CHAPTER 3

HOW TO GROW GREENHOUSE CROPS

INTRODUCTION

*The main goal of any grower is to successfully produce a crop and optimize yields.
Optimum yield = high quality with high yields.
*This Chapter will cover **how** to grow greenhouse crops including crop scheduling, greenhouse preparation and providing the optimum environment, plant spacing and crop layout and general cultural practices.
*This chapter will concentrate on tomatoes with reference to other crops to illustrate the variability in cultural practices between crops.

CROP SCHEDULING

*Plan ahead… When do you want to market your product for the best monetary return?
Arizona hydroponic tomato growers used to get a better price in Winter with no competition from field or northern greenhouses. Now, competition from Mexico.
Alternative: grow year around to maintain a stable, consistent market/shelf space.

*Tomatoes: 3 examples of crop scheduling

Example 1: UA/CEAC: Active cooling but need to conform to school year.
Seed late July, transplant early August, plant 1-month-old seedlings late August.
Harvest late October until May or June. Plants in 9-10 months - no interplanting.
Remove plants, clean greenhouse and prepare for the next Fall semester.

Example 2: EuroFresh: Originally, passive cooling (vents only): No Summer harvest.
Seed early July; transplant mid-July, plant 1-month-old seedlings in August.
Harvest from October until March with total time in the greenhouse = 8 months.
Top plants in February; remove when second crop begins producing in March.
Seed second crop in early December, transplant in mid-December and "Interplant" new 1 month old seedlings onto Rockwool slabs in January.
Harvest from this new crop from March until July. Remove plants. Clean.

Example 3: EuroFresh: Active cooling (vents & fan and pad): Year around harvest.
Seed, transplant and plant first and second crops as above, removing first crop at the end of March after 8 months (*) in the greenhouse
(*) Later changed to 10-12 months to save on the cost of transplants!
Continue second crop, harvesting from April through September.
Seed, transplant and plant the third crop, as the first, in July/August.
When third crop is ready to harvest in October, remove second crop… etc.

NOTE: Many commercial growers buy seedlings from a TRANSPLANT GROWER (see Chapter 6) so they can concentrate on production (growing, harvesting, marketing, etc.).
NOTE: Plants are not grown indefinitely: over time stems grow longer and it takes more energy to pump water/nutrients to the developing head causing reduced fruit size/quality.
NOTE: Interplanting is no longer recommended since it can increase pest problems.

GREENHOUSE PREPARATION (see also Chapters 11, 12 & 13)

*Select a site for the greenhouse that is appropriate for the operation (see Chapter 11).
*Select a greenhouse structure that is appropriate for the operation (see Chapter 12).
*Make sure all equipment is cleaned, serviced and working at optimum efficiency.
*For any crop, incl. tomatoes, the following items must be considered prior to planting:

Good light transmission: Choose the proper greenhouse covering and structure.
If year-around production is planned, shading may be used in Summer.

Adequate cooling: Either passive (vents or shade), active (fan and pad), or both.

Heating is necessary in Winter: Natural gas has been an economical way.
Other methods: propane, oil, electric & solar (growing technology).

Carbon dioxide generation: This is especially important for Winter mornings.
The sun rises, but it's cold. So if fans come on, it's only for a short time.
Plants begin to photosynthesize, using up the ambient carbon dioxide to the point where photosynthesis is effected and even reduced..
If photosynthesis is reduced, fruit set is reduced – and that's $$!

Ground cover: Usually white plastic or a white woven material is put down first.
- Reflects light back up into the crop increasing photosynthesis up to 30%.
- Provides a barrier between the plants and pathogens in the soil.
- Helps to control weeds.
- Allows for ease of cleaning: CLEANLINESS IS PARAMOUNT!
Trash, leaf litter, etc. is a perfect habitat for bugs/disease.

Irrigation system: (see Chapter 10 for details and diagram) This inlcudes:
- Timer/controller: regulates the "fertigation" (water + fertilizer) schedule.
This will be hard-wired to solenoid valves that open for watering.
- Reservoirs to contain the nutrient solution (full strength or concentrate).
- Injectors (if concentrates are used) to dilute the nutrient solution.
- Distribution tubing/emitters/drainage and/or recycling system.
- Integrated pH (acid/base) and EC (electrical conductivity) probes.

Overhead support wires: These need to be strong enough to support the crop and high enough (8-22 feet) to make use of the vertical space provided.

ENVIRONMENTAL CONDITIONS REQUIRED (see also Chapter 13)

***LIGHT:** Greenhouses today are built with a minimum of structure and strong, light-weight materials to allow more light in. Two factors of light are important and can be affected by greenhouse structures and coverings (see Chapter 12).

Quality: "Wavelengths" of light. This can vary slightly for each plant species.
- Visible light = 390-760 nm: blue at the low end, red at the high end.
- PAR (photosynthetically active radiation) = between 400 and 700 nm.
Primarily blue, yellow, orange and red (see Chapter 2).

Quantity: Is affected by both day length and sun angle (i.e., changes with season):
- Day Length: In Tucson, AZ on June 21 day length is 14 hours 15 min.
On December 21 day length is only about 10 hours. [less light = less ps]
- Sun Angle: Tucson AZ is located approximately 32.5^{o} North, 111^{o} West.
In June the angle is high = 81^{o} from the horizon (almost overhead).
In December the angle is low = 34^{o} from the horizon.

- The quantity (amount) of light is therefore higher in June and lower in December (in northern hemisphere) and will effect growth & fruit load.
  Example: For beef steak tomatoes in the desert southwest (high light area):
  During the Winter (low light) = 2 – 3 fruit/cluster.
  During Spring/Summer/Fall (higher light) = 4 – 5 fruit/cluster is typical
  Example: For smaller fruited types (TOV, Roma, Cherry, Grape, etc.), each cluster can hold more fruit than beef but still have fewer fruit in Winter.
- If light is too high (causing sunscald or plant stress) shading may be needed.
- In low light areas or during winter, lights may be used throughout the day or just in the morning and/or evening to extend the day length. [This costs $$!]

***TEMPERATURE:** Optimum temps (day/night) vary for different species and varieties.
- Example: for TRUST beef steak tomatoes (not a heat tolerant tomato variety):
  Germination and post-emergence temps = 23-25 C (74-77 F)
  Production temps = 20-25 C (68-77 F) day / 15-17C (60-64 F) night.

Rules of Thumb:
- Day temps should be higher than night temps. High night temps increase respiration which wastes photosynthates reducing yield potential.
- If possible, "ramp" temp up from ~3am to dawn to warm fruit → active "sink".
- Tall greenhouses (16'-22' at the gutter) optimize temps around the crop by allowing hot air to rise away from the crop (taller now than 50 years ago).
- Tucson/UA, and other hot regions are suitable for heat tolerant varieties.
- Smaller fruited varieties (cherries, grapes, etc.) are better for high temp regions.

***RELATIVE HUMIDITY (RH):** The amount of water in the air compared to the total amount of water that the air can hold at a given temperature.

$$\%RH = \frac{\text{Amount of water in the air}}{\text{Amount of water possible at a given temp.}} \times 100$$

As the temperature decreases, the amount of water the air can hold decreases… until the air is saturated & water condenses (clouds at altitude or fog near ground).
How does this relate to tomato plants growing in a greenhouse?
- As the RH increases around the leaf (concentration of water molecules outside increases) it makes it more difficult for the water molecules inside the leaf to move out (transpiration) via diffusion (the passive movement of a substance from high to low concentration – see Chapter 2).
- Therefore, as the RH increases, transpiration decreases, water and therefore nutrient movement decrease, and nutrient deficiencies can result.
- ALSO, as RH increases and transpiration decreases, leaf temperatures often increase, since transpiration is the plant's way of cooling itself.
- If RH is low, plants may transpire too much and wilt (i.e., mid-day wilt).

Optimum RH range for tomatoes (and most plants) = 55% - 85 or 90%
In Arizona during hot, dry weather, fan and pad cooling adds moisture to the air.
On hot, humid days, fan and pad cooling adds moisture but does not cool as well.
During cool, damp weather, RH inside the greenhouse can approach 95% !

***CARBON DIOXIDE:** Critical for photosynthesis. Enrichment is most important during Winter on cold mornings when vents/fans are still off (no exchange of air with the outside), but the sun is up and the plants are photosynthesizing. Average outside ambient levels are now around 400 ppm, up from ~315ppm in 1960, and steadily rising (higher in cities due to industrial/auto exhaust). You can enrich in the greenhouse up to 800 - 1000 ppm, but this costs money $$!

***AIR CIRCULATION:** This avoids pockets of high or low temperature, humidity or carbon dioxide. This also reduces the boundary layer (the physical "still air" layer around the leaf) so that proper gas exchange and transpiration can occur. When cooling fans are off, HAF (horizontal air flow) fans should be used.

***OXYGEN:** All parts of the plant require oxygen for respiration (see Chapter 2). There is usually no problem supplying the top part of the plant with enough. But water-logging and high temps. will inhibit oxygen movement to the roots.

PLANT SPACING AND CROP LAYOUT

*Plant spacing is determined by two main factors:

The availability of light to the canopy. Plants must be far enough apart so that a maximum amount of light reaches the leaves for optimum photosynthesis.

The availability of water and nutrients to the roots. Plants must be far enough apart so that all plants have an optimum supply of water/nutrients.

*Spacing for vining greenhouse crops (tomatoes, etc.) is much closer than for field crops.

Example: Field (bush) tomatoes = 4000 – 5000 plants/acre.
Hydroponic greenhouse tomatoes = 10,000 – 11,000 plants/acre.

*Why the difference in plant density between field and hydroponic tomatoes?

-A vine has a smaller diameter than a bush, so they can be closer together and the leaves will still obtain optimum light for photosynthesis.

-The roots of plants growing in hydroponics receive all the water and nutrients required via drip irrigation whereas field grown plants must grow large root systems to search for water and nutrients in the soil.

-Therefore, to avoid competition for light, water and nutrients, field grown plants must be positioned farther apart.

*****Typical hydroponic plant spacing: Tomatoes = 2.5–3 plants/m^2 (occasionally higher)
Peppers = 4–6 plants/m^2 8–10 pl/m^2 for mini's
Cucumbers = 1.25–3 plants/m^2

*Typical layout of a greenhouse for vining vegetable crops is in rows tending north and south. WHY: the sun moves from east to west and if the rows were also set up east to west, the southern most rows (in the northern hemisphere) would shade the rows behind them.

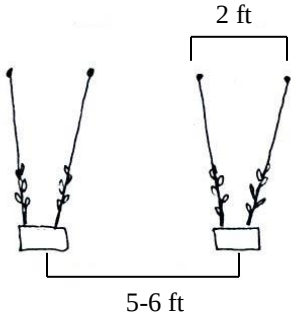
*Typically, tomatoes are also grown in "double rows" 5-6 feet apart.

Plants can either be single or double headed ("pinched"):

If single headed: plant 6 plants per slab/bag.

If double headed: plant 3 plants per slab/bag,

Overhead support wires are set at least 2 feet apart.



TRAINING AND PRUNING

***Introduction:**

In general, tall greenhouse crops (tomatoes, peppers, cucumbers) are indeterminate (vining) types, chosen to take advantage of the vertical height of the greenhouse.
Training and pruning techniques are described for high wire, bag culture, hydroponics.
Since plants have a finite amount of mineral nutrients and photosynthates, the pruning techniques presented help to maintain a balance between vegetative and reproductive growth in order to maximize plant growth and fruit production.

***Training:**

Plants are trained to 1-4 stems by removing (pruning) side shoots.
Tomatoes are routinely trained to 1-2 heads. Another head can be allowed to replace a topped or broken neighboring plant or during a season of high light.
Peppers are trained to 2-4 heads. They have brittle stems and can not be leaned/lowered.
Cucumbers can be trained using a single head, the "V-cordon", "umbrella", etc.

***Stem supports/Clipping (tomatoes):**

After the plants are placed on the bags, tomahooks (or some other support hook), with a sufficient amount of vine twine to last the duration of the crop (35-45 feet for 9 to 11 month's growth of indeterminate (beef-grape) tomatoes), should be hung from the overhead support cable. Initially, the tomahook should be placed not over its plant, but over the plant to the right (in our case). The vine twine is unwound and attached with a vine clip to the plant such that the twine slants up to the right as viewed from the side.
As plants grow (1ft or ~ 30.5 cm/wk), vine clips (hinge around twine, clip around stem)
…should be placed about 1 foot apart but no closer than 4-6" from the top.
…should be placed under a sturdy leaf and so as not to impinge on a cluster.
NEVER force a stem to the twine. Stems could crack. Reposition clips on a bent stem so the "bend" protrudes out from one side of the twine.
Remove clips from horizontal stems. Left on, they can rub, causing wounds.
Clean clips using 10% bleach solution for at least 2 hours. Rinse, dry and reuse.
NOTE: For TOV's, cherries, and smaller fruited varieties, some commercial growers do not use clips but rather "twist" the vine twine around the stem. This takes practice. If done improperly or with larger fruited varieties, the twine can damage the stem.

***Stem pruning (tomatoes):**

"Suckers" (side shoots) suck nutrients away from the main plant and must be removed so as to maintain a strong head and to train each plant/head, to a single stem.
Pop off (do not cut) suckers from the lower, middle and upper parts of the stem.
Do not prune suckers within 2-4 inches of the apical meristem (top) of the plant.
It is easy to confuse the apical meristem with a sucker and "top" the plant!
If the apical meristem is damaged or lost, allow a top sucker to take over.

***Leaning and lowering (tomatoes):**

When plants reach the overhead support cable they must be leaned and lowered.
Start at a point in the row where there is a space to the right. Lean and lower into that space. Lean and lower the next plant into the newly created space, etc.

Unwind the twine and lower the plant top no lower than 1.5 – 2 feet from the cable.
This should be the height of the temperature sensor in the greenhouse.
The temperature is set for the developing flowers which are at this level.
The resulting arch of the plant stem near the floor should not exceed 80 degrees.
Higher angles can promote stem cracking.
Rule of thumb: the arc should follow that of a person's finger tips when a straight arm is raised from the side of the body to shoulder height.
The tops of the plants should all be the same height to prevent shading.
If one plant is taller than its neighbor, it can be "leap frogged" around it.
Caution: Leaves and fruit may tangle. Make sure fruit does not pop off.
Always manipulate the plant by the vine twine from which it is hanging.
Do not try to lift or move the plant by grabbing the plant itself.
Tomahooks must be equally spaced (30cm) and "locked" (twine can't unravel).
For cracked stems – carefully straighten, align & wrap tightly with electrical tape.
A splint made with 2 cluster clips can be added after wrapping.

***Leaf pruning (tomatoes):**

As tomato plants grow, older leaves age (senesce), yellow spots appear due to loss of chlorophyll and photosynthesis is reduced. Remove these leaves.
Removing lower leaves also increases air movement around the stems which decreases humidity that can promote disease (e.g., *Botrytis*).
Removing lower leaves can also reduce certain insect pest populations.
Plants add ~3 leaves per week. Therefore, ~3 leaves per week should be removed.
The first 3 leaves will be removed when the plants reach 4-6 feet.
Start counting from the leaf opposite or just under the top-most flowering truss.
The number of leaves left on will depend on the time of year and the variety.
During high light periods leave more leaves on to shade the fruit.
During drier times leave more leaves on to increase humidity in the house.
During wet cool winters remove more leaves to reduce humidity/disease.
Remove more leaves from long leafed, vegetative varieties.
Leave more leaves on short leafed, reproductive varieties.
Cut or pop leaves off at the abscission zone (bulbous attachment between leaf and stem).
Do not tear leaves off. This produces a slow-healing wound and a point through which disease can enter (e.g., *Botrytis*).
It is best to remove leaves in the morning when plants are turgid and so the wound will have time to dry before the beginning of the cool, humid night.

***Cluster clipping (tomatoes – smaller fruited varieties may not need clips):**

Cluster clips (i.e., J-hooks) should be placed on clusters with 2.5 cm (1") diam. fruit.
Clips should support the fruit, not just be put around the cluster stem –
This is especially important for "stick trusses" (cluster stem is long/thin).
If the cluster clip is not long enough, tie the cluster to the stem with string.
Place clip beyond the second or third fruit so it doesn't slide on the stem.
As fruit is harvested, remove clips from empty clusters and clean (10% bleach).

***Cluster pruning (tomatoes):**

- Remove defective fruit including blossom end rot (leathery patch at blossom end), cat facing (hole in fruit with seeds showing), boats (elongated fruit), sunscald/green shoulder (white/non-ripening area caused by sun exposure) and insect or disease damaged fruit.
- Remove extra fruit – maintain a consistent fruit load for a consistent harvest.
- Tomatoes can set huge clusters. Since there is a finite amount of nutrients, if large clusters are allowed to stay, individual fruit size will be reduced and clusters higher on the plant may not receive enough resources resulting in fewer fruit or no fruit set at all.
- Recommended fruit/cluster will vary with type (beef, cherry, grape, etc.), season or treatment (i.e., grafted plants may be able to support more fruit/cluster than non-grafted):

Late Spring/Summer/early Fall (high light): beef = 4-5 fruit ; cherry = 14-18 fruit.
Late Fall and early Spring (medium light): beef = 3-4 fruit ; cherry = 12-16 fruit.
Winter (lowest light): beef = 2-3 fruit ; cherry = 8-10 fruit.
For grape, mini-plum, etc., "tip prune" (remove flowers) 3rd or 4th cluster down.

For beef types, remove empty clusters by cutting flush with the stem with sterile clippers.
This reduces rubbing of empty clusters on neighboring stems, causing wounds.
For TOV's, cherries, etc., harvest the intact cluster by cutting flush with the stem.
Remove leafy growth on clusters as this can divert nutrients away from the fruit.

***The area:**

Keep the floor around the plants clean.
Remove plant material from the greenhouse (habitat for insects & diseases).
Remove paper, old beneficial cards, string, etc. from the greenhouse.
"Dirty clips" must be cleaned (10% bleach solution) before reusing.
Drip tubing should be attached to drippers and dripping when system is on.
Make sure nutrient solution is dripping onto blocks (not on the bags, floor or stem).
Position the end of the tubing 15-30mm above the block so it is not touching the stem.
Otherwise, roots from the block or adventitious roots from the stem may grow into the tube and block the flow of nutrient solution.
Check for any algae growth: ("Algal Green" = nutrient solution leak).
Check for leaky drippers, diverted solution, leaky drainage troughs, etc.
If using stem supports, make sure they are secure and stems are resting on them.
Where stems go around the row ends, check for breaks & repair with electrical tape.

PHYSIOLOGICAL DISORDERS

*****Physiological disorders include noninfectious or abiotic disorders caused by extremes in light, temperature, or soil or root zone moisture, a lack of oxygen, high air pollution, toxicity to pesticides or improper cultural practices.
Note: Disorders resulting from diseases & insects/mites or nutritional problems will be covered in Chapters 4 and 9, respectively.

Leaves/Edema: High relative humidity around the leaves can reduce transpiration trapping water in the leaf tissue, causing blistering, then cell popping & death.
High water pressure in plants can also cause fruit cracking (see below).

***Tomato Fruit: [NOTE: some varieties are more susceptible than others]**

Boats: elongated fruit/blossom scar due to improper temperatures (too high or too low) or to improper pollination/fertilization resulting in flower fusion.

Cat Facing: breaks in the fruit skin with unfertilized seeds exposed due to abnormally cold temperatures during flowering, high nitrogen levels in the root zone, poor pollination, or a mechanical disturbance to the flower during anthesis.

Cracking: concentric rings around or radial cracks from the calyx due to slow-then-fast fruit expansion resulting from wide differences in day/night temps, rapid water uptake early in the morning due to high root pressure (or start fertigation too early), or a dry period followed by a rain/irrigation (less likely in hp).

Flower Drop: may be due to temperatures over 33C (90F) or below 10C (~50F), drought or excess nitrogen (in hp only if the irrigation system fails), too high a fruit load, periods of low light (i.e., winter or during cloudy weather which will reduce photosynthesis) or when nighttime temperatures are high which increases respiration burning photosynthates making them unavailable for flowers/fruit.

Gold Fleck: gold spotting due to high temperatures or rapid fruit/plant growth.

Microcracking or Russetting: when the air temperature is increased quickly from night to day (a rise of 4-10^{o}) the thin leaves heat up quickly but the fruit stays cool. Like a cold soda, set on the counter, the cool fruit acts as a moisture condenser. The water on the skin then causes the microcracking.

Stick Truss: thin, vertical truss with 2-3 fruit at most, caused by excessive heat.

Sunscald or Green Shoulder: white, shiny, leathery area caused by sudden exposure to sunlight (due to leaf overpruning, disease, etc.).

Blotchy ripening/"gray wall": due to low light in the canopy, high (>29C/85F) or changing temps during fruit ripening, high root moisture or low K in the fruit.

***Pepper Fruit:**

Cracking (around shoulder; calyx end): due to widely fluctuating temperatures.

Flower Drop: too much fruit set or other stresses (temperature, nutrient, etc.).

Glassy Patches: excessive root pressure forces water up bursting cell walls under the fruit skin. Excessive root pressure results if the air temperature drops significantly faster than the root zone temperature but the roots stay active and force water up through the plant. Can also occur from THRIPS damage (Ch. 4).

Sunburn or Sunscald: necrotic (dead) areas, caused by direct exposure of the fruit to high light. Allow crop to develop a dense foliage or use shade on the gh.

*__Cucumber Fruit:__

Crooking = excessive fruit curvature caused by one or a combination of:

-mechanical interference with the growth of the young fruit
-air pollution (carbon monoxide, ethylene, NO_X gases, i.e., nitrous oxide)
-insect damage (i.e., thrips) -adverse temperatures
-high root zone moisture -poor nutrition

FACTORS CONTROLLING PLANT ARCHITECTURE

*****Plant growth can be divided into 2 types:

1. **Vegetative growth:** Includes growth of the roots, stem and leaves.
2. **Reproductive (generative) growth:** Includes growth of the flowers and fruit.

*The tomato (pepper, cucumber, etc.) plant goes through 3 main stages of growth:

1. **Purely vegetative:** the production of roots, shoot and leaves only (4-6 weeks). During this stage all water, nutrients and photosynthates are going to form the vegetative portions of the plant.
2. **Before maximum fruit load:** vegetative parts continue to be produced but plants also begin to produce flowers and set fruit (4 weeks to 3 months). During this stage the plants will produce between 4-7 trusses. However, still mostly "vegetative" since flowers and fruit are a relatively small but increasing "sink" for the photosynthates from the plant.
3. **Maximum fruit load / "mature":** vegetative parts and flowers/fruit continue to be produced; fruit is also now being harvested (3 to 9 months or more).

*There needs to be a **balance** between **vegetative** and **reproductive** growth:

Vegetative growth: roots/shoots for a strong structure + leaves for photosynthesis.
Reproductive growth: flowers/fruit. This is your product ($$)!

Table 1. Characteristics that indicate vegetative versus reproductive growth in the tomato:

Character	**Reproductive Growth**	**Vegetative Growth**
Leaves	Flat and open, light green, soft	Curled, thick, dark green
Stem Diameter: thicker = beef, thinner = cherry	Thin; small diameter (relative to tomato type) Usually less than 0.8 cm	Thick; larger diameter (relative to tomato type) Usually greater than 1.2 cm
Flowering	Close to the top of the plant Within 5-8 cm Flowers open fast and uniform Rapid flowering within truss	Further from the top of the plant Greater than 13 cm Flowers open poorly; sepals stick Poor uniform flowering within truss
Flower Color	Dark yellow	Pale, light yellow
Truss Stem	Thick, sturdy, short and curved	Thin, long and sticking upwards Sometimes with leaves or suckers
Fruit	Large, many, good shape and fast development	Small, few, poor shape and slow development

Modified from: DeRuiter Seeds, Inc. Newsletter, Cultural Information, 11/03/97.

* **"Steering The Plant"**: Various environmental or nutritional factors and different cultural practices can affect the growth habit of tomato plants steering them more toward reproductive or more toward vegetative growth (as shown in the table below).

RULE OF THUMB: To remember these factors, note that "vegetative growth" is like foliage plants that evolved in the "jungle" (i.e., high humidity, high temperature, no difference between day and night temperatures and more frequent waterings).

Table 2. Techniques used to steer the plant towards reproductive or vegetative growth.

Factor/Practice	**Steer towards reproductive**	**Steer towards vegetative**
Difference between day and night temperature	Larger difference	Smaller difference
Day to night cooling rate	Quickly	Slowly or not at all
Position of grow pipe (metal or plastic pipe filled with circulating water running horizontally through the crop)	Three trusses under the top flowering truss	At the level of the truss to be harvested, or turn off
Temperature of grow pipe (0-80 C)	Raise	Lower
Relative humidity	Lower (make dryer)	Raise (make more humid)
Ventilate (where outside temp. is above 10 C)	More ventilation	Less ventilation
Carbon dioxide	Increase (800-1000 ppm)	Decrease
Irrigation: electrical conductivity (salt level) in the drip or input going onto the plants (2.5 - 4 mS/cm)	Higher (or very low) Stress the plant with very low or very high EC (1-1.5 or 3-4)	Lower Moderate EC (2-2.5)
Irrigation: how often and how long	Less frequent but longer duration	More frequent but shorter duration
Irrigation: start time	Later	Earlier
Irrigation: end time	Earlier	Later
Truss pruning	Less (leave more fruit on)	More (remove more fruit)
Leaf pruning Remove leaf opposite top flowering cluster	More (remove more leaves) Reproductive action	Less (leave more leaves on) --

Modified from DeRuiter Seeds, Inc. Newsletter, Cultural Information, 11/03/97.

Again, the idea is to keep the plant in balance: not too vegetative & not too reproductive.
-If the plants become too vegetative, use suggestions in the middle column, "steer towards reproductive" to return the plants to a balanced growth habit.
-If the plants become too reproductive, use suggestions in the right column.

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