

Preparing and Improving Garden Soil

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Knowledgeable gardeners know that a great garden starts with quality garden soil. Utah has unique garden soil quality challenges. Native Utah soils are relatively low in organic matter content compared with areas of the country that receive more rainfall. Furthermore the pH of Utah soils averages 8.0, which is ten times more alkaline than a neutral pH of 7.

Alkaline soils cause certain micronutrients to become less available leading to nutrient deficiencies in garden plants. Iron chlorosis is a deficiency of plant available iron and is one of Utah's most troublesome nutrient deficiencies. Iron chlorosis is greatly affected by soil pH. Despite these challenges, time and organic matter can transform most garden soils from brutal to beautiful!



Organic matter ready to be mixed into the garden.

Organic Matter

Organic matter is the best amendment for any soil type. It increases soil moisture retention, improves soil structure and decreases soil compaction. It also improves soil drainage and soil tilth and makes some soil-supplied nutrients more available. Even if these terms are not familiar they are important garden soil improvements.

Organic matter provides essential nutrients and also provides food and habitat to many soil macro- and micro-organisms. This soil flora and fauna creates important soil quality benefits such as improved aeration and soil structure. Hence, organic matter is often referred to as "black gold." Many Utah soils have poor soil structure. Soil structure is the aggregation of the mineral portion of the soil with organic matter. Adding organic matter helps form secondary particles that allow air and water movement into the soil. In addition to improved aeration, good structure improves the tilth or workability of the soil which ultimately improves plant growth.

Types of Organic Matter

Sometimes gardeners are confused by differences between types of organic matter. What differentiates compost from mulch? Organic matter is an umbrella term that describes once-living sources of carbon containing materials. This broad term of organic matter can describe kitchen scraps, leaves, wood, manure, grass clippings or even



Mulch applied to the soil surface can help retain moisture for plant roots.

paper. Compost is organic material that has decomposed to a state where the original parent material is no longer recognizable. It looks and smells like rich garden soil and is typically incorporated to improve soil quality.

Mulch is material that is applied to the soil surface to smother out weeds, protect trees and shrubs, reduce evaporation or beautify the landscape. It is usually not fully decomposed. The names mulch and compost are often used interchangeably but there are differences. Do not be confused by differences in names as all organic matter improves garden soil. Not all mulches or amendments are organic; some inorganic mulch options include rocks or glass. Inorganic amendments include perlite, pumice, vermiculite, Utelite and other products. These products improve the drainage and aeration of garden mixes.

Many gardeners think that the addition of amendments will also take care of the fertilizer needs. Amendments improve the physical properties of the soil but usually do not supply adequate plant nutrition.



Compost is mixed into the soil and improves many soil qualities.

Soil Testing

It is important to have soil tested before incorporating amendments that are high in nutrients such as phosphorus (P) and potassium (K). Some organic matter sources (including animal manures like bat guano) are naturally high in certain nutrients. Over-application of soil nutrients, especially nitrogen and phosphorus, may contaminate nearby water sources including lakes and streams or leach into groundwater. For more information on the impacts of nutrient loading on surface water supplies, access 'Understanding Your Watershed'

<https://extension.usu.edu/waterquality/htm/watershedinformation/uyw/>.



An overload of nutrients can have a harmful effect on water quality.

Organic Matter Sources and Approximate Nutrient Analysis

Organic Matter Source	% Nitrogen (N)	% Phosphorus (P)	% Potassium (K)
Compost (Kitchen Scraps)	1-3	1-2	1-2
Grass Clippings	1-2	0-0.5	1-2
Leaves	1	0-0.5	0-0.5
Legumes	2-4	0-0.5	2-3
Cattle Manure	2-3	0.5-1	1-2
Horse Manure	1-2	0.5-1	1-2
Swine Manure	2-3	0.5-1	1-2
Poultry Manure	3-4	1-2	1-2
Sheep Manure	3-4	0.5-1	2-3
Bat Guano	3	10	1
Pine Needles	0.5	0	1
Sawdust	0-1	0-0.5	0-1

*Referenced from “Selecting and Using Organic Fertilizers”

<http://extension.usu.edu/files/publications/factsheet/HG-510.pdf>.

Soil can be inexpensively tested through the USUAL soil testing laboratory at Utah State University. Visit www.usual.usu.edu for more information and pricing of soil testing. The following table lists several kinds of organic matter and their approximate nutrient analysis.

Avoid using dog, cat or other manure from other meat-eating animals because, unless they are hot composted, these materials carry some risk of pathogen spread to humans.

Sewage Sludge

Sewage sludge (bio solids) is being used more frequently as a soil amendment. Sewage sludge is a by-product of treated wastewater and contains organic matter in addition to some contaminants and pathogens. To address these risks, the USEPA adopted regulations in 1993 that set minimum standards for concentration limits of nine metals and pathogens for land applied sewage sludge. Multiple studies have been performed to assess the risks and benefits of using sewage sludge in the garden. For more information on sewage sludge, access the Cornell Waste Management Institute http://cwmi.css.cornell.edu/sewagesludge.htm#health_safety.

Amending Garden Soil

One common mistake gardeners make when amending garden soil is to expect immediate results. Garden soil quality improves over time. Incorporating 2 to 3 inches of organic matter into the soil annually will gradually improve soil quality. Organic matter can be incorporated in the spring or fall but only incorporate it when the soil is not wet. Tilling wet soil creates compaction and hard pan formation in clay soils.



Leaves are an excellent and inexpensive form of organic matter.

Avoid amending clay with sand. Organic matter is preferable to sand as a soil amendment.

Incorporating Organic Matter

Organic matter is incorporated into garden soil several ways. These include rotary tillers or other mechanical implements. Double-digging describes soil that is dug from an area of the garden, mixed with organic matter and returned to the same area. Annual replenishment is critical because Utah soils are constantly losing organic matter. How much organic matter is needed? Whatever you can afford! One inch per year prevents a net loss but 2 to 4 inches is preferred because it helps build your soil. Homemade compost from garden waste will not create problems if it is incorporated into the soil. Do not exceed 2 to 3 inches when adding manure-based amendments in order to avoid salt problems.

Adding materials that are not fully decomposed including leaves, sawdust, wood shavings or straw often ties up soil nitrogen. Avoid nitrogen deficiency (stunted, pale yellow plants) by adding one pound (1 pt) of ammonium sulfate (21-0-0) per each 1 inch of organic material per 100 square feet.

Some gardeners choose to avoid digging and spread the organic matter on the soil to slowly decompose and incorporate into the soil. This method takes longer, but is an acceptable option for the patient gardener.

Cover crops are an alternative way to increase soil organic matter. Treat cover crops with an appropriate herbicide or mow them down before incorporating them in the soil. Cover crops can be incorporated by tilling them under or burning green weeds with propane weed burner before planting. Flame torching the cover crop may not destroy the root system and plants might grow back. Check local restrictions on open flame use prior to weed burning. Flame torching may be illegal or present a severe fire hazard in some Utah counties and areas. Hand pulling cover crops is an alternative option to chemical and flame control. For more information on cover crops, reference "Cover Crops for Utah Gardens"
<http://extension.usu.edu/files/publications/publication/HG-521.pdf>.



Cover crops are a good way to add nutrients to the soil.

Sources of Organic Amendments

There are several sources of organic amendments including many inexpensive and free options! Mulched leaves are a wonderful source of organic matter. They are free, abundant and usually weed free. Mulch grass clippings on the lawn as clippings provide nutrients and do not contribute to thatch build-up. Homemade compost from kitchen scraps is a wonderful amendment option that is usually low in salts. Wood chips can be purchased or collected from tree care companies. Compost can be purchased from local garden centers, landfills or companies that specialize in compost products.

Never add lime to Utah soils and add gypsum only when trying to reclaim a sodic soil which is a soil with excess sodium ions. Sodic soils are not common in urban areas and do not grow productive gardens. Soil testing is the only way to verify sodic soils and quantify the amount of gypsum to add. For more information on treating soil problems, reference the following fact sheets.

Solutions to Soil Problems, I. High Salinity:

http://extension.usu.edu/files/publications/publication/AG_Soils_2003-01.pdf

Solutions to Soil Problems, II. High pH:

http://extension.usu.edu/files/publications/publication/AG_Soils_2003-02.pdf

Solutions to Soil Problems, III. Drainage:

http://extension.usu.edu/files/publications/publication/AG_Soils_2003-03.pdf

Solutions to Soil Problems, IV. Soil structure (compaction):

http://extension.usu.edu/files/publications/publication/AG_Soils_2003-04.pdf

Solutions to Soil Problems, V. Low Organic Matter:
http://extension.usu.edu/files/publications/publication/AG_Soils_2003-05.pdf

Resources

Koenig, R., and M. Johnson. 2011. Selecting and Using Organic Fertilizers. Online at <http://extension.usu.edu/files/publications/factsheet/HG-510.pdf>.

Card, A., Whiting, D., Wilson, C. and J. Reeder. 2011. Organic Fertilizers. Online at <http://cmg.colostate.edu/gardennotes/234.pdf>.

USU Extension Weber County Extension Service. Preparing & Improving Garden Soil. Online at http://extension.usu.edu/files/publications/factsheet/pub_8066784.pdf.

Hatch, D. 1990. Preparing Garden Soil. Online at http://extension.usu.edu/files/publications/factsheet/HG_H_01.pdf.

Sagers, Larry, "Fall is a good time to improve garden soil for next season" Quote from Grant Cardon. Deseret News, Nov. 6, 2011.

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