Efficient production strategies

- 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 100 ft.
- 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. Keep container weight reasonable. Put full ones near the path.

### Crop spacing chart

<table>
<thead>
<tr>
<th>Crop</th>
<th>Row spacing</th>
<th>In-row spacing</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beets</td>
<td>7&quot; (18 cm)</td>
<td>4&quot; (10 cm)</td>
<td>For early harvest</td>
</tr>
<tr>
<td></td>
<td>12&quot; (30 cm)</td>
<td>1&quot; (2.5 cm)</td>
<td>For max total yield (small).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2&quot; (5 cm)</td>
<td>For bigger beets</td>
</tr>
<tr>
<td>Beans, fava</td>
<td>18&quot; (45 cm)</td>
<td>4.5&quot; (11 cm)</td>
<td>For tall varieties.</td>
</tr>
<tr>
<td>Beans, green</td>
<td>18&quot; (45 cm)</td>
<td>2&quot; (5 cm)</td>
<td>12&quot;x 3&quot; (30x7.5 cm) gives same area/plant</td>
</tr>
<tr>
<td>Broccoli (Calabrese)</td>
<td>12&quot; (30 cm)</td>
<td>6&quot; (15 cm)</td>
<td>For equal amounts of heads and side shoots</td>
</tr>
<tr>
<td>Cabbage</td>
<td>14&quot; (35 cm)</td>
<td>14&quot; (35 cm)</td>
<td>For small heads</td>
</tr>
<tr>
<td></td>
<td>18&quot; (45 cm)</td>
<td>18&quot; (45 cm)</td>
<td>For large heads</td>
</tr>
<tr>
<td>Carrots</td>
<td>6&quot; (15 cm)</td>
<td>4&quot; (10 cm)</td>
<td>For early crops, limiting competition</td>
</tr>
<tr>
<td></td>
<td>6&quot; (15 cm)</td>
<td>1.5&quot; (4 cm)</td>
<td>For maincrop, medium size roots</td>
</tr>
<tr>
<td>Celery</td>
<td>11&quot; (28 cm)</td>
<td>11&quot; (28 cm)</td>
<td>For high yields and mutual blanching</td>
</tr>
<tr>
<td>Cucumber (pickling)</td>
<td>20&quot; (51 cm)</td>
<td>3&quot; (8 cm)</td>
<td>Max yield of hilled up leeks, average size</td>
</tr>
<tr>
<td>Leeks</td>
<td>12&quot; (30 cm)</td>
<td>6&quot; (15 cm)</td>
<td>Early crops under cover</td>
</tr>
<tr>
<td>Lettuce</td>
<td>9&quot; (23 cm)</td>
<td>8&quot; (20 cm)</td>
<td>Head lettuce</td>
</tr>
<tr>
<td></td>
<td>12&quot; (30 cm)</td>
<td>12&quot; (30 cm)</td>
<td>Baby lettuce mix</td>
</tr>
<tr>
<td></td>
<td>5&quot; (13 cm)</td>
<td>1&quot; (2.5 cm)</td>
<td></td>
</tr>
<tr>
<td>Onions</td>
<td>12&quot; (30 cm)</td>
<td>1.5&quot; (4 cm)</td>
<td>For medium size bulbs</td>
</tr>
<tr>
<td></td>
<td>12&quot; (30 cm)</td>
<td>0.5&quot; (1 cm)</td>
<td>For boiling, pickling, kebabs</td>
</tr>
<tr>
<td>Parsnips</td>
<td>12&quot; (30 cm)</td>
<td>6&quot; (15 cm)</td>
<td>For high yields of large roots</td>
</tr>
<tr>
<td></td>
<td>7.5&quot; (19 cm)</td>
<td>3&quot; (8 cm)</td>
<td>For smaller roots</td>
</tr>
<tr>
<td>Peas, shelling</td>
<td>18&quot; (46 cm)</td>
<td>4.5&quot; (11.5 cm)</td>
<td>Can sow dbl or trpl bands 4.5&quot; (11.5 cm)</td>
</tr>
<tr>
<td>Potatoes</td>
<td>30&quot; (76 cm)</td>
<td>9-16&quot; (23–41 cm)</td>
<td>Depends on size; small pieces closer</td>
</tr>
<tr>
<td>Sweet Corn</td>
<td>30-36&quot; (76–90 cm)</td>
<td>8&quot; (20 cm)</td>
<td>If &lt; 8&quot; (20 cm), plants shade each other.</td>
</tr>
<tr>
<td>Tomatoes, bush</td>
<td>19&quot; (48 cm)</td>
<td>19&quot; (48 cm)</td>
<td>For early crops</td>
</tr>
<tr>
<td>Watermelon</td>
<td>66&quot; (168 cm)</td>
<td>12–24&quot; (30–60 cm)</td>
<td>For small varieties. 5–10 ft² (0.5–1 m²) each</td>
</tr>
<tr>
<td></td>
<td>66&quot; (168 cm)</td>
<td>30–84&quot; (76–215 cm)</td>
<td>For large varieties. 13–40 ft² (1.2–3.7 m²) each</td>
</tr>
</tbody>
</table>

### Deciding Which Crops to Grow

1. Which crops suit the conditions? Check the cold-hardiness table
2. Which Crops are Most Profitable? Can you earn a living growing it? Use Crop Enterprise Budgets
3. Which Crops Sell for High Prices? Is there a market for it?
4. Which Crops are Easy to Grow?
5. Would you have to reduce space for another crop?
6. Would you lose efficiency by growing many different crops?
   - Consolidate and simplify (Asian greens)
   - Grow crops needing similar conditions or timing
   - Specialize in one Signature Crop, grow many kinds

7. How to Decide Which Crops to Grow
   - Quick Crops and Steady Crops

8. Crop Value Rating
   - **Shorter days to maturity** (fast crops = chance to plant more; give a point for 60 days or less)
   - **Higher yield** per linear foot (best value from the space; a point for 1/2 pound/linear foot or more)
   - **Long harvest period** (= more sales; a point for 4 months or longer)
   - **Popularity** (high demand, low market saturation)

**Sustainable Pest Management**

**4 steps of Integrated Pest Management**

1. Prevention (reduce chance of problems, eg plant flowers to attract beneficial insects)
2. Avoidance, (eg use insect netting; cover young plants with rowcover until flowering)
3. Monitoring (is action needed?)
4. Suppression (using least toxic solution, eg import parasites or predators)

**Sustainable Disease Management**

*Diseases need all 3 of:* A susceptible host, the presence of a pathogen, and suitable environmental conditions.

**Bio-intensive Disease IPM**

1. Cultural controls (prevention strategies)
2. Monitor crops for problems
3. When control measures are needed:
   a) Physical controls
   b) Biological controls
   c) Microbial controls
   d) Botanical controls
   e) Inorganic controls (Also known as as biorational disease controls)

**Sustainable Weed Management**

1. Preventing weeds from germinating – tarps, mulches
2. Reducing weed seeding – timely hoeing, tilling or flaming; stale seed-beds
4. Reducing the strength of perennial weed roots and rhizomes – frequent tilling or digging out.

**Season extension**

- Growing earlier crops in spring:
- Extending cool-weather crops into summer:
- Extending the survival of frost-tender crops beyond the first fall frosts
- Using spring *and* fall for beets, carrots, chard, spinach, Asian greens, cauliflower, turnips, rutabagas, cabbage, broccoli, kale, collards, kohlrabi, lettuce, salad mix, radishes (large and small), scallions.
  - We start sowing carrots as early as possible: mid–late February.
  - Then we sow every 4 weeks in March, April, May, and, if needed, June and July.
  - We make a huge fall planting in late July or early August. If we miss those dates, we wait till late August to avoid the high numbers of grasshoppers here in mid-August.
• We don’t do succession plantings for fall carrots, just one big one, because we are growing bulk carrots to store for use all winter and don’t need multiple harvest dates.
• With fall crops, even a difference of 2 days in sowing dates can make a difference of 2-3 weeks in harvest date, because plants grow slower as days get shorter and cooler.

Growing cold-hardy winter vegetables

**Season Extension in Hot Weather**

• Choose appropriate crops and varieties. Flavor, productivity, disease resistance and temperature tolerance.
• Use younger and smaller transplants. Sow and transplant in the evening.
• Use netting against bugs
• Use shadecloth.
• Interplant new crops in the shade of older ones
• Use a soil thermometer and tables of days to germination at various temperatures.
• Plant seeds deeper than you would in spring, as the soil is already warm and you don’t want seeds to dry out.
• In dry conditions sow in sunken furrows.
• Soak seeds, maybe presprout them.
• Sow indoors in a cool place, or outdoors with shadecloth, after cooling soil. Put ice on newly seeded rows.
• Water much more in hot weather.
• For winter crops sown in late summer, consider direct-seeding rather than transplants - more cold-tolerant

**Season Extension in Cold Weather**

• Choose fast-maturing cold-hardy varieties and crops
• From late fall to early spring, use transplants
• In spring, warm the soil with black plastic mulch
• In fall, use light-colored mulches to conserve soil warmth by reducing radiation losses
• Use thick rowcover – Dupont Xavan 5131 (aka Typar). 1.25 oz/sq yd spunbonded polypropylene gives about 6F (3.3C) degrees of frost protection. Use hoops to prevent frozen rowcover sticking to leaves, and abrasion..
• Low tunnels and Quick Hoops, wider version of using rowcover. Need weighting down.
• Caterpillar tunnels – 2 beds plus 1 path, tall enough to walk in. Rope holds cover in place, no sandbags.
• High tunnels (= hoophouses), single or double layer. Double layer gives 8F (4.5C) degrees of protection, plus plants tolerate colder conditions than they would outside. Leafy crops are not weather-beaten.
• Heated greenhouses - cost of heating may not be worthwhile for growing crops to maturity. Buy several hoophouses for the price of one greenhouse and heating. Heat is not the only aspect of growing plants.

**Winter Kill Temperatures of Cold-Hardy Vegetables** Spring 2018 revision

Some starting numbers of killing temperatures outdoors (without rowcover unless otherwise stated). Your own experience with your soils, microclimates and rain levels may lead you to use different temperatures. We are in zone 7a, with an average annual minimum temperature of 0-5°F (-18°C to -15°C). Note that repeated cold temperatures can kill off crops that can survive a single dip to a low temperature, and that cold winds, or cold wet weather can destroy plants quicker than simple cold.

In a double-layer hoophouse (8F/5C warmer than outside) plants can survive **14F/8C colder** than outside, without extra rowcover; **21F/12C colder** than outside with **thick rowcover** (1.25 ozTypar/Xavan). When outdoor temperatures were 14°F (-10°C) our hoophouse temperature was 10.4°F (-12°C), and our lettuce, mizuna, turnips, Russian kales, Senposai, Tyee spinach, tatsoi, Yukina Savoy survived without rowcovers. (Note that our hoophouse wasn’t much warmer than outdoors that night!) When the outdoor temperature dropped to -12°F (-24°C), our rowcovered lettuce survived -2.2°F (-19°C) indoors. Bright Lights chard got frozen leaf stems.

**35°F (2°C):** Basil
**32°F (0°C):** beans, cauliflower curds, corn, cowpeas, cucumbers, eggplant, limas, melons, okra, peanuts, peppers, potato vines, squash vines, sweet potato vines, tomatoes
**27°F (-3°C):** many cabbages, Sugarloaf chicory (takes only light frosts)
**25°F (-4°C):** some cabbages, chervil, chicory roots for chicons, Chinese Napa cabbage (Blues), dill (Fernleaf), endive (hardier than lettuce, Escarole more frost-hardy than Frisée), some fava beans (Windsor), annual fennel, some mustards
Winter wheat and winter rye (cover crops) are hardy to -22°F (-30°C).

Hairy vetch is hardy to -15°F (-26°C).

Austrian Winter Field Peas and Crimson clover (used as cover crops) are hardy down to -20°F (-29°C).

Leaves of overwintering varieties of cauliflower are hardy down to -30°F (-34°C) Narrow leaf sorrel, Claytonia and some cabbage (January King?) are said to be hardy in zone 3, -30°F to -40°F (-34°C to -40°C).

Storage Vegetables for Off-Season Use: Four Ranges of Cold Weather Crops

1. **Crops to harvest before cold fall weather (32°-25°F) and store indoors:** Chichory for chicons or heads; crosnes/Chinese artichokes, dry beans, Napa Chinese cabbage, peanuts, potatoes, pumpkins, seed crops, sweet potatoes, winter squash

2. **Crops to keep alive in the ground into winter to 22°-15°F (-6°C to -9°C), then harvest.**
   a. **Store:** Beets, cabbage, carrots, celeriac, kohlrabi, winter radish (including daikon), rutabagas, turnips,
   b. **Use:** Asian greens, broccoli, cabbage, chard, lettuce, radishes

Large oat plants will get serious cold damage. Large oat plants will die completely at 6°F (-18°C) or even milder than that.

Crimson clover is hardy down to 0°F (-18°C) or slightly colder

**Even Colder:** Votes kale survives 0°F (-18°C), although some leaves may be too damaged to use. Killed at -5°F (-19°C).

Leaves of overwintering varieties of cauliflower are hardy down to -5°F (-19°C). **Wall Walla** onions sown in late summer are said to be hardy down to -10°F (-23°C), but I don’t trust below 0°F (-18°C).
3. **Hardy crops to store in the ground and harvest during the winter.** In zone 7, they need to be hardy to 0°-10°F (-17.8°C to -12.3°C): Collards, horseradish, Jerusalem artichokes, kale, leeks, parsnips, scallions, spinach

4. **Overwinter crops for spring harvests before the main season:** In zone 7, they need to be hardy to 0°-10°F (-17.8°C to -12.3°C): Cabbage, carrots, chard, chicories (radicchio & Sugarloaf), collards, garlic, garlic scallions, kale, lettuce, potato onions, scallions, spinach. In mild areas, peas can be fall sown for a spring crop.

**Four Sets of Storage Conditions**

By providing storage spaces with these 4 types of conditions, 25 crops can be stored.

In my chart, the Summary column indicates the general conditions needed for each crop, and allocates each crop to one of 4 groups:

- **A= Cold and Moist:** 32°F–40°F (0°C–5°C), 80–95% humidity: refrigerator or winter root cellar conditions. Most roots, greens, leeks
- **B= Cool and Fairly Moist:** 40°F–50°F (5°C–10°C), 85–90% humidity: root cellar. Potatoes
- **C= Cool and Dry:** 32°F–50°F (0°C–10°C), 60–70% humidity: cooler basements and barns. Garlic and onions
- **D= Warm and Dry to Fairly Moist:** 50°F–60°F (10°C–15°C), 60–70% humidity: basements. Sweet potatoes, winter squash.

<table>
<thead>
<tr>
<th>Crop</th>
<th>°F</th>
<th>°C</th>
<th>% Humidity</th>
<th>Need for Ventilation</th>
<th>Summary</th>
<th>Storage Life in months</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apples</strong></td>
<td>30–40</td>
<td>−1−4</td>
<td>90–95</td>
<td>Low</td>
<td>B: Cool and Fairly Moist</td>
<td>2–7</td>
<td></td>
</tr>
<tr>
<td><strong>Beets</strong></td>
<td>33–40</td>
<td>−1−4</td>
<td>95–100</td>
<td></td>
<td>A: Cold and Moist</td>
<td>4–6</td>
<td></td>
</tr>
<tr>
<td><strong>Cabbage</strong></td>
<td>32–34</td>
<td>0–1</td>
<td>90–100</td>
<td>Low</td>
<td>B: Cool and Fairly Moist</td>
<td>5–6</td>
<td></td>
</tr>
<tr>
<td><strong>Carrots</strong></td>
<td>32–41</td>
<td>0–5</td>
<td>90–95</td>
<td>Medium</td>
<td>C: Cool and Dry</td>
<td>7–9</td>
<td></td>
</tr>
<tr>
<td><strong>Celerec</strong></td>
<td>32–40</td>
<td>0–4</td>
<td>97–98</td>
<td>Medium</td>
<td>C: Cool and Dry</td>
<td>4–8</td>
<td></td>
</tr>
<tr>
<td><strong>Celery</strong></td>
<td>32</td>
<td>0</td>
<td>95–100</td>
<td>Medium</td>
<td>A: Cold and Moist</td>
<td>1–3</td>
<td></td>
</tr>
<tr>
<td><strong>Chinese cabbage</strong></td>
<td>32–41</td>
<td>0–5</td>
<td>99–100</td>
<td>Medium</td>
<td>A: Cold and Moist</td>
<td>1–3</td>
<td></td>
</tr>
<tr>
<td><strong>Daikon radish</strong></td>
<td>32–34</td>
<td>0–1</td>
<td>95–100</td>
<td>Low</td>
<td>A: Cold and Moist</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Garlic</strong></td>
<td>32–38</td>
<td>0–3 or 18–30</td>
<td>60–70</td>
<td>Low above 50°F (10°C)</td>
<td>C: Cool and Dry, Or D: Warm and Dry</td>
<td>6–7 (1–3 months at warm temps)</td>
<td></td>
</tr>
<tr>
<td><strong>Ginger root</strong></td>
<td>54–57</td>
<td>12–14</td>
<td>85–90</td>
<td>Low</td>
<td>D: Warm and Fairly Moist</td>
<td>4–6</td>
<td></td>
</tr>
<tr>
<td><strong>Horseradish</strong></td>
<td>30–32</td>
<td>−1–0</td>
<td>90–100</td>
<td>Low</td>
<td>A: Cold and Moist</td>
<td>10–12</td>
<td></td>
</tr>
<tr>
<td><strong>Jerusalem artichoke</strong></td>
<td>32–34</td>
<td>0–2</td>
<td>90–95</td>
<td>Low</td>
<td>A: Cold and (Fairyly) Moist</td>
<td>4–10</td>
<td>Paper or plastic bag in cellar. Inground. Clamp. Temperatures above 45°F (7°C) cause sprouting.</td>
</tr>
<tr>
<td><strong>Kohlrabi</strong></td>
<td>32</td>
<td>0</td>
<td>95–100</td>
<td>Medium</td>
<td>A: Cold and Moist</td>
<td>2–3</td>
<td>Perforated plastic bag in cellar. Clamp.</td>
</tr>
<tr>
<td><strong>Leeks</strong></td>
<td>32</td>
<td>0</td>
<td>95–100</td>
<td>Medium</td>
<td>A: Cold and Moist</td>
<td>3</td>
<td>Perforated plastic bag, or plastic bucket with small amount of water, or dig up and replant in buckets in cellar. Inground.</td>
</tr>
<tr>
<td><strong>Onions (bulbs)</strong></td>
<td>32–40</td>
<td>0–4 or 16–32</td>
<td>60–70</td>
<td>Low</td>
<td>C: Cool and Dry, Or D: Warm and Dry</td>
<td>1–8</td>
<td>Net bag. Keep warm or keep cold... Never 45°F–55°F (7°C–13°C), or they will sprout. Never warm after cold either.</td>
</tr>
<tr>
<td><strong>Parsnips</strong></td>
<td>32–34</td>
<td>0–1</td>
<td>95–100</td>
<td>Medium</td>
<td>A: Cold and Moist</td>
<td>6</td>
<td>Perforated plastic bag in cellar. Inground. Clamp. Temperatures above 45°F (7°C) cause sprouting.</td>
</tr>
</tbody>
</table>
**Lettuce Year Round**

- We sow lettuce twice in January, twice in February, every 10 days in March, every 9 days in April, every 8 days in May, every 6-7 days in June and July, every 5 days in early August, moving to every 3 days in late August, and every other day until Sept 21. After that we ease back to every 3 days until the end of September. In the winter we harvest lettuce from our hoophouse and our greenhouse. Coldframes and low tunnels are other options.

- Lettuce germinates at 40°F–80°F (4°C–27°C). The optimum is 75°F (24°C) (germinates in only 2 days). Maximum germination temperature is 85°F (29°C).

- **Hot weather lettuce sowing:** Sow late afternoon or at nightfall - better emergence than morning sowings.

**Lettuce Varieties for every time of year**

We have 5 lettuce seasons, and we always sow 4 diverse varieties:


5. **Winter (Sept 8 – 27), 9 sowings.** Priority: Cold-tolerance. Examples:

**Hoophouse Vegetables**

In a double-layer hoophouse (8°F/5°C warmer than outside) plants can survive **14°F/8°C colder** than they can outside, without extra rowcover; at least **21°F/12°C colder** than outside with thick rowcover.
Salad greens in a hoophouse in zone 7 can survive nights with outdoor lows of 14°F (-10°C). A test year: Lettuce, Mizuna, Turnips, Russian kales, Senposai, Tyee spinach, Tatsoi, Yukina Savoy survived a hoophouse temperature of 10.4°F (-12°C) without rowcover, -2.2°F (-19°C) with. Brite Lights chard got frozen leaf stems.

We have 3 crop seasons in our hoophouse
- Winter crops planted in September and October to harvest until April, perhaps May
- Early warm weather crops planted in March and April, to harvest May to the end of July
- High summer crops planted in July to harvest in August and September

Remember to keep your fall planting dates and crop rotations in mind, especially if the winter greens and salads are the main purpose of the hoophouse. The bulk of our winter crops are planted from mid-September to mid-October.

Suitable Fall and Winter Hoophouse Crops

- **Lettuce heads** may survive an occasional dip to 10°F (-12°C) with inner rowcover Particularly cold-hardy lettuce varieties: Brune d’Hiver, Buckely, Ezrilla, Green Forest, Hampton, Lollo Rossa, Merlot, North Pole, Red Tinged Winter, Revolution, Rouge d’Hiver, Tango, Winter Marvel. Avoid depending on new sowings at the slow-growing time of year.
- **Baby lettuce mix** (more cold-hardy than large lettuce); **Small-leaf lettuces**: Johnny’s Salanovas, Osborne’s and High Mowing’s Eazyleaf; Tango, Oscarde, Panisse.
- **Brassica (Mustard) Salad Mixes**
- Many **cooking greens** can be used as salad crops while plants are small.
- Several **small greens** are very winter-hardy: mizuna, other frilly mustards, Arugula, parsley, Belle Isle upland cress, winter purslane, salad burnet and mâche (corn salad)
- **Leafy cooking greens**: Spinach (Renegade, Acadia, Escalade, Reflect), Russian kales, Swiss chard and beet greens, endives and chicories, Asian greens: senposai, komatsuna, tatsoi, Yukina Savoy, Napa and Michihili Wong Bok cabbage, Tokyo Bekana, Muruba Santoh, pak choy, Mizuna, frilly mustards Ruby Streaks, Golden Frills, Scarlet Frills, Red Rain.
- **Onions**: scallions, bulbing onions, garlic scallions
- **Peas and beans**: dwarf snap peas Sugar Ann (2/1-7/15), fava beans
- **Bare-root transplants**: In October we sow “filler” greens and lettuce to fill winter gaps in the hoophouse. In November we sow bulbing onions to plant outdoors 3/1. Jan 24 we sow kale, collards, spinach to plant outdoors in March
- **Seed crops**: legumes, lettuce, brassicas, okra

Fall Sowings to Transplant Inside

**Sept 15 and Sept 24**: We make outdoor sowings of crops to later transplant into the hoophouse at 2–4 weeks old. We use hoops and ProtekNet, and water frequently. Hardy leaf lettuce and romaines; pak choy, Chinese cabbage, Yukina Savoy, Tokyo Bekana, Maruba Santoh, chard, Red and White Russian kales, Senposai, frilly mustards and mizuna

Winter hoophouse harvests
- October onwards: beet greens, radishes, spinach, tatsoi
- November onwards: add arugula, brassica salad mix, chard, lettuce leaves, mizuna, other frilly mustards and scallions.
- December onwards: add baby lettuce mix, chard, kale, turnips.
- During December: heads of Tokyo Bekana, Maruba Santoh.
- January onwards: add Senposai and Yukina Savoy.
- During January: heads of pak choy, Chinese cabbage
- Most loose-leaf crops last until mid-March or later.

Suitable Hoophouse Crops for Warm and Hot Weather
Crops you'd like earlier, crops that grow in warmer climates, crops that grow better in drier climates, crops that are not in the same families as your main crops in other seasons.

- **Upright bush beans** **Strike** (3/15-6/15).
- **Tomatoes** transplanted 3/15, One bed of fast varieties (less than 70 days) *Glacier*, *Stupice*, *SunGold*, *Mountain Magic*, *Garden Peach* and one bed of workhorses *Tropic*, *Jubilee* and various heirlooms
- **Peppers, cucumbers** (*Spacemaster*), **summer squash** (*Gentry*) transplanted 4/1. A month earlier than outdoors. Cucumbers finish in mid-July, the squash and tomatoes at the end of July. We keep our peppers until cold weather arrives (October/November). **West Indian gherkins** resist Root Knot Nematodes.
- Fast-growing **salad crops** like arugula, lettuce mix, *Tokyo Bekana* if you shade, water enough and harvest very promptly.
- **Eggplant**, **melons**, **cowpeas** (*Mississippi Silver*, *Carolina Crowder*), **edamame** (*Envy*), **ginger**, **turmeric**, **galangal**.
- Smother crops: **sweet potatoes**, **West Indian gherkins**.
- **Cut flowers**, other decorative non-food crops
- **Cover crops**: buckwheat, soy, cowpeas, shorter millets, sunnhemp. **Brassicas**?

### Interplanting Warm Weather Crops

- **After 2/20**, we harvest the winter crops from the center rows first, plant the new early summer crops down the center, then harvest the outer rows bit by bit as the new crop needs the space or the light. This overlap allows the new crops to take over gradually. Our winter and spring crops end in April
- Fast growing crops like lettuce, radishes and greens can be planted between or alongside slower-growing crops to generate more income and diversity. Interplanting lettuce and tomatoes is 39% more efficient than growing each crop individually.

### Scheduling of Summer Crops

We plant frost tender crops in the hoophouse 4 weeks earlier than we can plant them outdoors. We have hoops in place and rowcover at the ready for freezing nights. In very cold areas, add a low tunnel for winter.

### Feeding the Soil: What is a healthy soil?

- Has good crumb structure, lets air and water in and out.
- Provides good habitat for soil organisms.
- Resists erosion and compaction.
- Absorbs, holds and releases nutrients.
- Promotes good root growth.
- Has a moderate pH (6.0 – 7.0).
- Has low levels of salts and toxins.
- Has balanced fertility with adequate levels of nutrients.
Crop Rotations for Vegetables and Cover Crops

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

Notes on the Steps:

Step 5. To help get a crop sequence figured out, we looked at the crop families of our major crops.
- We have three major plantings of nightshades: two of potatoes and one of tomatoes and peppers together.
- Two plantings (spring and fall) of brassicas,
- Six or seven sowings of sweet corn clustered into three plots,
- Two of cucurbits (winter squash and watermelons),
- One of alliums (garlic),
- One of Umbelliferae (carrots)
- One of Ipomoea (sweet potatoes).
We spread the 3 corn plots 3-4 years apart, and the 3 nightshade plantings likewise. We put the winter squash 3 years after the watermelon. Potatoes are said to do well after corn, so we put our spring potatoes after the previous year’s late corn and our summer potatoes after the previous middle corn planting.

We formed several “strings” of a few crops-and-cover-crops that followed each other well:
- Spring broccoli can be followed by rye and vetch in time to grow a thick stand for the no-till tomatoes the next year.
- Late corn can be undersown with oats and soy to provide a winter cover crop that is easily incorporated before a March planting of potatoes.
- The early corn can be followed by fall garlic planting.
- Then the garlic harvest can be quickly followed by fall carrots.
- Mid-season corn is finished in time to establish rye and crimson clover, which will do well and produce lots of nitrogen and biomass before we need to plant the June potatoes.

Step 6, Including cover crops
- For early spring food crops, a preceding cover crop of oats (maybe with soybeans) is ideal, as it winter-kills and is easy to incorporate. Oats need to be sown at our farm by 9/17, so they need to follow an early finishing crop, such as spring brassicas, spring potatoes or early corn. To get best value from crimson clover, wait until it flowers — mid-April at the very earliest — before turning it under. So after crimson clover it’s best if the food crop goes in after 4/30, such as later corn plantings, winter squash, transplanted watermelon, tomatoes, sweet potatoes or June-planted potatoes.
- Another factor is that crimson clover is best sown here before 10/14, so it has to follow a crop that is finished by then.

Step 7 Including No-till crops
- Rye and vetch is best sown here 9/7-9/14, creating another restriction on which crops the tomatoes could follow.

Step 8, All Year Green Fallow
- We undersow the fall brassicas with a mix of clovers (white, red and crimson) about a month after transplanting. The following spring, we bush hog the old brassica stumps and let the clover flourish. We have contingency plans: In spring, once the warm weather has arrived, if the weeds are too bad, or the clover stand not thick enough, we turn the clover under and sow sorghum-sudangrass hybrid with soy. This gets mowed to a foot (30 cm) when the sorghum-sudan is four feet (1.2 m) tall, to encourage deeper rooting for better soil drainage, and can stay until killed by the frost. If the plot is looking good, we let the clover grow all summer, mowing to prevent the crimson clover seeding. In August, we review again: if we still have the clover we may turn it under and sow oats. Or we may leave it over winter.
- We get 2 food crops in one year and none the next from that plot. It is ready early the next year for our first corn.
Cover Crops for Vegetable Growers

Use cover crops to feed and improve the soil, smother weeds, and prevent soil erosion. Select cover crops to use opportunities year round. Fit cover crops into the schedule of vegetable production.

Benefits of using cover crops

- Smother weeds, prevent germination, seeding
- Increase the biological activity in the soil
- Improve the tilth of the soil and the sub-soil structure
- Improve the soil’s ability to absorb and store water
- Fix nitrogen to feed the next crop
- Bio-fumigation for pest or weed control
- Add organic matter and nutrients to the soil
- Reduce erosion
- Improve soil drainage
- Salvage leftover nutrients from a previous crop
- Attract beneficial insects
- Kill nematodes

Five steps of cover crop planning

1. Identify your opportunities for cover crops (When, how long, how warm, crops before and after)
2. Clarify your cover crop goals for each opportunity (check list of benefits above)
3. Shortlist suitable cover crops for each situation (consult books and charts)
4. Make a decision from among the options to match your main goals and some secondary goals
5. Record your decisions and results, and review for possible changes next year.

Cover crop opportunities

- Late winter or early spring, if the area will not be planted with vegetable crops for 6 weeks (Oats)
- In spring, summer or fall, 4 weeks or more between one vegetable crop and a later one (Buckwheat)
- Undersowing at last cultivation (Oats and Soybeans in corn, Clover mix in fall brassicas)
- In fall, after food crops, for the winter (Oats for winterkill; Legumes if there is time in spring for them to flower)
- 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.
To replace a crop failure.
Year-round cover crops/green fallow.

**Choose cover crops matching your main goals**

- Smother weeds: sorghum-sudangrass, pearl millet, winter rye, wheat, barley, oats, buckwheat, brassicas (beware – rotation, bugs), lupins, red clover, subterranean clover, berseem clover, soybeans, cowpeas
- Add organic matter, improve the soil’s ability to absorb, hold water: bulky grasses and legumes, sorghum-sudangrass, millets, winter rye, velvetbean, cowpeas, sweetclover, sunn hemp
- Fixing nitrogen: clovers, vetches, Austrian winter peas, cowpeas, soybeans, lentils, sunn-hemp.
- Scavenging leftover nutrients: grains, brassicas, annual ryegrass (danger of it becoming a weed).
- Increase the biological activity in the soil – use varied mixes
- Reduce erosion: (good roots) grasses especially rye, barley, oats, sweetclover, cowpeas, sub clover,
- Improve the tilth of the soil, the sub-soil structure, soil drainage: sorghum-sudangrass, sunflower, daikon, sweetclover, crimson clover, alfalfa, lupins, cowpeas, forage radish, sugar-beet or forage-beet
- Bio-fumigation, including killing nematodes

**Choose cover crops matching your secondary goals to improve results in mixes**

- Scavenge leftover nutrients: (non-leguminous cover crops) grasses, brassicas (pest and rotation problems), annual ryegrass (danger of it becoming a weed)
- Fix nitrogen: (legumes) clovers, vetches, peas, cowpeas, soybeans, lentils, sunn-hemp.
- Attract beneficial insects: (flowers) buckwheat, peas, beans, clovers, brassicas, phacelia
- Pest or weed control: rye, brassicas, sorghum-sudan, sunn-hemp, white lupins, sesame.
- Kill nematodes: Pacific Gold mustard, white lupins, Iron and Clay cowpeas, OP French marigolds, sesame

**Cover crop mixes**

- A mix of several cover crops species will provide more resilience in the face of extreme weathers
- Extension.org recommend first selecting 1-3 cover crop species that serve your major goals, then identifying “missing services” and choosing 1 or 2 cover crops that provide this service to add to the mix.
- Mixes can generally be sown at a depth of 1” (2.5 cm), regardless of seed size. Up to 3” deep will be OK.
- When legumes and grasses are mixed, sow in the date range for the grass.
- When 2 grasses are mixed, the seeding rate of each is reduced by a third (not a half),
- Do not reduce the seeding rate of legumes by much in mixtures. Use at the same rate as a pure stand, or reduce the legume seeding rate by a maximum of 25%.
- In mixes with oats, reduce the amount of oats to as little as 30#/ac (34 kg/ha) so that the highly competitive oats don’t out-compete the other crops.
- We sometimes use a mix of rye, crimson clover and AWP if the date is borderline for crimson clover and the weather uncertain, especially if we have the seed on hand and don’t want to use it the next year when the germination rate and seedling vigor will be less good.
- Most mixes include some crops that attract beneficial insects and some legumes to add N.

**Spring mixes**

- Main ingredients could be oats and peas, 3 oats:7 peas
- Minor ingredients could include hairy vetch, radish, turnips and red clover.

**Summer mixes**

- Major ingredients could include soy, cowpeas, red clover and buckwheat.
- Lesser ingredients could include pearl millet, proso millet, radish, turnips, sunflowers and sunnhemp.
Fit your cover crop with the season (fall)

- Work back from your farm’s first frost date, to see what options you have.
- 80-120 days before frost - buckwheat, soy, cowpeas, Japanese millet, sorghum-sudangrass, or a fast vegetable crop.
- 60-80 days before frost - buckwheat, soy, cowpeas, Miami peas, Japanese millet, sorghum-sudangrass to winter-kill; or oats with Austrian winter peas, crimson clover, or red clover to grow into winter.
- 40-60 days before frost - oats with soy beans or Miami peas to winter-kill; winter barley or winter wheat with Austrian winter peas, crimson clover, hairy vetch, red clover, fava beans to survive the winter.
- 20-40 days before frost, winter rye, winter wheat, or winter barley, with crimson clover, Austrian winter peas, red clover or (40 days before frost) hairy vetch. Too late to usefully sow crops that are not frost-hardy.
- Up to 10 days past the frost date - winter rye or winter wheat with Austrian winter peas.
- Up to a month past your average frost date, still possible to sow winter rye.
- Only include legumes with if there will be time in spring for them to flower.

Fall cover crops at Twin Oaks
Spring cover crops at Twin Oaks

- **In February or March** we sow oats, where we have winter weeds, no cover crop, and will not be planting a food crop for 8 weeks. That is sufficient time for growth to out-compete weeds and add to the organic matter in the soil. Minimum soil temperature for germination is 38F (3C)
- **March 31** here is too late in spring for oats (they will quickly head up after making very little growth)
- In **late March or April**, we can sow winter rye, which “languishes” here once it gets hot.
- In **early April**, too late for oats, but too soon to sow frost-tender cover crops, we might till and make stale seed beds (till 2 or more weeks ahead of time, prepare beds, hoe once a week to kill weeds)
- In **late April** (close to our average last frost), we sow frost-tender cover crops like buckwheat or soy, mixed with a grain such as winter rye or wheat for insurance and some shielding from harsh weather.
• After our corn planting date, if a food crop fails, or we “discover” some space, we grow sorghum-sudangrass for the remainder of the warm season.

**Summer cover crops at Twin Oaks**

- When summer gaps occur between the end of one vegetable crop and the planting of the next, we sow a short-term cover crop (see earlier). Consider buckwheat, soy, cowpeas, millets, Brassicas (perhaps).
- **Buckwheat** is a warm-season broadleaf annual germinates in just a few days, Takes only 30-50 days to grow to full size - a height of 2-3'. Sow from around the last frost date to late summer (50 days before first frost). Incorporate 7-10 days after it starts flowering. A useful cover crop in case of crop failure or early end of a food crop.
- **The Millets:** German foxtail millet grows to 3’–4’ (1–1.3 m), Japanese millet to 3’–5’ (1–1.6 m). Pearl millet gets much taller, at 5’–10’ (1.6–3.2 m). Of the millets, pearl millet and German foxtail millet will mow-kill after heading (not before), but Japanese and browntop millets will not reliably mow-kill.

**Fit your cover crop with the season (summer)**

- If you have only 28 days until the patch is needed for a food crop, you can grow mustards or buckwheat. Or weeds, if you’re careful not to let them seed!
- If you have at least 45 days, you can grow soy or Japanese millet.
- If you have 50–60 days, Browntop millet is possible. In the right climate, sunnhemp can mature in 60 days.
- With 60–70 days, German foxtail millet, pearl millet and some cowpeas will mature.
- In high-moisture years, grow the most weed-suppressing crops, e.g., alfalfa.
- Clover fallow recipe: 1 oz crimson clover, 1 oz Ladino white clover, 2 oz medium red clover / 100 sq ft.

**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 (carbon:nitrogen) 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 ratio of 10:1. If the C:N ratio is greater than about 25:1, almost no N is available from the compost. Between 16:1 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.

**Succession planting for continuous vegetable harvests**

How to plan a sequence of planting dates to provide an unbroken regular supply of popular summer crops, such as beans, squash, cucumbers and sweet corn; year-round lettuce, winter hoophouse greens. Avoid gluts and shortages.

- As temperatures and day-length decrease in the fall, the time to maturity lengthens.
- As temperatures and day-length increase after the Winter Solstice, the time to maturity shortens – later sowings can almost catch up with earlier ones.
- To get harvests starting an equal number of days apart, shorten the interval between one sowing date and the next as the season progresses.

**The Rough Version is to sow:**

- Every 2 weeks for beans and corn.
- Every 3 weeks for squash and cucumbers, edamame.
- Once a month for carrots and muskmelons (cantaloupes).
No-paperwork methods:
- Sow more sweet corn when the previous one is 1"–2" tall;
- sow more lettuce when the previous sowing germinates;
- sow more beans when the young plants start to straighten up from their hooked stage.
- sow several varieties with differing days-to-maturity on the same day (works well for sweet corn).

The fall formula for frost tender crops - how many days to count back from the expected first frost date:
- add together the number of days from seeding to harvest, (that is, the days to maturity)
- the average length of the harvest period, (the length you’ll be satisfied with)
- 14 days to allow for the slowing rate of growth in the fall, (for warm weather crops) and 14 days to allow for an early frost.
- But using rowcover to throw over the last planting during cold spells, the growing season is effectively 2 weeks longer and there is no need to allow 14 days for an early frost, so the growing season is 28 days longer.

Making a close-fit plan: Gather three vital pieces of info (The Veg Finder)
We record info for bush beans, summer squash, cucumbers, sweet corn, carrots and edamame.
For each planting of each crop, we need to know the sowing date, first harvest date and last harvest date, (thus, the number of productive days of the planting).
For each crop, there are three things we need to know — first possible planting date, number of productive days of a planting, and last worthwhile planting date. This enables us to make a rough plan for how often to plant.

Determine your first spring planting date. Don’t plant too early!

Succession planting graphs - 6 Steps
1. Gather sowing and harvest start 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. Mark the first possible sowing date and the harvest start date for that.
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.
Growing Degree Days

- A measure of heat accumulation
- can indicate when it’s warm enough to plant tender crops,
- or when they might be ready to harvest.
- GDDs can also be used to plan dates for succession sowings.
- GDDs reflect actual conditions, rather than simply the calendar, a method which will not work well now climate change has taken hold.
- For most purposes a base temperature of 50°F (10°C) is used — roughly the temperature at which most plant growth changes start to take place. Each day when the temperature rises above the threshold, growing-degrees accumulate.
- Average the maximum and minimum temperatures for the 24 hour period, and subtract the base temperature. Add each day’s figure to the total for the year to date. This is the GDD figure.
- Wikipedia has a good explanation at [www.en.wikipedia.org/wiki/Growing-degree_day](http://www.en.wikipedia.org/wiki/Growing-degree_day)
- [www.farmprogress.com](http://www.farmprogress.com) has a free mobile phone app!
- There’s an article on using GDDs to plan dates for succession sowings for sweet corn at [http://www.hort.uconn.edu/ipm/veg/htms/scpltsched.htm](http://www.hort.uconn.edu/ipm/veg/htms/scpltsched.htm)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Planting Date</th>
<th>Harvest Dates</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brassica Salad Mix #1</td>
<td>sown 10/2</td>
<td>10/29 – 12/22</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>sown 12/18</td>
<td>? – 4/20</td>
<td>11 days to germinate.</td>
</tr>
<tr>
<td>#3</td>
<td>sown 1/27</td>
<td>4/15 – 5/15?</td>
<td>Only 2 cuts</td>
</tr>
<tr>
<td>#4</td>
<td>sown 2/1</td>
<td>2/12 is last sow date</td>
<td></td>
</tr>
<tr>
<td>Chard #1</td>
<td>transplanted 10/16</td>
<td>12/11 - 4/9</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>sown 10/26</td>
<td>2/6 - 5/1</td>
<td></td>
</tr>
<tr>
<td>Lettuce Mix #1</td>
<td>sown 10/24</td>
<td>12/14 - 3/15</td>
<td>Up to 8 cuts</td>
</tr>
<tr>
<td>#1.5!</td>
<td>sown 11/16</td>
<td>?</td>
<td>New this year</td>
</tr>
<tr>
<td>#2</td>
<td>sown 12/31</td>
<td>2/21 - 3/31 (4/15?)</td>
<td>3 cuts if we’re lucky</td>
</tr>
<tr>
<td>#3</td>
<td>sown 2/1</td>
<td>3/18 - 4/30</td>
<td>3 cuts if we’re lucky</td>
</tr>
<tr>
<td>#4</td>
<td>sown 2/15</td>
<td>3/25? - 5/15</td>
<td>Only sow if spring outdoor lettuce is late</td>
</tr>
<tr>
<td>Lettuce heads</td>
<td>until October</td>
<td>11/16 - 2/20</td>
<td>Harvest leaves from the mature plants</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2/21 - 3/31</td>
<td>Cut the heads</td>
</tr>
<tr>
<td>Mizuna #1</td>
<td>transplanted 10/20</td>
<td>11/25 - 1/25</td>
<td>Includes other frilly mustards</td>
</tr>
<tr>
<td>#2</td>
<td>sown 11/9</td>
<td>2/26 - 3/24</td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>sown 2/1</td>
<td>3/24 – 5/23</td>
<td>Scarlet Frill, Golden Frills outlive mizuna and Ruby Streaks</td>
</tr>
<tr>
<td>Onions (bulbing) #1</td>
<td>sown 11/10</td>
<td></td>
<td>Transplanted outdoors as early as possible in March</td>
</tr>
<tr>
<td>#2</td>
<td>sown 11/22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#3 back-up</td>
<td>sown 12/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radish #1</td>
<td>sown 9/6</td>
<td>10/3 - 11/16</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>sown 10/1</td>
<td>11/10 - 12/25</td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>sown 10/30</td>
<td>12/15 - 1/31</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>sown 11/29</td>
<td>?</td>
<td>Records lacking</td>
</tr>
<tr>
<td>#5</td>
<td>sown 12/23</td>
<td>2/13 - 3/30?</td>
<td></td>
</tr>
<tr>
<td>Scallions #1</td>
<td>sown 9/6</td>
<td>12/8 - 2/1</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>sown 11/18</td>
<td>3/19 - 5/15</td>
<td>Following radish #1</td>
</tr>
<tr>
<td>Spinach #1</td>
<td>sown 9/6</td>
<td>10/30 - 2/15 or later</td>
<td>Sprouted seeds sown</td>
</tr>
<tr>
<td>#2</td>
<td>sown 10/24</td>
<td>11/25 - 5/7</td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>sown 11/9</td>
<td>These later sowings are harvested until 5/7</td>
<td>We keep planting to fill gaps and pulling up finished plants</td>
</tr>
<tr>
<td>#4</td>
<td>sown 1/16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td>sown 1/17</td>
<td>Until mid-May</td>
<td>To transplant outdoors in February</td>
</tr>
<tr>
<td>Tatsoi #1</td>
<td>sown 9/7</td>
<td>10/30 - 12/31</td>
<td>9 weeks of harvest</td>
</tr>
<tr>
<td>#2</td>
<td>sown 11/15</td>
<td>2/12 - 3/12</td>
<td>4 weeks of harvest</td>
</tr>
<tr>
<td>Turnips #1</td>
<td>sown 10/14</td>
<td>12/5 - 2/20</td>
<td>Thinnings 11/29</td>
</tr>
<tr>
<td>#2</td>
<td>sown 10/25</td>
<td>2/1 - 3/13</td>
<td>Thinnings 1/11</td>
</tr>
<tr>
<td>#3</td>
<td>sown 12/10</td>
<td>3/5 - 3/20</td>
<td>Only worthwhile if thinned promptly and eaten small</td>
</tr>
<tr>
<td>Yukina Savoy #1</td>
<td>transplanted 10/6</td>
<td>12/5 - 1/25</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>transplanted 10/24</td>
<td>1/8 - 2/1 or so</td>
<td>Only one week extra</td>
</tr>
</tbody>
</table>
Resources – Books (alphabetical by author’s last name)
(I have reviewed some of these books on my blog at [www.sustainablemarketfarming.com](http://www.sustainablemarketfarming.com))

- Crop Planning for Organic Vegetable Growers, Daniel Brisebois and Frédéric Thériault ([www.coq.ca](http://www.coq.ca))
- Root Cellaring. Nancy and Mike Bubel (for construction details and advice)
- The Seed Garden, The Art and Practice of Seed Saving, Lee Buttala and Shanyn Siegel
- Market Farming Success: The Business of Growing and Selling Local Food, Lynn Byczynski
- Extending the Season: Six Strategies for Improving Cash Flow Year-Round on the Market Farm, Lynn Byczynski. A free e-book for online subscribers to Growing for Market [www.growingformarket.com](http://www.growingformarket.com)
- Grow a Sustainable Diet: Planning and Growing to Feed Ourselves and the Earth, Cindy Conner, New Society Publishers
- Garden Insects of North America, Whitney Cranshaw
- Growing Great Garlic, Ron Engelhard, 1991, Filaree
- The Hoophouse Handbook and The Hoophouse Update, 2010, both published by Growing for Market
- The Lean Farm, How to Minimize Waste, Increase Efficiency, and Maximize Value and Profits with Less Work and The Lean Farm Guide Ben Hartman, Chelsea Green
- The Bio-Integrated Farm, Shawn Jadrnicek.
- High-Yield Vegetable Gardening, Colin McCrate and Brad Halm, Storey Publishers
- Greenhouse and Hoophouse Grower’s Handbook – Organic Vegetable Production Using Protected Culture, Andrew Mefferd,
- SARE Crop Rotations on Organic Farms, A Planning Manual, Charles Mohler, Sue Ellen Johnson, editors
- Farming While Black, Leah Penniman, Chelsea Green
- Solar Gardening, Leandre Poisson, Gretchen Poisson and Robin Wimbiscus, 1994, Chelsea Green
- The Urban Farmer, Curtis Stone, New Society Publishers

Resources – General

- SARE [sare.org](http://sare.org) A searchable database of research findings. See the Season Extension Topic Room
- Growing Small Farms: [growingsmallfarms.ces.ncsu.edu](http://growingsmallfarms.ces.ncsu.edu) click Farmer Resources. Includes Farm Planning and Recordkeeping
- The Center for Environmental Farming Systems at North Carolina State University has good information on compost-making, such as Composting on Organic Farms. [cefs.ncsu.edu](http://cefs.ncsu.edu)
- Southwest Florida Research and Education Center, (All about transplants) [swfrec.ifas.ufl.edu/](http://swfrec.ifas.ufl.edu/) or [sswfreq.ifas.ufl.edu/programs/veg-hort/transplant/](http://sswfreq.ifas.ufl.edu/programs/veg-hort/transplant/)
- Cornell Extension website: [vegetablemdonline.ppath.cornell.edu/NewsArticles/All_BactSeed.htm](http://vegetablemdonline.ppath.cornell.edu/NewsArticles/All_BactSeed.htm) Good detailed information on seed treatments.
The Association of Specialty Cut Flower Growers [http://ascfg.org/]
Saving Our Seeds website has information on isolation distances, seed processing techniques, where to get manuals on growing specific seeds, and links to more information: [www.savingourseeds.org]
Growing Degree Days [www.en.wikipedia.org/wiki/Growing-degree_day]
Using GDDs to schedule sweet corn plantings [extension.udel.edu/weeklycropupdate/?p=6618]
Using Heat Units to Schedule Vegetable Plantings, Predict Harvest Dates and Manage Crops [smallfarms.oregonstate.edu/sfn/f11degreedays]
Ginger and Turmeric Page, Virginia State University [ext.vsu.edu/ginger-and-turmeric-page/]
Lettuce, North Carolina State Extension: [content.ces.ncsu.edu/lettuce]
How to Have Fresh Lettuce Year-Round, Without a Greenhouse or a Cold Frame (Zone 5a), Tom Clothier, [tomclothier.hort.net/page23.html]
Growing for Market magazine [www.growingformarket.com]

Resources – Planning

Southern Exposure Seed Exchange Online Planner [gardenplanner.southernexposure.com/]
AgSquared online planning software: [agsquared.com/]
COG-Pro record-keeping software for Certified Organic Farms: [cog-pro.com/]
Jean-Paul Courtens, Roxbury Farm [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).
Johnny’s Planning Tools and Calculators [johnnyseeds.com/growers-library-online-tools-calculators.html]
Mark Cain [drippingspringsgarden.com/] under the CSA tab, Harvest Schedule.
Crop Yield Verification, two charts, one of organic crops from The Owner-Built Homestead by Ken & Barbara Kern, one from California. [gardensofeden.org/04%20Crop%20Yield%20Verification.htm]
Tables of likely crop yields [johnnyseeds.com/assets/information/vegetablecharts.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
[www.johnnyseeds.com]. Growers’ Library, Winter growing guide
[www.motherofahubbard.com] Winter Vegetable Gardening
[www.Watherspark.com] weather and climate

Resources – Hoophouses

HighTunnels.org: [http://hightunnels.org/category-for-growers-growing-in-high-tunnels/] or [http://hightunnels.org/for-growers/]
Penn State High Tunnel Production Manual, William Lamont, $25 [https://extension.psu.edu/high-tunnel-manual]
U of MN High Tunnel Production Manual [http://www.extension.umn.edu/garden/fruit-vegetable/#high-tunnel]
U of MN Deep Winter Greenhouse [https://extension.umn.edu/growing-systems/deep-winter-greenhouses]