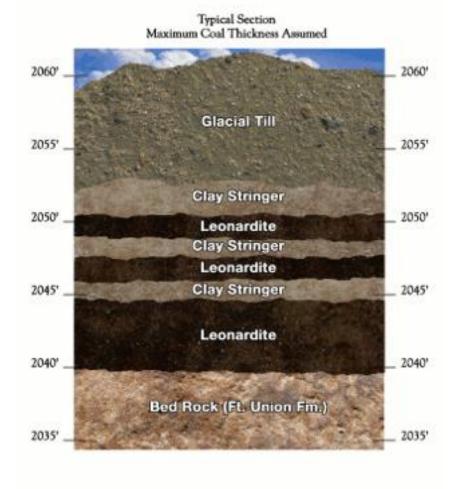
Differences between raw humate and processed humates (wet chemistry)

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Historical Perspective



For millions of years, trees, shrubs and grassland acted as solar panels capturing sunlight particles (photons) and converting it into the flow of electrons. This has provided energy for the conversion of CO2, H2O into sugars and starches



Because of geological, geophysical, geochemical and other environmental phenomenon, these trees and shrubs buried with different sediments and some change to coal, some to lignite and others into highly oxidized lignite that we call Leonardite.

HOW H.S. ENHANCE CROP PRODUCTION



According to Dr. Chucko (2008) these materials (Lignite-Leonardite-coal...) are the universal depot of carbon and energy and also possess a big biological potential that makes them an energy source <u>ATP</u> for biosphere.







According to many researchers from USA, Germany, Canada, Russia and Spain these materials are biologically refractory (means microbes can't degrade them easily) and chemically very reactive.

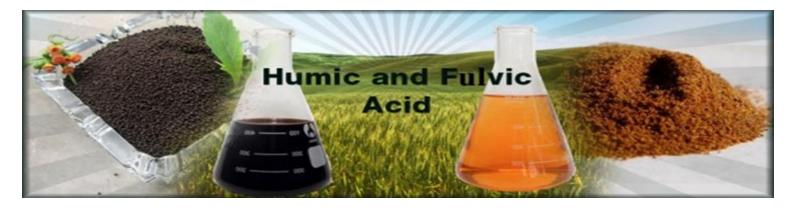
Concepts of Leonardite

Often the term used in the literature for oxidized lignite is leonardite. Leonardite is actually a particular geologic deposit of oxidized lignite in North Dakota but has often been misapplied to lignitic deposits found elsewhere. (M. Kerr)

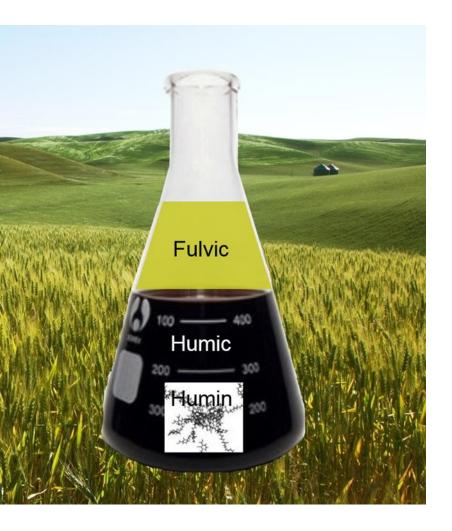


Since Humic Substances are comprised of extremely large molecules in the natural material; carbon bonds (-C-C- and –C=C-) must be "destructed" within the H.S. These bonds are broken by hydrolysis in alkaline, acidic, oxidative and reducing media.





- Humate is a common term used for humic and fulvic acid and humin.
- The term humic acid which is the alkali soluble but acid insoluble portion of a source of humic substances.
- These alkali extracts include the acid soluble portion (fulvic acid) component.



- In order to make fulvic, we use HCl acid to separate the fulvic from humic.
- Humin is the alkali (and acid) insoluble portion of H.S. that many manufacturers throw away, but some are able to extract and use it.

Comparison Dry vs. Processed Hydrolyzed Humates (Wet Chemistry)

Dry ore or leonardite is contain many functional groups that are nonionized within its own large molecules.

There are different companies using different types of dry humate from different sources.

Some spray dry with potassium hydroxide (hydrolysis or wet chemistry)

Some use dry with urea to make more effective.

Some use pure raw leonardite.

Raw Material Humate Substance

It takes longer for dry lignite/leonardite to be broken down and functional in the soil unless the purpose is long-term carbon sequestration.

In general, applying any source of carbon in the soil is beneficial for soil health and crop production.

Realistically, the main question is collectively which form is more functional for fertilizer and water-use efficiency, soil and plant health?

Hydrolysis or Wet Chemistry

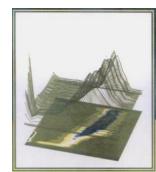
According to many researchers and I.H.H.S. in order to make functional groups more active, they use hydrolysis methods; alkaline, acidic, oxidative and reducing media...

Numerous publications shows the efficacy of hydrolyzed humates, (humic and fulvic acids, humin) influence soil health, fertilizer/water-use efficiencies and crop production.

How do they work? These are the functional groups in Humates

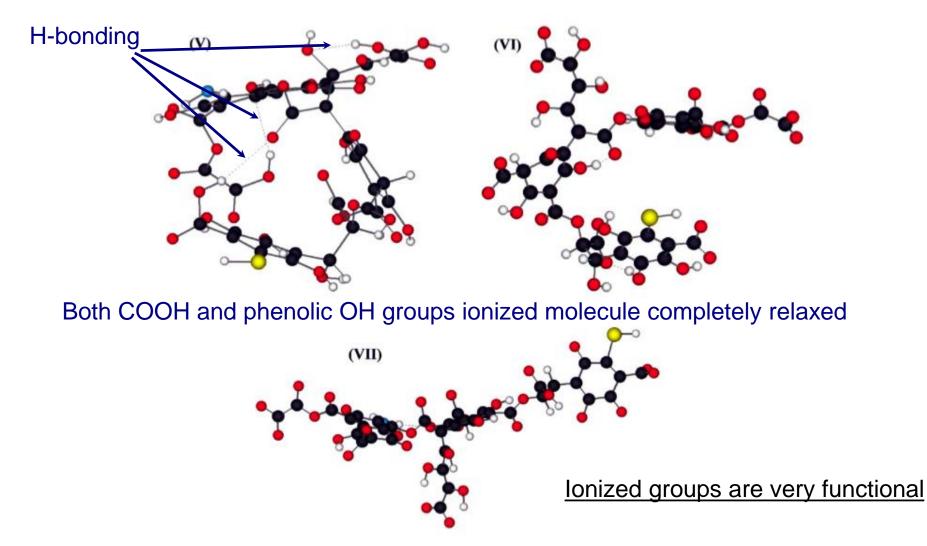
Carboxyl	-CO2H	
Phenol	-OHp	
Hydroxyl	-OHa	
Ketone	-C=O	
Ester	O=C-O-R	
Ether	-C-O-C-	
Amine	-NH2,-NH, -N	

Using hydrolysis methods, we replace Hydrogen and make them more functional, enhancing CEC, buffering, chelation, and complexation.

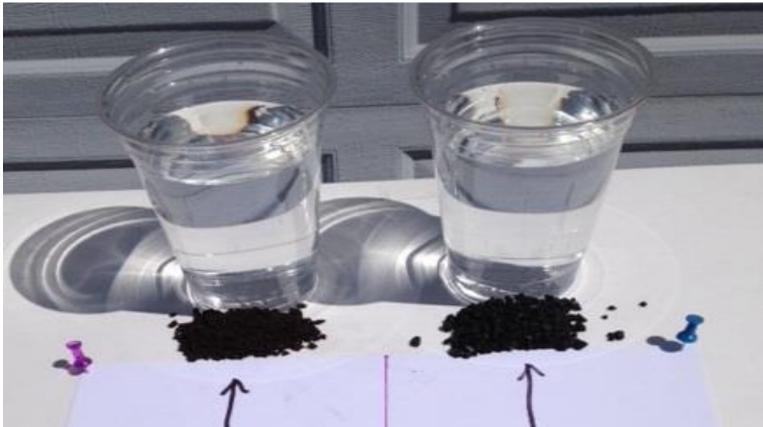


Comparison of non-ionized and ionized functional groups.

Non-ioinized-tight conformation COOH groups ionized-molecule begins to relax



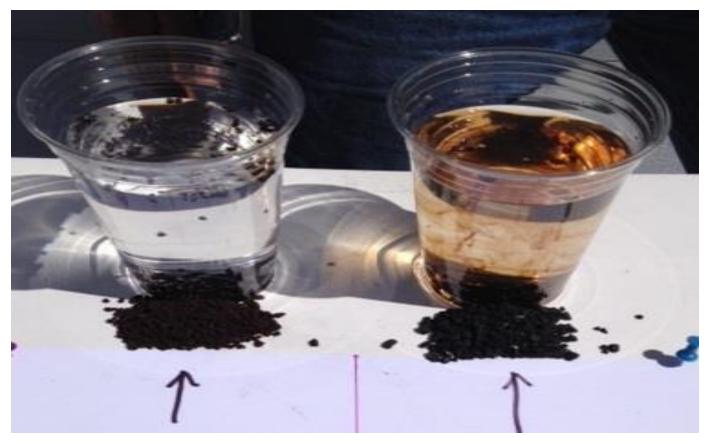
Evaluating Solubility Factors



Raw Humate

Wet chemistry Spray Dried Powder then granulated Humate

30 seconds later



Raw Humate

Wet Chemistry spray dried powder then granulated Humate

Solubility Index



Raw Humate

Wet chemistry spray died powder then granulated Humate

Reality check???

What percentage

of harvested crops, fruits, vegetables etc... are made of C-H-O?

Plant Composition

Content %

C, H, & O = 96.6%

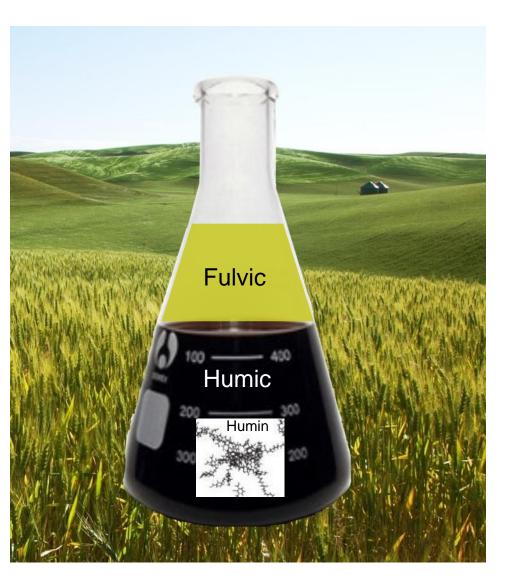
C O H N K Ca P S Mg The ionized functional groups will help soil physical chemical, and biological **dynamics**



It will make more micro-pores where roots, water and nutrients reside.

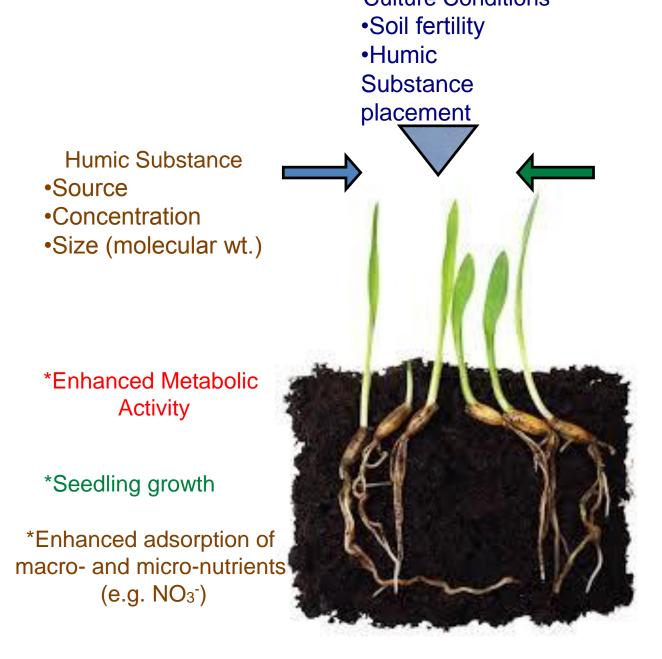
- Micro Pore Space
- Macro Pore Space
- Organic Matter
- Chemicals

The 5-R's of Nutrient Stewardship

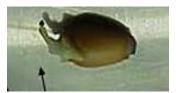


- Right Fertilizer
 Right Rate
- 3. Right Time
- 4. Right Place

5. Right Humic, Fulvic or Humin chemistry



Plant •Species •Age



*Seed Germination

*Shoot Development

*Root Initiation and Development

H.S. Dynamics in Plant Growth and Soil Health

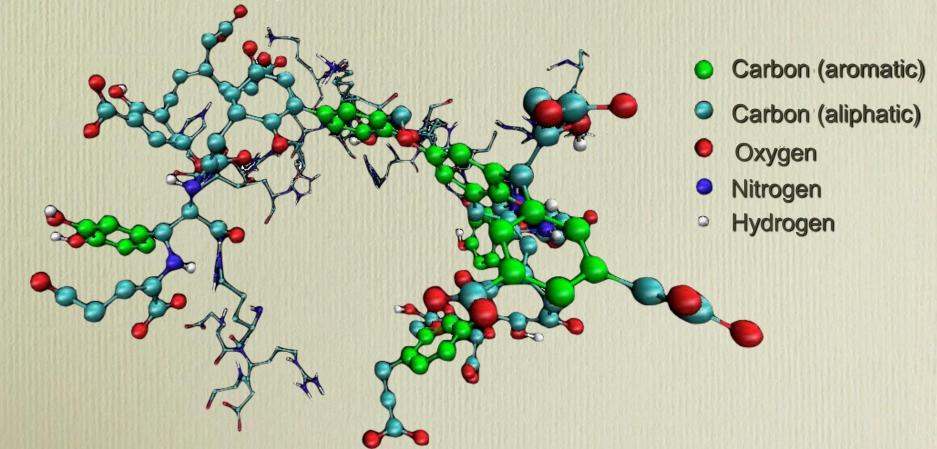
Interactions of soil minerals, Humic Substance and microbes

Physical: organo-mineral complexes and water infiltration

Chemical: soil solution chemistry, complexation-chelation and buffering

Biological: microbial activation, soil food web

Plant Stimulant Properties



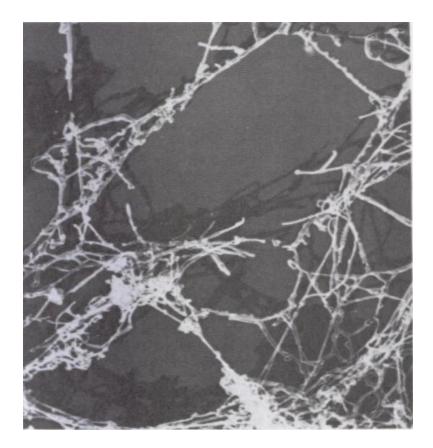
Soil Particles & HS in Perspective

Particle type	Diameter (mm)	Number of Particles/g	Surface Area Sq.cm/g
Very course sand	2.00-1.00	90	11
Course sand	1.00-0.50	720	23
Medium sand	0.50-0.25	5,700	45
Fine sand	0.25-0.10	46,000	91
Very fine sand	0.10-0.05	722,000	227
Silt	0.05-0.002	5,780,000	454
Clay	<0.002	90,300,000,000	8,000,000

Relative comparison .005 mm = 5,000 nanometers

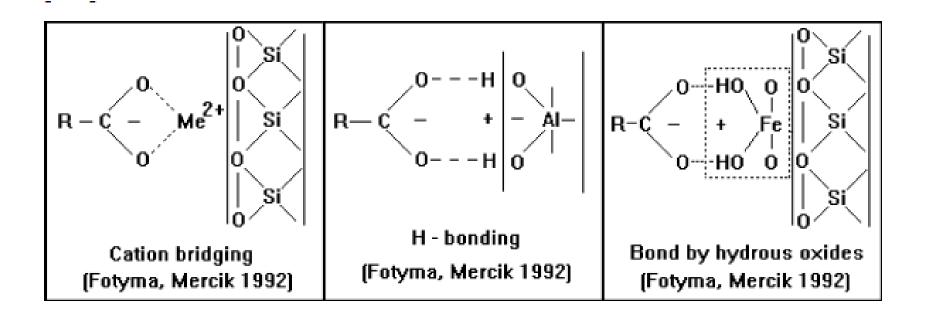


Particle size dynamics of Humic Substance And how they create organo-mineral complexes

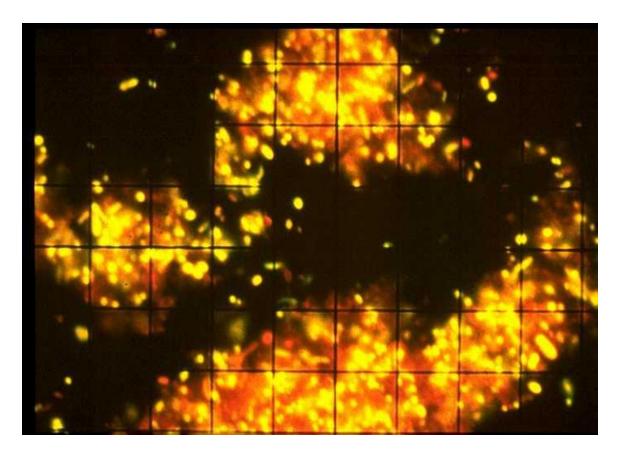


Transmission electron micrograph of a 0.01% (w/v) HA solution. The scale: 0.4 cm = 1 μ m. HAs and FAs form flat elongated multi-branched filaments of 20 to 100 nm in width. Smallest particles are spheroids of 9-12 nm in diameter.

How the ionized functional groups interact with the soil particles and other elements



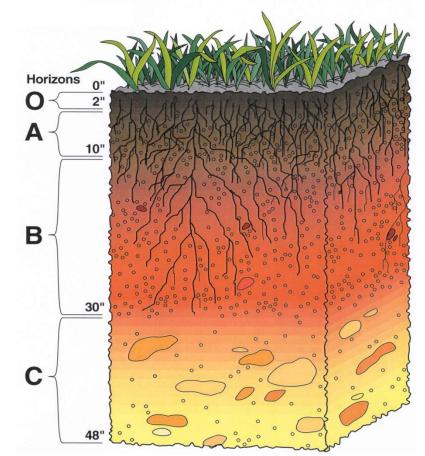
Humic Substance INFLUENCE SOIL HEALTH



Soil microbes inhabiting the surface of clay-humus crumb, glowing under UV light, stained with acridine orange, as seen under a high-resolution Leitz microscope.

These physical bondings will create good aggregate





Summary of Research Findings

1. SOLUBILIZATION OF MICRONUTRIENTS (e.g. Fe, Zn, Mn) & SOME MACRONUTRIENTS (e.g. K, Ca,P)

- 2. Buffers salts, reducing burning
- 3. Forms a bond with fertilizer preventing "Tie-up"
- 4. Increase crop production by 10-40%
- 5. Enhance plant nutrient translocation
- 6. Accelerate the ripening period 5-10 days



Summary of Research Findings

- 7. Enhance soil & plant health
- 8. Increase water sequestration by 11%
- 9. Decrease the content of nitrates and other harmful substances in fruit & improves nutritional quality
- 10. Increased plant's resistance to disease, frost damage and drought



THANK YOU

