

# Sustainable Farming Practices

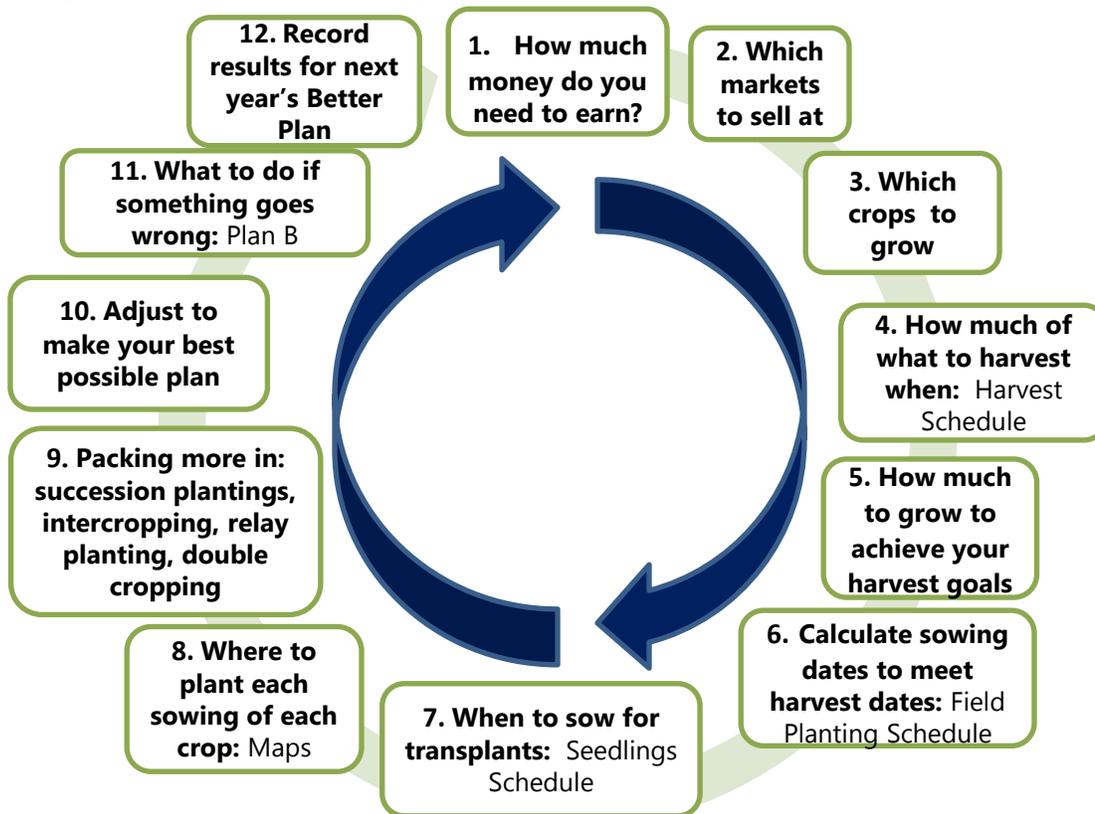
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Author of *Sustainable Market Farming* and *The Year-Round Hoophouse*.  
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## **Part 1 – Planning and Record-keeping** Be clear about your goals (before choosing tools).

**Tools for crop planning:** Create Your Own Field Manual. Planning is circular, just like farming. *The Fundamental Four:*

1. Descriptive month-by-month Calendar
2. Field planting schedule
3. Seedling schedule for greenhouse production of transplants
4. Maps of the layout of the crops

### **Planning is Circular, Just like Farming**



## **Part 2 – Feeding the Soil**

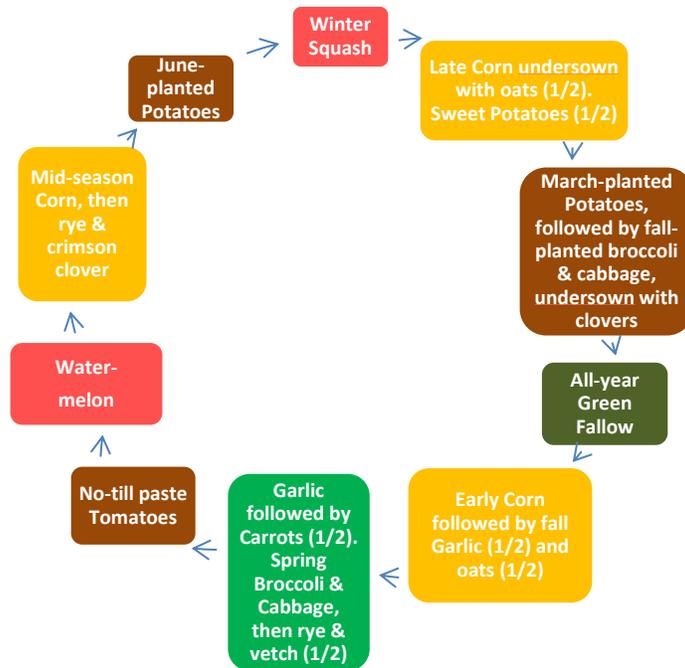
### **Crop rotations**

1. Figure out how much area is needed for each major crop (the ones needing the largest amount of space).
2. Measure and map the land available
3. Divide into equal plots
4. Group compatible crops together to fill each plot
5. Determine a good sequence
6. Include cover crops, Include no-till crops
7. Try it for one year, then make improvements

### **Twin Oaks Vegetable Rotation**

Winter Squash followed by rye and Austrian winter peas/Late corn undersown with oats (1/2); sweet potatoes (1/2) followed by wheat/ March-planted potatoes, followed by fall-planted broccoli & cabbage, undersown with clovers/ All-year green fallow/ Early corn followed by fall garlic (1/2) and oats (1/2)/ Garlic followed by carrots (1/2); Spring broccoli & cabbage, then

rye, vetch and peas (1/2)/ No-till paste tomatoes then rye and crimson clover/ Watermelon then rye and crimson clover/ Mid-season corn, then rye & crimson clover/ June-planted potatoes then rye and crimson clover.



### **Cover crop opportunities**

- Undersowing at last cultivation (oats and soybeans in corn example.)
- After vegetable crops in summer or fall, for the winter
- Frost-seeding of small seeds such as clover: Broadcast in the early morning when ground is frozen. As it thaws, the water draws the seeds down into the soil.
- Late winter or early spring, if the area will not be planted with vegetable crop until late spring. We use oats.
- In spring, between an early vegetable crop and a later one
- To replace a crop failure.

### **Compost making**

1. Hot (aerobic) compost combines 1 to 3 parts high-C materials with 1 part high-N materials in a 25:1 to 40:1 C:N ratio, and enough water to make the piles damp, enough air to keep the bacteria alive.
2. The first 2-3 days: Mesophilic bacteria active at 90°F–110°F (32°C– 43°C) begin to break down the sugars, fats, starches and proteins.
3. The next several weeks: Thermophilic bacteria increase, and keep working as long as decomposable materials remain available and the oxygen supply is adequate. Temperatures in the middle of the pile can reach 120°F–150°F (48°C–66°C). Pathogens, weed seeds and fly larvae are destroyed. Whenever the pile starts to cool, turn it because more oxygen or more water is needed. This remixes the material – ensuring all gets composted. Turning prevents the pile from overheating — above 150°F (66°C), thermophilic bacteria can die
4. When the compost stops heating, even if you turn it, the compost materials have all been consumed by bacteria and the N is converted to nitrates. The pile cools to around 100°F (37.7°C) The C is now resistant to further breakdown, and the N slowly becomes available for crops
5. Leave it to cure for about 30 days, so beneficial microorganisms can move back in. It is then ready to be used.
6. Finished compost ideally has a C:N (carbon:nitrogen) ratio of 10:1. If the C:N ratio is greater than about 25:1, almost no N is available from the compost and it is unable to mineralize. Between 16 and 20:1, about 10% of the N is available. Even at a C:N ratio of 10:1, only 50% of the N is available in the near term

**Organic mulches** - straw, hay, sawdust, woodchips, tree leaves, newspaper and cardboard all add organic matter

## **Part 3 –Year Round Production**

### **Efficient production strategies**

1. Plan ahead for success when growing a wide range of different crops and doing many different tasks each day.

- Plant similar crops together to minimize time-consuming switching of tasks.
- Plan roads and paths for your truck or carts to haul away the bounty.
- Break long rows up into manageable chunks. Don't ask anyone to haul a harvest crate more than 100ft. Keep container weight reasonable.
- Get the tools ready before you start. Make sure there enough knives, scissors, crates, etc. for everyone
- Set containers along the rows when you arrive. Put full ones near the path

### Transplant age and size

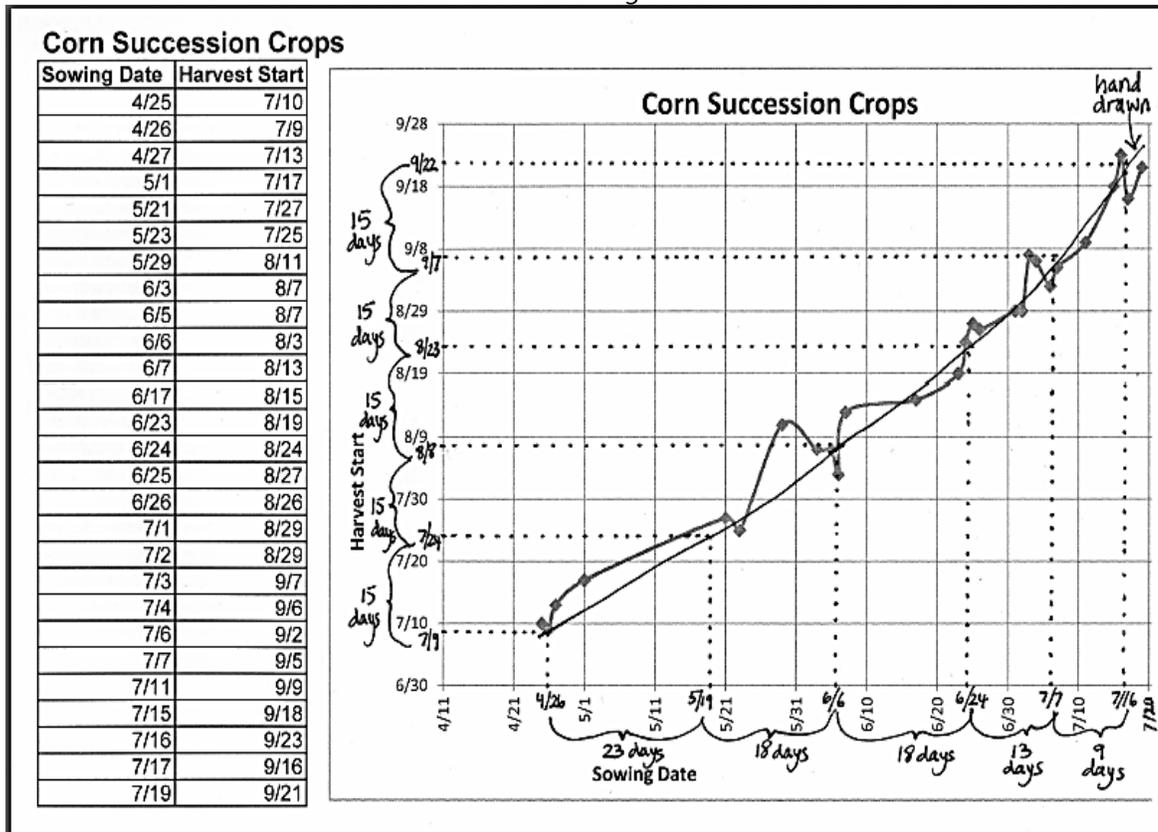
Vegetable	Notes	Ideal Age at Transplanting
Cucumbers/Melon/Squash	2 true leaves max (maybe less)	3-4 weeks
Watermelon	(older is OK)	3-4 weeks
Sweet Corn		3-4 weeks
Tomatoes	age is less important	4-8 weeks
Lettuce		4-7 weeks
Brassicas	5 true leaves is ideal	6-8 weeks spring/3-4 weeks summer
Peppers, Eggplant	4 or 5 true leaves. Not flowering.	6-8 weeks
Onions (spring sown), Leeks		10-12 weeks
Celery		10-12 weeks

### Optimal Plant Spacing for Vegetable Crops for Various Goals

Crop	Row Spacing	In-Row Spacing	Notes
Beets	7" (18 cm)	4" (10 cm)	For early harvest
	12" (30 cm)	1" (2.5 cm)	For max total yield (small). 2" (5 cm) in-row for big beets
Beans, fava	18" (45 cm)	4.5" (11 cm)	For tall varieties.
Beans, green	18" (45 cm)	2" (5 cm)	12" (30cm) x 3" (7.5 cm) gives the same area/plant
Broccoli (calabrese)	12" (30cm)	6" (15 cm)	For equal amounts of heads and side shoots
Cabbage	14" (35 cm)	14" (35 cm)	For small heads
	18" (45 cm)	18" (45 cm)	For large heads
Carrots	6" (15 cm)	4" (10 cm)	For early crops, limiting competition
	6" (15 cm)	1.5" (4 cm)	For maincrop, medium size roots
Celery	11" (28 cm)	11" (28 cm)	For high yields and mutual blanching
Cucumber (pickling)	20" (51 cm)	3" (8 cm)	
Leeks	12" (30 cm)	6" (15 cm)	Maximum yield of hilled up leeks, average size
Lettuce	9" (23 cm)	8" (20 cm)	Early crops under cover
	12" (30 cm)	12" (30 cm)	Head lettuce
	5" (13 cm)	1" (2.5 cm)	Baby lettuce mix
Onions	12" (30 cm)	1.5" (4 cm)	For medium size bulbs
	12" (30 cm)	0.5" (1 cm)	For boiling, pickling, kebabs
Parsnips	12" (30 cm)	6" (15 cm)	For high yields of large roots
	7.5" (19 cm)	3" (8 cm)	For smaller roots
Peas, shelling	18" (46 cm)	4.5" (11.5 cm)	Can sow in double or triple bands, 4.5" (11.5 cm) apart
Potatoes	30" (76 cm)	9-16" (23-41 cm)	Depends on size of seed pieces. Small pieces closer
Sweet Corn	30-36" (76-90 cm)	8" (20 cm)	Closer than 8" (20 cm) the plants shade each other.
Tomatoes, bush types	19" (48 cm)	19" (48 cm)	For early crops
Watermelon	66" (168 cm)	12-24" (30-60 cm)	For small varieties. 5-10 ft <sup>2</sup> (0.5-1 m <sup>2</sup> ) each
	66" (168 cm)	30-84" (76-215 cm)	For large varieties. 13-40 ft <sup>2</sup> (1.2-3.7 m <sup>2</sup> ) each

## Succession crop scheduling graphs - 6 Steps

1. Gather sowing and harvest start and finish dates for each planting of each crop
2. Make a graph for each crop: sowing date along the horizontal (x) axis; harvest start date along the vertical (y) axis. Mark in all your data. Join with a line. Smooth the line.
3. From your first possible sowing date find the first harvest start date.
4. Decide the last worthwhile harvest start date, mark that.
5. Divide the harvest period into a whole number of equal segments, according to how often you want a new patch.
6. Mark in the harvest start dates and see the sowing dates that match those harvest dates



## Season extension

- **Growing earlier crops in spring:** Choose fast-maturing hardy varieties, Warm microclimates, Transplants, Rowcovers, low tunnels, Quick Hoops, high tunnels (= hoopouses)
- **Extending the growth of cool-weather crops into summer:** Learn how to germinate seeds in hot weather, Shadecloth, ProtekNet to keep bugs off, Intercropping establishes a new crop in the shade of the old one
- **Using spring and fall** for carrots, beets, broccoli, cabbage, kale, spinach
- **Extending the survival of frost-tender crops beyond the first fall frosts**
- **Growing cold-hardy winter vegetables**

**Sustainable Pest Management** 4 steps of Integrated Pest Management: 1. prevention (reduce chance of problems), 2. avoidance, 3. monitoring (is action needed?) 4. suppression (using least toxic solution)

**Sustainable Disease Management** Diseases need a susceptible host, the presence of a pathogen, suitable environmental conditions

**Sustainable Weed Management** Ways to consider weeds:

Annuals and perennials; stationary perennials (docks) and invasive perennials (Bermuda grass); cool-weather and warm-weather types; quick-maturing and slow-maturing types; "Big Bang" types (pigweed) versus "Dribblers"

## Harvest and Maturity Indicators

- **Size:** Cow Horn okra at 5" (others shorter), green beans a bit thinner than a pencil, carrots at whatever size you like, 7" asparagus, 6" zucchini

- **Color:** Garden Peach tomatoes with a pink flush. The “ground spot” of a watermelon turns from greenish white to buttery yellow at maturity, and the curly tendrils where the stem meets the melon to turn brown and dry. *For market you may harvest “fruit” crops a bit under-ripe*
- **Shape:** cucumbers that are rounded out, not triangular in cross-section, but not blimps. Sugar Ann snap peas completely round
- **Softness or texture:** eggplants that “bounce back” when lightly squeezed, snap beans that are crisp with pliable tips. Harvest most muskmelons when the stem separates easily from the fruit (“Full slip”).
- **Skin toughness:** storage potatoes when the skins don’t rub off, usually two weeks after the tops die, whether naturally or because of mowing.
- **Sound:** watermelons sound like your chest not your head or your belly when thumped. Try the “Scrunch Test” - press down firmly on the melon

#### **Resources – Books**

- ❑ *The Market Gardener*, Jean-Martin Fortier, New Society Publishers
- ❑ *The Complete Know and Grow Vegetables*, J K A Bleasdale, P J Salter et al.
- ❑ *Knott’s Handbook for Vegetable Growers*, Maynard and Hochmuth
- ❑ *The New Seed Starter’s Handbook*, Nancy Bubel, Rodale Books
- ❑ *The Organic Farmer’s Business Handbook*, Richard Wiswall, Chelsea Green
- ❑ *Sustainable Vegetable Production from Start-up to Market*, Vern Grubinger,
- ❑ *The New Organic Grower, The Four Season Harvest, The Winter Harvest Handbook*, Eliot Coleman, Chelsea Green
- ❑ *Extending the Season: Six Strategies for Improving Cash Flow Year-Round on the Market Farm* a free e-book for online subscribers to Growing for Market magazine
- ❑ *Sharing the Harvest*, Elizabeth Henderson and Robyn Van En
- ❑ *Grow a Sustainable Diet: Planning and Growing to Feed Ourselves and the Earth*, Cindy Conner, (worksheet based). DVD/CD set *Develop a Sustainable Vegetable Garden Plan*
- ❑ *Crop Planning for Organic Vegetable Growers*, Daniel Brisebois and Frédéric Thériault ([www.cog.ca](http://www.cog.ca))
- ❑ *Nature and Properties of Soils, fourteenth edition*, Nyle Brady and Ray Weil
- ❑ *Garden Insects of North America*, Whitney Cranshaw
- ❑ *SARE Crop Rotations on Organic Farms, A Planning Manual*, Charles Mohler and Sue Ellen Johnson, editors.
- ❑ *Market Farming Success: The Business of Growing and Selling Local Food*, Lynn Byczynski
- ❑ *High-Yield Vegetable Gardening*, Colin McCrate and Brad Halm, Storey Publishers
- ❑ *How to Grow More Vegetables*, John Jeavons. Has charts: *Pounds Consumed per Year by the Average Person in the US and Average US Yield in Pounds per 100 Square Feet.*

#### **Resources – General**

- ❑ ATTRA [attra.ncat.org](http://attra.ncat.org) *Market Farming: A Start-up Guide, Plugs and Transplant Production for Organic Systems, Scheduling Vegetable Plantings for a Continuous Harvest, Intercropping Principles and Production Practices* (mostly field crops, but the principles apply to vegetable crops), *Season Extension Techniques for Market Farmers*, and many more.
- ❑ SARE [sare.org](http://sare.org) -A searchable database of research findings. Available to download: *Using Cover Crops Profitably* and *Crop Rotations on Organic Farms, A Planning Manual*
- ❑ [articles.extension.org/organic\\_production](http://articles.extension.org/organic_production) and <https://eorganic.info/> The organic agriculture community with eXtension. Publications, webinars, videos, trainings and support.
- ❑ *Growing Small Farms*: [growingsmallfarms.ces.ncsu.edu](http://growingsmallfarms.ces.ncsu.edu) Click *Farmer Resources*.
- ❑ The Center for Environmental Farming Systems at North Carolina State University has good information on compost-making, such as *Composting on Organic Farms*.
- ❑ Compost recipe software is available from Cornell University [www.cfe.cornell.edu/compost/science.html](http://www.cfe.cornell.edu/compost/science.html)
- ❑ Southwest Florida Research and Education Center, <https://swfrec.ifas.ufl.edu/> or <https://swfrec.ifas.ufl.edu/programs/veg-hort/transplant/> (All about transplants)
- ❑ Jean-Paul Courtens , Roxbury Farm [roxburyfarm.com/](http://roxburyfarm.com/). *Regenerative Farming Practices* tab: *Soil Fertility Practices; Biodynamic Practices; Whole farm Approach; Harvest Manual; Crop Manual; Purchasing Equipment; Crop Plan for a 100 Member CSA, including a CSA Share List, Greenhouse Plan, Field Plan* (with charts of possible crop yields).
- ❑ *Growing for Market* magazine [www.growingformarket.com](http://www.growingformarket.com)

### **Resources – Slideshows** are available at [www.Slideshare.net](http://www.Slideshare.net)

Search for Pam Dawling. If that doesn't work, search my name, name of slideshow and "slideshow"

- Cold-hardy Winter Vegetables*
  - Cover Crops for Vegetable Growers*
  - Crop Planning for Sustainable Vegetable Production*
  - Crop Rotations for Vegetables and Cover Crops*
  - Diversify your Vegetable Crops*
  - Fall and Winter Hoophouses*
  - Fall Vegetable Production*
  - Feeding the Soil*
  - Growing Great Garlic*
  - Growing Sweet Potatoes from Start to Finish*
  - Hoophouse Production of Cool Season Crops*
  - Lettuce Year Round*
  - Many Crops, Many Plantings, to Maximize High Tunnel Production Efficiency*
  - Producing Asian Greens*
  - Production of Late Fall, Winter and Early Spring Vegetable Crops*
  - Season Extension*
  - The Seed Garden: Planning for seed saving and lots of vegetables to eat*
  - Seed Growing*
  - Sequential Planting of Cool Season Crops in a High Tunnel (Hoophouse)*
  - Spring and Summer Hoophouses*
  - Storage Vegetables for Off-Season Sales*
  - Succession Planting for Continuous Vegetable Harvests*
  - Sustainable Farming Practices.*
  - Year Round Vegetable Production*
  - Year Round Hoophouse Vegetables*
- Mark Cain *Planning for Your CSA:* [www.Slideshare.net](http://www.Slideshare.net) (search for Crop Planning)
- Planning the Planting of Cover Crops and Cash Crops*, Daniel Parson [www.slideshare.net/parsonproduce/southern-sawg](http://www.slideshare.net/parsonproduce/southern-sawg)
- Cover Crop Innovation* by Joel B Gruver [www.Slideshare.net](http://www.Slideshare.net); *Cover crops for vegetable cropping systems*, Joel Gruver, [www.slideshare.net/jbgruver/cover-crops-for-vegetable-crops](http://www.slideshare.net/jbgruver/cover-crops-for-vegetable-crops); *Finding the best fit: cover crops in organic farming systems*. Joel Gruver, Some overlap with previous slideshow. [www.slideshare.net/jbgruver/cover-crops-decatur](http://www.slideshare.net/jbgruver/cover-crops-decatur)
- Cultural Practices And Cultivar Selections for Commercial Vegetable Growers*. Brad Bergfeld, Wide scope. [www.slideshare.net/guest6e1a8d60/vegetable-cultural-practices-and-variety-selection](http://www.slideshare.net/guest6e1a8d60/vegetable-cultural-practices-and-variety-selection)

### **Resources – Planning**

- The Twin Oaks Harvest Calendar by Starting Date and by Crop are available as pdfs on my website [sustainablemarketfarming.com/2013/11/07/growing-for-market-articles-2/](http://sustainablemarketfarming.com/2013/11/07/growing-for-market-articles-2/)
- AgSquared online planning software: [agsquared.com](http://agsquared.com)
- COG-Pro record-keeping software for Certified Organic Farms: [cog-pro.com](http://cog-pro.com)
- Interactive [Vegetable Garden Planner](http://www.motherearthnews.com/garden-planner), free for 30 days: [motherearthnews.com/garden-planner](http://www.motherearthnews.com/garden-planner).
- Target Harvest Date Calculator*: (Excel spreadsheet) [johnnyseeds.com/t-InteractiveTools.aspx](http://johnnyseeds.com/t-InteractiveTools.aspx)
- Growing Small Farms*: [growingsmallfarms.ces.ncsu.edu](http://growingsmallfarms.ces.ncsu.edu) click Farmer Resources, Farm Planning and Recordkeeping to download Joel Gruver's spreadsheets.
- Mark Cain [www.drippingspringsgarden.com](http://www.drippingspringsgarden.com) under the CSA tab, you can download their Harvest Schedule.
- [www.Weatherspark.com](http://www.Weatherspark.com) weather and climate
- Tables of likely crop yields [johnnyseeds.com/assets/information/vegetablecharts.pdf](http://johnnyseeds.com/assets/information/vegetablecharts.pdf).
- Clif Slade's 43560 Project: Virginia Association for Biological Farming newsletter [vabf.files.wordpress.com/2013/08/clif-slade-43560-demo-project.pdf](http://vabf.files.wordpress.com/2013/08/clif-slade-43560-demo-project.pdf).
- USDA annual vegetable consumption [www.usda.gov/factbook/chapter2.pdf](http://www.usda.gov/factbook/chapter2.pdf)
- The Center for Agroecology and Sustainable Food Systems at the UC Santa Cruz *Crop Plan for a Hundred-Member CSA*, for a range of 36 crops in its Unit 4.5 CSA Crop Planning: [casfs.ucsc.edu/education/instructional-resources/downloadable-pdf-files2](http://casfs.ucsc.edu/education/instructional-resources/downloadable-pdf-files2) or directly at [63.249.122.224/wp-content/uploads/2010/05/4.5\\_CSA\\_crop\\_plan.pdf](http://63.249.122.224/wp-content/uploads/2010/05/4.5_CSA_crop_plan.pdf)

### **Resources – Season Extension**

- Extending the Season: Six Strategies for Improving Cash Flow Year-Round on the Market Farm* a free e-book for online subscribers to Growing for Market magazine
- Fall and Winter Gardening Quick Reference*, Southern Exposure Seed Exchange, [www.southernexposure.com/growing-guides/fall-winter-quick-guide.pdf](http://www.southernexposure.com/growing-guides/fall-winter-quick-guide.pdf)
- [www.johnnyseeds.com](http://www.johnnyseeds.com). Growers' Library, Winter growing guide
- [www.motherofahubbard.com](http://www.motherofahubbard.com) Winter Vegetable Gardening
- Solar Gardening: Growing Vegetables Year-Round the American Intensive Way*, Leandre Poisson, Gretchen Poisson and Robin Wimbiscus, 1994, Chelsea Green