

MANAGING HOOPHOUSES FOR YEAR-ROUND PRODUCTION

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Living Web Farms

Types of Greenhouses

Coldframes, High Tunnels, Gutter Connected, Inflated, and Glass

The most expensive real estate in your garden, on the farm.

Q: To heat or not heat?

A: Heat and watch it get way more expensive.

- Heating can be cost-effective for high-value crops such as tomatoes, cucumbers, and peppers, also possibly for flowers but I'm not qualified to help you with that.

At Living Web Farms, we heat almost exclusively for seedling production.

We generally start heating in **mid-January**, which is when we start our onion crop. At this point we aim to keep temps above 40°F. Later once we've moved on from cold-weather crops such as Brassicas (broccoli, cabbage, and kale are some examples), salad greens, beets and cool weather Farmscaping plants to tomatoes, peppers, eggplant summer squash, we reset the temperatures higher ensuring that nighttime temperatures never dropped below 55°F.

We do not use heat to grow vegetables, although we may begin to use the co-generated heat from our biochar plant to extend the season for tomatoes, peppers and eggplant etc.

There are growers who profitably employ heat to grow greenhouse crops such as tomatoes. Usually they start those in December, plant in January and are harvesting before other farmers are setting out their tomatoes etc. If you do this consider developing an insulation system for your greenhouse. At the very least insure that the greenhouse is inflated. Consider a nighttime interior curtain keep the heat closer to the plants and reduce heat loss but also consider an exterior insulating system. Tom Elmore of Thatchmore farms uses concrete curing cover, a spunbound fabric within insulative layer of fpam on it.

Any vegetable that is even quarter hardy can be grown to maturity during our winters with no supplemental heat. You need to use at least an inflated structure or to cover the crops with row cover on the cold nights a combination of both will greatly increase your production.

Cold season crops that have done very well for us using this system include all salad greens, all cooking greens, beets, carrots, other root crops including turnips, rutabagas and radishes, all hardy herbs especially parsley, cilantro and dill. We also had significant success with broccoli, and broccoli raab (however recently fungal diseases have made them not cost-effective for us to grow in a greenhouse). Brussels sprouts have also been very successful however the space they take up means you need to get a very high price for them if you are growing for profit. If you're just going for your own consumption I

would say that one of my favorite winter vegetable greenhouse crops is Brussels sprouts.

Our first round of seeding for cool season /winter growing is done late August through mid-September this is the best time to seed things like carrots, beets and rutabagas, watermelon radish, and other Daikon type radishes. All of these are best started earlier but can be done as late as mid-September with the possible exception of watermelon radish. The earlier you get that started the better. We just keep seeding after that initial late August start, continuing on with spinach, salad greens, baby white turnips, smaller radishes etc.

We also have started transplants in late July through early August of cooking greens such as kale, collards, chard and various Pac and Bok choys. They are ready as transplants to go in just as we finish our initial direct seeding. I'm particularly fond of the purple Pak Choi. We also do seedlings and transplants of Johnny's Elegance Braising Mix, and soon after mid-September are transplanting them into the ground. If you are going to go for Brussels sprouts broccoli etc, the earlier you can get them into the ground the better. For Brussels sprouts even August is not too soon, however, I have planted them as late as October and still gotten excellent crops. Finally, celery is unto itself as a winter vegetable. I discovered this by accident when I had a few leftover from the summer planting, stepped them up into 4-inch pots and put them in the greenhouse in early September. By November I was harvesting the most spectacular celery I have ever grown. You can transplant them later in the season and they'll be really good but your best bet is to grow really big healthy plants and get them in the greenhouse in early September. Please do know that celery is pretty disease prone and if you get the disease about the only real option is to yank all of your celery since in response to disease celery can produce very toxic compounds.

We do successions of our direct seeded crops and as a season continues we cull ones that do not do as well as later plantings. These include watermelon radish, spinach, and mache. Watermelon radish is the first to be dropped, generally. I wouldn't bother with it after mid-September. Spinach can still be successful planted this late until the end of October and then is worth trying again in mid-January. Between these dates generally it just takes up space and doesn't do much.

The schedule is not locked in stone, given the variations in microclimates and days of sunshine etc. that occur around the mountain region. One should consider this handout as a starting guide, subject to your own experience.

Generally insect pressure is much reduced in cold season production. Aphids, rarely, and imported cabbageworm and the vegetable weevil are about all we've had to deal with from mid-October to April. Aphids can be controlled with insecticidal soap. However, a cool season aphid outbreak but is a great opportunity to build up your beneficial insect populations which can then leave your greenhouses in the spring and provide an early inoculation for your outside production. Consider putting the word out and getting people's house fall house invading ladybugs. Try releasing a few of those at each infestation site. This should give you control. It is important that you grow Farmscaping

plants such as calendula, Bachelor buttons, parsley, dill, and cilantro, and the let crops such as lettuce and arugula and radishes remain in small numbers once they've begun bolting. If necessary you can use BT to control imported cabbageworm. The vegetable weevil can be particularly tough particularly if, like us, you experiment with no-till production. Its cycle is such that the natural controls are not as effective as they are for many other insect pests. We had sufficient success using a combination of neem and Spinosad but it has taken repeated applications on occasion. Also it's important to spray as soon as you see the problem and not let it build up. This weevil can do major damage quickly.

Disease pressure is usually also very light when growing winter vegetables in greenhouses. However, as previously mentioned, fungal diseases on Brassica are significant enough that we no longer grow broccoli or broccoli raab in the winter. It seems possible that very careful attention to air circulation and sanitation could overcome this issue. Otherwise we had minor problems with powdery mildew on Brassicas, bottom rot on lettuce and late in the season as it is warming up, Cercospora on crops in the beet family. We don't spray for any of these but rather try to manage them environmentally and with good timing.

An important environmental management piece is air circulation. Depending on the size of your greenhouse you may want to install circulation fans. I recommend that you talk to a greenhouse supplier about these and have them help you to configure the correct pattern and number you will need. Note these can be expensive and of course require electricity.

Warm Season Production

If you're not using any supplemental heat, warm season production will involve transplanting out tomatoes and summer squash and cucumbers in early April. You should be prepared to use as many layers of row cover and other insulating material you need to avoid their being impacted by late deep cold. Towards the middle of the third week of April, we plant peppers and eggplant. We also may sow pole beans at this time. Over time we've learned to grow varieties that are specific for greenhouse production. Johnny's Selected Seeds (based in Maine. www.johnnyseeds.com) has an excellent selection of greenhouse tomatoes. Fedco Seed also has some good ones this year. Johnny's has introduced some greenhouse varieties that have significant heirloom genetics. The Cherokee Purple influenced "Manero" is very promising, and is by far the best tasting greenhouse tomato we've grown. Other great ones include Rebelski and Tomimaru Muchoo . We are only this year experimenting with peppers specifically designed for greenhouses. All greenhouse seed is much more expensive, but the peppers are incredibly expensive, so the jury's out still, and we will see if it's worth it at the end of the season. It is very worthwhile to grow greenhouse genetics in the realm of cucumbers. We are incredibly impressed with the productivity and quality of Corinto.

Our tomatoes, cucumbers and for the first time, some of our peppers are all grown on string trellis systems. This allows us to lower the plants and whenever possible bury the stems of our cucumbers and tomatoes that have been lowered. By doing this we renew

them and keep them producing vigorously all the way through hard frost in November.

We use the Florida Weave with a stake every second to fourth plant for our peppers and eggplant. Be aware that with proper fertility, these plants can become far larger in a greenhouse than you experience outside. Our peppers are often topping out at three and a half to four feet and eggplant have hit 5 1/2 feet.

Usually, even in summer, Farmscaping methods and careful attention to maximum fertility have kept our insect and disease issues pretty minor for greenhouse production systems. No matter the season, our solutions are the same year-round. We have had whitefly and spider mite pressure. We tried predatory mites for spider mites but for us predatory mites were not very successful. This year we tried minute pirate bug. This seems to be doing a better job of controlling the spider mites. If the whiteflies become a serious problem, there are predators that are very effective for them. So far, the fertility of our system has allowed us to let nature take its course with the whiteflies. There always is some Colorado potato beetle pressure on eggplant, but our Farmscaping systems ensure high enough levels of predators that we really don't have to do anything to control these. We also use Surround to reduce insect pressure. After some 15 years, striped cucumber beetle has returned to plague me. I believe that it was lack of severe cold the past two winters, which reduced the early arrival of the egg predating Pennsylvania Soldier Beetle and the C-Mac ladybug. As a result, we had a severe outbreak of Striped Cucumber Beetle this year and were forced to use Neem and Surround in order to get control. You can use Neem as a drench for any greenhouse crop and it will go systemic. This can be very helpful in controlling a tough infestation such as spider mites.

We had some trouble recently with soil born fungal diseases such as the Phytophthora capsici and R. ziziconia, although these are supposedly very long lasting in the soil and difficult to control. Our use of compost tea drenches and the application of Actinovate and Trihoderma seem to have given us good control. In really bad late blight years the disease sometimes makes it into the greenhouse this is also true for early blight. These diseases affect almost exclusively our tomatoes and we use the same controls for them indoors as we use outside. Copper sulfate is the most effective, and we try very hard not to use it. We also use Serenade, Sonata, Regalia and Double Nickel. We also try to apply compost tea at least once a week and always do a foliar feed as part of that spray routine. We spray to label Brown's hydrolyzed fish and Maxi crop Seaweed.

Harvesting: Given the intensive nature of greenhouse production, careful attention must be paid to timely and consistent harvesting. Although some crops such as kale and collards can be allowed to put a lot of size on before you begin the harvest, many crops including most of the salad greens and root crops benefit greatly from early and frequent harvesting. Likewise, if you want to maximize your tomato and cucumber production, be sure to remove all fruit that is sized up. Indeed, simply leaving too much fruit on your tomato plants can induce blossom end rot. We oftentimes will remove fruit that has just barely begun to color from our tomatoes, just to reduce the pressure on the plants. Failure to harvest in a timely way can greatly reduce the lifespan of your plants.

Spacing: Generally, for winter crops, we space in a manner similar to our outside production systems with the exception of giving more space to any Brassicas that are prone to downy mildew or other fungal diseases. Summer crops we often space more closely in the greenhouse than we do outside, in order to maximize production. We can do this because we have less disease pressure thanks to the exclusion of rainfall. So for example, we may have peppers as close as a foot apart, tomatoes 2 feet apart, cucumbers a foot apart, and eggplant 18 inches. We actually give our squash more space in the greenhouse since they tend to get so huge. We give them 3 feet per plant.

Notice I have eliminated Spring and Fall in this schedule. This is because these seasons are moderate enough that we can include them in our two main cropping seasons: hot weather and cold weather.