Compost, Soils, Compost Products and Soil Amelioration

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TERMINOLOGY

- Custom Made Soils
- Manufactured Soils
- Blended Root zone Media
- Site Soil Amelioration
- Organics- Conditioners, Blankets etc
Site Soil Amelioration

- For **Reconstructed Soil Profile** Both
- **Top soil & Subsoil** needs Chemistry Characterisation
  - **Top soil** Use pH, EC, Cations, Macro & Micro Nutrients & Org Matter
  - **Subsoil** Use pH, EC, Cations
- These are drivers of proper root development & plant nutrition
Building Blocks of Healthy Soil

Performance

In the *appropriate* Soil Type / Region / Climate

Optimum Mix of:

- Physical Properties
- Chemical Properties
- Biological Properties

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Custom Made Soil Profiles

Fact One
- Humans intervene in natural landscapes

Fact Two
- Humans have constructed soil profiles ‘custom made’ to facilitate enhanced vegetative production over time.

VIZ:
- Agriculture
  - Clearing, Cultivating
    → Crops / Pasture Productivity
- Landscapes
  - “Hanging Gardens of Babylon” & Roma Street Gardens
    → Visual Amenity
Focus is Compost & Uses?

Incorporation in soil of “Variable Qualities of Compost” is common

Inorganic Soil + Organic Conditioner

- Water Retention
- Nutrient Retention
- Active Biology
- Sustainability IF Quality Product

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Soil Organic Amendments

Composts

**Issues**

Can include Contaminants:

- Pesticides
- Toxins
- Heavy Metals
- Pathology (Bacteria, Fungi)

**Plant Health & WH&S Requirements**
WHAT is SOIL

Healthy Soil is a complex interaction of organic and inorganic particles in A Horizon (Topsoil)

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We are Discussing is:

1. Manufactured Soil &
2. Organic ‘Conditioners’
   - (1) is Mix of Inorganic (Soil + Organic)
   - (2) is Organic (Compost)
Fundamental Key to Assessing Organics – Composts & Mulches

Figure 1:

The three stages of composting.

The bars are the concentration of phosphorus, divided into plant-available inorganic P (yellow portion) and unavailable organic P (blue portion).

The solid line is the core temperature within the cotton trash windrow.
Plant-availability of N, P and K in a cotton trash compost over the duration of composting.

Based on soil testing methods (Rayment & Higginson 1992), not AS 4454.
Fertiliser value of feedlot manure compost and a greenwaste mulch

<table>
<thead>
<tr>
<th>Nutrient Source</th>
<th>Mineral Concentration kg/t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Manure (FM)</td>
<td>0.1</td>
</tr>
<tr>
<td>Compost Green Waste (HB)</td>
<td>0.3</td>
</tr>
<tr>
<td>FM &amp; SD</td>
<td>1.4</td>
</tr>
<tr>
<td>@ 14 t/ha</td>
<td>420</td>
</tr>
<tr>
<td>HB mulch</td>
<td>2.1</td>
</tr>
<tr>
<td>@ 14 t/ha</td>
<td>63**</td>
</tr>
</tbody>
</table>
Not all Composts are the Same!

Depends on

1. Type of Feedstock (e.g. Manure vs Green Waste & How Produced)

2. Maturity (is it Composted to Maturity ?–(Stabilization Grade)

3. Key Question (How Mature is it?)
1: Input Receival
2: Selecting Raw Inputs
3: Preparing the Mix
4: Active Composting
5: Curing
6: Screening
7: Final Product Specification
8: Quality Testing
9: Rejection of Raw Inputs

EXAMPLE
PROCESS FLOW CHART FOR WINDROW COMPOSTING

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Using of Compost and Compost Products Based on

“Fit for Purpose”

Applications of Quality Products used with a Quality Process

= On going confidence with results

= Healthy Soils & Plants

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Compost & Microbes

To achieve beneficial effects **Maintain**

- Aeration via particle size distribution in pile (correct bulk density)
- Correct moisture content (field capacity)
- Temperature (50-60°C)

If any or all above are not maintained
→ **Poor Results Poor Product Quality**

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What is in the Organics Pile?

X 400 mag.

oxygen
Pile Dynamics

- Poor Aeration - Excessive heat
  - **Kills** microbes/fires
- Too Dry
  - Composting **slows/stops**
- Too Wet
  - **Odours** (poor composting or weather)
- Temperature
  - 50-65°C
What is Composting

- Transforms organic materials
- Using biological means and temperature and water

- Aerobic Composting (Air not Limited)
Composting

- Micro organisms product heat
- Temperate gradients in Windrow (Pile)
- Turning Required

> Windrow Composting

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Heat – Pasteurises (Sanitises)

The Organics ------ and

- Destroy Weed and Seeds
- Kill Pathogens (Plant and Human)
- Complexes contaminants

Product Hygiene for both Plants & Users

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Composting Occurs when Sufficient Available of:

- Water
- Oxygen
- Organic Carbon (Feedstock)

Not all materials immediately suitable. **Co-composing** is Key.
Compost vs Mineral Fertilisers

- Adds organic carbon to soil
- Slow release nutrients in compost means lower nutrients losses & controlled supply
- More Like natural systems e.g. leaf fall

BUT Over much longer period
Response of microbes and nematodes in a tomato production soil

- Increases in microbial and beneficial nematode activity proportional to increased organic amendment,
- Caused a reduction in root knot nematode numbers
Use of Quality Organic Conditioners to Soil Medias

As Amendment or Input into Manufactured Soil / Ecobblankets / Compost Berms / Potting Mix etc.

Question:
How do we measure the positive (or negative) contribution to a soil?

Question:
What laboratory methods do we use?

Question:
How do we assess the compost before it is added into other media such as soil

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Industry Quality

Via composts via products endorsed by Compost Australia / Compost Queensland

Need - Uses & Quality Statement from:

- Manufacturers of RO products (including manure derived composts)
- Waste recycling and composting – (Manufacturers)
- Applicators (Users)
Compost Quality

- 5 Ticks Product Standards
  - Making and acting upon decisions
  - Policy making and advocacy
- Certified Product
  - Promoting RO products
  - Product differentiation specified

*FIT FOR PURPOSE*

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Market Standards
Market Development

To increase the use of quality “Fit for Purpose” Recycled Organics (compost products) and Applications
Advantages of Composting to Biological Stability

- **Organic carbon stable** (Nutrient Drawdown Low – Index High, no longer reheating)

- **Nutrients concentrated and stable** (Deduct plant-available N, P and K to nutrient budget for upper application rate)

- **Concentrated humus-like** compounds increase Cation Exchange Capacity and water holding capacity
ORGANIC MEDIA Types

MULCH & ORGANIC CONDITIONER

• MULCH = larger particles (>16mm), composted (6 weeks) to kill weeds, break down waxes (water-repellent)

• SOIL CONDITIONER = more fine particles (<10mm), composted (>16 weeks) to improve water & nutrient holding capacity (soil conditioning), and fertiliser value
MULCH AND ORGANIC SOIL CONDITIONER

- **MULCH** = **high rate application organic surface cover (coarse)**, reduces water loss, buffers soil temperature, controls weeds, favours soil animals

- **ORGANIC CONDITIONER** = **organic humus- amendment (finer)** used in soil to improve **identified need** (eg fertiliser & slow release nutrients) OR as Compost blanket, or Incorporation into Soil
What can Society DO?

- **Educate** on the importance of use of Soil Chemistry and Use of Recycled Soils and Organics
- Be part of **understanding** and working with site conditions
- Be part of the **beneficial reuse** of site materials
- Use site **soil testing** and appropriate co amelioration
- Understand projects better and demand proper site assessments using **Soil Chemistry** and Quality reuse strategies.
Need PROCESS CONTROL REQUIREMENTS ROU Info Sheet 3.1

- Quality Manual (Intent / Market)
- Procedures Manual (Ensure Critical Processes Covered, CCP)
- Work Instructions Manual (Detailed Steps / Activity)
Again - Key to Assessing Organics - Composts

Figure 1:

The three stages of composting.

The bars are the concentration of phosphorus, divided into plant-available inorganic P (yellow portion) and unavailable organic P (blue portion).

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QUALITY

CQLD promotes

- HACCP-based QA System which
- Avoids nutrient pollution
- Avoids Metals, Pesticides & Biological Contamination
- Hazard, Analysis, Critical, Control, Point = HACCP
Compost/Recycled Organics

Stabilisation (MATURITY)

- Stabilisation grades 1 or 2 are safest

They Reduce Or Eliminate

- Chemical residues via organic complexing
Stable RO Product

Achieves

- Pathogen disinfection

Promote soil health via

- Stimulating good fungi and bacteria
Compost Maturity Role

- Reduces leaching of nutrients (N&P)
- Provides nutrients in beneficial form
- Slow release source of plant nutrition i.e. balanced
HACCP - RO Management: The Solution

- Involves precautionary principle

To Prevent:
- Disease (by supplying beneficial bacteria)
- Pollution
Non HACCP Management

Uncomposted (not stable) causing

- Pollution
- Drawdown to native environment
- Poor plant performance
- Promotes Undesirable biology
Mulch Layers

- Do not use uncomposted (raw) products
- No composting = Toxins present
- Biologically unstable
- Promotes undesirable microbial growth
- Coliform bacteria do regrow
MULCHES

Chipped Woody Plants

• Durability due to toxins present

• Toxins deter predators – kills microbes (alkaloids and terpenoids)

⇒ Negative effects to living or freshly planted stock
MULCHES

If **composted to stability**
- Detoxifies harmful toxins
- Microbial population function
- Minimum 6 weeks composting
  \[\Rightarrow\] Detoxifies mulch
- Pasteurisation is not adequate
MULCHES

- 6 week HACCP composting to Grades 2,3
- Lowers **Pesticides** below detection
- Destroys organic waxes & Toxins
Biological Unstable Composts

- Produce nutrient drawdown
- Pathogen regrowth occurs (due to Avail C)
- Pathogenic coliform bacteria regrow
- Do reheat
Stable Composts

Highly unlikely to support:

- Undesirable Pathogen regrowth
- Is Biologically mature (stable)
- Fails to reheat
CQLD Promotes Composted “Fit For Purpose” Product

VIA:

- HACCP – based production plans
- Provides certification re stability
Stable Compost and Mulches

Benefits:

- Microbes detoxify most pesticides
- Phyto-toxicity of plant toxins minimised

e.g. most pesticides bind strongly to organic matter
Case Study (1)

Compost used to reduce pesticides

*Vischetti (2004)*

- Chlorpyrifos
- Fungicide metalaxyl
- Herbicide Imazamex

Degraded 50% in 14 days
Case Study (2)

OC and OP pesticides added to active compost pile

After 10 Days

- Lindane – no trace
- Endosulfan – 50% reduction
- Malathion – degraded to 5%
Case Study (3)

Plant Disease Suppression (Biocontrol)

- Increases beneficial Bacteria & Fungi
- Increases No. & Diversity of Biology
- Limits disease causing Microbes
- For example Root Rot (Phytophthora & Pythium Species) Reduced by 50-90%

Stirling 2001, Pittaway 2006
# Organic Conditioner Requirements

<table>
<thead>
<tr>
<th>Organic Soil Conditioner Parameter</th>
<th>Test Method</th>
<th>Organic Soil Conditioner Test Parameter Requirements</th>
<th>Organic Soil Condition Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visible extraneous material (% dry matter) –</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) glass, metal, rigid plastics &gt; 2mm</td>
<td>Appendix H</td>
<td>0.5%</td>
<td></td>
</tr>
<tr>
<td>b) plastics-light, flexible or film &gt; 5mm</td>
<td></td>
<td>0.05%</td>
<td></td>
</tr>
<tr>
<td>c) stones and lumps of clay ≥ 5 mm</td>
<td></td>
<td>≤ 5%</td>
<td></td>
</tr>
</tbody>
</table>

Refer AS 4454 – Composts, soil conditioners and mulches

<table>
<thead>
<tr>
<th>Soil Conditioner Quality USEPAA/625/R – 92/013</th>
<th>Thermophilic</th>
<th>Turning and temperature</th>
</tr>
</thead>
</table>

Control of pathogens

Refer AS 4419 – Soils for landscaping and garden use – NOTE MODIFIED REQUIREMENTS

*pH (H₂O, 1:5) – |
| a) General range | Clause 5.5 | > 5.5 and < 7.5 |
| b) Naturally occurring acid soils | | > 5.5 and < 6.5 |
| c) Naturally occurring alkaline soils | | > 7.0 and < 8.5 |

NDI (Nitrogen Drawdown Index) |
| Clause 5.9 | > 0.5 |

*Wettability |
| Clause 5.4 | > 5 mm/min. |

*EC (Electrical Conductivity) |
| Clause 5.6 | < 2.5 dS/m |

Particle size of soil conditioner – |
| a) to pass a 10mm sieve | Clause 5.14 | 90% by weight |
| b) to pass a 20mm sieve | | 8% by weight |
| c) not to pass a 20mm sieve | | 2% by weight |

Refer Appendix Table 1 – Method for Determination of Water Repellency of a Soil (Hydrophobicity)

Water Repellence Rating (for sands to clay loams) |
| Appendix Table 1 | Class 0 or 1 |

Refer ALHS (Australian Laboratory Handbook of Soil and Water Methods)

Moisture content |
| 2 B1 Rayment & Higginson | > 25% and < 35% |

Refer Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland - EPA

Heavy metals and organic chemicals contaminants |
| Appendix 9 Table 9.1 | Not to exceed EIL thresholds |

* Test requirements that have been modified from those in AS 4419 & ALHS.
RECAP - Advantages of Use of Stable (Mature) Organics

- Plant available slow release nutrients for plant growth
- Humic like substances increased
- Lignins and phenolics react biochemically with microbes and complex out
Stable (Mature) Mulches and Composts

- Do not reheat
- Complement and reduce inorganic fertilisers
- Increase soil CEC and nutrients
- Humus-like compounds complex and heavy metals
- Increase Soil Borne beneficial bacteria

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Unstable (Immature) Mulches and Compost

- Should not be used
- Should not be applied to soil (Toxins)
- Introduce pathogen contamination
- Can introduce heavy metal (manures)
Examples of:
Beneficial Refuse of Recycled Organics

(COMPOSTS)
Typical BAC “Soils“
Tugun Bypass

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HOW? FFP Compost at 50mm over Site Sub Soil
A New innovation
After 2 weeks in use
THANK YOU