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Crop Nutrition Following the 2012 Drought: Northeast

The 2012 drought will affect the nutrition of the 2013 crop. While its impacts may not have been as severe in Northeastern USA and Eastern Canada as in other parts of North America, crop nutrient cycling on many farms changed in unforeseen ways. To ensure the right management adjustments are made for 2013 cropping system performance, issues to be considered include carryover nutrient potential, crop nutrient removal, legume N credits, and the opportunity for cover crops.

Carryover nutrient potential

Since a drought-affected crop takes up less nutrients, more than usual may be left over. Nitrogen (N) behaves differently than phosphorus (P) or potassium (K). When dry soils are rewetted, a sudden flush of inorganic N release often occurs. This flush, arising from the decomposition of the microbes killed during the dry spell and release of organic compounds from clay mineral surfaces, can last for days to weeks. Fall-planted crops, such as winter wheat, may take advantage of high levels of mineral N in soil.

However, since most of this region receives enough rain in the winter to either cause leaching or saturate the soil, all this mineral N can easily be lost for crops in the following year. For corn, a spring nitrate test (at planting, or ideally at side-dressing time) can be useful to determine whether a useful residual remains. In Pennsylvania, the pre-sidedress soil nitrate test (PSNT) was first introduced in 1989, following the 1988 drought. Owing to a wet spring in 1989, the expected carryover N was lost, and the PSNT results showed that clearly. However, the possibility exists, if the coming winter is drier than usual, that some residual N may be available. So it may very well be worthwhile to plan on using the PSNT or some other assessment of mineral N next spring.

In contrast, P and K applied but not taken up will largely remain in the soil, regardless of winter precipitation. Soil tests in either fall or spring will usually detect the surplus P and K, but the effect of the residual nutrients on the soil test is not likely to be large. Leftover nutrients from a typical nutrient application for corn might increase soil test levels by 3 to 5 parts per million for P and K, assuming the worst-case scenario with zero yield and no nutrient removal from the field. If the drought cuts nutrient removal by only a portion, the increase caused by residual nutrients is likely to be smaller.

Dry soil conditions can also influence the availability of P and K in soils. But it can be hard to predict whether their availability will increase or decrease. Soil K tests will be particularly prone to some large variability from previous years' tests. Generally, soil test K increases with drying for soils with low to optimum K levels, and decreases with drying for soils with very high K levels. However, in recent years in Ontario and other parts of the corn-belt, many are seeing dramatic decreases in soil test K. Many laboratories air-dry all their soil samples before testing, but some use a field-moist sample for K analysis. Under normal conditions, the field-moist sample reduces variability in results from one year to the next, but it may also show a more dramatic change in response to severe drought conditions.

Crop nutrient removal

If the crop produced grain, but with lower yield than normal, nutrient removal will be less than usual. Keep in mind that under drought stress, most cereals like corn and wheat have higher protein, so the reduction in removal of N may be less than the reduction in yield. On the other hand, the lower stover production in drought-stunted corn will likely reduce N immobilization and response to N for the following crop. If crops planted for grain were harvested instead as forage, nutrient removal may be higher than that for a normal crop of grain—especially for K. Only about 20% of the K taken up by the corn plant is normally found in the grain.

Plant analysis can be useful in calculating crop nutrient budgets and balances. Crops harvested as forage may likely have been sampled for nitrate testing. Testing for protein, P and K would provide solid information with which to calculate the true crop removal of nutrients. Measuring nutrient contents in harvested crop portions takes the guesswork out of how the drought affected nutrient removal.

The early and warm growing season also opened more opportunity than usual for double-crop soybeans following wheat. If good weather prevails in the fall, the nutrient removal from the two crops could be quite substantial and should be taken into account in the crop nutrient balance.

***Drought-stricken corn** in Maryland 2012. What nutrients will remain for next year?*

Legume N credits

What N credit does a failed soybean crop provide to a subsequent crop of corn? The soybean N credit is a reduction in the N recommended for corn following soybean compared to corn following corn. While the exact causes of this reduction are still under investigation, several contributing factors have been identified. The most commonly cited factor in the N credit is biological N fixation. In an Illinois study comparing nodulated to non-nodulated soybean isolines, soil N supplies were higher after nodulated soybeans than after non-nodulated soybeans (Bergerou et al., 2004). However, both types of soybeans produced higher N supplies than where corn was grown. Consequently, additional factors beyond just biological N fixation are important for determining the N credit.

Soybean also appears to produce a pool of readily mineralizable N in the soil. This pool is thought to come from the soybean roots and the organic compounds they release. Decomposing soybean residue therefore releases N quicker than corn residue - soon enough to be used by the succeeding corn crop, which reduces the amount of fertilizer N needed. During a drought, N mineralization slows, and biological N fixation in soybean nodules lessens. Drought can reduce both the number of nodules on soybean roots as well as the quantity of N fixation in the nodules themselves. All of these changes can result in a decrease in soil N supply for the following corn crop. It is not clear just how much the N credit is affected. Sparse data indicate that the credit may range between half to the full rate normally used.

What N credit does a drought-stressed alfalfa stand provide to a subsequent crop of corn? In the case of forages, the accumulation of readily mineralizable organic N occurs over a longer time period. Much accumulation may have taken place already before the drought. Thus, less reduction in the N credit would be expected.

Cover crops

The early and warm growing season of 2012 opens up more opportunity than usual for cover crops. Some may be planted early owing to early grain harvest, or very much earlier following harvest as forage of crops intended for grain, or following crop abandonment. Planted earlier, cover crops are likely to take up more nutrients before their growth ceases in the fall.

How much of the N captured by a cover crop is made available to next year's crops? Research has not generally been able to show a reliable N credit for cover crops other than legumes, with one exception: both grass and legume cover crops, managed as green manure, can increase the fertilizer equivalence of the N from manure applied in late fall. But in addition, cover crops provide significant benefits to soil organic matter, soil structure, and soil trafficability. The P and K they contain is recycled back to the soil, maintaining the soil test levels of those nutrients. In addition, the N they capture is N loss prevented, and thus reduces impact on the environment through nitrate loss to water or nitrous oxide emitted to the air. So the opportunity for cover crops should not be neglected.

Since forages may be in demand in many areas, some of these cover crops may be harvested as emergency forage. Such harvests can generate substantial nutrient removals that need to be included in the crop nutrient balance.

Summary

The best social, economic and environmental outcomes arise from applying the right nutrient at the right rate, time and place. Drought in many parts of the Northeast in 2012 created a lot of unforeseen changes in nutrient cycles, and this means we need to re-evaluate what "right" means for 2013. Reassessments are critical. Measure the nutrients in the crops removed this year, whether it was grain or forage. Compare that removal to what was planned and reexamine nutrient budgets. Measure what's left in the soil to make informed adjustments to future applications of nutrients. ■

Reference

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Nutrient Deficiency Photo Application for iPhone/iPad Released

IPNI has released a new Crop Nutrient Deficiency Photo Library app for your iPhone or iPad (see http://info.ipni.net/ndapp). The app contains key photos of classic nutrient deficiency documented from research plots and farm fields for 14 common crops. It also provides supporting text and illustrations of nutrient deficiencies. This mobile app will be a great tool for crop advisers, consultants, farmers, and anyone wanting help in identifying nutrient deficiency symptoms in common crops. BC