

# Q & A: General Growing Practices



## Triangular planting

**Q.** I'm confused about triangular planting and working in the beneficial plants plus working in the cover crops. Coming up with a rotation scheme for vegetable crops and cover crops is the biggest hurdle, intellectually and logistically, the two of us faced when we started. As urbanites, we did not know the first thing about these. You will eventually get it if you persist. Whatever rotation scheme you use, the key thing is to treat your cover crops as you treat your main crops. Without good cover crops, you

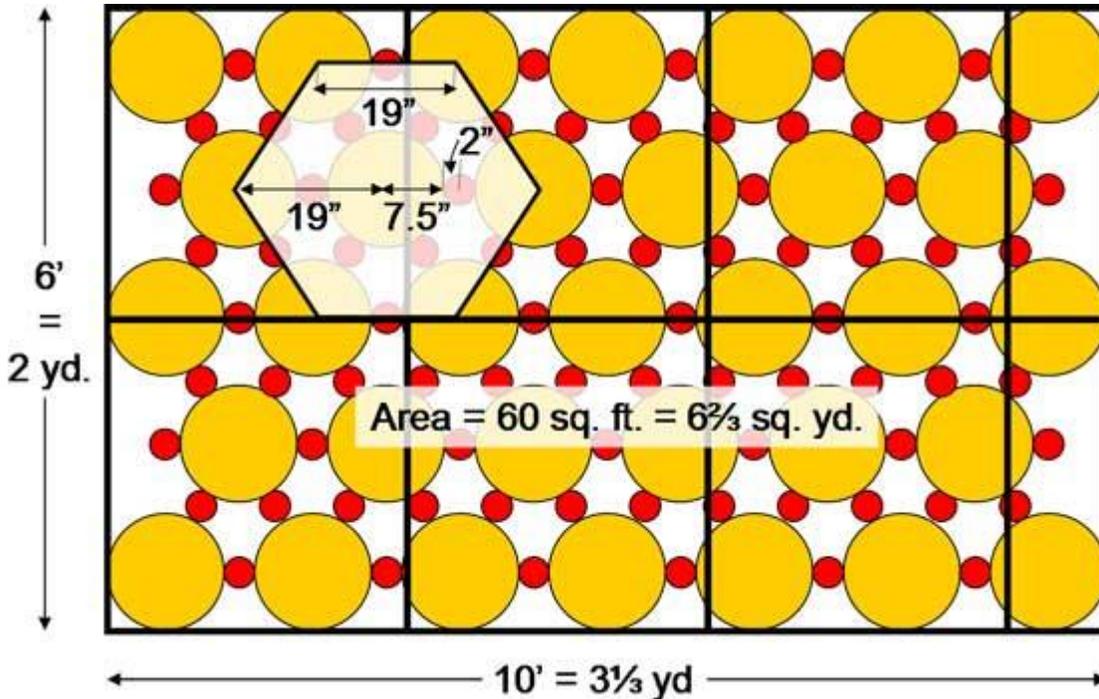
cannot get good main crops. Therefore, pull your tomatoes when it is time to plant the cover crop for the main crop that will be there next year. No sense leaving your tomatoes in until the last possible moment.

The second key thing is to distinguish early (cold weather) crops from late (warm weather) crops. The first include lettuce, carrots, beets, onions, kale, etc. You will find these on our "11Crops" file. Later crops include tomatoes, squash, corn, etc. You will generally plant oats or oats plus vetch in the late summer in those beds where cold weather crops will get planted the next season. You will generally plant rye or winter wheat, or these plus vetch, in the late summer to early fall in those beds where warm weather crops will get planted the next season. This is because oats winter kills, the roots decompose, and the beds are ready to go prior to your transplanting your early crops next spring. By contrast, rye and wheat get started in the fall, overwinter, and do their main growing in the late winter to early spring. Once you get this, you are two-thirds of the way there.

We allocate bed time in the spring to a cover crop mixture of barley or oats with vetch. Barley is another good grass that does well in the cool of spring. We use this combination for our winter greenhouse bed, and other bed sections which are in rotation. In the heat of summer, after peas are done, or early herbs (dill, caraway), we use Japanese millet. This stands heat well, whereas grasses do not. Clovers are good, too, in the spring.

Eliot Coleman discusses various rotation schemes in *The New Organic Grower*. We have synthesized Coleman, Jeavons, and companion planting in our Rotation Chart, which we have sent you.

To start out, Andy, I would recommend keeping things simple. Rather than following complicated inter-planting schemes, such as the one below, plant a patch of your main crop, and then a patch of your companion plant next to it. Or plant, say, tomatoes on one side of the bed, and basil on the other side. The idea is to have them in close proximity.



<http://organic.kysu.edu/CompanionSpacing.shtml>

**Q.** In looking at the presentation from the PASA conference a few years ago I noticed your triangular planting guides. Do you have a list of crops and their spacings so that I could create this type of tool for myself? Thanks!

We started with Jeavons spacings, but experiments have led us to increase some of them.

- 3" -- peas, scallions. Since a small triangle is hard to use, we now use a piece of corrugated cardboard about 15" long and 3" wide along the leg of a triangle, with 3" hash marks along the top and bottom edge. This allows for easier planting and straighter rows.
- 4" -- carrots, garlic, onions (bulbing, shallots), peas, turnips
- 5" -- beets, cilantro, mache, parsley, dill cover crops (alfalfa, clover [alsike, medium red, sweet white], barley, oats, wheat, rye)
- 6" -- beans (pole, bush), celery, leeks, mustard, parsnips, spinach, caraway
- 8" -- basil, beans (broad, fava), pole (lima), chard, lettuce (leaf, winter), Japanese millet (cover crop), rutabaga
- 9" -- lettuce (leaf, spring to fall), potatoes (Irish and sweet), burdock.

Another way to look at Jeavons' spacing is as "offset rows."

I made our triangles using thin 3-ply plywood I had lying around. I cut off the triangle at each apex to allow for the seedling, sanded and painted them. I used a thin-line black indelible Sharpie to label, then sealed with a coat of polyurethane. I drilled holes in each and got a steel ring to hold them all conveniently together. Of course, you can use ordinary corrugated cardboard as a short-term stand-in.

For larger crops we use a tape measure to lay out the triangles (tomatoes, squash, corn, peppers, cukes, melons, etc.). Jeavons has extensive tables in his famous "How to Grow More Vegetables" book which include not only spacing, but yields, germination rates, transplant intervals, nutritional data and much more info. You could probably find an inexpensive copy used on Amazon. If you can, get the spiral edition. It lays flat, and is more durable.

Jeavons encourages experimenting to determine whether small changes in spacings increase yields in your particular setting. After side by side comparisons we determined that longer spacing works better for beets and carrots, giving both higher yields (weight per square foot) and larger roots: 5" for beets and 4" for carrots. With onions, increasing distance to 5" gives larger bulbs but lower yields than 4", so we stick with higher yields and smaller onions. We find 9" too close for the extensive vines of sweet potatoes and are using 12".

### **Growing bed orientation**

**Q.** I was studying your diagram on p. 23 (Organic Gardening Primer) and note your recommendation to lay out the beds facing north-south for the summer and east-west for winter. I have plenty of southern exposure and it seems to me I have to put taller plants like corn or tomatoes in the north to not shade smaller plants. Working with 5 x 20 foot beds it doesn't seem to matter whether the long side of the bed runs north south or east west since one still has to put the tall plants on the northern part of the garden. Could you explain a bit more?

Our usual planning unit is a bed section, all across the entire bed width. Thus, our bed section for corn, tomatoes, peas, beans is 5 x 8'. Peppers and tomatillos are half this – 5 x 4'. Herbs are smaller, say, 2 x 2 1/2'. Yes, you could plant tomatoes in a bed section on the north half of an east-west bed, and something else on the south side – say, low-lying melons. That would work, especially since tomatoes and melons are warm-weather crops, and you would transplant both the same time. Both are heavy feeders, and would take the same cover crops. This would work as long as both bed sections are the same length. For us, it is easier to advance our bed sections with the same crop in it. It makes planting cover crops, skimming, aerating easier to do with a uniform section. What you are proposing could also work, but it might prove inconvenient. I don't understand why it matters whether the 20' dimension of the bed runs east-west or north-south. An east-west orientation is definitely better for winter beds, because you want the greenhouse to have its longest side facing the sun, getting the most light and heat in the lower and narrower cone of winter light. If you place the short end of the greenhouse facing the sun, the sun hits the two long sides and top at oblique angles, so penetration is lower. In the summer, a north-south facing bed puts sun on both sides of the bed.

## **Companion planting**

**Q.** How can I incorporate companion planting within biointensive? Did you say you have Jeavons' book "How to Grow More Vegetables?" He has an excellent chapter 8 on Companion Planting, from which I distill a few lessons we follow:

1. Keep in mind the two types of companion planting: companion planting in time (traditional rotation crops) and companion planting in space (traditional companion planting). You will be doing both. Below I focus on the latter, as we have already spoken about the former.
2. Go easy on yourself. Start with a few companion plants, and add more as your comfort level develops.
3. We have a largish border on two sides of our 8 vegetable beds where we plant perennial herbs (e.g, marshmallow, echinacea, valerian, hyssop, lemon balm, astragalus, St. John's Wort, elecampane, lovage). That way, these do not interfere with the rotation schemes of our annual vegetable crops. Within our rotation scheme, we plant annual herbs (e.g., dill, caraway [biennial], cilantro, parsley [technically a biennial, but we treat it as an annual], chamomile, basil). We give the square footage in our 11Crops Chart and plant these separately from the area we give to their vegetable companions; that is, we do not interplant in complicated patterns, but plant them nearby.
4. Note that these are all useful plants to us, beyond their benefit in attracting beneficials.
5. As to numbers of companion plants per so many main vegetable crops, I am not aware of any unified research on this, nor does Jeavons refer to any in his text, though he may have some in his extensive bibliography. In Chapter 8 he has four pages that list many common companion plants and what they are good for. In Chapter 9 he has a short chart on Insect Pests and Plant Controls. On pages 118-119 (Chapter 6, Seed Propagation) he gives heights and planting distances for a number of common flowers and herbs that might serve as companion plants. Those that are taller and are planted farther apart you will need fewer of, unless you are growing them as a crop for sale (e.g., echinacea for flowers or roots to make cold and flu tinctures).
6. Many of the companion plants you mention, and many others, have multiple uses. For example, calendula blossoms (orange), together with borage blossoms (sky blue) make a wonderful edible garnish on salads. You can include these with your spring greens for customers. However, the calendula is a small plant, and borage grows quite tall and rangy (however, the older stalks can be cut back, giving space for smaller branches to grow). Borage is a prolific self-seeder, and it comes up very early, so makes a nice leafy green to add to a salad mix when the plant is young (it may be somewhat toxic when older). It has a nice cucumber flavor. I don't know how large a strawberry patch you are planting, but we cover ours to reduce bird and chipmunk predation, so we plant borage nearby, not in the strawberry bed, as that would interfere with the netting. I suppose you could plant the borage in the bed after the fruiting season is over.

## Starting seeds

**Q. What is your seed starting process like?** We follow Jeavons and his use of standard wooden flats. We use ordinary 1x4 finished pine boards, with galvanized siding nails (their ridges hold the flat together well, and do not rust). Pine sap holds off rot for several years. We line the bottom of each flat with a sheet of newsprint cut in half from a 24" x 36" art newsprint pad. These are cheap, and available at art supply houses. Sometimes you can get roll ends of newsprint from a newspaper printing company. Avoid using newspapers unless you confirm from the newspaper firm that they are using soy-based black ink. Petroleum-based inks have toxic compounds and even heavy metals that can leach into the soil.

Each flat holds 300 seeds. We built one of his mini-greenhouses when we started in 1997, and this holds 14 flats which are 15 ½" x 23". We position the mini-greenhouse on our brick patio, which minimizes insect pests intruding on the flats and young seedlings. The mini-greenhouse is unheated, but benefits from absorbing heat during the day. We use this to start cold tolerant plants -- lettuce, spinach, bunching onions, collards, kale, beets, carrots, etc.

We will have an unheated greenhouse, do we need warming pads for the seeds? We start heat-loving plants inside on a plant stand: tomatoes, basil, peppers, tomatillos, heat-preferring flowers and those herbs requiring heat to germinate. All these require heating pads to get to a minimum temperature. Your greenhouse may be warm enough during the day, but not at night I would imagine.

**Q. Since we are starting with nothing, that is, no compost or well developed bed soil, what should we use as flat medium? I've read about soilless media and organic media that sound similar to which Jeavons refers. Any suggestions?** For the scale of operations you anticipate, getting bags of potting mix could be expensive. Each flat will require ~ 4.7 gallons (0.62 cu. ft.) of potting mix. You can do the math knowing the number of flats you want to fill. Do you have landscape supply companies near your property? Perhaps the least expensive way to start would be to get a load each of sifted topsoil and sifted compost from them. Visit the firms and examine the material. You want the topsoil to be dark brown, nice granular structure, few to no stones, little to no grit. The compost should be even darker, nice smelling, sifted to remove impurities, stones, shoes, etc.

A cubic yard of each gives you two cubic yards of material (2 x 27 cu.ft/cu.yd), enough to fill  $54/0.62 = 87$  flats. I'd mix the two in equal proportions. It might still be too heavy. To lighten, add (sphagnum) peat moss, which comes in large plastic-covered bales ~ 3.8 cu.ft./bale. Try adding it to your fifty-fifty mix, starting with 1 part peat moss to 8 parts mix. By the way, we screen our potting mix ingredients using a ¼" screen made of hardware cloth (nailed to a large wooden frame). That gives a nice small-grained mix. We have a potting mix recipe on the bottom of our Garden Metrics file, but you're not there yet. It may serve as a starting point once you have your own compost and good garden soil.

**Also, can you give me an idea of how many plants can be started in X amount of greenhouse space?** Jeavons mini-greenhouse is 5'x10'. We can fit 14 flats in it. Each flat holds 300 seeds. I am assuming that we will not have enough greenhouse space to start all of our plants, so I

suppose we will need to pick and choose? I know there are some plants that do not like being transplanted, and some that it is particularly advantageous to start early, but I am not sure how to go about the discrimination process. Any insight into this problem that you can offer would be helpful. Almost everything can be started in flats, which makes transplanting easier, because you just wheel the flat to your bed and transplant. The only crop we direct seed is beans, because the seeds are so large, and taproots break easily. You can also direct seed peas for the same reason. We have pathogens in our heavy clay soils that cause seed rot, so we start even peas in flats in a 50-50 mix of clean sand and peat moss (both are sterile).

**Q.** I will be starting the typical veggies - beans, tomatoes, spinach, etc. – and plan to order these seeds this weekend from Fedco. Can you clarify what soil medium I should be using? Is it a soilless mix? At a local hardware store I have found seedling trays approximating the 12 x 23” standard plastic trays you mentioned. These trays have 36 or 72 cells. Or is an alternative the soil blockers that are available through Johnny's Seeds? I checked these out and they look quite convenient but don't appear to be organic. Do you think this is an issue?

Since you are ordering from [www.fedcoseeds.com](http://www.fedcoseeds.com) , I suggest the following, from page 122 of their downloadable Growers Supplies catalog (2011, so numbers may have changed):

1. Get their heavy duty plant trays, # 9040 @ \$9 each. They will last for a few years, while the cheap thin plastic ones will quickly crack and leak all over your floor.
2. Get their “Plug Flats” either 50 cell (# 9032) or 72 cell (# 9034). 3 for \$5. Cheap.
3. Get their “Fort Lite” Vermont Compost Potting Soil, # 9066. 20 quarts for \$15. This is the smallest quantity you can buy, and will be more than enough for 2-3 trays. It is designed for cell tray seedlings. The shipping will come to something, but so what? They’ve done all the work for you.

Forget the soil blockers. This takes a special mix and practice, plus a special tool (also described on the same page, in several sizes).

### **Storing seeds**

**Q.** Do you have any simple tips on storing seeds?

1. We recently came across an interesting USDA research article on long-term storage at: <http://www.ars.usda.gov/is/ar/archive/sep98/seed0998.htm>

Dense, viscous glasses make seed last longer. But "if the glasses in seed are fluid, the seed will age faster," she adds. Walters has studied glasses in dried and frozen beans, peas, soybeans, corn, sunflowers, peanuts, lettuce, wild rice, coffee, tea, papayas, macadamia nuts, and yew seeds. She has even studied glasses in pollen from cattails and corn.

"Glasses in seeds that have been dried too much become porous," she says. "But glasses in seeds that are insufficiently dried are too fluid. Neither will store well or long."

Each plant species has a different optimal moisture content for storage. "That value changes with temperature," she says. "It can take more than a decade to directly measure it at storage temperatures used in germplasm banks--that is, at 5°C, -18°C, or -196°C. We can't do this for each of the 8,000 NPGS species."

2. More practical for we urban gardeners:

**Make sure the seeds are dry when placed in the freezer.** Using a silica gel pack can help with this. Harrington's Rule states that for every 1% decrease in seed moisture content, or every 10 degrees F decrease in storage temperature, seed life doubles. The moisture content of dried seeds stored in your house is probably roughly 10-12% or more (depending on where you live.) It's best to keep your seeds around 7-8%, or even as low as 5-6% if you want to freeze them (less than that the seeds will likely die.)

**Put the seeds in an airtight container.** This can be a mason jar or even a ziplock bag. Vacuum sealing works well too. However, zip-lock bags leak more than freezer type bags.

**Allow the seeds to thaw before planting.** These are for long-term storage, but good to keep this tip in mind. Always allow frozen sealed seed containers to warm to room temperature before opening, to avoid condensation.

**Some seeds are desiccant-intolerant.** That is, they cannot be dried without destroying them, and must either be planted quickly, or store in moist peat/sand/paper towels. Store cool, with air, but don't freeze. Examples: aquatic plants, buckeyes, oaks.

### **Planting peas in beds**

**Q. How do you plant peas in a bed format?**

Since the distances are small, and using a three inch triangle is difficult to keep aligned, we use a string stretched across the bed, together with a narrow trapezoidal piece of cardboard 3" wide with marks every 3" along the bottom and top edges of the trapezoid. We line up the trapezoid against the string, and plant at the marks. I start at one end, and Tania at the other. Then we move the string 3" farther along the bed and continue planting. We plant 600 seedlings (seeds in your case hopefully) in a 5 x 8' bed section.

We use a portable and collapsible pea trellis of our own design. You are only the 3<sup>rd</sup> or so person to ask about this in 14 years, so I do not have a readable design I can send you. I do, however, have a couple of pics, which I am including below. I used 2 x 2 uprights, held together to the horizontal members with bolts with wing nuts (allows for easy tightening and loosening). Triangular braces, one each on one end and one side, provide stability. I drive two pieces of pipe into the ground at the two corners of one side of the trellis and tie the two adjacent vertical uprights with wire to these. Once the frame is assembled, we hang 5' wide nylon mesh (7" square) stapled to 1 x 2s hung from the top of the trellis. I use bamboo stakes

woven between the uprights to keep the sides of the hanging nylon mesh under tension against the side of the trellis. I place the vertical curtains of nylon mesh ~ 9" apart. Here are the pictures:





Simpler Design for Pea Trellis. Use 1 x 2s x 8' pine strips, nylon mesh with 7" squares, screws and other ordinary hardware, and a staple gun to attach the mesh to the frames holding the mesh. You would also require a drill, saw, screwdriver, etc. Nothing complicated. Fedco sells nylon mesh: #9074 for 5 x 30' and #9075 for 5 x 60'.

You would make a number of mesh frames that would run across the (5' wide) bed. These mesh frames would be hung 9-10" apart from two horizontal boards near the tops and bottoms of the mesh frames. For an 8' long bed section for example, three of these mesh frames would have longer sides, ending in pointed ends, which would be sunk into your bed to provide stability. You would also provide rigidity by using two triangular braces, one along the bed and one across the bed. One or two pipes might be required to support two vertical edges on a diagonal. The bottom edges of the mesh frames might be 4-6" or so above the soil surface. The entire trellis is adjustable so it can accommodate site slope in either direction. You would use a level to ensure the uprights are vertical.

I suggested this design to a fellow gardener, and she and her son built it successfully. Here are two pictures – the first partially constructed, the second finished.



### **Planting fruit trees**

**Q.** Rather than merely digging holes, you mentioned having to dig beds for your fruit trees to improve drainage in your heavy clay soils. I can't picture this in my mind. Can you clarify?  
Below are two examples.

1. Peach-apricot bed with strawberries. In the center aisle are a dozen *Echinacea augustifolia*,

which take 3-4 years to mature for medicinal use. This is the last year for strawberries in this bed, but we will use the space for other crops or plants.



2. Peach-cherry bed. On the back side there are two pink champagne currants and two red gooseberries. In front, between the two trees, is our horseradish bed.



## **Edging beds**

**Q. How do you keep grass from growing into your perennial beds?** Three possibilities: plastic edging, V-trench, boards. We use plastic edging, which we buy in 20' rolls. It lasts a long time and saves a lot of weeding labor. We have also used the V-trench, but less frequently. You take your spading shovel, and cut a V-trench around the bed you are trying to protect from grass intrusion. I use a taut string to help me form a straight cut. First you cut one leg of the V, going along a length in this manner. Then, reset your string and cut the mating leg. The faces of the V might be 5-6" deep. The angle could be 60-90 degrees. You can clean this with a hoe quickly. We have found that on a sloping site, the V-trench works best going downhill. A trench parallel to slope ends up collecting dirt from the adjacent bed as rain washes soil from the bed into the trench. A friend of ours with a level lot edged his beds with 2x4s and then spread wood chips on the paths. It looked nice. He remarked to me that when the wood rots out, he will replace with 2x6s to give him more height.

## **Grass paths**

**Q. The rye grass I have in my paths between my beds is being trodden! What can I do?** Yesterday I came across a particular grass mix orchardists use in the rows between plantings: "Companion Grass," a mix of Elka Perennial Ryegrass (a genetically dwarf rye grass) and creeping red fescue. Benefits are low maintenance (only 2-3 mowings/yr), ability to withstand high traffic, and ability to choke out weeds. Search on line. One company was selling a 25# bag for \$63 plus shipping (2011).

## **Soil blockers**

**Q. Soil blockers. I have had trouble using soil blockers. Do you use these?** No, we plant our seeds in flats. For the large number of seeds we plant, and the limited greenhouse space we have, we would find blockers cumbersome and tedious. Eliot Coleman likes these for some plants. Coleman has his own soil blocking mix. Is this the recipe you are following? He discusses this recipe, and using soil blocks, in Chapter 13 of his "The New Organic Grower." Tania and I got a number of useful tips from Coleman. He is a row gardener, in contrast to Jeavons, who is a bed gardener (triangles).

## **Jeavons' planting densities**

**Q. I am starting a small market garden in Fairmont, West Virginia. I am following the plans outlined in Jeavons How to Grow More Vegetables and I want to confirm his plant per 100 square feet numbers. I realize that the triangular planting pattern maximizes efficiency, but the number of plants he claims can be fit in 100 sq. ft. seems extraordinarily high. I've read through most of your website and you seem to follow his methods closely. Have you found his numbers to be realistic?**

Jeavons' numbers are high. He justifies this by asserting that in a proper double dug bed, you achieve considerable loft, and therefore there is a considerable curve at the edges which makes the linear distance longer, allowing for more plants. .

In our case, we had to excavate considerable rock, so we end up with only a small loft. Second, we are on a slope, and over time the loft on the lower end has spilled over onto our paths. The idea of planting on a curve does not work well for us.

To show you how much our own experience deviates from Jeavons, consider a planting of peas on 3" triangles in a 5 x 8' bed section (40 sq.ft.). Jeavons claims 2507/100 sq.ft., which translates to 1,003/40 sq.ft. We get 32 rows with 20 seedlings in each row for a total of 640 pea seedlings, well below 1,003. Using Jeavons numbers of 200 germinated seedlings/flat, he would plant 3.2 flats for our 640 seedling requirements. In fact, we plant 3.5 flats, perhaps because our germination is lower.

So we recalculate based on a flat bed scenario, and plant enough seeds, using his column L2 (approximate # plants per flat adjusting for germination rate) and add a safety factor of 25%. Over time, we have adjusted up or down. It is always better to have more seedlings on hand than you require.

This discrepancy reduces considerably for plants planted farther apart -- e.g., corn, tomatoes.

I am attaching our "Metric" chart which we keep as the first page of our garden notebook for the current year. I am also attaching our "11Crops" file which gives our square footage and flat planting rates. Our flats hold approximately 300 seeds (note on bottom of this file). Feel free to adapt this information in any way you want.

### **Drip feed irrigation**

**Q.** Last year was a lot better, and I actually doubled the garden size. Which brings up the question of water. I want to figure out a good way to water without waste. Where can I go for information on how to set up a drip system if that is best, or what...would you think? Ag Extension? Google?

While I couldn't find anything on the backyard scale from Penn State Extension, I found the following informative sites, which will help you understand what is involved. In addition, some suppliers will work with you, using your garden map or plan to recommend a layout and appropriate parts.

1. We used the folks at dripworks (<http://www.dripworksusa.com/>). We sent them a map, and they laid out a system for us. Their website is informative.
2. This commercial site will also help you with your garden. You will find information, a manual, and kits. <http://www.dripirrigation.com/>
3. This site contains pictures and accompanying thumbnail sketches for key steps. <http://www.thisoldhouse.com/toh/how-to/intro/0,,1088902,00.html>
4. Scroll down to the 2nd video "vegetable garden irrigation system" and play. Raise the video

quality to at least 480. About 2/3rds of the way through, the video changes to another topic, so stop. This will give you a sense of the major parts you will require: (1) supply hose from your standpipe to the tops of the beds; (2) feeder hoses to rows of plants (drip tape with built-in emitters best); (3) separate arrangements for individual plants such as squash or shrubs; and (4) battery-operated timers if you are going to be away or want the added convenience of regular watering. If you're organic, you will not require the chemical fertilizer container shown near the timers.

<http://www.thegardenwateringsystems.com/466/implementing-garden-watering-system-for-easy-management/>

I hope this helps you get started.

### **Permaculture**

**Q.** Hi Gene & Tania! I am watching the video online of "One Man, One Cow, One Planet" and was wondering what you think of bio-dynamic methods. Here is the link:

<https://www.youtube.com/watch?v=vErQWRIV4Fw>

Have you ever heard any clarification as to how Rudolf Steiner came up with the methods of making the preparations and his understanding of the forces he taps? Listening to the explanation of the cow horn prep just seems so out there. Have there been data from comparison studies that you've heard of?

Also, I went to a talk on campus last week by Mark Shepard (Wisconsin) and also bought his book Restoration Agriculture which is permaculture based. Have you seen/heard of his methods? So nice to have had this warmer grace period between cold spells - gives me hope!  
Jackie

Jeavons' biointensive minifarming (renamed "Grow Biointensive" to distinguish his method from copycats that leave out key steps) is an amalgam of French Intensive and Biodynamic. According to Jeavons, the main difference is the use of biodynamic preps. Jeavons does not use them. We don't either. A minor difference is the adherence by biodynamicists to planting by the phases of the moon. Jeavons mentions this, but it is not clear to me that he takes this seriously. We do not plant by the moon. We plant by the calendar and the weather, which are over-riding factors in the life of any working farmer or gardener.

I would imagine that the similarity of the two schools of thought is sufficient to dissuade anyone from doing a comparison study. For me, the main contrasts are between conventional agriculture/gardening and either biodynamics or biointensive. What underlies the latter two is dedicated care for the soil, plants, and nature (i.e., the ecosystem).

I have never come across the source of Steiner's prep formulas. Steiner was Alan Chadwick's mentor, and Chadwick was Jeavons' mentor. Steiner schools still exist worldwide, but I cannot speak to them or his philosophy (theosophy).

Jeavons warns practitioners of biointensive against growing food for export, as this leads to

high exports of soil nutrients which cannot be recovered. Reliance on hand tools and hand labor also acts as a natural obstacle to running a biointensive operation on a commercial basis. Jeavons suggests limiting to ten percent that which you export (for cash). Admittedly, as urbanites, we flush down the toilet soil nutrients anyway, so we are unable to recover these. Of course, one could use sewage compost in your garden (from our local sewage authority). It works well. However, this doubtless contains hormone disrupters and pharmaceuticals, none of which are tested for. We limit use of sewage compost to non-food based landscaping, grassy areas, and preparing new beds for production. Once the bed is in operation, we put part of it in cover crops.

Don't know Mark Shepard. I merely repeat what Greg Williams (Hort Ideas editor) has said repeatedly over the years about permaculture (and edible forest gardening): great ideas, but how about some evidence? He and his wife have tried it on their Kentucky farm. His conclusion is that for northeasterners, and for a garden of a given size, you will not come close with permaculture or edible forest gardening to the caloric production of annual crops. You probably recall the laughable You-Tube video following Eric Toensmeier's walk around his 1/10 acre backyard edible forest garden. Laughable because of the tiny grape-sized perennial tubers he harvested for a meal from a perennial vegetable. I believe we have to ask of any growing regime some hard questions, absent the delusion of wishful thinking.

Let me know what you think about Shepard in this regard. I imagine you are collecting your thoughts for your CfS project. Nothing like a real project to motivate and crystallize your thinking. By the way, I just finished updating our 2009 caloric spreadsheet. Despite the passage of four years, we saw no significant increase in caloric or protein yield. We grow ~95% of our vegetables, 75% of our fruit, but only 11% of our calories. On the other hand, we produce 22% of our protein, which shocked me! Admittedly, this is vegetable protein, but I found that gratifying. It seems that we have reached a plateau. Our aim now is to replace crops that do not do well with those that do. Out lapin cherry! Out unproductive plums! Out goji berries! (But in with what??)

By the way, Wes Jackson's perennial polyculture is attracting serious world-wide experimental testing, if you believe the Land Institute's reports. We're talking foundations, land-grant institutions, and the Chinese.

There are so many dimensions to the growing and use of food! We will continue our focus on improving soil microbe populations, following the work of Elaine Ingham, who just left the Rodale Institute.

**Q.** My friend Betsy, a fellow gardener, took the biodynamic track at PASA this year (2014) and has been planting according to the biodynamic calendar for the last several years. I was invited to see the film shown in Millheim so I looked it up on line and found it was viewable there. I watched it and my skeptic hat came out which is why I asked about data. I use homeopathic meds which in some ways seems a similar thing to the biodynamic preps. Homeopathy has seemed to work well when I read all the indications correctly and choose the correct remedy. Biodynamic though, just seems too esoteric or at least I don't trust it. I haven't used it and will keep in touch with Betsy to learn if she feels it is worth it. I felt there was much heart in the film

but not much detail on the preps or why things were done.

How does the Jeavons method incorporate biodynamic if not using the preps or the planting schedule? I get the bio-intensive parts – double digging, close planting, etc. but where is it bio-dynamic like Steiner?

You two are always my go-to people for the harder data questions. Thank you for taking the time to respond so thoroughly. Many thanks, Jackie

First, I imagine Betsy is a caring organic gardener whose crops would do well under any (organic) growing regime. Caring is the bottom line. For her to draw conclusions about using the biodynamic calendar, she would have to do what agricultural scientists do: comparison trials during the same season in side by side beds with seeds from the same packet to minimize the effects of other factors. If she finds minimal differences, she might have to do this over additional seasons (repeated trials). We did such experiments on planting distances with beets, carrots and onions, and came up with dramatic differences, leading us to increase our planting intervals for beets, carrots and onions. One of the confounding factors that affected yields in these tests was whether the trial bed section faced east or west. We confirmed existing research showing that morning sun has a greater effect on yields than afternoon sun, so in our carrot bed section, we divided the plot into four quadrants to test east-west vs north-south differences. It is easy to rest on received wisdom absent data.

Second, you ask what is biodynamic about bio-intensive? Including French intensive, all three draw upon traditional growing practices in Europe, Asia, and traditional cultures that go back centuries if not millenia (recall F.A. King's Farmers of Forty Centuries). Boiled down, bio-intensive includes 7 practices: double dug beds, use of compost for soil fertility, triangular planting, companion planting in time and space, carbon-efficient crops, calorie-efficient crops, and open-pollinated seeds so you can save your own seed, and adapt them to your growing conditions.

These practices precede organic and are superior to organic, as they are sustainable, not relying on fossil fuels or machines. I wouldn't be surprised if biodynamic follows these, as it comes from the same traditions, but I leave it to you (with Betsy or others) to confirm this. Jeavons warns us that bio-intensive is geared to household subsistence, not commercial farming, as this latter depletes the soil, and using bio-intensive in a commercial venture would deplete the soil even faster. Thus, for me, the term "biodynamic farming" may pose a similar contradiction by requiring outside inputs to keep it going. Bio-intensive, by the way, is vegan. It does not rely on animal inputs. Practically, all agriculture depletes the soil; Jeavons recognizes this by recommending that you divide your homestead into quadrants, and rotate every 15-20 years or so. You'd grow trees in the first, shrubs in the second, pasture in the third, and your gardens in the fourth (or something like that). After 60- 80 years you'd return to the same quadrant for vegetables, having cleaned and refurbished the soil. This mimics succession in nature. Not possible for small-lot backyard gardeners like us.

Third, Jeavons has led us to appreciate the Importance of a school of thought. Bio-intensive and biodynamic are examples of schools of thought. What counts with each is the integration it

has achieved among many practices. These frameworks or schools answer not only what to do, but why, how and when in a way that prevents confusion in the novice and serves as a basis for improving practice among the accomplished. With my comments above I hope I have conveyed the sense that both biointensive and biodynamics are schools of thought worth emulating. By this definition, organic is not a school of thought, but merely a collection of practices, sometimes conflicting, contradictory and not necessarily sustainable. Open the pages of Organic Gardening magazine with this critical eye and the examples jump off the page: rototillers, hybrid seeds, bags of (organic) fertilizer, no use of cover crops, no crop rotation, plastic-edged "raised beds," etc. A veritable mish-mash. It gets worse with hydroponics and SPIN (small plot intensive). As Jeavons pointed out years ago, organic is not (necessarily) sustainable.

I invite your further comments.

**Q.** My main concern with what Shepard lays out is that he talks about exporting (selling) most all his crops (nutrients) and I don't see how that can be sustainable unless he is importing inputs as well. Jackie

A key question I ask of any growing operation, organizing framework, or school of thought is: "Where do you get your compost?" Many growing operations import organic matter in the form of fertilizers and compost; that is, they do not use cover crops nor produce their own compost, except in a haphazard way. Certified organic growers must use cover crops to build and retain soil fertility, but then commercial organic growers use tractors and turn under their cover crops. The material "composts" in place, a half-way measure and necessary consequence of using machine tools. To backyard gardeners cover crops are still largely a mystery. For Tania and me, the joint use of cover crops and rotation was our biggest intellectual hurdle. It seemed simple enough listening to Jeavons lecture, but when we got home ....

If Shepard is exporting crops to make a living, he may regard using cover crops as a waste of bed space that could be used to grow crops. Lacking cover crops, he may be importing compost, regarding this as an input specialized firms can do better than he can.

### **Greenhouses and urban farming**

**Q.** I thought of you and Tania at Neo-Terra when I read this article about urban farming. Steve <http://www.news.cornell.edu/stories/2014/02/indoor-urban-farms-called-wasteful-pie-sky>

Steve, Thanks for the Cornell analysis of the carbon footprint of greenhouses vs enclosed factory farms in urban areas. Cornell is where I got my Ph.D. Great analysis in the accompanying video that the two of us followed closely, and we agree with Professor Louis Albright on the energetic stupidity of growing lettuce either way.

In our presentation "Implications of and Alternatives to Petroleum Based Farming" at the PA Association for Sustainable Ag conference in 2006 we also analyzed the efficiency of producing a head of lettuce, in our case under four growing regimes: California imported lettuce, Eliot Coleman greenhouse winter production in Maine (close to his market), CSA (e.g.,

Tait Farms), and Self-grown (backyard). Being an agriculture professor in a land-grant institution it is not surprising that Professor Louis Albright didn't include "self-grown" in his comparisons; however, he was not asked to either.

In our earlier analysis (below) we used BTUs rather than CO2 or kwh, but we can draw an equivalence by recalling that each kwh = 3412 BTUs. The head of lettuce in our table weighs 0.75 lb. Thus, the respective CO2 produced by 1# of lettuce under each of the growing regimes from our table is:

for CA lettuce 30,340 btu/head x 1 head/0.75# x 1 kwh/3412 btu x 1 # CO2/kwh = **11.9# CO2/# lettuce**

for Eliot Coleman lettuce 22,596 etc = ..... **8.8#** "

for CSA lettuce 38,170 etc. = ..... **14.9#** "

for self-grown lettuce 7316 btu/head etc. = ..... **2.9#** "

Compare this to Prof. Albright's **8# CO2/#** of lettuce for an enclosed factory farm and **2.7# CO2/#** of lettuce grown in a hydroponic greenhouse. I am gratified that his and our analyses yield comparable figures.

Accepting Dr. Albright's data as more accurate, we can compare his greenhouse with Eliot Coleman's. Ratio is 2.7/8.8 = ~ 1/3. Applying this ratio to self-grown gives us a corrected figure of 2.9/3 = ~ **1 # CO/#** of lettuce slightly over 1/3rd the CO2 of his greenhouse-grown lettuce. **Thus, self-grown is the way to go if CO2 is your criterion.**

**Our data**

Energy Category	% <sup>1</sup>	BTUs per head of lettuce <sup>2</sup>			
		CA lettuce	Eliot	Self-grown	CSA
Farming	18%	5,461	5,461	5,461	5,461
Winter plastic		0	<b>1,855</b>	1,855	1,855
Food Processing	30%	9,102	9,102	0	2,276 <sup>5</sup>
Distribution	10%	<b>3,034</b>	6,178 <sup>3</sup>	0	28,578 <sup>4</sup>
Commercial Food Service	17%	5,158	0	0	0
Home Food Prep	25%	7,585	0	0	0
Total	100%	30,340	22,596	<b>7,316</b>	38,170
Efficiencies:		<b>7,316/30,340</b> = 24%	<b>7,316/22,596</b> = 32%.		<b>7,316/38,170</b> = 19%

The most efficient way to grow lettuce has a three-part answer, and Prof. Albright only hit upon the third one.

- (1) Eat in season. Forget trying to grow tomatoes and other warm-weather crops in the winter.
- (2) Store summer produce by canning, juicing, lactic fermentation, and other means. These are all traditional and require only modest energy.

(3) Use simple protective covers to grow hardy winter greens. This is what Eliot Coleman does in Maine, in plastic covered greenhouses, without supplemental heat or light. We do the same in our backyard without supplemental heat or light. Years ago, before he got his polycarbonate greenhouse, Tania's father used a Polish solution to grow winter lettuce in Bucks County; he created an enclosure of hay bales around his lettuce bed and covered it with old window frames.

If we are to be as serious as Albright suggests, realizing this three-part program requires that more of us become aware of our impacts on CO2 (and the environment), and committed to doing something about it by changing our behaviors (as indicated in the three-part program above). In the mid-19th century, Paris residents grew a large proportion of their greens within the city boundary using what is now called French intensive agriculture. Cuba, in particular Havana, did similarly during their "special period" (no petroleum post-Soviet era). I mention these two examples because the climates are so different -- Paris at 49 deg latitude, Havana at 23 deg latitude. Cubans ended up being healthier, more sociable, and more self-reliant in food.

Thanks for the stimulating exercise in allowing us to compare our analysis with that of Professor Albright.

### **Time we spend growing food and yields**

**Q.** Many thanks for sharing your experience/resources. I'm very interested in permaculture and Jeavons biointensive. I was wondering if you keep a log of time spent gardening?

I'm particularly interest in comparing the effort to yield ratios of a biointensive and more perennial/permaculture plots.

I'm trying to figure out the right balance between what some may call edible forest and biointensive. I've yet to see any data on how many calories over what area an edible forest can provide and am leaning towards going down the biointensive route to provide staples but am concerned it will be very time consuming for 4000+ sq feet (40 beds).

I note from one of your documents you achieve 10% of you calories from 3000 sq feet which is really useful info as I've seen many claims that 4000 sq feet is all that is required. (Interestingly I work on around .75 to 1 acre per person which is much closer to your figures.)

If there's a document on your site that reports yields and time spent I'd be grateful if you could point me towards it.

Kind Regards, James, UK

Dear James,

I'm just getting to your query, as we've been busily getting in our annual crops, and cleaning and adding compost to our perennial beds. You are raising some excellent questions, and I

can tell you are bringing analysis to bear at the beginning of your endeavors, a sensible way to proceed.

I spend an average of 12 hrs/week year 'round, and my wife perhaps 6. Of course, we spend more time during the growing season, and less time during the winter, when we coast, using stored food (frozen, dried, canned, lactic fermented, etc. ). Right now I'm probably out in the garden 6 hrs/day, so it's pretty intense (June 2, 2014)..

Our 3,000 sq.ft. of beds is roughly 1/3rd annual vegetables and 2/3rd perennial (permaculture) consisting largely of fruit. Keep in mind that this does not include access paths, our garage which contains our tools and supplies, a patio and deck area we use for starting our crops in two mini-greenhouses, etc. The entire property is ~ 0.8 acres, which contains the house, three compost areas, landscaping (flowers, decorative shrubs) and 30 or so mature trees, deciduous and coniferous.

We grow about 95% of our vegetables and 60% of our fruit. Some of our shrubs and trees are new, so we expect the fruit production to increase gradually. Based on an updated spreadsheet analysis done this past winter, our garden supplies 11% of our calories, and, surprisingly, 22% of our protein (uncomplemented vegetable protein). Without taking down more trees, we are now maxed out on production area. However, were we to expand our area, all the expansion would go into calorie production, and for these, root crops give higher yields (calories per sq. foot) than grains, are easier to grow and store, and require none of the threshing and winnowing that grains require.

From Jeavons (How to Grow More Vegetables) I compiled the caloric yields for high-calorie crops in the following table. The crops highlighted in yellow are root crops. We have grown ten of the crops on this table. Note that the numbers are for low yields.

<b>Top Vegetable Crops for Caloric Yield Per 100 sq.ft. (from Jeavons)</b>	<b>Calories per 100 sq.ft. (low yield)</b>
<b>Rutabaga</b>	<b>35,400</b>
<b>Parsnips</b>	<b>34,870</b>
<b>Sweet Potatoes</b>	<b>32,800</b>
<b>Burdock</b>	<b>30,000</b>
Leeks	29,520
<b>Irish Potatoes</b>	<b>27,900</b>
Swiss Chard (moderate oxalates)	20,800
Lima Beans	18,000
Field Corn	17,380
Collards	17,200
<b>Onions</b>	<b>15,700</b>
<b>Carrots</b>	<b>15,600</b>
<b>Cylindra Beets</b>	<b>15,070</b>
Brussels Sprouts	13,350
Wheat – Durum	6,000

In the next table below I give data for our highest yielding crops, ranked from high to low in column four for the years 2010-2013, except for sweet potatoes, which we began growing seriously in 2013. You can take this data, multiply by 100, and compare with Jeavons low yields above. We are using this data to fine-tune our plantings to get more calories out of our current area. Of course, there is only so much burdock you can eat! We were also amazed at our high caloric yields of collards, which I eat daily from early June through end of January.

We have replaced white potatoes with sweet potatoes as the latter are considerably more nutritious, and yields are higher!. We are in a marginal area, climatically, for sweet potatoes, in Central Pennsylvania (latitude 42 deg), but we manage, growing Beuregard, recommended for the shorter season of the northeast. In general, we have found that root crops require full sun to be productive, and in our somewhat shady yard we have probably maxed out on yields of our root crops. Here is our data

Ave recent years 2010-2013

<b>Crop</b>	<b>Our Yield lb/100 sq.ft.</b>	<b>Cal/lb</b>	<b>Cal/sq.ft. 2010-2013</b>
Burdock	130	400	519
Sweet potatoes	115	400	460 1/
Garlic	62	547	339
Dried beans	55	583	320
Collards (est)	150	181	272
Irish potatoes	95	279	265
Lebanese squash	91	73	256
Parsnips	84	293	246
Carrots	141	156	220
Onions	99	157	155
Beets	177	60	106

1/ data for 2013 and 2014

Were we to add more beds, we would definitely grow more sweet potatoes and (dried) beans. Each 100 sq. ft. bed would add 2.4 percentage points to our total caloric production. Thus, five more beds in half each beans and sweet potatoes would more than double our caloric production to just over 22%. If you have a sunny area, you could probably double this caloric production in the same area (with some practice).

Our fruit trees and shrubs (permaculture) produce just over half of our total calories, but requires 2x as much space as vegetables. The highest yield/sq.ft. are just over 100 calories/sq.ft. for apples and pears, and these are much lower than for our highest yielding root crops.

We are not fans of the edible forest garden concept. We find it overblown, with concepts that are nonsensical in practice (guilds beneath fruit trees and keyhole beds to name two). We have not come across any data of note, and this absence of data has been commented on by others. In the American two-volume set, Edible Forest Gardens by Jacke and Toensmeier

there are two examples only: a rather tepid two-page description of the eccentric Robert Hart's edible forest garden in Shropshire, England; and the initial stages of one of the author's application of principles to a tiny urban lot in Holyoke, Massachusetts. I cringe whenever I hear novices wax eloquent about wanting to have, or establish, an edible forest garden. I hold my tongue, and trust that they will learn something by trying.

I cannot tell from your note how far along your effort has gone. Jeavons warns enthusiasts to start small -- with one bed -- to get the principles down. This is what we did. We have been at this since taking Jeavons' workshop in 1997. We have fellow gardeners who jumped in way over their heads, attempting 10 beds in one case, and a quarter acre in another. Both bailed after one season. It isn't just the physical work. It's the intellectual work. For Tania and me were, we had the hardest time getting our minds wrapped around cover crops and rotation, to take the two topics most foreign to urbanites. Now these are second nature, but most gardeners never get the hang of these. Then there are the pests and diseases. We are slowly mastering these organically.

You may have additional comments and questions, and I will be happy to engage in further conversation.

### **pH of water**

**Q.** I recently bought a pH tester and my well water is very alkaline, 8.7 range. Do you agree that I need to get it into the 5.5-6 range? I've been reading up on it and now I'm thoroughly confused.

Espoma sells an organic sulfur. Other products have ammonium sulfate, citric acid and urea phosphate. I've experimented with peat and I can make a peat tea that brings it down but it takes a lot of peat. Any advice would be greatly appreciated. Best, Karl

Most water around here comes from or through limestone, so it has a higher pH. With the increasing rainfall we've been experiencing during the summer, there is less to worry about. Rainfall tends to be slightly acidic. The real issue is the pH of your soil. Unless you have a high quality pH tester, the usual garden devices one gets are not accurate or reliable. I would use the inexpensive PSU soil test to get a reading of your soil's pH, taken from a representative sample of the soil you want to test. Then I would decide what to do.

We use sulfur pastilles (little pellets) annually on soils in which we grow vegetables, and peat moss on fruit trees and shrubs (raspberries, gooseberries, etc.). On digging a perennial bed for the first time, I will add sulfur as I double dig. Then I use peat moss as part of the annual treatment, mixing it with compost prior to application. Sulfur and peat moss compensate for the high pH soil and the high pH of the compost made from leaves of trees in this soil, as this compost also has a high pH!

You can get sulfur pastilles in 40 pound bags. It doesn't degrade. I avoid using micronized powder because it blows around on application and gets lost in the air, and sticks to heavy clay clods. Pastilles are easier to work with.

I do not know what organic sulfur is. Sulfur is a mineral, on the periodic table. Designating it as organic may be a marketing ploy. Agricultural sulfur is 99% pure sulfur.