Comparing Natural and Synthetic Fertilizers

by Rita Pelczar

A BUMPER CROP OF tomatoes, a colorful bed of flowering annuals, and a towering oak all need the same 16 essential nutrients for healthy growth. Both natural fertilizers (from organic sources and natural rock powders) and synthetic fertilizers can supply the necessary nutrients, but there are some significant differences in their availability and how these materials affect the soil environment.

NUTRIENT AVAILABILITY

Most plant nutrients are obtained by plant roots from the soil solution, the liquid portion of the soil that surrounds soil particles. Natural fertilizers introduce nutrients into the soil as complex molecules that must be broken down by soil organisms before plants are able to make use of them. This process, known as mineralization, requires time, appropriate temperatures, air, moisture, and of course the digesting organisms, which include bacteria, fungi, actinomycetes, and earthworms.

These organisms are inactive in cold soils, but as temperatures rise above about 50 degrees Fahrenheit (F), so does their rate of activity. "A rule of thumb is that for every increase in soil temperature of 10 degrees Celsius (18 degrees F), the activity of soil organisms doubles," explains Michel A. Cavigelli, a research soil scientist who works at the USDA Sustainable Agricultural Systems Lab in Beltsville, Maryland.

The nutrients in synthetic fertilizers are generally much more readily available for plant uptake than those in natural fertilizers. Because they are already in a form that plants can use, they do not require soil organisms to break them into simpler forms. They also tend to be less expensive and are often easier to apply than natural fertilizers, which can be quite bulky. But their availability has its downsides: too much can burn plants, causing serious or lethal damage, and significant amounts of these soluble nutrients can leach through the soil beyond the root zone and contaminate nearby streams and groundwater.

Although it is possible to burn plants by applying excessive amounts of natural fertilizer—or by using manure that has not been aged—it is far less likely. And because microorganisms retain nutrients in their bodies, releasing them gradually into the soil solution, less is lost through leaching. According to USDA soil scientist Charles Kome, crop yields between synthetic and natural fertilizers are comparable. And although synthetic fertilizers may be more convenient, natural fertilizers, says Kome, "are better for the long-term stability of our global ecosystems."

Natural and organic fertilizers, such as these from Gardener's Supply, above left, and Planet Natural, right, are now widely available in a variety of formulations.

SUSTAINABLE GARDEN SOIL

A healthy soil is alive with organisms. Sustaining a viable population of these organisms is necessary for a continuous release of nutrients into the soil solution. These same organisms also contribute to improving a soil's structure.

As natural fertilizers such as animal manure, bone or blood meal, fish meal or emulsion, and seaweed are broken down by soil microorganisms, these creatures secrete a sticky substance that causes soil particles to cling together to form aggregates. Soil aggregation improves the soil's structure by increasing pore space and facilitating the movement of air and water.

Synthetic fertilizers have little or no effect on soil structure. And the repeated use of these fertilizers can cause an increase in salts, which is detrimental to soil organisms, depleting their populations and their beneficial effects on soil.

NATURAL FERTILIZER ANALYSIS

Most fertilizers—save foliar types—can be considered soil amendments, but not all soil amendments are considered fertilizers. Soil amendments such as compost, leaf mold, and peat moss, for instance, are added to soil primarily to improve the soil structure. Many contain nutrients, but often at low levels. A fertilizer—whether natural or synthetic—will have an analysis on the label

LEFT: COURTESY OF GARDENER'S SUPPLY. RIGHT: COURTESY OF PLANET NATURAL

detailing the percentage of nitrogen, potassium, and phosphorus it contains. This analysis is not required on products labeled as soil amendments.

There are many kinds of natural fertilizers, ranging from time-tested barnyard manure to prepackaged dry or liquid formulations. For non-packaged fertilizers, such as manure, the percentage of nutrients is variable, depending on the type of animal, what they were fed, the age of the manure, and other factors (see the chart below for the average nutrient analysis of many common organic materials).

Commercial natural fertilizers state their analysis on the label. Formulations may be supplemented with natural rock powders or plant and animal by-products for specific crops. These help boost certain nutrient levels or they may supply a wider range of nutrients. The Dramm Corporation, for example, adds four species of kelp to their fish-based fertilizer, called "Drammatic K." Tim Tetzlaff of Dramm says, in addition to adding several micronutrients, "Kelp contains natural hormones called cytokinins which plants use. The cytokinins help the plants' internal immune system during stressful situations, [such as] too cold, too hot, too dry, too wet."

USING FERTILIZER EFFECTIVELY

Although applying nutrients is important for healthy plant growth, it should be done properly to maximize its effectiveness and to avoid environmental damage. Whether you use natural or synthetic sources of fertilizer, you should first have your soil tested to determine your fertilizer needs so that you know exactly which nutrients are in short supply. The test will also indicate your soil reaction (pH) and whether it needs to be adjusted. If your pH is too high or too low, it can cause nutrients to become chemically bound so that, even though they are present, they are unavailable for plant use.

Nutrient needs vary somewhat among different plants both in amounts and timing. Know the needs of the plants you

SAVING MONEY AND ENERGY WITH MANURE

According to a recent report published by the National Research Conservation Service (NRCS), by appropriately substituting manure for commercial fertilizers, farmers could reduce the production cost of their crops by as much as $85 per acre. Using nitrogen-fixing plants as cover crops or as part of a crop rotation would further reduce commercial fertilizer needs.

According to data supplied by the U.S. Department of Agriculture, fertilizer accounts for as much as 29 percent of agriculture's energy use. Using organic fertilizers such as animal manure and cover crops could lead to significant savings in both energy and money.

AVERAGE NUTRIENT CONCENTRATIONS AND RATES OF AVAILABILITY FOR VARIOUS ORGANIC MATERIALS

Material	% Nitrogen	% Phosphate	% Potash	% Availability*	Notes**
Alfalfa hay	2–3	0.5–1	1–2	slow to moderate	
Bone meal	1–6	11–30	0	moderate	alkaline
Blood meal	12	1–2	0–1	rapid	acidic
Cottonseed meal	6	3	1	slow	acidic
Composts	1–3	1–2	1–2	moderate	alkaline
Feather meal	12	0	0	moderate	
Fish meal	6–12	3–7	2–5	rapid	acidic
Grass clippings	1–2	0–0.5	1–2	moderate	
Hoof/horn meal	12–14	1.5–2	0	moderate	alkaline
Kelp	1–1.5	0.5–1	5–10	moderate	zinc, iron
Leaves	1	0–0.5	0–0.5	slow	
Legumes	2–4	0–0.5	2–3	moderate	
Manures: Cattle	2–3	0.5–1	1–2	moderate	weed seed
Horse	1–2	0.5–1	1–2	slow	weed seed
Poultry	3–4	1–2	1–2	rapid	
Sheep	3–4	0.5–1	2–3	moderate	weed seed
Swine	2–3	0.5–1	1–2	rapid	
Pine needles	0.5	0	1	slow	acidic
Sawdust	0–1	0–0.5	0–1	very slow	
Sewage sludge	2–6	1–4	0–1	moderate	zinc, iron
Seaweed extract	1	2	5	rapid	zinc, iron
Straw/corn stalks	0–0.5	0–0.5	1	very slow	
Wood ashes	0	1–2	3–7	rapid	

*Approximate rate of nutrient release from the material.
**Special properties or characteristics of the material.

The chart is from Utah State University Extension's online bulletin, "Selecting and Using Organic Fertilizers," by Rich Koenig, Extension Soil Specialist and Mike Johnson, Grand County Extension Agent, January 1999.

TOP: COURTESY OF PURE BARNYARD, INC. BOTTOM: KEITH WELLER / COURTESY OF ARS-USDA

Sources

The following sources carry a variety of natural fertilizer products.

Bradfield Organics, *www.bradfieldorganics.com.*

Clean Air Gardening, *www.cleanairgardening.com/fertilizer.html.*

Dramm Corporation, *www.dramm.com*

Extremely Green Gardening Company, *www.extremelygreen.com.*

Gardener's Supply Company, *www.gardeners.com.*

MultiBloom, *www.multibloom.com.*

Planet Natural, *www.planetnatural.com/site/index.html*

Pure Barnyard, Inc., (makers of Cockadoodle DOO). *www.purebarnyard.com/cockadoodledoo/default.asp.*

Terracycle, Inc., *www.terracycle.net.*

Resources

The Soul of Soil, A Guide to Ecological Soil Management by Grace Gershuny and Joseph Smillie. AgAccess, Davis, California, 1995.

Teaming with Microbes: A Gardener's Guide to the Soil Food Web by Jeff Lowenfels and Wayne Lewis. Timber Press, Portland, Oregon, 2006.

National Sustainable Agriculture Research Service (NSARS) Alternative Soil Amendments, *http://attra.ncat.org/attra-pub/altsoilamend.html.*

plan to grow before you select or apply your fertilizer, and be aware of common nutrient deficiency symptoms. For example, tomato plants are heavy feeders. If they don't get enough nitrogen, lower leaves begin to yellow. Never apply more fertilizer than recommended.

Most natural fertilizers take time to break down, so work them into the soil in advance of planting or active growth. Subsequent applications can be made by topdressing with dry formulations such as Bradfield Organic's Tasty Tomato and Veggie, or Cockadoodle DOO, or applying soil or foliar applications of liquid fertilizers such as Terracycle All-Purpose Plant Food or Country Select MultiBloom. Maintaining a continuous supply of organic material such as compost will help sustain a balanced soil environment that is conducive to healthy plant growth.

A LIVING SYSTEM

The soil environment is a living system that supports plants both physically—providing anchorage for the aboveground growth—and nutritionally. While using synthetic fertilizers may be more convenient and less expensive in the short term, these products may cause significant imbalances in soil and water ecosystems in the long term. Instead, aim for sustaining a healthy soil system that minimizes environmental impact while maximizing garden results.

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