Purdue University Department of Agronomy
Soil Fertility Update

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Keep in mind soil test K and pH are affected by low soil moisture

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SUMMARY

Sample to the proper depth and retain the whole soil core to get a representative soil sample.

Sampling fields that have been dry since the crop reached maturity may have low soil test potassium (K) levels because K still remains in the crop residues and/or low soil moisture caused 2:1 clays to trap some of the potentially available K in soils that are adequate or higher in K.

Soil pH may also be lower than expected if low soil moisture limited the reaction of limestone applied in the spring.

Soil pH determined in water may also be lower than expected if more than the usual amounts of fertilizer salts remain in the sample. Some laboratories avoid this issue by determining soil pH in a salt solution, rather than water, and convert the results to a 'salt-free' water pH. Check with the laboratory to determine which method they use to decide whether soil pH was likely affected by the dry soil conditions.

INTRODUCTION

The accurate analysis of representative soil samples to determine lime and fertilizer needs is fundamental to crop production. Dry soils are hard soils, so be sure to sample the full 8" depth, otherwise soil test results will be higher than actual values. The opposite will occur if surface soil is lost from the sample core. When soils are excessively dry it is more difficult to keep the entire core in the probe with the surface soil likely to fall out of the probe. In most soils the highest pH and nutrient values are in the upper inches of soil, so if this soil does not make it into the sampling bucket soil test values will be lower than actual values.

Unfortunately, even if soil sampling is accurate persistent dry weather resulting in prolonged periods of low soil moisture can affect soil test potassium (K) and pH, resulting in misleading soil test values. Dry weather soil tests can still be useful if one understands the potential impact of low soil moisture on soil test K and pH and uses this knowledge to adjust the interpretation of soil test results.

SOIL TEST POTASSIUM

Typically soil test K levels are lower than expected in a dry fall. One factor contributing to low soil test K is more than half of the K taken up by the crop during the growing season remains in the residue and has not been returned to the soil by rainfall. Soybean and corn tissues at harvest contain about 80 pounds K_2O per acre at grain yields of 60 and 200 bushels per acre, respectively (Table 1). Tissue K is returned to the soil as plant tissue decays and falls to the ground and as rainfall leaches the K out of this tissue and the standing crop. Research conducted in Iowa[2] showed that most of the K in soybean tissue is removed from the residues with 5-10 inches of rainfall, and only 12% of the original K content remained after 20 inches of rainfall (an amount typical of an Indiana fall and winter). In contrast, K removal from corn residues was much slower and less complete – 10 to 15 inches of rainfall were needed to remove approximately 50% of the original tissue K content, and 31% of the K in corn tissue at physiological maturity still remained in the tissue after 20 inches of rainfall. In the Iowa study every 10 pounds of K_2O per acre returned to the soil increased soil test 4 parts per million (8 pounds per acre). Therefore, the difference in soil test K in a dry fall could be approximately 32 parts per million (64 pounds per acre) if all the tissue K at maturity remained in the residues of 60 and 200 bushel per acre soybean and corn crops.

Table 1. Approximate potassium (K_2O) content of soybean and corn grain and tissue at maturity[1].

	Soybean	Soybean (60 bu/a)	Corn	Corn (200 bu/a)
Crop	**lb K_2O/bu**	**lb K_2O/a**	**lb K_2O/bu**	**lb K_2O/a**
Grain	1.15	69	0.20	40
Residue	1.4	84	0.4	80

In addition to dry weather reducing the return of K in plant tissue to the soil, the availability of soil K as measured by soil test methods is also affected by low soil moisture. Most Indiana soils contain 2:1 clays that vary in soil test K with soil moisture. When field moist soil high in K is dried for analysis, soil test K decreases. In contrast, when soil testing low in K is dried, an increase in soil test K occurs. If persistent dry conditions continue prior to soil sampling, K availability will likely be overestimated in low testing soils and underestimated in high testing soils. In Indiana topsoils the change in soil test K with drying has been approximately ±15% at the highest and lowest soil test K levels examined.

SOIL pH

Low soil moisture can also affect soil pH. If soil moisture has been insufficient for normal amounts of limestone reaction in soils limed this past spring, then soil pH may be lower than expected. The limestone remains in the soil, however, and with good winter moisture it will react and continue to increase soil pH.

Additionally, soil pH measured in water can also be affected by dry soil conditions. If higher than normal levels of fertilizer salts remain in the soil sample due to dry weather, then the pH reading may be about 0.1 to 0.5 pH units lower than the actual pH. This is an artifact of how pH is measured and occurs only if the measurement is made in water. Some soil testing laboratories avoid this problem by measuring soil pH in a salt solution and then calculate what the pH would have been if measured in water, without the influence of salt. Ask the soil testing laboratory what method they use to determine if a low pH measurement may just be an artifact of excess salts remaining in the sample or if it may actually be low.

REFERENCES

[1] These publications were used to determine the values in Table 1:

Culman, S., A. Fulford, J. Camberato, and K. Steinke. Tri-State Fertilizer Recommendations for Corn, Soybean, Wheat, and Alfalfa. (2020) Bulletin 974. https://ag.purdue.edu/agry/soilfertility/Documents/Tri-State%20Fertilizer%20Recommendations.pdf

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Bender, R.R., J.W. Haegele, M.L. Ruffo, and F.E. Below. 2013. Nutrient Uptake, Partitioning, and Remobilization in Modern, Transgenic Insect-Protected Maize Hybrids. Agronomy Journal 105:161-170.

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Ciampitti, I.A., and T.J. Vyn. 2014. Nitrogen Use Efficiency for Old versus Modern Corn Hybrids. Better Crops 98(4):19-21.

[2] A.P. Mallarino and R.R. Oltmans. 2014. Potassium Management, Soil Testing and Crop Response. North Central Extension-Industry Soil Fertility Conference. 2014. 30:45-52.