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Guidelines to Nitrogen Application on Agronomic Crops in Massachusetts

Introduction:

Adequate nitrogen is essential for optimum crop production. However, applying excess nitrogen can have serious environmental consequences. Nitrogen, in the form of nitrate, is extremely soluble in water and will be carried down below the root zone as the water drains. Over-application of nitrogen can mean a decrease in profits and an increased potential for ground water contamination.

Nitrogen dynamics in the soil are very complex with over 98% of the nitrogen in the top 6" of soil is 'tied-up' in soil organic matter and not readily available for plants. Nitrogen is released slowly as microorganisms decompose the soil organic matter. The rate of release increases as soils warm. This makes it very difficult to estimate nitrogen needs for the season based on a soil test taken before planting.

The largest demand for nitrogen by corn, for example, begins 30-40 days after emergence. If soluble nitrogen fertilizer is applied at planting, much of it may have been lost from the soil root zone through leaching by the time the corn has its greatest nitrogen requirement. In determining nitrogen fertilizer rates it is important to be aware of all nitrogen sources on the farm and to give them adequate nitrogen fertilizer credits.

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Nitrogen Sources on Farms:

Soil Organic Matter - Organic matter is approximately 5% nitrogen by weight. As it decays, nitrogen will be released in a form suitable for plant use. About 10-40 lbs/acre of fertilizer equivalent-N will be available in a growing season for every 1% of organic matter in the soil. Rate of N release is dependent on soil temperature, pH, moisture, oxygen and type of organic material. For example, a soil with an organic matter content of 4% in average will supply about approximately 80 lbs N/acre.

Manure - Animal manures supply nitrogen to crops, but the fertilizer equivalent from manures will vary greatly depending on such factors as animal species, moisture content, handling and storage, and the elapsed time between spreading and incorporation. If manure is applied, it is important to know the analysis and the amount that you are spreading. If for example 20 tons/acre of dairy manure (10 lb N per ton in average) is applied and incorporated into soil the same day, then approximately 120 lbs/acre of nitrogen is available that year. Even though 200 lbs of nitrogen would be added to the soil, only 50 to 60% of that nitrogen is available the first year with the remainder becoming available in subsequent years. However, if the manure is incorporated after 48 hours or later only 40 lbs/acre of nitrogen will be available. More than 60 lbs will have been lost to the atmosphere and through runoff. Liquid portion of manure contains almost 50% of the total N and nearly 90% of the potassium. Therefore, it is very important to conserve the liquid portion of the manure.

Legumes - Legumes can supply substantial amounts of nitrogen when incorporated. The amount of nitrogen will vary widely depending on the legume species, the amount of time that it has been allowed to grow before incorporation, in addition to other climatic factors. The fertilizer equivalent can be as high as 100 lbs/acre from a reasonable stand of

alfalfa, or a good stand of hairy vetch planted in early to mid-September and incorporated in late May.

Non-legume cover crops - Non-legumes such as winter rye and oat are not as rich in nitrogen as legumes; however they will conserve nitrogen in the field and eventually release it when incorporated.
Many non-legumes are very efficient in 'mopping-up' nitrogen that is still available in the soil after crops are harvested. This emphasizes the importance of seeding cover crops soon after harvest since most of the leaching of nitrates in the Northeast occurs in the fall and spring. We are recommending that legumes be seeded in combination with grasses like rye and oat so that less nitrate will move below the root zone. Although legumes can fix nitrogen from the atmosphere, most are not as efficient as grasses in taking up nitrogen from the soil.

Composts - Composts can also be used to add nutrients and organic matter to the soil. Composting dairy manure can be used to help stabilize nitrogen in excess to crop requirement. Composts vary in their nitrogen supplying capacity and even though nitrogen is stabilized, some can supply substantial amounts of nitrogen.

Chemical Fertilizer - Most formulations of chemical fertilizer are readily available to crops soon after soil application. This however, is accompanied by a high leaching potential. Spring applications of chemical fertilizers coupled with the usual wet conditions at this time of the year increase the danger of leaching. As mentioned above, the greatest amount of nitrogen uptake by corn begins several weeks after plant emergence. Timing fertilizer applications to coincide with this time of greatest demand by the crop will make for more efficient fertilizer utilization.

Recommended Nitrogen Rates for Agronomic Crops:

Corn Silage-Recommended nitrogen rates are based on yield goals and should be reduced by the N credits from previous crops, previous manure application and current manure application. In Massachusetts the following rates are recommended:

- 140 lb N/ac for less than 20 ton corn silage per acre (or <100 bu/ac)
- 160 lb N/ac for 20 to 24 ton corn silage per acre (or 100 - 130 bu/ac)
- 180 lb N/ac for greater than 24 ton corn silage per acre (or >130 bu/ac)

Legume Based Hay-Nitrogen fertilizer application is not generally recommended for forage legume hay crops including alfalfa, clovers and birdsfoot trefoil. These legumes can fix sufficient atmospheric N to supply the needs of both the legume, and the grass in legume-grass mixtures. Adding nitrogen may encourage competition from the grass and from weeds as stands thin or are damage by harvest equipment or by winter conditions.

Use of a starter fertilizer during establishment of up to 20-60-20 lb (N-P_2O_5-K_2O) per acre may be beneficial especially in cool soils without a history of manure application. Band placement if possible to maximize the benefit of the phosphorus is highly recommended. Do not use any nitrogen in no-till seeding as this will encourage weed competition.

Application of manure when surplus to needs of the corn crop is possible to vigorous alfalfa stands and to stands that are running out. It is not recommended to stands in early stages of decline or to legume-grass hays where there is a desire to retain the legume.

For legume grass mixtures use the grass hay maintenance recommendation for hay crops that have little or no legume component. For example if the amount of birds foot trefoil has declined to 30% or less use the grass hay recommendation.

Grass Hay-For all perennial grasses seeded alone apply 40-40-40 lb per acre, banding if possible. Do not apply any nitrogen as plow down. Applying 30 lb N per acre in late summer of the establishment year can be beneficial.

For established grass apply up to 150 lb N per acre per year in split applications. Apply 50 to 60 lb/acre when the grass first greens up and 50 lb/acre after each cutting. The amount applied after each cutting should be based on the expected yield for the next cutting.

Pasture-Fertilizing pastures with nitrogen is not recommended if the legume content is greater than 30% because the legumes (usually clovers or trefoil) provide adequate nitrogen through N fixation. If there is less than 30% legume, fertilize similar to grass hay with 100 to 150 lb N per acre per year depending on the productivity and growth cycle of the species. Split applications applying at least three times, early spring, early summer, and late summer, with no more than 50 lb N per acre at any one time.

For more information visit www.umass.edu/cdl

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