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Flood Adulterated Grain - Nutrient Supply to Crops When Land Applied

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Abstract
Flooding has been extensive in several areas of Iowa this spring. In some cases, stored grain has been affected by flood waters. Land application of flood adulterated grain as a nutrient source for a future crop may be an option for some. See the Iowa Dept. of Natural Resources (IDNR) and Iowa Dept. of Agriculture and Land Stewardship (IDALS) publication for Proper Management of Flooded Grain and Hay. That publication states "Farms disposing of spoiled grain and feed on their own property can land apply damaged grain at the following application rates: 146 bu corn/acre and 50 bu soybean/acre". The publication also states that "Spoiled grain needs to be incorporated/disked into the ground the same day of application to prevent poisoning migrating waterfowl and other birds." This ICM News article discuss the implications for nutrient supply from land applied corn and soybean grain.

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Corn and soybean grain contain all of the plant essential nutrients. The nutrients most important to consider for crop production in Iowa are nitrogen (N), phosphorus (P), and potassium (K). Estimates of the concentration of each nutrient in corn and soybean grain, and bushels per acre that will be applied, are needed to approximately estimate nutrient amounts that will be applied to the soil. Wet grain can make estimating the amount of grain and nutrients applied difficult, and also difficult to achieve uniform application. Nutrient composition should not change significantly when grain becomes wet from flooding.

Phosphorus and Potassium

For P and K, the calculation to estimate crop available amounts applied is straightforward. Multiply the estimated bushels per acre applied times the concentration per bushel of

P_2O_5 and K_2O. For corn, 0.32 lb P_2O_5/bu and 0.22 lb K_2O/bu at 15.0% grain moisture content; and for soybean, 0.72 lb P_2O_5/bu and 1.20 lb K_2O/bu at 13.0% grain moisture content. One can simply assume that all of the grain P and K will be available the year of application. If a crop is not planted then the applied P and K nutrients can increase soil tests and be crop useable in future years. Assuming that the maximum amount of grain allowed by IDNR and IDALS will be applied, the amounts of P and K per acre will be the following. With 146 bu/acre corn grain, 47 lb P_2O_5 and 32 lb K_2O/acre and with 50 bu/acre soybean grain, 36 lb P_2O_5 and 60 lb K_2O/acre. In many cases, those amounts of P and K could meet fertilization requirements for a following crop.

If soils are Very Low testing in P and K, then some P and K fertilizer, or starter, may be applied in addition to the amounts applied with grain to ensure adequate early season availability. A fertilizer application would be more important for P than K as the K is present in grain as the plant available K^+ ion, while the P is mostly contained in organic forms that need to be broken down before becoming available for crops.

Nitrogen

For N, estimating the crop available amount applied is more complicated. If applied before a soybean crop, there should be no real need to estimate N from corn or soybean grain as the soybean crop can fix N that it can't obtain from the soil.

If land applied before corn, then an estimate of plant-available N is needed. The C:N ratio of corn grain varies, but is approximately 33:1. That C:N ratio means that microbial degradation of the corn grain will not provide a net amount of mineralized N, instead would be in an approximate balance with soil microbial demand as the corn grain is used as an energy (carbon) source. In other words, there would not be an expected release of plant available N to a corn crop. Applying corn grain before soybean would eliminate the need for estimating plant available N.

The soybean grain N content (mostly in proteins) varies, but 3.1 lb N/bu is a reasonable estimate. For example, assuming that the maximum amount of grain allowed by IDNR and IDALS will be applied, a soybean grain rate of 50 bu/acre would contain approximately 155 lb N/acre. In essence, think of the soybean grain as fertilization with an organic N form. Therefore, an estimate is also needed in regard to conversion of the grain N to plant-available inorganic N (ammonium and nitrate). Not all of the soybean grain N will be available the first year. Although it is not known exactly what the availability will be, a study of corn N response in fields with hailed-out soybean seed provides some guidance. In a study in 2002-2003 where soybean seed was hailed out at harvest time in the fall

2002 (estimated 35-45 bu/acre soybean grain yield on the ground), the next-year corn crop had an economic optimum N rate at 50 lb N/acre compared to 120 lb N/acre where the soybean crop had been harvested. That fertilizer N application which optimized corn yield indicated a first-year N availability from the hailed out soybean grain of approximately (at least) 60%. The Late-Spring Soil Nitrate Test (LSNT) test values were higher where the soybean seed was hailed out, but not up to the optimal test level. Therefore, for a 50 bu/acre soybean grain land application rate, the N available to a first corn crop would be approximately 90 to 100 lb N/acre.

Soil sampling in corn for the LSNT, or crop N stress sensing, can help confirm a corn N fertilization need. The LSNT results may be lower than expected due to grain N mineralization later in the season after sampling. Creating an "N-rich" or "non-limiting" N reference strip or multiple non-limiting small areas can provide a comparison of crop N response. If sidedressing is the intended method for N application in corn, a suggested management practice would be to apply part of the needed N (30 lb N/acre or more as starter, weed-and-feed, or manure) before or at planting to offset any early-season delay in N availability or lower than expected N supply from applied grain.

Secondary and Micronutrients

There seldom is a need for micronutrient application to Iowa soils, except perhaps for zinc (Zn) in corn and sorghum on very sandy soils or specific soils that are eroded and high pH with free lime. However, micronutrients will be supplied with the grain application. Concerning the secondary nutrients calcium (Ca), magnesium (Mg) and sulfur (S), only S deficiency has been an issue on some Iowa fields, and there will be S applied with the grain that can help with a potential S deficiency. On average corn has 0.04 lb S/bu and soybean 0.10 lb S/bu.

In Summary

The importance of nutrients when adulterated grain from flooding is applied to fields should not be underestimated. In spite of some application rate and nutrient supply uncertainty, considering the nutrient value of applied grain will help offset costs for production of the next corn or soybean crop.

Category: Crop Production Soil Fertility Soil Management

Crops:

Corn Soybean

Tags: flood damage flooded damaged grain land application

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