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Abstract: This article was first published in the Marion County Rose Society's newsletter "The Rose Rambler" edited by Carol Green. We thank Carol for making the article available to the DSD Audience.

This article talks about the all-important subject of soil composition helping the reader select the best soil for the garden. Next Dan talks about improving the water and nutrient retention capacity of the soil. Dan suggests organic materials that may be used. There are several ways to apply the material to your garden especially if it is a new garden. Dan covers the importance of soil pH and how to best bring it to proper levels for roses. Sheet Composting is briefly covered and is the subject of another of Dan's Award of Merit articles. A good set of tasks is listed to help the reader get a good start with a new rose. Dan ends by saying that "It may take a while, so be patient". Nature needs time to do its job.

Roses & Soil & Water

By Dan Mills, CR

One thing that all rose lovers can agree on is that we want our roses to bloom and re-bloom as much as possible throughout the growing season. Most of our modern roses and many of our OGRs are quite capable of repeat blooming with consistency as long as their basic needs are met. These needs include adequate sunlight, air, water, and mineral nutrients. It is our job as growers to first provide a planting site with full sun and good air circulation, and then make up for inadequacies in water and nutrients as the growing season progresses.

As pointed out in our ARS Consulting Rosarian Manual, nearly all water and nutrients taken up by roses comes from the soil. Therefore, it makes sense for us to try to understand the nature of our *native soil* and then try to manage it so that it provides our roses with the needed water and nutrients as efficiently as possible.

This is an especially challenging task for most of us living in the Central Florida area because our native soil is so sandy. Soil scientists have determined that the *ideal soil texture* for growing roses is 60% sand, 20% silt, and 20% clay. Most of our soils are 80-90% sand. This means that water and dissolved nutrients drain out of the root zone too fast. One consequence of this excessive drainage is that we have to water and fertilize more frequently than if we had a more ideal texture. Another consequence is added pressure it puts on local water supplies and on the quality of ground and surface waters. So the obvious question is: what can we do to our native soil to improve its *water and nutrient retention capacity*? Before an answer to that question is offered, let's first take a brief look at the make up of a good garden soil and get an idea of how its various components interact to help provide the needs of plants.

Composition Of A Good Garden Soil

A good garden soil for growing roses consists of approximately **25% water**, **25% air**, **45% inorganic material (often called mineral material)**, and **5% organic matter**. In view of our tendency to think of soil basically as a solid, it seems rather remarkable that the top several inches of good garden soil is actually about half water and air by volume. This fact alone makes it clear that water and air are very important in proper soil function.

Water is essential to all living organisms within the soil and to all plants rooted in it. Water keeps plants turgid and is a vital component of photosynthesis. This is the process whereby plants make their own food by utilizing the energy of sunlight to convert CO2 and water into carbohydrates. Water also transports in solution from the soil virtually all of the mineral nutrients that are utilized by plants as they grow and maintain themselves.

Air is required for respiration by all living organisms in the soil, including roots, earthworms, and microorganisms. Therefore, air along with water should be fairly evenly distributed throughout all portions of the soil that are biologically active.

The relative proportions of air and water in the soil can fluctuate significantly between successive rainfalls and between wet spells and dry spells. We typically compensate by having some kind of irrigation system to maintain a *continuously* moist soil. The amount and frequency with which we have to irrigate between rainfall events depends mostly upon how well the soil retains water. In this respect, both inorganic and organic materials play very important roles.

Inorganic material is made up mostly of tiny rock particles called sand, silt, and clay.

Sand particles are the largest and are visible to the naked eye. Silt and clay particles are microscopic, clay being the smaller of the two. As pointed out earlier the ideal combination for growing roses is 60% sand, 20% silt, and 20% clay. The 60% sand provides for adequate drainage of water, even during periods of excessive rainfall. Otherwise, roots could suffer or die from lack of oxygen as water pushes out air and fills up the pore spaces (the "wet feet" syndrome).

The 20% silt is ideal for retaining sufficient *available* water and freely giving it up to plant roots as needed. In fact, soil science has determined that much of the water taken up by plant roots comes directly from silt-size particles.

The 20 % clay is ideal for holding water and mineral nutrients *in reserve*. Collectively, as individual particles and lattice-like groups, these microscopic particles constitute a huge surface area on which a relatively large volume of water can accumulate and be held very tightly. They also carry a negative electrical charge, which accounts for their tendency to attract and hold mineral nutrients that are positively charged ions. Thus we see that the 60-20-20 combination of inorganic particles is the near perfect balance to help provide optimum water and mineral nutrient needs of roses.

Although the proportion of **organic matter** in a good garden soil is much smaller than the proportion of inorganic material, 5% vs. 45%, it nevertheless plays vital roles in *nutrient cycling* and in building and maintaining good *soil structure*. At this point it is worth mentioning that our native sandy soils typically contain only about 1% organic matter compared to the ideal of 5%

The living portion of soil organic matter (mainly the microorganisms and earthworms) is constantly at work breaking down the dead portion (organic waste) into (1) carbon dioxide and water (just the opposite of photosynthesis), (2) *mineral nutrients*, (3) a wide variety of organic compounds and (4) relatively stable end products called humic substances, or humus.

During the decay process, some of the released mineral nutrients eventually may be taken up by roots and utilized by plants. Some may be reabsorbed by microorganisms and cycled again through the process. Others may be held in storage by clay particles, or by humic substances, or by the combined action of the two. And, still others may leach out of the root zone along with excess soil water.

The humic substances tend to persist in the soil and provide a variety of very important benefits including the coating of inorganic particles (sand, silt, and clay), which promotes the grouping together of individual particles into aggregates. Aggregation leads to good soil structure, which in practical terms means greater pore space and better water, nutrient, and air retention. To convey this important concept in layman terms, soil scientists sometimes make the analogy between well-aggregated soil and a sponge.

Technically, humus is the very end, stable remains after virtually all degradable material has been removed.

Because it resists further decay, humus tends to slowly accumulate in the soil as long as conditions under which it formed remain the same. In our warm climate, exposure of soil to excessive heat from direct sunlight by frequent or permanent removal of vegetative cover can lead to a rapid decline in humus content. Thus, humus tends to survive or accumulate best under the canopy of a forest or a thick blanket of mulch in the garden. Humus particles are dark brown to black and very similar to clay particles in terms of their size and in terms of their tendency to attract and hold water and mineral nutrients in reserve. According to some sources, soil organic matter can hold up to 20 times its weight in water.

Dan's Article continues.

Improving Water and Nutrient Retention Capacity of Our Soil

From the discussion above, there appears to be two obvious possibilities for improving the *water and nutrient retention capacity* of our native sandy soil. We can either increase the amount of clay in the soil or we can increase the amount of organic matter. Both options are achievable depending on how much time, expense, and effort we are willing to give. Since the right kind of clay is often difficult to locate and transport, heavy to work with, and hard to incorporate into the soil, nearly all gardeners opt for using organic materials. In addition to improving the water and nutrient retention capacity of soil, regular additions of organic matter will also provide a steady supply of plant nutrients, better aeration and more even temperatures, and support a larger population of soil life.

In an ideal situation, organic materials probably should be incorporated into our native sandy soil and allowed to age for at least a few months *before* any roses are planted. In theory, this would get benefits from extra organic matter started in the root zone before planting. However, it is probably a fact that many rose growers do not become aware of the potential benefits of organic material until *after* they have planted roses. For either situation, there are ways to apply organic materials effectively. Some suggestions on kinds of organic materials to use and ways to apply them are presented below.

Organic Materials To Use

Most organic materials are useful for improving water and nutrient retention capacity of sandy soil. As a rule, the greater the variety of material used the greater the variety of potential nutrient release for future plant use. The nitrogen-rich materials contain sufficient nitrogen to support the microbial activity necessary to break them down in the soil. However, the carbon-rich materials are nitrogen deficient and, if used alone, require 1-1.5 pounds of nitrogen per 100 pounds of material to be mixed in at the time they are incorporated into the soil or applied on top of it.

Otherwise, the decaying organisms may actually rob the soil of needed nitrogen causing a nitrogen deficiency in plants growing in the soil. This sometimes happens when fresh wood chips are used alone as mulch. Ideally, a mixture of nitrogen-rich and carbon-rich amendments should be used together in such a proportion that a slight excess of nitrogen is released into the soil as decomposition progresses. This is also a critical concern in making compost at home, and more will be said about that in the November program.

Ways To Apply Materials

For new rose beds many different approaches are possible depending in part on how much time and effort one is willing to exert. One possibility first involves killing all grass and weeds with Round Up to eliminate future sprouting of root remnants of aggressive grasses such as Bahia and Bermuda. After the dead grass and weeds are removed or tilled in, the desired organic amendments would be spread evenly in thin layers over the entire bed, alternating nitrogen-rich and carbon-rich materials, to a maximum depth of 6-8 inches. Each layer should be moistened as it is applied.
The whole mass of amendments would then be spaded in or tilled in with a rotary tiller to a depth of several inches. This method amounts to composting in the ground instead of in a pile.

If the soil pH at the time of treatment is under 6.0, sufficient lime should be added and tilled in with the amendments. After several months of resting, the bed should be ready for planting. Just before planting, the pH should be checked again and adjusted if necessary. Sometimes a large treatment with organic material will acidify soil significantly because of the organic acids generated by the decay process. This tends not to be a serious problem in our area because most of our soils are underlain by limestone rock, which naturally tends to counteract acidity. If weeds start to grow in the bed before roses are planted, they can be mowed and the residue left in place. The whole bed will be mulched thickly after the roses are planted. A simpler version of the method described above is to skip "tilling-in" the layered amendments. The materials will decay "in place" on top of the soil if kept moist.

This method of composting is called "sheet" composting, and there is a body of reports attesting to its effectiveness.

Some who use "sheet" composting control or eliminate weed growth by covering the top layer of amendments with overlapping sheets of newspaper or cardboard and keeping it constantly moist until it "mats" in place. A better technique might be to crisscross the paper or cardboard with baling twine anchored down by ground-cover u-nails. After several months have elapsed, holes can be dug right through the composting material and roses planted.

When bushes are planted, the planting holes may be amended in the usual way (extra compost or aged manures, slow-release fertilizer, rock phosphate or super phosphate in the bottom of the hole, etc.). This is common practice to help new bushes get off to a good start. The real benefits from having treated the *whole* bed with organic materials prior to planting will show up in future years as the bushes outgrow their original planting holes.

Immediately after bushes are planted, the whole bed should be mulched to a depth of 3-4 inches with a coarse organic material such as pine bark or pine straw. This thickness of mulch should be maintained continuously by periodic replenishment as needed. The slow, continuous decay of mulch will contribute to the build up and maintenance of the organic level of the soil. The accumulation of humus is essential to achieving our goal of improving the soil's water retention capacity.

For rose beds that have *already* been planted, organic amendments may be applied evenly on the soil surface around each bush after the mulch has been raked back to the drip line or a little beyond. After the amendments have been applied, they should be covered with new mulch. It is *not* recommended that amendments be scratched in or dug in, because damage to rose roots could occur. There is evidence that surface applications of organic amendments have similar effects to "incorporation". It just takes longer. The old mulch that was raked back to make way for the amendments can be spread evenly over the space between bushes to help maintain an even thickness over the entire bed.

Perhaps the best time to do this "organic treatment" each year is immediately after late winter or early spring pruning is completed. This provides a month or two for the microbes to begin work on the new amendments before spring growth begins on the roses. Some rose growers do a second annual organic treatment in August immediately after the light pruning for the fall flush. These annual organic treatments should prove beneficial to all rose beds established in our native sandy soil.

Be Patient! It May Take A While*

One way of looking at what we are trying to accomplish here by building up the organic component of our soil is to view it as a sort of restoration of the natural cycle of growth, leaf fall, decomposition, and recycling of nutrients that is found in forests and grasslands. Nature is the model and we are trying to simulate it in our garden by artificially replenishing a major missing component, organic matter, and supplementing the process with sufficient water (when necessary) to make it work. It takes nature perhaps hundreds of years to evolve an effective forest or grassland in a suitable climatic zone. So let's be patient and give our efforts a little time (several months or a few years) to start yielding nature's benefits. They *will* begin to accrue, and our rose bushes will appreciate it!

* Three assessments of the time factor for achieving results are provided by:

(1) Toor and Shober, UF, IFAS Ext.Service, SL273, p. 3. "Building soil organic matter is a slow and gradual process...It may take a decade or more for organic matter levels to significantly increase. Fortunately, the beneficial effects of the changes in organic matter can be seen after few additions of organic residues/compost."

(2) Pleast and Morton, The Complete Compost Gardening Guide, 2008, p. 20. "In most soil, attaining an ideal level of 6 to 8 percent of stable and active organic matter usually takes three years if you mix in a 3" (7.6 cm) thick blanket of compost annually and use biodegradable mulches."

(3) Our experience at The Weed Patch, near Fairfield, Florida. Prior to 1998 the native soil had been used for the production of watermelons, various vegetables, and Bahia grass for 65 years or so. The organic matter content of the soil was about 1.0%. By 2009, following annual organic treatments and the maintenance of a continuous mulch cover, the organic matter content of rose bed soil averaged 3.7%.