Organic Seedling Production and Greenhouse Efficiencies for Small Farms

Ecofarm Conference

January 25, 2020
Seedling Production:
• To grow or not to grow your own:
• Elements you can and need to influence—to optimize seedling development
• How greenhouse infrastructure enhances environmental conditions
• System Efficiencies to improve outcomes and reduce labor
Buying in seedlings versus growing your own
Pros and Cons:
Buying In

Advantages:

• Does not require you to build and manage GH infrastructure
• Does not require any specific seedling growing skills and knowledge
• Can schedule crop maturity precisely to meet production schedules
• Cost per seedling can be very low when buying in large quantities

Disadvantages:

• Costs per seedling can be very high at lower volumes
• Most nurseries have large minimum order thresholds
• Many nurseries do not want to supply high crop diversity
• “Lead Time” from ordering to ready seedlings can be much longer than…
• Some nurseries won’t allow you to supply seed
Buying In
Additionally, plants are occasionally damaged in transport but more typically you will receive very high quality, uniform transplants when you buy in seedlings from a skilled growing operation.
Growing your own

**Advantages:**
Allows precise control of timing and varieties, quantities
Daily ability to see plants, adjust schedules, manage accordingly
Potential “slow season” work to help retain highly skilled staff

**Disadvantages:**
Requires GH infrastructure
Requires specialized skills/knowledge
Requires time/labor to make mixes, fill containers, sow seeds,
Water, manage GH conditions-temperature, air circulation...
Key environmental conditions influencing seedling germination and development:

- Temperature
- Air Circulation
- Soil Moisture
- Light
Seedling Life Stages and Environmental Management
- Pre-germination and Emergence
- Emergence and Development of True Leaves
- Development of Leaf Canopy and Root System
- Seedling Maturation and Hardening Off
- Qualities of Mature Transplants
- Holding Strategies and When to Cut Loose
Greenhouse structures create the ability to manage environmental conditions to optimize germination and development

*Passive and Active Environmental Controls*

**Temperature:** **Passive:** sunlight, capturing of solar radiation for heating and air circulation through venting for cooling  
**Active:** mechanical devices for heating and cooling

**Air Circulation:** **Passive:** through venting to promote rapid air exchange  
**Active:** HAF and exhaust fans to facilitate additional movement

**Water:** hand and automated delivery methods

**Light:** **Passive:** infiltration sunlight through roof/wall glazing  
**Active:** supplemental lighting, LED, metal halide, et al
Passive Design: Heating, Cooling, Air Circulation
Active Infrastructure: Heating, Cooling & Air Circulation
Active Heating:

Microclimatic control through Bottom Heat
Location Considerations and Optimal Greenhouse Siting:

• to optimize & conserve energy flow
• to make the most of natural lighting
Greenhouse Alignment and Solar Gain

- 70% solar gain at 45°
- 92% solar gain at 22.5°
- 100% solar gain at 0°
Growing your own: focus on Crop Quality

Crop Quality:
• Create capacity to manage environmental conditions optimally
• Soil mix quality and provision for fertility
• Irrigation: timeliness, proper volume and uniformity
• Knowledge of seedling maturity
• Timely plant outs: crop planning, field preparation and ability to prioritize most sensitive crops
• Have the capacity to hold and maintain seedling health
• Pest and disease prevention, monitoring, and intervention
System Efficiencies:
• Workspace design, movement & handling of materials
• Soils: making your own or buying in
• Container choices
• Sowing methods: vacuum seeders
• Germination chambers
• Optimizing use of bench space
• Irrigation delivery: tools and automation
• Supplemental Fertility: role and modes of delivery
Making Soil Mixes in House:

Advantages:
• Control of inputs, structure, texture
• Can choose more sustainable options
• Can optimize qualities based on crop
• Control of batch size
• Can optimize moisture levels for sowing

Disadvantages
• Must stockpile numerous raw ingredients
• Need to know basic chemistry to balance pH, nutrient levels
• Process can be imprecise without background knowledge, testing and or trial & error
• Huge time and labor inputs required to assemble and mix
Buying in Soil Mixes

Advantages:
• Possible to purchase high quality mixes with optimal texture, pH, nutrients
• Less materials to stockpile
• Huge time and labor savings
• Cost can be very low
• “Loose fill” totes much easier to handle

Disadvantages:
• Some mixes lack any fertility inputs
• Typically composed of non sustainable ingredients
• Large totes require forklift to move
• Compressed bales difficult to handle
• May dry in storage, become hydrophobic
• Cost can be very high
Propagation Containers: Cells/Plugs

Thermoformed Polyethylene

Injection Molded Polypropylene

Polystyrene
Tools for Efficient Sowing and Handling: Dibbler/Plug Popper
Tools for Efficient Sowing: Stationary Vacuum Seeder
Tools for Efficient Sowing: DIY Vacuum Seeder—a short video
Germination Chambers:

- Substantial reduction in days to germination & time in greenhouse
- Increased percentage germination
- Highly efficient use of space and energy
- Easily purchased “off the shelf” but expensive
- Easily DIY built, inexpensive with available parts but requires some tinkering
Caveats:

- You must be on top of timing...
- Steep initial learning curve to harness the benefits
Bench Space, Container Footprint, Cell Size, and Blocking: the challenges of inconsistency
Bench Space, Container Footprint, Cell Size, and Blocking: the benefits of consistency and uniformity
Water delivery by hand

Benefits and limitations:

- Knowledge intensive
- Can allow for success with diverse crops
- Can require multiple visits and lots of time to deliver needed water
- Less experienced waters: sometimes too much or too little
Automated Water Delivery

benefits and limitations:

• Upfront capital investment
• Success dependent on consistencies
• Steep initial learning curve
• Blocking critical to success
• Necessity of programing based on weather patterns, anticipated conditions
• Immense time and labor savings
• Improved crop quality
Supplemental Fertility:

- Reasons to use:
  - Soil media lacks provision for fertility
  - To accelerate growth to meet target dates
  - To support crops when “holding” is necessary

Materials:
  - Soluble NPK and micronutrients

Modes of delivery:
  - By hand via dilution in watering can (smallest scale)
  - By hand via Injector
  - By overhead system via injector
Greenhouse and Propagation Resources

Print Resources:
Styer, Roger, and David Koranski. 1997 Plug and Transplant Production. Ball Publishing

Web Resources:
Appropriate Technology Transfer for Rural Areas: trove of free PDFs on soil media, greenhouse management, pest and disease management, and much more
www.attra.org
UCSC Center for Agroecology and Sustainable Farm Systems, Teaching Organic Farming and Gardening, Unit 1.3 Propagation, Greenhouse Management
https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/part-1.html
Please attend our upcoming:
Organic Seedling Production
Field Day
March 25, 2020 at the
UCSC Farm Greenhouses

And be on the lookout for our free:
Seedling Grower Guide
Available in English and Español
in print and online June of 2020

Thank You
Christof Bernau
UCSC CASFS
christof@ucsc.edu