

Eco-system Management

In the previous chapters, we discussed a lot of theory. To summarize the main points:

1. We ourselves, our plants and animals, our farms and gardens are all part of a larger whole. While we can observe what is happening, we cannot expect to manipulate the world without affecting ourselves as well. We reflect our garden and vice versa. Perceive with humility.
2. The earth is a living being; it inhales and exhales over the course of seasons. It has a circulation, a pulse and a sensitive skin. The exhale of life-force gives us food substance in the harvest season, During the winter, the inhale stores energy for the next cycle.
3. Materials behave differently when they are within a living being. In life, elements are in a dynamic flux, continually entering and leaving. In contrast, "dead" chemical elements just react and sit there. Life is active functions rather than mere physical properties. This activity can be seen as "spirit" entering and flowing through the world.
4. The forms of living beings are in continuous change. We call the organizing formative forces the "etheric body". The etheric body interprets the general pattern and figures out how to adapt to individual circumstances.
5. The plant lacks the organs of an animal; the soil and surroundings serve as organs for the plant. Leaves spread to receive cosmic energy; flowers open to the insects, to air and warmth. Roots blend into the soil, merging with earth and water. Thus, we propose two fundamental polarities -- the earthly and cosmic streams of nutrition that feed living beings.
6. The points above are purely descriptive -- what is really amazing is that we can influence and modify these subtle life-forces. The process is one of identifying where and when the forces appear by observing complementarity, that is, by noticing the characteristic gestures or forms that relate to specific processes. Then we distribute the proper influence through methods similar to homeopathy. This claim confronts traditional science, yet a variety of experimental evidence has been presented in support.

Now we talk about practical applications. The idea of theory is to have a context, so that actions make sense. But the practical applications are also verified with experimental evidence.

Companion Plants

Nature is an interacting whole; so we expect that one part of the garden will affect other parts. In particular, some plants will affect other plants. Gardeners have observed that some plants are beneficial companions, encouraging their neighbors, while others are hostile and retard the growth of neighbors. The fact that there are such interactions does not seem

very controversial, but the experimental basis is not well documented. Most of the books referencing companion plants refer back to publications by biodynamic pioneers, the Philbricks and Richard Gregg. I have heard that their suggestions derived from experiments conducted by Dr. E. Pfeiffer, but have not found documentation. Some of the suggestions for companions may be based more of folklore than on experimental observations. Plants are actively engaged in seeking and rejecting nutrients. Their root hairs are constantly exchanging sugars for other nutrients from a hyphae network that links all the plants, regardless of species. So one can understand that hormones and other substances from one plant species are carried to another. Some plants are known to produce allelopaths, chemicals that are toxic to competitor plants. Fennel and wormwood (*Artemisia*), for example, are not liked by other plants. A list of companion plant likes and dislikes is included in the appendix.

Different species interact in the ways that they accumulate nutrient substances. We know about legumes as accumulators of nitrogen, but other plants soak up various minerals. For example, daises, buckwheat, and dandelion accumulate calcium. Henbane and valerian accumulate phosphorus. Foxglove soaks up iron, calcium, silica and magnesium. Chamomile collects calcium and potassium. The plants we think of as weeds may be performing a useful service by concentrating nutrients so that other organisms will benefit later. The appendix includes a table lists some plant accumulators.

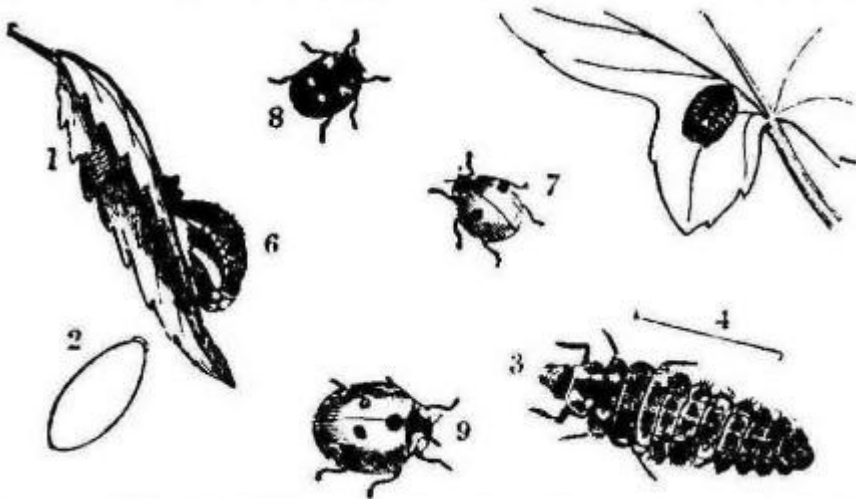
Comfrey is the king of accumulators. Studies at UC Davis found that comfrey outproduced alfalfa in tons of foliage cut from a field. The leaves are loaded with nutrients, including fungus-fighting silica. Studies in Germany have shown that comfrey reduces the incidence of potato rust. Comfrey is high nitrogen for the compost pile and the high calcium content strengthens the eggshells of chickens. Comfrey does contain small amounts of toxic alkaloids, so should not be a major part of the diet for any creature. It is a perennial propagated by root cuttings, so is difficult to remove -- make sure you want it before you start a bed. There are also some ornamental varieties that are attractive as perennial flowers.

Another reason for interplanting has to do with maintaining the insect part of the ecosystem. Some flowers, especially umbellifers, are a pollen source for beneficial insects. Pollen helps the insects survive so that they are available to combat any outbreak of pest insects. For example, the parasitic wasps that control aphids benefit from having pollen sources.

Insect Pests and Plant Controls

Pest	Controlled By
Ants	Spearmint, tansy herb, pennyroyal
Aphids, Black fly	Nasturtium, spearmint, nettle, southernwood, garlic, castor bean
Bean Beetle	Potato

Cabbage Butterfly	Sage, rosemary, hyssop, thyme, mint, wormwood
Cucumber Beetle	Radish
Cutworm	Oakleaf mulch, tanbark
Flea Beetle	Wormwood, mint
Flies	Rue, tansy herb, wormwood, tomato
Mosquito	Legumes, wormwood, rosemary
Moths	Sage, santolina, lavender, mint, nettle, herbs
Potato Beetle	Flax, eggplant
Slugs	Oak leaf mulch, tanbark
Squash Bugs	Nasturtium
Weevils	Garlic
Woolly Aphis	Nasturtium
Worms in Grazing Animals	Carrots, tansy herb, mulberry leaves

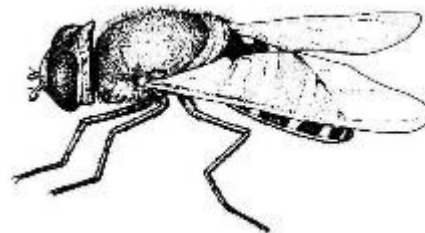


It's important to be able to recognize the good bugs when you meet them. The ladybug is the most familiar, but you may not know what the larva looks like. The ladybug (7-9) is easily recognized. Other stages are the eggs (1 and 2), larva (3, 5), actual size is less than (4), larva shedding skin (6). Should

you buy ladybugs for the garden? Probably not a good idea for several reasons. The ladybugs sold commercially are collected from the wild, usually the Sierra Nevada Mountains, when the bugs gather in colonies for fall hibernation. So you are taking bugs far away from their local environment. Some of the bugs carry fungal disease that they can spread to our local

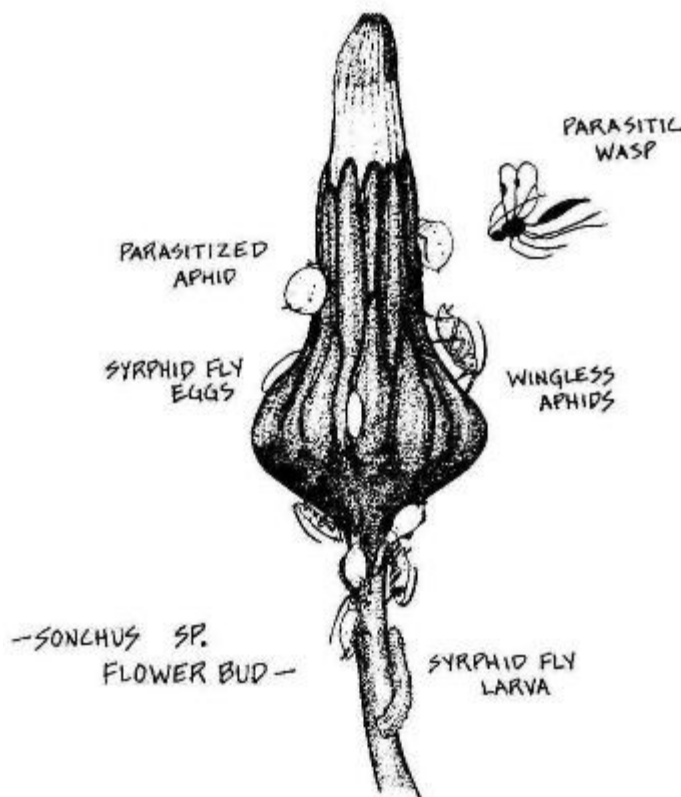
populations. If you see any bugs that are not active enough to crawl out of their container, these are suspect -- best to destroy those bugs. Finally, the active bugs have emerged from hibernation and are programmed to disperse to new homes. So if you place them in your garden, they are likely to fly away anyway. The best approach is to build up your own local population of good bugs.

The adult syrphid fly is called a "sweat bee" or "hover fly" because they hover around the gardener. But the larva are aphid eaters. Lacewings and the similar snakefly look delicate but prey on aphids.



If you want to buy predatory insects, lacewings are a good choice. They are raised for that purpose, not collected from the wild. They don't fly far, so are more likely to stay in you garden.

Two types of beneficial insects are active on this plant. Tiny wasps have parasitized some of the aphids -- the affected "mummies" look like bloated little spheres. Syrphid fly larva are actively hunting other aphids. Since this plant is just a weed, we might be tempted to destroy it. But then we would be losing valuable predators.



What are these insects? The scientific names may seem daunting but here are some descriptions:

Parasitic wasps -- almost invisible, these very tiny wasps control aphids and scale insects.

Large wasps -- Braconid, Ichneumon and potter wasps. Frequently, you will see these wasps hovering over cabbages, looking for caterpillars to eat. These large wasps appear frightening but rarely bother people. The exception is the yellow jacket, which aggressively seeks meat scraps in late summer.

Ladybug -- the best known "good" bug. Both the adults and larvae of these beetles prey on aphids.

Lacewing -- not as well known, but also preys on aphids. The adult is a delicate fly with horizontal, transparent wings.

Tachinid and syrphid flies. A number of flies whose larvae devour insect pests.

Ground beetles, soldier beetles -- large shiny black beetles that hunt at the ground level. They will eat earwigs, slugs and soil grubs.

Pirate bugs, big-eyed bugs, damsel bugs, assassin bugs. A number of small bugs that hide in flowers and plants preying on thrips, aphids and other small insects. Their distinguishing feature is large eyes, the better to see their prey.

Beneficial Insectary Plants

Plant	Beneficial Insects Attracted
Alfalfa	Pirate bugs, big-eyed bugs, damsel bugs, assassin bugs, ladybugs, parasitic wasps
Angelica	Ladybugs, lacewings, large wasps
Baby blue eyes (Nemophila inignis)	Syrphid flies
Buckwheat	Syrphid flies
Candytuft	Syrphid flies
Carrot	Pirate bugs, big-eyed bugs, damsel bugs, assassin bugs, ladybugs, parasitic wasps
Coriander	Tachinid flies
Evening Primrose	Ground beetles

Euonymous	Lacewings, tachinid and syrphid flies, large wasps, ladybugs
Fennel	Large wasps, tachinid and syrphid flies
Ivy	Large wasps, tachinid and syrphid flies
Morning Glory	Syrphid flies, ladybugs
Pigweed (Ambrosia artemisifolia)	Ground beetles
Rue	Ichneumon and potter wasps
Snowberry	Flower and tachinid flies
White Clover	Parasitic wasps for scale and whitefly
Wild Mustard (Brassica hirta)	Braconid and ichneumon wasps
Wild Lettuce (Lactuca canadensis)	Soldier beetles, lacewings, earwigs, sryphid flies
Yarrow	Parasitic wasps, ladybugs

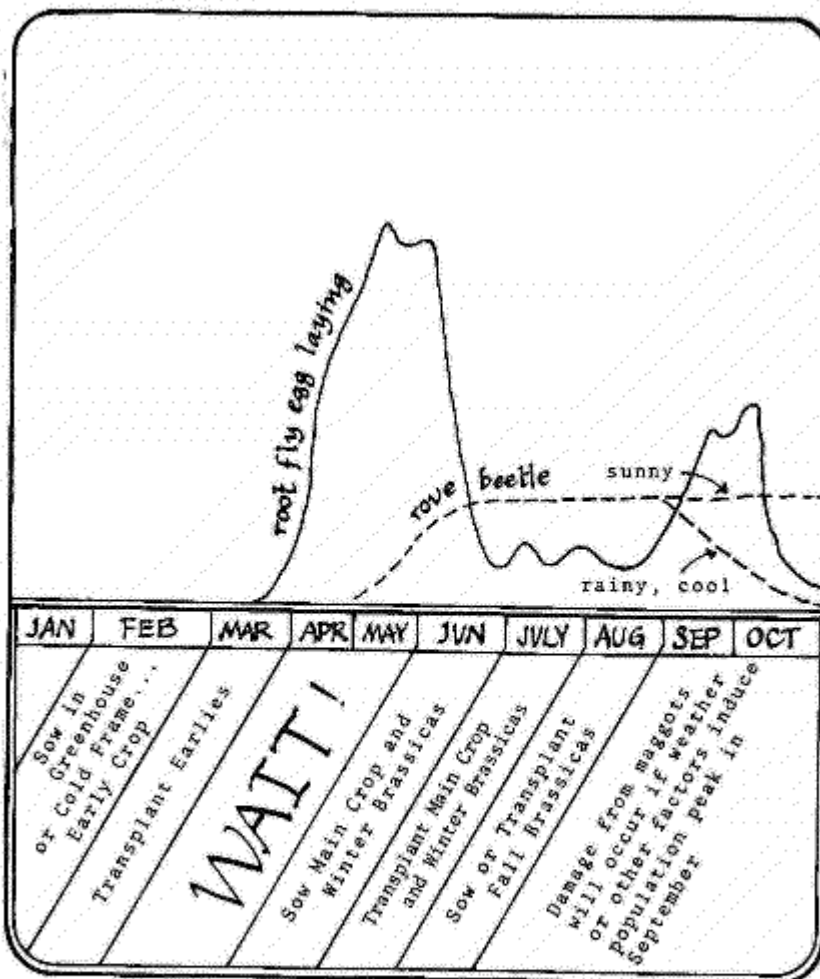
Insect Pests

It's tough to find out that last night's slugs have devoured the results of weeks of work. We have to remember that pest problems are at least in part our failing. If we provide nutritious, balanced soil, the plant will better able to fight off pests. If we provide a balanced ecosystem, there will be natural controls on pests. And finally, our job as managers is to deal with pests.

Insects and invertebrates are part of the natural breakdown cycle. Most of the time, their role is important in releasing food for the next plant generation. Bees and butterflies not only distribute pollen but function with the plant in carrying off the energy as the plant matures. The border between the manifested etheric (plants) and the manifested astral (animals) is where the insect meets the flowering plant and the worm meets the plant debris. When the plant loses its essence, it falls apart into pollen, aroma and seed, which the insects and birds help to carry away. Even when general feeders attack, it is usually a signal that some growth process is wrong.

So the first response should be to do nothing -- instead ask what is wrong. Try to figure out what is weakening the plant and what you can do about it. Maybe you don't have to do anything -- the problem will resolve in time. For example, roses explode into growth in the spring; their soft new growth attracts aphids. If you spray with pesticide, you could be damaging the beneficial predators, like ladybugs. If you wait, the problem will resolve itself. If the infestation is serious enough that you need to help, you can spray the hose on the roses to knock the aphids off. Then follow up with equisetum spray to toughen the roses. Some pesticides are considered "organic" because they are derived from plants. However, even these are dangerous to the beneficial bugs, not to mention the humans. Some natural pesticides are still quite toxic. So it's better to avoid anything that is toxic. Light traps (bug zappers) are a big mistake; they have little impact on pests like mosquitoes, but destroy harmless insects instead. Bacterial pesticides, like BT, are safe because they only affect chewing insects.

Root Fly Egg Laying Cycle



Key

— Root Fly Maggot
 - - - Rove & Ground Beetle

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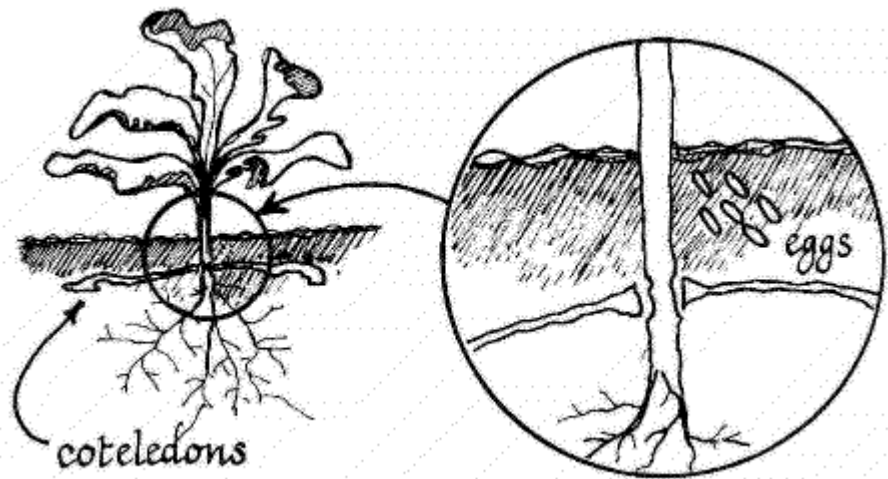
plants from seed to
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terfly that flits around
 r around cabbages looking
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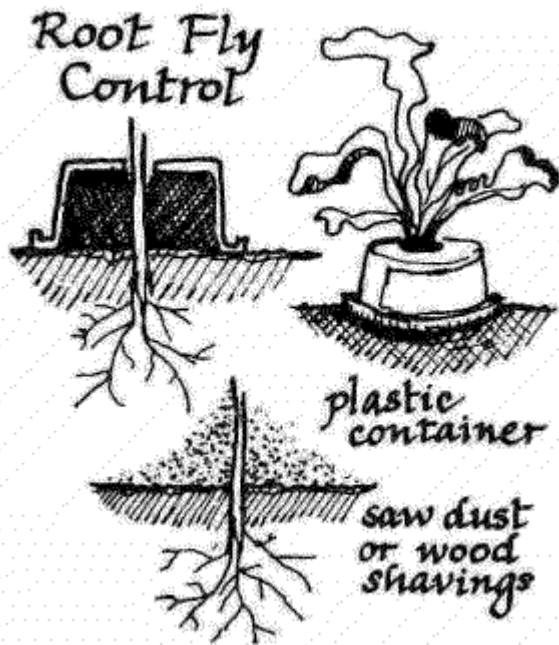
Cabbage root fly. This fly
 lays eggs when stem of plant
 is about 1/4 inch in diameter
 and the larvae much on the
 roots. A strong infestation
 will seriously set back any of
 the brassicas. Even a mild
 infestation makes it almost
 impossible to grow turnips or

daikon radish. See the chart of egg laying -- timing is critical!

Early in the spring is the highest population of the fly and the lowest of ground beetles, the natural predator. Mid May-June is best time to sow seedlings.



any eggs and larvae. If you find them, destroy them. You will have to repeat every few days. A similar trick is to place a collar around the plant that extends into the soil for an inch or so. The idea is that the larvae can't dig very deep and will be unable to find the plant.



The Hills Foundation suggests putting a cottage cheese container around the plant. Supposedly the fly will not lay its eggs in a dark place, hence cannot get close to the plant. This will have to be removed as the plant grows. Finally, a deep sawdust mulch will discourage laying eggs close to plant. Apply sawdust mulch 1 1/2 inch deep and 6-8 inches in diameter around the plant. One can also band radish or turnip seed with sawdust 1 inch deep, 6-8 inch but still one must harvest promptly to avoid maggots.

Food tea added to collar of affected plants, remedy of sprinkling wood ashes appears to be probably due to the added calcium helping the

inches. Use only well rotted compost. Allow light to minimize water and use dry, scratchy (ills). Of course, this advice doesn't help us

much in a wet climate. For predators, encourage chickens and wild birds. Apply Horn Silica. Slugs increase when Mars enters water signs. Maria Thun makes a let-it-rot slug spray: When moon is in Cancer, collect 50-60 slugs and leave to rot in water. Next month, when moon is again in Cancer, strain liquid and spray on soil, prepare a new spray and repeat next month. Repeat for 3X at intervals of 4 weeks. Hugh Courtney reports using a tea from spruce seeds to discourage slugs. To make the tea, 3 grams of crushed seeds of *Picea abies* (Norway spruce) were left to ferment in 1 liter of water for two weeks. One cup of the fermented extract was added to 2.5 gallons of water, stirred for 20 minutes and sprayed on the soil and plants with good results. Similarly, Hugh makes a tea from pokeberry (*Phytolacca americana*) juice. Results are not clear although one Oregon grower reports success using pokeberry juice early in the year to inhibit slug reproduction.

Aphids are a symptom of plant being too lush and soft. It may be due to over fertilization. However, some plants, like roses are so bred for growth that the pent-up winter forces can't help exploding into lush growth in our cool, moist spring. So we see aphids. If you can, leave it alone to see if predator populations develop as a natural control. One can knock off a heavy population with a spray of water. Most of the aphids will not be able to climb back to the plant. One can apply equisetum spray to toughen the plant. Avoid other sprays, even "organic" soaps, because they can damage predator insects.

Leaf miners are the larva of another fly. They tunnel into the leaves of the goosefoot family, spinach, chard and beets. Their wild host is lamb's quarter weed so it's almost impossible to avoid these bugs. The damage is usually mostly cosmetic. You can pick off the affected portions of the leaf. If your garden has a heavy infestation, first look to clean up any lambsquarter weeds in the area. One can cover the plants with Remay or spun-fiber floating cover to keep the flies from laying eggs on the plants.

Symphylans are a special pest of the Northwest. These look like a 3/16 inch long, flattened, pale miniature centipede, multiply jointed with 12 pairs of legs and two long antennae on the head. They are a tiny, shy, fast-moving soil dweller that avoids light and is hard to see. They need moisture and withdraw deep into the soil during dry periods. One way to check for a problem is to put a piece of cut potato in the soil, then dig out and count the next day. If you have 10 symps that's a problem. Symps eat rotting organic matter, but also the root hairs, especially from newly sprouting seeds. They are native to the area and found in heavy, wet clay soils. Back when all this area was forested, they were not a problem in forest duff. But as we cleared the woods, we left them with depleted soils and now root tips became attractive food. Symps are a signal that nature would like the ground to spend some time back in it's native eco-system. The population will build slowly over several years until suddenly spinach, beets, strawberries, and brassicas don't do well. Tomatoes, carrots, corn, lettuce, squash are somewhat immune. Grasses, weeds, fava beans are not appealing. Crop rotation important. One can use buckwheat as catch crop to lure symps away from desired plants, gradually how out buckwheat as plants grow. Rotation out of irrigation may be needed -- return to unirrigated grass for several years. One plan is to sow fava beans in fall, let them mature seeds during the next year, don't irrigate, till in fava stalks and seeds the next summer. This will provide a dense planting for the following spring. Repeat for three years. The dense planting will repress weeds and symps as well as add nitrogen and organic matter.

Disease Pests

Fungi and bacterial diseases are a signal of imbalanced growth forces. Fungi leave their normal abode of the soil when moon forces are too strong, typically, because of too much precipitation. In our wet climate, this is a particular problem. This can also happen when the full moon and perigee are close together, with uncomposted manure or with seeds harvested during unfavorable conditions. Try to provide good compost to start with. Thinning plants to proper distances allows sunlight to enter. Equisteam tea is the sovereign remedy for fighting fungus -- especially damp-off disease on young seedlings. Spray on the soil as well as plant. Chamomile tea and garlic teas are also used to fight mildew on cucumbers and squash. Compost tea itself is very beneficial as inoculates the plants with a culture of beneficial microorganisms.

Maria Thun has further recommendations: Cultivate soil in morning to help exhale excess moisture. For potatoes, don't cultivate on leaf days. For brassicas, rotate plots to prevent clubroot and boost pH with lime. Strawberries are growing at natural fungus level and often over-fertilized, so they are susceptible. Spread only finished compost, plant and cultivate on fruit days, harvest on fruit days. For fungus on fruit trees, pick fungus-infected leaves and make a let-it-rot tea. Strain and spray when moon is in Cancer on trunks, crown and soil. Repeat 2 times more at intervals of 4 weeks.

Weed Pests

A weed is a plant growing in the wrong place. Unfortunately, sometimes it's difficult to persuade the plant that it is a problem. For example, our wet, heavy, anaerobic soil is just right for bindweed. Bindweed sends its tuberous roots deep down into the heavy clay and never wants to leave. Once again, we have to recognize that the plant is only doing what it is supposed to. We have to learn to accommodate. Remember the weeds are also telling a story. Their presence indicates some problem with the soil. Below are some weed indicators and ways to remedy. The appendix includes a detailed list of weeds as indicators.

Weeds as Indicators

Weed	Symptom	Solution
Field thistle (<i>Cirsium arvense</i>)	Soil is compacted	Mow when moon is in Aquarius or Sagittarius to make sap flow. Mow whenever the moon is ascending until the plant is weakened.
Dock (<i>Rumex acetosa</i>)	Soil is acid	Cut repeatedly as above. Also can make seed ash pepper.
Horsetail (<i>Equisetum</i>), Bindweed (<i>Convolvulus arvensis</i>), Coltsfoot (<i>Tussilago farfara</i>)	Soil is poorly drained	Add drainage. Work up soil with compost.

When you first work the soil, you will be exposing weed seeds to the light and starting their germination. So one approach is to come back in a couple of weeks and till the bed again, this time destroying any weed seedlings before sowing our crops. If this operation is timed for just before the full moon or when the moon is in Leo, it will encourage the seed seeds to reveal themselves. Steiner gave a suggestion for preparing a "pepper" by ashing weed seeds. The pepper will discourage weeds from growing although it takes several seasons.

Let-It-Rot Tea

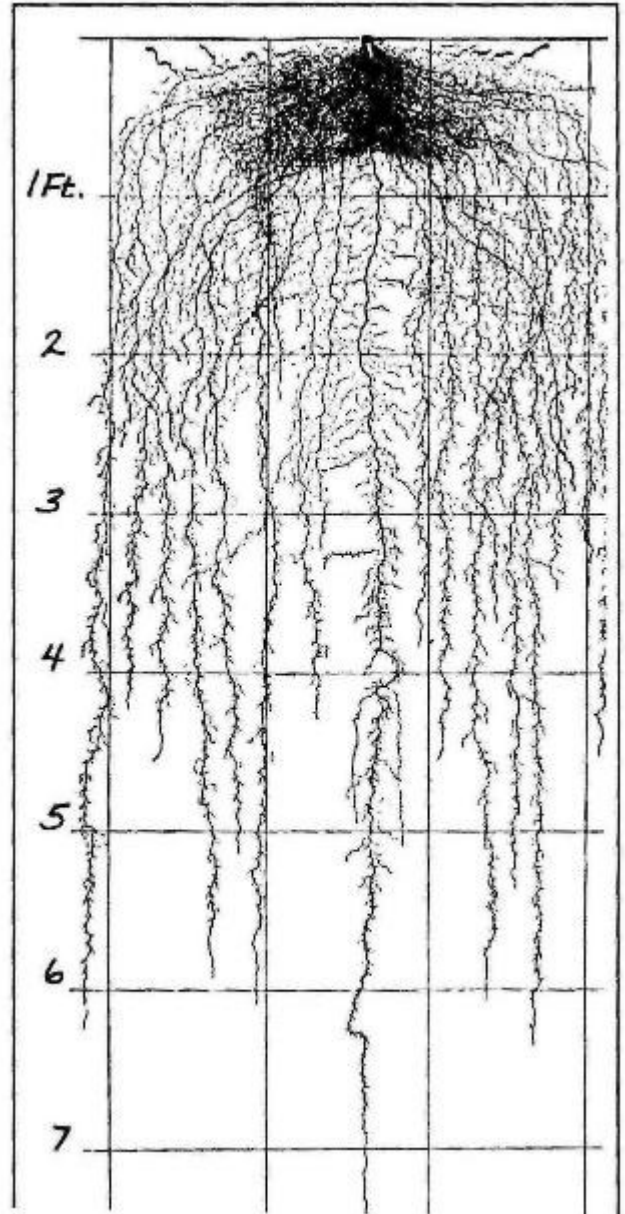
For the weeds with nasty roots, like bindweed, Canada thistle or crab grass, Maria Thun makes a weed tea. The offending weeds and their roots are left to ferment in a bucket of water. Stir occasionally on a leaf day. After the plants have completely rotted, the liquid is sieved and sprayed while the moon is in Cancer. She claims that this will eliminate the weeds. The same tea is a stimulant for cabbages, cucumbers and tomatoes, but should be diluted 1:10. It can also be added to the compost pile.

Interplanting And Integration

Planting several species together provides the symbiotic benefits and also better utilization of garden space. Plant a quick-maturing crop with a longer one. As the first crop is removed, it makes room for the second one to expand. For example, lettuce can be planted with cabbage. Then as the lettuce is removed or hoed in, the cabbage expands to take over the bed. Another example would be plants that occupy the niche differently -- so that a low, crawling plant can be planted among a tall one. For example cucumbers or squash under corn or pole beans. This way the ground cover plant provides a living mulch for the tall plant.

The biodynamic ideal is to make sure that all the plant forms have opportunity for expression. That is, the garden should always contain root, leaf, flower, and fruit/ seed crops. This way the ether forces are harmoniously balanced. The parallels to the intercropped ecosystem gardens of native peoples are obvious. The roots may be out of sight but don't neglect them.

Each vegetable puts out a distinctive, and very large, root system. We need to keep this in mind when intercropping. Look at this example -- a lettuce plant has most roots near the surface but sends roots as deep as seven feet!



For example, deep-rooted carrots can be combined with shallow-rooted lettuce. The table lists some common vegetables and their root zones.

Vegetable Root Zones

Name	Depth, ft	Width, ft
Shallow -- to 4 Feet		

Beans	3-4	2
Cauliflower	2-4	2.25
Onion	1.5-3	0.5-1.5
Radish	2-3	1-2
Pepper	3-4	1.5-3
Medium -- to 6 Feet		
Cabbage	4-5	3-3.5
Corn	5-6	1.5-4
Eggplant	4-7	4
Lettuce	4-6	0.5-1.5
Pumpkin	6	13-19
Spinach	4-6	1.5
Squash, winter	6	13-19
Tomato	10	2-4
Deep -- Over 6 Feet		
Beet	10	2-4
Carrot	6-7.5	4
Kohlrabi	7-8.5	3.5
Parsnip	6.5	4
Swiss Chard	6-7	3.5

Crop Rotation

Crop rotation follows the same idea. We grow a plant species to prepare the soil for the next species. The general rotation plan is to put on a heavy amount of compost and then grow a heavy feeder crop, such as cabbage, corn, squash or tomatoes. Then grow a soil improver crop, such as legumes. Then follow with light feeders, such as root crops. One can finish with a weed fallow or a green manure crop or a bee pasture crop (phacelia or buckwheat). Or one can apply the compost and start the rotation cycle again.

One catch is to know the families that plants belong to -- so that members of the same family are not planted over each other. Planting the same family repeatedly is monoculture; it wears out the soil in a one-sided fashion. The same holds true for weeds -- If a bed has recently been in weeds, you can be monoculturing if you plant the same kind of vegetable. Here are some of the major families:

Monocots: Grasses include grains and corn. Sometimes we grow rye as a winter cover crop. Lily family includes onions, garlic, leeks, chives and asparagus. Onion relatives do not make woody parts, indicating that they focus on the earth-water growth pattern. Leeks and asparagus are heavy feeders. Asparagus is perennial; vigorous fern-like leaves are needed to store food for the next season's shoots.

Crucifers are the cabbage family, named for their cross-like arrangement of flower petals. Cabbages come from a seashore weed, *Brassica maritima*. It has been bred into a variety of forms, including broccoli, cauliflower, kohlrabi, kale, and collards. Turnips and rutabagas are related, as are the Oriental cabbages. Other crucifers include the pungent horseradish, garden radish, mustard greens, and water cress. This plant is so fluid that every part forms a useful vegetable! Related weeds include shepherd's purse, winter cress and wild radish.

Legumes include peas and beans. Other members are fava or bell beans, vetch (used as a winter cover crop), chick peas (garbonzo), clover and alfalfa. The later are used for green manure or nitrogen-fixing. Legumes have a tendency to be more astral than other plants because of their special arrangement with nitrogen.

Carrot family (Umbrellifers) are also named for the shape of their flower. These are biennials that store food in their roots for the first season, then release in a light, lacy form the second year. These are light feeders and tolerate cool weather. Members include carrot, parsnip, parsley, celery, cerleriac, chervil, fennel, lovage, coriander, anise and caraway. Notice the number that produce aromatic seeds, consistent with dissipating forces in the second year. There are some dangerous plants, poison hemlock (used to kill Socrates) and cow parsnip, that one should be able to recognize. Weeds include Queen Anne's lace, the wild form of carrot. The flowers of this family are an important source of pollen for beneficial insects.

Goosefoot family (*Chenodiacea*) also are root vegetables. The family includes beets, Swiss

chard, spinach and orach. The root crops have a high sugar content, but the greens tend to contain oxalic acid which ties up nutrient minerals, such as calcium, during digestion. Weeds include lambsquarters.

Nightshade family (Solanacea) includes fruits that are treated as vegetables, tomato, eggplant and pepper, as well as the potato. These plants grow rankly and show an eagerness to reach toward astrality. As a result, many members contain poisonous alkaloids. These cases include tobacco, nightshade (henbane), datura, and belladonna. They also an exception in liking themselves as companion plants. Even the potato can produce toxic alkaloids; this is why one should no eat potato skins that are green. The flower of the family is the petunia. Except for the mountain-loving potato, these are warm weather plants and heavy feeders.

Gourd family (Cucurbits) like warmth and rich soil. These are vining plants, including gourds, squash, pumpkins, cucumbers and melons.

The Composite family exhibits complex flower heads, composed of many individual flowers. Each flower is complete, yet they cooperate into a greater whole. No wonder they bring a feeling of harmony to the garden! Vegetables include lettuce, endive, artichoke, salsify, Jerusalem artichoke, burdock (gobo) and sunflower. Useful members include yarrow, dandelion and chamomile used in the compost preparations, as well as chickory, tarragon, mugwort, and marigold. Weeds include groundsel, thistles, hawkweed, goldenrod and asters. These are all important food plants for wild birds.

Less common families are buckwheat (Polygonaceae) bringing sorrel and rhubarb, Morning glory (Concolulacae) bringing sweet potatoes, mallow (Malvaca) bringing okra and hollyhocks, amaranth, bringing pigweed and amaranth. Most fruits belong to the rose family although gooseberries come from the saxifrage family. Many aromatic herbs (mint, sage, oregano, thyme) come from the Labiatae family, marked by square stems and fragrant foliage.

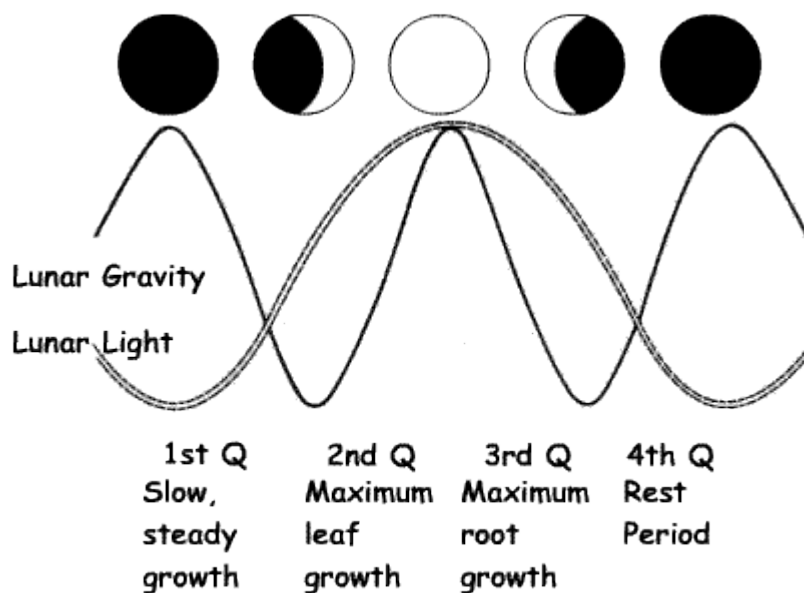
Koepf suggests a general plan: follow roots with fruiting vegetables, follow with leaf vegetables, then annual flowers. Strawberry beds last for several years but eventually need to be replanted. They do best after root crops; a new bed could be started in July-August after an early crop of carrots. Otherwise, they could be started in the spring after a winter cover crop. The old strawberry crop will be good for leaf vegetables. The same beds can be interplanted to include both early and late crops, such as lettuce and cabbage.

Cover and Green Manure Crops

Cover crops provide extra organic matter to the soil. The trick is that the soil must be active enough, and you need to allow enough time for their plant residues to breakdown and be digested by soil organisms. Obviously, when we have the soil in good vitality, this breakdown takes place faster. Cover crops create a large root mass that absorbs nutrients that will be useful for subsequent crops. If you are applying rock mineral fertilizers, cover crops may be a way to help the minerals become incorporated into the soil food web. Tall or thick crops,

such as fava beans or buckwheat, help shade out weeds. Legumes are viewed as beneficial because they fix atmospheric nitrogen. But that is only part of the story. If legumes are allowed to go to seed, they put all their nitrogen there. So legumes used as "green manure" need to be harvested while young and juicy. One potential problem is that some covers might encourage certain pests. For example, a cover of mustard would be a host for cabbage root maggots that can become a problem later.

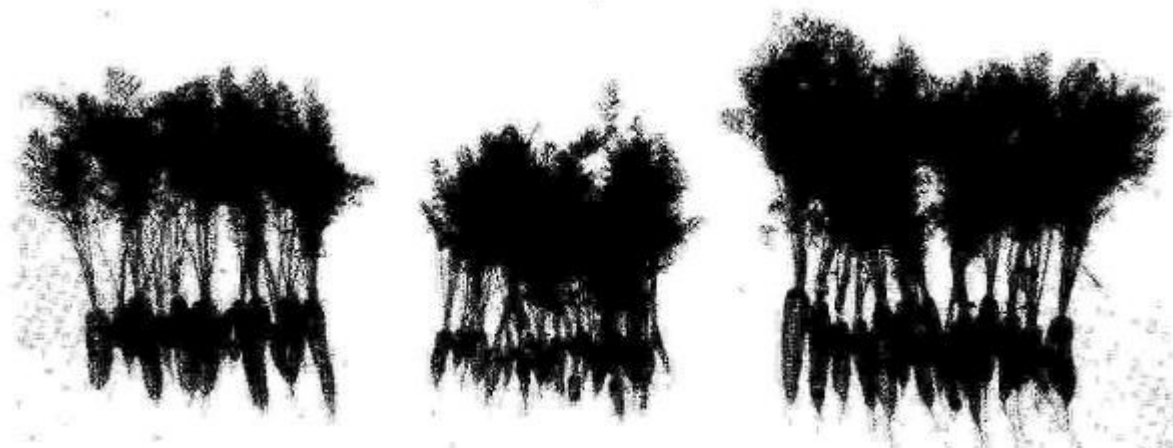
Lunar Rhythms



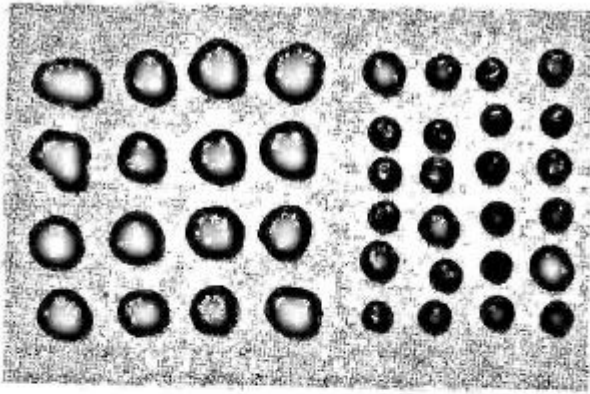
Living organisms, with so much internal water, respond to the moon in a similar way as the tides. The most important effect is the response to the waxing and waning moon. In general, the full moon helps to draw water into plants. Thus, germination of seeds is most rapid at the full moon. So the best time to plant is in the second quarter or just before the full moon. Root crops or transplanting can be done in the third quarter. The fourth quarter is a rest period, best for weeding and other chores.

Lunar Growth Cycle

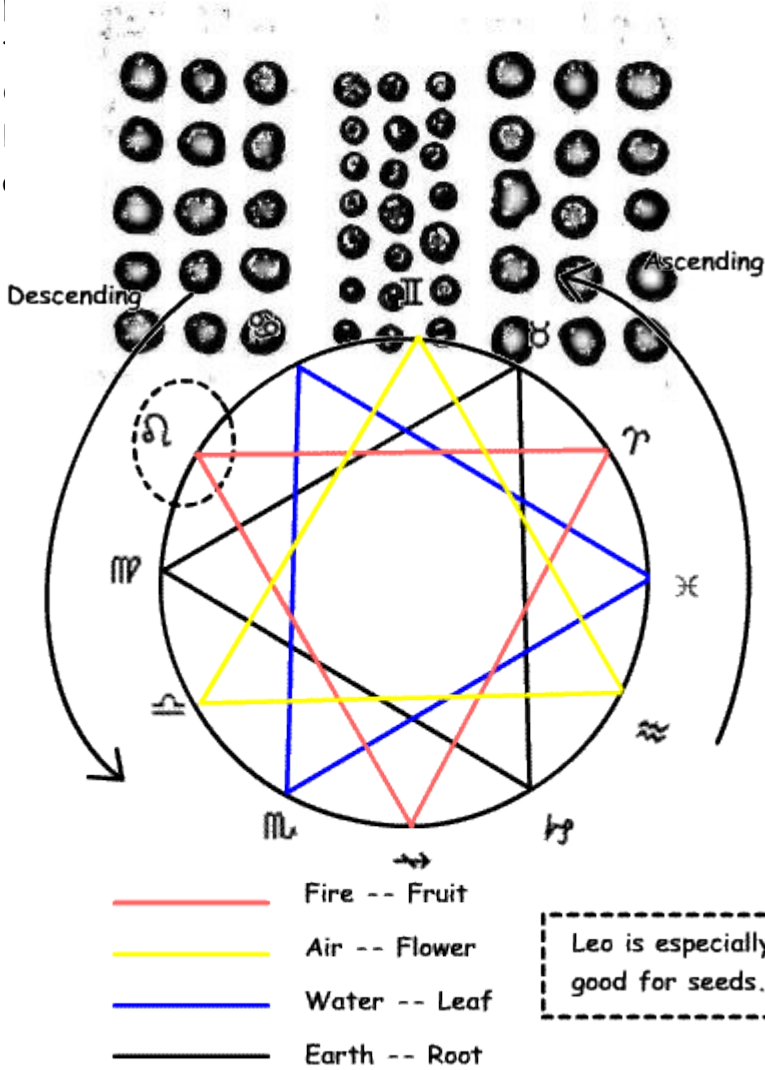
The following observations are based on a large number of experiments by L. Kolisko and others. Seedlings sown in the advantageous phase of the moon surpassed those sown two weeks earlier or later.



Kolisko: Carrots sown at 2 days before full moon, before new moon, before full moon.



Kolisko: Five series of tomatoes; sown 2 days before full moon, before new moon, before full moon, before new moon, before full moon.

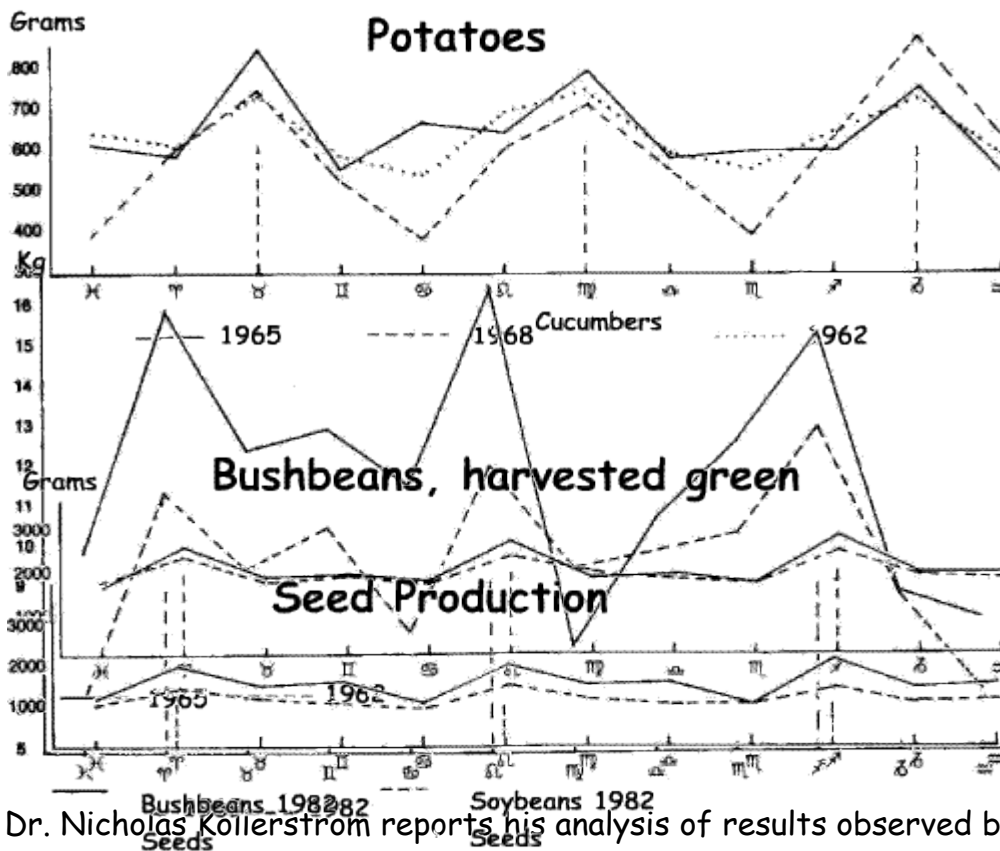


Planting by Moon Signs

juicier; those sown during the new moon -- potatoes and legumes can be planted by the roots. Apogee (Ag), when the moon is at its farthest from Earth, is good for root crops, but may be good for seeds. Perigee (Pg) plantings tend to be more fruitful. In general, it is better to plant when the moon passes the path of the ecliptic.

There are also connections with the zodiac sign of the moon. Maria Thun has conducted a number of experiments and found growth influenced by the zodiac. It should be mentioned that other practitioners have not found the same results, or at least not to the same degree. Below are some charts showing growth for some vegetables. Potatoes and cucumbers are quite responsive to the zodiac sign, beans are less so. A dry crop like seed beans is the least responsive, consistent with its low water content. Maria Thun interprets these effects according to the elements of the zodiac signs: Fire signs help plants that fruit, air signs those that flower, water signs are good for leafy plants and earth signs for root crops. Leo is a fruit sign that is especially beneficial to seed crops. The moon

moves through the signs quickly, roughly 2.5 days per sign. So if you need to wait for a better sign, it won't be long. When the moon is in a high sign, like Taurus, the upper parts are more vital; and when in a low sign, like Scorpio, the bottom parts are more vital. Old timers tried to graft trees when the signs were ascending. Descending signs are a good time for transplanting or pruning. If it seems hard to keep track of all these details, consult the Stella Natura calendar where the best planting days have been identified according to Maria Thun's system. Here are the results of some experiments testing the zodiac signs.



Potatoes respond to the zodiac signs indicated as the vertical lines.

Cucumbers respond very strongly.

Bush beans respond only moderately.

Dry beans respond very little. So, in general, it appears that the more watery vegetables respond to the moon signs.

Dr. Nicholas Kollerstrom reports his analysis of results observed by others, here summarized in the following table:

Crop	Year	Yield excess in trigon	Yield deficit (in other constellations)	Value of "t"	Significance Level
Barley & Oats	1970-'71	5.7+-7.5 (n=6)	-2.0+-4.9 (n=18)	3.1> +22	0.01
Carrots & Radish	1972-'74	15.9+-6.3 (n=6)	-5.3+-7.5 (n=18)	6.3>+22	0.0001
Potatoes	1976	+1.6+-1.1 (n=5)	-0.5+-1.1 (n=15)	3.6>+18	0.002

This table shows higher yields according to Thun's trigon system. The Significance Level indicates only a very small chance that the observed results might be due to random changes. The changes are most pronounced for the "juicy" carrots and radishes and less pronounced for crops with a lower water content. (Dr. Kollerstrom is a lecturer in mathematics and physics, and a Fellow of the Royal Astronomical Society.)

It must be mentioned that other researchers have not been able to duplicate the trigon results. There are many other variables such as weather that make demonstration difficult -- which is another way of saying that the effect, if it exists, is small. Hartmut Spiess conducted the most rigorous study, He found evidence for the effect of the phase of the moon but not for the trigon system, signs of the zodiac. Spiess points out that a calendar offered in the U.S., called Llewellyn's Lunar Organic Gardener, places the position of the

moon as seen in front of the astrological sign rather than behind as according to Thun. The result is that the assignments in Llewellyn's calendar are incorrect by 1-2 days according to Thun's system.

Walter Goldstein and Bill Barker conducted a carefully designed trial and found similar results -- the phases of the moon are important but the trigon influence is not distinguishable. Malcolm Gardner summarized these experiments and a number of other unpublished ones, all had problems demonstrating the trigon effect. Summaries of this work is posted at [Brian Keat's](#) calendar website.

Currently, [John Bach](#) is conducting planting experiments to verify lunar cycles. Although he has not collected data for an extended time, his results suggest that seeds for above ground crops sown during a waxing phase (two or three days before a full moon) produced the best results, and that seeds for below ground crops planted during a waning moon phase (two or three days before a new moon) produced the best results. Perigee was also associated with high plants yields and strong growth for both above and below ground crops. Of particular interest, Bach has a free planing calendar available as a download.

Integrating Animals

From all this discussion, it should be clear that the garden is an integrated ecosystem. We have already talked about making sure that we have the four elements represented in different plant forms. Similarly we want to encourage animal presence. The flying insects serve as the dispersing organs for the plant.



What can we do to provide for these other life forms? A mixed community of plants, including insectary species, is the first step. Gardeners can raise bee hives but the work is considerable. Furthermore, honeybees have been devastated by imported mites so their care goes beyond what a gardener would enjoy. However, there are a variety of sting-less native bees that can be encouraged. Orchard mason bees are easy to raise for orchard pollinators. Their active life amounts to only a few weeks in the spring, after that the adults die and the young hibernate for next year. Bumblebees are active

all summer long and can also be raised in "bumblebee houses". In the wild, these bees nest in the ground so merely ensuring some nesting habitat is all that it takes.

Birds and their songs enliven the garden on an energy level, beyond what they accomplish in controlling pests. Songbirds are encouraged by having sheltering hedges around the garden. Some species will respond if you make bird houses available. Bird feeders attract seed eating

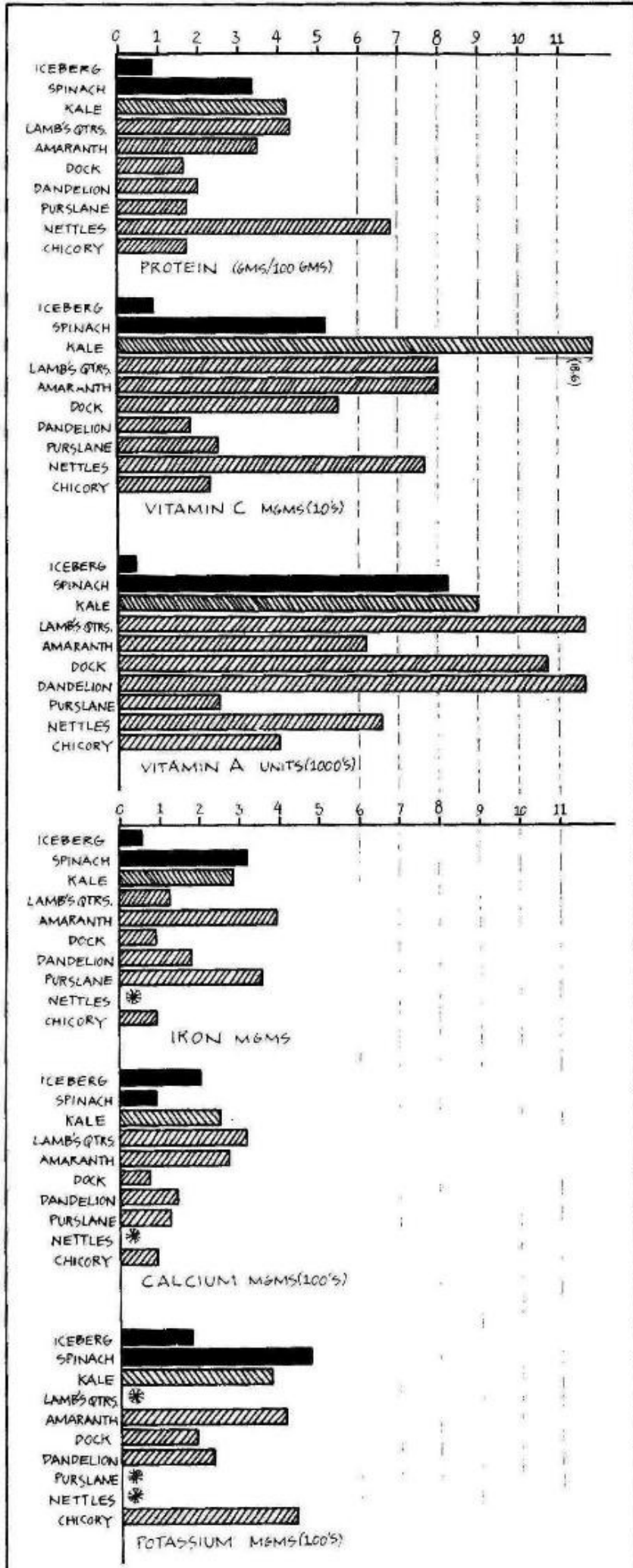
birds like finches. These will eat large quantities of weed seeds throughout the year. All the birds eat a certain amount of insects, but the ones that specialize in eating bugs will not be attracted to bird feeders. Insectivore species enjoy feedings of suet in the wintertime and will respond by hunting down insect eggs and pupae.

There is one critter that all gardeners successfully integrate -- the earthworm. We may not have the chance to raise cows and compost cow manure. But we all can raise earthworms and use the results of their metabolism. Earthworms are similar to cows in processing large amounts of vegetable matter. A large population adds about 2.5 lbs of castings per 1000 square feet. These castings contain 5-11 times the amount of nutrients and have about one-third more bacteria compared to the soil. In the process of grinding organic matter in their gizzards, worms create valuable humus and release soil minerals.

Harvest: Food Storage And Preparation, Seed Saving

Vital food --that's the whole reason for biodynamics. Steiner pointed out that agribusiness creates a diminished nutrition. Without live and vital foods, we will suffer a variety of health and spiritual problems. So eating right is what it's all about. In general, biodynamics does not grow more food than other types of organics. But it does try to grow food with more energy, more flavor and aroma and better keeping qualities. What does vital food mean?

Freshness! Gathering the food directly out of the garden means it's as fresh as possible. If possible, harvest at the optimal time of day. Leaf crops are best in the morning as vitality rises up during the night. Roots are best in the evening as the daytime energy is brought down. The optimal moment is fleeting. Alan Chadwick said that a fruit is perfectly ripe for only one moment. Before that it is green and after that it is already decomposing.



Choose healthy varieties. In the chart at left, iceberg lettuce contains the least amount of any nutrient. Wild greens contain the most! Kale is a powerhouse green.

Minimize processing. The closer to whole foods the better; a fresh carrot is better than carrot juice. Freezing is better than canning because less vitamins are destroyed. Sprouts and forced vegetables, like witlof, are a way to extend the growing season into winter. Storing without processing (like in a rootcellar) is a nice idea but most of us don't have a lot of storage options. For the best storage, withhold water and fertilizer before harvest. Harvest in dry weather and the waning moon. Sweet potatoes and squash need to be warm (50 degrees); root crops need cool storage (35 degrees). Roots and leeks can be left in the garden if it doesn't freeze too much. Other wise, they can be stored under leaves.

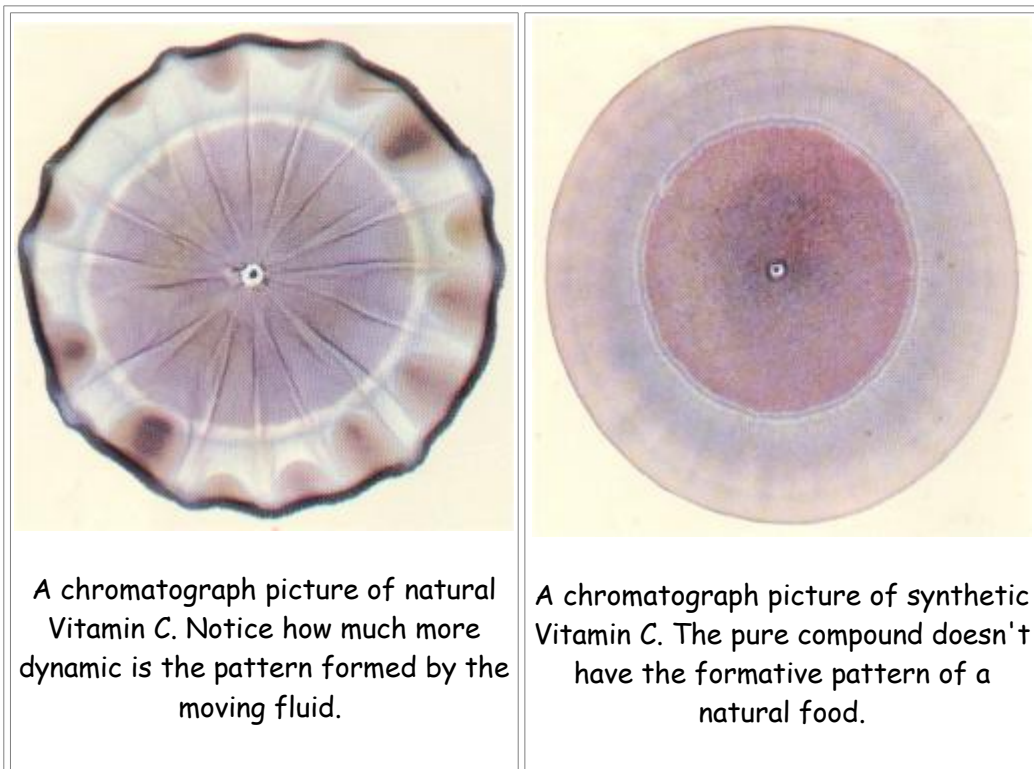
Cook with care. Steaming or a quick sauté preserves the nutrients. Most people over-rely on a staple, usually grain. It's better to keep variety and avoid too much carbo's. The general rule is that roots stimulate the head and nervous system. Leaves are for the respiratory and blood systems, flower and fruits aid the metabolic and limbs, while the staple provides

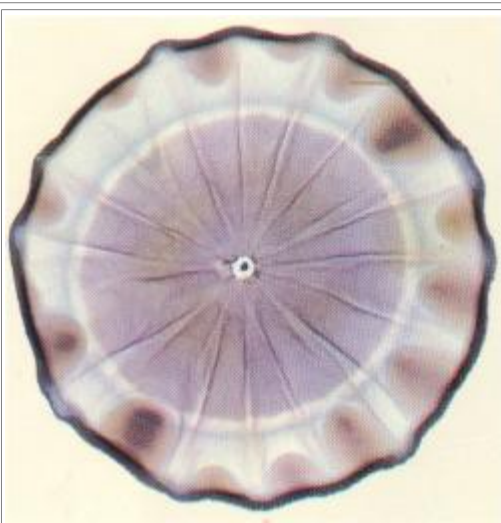
balance.

Saving seeds is a particular sort of harvest. If we can grow healthier, more vital plants than last year, then we are working with the forces of nature. That means we have a responsibility to choose the mother plants carefully -- only the very best should be saved for seed. If you aren't growing a lot of a particular variety, then maybe you aren't in a position to judge the quality. You must also consider if the plant is strong. Sometimes a plant may have a special flavor or color but still be weak or susceptible. For a strong strain, you need to think about origin-strength. It's like selecting the most weed-like lettuce rather than one that's refined into the human ideal of lettuce. Of course, we also have to balance the human preferences into selection too.

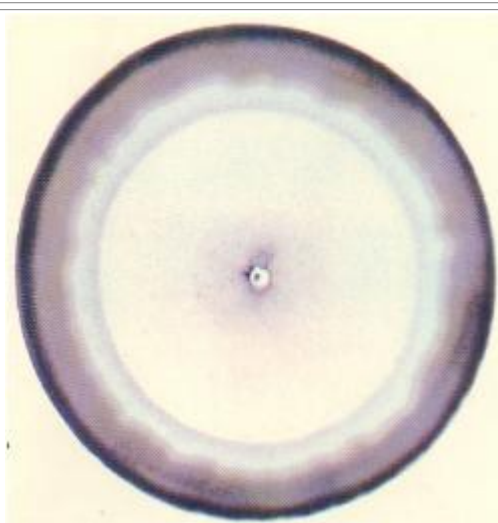
Hybrid varieties are not for seed saving; their offspring will have mixed heredity. Annuals are easier to deal with than biennials because those need an extra season in the garden. For vital seeds, make sure to use biodynamic compost and sprays during the year. Steiner tells us that planting closer to winter months improves the reproductive strength of grains, while planting closer to summer months improves the nutrition. The same may be true of vegetables. When we harvest and store the seeds, keep the natural fluff with them -- that's part of the seed. We can remove the fluff when we're ready to sow.

The vitality of biodynamic food is difficult to verify by analytical methods. Empirically, a number of experiments have shown that the food has better keeping qualities. A number of studies have shown a higher vitamin content. And a few studies have shown that animals fed on biodynamic food are healthier. The difficulty of verification is consistent with biodynamics claim that we are producing more of a vital life-force that is not recognizable by analysis. Picture methods have been used to try to show the differences in formative forces.





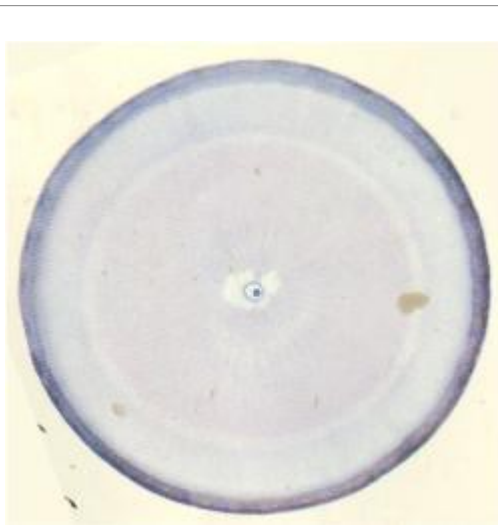
A chromatograph picture of fresh orange juice.



A chromatograph picture of commercial artificial orange drink.



A chromatograph picture of homemade whole wheat bread.



A chromatograph picture of commercial white bread.

Reaching the Community

None of us humans exist in isolation -- all of us are participants in our shared community. Steiner understood this and wanted to ensure that the way we grow plants is connected to the way we grow ourselves. For Steiner, it meant that we participate in three spheres: right-livelihood economics, political rights and spiritual/cultural activities. The connection to this three-fold social order is one that each of us has to develop in our own way. But there is a way to interconnect them. Biodynamics practitioners have been proponents of Community Supported Agriculture (CSAs), The idea is that city-dwellers can "adopt" a farm. The farmer provides a basket of produce each week, of whatever is in season. And the city residents support the farmer financially. This supports the economics sphere for both and allows the

city-resident to benefit from fresh produce. Consider a CSA as a way to supplement your garden. For many staple crops, it is more efficient to grow with a farm-scale operation. And the garden specializes in fruit, flowers and tasty treats that are not suited to larger scale.



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[Brian Keats](#), P.O. Box 1560, Bowral NSW 2576 Australia, Phone : (int code) + 61 24869 4975, <http://www.astro-calendar.com> offers an astronomical calendar for gardeners and provides useful background information.

John Bach has published results of his own planting calendar research at <http://www.bachbiodynamics.com/planting-calendar-research.html>. He also provides a free lunar cycle planting calendar download.

Chroma pictures from original research paper by M. Justa Smith, Ph.D., describing the chromatographic process, Human Dimensions Institute Professional Paper #4. Human Dimensions Institute, 4612 W. Lake Rd., Canandaigua, N.Y. 14424