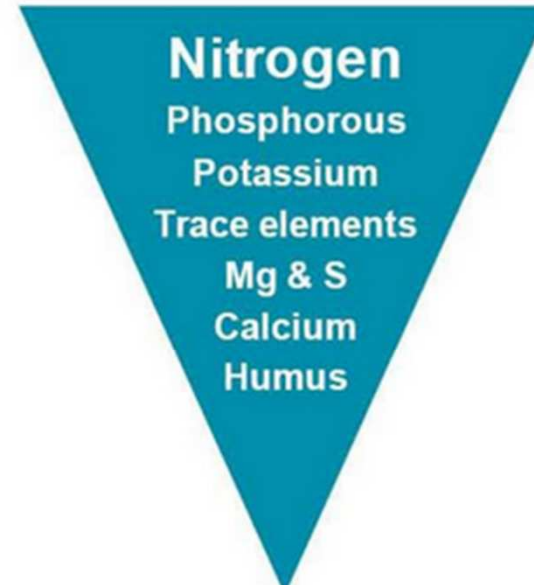
- Quantity / Production based. Feeding plants but not soil. Neglects human nutrition needs.
- Valid but Narrow-Minded commercial concerns, missing the holistic view, incl human health.
- Symptom treatment of pests / diseases

Holistic / 'Organic' / Biological / Nutrition based Agriculture:

- Quality / Nutrient based, production also important. NPK not the enemy but seen in balance.
- Feeding the soil and microbes which in turn feed healthy plants and healthy humans.
- Systemic (plant cell health) resistance to diseases and pests. Appropriate harmless technologies used to control problems without compromising health benefits of produce.



Organic



Conventional

<https://sustainablefarming.com.au/organic/>

What does the world say about getting 'good ground'?

Systems/Schools of alternative(natural) Agriculture:

(Elements of truth but not the whole truth)

- ***Organics*** – Focus on leaving out harmful chemicals, no guarantee of correcting soil nutrition. Expensive, but ethical farming represents real cost of food some say.
- ***Bio-Dynamic*** – Spiritualistic Theosophy background (Rudolf Steiner), pagan practices, some good ethical practices.
- ***Permaculture*** – Good general land use principles. Not addressing soil character. New Age 'save the planet' rather than the people.
- ***Mulch gardening*** – ('Back to Eden') Throw composting mulch at problem. Grace without Works.
- ***No-Dig*** – Microbes/Worms 'bio-till' doing work for us(true) but doesn't necessarily correct faults/supply lack.
- ***Biological/Natural Farming*** – Sometimes attempts at correction and improvement, but differing approaches.

What does the Biblical/ true science view say about getting 'Good Ground'?

- **Seek the Truth (soil test)** – facing defects, deficiencies and degradation

John 8:32 And you will know the truth, and the truth will set you free.

- **Correct faults** – Amending and supplying deficiencies

Phillipians 4:19 But my God shall supply all your need

Luk 13:8 The gardener 'said'....I'll dig around it and put some manure on it to make it grow.

- **"Work the Ground" soil stewardship** – "proper, intelligent cultivation"

Restoring the Character of the Soil

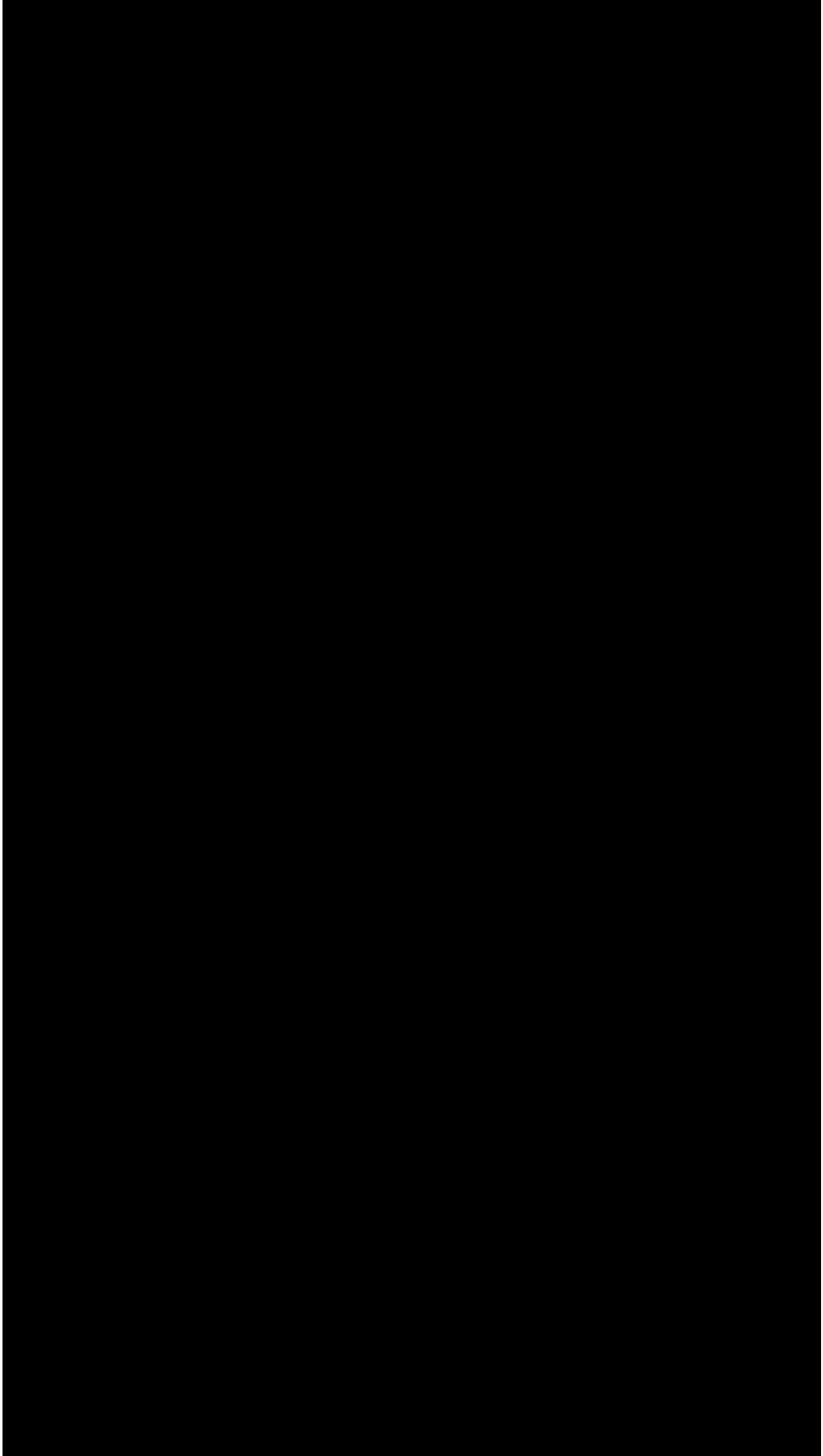
(Physical, Biological, **Chemistry**)



Mineral Amending:

Building up a “soil bank”: Establishing the right mineral environment (balancing and supplying deficits)

- Ensures consistently healthy crops and nutrient density, because they have access to all the minerals they need = healthy food security for you
- Supports highly active soil microbiology. These are the ‘digesters’ that process soil nutrients to make them available for plants in the best form and the plants available to you! (Like in our gut)



- The basic principle of soil balancing in the soil there are two types of minerals:
- **Cations (+V):** These are attracted to the negative charged soil colloid in terms of strength of charge. Ca^{++} and Mg^{++} are held by the soil much firmer than K^{+} and Na^{+} . Because of this the plant can feed relatively freely on these nutrients in the proportion with which they occur in the soil. The Basis of balancing a soil is ensuring you have the right combination (%) of these nutrients to allow for optimal soil structure (Calcium & Magnesium) and plant uptake.
- **Anions (-v):** Positive charges in the soil come from Organic Matter and other positive nutrients that are not tied up. Most soils do not contain enough Organic Matter to hold the quantity of $-v$ nutrients applied in one application, this is when these nutrients due to their chemical charge either leach or become tied up in the soil. The TopSoils approach to this situation is to use elemental based products that will weather and release nutrients over a longer period. This way you are feeding the plant over the entire growing season not saturation the pool of available nutrients with large applications of soluble $-v$ charged nutrient like Sulfate and Phosphate.

Table 1. Cations and anions in the soil.

Cations	Formula	Anions	Formula
Hydrogen (acid)	H^{+}	Phosphate	$\text{H}_2\text{PO}_4^{-}$
Ammonium	NH_4^{+}	Nitrate	NO_3^{-}
Sodium	Na^{+}	Chloride	Cl^{-}
Potassium	K^{+}	Sulfate	SO_4^{-}
Calcium	Ca^{++}	Boron	$\text{H}_3\text{BO}_3^{-}$
Magnesium	Mg^{++}	Bicarbonate	HCO_3^{-}
Copper	Cu^{++}		
Iron	Fe^{+++}		
Aluminum	Al^{+++}		

Cation Exchange Capacity (CEC)

Measurement of a soil's ability to hold cation (positively charged ion) nutrients in the soil

Cations are positively charged ions +

Ca ⁺⁺	Calcium
Mg ⁺⁺	Magnesium
K ⁺	Potassium
H ⁺	Hydrogen
Na ⁺	Sodium

Anions are negatively charged ions -

CEC (Cation Exchange Capacity)

'Carparks'

in the soil to park the major cation (alkaline, +charge) minerals

These minerals (Ca, Mg, K)

determine soil STRUCTURE and

thus how it functions and how

everything (microbes etc)

functions in it!

Base Saturation:

Refers to the quantity and ratio of cations adsorbed and held by the soil particles negative charge.

Dr. William A. Albrecht, University of Missouri

- Correlated soil chemistry (health) with human health
- Developed understanding of Base Saturation of the Cation Exchange Capacity in soils
- Emphasized the role of calcium in ratios with magnesium and potassium to promote optimum health



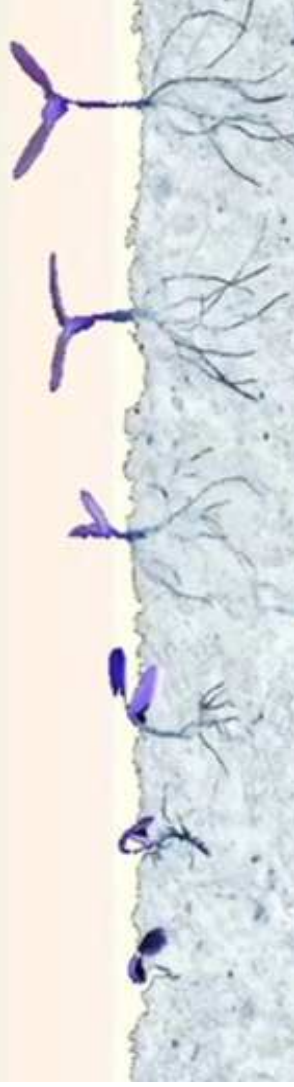
“NPK formulas, (nitrogen, phosphorus, potassium) as legislated and enforced by State Departments of Agriculture, mean malnutrition, attack by insects, bacteria and fungi, weed takeover, crop loss in dry weather, and general loss of mental acuity in the population, leading to degenerative metabolic disease and early death.”

William A. Albrecht

Plants *mine* the soil for minerals

Only a few of these are replaced through fertilization of crops

- Typically only Nitrogen, Phosphorous, Potassium are applied
- Occasionally Sulfur or Calcium are added
- Rarely some trace elements added through foliar applications
- Soil deficiencies are very rarely corrected
- The other 15 elements required for human nutrition are ignored as considerations in agriculture



*15 Additional Elements Required for Human Health

Aluminum*	Manganese
Arsenic*	Molybdenum
Boron	Nickel
Bromine*	Nitrogen
Cadmium*	Oxygen
Calcium	Phosphorous
Carbon	Potassium
Chlorine	Rubidium*
Chromium*	Selenium*
Cobalt	Silicon*
Copper	Sodium*
Fluorine*	Sulfur
Germanium*	Tin*
Hydrogen	Tungsten*
Iodine*	Vanadium*
Magnesium	Zinc

Soil Testing & Amending:

- Standard Ag Labs will only test with regard to an NPK focus fertilising program, ignoring base saturation (structural mineral correction), and most trace element needs for human health.
- **ALBRECHT based testing:** wholistic view of necessary corrections for soil that has a nutrition bank account filled, deficiencies corrected and results in quality nutritious produce.
- Where/How: Whitmar McConnell the soil science farmer expert of AdAgra says that there is only one lab in the world that does an accurate Albrecht science-based soil test that gives recommendations that properly address soil corrections: ***Kinsey Ag's Perry Lab, USA***. Whitmar McConnell himself offers the service of consulting on soil samples through Perry Labs and tweaking your recommendations for amending to best suit your situation (extra\$10 only)
- Perry lab soil test Costs(Through Whitmar): \$65 US per standard test (7major minerals, 5traces) \$15extra each for Cobalt and Molybdenum tested (recommended by Whitmar as they facilitate b12 formation and nitrogen metabolism).
- = \$90 (USD), plus P&H and conversion = about **\$130 (AUD)** per sample (with Co & Mo) or \$90 (AUD) /standard test.

- There are cheaper tests such as the Waypoint labs test which Bob Gregory of AdAgra uses which only costs \$16.50 USD per sample, but this is not as accurate or specific. (Mehlich Extraction)
- Australia also has soil labs that claim to use Albrecht's method, they cost about \$120 AUD. **SWEPS** lab is one of these.
- I have personally recently tried both Whitmar's service with Perry Labs and Waypoints cheap test and would highly recommend going through Whitmar as the recommendations are accurate and tailored to your situation, meaning you don't have to worry about making any calculations to try to figure out how to apply the test results to your situation. Plus you get advice/consulting with a soil expert. The Waypoint test seemed to be unreliable in comparison but a general indicator.
- Whitmar McConnell – Golden Moment Farm
- 2830 EAST FORK ROAD – MEANS, KY 40346 PHONE: 719-641-3859 (US) E-MAIL: goldenmomentfarm@gmail.com

How to take a soil Test?

- Contact Perry Lab for soil sample submission documents. (We have)
- ***Take samples from growing area:*** should be from all the same soil type(looks like the same type of topsoil), if soil type changes multiple tests for each soil type will be needed.

How: - dig down into the topsoil layer ½ to 1 foot deep(dependent on compaction/how deep you will grow/amend.) **Usually about 15cm**

- slice an even wedge of the soil profile vertically and put in sample bucket.
- do this several times in the area to get a representative sample.
- mix sample bucket soil evenly, soil should be dry, not wet. Take out one cup(or less depending on lab) and double bag in ziplock bags, label clearly, send off according to instructions.

Perry Samples

MN-01 (Matt Newitt Bottoms Paddock)

BM-02 (Beus veg patch)

CG-03 (Church Garden)

DJ-04 (Darrus veg patch)

MN-01

BM-02

CG-03

DJ-04

- Soil submission From
- Permit to receive Soils
- Quarantine materials labels (taped to outside of package)

Kinsey Agricultural Services, Inc. SOIL SUBMISSION FORM
315 State Highway 77 - Charleston, Missouri 63834
Telephone (573) 683-3880 Fax (573) 683-6227 Email: neal@kinseyag.com
www.kinseyag.com

OFFICE USE ONLY

Date Received _____
No. of Samples Received _____
Check # _____ Amt. _____

File Under: _____

☐ Please check here if **ORGANIC** recommendations are desired.

Farm (26 characters max.)	Field (10 char. max.)	Sample (8 char. max.)	Previous Plot ID	Crop Information				Planting Date (Mo/Yr)	Lime Applied Previous 3 Years?		
				Previous Crop	Previous Yield	Next Crop	Next Yield		Type	Mo / Yr	Lbs / Acre
1 Matthew Newitt	B-Padd	MN-01	—						<input type="checkbox"/> Cal Carbonate		
2 Ben Meldt	V-patch	BM-02	—						<input type="checkbox"/> Dolomite		
3 Church Garden	10x10	CG-03	—						<input type="checkbox"/> Gypsum		
4 Darren Jones	Garden	DS-04	—						<input type="checkbox"/> Cal Carbonate		
5									<input type="checkbox"/> Dolomite		
6									<input type="checkbox"/> Gypsum		
7									<input type="checkbox"/> Cal Carbonate		
									<input type="checkbox"/> Dolomite		
									<input type="checkbox"/> Gypsum		

Program Level (Check Only One)
Make recommendations for soil improvements with a view toward:
☐ Excellent*
☐ Building
☐ Maintenance
☐ Minimum Input
* Excellent level assumed if no box is checked.

Tests
☐ Standard (includes B, Fe, Mn, Cu, & Zn)
Special Tests
☒ Molybdenum ☒ Cobalt
☐ Salt Concentration / Chlorides
☐ Aluminum
☐ Other (specify) _____

Preferred Fertilizers Available - Please List:
☐ Nitrogen materials: _____
☐ Phosphate materials: _____
☐ Potassium materials: _____
☐ Limestone¹ (type & analysis): _____
☐ Compost / Manure²: _____

¹ Limestone: Please supply a recent analysis, or sample for analysis, to ensure proper Calcium and Magnesium recommendation.
² Compost/Manure: Please supply a recent analysis, or sample for analysis with traces, to ensure accurate nutrient recommendation from other sources.

Sender: Ben Meldt Ph: 0061 730591008
Add: 32 Staxland St, Woodridge QLD 4114 AUSTRALIA
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AMENDING



How to do soil Amending?

- Work out how much of all the amendments you need to cover your garden area.
- Purchase the amendments from Bunnings, Farm/Produce suppliers.
- Measure & calculate the area you will amend at one time, weigh out the exact amounts of each mineral amendment needed, apply.
- Apply: All amendments can be applied together dry. Mix very thoroughly (e.g. bucket with lid)
 - If dissolving trace elements because they are in small amounts, don't mix anions(molybdenum and boron) with cations(Cobalt, Iron, Manganese, Copper Zinc), (Usually Cobalt and Moly applied in tiny amounts so put in separate Watering cans.)
 - Broadcast dry mixture by hand or spreader evenly on the soil over the area being covered.
 - Water in any dissolved elements evenly with watering can shower nozzle.
 - Lightly fork into the top layer. Will take months/years to incorporate properly into the soil. Keep microbial / soil life active to assist in amendment incorporation.











How often to re-apply amending:

- First major corrections lays a stable foundation, fixing up the chemical 'mess' in your soil for the most part.
- Depends on what your growing and how much is being harvested out of the soil. Eg, lettuce takes out very little, passionfruit yielding 100kg of fruit takes out lots of nutrients.
- Some minerals will leach yearly like N, S, P, molybdenum and boron, anions being in solution aren't attached to soil particles and leech out of soil, whereas cations are more stable attached to particles etc.

Case Study Soil Sample: Bens Veggie Patch Soil Test (Perry Labs – through Whitmar McConnell)
 (Heavy Clay backyard soil, bombarded with compost, manure and mulch over 4 years)

Golden Moment Farm

SOIL RECOMMENDATION

2/25/2018

Location/ Farm:	Ben Meldt		
Field/ Sample:	V-PATCH/BM-02		
Crop:	Vegetables		
Total Exchange Capacity:	24.47		
pH of Soil Sample:	6.60		
Humus Content, Percent:	5.09		
Desired Ca : Mg Percent:	69:11		
BASE SATURATION PERCENT:			
CALCIUM (60-70%)	61.20		
MAGNESIUM (10-20%)	22.04		
POTASSIUM (2-7.5%)	4.49		
SODIUM (0.5-3%)	1.47		
OTHER BASES (Variable)	4.80		
EXCHANGEABLE HYDROGEN (10-15%)	6.00		
ALL RECOMMENDATIONS ARE PER 100 SQ. METERS BROADCAST			
NITROGEN-N (kg/ha)		ENR Value	100
Recommend applying 4.5 kg Feather Meal. Because of excessive Phosphorus, options are limited. Would need to consult.			
ANIONS			
SULFUR-S (kg/ha)		Desired Value	224
		Value Found	40
		Deficit/Surplus	-184
Low. Need supplied by other materials to be applied.			
PHOSPHORUS-P (kg/ha)		Desired Value	247.370
		Value Found	1024
		Deficit/Surplus	+654
Extremely excessive. Should not apply anything with Phosphorus in it. This includes Soft Rock Phosphate, compost, manure, castings, P containing protein meals and any fertilizers made from these items.			

CATIONS

CALCIUM-Ca (kg/ha)	Desired Value	7570	Apply 22.4 kg Gypsum (24% Ca, 14% S). Also apply 24.6 kg Warwick High Calcium Lime.
	Value Found	6714	
	Deficit/Surplus	-856	
MAGNESIUM-Mg (kg/ha)	Desired Value	724	Very high. None.
	Value Found	1450	
	Deficit/Surplus	+726	
POTASSIUM-K (kg/ha)	Desired Value	1497	Apply 2.8 kg Potassium Sulfate 0-0-41. Repeat application about 60 days later. Can also apply 2-3 kg Kelp Meal if budget allows.
	Value Found	961	
	Deficit/Surplus	-536	
SODIUM-Na (kg/ha)	Desired Value	127	None.
	Value Found	165	
	Deficit/Surplus	+52	

MICROS/TRACES

BORON-B (ppm)	Desired Value	2	Low. Apply 220 g 11% Borax. Rate can be doubled if nothing is growing yet and material is uniformly applied and worked in. Can also apply 14 g 20.5% Solubor, foliar, up to 4 times during season.
	Value Found	0.78	
	Deficit/Surplus	-1.22	
IRON-Fe (ppm)	Desired Value	360	Low. Apply 1 kg 30% Ferrous Sulfate.
	Value Found	188.75	
	Deficit/Surplus	-171.25	
MANGANESE-Mn (ppm)	Desired Value	240	Apply 500 g 32% Manganese Sulfate.
	Value Found	87.62	
	Deficit/Surplus	-152.38	
COPPER-Cu (ppm)	Desired Value	10	Deficient. Apply 390 g 25% Copper Sulfate.
	Value Found	1.30	
	Deficit/Surplus	-8.70	
ZINC-Zn (ppm)	Desired Value	20	Excessive. None.
	Value Found	93.65	
	Deficit/Surplus	+73.65	
COBALT-Co (ppm)	Desired Value	1-2	Deficient. Apply 11 g 32% Cobalt Sulfate.
	Value Found	0.23	
	Deficit/Surplus	-0.77	
MOLYBDENUM-Mo (ppm)	Desired Value	1-2	Low. Apply 5 g 39% Sodium Molybdate.
	Value Found	0.69	
	Deficit/Surplus	-0.31	

NOTE: DO NOT APPLY UNLESS RECOMMENDED COPPER IS APPLIED.

Excessive Phosphorous?

The Organic Gardeners 'Honeymoon Period'

- Lots of compost and manures applied to condition soil
- Nitrogen and Potassium used faster by plants but less Phosphorous which builds up in soil
- Lots of Carbon present which Chelates and buffers excess minerals like P, so long as you keep applying it looks like everything is ok.
- Microbial activity is high (supercharged) and lots of carbon breakdown and nutrient release so plants thrive and grow well and fast.
- After the 2-3yr mark P Excess starts showing in plant disease and pest pressure that builds and gets worse.



Excessive Phosphorous?

- Here are some of the symptoms of excessive phosphorus in soil:
- Increased weed growth (I surely have that!)
- Stunted plant growth (got that, too)
- **Harms beneficial root fungi, which help the plant absorb water and nutrients**
- **Decreases the plant's ability to uptake zinc (deficiency shows as bleaching of plant tissue)**
- **Decreases the plant's ability to uptake iron (deficiency shows as yellowing between leaf veins)**

*Phosphorus does not move in the soil as nitrogen does, so its staying power is higher. When in excess it can lock up in the soil making it harder to deal with. Because of this, it can stay in the soil in excessive amounts three to five years

Excessive Phosphorous?

- **Avoid adding manure as fertilizer,** Plants can usually remove slightly excessive amounts of phosphorous, but there's a limit to how much phosphorous each plant can remove each year. Plants reach that cap significantly faster when manure is added strictly to increase nitrogen.
- **Plant nitrogen-fixing vegetables to increase nitrogen without increasing phosphorous.**
- **Add phosphorous-free fertilizer.**
- **Spray foliar zinc and iron on plants in high phosphorous soils. High phosphorous levels require additional zinc and iron treatments for plants to maintain their health.** Texas A&M; University suggests mixing a spray that contains water with 1 percent foliar zinc and iron, then applying that spray to plants every week if phosphorous levels are excessively high. You may apply it every four weeks if phosphorous levels are slightly high. Soils with 300 parts per million phosphorous will take up to five years to go back to acceptable levels.

Extra Trace Minerals:

Soil test only covers 5-7 trace minerals. Many more are needed for human health (ocean contains around 87 minerals!) The other minerals are hard to test for and even if you could no-one might know which amount the soil should contain. Selenium and Iodine for example are important.

- Just do our best to supply a broad range of trace minerals from sources such as ocean minerals.
- Sources:
 - Diluted ocean water/ocean minerals/seaweed meal
(careful not to apply if Sodium is high in soil)
 - Seaweed extracts (Seasol), much lower salt content
 - Azemine: volcanic marine deposit. (don't know supplies)

Note: commercial trace mineral mix products mostly don't contain extras beyond your amending or in right amounts for your soil.

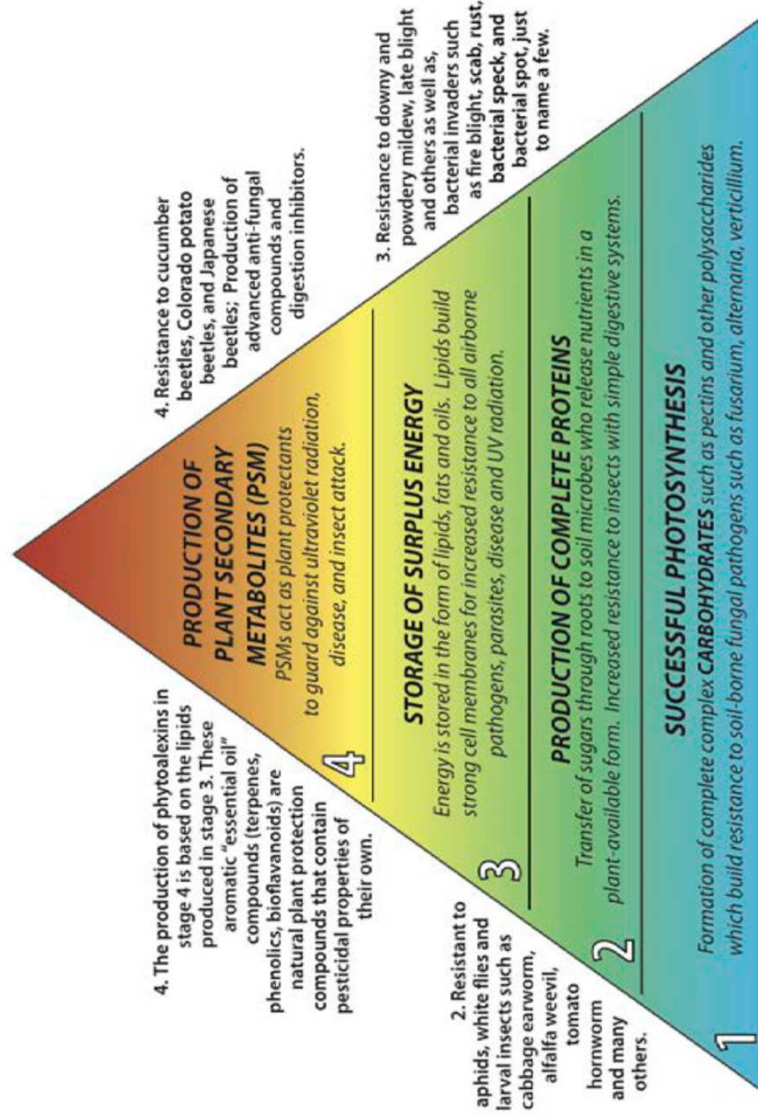
- Ian Mot is trying to set up a trace mineral supply service next year that puts together what you need and sends it to you, as some of them are hard to find.

Restoring the Character of the Soil

“Plants fed by healthy soil are less frequently attacked by insects and diseases. This goal may take several years to achieve but is well worth the study and effort. I have seen the rewards of such effort graphically illustrated in the Lifestyle Centre garden at Uchee Pines.the green beans my father planted in his garden, where the soil had received extra care in the form of compost and green manure crops, had beautiful beans and the Mexican bean beetles did not cause a problem. Another area that was not so enriched was attacked by the beetles even after being sprayed.” Stephen Meyer

Optimal Nutrition Enables Advanced Function in Plants

As soils and crops transition toward biological farming practices, they pass through stages of increasingly better health. The progression toward better health restores the natural and biological abilities of the plant and soil system. Innate characteristics and advanced functions are enabled such as immunity to soil and airborne pathogens, resistance to insects, production of lipids which strengthen cell membranes for tastier, more storable fruit, and more.



If we wish to produce "food as medicine" this is where the medicine is.

Restoring the Character of the Soil

(Physical, Biological, Chemistry)

Genesis 2:5 ... man to *work the ground* (ESV), KJV “till the ground”

Ground-Work: Compacted, hard ground needs to be worked to get the 25% Air and Water in it. Why?

- Roots and microbes need air and water and an aerobic environment for life to thrive.
- Sandy Soil: needs maybe nutrients/clay from deeper brought up, organic matter adds water retention.
- Clay Soil (hard ground): needs clay flocculated by calcium, clods broken up, bio-tilling by worms.
- **All soils need base saturation addressed (Ca,Mg,K ratios) to get the right STRUCTURE.**
- Compost / Organic matter breakdown: Increases water retention, microbe and worm activity.
- Bio Tilling: microbes and worms create pores and enrich, most active with organic material to break down.
- Root-Breakers: Daikon, Burdock, Dandelion

Restoring the Character of the Soil

(Physical, **Biological**, Chemistry)

Biology:

“The Creator designed the soil to be a self-sustaining, regenerating life support system for higher plants. In order to cooperate intelligently with this system we must think of the soil as a dynamic system containing myriads of living organisms. A handful of biologically active soil can contain more units of life than there are people on earth.

Along with earthworms, these millions of bacteria, fungi, and other microorganisms digest organic matter into humus and act as laboratories to produce nitrogen, vitamins, hormones and other ‘specialised formula’ foods for plants. To encourage these unpaid workers is the gardeners first job.”

(Stephen Meyer – Grow Your Health notes)

Restoring the Character of the Soil

(Physical, **Biological**, Chemistry)

Organic Matter:

(Feeds microbes, improves soil structure, aeration, and water and nutrient holding capacity)

Mulch

(low N high Carbon materials like hay, straw, dry leaves)

- Conserves moisture (harsh Australian sun)
- Encourages microbial life keeping soil shaded moist and even temp
- Suppresses weeds
- Feeds plants by slowly breaking down



Restoring the Character of the Soil

(Physical, **Biological**, Chemistry)

Organic Matter:

Cover Crops / Green Manures / Living Mulch

- Nitrogen fixing legumes (clover and vetch). Grasses (rye or oats). Or a mixture of grasses with low growing legumes like mung beans.
- Sowed thickly (over sowed) and dug in just before flowering.
- Adds nitrogen, organic matter and feeds soil life.
- Can be interplanted between rows of vegetable crop one month later to feed the next crop.



Green Manure of
Mungbean, Buckwheat and
some wild Amaranth





Hard Clay - couldn't get garden fork in an inch!



One month later a crop of radishes, wild cucumbers and green manure ready to dig in.

Restoring the Character of the Soil

(Physical, **Biological**, Chemistry)



Composting:

Alternate layers of carbon rich(brown) materials such as dry leaves, hay, straw, with nitrogen rich(green) materials such as green garden clippings, kitchen scraps, manure etc.

- Hot method: Make at least 1 cubic meter pile of layers and turn every few day days with hay fork to keep the pile hot with thermophilic bacteria activity. Can get to 60deg C +. Finished in 2-3months.
- Slow/Cold method: Break down materials in smaller piles or in a bin/bay or as a mulch layer. 3-6months.

Caution: If your soil is too high in Phosphorous(P) don't apply manures (high in P) or compost. If you have around 5% humus in the soil compost is unnecessary. Plant residues and a thin layer of hay mulch is enough to feed the soil life.

Worm Farms:



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Materials for the Compost Heap (bio-dynamic article recommend)

- When choosing materials for the compost heap it is important to keep in mind the need for a balance between those high in nitrogen (proteinaceous) and those high in carbon (carbonaceous) to achieve an ideal carbon : nitrogen ratio (C:N) which facilitates the controlled fermentation process necessary to produce the desired end product.
- Proteinaceous materials include; fresh animal manures, fish wastes and green plant materials such as lawn clippings, green weeds and seaweed. These tend to putrify on their own
- Carbonaceous materials include ; hay, straw, sawdust, woodchips and dry crops such as maize stalks. These tend to remain stable and do not decompose on their own
- Other additives include:
 - Earth – 5-10%
 - Clay – pulverised and sprinkled among layers
 - Lime or calcium in the form of dolomite or ground limestone lightly sprinkled among the layers
 - Wood ash finely laced throughout
 - Rock dusts
 - Old compost, nettle tea, comfrey tea etc.



Biodynamic Agriculture Australia Ltd

Carbon:

- **Carbon induction:** plants put out liquid carbon into soil, gets turned into stable humus. This creates most of the stable humus as apposed to applied compost which gets mostly burned up in metabolism and puts carbon more in the air than in soil.

This becomes obvious to the understanding organic gardener who applies excessive amounts of compost/manure/organic matter a few times each year just to see it all just disappear into a hungry garden.

Bio Char: (crushed charcoal 'inoculated' or 'charged' with nutrients)

- Increases CEC like humus with its huge pore space & surface area.
- Houses nutrients and microbes to increase soil capacity and building (look up: Terra Preta)



“Building organic matter,
re-mineralising the soil,
deep tillage,
and planting a living mulch
are basic steps to creating a living soil”

Stephen Meyer – Grow Your Health