Biofertilizers and Mycorrhizae

Biofertilizers and mycorrhizae are very important to any revegetation effort, as they help to rebuild the living soil that can get damaged by any earthwork. Most desirable species will have a very difficult time out competing weeds without mycorrhizae, or the slowly released nutrients provided by biofertilizers.

Biofertilizers

Biofertilizers are fertilizers containing living microorganisms, which increase microbial activity in the soil. Often, organic food is included to help the microbes get established.

Important functions of soil microbes:

- Convert ambient nitrogen into forms that the plants can use (Nitrate and Ammonia),

- Increase soil porosity by gluing soil particles together.

- Defend plants against pathogens by out-competing pathogens for food.

- Saprophytic fungi in the soil break leaf litter down into usable nutrients.

Mycorrhizae-coated Native Seed Mix

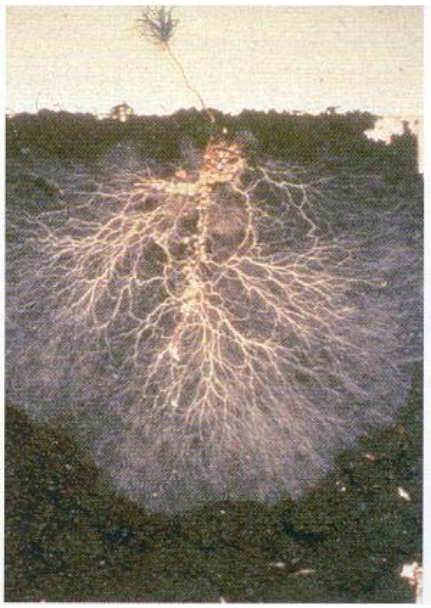
The high soil porosity (large spaces between soil particles) caused by microbes is important, because it aids water infiltration. If pore spaces are too small, they cannot break the surface tension of a water droplet, and water will run off, instead of saturating the soil, where it can be taken up by plant roots.

Chemical fertilizers are often over-applied, and end up polluting the water because they are not used up. The chemicals are less expensive in the short term, but must be continuously reapplied, and are therefore more expensive over the long-term.

A combination of chemical fertilizers and biofertilizers gives the plants a jump-start and maintains them until the microbes can get established.

Mycorrhizal Fungi

Mycorrhizal fungi form a bridge between the roots and the soil, gathering nutrients from the soil and giving them to the roots. There are two major types of mycorrhizae: Ectomycorrhizal Fungi (EM) and Endomycorrhizal Fungi (AM). While both types penetrate the plant roots, ectomycorrhizae spread their hyphae between root cells, while endomycorrhizae hyphae penetrate root cells. Ectomycorrhizae hosts include members of the Pine, Oak and Beech families, as well as few others in scattered families. Endomycorrhizae are the most common, and are found in grasses, shrubs, some trees, and many other plants. EM fungi are usually specific to a certain host species, but most species of endomycorrhizae will form relationships with almost any AM host plant, and is therefore much easier to specify. There are four major plant families that usually do not form mycorrhizae: *Amaranthaceae* (Pigweed family), *Brassicaceae* (Mustard family), *Chenopodiaceae* (Goosefoot family) and *Zygophyllaceae* (Caltrop family) (Peters, 2002). These plant families are well known as weeds. Therefore, if you do not ensure an adequate supply of mycorrhizae, you may inadvertently inhibit growth of desirable species and allow for rapid growth of undesirable species.



Relationships between Biofertilizers and Mycorrhizal Fungi

Plant roots secrete “food” for bacteria and fungi, which attracts nematodes (worms) to the roots, because nematodes eat bacteria and fungi, and excrete Nitrogen, Sulphur and Phosphorus in a form that the plants can use (URS, 2001). The nematodes only keep 1/6 of the nitrogen that they process – 5/6 is excreted to the plant. Once the nematodes have excreted the nutrients, the hyphae of the mycorrhizal fungi pick them up and transfer them into the plant. Because of this symbiotic relationship, the least-leachable form of Nitrogen you can apply is bacteria and fungi, and bacteria are the most Nitrogen-rich organisms on earth (URS, 2001).

AM hyphae pick up more nutrients than just those excreted by nematodes, however. One of the most beneficial properties of AM mycorrhizae is its ability to "mine" the soil great distances from the roots for nutrients, especially those, such as Phosphorus, that are poorly mobile in the soil. AM Mycorrhizae also assist in picking up water further away from the roots, and block pest access to roots (Peters, 2002).

Mycorrhizae also benefit plants indirectly by enhancing the structure of the soil. AM hyphae excrete gluey, sugar-based compounds called Glomalin, which helps to bind soil particles, and make stable soil aggregates. This gives the soil structure, and improves air and water infiltration, as well as enhancing carbon and nutrient storage (Peters, 2002).

Most natural, undisturbed soils have an adequate supply of mycorrhizae for plant benefits; however, the following practices can reduce mycorrhizae populations to inadequate levels (Peters, 2002):

- Erosion
- Grading
- Excavation
- Occupation with non-Mycorrhizal plants (weeds)
- Loss of original topsoil

The best way to be sure that you have appropriate mycorrhizal levels in your soil is to get a soil sample analyzed for mycorrhizal presence.

To maintain healthy mycorrhizae populations (Peters, 2002):

- Do not apply too much phosphorus, as high levels will limit mycorrhizal effectiveness, low to moderate levels, or slow-release phosphorus will maximize plant benefits.
- Limit fungicide use, as some fungicides damage AM fungi.
- Limit soil disturbance, as disruption of the hyphae in the soil limits water and nutrient movement into the root.

Application

Endomycorrhizae should be applied at a rate of 3,600,000 propagules per acre (8,900,000 propagules per hectare), which equates to 60 lbs per acre (67.5 kg/ha) or 1.4 lbs/1000 ft 2 , assuming the standard 120 propagules/cc. Mycorrhizae is most frequently applied via hand seeding, seed drilling, hydroseeding, broadcast and till, planting, or as a nursery medium.

If installing container plants, packets of mycorrhizae (such as RTI's MycoPaks) may be planted along with the plant, at a rate of 1 packet per foot of plant height or container width (RTI, 2003).

Cost

Assuming a cost of $5.50 per pound of AM Endomycorrhizae, materials cost will be $330/acre ($820/ha). The mycorrhizae can be applied via the same method as your seed and fertilizer, so there should be no additional costs.

Maintenance / Inspection

No maintenance should be necessary, although if plants do not appear to be growing vigorously, analysis of mycorrhizal density in the soil can help to determine if you need to apply more.

Sources

Peters, S. 2002. Mycorrhiza 101. Reforestation Technologies International, Salinas , CA .

Reforestation Technologies International 2003. MycoPak Product Information.

URS 2001. Caltrans Erosion Control Training for Landscape Architects, Section 8 – Seed and Fertilizer. California Department of Transportation.

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