Importance Of Soil Organic Matter Buildup

Proper use of crop residue and manure applications is a key management practice of production systems found on the High Plains of Texas, Oklahoma, Colorado, and Kansas. In deciding how to best use crop residues, the immediate benefits of burning or removal must be weighed against the long-term benefits of soil improvement that are brought about by the incorporation of the residues into the soil. Crop residues and manure applications incorporated into the soil profile improve soil productivity through the addition of organic matter (OM) and plant nutrients. Organic matter is the major factor in improving the physical condition of the soil, which increases the water infiltration rate and the plant-available water holding capacity of the top foot of High Plains soils.

The soils located on the Texas High Plains have water-holding capacity from 1.25 to 2 inches per foot of depth. About 45 percent of this soil water is available for plant uptake with the last 10 percent requiring considerable energy for plant roots to extract. Ten tons/A of manure, corn stover, or milo stover incorporated at 30 percent moisture contain 750 gallons of water. One inch of irrigation or rainfall water on a field in the growing season would be 27,146 gallons per acre. The one inch of water would bring the top foot of soil to approximately 90 percent of field capacity. Using this simplified soil/water model, the ten tons of OM matter complex would have the capacity of holding 2,250 gallons of water or about 8 to 10 percent of the available soil moisture in the top 12 inches. The water held by the OM complex would be 90 percent (+) available to the plant with very little energy use to extract it. This compounding effect plays a major role in the observed increase in crop yields attributed to crop residue and manure applications.

Another attribution to the soil/water/OM relationship is the increase in the ability of the soil to absorb water at a higher rate per period of time. The movement of water into the soil is called infiltration. The downward movement of water after it enters the soil is called percolation. Poor surface soil structure due to low levels of OM, soil compaction, and/or high sodium content will severely limit the infiltration process (see Table 1).

Table 1. Effects of soil texture and OM on soil infiltration.

Soil Texture	OM 2.7%> inches/hour	OM 1.2% inches/hour
Loamy sand	1.81	1.00
Loam	1.12	0.57
Silt loam	0.74	0.39
Clay loam	0.20	0.16

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The Estimated Nitrogen Release (ENR) calculated in soil test results and used in making fertility recommendations is dependent on the percent of OM. A Very Low rating of 0.3 percent OM on a clay loam soil would have a nitrogen (N) release potential of 30 lbs/A while a High rating of 3.8 percent OM would have a release potential of 120 lbs/A of N for a sandy loam soil.

Organic phosphorus (P) found in combination with OM represents about 40 percent of the available P. Much of the soluble P is built into bodies of soil microorganisms that subsequently become part of the OM complex. Thus, about half of the P requirements of a growing crop is dependent on the amount of P ions being released from P reserves via biochemical processes in the soil.

Sulfur (S) is the fourth major plant food nutrient for crop production. The largest portion of total S in the soil is contained in the soil organic matter. Crop plants absorb S as the sulfate (SO_4^{2-}) ion that is not generally retained in the soil in any large amount. Sulfate S becomes available to the plants through the bacterial oxidation of soil OM. The best method of building S reserves in the soil and available for plant use is by increasing the OM levels.

Organic materials, both from plant growth and manure applications, exert a profound influence on every facet of crop production. A successful crop production program must consider all the aspects to achieve a balanced fertility program that meets the economic requirements of the producer--and increasing OM levels in the soil is one of them.

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