

FALL SOIL HEALTH - GIVING BACK – OHANA KULEANA - FALL 2016 – Keoki Moore

MICROBIAL PRESENCE IN THE SOIL

The earth takes care of itself. It has been doing its own composting for three hundred and a fifty million years. The fertility of all the soils of the earth has been achieved and maintained principally by the decay of plant matter.

When we till the soil, we interrupt the earth's natural pattern of returning plant material to the soil, and in doing so, we create an intrinsic responsibility to care for that soil. We become surrogates. Furthermore, when we plant a seed in that soil; we take on the same responsibility to care for that plant. All of the functions and tasks that we perform relative to gardening are born from the need to fulfill our duty as a surrogate.

Plants live in two environments, above ground and below ground. We need to care for the plant in both environments. We humans have an easier time relating to the "above ground" aspect of gardening because that's the same environment that we live in. We share our environment in a symbiotic relationship with plants. We understand above ground tasks like selecting seeds, orientation and positioning of beds, sun/shade issues, weeding, disease control and bug control. However, we need to maintain our plants in both environments. Both involve understanding and planning. When it comes to the "below ground" side of gardening, we discover pretty quickly that it is going to take more than just watering to maintain a bioactive soil with good tilth. Every gardener should have a basic understanding of what a healthy, bioactive soil is, how to achieve it, and how to maintain it.

Creating and maintaining a healthy, bioactive soil, with its host of microbes, is the foundation of having a successful garden. Both micro and macro decomposers are our partners in the accomplishment of this task and they work harder than anything else in our garden.

The **micro decomposers (microbes)** are the unseen bacteria, molds, actinomycetes, protozoa, fungi and other organisms that break down plant material such as compost. Microbes break down plant matter into molecular compounds. These compounds are pulled apart and re-formed into many other compounds through chemical processes. Ultimately, plants recognize and use them as nutrition.

The **macro decomposers**, are physical decomposers such as mites, millipedes, centipedes, springtails, beetles and earthworms. They go to work when the plant material becomes partially decomposed by the micro decomposers. They are called physical decomposers because they tear, bite, suck, shred and grind the decaying plant matter.

This is how it works (simplified). A leaf falls to the ground. Microbes begin decomposing it. The macro decomposers begin their tearing and chewing process. Microbes continue the decomposition work until only molecular compounds of the leaf remain. In the process, they leave behind their metabolic waste and carcasses that are decomposed as well. Chemical processes take over and acids are produced that release bound up elements from the soil aggregate. The breakdown and re-construction of the molecular compounds continues until the compounds are recognized and taken up as nutrition by plant roots. This is a bioactive soil.

All of this work by the microbes can only be accomplished if they have an acceptable environment to live in. Favorable conditions such as a proper pH level and soil temperature are important for microbial health and survival. Furthermore, certain components in the soil need to be present. Good soil is 25% water, 25% air, 45% mixed aggregate and 5% decomposing plant matter. The 5% decomposing plant matter produces the food that keeps the microbes alive.

GIVING BACK

"Giving back" happens all year long, not just in the Fall. We need to keep those microbes fed all season long so that they may do their work. They need a constant supply of decaying plant material from which they find their nutrients. Many of us view the Fall as the end of the gardening season, when we should actually see it as the beginning of the next season. The attention that we give our soil in the Fall will increase our chances of having a successful garden the following year and reduce our work in the Spring. Our goal is to have a healthy, bioactive easy-to-work soil **going into the Fall**. This is accomplished by frequent attention to cultivation.

Cultivation:

Cultivation is any process that re-arranges soil **structure** using some activity. Soil structure is the arrangement of the solid parts or aggregates of the soil and of the pore spaces between them. A nicely structured soil has a web of micro pores and macro pores enabling the movement of plant nutrition, water and air while creating healthy biological activity. Using soil amendments such as plant material, compost, organic fertilizers and manures is part of cultivation. Watering and mulching can be viewed as cultivation as well.

Tilling the soil:

Tilling the soil is part of cultivation. We till the soil to improve structure. To do this, we use garden tools such as the

shovel, digging fork, rake, hand trowel, hoe, broadfork, rotary tiller*, and specialty tools. Try to use your hand tools instead of a machine*. It involves more work, but season-by-season, your soil structure improves and your work will decrease (but not cease).

Broadfork:

When using a broadfork, you might need to start a month before the ground freezes, depending on the condition of the soil. The idea is to crack and lift the soil **allowing compost to fall into the cracks** (see step #2 below). This places decaying plant material down deep and allows microbes to flourish and create pores for the movement of nutrients, water and air. Worms will be attracted to this environment too. If you are using a slow release fertilizer over Winter, now is the time to mix it in with your compost before application.

Step #1

First, starting at one end of the bed or row, work the broadfork into the soil down to twelve inches and lift. This is only a trial lift to check the condition of the deeper soil. Lift the clump without removing it and investigate below it to see how wet the soil is at twelve inches. You may have to lift the soil chunk up far enough to see or feel underneath it. If it is sticky wet, you may need to let it dry for several days before touching it again. (If the soil is moist but not sticky, go to Step #2). In the mean time, continue using the broadfork working the rest of the bed. Lift 4" chunks. If you have the strength to give the chunks a little twist before re-positioning them, then they will sit askew letting air in and moisture out. When this is done, let the bed set for a couple days of dry weather then check it again. When the soil is no longer sticky wet but not yet dry, you're ready for the next step. If the soil is not sticky wet when you do your trial lift, then go directly to step #2.

Step #2

If the soil is dry or just moist, cover the whole bed with 2 inches of compost. You can make your compost go further by mixing it with leaf mold**. Next, continue using the broadfork. Start by lifting the original trial chunk and reset it in place then continue to lift 6" chunks until the bed is done. This will allow the compost to fall into the cracks when you lift the chunks. Work the borders first and finish with the middle area.

Step #3

Now, make another pass over the whole bed with your broadfork coming at it from a direction perpendicular to that which you started with. When you finish this pass, most of the compost that you laid down will have disappeared between cracks into the soil. If at this time, you have hard, dry clods on the surface, you can water them just enough to moisten them. Keep the water on the surface. Do not water so much that you flood the spaces between the chunks made with the broadfork.

Step #4

You are now ready to put more compost down. This layer should be one inch thick and does not get worked into the soil; it stays on the surface. Mulch it with three or four inches of leaves. Lay some branches or wire fencing on top of the leaves to prevent them from blowing away. Give the bed one last watering before your water source is turned off for the Winter and you are done until Spring.

Spring:

When you are ready for spring work, rake off the leaves (save them for mulching) and make one more pass with the broadfork to help dry out the soil. This will allow more compost to penetrate deeply before the growing season begins. Follow your normal routine for breaking down the chunks. Apply half an inch of compost once a month during the growing season and keep the bed mulched and moist at all times and you will have soft, well structured, bioactive soil going into next Fall.

***Care should be taken when using rotary tillers.** Rotary tilling is considered to be extreme cultivation. It pulverizes soil structure in such a way that it destroys pore spaces and creates compacted soil in a short amount of time. It also destroys worm populations.

****Leaf Mold:** Put two bags of leaves in a pile and shred them with a lawn mower; this will almost fill a metal garbage container. Add one gallon of water or compost tea. Turn it occasionally and make sure that it stays moist and warm if possible. Add one shovel-full of compost if you want. It will take around two months for it to convert to leaf mold. Save a couple bags of leaves over Winter and make your leaf mold during the spring and summer months. Use it as a mulch or mix it with compost (50/50)

Some of the information in this document comes from The Cornell University Master Composter's Resource Manual and some comes from Texas A and M Earth Kind Landscaping Manual. The Oregon State University website and University of Vermont website also provide excellent information on composting and gardening; some of which is expressed in this document.