IOWA STATE UNIVERSITY
Extension and Outreach

Humic and Fulvic Acids and Their Potential in Crop Production

The use of soilborne compounds to protect seeds and enhance seedling growth is being investigated globally. Humic and fulvic acids are commonly used in organic crop production, greenhouse cropping of vegetables, and in horticultural programs. They also may have uses in Iowa's large-scale production systems to improve seedling health and plant response to stress.

Humic compounds such as humic acid and fulvic acid have been shown to stimulate plant growth in terms of increasing plant height and dry or fresh weight as well as enhancing nutrient uptake. These effects seem to depend on the concentration (2,3,5) and source of the substance and on the plant species.

Research is being conducted at Iowa State University to evaluate if humic and fulvic acid based compounds influence soybean yield and quality. Because these compounds are believed to enhance root development, their influence on soybean grown in the presence of the soybean cyst nematode (SCN) is also being investigated. SCN accounts for an estimated $1.5 billion in crop loss annually.

Humic and fulvic acids are the most characteristic compounds of soil humic substances. Humic substances are formed through the microbial degradation of plant material and the brown to black substances are the primary constituents of soil organic matter.


Photo: Wayne Fredericks

Humic substances have the ability to hold seven times their volume in water, a greater water holding capacity than clay soils. Water stored within the topsoil enables plant roots to quickly access available nutrients required for plant growth and yield.

Despite the amount of research information on humic and fulvic acids, there is surprisingly little on their effects on soybean and corn.

Early research on soybean found a significant increase in root dry matter after the roots and shoots were exposed to humic acid and fulvic acid. Nodule weight was also increased but the number of nodules was inversely related to increasing amounts of humic acid (5).

Stimulation of root and shoot growth by humic acid was also reported in corn (2). They reported an increase in branching and root hair development of corn roots when plants were

grown in a nutrient solution containing humic acids. Similar results were reported on tobacco roots (3).

Root proliferation is a benefit from applications of humic and fulvic acids at low concentrations. These stimulatory effects also have been directly correlated with enhanced uptake of nitrogen, phosphorus, sulfur, zinc, and iron (4).

However, use of these compounds at high concentrations also has been shown to decrease root and shoot growth (2,3,4,5). The source of the humic acid substances and the concentrations used in treatments are not uniform among experiments so few conclusions can be drawn from these studies. Hartwigsen and Evans (1) reported an increase in root fresh weight of horticultural crops when 2500 ppm humic acid was used while Lee and Bartlett (2) reported the optimum concentration for corn was 5 ppm humic acid.

CONCLUSIONS

Many positive effects of humic substances such as humic and fulvic acids on plant growth and development have been reported but their effects appear to be dependent on several chemical and soil factors. In leguminous crops such as soybean, humic acid applications reduced nodule number but remaining nodules were larger in size. At low concentrations, humic acid increased vegetative growth of soybean and corn in laboratory trials.

Understanding humic substances and the way they influence plant growth and development and nutrient uptake is crucial to developing sustainable cropping systems that improve overall soil quality. Although humic substances are currently widely used in organic production systems, they may have uses in Iowa's large-scale production systems to improve seedling health. Stimulation of root growth may improve plant resistance to disease, and plant response to feeding by herbivores and nematodes, and water stress caused by drought.

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