# Nutrient Management FAQs and Responses

## MANURE MANAGEMENT

### *I am planning for fall/winter applications and manure spreading. How do I prioritize fields/spreading locations?*

There are many factors to consider when determining which fields to winter spread manure, such a distance from source and transportation costs, field and crop residue conditions impacting nutrient runoff and leaching risks (field slope, percent residue cover, snow depth, soil texture, depth to bedrock, etc), spreading restrictions, setbacks and regulations, soil test levels, and next year's crop nutrient need.

To reduce loss and/or increase the potential crop response to applied nutrients, you may consider prioritizing crop fields:

- ✓ With very low and/or low soil tests for phosphorus and potassium
- ✓ With living plant cover
- ✓ Rotating into crops with high nitrogen, phosphorus, and potassium needs next growing season
- ✓ With high crop yield potential
- ✓ Deep, well to moderately well-drained, loamy or finer textured soils, without tile drainage

Follow all local and state regulations for winter spreading and consult the Wisconsin Runoff Risk Advisory Forecast before applications.

### *Am I out of compliance with my nutrient management plan (NMP) if I sell manure to a grain farmer? My neighbor needs more acres to spread their manure on, is it OK to spread it on my fields?*

Farms are allowed to sell/trade/apply manure to other farms. For non-permitted farms, the amount of manure moved off-farm should be noted in the field notes section of the source farm's nutrient management plan and the manure should be added as a nutrient source in the receiving farms' nutrient management plan.

Permitted farms should contact the Wisconsin Department of Natural Resources CAFO Agricultural Runoff Management staff - https://dnr.wisconsin.gov/topic/CAFO/contacts.html - for nutrient management plan requirements.

### *What nutrients are available in pen pack manure?*

The nutrient value of pen/bed pack manure is highly variable due to the amount and type of bedding used, bedding frequency and management, ration fed, housing type, season, and manure storage, application timing/time to incorporation. Therefore, manure testing is strongly recommended to accurately determine the amount of nutrients that will be crop available.

As bed/pen pack manure often contains significant amounts of high C:N ratio bedding material, nitrogen tie-up (immobilization) can occur after field applications. Farms should monitor crops for potential immobilization-induced nitrogen deficiencies.

### *Can certified manure compost be applied on shallow soils? Normally, the farm would apply fertilizers on these areas.*

Farms should contact their local land and water department for clarification on local and state regulations on the use of certified manure composts in shallow to bedrock areas and processes for verifying compost meets pathogen reduction standards.

### *What is my manure credit if it is not incorporated in the fall? How long does that credit last?*

Manure phosphorus and potassium credits are not significantly impacted by the lack of manure incorporation, regardless of the timing of application, unless the nutrients and/or manure are lost through erosion or surface water runoff.

However, due to gaseous losses (volatilization), manure nitrogen credits are impacted by the lack of manure incorporation, during all application seasons, as outlined in Table 9.3 from Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin. Additionally, similar to phosphorus and potassium, additional nitrogen losses may occur via erosion and/or surface water runoff of manure solids or dissolved nitrogen.

Depending on environmental and soil conditions, fall-applied nitrogen, both commercial or manure-sourced, is more susceptible to early spring leaching and/or denitrification losses than spring-applied or in-season applied nitrogen. Nitrogen availability from fall applied manure can be estimated using a pre-sidedress nitrate test (PSNT) in corn and is discussed in Soil Nitrate Tests for Corn Production in Wisconsin Soil Nitrate Tests for Corn Production in Wisconsin.

**Table 9.3.** Estimated first-year available nutrient content of manures.[a]

| | N | | | | | |
|---|---|---|---|---|---|---|
| | Time to incorporation | | | $P_2O_5$ | $K_2O$ | S |
| | > 72 hours or not incorporated | 1 to 72 hours | < 1 hour or injected | | | |
| **Solid manure** | lb/ton | | | | | |
| Beef | 3 | 4 | 5 | 6 | 10 | 1 |
| Dairy: semi-solid (11.1–20.0% DM[b]) | 2 | 2 | 3 | 3 | 5 | 1 |
| Dairy: solid (> 20.0% DM) | 2 | 3 | 3 | 3 | 6 | 1 |
| Goat | 3 | 4 | 5 | 6 | 8 | 1 |
| Horse | 2 | 3 | 4 | 5 | 6 | 1 |
| Poultry: chicken | 24 | 27 | 29 | 35 | 26 | 2 |
| Poultry: duck | 6 | 7 | 7 | 8 | 7 | 1 |
| Poultry: turkey | 26 | 28 | 31 | 35 | 25 | 2 |
| Sheep | 5 | 6 | 7 | 7 | 19 | 1 |
| Swine | 7 | 9 | 12 | 10 | 8 | 1 |
| **Liquid manure** | lb/1000 gal | | | | | |
| Beef | 5 | 6 | 8 | 6 | 12 | 1 |
| Dairy: liquid (< 4.0% DM) | 4 | 6 | 7 | 3 | 11 | 1 |
| Dairy: slurry (4.1–11.0% DM) | 7 | 10 | 12 | 6 | 17 | 1 |
| Goat | 4 | 5 | 6 | 6 | 15 | 1 |
| Poultry | 6 | 7 | 7 | 6 | 7 | 1 |
| Swine: finish (indoor pit) | 17 | 22 | 28 | 14 | 22 | 2 |
| Swine: finish (outdoor pit) | 7 | 9 | 12 | 6 | 8 | 1 |
| Swine: (farrow-nursery, indoor pit) | 8 | 10 | 14 | 6 | 10 | 1 |
| Veal calf | 3 | 4 | 4 | 2 | 13 | 1 |

[a] These estimates are based on the typical total nutrient contents of manures tested in Wisconsin (Table 9.2) multiplied by the estimated first-year nutrient availability (Table 9.1).

[b] DM = dry matter

### *Applying liquid manure to standing alfalfa, sandy soils. Good agronomically? Good environmentally?*

The potential for nutrient loss is reduced when manure is applied to actively growing crops than during times of fallow. The application of liquid manure to productive alfalfa stands growing on coarse-textured soils can be a sound agronomic and environmental practice if manure application rates do not exceed short-term crop needs and manure is applied in a manner and during times of the growing season to reduce runoff and leaching losses. To reduce potential damage to the alfalfa stand, applications should be made immediately after harvest to soils of with a proper moisture content to reduce soil compaction and crown damage. Rates of no more than 3,000 to 5,000 gallons per acre are recommended.

More information on the application of manures to alfalfa is found in Considerations when Applying Manure to Alfalfa.

### *If a field is high in phosphorus (P), but low in nitrogen (N), what can I do if manure cannot be applied?*

In situations where manure cannot be applied to a field, nitrogen can be added by using a single nutrient, nitrogen-based fertilizers, such as urea, ammonium nitrate or urea-ammonium nitrate (UAN) solution.

In this situation, the long-term drawdown of soil phosphorus levels will reduce the potential risk of phosphorus movement to local waters and reduce the soil test phosphorus and/or P-Index values below the threshold limiting manure applications to the field. Reducing soil test phosphorus levels can take many years to decades depending on soil test levels but is hastened in systems where crop biomass is removed (e.g., hay, corn silage) as compared to grain-only systems.

More information on managing phosphorus can be found in the publication Management Options for Farms with High Soil Test Phosphorus Levels.

## NUTRIENT MANAGEMENT PLANNING/SnapPlus

### *What is the best way to address overapplication of nitrogen identified in SnapPlus?*

The nutrient application rates set in SnapPlus meet state 590 nutrient management requirements and are based upon Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin.

If SnapPlus identifies an overapplication and all crop rotation, soil, and application information are correct, the nitrogen application rate in SnapPlus and in-field should be reduced to meet recommendations.

### *What will happen if my nutrient management plan is not up to date?*

Maintaining a current nutrient management plan is required by several local, county, state, and federal cost-share and/or incentive programs. If you participate or have participated in these programs, non-compliance with nutrient management plan obligations may result in a loss of benefits, requirement for repayment of cost-share funds, etc. Additionally, many counties have local ordinances requiring nutrient management plans.

To learn more, contact your local land and water office and/or Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) to discuss your requirements and responsibilities.

The WI DATCP Nutrient Management Division website contains contact information, information on pertinent legislation, upcoming farmer trainings, certified soil testing laboratories, and more (see https://datcp.wi.gov/Pages/Programs_Services/NutrientManagement.aspx).

## NITROGEN MANAGEMENT

### *What cover crops/green manures provide a nitrogen (N) credit?*

While non-legume cover crops, such as grasses and winter cereal grains(e.g., oats, winter rye, winter triticale) and brassicas (e.g., radish, rapeseed, turnips, etc), may scavenge nitrogen within the soil profile, a reduction in the nitrogen application rate to the subsequent crop is not recommended.

See Does OilSeed Radish Provide Nitrogen Credits and Cover Crops, Manure, and Nitrogen Management.

With legume cover crops (e.g., clovers, vetches), potential nitrogen crediting is dependent on stand density and biomass accumulation. For fall-seeded, legume cover crops achieving less than 6 inches of growth, a maximum of 40 pounds of nitrogen per acre credit is recommended.  Legume cover crops achieving minimal growth/biomass production likely provide no appreciable nitrogen credit to the following crop.

Potential nitrogen crediting of crimson clover and berseem clover planted after winter wheat in Sheboygan County, WI is discussed in Berseem and Crimson Clovers After Winter Wheat.

More information on nitrogen crediting of legumes can be found on pages 78-80 in Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin

It is important to remember estimated nitrogen credits referenced in the above publications

are for cover crop/green manure legumes planted in a solid stand, not a diverse mix. Potential nitrogen credits from cover crop mixes containing legumes will be dependent on the prevalence of legumes in the mix, overall cover crop mix composition, stand density, cover crop maturity, termination timing, and biomass accumulation.

## *How much nitrogen (N) credit can I take for rotating a marginal alfalfa field to corn?*

The potential first-year nitrogen credit for a terminated alfalfa stand is dependent on stand density, amount of vegetative regrowth, and soil texture. Suggested credits are listed below. The minimum credit on medium/fine textured soils is 90 pounds of nitrogen per acre.

**Table 9.4.** Forage legume nitrogen (N) credits.

| | Medium-/fine-textured soils | | Sands/loamy sands | |
|---|---|---|---|---|
| Crop/stand density | > 8″ regrowth | < 8″ regrowth | > 8″ regrowth | < 8″ regrowth |
| **First-year credit** | ------------lb N/a to credit------------ | | | |
| Alfalfa | | | | |
| Good (70–100% alfalfa, > 4 plants/ft²) | 190 | 150 | 140 | 100 |
| Fair (30–70% alfalfa, 1.5–4 plants/ft²) | 160 | 120 | 110 | 70 |
| Poor (0–30% alfalfa, < 1.5 plants/ft²) | 130 | 90 | 80 | 40 |
| Red clover, birdsfoot trefoil | ------------80% of alfalfa credit for similar stands------------ | | | |
| Vetch | 160 | 90 | 110 | 40 |
| **Second-year credit** | ------------lb N/a to credit------------ | | | |
| All crops, good or fair stand | 50 | 50 | 0 | 0 |

## *\Is my winter rye cover crop going to tie up nitrogen in the spring? Should I manage my fall-seeded cover crops differently?*

Wisconsin research has shown winter rye cover crops accumulating greater than 1,000 lbs dry biomass per acre at the time of spring termination may result in the tie-up (immobilization) of plant available nitrogen (N) when fall manure was applied. See Cover Crops, Manure, and Nitrogen Management.

Recommended adjustments to manure applied nitrogen with varying accumulations of winter rye biomass, from the above publication, are summarized in the table below. Note, this research found winterkilled spring barley and annual ryegrass had negligible impacts on nitrogen tie-up from fall-applied manure.

**Table 2.** Average aboveground biomass and N uptake for each cover crop and change in plant available nitrogen (PAN) in the spring relative to no cover crop use.

| Cover crop | Total aboveground biomass (lb/ac)* | N uptake (lb-N/ac)† | Change in PAN (lb-N/ac)‡ |
|---|---|---|---|
| **Annual ryegrass** | 970 | 26 | -5 |
| **Spring barley** | 1,210 | 46 | -10 |
| **Winter rye** | 2,150 | 54 | -40 |

* Cover crop biomass for winter rye was measured in the spring prior to chemical termination; biomass for annual ryegrass and spring barley was measured prior to winterkill in the fall.
† N uptake in aboveground biomass.
‡ PAN includes both nitrate-N and ammonium-N and was determined in the upper 2′ of soil 10 days before corn was planted; the change in PAN is the difference between the PAN in cover cropped plots minus the PAN in plots without cover crops. See study inset on page 3 for details.

The impact of cover crops on nutrient availability to the subsequent crop is an important consideration when making cover crop management decisions. If nitrogen tie-up is a concern, cover crops should be terminated before accumulating more than 1,000 pounds of dry matter per acre. However, as cover crops impact many crop production factors, such as

weed, disease, and insect populations, wind and water erosion risk, soil water and organic matter dynamics, manure applications, crop planting strategies, etc, farms should consider all potential agronomic, economic, and environmental benefits/challenges when determining a cover crop management strategy.

### *What are the most economical sources of fertilizer nitrogen? What nitrogen fertilizers give me the greatest return on investment (ROI)?*

In general, when comparing commercial fertilizers, the most economical nitrogen sources are typically those requiring the least processing to manufacture and/or those that can be sourced locally.

More specifically, to determine the most economical fertilizer source, you must identify the fertilizer with the lowest price per pound of available nitrogen. Calculating the price per pound of nitrogen requires some math. For example, if urea costs $700 per ton, the cost per pound of nitrogen in urea is $0.76. Nitrogen price can also be calculated with the N Price Calculator App.

### *Will nitrification and/or urease inhibitors help protect my N fertilizer investments?*

Urease and nitrification inhibitors impact the nitrogen cycle in different ways. Urease inhibitors temporarily delay the chemical conversion of urea-nitrogen to ammonium. Urease inhibitors are often used with in-season, surface-applied urea fertilizers to reduce potential volatilization losses that may occur between the time of fertilizer application and receiving of sufficient rain to dissolve and move the nitrogen into the soil profile.

Nitrification inhibitors are used to temporarily delay the microbial conversion of ammonium to nitrate and reduce the potential risk of nitrogen loss via leaching or denitrification. Nitrification inhibitors are often used with fall-applied ammonium-based fertilizers or manures. As part of NRCS 590 standards, nitrification inhibitors can also be used to meet application restrictions when using commercial ammonium-based fertilizers in the spring and summer to full season crops grown on high permeability (P) soils, when applying manure with less than or equal to 4% dry matter to wet (W) soils or when fall applying manure with less than or equal to 4% dry matter to permeable (P) and shallow to bedrock (R) soils.

The economic benefit of using nitrification and/or urease inhibitors is highly variable in corn production systems in Wisconsin. However, their benefit is greater when losses of nitrogen are more likely to occur due to unideal soil, weather, or fertilizer application conditions. In these situations, inhibitors may provide increased insurance against potential yield reductions if nitrogen losses occur.

The table below, from Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin, summarizes the relative probability of a nitrification inhibitor increasing corn yield.

**Table 6.7.** Relative probability of increasing corn yield by using a nitrification inhibitor.

| | Time of N application | | |
|---|---|---|---|
| **Soil type** | **Fall** | **Spring preplant** | **Spring sidedress** |
| **Sands and loamy sands** | not recommended | good | poor |
| **Sandy loams and loams** | fair | good | poor |
| **Silt loams and clay loams** | | | |
| Well drained | fair | poor | poor |
| Somewhat poorly drained | good | fair | poor |
| Poorly drained | good | good | poor |

The use of nitrification inhibitors with manure is discussed in Use of Nitrification Inhibitors with Manure.

A discussion of urease and nitrification inhibitors and Midwest research results is found in the North Dakota State University Publication, Nitrogen Extenders and Additives for Field Crops.

### *How low can my nitrogen rate go without impacting corn yield?*

When determining the amount of nitrogen to apply to a corn or wheat crop, profitability should be the focus, not yield. The first step to calculating the most profitable rate of nitrogen fertilizer to apply is to determine the maximum return to nitrogen (MRTN) factor. The MRTN allows us to determine the range of profitable nitrogen rates for a field. The MRTN is based on the expected cost of nitrogen fertilizer ($/lb) and price corn ($/bu). An example MRTN Calculation:

$$\frac{\$1000}{1\ ton\ urea} \times \frac{1\ ton}{2000\ lbs} \times \frac{1\ lb\ urea}{0.46\ lb\ N} = \frac{\$1.09}{lb\ N}$$

then

$$\$1.09/lb\ N \div \$5.00/bu\ corn = \textbf{MRTN of 0.20}$$

Once the MRTN has been calculated the appropriate rate is selected by correlating the MRTN factor with the yield potential of your soil. The suggested corn N rates can be found in table 6.1, page 38, of Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin.

**Table 6.1.** Suggested nitrogen (N) application rates for corn at different nitrogen:corn grain price ratios.

| | Nitrogen:Corn price ratio | | | |
|---|---|---|---|---|
| | **0.05** | **0.10** | **0.15** | **0.20** |
| **Soil** and previous crop | ------ total lb N/a to apply[a] ------ | | | |
| **Loamy: high yield potential soil** | | | | |
| Corn, forage legumes, legume vegetables, green manures[d] | **190**[b]<br>170 -------- 210[c] | **165**<br>155 -------- 180 | **150**<br>140 -------- 160 | **135**<br>125 -------- 150 |
| Soybean, small grains[e] | **140**<br>125 -------- 160 | **120**<br>105 -------- 130 | **105**<br>95 -------- 115 | **90**<br>80 -------- 105 |
| **Loamy: medium yield potential soil** | | | | |
| Corn, forage legumes, legume vegetables, green manures[d] | **145**<br>130 -------- 160 | **125**<br>115 -------- 140 | **115**<br>105 -------- 125 | **105**<br>95 -------- 110 |
| Soybean, small grains[e] | **130**<br>110 -------- 150 | **100**<br>85 -------- 120 | **85**<br>70 -------- 95 | **70**<br>60 -------- 80 |
| **Sands/ loamy sands** | | | | |
| Irrigated—all crops[d] | **215**<br>200 -------- 230 | **200**<br>185 -------- 210 | **185**<br>175 -------- 195 | **175**<br>165 -------- 185 |
| Non-irrigated—all crops[d] | **140**<br>130 -------- 150 | **130**<br>120 -------- 140 | **120**<br>110 -------- 130 | **110**<br>100 -------- 120 |

[a] Includes N in starter.
[b] Rate is the N rate that provides the maximum return to nitrogen (MRTN).
[c] Range is the range of profitable N rates that provide an economic return to N within $1/a of the MRTN rate.
[d] Subtract N credits for forage legumes, legume vegetables, animal manures, and green manures. This includes first-, second-, and third-year credits where applicable. Do not subtract N credits for leguminous vegetables on sand and loamy sand soils.
[e] Subtract N credits for animal manures and second-year forage legumes.

**Corn N rate can also be calculated using the Corn N Rate Calculator app.**

# GENERAL NUTRIENT MANAGEMENT

### *Am I removing more money by baling cornstalks than I am bringing in by selling the bales?*

The nutrient content of baled cornstalks is variable and is influenced by the nutrient content of the initial plant material, as well as the amount of rainfall received between corn grain harvest and stalk baling. Research by Iowa State University suggests an average of 12 pounds N, 3 pounds phosphate ($P_2O_5$), and 19 pounds of potash ($K_2O$) are removed with each dry matter ton of corn stalks. More information can be found in Iowa State Extension Publication -Nutrient Considerations with Corn Stover Harvest Nutrient Considerations with Corn Stover Harvest. Remember, phosphorus (P) and potassium (K) contents of fertilizers and crop biomass are often expressed on the oxide basis (phosphate (P2O5) and potash ($K_2O$), respectively) rather than elemental basis (P and K). To convert from P concentrations to $P_2O_5$, multiply P by 2.29. To convert K concentrations to $K_2O$, multiply K by 1.2.)

To calculate the value of N, $P_2O_5$ and $K_2O$ in cornstalks, multiply the average cost of a pound of comparable fertilizer-derived nutrient by the pounds of nutrient in a dry matter ton of corn stalks (listed above). Sum the resulting values to derive the approximate value of N, $P_2O_5$ and $K_2O$ in a dry matter ton of baled corn stalks. For example, if the cost per pound nutrient in commercial fertilizer is $0.90 per pound of nitrogen and $0.70 per pound of $P_2O_5$ and $K_2O$, the value of a dry matter ton of cornstalks would be $26.20.

(12 lbs N * $0.90/lb N) + (3 lbs $P_2O_5$ * $0.70/lb $P_2O_5$) + (19 lbs $K_2O$ * $0.70/lb $K_2O$) = $26.20 per dry matter ton of cornstalks

It should be noted cornstalks contain additional macro and micronutrients, as well as carbon, all of which have value to the soil and crop production systems. These values are not reflected in the fertilizer replacement value calculated using the method above. Additionally, if cornstalks are removed from the field, the potential for wind and water soil erosion risk and nutrient loss is increased due to reduced soil cover.

It should also be noted, if the stalks are retained in the field, nutrients may not be available to the subsequent cash crop due to slow decomposition of the corn residue, nutrient tie-up (immobilization), and/or loss of the nutrient via runoff, leaching, or erosion.

### *Can I get trendline yields with soil test phosphorus (P) and potassium (K) in the optimum range or do I need to have levels in the high or excessively high range?*

Soil fertilizer recommendations are based upon the probability of a yield response resulting in a positive return on investment (ROI) and long-term profitability, not the maximization of crop yield. Applying crop nutrients based upon crop response when soil tests are in the low and very low testing categories, resulting in the gradual build-up of soil test levels to optimum, and then applying nutrients based on crop removal to maintain soil test levels in the optimum range is recommended long-term strategy for managing phosphorus and potassium.

### *What fields will give me the best return on investment (ROI) on supplemental nutrients?*

Given there are no other yield-limiting factors (e.g., excessive or poor soil drainage, continuing weed, disease, or insect pressures, lower than optimum soil pH, etc), the greatest return on investment (ROI) with phosphorus (P) and potassium (K) fertilizers are typically achieved by applying fertilizers on the lowest testing fields.

As outlined in Optimum Soil Test Levels in Wisconsin, farms might expect a positive yield response from adding phosphorus or potassium fertilizers, on average, >90 percent of the time for very low, 60 to 90 percent for low, 30 to 60 percent for optimum, 5 to 30 percent for high, <5 percent of the time for very high/extremely high testing soils. As soil test levels increases, not only does the probability of a positive yield response decrease but so does the potential net return from fertilizer applications.

The recommended fertilizer rates for low and very low testing soils are based upon crop removal rates, plus an additional nutrient amount that will build soil test levels over time. Applying more than the recommended rates outlined in Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin will typically not produce a profitable crop response even on low and very low testing soils.

Soil fertility is just one factor influencing farm profitability. Selecting the proper hybrid/variety and pest management strategies for the field, ensuring proper field equipment setup and calibration, actively scouting and monitoring crop condition throughout the growing season, and limiting costs associated with field preparation, maintenance, and crop harvest

and storage are just a few options for maintaining profitability during times of high input prices. Suggestions for improving agronomic profitability are outlined in Grain Management Considerations in Low-Margin Years.

### *Should sulfur be added to my fertilizer program if I am not testing for it?*

Sulfur deficiencies are more likely to occur when growing high sulfur demanding crops on low cation exchange capacity (sandy) and/or low organic matter soils that have not received manure within the past two years.

Sulfur applications are more likely to have a positive economic response when applied to:

- ✓ Coarse textured soils where no manure has been applied within the past two years and crops with a medium to high relative need for sulfur are to be grown
- ✓ High sulfur need – alfalfa, brassicas, corn silage, sorghum-sudangrass forage, and soybean for grain and straw
- ✓ Medium sulfur need – corn grain, red clover, small grains for grain and straw, dried beans, potatoes
- ✓ Sulfur deficiency is verified by soil or tissue testing and relative sulfur need of the crop warrants an application

Recommended application rates are found below.

**Table 8.2.** General sulfur (S) fertilizer recommendations.

| Crop | S application rate (lb S/a) |
|---|---|
| **Forage legumes** | |
| Incorporated at seeding | 25–50 |
| Topdressed on established stands | 15–25 |
| **Corn, small grains, vegetable, and fruit crops** | 10–25 |

Sulfur fertilization is further discussed in pages 63-67 of Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin.

### *With the potential of not being able to purchase fertilizers in the spring, what should farms be doing?*

Each growing season presents its own challenges, with potential fertilizer supply and pricing challenges looming for 2022. While no one can predict exactly what situation farms will be facing come spring, adequate preplanning, including the use/development of a nutrient management plan and consideration of alternative crops or nutrient sources, can help farms address this challenge. However, as we look to the future, we need to ensure short-term work arounds to fertilizer challenges in 2022 don't have long-term consequences to farm viability and profitability for years to come. Any significant changes to crop rotations, and/or cropping, livestock, and manure management strategies must carefully consider impacts to all farm enterprises, cash flow and finances, and farm liabilities and risk management strategies.

As management approaches will look different for each farm, outlined below are some basic questions to help farms take stock of crop nutrient supply and needs.

#### Inventory On-Farm Nutrient Sources

- ✓ How much manure will be available for application to crop fields pre-plant and in-season?
- ✓ What is the nutrient content of the manure(s)?
- ✓ Are you using farm-specific manure test values or average "book values"?
- ✓ Are you using nitrogen credits from legumes such as alfalfa and clover?

#### Assess Crop Nutrient Needs

- ✓ Do you have up-to-date soil tests (sampled four years ago or less)?
- ✓ Have you considered updating soil tests on high producing fields sampled greater than two years ago where soil tests levels were in the very low, low, or optimal ranges?

- ✓ Are you following recommended nutrient application rates set forth in Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin?
- ✓ Are you using the appropriate Maximum Return to Nitrogen (MRTN) nitrogen to grain price ratio to calculate the optimum economic nitrogen rate for corn and wheat?
- ✓ Will manure-supplied on-farm meet current cropping system nutrient needs?
- ✓ Do you have fields where manure cannot be applied, and commercial fertilizers must be used?
- ✓ What nutrients and what amounts will need to be purchased commercially?
- ✓ Are you using the Preplant Nitrate Test (PPNT) or Pre-sidedress Nitrate Test (PSNT) to improve efficiency of nitrogen applications (see Soil Nitrate Tests for Corn Production in Wisconsin)?

### Nutrient Management Plans

- ✓ Is your nutrient management plan up-to-date?
- ✓ Are all nutrient sources properly accounted for in your nutrient management plan (1st and 2nd/3rd year manure credits (where appropriate))?
- ✓ Are your crop rotations, yields, and soil amendments updated for 2021?
- ✓ Are all new soil test reports uploaded?
- ✓ Are you using the appropriate Maximum Return to Nitrogen (MRTN) grain/price ratio within SnapPlus?

### Consider Cropping and Nutrient Alternatives

- ✓ Is the soil pH in an appropriate range for targeted crop production in all fields?
- ✓ Do you have the capacity for in-season manure applications to utilize nutrients as they are being produced?
- ✓ Would a rotational change allow for double cropping/in-season manure applications work with the farm and its crop needs (e.g. spring oats followed by manure application and warm-season forage)?
- ✓ Do you have the potential to take advantage of nitrogen credits from rotating out marginal legume pastures or hayfields to corn grain, corn silage, or another high nitrogen need crop?
- ✓ Can you alter your rotation to grow crops requiring lower fertilization, given you have the capacity and market?
- ✓ Do you sidedress nitrogen, particularly in soils with high potential for nitrogen loss via leaching or denitrification?
- ✓ Are you using fertilizer application strategies to reduce the potential risk of nutrient loss through volatilization or erosion/runoff?
- ✓ Are you using fertilizer application strategies to increase potential plant root interception, such as precision placement or banding?
- ✓ Can you barter for or purchase another farm's manure?
- ✓ Do you have access to purchase biosolids, and/or appropriate industrial by-products with a guaranteed nutrient and chemical analysis?

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### *I plan to sidedress the majority of the nitrogen needed for corn, but how much nitrogen (N), phosphorus (P), and potassium (K) do I need to maintain early growth until sidedress application?*

Phosphorus and potassium fertilizer applications are informed by soil testing. Due to their lower risk for nutrient loss as compared to nitrogen fertilizers, commercial phosphorus and potassium fertilizers are typically broadcast applied to fields going into corn in the fall or pre-plant, allowing for incorporation with subsequent field operations (if applicable). Alternatively (or additionally), phosphorus and/or potassium fertilizers may be added in-furrow or banded in a 2x2 placement at planting.

Wisconsin research has shown on high phosphorus testing soils, a complete starter application rate of 10-20-20 (N-P2O5-K2O) in a 2" by 2" placement maximizes corn response. However, higher rates of phosphorus and potassium may be needed to optimize corn production where soil test phosphorus and potassium levels are in the very low, low, and/or optimal ranges.

Nitrogen fertilizer application rates to corn should be based upon the Maximum Return to Nitrogen (MRTN) concept. Total pre-plant, at plant, and in-season nitrogen applications for each field should not exceed the recommended MRTN rate.

The optimal amount of nitrogen applied pre or at plant vs sidedress varies by soil texture, soil drainage class, growing season conditions, and crop management system. Wisconsin and Midwestern research has found sidedress nitrogen applications are often not superior

to preplant nitrogen on well and moderately well-drained, medium- and fine-textured soils. This does not imply sidedress nitrogen applications should not be used, but rather yield increases or nitrogen rate reductions should not be expected solely from the use of sidedress nitrogen applications. Alternatively, the use of sidedress nitrogen applications on coarse-textured soils is essential to achieving agronomic and nitrogen use efficiencies and reducing nutrient losses to the environment. More information on managing starter fertilizer can be found on pages 81 to 83 in Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin.

### *Do I really need to add lime? What if I cannot access lime? Should I not apply amendments or just apply what I can even if my pH is off?*

Maintaining soil pH in the target range for crops is important to sustain crop yield and quality (especially in pH sensitive crops like alfalfa), foster beneficial soil microbial activity and nitrogen fixation, maintain the availability of essential nutrients, reduce aluminum and micronutrient toxicity, maintain herbicide effectiveness, and suppress disease-causing pathogens.

Lime applications, when based upon soil test recommendations, are often cost-effective, resulting in improvements in crop yield and quality. Adjusting soil pH is often the first step to correcting crop nutrient deficiencies but will not replace fertilizer applications to meet nutrient needs.

If agricultural or pelletized lime is not available, few cost-effective alternatives exist. Liming materials contain a basic cation, such as calcium, magnesium, or potassium, and react with the soil to neutralize acidity. Common agricultural limes in Wisconsin are often calcium and/or magnesium carbonate materials. While products such as calcium chloride and gypsum (calcium sulfate) contain calcium, they do not have an effect on soil pH and therefore, are not limes. Liquid lime products, which are often finely ground calcium oxide, hydroxide, or carbonates, do neutralize soil acidity, the amount required to effectively change soil pH is significant and often cost-prohibitive to utilize in row-crop agriculture.

In situations where soil pH cannot be adjusted, altering soil fertilizer application techniques, such as banding of phosphorus fertilizers in low and very low testing soils, in addition to broadcast applications, and foliar applying micronutrients when deficiencies are present, may help maintain nutrient solubility and increase nutrient uptake efficiency.

Target soil pH for Wisconsin Field Crops. Adapted from Table 4.2 in A2809

| Crop | Target pH |
|---|---|
| Soybean | 6.3 |
| Corn | 6.0 |
| Alfalfa | 6.8 |
| Wheat | 6.0 |

The target pH for Wisconsin crops is found in table 4.2, pages 30 to 32, of Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin. The target soil pH for a crop rotation is determined by the most acid sensitive crop in the 4-year future rotation. For example, in a corn-soybean-wheat rotation, soybean has the highest target soil pH (6.3 vs 6.0 for corn and wheat). Therefore, the target pH for the rotation is 6.3.

Lime recommendations are based upon soil test results and reflect the amount of commercial lime required to reach the rotational target pH. The lime requirements when using 60-69 and 80-89 lime are typically listed on the soil test report. It should be noted, lime takes time to react. Lime's effective neutralizing material rating is based upon the material that will effectively increase soil pH over a 3 year time period.

## PASTURE NUTRIENT MANAGEMENT

### *What nutrients should I be applying to my pastures?*

Nutrient applications and management in pastures is similar to croplands, if adequate nutrients are not applied by the grazing herd. All nutrient applications, to croplands or pastures, should be guided by current soil tests and a 590 compliant nutrient management plan. An overview of pasture soil fertility management is found in Soil Fertility Guidelines for Pastures in Wisconsin.

Maintaining a proper soil pH for the pasture system is essential to ensuring nutrient availability and forage productivity and persistence. It is recommended that the soil pH in pastures be maintained at a target pH of 6.0 for pastures containing less than 30 percent legumes and 6.3 for pastures containing greater than 30 percent legumes, where the legume is dominated by clovers, or 6.8 for pastures with greater than 30 percent legumes, where the dominate legume is alfalfa. Lime applications should be considered when the soil pH is 0.2 units below the target pH for the system.

Nitrogen applications to pastures, particularly pastures containing <30% legumes, may improve forage quality and quantity.  Nitrogen recommendations for pasture systems is summarized below.

**Table 2.** Nitrogen fertilization guidelines for pastures.

| Crop | Yield range per acre | Soil organic matter content (%) | | | |
|---|---|---|---|---|---|
| | | < 2.0 | 2.0–9.9 | 10.0–20.0 | > 20.0 |
| | | ---------------------------lb N/a to apply ----------------------------- | | | |
| Pasture, grass[a,b] | 0.5–5 ton | 160 | 130 | 100 | 50 |
| Pasture, ≤ 30% legume-grass, seeding | 0.5–1.9 ton | 40 | 20 | 0 | 0 |
| Pasture, ≤ 30% legume-grass, established | 2–5 ton | 0 | 0 | 0 | 0 |
| Pasture, > 30% legume-grass, seeding | 0.5–1.9 ton | 30 | 10 | 0 | 0 |
| Pasture, > 30% legume-grass, established | 2–5 ton | 0 | 0 | 0 | 0 |
| Pasture, unimproved[a] | 1–4 ton | 120 | 100 | 70 | 30 |

[a]Split N applications into two to three applications per year.
[b]Grass = bromegrass, orchardgrass, fescue, ryegrass, timothy (any combination).

Nitrogen should be split applied (two to three applications) to pastures, targeting times of the year when grasses are actively growing. Pastures dominated by cool-season grasses often benefit from an early spring nitrogen application, while a nitrogen application to warm-season grass pastures may be postponed to later in the spring to better align with plant growth cycles. Both systems may benefit from a second nitrogen application in August to help maintain more even forage growth throughout the grazing season. Soil tests are essential when determining phosphorus and potassium fertilizer needs. Managing grazing patterns to improve manure distribution throughout the pasture may reduce phosphorus and potassium fertilizer needs over time. If needed, phosphorus and potassium fertilizers can be added aligned with nitrogen fertilizer applications and should not be applied to frozen ground to reduce potential runoff losses. Potassium fertilizer application rates and timing should consider the potential for plant luxury consumption and high forage potassium levels, particularly if grazing dry dairy cattle or goats.

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