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The Use of Poultry Litter in Row Crops

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Poultry litter contains many essential nutrients making it a potential source of nutrients and organic matter for row crop production. In eastern Arkansas, the value of poultry litter is best known for restoring the productivity of precision-leveled soils. In this fact sheet, we will answer some of the most frequently asked questions regarding the use of poultry litter as an alternative nutrient source for row crops on undisturbed soils.

What is poultry litter?

Poultry litter is a combination of poultry manure and bedding material, with the nutrient concentration of the litter depending on the type and amount of bedding material (rice hulls, sawdust, wood shavings, shredded paper), litter type (broiler, hen or turkey litter), number of flocks between cleanouts and the nutrients included in the poultry diet. The majority of the poultry litter generated in Arkansas is broiler litter, with small amounts of breeder hen and turkey litter.

Are the nutrients in poultry litter as good as the nutrients in chemical fertilizer?

Plants primarily absorb nutrients that are in the inorganic form (e.g., inorganic forms of N include nitrate and ammonium), regardless of their original source. Nutrients in inorganic fertilizers are readily available for plant uptake upon application, while the organic forms of nutrients are slowly available. Poultry litter contains both inorganic and organic forms of nutrients.

How much of the P and K in litter is considered available?

Some research has suggested that the P and K in manure are not as plant available as the P and K in inorganic fertilizers, while some others have suggested that they are. In Arkansas, we will assume that the majority (~90% to 100%) of the P and K in poultry litter is available for plant uptake during the season of application and that the total P and K content of litter, expressed in units of P_2O_5 and K_2O, is equivalent to equal rates of inorganic P and K fertilizers.

How much of the N in poultry litter is plant available?

Only a small portion (<10%) of the total nitrogen in poultry litter is present in the inorganic form (as nitrate and ammonium) – most of the N is present in the organic form. Organic N must be mineralized (broken down) into inorganic N before it is considered plant-available N. Mineralization of organic N is

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performed by soil microbes and is affected by temperature, soil moisture and soil pH, among other factors. Because the mineralization of organic N is affected by environmental and manure source factors, the general rule is that between 50% to 60% of the organic N is mineralized the first year, ~20% the second year and ~10% the third year. These values are good estimates that can be used ***to adjust*** the N-fertilizer rates of upland crops, but are not appropriate for flood-irrigated rice. For rice, multiplying the total N litter rate by 0.30 (30%) provides a reasonable estimate of the equivalent preflood urea-N rate. The release or mineralization of organic N from poultry litter is quite rapid, with the majority of N mineralized within two to four weeks after litter is applied in the spring. In general, for poultry litter to be a good N-fertilizer source, mineralization of organic N must be synchronized with the pattern of N uptake by the crop. Crop recovery efficiency of mineralized organic N is generally less than that for inorganic fertilizers due to application time, crop growth factors and the potential rates of N once applied to the soil.

Can litter be applied to any crop?

All crops can potentially benefit from the application of poultry litter. However, legumes, like soybeans, have the ability of fixing atmospheric N_2 gas, so they may not benefit fully from the N in the litter but will benefit from the P and K content. Previous research has shown that poultry litter and other animal manures applied directly to soybeans may reduce nodulation and N_2 fixation, but to compensate, soybeans absorb more soil or manure-derived N. In fact, these studies reported no appreciable yield losses and occasional yield increases when moderate rates were applied to the soybean crop.

Increased weed incidence has been reported by researchers, growers and consultants in fields or field areas receiving litter applications. Increased weed populations are most likely due to enhanced weed seed germination from organic acids present in manure and/or increased weed growth from the nutrients applied in manure, rather than the introduction of weed seeds in the litter.

Can poultry litter be applied to fields that are under no-till production?

Poultry litter applied to and remaining on the soil surface for extended time periods is susceptible to movement by wind and water. Also, poultry litter is an alkaline or high pH material. A great deal of the N in poultry litter can be lost to ammonia volatilization in warm and windy conditions, particularly in alkaline soils, if left exposed on the soil surface. Best management practices suggest that poultry litter should be mechanically incorporated as soon after application as possible to avoid loss of some of its N and P value.

What is the typical nutrient concentration in poultry litter?

The nutrient concentration in litter varies depending on the bedding system, feed ration, cleanout frequency and other production factors. The table below shows minimum, maximum and average nutrient and moisture levels of poultry litter from samples submitted to the University of Arkansas Agriculture Diagnostic Services Laboratory between 1993 and 2001. The wide variability in nutrient and moisture levels of fresh litter underscores the importance of analyzing the poultry litter before application. The laboratory analyzes manure on an "as-is" or moist basis and reports results (lbs N, P_2O_5 and K_2O) in both the moist and dry states per ton of material.

	% Moisture	N lbs/ton	P_2O_5 lbs/ton	K_2O lbs/ton
Minimum	2	22	18	23
Maximum	47	98	96	80
Median	22	60	57	52
Average	23	60	57	52

Values summarized by Karl VanDevender, Extension Engineer, University of Arkansas Division of Agriculture, Cooperative Extension Service.

How much litter should be applied?

The average N:P_2O_5:K_2O ratio found in litter in Arkansas is about 3.0:3.0:2.5. Since plants need more N than P, this ratio does not supply nutrients according to the plant's nutrient requirements. At present, the University of Arkansas recommends that poultry litter be applied based on the ***phosphorus*** needs of the crop to be grown and/or the corresponding phosphorus recommendation obtained from a ***soil test***. Applying litter based on the crop's ***nitrogen*** requirement would result in phosphorus rates well above the P-fertilizer rate required for optimum crop growth and yield. Once the rate of litter has been calculated (based on P requirements), supplemental nutrient rates can be estimated to fill the crop nutrient requirements.

When and how should the litter be applied?

Litter should be applied as close to planting time as possible and mechanically incorporated as soon after application as possible. This will minimize ammonia loss by volatilization and reduce the possibility of P loss by wind and water erosion. Litter applications well ahead of planting may result in increased loss of nutrients by runoff, volatilization, denitrification and/or leaching. The litter should be incorporated to promote faster release of nutrients and their efficient use during the growing season.

Should litter be stored on the farm?

Poultry litter should be stored for short periods, in amounts that supply the needs of the current growing season. Storing litter for longer periods may reduce the material's nutrient value and increase environmental risk and liability, especially if the material is not covered, as a portion of the nutrients could be lost by runoff. Research conducted in Georgia showed a 10% decrease in the percent nitrogen analysis of stored litter as compared to before storage.

Are there other benefits associated with the use of poultry litter?

In addition to nutrients, poultry litter is a source of organic matter. Infrequent or low litter application rates will not likely increase soil organic matter content. However, continued applications of low to moderate litter rates may help improve the soil structure and consequently increase the soil water-holding capacity, internal drainage and the ability of a soil to retain nutrients against leaching (increase CEC). Litter contains small amounts of micro-nutrients that may be beneficial to some crops on some soils. The organic acids produced during decomposition may help to chelate (protect) manure and soil nutrients and improve their uptake by plants.

Recommended practices to properly use poultry litter:

1. Take a representative soil sample to know how much P (P_2O_5) fertilizer is needed.
2. Obtain a chemical analysis of the litter.
3. Calculate the amount of litter needed to supply the amount of P_2O_5 required by your crop.
4. Calculate the amount of supplemental nutrients (i.e., N and K) needed.
5. Apply litter as close to planting as possible.
6. Incorporate the litter, if possible.
7. Take soil samples regularly to monitor buildup of nutrients in the soil.

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