NORTHWEST CROPS & SOILS PROGRAM
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CULTIVATING HEALTHY COMMUNITIES

INCREASING HIGH QUALITY HOMEGROWN FEEDS FOR THE ORGANIC DAIRY FACT SHEET SERIES

Soil Fertility Management of Certified Organic Perennial Pastures

Introduction

High quality and productive organic pastures start with healthy soils. Although good grazing management can greatly improve and maintain soil health, attention to soil fertility will help ensure that pasture plants have the nutrients they need for optimal growth and productivity.

Getting Started: Soil Testing

A good start to optimizing soil fertility is knowing what the soil is currently offering the pasture plants in the way of nutrients. Therefore, the first step is to conduct soil sampling for nutrient analysis. A standard soil test provides a report card of the soil's nutrient levels—including available aluminum, boron, calcium, copper, iron, magnesium, manganese, phosphorus, potassium, sulfur and zinc—and pH, as well as soil organic matter content and effective cation exchange capacity (CEC). All help diagnose the current health of the soil. In particular, soil test results will help identify if there are specific nutrients that may be limiting optimal plant growth or if there are other issues going on.

Next Up: A Look at pH

pH measures the relative acidity or alkalinity of a soil and is measured on a scale from 1.0 to 14.0, with neutral at 7.0; pH less than 7.0 is considered acidic and greater than 7.0 is considered basic / more alkaline. As with most crops, pasture plants prefer a soil pH between 6.0 and 7.0. In general, most essential nutrients are more available to the plants when the soil pH is within this range.

Correcting pH is an important next step in managing the fertility of the soil. Many soils start and/or become acidic over time; if the pH is off, a number of problems may occur, including:

- Decreased productivity of pasture plants;
- Potential increases in weeds, diseases, and insects;
- Nutrient run-off and/or soil erosion; and
- Reduced biological activity in the soil.

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Therefore, adjusting pH through liming and the addition of organic matter will benefit soil biota, improve movement and absorption of essential nutrients to the plants, increase palatability of forages, reduce abundance of certain weeds, and support good root growth and pasture plant production.

Providing Nutrients to Meet Pasture Plant Demands

The results from most standard soil tests provide current levels of and recommendations for application of both macronutrients (phosphorus, potassium, calcium, magnesium, and sulfur) and micronutrients (aluminum, iron, manganese, zinc, copper, and boron). Remember that all soil amendments applied on certified organic ground must be approved by a certifier prior to use.

Nitrogen

When other nutrients are at sufficient levels and are not limiting plant growth and productivity, another primary macronutrient to consider is nitrogen (N). Nitrogen deficiency in pastures can be common; for example, in one recent study of a small number of organic dairy farms in Vermont, soils on 92% of the fields on those farms were not meeting the basic nitrogen needs of the pasture plants.

One way to meet nitrogen requirements is through the use of legumes. Different varieties of legumes release nitrogen at different rates. Many pastures in the Northeast currently have low percentages of legumes and experts suggest that increasing the amount of legumes in pasture stands would improve pasture conditions. For example, one study found that clover can provide 49 to 100 pounds per acre of nitrogen to support grass N needs. Pastures with a mixture of grass and legumes are typically higher in crude protein, have greater digestibility, and provide higher quality forage longer into the season.

Before seeding legumes, it is recommended that pH is adjusted and amendments are added to the pasture to meet magnesium and potassium requirements (if needed). There are several methods to efficiently seed legumes including frost seeding in late winter / early spring, and "trample seeding," where seed is broadcast and the hoof action of the animals tamp the seed into the soil.

Some studies suggest that utilizing legumes as primary sources of nitrogen may be more profitable and sustainable than nitrogen fertilizer, in part because the nitrogen fixed by legumes becomes available to other plants at different points in the growing season. For example, nitrogen from white clover residue may be available 4 to 6 months into the growing season, red clover up to 6 months, and alfalfa nitrogen release ranges from 6 to 12 months, according to one study.

In general, it is suggested that nitrogen fertilization is likely not necessary in pastures with greater than 30% legumes. Nitrogen fertilizers do tend to favor grass growth over legumes so

care needs to be taken to not oversupply nitrogen to cause grasses to outcompete legumes, especially if the goal is for the ongoing provision of nitrogen that the legumes provide.

Good sources of nitrogen include manure, compost, feather meal, and fish emulsion. Care should be taken to applying nitrogen during the spring as early application of nitrogen favors crude protein and may elevate MUN levels; however, N applications can correct late summer pasture shortages and increase fall growth.

If applying nutrients, some research suggests that a lower rate of banded fertilizer can achieve as great a yield as broadcasted fertilizer.

Also, if applying manure by the livestock themselves, aim for a more even distribution of manure by keeping water sources within 800 feet of livestock, move placement of supplement feed, rotate frequently, increase stocking density, reduce paddock size, and/or dragging fields. These practices can prevent manure nutrients from concentrating in a particular area. Conversely, if there are nutrient poor areas within pastures, use the cattle's herd response to focus on improving those areas by placing water, shade, and feed supplements in these nutrient poor areas; livestock will congregate around these areas and so will their wastes.

Note that the nutrient benefits of animal wastes (feces and urine) extend beyond just nitrogen. One study revealed that these wastes are an important part of naturally cycling nutrients, returning 60 to 80% of nitrogen, 60 to 85% of phosphorus, and 80 to 90% of potassium of forage nutrients consumed by the animal back to the soil. Manure may also provide micronutrients like copper, zinc, iron, manganese, and boron.

Because manure is a primary nutrient source on most farms, it needs to be treated like a fertilizer. That means, understanding what nutrients are actually in the manure and how much to apply to meet the nutrient needs of the pasture plants—testing manure for nutrient analysis will provide this information. Note that manure N is treated a little differently than other fertilizers because the nitrogen becomes available as the manure breaks down; some N can be lost due to volatilization into the air or leaching, or become immobilized in in soil.

In addition to manure, compost and plant residues are readily available nutrient sources on most farms. Application of composted manure can increase yields and even improve forage quality more than fields amended with raw manure. Composted manure increases the amount of stable organic matter which can help both mitigate flooding and minimize drought damage by retaining water. Plant residues—in the form of cover crops, legumes, sod plow downs—also provide nitrogen. As a general rule of thumb, the more biomass of the plants, the more N they provide.

Additional Considerations

Soil health is a complex balance of the soil's physical, biological, and chemical properties. Maximizing the potential of each of these properties as well as maintaining a healthy balance between the three will result in a healthy soil. So, in addition to attending to the pH and nutrient needs, keep in mind that plants grow best in environments that support them. For example, soil organic matter is essential to improving soils under organic management as it influences nutrient availability, aggregation, water storage, the biology of the soil, carbon and nitrogen cycles, and more. In addition, the nutrient availability of N is biologically driven, so attention to the biological properties of soil, that is the bacteria, algae, fungi, insects, and other organisms that live in the soil, is also key.

In Summary

Pasture is a crop, and needs to be managed as such. The first step in managing any crop, including pastures, is learning what nutrients are currently available in the pasture soils. Therefore, taking soil samples for nutrient analysis is a good first step, especially when establishing a new pasture or renovating hay or other crop ground.

It is important to supply adequate levels of nitrogen without oversupplying phosphorus, an environmental health concern, or potassium, a livestock health concern. Nitrogen is often the first limiting nutrient. Meeting nitrogen requirements of the crop can be met by interseeding legumes or by applying soil amendments.

Managing soil health is critical to the overall production of the organic dairy. If soils are healthy, the plants will be healthy, animals will be eating better plants, and the animals will be producing healthier products.

Citations used to develop this fact sheet can be found in the "Literature Review: Soil Fertility Management of Organic Perennial Pastures," posted at http://www.uvm.edu/extension/cropsoil/organic-farming.

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