



LINKS BETWEEN HUMIC PRODUCTS, NUTRIENTS, ORGANIC FERTILISER PRODUCTS AND AGRONOMIC PERFORMANCE

1. INTRODUCTION. WHAT ARE HUMIC PRODUCTS

Humic and fulvic acids are the most important constituents of the natural decay of plant and animal materials. Humic matter is formed through the chemical and biological humification of plant and animal matter and through the biological activities of micro-organisms.

Humic acids comprise a mixture of weak aliphatic and aromatic organic acids having high molecular weight, which are not soluble in water under acid conditions but are soluble in water under alkaline conditions. So they can be extracted from leonardite or other carbon containing mineral raw materials by solubilization under alkaline conditions.

Fulvic acids are also a mixture of weak aliphatic and aromatic organic acids having a lower molecular weight than humic acids, and, consequently, are soluble in water at all pH conditions (acidic, neutral and alkaline).

Due to their high bioavailability and low environmental impact, humic substances are considered essential fertilizing agents for an ecological agriculture. *Recent studies highlighted that uptake of major plant nutrients is mediated by humic substances. One stimulative effect of humic substances on plant growth is enhanced uptake of major plant nutrients: nitrogen (N) phosphorus (P), and potassium (K). When adequate humic substances are present within the soil, the requirement for N, P, K fertilizer applications is reduced and their uptake is boosted. In most soils the applications of humate based fertilizers is more important than applying traditional N P K fertilizers.*

2. HUMIC ACIDS AND THEIR INFLUENCE ON SOIL FERTILITY

It was demonstrated that humic substances are a good source of energy for beneficial soil organisms. Humic substances and non humic (organic) compounds provide the energy and many of the mineral requirements for soil microorganisms and soil animals. Recent research work showed that the most important function of humic substances within the soil is their ability to hold water. Humic substances help create a desirable soil structure that facilitates water infiltration and helps hold water within the root zone. Because of the large surface area and internal electrical charges, humic substances function as water sponges. These sponge like substances have the ability to hold seven times their volume in water, a greater water holding capacity than sod clays. Water stored within the top soil when needed, provides a carrier medium for nutrients required by soil organisms and plant roots. Available water is without doubt the most important component of a fertile soil.

Also, humic substances in acidic and especially in alkaline form, are essential components of a friable soil structure, such soils which contain adequate humic substances have improved workability and are thus more efficiently maintained for crop production.

3. HUMIC SUBSTANCES AND THEIR INFLUENCE ON PLANT GROWTH

Plant growth is influenced indirectly and directly by humic substances. Indirect effects, previously presented, are those factors which provide energy for the beneficial organisms within the soil, influence the soil's water holding capacity, influence the soil's structure, release of plant nutrients from soft minerals, increased availability of trace minerals, and in general improved soil fertility.

Direct effects include those changes in plant metabolism that occur following the uptake of organic macromolecules, such as humic acids, fulvic acids. Once these compounds penetrate plant tissues several specific biochemical changes occur in membranes and various cytoplasmic components of plant cells. Thus, uptake of major plant nutrients is mediated by humic substances.

As I said above, when adequate humic substances are present within the soil the requirement for NPK fertilizer applications is reduced. Another important mechanism, which maximizes fertilizer efficiency and relates to a function of humic substances, is a reduction in the toxicity and leaching of nitrogen compounds into subsoil water. Humic substances hold these major plant nutrients in a molecular form which reduces their solubility in water. These binding processes reduce leaching nitrogen into the subsoil and help prevent volatilization into the atmosphere.

4. SOURCES OF HUMIC SUBSTANCE AND THEIR VALUE AS FERTILIZER COMPONENTS

The main source of humic acids are the sedimentation layers referred to as lignite and Leonardite. Leonardite is organic matter, which has not reached the state of coal and differs from soft brown coal by its high oxidation degree, a result of the process of coal formation, and has no value as fuel. Humic acids are found in high concentration in these layers and can be extracted and highly concentrated using various methods.

Humic acids and humates are an excellent natural and organic way to provide plants and soil with a concentrated dose of essential nutrients, vitamins and trace elements. Compared to other organic products, humic products enhances plant growth (biomass production) and fertility of the soil. Another advantage of Leonardite and humic substances extracted from specific carbon containing mineral materials, is their long-term effectiveness, as they does not get consumed as quickly as animal manure, compost or peat.

Fertilizer grade humic substances can be obtained from carbon containing mineral deposits throughout many parts of the world. Within EU and, especially, in Romania there are several mines and seams of carbon containing mineral deposits suitable for obtaining good agricultural grade humic substances, humic and fulvic acids, so they can be easily extracted in high yields from these raw materials by solubilization under alkaline conditions.

The quality and value of any mined humate or humic acid product depends on many different factors. Thus not all commercially marketed humic substances are equal in quality. The real test of any humic product is in the field.

Another secondary but valuable source of humic acids is obtained by composting of organic materials. Quality of humic substances extracted from composts are influenced by the composting ingredients and techniques. Compost starting materials that contain higher molecular mass compounds such as lignins, paraffinic macromolecules, suberins, melanins, cellulose or other wood products and various polyphenols, have superior values. The length of the composting period, how the compost is turned and watered also influence the quality of compost ana the content og humic substances. Also a superior compost can be prepared by adding dry leonardite in with the plant and animal wastes. The added leonardite creates a more complete balanced of trace mineral elements required by the composting microorganisms.

5. BENEFITS OF SOME ORGANIC-BASED FERTILIZERS

It was practically demonstrated that the use of organic-based fertilizers, including humic acids and humates in sustainable agriculture, benefits farmers, growers, consumers and the environment in many ways. As empirically demonstrated, organic-based fertilizers help to:

- *boost both nutrient efficiency and organic matter content in the soil;*
- *improve the efficiency of nutrient use to produce more robust crops;*
- *facilitate the slow release of nutrients in response to the dynamic needs of plants;*
- *boost the efficiency of water use to render crops more resilient and drought-resistant;*
- *improve the efficiency of resource use by incorporating natural raw materials.*

Taking into account the new trends in the European Union, for promoting a healthy diet based on organic food, as well as increasing food safety, reducing the excessive consumption of environmentally harmful products, the specialists and researchers of our company, **HUMINTRADE SRL**, established in Romania, have developed and tested a series of organic fertilizer compositions designed to promote sustainable agriculture.

First of these, named **KALIUM HUMAT 70**, is a concentrated organo-mineral fertilizer containing 90% potassium humate, equivalent to 70% native humic and fulvic acids, and 10% potassium (expressed as K₂O), made from particulate coal material by an alkaline extraction technology, and comes in the form of a dark-brown water-soluble powder.

Specific biological activity tests carried out in order to obtain the production and marketing authorization of the product showed its efficacy particularly in crops for which it was tested, namely:

- For maize crops, under different field conditions, treated with KALIUM HUMAT 70 using 3 applications of 3 kg / ha (as a 0.5% solution in water), were obtained production increases of above 12%, compared to the same plants without fertilizer used as control.
- For potato crops, under different field conditions, treated with KALIUM HUMAT 70 using 3 applications of 3 kg / ha (as a 0.5% solution in water), were obtained production increases of more than 33% over of the same crops grown without fertilizer used as control.
- Also, preliminary tests regardind the activity of KALIUM HUMAT 70 on tomato crops are ongoing, with promising results, these tests not yet being quantified.

Another product created by our specialists, named **LEGOFERT**, is also an organo-mineral liquid fertilizer composition for foliar fertilization, containing a complex NPK composition based on mineral and organic sources, together with some essential microelements and certain organic biostimulant compositions derived from natural vegetable sources, having an appreciable content of glycyl-betaine extracted from natural source. Glycyl-betaine naturally occurs in many plants and acts as an osmoprotectant by adjusting the osmotic balance within plant cells and tissues.

Specific biological activity tests carried out in order to obtain the production and marketing authorization for LEGOFERT, using as target plants specific vegetables, such as tomatoes, sweet peppers and cucumbers, have demonstrated the efficacy of this type of fertilizer as follows:

- For tomatoes, sweet pepper, and cucumber treated with LEGOFERT using doses of 3 L / ha (as a 1% solution in water), were obtained production increases of 30-32% (tomato), 30.8-33.7% (sweet pepper) and 34.3- 36.5% (cucumber), compared to the same plants without fertilizer used as control.
- The application of foliar treatments with LEGOFERT fertilizers has stimulated the photosynthetic assimilation process in leaves to all vegetable crops. The experimental results reveal significantly increases based on the control, both for each assimilator pigment and for the total assimilable pigments content by foliar fertilization.
- Experimentally, it has been observed that the application of foliar treatments with LEGOFERT fertilizer during the critical and maximum necessity times for the nutrition of vegetables significantly influences **the content of NPK macronutrients** present in foliar metabolism. By using 3 L/ha of LEGOFERT fertilizer, were obtained substantial increases of the NPK macronutrients content in foliar metabolism, compared to the untreated control, for all treated vegetable crops. **Particularly for phosphorus, an increase of the phosphorus content in foliar metabolism of about 39-41% for sweet peppers and about 40-43% for cucumber crops was attained at a dose of 3 L / ha LEGOFERT fertilizer (diluted 1% in water), repeated 3 times, relative to the untreated control.**

6. HUMIC ACIDS MARKET OUTLOOK

For the humic acid market, agricultural application will hold the largest share in the market by 2024, due to growing inclination for organic farming especially in the developed economies. Several government grants and subsidies in different nations will further boost the segment growth. Humic substances market is projected to exceed USD 1 billion by 2024.

The market for humic acid is projected to grow at a **Compound annual growth rate (CAGR)** of 6.1% in terms of value and reach USD 624.98 million in 2026.

North America is the main consumer with highest demand attributable to U.S., where consumption is driven by high demand for pollution detoxifiers and organic electrolytes. Asia Pacific is expected to register highest demand growth owing to industrial practices being adopted in agriculture to improve crop yield. High agricultural growth in China and India are expected to be major drivers for Asia Pacific industry's growth. Increasing organic farming in European Union is projected to drive European market growth over the forecast period.

European humic acid market will have growth trends by 2024 owing to the rapidly growing regional organic sector. Funding initiatives by the government in association with the Common Agriculture Policy will propel the European market growth. The region is estimated to observe revenue more than USD 300 million in the forecast timeframe.

7. MAIN TRENDS OF THE HUMIC ACIDS MARKET

- Increasing awareness towards benefits associated with humic acids has been observed at a global level. Manufacturers of organic farming components have started producing humate based product on a large scale.
- Humic acid market will have growth trends particularly due to the demand for a wide range of applications from the sectors such as dietary supplements, horticulture, agriculture, ecological bioremediation and few others including residential farming, vertical farms, gardening, medicinal applications etc.
- Adoption of granular form is expected to increase at a significant rate in the coming years. In granular form, the humates are delivered in convenient 2-4 mm granules and constitute approximately 70% humic acids. It offers all the benefits associated with humic acid in a slow-release form thereby stabilizing inputs throughout the crop cycle. Granular humic acid is expected to deliver a **Compound annual growth rate (CAGR)** of 5.5% in the forecast period.
- For the humic acid market, agricultural application will hold the largest share in the market by 2024, due to growing inclination for organic farming especially in the developed economies. Several government grants and subsidies in different nations will further boost the segment growth.

- Development of the recycling / circular economy of organic materials will create new opportunities for humic acids. Many by-products resulted from agriculture or the food industry will require neutralization or eco-friendly valorization, and this will be done through controlled composting processes, from which will result humic substances that can be returned, especially in organic farming.
- Europe biostimulants market is expected to become the largest plant biostimulants market, globally, which is projected to witness a steady growth rate of 12.1%, during the forecast period, to reach a revenue of USD 1100.44 million by 2022.

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