Non-Chemical Control of Plant Growth

Brian Whipker, NC State University

e-GRO Electronic Grower Resources Online

Environmental and Cultural Management of Plant Growth

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THE Fred C. Gloeckner FOUNDATION, INC.

Environmental and Cultural Management of Plant Growth

- Scheduling and cultivar selection
- Light and spacing
- Temperature
- Nutrition
- Drought, water management
- Pinching and mechanical stress

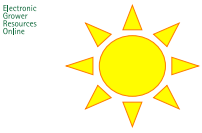
Crop Scheduling

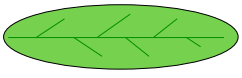
- Vary finish date of crops
  - Limiting need to hold

+2 0 -2

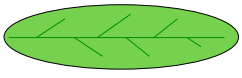
Cultivar Selection

- Select shorter growing cultivars
  - Practical? Not all colors / forms available





Light - Plant Leaf Filtering



Light - Plant Leaf Filtering

Sunlight has a ratio of R to FR light of around 1 to 1

Red = Far Red

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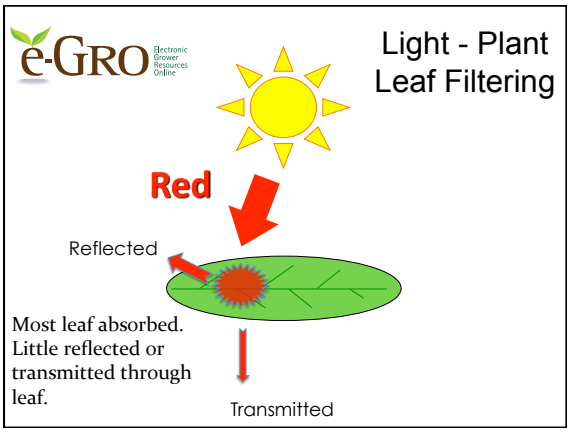

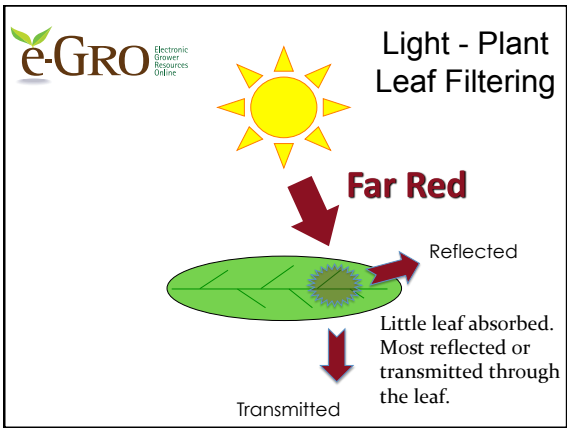

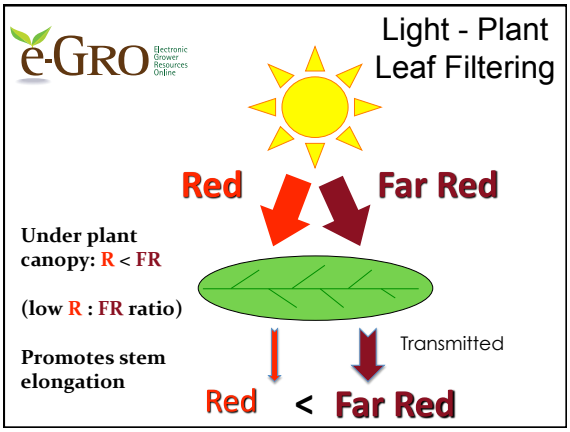

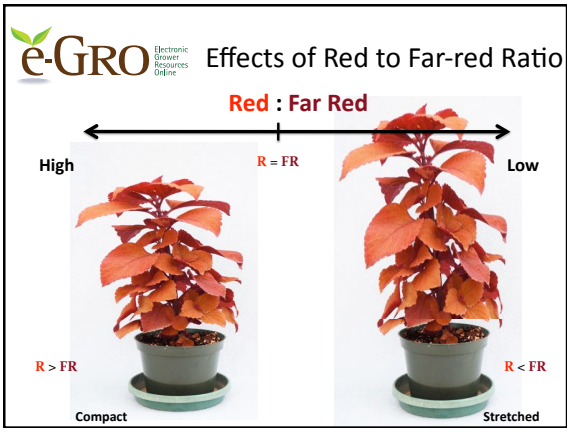

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Average Daily Temperature

- "A cool temperature produces shorter plants" is not really true.
- Plants develop progressively faster as the average daily temperature increases. So, at one point in time, plants grown cool will be shorter than plants grown warm because they are developmentally younger.
- However, at first flowering, plant height of crops grown cool is often similar to, or greater than, crops grown warm.

Daily Temperature Delivery

DIF

Plants grown at a cooler day than night temperature are often shorter than plants grown at a warmer day than night.

– DIF Warmer night

+ DIF Warmer day

DIF = Day temp - Night temp

Limitations of DIF

1. Not useful when multiple crops in the same greenhouse have different height control needs
2. Warm temperatures prevent the ability to provide cool day temperatures
3. Requires automated greenhouse environmental control
4. Energy for heating may be too expensive

DIP/Drop/Cold Shock

Air temperature is rapidly dropped before sunrise to provide a partial negative DIF response.

Keys to Dip (Drop) Response

- Temperature needs to be lowered before dawn to maximize the dip response – typically 30 to 60 minutes before sunrise
- Cool temperature duration should last 2 to 3 hours
- To deliver the same average daily temperature, need to slightly increase the temperature during the remaining portion of the day to compensate for the dip

Keys to Dip (Drop) Response

- Some growers let temperature naturally ramp down near the end of the night by turning off heaters
- If the greenhouse does not cool rapidly enough, venting may be necessary to achieve the desired low temperature
- Growers using energy curtains at night may need to slowly open the curtains before sunrise to allow the cool air above to reach plants below.

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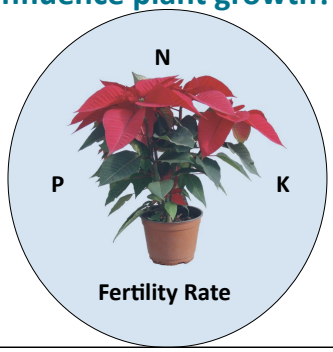
What key nutritional factors influence plant growth?



Understanding Nitrogen

Nitrogen Form

Type	Bag % NO_3-N	Bag % NH_4-N	Bag % Urea	Total % NO_3-N	Total % NH_4-N + Urea	Total % NH_4-N	Total % Urea
20-20-20	6.11	3.89	10.0	30.5%	69.5%	19.5%	50.0%
20-10-20	12.06	7.94	0.0	60.3%	39.7%	39.7%	0.0%
15-5-15	11.75	1.20	2.05	78.3%	21.7%	8.0%	13.6%
13-2-13	11.9	0.3	0.8	91.6%	8.4%	2.3%	6.1%

Prefer >80% as Nitrate N
NH4-N+Urea boost growth
Avoid excess NH4-N+Urea with cold temperatures

Understanding Phosphorus

- P is an essential element
  - Target 5 to 10 ppm in substrate
  - P is the primary contributor to plant stretch

Understanding Phosphorus

Phosphate vs. Compactness
P2O5 as a % of N in post-plant fertilizer

P2O5 = 50% of N (e.g. 20-10-20)	15% (13-2-13)	7.5%	0%

Understanding Fertilizer Rates

50 75 100 200 300 400

Gerbera growth as fertilization rate increases (in ppm N)

K. Yeon Jeong, B. Whipker, I. McCall, and J. Frantz

Irrigation

- Water required for growth
- Range wet to dry
- Affects need for additional growth regulation
- Drought stress generally reduces plant quality

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Drought for Growth Control

- Slight plant wilting between irrigations
  - Not permanent wilting
- Example crops
  - Impatiens and tomatoes
- Reduced Plant Quality?
  - Not cole crops (premature bolting)
  - Not New Guinea impatiens (delays flowering)

Water Stress / Container Size

- Root restriction can be used to slow plant growth
  - But may lead to water or nutrient stress

Drought for Height Control?

- Marigold: PGRs vs. Drought

Drought for Height Control?

- Zinnia: PGRs vs. Drought

Irrigation Strategy: Standard

- Generally, water to field capacity
  - Approx. 10% water leaves pot
- Water prior to drought stress

Physical Control

- Pinching
  - Hard
  - Soft
- Some crops hard pinch results in more vigorous growth

P. Allen Hammer, Purdue

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Mechanical Control

- Presentation developed by Dr. Joyce Latimer of Virginia Tech University

Types of Mechanical Stimulation

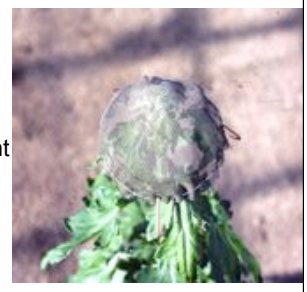
- Stem rubbing
- Mechanical impedance
- Shaking potted plants
- Vibration of pots or plants
- Water spray
- Wind or forced air
- Brushing shoots

Benefits of Mechanical Stimulation

- Non-chemical growth regulation
- Flexible control of growth
- Improves plant color and uniformity
- Increases stem and petiole strength
- May increase stress tolerance
- Reduce insect populations
- May improve landscape/field establishment

Mechanical Impedance

- Mechanical stimulation of peduncle
- Decrease plant height
- Strengthen peduncle of football mums
- Increase stem diameter of tomato



Shaking Apparatus

Shaking Apparatus

- Effective in height control and stem strengthening
- Hard on benches

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Wind/forced Air Stimulation

- Reduced height
- Caused early drought stress
- Desiccation damage to leaves
- Reduced yields of some crops

Air Flow Provides Stimulation

- Not usually sufficient air movement for center of the house

- Brushing with cardboard tube to strengthen peduncles of mums in Japan

Brushing

Brushing to Control Height

- Brushing reduced height by 50%
- Drought same height reduction
- Drought reduced dry weight and crop yield
- Brushing reduced thrips and aphid infestation

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- Brushing reduced plant height and increased stockiness
- Drought reduced dry weight and yield

Brushing Damage on Peppers

Brushing Damage on NGI 'Agadoo'

Columbine 'McKana Giants'

- Brushing gave better height control than PGRs, 4WAT

Commercial Operations

Commercial Grower Using Brushing

- 5 weeks
- once daily
- 25-35 cycles

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Commercial Application

- Organic herbs, brushed several times per day with vinyl strips; Yellow sticky to trap insects

Brushing Summary

- Very effective on young plants
- Physically stimulates growing points
- Reduces plant height (stem elongation)
- Increases stem strength
- Increases stress tolerance and landscape/ field establishment
- May reduce insect infestations
- Likely damage on stiff, brittle, or “sticky” foliage and on flowers
- Labor intensive, hard to automate for many crops
- Rapid resumption of growth (3-4 days) after treatment ceases

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