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BIOFERTILIZERS AND FREQUENCY OF APPLICATION

Biofertilizers are inoculants that supply living soil microbes that improve soil fertility, soil tilth, and plant mineral nutrition. These include primarily mycorrhizal fungi and beneficial rhizosphere bacteria. Since fungi and bacteria are living organisms capable of reproduction and self perpetuation, why do we recommend repeat applications of them?

The answer to this question is related to the biology of these organisms and their host plants. To be accurate, it is necessary to address mycorrhizal fungi and bacteria separately.

Mycorrhizal Fungi

Background

Mycorrhizal fungi form a very intimate, symbiotic relationship with the plant host. This involves the actual infection, or “colonization”, of the root by these fungi. This “colonization” produces a fungus-root complex, called a “mycorrhiza”, that improves water and mineral absorption. Once established, a mycorrhizal symbiosis is rather persistent, and less likely to be lost due to ordinary environmental stresses. However, spread of the mycorrhizal fungi to roots is dependent on the spread of new root growth. If stressed soil conditions limit root growth, then spread of mycorrhizal fungi will be seriously limited. Therefore, fertilizer or other treatments to encourage more root growth for colonization by mycorrhizal fungi is particularly helpful under conditions of severe soil stress, such as compaction, drought, low fertility, or competition with turf. A mycorrhizal fungus can be replaced by other fungi through competition over time. Inoculating with mycorrhizal fungi strains adapted to stressed sites will improve upon the overall function of the root system by adding to, or supplanting, the existing native fungal populations.

Trees and Shrubs

So how often should mycorrhizal fungi be reapplied to a tree or shrub?

It depends on the circumstances. Here are some guidelines:

New plantings should be inoculated at planting time to support survival during transplant stress. Mature, urban, suburban, or landscape trees should be inoculated at least once. Reinoculation makes sense if the tree subsequently experiences any of the following since its first inoculation:

- Construction damage, particularly to the root system
- Root pruning of any kind
- Excessive soil compaction
- A very severe drought
- Salt stress
- Any other significant stress (e.g., competition from turf)

If trees are of particularly high value, or if they are subjected to repeated traumas or stresses such as those listed above, then a regular reapplication regime is warranted. Most urban trees and shrubs live in a continuously stressed soil environment characterized by soil compaction, turf competition, and drought. The most frequent reapplication regime would be a yearly application of mycorrhizal fungi. A more moderate regime would involve reinoculation with mycorrhizal fungi every 2 to 3 years. A special inoculation outside of this timetable would be warranted any time the tree or shrub experiences a severe stress incident such as those listed above.

Scheduling of Mycorrhizal Fungal Inoculations for Trees and Shrubs

In summary, the scheduling of mycorrhizal fungal inoculations depends on circumstances and economic considerations. The following guidelines are recommended:

- Transplants should be inoculated at planting to promote survival during transplant stress.
- A reinoculation should be considered if a tree or shrub subsequently shows signs of stress due to severe drought, compaction, salt stress, or root damage.
- Health, high value or residential trees or shrubs in good soils should be put on a regular inoculation schedule of once every 2 to 3 years, or better.
- Extremely high value trees or shrubs in stressed soils should be inoculated annually as a hedge against stress.

Scheduling of Mycorrhizal Fungal Inoculations for Flower Beds and Gardens

Flowerbeds and gardens that are dug up and replanted periodically should be reinoculated at each planting. The fungi cannot survive without the plant hosts. While some spores and root fragments may carry the fungi over from one planting to the next, there is no way to guarantee the effectiveness of this. Reinoculation at every planting is recommended.

Rhizosphere Bacteria

What about Rhizosphere bacteria? How often should they be reapplied?

Background

Rhizosphere bacteria are free-living, and do not form a true symbiotic relationship with plants. They do not colonize plant tissue. Instead, these bacteria live in the rhizosphere, or “root zone”. This is the space very close to living roots where plants release (or “exude”) their nutritious byproducts, called “root exudates”. Rhizosphere bacteria thrive on these root exudates, which include sugars and vitamins. In addition, plants drop off old dead root cells, which rhizosphere bacteria readily consume.

The presence of these bacteria so close to the root is beneficial to the plant, because these bacteria perform some very valuable functions. Some will absorb atmospheric nitrogen gas, and incorporate it into bacterial proteins. Incorporating nitrogen gas into useful compounds is called “fixing” nitrogen. When these bacteria die individually, their proteins are decomposed by other bacteria into soluble forms of nitrogen, like ammonia or nitrates, which the plant can absorb. Other types of rhizosphere bacteria can convert insoluble mineral phosphorus into soluble phosphates, which plants can absorb and use. Remember that soluble forms of nitrogen and phosphates are two of the most important essential mineral nutrients required by plants. By fixing atmospheric nitrogen and solubilizing mineral phosphorus, these rhizosphere bacteria increase soil fertility, hence the

term “biofertilizer”. By virtue of their tendency to cause aggregation of small soil particles, these bacteria also improve soil structure or “tilth”.

So how often should rhizosphere bacteria be reapplied to a tree or shrub?

Rhizosphere bacteria are free-living, and must establish a lasting foothold in the soil and root environment. The rhizosphere is not typically “empty” when these inoculants are applied (unless they are applied to sterile soil). Other soil microbes occupy this niche. These other microbes can present significant competition to newly introduced strains. Typically, bacterial inoculants must be applied repeatedly before the bacteria succeed in dominating the rhizosphere. Reapplications ensure that their populations are established and maintained at effective levels.

Fortunately, bacteria are easier to produce than are mycorrhizal fungi. As a result, bacterial inoculants are less expensive than mycorrhizal fungi inoculants, and regular applications of bacteria inoculants are not hindered by the same economic pressures. In addition, unlike VA mycorrhizal fungi, bacterial inoculants can be applied by spray or drench. Therefore, the ease and economy of bacterial inoculants helps to compensate for their need to be reapplied.

Because of the great variability among soils from different locations, it is impossible to predict how frequently inoculations must be applied to ensure the continued establishment of the selected bacterial species. Generally, a regular, repeated application regimen should do the trick. Typical application frequencies vary from a maximum of every two weeks, to a minimum of twice a year. Sometimes, bacteria are added to a given inoculation regimen to supplement the other treatments. Considerations of economics and observed results will often influence the final application schedule.