Influence of Humic Substances on Soil Health, Crop Production And Environmental Quality

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The drastic decline of soil organic matter (SOM) in arable lands worldwide over the past century due to carbon turnover and cropping systems has resulted in seriously low levels of SOM in today's soils (Yang et al. 2003). Data drawn from a global compilation of studies quantitatively confirm that erosion rates from conventionally plowed agricultural fields average 1–2 orders of magnitude greater than rates of soil production, erosion under native vegetation, and long-term geological erosion. (Montgomery 2007) Sustainable cropping systems call for the protection of organic carbon in agricultural soils. Research shows the importance of microbial processes in soil and plant metabolism for the protection of organic carbon in agricultural soils and sustainable cropping systems. Humic substances (HS), a major component of SOM (75%), possess dynamic physical, chemical and biological properties essential to soil stability, fertility, and plant growth, including organo-clay/mineral complexation, chelation, mineralization, buffering effect, and cation exchange capacity. HS increase soil porosity and water-holding capacity. Direct influence of HS on plant growth include improved transport of nutritional elements, enhanced protein synthesis, plant-hormone like activity, enhanced photosynthesis, and effects on enzyme activity. Indirect effects include solubilization of microelements (e.g. Fe, Zn, Mn) and some macro elements (e.g. K, Ca, P), reduction of active levels of toxic elements, and enhancement of microbial populations. For over twenty years we conducted field trials on the effects of humic substances on crop production, and studies on nitrogen mineralization (NM) (the microbial conversion of organic N to ammonium (NH_4^+) and nitrate (NO_3^-) from compost, manure, and crop residue, in different sugar beet and potato fields in southwestern Idaho. NM was determined by using the buried bag method. A random soil sample was taken from each field at the beginning of the growing season, and an initial sample was analyzed for nitrate (NO_3^-) and ammonium (NH_4^+). Mineralization samples were placed in polyethylene bags and buried in the soil at their respective depths. Samples were retrieved at monthly intervals and analyzed for NO_3^- and NH_4^+. After converting NO_3^- and NH_4^+ values in pounds of mineralized nitrogen per acre for each crop, total nitrogen mineralization was determined by calculating the date we created in the total nitrogen pool for crop fertilization requirements in the farmers' fields. Our findings show a savings of an average of 50 lbs. of nitrogen per acre. Use of humic substances decreased irrigation requirements, increased fertilizer use efficiency, protected the environment against the surface water runoff and groundwater leaching of nutrients and pesticides, and reduced soil erosion.