



Design: Soil Regeneration

Site: Fox Hollow

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Prepared by: Bret Glassett & Beth Brettell

Contact: sierrasustainablelandscape@gmail.com

303.947.3770

Description: This document is the detailed system for approaching improving the garden soil from a permaculture perspective.

Background: Nature vs Humans

Mother Nature

Permaculture looks to nature to design garden systems. When it comes to building soil, mother nature doesn't truck in amendments / fertilizers. Rather, she creates a system that brings these minerals in for the plants without any excess energy loss, the plants do all the work.

Mother Natures fertilizing system:

- 1) Plant litter collects on the ground
- 2) Microorganisms start the decomposition process
- 3) Decomposition process attracts beneficial insects, microbes & fungi (primary decomposers) to break up soil
- 4) Decomposition builds the fungal & microbial component of the soil which in turn builds the organic and inorganic matter.
- 5) Fungal component spreads and brings nutrients to plants from far away

Humans

Humans on the other hand often till, bring in fertilizers and do not mulch/compost. It's worth noting that organic amendments are

unsustainable as they are mined elsewhere and use tremendous amounts of fossil fuels to resource and ship.

While this approach SEEMS to work since it produces a yield at first, it has two issues:

- 1) Requires constant work on the part of the human
- 2) In the long run it degrades the soil to an even worse condition require even more amending.

For further information view this documentary:

Natural World - A Farm for the Future:

https://www.youtube.com/watch?v=ixx1c3RSw_8



Natural World: Farm for the Future

Permaculture

Permaculture then provides a solution to the energy and money traditional gardening / farming methods require. Though it does require initial input for several years the end result, depending

upon how far the steps are taken, the result can be a low input or no input soil in your garden.

Incorporating these 3 steps will create a closed loop garden - meaning little energy input would be required once established. If steps 1 & 2 are done, this will provide much improvement but still require human power - step 3 is important in closing the cycle and moving from traditional farming to a sustainable permaculture system.

Fox Hollow

One advantage FH has is the clay soil - clay, while initially not suitable for growing many vegetable plants, is rich in minerals and nutrients. This means that the nutrients can be unlocked and utilized via building the soil.

STEP 1: No Tilling

Tilling

Simply put tilling destroys the soil - it kills much of the living components of soil and brings to surface dormant unwanted weed seeds. We till to loosen compacted soil yet over time tilling compacts the soil even greater. Tilling compacts the air out of the soil by destroying the soil aggregates that are glued together with slime from bacteria. The aggregates are aerobic and make space for oxygen in the soil.

Tilling Alternative

If you have hard soil that is unplantable, you can layer mulch (described later on) on the hard soil, giving yourself an immediate place to plant (directly into the layer mulch) and over time this will break up the soil below naturally (via micro-organisms, decomposers, roots, moisture etc) allowing easy root penetration deep below grade.

STEP 2: Building The Soil

You can use any of these following methods for building soil, each with its own specific use and place:

- 1) Compost
- 2) Layer Mulching

3) Cover Crops

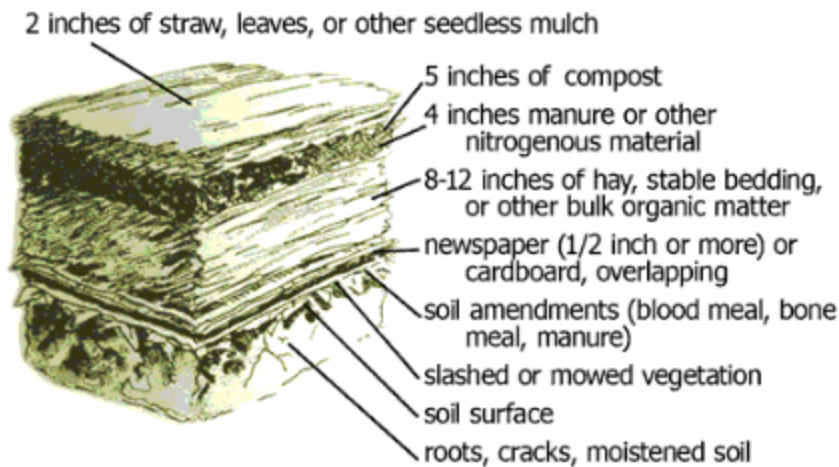
Compost / Manure

The more compost that goes down the better! The basic goal is to have soil that is continually composting itself in the beds. Undone compost is best as it provides many different stages of decomposition levels to be active in the soil.

Contrary to popular belief, modern soil science (by Elaine Ingram) says that the decomposition process DOES NOT take away nitrogen in the soil from growing plants. Using compost that is 'not done' is actually better than the 'finished' store bought compost as it provides more nutrients that are easier to access and provides habitats for the many beneficial micro-organisms needed for healthy soil.

Layer Mulching

The idea of layer mulching is to just keep piling on straw, manure compost, newspaper and plant directly into the layer mulch:



The newspaper keeps weeds at bay and decomposes as a carbon source. The Mulch helps keep moisture in and decomposes as well. Mulch is one key component to this system - bare dirt is dead dirt. Keep thick layers of mulch at all times.

An advantage to layer mulching is that your compost material go directly into your garden beds - possibly eliminating the need for a compost pile!

When to use Compost, Layer Mulching & Cover Crops

Compost - Best used when you are needing to establish a smaller bed quickly.

Layer Mulching - Best used to establish garden beds and you have time before planting.

Cover Crops - Best used in larger areas where it is unrealistic to compost or layer mulch.

Amendments

It will not be necessary to amend the soil with store bought mineral/chemical fertilizers such as NPK, Calcium, Potassium etc. Organic matter such as blood meal, bone meal etc are ok. Quality compost (not often the purchased kind) rich in organic matter will provide these elements in conjunction with the microorganisms.

Fungi & Microbes

A plant and its roots can only collect nutrients and water from its root hairs - which is not as much as the plant needs to be healthy. Microorganisms are nature's collectors that help bring moisture and nutrients to a plant. Here are some jobs that microorganisms do for us:

- 1) Microbes secrete antibiotics that protect plants from disease.
- 2) Many plants have dependant relationships with microbes and grow poorly without them.
- 3) Plants grow quicker in microbe rich soil.
- 4) Microbes make plant fertilizer right in the soil (phosphate, nitrate, sulfate & others)
- 5) Humus and soil organism hold on to nutrients and minerals that would otherwise leach away from the soil.
- 6) Microbes bring the nutrients and minerals to the plants roots as the plants roots do not actually contact very much soil

An interesting note about human applied amendments:

Plants only often use 10% of amendments applied manually and at most, though rare, 50% of amendments applied.

Why we don't want to amend soil with fertilizers:

Using fertilizers (natural/organic or synthetic) actually causes a surplus of minerals in the soil that in turn creates an imbalance in the soil due to not enough carbon being available for the amount of minerals to be used by microbes. Microbes then start pulling carbon from reserves, such as humus, rather than from the decomposed matter / waste products of other microbes.

Carbon is also pulled from the plants, in turn making them weaker. In this cycle of excess/lack many soil organisms die off due to the imbalances. The soils also begins to lose its ability to hold moisture and air (due to the humus being burned up - humus holds the moisture in soil); soil structure is reduced and this begins the cycle of poor yields.

Applying fertilizer the way nature does - tied to organic matter - uses far less fertilizer and also saves the energy consumed in producing, shipping and applying it. It also supports the broad assortment of soil life, which widens the base of our living pyramid and enhances rather than reduces biodiversity.

In short, a properly tuned ecologic garden rarely needs soluble fertilizers because plants and soil animals can knock nutrients loose from humus and organic debris (or clay, another nutrient storage source) using secretions of mild acid and enzymes.

STEP 3: Beneficial Plants & Food Forest

Beneficial Plants

Among the edible annuals should be beneficial plants that are left in place year round - plants that will do the job such as fixing nitrogen but not just in the 'off season' when the bed is not in use (as that required planting and tearing up a bed which is more expended energy than necessary).

Some example dynamic nutrient accumulators (full list available):

	Nitrogen	Phosphorus	Potassium	Iron	Magnesium	Silica	Manganese	Calcium
<i>Alfafa</i>	x	x		x				
Borage Borage			x			x		
Buckwheat		x						
Carrot Leaf			x		x		x	
Cattail	x							
Chamomile		x	x					x
Chickweed		x	x				x	x
Cleavers								x
Clovers	x	x						
Comfrey	x		x	x	x	x		x

Food Forest



A food forest is a garden turned into forest - neat and tidy rows of annuals are replaced with intermixed plantings of annuals, perennials. One can find an herb next to a green next to a beneficial shrub.

Again, permaculture looks to nature to design a food system, which is modeled after the abundant and healthy forests. Benefits of a food forest:

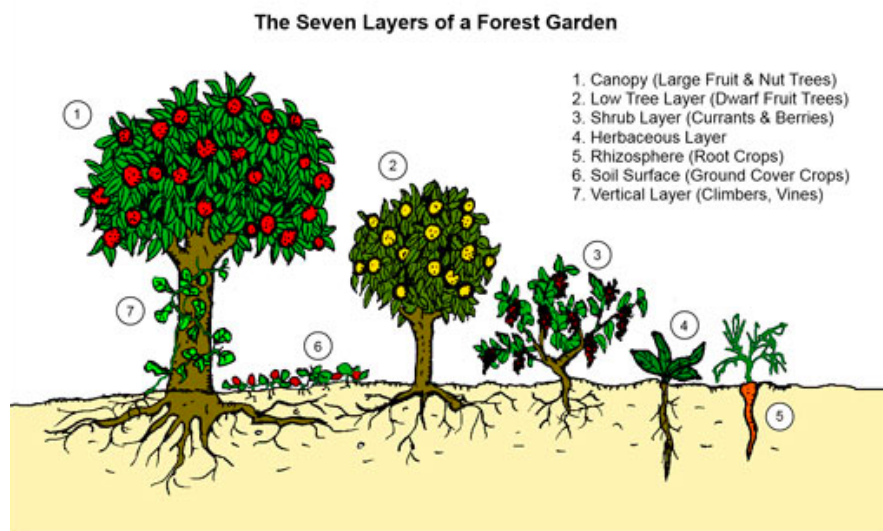
- 1) Over time can produce food with little maintenance
- 2) Once established it will fertilize itself, removing the need for compost, layer mulching and cover crops
- 3) Pest problems are minimal - When plants are in rows, it's very easy for bugs to hop from one plant they love to the next, when they are intermixed, there's less area for pests to multiply expansively - one of the reasons nature did not put rows of any one plant in her design
- 4) The only inputs would be any annuals desired. Annuals would benefit from the overall health of the ecosystem
- 5) Balance of pest and predators - this model mimics the natural ecosystem, keeping a moderated amount of any one species.

A food forest is considered a polyculture that maintains itself. There are case studies of established food forest requiring next to no work each year and providing more edibles than they did as traditional gardens!

There are many different degrees to which a food forest can be planted to and incorporated into a garden - from bringing a few elements into the garden to turning a garden into a full fledged forest.

With that in mind here are some general principles of a food forest:

- 1) Many layers (vertically, e.g. small plants, shrubs and trees)
- 2) Intermixed plants - This is important as mother nature does not plant in rows! By intermixing plants you are reducing susceptibility to disease and overabundance of one pest.
- 3) Many functions - use as many perennial edibles and dynamic accumulators as possible.



Fox hollow already has a start to a food forest - many intermixed annuals and perennials, small shrubs and fruit trees that are lending it toward a more sustainable nature. Here are some ways in which FH could continue to develop towards a food forest:

- 1) Use of more perennials vs annuals (e.g. flowers at bed's end, ramps/wild leeks, groundnut, sea kale, tree collards/kale, crosnes, Nine Star broccali, malabar spinach)
- 2) Integrating more dynamic accumulators that are not removed once a bed is planted
- 3) Mixing up the bed planting (e.g. not just a solid row of corn or kale)
- 4) Creating more layers in the garden
- 4) Research more about executing a food forest

A few simple examples of polyculture/food forest elements

Guild is a term applied to a grouping of plants that all benefit each other harmoniously.

Each species in a guild performs a specific function that is required for plant health - disease control, fertilizer production, pollination etc. If we leave plants out that perform these functions it is then up to the person to perform these tasks, reducing free time and costing money.

Three (or four) Sisters Guild



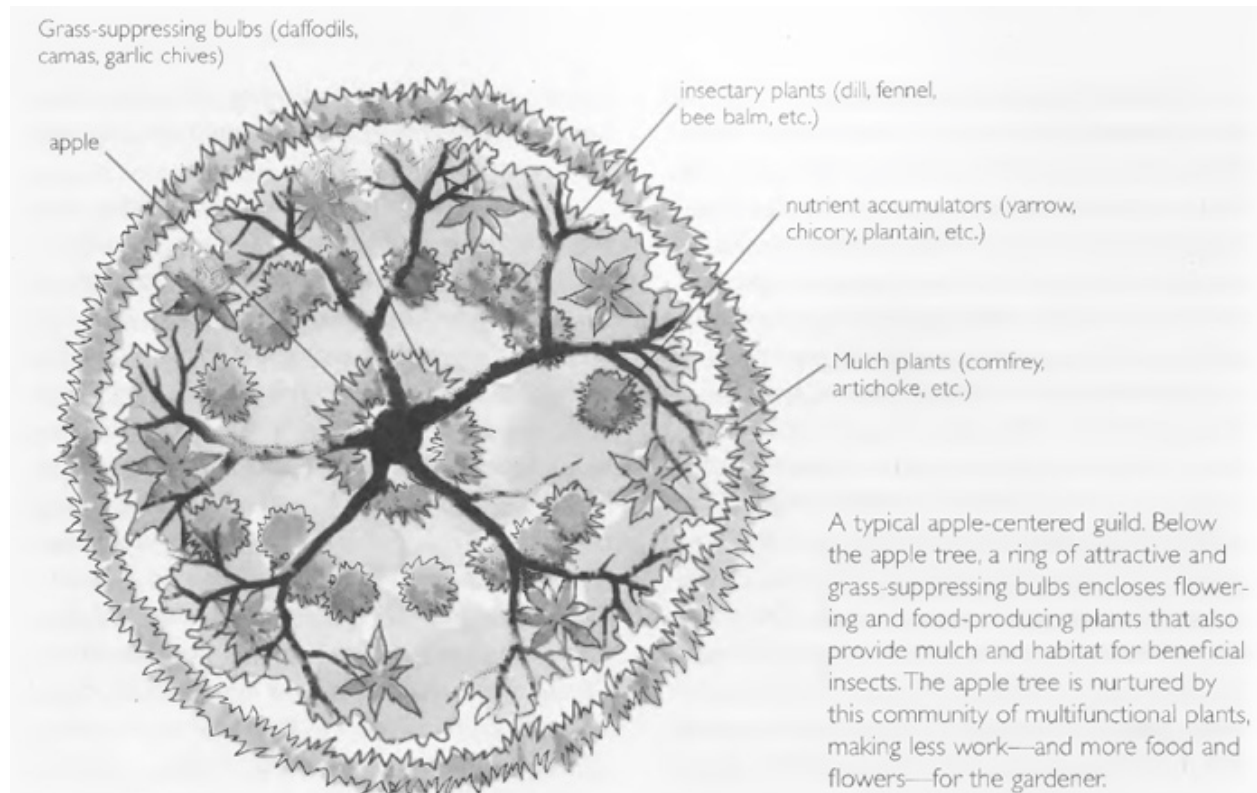
This guild is a good example of plants planted together that benefit each other in numerous ways. It consists of corn, beans and squash and bee plant (flower).

- The beans draw the nitrogen from the air and, via symbiotic bacteria, convert the nitrogen to the plant-available form, boosting growth for all of the plants.
- The cornstalks provide the trellis for the beans to climb
- The squash provides ground coverage keeping the soil cooler and moist and preventing weeds
- The bee plant attracts pollinators for all the plants in the guild.

An important aspect of this guild is actually the bee plant - it is this connection that ties the gardening aspect of this guild into the natural ecosystem; which is a very central goal of

working towards a food forest. The better the natural ecosystem, the more work mother nature will do for you.

Apple-Centered Guild



- In the center of this guild is an apple tree, though it could be applied to most any fruit tree
- Low growing grass suppressing bulbs grow beneath the canopy
- Insect and bird attracting plants (herbs, fennel) bring pollinators
- Plants such as yarrow and chicory are used to accumulate nutrients
- Plant such as clovers, alfalfa fix nitrogen

This guild, similar to the three (or four) sisters, combines a series of plants that support each other in specific ways - by luring beneficial insects for pollination, boosting soil fertility and tilth, reducing root competition, conserving water, balancing fungal populations to counter diseases, diversify the yield of food, creating habitat among other functions.

A guilds goal is to transform a solitary tree into a plant community that immensely lightens the human workload.

