EXTENSION
College of Agriculture, Biotechnology & Natural Resources

Master Gardeners

UNR Master Gardeners

Douglas County

Spring gardening is a time of renewal and anticipation for gardeners. As the days slowly warm up and the sun hangs in the sky longer each day, it is a perfect opportunity to think of soil health to ensure that you garden thrives during the growing season.

In this newsletter, we focus on the importance of soil health, composting and a short history lesson on legumes (great soil builders). Enjoy!

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Save the Dates

April 6 - Rose Care Class -
Time: 12:00 -1:00 pm
Location: Dangberg Home Ranch Historic Park

May 2024- UNR Master Gardener Training Registration Open!

May 18 -Native Plant Sale
Time: 9:00-1:00 pm
Location: TNC River Fork Ranch

May 29, June 5, June 12, - Heritage Park Gardens Live Q&A Session
Time: 5:30-6:30 pm
Location: 1461 Ezell St, Gardnerville

June 16-22 - Pollinator Week
Times: Vary
Locations Vary

June 25 - Gertrude's Garden Talks
Time: 5:30-6:30 pm
Location: Dangberg Home Ranch Historic Park

Good Soil is Alive

Author: Ingrid Angelini

Now you see it!

Good soil supports plant life and poor soil doesn't. Most of us have seen only those critters scurrying on top of the soil: worms, centipedes, ants and larvae. But they are only scratching the surface, up to 4 inches below. There are up to 50 earthworms in a square foot of soil.

And now you don't!

In actuality, a vast number of other organisms reside further down. An entire world of microscopic individuals: bacteria, fungi, protozoa and nematodes appear in overwhelming numbers, up to a mile beneath the earth's surface. Microbial scientists have discovered over a billion bacteria, several yards of fungal hyphae (filamentous output of fungi), several thousand protozoa and a few nematodes in a mere teaspoonful of good garden soil.

How it works

The energy required to support a few bacterial species comes from sulfur, nitrogen or iron, which they synthesize to meet their needs. The rest rely on carbon, derived from the organic materials in plants and the waste products or decaying bodies of other organisms.

Simply put, most organisms consume more than 1 kind of prey, so in the case of making a diagram of their food chain it becomes clear that this is not a straight line, but intersects a number of ways, creating an intricate web.

A lot of energy resulting from photosynthesis is used by the plants to create chemicals which are released through their roots. This, along with the sloughing off of cells with root tip growth, attracts the microbes listed above.

The story of the soil food web

Bacteria and fungi take up and use the chemicals released by a plant's roots. Larger microbes, the protozoa and nematodes, consume the bacteria and fungi. Their waste products are taken up by the plant's roots.

The protozoa and nematodes, in turn, are eaten by arthropods, those creatures exhibiting jointed legs, a segmented body and hard outer covering (exoskeleton), such as insects and spiders. These creatures consume each other (think of beneficial insects) and serve as food for snakes, birds, moles and others.

How this creates good soil

All the critters, moving around in the soil, searching for prey or protection, are beneficial in 1 of 2 ways. The smallest organisms, bacteria and fungi secrete slime and hyphae, respectively, which bind soil particles together. The bacterial slime can act as a means of propulsion, when squirted out of the organism. It is also used to prevent drying out when the soil is dry, and as a means of defense against bacteria or microbicides.

The larger animals, as they move through the soil, create spaces for air and water to pass through. Both the aggregation and aeration help to improve the soil's structure.

The death of any of these creatures becomes a food source for someone else in the community, preserving the nutrients in the soil. These nutrients are locked up within the organisms, and are not drained away, as they are with chemical fertilizers.

When the plants themselves die and decay, the nutrients within them are taken up by bacteria and fungi. Worms pull organic matter into the soil, where beetles and larvae shred it, making it available for the bacteria and fungi.

Soil health

The diversity existing in this microscopic world is beneficial for soil health. Up to 30,000 species may be present within the billion bacteria previously mentioned. This diversity keeps the pathogens in check. Some bacteria in the soil are pathogenic and cause things like canker, fire-blight, galls and black spot. Fortunately, the high diversity of non-pathogenic bacteria present in good soil will outcompete these guys for space and nutrients.

Certain bacteria and fungi produce vitamin-like and antibiotic-like chemicals to aid plant health. Penicillin and Streptomycin are produced, respectively, by a soil fungus and bacterium.

Conversely, if the number of bacteria and fungi drops, or if they disappear, the plant becomes susceptible to attack by pathogens.

Nitrogen is the most important of the nutrients appearing in the soil. It is dependent upon the total amount (biomass) of bacteria and fungi, and therefore regulates that which is available for the plant to use to increase growth.

Some plant communities, such as old growth forests, thrive on fungal-dominated soils, while others (annuals, grasses and vegetables) prosper with bacterial domination.

Interfering with this process

The natural soil environment is drastically changed when synthetic chemical agents (fertilizers, pesticides insecticides and fungicides) are used. The bacterial and fungal interactions are prevented from happening as the plant opts for the free nutrients (Taking the easy way out.). It then becomes necessary to keep adding chemicals, which increases expense.

As the bacteria and fungi disappear, so do the other members of this web of life. Earthworms will move out, as they are bothered by the synthetic nitrates and they become hungry. The organic matter doesn't get shredded and the soil structure deteriorates, making watering a problem. This creates an invitation to plant pathogens and pests, and results in increased work for the gardener.

Another way to destroy healthy soil is by disturbing it. Rototilling shreds the fungal hyphae and earthworms, as well as squashing the higher order arthropods. Compacting the soil with such a practice destroys the soil structure, which previously had offered access to air and water, thus increasing work for the gardener.

Deeper understanding

Improving poor or degraded soils rely upon increasing those organisms, which do most of the work in maintaining plant health. Good soil is about 45% mineral and 5% organic material. The organic matter results from surface animals and plants dying and becoming decayed by the bacteria and fungi. This conversion results in humus, the coffee-colored material found in compost.

Humus is comprised of strong carbon chains of molecules. The molecules have large surface areas which carry electrical charges. The charges attract and attach to mineral particles. These sponge-like carbon chains offer spots for soil microbes to move in.

Nearly 50% of the pore spaces in good soil are filled with water, leaving the rest available for air. As water moves through, stale air is released, to be replaced with fresh surface air. The working soil organisms take in oxygen and release carbon dioxide, which is exchanged for fresh air.

Compacted soils, on the other hand, have their pore space so compressed that air is not exchanged as water percolates down, leading to the decimation of plant root cells.

Good soil is dependent on texture, which depends on particle size. Sand is the largest and most rapidly draining, due to gravity. Silt is next, its ability to hold water greater than sand. Clay has the smallest particles, therefore having the greatest surface area and thus the most numerous and tiny pore spaces for water to adhere.

The nitrogen cycle
Nitrogen-fixing bacteria take up nitrogen (N2) from the air and convert it to a form which plants can take up. They are commonly found within the roots of legumes. Another nitrifying bacteria resides in the soil, decomposing proteins from protozoa and nematodes into ammonium (NH4). Then a second bacterium converts this into nitrites (NO2), The third species will then convert this to nitrate (NO3-), an ion which can be taken up by the plant. All this activity requires an alkaline environment, conveniently provided by the bacterial slime. Denitrifying bacteria then change the nitrogen salts back to N2, which is released into the air, beginning the cycle again. (This is not meant to be a lesson in chemistry, but rather to illustrate how perfectly intricately this community of organisms functions together.)

References:
"Teaming with Microbes". Jeff Lowenfels & Wayne Lewis
"Sharing the Knowledge, Book 2", UCCE Master Gardeners of Tuolumne County

Experimenting with Trench Composting

Author: Lorna Doerr

According to the EPA website, municipal solid waste in 2018 was approximately 4.9 pounds per person per day. Of that waste, some was recycled and some was composted. As I reflect on this number, I asked myself, How can I cut down on the waste generated in my own home? How can I make compost and use it to improve our garden soil? I know that that composting is a great alternative to burning or disposing of organic materials in the landfill. Instead of discarding food residual waste into the garbage, I could turn that substance into a valuable soil amendment for our garden.

Jessica Gardner, our Master Gardener Coordinator, introduced me to the technique of trench composting. The term "trench" is used loosely as it is basically digging a hole, filling it with kitchen scraps and garden waste, then filling it back up with soil. This interested me as I knew I wouldn't need special equipment. In fact, I already had a shovel, so all I would need was a compost bucket.

At Cost Plus World Market on Topsy Lane, I found this compost bucket for $29.99. I like that it has a charcoal filter in the lid to keep odors contained. And, it is only 8" tall so it doesn't take up much room. It has a 3.5 quart capacity which is about 3 days of waste from our kitchen.

Compost Bucket. Photo by Lorna Doerr

I kept track of what we added to our compost bucket. Daily coffee grounds, egg shells, vegetable stems and peels, tea bags, the last bit of lettuce from a salad mix, cut-up banana peels, cores from apples and pears, and citrus peels cut into small pieces. The shells from pistachios, peanuts, and edamame went into the compost bucket. Also, stems from cilantro and parsley as well as the seeds and strings from various types of squash became compost! The flowers that brightened our house expired, and I chopped those up and added them to the hole in the garden.

These items will provide protein-rich nitrogen and moisture to the soil.

I researched what items cannot be composted. Fatty food, meat, bones, grease, oils, dairy products, avocado peels, and onions are undesirable because they might attract rodents or pests, and these items don't add nitrogen to the soil.

As I started this process, I would go out to my flower bed, dig a deep hole, and bury the contents of the compost bucket. I flagged three of the "deposits" so that I could check the decomposing process!(Picture 2.1) Depending on the soil temperature, the number of microorganisms in the soil, and the carbon content of the waste, decomposition should occur in one month to one year.

After just 4 weeks, I took out the flag and dug into where I placed a compost deposit (Picture 2.2). The only recognizable items were egg shells! Everything else had decomposed into a gorgeous black soil! I vow to continue this practice, and I encourage you all to try it as well.

Picture 2.1 Photo by Lorna Doerr

Picture 2.2 Photo by Lorna Doerr

The Wonderful World of Legumes

Author: Laura Dick

For centuries legumes have been a food source for many people. Some researchers suggest legumes have been around for millennium. How long is somewhat unclear, but we do know that Indigenous peoples in the southwest used Honey Mesquite (Prosopis glandulosa) pods as a staple food1. The mesquite produces pods (fruit) even in drought conditions making it a reliable food source. Bread and cake were made from the ground bean flour and beverages from the pods. Flowers were also edible and eaten raw or were roasted. WARNING! Do not eat any wild plant unless you are 100% certain of its identification.

Figure 1 Mesquite pods. Photo credit Pixabay

Figure 2 Sweet pea pods. Photo credit: Pixabay

The legumes you may be most familiar with are dried
beans (Phaseolus vulgaris), peas (Pisum sativum) and lentils (Lens culinaris). However, those categories represent a small proportion. Legumes are in the family of Fabaceae/Leguminosae. Worldwide there are more than 19,500 species, close to 770 genera and six families (Cercidoideae, Detarioideae, Duparquetioideae, Dialioideae, Caesalpinioideae, and Papilionoideae) on all continents with the exception of Antarticia (2). Fabaceae habitats are quite diverse and include tropical rainforests, the Tundra and Alpine regions, so some legumes are bound to be here in Nevada.

Legume characteristics take many forms. They can be trees, woody vines, shrubs or herbaceous annuals, biennials and perennial plants. The leaves are usually compound, trifoliate or palmate. The fruit is either a legume or pod.

Legumes are used as forage and seed for livestock, fodder for domestic animals, timber, and industrial products. They are also used for soil conservation by reducing erosion, some are used for dyes, and others for shade trees and ornamental landscape

plants(2,3). Be aware that not all native North American legumes are edible. Two examples are Locoweed (Astragalus; Oxytropis) and Vetch (genus Vicia) which are extremely toxic. These legumes cause health and permanent neurological problems if consumed.

Figure 3 Chickpea plant. Photo credit: Britannica.com

Although we don't think of Nevada as a region for growing dried beans, interestingly, the University of Nevada, Reno collaborated with the U.S. Department of Agriculture to study the potential of growing Chickpeas (garbanzo beans). A one-year trial was conducted at the Fallon Research Center and Experiment Station in Fallon, Nevada.
Researchers tested various varieties for seed yield. One variety (CDC Palmer) showed promise as an alternate rotational cover crop. Of course, more research will be needed to confirm results (4).

The U.S. Bureau of Land Management (BLM) uses seeds of native and introduced species (including legumes) for reestablishing plants for wildlife and natural use areas, for wilderness study, and soil erosion in the Great Basin(5). The BLM studies and provides references showing the adaptability of plants for rehabilitation and conservation based on the effective annual precipitation required for viability

Beneficial Properties

Rhizobia bacteria resides in many soils. Rhizobia invades the roots of legumes creating root nodules. That's where the bacteria convert the nitrogen found in the atmosphere into a form that plants and soil organisms can use. Many soils contain a variety of native rhizobia, but to be beneficial, have to be compatible (well matched) with the legume type. Farmers use particular types of laboratory rhizobia to "inoculate plants" thereby improving soil nutrition on a large scale(6)6. This nitrogen fixation helps to reduce the use of nitrogen fertilizers.

Legumes are also key in human nutrition. Worldwide, legumes are an important high- quality protein food source. Mediterranean cultures consume the most legumes. The Mediterranean Diet has been studied extensively (PREDIMED Trial) and shown to confer many health benefits, including lowering serum
cholesterol and reducing cardiovascular disease risk7. The Mediterranean diet has several components, one being the consumption of edible legumes - dry beans, peas, chickpeas, lentils and soybeans.

Figure 4 Dried beans and peas. Photo credit: Pixabay

As you can see, the family of Fabaceae/Leguminosae offer many environmental and human benefits. From enjoying the sheer physical beauty in landscapes, appreciating their soil enrichment capability, and consumption as healthy food crop, we experience the multitude benefits legumes provide. So, on your next trip around town or around the Silver State, see if you can identify one of these beauties.

Types of Fabaceae/Leguminosae(8):

Alfalfa (*Medicago sativa*)
Clover (*genus Trifolium*)
Lupine (*genus Lupinus*)
Mesquite (*genus Prosopis*)
Redbud (*genus Cercis*)
Wisteria (*genus Wisteria*)
Green Beans (*P.vulgaris*)
Honey Locust (*Fledistia spp.*)
Sweet Pea (*L. odoratus*)
Palo Verde (*genus Parkinsonia*)
Smoke Tree (*Delea Sponosa*)

References

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3. Native legume for improving pastures in the southern U.S. -. Southeast AgNET. (2021, February 23). https://southeastagnet.com/2021/02/23/native-legume- improving-pastures-southern-u-s/
4. Walia, M., & Chen, C. (2020). Potential of chickpeas as a new crop for Nevada: Extension: University of Nevada, Reno. FS-20-27. https://extension.unr.edu/publication.aspx?PubID=3832
5. Guidebook to the seeds of native and non-native grasses, forbs and shrubs of the Great Basin. Bureau of Land Management. (n.d.). https://www.blm.gov/documents/national-office/blm-library/report/guidebook- seeds-native-and-non-native-grasses-forbs-and
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7. Sánchez-Villegas, A., & Sanchez-Taínta, A. (2018). The prevention of cardiovascular disease through the Mediterranean Diet. Academic Press, An imprint of Elsevier.
8. Petruzzello, M. (2023, June 29). List of plants in the family Fabaceae. Encyclopedia Britannica. https://www.britannica.com/topic/list-of-plants-in-the- family-Fabaceae-2021803

The Master Gardener Volunteers of Douglas County provide horticulture education on gardens, landscapes, plants, pest control and other home horticulture-related topics. This newsletter of April 2024 is one of the many resources of information available to the public to help accomplish this mission.