PLANTS

Nutrient Management

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SECTIONS

Section 1: SMART Nutrient Management

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INTRODUCTION

As a young or beginning farmer, you may be raising crops to reduce feed costs or to sell. One of the important decisions in crop production is managing the nutrient needs of the crop you'll grow. If you apply too many nutrients, potential profits are reduced; supply too few and plant growth may be limited. Correctly managing nutrients can help you optimize crop production and achieve your farm goals.

How To Get Started

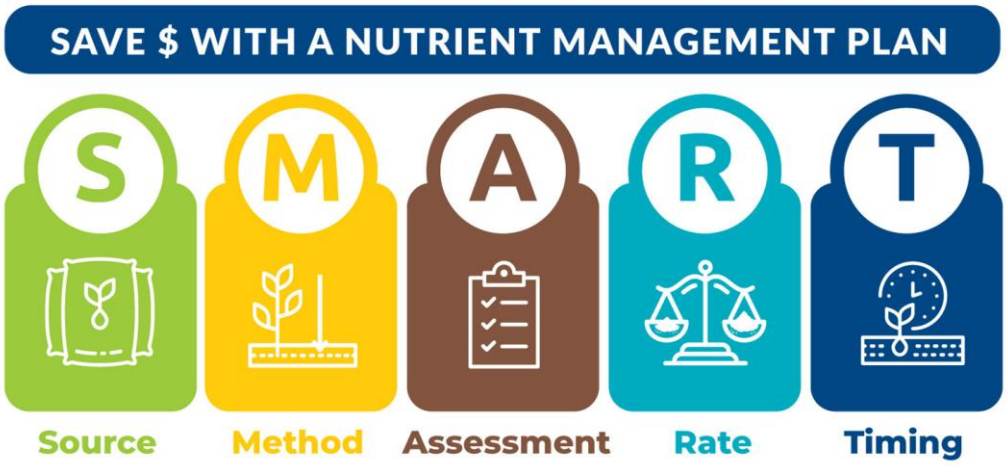
Many factors go into nutrient management. Understanding the soil is the first consideration since the properties and characteristics of the soil can greatly affect how pre-existing and added nutrients are available for the plant to use. Soil test results can tell you what nutrients are already present and if they are available to the intended crop. This is crucial information as you start to think about the amount, types and forms of nutrients needed overall.

A nutrient management plan is influenced by what the yield goals are and whether the soil needs to be built up. You'll also need to learn about the available forms of fertilizer. Using the information collected from both the soil and the available fertilizer options, you'll begin to create a nutrient management plan for the farm. Deciding how and when to apply the fertilizer completes the decision factors needed for a successful and profitable crop. Every few years, evaluate your nutrient management plan with repeated soil tests and recalibrate your plan to maintain optimal plant and soil health.

SECTION 1

SMART Nutrient Management

The **USDA-NRCS** has a SMART nutrient management plan framework. It is focused on the **s**ource, **m**ethod, **a**ssessment, **r**ate, and **t**iming of nutrient applications.



(https://www.nrcs.usda.gov/getting-assistance/other-topics/nutrient-management)

Primary Considerations

SOURCE

Whether you use commercially produced fertilizer, manure, or compost, ensure that the fertilizer content matches your soil needs. Soil testing and plant tissue tests can inform your source selection. Keep in mind that your nutrient management program can only be as successful as the most limiting nutrient.

- Not all compost is created equal! Composting can lead to issues with pest, disease, and weed pressure. Learn how to compost effectively before getting started. **CORNELL Composting**

METHOD

There are many **methods of fertilizer applications.** Consider how you will introduce the amendment into the environment. If you are planting perennial crops, it is significantly easier to make larger soil adjustments on bare ground before planting than it is after the plants are established. Application methods can include injection, broadcasting, incorporating with tillage, fertigation and foliar applications.

ASSESSMENT

Successful nutrient management requires an understanding of the baseline soil conditions. Assess the baseline land conditions, such as water drainage, and submit a comprehensive soil test. This will help make land use decisions and should inform your soil nutrient amendments.

- Testing soil for contaminants can alert you to heavy metal or PFAS contamination in your soil before you get started.
- Soil components can inform your most successful use of the land. For example, pH can be difficult to make large adjustments to and different crops have different pH requirements to efficiently uptake nutrients.

RATE

Consider your baseline nutrient availability, how your farming practices are impacting soil health, and the technology available to you when deciding rates. **Rate calculations** are highly dependent on the nutrient content of the product you are applying compared to what the crop needs.

TIMING

Nutrients should be applied when plants can uptake them. Consider whether spring, summer, fall, or split scheduled fertilizer timings are right for your crops. Rainfall can also have a significant impact on application success. For example, nitrate - a plant accessible form of nitrogen, is water soluble and will leach out of soil. Available technology will also impact nutrient application timing.

- **Fruit crops**
- **Row crops**
- **Vegetable crops**

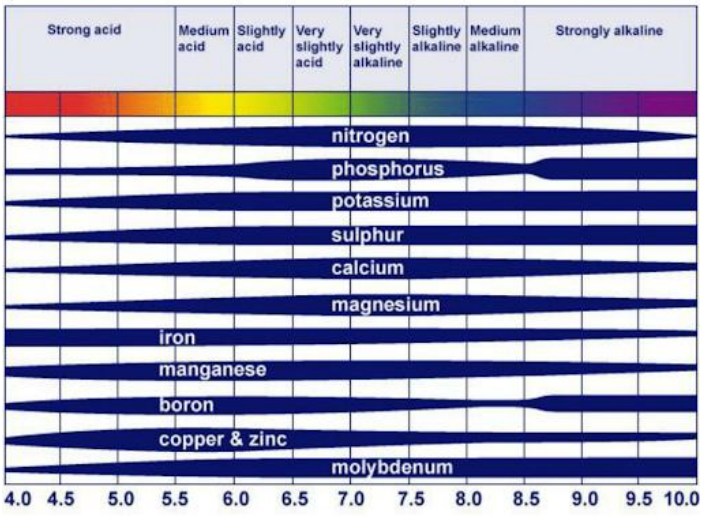
Process for Getting Started

As you get started with managing nutrition, it is important to understand plant nutrition fundamentals. This can include soil characteristics and nutrient movement.

SOIL CHARACTERISTICS

Soil pH and Nutrient Availability

- Soil pH is KEY. Make sure you know your soil's pH- especially before planting.
- The pH of the soil impacts the nutrient's ability to move within the soil and into the plants.
- The soil nutrient value (e.g. potassium in parts per million (ppm)) on a soil test is generally an estimate for plant available nutrients, not total nutrients
- Soil pH and available nutrients may vary greatly across a field. Sampling by zone (as described in **A Field Guide to Soil Sampling**) can produce more accurate results in variable soil.



Source:

Review of the non-NPKS nutrient requirements of UK cereals and oilseed rape - Scientific Figure on ResearchGate.

Available from: **https://www.researchgate.net**

Soil Texture

- Inherent to your farm- can't really change. Texture greatly impacts water retention and cation exchange capacity (CEC).
- Check out your farm's soil texture here: **Web Soil Survey**
- **Soil Organic Matter** fact sheet

Soil Organic Matter

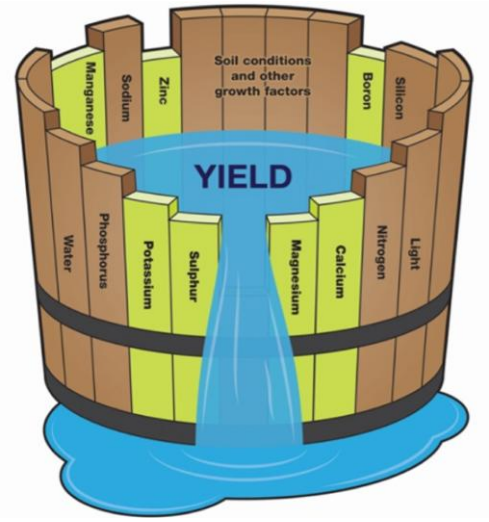
- Hard to build, easy to lose. Prevent soil organic matter loss by putting more carbon in than you take out (ex. compost, manure etc.).SOM is lost through tillage and crop removal. SOM can be built with cover crops and compost and manure application.
- Mineral soils in Michigan are generally <4% SOM, while organic soils (muck or peat) can be >30% SOM
- **Soil organic matter in cropping systems**

Cation Exchange Capacity (CEC)

- Dependant on your soil texture
    - Sandy soil = low CEC (<10)
    - Clay-y soil = high CEC
    - The more organic matter in your soil- the higher the CEC
- **Calculating Cation Exchange Capacity, Base Saturation, and Calcium Saturation | Ohioline**

NUTRIENT MOVEMENT

- **Knowing nutrient mobility is helpful in diagnosing plant nutrient deficiencies - Agriculture**
- **Plant-Soil Interactions: Nutrient Uptake | Learn Science at Scitable**
- **3.3 Roots – The Science of Plants**
- **Vegetative plant parts | OSU Extension Service**



According to the Law of the Minimum, your crop can only perform as well as the most restrictive nutrient allows for, even if all other nutrient needs are met. Addressing the holistic nutrient availability of your soil allows for maximum yields.

Disclaimer. For a specific list of resources in the above description, view the Necessary Resources area of this section.

SECTION 1

COMMON QUESTIONS

01 How do I soil test?

In order for soil testing to help you in your nutrient management journey, you have to understand how to conduct the tests and how to interpret the results.

Soil tests are available through Michigan State University as well as multiple commercial companies. Be sure to review soil sampling procedures to get the most out of your test.

- **Get Started | MSU Soil Test**
- **A Field Guide To Soil Sampling**
- **LIME FOR MICHIGAN SOILS**

02 When do I soil test?

Soil test prior to planting and every 2-5 years. Regular testing ensures that your nutrient management plan is continuing to improve your soil health.

Try to test at the same time each year. General rule of thumb: sampling in spring will give you an idea of this year's nutrients, sampling in the fall will give you a more long-term outlook on soil nutrition.

03 I got a soil test, now what?

Once you have completed the soil test, it is time to decide a course of action. Review the following resources on understanding soil test reports prior to making soil amendments. Never hesitate to reach out to a local extension office for help interpreting results.

- **The Anatomy of a Soil Test Report**
- **Understanding the MSU Fertilizer Recommendation Program**
- **Soil Test Interpretation Guide**

04 How do I calculate the required nutrition based on my soil test?

Start with the example worksheet below to better understand how to calculate fertilizer rates.

- **Calculating fertilizer rates example worksheet by MSU Extension**
- **Soil test nutrient values to crop specific nutrient recommendations** (in case your soil test does not give recommendations)
- **Nutrient recommendations to fertilizer requirements**

05 Where do I source fertilizers?

Local agriculture stores and gardening centers have fertilizer. Consider the rates you already calculated when choosing ratios of products. Additionally, organic sources of fertilizer like manure will have lower rates of nutrition content.

When reading a fertilizer label, it will have three numbers that are usually referred to as the fertilizer analysis. These numbers represent the percentage of Nitrogen(N), Phosphorus(P), and Potassium(K) and will be presented in the format N-P-K. If there are any other nutrients outside of those, it will be listed further down the label. Veteran growers might refer to a fertilizer as its analysis so if someone says they applied 20-20-20, they're talking about their fertilizer!

06 How do I calculate lime rates based on soil test recommendations?

Start with a review of lime requirements based on soil type and lime source options: **Lime for Michigan Soils Factsheet**

RESOURCES & PARTNERS

Necessary Resources

Macronutrients and Micronutrients

Both are required for plant growth and development, but macronutrients are required in larger quantities than micronutrients within plants.

Nitrogen

- Nitrogen in the Plant | MU Extension

Potassium

- Elevate your knowledge of the potassium cycle – Crops and Soils
- Potassium Uptake and Ohio Crop Response | Ohioline

Phosphorus

- Understanding phosphorus fertilizers | UMN Extension

Calcium

- Beware of Liquid Calcium Products
- Understanding Plant Nutrients: Soil and Applied Calcium — The Learning Store

Magnesium

- Magnesium for crop production | UMN Extension

Iron

- Understanding Plant Nutrients: Soil and Applied Iron — The Learning Store

Manganese

- Manganese in Minnesota soils | UMN Extension

Copper

- Copper for crop production | UMN Extension

Zinc

- Zinc for crop production | UMN Extension

Boron

- Boron for Minnesota soils | UMN Extension

Chloride

- Chloride is Crucial for Crops! | Extension News and Publications

Molybdenum

- Soil and Applied Molybdenum (A3555)

Soil Testing

- The Anatomy of a Soil Test Report
- Understanding the MSU Fertilizer Recommendation Program
- Soil Test Interpretation Guide
- Get Started | MSU Soil Test
- A Field Guide To Soil Sampling

Nutrient Movement

- Knowing nutrient mobility is helpful in diagnosing plant nutrient deficiencies - Agriculture
- Plant-Soil Interactions: Nutrient Uptake | Learn Science at Scitable
- 3.3 Roots – The Science of Plants
- Vegetative plant parts | OSU Extension Service

SMART Nutrition Management

- How To Get Started with Nutrient Management

Northeast Region Certified Crop Adviser Nutrient Management Study Materials

- Certified Crop Advisor study resources (Northeast region)

Cornell Soil Science Full Course

- PLSCS 2600 - Soil Science w/ Jonathan Russell-Anelli, Cornell University - YouTube

A Guide to Understanding Fertilizers

- A guide to understanding fertilizers | OSU Extension Service

Crop Nutrition 101

- Crop Nutrients 101 – Crops and Soils

Tri-State Nutrient Recommendations for Corn, Soybean, Wheat, and Alfalfa

- https://www.canr.msu.edu/news/revised-tri-state-fertilizer-recommendations-now-available

Cornell Soil Health Assessment Training Manual

- https://www.canr.msu.edu/foodsystems/uploads/files/cornell_soilhealth.pdf

Fertilizer Rate Calculation

- Calculations Used to Determine the Amount of Fertilizer Needed to Treat Turf

Lime for Michigan Soils

- LIME FOR MICHIGAN SOILS

Building Soils for Better Crops

- Building Soils for Better Crops - SARE

SARE Soil Health Resources

- Soil Health in Sustainable Agriculture - SARE

Nutrient Application Timing

- Fertilizer Placement and Timing

Composting Resources

- CORNELL Composting

Cornell Soil Health Assessment Training Manual

- https://www.canr.msu.edu/foodsystems/uploads/files/cornell_soilhealth.pdf

Fertilizer Rate Calculation

- Calculations Used to Determine the Amount of Fertilizer Needed to Treat Turf

Lime for Michigan Soils

- LIME FOR MICHIGAN SOILS

Building Soils for Better Crops

- Building Soils for Better Crops - SARE

Partners

SARE: Sustainable Agriculture Research and Education

https://www.sare.org/

USDA-NRCS: National Resources Conservation Service

https://www.nrcs.usda.gov/