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## **Lignohumate in Field Husbandry: Scope of Application**

*This paper deals with humic substances in general; particular emphasis is made on Lignohumate, humic fertilizer that acts as growth stimulant and antistress agent. Composition of Lignohumate, its functions and scope of agricultural application are considered. Furthermore, the paper describes the usage of Lignohumate as a component of composite preparations, in combination with fertilizers, plant protection agents, and biological preparations.*

### **Humic Substances**

Humic substances are the most widely-distributed organic compounds in nature. Amount of carbon bound in humic acids contained in soil, peat and coal, is almost four times as big as that bound in organic substance of all flora and fauna in the world. Humic substances constitute a specific group of high-molecular dark-colored matters, generated as a result of decomposition of organic residues in soil, through synthesis from disintegration/putrefaction products and mortified animal & plant tissues, i.e., in the process of their humification. Humic substances, however, are not mere vital functions waste; they are natural products of simultaneous evolution of mineral and biological matters throughout the earth history.

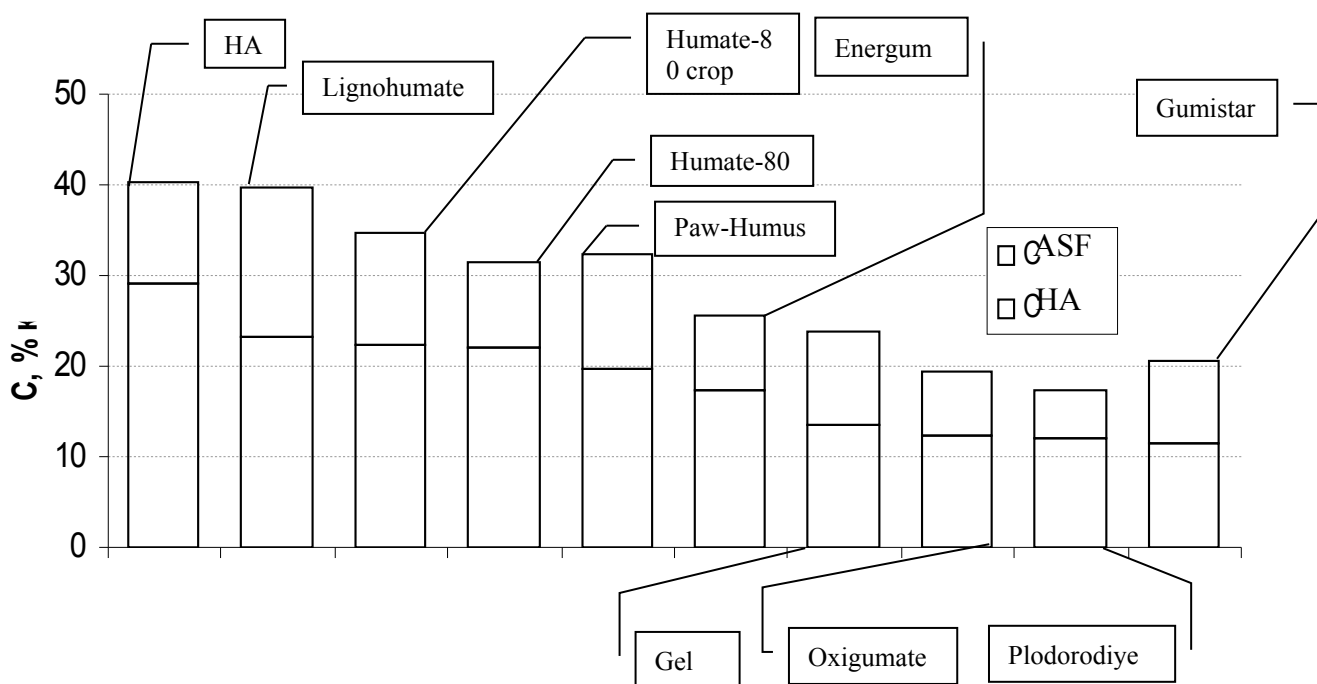
Humic substances (from Latin term Humus – earth, soil) have been discovered in 1786 by German scientist F. Achard, and for the period of over 200 years are being explored and implemented by scientists worldwide. For the last half-century, substantial contribution into humic substances studies was made by Russian and Soviet scientists, including, e.g., L.V.Christieva (Dnepropetrovsk), I.V.Tyurin, M.M.Kononova, S.S.Dragunov, D.S.Orlov (Lomonosov Moscow State University), et al.

Nowadays humic preparations (humates) are widely used in agriculture. Inherent in humates are all the useful properties of humic substances as biopolymers, viz.: high cation and anion exchange capacity; chelating capacity; ability to boost plant protective functions, their growth and development; ability to interact with soil ferments, vitamins and other substances.

Humic preparations are being commonly produced from brown coal, peat, sapropel, and other matters. Among such preparations there is Lignohumate, a product of oxidation/hydrolytic destruction of lignin-containing raw materials. Lignohumate was tested at Moscow State University (Soil Chemistry Department) together with other industrial humates at different tiers of their structural and molecular organization (preparation, associate, and molecular levels). The research revealed that HA content in the preparation exceeds 60% of organic matter (in carbon equivalent), while content of acid-soluble fraction (fulvic acids, polybasic organic acids and other organic substances) reaches 40%.

On molecular level, in terms of elemental composition, aromaticity, O/C and H/C ratios, and acidic functional groups (COOH and OH), Lignohumate, of all tested preparations, is one the most affine to soil-contained humic acids. The above groups are known to be primarily accountable for exchange capacity, chelating capacity, and ability to transport thus yielded chelate complexes to plants. Furthermore, Lignohumate is one of few preparations whose solubility approaches 100%, which makes it particularly suitable for usage in up-to-date trickling watering systems. Due to its nearly absolute water-solubility, Lignohumate is easily available for plants, and displays high biological potency even in light application, which was demonstrated by tests.

Lignohumate contains sulfonate groups that increase its surfactant capacity, including its ability to stabilize various dispersions (suspensions and emulsions), which is particularly important for its application as a component of complex tank compounds.



Courtesy O.S.Yakimenko, Lomonosov MSU, Edaphology Department, Moscow

### Lignohumate

Lignohumate is high-performance practically-feasible humic fertilizer containing chelic microelements and no ballast, that acts as growth stimulant and antistress agent. Lignohumate has wide spectrum of action onto plants. It is highly efficient for all crops of any importance.

Lignohumate application contributes into:

- increase in productivity by 10–25% (depending on crop species and agrotechnology practised);
- crop quality (wheat gluten increases by 2–2.5%, also Lignohumate application raises beat saccharinity, ascorbic acid content in vegetables, sugar content in grapes and horticultural crops);
- higher plant immunity;
- drought- and freeze-thaw resistance, primarily, via plant rootage enhancement;
- efficiency of foundation stock treatment when applied together with protectants (higher field germination rate, stronger pathogen suppression, higher plant immunity);
- stress coping, and better efficiency of foliar dressing with pesticides and complex tank compounds (stimulates plant growth and development, relaxes stress at complex treatment, stimulates photosynthesis);
- higher efficiency of mineral fertilizers (higher nitrogen and phosphorus use factor, which enables reduction in fertilizer application rate by 20–30%).

## Properties and Functions

Lignohumate performs numerous functions in biosphere, of which the most important are the following:

1. Accumulative function. It consists of accumulation of chemical elements and energy essential for living organisms. Humic substances contain 30–45% C, 40–45% H, 0.3–1.8% N, 14–16% O (atomic values), as well as sulphur, phosphorus, and a number of metallic cations, including microelements. Humic substances deliver essential nutrients to living organisms gradually, as they are being consumed, thus maintaining depot of such nutrients at sufficient level. In this respect they radically differ from many other mineral compounds with nutrition capacity.

2. Transportation function. This function means formation of geochemical flows of minerals and organic substances.

3. Protective function. This function implies humic substances' capacity to bind toxic and radioactive elements, as well as environmentally-unfavourable compounds, into sedentary or hardly dissociable matters. In particular, they are able to bind some pesticides, hydrocarbons and phenols. Protective function of humic substances is strong enough for humic-rich soils to fully prevent escape of lead ions and other toxic matters to subterranean waters.

4. Regulatory function. This function, which encompasses numerous phenomena and processes, deals with soils, waters, and other natural substances. Regulatory function of humic substances may be split into several components, viz.:

- a) Regulation of ion exchange between solid and liquid phases;
- b) Influence on acid-base and reduction-oxidation processes;
- c) Regulation of living organisms' nutritional conditions by changing mineral components' solubility;

5. Physiological function. Various humic substances, especially acids and their salts, were identified by many scientists as able to stimulate growth of animals, and enhance productivity of cattle and poultry. Moreover, humic preparations were demonstrated as capable to impede malignant neoplasm development, and enhance resistance to various inflammatory processes.

Lignohumate mineral components include both macro- and microelements. Sodium and potassium accounts for the most part (ca. 20%) of humate weight, which depends on hydroxide cation used in humate production technology. From physiological viewpoint, the main role of these elements is maintenance of favourable physicochemical conditions, viz., freeze-thaw resistance and tolerance towards changes in water relationships. For example, deficiency in potassium results in worsening of product's biochemical quality (lower starch content in potato), while deficiency in sodium promotes synthesis of simplex carbohydrates and sugar transportation from leaves to root, whereby sugar content in, e.g., beet is regulated.

Sulphur also plays important role in plant life, since it is contained in protein, vitamins, and plant mineral components. The problem of introduction of additional sulphur with fertilizers is currently discussed worldwide. In this respect, Lignohumate containing over 3% sulphur seems the best solution.

**Due to the above properties, Lignohumate found wide application in various sectors of agriculture and industry.**

## **Scope of Application**

- Field Husbandry
- Animal Husbandry
- Bioengineering
- Landscape design
- Ecology
- Cosmetics
- Medicine

Below we discuss Lignohumate in field husbandry in more detail.

### **Field Husbandry**

Humic substances promote cellular metabolism and regenerative processes. This effect is reached through activation of some ferments, which results in acceleration of oxidation-reduction processes, improvement in gaseous metabolism and tissue respiration, and suppression of free-radical oxidation in tissues. Said mechanism leads to higher chlorophyll content and photosynthesis productivity, which is a major requisite for higher crop and yield of ecologically pure products. Lignohumate applied as a component of foliar dosing compounds facilitates leaf area snowballing, and, therefore, efficient atmospheric nutrition of plants.

### **Plant Growth Stimulation**

Use of Lignohumate in field husbandry results in enhanced yield and product quality, enhanced seed germinating capacity and emergence rate; furthermore, it prevents stress upon plants due to pesticide treatment, frost or draught, boosts plant growth and development, and reduces vegetation period.

### **Lignohumate in Combination with Fertilizers**

Lignohumate is well suitable for being applied in combination with fertilizers. Addition of Lignohumate considerably improves important functional characteristics of fertilizers (such as scuffing and consolidation) as compared with standard mineral analogs.

This agronomic practice allows to reduce total costs of fertilization, and ensures more efficient use of main mineral nutrient components. Such effect is reached due to intensification of natural mechanisms of nutrient transportation by plants, enhancement in soil microbiological activity, and conversion of poorly-assimilable forms of phosphorus and nitrogen into easily-assimilable ones. Therefore, Lignohumate addition enables to reduce fertilizer dosage by 10-30%, depending on agricultural background, plant species, and Lignohumate consumption.

Based on long-term experience in Lignohumate-related techniques, the method of Lignohumate combination with mineral fertilizers was upgraded to the development of technologies and facilities for manufacturing of innovative products – humic mineral fertilizers (HMF).

Such products constitute new step in the progress of fertilization system. Main types of Lignohumate-contained mineral fertilizers were granted state registration in Russia (viz., carbamide-based HMFs, ammophos, azophoska, superphosphate, ecophoska, and LCF). Currently they are being produced in limited amounts at our company's facilities; in bulk quantities they are planned for production either directly at mineral fertilizer factories or with special equipment, based on, e.g., modified bulk blending plants.

### **Lignohumate Mixed with Crop Protecting Agents**

Lignohumate is well compatible with crop protecting agents. Pesticides' efficiency can be determined as their ability to suppress diseases, weeds, and plant pests. At the same time, most part of pesticides may cause reduction in protected crop productivity due to their toxic impact. This effect can be offset by antistress agents. Lignohumate is known as one of the most efficient

antistress agents. Joint application of Lignohumate and fungicides contributes into better efficiency and quality of chemical treatment, because Lignohumate, apart from antistress capacity, has the effect of light fungicide and strong sticking agent. The highest efficiency of grain treatment is demonstrated by Lignohumate/protectant combination when applied to cereals and leguminous plants. Judging by practical experience, Lignohumate increases the efficiency of phytopathogene suppression by 20-50 %, depending on inoculum infection rate. As efficient is Lignohumate combined with fungicides in foliar dressing, where, apart from enhancement of pesticide efficiency, it stimulates plant immune system. This increases natural endurance of a plant towards diseases. Lignohumate in combination with crop protecting agents contributes into stress relaxation of pesticide-treated plants, which is particularly true for "hard" pesticides and multi-component tank compounds. Said properties are most manifest in such crops as beat, flax, and cereals. With these crops, stress relaxation results in higher productivity and quality.

To make use of Lignohumate stress relaxation capacity, our company, in cooperation with Kuban Agricultural University, developed new Lignohumate modifications with enhanced fungicidal activity (BM-F and BM-ZSS), which are currently in the process of state registration.

### **Lignohumate as a Component of Biological Preparations**

Lignohumate is widely used in bioengineering. Due to its high biological potency, Lignohumate promotes growth and development of numerous groups of microorganisms (such as *Pseudomonas*, *Bacillus*, *Azomonas*, *Agrobacterium*, *Flavobacterium*, and *Arthrobacter*). Lignohumate is particularly efficient in combination with nitrogen-fixing bacteria (symbionts and free-living bacteria). Lignohumate in minor concentrations stimulates growth and development of bacteria, raises tolerance of microbiologic preparations to storage and transportation. Highly-concentrated Lignohumate may inhibit growth of some bacteria species and act as a preserving agent. Today Lignohumate is being used by a number of Russian biologic manufacturers, such as:

- "Bisolby Inter" – biological preparations for field husbandry
- "ECOS" – biological preparations for field husbandry
- "St-Petersburg Biotechnologies" – biological preparations for field husbandry
- "Ecoprom" – oil-destructive biological preparations
- "Biocen" – biological preparations for oil destruction and field husbandry applications.

### **Complex Preparations**

The preparations are most efficient when used as components of **complex** tank mix. **Complex** tank mixes contribute into better productivity and weed suppression in agrophytocenosis. **Complex** tank mixes also contribute into better product manufacturability.

A number of domestic and international manufacturers of complex preparations make use of said Lignohumate effects.

E.g., "**DURST**" Company (Czechia) offers liquid preparations under "Trisol Activator" trade mark, which, apart from Lignohumate, contain numerous macro- and microelements in form of chelates.

Group of Czech scientists (from LEXICON & AMAGRO Company) developed unique Lignohumate-based preparation under "Lexin" trade mark. Apart from Lignohumate, Lexin contains a complex of phytohormones. To date, the preparation is one of the strongest plant growth stimulants with directional effect. It includes substances used in agriculture for the first time.

## References

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