Friendly Aquaponics, Inc.

Sprouting And Planting Systems

1. Types Of Seeds

If you choose to pursue organic certification, you must purchase organic seeds whenever they are available in the varieties you plan to grow.

Some Organic Seed Suppliers:

Albert Lea Seed House - www.alseed.com
Baker Creek Heirloom Seeds http://www.rareseeds.com/
Filaree Farm - www.filareefarm.com. Over 100 varieties of organic garlic.
High Mowing Organic Seeds - www.highmowingseeds.com
Horizon Herbs, LLC - www.horizonherbs.com - medicinal and culinary herb seeds
Johnny's Seeds (IS NOT OWNED BY MONSANTO!!) – www.johnnyseeds.com
Keeton Farms - Phone: 541-545-1918 Email: bonanzahgp@yahoo.com
Natural Gardening Company - www.naturalgardening.com
Seeds of Change - www.seedsofchange.com
Seedway LLC – www.seedway.com
Southern Exposure Seed Exchange – www.southernexposure.com
Territorial Seed Company – www.territorialseed.com

Organizations working with organic seeds:

Organic Seeds Partnership - http://www.plbr.cornell.edu/psi/OSP%20home.htm. The Organic Seed Partnership will enhance and expand a set of existing complementary, regionally-focused activities to create a strong national network aimed at developing and delivering improved vegetable varieties selected for superior performance in organic systems.

Organic Seed Alliance - http://seedalliance.org. The Organic Seed Alliance has created a Seed Producers Database, which is designed to facilitate connections between seed growers and larger-scale seed purchasers. Both seed growers & seed purchasers can reach a wider audience more easily through the OSA Seed Producers Database.

Organic seed supplier lists:

ATTRA - National Sustainable Agriculture Information Service - http://attra.ncat.org/attra-pub/altseed_search.php
Among many other publications and resources, ATTRA runs a Suppliers of Seed for Certified Organic Production Database. This database provides sources for organic seed of both agronomic and horticultural crops. Some national, mail-order suppliers of untreated seed are included, with the emphasis on small alternative seed companies offering open-pollinated vegetable, flower, and herb seed.

Pennsylvania Certified Organic - http://www.paorganic.org/
This accredited organic certifier publishes an annual list of the companies its aware of which sell organic seeds. The current version was released in January 2007.

Saving Our Seed Project - http://www.organicseedsourcing.com/
The Save Our Seed Project of the Carolina Farm Stewardship Association offers a comprehensive search of organic sources. Growers searching for organic seeds submit an organic seed "Wish List."

Washington State University - http://csanr.wsu.edu/Organic/OrganicSeed.htm
The Center for Sustaining Agriculture & Natural Resources at Washington State University produced a list of organic seeds by variety in January 2006.

2. Pots, Potting Mix, And Seeding

Good aquaponics sprouting methods involve putting the seeds into a slit pot holding potting media. Right from the beginning, we always used 60% fine coconut fiber (coir) and 40% vermiculite for this – **NEVER** use anything that contains peat, soil, or other "potting mixtures", even if it says it's sterile, as it will bring **fungi** and **destructive molds** into your system! Wet the coconut fiber overnight in a plastic garbage can (or other appropriate container) full of water, then break into small pieces to mix more easily with the vermiculite.

Put this 60/40 potting mixture in 2-inch slit pots in a plastic nursery tray that holds a lot of them for easy handling, then put the seeds on the **top** of the damp potting mix in the pots. Now, spread a thin layer of vermiculite **only** on top of the pot, covering the seed with 1/8 inch or so of vermiculite. Water the nursery trays full of pots on top of the vermiculite to make sure the seeds are nice and damp, then put the nursery tray directly into the sprouting table (we'll cover those in a moment).

Special Note: You **don't** need to use bigger slit pots than 2-inch: we've grown a 7-pound taro corm and a 2.87 pound turnip in 2-inch pots using this technique! We tried leeks in 3-inch pots for awhile (3-4 leeks to a pot), until we realized we weren't getting any better production per pot, and were using more system real estate with the 3-inch pots! Well, we did use a 3-inch pot once to grow a 10-foot tall banana tree in a raft, but that was just an experiment, not commercial production!

You can't beat these little plants over the head: if it's **wintertime** and your sprouting tables are **too cold** for optimum germination (or for germination **at all**), you may need a heated germination area (70-80 degrees F), **plus** heated sprouting tables to give your seeds the best chance to germinate and grow. If it's **summertime** and your sprouting tables are too **hot**, you may want to add some light Aluminet or other infrared-reflective shade cloth over the tables (try 20% to 30% shade cloth, any more shade may make the sprouts attenuate (lengthen towards the light).

Can't find coco coir? We've heard of people successfully using shredded dried banana leaves and plant stems for potting mix. Try whatever you can find locally that is soft, holds water, and won't poison your plants or fish. **Try it in a small aquaponics system first!**

3. Germination And Seed Testing

Seeds don't all germinate, and sometimes they don't germinate **at all**. Let us explain: on every seed packet (from reputable seed houses like Johnny's) you usually see a statistic, expressed as a percentage, of their germination rate. It looks like this: germination = 94%.

What that means is that Johnny's has taken several batches of these seeds and "test-germinated" them to see how good they are. 94% means that 94 out of 100 seeds they tried did germinate. When you plant them, that is what you should get.

However, something may have happened to the seeds on their way to you; they may have sat on a freezing or frying loading dock somewhere for too long in their little Post Office or UPS envelopes; this really interferes with the seed's germination rate, or kills them outright. This can happen at home if you leave the seeds outdoors overnight (too cold!), or if you leave them on a sunny windowsill or in the sun anywhere (too hot!). So, keep seeds dry and warm indoors until you need to use them, then get them back to a protected spot as soon as you're done.

The germination area and/or sprouting table MUST be around 75 degrees F; this will give you optimum germination and growth of these small plants when they are most delicate. **Heat your germination area and/or sprouting table** to this temperature if you need to, because otherwise, **getting no germination** is a possible outcome here. "Germination" is the period during which the little plant sticks its first roots out and puts out its first two tiny leaves. After 3 to 4 days, your seeds will have germinated into sprouts, and you can move them to your sprouting tables (which are fiberglassed, waterproofed tables like long trays; photo soon).

Getting Enough Light To Your Sprouts

Sometimes you will have difficulty getting proper growth in the period right after germination; you will notice that your sprouts are getting long and "leggy". If you see this happening, you have a serious problem that you need to fix before doing anything else. This is called "attenuation", and is happening because **your sprouts are not getting enough sun**. This is totally normal for little plants to do; they're simply trying to get taller and hoping to get some more light when they finally get "up there". There can be several reasons for them not getting enough light:

1. The most common reason is that it is wintertime (which is a low light period anyway) and you are in the middle of an extended cloudy period which reduces the light that reaches your plants even further. There just isn't much light coming in to the baby plants, and they're attenuating as a result. The fix? Get some artificial light on them as soon as possible, in the appropriate amount. There's a document covering artificial lighting in your DropBox files called **"Lighting For Aquaponics.PDF".**

However, even if you get lights on them right away, they may already be gone. If they're already attenuated, it's too late. Here;s why: if a batch of sprouts gets attenuated, they are already "shocked" to an unknown extent, and you have a bunch of plants that may have poor growth all the way through to harvest time. Adding lights after they become attenuated may not fix it; the plants may be past the point where the additional light will correct the situation. And by poor growth, I mean they may only weigh one-quarter (or less) what healthy plants that got enough light when they were germinating would weigh, but you will expend just as much labor harvesting them as you would plants of full weight. If they were badly shocked, they may not even grow **that** well.

Get the lighting installed before you germinate the next batch of sprouts or you're likely to have the same problem on an ongoing basis. **If the sun comes out, you don't have to pay for electricity, but if you don't have the lights, you may lose much of your production.**

2. A second common reason is you have put a second layer of plastic film between the sprouts and the sunlight. This is easy to do if you see your sprouts getting cold; you may figure you can cover the sprouting table (which is already inside **one** layer of plastic inside the greenhouse) with a layer of plastic to help 'keep the heat in". What you weren't aware of is that each layer of plastic will **block** from **14% to 25%** of the available light; with two layers, you are losing **28% to 50%** of the light! Half the light gone! **Don't put** two layers of greenhouse plastic over the sprouts to "keep them warm", for this will keep the sunlight off also, and they will grow poorly. How to fix this?

Your germination area and/or sprouting table MUST be around 75 degrees F; this will give you optimum germination and growth of these small plants when they are most delicate. **Heat your germination area and/or sprouting table** to this temperature if you need to, because otherwise, **getting no germination** is a possible outcome here. "Germination" is the period during which the little plant sticks its first roots out and puts out its first two tiny leaves. After 3 to 4 days, your seeds will have germinated into sprouts, and you can move them to your sprouting tables (which are fiberglassed, waterproofed tables like long trays; photo soon).

Here's a link to plans for a "Seed Germinator" that one of our students has used with success: it's made from an old refrigerator, so has limited space for a larger commercial operation, but it will give you an idea. $18 from Amazon.com at the following link: http://www.amazon.com/Build-Seed-Germinator-From-Refrigerator/dp/1497330270, or you can just search **"How To Build A Seed Germinator With A Junk Refrigerator"**, and that will get you there too.

How To Correct Poor Germination If You Don't Have Time For New Seeds:

If you find you are having trouble with germination on a particular species, and there's not enough time to get new seeds ordered and shipped, then plant two or three per pot, and thin them by hand at this point back to a single plant, before they go into the rafts. If you are only getting 50% germination with the only seeds you have, planting **two to a pot** will almost always ensure that **one** comes up! It's more work, but contrast this to having only half as many plants come up and having to cull half your pots at transfer time!

IMPORTANT! Every time we get a new batch of seeds we sprout 100 to see what the germination rate is. This way, we know ahead of time if a batch of 5,000 or so seeds is bad, and we've checked them ahead of the

time we actually **need** to use them, so we don't get caught with our pants down and not enough time to order new seeds.

4. Sprouting Table System In Aquaponics' Side Flow

For our smaller backyard systems, we use a waterproof 4-foot by 8-foot sprouting table **f**or germinating and growing out the sprouts. **A sprouting table** is a simple plywood and lumber-framed table with a fiberglass coating in the bottom and 2 inches up the sides, with a drain fitting at one end to drain the water back to the aquaponics troughs. For this small a table, you can just bring a 5-gallon bucket of water or two over from the aquaponics trough and dump it slowly and carefully into the uphill end of the table. We put the slit pots in nursery trays that hold 32 pots and they go on top of this table.

(Below) A friend's Micro System (to the right in the distance), and 4X8 sprouting table ((near left) with storage area underneath.

(Left) Our 24-foot sprouting tables for commercial-scale operations are the most labor efficient way we know to water tens of thousands of baby plants in only minutes.

They also keep the plants moist for a long time; you usually only have to water once a day even in tropical heat.

For our commercial operation, we use bigger 24-foot (or longer) sprouting tables. They are even less work than the small backyard tables, because these larger tables are plumbed so their water supply gravity flows from the fish tank, then back to a trough. All one has to do is turn on a valve at one end of each table and come back 15 minutes later: all the pots in the table have been nicely watered from the water flowing past underneath them and wicking up through the potting mix in the pots. I can water **60,000 sprouts** in 12 sprouting tables in a total of about **8 minutes a day** in our sprouting tables.

The idea is to just keep the potting media medium **damp** without soaking it or letting it dry out. This germinates and starts seeds really well, because of the nutrients contained in the system water you are using to keep the potting media moist with. And the best part? Seeds that used to take 3 weeks now sprout in ten days using this method.

This is hugely important for a commercial operation, since this technique cut our sprouting time in half, meaning more production. It also meant that we only needed half as many sprouting tables, since the sprouts came off the tables in half the time!

Here are differing sizes of net pots. We use 2" net pots for almost all greens and herbs, including leeks, bulbing onions, and taro.

This is an example of the trays that hold the net pots. We use 2" net pots, and the trays that fit them hold 32 net pots.

Above are our sprouting tables, which use flow through from the main fish tank. Note the PVC piping at the bottom of the photograph, with valves to turn the flow off and on. That's baby Rose about a year old in the aisle.

- **We provide you with a manual that extensively covers how to build these sprouting tables yourself,** in your DropBox files in a folder titled (appropriately) "Manuals".

5. What Doesn't Work:

1. First, you can accidentally kill your seeds with a strong enough application of cold, heat, moisture, or a combination of these three. This can happen at home if you leave the seeds outdoors overnight, leave them on a sunny windowsill or in the sun anywhere (where the seeds can get up to 140 degrees on a really sunny day!), or let the seed packets get damp or wet (they will mold then!). So, keep seeds dry and warm indoors until you need to use them, then get them back to a protected spot as soon as you're done. It's **really** difficult to get dead seeds to germinate!

2. Don't use peat or store-bought "potting mixes" instead of the coco coir/vermiculite mix we recommend (we'll call it CV from now on for simplicity). First, these types of potting mixes hold far

more moisture than the CV mix does, and are less "airy", allowing less oxygen to the developing plant's roots, if used in a flood and drain sprouting table. As a result, the plant roots often simply rot off, or "damp off", and die at some point in the sprouting table.

In addition, these types of potting mixes often bring ***pythium*** or ***fusarium*** molds along with them, even though they say they're "sterilized". Both of these molds can become epidemic in your aquaponic system given the right conditions, and can also be difficult to get rid of. Don't take the chance, there's no cheese at the end of this tunnel!

3. Don't use dirt instead of the CV potting mix! Plant roots develop differently in dirt than they do in the CV potting mix, and appear to simply rot off, or "damp off", and die when they're put into the rafts where their roots are wet all the time.

4. There's no need to use larger, more expensive pots (that occupy more aquaponic "real estate"): we grew a 7-pound taro and a 2.87 pound turnip(root vegetables) as well as bulbing onions, in 2-inch pots. They simply grow on top of the raft. We never use 3-inch pots now, because everything grows just fine in 2 inch pots, and we get far more of them into every square foot of raft space, which equals more production from the same-sized system.

What follows from this (of course!) is that there's also never any need to "repot"; that is, take a plant out of a small pot and put it into a bigger pot. This is a good way to either kill a young plant or retard its growth so that it never achieves full size.

8-year-old Jack and the 2.87 pound turnip that grew just fine in a 2-inch net pot on top of the raft!

The pot is the little bump behind Jacks left forefinger.

5. Don't "recycle" your CV potting mix. We found when we re-used our potting mix that our "germination rate" dropped to 50% (this means only half of our seeds sprouted). We don't know why, but we do know enough to **stop** doing things that **don't work**.

6. We tried using red and black volcanic cinder for potting mix. The black cinder worked **great** The plants grew better, faster, and had excellent germination rates. Except that after two or three planting cycles, the pots started shredding and we had to throw them away.

We found that when the plant's roots grew, they forced the cinder out through the sides of the pot, breaking them. We'd gone from throwing away CV planting mix that cost us $0.001 (one-tenth of a cent) each planting cycle to throwing away pots that cost us $0.03 (three cents) after two or three uses (and we didn't actually "throw away" the used CV mix; it went into the compost, and was of further benefit to our farm there). Our potting expense went up by a factor of ten as a result of this, and we were throwing away a "non-recyclable" plastic pot instead of recyclable potting mix.

This is hugely important for a commercial operation. Even at the small scale we operated at, this added a penny to each month's cycle of 25,000 pots, or $250 per month and $3,000 per year. Every little bit counts when you're running a commercial operation!

7. We also tried "rock wool cubes" with less than inspiring results; we used the "Oasis cubes", plus other brands. Our results included poor germination, much higher costs, and more labor when compared to using the CV potting mix we recommend.

8. There's also no need to use expensive potting media such as Hydroton or other expanded media. The CV mix we recommend is economical and widely available.

9. If you are tempted to use Perlite (because we haven't said anything bad about it yet), take a handful of Perlite and throw it into a bucket of water. You'll notice that some of it sinks, some of it floats, and some of it is almost perfectly suspended in the middle of the bucket. Now take another handfull of Perlite and grind it together between your hands; notice the abrasive, sandpaper-like dust that results?

We shudder at the thought of Perlite loose in our systems, floating through at all levels from the water surface to the bottom of the tanks, abrading our pump shafts, impellers, and seals with each pass through the pump. We shudder even more about the possibility of it going through our fish's gills until the fish died suffering from the abrasions on its breathing surfaces. You can try it, we'll pass.

10. After the starts reach their optimum maturity in the sprouting table (which is when the little plants are about 1-1/2-2 inches tall, and their roots just barely start coming out of the net pots into the plastic trays) they get moved into the rafts in the Aquaponics system. You may be tempted to "let them get a little bigger and stronger" before the transfer. **Don't wait longer!**

If you wait too long to take the sprouted pots out of the trays, the roots will be tangled with the hole or the mesh at the bottom of the tray, and will rip off, "shocking" the little plant. This shock can be so severe that the plant **doesn't recover** much, or at all, and will **never** grow well. So be sure to take your babies out of the sprouting table and put them into the system rafts at the appropriate stage of growth.

11. Conventional university sprouting methods involve putting the seeds into potting media in net pots in some kind of a plastic tray that holds a bunch of them for easy handling, then they go on a nursery table (which is a wire-topped table that drains excess water out the bottom of the wire onto the ground). You water them with an overhead spray or by hand-watering using tapwater until they sprout and you put them into the rafts in the aquaponics system. Sprouting this way involves a lot of hand labor in the watering, and since it does not use any kind of nutrient solution for watering, the sprouted plants grow more slowly than is possible with other methods. **It's a waste of your time.**

12. We tried putting the net pots **directly into the system rafts**, and they sprouted and grew just fine. There were two problems, though: it used up a lot of aquaponics "real estate" that could have had more mature plants in it making money for the farm; and about 30% of the plants sprouted in this fashion simply **rotted off at the roots** and fell over, requiring replacement. **It's a waste of your time and your system real estate.**

13. We tried vacuum seeders, because the university recommended them. These hook up to a vacuum cleaner and hold your seeds in place. When you turn the vacuum seeder upside down over a tray of pots, then turn off the vacuum, all the seeds drop conveniently into the centers of the pots. Fortunately Tim knows how to make stuff like this, so we made two excellent vacuum seeders (of slightly different designs) rather than purchase two (for up to $675 each). Although both these seeders worked as well as the commercially available ones, what we found is that even the commercially available ones don't work that well. Even after we got fast on the vacuum seeders, we found that the same person could actually seed 50% more in the same time by hand seeding.

14. If you let the sprouts in the sprouting table go "too long" between waterings, you can "shock" them, which can make them grow poorly or **not at all** during the rest of their life. We had some plants that just didn't do well at all, and when we analyzed the situation, we found out an employee had neglected to water them for two to three days at a stretch. This wasn't enough to **kill them**, but was enough to **shock them** so that they wouldn't **grow**. If you can identify a "shocked" batch of seedlings like this, **throw them away and start over!** They will never grow! And water your sprouting tables once a day after this, like clockwork!

6. Transferring To The Rafts

After the starts reach their optimum maturity, which is when the roots come out of the net pots and begin getting inhibited by hitting the sides and bottoms of the plastic trays, they get transferred from their nursery trays into the rafts in the aquaponics system. In just a bit, we will show you this system in detail.