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Small Fruit and Vegetable Production

USDA NIFA | UGA extension | GEORGIA ORGANICS

Session 4

Vegetable Growing Seasons in Georgia

Timothy Coolong PhD
Commercial Vegetable Extension Specialist
University of Georgia, Tifton Campus

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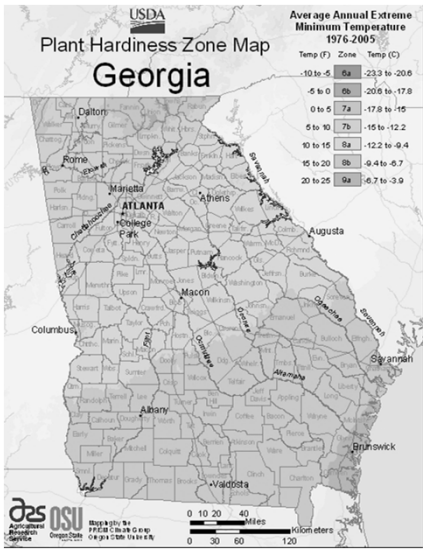
Georgia Growing Seasons



- Georgia can be divided into 3 growing regions
  - Mountains (Rome, Rabun, Blairsville)
  - Piedmont (Athens, Atlanta)
  - Coastal Plain (S. GA, Tifton)

Georgia Growing Seasons

- In the Mountains and Piedmont frost protection provides clear advantages for markets
- In S. GA year-round production of vegetables occurs

- First/Last Frost Dates

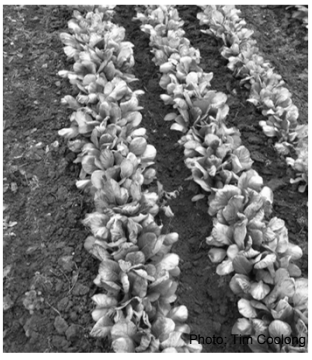
Location	First Frost	Last Frost
Blairsville	9/23-11/6	3/31-5/21
Watkinsville	10/9-11/25	3/5-4/19
Tifton	11/1-12/21	1/26-3/21
Dates gathered from data from 1994-2015 time period		

Warm and cool season crops

- Many warm season crops are fruiting crops (pepper, cucumber, tomato)
- Many cool season crops the leaves are consumed (cabbage, greens, lettuce)
  - There are exceptions – bulbs and root crops (beets) are cool season
  - Some root crops (sweet potato) are warm season
- While you can grow crops out of season expect to encounter more problems under less than optimal conditions
- Season extension techniques

Cool Season Crops

- The following crops will tolerate frosts and freezes
  - Onion (15-18 ^{o}F)
  - Cabbage (20-22 ^{o}F)
  - Greens, Spinach (18-24 ^{o}F)
  - Broccoli/Cauliflower (24-30 ^{o}F)
  - Carrot (22-24 ^{o}F)
  - Lettuce (24-28 ^{o}F)
- Freeze/frost tolerance is related to species as well as
  - Growing conditions
  - Stage of growth



Damage to mustard greens after cultivation and cold weather

Warm Season crops

- All of these crops will be damaged by frost
  - Solanaceous crops (tomato, pepper, eggplant)
  - Cucurbits (cucumber, watermelon, cantaloupe, squash)
  - Sweet corn
  - Beans, Peas
  - Okra, sweetpotato

Lettuce bolting

Days to maturity

- Days to maturity are an estimate only
  - Ex. Sweet corn in spring and fall can differ by 20 days in maturity
  - Think in terms of heat units
  - Most warm season crops use a base temperature of 50 ^{o}F for growth

- Days to maturity cont.
  - Differ based on a direct seeded or transplanted crop
    - Beans are 50-55 days from seeding to maturity
    - Peppers may be 70-75 days from transplanting (6 week old transplant)

Growing seasons

- N. GA Mountains
  - 1 warm season crop
  - 1-2 cool season crops
  - Planting warm season May 1 (estimate)
  - Cool season crops planted March and August
- Piedmont
  - 1 or 2 warm season crops (2 short season crops such as squash/cucumber
  - 2 cool season crops
  - Plant warm season early-mid April and early August
  - Cool season March and August

Growing season

- S. GA
  - 2 warm season crops
  - 2 cool season crops
  - Warm season planted late Feb-late March and Aug 1-Aug 15
  - Cool season planted mid Jan-early Feb and Aug 15-Sept 15
- In the southern part of the state the second warm season crop will be under severe disease and insect pressure
  - Disease resistance in varieties is critical

Transplant production

- For many fall crops transplant production can be challenging
  - Seeded and grown during the hottest time of the year
  - Germination rates of cool season crops suffer in heat
- Direct seeded fall crops (carrot, bean) need to have constant wetting of the soil to prevent crusting and improve germination.


Photo: Tim Coolong

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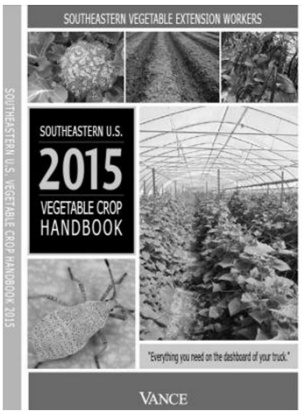
Additional Resources

- General planting dates for GA
  - Vegetable gardening in GA
    - http://extension.uga.edu/publications/detail.cfm?number=C963
  - SE Regional Vegetable Production Guide
    - http://www.thepacker.com/grower/2015-southeastern-us-vegetable-crop-handbook



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Session 4
Crop Selection

Timothy Coolong PhD
Extension Vegetable Specialist
University of Georgia, Tifton Campus

Learning Objectives

- Basic crop and variety selection –
  - Matching soils, climate, landscape position, amount of sun, and markets to your cash crop using examples
  - Open pollinated vs. hybrids and disease resistance
  - Determinate vs. indeterminate

Site Selection/Plan

- Most important considerations for site selection
  - Have good water
    - Horticulture Crops contain 90% water must have plenty of water
  - Soil Quality
    - It might take a while but you can really improve soil over time
      - Well drained soils are preferred over those that drain poorly
      - Drain tile may be an option – vegetable crops do not tolerate standing water

R.J. Reynolds Tobacco Company, Bugwood.org–See more at: http://www.ipmimages.org/browse/detail.cfm?imgnum=1440065#sthash.MP8pwGV3.dpuf

Variety and Crop Selection

- Hybrid (F1) vs. Open Pollinated (OP)
- Hybrids are a controlled cross between 2 inbred parental lines
  - Have vigor
  - Do not look like parents
  - Have improved disease resistance (typically)
  - Most new varieties
  - Cannot save seed – they will not come true to type

Varieties and Crop Selection

- Open pollinated
  - Older types – heirloom vegetables are open pollinated – some new releases are also OP.
  - Can save seed from these and they will be true to type
  - Often lack disease resistance that newer varieties have
  - Seed are typically much cheaper
  - May differ significantly between companies
    - Hybrids are usually associated with a single company, while OP types can be sold by several sources

GMO vegetables

- Although GMO crops grab a lot of headlines they have a very minor impact on vegetables
  - Commercially there are GMO sweet corn (herbicide and insect resistance) and squash/zucchini (virus resistance)
  - Very little GMO sweet corn is grown by large wholesale growers
  - GMO Squash is limited to the fall market in Georgia (enhanced disease resistance)
  - Other GMO vegetables have patents issued but are not sold commercially

Variety Selection

- Disease resistance in varieties is a critical tool to us
  - Often disease resistance is not present in varieties with certain quality characteristics
- As the season progresses, disease resistance becomes more important (inoculum and vectors increase)
  - For ex. In spring non-virus resistant squash can be grown, but that becomes challenging later in the summer

Photos: Tim Coolong

Disease resistance

Cross pollination

- Most different species will not cross pollinate
  - Interspecific hybrids can occur
  - Not an issue since the fruit will not be affected, only the seed
- Generally self pollinate (perfect flowers)
  - Beans, peas, tomatoes, peppers
- Cross pollinate w/ insects (male/female flowers)
  - Cucurbits
- Cross pollinate w/wind
  - Corn

Sweet corn types

- There are at least 9 types of sweet corn available now
- Most come from 3 genes and combinations
- Su (standard sweet corn)-5-15%
- Se (sugary enhanced) – 8-20%
- Sh2 (shrunken 2/super sweet) 25-40%

Sugary enhanced

- Has either one or two copies of the recessive *se-1* gene
- Either 25% or 100% kernals contain the se characteristics
- Works in conjunction with the recessive su-1 gene (regular sweet corn)
- Produces extra sugars, but does not slow starch conversion
- Tend to be creamy, do not ship well – sold for direct markets

Supersweet (*Sh-2*)

- Supersweets contain a recessive gene of *sh-2*
- This increases sugar and prevents the conversion of sugars to starch
- They lack the production of phytoglycogen (starch)
  - Why they are not creamy
- Also do not germinate well because no starch available
- Ship very well and are sold on the wholesale market

Sh-2 kernel,
Harris Moran Seed Company

In summary

- Se, Su, Synergistics can grow together
- Sh-2, and augmented supersweets can be grown together
- Keep the two groups isolated
- Isolation 250 feet will get minor contamination
- Isolation of 700 feet will be complete
- 10-14 days of maturity/planting time

Other varietal characteristics to be aware of…

- Tomatoes
  - Indeterminate vs. determinate
    - Indeterminate will continue to grow, eventually getting very tall
      - Many heirloom types
      - Harvest spread out over a long period
    - Determinate will terminate in a flower bud (fruit cluster) after a set time period
      - Hybrid types, shorter more compact, concentrated yields

Determinate tomatoes in a field

Systems-based farming

Photo: Tim Coolong

Crop Selection

#1 – Grow what you can sell and have it sold before you plant it

#2 – Can it fit into your production system

- Weed and pest control, post-harvest treatment, labor, etc.

Photo: Tim Coolong

Crop Selection

Slide courtesy of Dr. Brent Rowell, University of Kentucky.

- Labor is a significant factor in crop selection.
  - Tomatoes are widely regarded as the most labor intensive

Crop Selection

- How does the crop grown fit into your system
  - Example weed management for a crop-
    - Decisions made regarding selecting a crop

Photos: Tim Coolong

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Will you use herbicides?

- What herbicides are available? http://www.gaweed.com/
- Do they have rotation restrictions?
- Can they be used on a variety of crops

Photo: Tim Coolong

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What will you grow

- Staked or vining-how will you cultivate

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Plastic or Bare Ground?

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Crop Selection

- Short season vs. long season

Photos: Tim Coolong

Crop Selection

- Quick coverage vs. poor competitors

Photos: Tim Coolong

Crop Selection Storing Vegetables

Not all vegetables should be refrigerated

- Cool and dry
  - Room temperature or slightly cooler (~ 60F)
  - ~ 60% relative humidity
- Cool and “moist”
  - ~ 55-60 F, refrigeration for a few days generally ok
  - Protect from drying (silted plastic bag, slightly open container)
- Cold and moist
  - Refrigerated (32-40 F)
  - ~ 95% relative humidity

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Storing Vegetables

- Cool and dry
  - Potatoes
  - Pumpkins/winter squash
  - Watermelons
- Cool and “moist”
  - Cucumbers
  - Summer squash
  - Eggplant
  - Peppers
  - Tomatoes
- Cold and moist
  - Beans
  - Beets
  - Broccoli/cauliflower
  - Cabbage
  - Cantaloupe
  - Carrots
  - Corn
  - Leafy greens (lettuce, spinach, kale)
  - Radishes

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Additional Resources

- SE Regional Vegetable Production Guide
  - http://www.thepacker.com/grower/2015-southeastern-us-vegetable-crop-handbook
- GA Pest Management Handbook
  - http://www.ent.uga.edu/pest-management/

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Vegetable Propagation, Seeds and Transplants

Dr. George Boyhan
Horticulture Dept.
University of Georgia

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Learning Objectives

- Give an example of a crop that should be direct seeded
- List three reasons you might want to use a transplant

Crop Propagation

Goal is:

- Consistent stand maximize use of space
- Straight rows helps with weed control
- Proper spacing for best plant growth, reducing weeds and disease

Either direct seeding or transplanting can work.

Direct Seeding vs Transplanting

- Direct seeding advantages
  - Don't need greenhouse for transplant production
  - Better for root crops like carrots, beets, turnips
  - Better for thickly seeded leaf crops – lettuce mixes, microgreens
  - Always used for cover crops
- Direct seeding disadvantages
  - Usually requires more seed
  - Less control of germination conditions
  - Smaller window for production

Direct Seeding vs Transplanting

- Transplanting advantages
  - Insures a perfect or near perfect stand
  - Extends growing season
  - Production for early markets
  - Save on irrigation
  - Improve crop uniformity
  - Save on expensive seed
- Transplanting disadvantages
  - Initial investment in greenhouse infrastructure
  - Extra labor to produce transplants

Direct Seeding -Getting Started

- Good bed or ground preparation for good seed-soil contact
- Know the right planting depth!
- Know the right spacing!

You can find this information on many seed packets or in the seed catalog.


Photo: Julia Gaskin

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Seeding Equipment & Methods

- Hand seeding
- Broadcasting
- Drilling – planting one seed next to another
  - Cover crops
- Precision sowing –best stand establishment for specific spacing
- Chitting – pre-germinate seed until radical appears
- Precision seeders
  - Plates
  - Belts
  - Vacuum

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Seeding Equipment & Methods

- Handseeding
  - Place stake with string, pull tight to mark straight row
  - Pull hoe along string to make furrow at right depth
  - Walk along furrow and drop seeds in at right spacing
  - Use hoe to cover furrow
  - Water

Photo: Jessica Cudnik

Photo: JoHannah Biang

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Seeding Equipment & Methods

- Handseeding in biointensive beds
  - Offset rows to plant in triangles to maximize plants in a given space

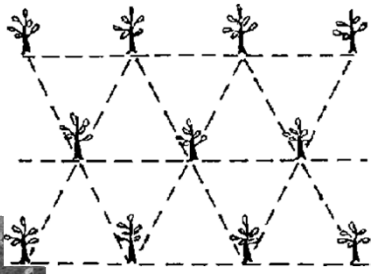

Photo: http://www.nzdl.org - SPWP - Planting Trees - An Illustrated Technical Guide and Training Manual

Photo: Katie Chatham

Photo: http://simple-green-frugal-co-op.blogspot.com

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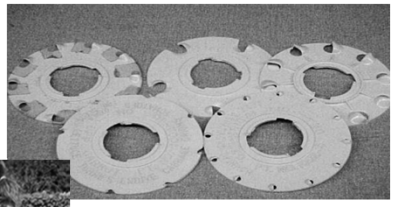
Seeding Equipment & Methods

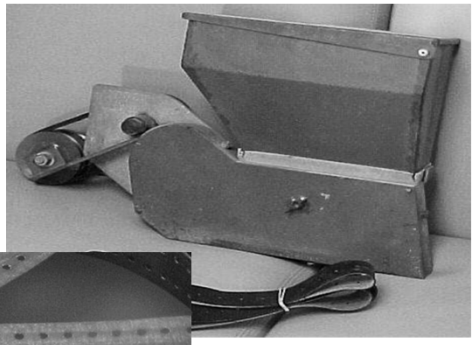
- Push seeders
  - Have different plates for right spacing for different crops
  - Row markers can be set for right row spacing

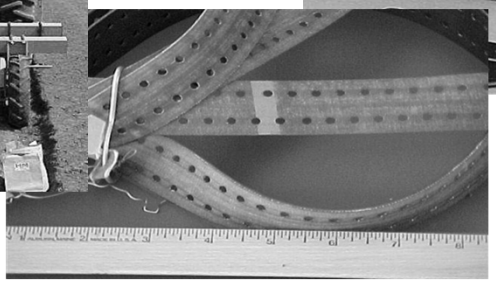


Photos: http://www.johnnyseeds.com/

Seeding Equipment & Methods

- Tractor pulled seeders





Photos: George Boyhan

Seeding Equipment & Methods

Photos: George Boyhan

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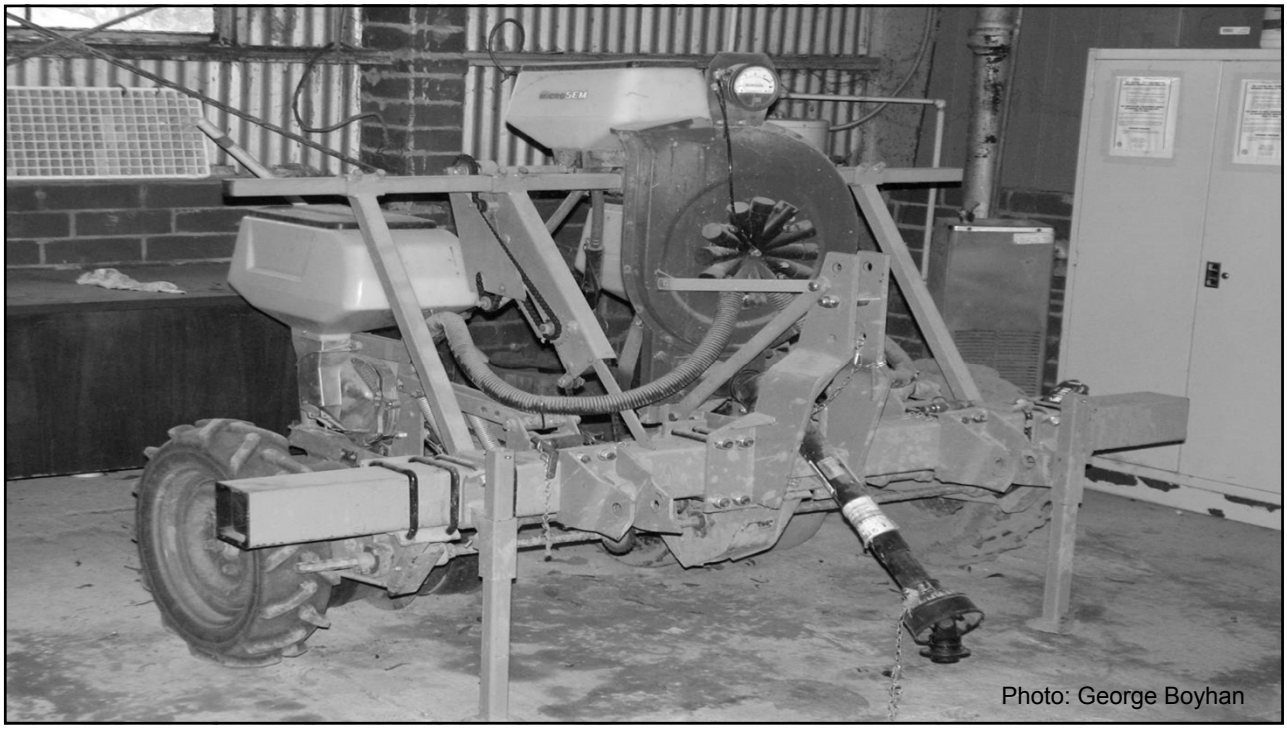


Photo: George Boyhan

Photo: George Boyhan

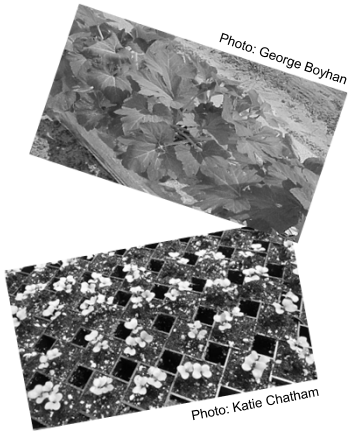
Seeding Equipment & Methods

Transplant Production

- Is it cost effective?
- How much seed?
- When to plant?
- Containers, media, fertilizer?
- Handling and transportation?
- Field grown bareroot production
- Sets – specialized reproductive structure
  - (ex. onions)

Commonly Transplanted Vegetables

- Broccoli
- Brussels sprouts
- Cabbage
- Cauliflower
- Celery
- Collards
- Cantaloupe
- Cucumber
- Eggplant
- Lettuce
- Onion
- Pepper
- Sweetpotato
- Tomato
- Watermelon
- Squash



Field Production

- Large industry in south Georgia years ago
  - Limited current production
  - Ex. Bonnie Plant Farms – Union Springs, AL
- Onions – still a significant industry
  - On-farm production

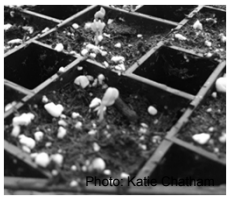
Photos: George Boyhan

Transplant media and containers

- Peat based media
  - Peat moss, perlite, vermiculite, pine bark
- Other additives
  - Lime, fertilizer (enough for the crop, organic water soluble fertilizers are not available)
- Containers
  - Speedling trays, flats & inserts, single piece polyethylene flats

Photo: Julia Gaskin

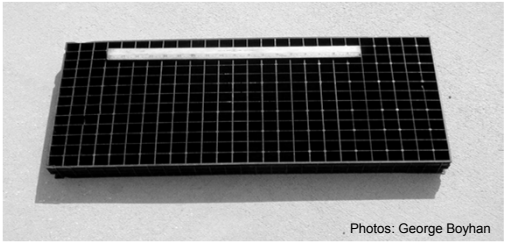
Example Potting Mix



- Organic media mix:
  - 0.4 yard sphagnum peat moss or ground pine bark
  - 0.3 yards vermiculite or perlite
  - 0.3 yards compost or topsoil (ex. Black Cow Topsoil)
  - 4 cups complete organic fertilizer (ex. 5-6-6)
  - 1 cup blood meal
  - 5 lbs ground limestone

Polyethylene flats & inserts

Styrofoam Speedling Trays



One piece polyethylene

Tray cell sizes

- Standard flat 11 x 22 inches
- 36, 50, 63, 72 cells per flat
- Other sizes available
- Seedling trays
  - Slightly larger 13.5 x 26.5 inches
  - Sold by the number of cells per tray
  - Ex. 242 cells per tray (1” square, 2” deep)

Photos: George Boyhan

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Transplant Timing

Crop	Seed/10,000 seedlings	Germination (days)	Time Required (weeks)
Broccoli	2 oz	4-9	5-7
Cucumbers	0.5-1.0 lbs	3-7	2-3
Eggplant	4 oz	5	5-7
Muskmelon	0.5-1.0 lbs	3-7	4-5
Pepper	7 oz	8	5-7
Pumpkin	2.5-6.5 lbs	3-7	2-3
Onion	3 oz	4	8-10
Squash	2-3 lbs	3-7	2-3
Tomato	3 oz	5	5-7
Watermelon	3.25 lbs	3	3-4

Adopted from Knott’s Handbook for Vegetable Growers

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Transplants Per Acre

Crop	Transplants/acre
Broccoli	17,500 – 26,250
Cabbage	12,500 – 23,200
Cucumbers	14,500 – 19,300
Eggplant	4,000 – 6,000
Muskmelon	2,000 – 5,500
Pepper	9,300 – 14,500
Pumpkin	1,000 – 3,000
Onion	80,000 – 100,000
Squash	9,600 – 14,500
Tomato	9,300 – 14,500
Watermelon	1,600 – 3,000

Activity – Seed Numbers and Transplants

- *Locally Yours Farm* wants to grow two 5 x 20 ft beds of summer squash this year for an early market. How many transplants should they start? How many seeds do they need?

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Special Handling

- Triploid Watermelon
  - Expensive seed
  - Keep media on dry side
    - Particularly 1st 48-72 hrs
  - High temperature
    - Above 70 deg. F. nights
  - Coordinate with pollenizer production

Photos: George Boyhan

Transplant Finishing & Handling

- Size (1-3 inch diameter cells)
  - Smaller the size the more care required (watering etc.)
- Disease or insect problems
- Hardening off
- Delivery
- Delay in Planting

Hardening Off

- Reduce water and/or temperature
  - Move out of the greenhouse 3-5 days prior to transplanting
  - Protect from excessive cold (move back to greenhouse at night if needed)
  - Protect from excessive light (place in the shade and/or watch the watering)
- Effects
  - Reduces growth
  - Thickens cuticle
  - Increases dry matter
  - Increases water holding colloids
  - Decreases free water
  - Anthocyanins increase
  - Increase carbohydrates


Photo: Julia Gaskin

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Transplanting

- Similar to direct seeding – mark off row
- Make hole with hoe or dibble at correct spacing or
- Use hand transplanter
- Put in transplant
- Step on side to close hole
- Water


Photo: Jessica Gadrois

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Photo: Julia Gaskin

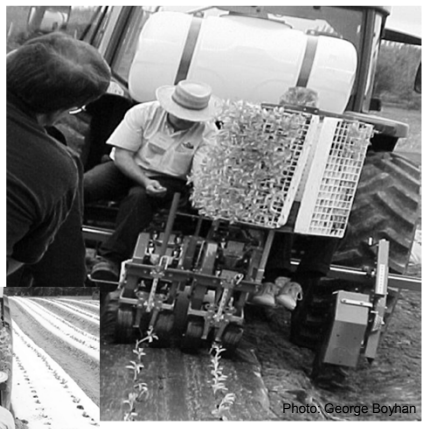

Photo: George Boyhan

Photo: Julia Gaskin

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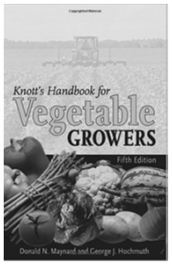
Additional Resources

- Maynard, D.N. and G.J. Hochmuth. 2007. Knott's Handbook for Vegetable Growers 5th Edition. John Wiley & Sons, Inc. Hoboken, NJ. ISBN-13: 978-0471-73828-2.



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Small Fruit and Vegetable Production

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Session 4
Considerations for Small Fruit Production

Dr. George Boyhan
Horticulture Dept.
University of Georgia

Learning Objectives

- Name three resources for small fruit production.

Small Fruits for Sustainable Production

- Definition: Perennial crop producing small fruit.
  - Blueberries
  - Muscadines
  - Blackberries
  - Strawberries (often grown as an annual)

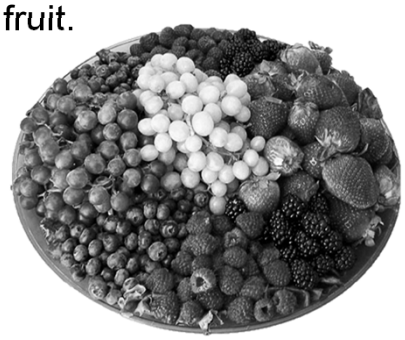


Photo: www.stoltzfusmarket.com/Fruit-Trays.rhtml

Blueberries

Photo: pendergardener.blogspot.com /2010_06_01_archive.html

- Rabbiteye – main season varieties
- Southern Highbush – early maturing, challenging to grow, not recommended in mountain regions
- Plant multiple varieties to insure proper pollination
- Acid soils – pH 4.5-5.2
- Plant with peat moss or pine bark to insure acidity
- No lime
- Cane renewal pruning after establishment (4-6 ft)
- Very few problems

Muscadines

Photo: https://pender.ces.ncsu.edu/2012/08/its-time-for-muscadines

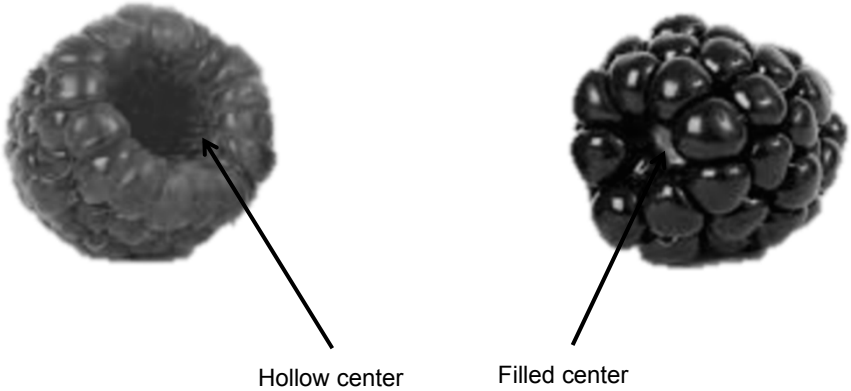
- Adapted to the Southeast
- Immune to Pierce's Disease
- Grown on trellis
- Plant multiple varieties to insure pollination
- Training & pruning is required
  - Fruit on new growth from last year's wood

Blackberries

- Brambles – includes blackberries, raspberries, etc.
- Raspberries are not well adapted to the south
- Erect, semi-erect, & trailing types
- Fruit produced on two-year-old canes (floricanes)
  - Current year's growth are called primacanes
  - Cane renewal pruning - floricanes are removed after fruiting

Photo: http://today.agrilife.org/2012/11/14/horticulturist-tells-how-to-have-a-berry-good-farm-in-texas/

Raspberries versus blackberries



Photos: http://www.examiner.com/article/how-to-tell-blackberries-from-black-raspberries

Stiles Shift Trellis

Photo: teamrubus.blogspot.com/.../blackberries-on-shift-trellis.html

Photo: www.sdedible.org/blackberry-care--cultivars.html

Strawberries

- Annual Hill Culture versus Matted Row
  - AHC results in larger fruit, less disease
  - AHC requires more management and are usually grown on plastic
- Plastic mulch requires all fertility preplant
  - No water soluble organic fertilizers
  - Fertility management can be problematic
- Overwintering crop that requires frost protection
  - Overhead irrigation and/or row covers

Photo: www.homelife.com.au

Strawberries

- Important to establish fall planted transplants prior to winter weather
- Obtain healthy disease free plants
  - Certified organic growers must obtain organically grown transplants

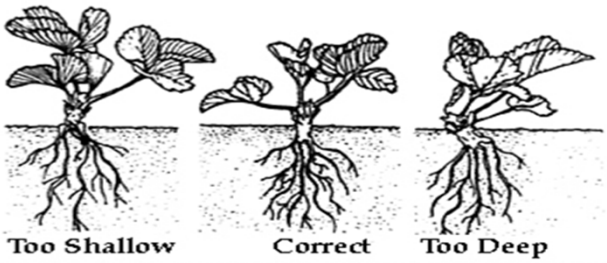


Figure 1. Set plants deep enough so all of the roots are covered, but making sure the crown is above the soil line. The plant on the left is too shallow and the one on the right is set too deep. The roots should extend straight downward

Photo: http://vsadulyvogorode.ru/sadovaya-zemlyanika/sadovaya-zemlyanika

Additional Resources

- Grow Your Own Organic Small Fruits - http://www.sustainagga.org/documents/OrganicSmallFruits-brochure.pdf
- Organic Blueberry Production - http://www.sustainagga.org/documents/06organicblues2.pdf
- SustainAgGA.org – Go to Resources, Crops, Small Fruits

JOURNEYMAN FARMER CERTIFICATE PROGRAM

JOURNEYMAN FARMER
CERTIFICATE PROGRAM

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