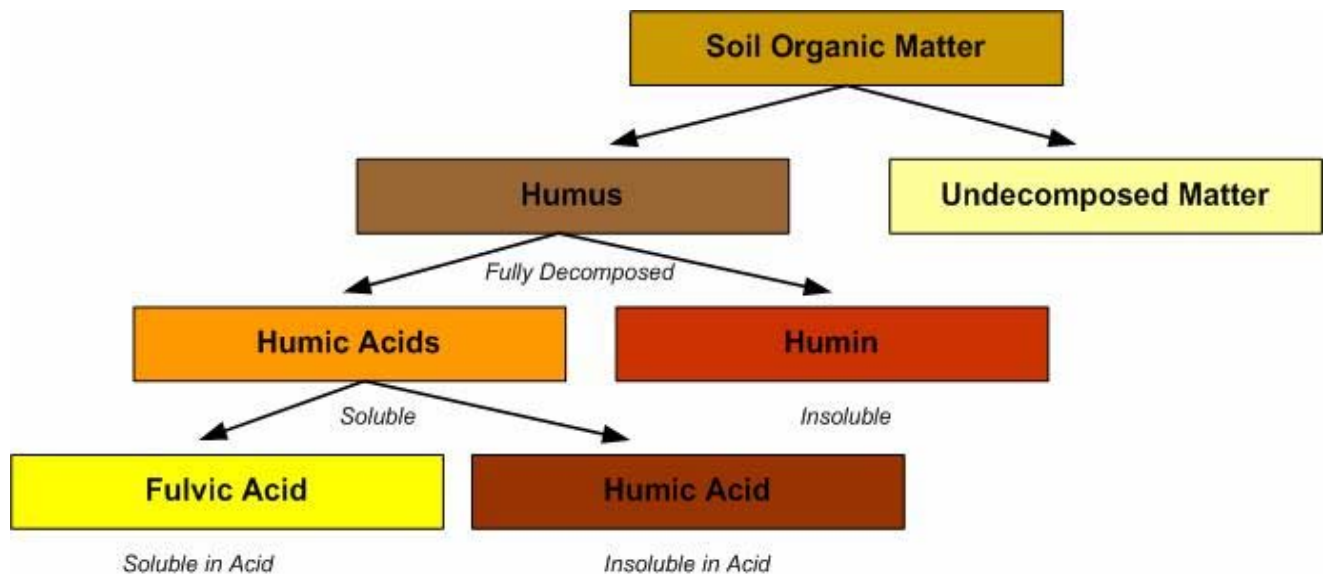


WHAT ARE HUMIC AND FULVIC ACIDS?

- The benefits of Soil Organic Matter to plant growth has been recognised for centuries as being the major contributor of plant nutrients. Soil Organic Matter is very rich in many elements, including significant quantities of humic acids.
- Humic acids can be concentrated by their extraction from decomposed organic matter for use in all agricultural crops through fertigation and foliar sprays.
- Humic and Fulvic acids (humates and fulvates) are associated with significant improvement in plant shoot and root growth.

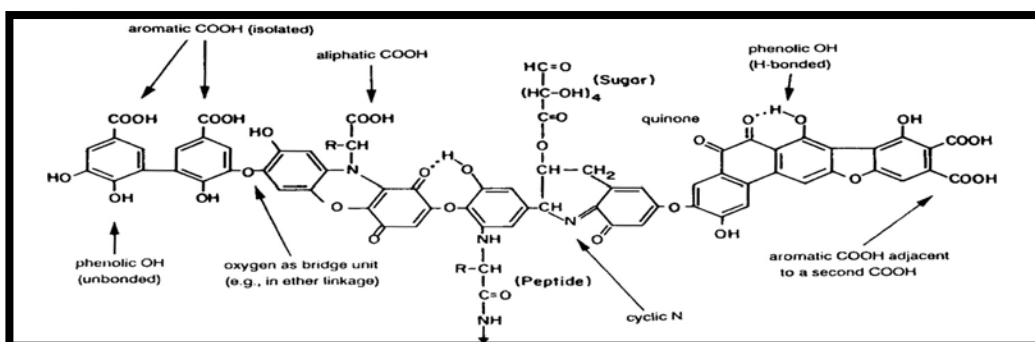
THE MAKE-UP OF ORGANIC MATTER



WHAT PROPERTIES OF COMMERCIAL HUMATES ARE IMPORTANT FOR AGRICULTURE?

- A component of humic and fulvic acids
- High total organic carbon percentage
- Number of associated functional groups
- Percent associated carboxyl groups
- High total amount of available nitrogen

HYPOTHETICAL STRUCTURE OF HUMIC ACID



WHY APPLY HUMATES??

Humates benefit plant growth through their:

- **Increased fertiliser efficiency.** Humic acids bind to soil nutrients and hold them in a plant available form— this reduces fertiliser leaching.
- **Nutrient carriers**— Fulvic acids are smaller than humic acids. They are small enough to bind to soil nutrients and enter the plant system by reducing the permeability of the plant cell membrane carrying nutrients right into the plant system.
- **Chelation with trace elements**- both humic and fulvic acids are charged molecules with a large surface area to which many plant essential trace elements such as calcium, manganese and zinc can bind and remain plant available.
- **Increased water holding capacity**— Humic acids can hold up to seven times their weight in water. When they are soil applied more water can be held in the root zone.
- **Increased microbial development**— Humic acids stimulate the microbial environment.
- **Removal of heavy metals and reduce nutrient toxicities**- Humic acids can bind to heavy metals and nutrients that are at toxic levels and reduce their availability to the plant.
- **Increase root and shoot growth and reduce time to germination**— Humic acids are known to effect root and shoot growth and can reduce germination times. BioHumates greenhouse trials indicated that humate application with the 12% solution resulted in statistically significant increase lettuce yield and increased barley tiller number.

All of these benefits result in increased yield and more sustainable farming practices!!

COMPARISONS WITH EXISTING PRODUCTS

MATERIAL	Acid Group content mmol/ml	TKN %w/v	Humate wt%	Fulvate wt%
BioHumates Potassium Humate 12%	0.87	0.33	9.3	1.9
OMNIA 18% K Humate	0.71	0.13	9.5	1.7
Nutritech Humatech Liquid Humus	0.5	0.17	8.4	0.86
Chalmers TriHumic 12%	0.49	0.14	5.6	0.79

The BioHumates advantage

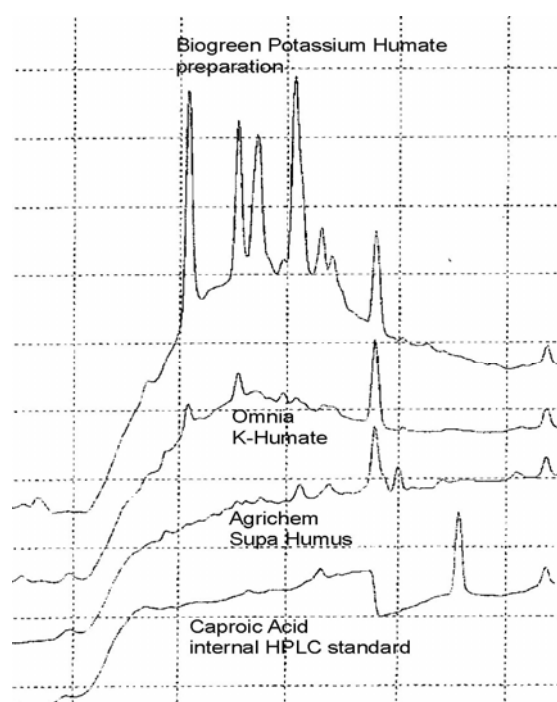
BioHumates Potassium Humate 12% has a high percentage of humate and fulvate and organic carbon compared to existing products.

What is important when comparing humic acids?

Carboxyl Group Content- Carboxyl groups are the most important functional groups associated with humic substances. They are involved in most of the chemical activity. Carboxyl groups account for the majority of humic acids charge behaviour, acidity, and metal / surface binding characteristics.

Acid group content- indicates the level of anions bound to the humic structure. Anions bound to the humic structure remain in a plant available form. Higher acid group content indicates better nutrient uptake and plant growth.

TKN= This parameter is the total N available to plants associated with the humic structure. A higher N value indicates higher biological efficacy and an enhanced microbial environment resulting in increased mineralisation and greater nutrient availability.



The spectra above indicates BioHumates Potassium Humate 12% preparation is enriched in fulvic acids relative to other humic solutions. Also, the BioHumates humic acid has more functional groups associated- resulting in increased fertiliser efficiency.

MATERIAL	Solids wt%	Ash wt%	Carboxyl (as a % of C) wt%	Predominant Functional Group	TOC %w/v
BioHumates Potassium Humate 12%	17	6.1	15	Alkyl, Aromatic, O-alkyl, Carboxyl	6.1
OMNIA 18% K Humate	19	5.9	10.7	Alkyl, Aromatic, Carboxyl	7.6
Nutritech Humatech Liquid Humus	12	2.4	9.6	Alkyl, Aromatic, O-alkyl	6.9
Chalmers TriHumic 12%	9.7	3.1	10.1	Alkyl, Aromatic, O-alkyl	4.5



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