Humic substances as a natural biotic adaptogen

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The mechanism of the adaptive effect of humic substances (HS) on plants and biota was formed and tuned over millions of years of the bio- and humosphere joint evolution. HS significantly increase the adaptation (nonspecific resistance) of plants and animals to chemical and climatic stresses and other unfavorable environmental conditions.

Nowadays, the adaptive properties of HS are used in plant growing, animal husbandry and various ecoprotective technologies, as well as in medicine and veterinary medicine. In plant growing and animal husbandry, using preparations based on HS, it is possible to achieve an increase in yield and weight gain up to 20%.

We record this phenomenon in the form of physiological and bioprotective activity of HS in relation to biota, including animals and humans. The phenomenon of physiological activity of HS was studied from different angles and at different levels of biota organization

- from plant tissues (coleoptiles) to unicellular and more complexly organized plant and animal organisms, including animals and humans. But the mechanism of the biological action of HS on living organisms is still unclear. On the one hand, this is due to the variability and polydispersity of the HS structure. In other hand, this is due to biodiversity and multifactorial physiological reactions of living organisms to the effect of HS preparations in laboratory experiments.

The hypothesis of membranotropic activity assumes that HS are adsorbed on the membranes of living cells (root hairs, unicellular organisms, etc.) and activate the entry of mineral nutrients and water into cells. In addition, HS may act through membrane receptors on the expression or depression of certain regions of the genome of living organisms, performing a trigger function. Perhaps this explains the adaptive and bioprotective activity of HS.

In our studies, it was possible to trace the relationship between physiological activity and the concentration of HS free radicals. This relationship is consistently traced at different levels of organization of plant organisms - on isolated plant tissues (coleoptiles), and on whole unicellular and multicellular organisms.

HS of virgin soils favorably affected the growth of corn coleoptiles and metabolic processes in unicellular organisms. HS of arable and buried soils "worked" much worse. Moreover, HS of buried soils, which have the lowest content of free radicals, weakly stimulated photosynthesis and sharply increased the oxygen consumption by cells. In this case, this can be considered as a stress reaction of the plant to the action of these HS. 'This indicates a decrease in the physiological activity and adaptive potential of soil HS under anthropogenic impact.

In experiments with pollution of the environment with heavy metals, it was found that HS stimulate the internal nonspecific adaptive mechanisms of plants, which allow them to overcome the negative effect of chemical stress. The results obtained allow us to put forward a generalizing hypothesis of the systemic response of a living organism to the effect of HS, depending on their molecular structure, which will allow us to take a fresh look at their adaptive role in the soil – plant system.