



# Manure Use for Alfalfa-Grass Establishment

Agronomy Factsheet #16 summarized the main points of a scientific literature search on the potential agronomic and environmental impacts of manure application to established alfalfa and mixed alfalfa-grass stands. This fact sheet focuses on manure use in the establishment year of the stand. Key questions addressed are "How much N, P, and K does an alfalfa crop remove per ton of DM?", "How much N, P and K is needed for alfalfa establishment?", and "What are the pros and cons of applying manure to build P and K fertility prior to stand establishment?".

## Crop Removal in the Establishment Year

- Alfalfa-grass harvest is expected to remove about 13 lbs of  $P_2O_5$  and 56 lbs of  $K_2O$  per ton dry matter (DM), and in average conditions, producers may typically expect to harvest 2 tons of DM in the establishment year.
- An alfalfa-grass mix with an average crude protein (CP) content of 15%, removes about 40 lbs of N per ton DM whereas a 20% CP crop will remove roughly 55 lbs of N/ton DM.

## Phosphorus and Potassium Management

- It should be recognized that crop nutrient removal is a management concept rather than a goal or requirement. Given this, with a typical P content of liquid dairy manure and crop removal estimates as listed above, an application of less than 2,000 gallons/acre will replace the P removed by a 2 ton DM/acre yield. For K, an application of a little more than 4,000 gallons/acre will replace K removed with a 2-ton DM/acre harvest. More accurate estimates can be obtained if actual harvest yield is tracked and manure is analyzed for nutrient content.
- If manure is applied to meet crop N needs for the corn in a corn/hay rotation, P and K deficiencies are not likely (Figure 1). Therefore, it is recommended to test soils for P and K (and other nutrients) annually, or at least once in three years (prior to rotation) to determine P and K needs.

- Phosphorus needs in the seeding year (for soils with a Cornell Morgan P test <80 lbs/acre P) can be met with spring-applied manure. However, rates should be limited to 3,000-4,000 gallons/acre to reduce N loss expected to occur when manure N is released shortly after application. This is because during the first 4-6 weeks after germination the N requirement is low. If soil test P levels are  $\geq 80$  lbs/acre, no additional P is needed and manure applications prior to seeding of a new alfalfa-grass stand should be avoided to reduce N loss and, for excessive P levels, enable P drawdown.

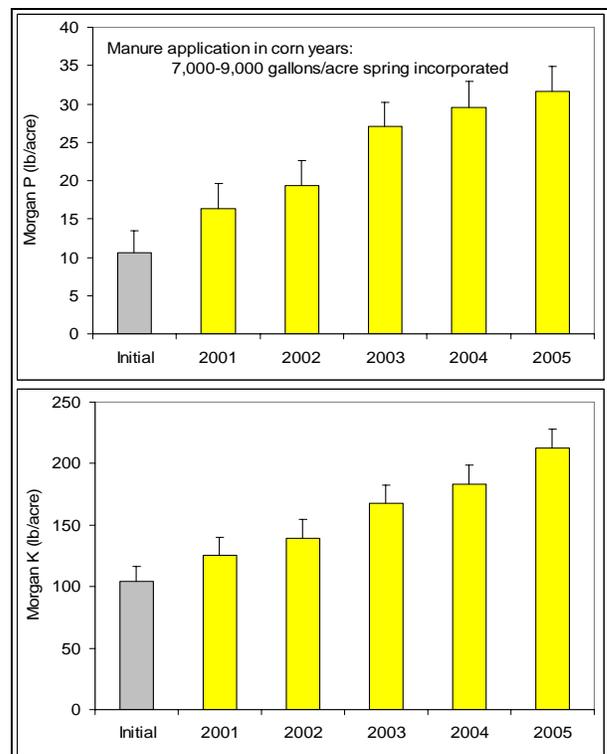


Figure 1: An example of phosphorus and potassium buildup with manure in corn years under a corn-alfalfa rotation. These trends were measured at the Aurora Research Farm in Central New York (calcareous soil).

## Nitrogen

- A very small amount of N is needed in the first 3-4 weeks after germination and before nodules for N fixation are in place. Initial soil nitrate levels and/or soil organic matter

mineralization will usually be sufficient to meet these minimal N needs.

- Most fields in a well-managed corn and alfalfa rotation will meet the conditions needed to establish nodules and initiate N fixation 3-4 weeks after germination. These conditions are: (1) soil pH of 6.8 or higher; (2) soil temperatures of 60°F or higher within 3-4 weeks after germination; (3) optimal soil P and S fertility; and (4) presence of healthy populations of N-fixing bacteria.
- Nitrogen fixation will ensure sufficient N for the new seeding as N needs increase during the first few months after establishment. As a result, applying pre-plant N (either with manure or fertilizer) to a new alfalfa or alfalfa-grass seeding will not increase yield. In addition, elevated nitrate levels due to manure or fertilizer application may negatively impact nodulation and N-fixation.



- Seedings with companion crops harvested for silage or grain (e.g. oats, spring barley, triticale) will require N, but fertilizer N applications should be limited to 60-80 lbs N/acre for agronomic returns. Manure can be applied to meet the N needs of the companion crop. However, spring manure application rates in excess of 6,000-8,000 gallons/acre can lead to lodging of the companion crop and increase N loss to the environment.

#### **In Summary/Management Options**

- When manure is applied to meet N needs during the corn portion of the rotation, P and K levels are expected to be adequate. In this case, a new seeding should not need additional P and K, and with manure nutrients now worth more than ever, it may

make sense to apply the manure to other fields. Use a soil test to confirm fertility needs.

- To reduce N losses, for seedings without a companion crop, manure should be applied only at low rates (3,000-4,000 gallons/acre), with fields needing P or K being a priority.
- Seedings with companion crops will need N and manure can be used to supply it but limit application rates to no more than 6,000-8,000 gallons/acre to reduce the risk of lodging and N loss to the environment.
- As K removal with harvest can be high, K levels can be a limiting fertility factor in older alfalfa stands. If soil test results indicate additional K is needed, a practical approach to rebuilding K levels over a rotation could be to apply manure at 4,000 gallon/acre after cuttings (where field conditions and odor management expectations allow) in the final years of the stand.

#### **Additional Resources**

- Cornell University Agronomy Fact Sheet #16 (Manure Use for Established Alfalfa-Grass Stands). <http://nmsp.css.cornell.edu/publications/factsheets.asp>.
- Manure Use for Alfalfa-Grass Production. Dept. of Animal Science Mimeo 231/Dept. of Crop and Soil Sciences Extension Series E08-3. Cornell University. By: Q.M. Ketterings, J.H. Cherney, K.J. Czymmek, E. Frenay, S.D. Klausner, L.E. Chase, and Y. H. Schukken. The 43-page document is downloadable at: <http://nmsp.css.cornell.edu/publications/articles/extension/Manureandalfalfa.pdf>.

#### **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  
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Nutrient Management Spear Program  
<http://nmsp.css.cornell.edu>

Quirine M. Ketterings, Jerry H. Cherney,  
Karl Czymmek, Erica Frenay, Stuart D. Klausner,  
Larry E. Chase, and Ynte Schukken

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