insideGROWER

October 2015

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Growing Greenhouse Tomatoes in Containers

A good way to jump into producing finished greenhouse vegetables from bedding plants is to grow tomatoes.

by **NEIL MATTSON**

Increased consumer demand for fresh, high-quality produce has led some bedding and potted plant greenhouses to consider vegetables for produce sales. Greenhouse operations are keen to put their facilities to use during their offseason. Doing so has the potential to increase their annual net revenue by growing another crop to help pay for fixed expenses (such as depreciation, property taxes, insurance, management salaries). Adding in vegetable crops during the off-season can also allow operations to keep labor employed year-round.

The first thing to consider with any new crop is the market channel that will be used to sell it. Some market channels include a retail store, farmer's markets, restaurants and local supermarket chains. Each grower must carefully scrutinize the costs of growing vegetables against their potential returns. Because this requires a lot of data on crop labor and input needs, as well as time to develop new markets, I've observed many bedding plant growers starting with veggies at a small-scale, exploratory basis.

Figure 1. Commercial greenhouse tomatoes growing in Dutch buckets (also known as "Bato" buckets).

Figure 2. The containers used in this study—Smart Pots—are a durable fabric container.

SUMMER TOMATOES IN CONTAINERS

Fresh, vine-ripened tomatoes are a consumer favorite. Tomato plants have high light demand for decent yields, a minimum daily light integral (DLI) of 20 moles of photosynthetically active radiation per square meter per day (i.e., 20 mol/m^2/day). To put this into perspective, suggested DLI requirements for high-quality bedding plants are on the order of 10 to 12 mol/m^2/day. For tomatoes, yield goes down by 1% for every 1% decrease in light. Therefore, year-round production requires supplemental light in much of the U.S. Because greenhouses are often idle from summer through early fall and have high natural light during this period, it's an ideal time to grow greenhouse tomatoes. Tomato plants are typically grown in rock wool slabs or containers, such as 3-gal. Dutch buckets (Figure 1) or 5- to 10-gal. round containers.

CORNELL TRIAL

We conducted a trial at Cornell University growing greenhouse tomatoes in a production system that could be adapted readily by bedding plant growers, using 5- to 10-gal. containers with potting mix and drip irrigation. We wished to determine the influence of container size on the fruit yield of greenhouse tomatoes growing in containers. The containers used in this study were Smart Pots, durable, soft-sided fabric containers often used in the nursery industry for root-pruning and aeration (Figure 2).

Seeds of Primo Red, a determinate large beef-steak tomato, were started by a commercial propagator on March 1. Seedlings were transplanted into square 3-in. pots. On April 15, we established our greenhouse trial—too early for a bedding plant grower—but we believe they could have transplanted and held at a higher density for some weeks until more greenhouse space was available. Seedlings were transplanted into Smart Pots with either a 5-, 7- or 10-gal. volume. The containers were filled with a peat/perlite-based substrate (Lambert LM-111). At this time, plants were placed in the greenhouse at a final spacing. Recommended plant spacing is 1 plant per 4 to 6 sq. ft. (Under low light, the wider spacing is suggested.)

We chose a spacing of 1 plant per 5½ sq. ft. to give us ample space to get to each plant. From the center of each plant, they were spaced 20 in. apart between the plants within a row and 40 in. apart between rows. Plants were on a drip irrigation with two emitters per plant. Plants were placed in an older glass greenhouse with fan and pad cooling. No supplemental light was used. In late May, a light application of shading compound (about 30% shading) was applied to the exterior of the glass to help with temperature control. Our green-

house temperature set points were 75/63F (23/17C) day/night temperature.

Tomato plants have higher demands for magnesium, potassium and calcium than traditional bedding and potted plants. Therefore, 25-lb. bags of "complete" water-soluble fertilizer used for potted flowering crops cannot typically be used as the sole fertilizer source. Besides our standard bedding plant fertilizer 21-5-20 (which contains micronutrients, but no calcium or magnesium), we added calcium nitrate, potassium nitrate and magnesium sulfate (Epsom salts). Calcium nitrate isn't compatible with 21-5-20 because a precipitate forms. Therefore, we used two stock tanks to prepare our fertilizers.

Because we had only one fertilizer injector, we alternated between the two stock solutions. During weekdays we used 150 ppm N from 21-5-20 plus 50 ppm magnesium from magnesium sulfate. During weekends, we switched stock tanks to deliver 150 ppm nitrogen from calcium nitrate and 100 ppm N from potassium nitrate. We monitored substrate electrical conductivity and pH weekly. When substrate pH was greater than 6.8 (optimum pH is 5.5 to 6.0), we switched to a more acidic fertilizer 21-7-7 in place of the 21-5-20 for a few days to bring pH back down. For a more in-depth article on fertilizer recipes for hydroponic fruiting crops and leafy greens, see "A Recipe for Hydroponic Success" in the January 2014 issue of *Inside Grower.*

Although the plants we used were determinate, they still grew several feet high, 6-ft. in our case, and needed to be trained to keep them upright. We suspended 9-gauge wire 7 ft. above each row and hung a spool of string from the wire to the base of each plant. Periodically, we used plastic clips to secure the stem below a strong leaf to the string, using clips about every foot of stem.

Early in the growing season, we removed lateral stems, or suckers, when they were 1 in. long. This encourages development of fruit instead of vegetative growth. About two months after transplanting in mid-June we let a few lateral stems grow on each plant, these provided fruit later in the season when the main stem had stopped producing. If an indeterminate variety of tomatoes is used, all suckers are typically removed. In addition, when indeterminate plants get taller, string is unwound from the spool and plants are leaned over and lowered so you can still reach the upper part of the plant. We removed older leaves up to the ripening fruit. This is important to promote good airflow to reduce disease incidence and to reduce habitat for insect pests. Regarding pollination, we didn't use a hand pollinator or bumblebees to aid in pollination of

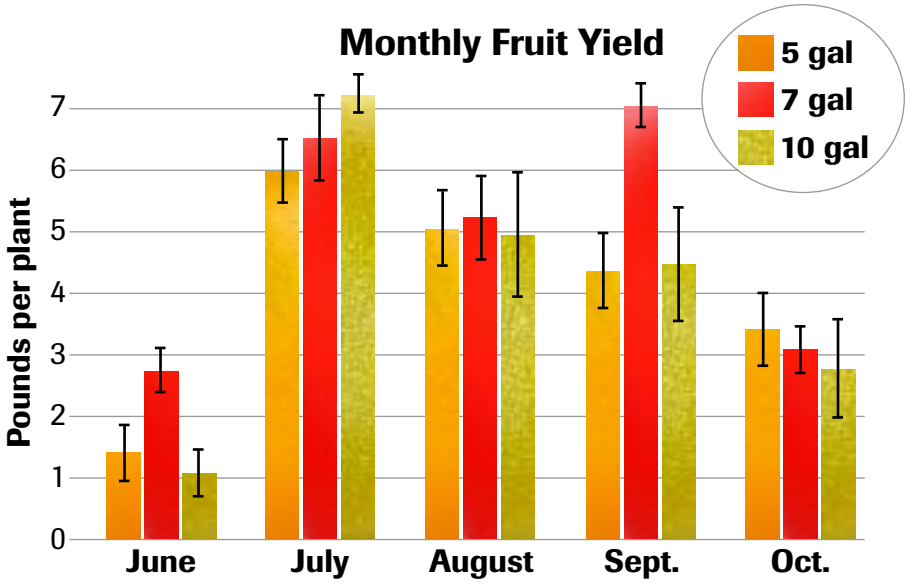

Table 1. Monthly fruit yield (pounds per plant)* in response to container size.

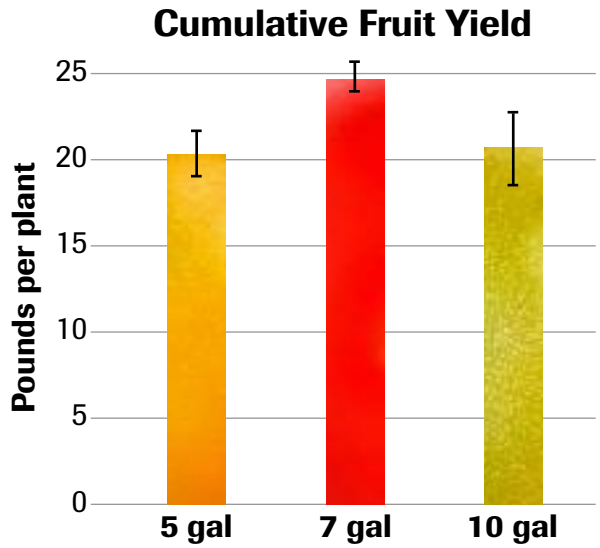

Table 2. Cumulative fruit yield (pounds per plant)* during the entire production cycle.

*Data are averages +/- standard deviation of 10 plants per treatment combination.

flowers; however, these methods are reported to improve fruit yields by about 20%. Fruits were harvested three times a week at the red stage (i.e., vine ripened).

Our first fruit were ready to harvest on June 4—about 7 weeks after transplanting (Tables 1 and 2). Plants yielded 1 to 2.5 lbs. of fruit in June. Peak harvest months were July, August and September, when plants produced about 6, 5 and 4.5 lbs. per month, respectively (Table 1).

We concluded the trial at the end of October, as plants were yielding few marketable fruit by the end. Average fruit size was about 13 oz. for the first month and 9 oz. thereafter. We believe the decrease in fruit size is because later on there were many more fruits per plant to which the plant's energy had to be divided between. Interestingly we found that container volume of the Smart Pots significantly impacted plant yield. Cumulative plant yield over the entire crop season was greatest with the 7-gal. Smart Pots with an average of 24.5 lbs. per plant (Table 2). Plants in the 5- and 10-gal. containers produced about 20 lbs. of tomatoes per plant. We're unsure of the reason behind this, but we propose that the 5-gal. containers didn't hold quite enough water/nutrients for >>>

our fertilizer regime, while 10-gal. containers may have held too much, thereby keeping plants more vegetative and less reproductive.

Overall, our study shows Smart Pots could be successfully used to produce container tomatoes in the greenhouse. Our methods for container tomatoes can be readily adapted by bedding plant growers wishing to use summer greenhouse space. As with any new crop, growers should begin with small-scale trials to learn about the specific production system and determine if a profit can be made given their market and crop expenses.

Disclaimer: Mention of trademarks or brand names is for informational purposes only and does not imply its approval to the exclusion of other products that may be suitable.

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Tomato plants from the Cornell trial (supplemental lights weren't used).