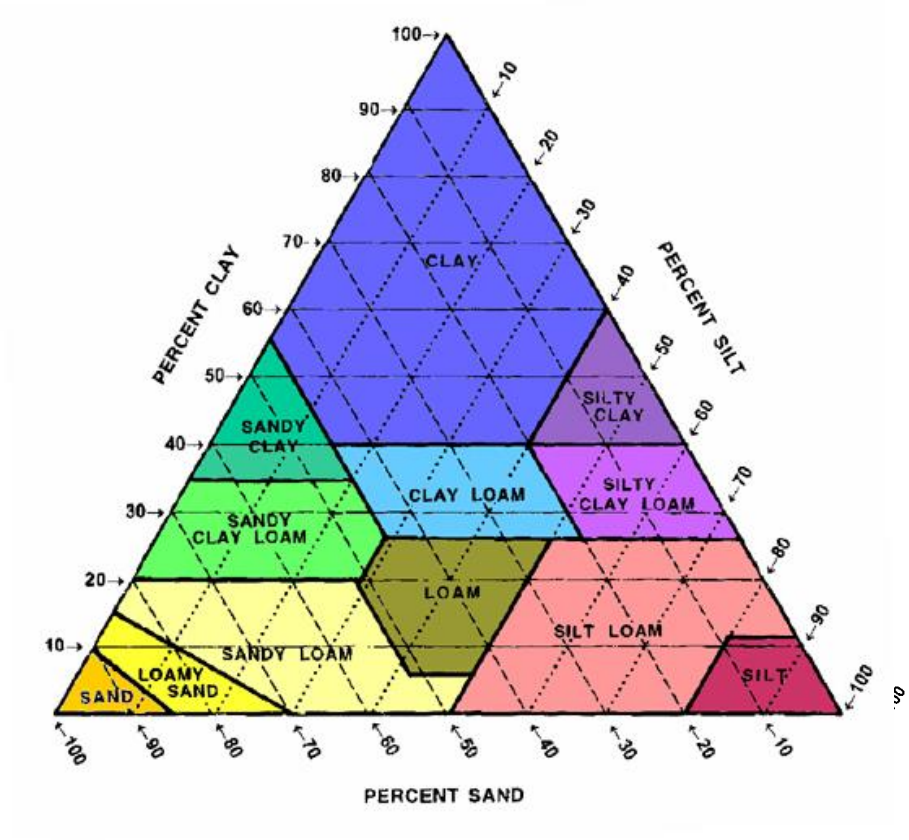
CHIP AND SOIL DAY

Garden Soil Improvement Tips

City Beautification Committee

Credits- Manitoba Agriculture,

Colorado State Master Gardiners Program



- A fine-textured or clayey soil is one dominated by tiny *clay* particles.
- A coarse-textured or sandy soil is one comprised primarily of medium to large size *sand* particles.
- loamy soil refers to a soil with a *combination* of sand, silt, and clay sized particles

Identifying Soil Texture by Measurement

Spread soil on a newspaper to dry. Remove all rocks, trash, roots, etc. Crush lumps and clods. Finely pulverize the soil.

Fill a tall, slender jar (like a quart canning jar) 1/4 full of soil.

Add water until the just is 3/4 full

Add a teaspoon of non-foaming dishwasher detergent.

Put on a tight fitting lid and shake hard for 10 to 15 minutes.

Set the jar where it will not be disturbed for 2-3 days. Soil particles will settle out according to size.

After 1 minute, mark on the jar the depth of the sand.
After 2 hours, mark on the jar the depth of the silt.
When the water clears mark on the jar the clay level (several days)

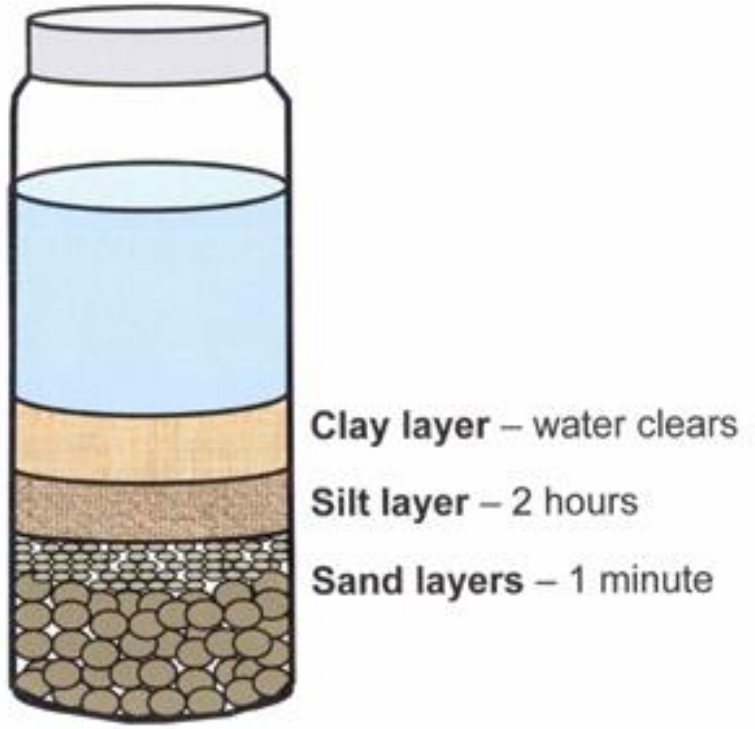
Measure the thickness of the sand, silt, and clay layers.

Thickness of sand deposit ____
Thickness of silt deposit ____
Thickness of clay deposit ____
Thickness of total deposit ____

Calculate the percentage of sand, silt, and clay.

[clay thickness] / total thickness] = ___ percent clay
[silt thickness] / total thickness] = ___ percent clay
[sand thickness] / [total thickness] = ___ percent sand

Turn to the soil texture triangle and look up the soil texture class.



Managing Soil Texture and Structure

- Routine applications of organic matter should be essential.
  - On coarse-textured sandy soil, water and nutrient holding capacity improves.
  - On a fine-textured clayey soil, over time the O.M. glues the tiny clay particles into larger chunks or aggregates creating large pore space. This improves water infiltration and drainage, air infiltration, and allows for deeper rooting depths (a larger supply of water and nutrients).

- Using organic soil amendments is a great way to turn leaves, grass, etc., into compost for improving soil tilth.

- Only a portion of the nutrients are available to plants in any one growing season. Soil microorganisms must process the organic compounds into chemical form before plants can use them.

- Cultivate or hand-turn the organic matter thoroughly into the soil. Never leave it in chunks as this will interfere with root growth and water movement.

Gardening on Coarse-Textured, Sandy Soils

- Major ***limitations*** of sandy soil
  - Low capacity to hold water and nutrients.
  - Plants need to be watered more frequently but with smaller quantities.
  - Water readily leaches below the root zone. Heavy watering is a waste.
  - Water-soluble nutrients, such as nitrogen, leach below the rooting zone with excessive watering or rain.

- The best ***management*** practice for sandy soils
  - routine applications of organic matter.
  - Organic matter holds 10 times or more water and nutrients than sand.
  - Sandy soils with high organic matter content (4-5%) make an ideal gardening soil.

Gardening on Fine-Textured, Clayey Soils

- *Limitations* of clayey soils
  - lack of large pores, thus restricts both water and air movement.
  - Soils easily waterlog when water cannot drain through the soil.
  - During watering or rain events, the limited large pore space quickly fills with water, reducing the roots' oxygen supply.

- The best ***management*** practice for clayey soils
  - Routine applications of organic matter
  - Nurture the activity of soil microorganisms and earthworms.
  - As soil microorganisms decompose the organic matter, the tiny soil particles bind together into larger clumps or aggregates, increasing large pore space.
  - This improvement takes place over a period of years. A single large application of organic matter does not do the trick.

Gardening on Fine-Textured, Clayey Soils

- The best ***management*** practice for clayey soils
  - soil conditions improve after a couple of years as the organic content reaches 2-3%.
  - As the organic content increases, earthworms and soil microorganisms become more active; and over time improves soil tilth.
  - The ideal soil for most gardens has 4-5% organic matter, and at this level, additional fertilizer will not be needed.
  - Take extra care to minimize soil compaction.
  - Soil compaction reduces the large pore space, restricting air and water movement through the soil, thus limiting root growth.
  - Soil compaction is the primary factor limiting plant growth in landscape soils and high activity areas.

When Soil Amendment Is Not Practical Or Possible.

- Understand that without soil improvement the gardener may need to accept less than optimum plant growth and increased maintenance.
- Select plants more tolerant of the soil conditions. This includes tolerance to low soil oxygen and reduced root spread (compaction issues), poor drainage (tolerance to wet soils), drought (tolerance to dry soils), and low fertility (fertilizer need).
- Space plants further apart to reduce competition for limited soil resources.
- Small transplants may adapt to poor soils better than either larger transplants or trying to grow plants from seed.

- Raised-bed gardening and container gardening may be a practical option when soils are poor.
- Pay attention to minimizing additional soil compaction with the use of organic mulches and management of foot traffic flow.
- Organic mulch (wood/bark chips) helps improve soil tilth over a period of time as the mulch decomposes and is worked into the soil by soil organisms. To allow this process to occur, add material periodically.

Summary of common practices that should be avoided to maximize soil tilth and plant growth potential.

- Avoid working the soil when wet – water lubricates soil particles, making the soil easier to compact.
- Avoid excessive fertilization – This has the potential for surface and ground water pollution and adds salts to the soil that can become toxic to plants. Heavy fertilization will not compensate for poor soil preparation. Many gardeners have over applied phosphate and potash.
- Avoid adding too much organic matter – This leads to salt build-up, large release of nitrogen, the build-up of excessive phosphorus, and an imbalance in potassium, calcium, magnesium, and iron.

Summary of common practices that should be avoided to maximize soil tilth and plant growth potential.

- Avoid adding lime or wood ashes – Being calcium sources, they are used to raise the pH on soils with a soil pH below 5.5.
- Avoid adding gypsum (a calcium source) – Gypsum is used to reclaim sodic soils by displacing the sodium with calcium.
- Avoid creating texture interfaces – when making a raised bed, adding a different soil in the box creates an interface at the change line. Use similar soils and mix the soils.
- Avoid trying to make dramatic changes in soil pH – If the soil is high in *free lime (calcium carbonate),* lowering the pH is not effective.

What About Adding Sand?

- Adding sand to a clayey soil may actually reduce large pore space until enough medium-to–coarse-size sand is added to reduce the clay content well below 20%. On clayey soils, this actually become a process of soil replacement rather than soil amendment.
- In some situations, adding sand to clayey soil can create concrete-like soil properties.
- To improve the soil, put efforts into adding organic matter, not sand.

Considerations in Selecting Soil Amendments

Need for fertilizer after amending
- Soil organic content

- *Precautions* with specific products
  - Salts (manure and biosolids)
  - Weed seeds (manure and compost)
  - Plant pathogens (compost)
  - Human pathogens (manure)

- *Alternatives* to amending
  - Potential to incorporate amendments
  - Accepting a reduction in plant growth and vigor
  - Accepting increased maintenance requirements
  - Selecting plants more tolerant of poor soils
  - Avoid crowding plants competing for limited soil resources
  - Mulching with organic mulch to slowly improve soil over time
  - Container and raised-bed gardening

Selecting Soil Amendments

Longevity of the product

- Products that decompose rapidly (like grass clippings and manure) give quick results.
- Products that decompose slowly (like wood chips, bark chips and peat) provide longer lasting results.
- For quick improvements that last, use a combination of materials.

Need for nitrogen fertilizer

- Soil microorganisms release nitrogen tied-up in organic matter over a period of time.
- Release rates from compost are very slow, over a period of years.
- The need for nitrogen fertilizer is based on the soil organic content.
- As the soil organic content increases, the need for fertilizer decreases.

Over Amending

Adding large quantities of amendment in a single season can result in following problems:

- High ammonia (burns roots and leaves)
- High salts
- High nitrogen
- Low nitrogen (from the tie-up of nitrogen due to a carbon to nitrogen ratio imbalance)
- Holding too much water

Continual application of high rates can result in the following problems:

- High salts
- Excessive nitrogen, phosphorus, and potassium
- Micronutrient imbalance
- Ground water contamination

Examples Of Soil Amendments

Worm Castings

- Red worm castings are the feces from compost worms.
- Castings can be applied as a top dressing, 1/4 inch deep, on potted plants, as 25% of a soil mix (1 to 4 mix) or tilled into a garden at 1 gallon per 13 square feet or 7.5 gallons (1 cubic foot) per 100 square feet. Generally used in small gardens or potting mixes.
- Very costly unless raise own worms.

Perlite and Vermiculite

- Perlite and vermiculite are common inorganic amendments used in potting soils and planter mixes.

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Garden Soil Composting Tips

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Compost Products

- Home made or commercial compost is a great source of organic matter for the garden. Compost provides a food source for beneficial soil organisms, enhancing the soil food web and releasing nutrients over the long term.

- A home compost bin is an environmentally sound method to convert yard wastes.

- Using compost has also been found to suppress some soil borne plant disease pathogens in special situations.

- Home compost has the advantage that the gardener controls what goes into the compost pile and can avoid weed seeds, diseased plants, and salt problems.

Application Rates and Salt Problems

General application rates for compost are based on the salt content of the compost and soil and on the depth to which it is cultivated into the soil. Ideally, cultivate the compost into the top six to eight inches of the soil.

Routine Application Rate for Soil Amendments

• Three cubic yards (67 bushels) covers 1,000 square feet approximately 1 inch deep.

• Cultivate compost into the top 6-8 inches of the soil. On compacted/clayey soils, anything less may result in a shallow rooting depth , poor growth, low vigor and low stress tolerance.

• Use this application for composts from plant materials (leaves, grass clippings, wood chips and other yard wastes). Also for other compost known, by soil test, to be low in salts.

•Use this application rate for any compost made with manure or biosolids unless the salt content is known, by soil test, to be low. Excessive salts are common in many commercially available products sold.

Site	Incorporation Depth	Depth Before Incorporation Plant Based Compost
One-time application	**6-8 in.**	**2-3 in.**
Annual application -first three years	**6-8 in.**	**2-3 in.**
Annual application -fourth year +	**6-8 in.**	**1-2 in.**

Nitrogen Release is Slow

- Typical nutrient content includes 1.5% to 3.5% nitrogen, 0.5% to 1% phosphate, and 1% to 2% potash, plus micronutrients. Compost is more of a soil conditioner than a fertilizer.
- In gardens where compost is routinely added, phosphorus and potassium levels are likely to be adequate.
- The nitrogen release rate from compost will be very slow, (i.e., over a period of years).
- When the organic content is below 4-5%, additional supplemental organic or manufactured nitrogen fertilizer may be needed.

  - **4-5% Organic Matter** – Soils with 4-5% organic matter from compost will mineralize (release to plants) about 0.2 pound of nitrogen per 100 square feet per year. This should be sufficient for plant nitrogen needs.
  - **2-3% Organic Matter** – Soils with 2-3% organic matter from compost will mineralize about 0.1 pound of nitrogen per 100 square feet per year. Additional nitrogen fertilizer will be needed for crops like broccoli, cabbage, and potatoes.
  - **<2% Organic Matter** – In soils with less than 2% organic matter, the release rate for nitrogen will be too low to adequately provide the nitrogen needed for crop growth. A supplemental organic or manufactured nitrogen fertilizer may be needed.

Weed Seeds and Diseased Plants

- It is best not to compost diseased plants or weeds loaded with seeds.
- All parts of the compost should reach 145ºF to kill weed seeds and plant disease pathogens.
- Because only the inner layers of the pile will reach this temperature, it is important that the outer layers are folded into the inner layers and the pile is allowed to reheat to 145ºF for at least 3 days.
- Livestock manure (horse, sheep, cow, swine, etc.) can also be a source of weed seeds in compost.
- Do not add cat, or dog feces to compost as this can attract nuisance animals and increase risk of disease transmission to humans.

Making Compost – A Review

What Items Should and Should Not be Composted?

Materials to use

- Leaves
- Garden debris free of diseases and weed seeds (i.e., carrot tops, chopped corn stalks, pea vines, spent flowers, etc.)
- Weed, free of seeds
- Kitchen scraps, **NO** meat, dairy, fats, and oils
- Shrub and tree pruning smaller than one-quarter inch in diameter
- Hay, straw, and other plant residues

Materials to avoid

- Weeds with seeds; seed may not be killed if compost piles does not heat to 145˚F.
- Diseased plants, including tomato and potato vines and potato peelings.
- Tree branches great than quarter inch in diameter; large sizes should be run through a chipper first, as they will be very slow to decompose.
- Meat and dairy products, slows decomposition and attracts pests
- Fats, oils, and grease, slows decomposition and attracts pests
- Kitchen scrapes with meat, dairy, fats, oils, or grease
- Pet or human feces, may transmit diseases
- Synthetic or plastic fiber, does not decompose
- Wood ash and lime, drive up the pH of the soil

- Large amounts of grass clippings – Due the small particle size and high nitrogen, they tend to smell unless mixed with brown materials. Rather recycle the nutrients back to the grass by not bagging.
- Manure – Manures may contain strains of *Escherichia coli and other bacteria that cause human illness. If manure is composted for food gardens, a four month curing process following composting is necessary to reduce pathogens.*
- Large amounts of plants/weeds treated with pesticides (herbicides, insecticides, and fungicides) – Most pesticides readily break down in the composting process and present no threat as long the decomposition process had been completed.
- Large amounts of high tannin-containing leaves (oak and cottonwood) - slow to decompose, but can be used in small quantities if chopped well and mixed with other materials.

Materials to use in limitation

- Large amounts of juniper, pine, spruce, and arborvitae pruning – Resins protect these materials from decomposition and extend the time needed for composting in comparison with other plant materials.
- Large amounts of paper products – Newsprint is best recycled through recycling collection operations rather than converted to compost. If paper is composted due to a shortage of dry materials, add no more than 10 % of the total weight of the material being composted.
- Large amounts of soil - Large amounts of soil increase weight, decrease oxygen infiltration, and can suffocate microorganisms. Soil-less composting is often practiced.

Using Manure

In some areas, manure is readily available as a source of organic matter to build soils and add small amounts of nutrients.

Some precautions:

- Due to the potential of transmitting human pathogens, such as E. coli, fresh manure should not be used on fruits and vegetables.
- On edible crops with soil contact (like carrots, beets, potatoes) fresh manure applications should be made at least four months prior to harvest.
- On other edible crops, fresh manure applications should be made at least three months prior to harvest. Put simply, apply fresh manure only in the fall; but not in the spring or during the growing season.

- The nutrient composition of farm manure varies widely.
- Where manure is routinely added, garden soils will likely have adequate phosphorus and potassium. Manure is a great source of micronutrients like zinc.
- The nitrogen in manure is not all available the first year. Nitrogen becomes available to plants when soil microorganisms ***mineralize*** organic compounds.
- Continual and/or heavy applications of manure can lead to a salt build-up.
- Potential burning of roots and foliage from high ammonia.
- High potential for weed seeds.
- Labor and transportation necessary to apply the manure to the garden.