MEASURE AND MANAGE

Soil Fertility versus Soil Productivity

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Fertile soils are usually productive but not always and, productive soils are not always fertile soils.

The soil test we currently use to measure various soil components such as P and K and micronutrients serves us well in determining if we need further amendments. The soil test is designed to measure a soils ability to supply a given nutrient. A high test indicates a soil has a greater ability to supply and therefore we need less fertilizer and low readings indicate the opposite we need to supply nutrients. How much nutrient to supply at a given test was determined by calibration trials with different rates of fertilizer to determine crop response.

Quite often the soil test report is much maligned as farmers experience different responses to different fertilizers in some years and not in others this varied and confusing situation often results in farmers and industry people questioning the validity of soil testing. We are often hopeful that a nutrient application will fix the problem and it may provide some relief however it is not necessarily a long-term fix. Many of us think we can fertilize our way out of production problems. The current magnesium deficiencies are a classic example of adequate fertilizer applied and a high Mg soil test and we still see the deficiency. Plant tissue test on seedling corn have shown low levels of all non mobile nutrients because of poor root development largely due to weather, cold soil temperatures and compacted seed beds early in the spring.

When the soil test is high we are fertile; if we are not productive it is seldom nutrient related. If highly fertile fields are not yielding up to expectations, then question the expectations and dig a little deeper. Dig in the soil.

The answers to poor performance lie not in trying a new soil test method but in understanding how nutrients and water move to and into plant roots. Root interception, Diffusion, Mass flow these are the mechanisms that move nutrients to plants and are largely responsible for desired plant performance. These mechanisms of nutrient uptake work best in well structured, aerated, deep soil, high in organic matter, low bulk density, adequately drained and proportioned micro and macro pore sizes. A productive soil is usually one-third air, one-third water, and one-third solids.

A well structure soil allows for a large unrestricted root system to develop. Big yields come from big plants and big plants have big roots.

We quite often experience a response to starter fertilizer on corn and cereals. The nutrient most often considered important in a starter is the non-mobile nutrient phosphorous. Root interception and diffusion is largely responsible for P uptake. In a high testing soils we should not see consistent responses to applied P especially row placed. However we quite often witness 8 to 30 bushel responses on corn to starter placed P. The response is often greater on fine textured soils. These soils tend to restrict root growth especially under less than ideal root zone conditions such as compaction. The yield responses are expected under restrict rooting environments (tight soil) and under conditions that do not favor rapid root expansion (cool temperatures).

When the test values are high and the yields are low it is time for the shovel. Digging up plant roots and looking at root development in season can reveal a great deal about root zone quality. Feeling the soil between thumb and forefinger will tell you about texture. A smooth feeling soil that ribbons out from the fingers indicates a clay texture while a coarse gritty feeling indicates a sandy texture. Relating texture and root habit will tell you about root zone quality, possible clues to compaction, poor drainage, low aeration, greater disease incidence, higher pathogen infection, more insect damage, These are all clues to soil problems that have little to do with soil fertility directly. The causes of additional plant stresses can be indirectly related to soil quality factors, which do not support rapid root expansion and therefore vigorous growth. Out- growing stresses are one of the crops defense mechanisms or tolerance traits. Slow growing plants have a longer window of susceptibility to insect attack and disease infection.

Shallow compacted soils, limit root growth, this limitation can show as a nutrient deficiency, by exhibiting, chlorotic growth, or stunting, or accumulation of metabolites that produce different plant pigments such as purple and red colors signifying a weather induced P deficiency or accumulation of sugars and anthocyanins. Poor root development limits diffusion rates and mass flow making micronutrient uptake difficult. In the case of corn, zinc uptake is by one-third diffusion, one-third mass flow and one-third root interception. All of these mechanisms need developing roots to take up zinc. Early season growing stresses quite often exhibit micronutrient deficiencies even though micro levels are high or a starter containing micronutrients has been applied. Hostile root zone environments limit root development. Most non-mobile elements uptake will be limited under stress conditions that limit root growth.

If we learned nothing else from Site Specific Crop Management we should know that yield patterns across the landscape are more highly correlated to slope and texture changes than they are to soil fertility values. Fertility is important as it relates to productivity. A highly productive soil one which is well structured needs to have adequate and balanced soil test values above the low to medium soil test level. A less productive soil should not have soil fertility levels built or maintained at the excessive rating. This has lead us to a zone management practice of sampling fertilizing and observing crop production in unique or *like areas of production* within the field. Variable rate nitrogen management is a natural extension of this approach.

Whenever crop performance becomes a concern, check the soil test levels then check the conditions of the root zone. Relate soil quality to productivity and fertility.