HOW HUMIC ACIDS IMPROVE

SOIL FERTILITY, INCREASE DROUGHT–RESISTANCE & BOOST PLANT GROWTH AND HEALTH

A whitepaper by Advanced Nutrients

ABSTRACT

A great deal of uncertainty has reigned over the proper role of Humic acids in a managed nutrient supplement process to improve crop yields with many exaggerated claims being made by marketers.

This paper examines the evidence and reveals how Humic acid functions best as a bio-catalyst that improves soil organic matter (soil fertility) and improves the uptake of traditional fertilisers.

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EXECUTIVE SUMMARY

Marketing literature often boasts that nurturing a humate-rich environment — through the application of Humic and Fulvic acids — is the best way to convert key nutrients into usable forms that drive healthy crop growth and boost yields.

This paper examines the evidence and reveals how Humic acid functions best as a bio-catalyst that improves soil organic matter (soil fertility) and improves the uptake of traditional fertilisers.

Some the key findings about Humic acids in this whitepaper:

- Humic acid derived from Leonardite is particularly effective.
- Leonardite, a highly oxidised form of organic matter, is among the richest sources. It contains up to 90% Humic acid.
- Humic acids provide physical improvements to soil, chemical benefits and biololgical ones. All of these interact to improve fertiliser effectiveness and crop health.
- Humic acid improves soil aggregation in both clay and sandy soils.
- Australian soils tend to be low in carbon and humus. Adding Humic acid can increase water retention, and prevent soil cracking improving drought and heat-stress resistance of crops.

Humic acid — a key component of soil humus

When plants and animals die and decompose, the final residue is humus —organic matter that plays a significant role in the moisture and nutrient retention of soil.

Among other substances that naturally occur when plant and microbial matter breaks down, soil humus contains a concentration of organic acid radicals. Humic acid (composed of Humic, Fluvic and Ulmic varieties) is the collective name for these acid radicals.

Humic acids are full of energy — as much as 5,000 calories per gram — and this energy-holding capacity makes them a key building block of fertile, productive soil.

Why is humic acid important in agriculture?

Humic acid is, technically, not a fertiliser. Evidence indicates that it does not directly provide nutrients to plants. However, it does function as complement for many important fertilisers (such as nitrogen-delivering urea) — improving their efficiency and reducing nutrient leachage.

Agronomists now recognise that Humic acids have a beneficial effect on the growth and cultivation of crops (vegetable and non-vegetable) — particularly in organically-deficient soils.

In fact, Humic acids perform a number of functions within the soil that are beneficial for agriculture.

1. Physical improvements that promote agglomeration in sandy soils, and open up compact clay soils, both of which improve soil wetting and water penetration and retention.
2. Chemical benefits that boost the soil's nutrient- and water-holding capacity, free-up inorganic soil-bound nutrients and provide a buffer against fertiliser-driven pH changes.
3. Biological improvements through increasing the carbon composition of the soil, and stimulation of beneficial fungi and bacteria.

Although this paper examines these properties individually, it is important to emphasise the dynamic and interactive nature of the soil system. Changes in one are often likely to affect other soil properties as well.

As a result, Humic acid concentrates have become an invaluable soil supplement for those who grow crops.

Not all Humic acids are equally beneficial

Humic acid is primarily found in manure, peat, lignite coal, and Leonardite. Leonardite, a highly oxidised form of organic matter, is among the richest sources. It contains up to 90% Humic acid.

Numerous researchers have proven that not all Humic acids provide the same value and benefits to soil fertility. This is because the raw source and method of extraction plays a crucial role in determining the level of beneficial effect.

Humic acid derived from Leonardite is particularly effective —rapidly accelerating microbial action to lock up and retain carbon in soils. In fact, Leonardite ore has proven to be the most beneficial raw material, and combination pH extraction followed by purification and concentration the most valuable extraction method.

Natural Sources	Content of Humic and Fulvic Acids in % (from - to)
Leonardite/Humate	40-85
Black Peat	10-40
Sapropel Peat	10-20
Brown Coal	10-30
Dung	5-15
Compost	2-5
Soil	1-5
Sludge	1-5
Hard Coal	0-1

Soil aggregation and moisture retention

The most desirable type of soil in agriculture is a sandy clay loam – pore spaces of varying size absorb water rapidly, yet also have high water-holding capacity and allow roots to easily penetrate and grow.

Texture	Total Water (in/ft)	Available Water (in/ft)
Sand	1.2	0.9
Sandy Loam	1.9	1.3
Fine Sany Loam	2.5	1.7
Loam	3.2	2.0
Silt Loam	3.5	2.1
Sandy Clay Loam	3.7	2.1
Clay Loam	3.8	2.0
Silty Clay Loam	3.8	1.7
Clay	3.9	1.5

Clay soils have a large total pore space between molecules, but mostly these pores are very small. As a result, water is held too tightly for deep infiltration, and plant roots cannot penetrate the clay to extract either the water (or nutrients) needed for growth.

Humus combines with clay minerals to form naturally friable units called aggregates. When applied to clay soils, Humic acid helps break up these compacted soils, enhancing water penetration and improving root zone growth and development.

On the other hand, sandy soils have relatively few pore spaces that are comparatively large. Water readily penetrates but also drains away rapidly, often carrying vital nutrients with it. Humic acid adds organic material and bulk to sandy soils, reducing water runoff and reducing leaching of vital plant nutrients.

The level of organic matter, and its biological activity has the greatest influence on aggregation. Microbes produce the gluey substances that bind soil components into stable aggregates. Any means of promoting organic matter and reducing the impact of machinery tillage will aid aggregation.

Bkardwaj and Gaur (1972) found that humic acid as sodium humate and fulvic acid had a marked growth stimulating effect on Rhizobium trifolu. The maximum effect was at 500 mg/litre.

Improved crop drought and heat resistance

The water-retaining capacity of many soils is proportional to their humus content. That is, when humus increases in the soil, so does the soil's ability to hold water.

Humates can hold up to 20 times their weight in water, and research shows that every 1% of organic matter can hold 0.5ML/ha/m.

Humate also prevents soil cracking, which exposes roots to the air and can cause crops to burn in severe heat conditions.

In one 1986 trial (Xudan), when wheat plants were subjected to drought stress at head development stage, grain yield by untreated plants was depressed by 30% compared to the irrigated control. However, plants treated with fulvic acid suffered only a 3% yield loss compared to the irrigated control.

Humic acids have a beneficial effect on soil, relating to the production and formation of organic matter and soil structure, which helps drought proofing. They increase water holding capacity, reduce the need for crop irrigation and protect against drought.

This can be especially helpful for Australian soils, which tend to be poor in carbon and organic matter.

Promoting reproduction of beneficial soil microbes

Healthy, productive soil is full of root zone microorganisms that perform all sorts of vital tasks that are crucial to sustainable soil and plant growth.

Humic acid is proven to stimulate rapid growth and proliferation of these desirable micro-organisms.

They solubise vital nutrients (including phosphorous, nitrogen and potassium). In this soluble form (and only in this soluble form) can then these nutrients be absorbed by the Humic acid and then become available to crops.

Trace nutrients are also converted into crop-usable forms in the same way. Humic acids also provide more sites for microflora to colonise, creating a virtuous cycle of growth.

One 1997 study (Vallini et al), investigated the effect of Humic acids on activity and growth of two bacteria: Nitrosomonas europaea and Nitrobacter agilis.

Humates derived from compost-stabilised vegetable waste or Leonardite were added to the culturing medium.

The study found both types of Humic acids increased either NH_4^+ or NO_2 oxidation and cell growth of nitrifying bacteria.

By combining these results with data from a comparative growth evaluation of N. agilis, they concluded that nitrifiers cannot use humic acids as an alternative carbon and energy source. Instead, they attributed the stimulating effect of humic acids on these bacteria to an increase in microbial membrane permeability favouring a better utilisation of nutrients.

Humic acid improves the yield on synthetic and organic fertilisers

As mentioned, Humic acid is not a fertiliser. However, it is an excellent bio-catalyst that complements synthetic and organic fertilisers. In many instances, the use of Humic acid reduces the need for fertilisation — all because it improves the soil and crop's ability to make better use of it.

One 1995 study (Wang et al.) analysed the effect of Humic acids on the transformation of phosphorus fertiliser.

Humic acids and phosphorus fertiliser were added to the soil, soil phosphate levels were analysed at four and 15 days later. Phosphate in the soil and in the crop was determined at heading stage and at maturity in a pot experiment, while wheat yield was examined in a field trial.

The study revealed that Humic acids combined with Phosphorus fertiliser significantly increased the amount of water-soluble phosphate, strongly retarded the formation of occluded phosphate, and increased the phosphate uptake in the crop by 25%.

Humic acid improves plant health, growth and yield

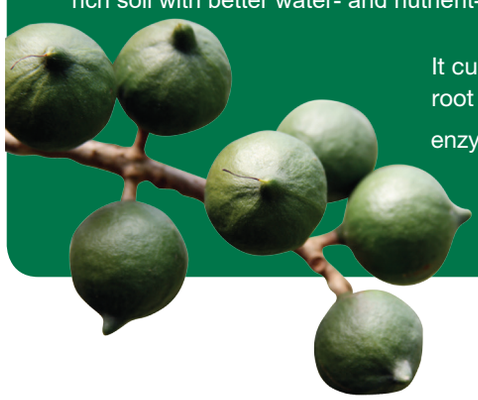
Soil scientists now hold a more holistic view and at least recognise that humus influences soil fertility through its effect on the water-holding capacity of the soil.

Since plants have been shown to absorb and translocate the complex organic molecules of systemic insecticides, they can no longer discredit the idea that plants may be able to absorb the soluble forms of humus; this may in fact be an essential process for the uptake of otherwise insoluble iron oxides.

A study on the effects of Humic acid on plant growth was conducted at Ohio State University which said in part "humic acids increased plant growth" and that there were "relatively large responses at low application rates".

ENHANCE MAX™ — SIMPLY A BETTER HUMIC ACID

Enhance Max™ is a Tech Grade Humic Acid extracted from Leonardite using pH combination extraction. Packed with the Organic acids, vitamins, mineral and non-ionic surfactants, it encourages rapid growth of the beneficial soil microbes that boost soil health and fertility, and create a naturally rich soil with better water- and nutrient-holding capacity.



It cultivates a naturally aerobic soil environment that keeps soil and root pests at bay. And it contains plant growth hormones and enzymes that foster stronger, healthier root systems.

This improves nutrient-use and water uptake for consistently better yields, and reduced fertiliser waste.

Three questions you should always ask before purchasing Humic acid

Not all Humic acids are the same. Here are three questions that growers should ask before investing their hard-earned capital in any Humic acid supplement.

1. W**hat is the raw material it was derived from?** Some humic sources are better than others. Leonardite is generally regarded by scientists as the highest-quality source of humic substances.
2. **What was the process used to extract the Humic acid?** Some extraction processes are more efficient. Look for Humic acid that has been extracted using combination pH extraction, followed by purification and concentration.
3. **The ratio of acids is important.** Analysis is an important factor, but the ratio of the base acids, ie Humic, Fulivc, Olmic and Amino in the Humic Acids is key to performance. Ask for one that contains all the base acids.

Contact us to trial Enhance Max on your crops

We hope you've found this whitepaper both interesting and useful.

If you'd like to learn even more about Humic acid, or explore the potential for a trial on your crops, so you can see for yourself how it measures up — both in terms of reduced inputs, and increased yields and profits — contact us at - **service@advancednutrients.com.au** or call **- 1800 244 009.**

References

Michael Karr. 2001. Oxidized Lignites and Extracts from Oxidized Lignites in Agriculture.

Evelyn S Krull, Jan O Skjemstad, Jeffrey A Baldock. Functions of Soil Organic Matter and the effect on soil Properties. CSIRO Land & Water and CRC for Greenhouse Accounting.

RL Mikkelsen. 2005. Humic Materials for Agriculture. Better Crops Volume 89.

Crow Miller. 2000. Understanding the Carbon-Nitrogen Ratio. ACRES. A Voice for Eco-agriculture.

Gary Murdoch-Brown. 2002. Drought – Aid from Humic Acid and Microbes. Advanced Nutrients.

Gary Murdoch-Brown. Soil Organic Carbon and Its Critical Role: A Review of the Literature. Advanced Nutrients.

New AG International. Humic and Fulvic Acids: The Black Gold of Agriculture?

About Advanced Nutrients

Advanced Nutrients is a leader in the development of innovative, environmentally Enhanced Efficient Fertilisers, Bio-stimulants, Irrigation Line Cleaning & Water Conditioning products which cost less and deliver more.
For the last 23 years, smart agricultural, horticultural and livestock producers throughout Australia, Africa, Asia and the Middle East have been using our products to cut input costs, boost returns and reduce farming risks.

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