

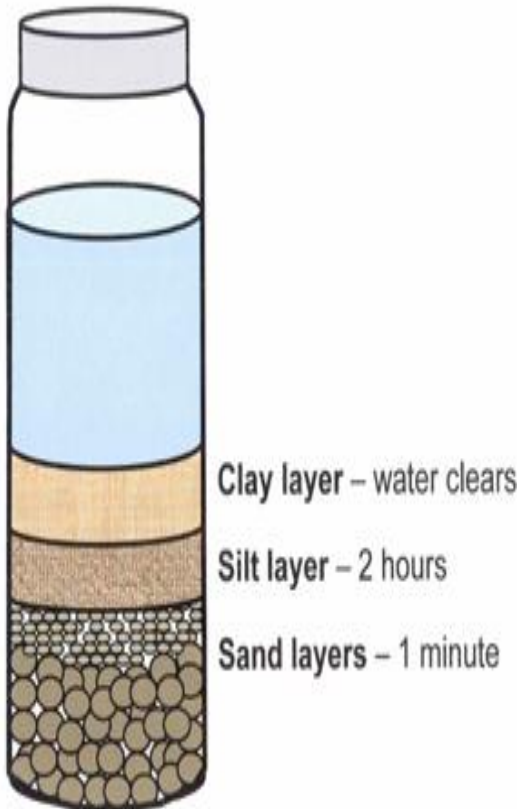
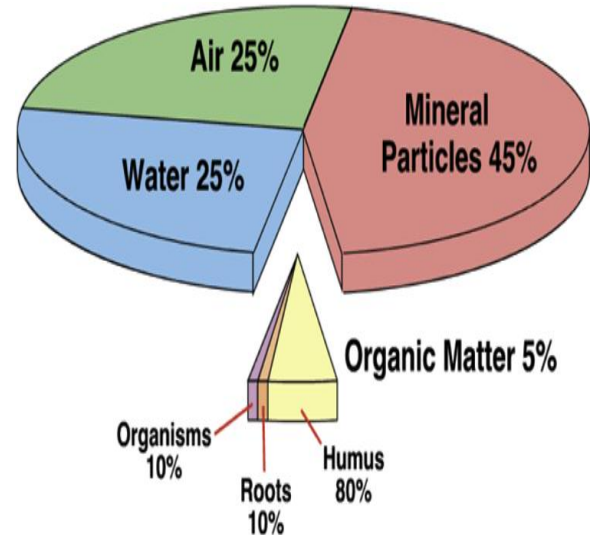


Soil Fertility and Plant Nutrition



USDA-SARE – Qualities of a Healthy Soil:

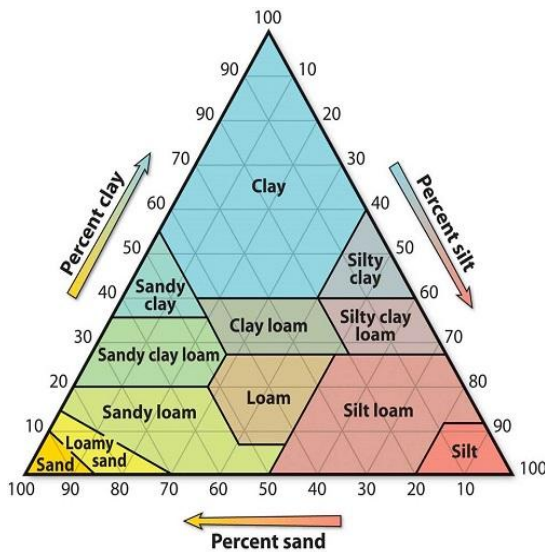
1. Accommodates active and diverse populations of beneficial organisms, with plant pest populations minimized by beneficials.
2. Contains high levels of relatively fresh residues that provide beneficials with food.
3. Includes high levels of decomposed organic matter, which help it retain both water and readily leachable nutrients.
4. Contains low levels of such toxic compounds as soluble aluminum and only low to moderate concentrations of salt.
5. Supports adequate levels of nutrients because excessive nutrients can make the crop more attractive to insect pests or can increase the threat of surface or subsurface water pollution.
6. Has a sufficiently porous surface, with many pores connected to subsoil to permit easy entry by rainfall or irrigation water.
7. Has good tilth that allows plant roots to easily penetrate large volumes of soil.



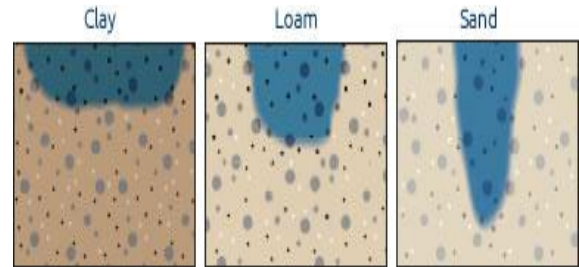
Estimating Soil Texture Using the Jar Test:

1. Spread soil on a newspaper to dry. Remove all rocks, trash, roots, etc. Crush lumps and clods.
2. Finely pulverize the soil.
3. Fill a tall, slender jar (like a quart canning jar) one-quarter full of soil.
4. Add water until the jar is three-quarters full
5. Add a teaspoon of non-foaming dishwasher detergent.
6. Put on a tight fitting lid and shake hard for 10 to 15 minutes. This shaking breaks apart the soil aggregates and separates the soil into individual mineral particles.
7. Set the jar where it will not be disturbed for 2-3 days.
8. Soil particles will settle out according to size. After 1 minute, mark on the jar the depth of the sand.
9. After 2 hours, mark on the jar the depth of the silt.
10. When the water clears mark on the jar the clay level. This typically takes 1 to 3 days, but some soils may take weeks.
11. Measure the thickness of the sand, silt, and clay layers.
 - a. Thickness of sand deposit ____
 - b. Thickness of silt deposit ____
 - c. Thickness of clay deposit ____
 - d. Thickness of total deposit ____
12. Calculate the percentage of sand, silt, and clay.
 - a. $[\text{clay thickness}] / \text{total thickness} = \text{___ percent clay}$
 - b. $[\text{silt thickness}] / \text{total thickness} = \text{___ percent clay}$
 - c. $[\text{sand thickness}] / [\text{total thickness}] = \text{___ percent sand}$
13. Turn to the soil texture triangle and look up the soil texture class.

Soil Texture Triangle:



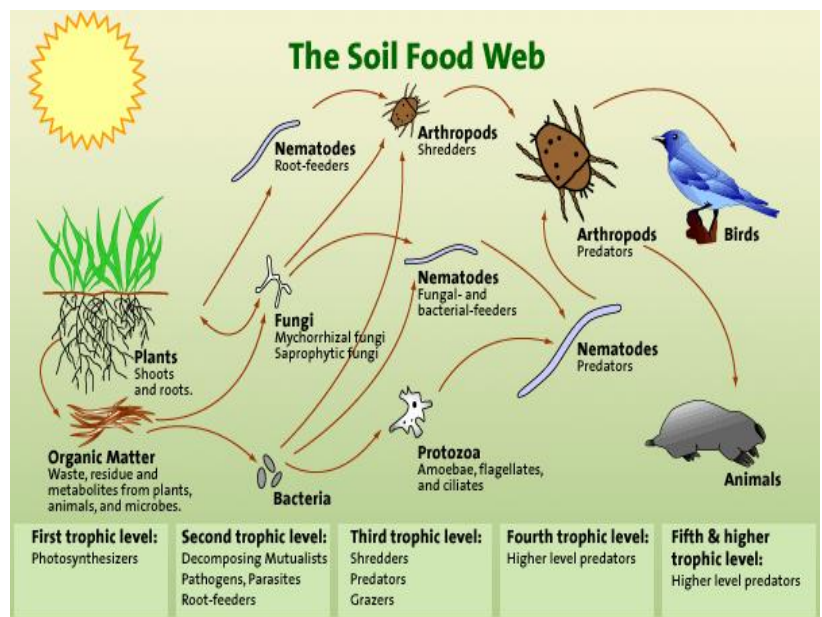
The *soil texture triangle* gives names associated with various combinations of sand, silt and clay. A *coarse-textured* or *sandy* soil is one comprised primarily of medium to coarse size sand particles. A *fine-textured* or *clayey* soil is one dominated by tiny clay particles. Due to the strong physical properties of clay, a soil with only 20% clay particles behaves as sticky, gummy clayey soil. The term *loam* refers to a soil with a combination of sand, silt, and clay sized particles. For example, a soil with 30% clay, 50% sand, and 20% silt is called a *sandy clay loam*.

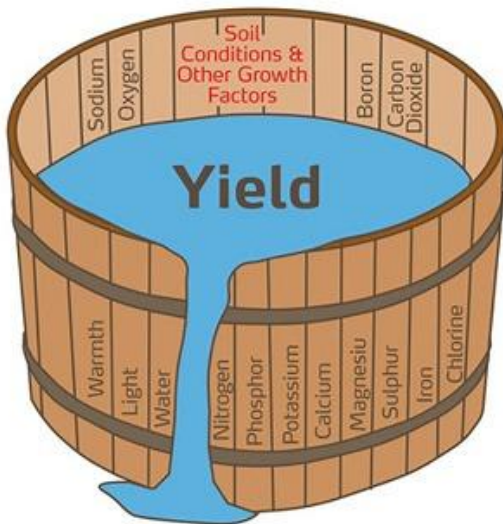


Soil Wetting Patterns

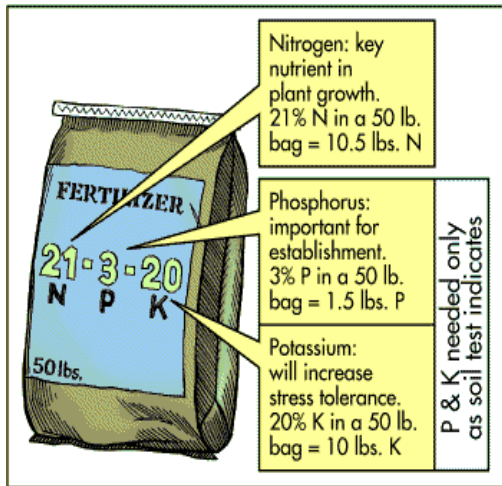
Soil Food Web Gardening Rules:

1. Some plants prefer soils dominated by fungi; others prefer soils dominated by bacteria
2. Most vegetables, annuals, and grasses prefer their nitrogen in nitrate form, and do best in bacterially dominated soils
3. Most trees, shrubs, and perennials prefer their nitrogen in ammonium form and do best in fungally dominated soils.
4. Compost can be used to inoculate beneficial microbes and life into soils around your yard and introduce, maintain, or alter the soil food web in a particular area.
5. Adding compost and its soil food web to the surface of the soil will inoculate the soil with the same soil food web.
6. Aged, brown organic materials support fungi; fresh green organic materials support bacteria.
7. Mulch laid on the surface tends to support fungi; mulch worked into the soil tends to support bacteria.
8. If you wet and grind mulch thoroughly, it speeds up bacterial colonization.
9. Coarse dryer mulches support fungal activity.
10. Sugars help bacteria multiply and grow; kelp, humic, and fulvic acids and phosphate rock dust help fungi grow.
11. By choosing the compost you begin with and what nutrients you add to it, you can make teas that are heavily fungal, bacterially dominated, or balanced.
12. Compost teas are very sensitive to chlorine and preservatives in the brewing water and ingredients.
13. Applications of synthetic fertilizers kill off most or all of the soil food web microbes.
14. Stay away from additives that have high NPK numbers.
15. Follow any chemical spraying or soil drenching with an application of compost tea.
16. Most conifers and hardwood trees (birch, oak, beech, hickory) form mycorrhizae with ectomycorrhizal fungi.
17. Most vegetables, annuals, grasses, shrubs, softwood trees, and perennials form mycorrhizae with endomycorrhizal fungi.
18. Rototilling and excessive soil disturbance destroy or severely damage the soil food web.
19. Always mix endomycorrhizal fungi with the seeds of annuals and vegetables at planting time or apply them to roots at transplanting time.





The Capacity of the Barrel represents plant yield, which is limited by the height of the shortest stave of the barrel.



N 7 Nitrogen	P 15 Phosphorus	K 19 Potassium	
Mg 12 Magnesium	S 16 Sulfur	Ca 20 Calcium	
B 5 Boron	Cl 17 Chlorine	Mn 25 Manganese	Fe 26 Iron
Ni 28 Nickel	Cu 29 Copper	Zn 30 Zinc	Mo 42 Molybdenum
H 1 Hydrogen	C 6 Carbon	O 8 Oxygen	

- Macronutrients
- Secondary Nutrients
- Micronutrients
- Non-Fertilizer Elements

Fertilizer	N-P-K	Cost Per Pound/Location	Yearly Application Rate 10 ft ²
Alfalfa Meal	2-1-3	\$.40 at OK Feed	2.5/lbs
Bat Guano	10-10-1	\$4.67 at Mesquite Valley	0.5/lbs
Bat Guano	0-5-0	\$3.25 at EcoGro	---
Blood Meal	12-0-0	\$2.33 at Mesquite Valley	0.40/lbs
Bone Meal	3-15-0	\$1.35 at Mesquite Valley	1.66/lbs
Cotton Seed Meal	6-4-1.5	\$.40 at OK Feed	.85/lbs
Fish Emulsion	2-4-1	\$5.00 at ARBICO Organics	2.5/lbs
Fish Meal	10-6-2	\$.83 at OK Feed	0.5/lbs
Kelp Meal	1-0-4	\$1.60 at OK Feed	5/lbs
Dr. Earth Home Grown	5-7-3	\$2.08 at EcoGro	1/lb
Dr. Earth Natural Wonder	7-4-2	\$2.08 at EcoGro	.70/lbs
Happy Frog All Purpose	5-5-5	\$2.25 at Eco Gro	1/lb
Happy Frog Fruit and Flower	5-8-4	\$3.00 at Mesquite Valley	1/lb

Compost Tea Recipes and Ingredients

Type of Plant	Type of Tea
Cabbage Family Plants	Highly Bacterial
Other Vegetables & Grasses	Moderately Bacterial
Berries and Shrubs	Balanced with Bacteria/Fungi
Deciduous Trees	Moderately Fungal
Coniferous Trees	Highly Fungal

Ingredient	What it Feeds
White Sugar	Bacteria
Molasses	Bacteria/Fungi
Corn syrup	Bacteria
Fruit Pulp	Bacteria/Fungi
Kelp	Bacteria/Fungi
Rock Dusts	Bacteria/Fungi
Humic Acid	Bacteria/Fungi
Maple Syrup	Bacteria
Cane Sugar	Bacteria
Fish Emulsion	Bacteria
Fish Hydrolysate	Fungi
Yucca Extract	Fungi
Ground Oatmeal	Fungi
Soybean Meal	Fungi

All Recipes for 5 Gallon Brewer

Balanced Compost Tea Recipe

- 1.5 pounds of balanced compost (equal parts bacterial to fungal biomass)
- 1.6 ounces of [humic acids](#)
- 1 ounce of [liquid kelp](#)*
- 1 ounce of soluble un sulphured black-strap molasses

*We've specified liquid kelp here, however, sometimes we like to add a tablespoon of kelp meal as well to provide surfaces for the fungi to attach too.

Bacterial-Dominated Compost Tea Recipe

- 1.5 pounds of bacterial-dominated compost (vermicastings work well)
- 2 ounces of cane sugar
- 1 ounce of [soluble kelp](#)

Bacteria love simple sugars, so feel free to add in a teaspoon of maple syrup, or even white sugar.

Fungal-Dominated Compost Tea Recipe

- 2 pounds of [fungal-dominated compost](#)
- 2 ounces [humic acids](#)
- 2 teaspoons of yucca extract*
- 1 ounce of liquid kelp
- 2 tablespoons of ground oatmeal

*We like to add yucca extract near the end of the brewing process, since it has a tendency to create a lot of foam. Also, you'll want to make sure your yucca doesn't have any preservatives, but does have a high saponin content.

Compost piles built using more "Green" or nitrogen rich material will be **Bacterially** dominated
 Compost piles built using more "Brown" or carbon rich material be **Fungally** dominated.