Using Layer Manure for Crop Production[1]

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Animal manure can supply nutrients needed for crop production and replace nutrients removed by crop harvest. Manure contains many nutrients; therefore, application to fields should consider what is needed for the crop to be grown, subsequent crops, and how the ratio of nutrients in the manure might affect soil tests. This is important for supplying adequate amounts of nutrients and also to address over- or under-application and nutrient buildup or depletion in soil. Also, since manure has a mix of organic and inorganic nutrient forms, nutrient supply can vary by manure source, species, and production practice.

Manure Use for Crop Production

A new Iowa State University Extension publication was developed to address issues related to manure nutrient availability and supply for crop production. That publication, *Using Manure Nutrients for Crop Production*, PMR 1003, is available for purchase or download (http://www.extension.iastate.edu/Publications/PMR1003.pdf) from the ISU Extension Store (https://www.extension.iastate.edu/store/). Many items specific to manure nutrient management are discussed in the publication, including need for manure sampling and analysis, manure nutrient availability for crops, nitrogen (N) volatilization with surface application, issues related to manure nutrient supply and losses, and considerations for time of application.

Items of particular importance with use of layer manure as a nutrient resource center on crop availability of N, phosphorus (P), and potassium (K) and volatile-N loss estimates. For N, the suggested first-year availability estimate is 50-60% of total poultry manure N (all poultry species). This estimate does not include potential volatilization losses during and after land application. Second-year N availability is low, 0-10% of applied total N, and no third- and subsequent-year availability. This means that not all of the poultry manure N should be considered plant available over the long-term. For P and K, the first-year availability estimate is 90-100% (all poultry species). The expectation is that all P and K applied in manure will be plant available over time. The lower availability values are suggested for soils testing in the Very Low and Low soil test interpretation categories where large yield loss could occur if insufficient P or K is applied, and buildup is desired. When maintaining soil tests in the Optimum category, use of 100% availability is suggested. Residual P and K not used by crops in the year of application will

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be reflected in soil tests and subsequent crop use, like fertilizer P and K applied in one year for multiple crop years. Since K is not contained in organic manure compounds, but instead is all in the soluble K^+ ionic form that is taken up by plants, all poultry manure K is considered crop available.

Phosphorus and K are not subject to volatilization loss. However, N components in manure can be lost to the atmosphere before and during application and also if manure is left on the soil surface. For solid manure that is broadcast with immediate incorporation, estimated loss is 1-5% of applied total manure N. For solid manure that is broadcast and not incorporated, estimated loss during and within four days of application is 15-30%. Much volatile N loss can occur at excretion, in storage, and in stockpiling/handling/mixing. Therefore, it is important to sample poultry manure for nutrient analysis at a time that best reflects the content at application.

Recent Poultry Manure Research

A multi-year on-farm research project was recently completed that studied the agronomic use of N and P in poultry manure. The final report of that project is available at http://www.agronext.iastate.edu/soilfertility/info/IFLMPoultryManureFinalReport.pdf. A summary of that work follows. Results of the project and other research on use of poultry manure nutrients in crop production will be presented at the conference.

The results of 18 on-farm trials confirmed the significant value of nutrients in poultry manure. Corn grain yield increases from manure application measured in long strips across production fields ranged from 7 to 68 bu/acre and averaged 40 bu/acre across field sites and manure application rates. Grain yield response to supplemental N fertilization after applying manure indicated that poultry manure N is not fully available in the year of application, and ranged from 42 to 55% of comparable N fertilizer rates. These values are lower than commonly suggested for manure nutrient planning, but do include any field losses that may have occurred, such as ammonia volatilization. Both corn grain yield and early growth responses indicated that poultry manure P availability is much higher than the previously suggested 60% estimate and is near 100%. The project demonstrated that supplemental N fertilizer is almost always needed when poultry manure having average nutrient analysis is applied at rates commonly used by farmers (about 2 ton/acre). However, supplemental P fertilizer seldom is needed when these manure rates are applied, as long the manure is applied uniformly and the total P rate applied is within current recommendations according to soil-test P interpretations. In fact, these poultry manure application rates often apply more P then needed for corn and enough for at least one additional crop.

Results for both nutrients suggest that the reason for lower poultry manure nutrient availability compared with fertilizers is not solely due to the plant availability of N or P forms themselves. Use of manure nutrients does involve a higher degree of error and uncertainty than for fertilizers due to heterogeneity of the manure material, nutrient content variation, manure sampling error, difficulties for uniform application, and (for manure N) likely high rates of N loss through volatilization while the manure is being applied and after application.

Results from this project also indicated that N and P availability to crops is similar for various poultry manure sources, including egg layers, pullets, and turkeys. Therefore, the same N and P availability estimates, for first-year and subsequent years, are suggested for all poultry species. Similar results have also been obtained in lab incubations (55% plant available N for

turkey manure and 66% for layer manure; 90 to 100% plant available P for both sources) and field studies directly comparing time of manure application (estimated 42-55% first year N availability, including any volatilization losses, for both layer and turkey manure). In these field studies where the manure was applied in the fall or spring with incorporation within six hours or in the winter without incorporation until spring, there was no difference in N availability.

Summary

Poultry manure can work well as a crop nutrient source, with good crop response to applied nutrients. However, applications need to account for the specific nature of poultry manure and nutrient properties in order to best utilize nutrients contained in the manure. Of particular importance is the low first-year availability of N (50-60%), very low second-year N availability (0-10%), and no third year N availability; and the high availability of P (90-100%) and K (90-100%). Of equal importance is the typical high ratio of plant available P:N in poultry manure, which means that application rates must account for P loading as well as N available for plant use. At typical poultry manure rates applied for corn, usually only partial N requirements are supplied and multiple years of needed P are added. This results in a need for supplemental fertilizer N application and accounting for P applied for multiple crop years to avoid undesirable soil test P buildup. Use of egg layer (and other poultry species) manure as a nutrient source for crop production can be improved by careful use of diagnostic tools and consideration of management practices that affect nutrient supply and losses, such as manure nutrient analysis, application rate, and both application distribution and timing. Often these supply issues are more critical than estimates of manure nutrient availability.