

## **Mycorrhizal Fungi and Healthy Soils**

by Cliff Winger

I was asked by one of our members to write an article on mycorrhizal fungi which have been recently discovered in the 20<sup>th</sup> century, even though we have fossil records of mycorrhizae that are 400 million years old. Some think that because mycorrhizae improve plant adsorption of nutrients by a factor of several hundred this is a gardener's "Silver Bullet." A healthy soil gives healthy and prosperous plants. Healthy soil is an ecosystem of millions of living organisms. You cannot simplify this system of millions of organisms per ounce. Lucky for us gardeners nature gives our soil many diverse organisms that work together automatically. In the soil, small animals, worms, insects, arachnids, protozoa, bacteria, fungi, and actinomyces work on dead roots and buried plant material. Each life form moves plant material from recognizable plant parts to microscopic humus, and soils rich in humus are fertile. An excellent way to maintain a healthy soil ecosystem is to feed your garden with well matured compost.

So what are mycorrhizal fungi? Mycorrhizae are a symbiotic association between a fungus and the roots of a vascular plant. (Ainsworth and Bisby's Dictionary of the Fungi) Over 92% of plant families have a symbiotic relation with a mycorrhiza. Mycorrhiza are divided into three groups: ectomycorrhizas, endomycorrhizas and ericoid mycorrhizae. Mycorrhizal fungi form microscopic filaments (hyphae) that bring soil nutrients to the plant roots. In exchange for soil nutrients, the plant "donates" sugars (energy) to the fungi. Thus, the plant and the fungi support each other. The microscopic filaments significantly increase the surface area available for plant to receive soil nutrients.

Healthy soil contains many types of mycorrhizae however, the best method for plants to associate with mycorrhizae is at seed germination, or for roses when cuttings are planted; this is when new rootlets are forming. Once a live plant has a mycorrhizal association, the two will be together until one or the other dies. Mycorrhizae protect plants from high concentrations of metals in the soil and buffer soil pH for the root system.

An important discovery published in July 2009 found that mycorrhizae fungi can apply a pressure onto soil minerals to penetrate the microscopic crystal structure of mineral crystals. Once the crystal structure is weakened, the mycorrhizae proceed to remove the potassium and other useful nutrients from the crystal, passing the nutrients onto the roots. Rock is broken down and the plant is fed.

An Auburn University study found that "sterile" soils from clear cutting or forest fires were not helped with mycorrhizae fungi on conifer seedling roots. The seedlings dried out faster with the mycorrhiza and only certain mycorrhizae species helped certain plants. Further study found the importance of below ground soil grazers: soils that did not have protozoa and microarthropods consistently lost the beneficial effect of mycorrhiza. These microscopic animals are important in the nutrient cycle and they made the difference between dying and surviving of cuttings in reforestation. Mycorrhizae fungi are an important part of a healthy soil and rose gardens. However, your soil must have a healthy mix of microorganisms. This is why gardeners must be careful in the use of chemical herbicides and insecticides that not only kill plants or pests, but can also kill important soil organisms. Fungicides and mildewcides will kill your soil mycorrhizae fungi. The most essential part of growing healthy plants is healthy soil. Chemical fertilizers increase the salinity of your soil and change soil pH so they should be used sparingly. A healthy plant does not need too much help from us gardeners; roses have been cultivated since biblical times without chemicals. Many old garden roses have survived without human attention for decades. Modern rose cultivars are more disease resistant and with good gardening practices no chemicals are, for the most part, necessary in our Inland Northwest.

Action plan for roses and healthy soil: Michael Marriott of David Austin Roses, England tells us: "The most important thing is good soil preparation for roses. Almost any soil can be adapted for roses. They like plenty of humus, which can be well rotted garden compost, manure, or green waste. Mix to a depth of twenty inches and plant the rose [with the bud union four to six inches below ground level.] It's dead easy after that: a bit of fertilizer in April and June, and a mulch in spring after fertilizing; a bit of pruning after winter."

Roses prefer well-drained soil with a pH near the neutral value of 7.0. Roses are not salt tolerant. Nitrogen is the nutrient typically in shortest supply for roses. UC Davis recommends one pound actual nitrogen per 1,000 square feet twice per year one month apart. For mature plants, adding nitrogen once in early spring may be sufficient. Too much nitrogen may shift plants into vegetative growth at the expense of flowers. Adding compost will give roses other needed nutrients as well as support your soil ecosystem and top dressing with compost reduces the loss of moisture in the heat of summer and reduces weeds. [About 100 pounds of compost, (approximately one pound of dry compost per rose) give one pound actual nitrogen per 1,000 square feet. Many in the Spokane Rose Society use the Northland Rosarium organic rose food developed by Larry Parten.] Use nature to help you garden and grow better roses.