Raising high quality vegetable transplants

Why transplants?

- Uniform seed germination
- Eliminate variability caused by direct seeding
- Early start
- Extends growing season
- Enhanced yield and productivity
Ease of growing transplants

<table>
<thead>
<tr>
<th>Easy to transplant</th>
<th>Medium difficulty</th>
<th>Difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>broccoli</td>
<td>cauliflower</td>
<td>cucumber</td>
</tr>
<tr>
<td>brussels sprouts</td>
<td>celery</td>
<td>muskmelon</td>
</tr>
<tr>
<td>cabbage</td>
<td>eggplant</td>
<td>squash</td>
</tr>
<tr>
<td>lettuce</td>
<td>onion</td>
<td>watermelon</td>
</tr>
<tr>
<td>tomato</td>
<td>pepper</td>
<td></td>
</tr>
</tbody>
</table>

Any problem in these cucumber transplants?
Why don’t I buy from a commercial grower?
- Inexpensive if you only need a few plants
- No time commitment and care

Some disadvantages
- Quality
- Transplants may introduce disease, insects, or weeds
- Limited cultivar selection

Producing your own transplants
- Best use of expensive seeds
- Time transplants based on your planting schedule
- Choose your own cultivar

Challenges
- Know A-Z about transplant production
- Time commitment
- Optimum production and management plan
Factors to consider

- Seed source
- Trays, flats, cell size
- Growing medium
- Nutrition
- Light
- Temperature
- Moisture
- Hardening

Seed

GOOD SEED DOES NOT COST, IT PAYS

Poor quality seeds could lead to low germination rates and lose of plant vigor

Pelletized vs non-pelletized

Ease of seeding
Storage consideration
Seeding individual cells

Improve seeding efficiency
Cell size

Variety of cell sizes available

Most common ones used are 128, 98, 72, or 50-celled flats

Smaller cells = reduced production costs
  = reduced transplant size
  = reduced earliness and quality

Larger cells = higher production costs
  = larger transplants
  = enhance earliness and quality

Effect of cell size on medium quantity

<table>
<thead>
<tr>
<th>Cell size</th>
<th>Depth (inch)</th>
<th>Volume of medium (cc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>128</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>98</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>72</td>
<td>2 1/4</td>
<td>56</td>
</tr>
<tr>
<td>50</td>
<td>2 3/8</td>
<td>96</td>
</tr>
</tbody>
</table>

Adaptation to transplanting
Ability of the plant to reestablish quickly
Root size
Recycle Reduce and Reuse

WATER

10% BLEACH

WATER

Growing medium

Medium – Sterile, free of insects and pests
Regular greenhouse Soilless Mix
Can formulate your own mix

Commercial Mixes – Jiffy Mix, Sunshine Mix, Metro Mix, etc.
Why transplant the medium is important?

Advantages:
- Sustained growth
- Healthy root and shoot system
- Better field performance

Medium components: Sphagnum Peat

- Holds moisture
- Light weight; packed tightly; easy to ship
- Growing medium
- Stable organic matter
- Quite acidic (3.5 to 4.0)
- Lighter is better than darker
- Organic growers should be careful - wetting agents, against NOP

$4/cub ft.
- pH: 3-4
- CEC: 7-13 me/100cc

IOWA STATE UNIVERSITY
Extension and Outreach
Coir

- High moisture holding capacity
- Light weight; packed tightly; easy to ship
- Not as acidic as peat (5.5 to 6.0)
- Expands and holds water (6-7 times of its volume)
- Expensive than peat
Vermiculite

- Volcanic mineral
- Holds moisture
- Provides pore space

$4/cub ft.

Perlite

- Volcanic mineral
- Holds moisture
- Provides pore space

$4/cub ft.
COMPOST

Not to exceed more than 15-25% of the mix

Leachate with high EC
Suggested proportion for transplant medium

- COMPOST: 25%
- PEAT: 50%
- Perlite/Vermiculite: 25%

Commercial potting mixes

- Sunshine Professional Growing Mix
- Fafard Potting Mix
### Fertility: Organic fertilizers

<table>
<thead>
<tr>
<th>Amendment</th>
<th>Estimated N-P-K</th>
<th>Rate of release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood meal</td>
<td>12.5 – 1.5 – 0.6</td>
<td>Medium-fast</td>
</tr>
<tr>
<td>Bone meal</td>
<td>4.0 – 21 – 0.2</td>
<td>Slow</td>
</tr>
<tr>
<td>Feather meal</td>
<td>15 – 0 – 0</td>
<td>Slow</td>
</tr>
<tr>
<td>Fish meal</td>
<td>10 – 5 – 0</td>
<td>Medium</td>
</tr>
<tr>
<td>Alfalfa meal</td>
<td>2.5 – 0.5 – 2.0</td>
<td>Slow</td>
</tr>
</tbody>
</table>
Examples

Organic commercial sources

- Fish and seaweed-based
Synthetic Fertilizers

- Easily available
- 100% water soluble
- $40/25lb bag

<table>
<thead>
<tr>
<th>Time (after seeding)</th>
<th>N concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 week</td>
<td>150 ppm</td>
</tr>
<tr>
<td>3 week</td>
<td>250 ppm</td>
</tr>
<tr>
<td>4 week</td>
<td>300 ppm</td>
</tr>
<tr>
<td>5 week</td>
<td>200 ppm</td>
</tr>
<tr>
<td>6 week</td>
<td>150 ppm</td>
</tr>
</tbody>
</table>

Fertilizer calculation: What if a liquid fertilizer

- 1% = 10,000 ppm
- C1 x V1 = C2 x V2

**Question:** The fertilizer container says 10% N. Make 100 liters of 200 ppm fertilizer solution

**Answer:**

100,000 x V1 = 200 x 100
V1 = 0.2 liters
Dry fertilizer

1 ppm = 1mg/L
So if you need 200 ppm, then add 200 mg fertilizer in 1 liter

Since the fertilizer is 10% N, we need to add ten times of that to get 100% strength

So to prepare 200 ppm final fertilizer solution add 2,000 mg in 1 liter. Since you need 100 liters, 2,000 x 100 = 200,000 mg
**Light and Lighting**

**What is light?**
Light is photons, which are a quantum, or individual unit. Since individual photons possess tiny amounts of energy, photons are measured in units of moles (abbreviated mol)

**Components of light**
- Intensity
  - Quality
    - Plants require different wavelengths than our eyes perceive
  - Day length
    - Plants use day length to tell when summer or winter is coming

Inadequate levels of any of these components will cause a plant to sense inadequate level of light

---

**IOWA STATE UNIVERSITY**
Extension and Outreach

---

[Image of light spectrum and plant growth]
Light intensity as a percentage of July, based on a 5 year average

Several options

1. Incandescent  7% efficiency; not recommended
2. Fluorescent  20% efficiency
3. High Pressure Sodium  37% efficiency
Red vs. Far Red Light

• Controlling the red to far red light ratio is a means of controlling seedling height without reducing fruit yield or quality
• Incandescent lamps, which are low in R:FR ratio, frequently lead to stem elongation while fluorescent sources, which are high in R:FR ratio, produce short and compact plants.

Fluorescent Lights

• 12 to 16 hours per day
• Close to the plants (no more than 4 inches above the tops of the seedlings)

• One cool-white plus one warm-white tube
  – Or
• Use Full Spectrum Grow Lights
Great investment but expensive

High Intensity Discharge
High Pressure Sodium
• Can I get extra productivity or higher plant quality to justify the investment in HPS lamps?

• Answer is Yes, but should justify for your own operation

• Greater benefit when plants are small and growing rapidly. Economic benefit decreases when plants get older

Do your math

IOWA STATE UNIVERSITY
Extension and Outreach

Let's do a cost analysis on HPS

Unit + Ballast + reflective cover = $400 to $450
400W lamp + 50W ballast ~ 500W

@ 10cents/kwatt hour~~~ 5cents/hour/lamp

If running 16 hours, then 16 x 5 cents = 80 cents/day

For a 20 ft x 25 ft greenhouse we would approximately need 16 lamps to maintain 300µmol/m²/s at the bench, therefore, 16 x $0.80 = $ 12.8 ~ $13/day
Average intensity (µmol/m²/s)

Date (2013)

HPS  Greenhouse  Fluorescent
Fluorescent GH

Plant Height (cm)

- Fluorescent
- GH
- GH + HPS

Plants from 50-celled flat
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Stem Girth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent</td>
<td>4.0</td>
</tr>
<tr>
<td>GH</td>
<td>6.0</td>
</tr>
<tr>
<td>GH + HPS</td>
<td>8.0</td>
</tr>
</tbody>
</table>

44% increase in stem girth compared to Fluorescent treatment.

Plants from 50-celled flat

4 weeks after seeding

- Greenhouse + High Pressure Sodium
- Greenhouse
- Fluorescent
Watering

• One of the most important greenhouse operation
• Low priority.....boring task
• Plants are 80 to 95% water
• Applying correct amount of water is important
Three rules to follow

RULE 1 - Growing medium should be well drained
RULE 2 - Water thoroughly each time
RULE 3 - Apply water just before the plant shows signs of water stress
WONDER WATER

Water Quality

• Test your water periodically
• Major problem with water are:
  salt concentration
  imbalance in individual nutrient
• Alkalinity of water: 
  carbonates and bicarbonates of Ca, Mg, and Na
• If alkalinity value 1.0 - 1.5 meq/L (75 ppm calcium carbonate equivalent) – ok range
• More than 1.5 meq/L – caution
• You do need some alkalinity otherwise water will dissolve the limestone from your soilless mix and decrease pH to that of the peat moss
• Na level should not exceed 50ppm

### How long in the greenhouse

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Number of weeks</th>
<th>Vegetable</th>
<th>Number of weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broccoli</td>
<td>5-7</td>
<td>Lettuce</td>
<td>4-5</td>
</tr>
<tr>
<td>Cabbage</td>
<td>5-7</td>
<td>Muskmelon</td>
<td>3-4</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>5-7</td>
<td>Onion</td>
<td>10-12</td>
</tr>
<tr>
<td>Cucumber</td>
<td>2-3</td>
<td>Pepper</td>
<td>6-8</td>
</tr>
<tr>
<td>Eggplant</td>
<td>6-8</td>
<td>Tomato</td>
<td>5-7</td>
</tr>
</tbody>
</table>
Hardening off

Many Thanks

Kristine Lang
Moriah Bilenky
Neel Solanki
Sarah Steffen
Brandon Carpenter
Nick Howell

IOWA STATE UNIVERSITY
Extension and Outreach
Contact

Dr. Ajay Nair
Email: nairaj@iastate.edu
Phone: 515-294-7080

Questions?

www.extension.iastate.edu/vegetablelab
www.iowavegetables.blogspot.com