

...On Starting Tomato Seeds

From the staff of HGI Worldwide, Inc.

The importance of growing good seedlings can translate into good performance from the plants for the life of the crop. There are many ways to start tomato seedlings. The following suggestions may help you get a good start on your next crop.

When to plant

Most growers in the Northern part of the U.S. will plant their seeds between the 1st & 15th of December. They expect to transplant these seedlings into the greenhouses about the 1st of February. Fruit production should begin during the first part of April. Many growers will run this crop until about Thanksgiving (or the end of November). Some growers choose to grow two crops per year. The Spring crop will be pulled about the 20th of July. The replacement seedlings for the Fall crop are started about the 15th of June and transplanted about July 25th. In either case, the crops are removed during the latter part of November. The greenhouse is then shut down during December and January. This allows time for maintenance, avoids the high cost of heating and allows the grower to “skip over” the shortest day-length time of the year.

Most growers in the Southern part of the U.S. will plant their seeds between the 20th & 25th of July. They expect to transplant these seedlings into their greenhouses about the 1st of September. Fruit production should begin during the first part of November and will continue until the crop is pulled during the first part of June. This allows the grower to “skip over” the extremely hot times of the year.

Before you begin

Make sure you have all of the necessary materials to begin your seedlings. Order your supplies early. Try to have all of the supplies on hand about two weeks before they are needed. We try to anticipate your needs and hope we have everything on hand that you will want to order. However, once in a while, there will be a lost shipment - or a damaged shipment - or one of our suppliers is running behind on a certain item.

Check out your germination equipment. Make sure your benches; propagation mats, timers, pumps, lights, etc. are all in proper working order before you actually need them. Allow time to order replacement parts, if necessary.

Check the germination

Whether you are ordering fresh seed or using leftover seed from your last crop - check the germination. You should place 10 or 20 seeds between two layers of damp paper towel. Place the paper towels in a plastic bag and set this in a warm place in your house. (On top of the refrigerator is a good place.) You should have germination in 3 - 5 days. Count the number of seeds that have germinated (you can see the taproot extending out from the seed). You can then calculate the percentage of germination for this seed lot.

Seed should be stored in a sealed container - in your refrigerator. Seed that is properly stored should remain viable for over a year. The sealed container helps to stabilize the relative humidity around the seeds. Refrigerator temperatures simulate winter conditions, and the seeds will remain dormant. Seed should NEVER be stored in your greenhouse.

Isolate your seedlings

If you want a good, fresh start with this new crop, isolate your seedlings from the older crop. This will help prevent carryover of pests and disease. Most insect pests prefer the tender, new growth of plants. They will be attracted to these new seedlings if they are grown in with your existing crop. Exposing the new seedlings to your old crop is a perfect invitation for all pests to begin infesting the new seedlings. We offer several sizes of small greenhouse buildings that can be used for seedling production. (These buildings can also be used for experimenting with other types of crops - when they aren't being used for seedling production.) If you have someone else start your seedlings - you may be inviting all of the problems from this other greenhouse facility into your own.

We recommend that you start your seeds in Horticultures™ - either the 1" cubes (Part # 5E163 or # 5E164) - or the 1.5" cubes (Part # 5E165). The size of Horticultures™ you choose will depend upon how long you plan to grow the seedlings before transplanting them into the Net Pots. Obviously, the smaller sized Horticultures™ will need to be transplanted sooner than the larger cubes. Horticultures™ are sterile, lightweight and are designed to maintain a high relative humidity and the proper pH level around the seeds as they germinate. The smallest

Horticubes™ we offer, (Part #5E166) are used mainly for lettuce seedling production and are not recommended for starting tomato seedlings.

Horticubes™ fit perfectly into our propagation flats (Part #7W031). We prefer the propagation flats with drain holes. Your propagation area should be designed to handle the drainage from misting and watering your seedlings. However, if it isn't - you may elect to use the propagation flats without drain holes.

Planting your seeds

Place a "dry" sheet of Horticultubes™ into a propagation flat. One of the simplest ways to plant tomato seed is to fold a 3" x 5" card in half (the long way). Hold the card in your hand with the crease of the fold touching the palm of your hand. Allow the card to spread open between your thumb and fingers. Sprinkle some tomato seeds onto the card. Position the crease of the card over the hole in the Horticultube™. Using the sharp point of a pencil, slide ONE seed from the card into the hole. Work your way across the sheet of Horticultubes™, depositing one seed in each hole. Once you have finished the entire sheet of Horticultubes™, go back and make sure you didn't skip over a row of cubes. Set the finished tray to the side and repeat the process until the desired number of seeds has been placed in the Horticultubes™.

Once all trays have been planted, and you have double-checked to make sure all the cubes contain a seed; we recommend that you fill each hole with vermiculite. Sprinkle it into each hole until the hole is filled - don't pack it. Vermiculite is expanded mica. It is sterile and will help to hold moisture around the seed as it germinates. It also provides something for the young seedling to push against as it sends out its taproot. This allows the taproot to penetrate the Horticultube™ and will help the young plant shed it's seed coat as it works it's way up through the vermiculite.

Plant Extra Seeds

Most tomato seeds cost more than the Horticultubes™. Therefore, we think it makes more sense to use extra Horticultubes™, than to plant more than one seed per cube. Most tomato varieties will have a germination percentage of 85% or higher. It is prudent to start 15% - 20% more seeds than you desire in actual plants. This extra amount of seeds will allow you the opportunity to compensate for the germination rate of the tomato variety and to "cull" some seedlings that may not develop as well as you desire. There are "birth defects" in some tomatoes - the same as with any other living creatures. It is much better to have a few extra seedlings, than to have a portion

of your crop that is a few weeks behind the majority of the plants within your greenhouse.

Propagation Mats

Whether you are starting your seeds in a greenhouse, in a germination chamber or in a room in your home, we recommend the use of propagation mats. The ideal temperature for starting tomato seeds is 78° F. Temperatures above this (especially temperatures above 85° F.) can "cook" the seeds and kill them. Cool temperatures (especially temperatures below 72° F.) can delay the germination for several days and can allow time for *Damping Off* fungus, *Rhizoctonia*, or *Pythium* to attack the seeds. A temperature of 78° F. will allow your seeds to germinate in the shortest amount of time. Use a Minimum-Maximum thermometer to insure your temperature settings are correct (Part # 5E145T).

We offer three difference sizes of propagation mats. Most growers will use the largest mat (Part # 5E160) which is 22" x 96". Each large mat will hold up to 8 propagation flats (Part # 7W031). If you are using the 1.5" Horticultubes™, each propagation flat will contain 50 Horticultubes™ - therefore, each propagation mat will hold 400 cubes. If you are using the 1" Horticultubes™, each propagation flat will contain 162 Horticultubes™ - therefore, each propagation mat will hold 1,296 cubes. We have two automatic thermostatic controls for propagation mats (Part # 5E161 for controlling up to 4 propagation mats and # 5E162 for controlling a single mat). Both of these controls have a remote temperature sensor that is placed within one of the propagation flats and automatically regulates the temperature within a 1° F. differential.

Propagation mats should be placed on top of **wooden** benches (metal benches can conduct electricity). If you are using metal benches, place a sheet of plastic under the propagation mats to insulate them from the bench. The mats should be **covered with a layer of plastic** to prevent water from getting to the electrical wiring. Your benches should have a slight slope to allow the drainage of water away from the electrical wiring.

Preparing to water

A tank, such as our Rubbermaid Brute™ 55-gallon tank with lid, should be filled with **room temperature** water adjusted to a pH of 6.5. Use **plain water** - not water that contains a fertilizer solution. There should be enough stored food reserves within the seed to allow the seed to properly germinate. The application of additional fertilizer at this time may actually "burn" the seeds and kill them. Place a Little Giant™ submersible pump with a garden hose attached into the tank. Any of

the Little Giant™ pumps that are rated at 300 GPH or larger should work fine.

You should also have a bucket of **room temperature** water that will be used to mix up Mycostop™. Mycostop™ requires about 30 minutes to completely dissolve. It is best to begin preparing this solution before you actually water the Horticultes™. One gram of Mycostop™ is enough to cover about 108 ft² of seedlings. You should determine the approximate square footage of your seedling area. Open the packet of Mycostop™ and remove the amount that is necessary to cover the square footage of your seed flats. The unused portion of Mycostop™ should be placed in a “zip-lock” plastic bag and stored in your freezer. (You will apply this remaining amount to your seedlings in 3 - 4 weeks.) Place the Mycostop™ in the bucket of water and stir it. Allow it to set for a few minutes and stir it again. Repeat until all of the lumps are dissolved. (Note: Mycostop™ is living bacteria - **do not use hot water** - this will kill it.)

Mycostop™ is a beneficial *streptomyces* bacterium that will grow around the roots of plants and will help shield the roots from attack by various diseases; such as *fusarium*, *damping off*, *Rhizoctonia* and *pythium*. You will get the most benefit from Mycostop™, when you begin applications at the time of seeding. (Note: *Streptomyces* bacteria are what give soil its odor. You will notice a strong “soil” odor when you open the packet of Mycostop™.) It will also form a beneficial relationship with the plant that helps the plant grow stronger and be more productive.

Watering your seedlings

Place the seeded flats on your propagation mats. We recommend that you use a Fogg-it™ nozzle (Part # 1W550) attached to a garden hose to gently mist the Horticultes™. The Fogg-it™ nozzle will apply a soft mist that will not disturb the seeds or blow the vermiculite off the Horticultes™. Continue to apply a fine mist until water is running from each flat and the Horticultes™ are saturated with water.

Once the Mycostop™ is completely dissolved, add 1 packet of Guardian™ beneficial nematodes (1 million) to the bucket of Mycostop™. Guardian™ is an insect parasitic nematode that will search out and kill insect larvae that lives in the root zone of your plants. They are completely safe for people, plants and pets. They are capable of surviving for several weeks at greenhouse temperatures. Your new seedlings are going to attract fungus gnats, thrips, slugs and several other insect pests that could develop into a serious problem. It is best to set up a natural defense system for your plants from the start.

Guardian™ nematodes will come to you in a sponge. You should place this sponge in the bucket of Mycostop™ solution and squeeze the sponge several times to rinse the Guardian™ into the solution.

Apply the initial treatment of Mycostop™ and Guardian™ to your seed flats. Evenly apply the full amount that you have mixed up. (Note: Guardian™ will gradually settle to the bottom of “still” water. Make sure you stir the solution as it is applied.)

Cover with Newspaper

Once you have finished applying the Mycostop™ and Guardian™, cover the seed flats with a single sheet of newspaper. Mist the paper with plain water until the paper is completely wet. The newspaper will become a “blanket” over the seed flats. It will help to stabilize the temperature around the seeds. It helps to hold a high humidity level around the seeds. It will allow for a slight amount of air circulation. As the paper dries out, it will serve as an indicator of when to water the seed flats again. If you are starting your seedlings in a greenhouse, the newspaper will also serve as a shade cloth to keep the temperature of the Horticultes™ at the proper temperature. Remember that temperatures above 85° F. can “cook” the seeds. When sunlight shines on any dark growing media, it absorbs heat.

Depending upon the amount of air circulation around your seed flats, you may need to mist the newspaper 2 or 3 times per day. Use room temperature water each time you mist the seed flats. Mist the newspaper until it is uniformly wet and you notice a slight amount of drainage coming from the bottom of the trays. The newspaper should remain on top of the seed flats until the plants begin to emerge from the Horticultes™ in 4 - 5 days. At that time, you should remove the newspaper.

One final note as you start these seedlings. We don't think a year has gone by, that we don't get at least one call from a grower who has lost a portion of their seeds to MICE. If you are going to grow your seedlings on the floor - or if your benches are positioned where mice can get on top of them - do something to keep the mice away from your seeds.

After 4 - 5 days

After 4 - 5 days, the tomato seedlings should begin emerging from the Horticultes™. At this time, the newspaper should be removed. As these seedlings emerge, they need to receive light. If you are growing these seedlings in a greenhouse, a 50% shade cloth should be placed over the seedlings. If they are being grown

indoors, you can use a bank of fluorescent lights. Fluorescent lights should be positioned 4" - 6" above the plants. This will provide 300 - 500 foot-candles of light and is sufficient light intensity to grow the seedlings for about two more weeks. We have tried several different types of lights and have not found that the growth of the seedlings changes significantly with any of the different light spectrums. Standard cool white fluorescent bulbs work just fine. The lights should be turned on for 16 - 18 hours per day. (Note: If you are building several "banks" of fluorescent lights, you may want to remove the ballasts to a separate location to prevent heat buildup in the seedling area.)

The decision to grow your seedlings in a growth chamber or in a room in your home - as opposed to starting them in your greenhouse needs to be based on your personal situation. This period of growth takes about three weeks. You have to consider the cost of operating your greenhouse for three weeks. Can you accurately control the temperature? Will it get too hot? Will you have to remove producing plants to make room for these seedlings? How much production will you lose? Will you spread pests and diseases from your existing plants to the new seedlings? The lights give you control over the length of time and the amount of light your seedlings will receive. In a growth chamber or room, you should be able to control the temperature more accurately and the seedling growth period should be more predictable from crop to crop.

Day 8

Lower the night temperature to 62° - 64° F. Plants need a day-night differential temperature of at least 10° F. Lowering the temperature to 62° - 64° F. will not only establish this differential, but also will also save energy and cause the plants to have a more compact growth habit. When the seedlings are receiving light, the temperature should be maintained at about 78° F.

Begin to fertilize with a solution that is 1/2 the strength shown in our catalog for "Seedling Plants". The nutrient mix shown in the catalog is intended for larger seedling plants - once they are transplanted into your greenhouse. To mix the formula for your new seedlings, use a rate of 4 oz. of 4-18-38 - 2 oz. of Calcium Nitrate - 2 oz. of Magnesium Sulfate - per 100 gallons of water. This should raise the conductivity of the water about 600-700 PPM on your conductivity meter (Part # 5E512) or about 1.0 if you are using a millimhos meter (Part # 5E513).

Adjust the pH of the fertilizer solution to about 6.5. To test the pH of your fertilizer solution, use a pH test kit (Part # 5E130) or a Pocket pH Meter (Part # 5E132). You can adjust the pH of a small volume of water by using vinegar to lower the pH (make it more acid) and

baking soda to raise the pH. When working with larger volumes of water, use Phosphoric or Sulfuric acid to lower the pH and DiPotassium phosphate to raise the pH (See pH Adjusting Chemicals in our catalog). Your first goal in raising new seedlings is to establish a strong root system on the plant. High phosphorus levels will stimulate a root growth response from the plants. Phosphorus is more available to the plants when the pH is at 6.5 or higher. High nitrogen levels will stimulate the growth of leaves and plant tissue. In this seedling formula, you will notice that the calcium nitrate is lower than it will be once we get into the flowering stages of growth. Always allow the temperature of the water to climb to room temperature. Cold water will shock the seedlings and slow their growth rate.

Continue to water the seedlings with the mild fertilizer solution until you are ready to transplant them into the net pots. The seedlings should be kept damp - but not soggy. You may need to water them 1 to 3 times per day depending upon ventilation and relative humidity. Keeping the seedlings slightly on the dry side will encourage the plant to send out more roots searching for water. However, you don't want the plants to wilt. Do not water at night. Watering at night will only encourage the growth of fungus.

The seedlings are ready to transplant into the Net Pots when roots begin growing out the bottom of the Horticultures™ and when they approach the point where the leaves are about to touch. If you allow the leaves to begin touching, the seedlings will begin competing for light. This will cause them to elongate and become spindly. **The goal with seedlings is to grow a plant that is as wide (or wider) than it is tall.**

As the seedlings grow, their demands for sunlight will increase. They also will require more growing space, both for their roots and for their top growth. As a grower, you are trying to produce these plants in the least amount of space, also with the least amount of labor and energy invested into them. The seedlings can be grown for 2 1/2 to 3 weeks (from seeding) on the propagation mats and by using lights. However, attempting to grow them longer will require that they be moved into an area where they can receive more sunlight and that they are transplanted into a larger growing container.

Avoid Transplant Shock

The objective to growing good seedlings is to get these plants into production in the least amount of time and with very efficient use of labor and energy. Anything you do that will delay the growth of these plants will translate into fewer days (or weeks) that these plants are in actual fruit production. A plant in full fruit production

is capable of producing 1 - 1 1/2 pounds of fruit per week. If you shock these seedlings, you may delay your fruit production by a week or more. How much will this cost you in potential income?

As you prepare to move these seedlings from your germination area into the seedling greenhouse, please keep a few points in mind. Your seedlings have been growing in very controlled conditions. They are fragile and can be shocked by extreme changes in temperature and relative humidity. Make sure your greenhouse is operating properly. The greenhouse should be turned on and allowed to operate for a day or two prior to transplanting. The temperature of the interior of the greenhouse should be allowed time to stabilize to the normal temperatures for the seedlings. All equipment should be in proper working order. All transplanting supplies should be in place and ready to use.

If you are moving the seedlings during freezing weather, slip the tray of seedlings into a plastic trash bag to protect the seedlings from the cold. Every winter, we talk to at least one grower who has “nipped” their seedlings by exposing them to freezing weather. The leaves of a seedling are very thin and sometimes even a few seconds of exposure to freezing temperatures can damage them. Do not move more seedlings into the greenhouse than you can transplant in about an hour. Instead, move the seedlings into the greenhouse AS you transplant. If you notice any signs of wilting, have a hose ready to mist the seedlings.

Potting into Net Pots

There are many types of growing media that can be used for raising tomatoes. A grower can be very successful using any of them. Each type of media will have different characteristics that will have to be adjusted for. The growing media should be capable of growing a healthy plant - for the life of the crop. Some considerations should be the initial “cost per plant” and the “operating cost per plant” of using the media. (Some types of growing media require considerably more water and fertilizer on a daily basis). Will there be a “secondary” use for the media once you have completed the crop?

The growing media that you intend to use in the Net Pots should be slightly dampened with a mild fertilizer solution. Using a “dry” growing media may draw too much moisture from the Horticulture™ and cause the seedlings to wilt. By using a “damp” growing media, you will reduce the amount of dust in the work area and you will find the growing media stays in the Net Pot better.

You can separate the Horticulture™ by removing them from the propagation tray onto a cutting board (or bench top) and slicing between each cube with a sharp knife. Always handle each individual plant by holding onto the cube and not the actual plant. The stem of the plant is fragile and you may damage it. Any seedling that has not developed properly should be “culled” and not transplanted.

Place about 1/2" of growing media in the bottom of a 3" Net Pot (Part # 5W580). Set the Horticulture™ containing the seedling in the center of the Net Pot. Fill in around the sides of the Horticulture™ with growing media. Continue to fill the Net Pot with media until the Horticulture™ has been buried about 1/2" with growing media. Be careful to keep the stem of the seedling in an upright position. Gently firm the media around the seedling, eliminating any air spaces that might exist around the Horticulture™. Place the “potted seedling” back into the propagation flat (or other tray you may use to transport the seedlings to the growing area). When the tray has been filled with potted seedlings, you should mist the plants with a mild fertilizer solution.

Transport the seedlings to the growing area. Place them on 6" centers. The center of one Net Pot is positioned 6" from the center of the next Net Pot. The plants will be grown on this spacing until they are about to touch. Be sure to leave room for aisles. You will need aisles for watering and inspecting the seedlings as they grow.

For the next 3 weeks or so, the seedlings will be grown at this spacing. During this time, they should be watered with a fertilizer solution that is approximately 3/4 of the seedling strength described in the catalog. If you are watering them with a Fogg-it™ nozzle, you may find it quicker to drill out the holes of the Fogg-it™ nozzle with a 1/8" drill bit. This will still deliver a very gentle spray, but will allow more water to pass through the nozzle. (Or use Part #1W555 - "400" Water Breaker.)

A Few Reminders

A garden hose can be a very dangerous tool around seedlings. It is a good idea to drive posts (or 1/2" electrical metal conduit) into the ground at the corners of the aisle ways. This will allow you to pull a garden hose down an aisle and protect the seedlings at the end of the rows from being knocked over.

Be sure to monitor your day and night temperatures - AT THE SEEDLING LEVEL. Maintain day temperatures of 78° F. and night temperatures of 62° - 64° F. If you notice the stems and leaves showing a slight purple color, they are probably getting too cold.

Hang yellow sticky ribbons (Part # 5P339) at several locations, just above the seedlings. A yellow sticky ribbon placed about every 60 ft² will help catch whiteflies, aphids, thrips and fungus gnats that may come into your seedling area. Each insect you catch is one that can't lay any more eggs on your seedlings. Apply the remainder of the Mycostop™ that you have stored in your freezer, shortly after you have placed the seedlings in the Net Pots.

Continue to grow the seedlings until the leaves are about to touch. When they are about 6" tall and 6" wide, they will be ready for their final transplanting into your greenhouse.

The total growing time - from seed to final transplant into the greenhouse will vary depending on the time of year. Seedlings grown in the Summer will be ready for transplant in about 5 weeks. Seedlings grown in the Winter will be ready for transplant in 6 - 7 weeks.

It is important that the seedlings be transplanted 7 - 10 days before the first flowers open. They need time to get their root systems established in the final growing position. If you hold them too long, they may begin to fall over and the stem could be damaged.

Flowers will begin to appear on the tomato plants between the 6th and 10th true leaf. It is important to understand that these flower clusters began developing within the plant 2 or 3 weeks before they were visible. Any adverse conditions may have an impact of the quality of these developing flowers.

Take good care of your seedlings; any treatment that might cause these flower clusters to develop improperly should be avoided. A normal flower cluster will have 4 - 6 flowers. Cold temperatures - down in the 50° F. range, will cause excessive flowering. This should be avoided. You should prune each cluster to 3 -4 fruit; otherwise all the fruit on the cluster will develop small. Avoid the use of growth regulators or growth retardants as these may affect the growth of your plants for up to 30 days.

Once the flowering process begins, a healthy plant will produce a cluster of flowers - then 3 leaves - then another cluster of flowers - then another 3 leaves. Under normal light and temperature conditions, new flower clusters will appear approximately every 7 - 10 days.

Final Spacing

When the seedlings are transplanted into your greenhouse, you should allow 4 - 4 3/4 ft² of greenhouse space for each plant. As an example, let's assume your greenhouse bay is 30' x 132' or 3,960 ft² and you want to allow 4 1/2 ft² for each plant. Let's also assume that you will have 5 rows of upright 5-gallon bags (Part # 5W575) and you will place 2 plants in each bag.

3,960 ft² divided by 4 1/2 ft² per plant = 880 plants
880 divided by 2 plants per bag = 440 upright bags
440 divided by 5 rows = 88 bags per row

Subtracting 4' on each end of the building for aisle ways, the actual length of each row will be 124' multiplied by 12" = 1,488 inches.

1,488 inches divided by 88 bags = 16.91" from center to center for each bag within the row. Review the very first pages of our catalog to see how this layout would appear in a greenhouse bay.

Crowding too many plants into a building will cause several problems. There will be more competition for available sunlight, which will cause the plants to grow spindly and weak with each plant producing less fruit and smaller fruit. Spindly plants would have more distance between the leaves and hands of fruit. You would have to lean and lower your plants more frequently. Crowding can also reduce the ventilation within the plant canopy. Lack of ventilation can cause more problems with fungus and insects. All of these problems will increase the amount of labor that must be invested into the crop.

Your production should be measured by how many **pounds per square foot** of greenhouse you can produce during the growing season. Remember that "Insecticide Free" produce will usually bring a higher price in the marketplace. Use bio-"logical" controls whenever possible. Labels on your fruit will also enhance the market price.

Each time you raise seedlings be sure to keep good records. Make notes. Evaluate the progress of your plants. What could you do better next time?

If you have questions, please contact Hydro-Gardens at:

1-800-634-6362

Or

hgi@hydro-gardens.com

Good Luck!!