

## Organic Vegetable Production

A Short Course given January 25, 2007 at the Southern SAWG 16<sup>th</sup> Annual Conference in Louisville, KY. This course was offered by the Southern Sustainable Agriculture Working Group in partnership with the USDA Risk Management Agency ([www.rma.usda.gov](http://www.rma.usda.gov)).

Instructors: Alex Hitt and Debbie Roos  
Facilitator: Debbie Roos  
Recorder: Karen Wynne

### Proceedings

These notes provide information, discussions, and questions and answers from the course that are additional to the printed materials provided to participants (enterprise manuals, presentations, and other resources).

#### **OVERVIEW:**

- Information
  - the glue that binds it all together
  - gathering is a continuous job
  - from where?
    - records
    - customer feedback
    - conferences and trade shows
    - farm tours
    - written info from all sources
  - study, observe, think!
- Marketing Plan
  - affects everything
  - sets the whole train in motion
    - where to market and why
    - what to market and why
    - when to market
- Soil Fertility
  - get the soil right
  - don't depend on supplements, you will fail
  - two phases: building and maintaining balance
  - sources of fertility:
    - on site: nutrient cycling, manure, cover crops
    - off site: think about all the costs

- Rotations
  - the most important pest management tool
  - hand in hand with Soil Fertility
  - diversity is the key ingredient
  - include cover crops, animals (pastures), perennial crops and rest periods in planning
  
- Farm Design and Crop Decisions
  - efficiency and access
  - planting system
  - equipment
  - transplants vs. direct seeding
  - spacing
  - timing
  - season extension
  
- Labor
  - the most limiting factor in the system
  - the most expensive input
  - spread labor out, balance production
  - use efficiently and sparingly
  
- Weed Control, Irrigation, Trellising
  - timing, rotation, and planting decisions are the keys to weed control
  - do not even consider high value crops without irrigation
  - drip most efficient, fewer disease problems
  - trellising improves space efficiency, disease control, harvesting speed, crop quality
  
- Harvest and Post Harvest
  - proper time and maturity
  - get the heat out and keep it out
  - quit messin' with it
  - store it right
  - get it to market ASAP
  
- Pest Management
  - If you did everything else right, this is the least important part of the system.
  - Problems are generally an indication that some part of the system is not working properly

### **ALEX'S LAWS OF SUSTAINABILITY**

- Each Situation is Different—it's site specific
- Nothing Is Fixed In Stone—a goal to work towards

- Rome Wasn't Built In A Day—keep a long term perspective
- They're Not Makin' Anymore Of It—have to preserve and improve the natural resource
- This Isn't Easy—complex information and management dependent systems
- Keep It Simple and Close to Home—Local is best
- We're Runnin' Out of Some of The Stuff They're Not Makin' Anymore Of—only 40 years of oil and 60 years of phosphorus left

The Social Component: It's About Quality of Life

Employees and Family

Customer:

Market, CSA, Chefs, Wholesale Produce Buyers

Local Community:

Neighbors, Fellow Farmers, Townspeople

**SOIL AND COVER CROPS**

- Soil Fertility
  - get the soil right
  - don't depend on supplements, you will fail
  - Two phases
    1. Building
    2. Maintaining balance
  - Sources of Fertility
    - on site—nutrient cycling, manure, cover crops
    - off site—think about all the costs
  
- Sustainable Soil Management
  - Three parts of soil:
    1. Physical—sand/silt/clay—can't do much to change other than additions of OM and when and how you till
    2. Biological—organic matter and the soil food web that feeds on it
    3. Chemical—nutrients
  
  - Biological:
    - Organic matter maintenance
    - Feeding the beast
    - Where does OM come from?
      - crop residue
      - cover crops
      - manures
      - compost

### Inoculate the soil

- manure
- compost
- worm castings can be used in potting mix to strategically inoculate the root zone

### The right conditions to maximize biological activity:

- warmth
- aeration
- moisture
- near neutral pH (6.0 up to 6.5 in cooler climates)

This will release the most nutrients but also burn up the most organic matter

- till as little as possible which reduces aeration and warmth
- tilling when either cool or dry will burn up less O.M.
- a reasonable goal is about 1/2 the surrounding natural O.M. levels
- trying to attain the slow burn, constant release during the growing season

### ● Cover Crops

#### How Cover Crops Improve the Soil

- Increase soil organic matter through additions of plant biomass.
- Form soil aggregates, which stabilize soil and reduce runoff and erosion.
- Increase soil porosity and decrease soil bulk density to promote root growth.
- Improve soil tilth, which reduces crusting and increases the rate of water infiltration.
- Encourage populations of soil microbes, micro- and macro-arthropods and earthworms, all of which contribute to efficient nutrient cycling and improvements in soil structure.

#### Legumes and Nitrogen (N) Fixation

##### Rhizobium bacteria

Inoculate or not? Need to inoculate with:

- Fresh inoculant
- Correct rhizobia species for the crop
- Good source:

Becker Underwood  
801 Dayton Avenue  
Ames, Iowa 50010  
515.232.5907

[www.beckerunderwood.com](http://www.beckerunderwood.com)

Check your nodules to see if they are fixing nitrogen: slice the root nodule in half with your thumbnail; the inside should be purple

Maximum N at about ½ bloom

- Types of Cover Crops
  - Annuals: Winter and Summer
  - Biennials
  - Perennials: Long and Short Term
  - Legumes
  - Grasses
  - BrassicasCombinations are best
  
- Winter Annual Cover Crops
  - Legumes: Crimson Clover, Hairy Vetch, Winter Peas, Red Clover
  - Brassicas: Rapeseed, Mustards, Radishes (oil seed and forage)
  - Grasses: Rye (grain), Oats, Wheat, Triticale, Barley
  
- Summer Annual Cover Crops
  - Legumes: Soybeans, Cowpeas, Velvet bean, Sun hemp
  - Grasses: Sorghum-Sudan grass, Millets,
  - Buckwheat
  
- Biennial and Perennial Cover Crops
  - Legumes: Sweet Clover, White Clover, Lespedezas
  - Grasses: Fescues, Perennial Rye grass, Orchard grass, Bermuda grass

Additional Notes:

- Long term perennial cover crops can be used with small fruits or in an orchard
- Common mixes: grain rye and hairy vetch, crimson clover and oats, soybeans and Sudan grass, cowpeas and millet
- If a fall cash crop follows the summer cover, millet doesn't get woody like Sudan grass does
- Hairy vetch and crimson clover are the easiest
- Grain rye is number one winter biomass producer, oats is second
- Mustards have nematicidal properties
- Black oats or a late planting of millet are good candidates for intentional cover crop winterkill
- Buckwheat is good for honeybees and other beneficials
- When sudangrass reaches 18-36", mow it to encourage deeper rooting
- Rotate your cover crops too
- Rotate turkeys in: they love soybeans and cowpeas, supply 1000 pounds of manure per acre per year
- Lespedeza germinates in late winter and early spring; Alex is working with it in asparagus

- Alex incorporates cover crops with a flail mower and disc
  - Nutrient Management
    - Cation Exchange Capacity—ability of soil to hold cation nutrients
      - Cation nutrients- Potassium (K), Calcium (Ca), Magnesium (Mg)
    - Soil Testing
      - You can use your state lab
      - Test at the same time every year (fall best)
      - The only way to monitor the mineral nutrients
      - Pull many samples from a field in a Z pattern when soil is not wet
      - Mix in a clean plastic bucket
- Not just a substitution of materials—rethink the entire system and ecosystem  
Where do they come from?
- crop residues
  - cover crops
  - manures
  - compost
  - rock powders
  - seed meals
  - animal by-products
- Know your area—do the math!  
One acre is 43,560 square feet, 208 feet by 208 feet  
A quarter of an acre is 104 feet by 104 feet
  - Keep it simple & close to home
    - The goal is to try and close the nutrient loops
    - Lime—watch Mg
    - Correct Phosphorus (P) & K—watch Mg
    - Cover crops for N and to recycle nutrients
    - supplemental N
      - Manures
      - Seed meals
      - Animal by-products
  - Liming Materials—Primarily Ca to raise the pH
    - Calcitic or Hi-Cal 25-40% Ca, <3% Mg
    - Dolomitic 19-22% Ca, 6-13% Mg
    - Wood ashes 23-35% Ca, 2% Mg, 6% K, and some P, fast acting
    - Ground clam and oyster shells 34% Ca
    - Rock phosphates have 21-33% Ca

- Gypsum is used to add Ca (23%) but will not raise the soil pH (17% Sulfur)
- Phosphorus (P) materials
  - Phosphorus is harder to maintain w/o manures
  - Rock phosphate 30% (~3% available)
  - Colloidal phosphate 18% (~2% available)
 Bone meal 20%--expensive, but more quickly available
- Potassium (K) materials
  - Potassium maintained mostly through organic matter additions
  - Sul-Po-Mag or K-Mag 22%K, 11%mg
  - Potassium Sulfate 50%K
  - Wood ashes 6%K
  - Greensand 7%K

- Rotations

- the most important pest management tool
- hand in hand with Soil Fertility
- diversity is the key ingredient
- include cover crops, animals (pastures), perennial crops and rest periods in planning

“From his experience as a researcher at Rutgers, Firmin Bear stated that well-thought-out crop rotation is worth 75 percent of everything else that might be done, including fertilization, tillage, and pest control.

Rarely are all principles of crop rotation applied as thoroughly as they might be in order to garner all of their potential benefits.

To my mind, crop rotation is the most important practice in a multiple-cropping program.”

--Eliot Coleman

#### What is crop rotation?

A planned system of growing different kinds of crops in recurrent succession on the same piece of land. Generally the aim is to plant crops that are not related botanically, do not share the same nutrient requirements, and do not share the same pest problems. Rotation is both spatial (crops move over an area) and temporal (crops change over time)

#### Why is it important?

Crop rotation is planned diversity, which provides stability to biological systems.

Rotation breaks up disease, weed, and insect life cycles by spacing susceptible crops at intervals sufficient to hinder the buildup of their specific pest organisms. Rotation encourages better use of soil nutrients and amendments.

Possible benefits (per Eliot Coleman)

- Increase in soil nitrogen
- Improvement in the physical condition of the soil
- Increased bacterial activity
- Increased release of carbon dioxide
- Excretion of beneficial substances
- Control of weeds, insects, disease

Possible deleterious effects of preceding crops:

- Depletion of soil nutrients
- Excretion of toxic substances
- Increase in soil acidity
- Production of injurious substances resulting from decomposition of plant residue
- Unfavorable physical condition of the soil due to a shallow-rooting crop
- Lack of proper soil aeration
- Removal of moisture
- Diseases passed to subsequent crops
- Influences of crops upon the soil flora and fauna

Three types of rotations

- Cash crop based
- Cover crop based
- Nutrient based--roots-shoots-leaves have different nutrient needs

Guidelines for Rotation

- Separate similar crops or families of crops as much as possible
  - Apiaceae* (Carrot Family): carrot, parsnip, parsley, celery
  - Asteraceae* (Sunflower Family): lettuce, endive, radicchio
  - Brassicaceae* (Mustard Family): cabbage, broccoli, cauliflower, Brussels sprouts, kohlrabi, turnip, radish, Chinese cabbage, kale, collards, rutabaga
  - Chenopodiaceae* (Goosefoot Family): beet, Swiss chard, spinach
  - Convolvulaceae* (Bindweed Family): sweet potato
  - Cucurbitaceae* (Gourd Family): cucumber, muskmelon, watermelon, squash, pumpkin, gourd
  - Fabaceae* (Pea Family): garden pea, snap bean, lima bean, soybean
  - Liliaceae* (Onion Family): onion, garlic, leek, shallot, chive
  - Malvaceae* (Mallow Family): okra
  - Poaceae* (Grass Family): sweet corn, popcorn, ornamental corn

*Solanaceae* (Nightshade Family): tomato, pepper, eggplant, potato, husk  
tomato

- Alternate cover crops  
legumes/grasses  
cool-season/warm-season
- Alternate heavy feeders with light feeders
  - Heavy feeders: broccoli, Brussels sprouts, cabbage, cauliflower, celery, collards, corn, cucumbers, eggplant, endive, escarole, kale, kohlrabi, lettuce, okra, onions, parsley, pumpkins, rhubarb, spinach, squash, tomatoes
  - Light feeders: beets, carrots, garlic, leeks, mustard, parsnips, potatoes, radishes, rutabagas, shallots, sweet potatoes, Swiss chard, turnips
  - Soil builders: alfalfa, broad beans, clover, lima beans, peanuts, peas, snap beans, soybeans, vetch
- Alternate flowering crops with vegetative crops
- Place crops with different canopy heights next to each other
- Alternate cool season crops with warm season crops
- Be mindful of the allelopathic effects of certain crops
- Alternate deep-rooted crops with shallow-rooted crops
  - Shallow-rooted crops are those whose main root system is in the top 1-2 feet of soil. Examples are cabbage, cauliflower, lettuce, celery, sweet corn, onion, white potato, and radish.
  - Moderately deep-rooted crops are those that have the main root system in the top 1-4 feet of soil. Examples are snap bean, carrot, cucumber, eggplant, peas, pepper, and summer squash.
  - Deep-rooted crops are those whose main root system is in the top 1-6 feet of soil. Examples are cantaloupe, pumpkin, tomato, and watermelon.

#### Suggestions, Hints and Refinements

Observe and record the good and bad effects from your rotation strategies. Coleman noted certain patterns from his readings and experience:

Legumes are generally beneficial preceding crops;

The onions, lettuces, and squashes are generally beneficial preceding crops;

Potato yields best after corn;

For potatoes, some preceding crops (peas, oats, and barley) increase the incidence of scab, whereas others (soybeans) decrease it significantly;

Corn and beans are not greatly influenced in any detrimental way by the preceding crop;

Liming and manuring ameliorate, but do not totally overcome, the negative effects of a preceding crop;

Members of the chicory family (endive, radicchio, etc.) are beneficial to following crops;

Onions are often not helped when they follow a leguminous green manure;  
Carrots, beets, and cabbages are generally detrimental to subsequent crops;

“...the rotation guidelines...qualify under the category of standard crop rotation ‘rules,’ the patterns above belong more in the category of ‘suggestions, hints, and refinements.’ The effect of any of them on improved yield, growth, and vigor may only be 1 percent, an amount that may not seem worth considering to some. What must be understood is that a biological system can be constantly adjusted by a lot of small improvements. I call them ‘one percenters.’ *The importance of these one percenters is that they are cumulative.* If the grower pays attention to enough of them, the result will be substantial *overall* improvement.”  
--Eliot Coleman

Tips to make it easier to live with a rotation:

“A rotation that really suits your farm will create a structure that actually allows for a lot of options and flexibility. What’s really remarkable is how many aspects of a market garden can be rotated and integrated in an organized fashion.”

--Anne and Eric Nordell, Beech Grove Farm, Pennsylvania

- Make rotational units (blocks/sections/fields) the same size if possible, with the size large enough to hold either the crop with the most space/production requirements or half of it
- If the rotational unit is not filled with cash crops then grow a cover crop
- Allow for expansion
- You can have more than one rotation scheme on a farm (hoophouses, field crops)
- Try and have rotational units with crops going in at the same time and coming out at the same time to better accommodate planting and turning under of cover crops
- Try and group crops with similar cultural requirements (weeding, irrigation, etc.)
- Maintain good records of your crop rotation plans!

“Although vegetable crop rotations are unlikely to be fulfilled *exactly* as planned, it is still advisable to develop a written plan and to follow it up by writing down what was actually planted where. Such recordkeeping is key to improving rotations over time, since it helps track what worked and what didn’t)--information that should be the basis of future plans.”

--Vernon Grubinger

- Rotate with livestock and perennials, moving animals annually through cropping fields.

- Alternate annual production with several years in soil building perennials.

Steps to Planning a Rotation:

- Identify all crops to be grown and expected acreage requirements
- Using the guidelines from above group crops based on botanical family, production practices, pest complex, or other features
- Define the size of the rotational unit
- Determine the land area (number of rotational units) needed for each grouping of crops
- Use 3x5 notecards with different crops on each card to visualize the rotation

“Time spent planning a rotation is never wasted. Not only will you learn a great deal about important biological balances on the farm, but the results will be so effective in halting problems before they occur that you may sometimes have to remind yourself that a lot is happening. Very often farmers fail to take full advantage of a well-planned rotation, because rotations don’t have any computable costs and because they work so well at preventing problems that farmers are not aware of all the benefits. Those benefits are, in a sense, invisible.”

--Eliot Coleman

- Farm Designs and Crop Decisions
  - efficiency and access
  - planting system
  - equipment
  - transplants vs. direct seeding
  - spacing
  - timing
  - season extension
- Farm Land Purchase and Development
  - Location--Proximity to markets, paved roads, utilities, supplies
  - Buy good soil with good orientation--Well drained with workable topsoil (sandy loam), SE-SW orientation slight slope
  - Buy cleared land
  - Irrigation water--Well, creek, pond. It takes more than you think. ¼ acre of beds with one drip line per bed takes approximately 12 gallons per minute, 750 gal. per hour, 1500 gal. per day every day!
  - Measure your fields--You have to know the area to accurately plan crops and soil amendments
  - Plan field layout for efficiency and to accommodate rotations
- Transplant production

Why?

- The only way to produce certain crops
- Early season production
- Insure true variety
- Grown for your schedule
- Better quality plants
- Less disease and insect problems

A good transplant has these characteristics:

- A large root system in proportion to the top
- Cotyledons that are large, free of defects, a healthy green color, and are attached to the plant at the time of setting
- Stems that are heavy, turgid, and stocky
- True leaves that are well-spread and moderately green with no yellowing
- No fruit set
- A high reserve of nutrients so growth starts soon after being planted

Keys to transplant production

- Proper cell size
- Soil less potting mix
- Correct germinations requirements
  - Warmth
  - Temperature
  - Light
- Correct watering
- Fertilization
- Good airflow in greenhouse
- Keep the greenhouse and area around clean
- Harden-off before transplanting to field

Alex uses 50-128 cell trays and Fafard #2 potting mix

Containers

- Liners in trays
- Flexible thin plastic trays
- Rigid plastic trays
- Styrofoam trays (Speedling)
- Individual pots
- Common flats
- Soil blocks

Look for Winstrip rigid plastic trays

Germination

- Fill flats well
- Wet soil completely
- Seeders
  - Hand
  - Vacuum
- Cover seed
- Water lightly
- Keep at proper germination temperature with high humidity
- Move out to light as soon as the cotyledons appear

A germination box can be used to keep a smaller area at the proper temperature for germination.

### Growing on

- Adequate light
  - Water early in day until water drains from bottom of plug
  - Cool nights and good airflow result in sturdy plants
  - Cool greenhouses increase time to produce a transplant
  - Begin to foliar feed after two sets of true leaves appear
  - Move up to larger containers after two sets of true leaves
  - Harden-off a week before planting to the field--move them out on a good day either early in the morning or late in the day
- In the field—soil prep
    - Do major/deep soil work in fall (or when it's the driest)
    - Spread mineral soil amendments in fall
    - Raised beds drain and warm up faster in the spring
    - Turn under cover crop 4 weeks before planting
    - Day of planting apply additional N and shallowly till for good seed bed

### Soil prep equipment needs

- Deep soil turning
  - Bottom plow
  - Subsoilers, field cultivators
- Residue incorporation
  - Mower
  - Manure/compost spreader
  - Disk harrow
  - Rototiller
  - Spaders
- Seed bed preparation
  - Bed shapers/hillers
  - Fertilizer spreader
  - Rototiller

- Rolling baskets
  - Hand raking
- In the field planting system
  - Tractor tire width determines bed width or row spacing
  - Straight-parallel rows facilitate accurate and fast cultivation
  - Spacing between rows affects cultivation, irrigation and trellising
  - Spacing between plants dependent on crop
  - Synthetic mulches
    - Generally laid in fall with drip irrigation
    - Black, white, colored plastics
    - Landscape fabric
  - Natural mulches
    - Applied just before or after planting
    - Paper, straw, leaves
  - Bare ground
    - Close spacing, fast crops
    - Think about the cultivation system
  - No-till
    - Dependent on heavy cover crops
    - Equipment
- Seeding

A fine seed bed is needed for good soil to seed contact.  
Soil worked too fine will result in crusting.

- Old row covers

Seeders--depends of seed size and spacing:

- Push
  - Earthway
  - Glaser
  - Johnny's European push seeder
  - Planet Jr.
  - Nibex
  - Salad mix multi-row
- Tractor
  - Belt--Stanhay
  - Vacuum--Maternac, Monosem
  - Plate--Planet Jr.

Use a hot glue gun to cover some of the holes on the Earthway seed plate if it is seeding too heavily

- Transplanting

- Water flats well before planting
  - Mark rows
  - Cover root balls with soil to prevent drying
  - Water in
  - Make a dibble that perfectly fits your seedling: spray oil in the seed tray, fill it with Bondo and stick a bolt in while it is drying
- Season Extension is Just Climate Modification
    - Air Temperature
    - Soil Temperature
    - Wind
    - Soil Moisture
    - Precipitation
    - Light (> 10 hrs)

Decision:

don't just go for the high-priced solution

What factor are you trying to modify? Why?

What problem are you trying to correct?

Is the crop valuable enough? Think \$10,000 per acre or more for tunnels

Is there a low technology answer?

The season extension continuum

South sloping fields

Raised beds

Run beds East-West

Cover the soil with black plastic or fabric

Use large transplants of early varieties

Plant windbreaks

Floating row covers

Low tunnels

High tunnels

Shade cloth

Heated greenhouses

- Crop Scheduling--Making a Plan
  - What season does it grow best in?
    - a. What season will it not grow in?
    - b. Best temperatures for growth
  - Can you or should you succession plant this crop?
    - a. How long does a planting produce?
    - b. How many times to plant?

- c. How much time between plantings?
- Direct seed or transplant or both?
  - a. If direct seeded how long does it take to germinate?
  - b. How long does it take to grow a transplant?
- Germination Requirements?
  - Optimum soil temperatures
- Plant spacing?
  - a. How many plants per bed?
  - b. How many seeds per foot of row?

Steps to making a plan: cool season crops

- Determine last harvest date based on temperatures for good growth
- Count weeks backwards to get the plant in the field date based on days to maturity
- If transplanted count the weeks backwards to get the seeding to flat date based on the weeks to grow a transplant
- Take into account slower germination in cool soils early and slower growth in the field
- Take into account faster growth in the last few weeks of the good growth period as temperatures and day length increase

*Example: direct seeded spinach*

Maximum avg. temp 75° - ~ 6/15;

1 week of harvest;

Harvest window--6/11, 6/4, 5/28, 5/21, 5/14, 5/7, 4/30, 4/23;

Days to maturity 42 or 6 weeks

Seed to field on 4/30;

Succession plant every week until minimum soil temp for germination is reached-- 45°

4/23, 4/16, 4/9, 4/2, 3/26, 3/19, 3/12, 3/5;

Take into account slower germination in cool soils early and slower growth in the field;

Approximate soil temps--40° - 2/15, 45° - 3/1, 50° - 3/15, 60° - 4/15

How much to plant? Avg. yield per 100' row is 40 pounds (Johnny's)

How much seed to order?

10 seeds per foot of row

1000 seeds per 100' of row

3 rows per bed = 3000 seeds

Avg. 2200 seeds per ounce

3000 divided by 2200 = 1.37 oz. per 100' bed

*Example: transplanted lettuce*

Maximum avg. temp 75° - ~ 6/15;

1 week of harvest;  
 Harvest window--6/11, 6/4, 5/28, 5/21, 5/14, 5/7, 4/30, 4/23, 4/16;  
 Days to maturity (from Johnny's) for full heads  
 redleaf variety Vulcan 52 days = 7+ weeks (direct seeded)  
 Subtract 10-14 days if transplanted = 5 weeks optimum growth  
 conditions (60°- 65°, ~4/15 - 5/7);  
 Add up to 3 weeks or more in cooler weather;  
 Transplant to field on 4/16 (5 weeks), 2/19 (8 weeks);  
 Earliest possible transplant date ~2/1, temps >20°;  
 It takes 5 - 7 weeks to grow a transplant, shorter with warmer temps and  
 longer days;  
 Seed to flat date 3/12 (5 weeks), 1/1 (7 weeks)

How many plants? 3 rows to the bed, 12" X 10", is 360 plants per bed  
 You want 20% - 25% more plants in the field than you actually plan to sell  
 You want to seed 20% - 25% more cells than plants you need in the field to  
 account for poor germination  
 You plan to sell 100 heads of a lettuce variety a week for 5 weeks  
 You plant 125 heads in the field  
 You seed 156 cells in the greenhouse X 5 weeks = 780 seeds  
 Lettuce seeds are average 24,000 seed per ounce  
 You need to order .04 ounce

#### Warm season crops

- Determine last frost date
- Plant first planting at coolest optimum soil temp or air temp
- If transplanted count the weeks backwards to get the seeding to flat date based on the weeks to grow a transplant
- Last planting generally 8-10 weeks before first frost for direct seeded crops
- For tomatoes last planting by July 1

#### Fall cool season crops

- Crops need to reach maturity by the first frost date
- Crops stop growing when daylight hours drop below 10 hours
- Most crops are direct seeded in August and early September
- Transplanted crops in late August and early September

#### ● Labor--the most limiting factor in the system

- the most expensive input
- spread labor out, balance production
- use efficiently and sparingly

Rule: One person per acre

At Peregrine Farm, 15% - 20% of gross goes to labor; workers receive \$7.50 to \$10/hour plus one week paid vacation and bonuses

- Hiring good help
  - Have an honest job description
  - Have them come to the farm for a face to face interview
  - Ask why they want to work on a farm
  - Do they have off farm obligations?
  - Do they have any physical limitations?
  - Pay them well
  - Be flexible
  
- Doing the work
  - Know the job yourself
  - Be organized and have a daily plan
  - Explain why it's done that way
  - Don't have people work alone
  - Teach quality and efficiency

It's as much about quality of life as the job itself

- Weed control, Irrigation, Trellising

Weed control

- Timing, rotation, and planting decisions are the keys to weed control
- Do not even consider high value crops with out irrigation
- Drip most efficient, fewer disease problems
- Trellising improves space efficiency, disease control, harvesting speed,
  
- Keys to weed control crop quality
  - Reduce weed seed bank
  - Rotation design
  - Timing is everything
  - Plant spacing
  - Planting system
  - Tools
  
- Tools for weed control
  - Transplanting
  - High density planting
  - Mulches
  - Mowing
  - Hand tools
  - Tractor equipment

- Flame weeding and stale seed beds

Perennial grasses should be turned over in the fall and planted with a winter and then summer cover crop.

Dealing with Johnson grass:

- has deep rhizomes
- pigs will dig it up
- keep it mowed or turned over

Corn gluten as an herbicide: is expensive and has mixed results--depends on rain and quality of the corn gluten.

### Irrigation

- Do not even consider high value crops without irrigation
- Drip is the most efficient:
  - Less water required
  - Uses less energy
  - Fewer disease problems
- Some crops are more efficient to water overhead
- Work with a good irrigation company--they will design for free, and you need good service
- Water is the limiting factor: it takes more than you think:
  - ¼ acre of beds with one drip line per bed takes approximately 12 gallons per minute, 750 gal. per hour, 1500 gal. per day every day
- How much water?
  - $G = 50 * E_p * S$ 
    - G = gallons required per day per 100' of row
    - $E_p$  = average daily evaporation in July, inches
    - S = row spacing in feet
  - Example  $50 * .27 * 4 = 54$  gallons/day/100' of row
  - How long to irrigate?
  - Irrigation hrs./day =  $\tilde{G} / 60 * R$ 
    - G = gallons required per day per 100' of row
    - Drip line flow rate, gal./minute/100' of line
  - Example  $54 / 60 * .5 = 1.8$  hrs. per day

### Trellising

- Trellising takes more labor--needs to be fast to put up and take down
- Trellising improves:
  - space efficiency
  - disease control
  - harvesting speed
  - crop quality

- Harvest and Post Harvest
  - Harvest at the proper time and maturity
  - Get the heat out and keep it out
  - Quit messin' with it--the less handling the better
  - Store it right
  - Get it to market ASAP

#### Harvest

- This is where the majority of the labor is
- Efficiency and good tools are key
- Quit messin' with it! Reduce the number of times a piece is handled
- Heat is the enemy
  - Harvest in the cool of the day
  - Keep it out of the sun

#### Post Harvest

- Get the heat out and keep it out
- There is a lot of water involved
- Store it at the right temperature
  - Cool season crops close to 32°
  - Warm season crops 45°
  - Tomatoes never below 55°
- Get it to market ASAP

- Pest Management
  - If you did everything else right this is the least important part of the system
  - Problems are generally an indication that some part of the system is not working properly

Start with healthy plants to combat pests--research has found that insects are more attracted to unhealthy-colored plants.

Aphids are attracted to over-fertilized plants with lots of new growth.

#### Pest control

- Plant around pest life cycle
 

Example: pickleworm comes from Florida to North Carolina in early July, so growers plant winter squash in May so that the pickleworm doesn't eat the young squash
- Use trap crops, but you have to have a method to for destroying the pest you've trapped
 

Example: planted mustard can be used as a trap crop for flea beetles and harlequin bugs in broccoli, with a ratio of 300' broccoli for 10' mustard, then spray the mustard with insecticidal soap

- Physical barriers: row covers
- Beneficials: predators, parasitoids, pathogens  
Wheel bug, lady beetles, predatory flies, braconid wasps, Trichogramma, etc.
- Pesticides  
Botanicals: Neem, Pyrethrin  
Rotenone, sabadilla, ryania are not approved for organic production
- Microbial: Bt, Beauveria, Spinosad, nematodes

#### Controls for selected Southeastern pests

- Flea beetles: diatomaceous earth on plants, row cover, spinosad, neem, pyrethrum, nematodes
- Harlequin bugs: sanitation, insecticidal soap, pyrethrum
- Colorado potato beetle: rotation, resistant varieties, straw mulch, flaming, trenches, row covers, spinosad, Beauveria

Treating seed: soak seeds for 40 minutes in a 4:1 water to bleach ratio

#### Four-legged pests

- Do more damage than the flying and crawling kinds
- Deer adapt very quickly
- Fencing is the only real answer: Tall standard electric fencing

#### ● Marketing Plan

- Affects everything
- Sets the whole train in motion
- Where to market and why
- What to market and why
- When to market

---

**Higher Selling Price**

Most time off the farm  
Smaller scale operation  
Higher quality  
Lower volume  
Higher management input  
More labor required  
Better Feedback

**Lower Selling Price**

Least time off the farm  
Larger scale operation  
Lower quality  
Higher volume  
Lower management input  
More labor required  
Poor feedback

---

**More Customer Contact**

Farmers' Market  
Roadside Stand  
CSA  
PYO  
Restaurants  
Direct to Store Wholesale  
Cooperative  
Direct to Warehouse Wholesale  
Brokers

**Less customer contact**

---

**Keys to marketing success**

- Diversification
- Specialization
- High Quality
- Display
- Consistency
- Customer Relationships

At Peregrine Farm, farmers' market sales are 75 percent of business.

Ideally, they would have 100 core customers, plus one grocery store and three restaurants for overflow

Goal is \$20,000 per acre, or \$200 per bed per crop and \$400 per bed in high tunnels

- Diversification
  - Multiple marketing options
    - Different crops
    - Excess production
    - Spread the workload
  - Multiple crops:
    - Spread the risk
    - Expand the selling season

- Helps with consistency
  - Attract more customer
- Specialization
  - Differentiate yourself from the other market sellers
  - Grow more varieties of what you do well
  - You can't be everything to everyone
  - Produce what you really like
  - "grow what sells not sell what grows"
  - It is hard to display many crops in a small space
- High quality
  - Quality is more important than price
    - Proper stage of maturity
    - Good post harvest treatment
    - Rigorous grading (would you buy it?)
  - Present yourself well
  - Be genuine and original
- Display
  - Good displays attract customers
  - Make it look like a lot
    - He who has the biggest pile wins
    - Stack it high and kiss it goodbye
  - Good signage
    - Tell your story
    - Tell the products story
    - Make them readable
    - Don't make them ask the price
- Consistency
  - You need to be there every week once you start
  - Have a consistent supply
    - Multiple crops, multiple plantings, irrigation
  - Have a consistent message
  - Keep good records so you know what sells and when
- Customer relations
  - This is what it is all about
  - Tie them to you and your farm
  - All you need is a core group
  - Information is what they want

- Signage
  - Newsletters--send out weekly newsletter, put out a sign-up sheet at the market
  - Farm tours
  - Recipes
- Participate in market governance
  - Would you let somebody else run your business?
  - Help make decisions that make sense for farmers
  - Work within the market rules
  - Be a good market citizen
- Record keeping
  - Record the things that give you the information you need to make decisions:
  - Production Plan
  - Field History
  - Daily Work Records
  - Market Records
  - Sales Invoices
  - Financial Records
  - Sales Chart
- Money Money Money
  - Borrow only for long term items
  - Pay cash for everything you can
  - Do you really need it?
  - Can you build it or make it?
  - Make use of timely short term loans
  - Save money for the winter
  - Pay yourself
  - Save for retirement
- Keys to success
  - Good markets
  - Continuing Education
  - Good Records
  - Diversification
  - Specialization
  - High Quality
  - Consistency
  - Customer Relationships
  - Participate In The Greater Farming Community
  - Teach

- Balance