Container Growing:
Managing greenhouse tomato for consistent and optimum yields

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Greenhouse tomato yields have increased dramatically in recent years. Advanced knowledge of how this crop responds to cultural conditions combined with intensive environmental and crop management capabilities are the reasons for these advances.

Managing light, temperature, and crop water and fertility status are the keys to optimal production. How we manage these factors and how we manage the crop in response to seasonal and daily environmental changes, greatly influence plant productivity, consistency of yield and fruit quality. In this session I will show how changes in environmental conditions affect plant response and how these changes influence your crop management decisions.

It all starts with light

Yield potential all starts with light. The relationship between available sunlight and yield is fairly direct – the more light the greater the yield potential. A rule of thumb is that a 1% increase in light equals a 1% increase to crop growth. You can increase growth potential by increasing the amount of light available, by increasing the amount of carbon dioxide, or by maximizing the efficient utilization of the available sugars created from photosynthesis. We can split the year into the light limited season and the light unlimited season. During the light limited season growers need to take steps to maximize utilization of all available light.

Adjust temperature to match the prevailing light condition

Temperature, water, and fertility must all be managed in response to the prevailing light condition. Temperature controls the rate of plant metabolism. When night temperatures are high plants burn more energy in respiration but also have the ability to produce more growth. When night temperatures are lower, growth is slowed but energy lost to respiration is also reduced. On bright days, plants store a lot of food (sugars created from photosynthesis) and can sustain high growth rates. However, on nights following cloudy, dark days, plants have very limited energy available for growth. To optimize growth you must balance energy lost to respiration with energy available for tomato growth. In this session I'll discuss strategies for achieving this aim.

Give plants adequate space

As a general rule each plant should have 4-6ft^2 of floor space. Most new growers jam too many plants into the house. This does not increase overall yield but it does result in smaller fruit and more difficulty in handling and managing the crop. Under light limited conditions growers should provide 5-6ft^2 per plant, but if you grow primarily during the

high light late spring and summer months, 4-5ft^2 will be adequate. Over the range of 4-6ft^2 per plant, yields are pretty constant per acre. The big difference is in fruit size. With a more generous spacing each plant produces more fruit and the fruit tend to be larger.

Managing fruit load & size
Quality fruit start with pollination. There is a strong correlation between the number of pollen grains that pollinate a flower and the potential size of the fruit. Each pollen grain produces a single seed. Fruit with large seed counts have the potential to grow large but fruit with few seed do not. Bumblebees are the best pollinators and even for a small grower it is worth using bees to set fruit.

Matching fruit load to the carrying capacity of the plant is an important aspect of crop management. If consistent yield in important, you need to avoid the roller coaster of heavy set early followed by lost plant vigor and poor fruit set later. Growers can even out yield and maintain crop vigor over time by limiting the number of fruit on the plant to correspond with the seasonal light conditions. Cluster pruning can also be used to increase fruit size.

Water and nutritional management also influence the tendency toward either vegetative growth or fruit production. This is a balancing act you must manage. Too much generative growth (fruit production) and crop vigor will decline.

Water management
Irrigate before daybreak to put the plants in a good water status for active photosynthesis at first light. After daybreak, limit the amount of dry down between irrigation events to 8-10% in the morning. This will favor vigor and active growth. Increase water stress by increasing the dry down to about 16-18% in afternoon. This will favor generative growth. Frequent light irrigations work best. Avoid daily extremes. Irregular watering and excessive stress favor a number of fruit disorders including concentric cracking, vertical cracking, crazing etc. Plants under low light will require less water then plants in a high light environment.

Nutrient management
The ratio of potassium (K) to nitrogen (N) in the nutrient solution influences the tendency toward vegetative or generative growth. Maintain a K:N ratio of 1K:1N during seedling development. This will favor strong vegetative development. At first flower the ratio should be about 1.5K:1N. As fruit approaches ripening a ratio of 1.7K:1N will favor good color development. If plant vigor starts to decline too much, shift the ratio in favor of vegetative growth by temporarily increasing the relative proportion of nitrogen (1.25K:1N) until vigor recovers. Limit the amount of ammonical-form nitrogen to less than 10% of the total nitrogen.

Overall salt levels also impart a water stress on plants and affect the vegetative/generative growth tendency. High EC favors generative growth

Growers should note that water management involves adjustments on a daily-basis as dictated by prevailing weather conditions. However, nutrient management involves adjustments over a longer period of time based on crop performance and seasonal expectations.

Using grafted rootstock

Grafting is widely used in horticulture for a variety of reasons. Increasingly greenhouse tomato growers are using grafting to both decrease susceptibility to root diseases and to increase fruit production through increased plant vigor.

Grafting involves splicing the fruit-producing shoot (called the 'scion') of a desirable cultivar onto the rootstock of another cultivar to increase disease resistant and/or vigor and yield. Two cultivars still widely used for rootstock in the greenhouse are 'Maxifort' and 'Beaufort' but many other rootstock with outstanding disease resistance characteristics are commercially available (http://www.vegetablegrafting.org/wp/wp-content/uploads/2015/02/usda-scri-tomato-rootstock-table-feb-15.pdf).

Vigorous rootstock change the way we manage the greenhouse tomato crop. With non-grafted plants, the management challenge is to keep the plants vigorous enough so that they don't stall-out and lose production. With grafted rootstock, the opposite is true. Growers need to work to rein-in plant vigor so that they don't become too vegetative. This is an easier management challenge because you can control vigor by increasing plant stress or by limiting the number of leaves on the plant

Reading the plant

A big part of successful greenhouse tomato management is being able to quickly recognize how the crop is responding and then make the proper adjustments before problems develop. This ability to 'read the plant' comes with experience, and is vital to optimizing production. Here's what to look for. Leaves should be closely spaced and deep green with a slight downward curl. Early in the day plant leaves should appear bright and turgid (indicative of low water stress). Later in the day, leaves should appear darker under moderate water stress used to induce generative growth. Plant stems should be thick, about 0.5 inches at 6 inches down from the growing tip. Stems that are thicker indicate growth that is too vegetative, while stems that are thinner indicate too much stress. Most importantly, flowers should develop and open without aborting, and fruit should set easily and size rapidly.