Tomato Transplant Production for Iowa Early Fresh Market

By Henry G. Taber
Department of Horticulture
Iowa State University
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The objective is to produce a healthy, stocky, transplant able to withstand harsh Iowa spring conditions. Of course, plastic mulch, rye windbreaks, and perhaps row covers should be used to maximize high yields of large fruit. In recent years, a trend to plug transplant production (128 to 200 cell trays) has taken place to reduce transplant and shipping costs.

However, older research has shown bigger is better as far as early yields of fresh market tomatoes are concerned. Michigan State University demonstrated in 1980-1981 experiments that there was a linear increase in early yield as cell size increased from 0.8-inch to 1 ¾ - inch (resulting in a 12000 lb/acre increase). University of Florida has reconfirmed these results with studies in 2000 (see results at http://edis.ifas.ufl.edu/HS107). Thus, growing a tomato transplant in the largest cell tray economically feasible will result in the highest early yield of large fruit.

In most cases, a 5 to 7 inch plant will work well in many mechanical transplanters. The stem must be thick and rigid enough to hold the plant in position during the handling and planting process and remain upright after planting. A plant that is stocky, is moderately dark green and shows slight purpling of the veins on the underside of the leaves, but has no flower buds is an excellent transplant. One that is over-hardened, yellow and shows evidence of severe drying of the roots will not recover rapidly after planting. Growth rate in the greenhouse is primarily affected by excessive N fertilization, poor light conditions, and high temperature. The faster the growth the lower the carbohydrate reserves and less likely the transplant will be able to withstand transplanting shock. Thus, the plants should be hardened off just prior to transplanting. This can be done by exposing plants to lower growing temperatures, wind, or reduced amount of N and water.

The below steps have worked well in our research studies with fresh market tomatoes.

1. Use an artificial soilless mix containing peat, vermiculite, perlite, and or pine bark. There are many choices on the market. Some may have a small amount of fertilizer which is okay, but do not select a mix that has a ‘high fertilizer charge’ as seedling size will be difficult to control. Common ones are Metro Mix 360 and Fafard Sunshine Mix SB300.
2. The timing of seeding, transplanting, and transplants set in the field will depend on the growing temperature and, of course, the ideal field transplant time for your area. In central Iowa we transplant from May 1 (early with row covers) to May 15 (normal). The total time to grow the transplant crop ranges from 5 to 7 weeks. Thus, our seeding in the greenhouse would occur from late March to about April 10th. Germination of seeds occurs in about 4-7 days, seedling growth for 1 week until transplant to cell trays, and then grow 2 ½ to 3 weeks to field transplant size.

3. Broadcast seed in a seedling flat containing the artificial mix with rows about 3-inches apart and the flat about 3-inches deep. For example, a 10-inch by 20-inch deep tray with 5 grooves per tray and about 300 seeds per groove. You may want to over-seed your total need by 10-20% depending on germination performance of the seed lot. Maintain root-zone temperature at least 75°F (optimum germination temperature is 78-82°F). A heating pad may be best. The flat does not need to be in light. When seedlings germinate, about 4-6 days depending on temperature, immediately move to light (high light lamps will be helpful at this point) in the greenhouse.

4. Grow for 4-7 days or until the 1st true leaf is visible. Prick out the most uniform seedlings, discarding the rest, and transplant singly into at least a 50 or 72-cell tray (50-cell = 1 7/8-inch diameter and 72-cell = 1 5/16 diameter cells) containing the soilless mix. A square cell is better than a round, pyramid type. Plant as deep as possible, right up to the cotyledons. Again, over transplant by at least 10%.

5. Water and fertilize on an ‘as needed’ basis. This is done in conjunction with light conditions. On dark, cloudy days withhold water and nutrients. A rate of 200 to 300 ppm N and K in the fertilizer water should be adequate. You might start off with a ¾ rate. Including the fertilizer in the water twice per week is usually sufficient. Some common analyses are 17-5-19, 21-5-20, or 25-5-15 at one lb per 100 gals. Use a fertilizer low in urea and ammoniacal N. Maintain day temperature at 65 to 70 °F and a minimum night temperature of 60 °F. If the night temperature drops to 50 °F or lower severe fruit cat-facing will occur with several varieties (notable on Sunstart variety). We have found it difficult to maintain the day temperature at 65-70 °F on bright sunny days, so our production schedule is usually closer to 5 weeks rather than 7 weeks.

6. You can monitor the soluble salt level in the root-zone with an inexpensive pocket Ec meter. A reading of 0.15-0.35 (1:5 dilution) just after pricking out is good. As the crop grows you can let the Ec reading rise to 0.35-0.50.

7. Moving transplants directly from the greenhouse to a field environment could result in transplant shock and loss of early yield. The leaf cuticle (outer, waxy coating) has not formed yet and loss of water from the leaves will be high. Anti-transparent products, such as vapor guard, have been tried without success. The material tends to plug the
stomates (leaf pores) that are necessary for air exchange. Harden-off the plants by placing trays outside during mid-day to allow light and wind to condition them. Or, depending on the greenhouse, roll up the sides and open the end doors to allow cool, outside air (48-50°F) to lower the temperature. You can also withhold water to dry out the flats for a few hours each day. Do not be concerned if the plants droop, but this condition should not be allowed to remain for more than 2-3 hours. Three to five days hardening is sufficient.

8. Prior to transplanting in the field fertilize the trays with a full fertilizer rate. Or, use a high phosphate starter in the transplanting water. For example, 3 lbs/50 gals of 10-52-10, 23-21-17 or similar analysis. The high phosphorus liquid starter, 10-34-0, can be used at the rate of 2 quarts per 50 gallons of water. Apply the starter solution at 0.5 pint (8 ounces) per plant. Be sure to irrigate the field after transplanting.

9. Pest problems can be numerous, but we have only experienced thrips and damping off disease.
   - **thrips** (more specifically the western flower thrip) spreads the tomato spotted wilt virus. Your best line of defense is sanitation. Remove old debris from the greenhouse, clean up outside weeds growing along the sides and ends, and power wash with a sanitizer (bleach). Also, it is important not to maintain vegetatively propagated ornamentals in the same greenhouse. Finally, use yellow sticky traps in the seedling flats to monitor the presence of thrips (and other insect pests). The thrip is tiny, about 1-2 mm. [photo courtesy of UC Statewide IPM Project, University of California]
   - **Damping-off fungus** can affect seedling flats and more predominately newly transplanted tomato, pepper, and vine crops. The stem at the soil line becomes water-soaked and restricted leading to collapse of the plant. There can be several causal agents such as Fusarium, Phythium, Phytophthora, etc. Recently we have seen the problem flare up in transplanted peppers in high tunnels, particularly the wall rows. Use ‘clean’ soil mix (artificial), grow at proper temperature, and prevent overwatering. [Photo courtesy of Dr. Dan Egel, Purdue University].
For your information, the following table contains growing conditions for other common vegetables transplants.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Temperature, °F</th>
<th>Germination</th>
<th>Day</th>
<th>Night</th>
<th>Time, weeks</th>
<th>Plants/sq.ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broccoli</td>
<td>70 – 85</td>
<td>65-70</td>
<td>60</td>
<td></td>
<td>5 – 6</td>
<td>48</td>
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<tr>
<td>Cauliflower</td>
<td>85 – 95</td>
<td>70-75</td>
<td>65</td>
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<td>3</td>
<td>24</td>
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<tr>
<td>Cucurbits</td>
<td>70 – 85</td>
<td>70-75</td>
<td>60</td>
<td></td>
<td>5 – 7</td>
<td>36</td>
</tr>
<tr>
<td>Pepper</td>
<td>70 – 85</td>
<td>70-75</td>
<td>60</td>
<td></td>
<td>5 – 7</td>
<td>36</td>
</tr>
<tr>
<td>Tomato</td>
<td>70 – 85</td>
<td>75</td>
<td>60</td>
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<td>4 – 6</td>
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<tr>
<td>Eggplant</td>
<td>75 – 85</td>
<td>70-85</td>
<td>65</td>
<td></td>
<td>5 – 7</td>
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