

Humus & Organic Matter - the essence of highly productive soils

Quality of production is based on the interaction between soil parent material and humus build up.

Humus build up varies from region to region depending on soil, climate, vegetation and in agriculture the effects of management. While we have to live within climate limitations we can influence soil inputs – both biological and mineral, physical management, and the diversity of pastures or crops we grow and how we graze them.

A common misunderstanding is organic matter (OM) being confused with humus. Indeed one contributes to the other but they are not the same. In simple terms humus may be described as the end product of OM, however, carbon supplied via plant root exudates is the primary component – the liquid carbon pathway.

A key point is that humus formation it is not an automatic process under modern agricultural practice. Humus development and maintenance is impacted by conditions, fertiliser inputs and soil management. The presence of photosynthesising plants is always required. Humus cannot be taken for granted.

Humus distinguishes quality of top soil and differentiates top soil from sub soil. It is incumbent on farming practice to enable and maintain the conditions for humification in order to retain the long term productive capacity of soils. It would be apt to call humus our natural capital, certainly it is our soil capital.

So what is humus?

Humus is a combination of liquid carbon via plant root exudates and metabolites derived from fungi associated with the digesting of OM into smaller particles. These smaller particles are then recombined into a wide variety of large molecules by the activity of yet another set of micro-organisms. The complex, diverse and stable molecules contribute to what we know as humus.

Digestion of OM is a two-step process in which the digestion of fresh OM by a community of micro-organisms provides plant nutrients including CO₂, Anions like N, P and S, Cations like Ca, K, Mg, Na, and Trace elements. Another community of micro-organisms will re-synthesise (humification) the “left over’s” into large 3D molecules forming a part of humus. Both processes of humification and mineralisation are required to feed pastures and crops contributing to soil and plant health, quality and function.

Without the processes described above OM remains just that, organic matter. Unless there is an active mineralisation and humification process OM is simply unrealised potential.

Humification – the building and maintenance of soil where soil biology (ecology) processes plant (and animal) matter into humus. This process creates the structure for air, water, micro-organisms and nutrient storage. Nutrient availability - some nutrients are made available by micro-organisms decomposing humus (1-5%). Humus (humification) is also where other metabolic substances are created and stored e.g. enzymes, secondary metabolites, vitamins, natural growth hormones.

Mineralisation – is the delivery mechanism of nutrients from soil and soil organic matter. Primarily driven by biological activity (micro-organisms) creating plant available forms but also involves chemical and weathering mineralisation.

Organic matter mineralisation rates:

1. Fresh organic matter – 50 to 70% per year
2. *Dynamic (active) organic matter – 30 to 50% per year
3. Humus – 1 to 5% per year

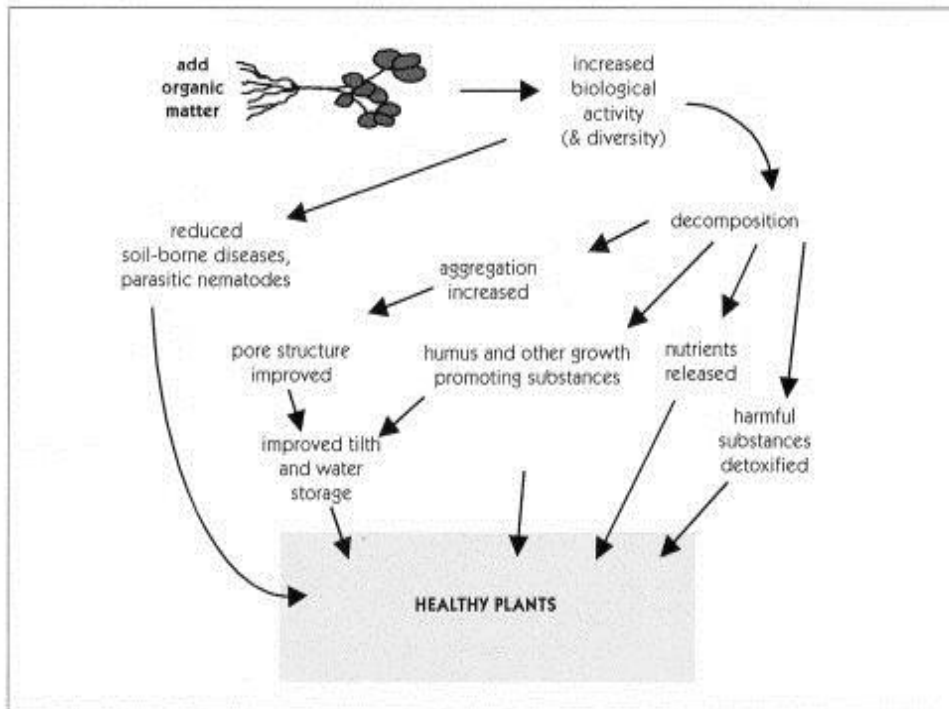
*Dynamic or Active organic matter is the transition phase where the parent material is no longer recognisable

Source: Frank van Steensel (M.Ag.Sc) www.ecodynamics.co.nz

What does humus do?

Humus provides stability through complexity in soil, and as a spin off, in the plant. Humus buffers levels of extremes, e.g. extreme weather conditions, harsh or large inputs or actions. Humus secures the proper distribution of water, air (oxygen and CO₂), warmth, food (plant roots and soil micro-organisms), buffers pH against extremes and sequesters carbon captured from plant material, water and atmosphere (micro-organisms).

Fig 1 Modified from Oshins, 1999.



Humus is also where metabolic substances are created and stored such as enzymes, secondary metabolites, vitamins and natural growth hormones. See fig 1.

If humus levels go down so will the diversity and amount of micro-organisms that provide plant nutrients and feed the humification process. This reduction in plant food supply will result in a downward spiral first affecting plant health, then animal health and produce quality. Generally this downward spiral is masked by increasing amounts of fertiliser inputs to secure production levels and agri-chemicals to treat symptoms.

How do we balance digestion of OM and humus build up?

We need to provide water, air, food via plant roots and soil (micro) organisms, appropriate pH and balance the cation minerals. Soil structure maintenance is required and contributing to this are diverse pasture species or inter-row crops providing a variety of plant root systems. Functionally available calcium and phosphate is required by the soil/plant energy system which can be provided by an integrated biological input, mineral and management plan.

The role of soil biology in the maintenance and enhancement of humus is now well recognised in science.

Farmers who adopt a holistic approach to their farm management whereby they correctly observe and connect nature's organic (carbon) cycles with appropriate mineral and physical management are best placed sustain soil performance while maximising nutritive quality of their produce.

Building humus represents an investment in natural capital, the soil and is applicable to all farmers.

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