Growing Vegetable Transplants

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Growing your own transplants is done for a number of reasons including earliness, ensuring uniform plant stands, providing plants of cultivars not available commercially, and establishing crops that are difficult to germinate under field conditions. That said, although any crop can be transplanted into the field, not all crops will benefit from the effort and cost of using transplants. Crops likely to benefit from transplanting include brassica head crops, lettuce, onions, celery, nightshades like tomato, etc. and cucurbits. Crops such as root crops or legumes like beans or peas would not benefit from transplanting under normal conditions. In our challenging climate, the two or three weeks of earliness that transplants may provide can make the difference between having a marketable crop or no crop at all. Examples of this are the brassica-head crops such as cabbage, broccoli and cauliflower. These crops fit into a narrow time period in the spring and fall seasons. If they are late in the spring, they become bitter and unmarketable; if late in the fall, they will not fully mature prior to frost. Using quality transplants make it possible to produce these crops in our climate.

Transplant production requires knowledge about crop germination and growing requirements, attention to details, and a willingness to provide consistent care for transplants seven days a week. Compared to field or garden production, caring for transplants is completely up to growers with no help from mother-nature. Crop requirements such as water, fertility, temperature, light, etc. must be taken into account by the grower.

Growing Medium

There are a number of different ways to provide growing media for growing transplants. In most instances, topsoil from the garden is not suitable for growing transplants because it lacks the proper water and nutrient retention, may contain plant diseases or pesticide residues, and when put into containers does not drain well enough. Whichever media is selected, you will need to provide for both the physical and nutritional needs of seedlings grown in it. This will include physical space for roots to grow in, water and nutrient retention, and air-space in the mix to allow for the oxygen needs of plant roots. Most growing media mixes will include components such as bark, sphagnum peat moss, vermiculite and perlite, while specific germination media mixes exclude bark.

Commercially available soilless mixes are a simple means of providing for the growing media needs of transplant growers. They are readily available, usually have a proven record of performance and don't require experimentation by the grower to develop. Costs of commercial soilless mixes can vary, but are likely to be competitive with mixes developed by the transplant grower, particularly when considering equipment, materials, storage and development costs. This is especially true if only a small number of transplants will be grown. Another advantage is that suppliers of commercial soilless mixes can provide advice about media selection. Some commercial mixes that are available in Oklahoma include "Redi-Earth," "Metro Mix," "Pro-Mix," "Sun Gro," "Sunshine" and "Jiffy Mix," to name a few.

If the transplant grower decides to make their own growing media, the following is a list of the ingredients for a soil-free growing media.

Table 1. Ingredients for soil-free growing media.

Materials	*Amount for 1 Cubic Yard of mix*
Shredded sphagnum peat moss (loose)	11 bushels
Horticultural vermiculite (sizes 2, 3,4)	11 bushels
Dolomitic limestone (pulverized)	2.5 to 5.0 lbs.
20% superphosphate (pulverized)	1.25 to 2.5 lbs.
Potassium nitrate or calcium nitrate	1.0 lb.
Trace elements	
Fritted trace elements (i.e. FTE)	1.0 oz.
Or Borax (11% boron) +	0.5 oz.
Chelated iron (i.e. NaFe, 138, 330)	1.0 oz.

Fertilize with 15-15-15 at seeding (4 to 6 oz./100 gallon), then at weekly intervals (8 to 12 oz./100 gallon). If chlorosis develops, apply supplemental chelated iron at rates recommended on the product label. In calculating the amount of media needed, 1 cubic foot of medium will fill approximately 275 pots 2 1/4 inches square or 20 packs measuring 5 by 8 inches by 2 3/4 inches deep.

Improving Planting Efficiency

Being efficient at planting is an important aspect of growing transplants. Even when growing a small amount of transplants, there are basic steps to make it easier and physically less difficult. First, if you have more than a few flats to plant, take time to adjust the height of the potting bench or table that will be used, so those doing the seeding will not have to bend over or reach excessively while seeding. Select containers that allow handling multiple containers or pots as a unit, not individually. Fill containers with growing media and use a dibble board (Figure 1) to slightly compact the media and to make multiple planting holes at a time of uniform in depth. Label containers in some manner to indicate planting date, crop species, and variety.

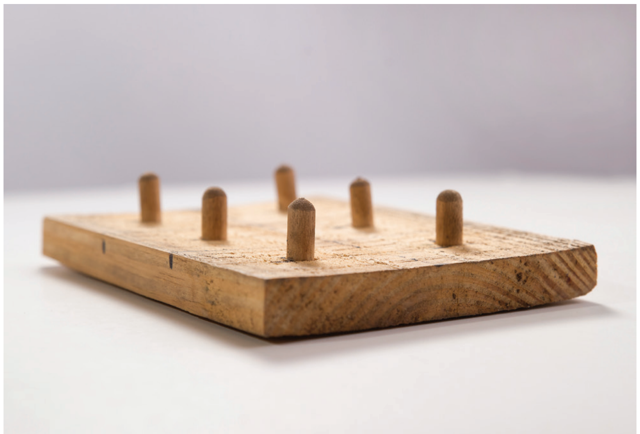

Figure 1. Dibble board.

Starting the Plants

Two basic systems are used for starting seedlings:

1. Seeding directly in small pots or growing containers that will be used for the entire period of transplant production.
2. Seeding into flats and later transplanting into growing containers where the transplants will be finished.

The first method involves less labor for handling small plants. Growers who seed in flats and later transplant into pots would do so because of space limitations. The point to remember is that it takes considerable time to transplant small seedlings into finishing containers and often root damage and poor growth are the result. Vine crops (cucumbers, muskmelon, watermelon, pumpkin and squash) need to be directly seeded into their finishing containers, since they do not survive well if transplanted as seedlings. When seeding directly into the finishing container, there should be one (maximum of two) seeds to each container. It is important to realize seedlings will need to be thinned to one plant per container. Over-planting will require extra time to thin.

When seeding is done in flats, seeds are sown in rows two or three inches apart. Seed should be distributed eight to ten per inch in the rows. For depth of planting refer to Table 2.

For good germination, the soil must be kept moist. To help maintain proper temperature (Table 2) and moisture for germinating seeds, the flats or pots may be covered with plastic until the seedlings begin to emerge from the soil. Be certain the optimum germination temperature range is maintained in the soilless media. Bottom heat from a plant heating mat is useful for maintaining soil temperatures and is less expensive than maintaining higher air temperatures in the entire growing structure.

Containers to Consider

There are many different types of containers to consider for growing transplants, but first there are a few questions that a transplant grower should ask themselves before selecting containers.

1. How critical are labor and space issues in your operation?
2. Are transplants being grown for sale or use in the same business?
3. Does the operation desire reusable containers?
4. What are the space requirements for the transplants being grown?

Containers for growing transplants vary both in design and in the materials of which they are made. Materials can range from compressed peat moss, styrofoam or plastic. Containers can be individual or formed into multiple container sheets, with each type having its unique advantages and disadvantages. Transplant growers should consider how transplants will be handled; i.e. as multi-celled units or as single pots. On a small scale, 10 to 20 transplants it really does not matter. When producing on a larger scale of fifty to hundreds or even thousands, multi-celled units are much easier to handle than single pots.

Compressed peat containers: These containers come in a number of configurations with single pots and multi-celled container sheets and compressed pellets (Figure 2). One advantage they have is that the transplant can be left in them with the entire pot and transplant being planted in the planting hole. This will allow the pot to degrade in the soil, adding a small amount of organic matter to the planting hole. One caution to be considered is that if the transplants have to be held for and extended time period prior to transplanting, the peat container may begin to breakdown, causing problems with watering and handling the transplants. Another consideration when using compressed peat pots is the edges of the pot should not be allowed to be above the soil surface after planting. It will act as a wick and pull moisture away from the transplant.

Styrofoam containers: Styrofoam can be formed into multi-celled transplant trays that are relatively long-lasting and can be reused to grow multiple crops of transplants (Figure 3). These trays are a standard length and width, but the number

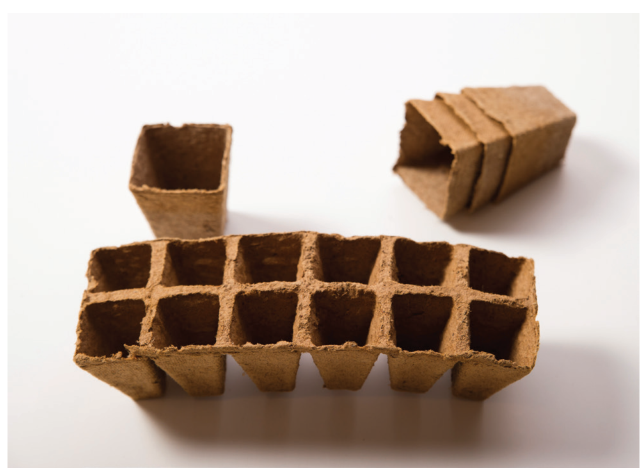

Figure 2. Peat containers.

of cells per tray will vary from one type to another. Standard sizes range from 72 to 200 cells per tray, but other sizes are also available. Advantages of these containers include long life, ability to be "floated" and sub-irrigated in a fertilized water solution and reduction in soil temperature changes due to the insulating value of styrofoam. As with all reusable containers, these trays will need to be washed and sanitized with a 10 percent bleach solution prior to reuse.

Plastic containers: Plastic containers come in all shapes and sizes and can be either single or multiple use containers (Figure 4). Plastic can be formed into multi-celled container sheets making handling much more efficient. One advantage of plastic is that printed sticky labels will adhere to plastic containers, which allows for labeling of each container. If plastic containers are to be reused, be certain to wash and sanitize them with a 10 percent bleach solution prior to reuse.

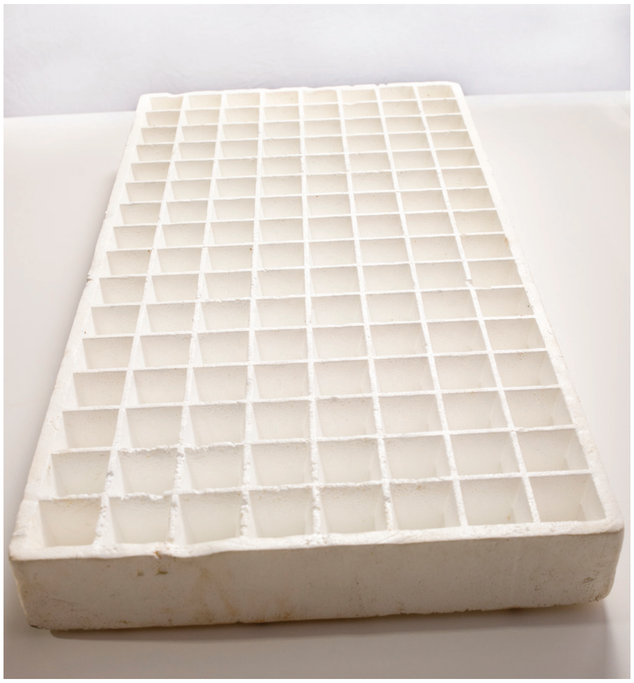

Figure 3. Styrofoam container.

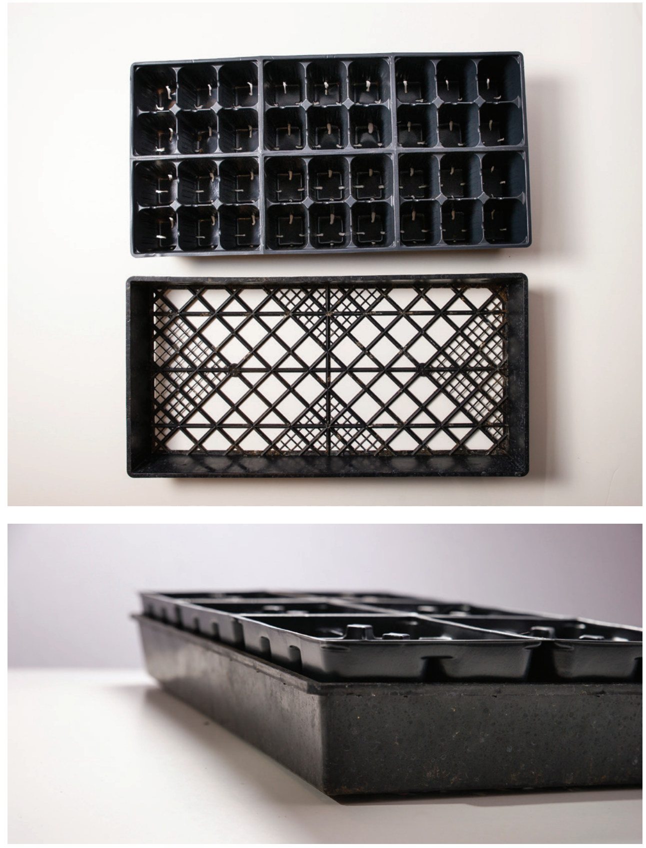

Figure 4. Plastic containers.

Table 2. Vegetable Seed Sowing, Growing Temperature and Spacing Guide.

Kind of Vegetable	*Approx. No. of Seeds per oz.**	*Approx. No. of Plants to expect per oz.*	*Time Needed to Grow Plant (Weeks)+*	*Seed Planting Depth (Inches)*	*Temperature Range for Germination (°F)*	*Plant Growing Temperatures °F++ Day*	*Night*	*Minimum Space forTransplants (Inches)[a]*
Cabbage	7,000	4,000 - 5,000	5 to 7	1/2	70 - 80	60 - 70	50 - 60	1 1/2 x 1 1/2
Cauliflower	10,000	3,000 - 4,000	5 to 7	1/4 to 1/2	70 - 80	60 - 70	55 - 60	2 x 2[b]
Broccoli	10,000	4,000 - 5,000	5 to 7	1/4 to 1/2	70 - 80	60 - 70	50 - 60	2 x 2[b]
Brussel Sprouts	8,500	4,000 - 5,000	5 to 7	1/4 to 1/2	70 - 80	60 - 70	50 - 60	2 x 2[b]
Head Lettuce	20,000	7,000 - 10,000	5 to 7	1/4 to 1/2	60 - 75	60 - 70	50 - 60	1 1/2 x 11/2[b]
Onions	9,500	4,000 - 5,000	8 to 10	3/8	65 - 80	60 - 70	45 - 55	------
Celery	70,000	10,000 - 15,000	10 to 12	1/8	60 - 70	65 - 75	55 - 65	1 1/2 x 1 1/2[b]
Tomatoes	10,000	3,000 - 4,000	5 to 7	1/4 to 1/2	70 - 80	70 - 80	60 - 65	2 x 2[b]
Peppers	4,500	1,000 - 1,500	6 to 8	1/4 to 1/2	75 - 85	70 - 80	60 - 70	2 x 2[b]
Eggplant	6,000	1,500 - 2,500	6 to 8	1/4 to 1/2	75 - 90	70 - 80	65 - 70	2 x 2[b]
Cucumber	1,000	400 - 500	3 to 4	3/4 to 1	70 - 95	70 - 90	60 - 70	3 x 3[c]
Muskmelon	1,000	400 - 600	3 to 4	3/4 to 1	75 - 95	70 - 90	60 - 70	3 x 3[c]
Watermelon	225 - 300	150 - 175	3 to 4	3/4 to 1	70 - 95	70 - 90	60 - 70	3 x 3[c]
Squash (Summer)	225 - 300	100 - 300	3 to 4	3/4 to 1	70 - 95	70 - 90	60 - 70	3 x 3[c]

* Varies with variety and seed sample
\+ Depends upon type of plant-growing structures used and heating facilities available
++ Reduce day termperatures 5° to 10°F during cloudy weather.
a Depends on size of plant desired, type of container, and the length of time plants are to remain in the flat or container.
b For growing in flats.
c Seeded directly into individual containers.

As soon as seedlings emerge, they should be grown at a somewhat lower temperature than required for germination (Table 2). The growing media should be irrigated as often as is necessary to keep the young plants growing, but not excessively, which can create disease and transplant quality issues. Various fungicide drenches or sprays can be used to help control plant disease in transplants. Banrot® is one example, but be certain to read and follow all instructions on the label. Transplants should not be overwatered except to flush excess salts from the growing medium. An occasional slight wilting of transplants is not harmful. Irrigation is a critical part of growing transplants. It requires attention to detail and may mean that the grower will need to check on transplants multiple times per day, particularly once plants have emerged. If possible, plants should be irrigated in the morning or early afternoon to prevent plants from remaining wet overnight.

Water, temperature and nitrogen fertilizer can be adjusted to control growth if plants are growing too fast and beginning to stretch (excessive stem elongation). To prevent transplants from stretching, manage the growing environment to provide high light levels, adequate, but not excessive nitrogen and maintain temperatures at an optimum level, since high temperatures causes plants to stretch. Seedlings exposed to a high light level (full sunlight) will mature quicker and produce higher quality transplants.

For those who germinate seeds in flats and then transplant to the finished container, transplant seedlings when the first true leaves are forming, usually two to three weeks after direct seeding in flats. Set the seedling slightly deeper than it was growing in the seedling flat. When handling the seedlings, hold by the cotyledons since handling it by the stem often irreparably damages the plant. Take care in firming the soil around the plant to avoid injuring the tender stems then water seedlings thoroughly immediately after transplanting to prevent excessive wilting. Table 2 gives plant spacing for transplanting to other flats or containers. Later, individual plants, flats or containers may be spaced further apart to increase light availability and plant quality.

Gradually harden plants for a week before transplanting them into the field or garden. Hardening prepares plants to withstand conditions such as chilling, high temperatures, drying winds and water stress. Reducing watering, withholding nitrogen fertilizer, and moderately lowering temperature are the best ways to harden transplants. Part of the hardening process should also include moving the plants to a sheltered and secure outdoor area where plants will receive full sun, exposure to wind and temperature swings, but monitor weather forecasts and protect the plants by covering or moving indoors if storms, frost, etc. are forecast. A young transplant is much better than an old transplant. One of the most common errors made by transplant growers is to start plants too early in the season. For maximum season's yield, transplants should never have fruits, flowers, or flower buds before transplanting. An ideal transplant is young, growing fairly rapidly, but slightly hardened at transplanting time. It should not be over-hardened or too soft when transplanted. Rapid growth following transplanting ensures well established plants before fruit develops.

Follow these steps to produce disease-free transplants:

(1) Use disease-free seed or seed treated for disease-causing organisms.
(2) Use plant growing containers free of disease-causing organisms.
(3) Use a planting medium free of disease-causing organisms.
(4) Follow strict, "kitchen clean," sanitary practices.
(5) Keep plants and soil from remaining wet for long periods of time.
(6) To help prevent damping-off diseases, it may be necessary to use fungicide sprays or drenches.

Original content for this Fact Sheet was developed by Warren Roberts and James Motes at Oklahoma State University.

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