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Manure as a Nutrient Source for Alfalfa

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INTRODUCTION

Alfalfa removes more nitrogen (N), phosphorus (P), and potassium (K) on a per acre basis than any other major crop in Indiana (Table I), so fertilizing productive alfalfa fields is expensive. Livestock are not very efficient at using the nutrients supplied in feed and excrete about 75 percent of the N, P, and K they consume. Even though manure nutrient contents can vary considerably from farm to farm (even within the same animal species), manures are excellent sources of N, P, and K. In general, poultry manure has the highest nutrient content of all solid animal manures (Table 2). When a livestock producer with a limited land base happens to be located near an alfalfa producer with a need for fertilizer nutrients, great things can happen for both parties involved.

THE MANURE MANAGER'S DILEMMA: THE RIGHT THING AT THE WRONG TIME

Livestock generate manure continuously, so one of the biggest challenges in manure management is matching the timing of application with nutrient uptake by crops. Livestock producers try to apply manure to corn prior to planting in spring and after harvest in fall. Unfortunately, these application windows are in direct conflict with other critical activities like field preparation, planting, and harvesting. Due to limited manure storage capacities and lack of available labor during spring and fall, many producers must apply large quantities of manure to wheat ground after harvest. Obviously applying high rates of manure to fields without actively growing crops is not a good management practice for maximizing nutrient use efficiency and has a significant potential to negatively impact surface and ground water resources.

An alternative management strategy is to apply the manure to established alfalfa (or other hay/pasture) fields immediately after harvest from June through September, when corn and soybean ground is usually not available for spreading. Spring manure applications to alfalfa can be delayed until after grain crops have been planted. By increasing the number of manure application opportunities, producers can generally distribute the manure to more distant fields, decrease application rates, increase nutrient use efficiency, and reduce the potential for soil compaction by not spreading on wet fields in the early spring and late fall.

THE ALFALFA PRODUCER'S HIGH COST OF LOW QUALITY ALFALFA

High quality alfalfa can be a valuable commodity, but clouds seem to take great pride in raining on our best crops six hours before we are ready to bale. As a result, we spend significant amounts of money on P and K fertilizers to produce excellent stands of hay, then stand by helplessly as crop quality is degraded by Mother Nature. The net effect of poor weather conditions is that nutrient use efficiency is often less than what we would like when dry matter yield is coupled with feed quality. Because alfalfa has such a high nutrient requirement 'relative to other crop species, anything a producer can do to reduce fertilizer input costs will greatly improve net profitability.

Although it goes without saying that nobody who attends Hay Day would ever consider trying to produce alfalfa on fields with marginal fertility levels, many of you have neighbors, brother-in-laws, etc. who have tried this with little, if any, success. Applying manure to these marginal fields is the quickest and most cost effective way to raise soil test levels into the optimum range for alfalfa production.

NUTRIENT MANAGEMENT CONSIDERATIONS

Animal manures are excellent sources of N, P, K, and many secondary and micronutrients for plants. Unfortunately, the relative amounts of these nutrients do not generally match crop nutrient needs. For example, if we base manure applications on crop N or K requirements, P is almost always applied in excess of plant needs. When using manure as a nutrient resource, we must make sure that we are supplying the proper mix of nutrients to our crops. Ration balancing for plants can be just as important as ration balancing for animals. For example, we have found that when ammonium N (which is the primary N form in manure) is applied to alfalfa plants that are low in potassium, plant survival is reduced. We do not see this effect when plants are supplied with adequate K. Therefore we must make sure that we have adequate soil test K levels and substantial amounts of Kin the manure we apply to alfalfa.

The N present in manure may also have some potential benefits for alfalfa during early regrowth. Bacteria present in alfalfa root nodules convert atmospheric N_2 to plant usable forms in exchange for carbohydrates produced by alfalfa during photosynthesis, so we do not routinely fertilize alfalfa with N. However, when alfalfa is cut, N2 fixation is drastically reduced for up two weeks. During this time, alfalfa uses protein N stored in taproots to support early shoot, growth. These proteins then begin to re-accumulate in the taproot about midway through regrowth. If alfalfa can use manure N to support shoot regrowth immediately after harvest, it may be possible to reduce taproot protein use during early regrowth and allow producers to harvest earlier and increase feed quality without reducing stand persistence.

As we stated earlier, when manure is applied to meet crop N or K requirements, P is almost always over-applied. High soil test P levels do not generally cause crop production challenges, but excessively high levels can increase the potential

for P runoff to surface waters. High P in surface waters can cause algae blooms, fish kills, and increase the cost of water treatment for human consumption. In addition, manure applied to fields with high soil test P and K levels is of little economic value. Therefore, manure applications should be avoided in high testing fields.

Our practical experience with producers is that about half say that putting manure on alfalfa has improved yields without reducing stand performance, while the other half say that manure killed the alfalfa and grasses moved in. Some of these differences may be due to management practices like application rates, timing of application after harvest, and compaction. Since grasses can yield well at much lower soil test K levels than alfalfa, we believe that soil test K and the relative amounts of ammonium N and K in the manure are important factors that will determine whether manure applications on alfalfa will succeed or fail.

Obviously, the value of manure nutrients will be decided by the two parties concerned, but in general the cost of these nutrients is much lower than purchasing a similar quantity of inorganic fertilizer materials. Remember, N should not be included in the fertilizer value of manure when it is applied to alfalfa and other forage legumes.

FINAL THOUGHTS

Manure nutrient management has become a critical issue facing livestock and poultry producers because more animals are being produced on fewer acres in large, intensively managed, production facilities. Livestock and poultry excrete about 75 percent of the nutrients they consume, so animal manures are excellent sources of plant nutrients. Unfortunately, many animal operations lack the land base required to utilize manure nutrients in an environmentally sustainable manner. If alternative land can not be found to apply these manure nutrients, many operations will hove to cease production. Crop producers should consider using manures and other by-product materials as fertilizer resources if they can effectively manage these materials within the constraints of their overall nutrient management program. After all, without the animals where would we market our crops?

Table 1. Nitrogen, phosphate and potash removal by by selected cropping systems.

Cropping System	N	P_2O_5	K_2O
	----------lbs removed /acre----------		
Corn grain, 150 bu/a	110 (175)	55	40
Corn silage, 25 tons/a	210(175)	80	200
Soybeans, 45 bu/a	170*	40	65
Wheat, (with straw) 90 bu/a	135(110)	65	115

Alfalfa, 6 tons/a	335*	80	300

Numbers in parenthesis are fertilizer recommendations

*Legumes fix atmospheric N_2 and do not require N fertilizers

Table 2. Typical nutrient contents of solid animal manures.

Species	Bedding or litter	Dry matter	Available N*	P_2O_5	K_2O
		%	----------lbs./wet ton----------		
Beef	No	15**	7	7	10
	No	52***	12	14	23
	Yes	50	11	18	26
Dairy	No	18	6	4	10
	Yes	21	6	4	10
Horse	Yes	46	6	4	14
Poultry	Yes	45	28	48	34
	No	75	42	45	34
	Deep pit	76	55	64	45
Sheep	Yes	28	8	11	26
	No	28	7	9	25
Swine	Yes	18	8	9	8
	No	18	7	7	7
Turkey	Yes	22	20	20	17
	No	29	15	16	13

* Assumes manure incorporated within 24 hours and manure applied near time of plant uptake.

**Open concrete lot.

***Open dirt lot.