Agronomy Facts 3
Revised July 23, 2015

Drought

Considerations in Soil Fertility

By Oscar F. Ruiz Jr DPM and Pauric C. Mc Groary PhD

Drought can have a marked effect on soil's pH, nitrogen, phosphorus, and potassium fertility levels. Below is our perspective of how it may affect your soil pH and nutrient levels

pH

Drought normally will impact your soil by making it more acidic. This is true for the majority of soils in the Eastern, Southeastern and Midwestern US. Why? Because applied fertilizer will displace aluminum and hydrogen and lower the soil pH. Moisture is required to release K, Ca, and Mg (bases) back into the soil to raise the pH. Fertilizers are often placed on the surface of the soil; therefore a shallow soil sample may show a significantly lower soil pH. This issue, referred to as *stratification*, is more pronounced on fine to medium textured soils.

Furthermore, soil pH may be abnormally low even if lime was applied in the spring. This is due to the lime not having enough time to fully react and fully dissolve. Hence, your soil test result may indicate a low soil pH that requires the same or more lime that was recommended and applied earlier in the season. Not all lime is created equal. Be sure to know the relative neutralizing value (RNV) of your lime. The closer the RNV is to 100 the faster your lime will react.

Solution: Wait at least a couple weeks after a good rain event that allows sampling to a the proper depth. Know the RNV of your lime. If you have applied the full recommended rate of lime earlier in the season, do not apply anymore lime regardless of the soil pH result. Once the soil has received moisture the lime will proceed with its reaction. Lime needs time and moisture.

PHOSPHORUS AND POTASSIUM

Several factors will affect the amount of residual P and K. What were the initial levels of P and K in the soil at the beginning of the season? Do you have low CEC (sandy, coarse) or high CEC soils (loamy to clay, fine)? Did you harvest the grain? Did you harvest the field for hay/silage instead? If you harvest the grain and you have high, optimum, or very high nutrient levels, a couple of math calculations can help you figure how much is left in the soil. If your levels of the P and K are very low to medium, you should be applying the full recommended rate of fertilizer on the next crop regardless of what is left over. The reason is the following. In fine textured soils, with low to medium levels, K goes from being completely available in the soil solution to less available because it is adsorbed on the exchange sites and/or becomes fixed between the interlayer spaces of some type of clays. When it is fixed, it is very slowly available or not available at all for plant uptake. In coarse textured soils, K is very easily leached. Phosphorus is in its most available state very soon after the fertilizer dissolves into the soil solution. With time, this P becomes less and less available becoming fixed into less soluble forms with calcium, aluminum and iron even within the pHs between 6 and 7. This is not the case on soils that have high or very high levels of P and K. High to very high levels of P and K means more of these nutrients will be in the soil solution and readily available for plant uptake. A grower affected by the drought whose field's soil nutrient level is high can afford to calculate what was left over in the soil (see table 1). Please be very aware that hay and silage remove a much greater amount of nutrients

from the soil than a grain harvest! Therefore, none or less of the nutrients that were applied will be left if you have soil test levels that are very low, low or medium. If you do not have a recent soil test, then you do not have any information to base your nutrient management decisions. A soil analysis is simple, quick, cheap, and extremely useful and it always saves or makes you money.

Solution: Know the history of your field. Use a recent soil test. If you don't have one, get one. Determine what your P and/or K levels are. If they are high, optimum or very high then you can do a little math and account for what may be left out in the field. If they are very low, low or medium, then apply the full recommended rate of P and K fertilizer for the following crop.

NITROGEN

Plant available N levels can change drastically from day to day. Its levels in the soil can change day to day depending on soil texture, soil moisture, and temperature, rainfall and plant uptake. Plant available N is available in two forms: ammoniacal and nitrate N. Ammonium ($NH4+$) has a positive charge and can be held by the negative charges of the cation exchange capacity (CEC); therefore it is not readily leached in medium to fine textured soils. Ammonium in soil is short lived because it is quickly converted to nitrate. Nitrate has a negative charge (NO^{3-}) and not held on the CEC sites; therefore it can leach readily, especially in coarser textured soils. Here are a few scenarios.

Example: Nitrogen fertilizer broadcasted on to corn crop at the beginning of the season/pre-plant as urea or UAN. Timely rain should have moved the N fertilizer into the profile sufficiently to put it in the root zone. How much so, will depend on the soil type and the amount of rain.

Scenario 1: If the amount was a pre-plant rate of 30-60 lb/acre, rainfall was sufficient and the soil moisture was adequate up until the V3 or side-dress stage, it is likely the N was taken up by the plant. The side-dressed N is another matter. A side-dressed application of N during the drought may have been volatilized, taken up by the plant or remained in the soil or all three. The best way to determine how much residual plant available N remains is by analyzing the soil for nitrate-N.

Scenario 2: If the TOTAL amount of required N was applied at pre-plant and rainfall was sufficient to move the fertilizer into the profile, it is likely that some of the fertilizer was taken up by the plant and some was left in the soil. The best way to determine how much residual plant available N remains is by analyzing the soil for nitrate-N.
Scenario 3 through 100: (Insert your plots here). The best way to determine how much residual plant available N remains is by analyzing the soil for nitrate-N.

Residual plant available N should not be calculated off of the yield of the corn grain, hay, or silage because the plant is capable of taking up more N that it can use. If there is insufficient moisture during the plants development, then nitrate-N will remain in the corn stalk. This nitrate-N will not have gone towards grain yield or biomass growth. The amount of N removed from the field could be substantially higher.

Solution: Soil test for plant available N (nitrate-N) if you are going to plant a small grain in the fall. Take at least 15 cores from different locations in the field and combine them. Each core should be taken down to 6 inches in depth. Results of 30 ppm of nitrate-N or higher indicate you do not need to apply pre-plant N to your small grain (Alley et al., 2009). Do not rely on residual nitrate-N determined in the fall if you are to plant a crop until the following spring. Residual nitrate-N will likely be lost during the fall, winter and spring rains in most areas of the Midwest, South and East unless a cover crop is utilized.

Table 1. Removal rates for Harvested Portions Corn and Soybean				
		Nutrient Removal (lb/A)		
Crop	Units	N	P_2O_5	K_2O
Corn-grain	Lb/Bu	‡	0.44	0.29
Corn-silage	Lb/Ton	‡	3.60	8.30
Corn-Hay	Lb/Bu	‡	0.57	1.33
Soybean	Lb/Bu	***	0.80	1.40

‡ Nitrogen uptake in corn cannot be determined by silage, hay or grain yields in drought years.
*** Soybeans fix their own nitrogen.

If you have any further questions regarding the impact of the drought on soil fertility, please feel free to call us.

Agronomists:
Memphis, TN Oscar F. Ruiz Jr. D.P.M. (901) 213-2400
Richmond, VA Pauric C. Mc Groary Ph.D. (804) 743-9401

References:

Alley, M. M., P. Scharf, D. E. Brann, W. E. Baethgen, and J. L. Hammons. 2009. Nitrogen Management for Winter Wheat: Principles and Recommendations. Virginia Cooperative Extension. 424-026.