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ROLE OF HUMIC SUBSTANCES IN ECOSYSTEM SERVICES

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ABSTRACT

The soil and climate conditions have a big impact on plant nutrition dynamics. Increased salt concentrations and hazardous metals diminish the availability of plant nutrients, limiting crop plant growth. Plant nutrient availability may be improved by modifying the rhizospheric environment. As performing chelating agents, low molecular organic acids mediated nutrition access. Humic compounds are essential in fertilizer development and soil parameter change, particularly soil fertility. Humic compounds help to improve nutrient usage efficiency and soil microbial diversity, which leads to long-term crop output.

INTRODUCTION

The most common ligands found in nature are humic compounds (HS). HS were found even on the soil as at Antarctic continent. The term "humus" dates back to the Romans era referring to soil which also synonym with soil organic matter and compost as well. Sprengel published the first significant investigation of the origin and chemical composition of HS in 1839.His detailed analysis of the acidic character of HAs is often regarded as his most important contribution to humus chemistry.

TYPES OF HS

Fulvic acids (FAs), humic acids (HAs), and humin are the three components of humic substances. HAs are one of the most significant aspects of HS. Using “classical” extraction techniques using aqueous solutions, these three fractions are isolated from various materials. After treating the humic substance with a strong alkali (basic), an acid was applied. The acid precipitated a coagulated, black, sludge-like substance from the solution. The precipitate was given the term "humic acid" by the researchers. An acidic liquid and a solid were the only parts of the mixture that survived the base/acid treatment. The liquid was named "fulvic acid," and the unaffected solid was named "humin." The most common alkali

used by manufacturers to extract humic acid from leonardite is potassium hydroxide. Because the residual liquid solution is quite alkaline, with a pH of 8 to 12, because it is a salt produced by adding acid to an alkaline solution, the term "humate" may be more suitable.

WHAT IS HUMIFICATION?

Humification is the natural process of geo-microbiological systems converting organic matter such as leaves into humic compounds. Compost is a mixture of humic compounds and partially degraded organic materials that is used as a filler. Different chemicals predominate at different points as the conversion process progresses and then finally converted entirely to humic compounds.

GENESIS OF HUMIC SUBSTANCES

Humic compounds are formed in the soil through various processes during the breakdown of plant and animal remnants.

- ✓ ***Lignin theory (Pathway 1):*** Microorganisms only use a portion of the lignin, and the remainder becomes part of the soil humus. Loss of methoxyl (-OCH_3) groups with the production of O-hydroxyphenols and oxidation of aliphatic side chains to create -COOH groups are two examples of lignin modification.
- ✓ ***Polyphenol Theory (Pathway 3):*** Lignin is still vital in the synthesis of humus, but in a different way. Enzymatic conversion of phenolic aldehydes and acids released from lignin during the microbiological attack to quinines, which polymerize in the presence or absence of amino compounds to create humic-like polymers.
- ✓ ***Polyphenol Theory (Pathway 2):*** Pathway 2 is similar to pathway 3, except the polyphenols are produced by microbes from non-lignin C sources such as cellulose. Enzymes then oxidize the polyphenols to quinones, which are then transformed into humic compounds. As previously stated, many researchers now regard Waksman's classical theory to be outmoded. According to current theories, lignin-derived quinones and those produced by bacteria are the primary building blocks of humic compounds.
- ✓ ***Sugar-amine condensation theory (Pathway-4):*** The idea that humus is made up of sugars (pathway 4) has been around since the beginning of humus chemistry.

APPLICATIONS OF HUMIC ACID

a) APPLICATION IN AGRICULTURE

FERTILIZER: Humic acids have many advantages, and farmers worldwide embrace them as an important part of their fertilizer program. Humic acids are naturally occurring biochemically active andplant-responsive humic substances. They can be sprayed directly on plant foliage or applied to the soil as granules or as part of a fertilizer mix.

PLANT NUTRIENT MOBILIZATION: Increases soil fertility, organic content, effectively chelates metals, enhances soil phosphate availability, breaks up unproductive clay soils and transforms them into good soils, increases soil microorganism metabolic activity, stimulates respiration rates, increases root and shoot growth, and enhances plant root uptake of P, K, Fe, Cu, Zn, and Ca. Humic substrates also have a high capacity for base exchange, which is crucial for soil fertility. In the presence of humic elements, soil productivity is boosted in a variety of ways.

b) APPLICATION IN INDUSTRIAL

In large-scale construction, humic chemicals have been utilized. Humic substances have also been used in the manufacture of leather. Initially, they were employed as a leather dye, then as a tanning agent, and lastly, as a component of a leather finishing solution. It is also used in the furniture sector. They were used to make natural indigo, which was then utilized to color wood veneer. As a component of water-soluble stains for wood furniture, humic elements appeared to be acceptable. In addition to the paper sector, humic materials have a wide range of applications. They are used in various manufacturing processes, including the fabrication of electricity-conducting paper sheets and high-tensile-strength paper and the recycling of paper. Humic compounds have a high capacity for retaining transition metals.

ENVIRONMENTAL APPLICATIONS

Radionuclide transport agents viz; humic and fulvic acids are essential in the environment. The abundance of humic compounds in natural waters has been shown to affect the uptake of radionuclides by biological solids. Pesticides are now removed from sewage, and phenol is removed from water using humus-based filters.

c) APPLICATION IN BIOMEDICAL

The use of humic materials in medicine and biology has grown in popularity over the last few decades. The primary reasons for their growing popularity are the antiviral, fibrinolytic, anti-inflammatory, and estrogenic properties of humic acids. Commercially manufactured humic compounds are employed in veterinary and human medicine. Prophylactic administration of humic acids to rats reduced the extent of an ethanol-induced stomach injury.

CONCLUSIONS

In the realm of soil fertility management, humic acids perform better. The use of humic acid may result in the mobilization of plant nutrients such as phosphate and micronutrients that have been immobilized. These are low-molecular-weight acids that function as chelating agents, forming a compound and increasing plant nutrient concentration in low-fertility or problematic soils. These compounds have a crucial function in plant nutrient dynamics and crop yield enhancement.

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