Demonstrating Sustainable FARM PRACTICES

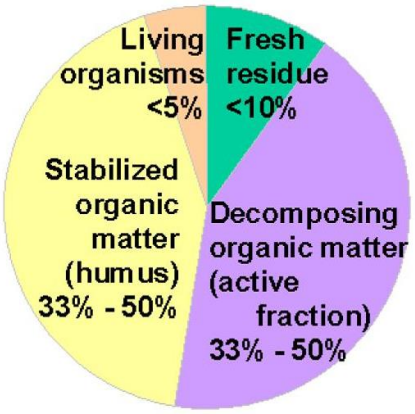
Organic Soil Amendments - Chris Alenson Sep '14

"The role of organic matter can be summarised in this way. It is necessary as food for the bacteria, fungi, and earthworms. The bacteria, fungi and earthworms are essential, for building soil structure. The chief cause of soil decline is the loss of organic matter". US Soil Conservation Service, 1938

Introduction

Soil organic matter (SOM) is basically all the organic substances (anything with carbon) in the soil, both living and dead. Organic matter on decomposition provides a well-balanced, slow release source of nutrients.

Our pie chart indicates that soil organic matter has four components, the active (33-50%), the passive (33-50%), living organisms, <5% and fresh residue, plant material roots <10%. Soil organic matter includes plants, blue green algae, microorganisms (bacteria, fungi, protozoa, nematodes, beetles, springtails, etc.) and the fresh and decomposing organic matter from plants, animals, and microorganisms. Soils that are biologically alive have higher amounts of active carbon recycled and release more nutrients for plant growth than soils that are biologically inert and contain less active organic matter. To be biologically active microorganisms require moisture, oxygen and temperature.



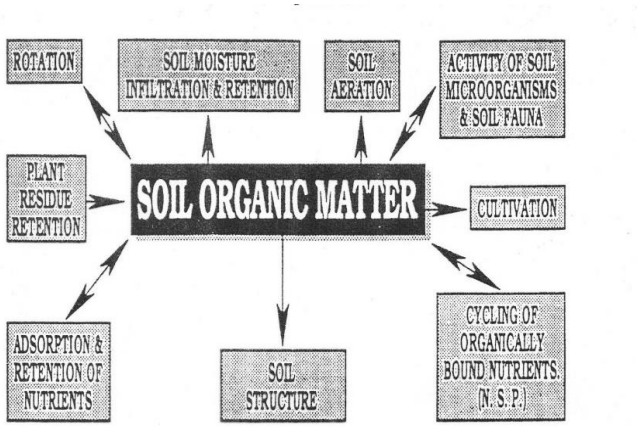
Soil organic matter components. Source: USDA NRCS

The active organic matter (33-50%) in the surface soil awaits decomposition by fungi, bacteria and other microorganisms. Their food source is the nitrogen, carbon and mineral elements in this soil. If we want this decomposition to take place **we need to ask the following questions.** Does the surface profile to a depth of 100mm or more have an open well aggregated structure to allow penetration of oxygen and moisture? Is the pH favourable for microorganism activity? Are the plant roots able to penetrate down through the initial 100mm or do they source their food (mineral elements, moisture, oxygen) solely from this top 100mm of soil? If this soil is compacted then decomposition of the organic matter may also be inhibited.

Improving soils with organic matter

Physically it provides a balance between free draining pores for aeration and small water retentive pores. For every 1% of organic matter indicated by a soil analysis approximately 13 kg/ha of nitrogen maybe released during the growing season. This is a considerable contribution of nitrogen and does not include nitrogen produced by the action of bacteria in the nodules of legumes.

Humus, like clays is a soil colloid with a high cation exchange. It is involved in nutrient supply via exchange mechanisms. Humic acid is a chelate and can mobilise locked up nutrients that otherwise would not be available to the plant. It has the ability to absorb trace elements such as copper and cadmium which might otherwise be toxic. It has a moderating influence on nutrient supply where elements might be either too low or too high.



Role of organic matter in soil processes, Rovira (1990)

Management effects on organic matter

The exposure of the soil by cultivation and over grazing are the main culprits in terms of decreasing the soil levels of organic matter. This of course has an associated decrease in the physical and biological properties of the soil ultimately affecting crop growth and productivity.

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Evaluating the value of organic inputs

Calculating and contrasting an economic value to organic inputs against inorganic inputs is relatively easy in terms of their relative nutrient content and availability (N,P,K). What is far more difficult is calculating the value of the input in terms of an increase in crop yield, improvement in soil condition, an increase in moisture absorption, the increase in biological activity and disease resistance and increased availability of scarce trace elements. Organic amendments enhance soil fertility while inorganic synthetic fertilisers may decrease biological activity and affect negatively the pH and cation exchange capacity of the soil.

It also must be understood that organic soil amendment/fertilisers may vary considerably in their nutrient analyses; they may contain weed seeds, soluble salts and heavy metals. The cost can be quite variable depending on supply and distance from the source.

How do I choose which organic input should be used?

A thorough knowledge of the production system should be undertaken based on soil analysis, soil observations, animal health and productivity, pasture/crop production and weed burdens. It is important that producers request analysis of the considered inputs to ensure they match the needs of the production system. If for example soil assessment and analysis indicates low levels of organic matter then compost rather than poultry manure might be the course of action. Low phosphorus levels may suggest that poultry manure might be a better approach.

Beef/dairy and poultry manures

Livestock free grazing on pastures are natural fertiliser spreaders. Livestock manures are good fertilisers and soil conditioners and can improve soil physical characteristics, stimulate soil biology and enhance the soil chemistry.

The effectiveness of manure as a fertiliser deposited by cattle on pastures depends on how quickly the manure decomposes. Soil biology commencing with dung beetles and earthworms play a crucial role in this nutrient cycling process.

Poultry manure accessed by farmers is generally deep litter manure that varies in composition depending on its age and the type of litter that it is composed of. Generally speaking poultry manure is higher in nitrogen than other animal manures as poultry excrete liquid wastes along with their solid wastes.

Nutrient content of some manures and composts

Typical nutrient analyses (dry matter basis) for animal manures (average and ranges-DEPI)

Source	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Moisture (%)
Poultry (cage)	**3.4** (2.8 - 4.8)	**2.5** (1.9 - 4.0)	**1.5** (1.2 - 2.1)	**35** (15 - 65)
Poultry (litter)	**2.6** (1.4 - 4.2)	**1.8** (1.6 - 2.8)	**1.0** (1.1 - 1.9)	**25** (10 - 51)
Cattle	**1.5** (0.7 - 2.5)	**0.5** (0.2 - 1.4)	**1.2** (0.7 - 1.8)	**40** (9 - 54)
Horse	**1.2** (1.0 - 1.5)	**0.2** (0.1 - 0.4)	**0.8** (0.3 - 1.0)	**35** (6 - 62)
Sheep	**1.7** (1.3 - 2.6)	**0.5** (0.3 - 0.8)	**1.2** (0.6 - 2.5)	**30** (8 - 60)
Pig	**2.3** (1.4 - 2.7)	**2.3** (1.4 - 3.7)	**0.6** (0.2 - 1.3)	**60** (50 - 76)

Moisture content must be taken into account when costing the nutrients provided in organic fertilisers and when calculating the rate of the spread nutrients.

Below are some recent analyses of manures and composts sampled by the Western Port Catchment Landcare Network

	Poultry manure %	Farm made compost %	Green waste compost %
pH	6.7-7.0	7.6 - 8.2	5.8 - 8.2
Organic carbon	32.8-37.7	13.6 - 20.7	15.6 - 20.8
C/N ratio	10.8/1	9.1/1 - 13.2/1	13.3/1 – 17.5/1
Nitrogen	3.0-4.7	1.4 - 1.6	1.02 - 1.57
Phosphorus	1.5-2.1	0.36 - 0.79	0.23 - 0.37
Potassium	1.89-1.97	0.89 - 1.20	0.48 - 0.70

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Poultry manure

Using the average analysis of poultry manure provided in table above, an application of 7.5 m^3 per hectare at \$25m^3 = \$187ha would supply:

- 80 kg N, equivalent to 170 kg urea
- 55.5 kg P, equivalent to 630 kg superphosphate
- 31 kg K, equivalent to 62.5 kg muriate of potash

Nutrient management in manures

Nitrogen availability declines as manure ages due to leaching and volatilisation. Poultry manure nitrogen is more readily available than manure from other animal sources although it is far more easily leached and lost through volatilisation. Poultry manures although higher in phosphorus than composts may not supply sufficient nitrogen for the amount of phosphorus they contain. (NSW Agriculture)

It is recommended that stock should be kept off pastures for 3 weeks or more after the application of animal/poultry manures and composts. Care needs to be exercised in applying poultry manure to ensure that residues do not find their way into water courses. Application to pastures that have been recently grazed can minimise these issues as the manure will be trapped in the remaining stubble.

COMPOST

What is Compost?

Compost is pre-digested organic matter enriched with an array of microorganisms and humic materials that can enrich and inoculate your soil thus enhancing its long term sustainability. It is well balanced in the major plant nutrients and contains many essential trace elements which are slowly released as the plants require them. Compost has been demonstrated to have a disease suppression effect on a number of pathogenic organisms (Hoitink, & Kuter, 1984). Good quality compost has an earthy smell with a granular texture illustrating that all residues in the process have been decomposed.

Domestic green waste composts are generally lower in all nutrients than composts made with animal/poultry manures with a lower biological profile. Using these composts at high rates to supply nitrogen would generally make them uneconomic for use. As a soil amendment to supply organic matter/carbon would be their most important attribute.

When the compost process takes place organic matter is changed into humus and other compounds which plants can use for food.

Nutrients in compost

In compost nitrogen is stabilised in humus compounds that are not easily mineralised. Composts and manures with less than 1.5% nitrogen may struggle to supply nitrogen to crops during the first weeks of application due to the immobilisation of nitrogen in humic materials. The higher the C/N ratio of the manure/compost the more a temporary nitrogen tie-up will occur.

Compost use

Compost can be used as a soil conditioner enhancing soil health, as a high-value mulch and as a starter for the fermentation of compost teas. Surface application is generally from 2.5 -5 tonnes per hectare.

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As a soil amendment it can:

- Improve soil structure, tilth & depth
- Increase soil fertility with slow element release
- Increase soil biological activity
- Increased water infiltration and storage
- Increased cation exchange
- Increase the disease suppressive nature of soil
- Enhanced element availability
- Enhanced microbial environment
- Increased organic matter & soil carbon storage

Humic materials

Humic substances are a mixture of complex organic molecules. They make up a large proportion of the organic matter in brown coals and peat. Three principle components are recognised: Humic acid, fulvic acid and humin. Humic products are generally sourced from brown coals, peats and composts. They are used as soil amendments and often blended with a range of other nutrient and plant materials to improve the soils physical, chemical and biological characteristics.

A very comprehensive review of humic products was conducted by NSW DPI (Billingham, 2012) and in the conclusion to their document they state, "To date, sufficient field trials have still not been conducted to make recommendations to farmers about the efficacy of these products". So where does that leave the farmer? There is a strong body of anecdotal evidence that indicates beneficial effects can be seen from the use of humic substances. It is suggested that farmers undertake trials on small areas to see whether their production system will benefit from the use of such materials before wider application.

References

Billingham, K. 2012, Humic products, Potential or presumption for agriculture, NSW Department of Primary Industries

Hoitink, H.A. J. & Kuter, G.A., 1984, Role of Composts in Suppression of Plant Pathogens in Ornamental Plants, Bio Cycle, Vol.25, No.4, May/June

Chicken litter as fertiliser for broad acre grain crops
http://www.ruraldirections.com/media/Documents%202013/Chicken%20Litter%20Users%20Guide%20V4.pdf

Best practice guidelines for using poultry litter on pastures
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/140359/Best-practice-guidelines-for-using-poultry-litter-on-pastures.pdf

Introducing fertilisers http://www.depi.vic.gov.au/agriculture-and-food/dairy/pastures-management/fertilising-dairy-pastures/introducing-fertilisers

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