Manure Use for Soybeans

Introduction

In recent years, New York State farms have increased their soybean acreage driven by both the high price of soybean meal and the low input costs for soybeans. Manure can provide an important source of nutrients for soybeans on dairy farms as well as neighboring crop farms. Soil pH and fertility guidelines for soybeans are presented in Factsheet 74. This factsheet focuses on the potential benefits and concerns related to manure use for soybeans.

Benefits

Soybeans do not require supplemental N fertilizer because they can fix N through a symbiotic relationship with *Bradyrhizobium* bacteria. Therefore, soybean fields are not the best choice for maximizing the value of manure nutrients if there are other crops like corn or grass hay fields that can benefit from the N. However, manure addition does have benefits beyond N supply and there are legitimate reasons to apply manure to that will be rotated to soybeans. For example, manure supplies nutrients other than N and where low soil test levels suggest a potential response to phosphorus (P), potassium (K), sulfur (S), or micronutrients, manure is a reasonable choice to supply these nutrients. Furthermore, since harvest of soybeans will remove nutrients such as P, K, and S from the field (Table 1), manure can reduce the need for fertilizer purchases.

Table 1: Estimates of soybean nitrogen (N), phosphorus (P_2O_5), potassium (K_2O), magnesium (Mg), and sulfur (S) removal (estimates assumes 52.2 lbs/bu test weight).

			Pounds removed		
			Soybean yield in bu/acre		
	Nutrient content		30	45	60
	% of DM	lbs/bu	lbs nutrient/acre		
N	6.41	3.35	100	151	201
P_2O_5	1.47	0.77	23	35	46
K_2O	2.24	1.17	35	53	70
Mg	0.25	0.13	4	6	8
S	0.31	0.16	5	7	10

Fields that receive manure are typically better able to cycle soil nutrients because they have greater water infiltration and holding capacity, tend to be better structured, and have a greater cation exchange capacity. As a result, manured soils are typically healthier soils that can supply more nutrients and sustain greater yields.

Figure 1: New York State farms have increased their soybean acreage driven by both the high price of soybean meal and the low input costs for soybeans.

Concerns/Considerations

Nitrogen fixation is reduced but not eliminated when manure is applied. In addition, a significant portion of the N taken up by soybean plants comes from nitrate supplied by mineralization of organic N sources in the soil. As a result, not all of the N applied with manure (or fertilizer) will be taken up by the plants. Research has shown that N losses from manure or fertilizer through leaching or denitrification can increase substantially if the additional N applied with fertilizer or manure exceeds 50% of the total N removed by the soybean harvest. Thus, it is recommended to limit applications of manure to rates that supply no more than 50% of the expected N removal based on manure N credit estimates. Assuming estimated crop removal shown in Table 1, N credits from manure should not

exceed 50, 75, or 100 lbs of N removed per acre for estimated soybean yields of 30, 45, or 60 bu/acre. Based on average dairy manure composition data, application rates of about 6,000-7,000 gallons/acre of liquid dairy manure (untreated) will supply about 100 lbs N/acre, if incorporated prior to planting of the soybeans. Limiting rates to these levels will also reduce the risk of lodging.

It is recommended to inject or incorporate the manure shortly after application (Figure 2) to reduce the risk of manure runoff and N volatilization. Rates should be adjusted based on the application method. See Agronomy Factsheet 4 for more details on estimating N credits from manure.

Figure 2: Injection or incorporation reduces the required application rate and runoff risk.

In corn grain-soybean rotations, fall application of manure into corn stubble can help break down the corn crop residue but fall manure application in row crop systems (especially without a cover crop) can result in increased nitrate leaching over the winter and early spring. Similarly, surface applications of liquid manure without incorporation are likely to result in N volatilization losses.

Another consideration with the use of manure as a fertilizer source is the potential to over-apply P. Crop removal of P varies, but is typically around 0.8 lbs P_2O_5 per bushel (Table 1). Manure applications that add P beyond crop removal to soils that test very high in P is not encouraged as such applications will further increase soil test P levels over time.

Disease pressure is an additional consideration when using manure on soybeans; fields with a history of diseases like *Pythium* and white mold are at higher risk of increased disease pressure when manure is applied. Therefore, manure application to such fields is not recommended either.

Guidance

If manure is applied to meet crop P, K, S, or micronutrient needs:

- Analyze manure nutrient content prior to determination of application rates.
- Limit rates to no more than 50% of estimated crop removal of N.
- Avoid or limit manure applications for soils that test very high in P.
- Consider injection or incorporation of spring applied manure to reduce volatilization and runoff losses.

Summary

Manure application to soybeans represents additional flexibility for dairies or their neighbors that may be spreading manure. Limit manure applications to rates that supply available N at no more than 50% of expected N removal with harvest of the crop. Understanding potential impact of manure management decisions before application can help farmers make better choices when applying manure.

Additional Resources

- Nutrient Management Spear Program Agronomy Fact Sheet Series: nmsp.cals.cornell.edu/index.html
- Cornell Guide for Integrated Field Crop Management: https://psep.cce.cornell.edu/store/guidelines/Item.aspx?Item=2
- Nutrient Guidelines for Field Crops in New York: nmsp.cals.cornell.edu/guidelines/nutrientguide.html

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

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