Effects of Humic Substances on Soil

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Can Humic Acids Fix Oil and Salt Damaged Soils?

By Michael Martin Meléndrez – Founder and Managing Member of Soil Secrets LLC

The terms Humic substances, Humates, Humic acids and Humus are often used interchangeably in the industry of agriculture. Within these substances there is thought to be another organic chemical called Fulvic acid, which has many claims of benefits concerning agriculture and human health associated with it. Humate has a more technical description in the field of geology, but in the business of agriculture for those selling and purchasing these materials, the term is basically used to describe the geological ore that remains after coal has been ruined as a fuel source by oxidation, where most of the calorie or BTU value has been lost. In geology this ore is called Oxidized Lignite. The Leonardite ore of the Dakota's is the same thing as the Humate of Utah and New Mexico, with both being Oxidized Lignite, and with both having a polymorphic representation of minerals and Humic Acids. In the opinion of this author and after taking into consideration the maturation of languages over time, the term Humus is simply the common term used by the general population, while Humic substances is the term of science that is describing the same thing. They both represent the substance in its whole form as it is found in soil, while Humic acids are the theoretical extractible biologic chemicals that are found in the whole material of Humus, including the Humic acid and the Fulvic acid. I say theoretical, because the industry of manufacturing these agricultural inputs has struggled for decades with the problem of trying to extract, isolate, purify or even describe what the heck a Humic or a Fulvic acid really are. It's important to know that there is not a standardized method of analysis of Humic acids from either soil or from Humate and the methods used by every university or commercial soil lab on earth are not capable of doing an actual molecular analysis of these naturally occurring chemicals. In essence, these non standardized methods used are what science calls a **1st level operational assessment**, a nice way of saying that we are using an affordable method using affordable equipment, that gives us a value that is probably not accurate. At the present, Soil Secrets LLC is sponsoring research taking place at Los Alamos National Laboratories in New Mexico, via a Technology Transfer Program, where new methods of molecular analysis are being developed to help solve this mystery of science. With the information generated so far, Soil Secrets has developed formulations that are Patent Pending, and which the technical description of these molecular substances can be defined and described accurately. This new information will push the envelope of knowledge on

Humic substances along with the hundreds if not thousands of benefits that can be derived from them.

Claims: The following, is information on Humic substances generally accepted as true and in many cases has research data that supports the claim. While some claims may not have good evidence of science for full support, there are studies published in Journals of Science that state, Humic acids and or Humic substances are essential for a healthy and productive soil, therefore Soil Secrets does hang its hat on the merits of these substances and continues to expend financial resources studying these natural chemicals of nature down to a sub atomic level. For information purposes only, Soil Secrets is sharing with you a list of these common claims made in the industry of marketing Humates, Leonardite, Humic acids, Fulvic acids and Humus. Not all claims are necessarily those made by Soil Secrets!

General Benefits Commonly Claimed:

1. Biological – plant stimulation
2. Stimulates plant enzymes
3. Acts as an organic catalyst
4. Stimulates growth and proliferation of desirable soil microorganisms.
5. Increases root respiration and formation
6. Increases vitamin content of plants
7. Increases germination and viability of seed
8. Stimulates plant growth by accelerating cell division
9. Increases the yield or biomass production of crops

Chemical Benefits:

1. Chemically changes the fixation properties of the soil
2. Increases the buffering properties of soil
3. Rich in both organic and mono-mineral substances essential for plant nutrition and growth
4. Chelates metal ions under alkaline conditions
5. Retains water-soluble inorganic fertilizers in the root zone and releases those nutrients to plants as needed. See item # 10.

6. Possesses an extremely high ion-exchange capacity, depending on the pH of the material
7. Promotes the conversion of a number of elements into forms available to plants
8. Promotes the respiration of soil microbiology in soils that are low in oxygen (hypoxic) or lacking oxygen (anoxic). Humic acids can function as an electron acceptor!
9. Participates chemically directly, in solubilizing minerals in soil, from a formerly unavailable form into a mono-mineral plant available form. Also helps soil microbiology do the same by helping with the respiration of microbiology by functioning as an electron acceptor.
10. Can have an extremely high Cation Exchange Capacity, contributing to a soil the ability to capture and retain for plant use the cations of plant nutrition. This is particularly important when growing a landscape or crop on a soil with a low CEC, such as in sand, sandy loam, or a loamy sand.
11. Water Management in an arid climate. Some Humic substances if they have the proper chemical characteristics can help a soil retain moisture during drought.

Physical Benefits:

1. Modifies the soil, if clay by helping to improve the porosity
2. Improves the tilth and workability of soil
3. Increases the aeration of soil, improving the availability of oxygen in the root zone of plants
4. Increases the water holding capacity
5. Improves seedbeds
6. Reduces soil erosion

A little science: The use of Humic acids or Humic substances have been explored for the objective of remediating soils contaminated with oil or with salt. The oil remediation part is important news to the petroleum industry as is the salt remediation, since both salt and oil contamination issues can be part of that industry. But the benefit of salt remediation is of particular interest to me in the venue of agriculture, since salting of the soil caused by fertilizers and irrigation water has been an on-going problem across the globe. Soils

contaminated with salt are problematic and difficult to fix and may in time reach a point of cascading failure resulting in the final demise of farming in many agricultural areas. In addition, salt upsets the uptake of water by plants as water is attracted to salt, robbing the plant of moisture. As salt accumulates in the soil, or is made in the soil by the use of acid based fertilizers, the uptake of water into a plant is inhibited. Think of the ocean, 'water water everywhere but not a drop to drink.' In many parts of the world, irrigation water is a major source of salt, contributing to accumulation in the soil.

Case Study 1

Remediation of Crude Oil in Clay Soil

Method: A clay bottom pit contaminated with 38 API (American Petroleum Institute) gravity crude oil was treated with 3% dry Humic substance by weight (3 pounds of Humate per 100 pounds of contaminated soil), plus 2 lbs. of nitrogen and 5 pounds of organic matter per ton of contaminated soil. The organic matter is for a calorie rich carbon source needed by the microbiology. Lime was also added for the objective of increasing the soil pH to 9, since soil microbiology prefers a soil with a high pH, and a massive population explosion of soil saprophytic microorganism was needed to consume the hydrocarbons of the oil.

Results

Elapsed Time	Sample No.	TPH	Methodology
Initial	368	148,600	EPA 418.1
week 1	368A	107,000	EPA 418.1
week 2	368B	94,900	EPA 418.1
week 4	368C	78,900	EPA 418.1
week 5	368D	68,800	EPA 418.1

Results: The Hydrocarbons in the soil have effectively been reduced in a 5-week period by 53%. It's can be extrapolated that a reduction of 90% will required about 120 days based on the rate of hydrocarbon decomposition.

Sponsor of this study: O'donnell, Linda of the Research Project- National Oil Company (Pemex Sample), Tucan Water Works, Norman, Oklahoma, May 1996.

Case Study 2

Salt Contaminated Soil Clean Up Test

The objective of this case study was to quantify and qualify the remediation of soil that has been saturated with salty brackish water that resulted from the rupture of an Oil Battery (crude oil collection tanks). Brackish water is very corrosive to metal which can cause the plumbing and tanks in the oil fields to rot out and rupture, dumping the contents onto the surrounding land. While this is an extreme example of salt poisoning of the soil, I believe it exemplifies the potential of using the same technique in remediating agricultural soils.

Method: Soil samples for analysis were taken at several points in the salt spill area. Samples were taken from the surface, four inches deep and at 8 inches. All samples were blended together in equal number and submitted to the lab for analysis.
Humic substances rich in Humic acids were then cultivated into the soil to a depth of 6 inches, at the rate of 40 pounds per 1000 square feet. 5 pounds of organic matter per 1000 square feet was spread on the site as a source of calorie rich carbon food for microbiology. Note, Humic acids and Humic substances are rich in carbon, but they are not microbial food. The site and the organic matter were then tilled to a depth of 4 inches. The site was then left undisturbed for a period of eight weeks and then cultivated again. The test was completed and evaluated at 16 weeks.

Results

Component Value	Initial	8 day	16 week	Unit
pH	7.1	6.4	6.7	
Electrical Conductivity	62.7	54.6	43.4	Mmho./cm.
Sodium	15,570	9472	911	ppm
Potassium	746	610	67	ppm
Calcium	8060	5722	5148	ppm
Magnesium	1983	1383	1132	ppm
Na Absorb. Ratio (SAR)	40.2	29.1	3	

Results: Analysis of the above data shows a reduction in sodium of 94%, a 91% reduction in Potassium and a drop in the sodium absorption ratio from 40.2 to 3.0. Of significant interest was the 40% sodium drop at the eight-day test. Sodium absorption ratios of 12 or below generally indicate the ability of the soil to sustain salt tolerant grasses. A plot of sodium absorption ratio against time indicated the SAR level of 12 was reached at week 10 and continued to drop to a level of 3 by the end of the study at week 16. A SAR greater than 12 is too high for most plants. This grow out trial shows strong evidence that incorporating the technical material of Humic acids contributes significantly to remediating toxic levels of salt from soil.

Sponsors of this study: North Texas Oil and Gas Association, June 1995. Remediation of Salt Damaged Soils, Stallworth, W.B.