



Transplant production in the Greenhouse.

1. Knowing how to grow transplants is critical for organic agriculture. A large transplant is more competitive with weeds and more resistant to soil pests. While the transplant is growing in the greenhouse beds can be prepared and pre-irrigated and cultivated to control weeds. Transplanting usually results in more complete plant stands. Transplants can be sown early in the season in the greenhouse, and then transplanted to the field when outside temperatures increase. It is also more economical to prepare transplants rather than direct seeding, when using expensive seed. For this module, you should help to prepare seed flat mix, sow plug trays with seeds, monitor the growth of the transplant, and transplant seedlings in the field.



A 128 cell plug tray.

2. Plug trays: Most growers today use plug trays to grow transplants. These trays are made of plastic or Styrofoam and have been shaped into cells where individual plants are grown. As the roots fill in the cell, a plant with an intact root system forms. It can be transplanted without disturbing the roots, which all but eliminates transplant shock. Before plug trays, transplants were grown in open flats, and separated and transplanted “bare-root” when mature.



An open flat.

Because the roots were so disturbed, delays to plant growth due to transplant shock could be significant. Plug trays are available in different sizes, based on the number of cells in the tray. We use 128 and 72 cell trays. The 128 cell trays are for all cool season vegetables that are transplanted, such as broccoli, lettuce, and chard. One month after sowing, these vegetables are ready to be transplanted. The 72 cell trays are used for warm season vegetables like tomatoes, eggplant, and peppers that are likely to be in the tray for longer than a month, and need extra room to grow. Soil is not the medium used in plug trays. It is too dense when confined in a small cell, and doesn't allow enough drainage and air space for optimal growth. Instead, a seed flat mix is used that is less dense than soil.



A 72 cell plug tray.

3. Seed Flat Mix: Seed flat mix must support the plant, provide nutrients for growth, and allow for good water penetration and drainage. A typical organic seed flat mix is composed of aerobic compost, peat moss, and perlite or vermiculite. Peat moss comes from digging up peat bogs in Canada and is environmentally disruptive.



Peat Moss

In recent years, coco-peat, which is a by-product of coconut production, is being used as an alternative to peat moss. Coco peat is sold in small, highly compressed bricks, which should be pre-moistened before use. If used dry the bricks are difficult to break up. Coco peat is shipped from coconut producing areas of the world.



A bag of perlite.

Perlite is a mineral that is mined in Nevada. It is an amorphous volcanic glass that is heated to 1200 F when the water content in the mineral vaporizes and expands the perlite into light and aerated pieces. Perlite improves drainage in the seed flat mix. It has no nutritive value. Perlite is a very dusty material and must be moistened with water before use. AVOID BREATHING PERLITE DUST!

The third ingredient in our seed flat mix is aerobic compost. It provides nutrients for the seedlings and also serves to reduce compaction in the plug cell.

Organic seed flat mix is different than conventional seed flat mix in that it is “live” and not sterilized. The micro-organisms from the compost help to suppress diseases that may harm seedlings. (1. Hoitink, Harry A. 1986. Basis for the control of soil borne plant pathogens with composts. Annual Review of Phytopathology. Volume 24. p. 93–114. 2. Trankner, Andreas. 1992. Use of agricultural and municipal organic wastes to develop suppressiveness to plant pathogens. p. 35-42. In: E.C. Tjamos, G.C. Papavizas, and R.J. Cook (ed.). Biological Control of Plant Diseases: Progress and Challenges for the Future. NATO ASI Series No. 230. Plenum Press, New York, NY.) Worm compost can be used in seed flat mix as well, but weed seed is likely to remain viable because temperatures remain low in worm composting systems. Weeds can cause problems in plug trays. To complement compost based disease suppression, provide good airflow and avoid overwatering.

4. Preparing Seed Flat Mix: Seed flat mix is made in a wheel barrow or seed flat mixing machine. One 5 gallon bucket of compost is sifted through a $\frac{1}{4}$ inch mesh screen, and mixed with a bucket of perlite, and bucket of coco peat (broken up and mixed with water. More water is added gradually until the mixture has the moisture content of damp sponge. If the mix is too dry, there is too much surface tension and irrigation water may not penetrate well into the plug. If the mix is too wet, it compresses and becomes anaerobic, and the plants may not grow as well. Add the finished mix to plug trays by placing it on top of the tray and removing any excess. Tap the trays a couple a times on the bench to settle the mix, and fill in any low spots. Depressions can be made in the plug cells by evenly pressing another plug tray on top of the mix filled tray, or with your fingers or with a mold constructed to make even depressions. For almost all seeds, the depressions should be no more than $\frac{1}{4}$ inch deep. If the germination rate of the seed is high, approaching 100%, place one seed in each cell. If the germination rate is lower, multiple seeds can be sown in each cell, but thinning will be necessary. There are some crops we transplant, like onions and basil, where multiple plants in each cell is desirable, and they will not be thinned to one plant/cell. Seeds should be covered with a thin layer of seed flat mix or perlite. We have been using perlite because it creates a surface that is supposedly less attractive to fungus gnat egg laying (based on information from other greenhouse workers). We have not tested this ourselves. After the seed is sown a label must be put in the tray identifying the variety name and date and any other info deemed important, like seed source (seed company name, saved seed, special source, or for another program like the children’s garden). FYI, “broccoli” is not a variety name, but “Windsor” is. “Tomato” is not a variety name, but “Shady Lady” is. If the variety name is not present it is very difficult to match special horticultural requirements to the plant. Does “tomato” require pruning, or staking? Write this information on wooden stakes

with either a permanent magic marker or a pencil. Pen doesn't work, it will wash off and variety names will be lost, leading to more chaos.



Dino kale label in pencil.

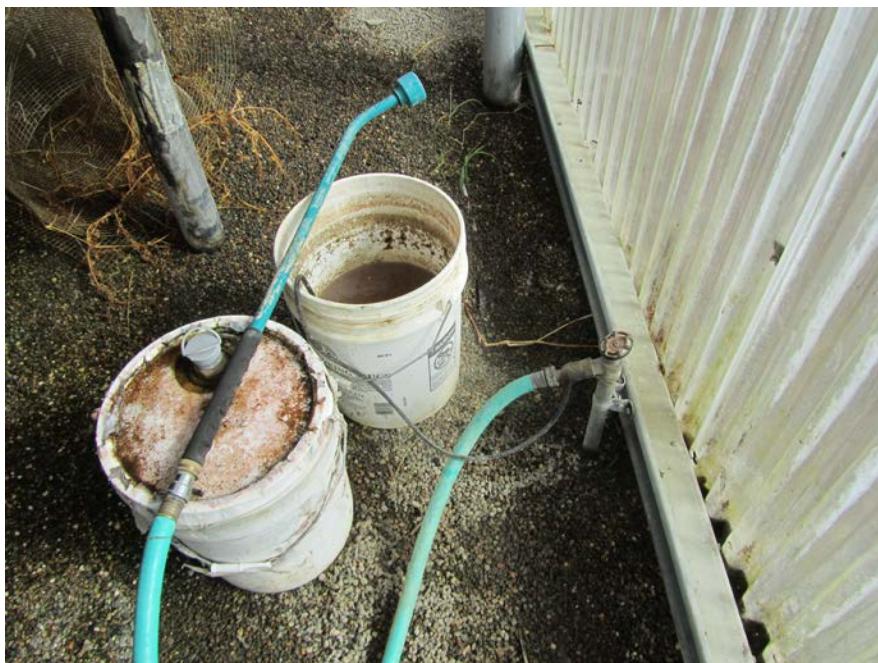
After labeling, move the sown trays to a bench that has irrigation and cover the trays with a wire cage to prevent rodents from digging up the seed. Water the trays with a fan attachment on the hose. Adjust the water to a moderate (a 3-4 foot length) stream, and point the fan up, so the water goes up before it goes down. If the fan is pointed directly at the seed flat, the mix and seed will be washed out of the cells. Keep the water from the fan moving across the trays at all times. If too much water falls in one place mix and seeds will be floated away. Quit watering after a few passes.

After the first watering, the seed flats in the green house are irrigated with a system of spinners and fan sprays that are on a timer. This system does a decent job of providing water evenly to the plants, but can miss some areas on the edges of the tables.



Digital timer for green house irrigation.

In order to improve coverage on the edges, and to add nutrients, we water the seed flats each day with a hand wand that siphons fish emulsion into the irrigation water. When using this system, turn the spigot on full blast, because the siphon greatly reduces water pressure in the hose. Make sure that the siphon tube is in the nutrient mix bucket and the bucket has at least an 8 inch depth of solution. If there is not enough solution, mix one cup of fish emulsion with 5 gallons of water. Water all of each flat with the wand and look for dry areas to give extra coverage. Water all the flats on all the tables. When finished, turn the spigot completely off.



Nutrient bucket on right with siphon tube. Notice siphon attached to spigot.

5. Alternatives to plug trays: A. Elliot Coleman, a farmer and author in Maine, helped develop the concept of soil blocks, which replaces plug trays. Soil blocks are made with a special mold. The mold is pressed into the seed flat mix and then the compressed mix is pushed out on flat trays. Imagine using a bucket at the beach as a mold to make sand buckets. A seed is placed on the top of each block in a small depression, and not covered. The blocks are then watered as you would water plug trays. For soil blocks to work, the seed flat mix must be more dense and cohesive than the plug tray mix. Adding sand helps hold it all together. When the plant starts to grow in soil block, its roots are “air pruned”, because roots won’t grow out of block and into the air. This system works, but the soil blocks are generally less robust and need more space than the plug tray plugs. B. Seedlings can also be sown in open flats. The flat should be filled with seed flat mix and leveled carefully. Seeds can either be broadcast onto the flat, or sown in rows. Additional seed flat mix or perlite is added to cover the seeds. When the plants are 3 to 4 inches tall, they are pulled out of the tray individually and planted “bare-root”. This system works well with the vegetables that transplant readily, like the broccoli family, lettuce, tomatoes, eggplant, peppers, and basil. It does not work well for members of the Cucurbitaceae.

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