MANAGING NITROGEN ON ORGANIC FARMS

By Vern Grubinger
Vegetable and Berry Specialist
University of Vermont Extension

Organic farmers, like any others, need to provide enough nitrogen (N) for their crops to maintain good yields, product quality, and profitability. But organic farmers rarely rely on bagged fertilizers alone to feed their crops. That approach would be costly as well as inconsistent with the organic standards, which emphasize the importance of crop rotation with legume cover crops and application of compost or manure. However, on many organic farms there may be a need to supplement those practices with N fertilizer.

Applying the right amount of fertilizer N is just as important organically as it is conventionally, although it can be a bit more challenging.

How much N is needed? The first step in any fertilizer decision is to figure out what quantity of nutrient is necessary to grow a particular crop. Your regional or state Extension Crop Management Guide may provide that information. If not, you can use a text like Knott's Handbook for Vegetable Growers. It contains a table which shows that vegetable crops generally remove between 100 to 200 pounds of N per acre. Crops that produce a lot of biomass, like potato or Brussels sprouts, take up the most N. Crops of small stature, like spinach and lettuce, take up the least. A good sweet corn crop uses about 150 pounds of N per acre.

How much N is already there? Soil organic matter, manure, cover crops, and compost all contribute to the available N supply. These sources need to be accounted for in order to avoid over-applying N, which wastes money and can lead to pollution.

To figure out your N 'credits' start by estimating how much N will be released from soil organic matter over the season. Next, add up the N that will be provided by animal manure, green manure, plus compost, and subtract that. What's left is the fertilizer N requirement.

Don't ignore soil organic matter. The total amount of N in the plow layer of agricultural soils can be surprisingly large. A soil with 4% organic matter contains about 4,000 pounds of total N per acre. However, the amount of N that becomes available to plants in any one year is relatively small. In most soils, it's just 1% to 4% of the total N. So, in a soil with 4,000 pounds of total N per acre, anywhere from 40 to 160 pounds of N could be released annually for plant use. On well-managed soils with good structure, a reasonable estimate is that for every 1% of soil organic matter, 20 to 30 pounds of N per acre will become available during the growing season. In warm seasons with optimal soil moisture levels this can increase to over 40 pounds of N.

Do the manure math. Up to 50% of the total N in fresh cow manure is available to crops in the year of application. That's about 5 pounds of N per ton applied, or about 100 pounds of N from a 20-ton application. To maximize the availability of N from fresh manure it should be incorporated immediately after spreading, shortly before growing a crop. However, the use of fresh manure on organic farms is limited by the requirement to wait 90 to 120 days after application until harvest of the crop. (Ninety days if the harvested portion of the crop does not come in contact with the soil, 120 days if it does.)

In the year after fresh manure has been applied, much less N is released. Between 5% and 10% of the total N it originally contained may become available. In the year following a 20 ton per acre application of fresh cow manure that's about 15 pounds of available N per acre. In the next year, two years after application, the release of N declines again, by at least half, and the year after that the release declines again, and so forth, until the old manure is releasing N at the same low rate as soil organic matter. In fields where manure has been applied consistently over many years, this all adds up to a lot of N being available, so little or no fertilizer N may be needed.

Poultry manure can supply roughly 3 to 6 times more N per ton than fresh cow manure, or about 15 to 30 pounds of available N per ton per acre in the year of application, depending on how much moisture it contains. With poultry manure, a higher percentage of the total N is converted to plant-available forms in the year of application, so there is relatively less carry-over of N to crops in succeeding years.

Green manures are cover crops that are turned under to improve soil fertility. Legume cover crops such as alfalfa, cowpeas, or hairy vetch can fix 150 pounds of N or more per acre under good conditions. Clovers and field peas generally fix about half as much. To provide the most N to a subsequent crop, these legumes should be incorporated just before or at flowering. At that stage, leafy annual legumes tend to contain 3% to 4% nitrogen, and about 80% water.

Here's how you can estimate the N contribution of a legume green manure. Clip four square feet of typical growth and weigh it. Multiply by 11,000 to get the fresh weight yield per acre. Divide that number by 5 to estimate dry weight yield per acre. Multiply that by 3.5% (.035) to get total N per acre. If the soil is warm and well-aerated, about 50% of that total N in the legume will be available in the summer following incorporation.

Several factors can reduce the contribution of N from legume green manures. If the seed is not properly inoculated, a legume may not form the root nodules necessary to fix N from the air. A fair stand will provide significantly less N than a good stand. As legumes age and get woodier, the foliage will contain a lower percentage of available N. And, if conditions are wet or cool, microbial activity will be reduced and so will the amount of N release via decomposition.

Legume green manures are a great way to obtain N for several reasons. They fit into a good crop rotation plan, helping to maintain soil structure. By growing your own N, they can help avoid the need to purchase more expensive N sources. And, they allow you to add N to the farm without adding other nutrients. This is especially important when soil P levels are already high.

Mature compost: is a soil conditioner. Mature compost is good for the physical and biological health of soil, but it is not a strong fertilizer. It generally contains about 1% total N, with some variation depending on how it's made. As compost ages, the availability of the N it contains tends to decrease. The majority of the N in finished compost is tied up in organic compounds that slowly decompose over a period of years. A rough estimate is that only 10 to 15% of the total N in compost will become available to a crop in the year of application. That's about 2 to 3 pounds per ton.

Use the lab. Soil testing labs can help you manage N in several ways. Soil organic matter percentage is often reported as part of normal soil test results, or it may be available upon request for an additional fee, depending on the lab you use. Compost and manure tests report the total N and the available N content, as nitrate and ammonium. The pre-sidedress nitrate test is available in some areas, for specific crops, to estimate how much available N the soil will supply over the growing season, and whether supplemental N fertilizer should be applied.

Organic fertilizers are a last resort, to be used only if the sources described above will not fulfill your crop's N needs. Organic fertilizers may be made of animal by-products, plant-derived materials, mined minerals, or a combination. As with conventional materials, organic fertilizers can provide primarily N, or a blend of nutrients. All fertilizers are less expensive per unit of nutrient when purchased in bulk.

Animal-derived N fertilizers include: blood meal, crab meal, feather meal, fish meal, and pelletized, composted chicken manure, to name a few. Plant-derived N fertilizers include alfalfa meal, peanut meal, and soy meal, to name a few. Be aware that GMO issues may affect the acceptability of certain plant by-products in organic agriculture.

Chilean nitrate is a mineral source of N for organic farms, but its use is limited to providing up to 20% of a crop's N needs, and it may be further restricted by some certifying agencies. It can be helpful in providing available N to crops early in the season when soils are cool, microbes are sleepy, and the release of N from other sources is low.

If you are an organic farmer, before purchasing or applying any fertilizer make sure it is complies with the organic standards! Look for the OMRI seal, or check with your certifying agency to get assurance that the brand of fertilizer, not just the generic ingredient, is allowed for use on organic farms.