Soil Management Manual

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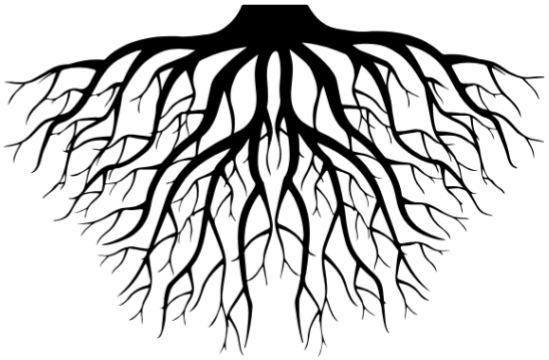
SOIL



Introduction:

Community Through Colors operates La Finca de Hamberto, a small-scale USDA-certified organic farm in Vieques, Puerto Rico, and educational project AVES (Apoyo en Vieques para la Educación y la Sostentabilidad). We are a proud member of the Vieques Agricultural Collective. Vieques is a historically underserved community with a majority Spanish-speaking population.

La Finca operates as a learning farm, hosting educational seminars, assisting others with at-home farming and livestock rearing, and preparing for natural disasters through food security. Currently, 99% of food on Vieques is brought from mainland Puerto Rico by ferry, which is routinely unreliable in bad weather. Furthermore, the few existing farms on Vieques currently face resource insecurity and climatic challenges, making the work we do here extremely important. Consequently, the farm is built primarily from recycled materials, including shipping pallets otherwise destined for the landfill. La Finca de Hamberto is home to goats, sheep, pigs, chickens, ducks, geese, rabbits, and, of course, dogs and cats. The farm also produces a variety of vegetables, herbs, and specialty goods, including arugula, mustard, bok choy, radish, basil, microgreens, goat cheese, soap, canned vegetables, pesto, tostones, and more.

The purpose of this guide is to provide useful information and farm processes for soil conservation and management we have developed at La Finca de Hamberto. This guide is intended to help the following farming populations: farmers in the Caribbean region; historically underrepresented/underserved farmers; socially disadvantaged farmers; and limited-resource farmers. ***NOTE: This document provides information on operations at Community Color's La Finca de Hamberto Farm and is not applicable to all farms or farming operations. Please feel free to use or adapt the information in this manual to best suit your needs.***

Safety:

Before starting a task or operating machinery, please be aware that without proper attire or preparation you may sustain injuries. We recommend the following at all times:

- Closed shoes (Work boots, Hiking boots, or Rubber boots)
- Protective clothing (Long pants, High socks, Long sleeve shirts etc.)
- Sun protection (Hats, Long sleeves, Sunscreen)
- Gloves while working with spiny/thorny vegetation or fencing materials

Note: This is just a recommendation, as we understand a preference for comfort, but you must be aware of the risks in not wearing protective attire during certain tasks. Please understand you may be denied from participating in a task due to improper attire. Our first priority is to avoid accidents and injury.

The following section outlines methods of identification, analysis, and health of soil. Maintaining healthy soil is essential for crop production. This is a living document and will be updated as needed to reflect the most current processes at La Finca de Hamberto.

COVER CROPPING

Cover cropping, or crop rotation, can improve soil health and fertility over time. It is important to choose crop varieties that complement primary crop production by restoring soil nutrients and maintaining soil organic matter. Note that some benefits of cover crops occur during the life of the crop and others Examples of cover crops and their purposes include:

Mustard (*brassicaceae)*: mustard may be used as a smother crop or a biofumigant crop. The broad leaves of the mustard outcompete other plants during its growth cycle and decomposition releases chemicals which deter pests

Radish (*brassicaceae)*: radish may be used as a catch crop. The taproot of radish breaks up the soil and takes up NPK, preventing nutrient runoff during erosion events.

Beans, clovers, and peas (*legume):* beans and peas may form a symbiotic relationship with microorganisms in the soil, increasing availability of soil nitrogen.

An example of a crop rotation is provided in the following chart.

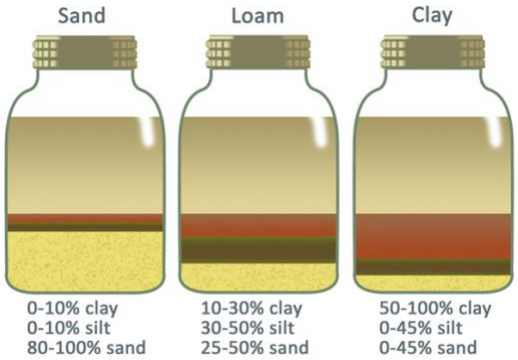
Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Garlic	Garlic	Garlic	Arugula	Arugula	Arugula	Beans	Arugula

SOIL TYPE

It is incredibly important to know soil type, since this will help identify what should be added to improve harvest. For example, sandy soils provide a lot of drainage, but hold no water or nutrients. Silt is very fine and compacts easily, making it good for water retention. Clay has a pH level suitable for some plants, but not all. Some plants prefer soils with high drainage (sand) whereas others do well in low drainage (clay). There is no bad soil, but some soils need more conditioning than others. Adding compost and organic material is a good way to condition any type of soil.

SOIL TESTING

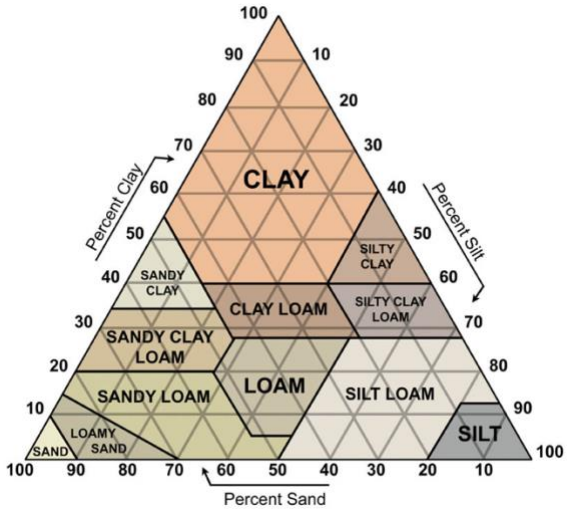
To test soil, place a sample in a clear container with water and let it set for a week. The separation of different materials along with the quantity of material in each layer can be used to determine soil type. Refer to the image for reference.
**If there are small branches, wood chips, and other black material floating on the very top, that is organic matter! Very good indication of healthy soil.



SOIL PYRAMID

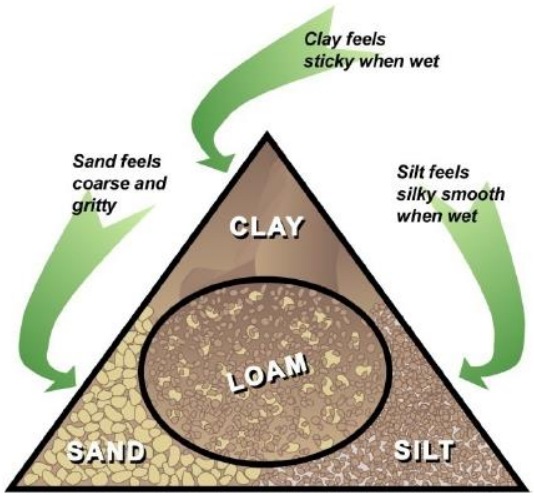
A soil pyramid can help you determine what type of soil you have and how to proceed. Refer to the diagram as you complete the following steps.

1. Start with the sand percentage and follow the diagonal line to the left until you hit a horizontal line that matches your clay percentage.
2. Once you find this spot it will automatically be on the spot where a diagonal line to the right hits a silt percentage. That is the amount of silt you have in your soil.
3. Where these three lines meet is the type of soil you most are most likely working with.



Clay soil: Clay soils are very fertile but can easily compact and do not provide proper drainage for most plants. Their compactness can be broken up by adding organic matter, as this breaks it down to crumbs, making nutrients more available to the plant roots. Breaking up the soil makes it easier to work with as well.

Sandy soils: These soils are almost always low in nutrients, and do a poor job of retaining water. You can promote water and nutrient retention by adding organic matter/compost. However, root vegetables might benefit from the excellent draining, and the lightness of this soil promotes better tuber growth, as the root doesn't have to compete with compacted soil.



Silt soils: These soils are made of very fine particles that compact easily. They clump, erode, and wash away easier than the other soils, However, these can be the most fertile soils. You can condition this soil for better drainage by adding organic matter.

Loams: This is the type of soil that everyone wants. A near perfect balance of all soil types. These soils will have a nice balance between good drainage, good water retention, and good fertility. Although not necessary, it's good to still add organic matter for nutrients and IMOs, especially if you plan on cultivating on these soils year after year.

ALTERNATIVE SUBSTRATES

Some plants prefer alternative substrates, such as vanilla. Vanilla has aerial roots and prefers to grow in a mixture of peat, sand, perlite, or bark. An acceptable substitute is a mixture of composted soil, leaves, and almácigo bark.

INDIGENOUS MICROORGANISMS

Indigenous Microorganisms (IMOs) may include types of fungi, bacteria, algae, protozoa, and more. These microorganisms provide soil structure and help with proper water retention and nutrient provision. For soils that have been exposed to the sun for lengthy periods of time or that lack proper balance, adding IMOs may be necessary prior to attempting to plant crops. Before starting, prepare the following:

- Collection box
    - Collection boxes should be approximately 10” x 5” x 8.5” with small holes on the sides and the bottom. The bottom should be made of slats, not of solid wood, also with holes
- Rice/substrate
    - Rice should be cooked al dente ~2:1 rice:water, in sufficient quantity to fill the box ½ to ⅔ with rice
- Healthy IMO collection site (somewhere with established IMOs)
    - The site should be home to diverse species and old trees. There should be visible IMOs in the soil. You can tell if there are IMOs if 1) you see white mycelium on leaves or sticks or 2) the organic matter is clumping together
- Paper towel, mesh cover, four screws, and screwdriver
    - Secure any breathable material to the top of the container
- Carbon, mulch, and carbohydrate sources (coffee husks, woodchips, and rice)
- Compost thermometer
- Grow liquid (required for IMO3)
- Protected grow location
    - An easily accessible location protected from rain and excess humidity

1. IMO1 (3 or 4 days to collect depending on temperature and humidity; shelf stable only a few hours)
    a. Fill box with rice ⅔ full, add a hyphae-covered clump of leaves or stick from the IMO collection site into the box on top of the rice
    b. Cover box with paper towel and mesh and secure with screws
    c. Place the box in a location with large, diverse, old trees, healthy plants, cool and damp but not wet

i. Bury the box halfway to cover all holes and cover with leaf or other rain protection

2. IMO2 (shelf stable a few months covered loosely; if dry → add water, if bubbling → add brown sugar)
    a. Wash hands with water or isopropyl alcohol-no soap or chlorine
    b. Weigh collection box filled with mycelium (white or colored, no slime) and combine with 1 mass brown sugar in a large bucket
        i. Seal losely, such as with an old breathable shirt. Do not label with sharpie directly on the top, as the grow will "breath" these chemicals
    c. Store in a dark, cool area, checking regularly to make sure it does not become too dry or too wet
3. IMO3 (5 to 7 days to grow out; finished when temperature drops, clumping, and hyphae are visible)
    a. Mix 1:2 carbohydrate/rice:carbon/coffee husks by mass and double with mulch by volume
        i. Do not use rice as a carbohydrate source if the grow is infested with weevils-this will encourage growth of organisms that kill bees
        ii. If necessary, grow liquid may be excluded but it is helpful to maintain warm temperature (dechlorinated water is ideal)
    b. Add grow liquid until moist but not dripping water (1L water)
        i. 1:500 fermented plant juice (2mL)
            1. Harvest a jucy plant, such as nopales or aloe vera, early in the morning for peak IMO activity. Ideally, the leaves are moist but if the plant is dry, perform a 24 hour presoak
            2. Cut leaves into thin strips and mix with equal weight of brown sugar in a large five gallon bucket no more than ⅔ full
                a. The sugar acts as a desiccant to bring out the plant juices, so brown sugar is preferred over white
            3. Cover the bucket with a breathable cloth; do not label with sharpie directly on top since the FPJ will "breath" in these chemicals
            4. Store in a dark, cool area, checking regularly to make sure it does not become too full or too dry
            5. Fermentation is complete when 1) the plant material floats and liquid settles 2) there is a light alcohol smell 3) the liquid is sweet, not bitter 4) there are bubbles on the top (~1 week)
            6. In one week, separate the liquid from solid. The liquid is FPJ and the solid can be fed to animals or added to compost
        ii. 1:500 living vinagre (2mL)
        iii. 1:1000 oriental herbal nutrient (1mL)

1. Angelica root (2x) + licorice root + garlic + ginger + fresh whole cinnamon bark
    a. Soak roots in beer for one day; smash garlic and ginger
    b. Add equal parts brown sugar to each individual component and leave to ferment for one week
    c. Add at least 35% alcohol/rum to cover
    d. Stir every day for two weeks, then extract one quarter of the component and add back an equal amount of rum (repeat 5x)
    e. By the fifth extraction, remove all liquid and mix components together

iv. 1:30 sea water (33nL)

v. 1:500 humic acids (2mL)

c. Keep between 110-116F
    i. If the pile becomes too hot, bacteria will take over and out compete fungi. To cool, lower the height. If the pile is too cold, growth will stagnate. To heat, add water or increase the height.

4. IMO4
    a. Mix with natural topsoil from garden at a ratio of 1:1 and allow to grow out
    b. Add to bed after tilling and before planting at a low concentration

MULCHING

Mulch consists of dry vegetative material that can be placed on the garden beds. This may include but is not limited to:

- Dry leaves or branches
- Coconut husk
- Palm tree fiber
- Shredded cardboard or paper
- Hay or dry grass (without seeds)
- Woodchips

Mulching is very important especially in the tropics to control weeds, pests, and help retain moisture. Mulch can be a deciding factor whether a crop survives the dry season or not. Mulching during the winter through spring, before our really hot days arrive, is very important to start conditioning and help retain moisture in the soil throughout the dry season. Another benefit of mulching is that the deeper the mulch layer, the cooler the ground can be, and when you are in a tropical climate you want to keep the plants as cool as possible. Finally, mulch provides a healthy environment for indigenous microorganisms to thrive and helps suppress weeds, enhancing the soil and providing key nutrients to the crops.

While you are mulching, make sure to place the mulch in a circle around the stem of the plant and not on the leaves A circle around the stem is left without mulch to avoid stem rot and for ease of watering, as a lot of mulch can accidentally redirect water flow away from the plant. If the plants are small, place a pot upside down on top of them to protect them from the mulch. Remove after mulching. It is also typically a good idea to put mulch on the designated garden area even without plants to maintain healthy soil.