CONNECTING SOIL AND NUTRIENT LOSS TO CROP PRODUCTION

Francisco J. Arriaga [1/]

The 4R concept (right source, right rate, right time and right place) provides a useful structure to achieve increased crop production, improved farm profitability, greater environmental protection and better sustainability. However, crop nutrient management should go beyond the 4Rs of fertilizer and manure stewardship. Other soil management factors that affect crop productivity, farm profitability, the environment, and sustainability should be considered when thinking about crop nutrient management. While fertilizer and manure applications affect nutrient availability to crops short-term (e.g., current growing season or following year), other soil management factors affect nutrient availability long-term. More specifically, factors that affect crop residues after harvest and soil structure/ aggregation affect the availability of nutrients in future years. One such soil property is soil organic matter content.

Organic matter in the soil has several important roles. One such role of organic matter is helping the formation of soil aggregates which are indispensable for well-functioning soil hydraulic properties. Greater levels of soil aggregation are associated with greater infiltration rates, plant water availability and drainage capacity (Hillel, 1998). However, organic matter also helps increase the cation exchange capacity of a soil. The cation exchange capacity of soil is often referred to as the store house of fertility. Soil particles have a small negative charge, which helps retain positively charged plant nutrient ions. Note that an ion is a chemical element or molecule with either a positive or negative charge; a positively charged ion is also called a cation. Most plant nutrients exist as ions in the water within the soil (Foth and Ellis, 1988). Plant roots uptake these ions that are dissolved in the soil water, or soil solution. As crop roots take up these nutrient ions from the soil solution, they are replaced by other ions that were stored near a soil particle thanks to the cation exchange capacity of soil. The cation exchange capacity also prevents plant nutrients in a cationic form from been lost out of the root zone by leaching.

As mentioned earlier, soil particles inherently have a negative charge. However, organic matter can contribute significantly to the cation exchange capacity of soil and boost the nutrient retention capacity of soil (Parfitt et al., 1995). In some soils it has been reported that organic matter contributes between 30 to 60% of the cation exchange capacity of the plough layer (Schnitzer, 1967). Therefore, avoiding reductions and increasing organic matter content in soil helps increase the nutrient retention capacity of a soil. Further, plant nutrients are released and made available for root uptake as organic matter decomposes in soil.

[1/] Assistant Professor and State Soil Specialist, Dept. of Soil Science, Univ. of Wisconsin-Madison and Univ. of Wisconsin-Extension, 1525 Observatory Dr., Madison, WI 53706.

There are several ways that organic matter content in soil can decrease, such as erosion, fast oxidation from excessive tillage, and reductions in additions of organic materials to soil (e.g., long-term reductions in crop residue inputs because of crop biomass harvest). The impacts and implications of crop/soil management practices such as tillage and crop residue handling from a crop nutrient perspective and fertilizer replacement value will be discussed during this presentation.

References

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