



## **Nutrient Research**

### **Scientific research on some favorite amendments**

After hard pruning roses in the late winter/early spring, the rosarian's thoughts turn to ideas about organic additions to the garden that will enrich the soil and promote more growth and flowers. Surveying the literature and the internet about rose culture results in a number of suggestions about how to give your roses an extra boost or special treat.

But how does the gardener decide what to add and when? Plenty of rosarians will give you advice, and the companies that make these products will publish lots of positive information on their websites to encourage you to buy them. Probably the best indicator is also the most factual one: research conducted by scientists.

But, you say, research is so boring and hard to read. Well, I'll try to make this as painless as possible. Here's a review of some popular organic amendments and fertilizers and what the research supports.

### **Alfalfa Meal/Tea**

Alfalfa as a fertilizer provides a number of nutrients to your plants. It is a good source of slow release organic nitrogen. However, the ingredient that makes alfalfa unique is its growth stimulant, triacontanol, a compound that has been proven to increase cell division and produce large root and shoot mass.

Research on this originated in 1977 when Stanley Ries, a professor at Michigan State University, published an article claiming that alfalfa meal and chloroform extracts of the meal increased the growth and yield of several plant species. Since that time a number of studies have confirmed that triacontanol in alfalfa and alfalfa water extracts stimulate plant growth, even in the dark, independent of photosynthesis.

There are a few caveats to consider here. First, the studies concentrated mostly on the compound itself, rather than the alfalfa that contains it. Triacontanol itself is available as a liquid additive that can be sprayed on plants or used as a drench. Apparently the compound is difficult to extract or combine with other additives. But Ries's initial experiments relied on alfalfa plants as a source of triacontanol, and we know alfalfa contains this chemical.

Alfalfa meal is ground and, perhaps when well watered in, the triacontanol may become available. Another concern of some scientists is that alfalfa meal may make alkaline soils more alkaline. However, the studies do not show this as a permanent effect and the pH levels did not increase to damaging levels. Using alfalfa meal as a tea may reduce this effect, and it gives the meal time to ferment and perhaps more effectively release its triacontanol.

### **Earthworm castings**

Worm castings are what earthworms leave after digesting food and soil. Worms feed on many forms of organic matter in the soil including plant parts, animal and insect remains, bacteria, and fungi.

When these materials pass through the worm's gut, their nutrients are changed into a form that is more available for plant uptake, such as the nitrate form of nitrogen, soluble potassium, and exchangeable phosphorus and calcium.

The castings hold two or three times their weight in water, making its retention in the soil another benefit. The surface area of the castings is larger than that of soil particles and supports beneficial microbial activity.

Research at Ohio State University that compared the effects of the fertilizer components that were the same as those contained in worm castings found that these components did not produce the same growth responses as the castings, leading to the assumption that the castings produced some kind of hormone-induced activity or that some kind of growth regulators were involved.

“...the growth responses of plants from vermicompost appears more like “hormone-induced activity” associated with the high levels of humic acids and humates in vermicompost rather than boosted by high levels of plant-available nutrients.”

—Soil Ecology Laboratory, Ohio State University

University plant growth research at Ohio State, Cornell University, U.C. Davis, and at other agriculture organizations have shown that plants treated with worm castings had increased plant size and bloom quantity and quality. The optimum

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application rate is a ratio of 10 to 20 percent castings to soil. A larger application did not improve results.

Finally additional testing has shown using worm castings decreases the number of aphids, mealy bugs and other arthropod pests. Earthworms produce a high level of chitinase enzymes in their castings. Chitinase dissolves the chitin in insect skeletons. Insects can detect the presence of chitinase in the soil and avoid it. Thus worm castings can work as an effective pest repellent.

### **Humic acid**

Humic acid is the carbon-rich material that remains after years of decomposition of living organisms such as plants, insects, and animals. It is produced in peat and coal. It occurs naturally as a liquid, but when the liquid is dehydrated, it leaves humates that contain the same compounds and have the same benefits as the liquid.

Humic acid and humates improve the cation exchange capacity of the soil; this interaction of positive and negative ions allows it to hold onto nutrients.

The crumb structure of the soil improves which enhances water retention and oxygen distribution. Humic acid can buffer high or lower pH in the soil, making nutrients and trace elements that might be bound in the soil more available to the plant. As a result, photosynthesis is improved, increasing the sugars in the plant and promoting growth.

Numerous research studies conducted in the last 25 years have found that applying humic acid to the soil helps break up compacted soils, enhances water retention, improves root development, stimulates the development of beneficial microflora populations, and chelates nutrients, such as iron, so that the plant can absorb them.

*“various micronutrients are further complexed with humic acid to form chelates - zinc, calcium, iron, and others... humic acid had beneficial effects on nutrient uptake by plants and was particularly important for the transport and availability of micronutrients.”*

— *Journal of Plant Nutrition*, 2008

### **Mycorrhizae**

Mycorrhizal fungi create a symbiotic relationship with a plant's roots. Because the filaments that this fungi produces as it grows from the

roots are finer than root hairs and grow further into the soil, a plant's access to water and nutrients is increased. In exchange, the fungi feed on sugars from the plant.

Around 15 to 20 years ago mycorrhizal fungi was considered the best new thing for roses; nurseries offered expensive inoculants to apply to the soil. Since that time information has become available to the home gardener about the fungi's fragility. Disturbing the soil and using chemical fertilizers will kill this beneficial web. Soils high in phosphorus, the nutrient that many rosarians use for increased bloom, will significantly reduce the amounts of this fungi.

The fungi are plant specific and are most beneficial in poor or unfertilized soils. General opinion now is that our garden soils already contain many of the nutrients that added mycorrhizae would capture; in addition, the fungi native to your soil may already exist as well as it can in your pampered garden. Many balanced organic fertilizers now contain a combination of different mycorrhizal fungi; buying a special inoculant is not necessary.

### **Seaweed/Kelp**

Seaweed amendments can be liquid or solid, in emulsions or meals. The major nutrient that seaweed has the most of is potassium. But the special thing about seaweed is the growth stimulant it contains; in addition, seaweed has many trace minerals (over 60), amino acids, and vitamins that promote plant and soil health. The carbohydrates in seaweed provide food for beneficial microorganisms. Liquid seaweed can act as a soil conditioner, improving its texture and water retention.

Research supports the biostimulant effects of seaweed, and it has been used in crop production. Several university studies have demonstrated the impressive results of using seaweed.

*“The wide range of growth responses induced by seaweed extracts implies the presence of more than one group of plant growth promoting substance/hormones.”*

— *Journal of Plant Growth Regulation*, 2009

The same studies determined that drought stressed plants treated with seaweed extract and humic acid increased their root mass by 21-68%. Researchers found that seaweed

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products create abiotic stress tolerance in plants. Although the action of the compounds that do this and increase plant growth are not clearly known, there is no doubt about seaweed's benefits.

Another interesting aspect to the research on seaweed is the discovery of the inhibiting impact of seaweed on root-knot nematodes. Nematodes are one of the rose lovers' major frustration; because the damage occurs under the ground, it is hard to diagnose, other than observing the weakening of the plant.

*"Seaweeds... showed more or less similar suppressive effect on root rotting fungi and root knot nematode to chemical fungicides (Topsin-M) and nematicide (carbofuran)."*

*— Journal of Applied Botany and Food Quality, 2011.*

Application of seaweed can result in decreased levels of female nematodes and their eggs.

### **Fish Emulsion**

Fish emulsion is made by processing the remains of fish products, grinding them into a slurry, and then straining the liquid. Its NPK is around 5-2-2, making it a good source of organic nitrogen. This is multiplied by the fact that the nitrogen in fish emulsion is quickly converted, for an organic fertilizer, into a form (mineralization) that the plant's roots can absorb, around two weeks after application. Fish emulsion may also contain micronutrients and whatever trace elements the manufacturer adds.

The research on fish emulsion is ambivalent. Most of the studies are done for the purpose of comparing it to chemical sources of nitrogen, in hopes of using it as a substitute that is organic and works well in poor soil. Many of the more recent studies have been based in third world countries where soil is not fertile and chemical fertilizer is expensive.

For example, a paper published in Ethiopia in 2013 concluded:

*"the yield harvested from tomato and onion treated with fish offal's fertilizer is as comparable as that of chemical fertilizer."*

*— African Journal of Agricultural Research.*

Other studies determined that fish emulsion provided benefits in some ways but not in others. One could conclude that fish emulsion is no better than any other organic source of nitrogen. But the relatively

quick mineralization rate of the nitrogen in it makes fish emulsion a good choice when you want to give your plants a quick shot of organic nitrogen that won't burn roots.

### **Gypsum**

Gypsum is calcium sulfate, a naturally occurring mineral. The benefits of gypsum are highly dependent on the type of soil in your garden. Although gypsum has been considered a soil amendment, its real impact lies in the fact that it is high in calcium and sulfur. Both of these elements can upset the balance of nutrients in the soil if it has too much of them.

Soils that are heavy in clay, weathered, or high in sodium benefit from gypsum application. High sodium levels will reduce the soil's ability to absorb water and make the soil more compact. By absorbing sodium gypsum makes the soil more water absorbent and permeable. But most home gardens do not have these levels of sodium in their soil.

Although it is high in sulfur, this sulfur is not the elemental sulfur that acidifies soil. Thus gypsum has very little impact on the pH of the soil. Gypsum is more useful in agricultural applications in large growing fields than in the home garden. Although it may not impact pH, it will add calcium to the soil that will have negative effects if the soil already has adequate quantities of this element. "Soils in low-precipitation regions tend to be neutral or basic in pH with considerably high concentrations of Ca... Typically, gypsum is not necessary in such regions due to the high native Ca content." (Advances in Agronomy, 2017) If soil compacting is a problem, the home gardener can remedy this by adding compost, a substance that will not affect the balance of nutrients in the garden.

### **Epsom Salts**

What better way to end this review than to look at the controversial topic of Epsom salts and its affect on plants. Exhibitors and organic gardeners habitually put down Epsom salts to give their roses a little more color with its magnesium content or encourage basal breaks. Its use is advised by many gardening magazines and websites. It has been recommended by gardeners and professionals for years. These word of mouth endorsements from experts may be enough to convince a rose lover to use it on their roses.

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Once again, overabundance of this nutrient will affect the uptake of others. Chances are your garden soil has enough magnesium; it may not be available to the plant because of high levels of another nutrient, such as potassium. Adding more will not get more magnesium to the plant.

Although sandy and acidic soils may be magnesium deficient a garden lover’s fertilized soil probably isn’t. If it is, again, compost will help level things out without affecting nutrient balance. And if that is not enough to convince you, read the following.

*“A soil test is absolutely required before using this chemical.”*

—Washington State University

*“Epsom salt has not been demonstrated through research to help roses grow or bloom better.”*

—Kelloggs Garden

### The Bottom Line

The above reference to the necessity of a soil test is very relevant when using amendments that contain plant nutrients. Soil pH has the most direct effect on plants’ nutrient absorption, and high levels of nutrients or micronutrients, with the possible exception of nitrogen, will inhibit the effectiveness of others.

There’s a balanced, chemical, ionic dance going on in your soil. Other factors such as beneficial microbes and bacteria contribute to soil health as well. When it comes to nutrient interaction, chemistry is a major factor contributing to success or failure. It’s a complex, natural harmony.

Although we want to pamper our roses and produce the largest blooms, we could inadvertently become our garden’s biggest enemy if we try to change things without the proper information.

Before you add potential unneeded nutrients to your soil, check out what is already there with a soil test. But you can still add good things to the garden that will enhance your roses’ growth and development.

Worm castings, humic acid, kelp, and fish emulsion won’t change your soil pH and have been researched and consistently found to have positive, nondestructive benefits for the garden. You can’t go wrong with them. Make sure to read the directions on the product you choose for the proper application. There’s no point in using more than your need and it won’t benefit your plants.

\*References available upon request.

—Carolyn Elgar, Master Rosarian. As reprinted in the March 2020 Rose Gazette, newsletter of the Orange County Rose Society.

Product	Benefits	Research Results	Recommendation
Worm castings	mineralizes nutrients; improves soil texture and water retention; increases microbial activity; contains growth hormones	Very positive	Use it
Humic acid	improves nutrient retention in soil; improves soil texture and water retention; chelates minerals for improved uptake	Very positive	Use it
Seaweed/kelp	60 trace elements; growth stimulant; nematode suppression	Very positive	Use it
Fish emulsion	mineralizes nutrients quickly; 5% nitrogen	Ambivalent	Use it for nitrogen
Alfalfa	contains triacontanol, a growth stimulant;	Positive for triacontanol	Other things are better
Mycorrhizae	increases roots’ nutrient and water uptake	Good for poor soils	Get it in organic fertilizer
Gypsum	contains calcium and sulfur; decreases soil sodium	Use for calcium	Get a soil test first
Epsom salts	contains magnesium sulfate	Has no effect on plant	Get a soil test first