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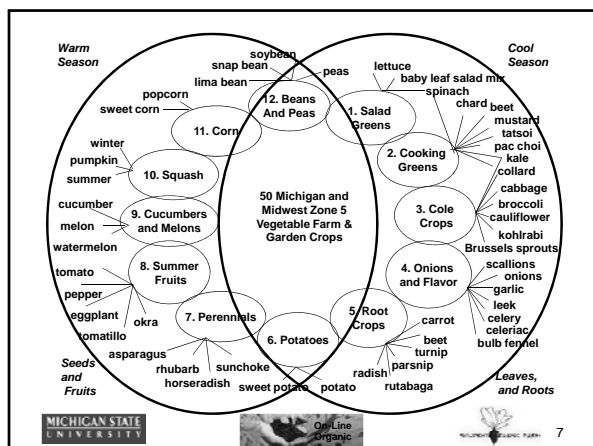
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## Common Farm Transplants

onions, leeks, green onions  
celery, celeriac  
broccoli, cabbage, cauliflower,  
Brussels spouts, kale, kohlrabi  
lettuce, chard, Chinese cabbage, pac choi  
tomato, pepper, eggplant, okra, tomatillo  
squash, melons, cucumbers  
cut flowers – snapdragons,  
lisianthus, statice, etc  
herbs – parsley, sage, oregano,  
rosemary, thyme, etc

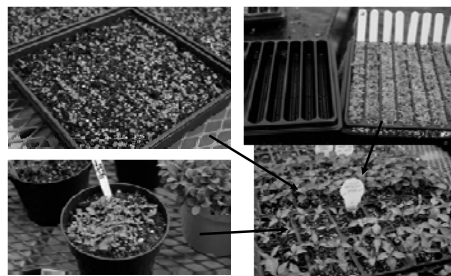
## What makes a good transplant?

- Large enough to handle easily and quickly without damaging the shoot or roots
- Root medium full of roots – easy to remove from container (not needed for soil blocks)
- Strong, short, thick stem (hypocotyl)
- Actively growing roots and shoot – not nutrient or drought stressed
- Shoot to root ratio near 1
- Appropriate number and size of leaves
- Appropriate color of leaves and roots
- Buds or flowers not present
- Free of insects or diseases
- Hardened or acclimated to field conditions

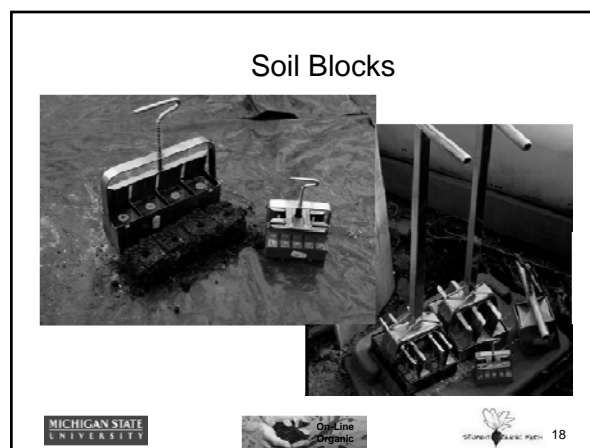
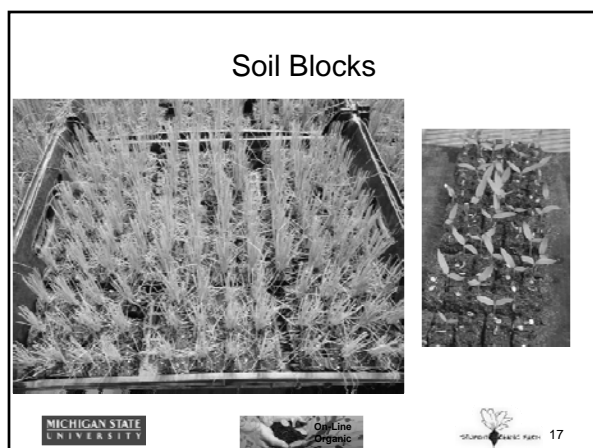
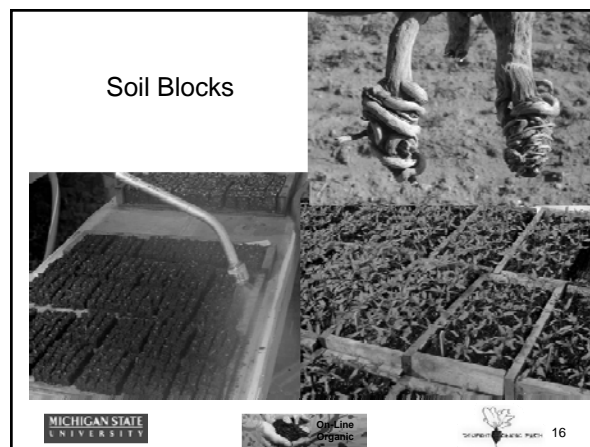
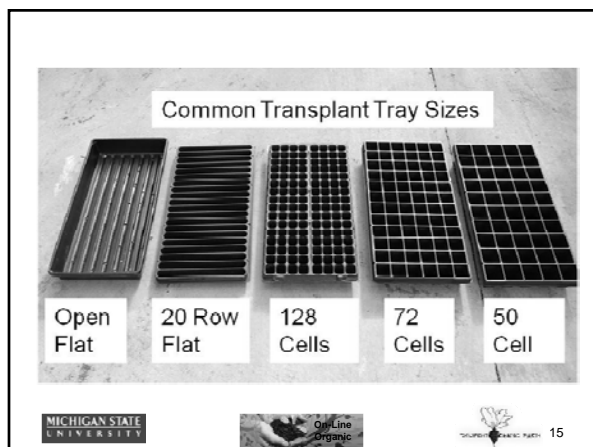
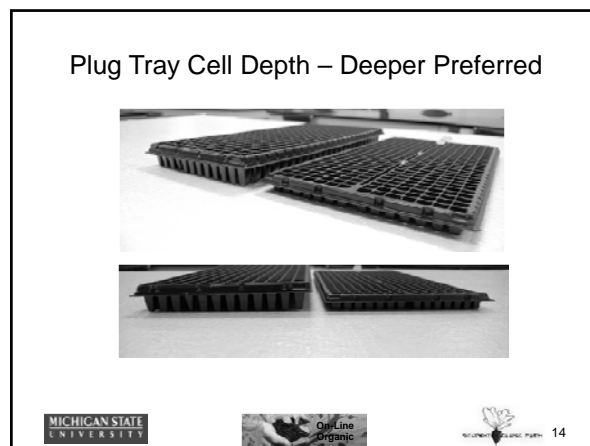
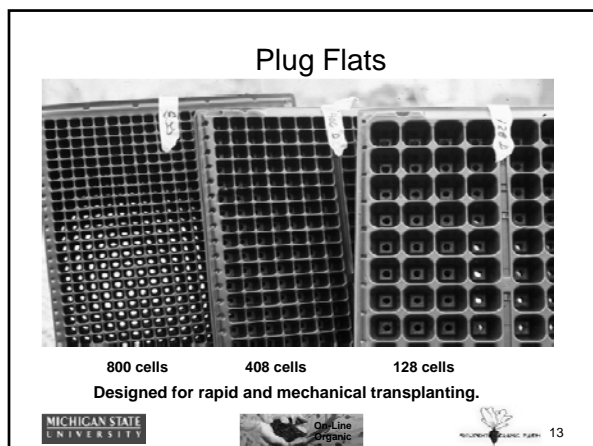
## Transplant Production Systems

- Open trays with pricking-out to cells
- Plug trays with transfer to transplant flats
- Direct sow in transplant flats
- Use of soil blocks
- Selection of a system is in part dependent on the seed handling method or seeding equipment available

## Open Flat for Bare Root Transplanting ("Pricking Out")



Each Seedling must be bare-root transplanted to a cell tray



What is the primary system you use for transplant production?

- A. Not currently growing transplants
- B. Open trays with pricking-out to transplant flats with cells
- C. Plug trays with transfer to transplant flats with cells
- D. Direct sow in transplant flats with cells
- E. Soil blocks



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What do you use for root medium?

- A. Don't grow organic transplants yet.
- B. Purchase certifiable root medium.
- C. Make root medium on farm.



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Do you use compost in your medium?

- A. Purchase prepared root medium.
- B. Do not use compost in medium I make.
- C. Use purchased compost in medium I make.
- D. Make compost on farm for root medium.



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Organic Media & Fertility Options

- #1: Purchase a certified organic root medium and supplement with approved soluble fertilizer if needed.
- #2 Make a peat-based medium without non-allowed fertilizers and wetting agent and fertilize the peat based medium with fish emulsion or Omega 666.
- #3: Add organic nutrients to the peat based root medium prior to planting (blood meal, greensand, rock phosphate) and then use liquid sources if needed.
- #4: Use mature, well made compost at 25% to 75% by volume mixed with peat, coir or other allowed components. Can supplement nutrients either before or after planting from organic approved sources.



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#1. Use Organic Approved Transplant Media

- Vermont Compost
- Morgan Compost
- Traditional Suppliers
- Others



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Do you use fish emulsion or hydrolysate for your transplant production?

- A. I don't produce transplants yet.
- B. Yes, I use soluble fish products for fertilizing my transplants.
- C. No, I don't use soluble fish products for fertilizing my transplants.



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## #2. Prepare medium with approved components & use soluble organic fertilizers



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## Root Medium Components

- Peat – multiple grades
- Pine bark – not recommended
- Coco Coir
- Perlite
- Vermiculite
- Compost – covered later

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When nutrients are not in the soil, applying water soluble nutrients is the next option



4 media with different levels of fertility.



All look the same when water soluble fertilizer is applied.

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## Organic Version – 20 years later



Adequate medium fertility with plus liquid on right



Low medium fertility with plus liquid on right.

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## Water Soluble Mid-Crop Additions

- Fish emulsion or hydrolysate
  - Fragrance issue; sustainable?
- Omega 666
- Other? Generally expensive.
- Compost Extracts or Tea
- Top dressing with compost? - later

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## How much to apply?

- Partially a function of concentration.
- Example Dilution: 1 fluid ounce in 1 gallon = 1:128
- 5% N fish emulsion = 50,000 ppm N
- Diluted 128 times = 400 ppm – a high rate; could use half that rate or a Tbl/gallon.
- Partially a function of volume.
- Apply a pint (16 floz) or a quart (32 floz) per flat? Makes a large difference.
- Quantity equals concentration x volume

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## Parts per million Nitrogen

- Range of rates:
  - Low 100 ppm Nitrogen
  - Medium 300 ppm Nitrogen
  - High 600 ppm Nitrogen
- For liquid fertilizers like fish emulsion, 1% Nitrogen equals 10,000 ppm
  - 5-1-1 or 5% = 50,000 ppm
  - Dilute 100x for 500 ppm (moderate to high rate reasonable at 2 week intervals at 1 quart/flat).
  - Dilute 1000x for 50 ppm (low rate)



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## How to apply liquid fertilizer?

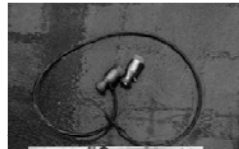
- Mix in a bucket or tank and apply with a watering can.
- Mix in a bucket or tank and use a small submersible pump attached to the watering hose.
- Make up a concentrated solution and use a fertilizer injector or proportioner.



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## Fertilizer Injectors

- Not made for "solutions" with solids.
- Hozon - \$15-\$20
  - variable
- Dosatron - \$400
  - Good product
- Need to make sure the injector is working properly



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## Compost Extracts or Tea



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## # 3. Mix Media and Add Amendments



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## Mineral Based Amendments

- Lime (5-10lbs/yd<sup>3</sup> of peat)
- Gypsum (calcium sulfate)
- Rock (calcium) phosphate
- Greensand (K and micros) 0-0-7 (low solub)
- Potassium sulfate 0-0-50 (high solubility)
- Potassium magnesium sulfate 0-0-21
- Basalt or granite rock powder (5-10% K<sub>2</sub>O)



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## Plant Based Amendments

- Alfalfa meal (3-0.5-3)
- Soybean meal (6-1.4-2)
- Cotton seed meal (6-3-2)
- Kelp and seaweed (1-0.3-2)
- Wood ash (lime, K, micros)



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## Animal Based Amendments

- Blood meal (12-0-0)
- Bone meal (6-12-0)
- Fish meal (7-7-0)
- Feather meal

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## How Much? - Rates of Fertility

lbs/yd<sup>3</sup> is a standard measure

- Can be converted to any other measure
- 3'x3'x3' or 27 cu ft
- 1 cuft = 7.5 gallons
- 1 lb/yd<sup>3</sup> =
  - 16.8 grams/ft<sup>3</sup>
  - About 0.5 ounce/ft<sup>3</sup>



Cubic foot box for medium measuring and adding amendments.

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## Amendments – Options

- Coleman formula
  - Blood meal
  - Bone meal
  - Rock phosphate
  - 1 part each by volume mixed
  - on weight basis makes about 1:1:1 ratio N:P:K
  - Rate added: 14 lbs/yd<sup>3</sup>

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## Amendments: Options



OMRI listed  
Potassium sulfate, poultry protein, humates, and molasses added.



And of course, plain old baled alfalfa hay.

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## Concerns with Organic Amendments



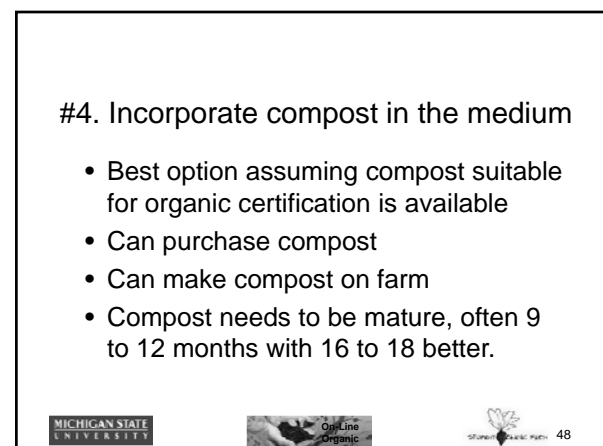
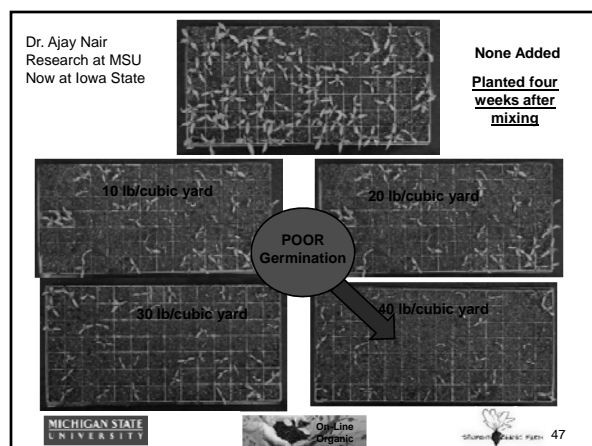
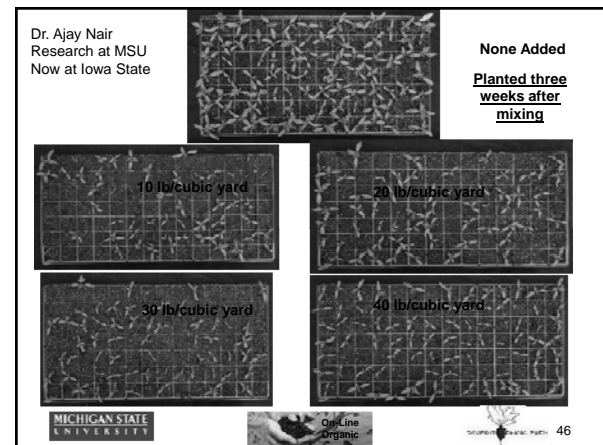
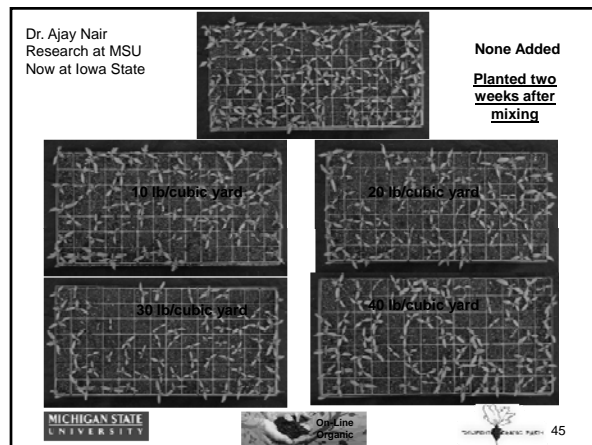
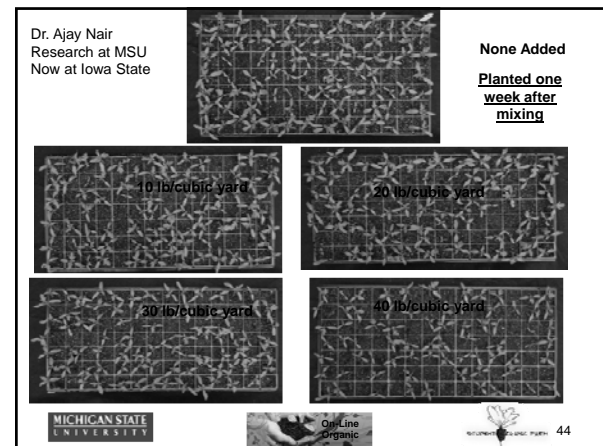
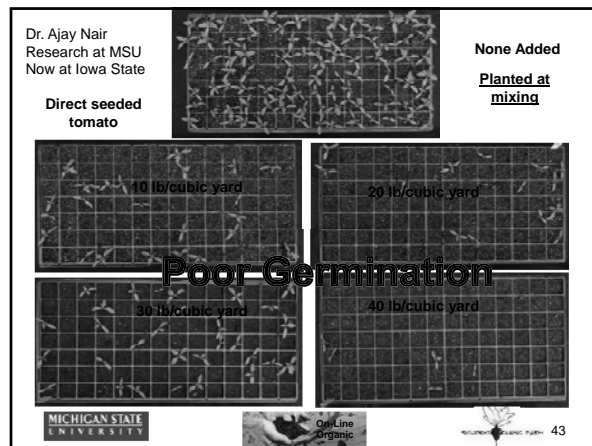
- Planting right after incorporation killed poinsettias.
- The same medium used 2 weeks later was fine.
- Fungal growth was visible in the medium

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## Compost Based Media

- Compost can be made specifically for seed and transplant media.
- Peat can be added to compost pile.
- Mineral amendments can be added.
- Manure typically increases nitrogen
- 1 bale straw
- 1 bale hay
- 1 bale peat
- 1 bale shavings
- 1 "bale" soil
- 2-3 "bales" greens
  - Grass clippings
  - Green manure
  - Comfrey
  - Weeds (no seeds)

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PEAR TREE FARM

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## Pear Tree Farm (PTF) Transplant & Tea Mix

Amount of comfrey and soil shown used per bale of others.



These components are readily available to make a very reproducible mix, low N, good fungal activity

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PEAR TREE FARM

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## Designer Compost with Manure Spreader



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PEAR TREE FARM

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## Non-Manure Media Compost

- Compost was started in June and finished by end of July. Was ready to use the next spring.
- Nitrogen low enough to start seeds but needed more fertility for long term transplant production.
- Can be modified with peat or vermiculite.
- This compost is also being used in compost tea research.
- If available tree leaves are a great addition and likely improves the compost for transplants.

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PEAR TREE FARM

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Pallet Compost: hay, straw, wood shavings, peat, etc – after 7 months with no turning or mixing but water has to be added.



January 2007



Pile made April 8, 2006  
Picture Sept 27, 2006  
6 months, no turning

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PEAR TREE FARM

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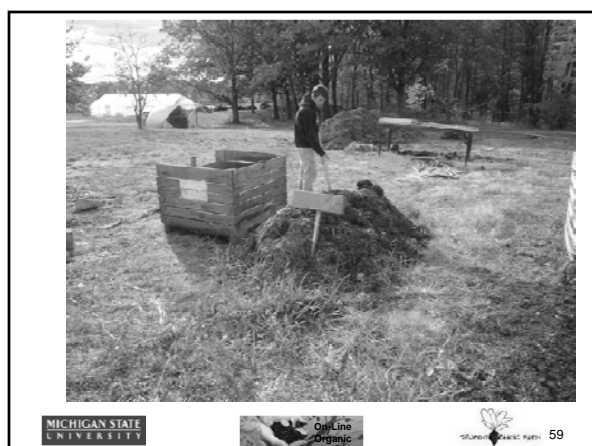
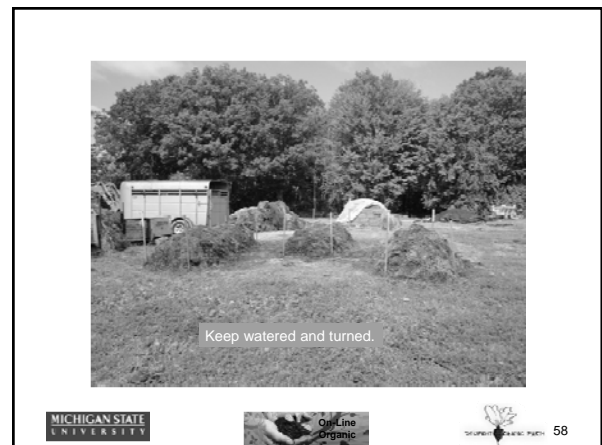
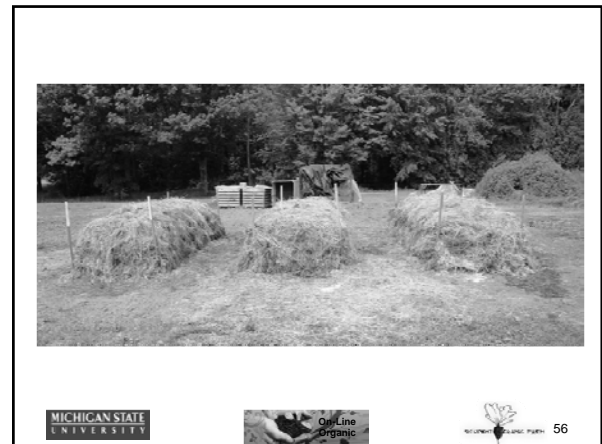
6 hay @ \$3 = \$12  
3 straw @ \$2 = \$6  
3 shaving @ \$6 = \$18  
3 peat @ \$10 = \$30  
Total = \$66

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PEAR TREE FARM

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### Transplant Compost

Mixed 50% compost, 25% peat, 25% vermiculite  
starting in January (stored in greenhouse)

6 hay @ \$3 =	\$12
3 straw @ \$2 =	\$6
3 shaving @ \$6 =	\$18
3 peat @ \$10 =	\$30
<b>Total -</b>	<b>\$66</b>

Early June

40' x 40' x 48' = 1.6 cu yd  
Early October - 4 months

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1 bale of each + ~ 100 gal water  
Each ¼ bale absorbed about 5 gallons  
160°F in 3 hrs (October 10, 2011)



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## Compost and Nitrogen Availability

- The availability of nitrogen increases gradually over several (3 to 6) months while compost is curing and maturing.
- Levels of nitrate have risen to over 800 ppm in moist compost sitting in containers indoors; ie, it can be very high.
- However, in our first experiment with municipal compost, nitrogen was limiting.

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IF Growth is Limited, Compost or Soil Based Media Usually Only Lack Nitrogen – Probably not “mature” yet



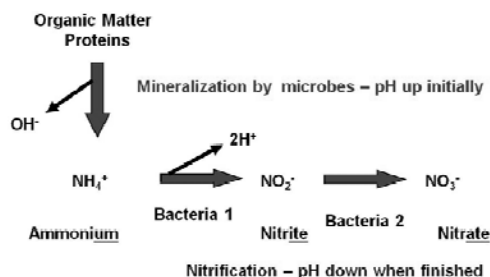
Poinsettias with municipal compost and peat. Plant on right had urea (not approved for organic certification–for experiment demonstration only) which only added nitrogen.

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## Nitrogen Availability



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IF Growth is Limited, Compost or Soil Based Media Usually Only Lack Nitrogen



Impatiens in soil based media had poor growth unless nitrogen was added.

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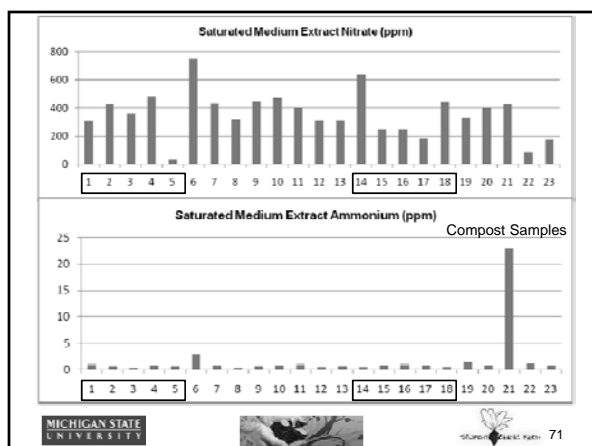
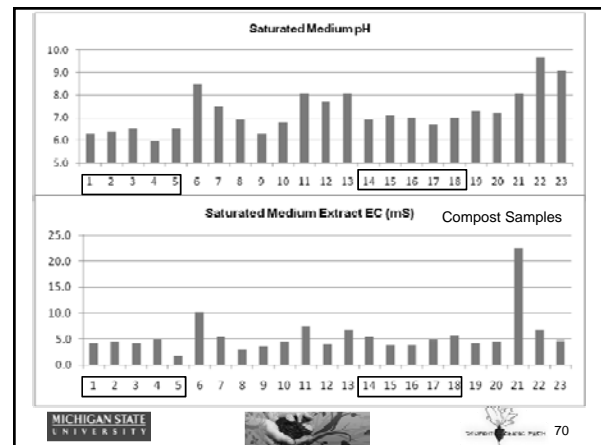
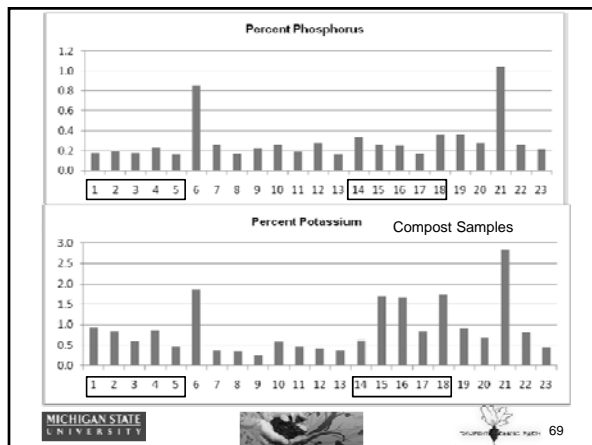
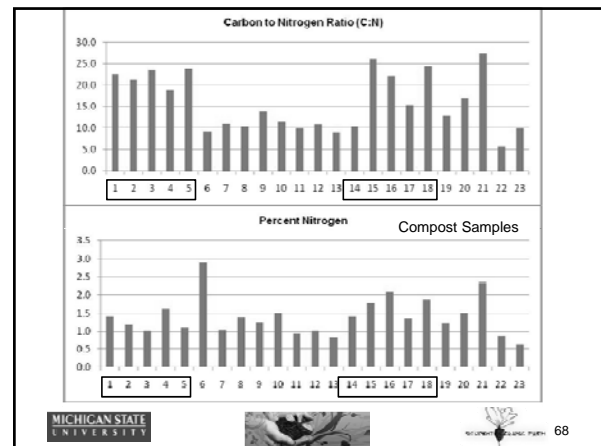
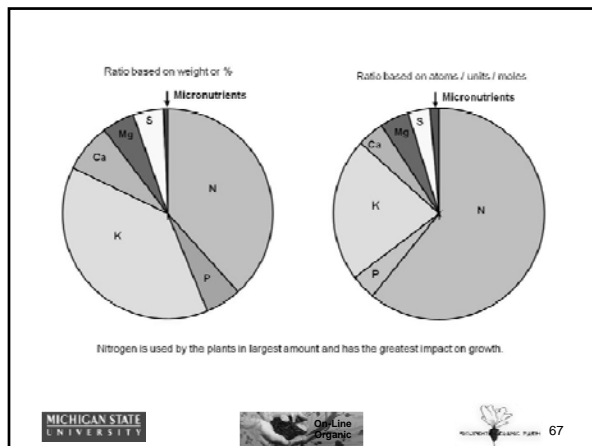
## At least two issues to consider

- The compost in our early tests was likely not “mature” enough. Nitrogen becomes available after the compost has “cured” or aged for many months.
- Nitrogen is the nutrient used in the greatest quantity.

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## Phosphorus Availability

- In peat-based (soilless) media, phosphorus is very available, can easily leach, and leads to taller plants.
- In media with compost and/or mineral soil, phosphorus is less available, less likely to leach, and stretching (taller plants) that can be a problem with water soluble fertilizer is not an issue.

## Compost or Mineral Soil Can Make a Large Difference



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## How Much Compost?

- Method 1: Do a trial run
  - 25%, 50%, 75%, 100% by volume mix
  - Test with a) seeds and b) transplants
- Method 2: Have the compost analyzed
  - C:N > 20 & nitrate <200 -- 50% or more
  - C:N 15-20 & nitrate 200-500 – 25-50%
  - C:N <15 & nitrate >500 – 25% or less
  - These are educated guesses not determined by controlled studies or research comparisons.

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## Worm Castings or Compost

- Worm castings are an excellent source of fertility for transplant media.
- In our limited experience, there has been high nitrogen and phosphorus.
- Addition rates based on limited experience would be in the 10% to 20% by volume rate.
- We have recently germinated lettuce seeds in 100% worm compost.

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## Top dress with compost or worm compost



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## Top dressed worm compost Starting rate of ~ 1 cup per flat



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## Have you ever applied dried compost to transplant flats as fertilizer during production?

- A. Don't grow organic transplants.
- B. No
- C. Yes

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## pH Influences Nutrient Availability

- Medium pH can change quickly in peat-based media, particularly in small containers.
- Often an issue in greenhouses and time is spent managing & adjusting.
- Does not appear to be an issue when soil or compost is included in the root medium.
- Root medium testing on-site or by sending samples to a lab is an important management strategy.

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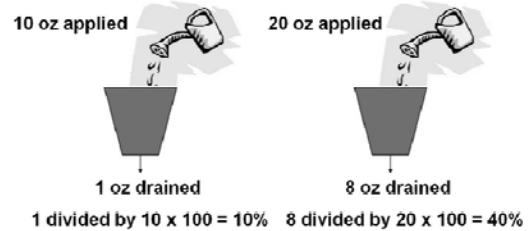
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## Leaching impacts nutrient retention

### How to Calculate Leaching



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## Leaching is minimized in organic systems

- Keep nutrients in the root medium.
- Add enough water to moisten the entire root zone.

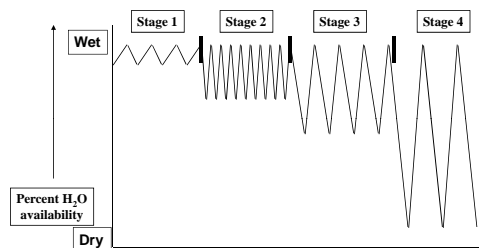
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## Variations in Moisture Levels by Stage



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## General Outline

Growing Systems  
Root Media Components  
Root Media Amendments  
Midcrop Fertility Options  
Water and Irrigation  
Review and Questions

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## Have you prepared an organic farm plan?

Specific information is requested.  
Sample Farm Plans available at  
[www.attra.org](http://www.attra.org) or from certifiers.

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**SECTION 3: Seeds and Seed Treatments**  
NOP Rule 205.204

NOP Rule requires the use of organically grown seeds, unless the variety is not commercially available. If using non-organic seeds, you must have records of your attempts to source organic seed. Synthetic seed treatments are prohibited unless included on the National List. Genetically engineered/modifier (GMO) seeds and inoculants are prohibited in organic production. NOP Rule uses the phrase "excluded methods" to refer to GMO products. Please save all seed and inoculant labels, and documentation of commercial unavailability of organic seeds to show the inspector.

List all seeds used or planned for use in the current season. Check the appropriate boxes and provide other information as needed. Attach additional sheets if necessary.  
No seeds used    All seeds are organic    Some untreated seed used    No GMO seeds purchased/planted

Seed/variety/brand	Organic (✓)	Untreated (✓)	Treated (✓)	GMO (✓)	Type/brand of treatment Fungicide Inoculant	What attempts did you make to use organic/untreated seed?

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**SECTION 4: Source of Seedlings and Perennial Stock**  
NOP Rule 205.204


Annual seedlings must be produced according to organic standards. Non-organic perennial plants (planting stock) must be managed organically for at least one year prior to harvest of crop or sale of the plant as certified organic planting stock. Organic seedlings and planting stock must be used if commercially available. Contact the certifying agent if you need to use non-organic seedlings because of an emergency. A prohibited treatment may be used if such treatment is a Federal or State phytosanitary requirement.

**A. DO YOUR PURCHASE ORGANIC SEEDLINGS?** Yes No  
Not applicable

Who are the suppliers?

If certified, by which agents?

Do you purchase non-organic seedlings?  
Yes No  
If yes, state why and describe your attempts to purchase organic seedlings.

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**B. IF YOU GROW ORGANIC SEEDLINGS ON-FARM:**  
Not applicable

What type and size is your greenhouse?

Do you raise potted plants or plant crops directly in the ground in the greenhouse?


If treated wood is used in any part of your greenhouse, where is it used?

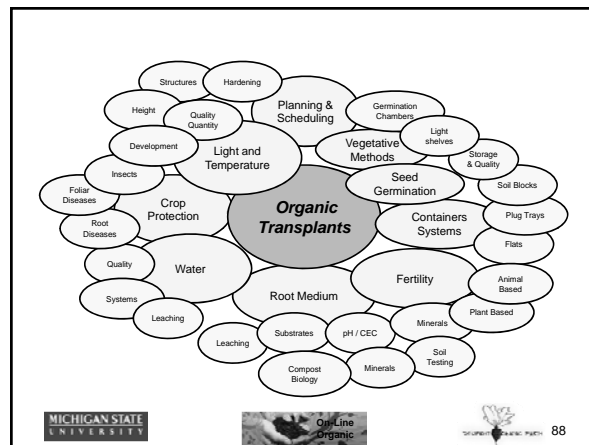
List all soil mix ingredients, fertility products, foliar sprays, and/or pest and disease inputs used or planned for use in your organic greenhouse operation. Attach labels or have labels available for inspection, as applicable.

Product	Brand name or source	Status: approved (A) restricted (R) prohibited (P)	If restricted, describe compliance with NOP rule annotation	Check if GMO (✓)

What equipment do you use in your watering system?

How do you prevent seedling diseases and/or insect problems?


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Are you interested in a 5-week on-line course on organic transplant production that would cost \$150?

A. Yes  
B. Maybe  
C. No

If yes, email John Biernbaum at [biernbau@msu.edu](mailto:biernbau@msu.edu)  
Put "transplants on-line" as the subject

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