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## **Mycorrhizal Inoculants**

DIEHARDd® mycorrhizal inoculants are used as amendments, injectables, and bare root preparations to inoculate trees with live beneficial fungi when transplanting, and for treating established trees in decline. Humic acids, biostimulants, beneficial bacteria, sea kelp, yucca extracts and organic soil conditioners are added to promote rapid root development. To reduce transplant stress and watering maintenance, and to slow release all soluble parts of the formulation, Horta-Sorb® gels are added.

## **General Discussion**

DIEHARD™ mycorrhizal inoculants are formulated as transplant soil amendments, injectables, and bare root preparations to inoculate landscape trees and shrubs, flower beds, established trees and shrubs and bare root seedlings with live beneficial mycorrhizal fungi. The inoculant contains highly selected strains of low host specificity endo- and ectomycorrhizae fungi that will quickly colonize the roots of new transplants to provide the best possible conditions for the roots to become mycorrhizal during the establishment period and beyond. The mycorrhizal inoculants are combined with humic acids, biostimulants, beneficial bacteria, soluble sea kelp, yucca plant extracts and organic soil conditioners to promote rapid root development. To reduce transplant stress and watering maintenance, and to slow release all soluble components of the formulation Horta-Sorb® water management gels are added to complete the package. The results are better survival and growth rates and less watering.

For convenience, consistency, and to reduce waste, transplant products are available in pre-measured, labeled bags.

## **What Does Mycorrhizae Do**

The full story of what effect mycorrhizal roots have on plants is still evolving. To date we know that some plants cannot live without mycorrhizal roots. We also know there are a few obscure plants that do not need mycorrhizae. Most brassicas, for example, which include broccoli, brussels sprouts, cabbage, and cauliflower do not associate with mycorrhizae. But the fact is that nearly all plant life is dependent on the association of mycorrhizae and plant roots. Mycorrhizae grow through the soil by extending its hyphae, which are the "roots" of the fungus, into the soil. These "roots" are extremely fibrous and engulf every tiny crack and cranny in the soil to absorb water, and nutrients in solution, and give this solution to the roots of the plant.

The only food source for mycorrhizae comes from the plant. Thus, if anything begins to slow the food source, the mycorrhizae becomes more active, and aggressive, to feed its host - the roots of the plant. This is why plants in stressed conditions benefit from mycorrhizal roots. Regardless of the cause, i.e., drought, heat, high salt, wind burn, freeze, parasites, negative organisms, etc., mycorrhizae has evolved to bring relief to the plant. Mycorrhizae is a natural phenomenon.

To give you an idea of how mysterious this fungus is in 1996, the USDA Agricultural Research

Service reported their findings on a study where young trees were planted next to mature trees. The scientist studied where the foods feeding the young trees was coming from. What they discovered was unexpected, yet very natural. A great deal of the food supplied to the young trees actually came from the mature trees through the transfer of foods at the hyphea level between the hyphea of the mature trees and that of the mycorrhizae associated with the young trees. Although no one has yet given good scientific fact for this to have occurred, isn't the parent feeding the child a natural, predictable phenomenon?

### **Why Inoculate**

The reason we need to inoculate is because standard nursery and landscape practices have largely ignored this whole part of a complete plant system. Horticultural classes in our universities and technical schools give little attention to the topic of mycorrhizae - but this is changing rapidly. Commercially speaking our focus has been on quantity, not quality. Because of the pressure the typical nurserymen has to turn inventory, little, if any attention, has been given to the natural health of the plant. As a result of this viewpoint the nursery industry has been producing, and selling, plants that are not naturally complete. Because nearly all plants are not complete without the mycorrhizal association they are relatively fragile and can quickly die if not maintained intensively. We have this perfect system available to us but we have ignored it and instead employed billions of dollars in chemicals to control growth and predators.

LANDSCAPE CONDITIONS ARE NOT IDEAL. Most will agree that we could use some help for better results with newly planted landscapes. Often newly planted landscape go into sever shock. Generally the reason is poor water management, but heat, time of the year, soil conditions, along with untold other factors also play important roles here. One of the biggest problems that no one seems to talk about is the fact that most nursery grown plants have little, if any, natural systems working with the plant. Mycorrhizal roots take hold faster - there is little doubt on this fact. Plus, what attention is given to the microbial activity in the soil. Without good bugs in the ground we lose the opportunity of using the natural minerals that make up the ground.

If the landscaper was planting a complete plant system in less than ideal conditions there would still be stress, etc., but the degree of damage to the plant would not be as great with these natural systems working for the plant. If all conditions were ideal there wouldn't be a gamble when transplanting and one wouldn't need to worry about inoculating. But generally conditions are not ideal and you could use some help in "stacking the deck" on your side. Inoculation can significantly aid transplanted trees, shrubs and flower bed results, especially under adverse conditions. Feeding the ground with biostimulants to energize the soil, and even adding beneficial bacteria, can make a world of difference for the transplant. Finally, including a water management gel to hold water and manage all the solubles can have dramatic results.

DIEHARD™ inoculants, with all the additional additives, are an investment that can return its cost several times over in a number of ways. Just think how you would feel about your projects if you had all the goodies Mother Nature has to offer working for you.

### **Plant Species and Type of Mycorrhizae**

<b><i>Endomycorrhizae</i></b> *	<b><i>Ectomycorrhizae</i></b>	<b><i>Both Endo and Ectomycorrhizae</i></b>
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Acacia	Maple	Arborvitae	Alder
Ailanthus	Melaleuca	Aspen	Casuarina
Ash	Mesquite	Basswood	Cedar
Bay	Mimosa	Beech	Cottonwood
Boxelder	Mulberry	Birch	Cypress
Buckeye	Monkey-Pod	Chestnut	Eucalyptus
Catalpa	Palm	Chinquapin	Willow
Chokeberry	Palmetto	Fir	
Cherry	Paulownia	Hemlock	
Coffee	Persimmon	Hickory	
Crabapple	Raintree	Larch	
Cryptomeria	Redbud	Linden	
Cypress	Redwood	Madrone	
Dogwood	Russian Olive	Oak	
Elm	Sassafras	Pecan	
Ginko	Serviceberry	Pine	
Gum	Sequoia	Poplar	
Hackberry	Silverbell	Spruce	
Hawthorn	Sourwood	Willow	
Holly	Sumac		
Hophornbeam	Sycamore		
Hombeam	Tree-of-		
Horsechestnut	heaven		
Juniper	Tupelo		
Locust	Walnut		
London	Yellow poplar		
Planetree	Yew		
Magnolia			

\*All nut trees except Pecan, all fruit trees, grapevines, grasses and many vegetables, all berries except blueberry, cranberry and lingongerry. All shrubs and foliage except Laurel, Rhododendron, and Azalea

### **Why Include Horta-Sorb® Water Management Gels?**

Formulations of DIEHARD™ contain Horta-Sorb® water management gels to protect the roots, reduce transplant stress and watering maintenance, and to slow release all soluble components of the formulation. University research has shown for over a decade that water management gels absorb fertilizer and slow release it to the roots.

### **Mycorrhizal inoculants for every purpose in the "Green Industry"**

So, how can we treat plants with mycorrhizae? The rules haven't changed a bit - root dips, transplant amendments, root injection, drenches and vertimulching. What do we treat the plants with? And since we are going through the exercise, is there anything else that we can do? You bet there is. If the concept makes sense lets consider a "cocktail". Instead of a simplistic

approach (chemicals) lets use a systems approach (natural systems, that is). In fact, forget the "cocktail", lets give the plant a banquet:

Endomycorrhizae - *Glomus mosseae*, *Gigaspora margarita*, *Glomus brasilianum*, *Glomus deserticola*, *Glomus Clarum*, *Glomus etunicatum*, and *Glomus intraradices*.

Ectomycorrhizae - *Pisolithus tinctorius* and four *Rhizopogon* species.

Biostimulants - Over a hundred from Sea Kelp Extract, Humus, and Yucca Plant Extract.

Amino Acids - Buffers heavy metals and high salts and improves microbial activity in the soil.

Vitamins & Enzymes - Biotin, Folic Acid, B, B2, B3, B6, B7, B12, C, and K. Essential for chlorophyll production, cell division, transpiration and respiration.

Beneficial Bacteria - Nitrogen fixing, phosphorus solubilizing, and a growth hormone promoting bacillus to stimulate roots.

Water Management Gels - Agricultural grade to slow release water and nutrients.

### **Plus**

Fish Meal - Contains Nitrogen and is rich in essential amino acids.

Blood Meal - An excellent source of natural iron.

Bone Meal - Contains high levels of Phosphate and Calcium.

Feather Meal - Undecomposed feathers from poultry containing Nitrogen.

Sulfate of Potash - A natural mined mineral high in soluble potash.

All of the above ingredients are well proven, commercialized, and inexpensive - each loaded with benefit to the plant and its growing environment. (If you think one, or two, aren't important, forget them and focus on the rest!) Including a water management gel to hold water and slow release all the solubles can make a world of difference for the transplant and provides dramatic results.

**If You Deal With Plants - We've Got You Covered!!**

DIEHARD™ mycorrhizal inoculants are formulated as transplant soil amendments, injectables, and bare root preparations to inoculate landscape trees and shrubs, flower beds, established trees and shrubs and bare root seedlings with live beneficial mycorrhizal fungi. The inoculant contains highly selected strains of low host specificity endo- and ectomycorrhizae fungi that will quickly colonize the roots of new transplants to provide the best possible conditions for the roots to become mycorrhizal during the establishment period and beyond. The mycorrhizal inoculants are combined with humic acids, biostimulants, beneficial bacteria, soluble sea kelp, yucca plant extracts and organic soil conditioners to promote rapid root development. To reduce transplant stress and watering maintenance, and to slow release all soluble components of the formulation Horta-Sorb® water management gels are added to complete the package.

### **Product Benefits**

#### **IMPROVES**

Survival  
Rooting

Flowering  
Water Absorption  
IBA Effectiveness  
Improves Fe-Efficiency  
Nutrient Availability  
Yields and Production  
Client Satisfaction & Goodwill

### **REDUCES**

Plant Losses  
Fertilizer Use  
Plant Diseases  
Need Of Pesticides  
Heat Stress Damage  
Irrigation Frequency  
Biocontrol of Fusarium Root Rot  
Losses From Drought Conditions

### **OUR PRODUCTS**

#### **DIEHARD™ Root Dip**

DIEHARD™ Root Dip is formulated as a bare root treatment with live beneficial mycorrhizal fungi to inoculate the roots of bare root plants before planting. It contains highly selected strains of low host specificity endo- and ectomycorrhizae fungi that will quickly colonize the roots of bare root plants to provide the best possible conditions for the roots to become as effective during and after planting. The mycorrhizal inoculants are combined with humic acids, biostimulants, beneficial bacteria, soluble sea kelp, yucca plant extracts, to promote rapid root development. The mycorrhizal inoculant is managed with Horta-Sorb® SM which also protects the roots from drying out. The results are better survival and growth rates and less watering for all transplants.

#### **DIEHARD™ Ecto Root Dip**

DIEHARD™ Ecto Root Dip is formulated as a bare root treatment with live beneficial mycorrhizal fungi composed of *Pisolithus tinctorius* (Pt) ectomycorrhizae and 4 select strains of *Rhizopogon* to inoculate the roots of bare root plants before planting. It contains highly selected strains of low host specificity ectomycorrhizae fungi that will quickly colonize the roots of bare root plants to provide the best possible conditions for the roots to become as effective during and after planting. The mycorrhizal inoculants are combined with humic acids, biostimulants, beneficial bacteria, soluble sea kelp, yucca plant extracts, to promote rapid root development. The mycorrhizal inoculant is managed with Horta-Sorb® SM which also protects the roots from drying out. The results are better survival and growth rates and less watering for all transplants.

#### **DIEHARD™ Ecto Injectable - OneStep®**

Contains live spores of ectomycorrhizal fungi inoculant containing live spores of beneficial endo-

and ectomycorrhizal fungi, a dry, water soluble root growth stimulant with nitrogen fixing, phosphorus solubilizing and growth promoting beneficial bacteria, and Horta-Sorb® SM packaged in premeasured paks for easy application with a tank sprayer.

### **DIEHARD™ Ecto Nursery Drench**

DIEHARD™ Ecto Nursery Drench is formulated with live beneficial mycorrhizal fungi to inoculate the roots of containerized plants in the nursery. It contains highly selected strains of low host specificity ectomycorrhizae fungi that will quickly colonize the roots of tree seedling. When water and soluble nutrients are amply provided non-mycorrhizal seedlings can grow well in artificial growing media. However, until they form mycorrhizae, they do not adequately take up water and nutrients upon outplanting. Routine nursery practices such as fumigation and high levels of water and nutrients produce non-mycorrhizal seedlings or seedlings with “nursery fungi”, poorly adapted to individual species or field conditions. Horticultural Alliance, Inc. supplies DIEHARD™ Ecot Nursery Drench spores of native mycorrhizal fungi that are specific to particular plants and function effectively in both the nursery and field environments.

You'll find DIEHARD™ Ecto Nursery Drench inexpensive and easy to use. Just water in spores through your existing irrigation system, or conventional sprayer - even pump up and backpack sprayers can be used. You tell us the species that you wish to inoculate and the number of seedlings per greenhouse, or field row, and we supply you with custom packaging for your convenience. For example if you are to treat 5 greenhouses, each with 30,000 seedlings we will formulate and ship to you 5 containers, one for each house, with ample mycorrhizae spores to treat 30,000 seedlings.

### **DIEHARD™ Biostimulant**

DIEHARD™ BioPac is a dry, water soluble root growth stimulant with nitrogen fixing, phosphorus solubilizing and growth promoting beneficial bacteria packaged in pre-measured, labeled bags for easy use with tank sprayers. BioPac contains humic acid extracts, soluble sea kelp, yucca plant extracts, amino acids and natural sugars to “energize” the microbial activity in the ground and promote cell division and lateral bud development as well as delay the aging process of plant tissue. Our unique formulation of ingredients affect the permeability of cell wall membranes in roots, improve plant respiration, photosynthesis, promote cell division and lateral bud development as well as delay the aging process of plant tissue. All these factors are well known to provide major benefit to plants promoting vigorous root growth and the overall general condition of the plant environment.

### **DIEHARD™ Biostimulant with Iron**

DIEHARD™ Biostimulant with Iron is a dry, water soluble root growth stimulant, fully chelated iron micronutrient with nitrogen fixing, phosphorus solubilizing and growth promoting beneficial bacteria packaged in pre-measured, labeled bags for easy use with tank sprayers. IronPac contains humic acid extracts, soluble sea kelp, and essential amino acids to “energize” the microbial activity in the ground and promote cell division and lateral bud development as well as delay the aging process of plant tissue. Our unique formulation of ingredients affect the permeability of cell wall membranes in roots, improve plant respiration, photosynthesis, promote cell division and lateral bud development as well as delay the aging process of plant tissue. All these factors are well known to provide major benefit to plants promoting vigorous root growth

and the overall general condition of the plant environment.