

Raybo's (Leak-proof) InnTainer™

18 (or 14) Gallon Self-Watering Container Construction, Planting, and Maintenance Guide

Revision 1.2

Note: Added option for a smaller and lighter weight 14 gallon version

February 14, 2012

INTRODUCTION: This Construction Guide describes the construction steps and materials list for an indoor, leakproof self watering container system based on an 18 (or 14) gallon Rubbermaid tote. The design incorporates an easy to view external water level indicator, which shows the actual water amount residing in the water reservoir in real time.

Chapter One - Constructing The InnTainer Grow System

Chapter Two - Filling The InnTainer, Fertilizer, And Planting

Appendix: Parts List And Tools

Suggested Additives, Fungal, and Pest Control Products For Use In The InnTainer

“Tweaks” For The Experts

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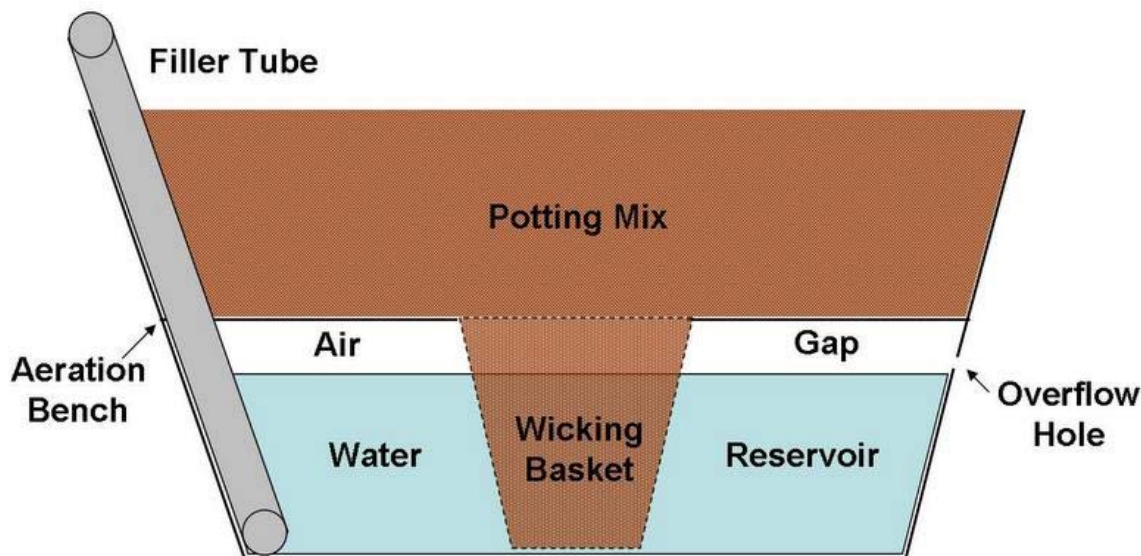
Please visit www.EarthTainer.org from time to time, and follow the progress of InnTainer growing and news events throughout the Season.

Overview

The basic principle of the InnTainer™ dates back thousands of years when the Egyptians and others of that era employed “wicking” properties to craft oil lamps, and other moisture absorbing materials. This Law of Nature (capillary action) enables moisture to “defy the Laws of Gravity” and actually flow upward in a porous medium.

In the InnTainer, a centralized wicking basket provides the “charge pump” to disperse water evenly throughout the Grow Media chamber. A 4 gallon water reservoir coupled with a 2.2 cubic-foot Grow Media capacity provides ample room to grow the largest varieties of tomatoes and other vegetables.

The indoor InnTainer is based on the design principles of its “parent” EarthTainer:



There are numerous advantages to InnTainer gardening. Most important today is the water conservation properties of a 100% self-contained eco-system. Virtually no water is wasted growing weeds, or loss from water run-off. In a time of Worldwide drought, savings of up to 75% in water use reduction is significant, as compared with traditional in-ground gardening. The InnTainer also provides Winter gardeners the opportunity to now take advantage of both sunlit indoor locations as well as supplemental lighting to grow their own, quality organic vegetables, all year long.

As the soil in the InnTainer typically warms up to planting temperature earlier than in-ground beds, the “early-bird” gardener can get ripe tomatoes much sooner in the season.

InnTainer construction requires simple power and hand tools. It also requires a moderate degree of hand/arm strength. Only attempt to build an InnTainer if you have experienced skills with power and hand tools. If you are not totally comfortable handling power tools and cutting devices, please do not attempt construction of the InnTainer.

Cost of components for the completed 18 gallon InnTainer is approximately \$23.00 (when building multiple units at a time).

Chapter One - Constructing the InnTainer

With the goal of using commonly available components to fabricate the InnTainer™, as well as having a stable finished unit that will remain upright even under windy conditions, the Rubbermaid brand Roughneck Tote 18 gallon container was selected. It is widely available from Home Depot, as well as most full service Hardware stores. Fully loaded with water and Grow Media, the InnTainer weighs approximately 60 pounds.

The InnTainer is constructed from two 18 gallon Rubbermaid containers, one of which will be cut down to become two components - the bench support, and the upper “Aeration Bench” - both of which are inserted into the base container.

Note: The InnTainer may also be fabricated from two 14 gallon Rubbermaid Roughneck containers if growing smaller, dwarf type plants. All drill and cut dimensions remain the same, with the exception of the Filler Tube, which should be cut to a 16 inch length.



The second key component used is an Aquatic Plant Basket to serve as the “wicking basket”. The one selected is available from aquarium stores and Hydroponics Shops (where it is called a 5 inch “Net Pot”). The InnTainer uses a 5” diameter by 4” high basket. As they are thin-walled, be careful when handling and do not crush them down, as the thin plastic will break. (The support assembly will be described later). Do not use anything larger as the InnTainer would run too moist, and over-water the plants. Note: If necessary, you can substitute an equivalent size Deli container, but drill numerous small holes in it to permit water to enter.



Step 1: Cut a section of 1-1/4” Inside Diameter Schedule 40 PVC pipe to a length of 20” for the filler tube.

Note: As an option, you can substitute 1-1/2” I.D. Schedule 40 PVC pipe to better accommodate the Watering Can spout when filling, which will minimize random water being spilled on the floor, carpet, etc. Use a 2” hole saw for this size filler tube.



Approximately 1” up from the bottom, drill two 3/8” diameter holes through both sides of the pipe. Move up another inch and repeat drilling another 2 holes.

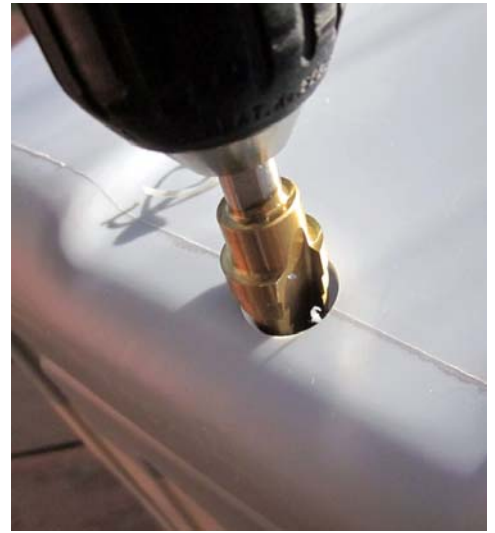


Set this tube aside for later installation.

Step 2: On the base container (#1), place an indicator mark centered below one of the handles approximately one inch up from the bottom of the container on the seam, as shown:



Step 3: Using a precision $\frac{3}{4}$ inch drill bit, CAREFULLY drill through the wall of the container. It is extremely important for the hole to be uniform in shape, as if the result is a ragged hole, the container will possibly leak.



This type of $\frac{3}{4}$ inch drill bit is highly recommended:

Alternatively, a precision $\frac{3}{4}$ inch wood auger bit may also be used, at very low speed.

Do not use a crude wood boring bit nor even a regular metal drill-bit, as this will likely result in drilling a non-uniform hole.



This is what the finished $\frac{3}{4}$ inch hole should look like:

For even greater precision, a $\frac{3}{4}$ inch metal hole punch can be used.

Note: With your finger, remove any remaining burrs around the edges of the hole, both inside as well as outside the container.

Hint: if you do mess up drilling a uniform hole on the first try, you can now use this container as container #2 for the bench support and the Aeration unit.



Step : Lightly moisten the narrow end of the $\frac{1}{2}$ inch (I.D.) rubber grommet. (Do not use a lubricant which will interact with rubber compounds.) Saliva works just fine! SLOWLY and with steady pressure, work the grommet completely into the $\frac{3}{4}$ inch opening.

On the inside of the container, use your finger to pull the grommet edge to fully “seat” the rim. Feel around the entire edge to assure a uniform fit. This is very important to prevent any leakage when the water reservoir is filled.



Step 4: Cut a 10 inch section of 5/8 inch O.D; 1/2 inch I.D. clear tubing, and affix it on one end of the nylon elbow as shown. Make sure it is fully engaged over all of the barbs.

Note: Use only the nylon 1/2 inch barb elbow. The commonly available 1/2 inch black plastic elbows are too long and will not seal properly within the grommet.



Step 5: Very gently, begin to work the other end of the nylon barb into the grommet. A slow, gentle rocking motion is most effective. If you push too hard, you will unseat the grommet to the inside of the container - - and will have to start the grommet process all over again. Slow and steady rocking approach gets the job done (You Ladies *know* what I'm talking about!).



When all barbs of the nylon elbow are seated within the grommet, you are done. Stop pushing.



The nylon elbow should protrude approximately 1/4 inch beyond the inner grommet edge:



Step 6: With the container laying on a flat surface, measure up 4-1/4 inches and place a mark.



Step 7: Cut a thin section of the red banner from the Roughneck label and affix it at the mark, around the level indicator tube.

Note: To periodically (recommend 3 months) drain the water reservoir, slowly rotate the filler tube assembly to the left or right horizontal position, in small increments. This will permit drainage of most of the water. You can then tilt the InnTainer up slightly at the other end to remove even more residual water.

We are now done with container #1 for the moment, set it aside.

Step 8: Turn container #2 upside down on a flat surface. Using a piece of duct tape, affix a Sharpie marker to the bottom of an inverted Net Pot as shown. Make sure the marker is set to scribe the line adjacent to the ridge on the container.



Move the wicking basket alongside the container, and with the marker draw a horizontal scribe line around the outside perimeter of the container. This will create a mark approximately 4-1/2" up from the bottom of the container. It is much easier to rotate the container around the pen to do this.



Step 9: Drill a 3/8 inch pilot hole anywhere on the line, as the entry hole for the jigsaw (or hand shears).



Step 10: Using a power jig-saw, begin cutting along the scribe line, completely around the circumference of the container, just below the ridge. Make the cut keeping the "feet" on the 4-1/2" support piece. (Be EXTREMELY cautious with this step, always alert as to where your hands and legs are. Also, always wear glasses or safety goggles to protect your eyes).



If you do not have a power jig-saw, you can use a sturdy pair of kitchen scissors to manually cut the container along the scribe mark (this will require good hand strength).



Step 11: Take the cut-off 4-1/2 inch piece and invert on a level surface. Use a de-burring tool (or sandpaper) to remove any hanging fragments, etc.



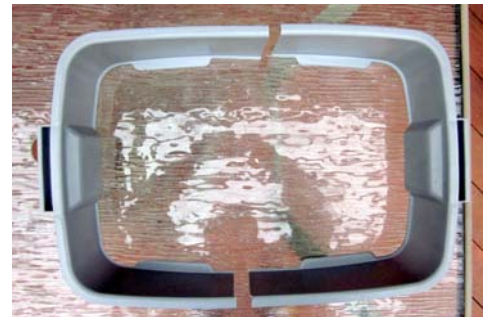
Step 12: Notice the “ribs” spaced uniformly on the underside of the lip rim. Locate the rib at the center of the long side. Measure one inch to the left and scribe a mark.

Rotate the piece and make a mark and line at the same measurement (1 inch to the left of the center rib also).



Step 13: At the two scribed lines, make cuts with kitchen shears.

You will then have two identical sections, both with one “leg” longer than the other by 2 inches.



Step 14: Arrange the two sections interleaved with each other as shown here with the shorter sections to the inside, and the longer sections wrapping around the outside.

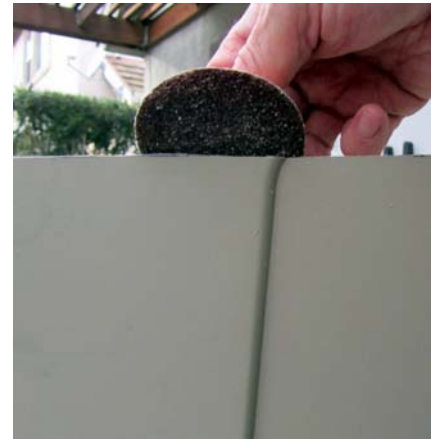


Step 15: In order for the top lid to fit securely, we need to next remove a 1-3/8 inch section from the top of Aeration Bench (container #2). Invert the Aeration bench on a flat surface and scribe a 1-3/8 inch line around all sides of the unit. Hint: as with the wicking basket scribe, it is easier to use a 1-1/4 inch “spacer” to rest the Sharpie pen on. Then rotate the Aeration Bench against the stationary pen. Drill a single pilot hole on this line for cutting in the next Step.



Step 16: Lock the Aeration Bench in a Work-Mate or firmly secure the edge, then with a jig-saw (or hand saw) cut off this 1-3/8 inch section.

Alternatively, tin snips or kitchen shears may be used to make the cut. Hand sand the burrs off and level any protrusions with a sanding disk.



Step 17: Draw a circle 3 inches in diameter in the center of the inverted Aeration Bench (container #2). Also, draw a 1-3/4 inch circle at one of the corners to mark the location of the filler tube hole.

Next, using a yardstick or folding ruler, place marks with a Sharpie pen every 1 inch apart as shown.

TIP: You can use a piece of Pegboard as a template to either mark, or drill the holes directly through the Pegboard's holes. Cut the Pegboard slightly larger than the Aeration Bench surface, then use short pieces of duct tape on 2 ends to hold it temporarily in place.



Step 18: Using a hole saw, drill out the 3 inch section. Alternatively, a jig-saw or kitchen shears can be used. Use a 1-3/4 inch hole saw to drill out an opening for the Filler Tube in the lower corner in the Aeration Bench. Remember, the Aeration Bench is inverted so when installed, the Filler Hole will be on the lower left side of the InnTainer in this example. You can elect in which corner you want to drill the hole. Next, using a 1/4 inch drill-bit, drill the aeration holes as shown.

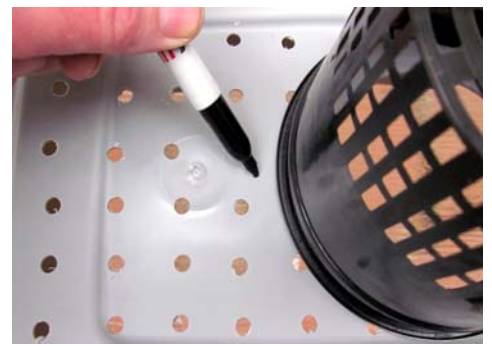


Note: To speed the process, you can “pancake” 2 or 3 units together, reducing marking and drilling time.

When drilling has been completed, separate the Aeration Benches.



Step 19: Using a 5/32 inch drill-bit, drill a hole approximately ½ inch down from the lip of the pond basket. Rotate the basket and repeat on the opposite side.



On the inverted Aeration Bench, center the basket over the opening with the 2 holes in the 9:00 o'clock and 3:00 o'clock position. Place a mark ½ inch outside these two holes.

Drill 5/32 inch holes in the Aeration Bench for the basket attachment.

Insert a zip tie in each of the 2 holes as shown, with the flat surface of the zip ties facing upward.



Next, invert the Aeration Bench on a flat surface and feed the ends of the 2 zip ties through the center opening.



Reaching inside the Aeration Bench, then feed the zip ties up through the 2 attachment holes in the Aeration Bench and ratchet them loosely.



Pull the zip ties tight so the wicking basket is secured over the center of the opening. Cut off excess.



Step 20: Insert the Filler Tube into the base container, aligned with the hole in the Aeration Bench.



Turn Aeration Bench upright and place in Container #1, sitting on the bench assembly



Make sure that the lip of the Aeration Bench does not exceed the height at the handle mold as shown:

The cover lid will not snap on properly if the Aeration Bench sticks up above this surface.



Step 21: Make a mark 2 inches under the center rib. Using a ¼ inch drill-bit, drill through both the outer container as well as the Aeration Bench. Be mindful of where your hands are at all times!! Rotate the InnTainer and repeat on the other side. Be sure to remove label on container – now, or later. SLOWLY removing the label works best. If it does not fully come off, use some Windex on the remaining fragments to loosen them up and scrape off.



Step 22: Insert a ¼-20 by half inch machine screw through a 1-1/4 inch fender washer, and secure inside with another fender washer and nut. Rotate InnTainer and repeat on the other side. The gaps between the sidewalls allow for better air circulation in the Aeration Bench, as well as act somewhat like a Thermos Bottle, keeping the root system cooler in the Summer from the Sun's rays on the outside walls.



Congratulations, you have now completed all the steps in building your InnTainer!

Chapter Two - Filling the InnTainer, Fertilizer, and Planting

Container growing varies significantly from traditional in-ground in several areas. First, unlike conventional soil where worms and other insects provide “channels” for natural aeration, the growing media in container gardening requires a loose, porous mix to replicate the aeration process. Therefore, the choice of growing medium is extremely important. More experienced container gardeners blend their own homemade mix. However, there are several choices of ready-made available at your local Nursery and Hydroponics Shop that will provide excellent results. The key is to select Grow Media, and not potting SOIL for container gardening.

I recommend Sunshine #4 Mix, and Premier Pro-Mix BX for optimum wicking and plant vigor. If economy is of prime importance, Miracle-Gro Potting Mix (WITHOUT Moisture Control) can be substituted. Never use Potting “Soil” as this will compress too much, negatively affecting root aeration.



In addition, a phenomenon known as Blossom End Rot which is believed to be caused by a calcium deficiency, or uneven watering can afflict tomato plants grown in containers. The addition of Dolomite Lime (or Agricultural Lime) tends to inhibit BER from developing. (Note: NEVER use Hydrated Lime - - it is too fast acting and can cause damage to the plants).



Preparing your Growing Media. Using a wheelbarrow, or plastic tote bucket, add in 5 scoops of Grow Media, then add in 1 scoop of Perlite. (If using Miracle-Gro Potting Mix, use 2 scoops Perlite.) Use breathing protection when working with Perlite as it is quite dusty and it should not be inhaled. Blend the mix together by stirring with your scoop. Repeat the process when filling successive layers in the InnTainer.



Step 1: Fill the water reservoir half way to the red “full” label on the level indicator tube.

Step 2. Fill the wicking basket with Grow Media at this time. Pack firmly into the basket until water seeps up into the top of the mix. Make a 1” to 1-1/2” high “cupcake” mound of the Grow Media above the wicking basket opening and thoroughly wet. This is VERY important to maintain wicking as the Grow Media settles in the wicking basket over time.

Step 3. Continue adding layers of the Grow Media thoroughly saturated with moisture, then stop when the Grow Media is within 4” from the top.



Step 4: When you have filled the InnTainer to within 5" from the top, sprinkle 2 cups of Dolomite Lime on the surface area. Trowel in thoroughly. Continue to fill with the Mix to the top. Water-in gently at this stage.

Step 5: If planting 2 tomato plants, carve a 3 inch deep trench in the center of the InnTainer, from front to back on the short dimension (use a horizontal center trench if planting 4 Pepper plants). Spread one cup of Tomato fertilizer evenly in the trench. Cover the fertilizer strip and pat down firmly. Use tomato fertilizers that have specially added micro-nutrients optimized for tomatoes. Avoid using fertilizers that have an N-P-K higher than 10-10-10, as they could "burn" the plants.



Liquid water soluble fertilizers such as FoxFarm GrowBig / Big Bloom combination can be added into the Filler Tube instead of using fertilizer strips; or can be added periodically to supplement the granular fertilizer strips, if desired.

Mid-Season application of Botanicare's Clearex (or similar product) will help prevent buildup of nutrient salt deposits in soilless grow media. Clearex is a drench solution, which binds with the excess nutrient salts and leaches it from the grow media. Treat when you see white scale buildup at the overflow hole.



It is very important to keep the plants at a constant moisture level, which is difficult in low humidity, indoor Winter growing conditions. The Rubbermaid lid can be cut as shown to provide some degree of moisture retention within the InnTainer.

You can make cut-outs using the 3-5/8 inch hole saw for the plants to grow through.



Alternatively, you can simply wrap the top surface of the InnTainer with aluminum foil, which has a beneficial side effect of reflecting light on the undersides of the leaves.

For indoor Winter growing, select dwarf type tomato plants such as: Extreme Bush, Demidov, Mano, Mountain Princess, Polish Dwarf, Rozovyi Flamingo, Sophie's Choice, Stakeless, Victorian Dwarf, and other similar varieties.

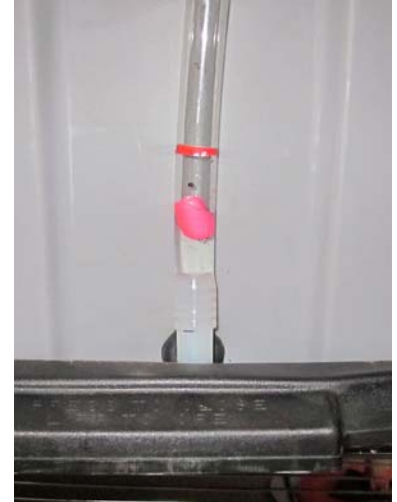


Another tip is to use neon colored 3/8 inch fishing floats in the level indicator tubes.

Alternatively, you can also use 3/8" hollow plastic balls from a Hobby Shop or similar store.



This makes scanning water levels at a distance far easier to see.



So that's all there is to it. After you build the initial one, it will take an average of 45 minutes per InnTainer using the methods described above, from start to finish when constructing three at a time.

Enjoy the fruits of your labor!



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Appendix: Parts List and Tools

2 ea Rubbermaid Roughneck storage totes, 18 gallon **Note: You can use other brand 18 gallon containers, but be sure they are thick walled or you may experience premature container failure.**

1 “PondLife” 5” diameter Aquatic plant basket from an Aquarium store or any Hydroponics store.

See photo at this link for reference description. (Typical pricing at a Hydroponics store is \$1.25):

<http://www.thatpetplace.com/pet/prod/209728/product.web>

2 cable zip ties to hold wicking basket

1-1/4" ID Schedule 40 PVC pipe 20" long.

2 ea 1/4 x 20 by 1/2 inch machine screws and nuts.

4 ea 1/4" hole by 1 1/4" Fender Washers

1 rubber grommet General Hydroponics part number 4165. Available ONLY at Hydroponics Shops.

1 1/2 inch white nylon barbed elbow. Watts part number 457. Do not use the longer black plastic 1/2 inch landscape elbow as it will not seal properly in the grommet.

12 inch section of 5/8 inch O.D; 1/2 inch I.D. clear plastic tube



Tools:

Power drill, 3/8" bit, 1/4" bit, 5/32" bit;

3/4" precision bit; http://www.amazon.com/Neiko-Titanium-Step-Drill-Bit/dp/B000FZ2UOY/ref=sr_1_1?ie=UTF8&qid=1317333297&sr=8-1

Power jigsaw, or pistol-grip hand saw

1-3/4" hole saw, 3" hole saw – Available at Harbor Freight, or on Amazon:

http://www.amazon.com/NeW-Hole-Saw-Kit-saws/dp/B002CSS136/ref=sr_1_3?s=hi&ie=UTF8&qid=1317401164&sr=1-3

Sanding disk, Kitchen shears or Tin Snips

Sharpie Marker, Folding ruler / yardstick



Planting Medium:

1.5 cu ft PottingMix (not SOIL), avoid brands with “Moisture Control” additives.

.3 cubic foot of Perlite

2 cups Dolomite Lime or Agricultural Lime – (Do NOT use any product labeled “Hydrated Lime”)

2 cups tomato fertilizer.

Suggested Additives, Fungal and Pest Control Products for use in the InnTainer

Commercial growers have long been aware of the benefits growing vegetables inoculated with Mycorrhizae. I have found both of these products effective in root development leading to increased yields. At about \$6.00 per packet, it is very cost effective.



I am also very impressed with the results I've had in adding an Organic Fungicide as a soil drench called **Actinovate**. It increased my plant vigor and yield on Snow Peas this Season ('Tainer on the left treated with Actinovate, 'Tainer on the far right without Actinovate).



Serenade is a relatively benign Fungicide which works well to treat Fungal diseases and issues such as Powdery Leaf Mildew.

Also, **Take Down Garden Spray** does a good job of controlling pests such as Psyllids, Mites, Aphids, etc.



Control of indoor pests and insects is essential. An effective “passive” trap works quite well. Available at all Hydroponics Shops.



“Tweaks” For The Experts

While the 5:1 ratio of Grow Media and Perlite works well as a general purpose InnTainer combo mix, you may want to experiment with additional combo mix ingredients for the particular vegetable you are growing. For example, for Heirloom Tomatoes I have added a third ingredient known as “Micro-bark” (called “Groundcover Bark” at Home Depot) to minimize compaction and provide additional aeration for the root system.

Here is an excerpt from an article written by Premier (the folks who make Pro-Mix) regarding aeration:

“The process of aeration is one of the most important factors of productivity. Plants absorb oxygen (O₂) and release carbon dioxide (CO₂) during the respiration process. “Respiring” roots use the sugars made during photosynthesis to provide the energy necessary to drive mineral salt absorption. For most plants, internal transfer of oxygen from the leaves and stems to the roots is too slow to supply enough oxygen to the roots. In order to have good plant growth, the growing media needs to be “aerated”, meaning that air exchange between the growing medium and atmosphere has to provide the plant roots with sufficient oxygen and to remove excess carbon dioxide from the root zone.”””

My Combo Mix Trials have shown improved Tomato plant health and production using a 3:2:1 ratio of Sunshine #4 Mix, Micro-bark (also called “Decorative Groundcover Bark, or Bark Fines), and Perlite.

For the second and subsequent years in re-using the previous Combo Mix (5 year maximum is recommended), modify the one cubic ft. re-charge amount’s ratio to 3 parts Grow Media, **3 parts** Micro-bark, and 1 part Perlite. Micro-bark (unlike Perlite) will decay over the course of the prior growing Season, so modifying the re-charge amounts will equalize out the total second Season ratio back to approximately 3:2:1. Be sure to thoroughly stir in the newly added 3:3:1 Combo Mix into the old Mix.

