

How to Use and Sell Horta-Sorb® in Forestry, Greenhouse, Landscaping, Interiorscape, Nurseries, and Turf.

By James J. Quinn, President
Horticultural Alliance, Inc.
PO Box 5744, Sarasota, FL 34277

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Introduction

Horta-Sorb® --- An Introduction

General Comments

A plant's most important nutrient is water—without water, a plant cannot grow. Horta-Sorb®, the brand name for our family of super absorbent copolymers, absorbs many times its weight in plant available water and is one of the most cost effective water management tools in use today. Horta-Sorb® helps to manage that water in the root zone of the plant for an extended period.

What It Is

Each particle of Horta-Sorb® acts like a “super sponge”, absorbing and storing hundreds of times its weight in plant available water, releasing it to the plant on demand.

The family of Horta-Sorb® products presently include three synthetic formulations and two starch formulations, Horta-Sorb® and Horta-Sorb® SC, seed coating, which were introduced by us in 1976. The synthetic polymers, which we introduced in 1983, have evolved into three separate products with different particle sizes, which are specific to particular applications. These products, Horta-Sorb® LG, Horta-Sorb® MD, and Horta-Sorb® SM are long-lasting acrylamide copolymers engineered for applications within the agricultural and horticultural markets that we service.

The following summarizes physical characteristics of Horta-Sorb® brand super absorbents:

Horta-Sorb® LG

Composition:	Polyacrylamide Copolymer
Appearance:	White granular
Particle Size:	2 mm to 4 mm
Absorption Capacity:	300X to 400X its weight
Effective life:	4-5 years

Horta-Sorb® MD

Composition:	Polyacrylamide Copolymer
Appearance:	White granular
Particle Size:	1 mm to 2 mm
Absorption Capacity:	300X to 400X's its weight
Effective life:	4-5 years

Horta-Sorb® SM

Composition:	Polyacrylamide Copolymer
Appearance:	White granular
Particle Size:	0.3 mm to 0.8 mm
Absorption Capacity:	300X to 400X's its weight
Effective life:	4-5 years

Horta-Sorb® OS (Original Starch)

Composition	Starch graft
Appearance:	Brown flake
Absorption Capacity:	200X's its weight
Volumetric Expansion:	30X's its size
Effective Life:	6- 12 months

Horta-Sorb® SC - SEEDCOATING

Composition:	70% Starch graft
Appearance:	Black powder
Absorption Capacity:	140X's its weight
Volumetric Expansion:	NA
Effective Life:	Until Germination

All Horta-Sorb® formulations are non-toxic and non-hazardous to the environment. All are neutral and effective over a wide range of pH. All are compatible with fertilizers and other industry chemicals.

How It Works

When water comes into contact with Horta-Sorb®, an electrical force pushes the outward structure of the particle away from the center drawing water into the polymer resulting in rapid swelling of each particle. When this water evaporates into the soil atmosphere, or is drawn down by a root that has grown into the swollen particle, the material shrinks. When water is again introduced, the material will re-swell, absorbing water again.

This cycle will continue for a period of several months to several years depending on the type of polymer employed. Starch polymers, because the starch is actually a food to bacteria in the soil are the shortest lasting of super absorbents because the bacteria consume them.

Factors Affecting Absorbency

The absorption capacities of anionic super absorbents like Horta-Sorb® are affected by acidity and alkalinity (pH), conductivity, and other variables that inhibit expansion of the gel particles. The pH of the absorbed fluid should not present a problem in most plant-related applications since the pH in the growing environment is normally within the ideal range (4.5 - 8.0) for optimum absorption. Although fertilizers, salts, and other chemicals in the growing environment do affect absorption capacity of super absorbents, these conditions, should they have an adverse effect, are solved with increased application rates to compensate for lower absorption.

All Super Absorbents Are Not Alike

Super absorbents present in the market today absorb from 30 times to 800 times their weight in water. Some having a very high absorption capacity (i.e., over 400 times) are more sensitive to fertilizers and other ionic substances, rapidly losing much of their water absorption capability. Because of the effect of fertilizers and other materials on absorption, it is not uncommon for a super absorbent having an absorption capacity of 800-1000 times its weight in pure water to absorb 200 times or less in actual use.

Another type of super absorbent absorbs only 30-40 times its weight in usable water for the plants. Although its absorption capacity is less affected by fertilizers when compared to Horta-Sorb® (which absorbs 300-400 times its weight in water), 5 to 10 times as **much of these types of super absorbents (by weight) must be used to absorb and manage an equal amount of water. Because of this adverse cost difference, low absorbing super absorbents have gained limited acceptance in the market.**

Some brands of super absorbents now marketed are nothing more than repackaged healthcare (diapers, etc.) super absorbents. These polymers are engineered to absorb, but not release fluids. Healthcare super absorbents are not effective for horticultural use. The key to choosing a good horticultural polymer is in finding the

right combination of: 1) polymer stability, i.e., resistance to chemical and biological degradation, and 2) ability to store and release plant available water. Horta-Sorb® is manufactured to release 95% of the water it absorbs and remains effective in the ground for 4 to 5 years or more.

Since super absorbent polymers look similar, the consumer must make sure the super absorbent that they choose has been used sufficiently in the market to substantiate claims made by a supplier/manufacturer.

Useful Life

Starch super absorbent materials remain effective 6 to 12 months and totally biodegrade. Synthetic formulations remain effective through many swell-shrink cycles, generally lasting 4 to 5 years. The final breakdown products from release of monomers would be carbon dioxide, water, and ammonia. There will be no residual toxicity.

How It Is Used

There are five basic ways to use Horta-Sorb® brand polymers:

1. Add to growing media in dry or expanded form.
2. Broadcast over surfaces prior to planting or seeding in dry and expanded forms.
3. As a gel to treat roots, root balls and seed.
4. As a dry seed coating (Horta-Sorb® SC).
5. As a carrier for chemicals in dry or expanded form (i.e., fertilizers, insecticides, etc.).

General Benefits

Promotes Faster Growth

Managing water in the root zone differently does cause plants to grow faster because plants tend not to slow down as much between irrigation. Plants are watered on a schedule somewhere between field capacity and wilting. During the time between

irrigation, growth of the plant speeds up and slows down as conditions of moisture, aeration, temperature, etc., become ideal and then move to a less favorable combination. Understanding how Horta-Sorb® can affect these variables enables a grower to boost production and reduce production time. This knowledge is used to achieve an increased growth rate at whatever combination of moisture, aeration, temperature, etc., provides the best growth for the plant.

Aeration & Water Retention

Over 90% of **moisture** held by Horta-Sorb® is available to the plant. No other component used in growing mixes gives up this much retained water to the plant. As Horta-Sorb® expands and contracts, it opens and exercises the growing medium by forcing soil particles apart.

Aeration is the space between particles in a grower's mix. It is important because it provides for the exhaust of carbon dioxide expelled by growing roots and other microorganisms in the soil. It also facilitates the intake of oxygen into the soil that is necessary to support root development and growth.

The amount of water that can be retained in the soil is largely determined by soil particle size, i.e., the larger the soil particle size, the less its ability to attract and retain water. Conversely, the smaller the particle size the greater its ability to attract and retain water. The smaller the particle size the stronger the water will adhere to it. Consequently, its retained moisture is less available to the plant.

Because aeration and retained available water are directly associated with larger soil particles (openings or pore spaces between particles of the mix), and water retention and lack of aeration are directly associated with smaller soil particles, a "Catch-22" situation exists which has frustrated growers as they have attempted to develop the "ideal" growing medium for their plants.

It is important to recognize that aeration in a mix is much more difficult to manage **than moisture**. If moisture deficiency exists, irrigation frequency and duration is adjusted. However, if aeration deficiency exists, the plant must be removed from the soil and the rooting environment modified with larger particles to

improve drainage and porosity. Using Horta-Sorb® to **manage water in a mix permits growers to use very well aerated mixes which, when combined with more controllable moisture management, provides conditions for roots to develop more quickly. Instead of using organic matter like peat moss for water management, which breaks down and eventually “plugs-up” the mix, less degradable mix components can be used to achieve precise aeration and moisture with Horta-Sorb®. Using more stable mix components is a major step toward improving production and controlling problems associated with traditional management of a growing media.**

Provides Efficient Use of Water

A major advantage of using Horta-Sorb® is its ability to make use of moisture present in soil which otherwise is not available to plants. As explained below, moisture held in soils fall into one of three categories:

1. **Gravitational water** is water that freely moves through the soil due to the forces of gravity. This water is usually not available to the plant because it rapidly moves down through the soil beyond the root zone. Horta-Sorb® “grabs” this water and holds it for the plant•
2. **Capillary water** is water held very loosely around the soil particles. The water held by cohesion (attraction between like molecules) • Most of this water is available to plants. Capillary water is water held in the form of a thick film around the soil particles. The water moves to the point of highest tension (lowest pressure). The root hairs create a low pressure and are capable of drawing moisture until the attraction between the soil and the water molecules exceeds the attractive forces of the roots (permanent wilting point).
3. **Hygroscopic water** is water held in the form of a very thin film around soil particles. It is usually not available to plants. Most of the moisture held in small particle soils (clay, etc.) is of this type.

Landscaping &, Turf

Transplanting

Why Horta-Sorb® Is Necessary: Inadequate management of water from the time a plant leaves the nursery until it is established in the landscape costs the landscape industry hundreds of millions of dollars per year in plant replacements, labor, equipment wear and tear and opportunity costs (lost profits from other jobs available but declined due to limited resources). These costs are absorbed by developers (guarantee provisions in contracts), landscape contractors (all have “grave yards and over-purchase for expected resets), and nursery growers. The use of Horta-Sorb® when transplanting significantly reduces these costs.

With balled and burlapped (B&B) material, 75% + of the root system of the plant remains in the ground at the nursery. With only 25% of the root system remaining, water is the most critical element for success in transplanting.

With containerized material, the total root system is intact. However, water needs are twice as much after the container is removed and during the establishment period, than they were in the nursery where the plant was grown in a container. This is because the medium and the bottom part of a container remains saturated after irrigation due to the equilibrium of downward gravitational pull and the attraction of water adhering to soil particles in the container. **The smaller the particles of the media the stronger attraction, and therefore, the deeper the saturation zone.** Water held in this saturation zone is mostly available to the plant between irrigation, but once the plant container is removed and the plant set into the ground this saturation zone condition no longer exists, as water moves freely downward. Therefore, the use of Horta-Sorb® as an amendment in the root zone is essential to provide as much water as possible to the transplanted containerized plant to overcome the loss of its saturation zone upon transplanting.

Sales Tips

Sell Horta-Sorb® by selling how much water it will manage in a root zone to reduce transplant stress and re-sets. With trees and shrubs, sell the 3 oz. Contractor Pac as managing 5-7 gallons in the planting pit of the transplant. Sell the Contractor Pac's big

advantage of reducing waste by metering (due to appropriate labeling) the use of Horta-Sorb® being applied. Emphasize that the 3 oz. Contractor Pac is the least costly way to use Horta-Sorb® because of this fact.

Conditions of Nursery Stock

- Wind burn during transit (not covered) - Plant dehydration - use Horta-Sorb® in the medium or distribute between root ball and burlap when bailing.
- Grown too fast (plant is young and tender) --physiology of plant is high - use Horta-Sorb® when transplanting to reduce stress which will take place due to high growth character.
- B & B not root pruned (no feeder roots) - Water vital for new feeders - use Horta-Sorb® applied between the root ball and burlap when bailing the plant and as an amendment when planting.

B & B not acclimated (plant lifted yesterday) --Severe shock, need water - use Horta-Sorb® applied between the root ball and burlap when bailing the plant and as an amendment when planting.

Conditions at the Planting Site

- Site prep not complete (planting delayed) - If poorly held, losses/resets - use Horta-Sorb® when planting.
- Irrigation system not completely installed yet m use Horta-Sorb® to manage water delivered by hand during this period.
- Irrigation not used (hand watering) m High labor costs - cut 50% -- use Horta-Sorb® to reduce frequency of hand watering.
- Poor drainage (expect root rot, losses) - Encourage shallow roots - use Horta-Sorb® in the upper part of the planting pit to hold water (reducing the level of water in the bottom of the planting pit).
- Excessive drainage (high stress, losses) - High replacement costs - use Horta-Sorb® when planting to hold water where it is needed—in the root zone.
- Time of year (summer heat, spring/fall winds) -High stress, resets, costs - use Horta-Sorb® when planting to better manage water in the root zone and reduce costs.

- Remote location (long transit, high stress) -Watering, high cost - cut 50% with Horta-Sorb® in the root zone.

Conditions Following Installation

- Plant dry out (container conditions no longer exist, initial water needs are twice as high as in the nursery) - Stress, leaf drop, resets - cut with Horta-Sorb® during installation.
- Irrigation system fails (equipment/design/ damage) - Hand watering, resets - insure with Horta-Sorb® during installation.
- Irrigation designed for established landscape (not sufficient for initial establishment) - High stress, leaf drop - get maximum use of water available with Horta-Sorb® during installation.
- Drought conditions prevail (high water needs) - Plant death, resets - insure with Horta-Sorb® during installation and reduce labor, resets, and watering costs.

“Certain Sell” Clients:

Landscape Architects

- Responsibility for problems encountered in a landscape installation rests with them.
- They have the responsibility of insuring that their client employs the latest improved management techniques—specify Horta-Sorb® using the Specification Sheets presented in APPENDIX C.

Landscape Contractors

- Tree plantings (high cost per unit)
- \$1.25 of Horta-Sorb® treats a \$50-\$200 tree during installation.
- Extremely good Return on Investment when used during installation.
- Municipalities (reduced budgets, little maintenance budgets for new plantings—they like insurance)
- Stretched resources - use Horta-Sorb® in all aspects of installations of plant materials, i.e., trees, shrubs, annual beds, interior, etc., to extend available labor and water—

High mortality—use Horta-Sorb® during installation to reduce these costs.

- Real Estate Developers (lushness, absence of shock important)
- Budget funds available—use Horta-Sorb® to insure lushness and reduced transplant shock, leaf drop, and unsightly resets.
- Flowering annual beds—use Horta-Sorb® amended 4-6 inches to reduce maintenance and watering and extend the time between plantings.
- State DOT, Parks Department, General Services
- Mostly non-irrigated work - use Horta-Sorb® to reduce transplant shock, watering, labor.
- Full Service Garden Centers (landscapers, architects, growers, etc.)
- Stretched resources—use Horta-Sorb® to get the most productive use of labor.
- Walk-in customers—sell Horta-Sorb® to insure their plants and provide more profits.
- Grows hanging baskets - use Horta-Sorb® to prevent “dry-outs” and reduce watering.
- As an “add-on” with landscape jobs - sell Horta-Sorb®, especially with guaranteed plants—Prime candidate for pre-measured Contractor Pac.

Applications and Costs

Trees - Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY 1%, OR LESS, OF THE COST OF PLANT MATERIAL

Example: a \$275.00, 12’ to 15’ tree is treated for about \$2.00 to \$3.00.

Tree Spades - Moisten the walls of the planting hole with water

and broadcast Horta-Sorb® LG evenly throughout the planting pit at the recommended rate being sure that the Horta-Sorb® LG does not all fall to the bottom of the planting pit.

COST—GENERALLY 1%, OR LESS, OF THE COST OF THE PLANTED TREE

Annual Beds - Amend root zone of bed with Horta-Sorb® LG at the rate of 3 lbs. per thousand square feet for each 2" deep. Bed should be amended 6" deep. Dip small transplants (1-2" root ball diameter) in a Horta-Sorb® SM gel mixed at a rate of 1 lb. to 25 to 40 gallons of water.

COST—AMENDMENT, 5 CENTS PER SQUARE FOOT
ROOT BALL DIP, ½ CENT PER PLANT

Shrubs—Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY, 10 CENTS PER GALLON SIZE PLANTED

Example: 30 cents for a 3-gallon container

Seeding & Turf

Why Horta-Sorb® Is Necessary: Successful germination of seed and establishment of sprigs and sod are largely due to frequency of watering. On irrigated installations, it is difficult to determine how much water to apply for good results. On non-irrigated installations, the likelihood of high mortality is obvious, resulting in much replanting, complaints, etc. In both cases, the use of Horta-Sorb® contributes greatly by holding water for the seed or in the root zone, offering better overall results **and** a more successful installation.

With seeding and sodding at 3 pounds per thousand square feet, Horta-Sorb® will manage over 100 gallons of water per thousand square feet. That is nearly 2 - 55 gallon drums of water! Be

visual; give them something that they can relate to. At 3 pounds per **thousand** square feet, Horta-Sorb® will manage 4000 gallons of water per acre. Again, mention that that is equal to 82 -55 gallon drums. Wow, that is a lot of water that otherwise would flow through the root zone and be lost for use by the plant.

Sales Tips

Conditions of Plant Stock:

- Dried out sod (90% of roots absent)
- Poor vigor—use Horta-Sorb® MD by broadcasting (Prior to setting sod), to speed establishment and reduce watering.

Conditions at Planting Site:

- Water not available (turf on its own)
- Success questionable—use Horta-Sorb® MD to reduce watering and replanting.
- Irrigation not used (manual watering)
- High labor/equipment cost—use Horta-Sorb® MD to reduce labor and watering costs.
- Excessive drainage (ground dries out fast)
- Replanting likely—insure with Horta-Sorb® MD to promote quicker establishment and reduce “dry-outs”.
- Remote location (long transit, high cost)
- Watering, replacement, high cost—use Horta-Sorb® HB to reduce labor, watering and reset costs.
- Time of year (summer heat, spring/fall winds)
- Fast dry out, replacements—use Horta-Sorb® MD to reduce costs and transplant shock.

“Certain Sell” Clients:

- Golf Course Architects
- BIG USERS on fairways, greens and landscaping.
- Money is no object to get results (quick establishment).
- Water holding capacity of turf areas critical during establishment—use Horta-Sorb® MD.
- Cannot water during tee times.
- Establishment time critical (high investment).
- Lushness important (pride) -- use Horta-Sorb® MD.
- Very professional customer group (I have never met a superintendent that owned the course.).

- Developers (Grand openings, entranceways).
- Establishment time important (high investment) --use Horta-Sorb® MD to establish turf quicker.
- Lushness important—use Horta-Sorb® MD to insure quick establishment.
- Usually can provide good contacts with the local (or in-house) Landscape Architect.
- State DOT, Parks Dept., General Services - Spend huge amounts on watering - cut 50% with Horta-Sorb® MD during installation - May not have budget \$'s available for watering (subsequent watering viewed as maintenance). Being able to manage water in the root zone is a big plus.
- Shoulder repairs very tough in certain places. Questionable resources available to do job correctly—use Horta-Sorb® MD to better manage labor and watering resources.
- Mostly non-irrigated installations—use Horta-Sorb® I-IB to reduce costs and encourage quicker establishment.

Applications and Costs

Sodding - Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work in, lay sod, roll and water.
COST -- 1.5 CENTS PER SQUARE FOOT

Seeding - Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work into the top 1" of soil. Mix ½ lb. Horta-Sorb® SC, Seed coating, per 50 lbs. of seed.
COST - AMENDMENT, 1.5 CENTS PER SQUARE FOOT
SEEDCOATING, 50 CENTS PER 1000 SQUARE FEET

Sprigging—Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work into the top 1" of soil.
COST - 1.5 CENTS PER SQUARE FOOT

Hydromulching—Add Horta-Sorb® SM to tank at the rate of 50 pounds per acre before adding fertilizer. At a typical rate of 3,000 gallons of water per acre, 50 pounds of Horta-Sorb® SM will hold **1,500** gallons of this water on the surface of the ground where the seed is, and hence, promote much faster germination. Use with hydroseeding also recommended.
COST - 1/2 CENT PER SQUARE FOOT

Sod Plugs—Hydrate Horta-Sorb® MD to full capacity (let stand 2 hours). Pour into each plug hole ½ cup of this hydrated gel before placing sod plugs into holes.
COST - ½ CENT PER SOD PLUG

Divot Mixes—Recommend 1 PRE-MEASURED Horta-Sorb® Contractor Pac (2 ounce original starch—short life) be mixed with 10 gallons (two 5 gallon buckets) of divot mix. Treat seed with Horta-Sorb® SC, Seed coating, at ½ lb. per 50 lb. bag of seed.
COST -- \$1.50 PER 10 GALLONS (BY VOLUME) OF DIVOT MIX

Landscape, Seeding & Turf Uses

Athletic Fields

New Construction—Broadcast Horta-Sorb® MD at 150 to 200 pounds per acre to develop quicker establishment using less water. Work in, seed, sprig, or sod, then roll and water.
COST -- 1.8 TO 2.4 CENTS PER SQUARE FOOT

Existing Turf—Place Horta-Sorb® MD into the root zone in either dry or hydrated form at the rate of 3 to 4 lbs. per thousand square feet.
COST -- 2 CENTS PER SQUARE FOOT

Overseeding—Mix ½ pound Horta-Sorb® SC with each 50 pounds of seed.
COST - \$20.00 PER 100 POUNDS OF SEED

Cemeteries

Interments: Broadcast the contents of 1 Horta-Sorb® LG Contractor Pac onto the prepared area before replacing sod. (The pre-measured Contractor Pac is recommended because of the small amount of Horta-Sorb® needed with this application and the singleness of use, i.e. if four interments are to be treated in an afternoon the maintenance crew only takes four bags with them.)
COST -- \$1.25 PER INTERMENT

Annual Beds - Amend root zone of bed with Horta-Sorb® LG at the rate of 3 lbs. per thousand square feet for each 2” deep. Bed should be amended 6” deep. Dip small transplants (1-2” root ball diameter) in a Horta-Sorb® SM gel mixed at a rate of 1 lb. to 25

to 40 gallons of water.

COST - AMENDMENT, 5 CENTS PER SQUARE FOOT
ROOT BALL DIP, ½ CENT PER PLANT

NewTurf Construction—Broadcast Horta-Sorb® MD at 150 to 200 pounds per acre to develop quicker establishment using less water. Work in, seed, sprig, or sod, then roll and water.
COST -- **1.8 TO 2.4 CENTS PER SQUARE FOOT**

Existing Turf—Place Horta-Sorb® MD into the root zone in either dry or hydrated form at the rate of 3 to 4 lbs. per thousand square feet.
COST m 2 CENTS PER SQUARE FOOT

Overseeding—Mix ½ pound Horta-Sorb® SC with each 50 pounds of seed.
COST m \$20.00 PER 100 POUNDS OF SEED

Transplanting Trees And Shrubs – Refer to pages

Croquet Fields

Full Root Zone Amendment—Amend Horta-Sorb® MD to a depth of six to eight inches using 2 pounds per thousand square feet for each 2 inches of depth. When using a blender, amend Horta-Sorb® MD at a rate of 5.2 ounces per cubic yard for 6 inch depth and 7.0 ounces per cubic yard for 8 inch depth.
COST m 4 to 5 CENTS PER SQUARE FOOT

Partial Root Zone Amendment - Amend Horta-Sorb® MD at 3 pounds per thousand square feet into the top 2 inches.
COST - 1.5 CENTS PER SQUARE FOOT

Seeding And Overseeding - Mix 1/2 pound Horta-Sorb® SC with each 50 pounds of seed.
COST - \$20.00 PER 100 POUNDS OF SEED

Garden Centers

Retail Division—The Horta-Sorb® LG 3 oz. bag should be placed at each check out location and actively sold with plant sales. The 4 lb. Horta-Sorb® MD package should be sold with every pallet of turf.. Horta-Sorb® SC, seedcoating 1/2 lb. bags should be sold with each 50 lb. bag of grass seed.

COST—THE NORMAL MARK-UP ON THE Horta-Sorb® and DIEHARD™ LINES IS OVER 100 PERCENT
THE NORMAL MARK-UP ON THE HORTA-SORB® SC, SEEDCOATING, IS OVER 100 PERCENT.

Landscape Division u Recommend the Horta-Sorb® LG Contractor Pac be used with all transplanting and that Horta-Sorb® MD be specified and used with turf jobs.

Greenhouse/Nursery Divisions—Refer to Nursery and Greenhouse Use section, page 31.

Golf Courses

Fairway Construction—Broadcast Horta-Sorb® MD at 150 to 200 pounds per acre to develop quicker establishment using less water. Work in, seed, sprig, or sod, then roll and water.
COST -- 1.8 TO 2.4 CENTS PER SQUARE FOOT

Greens Construction

Full Root Zone Amendment: Amend Horta-Sorb® MD to a depth of six to eight inches using 2 pounds per thousand square feet for each 2 inches of depth. When using a blender amend Horta-Sorb® MD at a rate of 5.2 ounces per cubic yard for 6 inch depth and 7.0 ounces per_T cubic yard for 8 inch depth.
COST -- 4 to 5 CENTS PER SQUARE FOOT

Partial Root Zone Amendment: Amend Horta-Sorb® MD at 3 pounds per thousand square feet into the top 2 inches.
COST -- 1.5 CENTS PER SQUARE FOOT

Trees—Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY 1% OR LESS, OF THE COST OF PLANT MATERIAL

Example: a \$275.00, 12' to 15' tree is treated for about \$2.00 to \$3.00.

Annual Beds - Amend root zone of bed with Horta-Sorb® LG at the rate of 3 lbs. per thousand square feet for each 2" deep. Bed should be amended 6" deep. Dip small transplants (1-2" root ball diameter) in a Horta-Sorb® SM gel mixed at a rate of 1 lb. to 25 to 40 gallons of water.

COST—AMENDMENT, 5 CENTS PER SQUARE FOOT
ROOT BALL DIP, -/2 CENT PER PLANT

Shrubs—Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY, 10 CENTS PER GALLON SIZE
PLANTED

Example: 30 Cents for a 3-gallon container

Hydromulching

Add Horta-Sorb® SM to tank at the rate of 50 pounds per acre before adding fertilizer. At a normal rate of 3,000 gallons of water per acre, 50 pounds of Horta-Sorb® SM will hold 1,500 gallons of this water on the surface of the ground where the seed is, and **hence**, promote much faster germination. Use with hydroseeding also recommended.

COST—1/2 CENT PER SQUARE FOOT

Landscape Architects

Ask the Landscape Architect to consider using Horta-Sorb® with his clients' projects, as the responsibility for problems encountered in a landscape installation rests with them.

Remember that the Landscape Architect has the responsibility of insuring that the latest improved management techniques be used on his clients' projects.

COST- GENERALLY 2%, OR LESS, OF THE COST OF THE

PROJECT. (Refer to appropriate topic areas for specific costs.)

Landscapers

The landscape industry loses hundreds of millions of dollars each year caused by inadequate water management in the root zone of transplanted materials. This cost, referred to as “reset costs” are included in the bid process as a typical cost of all installations. The use of Horta-Sorb® during installations significantly reduces these costs. It should be pointed out to the landscaper that just because he makes provisions for reset costs in his bids doesn't mean that, as a businessman, he shouldn't do all that is economically possible to reduce these costs.

COST ARE GENERALLY 2 %, OR LESS, OF THE COST OF THE PROJECT. (Refer to appropriate topic areas for specific costs.)

Park Departments

This customer must constantly deal with the changing political environment that generally dictates “more trees, flowerbeds, etc.”, but typically with little, or no additional funds to maintain these new plantings. (Funds that are allocated for new plantings frequently are not accompanied with funds to maintain these new plantings.)

Trees - Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY 1%, OR LESS, OF THE COST OF PLANT MATERIAL

Example: a \$275.00, 12' to 15' tree is treated for about \$2.00 to \$3.00.

Tree Spades - Moisten the walls of the planting hole with water and broadcast Horta-Sorb® LG evenly throughout the planting pit at the recommended rate being sure that the Horta-Sorb® LG does

not all fall to the bottom of the planting pit.
COST—GENERALLY 1%, OR LESS, OF THE COST OF THE PLANTED TREE.

Annual Beds—Amend root zone of bed with Horta-Sorb® LG at the rate of 3 lbs. per thousand square feet for each 2" deep. Bed should be amended 6" deep. Dip small transplants (1-2" root ball diameter) in a Horta-Sorb® SM gel mixed at a rate of 1 lb. to 25 to 40 gallons of water.
COST—AMENDMENT, 5 CENTS PER SQUARE FOOT
ROOT BALL DIP, ½ CENT PER PLANT

Shrubs—Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY, 10 CENTS PER GALLON SIZE PLANTED

Example: 30 cents for a 3-gallon container

Sodding - Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work in, lay sod, roll and water.
COST - 1.5 CENTS PER SQUARE FOOT

Seeding—Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work into the top 1" of soil. Mix ½ lb. Horta-Sorb® SC, Seed coating, per 50 lbs. of seed.
COST - AMENDMENT, 1.5 CENTS PER SQUARE FOOT
SEEDCOATING - 50 CENTS PER 1000 SQUARE FEET

Sprigging—Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work into the top 1" of soil.
COST -- 1.5 CENTS PER SQUARE FOOT

Hydromulching—Add Horta-Sorb® SM to tank at the rate of 50 pounds per acre before adding fertilizer. At a normal rate of 3,000 gallons of water per acre, 50 pounds of Horta-Sorb® SM

will hold 1,500 gallons of this water on the surface of the ground where the seed is, and hence, promote much faster germination. Use with hydroseeding also recommended.
COST - ½ CENT PER SQUARE FOOT

Sod Plugs—Hydrate Horta-Sorb® MD to full capacity (let stand 2 hours). Pour into each plug hole ½ cup of this hydrated gel before placing sod plugs into holes.
COST - ½ CENT PER SOD PLUG

Road Departments

This customer generally subcontracts landscape and vegetation plantings. Included in the costs of all projects that they administer are labor, watering costs and reset costs (guarantees by the contractor). The use of Horta-Sorb® will significantly reduce these costs and provide a faster established landscape.

New Construction—Broadcast Horta-Sorb® MD at 3 pounds per thousand square feet. Work in, seed, sprig, or sod, then roll and water.
COST -- 1.5 CENTS PER SQUARE FOOT

Seeding and Overseeding - Mix 1/2 lb. Horta-Sorb® 2OOG with each 50 lbs. of seed.
COST -- \$20.00 PER 100 POUNDS OF SEED

Hydromulching - Add Horta-Sorb® SM to tank at the rate of 50 pounds per acre before adding fertilizer. At a normal rate of 3,000 gallons of water per acre, 50 pounds of Horta-Sorb® SM will hold 1,500 gallons of this water on the surface of the ground where the seed is, and hence, promote much faster germination. Use on hydroseeded flat areas that have little or no irrigation.
COST -- ½ CENT PER SQUARE FOOT

Trees - Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY 1%, OR LESS, OF THE COST OF

PLANT MATERIAL

Example: a \$275.00, 12' to 15' tree is treated for about \$2.00 to \$3.00.

Tree Spades - Moisten the walls of the planting hole with water and broadcast Horta-Sorb® LG evenly throughout the planting pit at the recommended rate being sure that the Horta-Sorb® LG does not all fall to the bottom of the planting pit.

COST—GENERALLY 1%, OR LESS, OF THE COST OF PLANT MATERIAL

Shrubs - Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST - GENERALLY, 10 CENTS PER GALLON SIZE PLANTED

Example- 30 cents for a 3-gallon container.

School Maintenance Departments

This customer generally has tight budget constraints and a constantly changing political environment that generally dictates “more trees, flowerbeds, etc.”, but typically with little, or no additional funds to maintain these new plantings. (Funds that are allocated for new plantings are considered capital expenditures as compared to maintenance funds that are appropriated annually.)

Trees—Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST—GENERALLY 1%, OR LESS, OF THE COST OF PLANT MATERIAL

Example: a \$275.00, 12' to 15' tree is treated for about \$2.00 to \$3.00.

Tree Spades - Moisten the walls of the planting hole with water and broadcast Horta-Sorb® LG evenly throughout the planting pit at the recommended rate being sure that the Horta-Sorb® LG does not all fall to the bottom of the planting pit.

COST D GENERALLY 1%, OR LESS, OF THE COST OF THE PLANTED TREE

Annual Beds - Amend root zone of bed with Horta-Sorb® LG at the rate of 3 lbs. per thousand square feet for each 2" deep. Bed should be amended 6" deep. Dip small transplants (1-2" root ball diameter) in a Horta-Sorb® SM gel mixed at a rate of 1 lb. to 25 to 40 gallons of water.

COST - AMENDMENT, 5 CENTS PER SQUARE FOOT
ROOT BALL DIP, t/2 CENT PER PLANT

Shrubs - Recommend the PRE-MEASURED 3 OZ. Horta-Sorb® LG Contractor Pac for:

Sandy Soils: Broadcast ½ the recommended amount of Horta-Sorb® LG throughout planting hole and amend backfill with remaining ½.

Normal Soils: Mix recommended amount throughout backfill.

Heavy Soils: Mix recommended amount with the backfill placed into the upper - to ½ of the planting pit.

COST - GENERALLY, 10 CENTS PER GALLON SIZE PLANTED

Example: 30 cents for a 3 gallon container.

Sodding—Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work in, lay sod, roll and water.

COST -- 1.5 CENTS PER SQUARE FOOT

Seeding - Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work into the top 1" of soil. Mix ½ lb. Horta-Sorb® SC, Seed coating, per 50 lbs. of seed.

COST - AMENDMENT, 1.5 CENTS PER SQUARE FOOT
SEEDCOATING, 50 CENTS PER 1000 SQUARE FEET

Seeding and Overseeding - Mix ½ lb. Horta-Sorb® SC with each 50 lbs. of seed.

COST -- \$20.00 PER 100 POUNDS OF SEED.

Sprigging—Broadcast Horta-Sorb® MD at 3 lbs. per thousand square feet. Work into the top 1” of soil.

COST - 1.5 CENTS PER SQUARE FOOT

Hydromulching - Add Horta-Sorb® SM to tank at the rate of 50 pounds per acre before adding fertilizer. At a normal rate of 3,000 gallons of water per acre, 50 pounds of Horta-Sorb® SM will hold 1,500 gallons of this water on the surface of the ground where the seed is, and hence, promote much faster germination. Use with hydroseeding also recommended.

COST—1/2 CENT PER SQUARE FOOT

Tree Movers—Spade

Trees planted with a tree spade are high cost materials. Although the amount of soil that is moved with the tree can weigh as much as 6,000 lbs. (with an 88” spade) the actual amount of roots, which are attached to the tree is generally thought to be about 20 to 25 percent of the total of the root system. With such a small amount of the roots intact, and such a high dollar cost of the spaded tree, the use of Horta-Sorb® during installation is simply good management.

Application—Moisten the walls of the planting hole with water and broadcast Horta-Sorb® LG evenly throughout the planting pit at the recommended rate being sure that the Horta-Sorb® LG does not all fall to the bottom of the planting pit.

COST - GENERALLY 1%, OR LESS, OF THE COST OF PLANT MATERIAL

Turf Farms

Although there are numerous places that these customers could use Horta-Sorb® the relatively low cost of using Horta-Sorb® to a sod user, i.e., landscaper, parks dept., etc., is too high for them to consider in a sod production operation. HOWEVER - Horta-Sorb® SC, Seed coating, is a product of ours that they are using, especially with high cost turf grass seed.

Seeding and Overseeding - Mix 1 lb. of Horta-Sorb® SC with each 50 lbs. of seed.

COST -- \$20.00 PER 100 LBS. OF SEED.

Nursery and Greenhouse Use

Used As A Soil Amendment

Why Horta-Sorb® Is Necessary: As any greenhouse manager knows, water management is a vital factor. Too little water can cause unwanted stress; too much m root rot, fungus, and lost crops.

In designing a potting mix, the manager must determine the proper balance of materials, which will hold water, provide drainage, and offer extended shelf life or transport benefits.

The use of Horta-Sorb® offers a unique combination of additional available moisture, improved drainage, reduced potting mix, less media settling after potting, and increased shelf life. This is accomplished with less watering, which can influence labor costs, fertilizer costs, fungicide use, etc.

These benefits are available to the growers that will invest their time into sorting out the various ways that super absorbents can be employed in their overall management plans.

Sales Tips

Each year we sell over a truckload of Horta-Sorb® MD to potting soil manufacturers that add it to their mixes for both commercial and retail markets. This market has grown at a 15% annual rate for the past 8 years.

Conditions to Ask About:

Plant dries out too much between irrigation (hanging baskets, bedding plants, etc.) -- Longer crop time, poorer quality because the plant has hardened—**use Horta-Sorb®** in soil or soil-less mixes.

“Dry outs” (edge of benches, rows)

Plant losses, culls—**use Horta-Sorb®** to provide that extra control to prevent this condition.

Poor drainage (frequent root rot and fungicide use). Lost production—**LIGHTEN UP MIX**; **use Horta-Sorb®** instead of organics to increase water-holding capacity

Chain store sales (shelf life)

Use Horta-Sorb® to boost shelf life and business to these customers.

Does the grower handle bare root material?

Use Horta-Sorb® SM (over 2 billion plants treated YEARLY!) to protect these fragile roots.

Applications and Costs

Dry or Expanded Use: Most growers will initially use Horta-Sorb® in dry form, mixing it with their existing mix. When the mix is initially watered, it will generally swell to a greater volume as Horta-Sorb® absorbs the water.

The amount of swelling depends upon the particle size of the mix, and the particle size of the Horta-Sorb® used. Smaller particle size mix components will result in greater swelling with Horta-Sorb® because air pores are smaller. As each particle of Horta-Sorb® swells, it will push soil particles away from it. Conversely, mixing Horta-Sorb® with a large particle mix will result in less expansion of the mix, since more air space is present where Horta-Sorb® is expanded.

It is most important to understand that the incorporation of Horta-Sorb® into existing mixes changes the character of moisture and aeration in the mix. In order to benefit the most from the use of Horta-Sorb®, the grower must examine his present mix as it pertains to particle size and air pore space.

An existing mix may, for example, include large amounts of organic matter for water holding capacity. In this case, consider opening up the mix to increase aeration and drainage by omitting some or all of the organic materials, and substituting large-particle, well draining, components. Horta-Sorb® will give you as much water-holding capacity as you want. It is simply a function of how much is used. **Focus on air pore space and drainage.** Using Horta-Sorb® to hold moisture at a predetermined level can preclude the use of organic materials typically employed for this purpose.

Should expected results not be accomplished with dry use of Horta-Sorb®, expand Horta-Sorb® and add expanded gel nuggets to the mix. Many smaller nurseries use Horta-Sorb® in expanded form. Horta-Sorb® particles are added to water and expanded BEFORE mixing into their mix. By doing so, the impact of using Horta-Sorb® on aeration and drainage in their present mix is minimized. Using expanded Horta-Sorb® as a mix amendment is recommended, should using Horta-Sorb® in dry form not yield

desired results with existing mix components.

Finally, water-soluble fertilizers can be added to the water before it is hydrated. The particles will absorb the fertilizer and provide a time-released effect.

Hand Mixing - On a workbench or concrete slab incorporate into the mix 2 pounds of Horta-Sorb® MD or LG per cubic yard. Mix ½ of the recommended amount into mix, and then add the remaining ½ to obtain better overall distribution.

Alternatively, it may be easier to achieve a more homogeneous mix by first expanding Horta-Sorb® MD or LG into 20-25 gallons of water per pound. Then, mix the gel nuggets with other mix components, and pot up as usual.

COST -- 3 CENTS FOR AN 8" HANGING BASKET

Machine Mixing—Add 2 pounds per cubic yard of Horta-Sorb® FIB or LG slowly to dry mix until thoroughly mixed.

Alternatively, add two pounds of Horta-Sorb® I-IB or LG to 50 to 80 gallons of water and incorporate the resulting gel into the mix.

COST- 3 CENTS FOR AN 8" HANGING BASKET

5 CENTS FOR A 1-GALLON STANDARD

Bare Root Treatments

Why Horta-Sorb® Is Necessary: Plants that are lifted from beds and shipped for subsequent planting are subject to damage. Any drying of the roots will cause damage and perhaps death of the plant.

Horta-Sorb® is used with over TWO BILLION seedlings each year because it helps to protect roots during transportation and planting. No other packaging or root treatment is as widely accepted in the industry as Horta-Sorb® -- not clay, not peat, not mulch.

Sales Tips

Name drop—Departments of Forestry—All State forest nurseries and commercial nurseries now use super absorbents as packaging media for bare root shipments.

VERY cost effective.

If a grower uses/handles bare root Horta-Sorb® SM will protect

and enhance this product.

Ask to demonstrate dipping and packaging treatment of a bundle of seedlings. (Call our office for more information if you need it.)

Applications and Costs

Establishment In Containers—Dip seedlings into a gel of Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water) before potting into containers.

COST -- 50 CENTS PER THOUSAND

Establishment In The Field - Dip seedlings into a gel of Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water) before setting. If seedlings were treated at the nursery, re-dip the roots at out plantings to boost survival and reduce transplant shock.

COST -- 50 CENTS PER THOUSAND FOR 6" STOCK

As A Packaging Medium—Horta-Sorb® SM is used extensively as a dip or spray to treat seedling roots at a rate of 1 pound to 25 - 40 gallons of water.

COST -- 25 CENTS PER THOUSAND

As a Carrier For Chemicals—Research has shown good results in adding chemicals to water absorbed by Horta-Sorb® SM to treat the root systems of citrus and forest seedlings. Treat with 1 pound of Horta-Sorb® SM per 20 - 30 gallons of solution.

COST -- 25 CENTS PER GALLON

Nursery Field Production

Why Horta-Sorb® Is Necessary: Field-grown plants experience significant stress when set out in the nursery field. Containerized plants must transition the loss of their “perched water table and therefore also go into transplant shock at planting. Bare root materials are much more fragile, and maintaining moisture in the roots and in the root zone is vital.

When field-grown materials are harvested, moisture plays an extremely important role as plants are placed into holding areas for accumulation. Further, as plants are shipped to the landscaper, moisture must be adequately managed to insure plants arrive in good condition.

The use of Horta-Sorb® in all these situations will help in the establishment, growing, holding and shipping of plant materials by the field grower.

Sales Tips

Field grown plants are either planted from containers or bare rootstock. First, determine which way the grower plants his stock, and then suggest either dipping bare root materials, or amending the planting pit with containerized materials.

Conditions At Planting Time:

Grower uses bare rootstock to line out his field—use Horta-Sorb® SM as a bare root dip to protect the roots and reduce stress.

Grower uses containerized stock to line out his fields use Horta-Sorb® LG or MD as a soil amendment to help overcome the loss of the saturation zone present in all containerized growing.

The grower plants several different types of plants in the same irrigation block—use Horta-Sorb® as a soil amendment to even out the level of water with those plants which will respond to additional water held in the root zone.

Conditions at Harvest: Lifted bare root plants - roots subject to drying—use Horta-Sorb® SM to protect the roots until they are re-planted.

B&B lifted -- 75 % of the root system remains in the field—only 25% is lifted with the plant—use Horta-Sorb® MD between the ball and burlap to hold moisture and reduce the level of shock that the plant experiences.

Conditions When Shipping:

Shipments of bare root materials dry out. - use Horta-Sorb® SM to maintain moisture during shipment.

Shipment of B&B materials over long distances dry out in transit—use Horta-Sorb® MD between the root ball and burlap to hold moisture while in transit and during establishment.

Applications & Cost

Field Planting—Dip bare root seedlings into a gel of Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water) before setting into the field.

COST -- 50 CENTS PER THOUSAND FOR 6" STOCK **\$2.00**
PER THOUSAND FOR 3' STOCK

With containerized seedlings - Amend the planting pit with Horta-Sorb® LG at the rate of 1 ounce per inch of caliper of seedling planted.

COST—GENERALLY, 10 CENTS PER GALLON SIZE
PLANTED

Field Harvesting—With bare root materials dip or spray the roots as they are lifted with Horta-Sorb® SM at the rate of 1 lb. added to 25 - 40 gallons of water.

COST -- 50 CENTS PER THOUSAND FOR 6" STOCK **\$2.00**
PER THOUSAND FOR 3' STOCK

With B&B materials, wet burlap and sprinkle Horta-Sorb® MD onto the burlap before wrapping ball at the rate of 1 ounce per inch caliber.

COST - 40 CENTS PER INCH CALIBER

Interiorscaping

Why Horta-Sorb® Is Necessary: We have all seen many instances where interior plant materials are in poor condition. In offices, fast food restaurants, etc., a stressed, drooping plant reflects poorly on the client and the interiorscaper.

Interior installations are not easy to maintain because of the wide range of conditions in which we try to force plants to live. Windy, low light, low humidity, high light (sunny windows), and hard-to-get-to-places, are all tough on maintaining adequate care. When you consider all the different types of plant material that are present in a single interiorscape installation, it is easy to imagine the extent of obstacles the interiorscaper must manage. Horta-Sorb® can play an important role as a management tool to help the interiorscaper with these challenges.

Sales Tips

Introduce Horta-Sorb® to greenhouse operators that specialize in supplying interiorscapers. The use of Horta-Sorb® with their plants will be a significant marketing tool for these operators.

Show the interiorscaper how to treat existing potted plants with dry Horta-Sorb® by poking holes into the medium and treating—do this at a job site.

Suggest to the interiorscaper that he request his suppliers use Horta-Sorb® in the mixes of the plants that he buys so that maintenance is reduced.

Applications And Costs

Root. Ball Dip - With short-term crops like flowers, remove the root ball from the container and dip in a gel made with Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water). Replace root ball in container.

COST -- 1 CENT FOR A 4" CONTAINER

Established Containers, Dry Method - With a pencil, poke numerous holes deep into the medium. Distribute Horta-Sorb® LG evenly throughout the holes at a rate of 1 teaspoon per gallon container size. Push top of holes shut. Water thoroughly.

COST -- 0.6 CENTS FOR A 4" CONTAINER

Soil Amendment - To each cubic yard of mix add 2 pounds of Horta-Sorb® MD for small containers and Horta-Sorb® LG for larger containers. Mix either dry Horta-Sorb® crystals, or premix 2 pounds of Horta-Sorb® to 50 to 80 gallons of water, and add the expanded Horta-Sorb®.

COST -- 0.85 CENTS FOR A 4" CONTAINER

Injection Treatment With Short-Term Color Crops - Prepare a gel with Horta-Sorb® SM at the rate of 1 lb. to 25 to 40 gallons of water. With a pump-up, or power unit, inject gel into root ball at a rate of 1 fluid ounce per inch diameter of container or until gel becomes visible. Remove screens in sprayer should they become plugged.

COST -- 1 CENT FOR A 4" CONTAINER

Garden Centers

Nursery/Greenhouse Division—Recommend that the owner use Horta-Sorb® LG and Horta-Sorb® MD as a soil amendment when potting up materials or propagating. Many of these

customers are small operations and can benefit their production significantly with the use of Horta-Sorb®, especially with hanging baskets and other plants that they handle and grow on. Most of these businesses use only one or two different types of potting soil mixes. When they are potting up “water lovers”, they can simply add expanded Horta-Sorb® to their existing mix to modify its water holding character for an individual species of plant.

Applications And Costs

Hand Mixing—On a workbench or concrete slab, incorporate into the mix 2 pounds of Horta-Sorb® MD or LG per cubic yard. Mix ½ of the recommended amount into mix, and then add the remaining ½ to obtain better overall distribution. Alternatively, it may be easier to achieve a more homogeneous mix by first expanding Horta-Sorb® MD or LG into 20-25 gallons of water per pound. Then, mix the gel nuggets with other mix components, and pot as usual.

COST -- 5 CENTS FOR AN 8 II HANGING BASKET

Machine Mixing - Add 2 pounds per cubic yard of Horta-Sorb® MD or LG slowly to dry mix until thoroughly mixed. Alternatively, add two pounds of Horta-Sorb® MD or LG to 50 to 80 gallons of water and incorporate the resulting gel into the mix.

COST - 5 CENTS FOR AN 8” HANGING BASKET
5 CENTS FOR A 1-GALLON STANDARD

Bare Root Materials Into Containers - Dip seedlings into a gel of Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water) before potting into containers.

COST - 50 CENTS PER THOUSAND

Bare Root Materials Into The Field—Dip seedlings into a gel of Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water) before setting. If seedlings had been treated in the nursery from which they have come, re-treat to boost survival and reduce transplant shock.

COST -- 50 CENTS PER THOUSAND FOR 6” STOCK \$2.00
PER THOUSAND FOR 3 FT. WHIPS.

As A Packaging Medium—Horta-Sorb® SM is used extensively as a dip or spray to treat seedling roots at a rate of 1 pound to 25 -

40 gallons of water.
COST - 25 CENTS PER THOUSAND

Interiorscape Division -

Root.. Ball Dip - With short-term crops like flowers, remove the root ball from the container and dip in a gel made with Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water). Replace root ball in container.

COST -- 1 CENT FOR A 4" CONTAINER

Established Containers, Dry Method - With a pencil, poke numerous holes deep into the medium. Distribute Horta-Sorb® LG evenly throughout the holes at a rate of 1 teaspoon per gallon container size. Push top of holes shut. Water thoroughly.

COST -- 0.6 CENTS FOR A 4" CONTAINER

Soil Amendment - To each cubic yard of mix, add 2 pounds of Horta-Sorb® MD for small containers and Horta-Sorb® LG for larger containers. Mix either dry Horta-Sorb® crystals, or premix 2 pounds of Horta-Sorb® to 50 to 80 gallons of water and add the expanded Horta-Sorb®.

COST -- 0.85 CENTS FOR A 4" CONTAINER

Injection Treatment With Short-Term Color Crops—With a pump-up, or power unit, inject Horta-Sorb® SM gel (25 to 40 gallons of water per lb.) into the root ball at a rate of 1 fluid ounce per inch diameter of container or until gel becomes visible. Remove screens in sprayer should they become plugged.

COST -- 1 CENT FOR A 4" CONTAINER

Landscaping Division - Refer to Landscape, Seeding & Turf section, page 21.

Retail Division - Refer to Landscape, Seeding & Turf section, page 22.

Greenhouse Operator

Hand Mixing—On a workbench or concrete slab, incorporate into the mix 2 pounds of Horta-Sorb® MD or LG per cubic yard. Mix ½ of the recommended amount into mix, then add the remaining ½ to obtain better overall distribution.

Alternatively, it may be easier to achieve a more homogeneous

mix by first expanding Horta-Sorb® MD or LG into 20-25 gallons of water per pound. Then mix the gel nuggets with other mix components and pot up as usual.
COST -- 5 CENTS FOR AN 8" HANGING BASKET

Machine Mixing - Add 2 pounds per cubic yard of Horta-Sorb® MD or LG slowly to dry mix until thoroughly mixed. Alternatively, add two pounds of Horta-Sorb® MD or LG to 50 to 80 gallons of water and incorporate the resulting gel into the mix.
COST -- 5 CENTS FOR AN 8" HANGING BASKET
5 CENTS FOR A 1 GALLON STANDARD

Interiorscaper

Root. Ball Dip - With short-term crops like flowers, remove the root ball from the container and dip in a gel made with Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water). Replace root ball in container.
COST -- 1 CENT FOR A 4" CONTAINER

Established Containers, Dry Method - With a pencil, poke numerous holes deep into the medium. Distribute Horta-Sorb® LG evenly throughout the holes at a rate of 1 teaspoon per gallon container size. Push top of holes shut. Water thoroughly.
COST - 0.6 CENTS FOR A 4 INCH CONTAINER

Soil Amendment - To each cubic yard of mix add 2 pounds of Horta-Sorb® MD for small containers and Horta-Sorb® LG for larger containers. Mix either dry Horta-Sorb® crystals, or premix 2 pounds of Horta-Sorb® to 50 to 80 gallons of water and add the expanded Horta-Sorb®.
COST - 0.85 CENTS FOR A 4" CONTAINER

Injection Treatment With Short-Term Color Crops - With a pump-up, or power unit, inject a gel of Horta-Sorb® SM (25 to 40 gallons of water to 1 lb.), into root ball at a rate of 1 fluid ounce per inch diameter of container or until gel becomes visible. Remove screens in sprayer should they become plugged.
COST - 1 CENT FOR A 4" CONTAINER

Mail Order Shipper

Bare Root Packaging Medium - Horta-Sorb® SM is used extensively as a dip or spray to treat seedling roots at a rate of 1 pound to 25 - 40 gallons of water. Use with or without conventional packing materials.
COST -- 50 CENTS PER THOUSAND

Nursery Containers - Most of these businesses use only one or two different types of potting soil mixes. When they are potting up “water lovers”, they can simply add expanded Horta-Sorb® to their existing mix to modify the water holding capacity of the mix for an individual species of plant.

Hand Mixing—On a workbench or concrete slab, incorporate into the mix 2 pounds of Horta-Sorb® MD or LG per cubic yard. Mix ½ of the recommended amount into mix then add the remaining ½ to obtain better overall distribution.

Alternatively, it may be easier to achieve a more homogeneous mix by first expanding Horta-Sorb® MD or LG into 20-25 gallons of water per pound. Then mix the gel nuggets with other mix components and pot up as usual•
COST -- 5 CENTS FOR AN 8” HANGING BASKET

Machine Mixing - Add 2 pounds per cubic yard of Horta-Sorb® MD or LG slowly to dry mix until thoroughly mixed. Alternatively, add two pounds of Horta-Sorb® MD or LG to 50 to 80 gallons of water and incorporate the resulting gel into the mix.
COST -- 5 CENTS FOR A 1 GALLON STANDARD

Bare Root Materials Into Containers - Dip seedlings into a gel of Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water) before potting into containers.
COST -- 50 CENTS PER THOUSAND

Nursery—Field Grower

BareRoot Materials Into The Field - Dip seedlings into a gel of Horta-Sorb® SM (1 lb. per 25 - 40 gallons of water) before setting. If seedlings had been treated in the nursery from which they have come, re-treat to boost survival and reduce transplant shock.
COST-- 50 CENTS PER THOUSAND FOR 6” STOCK -- \$2.00

PER THOUSAND FOR 3' STOCK

Forestry & Soil Conservation

Forest Nursery Seed Beds

Why Horta-Sorb® Is Necessary: Maintaining moisture near the seed in forest nursery seedbeds is critical for good germination of the seed. The germination rate of unimproved seeds (seeds collected in the forest) is often no more than 50%. Even the success of improved seed (from a seed orchard) depends on good water management in the seedbed. Too much moisture from heavy irrigation hold high moisture levels for germination but, can cause fungus problems. The use of Horta-Sorb® in the planting environment gives the manager superior management of water, the most important factor for germination.

Sales Tips

If nursery is currently top dressing with hydromulch, add Horta-Sorb® SM to the tank to hold moisture on top of the bed where the seed is.

Use Horta-Sorb® SC Seed coating, to treat the seed.

Applications And Costs

Soil Amendment - Broadcast Horta-Sorb® MD at a rate of 3 pounds per thousand square feet. Work into soil 1 to 2 inches.

COST - 1.5 CENTS PER SQUARE FOOT OF BED

Seed. Treatment—Apply Horta-Sorb® SC, Seed coating to the seed at the rate of 1 to 2 pounds per 100 pounds of seed.

COST - 15 TO 30 CENTS TO TREAT 1 LB. OF SEED

Top Dressing—Add Horta-Sorb® SM to hydromulch tank at a rate of 1 pound per 50 gallons of water.

Top dress seed bed with a light gel. Consider elimination of wood fiber mulch.

COST -- 1 CENT PER SQUARE FOOT OF BED

Forest Nursery Containers

Why Horta-Sorb® Is Necessary: The primary reason forest seedlings are container-grown is to increase survival. With bare root seedlings, some species do survive well. Containerization is used to commercialize production of these seedlings. Horta-Sorb® as a soil amendment not only will enhance the nursery production of seedlings, but more importantly, it can further enhance survival at out planting.

Sales Tips

INCREASED SURVIVAL.

With private paper company nurseries, STRESS return on investment.

If seedlings are for foreign markets, STRESS survival.

If seedlings are hard to transplant, STRESS survival.

Applications And Costs

Soil Amendment—Mix Horta-Sorb® MD in dry or expanded form into the media at a rate of 2 pounds per cubic yard dry or 50 to 80 gallons of gel.

COST -- ½ CENT PER SEEDLING

RESEARCH CONTINUES - As A Carrier For Chemicals - Horta-Sorb® will absorb many different types of chemicals which university research now shows offer longer life and permit less amounts of chemicals to be used.

Packaging Medium Forestry Bare Root Seedlings

Why Horta-Sorb® Is Necessary: Horta-Sorb® INCREASES SURVIVAL. Each year over TWO BILLION seedlings are treated with Horta-Sorb®.

Sales Tips

Name Drop—Many states and private forest companies have used

Horta-Sorb® for years.

The bare root application is the MOST DEVELOPED USE OF SUPERABSORBENTS IN THE WORLD TODAY. Why? Because of its cost effectiveness and influence on survival.

Applications And Costs

Seedling Grading Operation - Mix Horta-Sorb® SM with 25 to 40 gallons of water and spray or dip the roots of seedlings while packaging.

COST -- 25 CENTS PER THOUSAND

FieldPackaging Operation - Mix Horta-Sorb® SM with 25 to 40 gallons of water and spray or dip the roots of seedlings while packaging.

COST -- 25 CENTS PER THOUSAND

Out planting Forest Seedlings

Why Horta-Sorb® Is Necessary: It is very important to RE-TREAT bare root seedlings or dip containerized seedlings during out planting with Horta-Sorb®. This additional treatment will boost survival and pay off significantly.

Sales Tips

Show Horta-Sorb® to County Extension agents responsible for forestry.

Show Horta-Sorb® to area Soil Conservation agents

Attend local Christmas tree conferences and show Horta-Sorb® to landowners.

Applications And Costs

Manual Planting - Mix Horta-Sorb® SM with 25 to 40 gallons of water. Let stand for 30 minutes. Dip seedlings immediately before planting. Adjust gel to a thickness that permits the maximum amount of gel to adhere to the roots.

COST -- 30 CENTS PER ACRE

Machine Planting—Mix Horta-Sorb® SM with 25 to 40 gallons of water. Let stand for 30 minutes. Keep gel **on roots at** all times. Devise a trough on planter to hold seedlings upright. Place gel into trough with roots in gel.

COST -- 30 CENTS PER ACRE

Forestry Customers

Forest Seedling Planters

Manual Planting - Mix Horta-Sorb® SM with 25 to 40 gallons of water. Let stand for 30 minutes. Dip seedlings immediately before planting. Adjust gel to a thickness that permits the maximum amount of gel to adhere to the roots.

COST -- 30 CENTS PER ACRE

Machine Planting - Mix Horta-Sorb® SM with 25 to 40 gallons of water. Let stand for 30 minutes. Keep gel on roots at all times. Devise a trough on planter to hold seedlings upright. Place gel into trough with roots in gel.

COST -- 30 CENTS PER ACRE

Forest Seedling Nurseries

Seedling Grading Operation - Mix Horta-Sorb® SM with 25 to 40 gallons of water and spray or dip the roots of seedlings while packaging.

COST -- 25 CENTS PER THOUSAND

FieldPackaging Operation - Mix Horta-Sorb® SM with 25 to 40 gallons of water and spray or dip the roots of seedlings while packaging.

COST -- 25 CENTS PER THOUSAND

Agriculture—Food Crops

Transplants—Vegetables

Why Horta-Sorb® Is Necessary: Over 20 BILLION vegetables plants are transplanted each year as farmers try to extend their growing seasons, use less labor, and compete in a global market. The most critical period in the life of these tender transplants occurs during transporting and transplanting the seedling when water stress is likely. Productivity losses from transplanting are severe due to moisture losses in transit, cool/dry spring temperatures, poor cultural practices, dry field conditions, etc.

Progressive farmers use Horta-Sorb® to reduce transplant stress and encourage better establishment in the shortest period.

Sales Tips

All transplants go into shock—use Horta-Sorb® to reduce this. Generally, the local greenhouse that grows the transplants will recommend local farmers to work with to establish trials for using Horta-Sorb® in transplanting crops.

Applications And Costs

Plug Transplants - Mix Horta-Sorb® SM with 25 to 40 gallons of water (or water and starter fertilizer) and add to water tank on tractor. One to two ounces of gel per transplant hole is ideal.

COST - LESS THAN \$2.00 PER THOUSAND

Bare Root Transplants - Mix Horta-Sorb® SM with 25 to 40 gallons of water (or water plus starter fertilizer) and add to water tank on tractor. One to two ounces of gel per transplant is ideal.

COST—LESS THAN \$2.00 PER THOUSAND

RESEARCH CONTINUES—

University research shows that Horta-Sorb® used with a starter fertilizer offers significant benefit. Prepare a gel with fertilizer-enriched water instead of plain water. Mix Horta-Sorb® SM at the rate of 15 - 25 gallons of water per pound depending on the effect that the fertilizer has on absorption capacity. The resulting gel should have the consistency of heavy gravy, which will permit the gel to adhere to the transplant root system.

Transplants—Orchards & Groves

Why Horta-Sorb® Is Necessary: Fruit tree transplants are high value transplants. Should conditions be poor when these young seedlings are transplanted, the trees may take considerable time to recover. Prolonged transplant recovery time increases the likelihood that the plant will “harden-off” and be less productive, and take considerably more time to become mature. Further, a hardened plant generally will not mature into a highly productive plant. Although decreased transplant shock is not as obvious, a benefit as fewer resets and less watering, real benefit is present in reducing transplant shock. With long-term fruit crop trees, poor

recovery time causes undo hardship on the grower due to his continued investment in less productive crops, which have hardened during transplanting. Horta-Sorb® used during the installation of orchard and grove material reduces transplant shock by managing moisture in the root zone during establishment.

Sales Tips

- Very BIG potential use of Horta-Sorb® due to increasing size of commercial orchards and groves (multi-thousand dollar orders not unusual).
- If the farmer owns a water truck he will use Horta-Sorb®.

Extremely cost effective.

Applications And Costs

Containerized Transplants - Mix Horta-Sorb® LG into the planting pit at 1 to 2 ounces (dry) per transplant.
COST m 50 CENTS PER PLANT

Bare Root Transplants—Dip root system of transplant into a gel of Horta-Sorb® SM prepared with 1 lb. per 25 to 40 gallons of water (or water plus fertilizer).
COST - 5 CENTS PER 3-4' PLANT

Injecting Fertilizers - University research shows that gels injected into the root zone of trees offers significant benefit. Prepare a gel with fertilizer-enriched water instead of plain water. Mix Horta-Sorb® SM at the rate of 15 - 25 gallons of water per pound depending on the effect that the fertilizer has on absorption capacity. The resulting gel should have the consistency of heavy gravy, which will permit the gel to adhere to the transplant root system.
COST - 15 CENTS PER GALLON OF ENRICHED GEL

Seed coating With Horta-Sorb® SC

Direct Seeding

Why Horta-Sorb® Is Necessary: Seeds germinate once they have absorbed sufficient water to literally break the shell of the

seed and permit the radical to emerge and begin its downward trek to anchor the seed contents into the ground. Using Horta-Sorb® to manage water for absorption into the seed provides significant utility for agricultural interests.

Sales Tips

Much of the seed used in agriculture today does not have high germination rates. Cottonseed, for example, generally has about an 80 percent germ rate. A farmer that realizes that 20 percent or more of his seed cost is for seed that is not going to germinate is a perfect candidate to use a seed treatment that will boost germination rates. Seed treatments are accomplished by using Horta-Sorb® SC; Seed coating, to coat seed, Horta-Sorb® SM as a gelling agent in fluid drilling and gel seedling, and Horta-Sorb® MD as an amendment in plug mixes.

Applications and Costs

Seed coating - Horta-Sorb® SC Seed coating is mixed dry with seed before planting at a rate of 1 lb. per 100 lbs. of seed. It requires no tackers, stickers, or processing and absorbs water - keeping it on the seed - to enhance germination.

COST - 15 TO 30 CENTS TO TREAT 1 LB. OF SEED

Fluid Drilling/Gel Seeding - Mix Horta-Sorb® SM at a rate of 1 lb. to 25 to 40 gallons of water. Adjust thickness of gel to obtain desired consistency by adding more water, or more Horta-Sorb® SM. Let gel set for 1 hour before attempting to alter consistency. Once adjustments are complete, record the actual mixing rate for future reference as absorption rate is based upon the water used. Horta-Sorb® SM may be used in conjunction with other chemical such as starter solutions, hormones, fungicides, etc., following the manufacturers recommended dosage rates of these chemicals.

COST - 10 CENTS PER 100 GALLONS OF SOLUTION

Plug .Mix Amendment - Mix Horta-Sorb® MD at the rate of 2 lbs. per cubic yard of plug mix. When seed is mixed with water, peat, fertilizer, etc., and applied in moist clumps to germinate for row crops, the addition of Horta-Sorb® SM or MD, to the mixture at 2 pounds per cubic yard yields faster germination and a better germination rate.

COST - \$1.75 PER THOUSAND (4 OZ. EA.)

Agricultural Customers

Groves And Orchards

Containerized Transplants - Mix Horta-Sorb® LG into the planting pit at 1 to 2 ounces (dry) per transplant.
COST E 50 CENTS PER PLANT

Bare Root Transplants - Dip root system of transplant into a gel of Horta-Sorb® SM prepared with 1 lb. per 25 to 40 gallons of water (or water plus fertilizer).
COST -- 5 CENTS PER 3-4' PLANT

Injecting Fertilizers - University research shows that Horta-Sorb® injected into the root zone of trees offers significant benefit. Prepare a gel with fertilizer-enriched water instead of plain water. Mix Horta-Sorb® SM at the rate of 15-25 gallons of water per pound depending on the effect that the fertilizer has on absorption capacity. The resulting gel should have the consistency of heavy gravy that will permit the gel to adhere to the transplant root system.
COST - 15 CENTS PER GALLON OF ENRICHED GEL
ROW CROPS

Seed coating—Horta-Sorb® SC Seed coating is mixed dry with seed before planting at a rate of 1 lb. per 100 lbs. of seed. It requires no tackers, stickers or processing and absorbs water - keeping it on the seed—to enhance germination.
COST - 15 TO 30 CENTS TO TREAT 1 LB. OF SEED.

Fluid Drilling/Gel Seeding - Mix Horta-Sorb® SM at a rate of 1 lb. to 25 to 40 gallons of water. Adjust thickness of gel to obtain desired consistency by adding more water, or more Horta-Sorb® SM. Let gel set for 30 minutes before attempting to alter consistency. Once adjustments are complete, record the actual mixing rate for future reference, as absorption rate is based upon the water used.

Horta-Sorb® SM may be used in conjunction with other chemical such as starter solutions, hormones, fungicides, etc., following the manufacturers recommended dosage rates of these chemicals.
COST—10 CENTS PER 100 GALLONS OF SOLUTION

Plug . Mix Amendment - Mix Horta-Sorb® MD at the rate of 2 lbs. per cubic yard. When seed is mixed with water, peat, fertilizer, etc., and applied in moist clumps to germinate for row crops, the addition of Horta-Sorb® SM or MD, to the mixture at 2 lbs. per cubic yard yields faster germination and a better germination rate.
COST -- \$1.75 PER THOUSAND (4 OZ. EA.)

Banding In Rows - Band Horta-Sorb® MD into the rows with vegetable and row crops at the rate of 15 to 30 lbs. per acre.
COST -- \$125 PER ACRE

Tobacco Growers

Plug Transplants - Mix Horta-Sorb® SM with 25 to 40 gallons of water (or water and starter fertilizer) and add to water tank on tractor. One to two ounces of gel per transplant hole is ideal.
COST—LESS THAN \$2.00 PER THOUSAND

Bare Root Transplants - Mix Horta-Sorb® SM with 25 to 40 gallons of water (or water plus starter fertilizer) and add to water tank on tractor. One to two ounces of gel per transplant is ideal.
COST - LESS THAN \$2.00 PER THOUSAND

RESEARCH CONTINUES

University research shows that Horta-Sorb® used with a starter fertilizer offers significant benefit. Prepare a gel with fertilizer-enriched water instead of plain water.

Mix Horta-Sorb® SM at the rate of 15 - 25 gallons of water per pound depending on the effect that the fertilizer has on absorption capacity. The resulting gel should have the consistency of a heavy gravy which will permit the gel to adhere to the transplant root system.

Transplant/Vegetable Growers

Plug Transplants - Mix Horta-Sorb® SM with 25 to 40 gallons of water (or water and starter fertilizer) and add to water tank on tractor. One to two ounces of gel per transplant hole is ideal.
COST—LESS THAN \$2.00 PER THOUSAND

Bare Root Transplants - Mix Horta-Sorb® SM with 25 to 40 gallons of water (or water plus starter fertilizer) and add to water tank on tractor. One two ounces of gel per transplant is ideal.

COST—LESS THAN \$2.00 PER THOUSAND

Banding In Rows - Band Horta-Sorb® MD into the rows with vegetable and row crops at the rate of 15 to 30 lbs. per acre.
COST - \$125 PER ACRE

RESEARCH CONTINUES

University research shows that Horta-Sorb® used with a starter fertilizer offers significant benefit. Prepare a gel with fertilizer-enriched water instead of plain water. Mix Horta-Sorb® SM at the rate of 15 - 25 gallons of water per pound depending on the effect that the fertilizer has on absorption capacity. The resulting gel should have the consistency of heavy gravy that will permit the gel to adhere to the transplant root system•

Appendices

A.....FAQ's About Super Absorbents
B..... What Researchers Say About Horta-Sorb®
C..... General Specification Sheets

A - FAQ's About Super Absorbents

1. **Can a super absorbent cause over watering?** No. Over watering is caused by standing water in a root zone. Standing water is the result of lack of drainage. Drainage is based upon the particle size of the soil, mix, or gel that is considered the root zone. Super absorbents, especially when fully hydrated, are of a large particle size. In fact, the swelling and shrinking action of a super absorbent between watering should "exercise" the mix and promote drainage. A super absorbent can actually improve drainage by allowing the grower to move to a extremely well drained mix, one he/she could not use without a super absorbent as an amendment. Remember, roots grow into the pore space between soil particles - so the more pore space, the more space for roots to grow. The problem with lots of spore space is that such a mix does not hold water. Think again. With a super absorbent it can hold as much water as you want! MOREOVER, roots will grow into a hydrated "nugget" of water!

2. **How long have super absorbents been used in horticulture?** Super absorbents were first introduced by Union Carbide back in the mid 60's into the retail gardening market. In the 70's the products could be found in only a handful of garden centers and were used very little by the commercial grower due to their low swell ability (about 30 times) and consequently high cost. In the early 80's super absorbents were developed with an eye towards the baby diaper market. The baby diaper market represented a potential of hundreds of millions of pounds. Soon newer, higher swell, super absorbents were developed for this market which lead to refinements in products suitable for agriculture, which were also long lasting. The commercial market for super absorbents today in the US market alone exceeds \$10,000,000. All attempts at the retail market have resulted in little because no company will invest the necessary millions for promotion when there is little barriers to entry into these markets.
3. **How long does a super absorbent last in the soil?** Under most conditions a quality agricultural super absorbent will last 4-5 years, which makes them very cost effective for long-term maintenance situations. Baby diaper polymers last a couple of months in the soil and are sold commercially by several companies as "agricultural grade" super absorbents.
4. **What is the purpose of having several different particle sizes of super absorbents?** It's simply a physical thing. A small particle size is used for gel bare root dips. If you used a larger particle size it would become so heavy it would fall off of a root instead of coating the root. On the other hand, a small particle size used as a soil amendment would be very difficult to use since it would stick together with other small gel particles and be a mess.
5. **What is the most accepted use of a super absorbent?** Bare root treatments began back in the early 80's are the most accepted with landscape and nursery mix amendments are tied for #2. The fastest growing application today is nursery/greenhouse mix amendment uses. In 2002 over ½ million pounds will be used in this application.

6. **What ever happened to such and such?** In the past 20 plus years there have been about 100 companies enter the market with a super absorbent product. Ninety five percent of them are gone. The problem for the consumer is that a poor quality super absorbent looks the same as a quality agricultural grade super absorbent. The companies that sell these poor products damage the image of super absorbents unfairly. Forget trade names too. Trade name can be purchased and then used with different products. Unfortunately, as a consumer you must constantly check the quality of the super absorbent that you use until you are comfortable with the company from which the super absorbent is coming from. A successful company is only successful because the quality of its products has won it a place in the market. Sooner, or later, the poor company will go away. So stick with a winner, and you too will me a winner.
7. **What is HORTA-SORB®?** HORTA-SORB® is a family of starch and synthetic absorbent polymers capable of absorbing hundreds of times their weight in water that is available to plants.
8. **How is HORTA-SORB® used?** HORTA-SORB® is used in five ways. First, adding HORTA-SORB® to water forms a gel that is used as a transplant dip, or spray, for small transplants in greenhouse, field growing, and forestry and as a packaging media for bare root plant materials. Secondly, HORTA-SORB® is used as a soil amendment in landscaping and horticulture to reduce watering, transplant shock and increase shelf life/or viability of both indoor and outdoor plant materials. Thirdly, HORTA-SORB® is used by broadcasting over an area to be seeded or sodded to reduce watering and maintenance by 50%. Fourth, HORTA-SORB® is used as a seed coating to give faster germination and a better germination rate. Finally, HORTA-SORB® is used as a carrier for chemicals in dry or expanded form.
9. **How quickly do HORTA-SORB® polymers absorb water?** The starch polymers absorb 90% capacity in less than a minute. Synthetic formulations take longer, depending on particle size, but generally achieve 90% absorption in one hour.
10. **What effect does HORTA-SORB® have on water it**

absorbs? HORTA-SORB® is inert and insoluble and does not chemically alter liquids absorbed by it.

11. **What effect does HORTA-SORB® have on pH?** HORTA-SORB® is neutral and works over a wide range of pH.
12. **Can HORTA-SORB® cause root rot?** No. HORTA-SORB® improves aeration and drainage of the growing media. As HORTA-SORB® particles expand; they open the media by forcing the particles apart, increasing aeration and improving drainage, but not causing standing water.
13. **How long are HORTA-SORB® super absorbents polymers effective?** The effective in-soil life of HORTA-SORB® polymers depends on such factors as soil acidity and alkalinity, mineral content, soil microorganisms and type of fertilizers. Typically, HORTA-SORB® starch polymers are effective for 6 - 12 months. HORTA-SORB® synthetic formulations are effective 4 - 5 years or more.
14. **How does HORTA-SORB® compare with peat in giving up its absorbed water to plants?** The water held by HORTA-SORB® is twice as available as the water held by peat. Nearly half of the water absorbed by peat is not available to plants. HORTA-SORB®, by weight, is fifty times as effective as peat moss in absorbing available water for the plants.
15. **In what situations are HORTA-SORB® starch polymers used most.** HORTA-SORB® starch polymers are best suited in applications where long life is not desired.
16. **In what situations are HORTA-SORB® synthetic polymers used most. Where long life (4 - 5 years or more) is desired, the use of synthetic polymers is the answer.** Synthetic polymers are used in horticultural mixes, indoor and outdoor planter boxes and flowerbeds, hanging baskets, etc.
17. **What are the benefits of using HORTA-SORB® to the greenhouse operator that currently does not have a water problem.** Increased shelf life, reduced transplant shock, reduced irrigation (particularly for seed flats and sticking beds where foliage wetness can cause problems), and reduced

media of up to 20% (which offsets cost).

18. **If a greenhouse grower currently spends \$20.00 per cubic yard for potting mix, how much would it cost to add HORTA-SORB®?** If it is the intent of the grower to reduce the amount of media he is currently using and replacing it with the proper formulation of HORTA-SORB®, in volume packaging, with 20% reduced media, it would only cost \$6.30 to treat one cubic yard of media. (About 5 cents for an 8” hanging basket.)
19. **In a landscaping situation that is irrigated what are the benefits of using HORTA-SORB®?** Reduced transplant shock and better survival. Transplanted materials go into shock when set. Most irrigation systems are designed for established plant materials. Water, during establishment is the single most critical element in insuring that plant materials do not go into shock. Finally, by using HORTA-SORB® in the project the landscaper provides a “water buffer” in case of human or equipment failure.
20. **In landscaping how much would it cost to treat a tree with a two-foot diameter root ball and what benefits would I get?** It would cost less than a dollar and would result in cutting watering requirements by at least 50%. In addition, the transplanted tree would experience less shock and increased lushness.
21. **If HORTA-SORB® is used in a landscaping situation and after application it rains 3 “, can this cause problems?** No. Once HORTA-SORB® fully absorbs the water any excess simply flows through or over the HORTA-SORB®.
22. **As a potting soil manufacturer what are the benefits of mixing HORTA-SORB® into your mix?** HORTA-SORB® amended mix can represent an improved media for your company in that your mix will require less maintenance. In addition, there are numerous opportunities for special blends where the typical growing environment is enhanced significantly with HORTA-SORB® like plug mixes, hanging baskets, interior uses, etc.
23. **Is HORTA-SORB® the same as other polymers?** No. Some brands of super absorbents now marketed are nothing

more than repackaged health care (diaper) polymers, which are engineered to absorb, but not release fluids. HORTA-SORB® is engineered to release nearly all of its stored water and will remain effective in the ground for 4 - 5 years or more.

24. **What does HORTA-SORB® LG, SM and MD biodegrade into?** The final breakdown products from synthetic HORTA-SORB® would be carbon dioxide, water, and ammonia. There would be no residual toxicity.
25. **Can too much HORTA-SORB® be used?** Yes. The application rates suggested for using HORTA-SORB® are conservative and will result in good use of polymer technology. Follow recommended application rates for best results.
26. **Does HORTA-SORB® cause shallow root development.** No. Shallow root development is caused by short irrigation cycles or non-draining (high water table) soils.

Horta-Sorb® superabsorbents are unique. No other commercially available super absorbent is identical to the chemical makeup of our products that have been based upon over 20 years experience in determining what components provide the longest lasting super absorbent. Other companies marketing “me-too” products have no idea of the chemistry. They listen to manufacturers that have little knowledge of what actually happens in the real world.

B – Research On Super Absorbents

Airhart, D. L., N. J. Natarrella and F. A. Pokorny. "Influence of Initial Moisture Content on the Wettability of a Milled Pine Bark Medium" *HortScience*, 13(4):432-434. 1978.

Amador, Adolfo Minero and Katrine A. Stewart. "Osmotic Potential and pH of Fluid Drilling Gels as Influenced by Moisture Loss and Incorporation of Growth Regulators" *J. Amer. Soc. Horta. Sci.*, 112(1):26-28. 1987.

Azzam, Reda A. I. "Agricultural Polymers. Polyacrylamide Preparation, Application and Prospects in Soil Conditioning" *Comm. Soil Sci. Plant Anal.*, 11(8):767-834. 1980.

Azzam, Reda A. I. "Polymeric Conditioners Gels for Desert Soils" *Commun. Soil Sci. Plant Anal.*, 14(8):739-760. 1983.

Azzam, Reda A. I. "Tailoring Polymeric Gels for Soil Reclamation and Hydroponics" *Commun. Soil Sci. Plant Anal.*, 16(10):1123-1138. 1985.

Banko, Thomas J. "Medium amendment plus watering system may improve rooting" *Amer. Nurseryman*, pp. 51-53. May 15, 1984.

Baxter, Lawford and Luther Waters, Jr. "Effect of a Hydrophilic Polymer Seed Coating on the Field Performance of Sweet Corn and Cowpea" *J. Amer. Soc. Horta. Sci.*, 111(1):31-34. 1986.

Baxter, Lawford and Luther Waters, Jr. "Effect of a Hydrophilic Polymer Seed Coating on the Imbibition, Respiration, and Germination of Sweet Corn at Four Matrix Potentials" *J. Amer. Soc. Horta. Sci.*, 111(4):517-520. 1986.

Baxter, L. and L. Waters, Jr. "Field and Laboratory Response of Sweet Corn and Cowpea to a Hydrophilic Polymer Seed Coating" *Acta Horta.*, Issue 198, pp. 31-35. June, 1987.

Bearce, Bradford C. and Rebecca W. McCollum. "A comparison of peat-lite and noncomposted hardwood-bark mixes for use in pot and bedding-plant production and the effects of a new hydrogel soil amendment on their performance" *Florists' Review*, 161(4169):21-23, 66-67. 1977.

Berdahl, J. D. and R. E. Barker. "Germination and Emergence of Russian Wildrye Seeds Coated with Hydrophilic Materials" *Agronomy J.*, 72:1006-1008. 1980.

Bilderback, T. E., W. C. Fonteno and D. R. Johnson. "Physical Properties of Media Composed of Peanut Hulls, Pine Bark and Peatmoss and their Effects on Azalea Growth" *J. Amer. Soc. Horta. Sci.*, 107(3):522-525. 1982.

Bilderback, T. E. "Moisture Extender and Wetting Agent Effects on Two Drought-Sensitive Nursery Crops" *HortScience*, 22(5):1049. 1987.

Bilderback, T. E. and W. C. Fonteno. "Effects of Container Geometry and Media Physical Properties on Air and Water Volumes in Containers" *J. Environ. Horta.*, 5(4):180-182. 1987.

Boaz, M. M. and J. L. Nus. "Effect of Cross-Linked Polyacrylamide and Starch Polymers on Rootzone Impact Absorption, Oxygen Diffusion Rate, Water Holding Capacity, and Rooting of Tall Fescue" *Agron. Abst.*, p. 172. 1991.

Bradford, Kent J. and Shang Fa Yang. "Physiological Responses of Plants to Waterlogging" *HortScience*, 16(1):25-30. 1981.

Callaghan, T. V., H. Abdelnour and D. K. Lindley. "The environmental crisis in the Sudan: the effect of water-absorbing synthetic polymers on tree germination and early survival" *J. Arid Environ.*, 14:301-317. 1988.

Callaghan, T. V., D. K. Lindley, O. M. Ali, H. Abd El Nour and P. J. Bacon. "The Effect of Water-Absorbing Synthetic Polymers on the Stomatal Conductance, Growth and Survival of Transplanted Eucalyptus Microtheca Seedlings in the Sudan" *J. Applied Ecol.*, 26:663-672. 1989.

Carrow, R. N. "Influence of Soil Compaction on Three Turfgrass Species" *Agronomy J.*, 72:1038-1042. 1980.

Castillo, Evangeline T. "Testing for the effectiveness of alxosorb in promoting growth and survival of forest tree seedlings under Pinatubo volcanic ash media" Internal study, Grassland and Degraded Areas Ecosystems Research Division Ecosystems Research and Development Bureau College, Laguna, Philippines. 1991.

Castle, Laurence, Maria-Jesus Campos and John Gilbert. "Determination of Acrylamide Monomer in Hydroponically Grown Tomato Fruits by Capillary Gas Chromatography-Mass Spectrometry" *J. Sci. Food Agric.*, 54:549-555. 1991.

Conover, Charles A. and Richard T. Poole. "Influence of pH on Activity of Viterra® 2 and Effects on Growth and Shelf Life of Maranta and Pilea" *Proc. Fla. State Horta. Soc.*, 92:332-333. 1979.

Costigan, P. A. and S. J. Locascio. "Fertilizer Additives within or around the Gel for Fluid-drilled Cabbage and Lettuce" *HortScience*, 17(5):746-748. 1982.

Csiznszky, C. C., C. D. Stanley and G. A. Clark. "Polyacrylamide Gel as a Soil Amendment for Mulched, Microirrigated Bell-Pepper, *Capsicum Annuum L.*, cv. Bell Captain" *Proc. Fla. State Horta. Soc.*, 104:234-237. 1991.

Davies, F. T., Jr., Y. Castro-Jimenez and S. A. Duray. "Mycorrhizae, Soil

Amendments, Water Relations and Growth of *Rosa multiflora* under Reduced Irrigation Regimes" *Scientia Hortae*, 33:261-267. 1987.

Dexter, S. T. and Takao Miyamoto. "Acceleration of Water Uptake and Germination of Sugarbeet Seedballs by Surface Coatings of Hydrophilic Colloids" *Agron. J.*, 51:388-389. 1959.

Duhlin, Ronald Myles. "Kentucky Bluegrass and tall fescue grown in soil amended with cross-linked polyacrylamide polymer" Masters thesis, Colo. State Univ. 1992.

El-Hady, O. A., M. Y. Tayel and A. A. Lofty. "Super Gel as a Soil Conditioner II - Its Effect on Plant Growth, Enzymes Activity, Water Use Efficiency and Nutrient Uptake" *Acta Hortae*, 119:257-265. 1981.

Elliott, George C. "Imbibition of Water by Rockwool-Peat Container Media Amended with Hydrophilic Gel or Wetting Agent" *J. Amer. Soc. Hortae Sci.*, 117(5):757-761. 1992.

El-Morsy, E. A., M. Malik and J. Letey. "Polymer Effects on the Hydraulic Conductivity of Saline and Sodic Soil Conditions" *Soil Science*, 151(6): 430-435. 1991.

El Sayed, Hameda, R. C. Kirkwood and N. B. Graham. "The Effects of a Hydrogel Polymer on the Growth of Certain Horticultural Crops under Saline Conditions" *J. Exper. Bot.*, 42(240):891-899. 1991.

Fanta, George F., Robert C. Burr, W. M. Doane and C. R. Russell. "Graft Copolymers by Simultaneous ⁶⁰Co-Irradiation of Starch, Acrylamide, and N,N,N-Trimethylaminoethyl Methacrylate Methyl Sulfate" *J. Appl. Polym. Sci.*, 18:2205-2209. 1974.

Fanta, G. F., R. C. Burr and W. M. Doane. "Graft Polymerization of Acrylonitrile and Methyl Acrylate onto Hemicellulose" *J. Appl. Polym. Sci.*, 27:4239-4250. 1982.

Ferrazza, Joseph. "Grower evaluates soil amendment" *Florists' Review*, 155(4019):27, 69-70. 1974.

Finch-Savage, W. E. and C. J. Cox. "Effects of Adding Plant Nutrients to the Gel Carrier Used for Fluid Drilling Germinating Lettuce and Onion Seeds" *Ann. Appl. Biol.*, 102:213-217. 1983.

Flannery, R. L. and W. J. Busscher. "Use of a Synthetic Polymer in Potting Soils to Improve Water Holding Capacity" *Commun. Soil Sci. Plant Anal.*, 13(2):103-111. 1982.

Fonteno, W. C., D. K. Cassel and R. A. Larson. "Physical Properties of Three Container Media and their Effect on Poinsettia Growth" *J. Amer. Soc. Hortae Sci.*,

106(6):736-741. 1981.

Fonteno, William C. and Paul V. Nelson. "Physical Properties of and Plant Responses to Rockwool-amended Media" *J. Amer. Soc. Horta. Sci.*, 115(3):375-381. 1990.

Fonteno, W. C. and T. E. Bilderback. "Impact of Hydrogel on Physical Properties of Coarse-structured Horticultural Substrates" *J. Amer. Soc. Horta. Sci.*, 118(2):217-222. 1993.

Foster, William J. and Gary J. Keever. "Water Absorption of Hydrophilic Polymers (Hydrogels) Reduced by Media Amendments" *J. Environ. Horta.*, 8(3):113-114. 1990.

Frazier, Diamantina C., Steven C. Wiest and Richard D. Wootton. "Storage of Pregerminated Seed of Snapdragon (*Antirrhinum Majus* L.) in Hydrophilic Gels" *J. Amer. Soc. Horta. Sci.*, 107(4):660-664. 1982.

Fry, Jack D. and Jack D. Butler. "Water Management during Tall Fescue Establishment" *HortScience*, 24(1):79-81. 1989.

Furuta, Tok and Richard Autio. "Hydrophilic polymers in potting soil mix" *Calif. Agric.*, page 19. May-June 1988.

Gehring, J. M. and A. J. Lewis, III. "Effect of Hydrogel on Wilting and Moisture Stress of Bedding Plants" *J. Amer. Soc. Horta. Sci.*, 105(4):511-513. 1980.

Goheen, S. M. and R. P. Wool. "Degradation of Polyethylene-Starch Blends in Soil" *J. Appl. Polym. Sci.*, 42:2691-2701. 1991.

Graham, N. B., N. E. Nwachuku and D. J. Walsh. "Interaction of poly (ethylene oxide) with solvents: 1. Preparation and swelling of a crosslinked poly (ethylene oxide) hydrogel" *Polymer*, 23:1345-1349. 1982.

Hadas, A. and D. Russo. "Water Uptake by Seeds as Affected by Water Stress, Capillary Conductivity, and Seed-Soil Water Contact. I. Experimental Study" *Agron. J.*, 66:643-647. 1974.

Hadas, A. and D. Russo. "Water Uptake by Seeds as Affected by Water Stress, Capillary Conductivity, and Seed-Soil Water Contact. II. Analysis of Experimental Data" *Agron. J.*, 66:647-652. 1974.

Hanan, Joe J. "Bulk Density, Porosity, Percolation and Salinity Control in Shallow, Freely Draining, Potting Soils" *J. Amer. Soc. Horta. Sci.*, 106(6):742-746. 1981.

Henderson, Janet C. and David L. Hensley. "Ammonium and Nitrate Retention by a Hydrophilic Gel" *HortScience*, 20(4):667-668. 1985.

- Henderson, Janet C. and David L. Hensley. "Efficacy of a Hydrophilic Gel as a Transplant Aid" *HortScience*, 21(4):991-992. 1986.
- Henderson, Janet C. and David L. Hensley. "Effect of a Hydrophilic Gel on Seed Germination of Three Tree Species" *HortScience*, 22(3):450-452. 1987.
- Henderson, Janet C. and F. T. Davies, Jr. "Effect of a Hydrophilic Gel on Water Relations, Growth and Nutrition of Landscape Roses" *HortScience*, 22(5):1114. 1987.
- Henderson, Janet C. and David L. Hensley. "Do hydrophilic gels improve germination and survival?" *Amer. Nurseryman*, 166(4):189-190, 192, 194. 1987.
- Henderson-Cole, Janet C. and David L. Hensley. "Influence of Field-grow Fabric Containers and Various Soil Amendments on the Growth of Green Ash" *J. Environ. Horta.*, 10(4):218-221. 1992.
- Hoagland, D. R. and D. I. Arnon. "The Water-Culture Method for Growing Plants Without Soil" *Calif. Agric. Exp. Sta. Circ. No. 347*, Univ. Calif., Berkeley, Calif. December, 1938.
- Ingram, Dewayne L. and Will Burbage. "Effects of Irrigation Regime, Antitranspirants, and a Water Absorbing Polymer on the Survival and Establishment of Transplanted Live Oaks" *Proc. Fla. State Horta. Soc.*, 98:85-87. 1985.
- Ingram, Dewayne L. and Thomas H. Yeager. "Effects of Irrigation Frequency and A Water-Absorbing Polymer Amendment on Ligustrum Growth and Moisture Retention by a Container Medium" *J. Environ. Horta.*, 5(1):19-21. 1987.
- James, E. A. and D. Richards. "The Influence of Iron Source on the Water-Holding Properties of Potting Media Amended with Water-Absorbing Polymers" *Scientia Horta.*, 28:201-208. 1986.
- Johnson, Michael S. "Effect of Soluble Salts on Water Absorption by Gel-forming Soil Conditioners" *J. Sci. Food Agric.*, 35:1063-1066. 1984.
- Johnson, Michael S. "The Effects of Gel-forming Polyacrylamides on Moisture Storage in Sandy Soils" *J. Sci. Food Agric.*, 35:1196-1200. 1984.
- Johnson, Michael S. and Cornelis J. Veltkamp. "Structure and Functioning of Water-storing Agricultural Polyacrylamides" *J. Sci. Food Agric.*, 36:789-793. 1985.
- Johnson, Michael S. and Richard T. Leah. "Effects of Superabsorbent Polyacrylamides on Efficiency of Water Use by Crop Seedlings" *J. Sci. Food Agric.*, 52:431-434. 1990.
- Karlovich, P. T. and W. C. Fonteno. "Effect of Soil Moisture and Soil Water

- Content on the Growth of Chrysanthemum in 3 Container Media" J. Amer. Soc. Horta. Sci., 111(2):191-195. 1986.
- Keever, G. J., G. S. Cobb, J. C. Stephenson and W. J. Foster. "Effect of Hydrophilic Polymer Amendment on Growth of Container Grown Landscape Plants" J. Environ. Horta., 7(2):52-56. 1989.
- Kopec, David M. "Understanding Turfgrass Water Use" Golf Course Management, pp. 14-24. June, 1992.
- Lamont, G. P. and M. A. O'Connell. "Shelf-life of Bedding Plants as Influenced by Potting Media and Hydrogels" Scientia Horta., 31:141-149. 1987.
- Letey, J., W. C. Morgan, S. J. Richards, and N. Valoras. "Physical Soil Amendments, Soil Compaction, Irrigation and Wetting Agents in Turfgrass Management III. Effects on Oxygen Diffusion Rate and Root Growth" Agron. J., 58:531-535. 1966.
- Letey, John, Pete R. Clark and Christopher Amrhein. "Water-sorbing polymers do not conserve water" Calif. Agric., pp. 9-10. May-June, 1992.
- MacPhail, J. M., J. L. Eggens, P. M. Harney and M. J. Tsujita. "Effect of Viterra 2 Hydrogel on Germination and Sod Establishment of Kentucky Bluegrass" Can. J. Plant Sci., 60:665-668. 1980.
- Magalhaes, G. E. Wilcox, F. C. Rodrigues, F. L. I. M. Silva and A. N. Ferreira Rocha. "Plant Growth and Nutrient Uptake in Hydrophilic Gel Treated Soil" Comm. Soil Sci. Plant Anal., 18(12):1469-1478. 1987.
- McGrady, John J. and Donald J. Cotter. "Preplant Seed Treatment Effects on Growth and Yield of Chile Pepper" HortScience, 22(3):435-437. 1987.
- McGuire, E., R. N. Carrow and J. Troll. "Chemical Soil Conditioner Effects on Sand Soils and Turfgrass Growth" Agron. J., 70:317-321. 1978.
- Milks, Robert R., William C. Fonteno and Roy A. Larson. "Hydrology of Horticultural Substrates: I. Mathematical Models for Moisture Characteristics of Horticultural Container Media" J. Amer. Soc. Horta. Sci., 114(1):48-52. 1989.
- Milks, Robert R., William C. Fonteno and Roy A. Larson. "Hydrology of Horticultural Substrates: II. Predicting Physical Properties of Media in Containers" J. Amer. Soc. Horta. Sci., 114(1):53-56. 1989.
- Milks, Robert R., William C. Fonteno and Roy A. Larson. "Hydrology of Horticultural Substrates: III. Predicting Air and Water Content of Limited-volume Plug Cells" J. Amer. Soc. Horta. Sci., 114(1):57-61. 1989.
- Miller, D. E. "Effect of H-SPAN on Water Retained by Soils After Irrigation" Soil Sci. Soc. Amer. J., 43:628-629. 1979.

- Mogensen, V. Overgaard. "Drought Sensitivity at Various Stages of Barley in Relation to Relative Evapotranspiration and Water Stress" *Agronomy J.*, 72:1033-1038. 1980.
- Morgan, W. C., J. Letey, S. J. Richards and N. Valoras. "Physical Soil Amendments, Soil Compaction, Irrigation and Wetting Agents in Turfgrass Management I. Effects on Compatibility, Water Infiltration Rates, Evapotranspiration, and Number of Irrigations" *Agron. J.*, 58:525-528. 1966.
- Mortvedt, J. J., R. L. Mikkelsen and A. D. Behel, Jr. "Grain Sorghum Response to Granular Formulations of Iron Sources and Hydrophilic Polymers" *J. Plant Nutr.*, 15(10):1913-1926. 1992.
- Mortvedt, J. J., R. L. Mikkelsen and J. J. Kelsoe. "Crop Response to Ferrous Sulfate in Banded Gels of Hydrophilic Polymers" *Soil Sci. Soc. Amer. J.*, 56:1319-1324. 1992.
- Nus, Jeff. "Water-Absorbing Polymers" *Golf Course Management*, pp. 26-40. June 1992.
- Odell, G. B. "Stand Establishment of Direct-seeded Tomatoes under Heat Stress" *Acta Hort.*, 198:23-30. 1987.
- Oosterhuis, D. M., F. Le Maire and C. Le Maire. "Leaf Water Potential and Crop Color Change in Water-stressed Plants" *HortScience*, 22(3):429-431. 1987.
- Pill, W. G. and D. M. Watts. "Nutrient-fortified Gel as a Growth Medium for Tomato Seedlings" *HortScience*, 18(6):909-911. 1983.
- Pill, W.G. and W.J. Fieldhouse. "Emergence of pregerminated tomato seed stored in gels up to twenty days at low temperatures" *J. Amer. Soc. Horta. Sci.* 107:722-725. 1982.
- Pill, Wallace G. and Colette C. Jacono. "Effect of Hydrogel Incorporation in Peat-Lite on Tomato Growth and Water Relations" *Comm. Soil Sci. Plant Anal.*, 15(7):799-810. 1984. Pill, Wallace G. and Mark Stubbolo. "Tomato Seedling Growth in Peat and Peat-Lite Blocks Amended with Hydrophilic Polymer" *Comm. Soil Sci. Plant Anal.*, 17(1):45-61. 1986.
- Pill, Wallace. "Granular Gels as Growth Media for Tomato Seedlings" *HortScience*, 23(6):998-1000. 1988.
- Roule, David A. "The Complexities of Water Management" *Golf Course Management*, pp. 8-10. June, 1992.
- Sabota, Cathy, Caula Beyl and Jo Ann Biedermann. "Acceleration of Sweet Corn Germination at Low Temperatures with Terra-Sorb or Water Presoaks" *HortScience*, 22(3):431-434. 1987.

Schultheis, Jonathan Richard. "Comparison of planting methods and their effects on stand establishment and yield in bell peppers" Univ. of Fla. Masters Thesis. 1985.

Shea, Kenneth J., Yoshio Okahata and T. Kirk Dougherty. "Fluorescence Probes in Polymer Chemistry. Application of 5-(Dimethylamino)-1-naphthalenesulfonamides to the Study of Solvation of Styrene-Divinylbenzene Copolymers" *Macromolecules*, 17:296-300. 1984.

Sparks, Darrell. "Drought Stress Induces Fruit Abortion in Pecan" *HortScience*, 24(1):78-79. 1989.

Still, Steven M. "Growth of 'Sunny Mandalay' Chrysanthemums in Hardwood-Bark-Amended Media as Affected by Insolubilized Poly (ethylene Oxide)" *HortScience*, 11(5):483-484. 1976.

Swietlik, Dariusz. "Effect of Soil Amendment with Viterra Hydrogel on Establishment of Newly-planted Grapefruit Trees CV Ruby Red" *Commun. Soil Sci. Plant Anal.*, 20(15&16):1697-1705. 1989.

Tayel, M. Y. and O. A. El-Hady. "Super Gel as a Soil Conditioner" *Acta Hort.*, 119:247-256. 1981.

Taylor, K. C. and R. Gordon Halfacre. "Hydrophilic Polymer Effect on Nutrient and Water Availability to *Ligustrum lucidum* 'compactum' Grown in Pinebark Medium" *HortScience*, 18(4):603. 1983.

Taylor, K. C. and R. G. Halfacre. "The Effect of Hydrophilic Polymer on Media Water Retention and Nutrient Availability to *Ligustrum lucidum*" *HortScience*, 21(5):1159-1161. 1986.

Taylor, N. W., G. F. Fanta, W. M. Doane and C. R. Russell. "Swelling and Rheology of Saponified Starch-g-Polyacrylonitrile Copolymers. Effect of Starch Granule Pretreatment and Grafted Chain Length" *J. Appl. Polym. Sci.*, 22:1343-1357. 1978.

Teng, Whei-Lan and Yann-Jiun Liu. "Restricting Hyperhydricity of Lettuce Using Screen Raft and Water Absorbent Resin" *Plant Cell, Tissue and Organ Culture*, 34:311-314. 1993.

Thurman, P. C. and F. A. Pokorny. "The Relationship of Several Amended Soils and Compaction Rates on Vegetative Growth, Root Development and Cold Resistance of 'Tifgreen' Bermudagrass" *J. Amer. Soc. Horta. Sci.*, 94:463-465. 1969.

Tilt, Kenneth M., T. E. Bilderback and W. C. Fonteno. "Particle Size and Container Size Effects on Growth of Three Ornamental Species" *J. Amer. Soc. Horta. Sci.*, 112(6):981-984. 1987.

- Tripepi, R. R., M. W. George, R. K. Dumroese and D. L. Wenny. "Birch Seedling Response to Irrigation Frequency and a Hydrophilic Polymer Amendment in a Container Medium" *J. Environ. Horta.*, 9(3):119-123. 1991.
- Tu, Z. P., A. M. Armitage and H. M. Vines. "Influence of an Antitranspirant and a Hydrogel on Net Photosynthesis and Water Loss on *Cineraria* during Water Stress" *HortScience*, 20(3):386-388. 1985.
- Valoras, N., W. C. Morgan and J. Letey. "Physical Soil Amendments, Soil Compaction, Irrigation, and Wetting Agents in Turfgrass Management II. Effects on Top Growth, Salinity, and Minerals in the Tissue" *Agron. J.*, 58:528-531. 1966.
- Wang, Yin-Tung and Carol A. Boogher. "Effect of a Medium-Incorporated Hydrogel on Plant Growth and Water Use of Two Foliage Species" *J. Environ. Horta.*, 5(3):125-127. 1987.
- Wang, Yin-Tung. "Medium and Hydrogel Affect Production and Wilting of Tropical Ornamental Plants" *HortScience*, 24(6):941-944. 1989.
- Wang, Yin-Tung and Lori L. Gregg. "Hydrophilic Polymers - Their Response to Soil Amendments and Effect on Properties of a Soilless Potting Mix" *J. Amer. Soc. Horta. Sci.*, 115(6):943-948. 1990.
- Whie-Lau, Teng & Yann-Jiun Liu. "Restricting hyperhydricity of lettuce using screen raft and water absorbent resin" *Plant Cell, Tissue and Organ Culture* 34: 311-314, 1993.
- Woodhouse, J. M. and M. S. Johnson. "The Effect of Gel-forming Polymers on Seed Germination and Establishment" *J. Arid Environ.*, 20:375-380. 1991.
- Woodhouse, J. M. and M. S. Johnson. "Water Storing Soil Polymers and the Growth of Trees". *Arboricultural Journal* 15 (1) :27-35.

C - General Specification for Horta-Sorb®

Horta-Sorb®

Water Management Gel

Product Description

A water management gel used to absorb water and fertilizers and manage the resulting liquid in the root zone of plants.

Product Specification

Name:	Horta-Sorb® LG Horta-Sorb® MD Horta-Sorb® SM
Chemical Description:	Cross linked polyacrylamide copolymer not made by Stockhausen in Germany
Particle Size:	Horta-Sorb™ LG - 2.0 mm. to 4.0 mm. Horta-Sorb™ MD - 1.0 mm. to 2.0 mm. Horta-Sorb™ SM - 0.2 mm to 0.8 mm.
Percent Soluble:*	Less than 5%
Effective Life:	5 years minimum
Absorption Capacity:*	330 - 400 times in distilled water.
Fade Resistance:*	Hard crystals, firm to touch with no more than very slight softness.

* Test procedures for alternative products available from specifier.

Application

Trees & Shrubs

Horta-Sorb™ LG - Mix product with backfill in the top first 8-10 inches of planting hole for larger plants, and 4-6 inches for smaller plants, making sure that it is in contact with the root ball and not at the bottom of the planting hole using the following dosage rates:

Size	Amount	Size	Amount	Size	Amount
4" Container	½ tsp	1" Caliper	1 oz.	24" Box	3 oz.
1 Gallon	1 TBS	2" Caliper	2 oz.	30" Box	6 oz.
2 Gallon	2 TBS	3" Caliper	3 oz.	42" Box	9 oz.
3 Gallon	3 TBS	4" Caliper	6 oz.	48" Box	12 oz.
5 Gallon	1 oz.	6" Caliper	9 oz.	72" Box	18 oz.
7 Gallon	1 ½ oz.	8" Caliper	15 oz.	24" Spade	2 oz.
10 Gallon	2 oz.	2' Height	2 TBS	30" Spade	3 oz.
15 Gallon	3 oz.	3' Height	1 oz.	52" Spade	6 oz.
20 Gallon	4 oz.	6' Height	3 oz.	66" Spade	9 oz.
30 Gallon	6 oz.	8' Height	6 oz.	80" Spade	12 oz.
50 Gallon	9 oz.	12' Height	9 oz.		
100 Gallon	15 oz.				
200 Gallon	24 oz.				

Flower Beds

Broadcast Horta-Sorb® MD at the rate of 1 lb. per 100 sq. ft. and work into the ground 3-4 inches.

Turf

Soil Amendment: Broadcast Horta-Sorb® MD at the rate of 3 lbs. per 1,000 sq. ft. With sprigging and seeding, work into the first 1" of soil with a till or by chain drag dressing at this rate for every 2 inches of soil depth, i.e., you could apply 3X the normal rate so long as the 9 lbs. per 1,000 sq. ft. was incorporated in six inches. With sod, simply lay sod on top of treated area without the need for tilling at the 3 lb. per 1,000 sq. ft. rate.

Bare Root Treatment

Bare root treatment: Dipping Roots - Mix Horta-Sorb® SM at the rate of 1 lb. per 30 to 35 gallons of water to form a root dip*

the consistency of a heavy gravy. Adjust application rate to achieve this consistency.

Hydroseeding/Hydromulching

Add Horta-Sorb® SM at the rate of 10 – 50 lbs. per acre depending on severity of conditions and budget considerations. Add Horta-Sorb® SM to the tank before adding fertilizer, mulch and seed.

Execution

Use in accordance with approved submittal for each type of planting required in strict accordance with supplier's instructions and recommendations.

Manufacturer's Service

At the request of specifier provide the services of a qualified technical representative to instruct the user in proper mixing and handling of the product.

Verification of Use

At the request of the specifier excavation of random plots of up to 1% of planted materials. Alternative procedures if product has not been used shall be required by specifier after consultation with manufacturer.