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Soil Amendments in Landscape Plantings

It has been said that all human life depends on six inches of topsoil -- the top half-foot of soil where most roots grow, and most water and nutrients are taken up by the food crops and ornamental plants we cultivate.

Many common landscaping practices, from driving heavy equipment over construction sites to the over-tilling of fields, contribute to the destruction of healthy soils. In fact, the poor performance of landscape plants can be traced to poor soils more often than to any other single factor.

Once a landscaper or homeowner has determined that a particular soil is compacted, poorly structured, badly drained, or infertile, he or she ordinarily wants to know what can be done to improve the soil. This is where soil amendments, or added materials, come into the picture.

Benefits of Amendments:
Depending upon the type of soil and its condition, different amendments can help to overcome a number of limitations.

In sandy or gravelly soils, for example, organic matter can increase the soil's water-holding capacity -- the amount of water that can be held and released for root uptake. Water-holding capacity can also possibly be increased by amending soil with a hydrogel, a compound of polymer crystals that swells with water that is released to roots as needed.

Soil structure refers to the arrangement of primary soil particles into other units. Organic matter promotes good structure by helping a clay soil's ability to form *aggregates,* the granules made up of many individual particles. The more aggregated a soil is, the better its drainage and aeration characteristics *(tilth).* The larger pores created in a well-aggregated soil make the soil more *friable,* or easier to work, and allow roots to grow more freely.

While the formation of soil aggregates is a slow process, aggregation can be quickly destroyed by compacting the soil. Soils with a high sand content do not aggregate well in response to additions of organic matter.

In some cases, water drainage in a heavy clay soil can be improved by amending with large-particle mineral materials, such as sand, perlite, or vermiculite to improve the *texture,* or relative proportions of sand, silt, and clay particles. But, as explained later, very large quantities must be added to positively affect soil texture.

As organic amendments decompose, they can add nitrogen, phosphorus, potassium, and other valuable nutrients to the soil. Although the quantities of these released nutrients are not great, their contribution can complement a regular fertilization program.

Characteristics of Principal Soil Amendments:
There are three principal families of amendments: organic, such as compost and manure; mineral, including sand, perlite, vermiculite, and Turface® and synthetic hydrogels. The particular amendment(s) chosen depends on the type of soil, the planting situation, the plants that will be grown, and your budget.

Compost — Thoroughly decomposed compost can be of great benefit to a soil. In addition to the attributes described for organic amendments, compost has also been shown in recent research to suppress several soil-borne diseases on crops such as turfgrass, vegetables, and apples.

Materials appropriate for composting include all forms of yard waste (other than sticks and brush); kitchen scraps other than meat; lawn clippings not treated with herbicides; paper; and wood ashes.

It is critically important that compost be fully decomposed before it is used. Depending upon such factors as size and type of raw materials, moisture, aeration, and microorganisms, this process may take from one month to more than a year. Finished compost is not hot to the touch, has a uniform texture and color and a mild aroma. Compost that has a foul smell like rotten eggs, ammonia, or vinegar probably has decomposed *anaerobically,* or without sufficient oxygen. Products of anaerobic decomposition include hydrogen sulfide (which causes the rotten odor) as well as certain acids and alcohols harmful to plants. To leach out harmful by-products, anaerobically-decomposed compost should be turned and spread out in a thin pile for several months.

Many municipalities now have central composting facilities, from which finished compost is available to be trucked away. For more information on home composting, see NRAES43, *Composting to Reduce the Waste Stream.*

Manure — Manures from horses, cows, sheep and chickens can be used as organic amendments if they are first aged well. Fresh manures are objectionable to handle, may be so high in soluble nitrogen that they burn tender plants, and may have high concentrations of weed seeds. After one year of composting and turning, a manure pile should be ready for use. Even then there may be hard lumps that should be screened before the manure is incorporated into a soil.

Manures are often available from farmers for a nominal delivery fee. Manure will increase the bacterial and fungal activity of soils, making nutrients more available to plants.

Peat Moss — Peat moss has been the most widely available and heavily used organic amendment for landscape use for many years. Mined from North American and European peat bogs, peat moss is normally sold in a shredded or milled, un-decomposed state.

A peculiar characteristic of dry peat moss is the very high surface tension on its individual strands, making them difficult to wet. This problem can be eased by adding a commercial wetting agent or a small quantity of powdered (non-phosphate) laundry detergent to the peat moss before incorporating into the soil. Once wetted, peat moss holds onto water very strongly and, because of this sponge-like quality, we recommend caution when using it as a backfill amendment in tree or shrub planting holes. During times of heavy rainfall or excess irrigation, the peat moss can absorb so much water that the planting hold becomes a bathtub, drowning the plant roots. Conversely, under dry soil conditions peat may dry out and be unable to absorb water from the surrounding soil.

The water-repelling or retaining characteristics of peat moss are not as much of a consideration in the preparation of garden beds. Plan to add 25% (by volume) of peat moss before tilling garden beds.

Peat moss is readily available from garden supply stores. Unlike compost and manure, it is a fairly uniform product for incorporating into soils.

Peat-humus — This highly decomposed form of peat is dark brown to black and an excellent soil conditioner. It promotes particle aggregation, improves drainage, and provides some nitrogen. It is not spongy like peat moss, and has much lower water-holding capacity.

Peat humus is available in packaged form from garden suppliers. It is considerably more expensive per unit volume than peat moss.

Sand — Sand can improve soil texture by creating larger pores in heavy clay soils, but very large quantities of coarse sand are required to make a positive change. In fact, not until sand is 45% of the volume will a soil begin to have some of the properties, such as improved drainage, associated with sandy soils. In lesser quantities, the sand particles will actually fill existing pores, making drainage poorer than it was previously.

Obviously, amending with sand is an option only in very localized situations. For example, to plant particular alpine rock garden plants, one might first displace the existing soil from planting holes and replace it with a mix of 2/3 washed coarse silica sand and 1/3 native soil.

Vermiculite and Perlite — Vermiculite is derived from a mica-like mineral that is heat treated to form flakes 20 times their original thickness. Perlite is a granite-like volcanic material, crushed and heat treated to pop into white, hardened particles.

These materials are valuable amendments in synthetic or soil-less mixes used in greenhouse bedding plant or houseplant production. In a garden, however, these materials lack sufficient mechanical strength. As the particles are crushed by the weight of the soil and surface traffic, drainage is impeded rather than enhanced.

Calcined clay (Turface®) — Calcined clay is a rigid, odorless mineral that resembles cat litter. Extensively used on golf greens to improve drainage, it can also be incorporated into soils. Some succulents and alpines that require excellent water drainage can be grown more successfully if one part Turface® is added to two parts native soil.

If incorporated in large enough quantities, the calcined clay particles can keep a soil loose and aerated and produce a deep, sturdy, and healthy root structure.

Hydrophilic polymers (hydrogels) — Hydrogels are hard, crystal-like polymers which, when they come in contact with water, absorb it and expand. In theory, this absorbed water is then slowly made available to plant roots to prevent or delay water stress.

The time required to reach full expansion of a hydrogel may be as little as 30 minutes for some types or more than six hours for others. Individual particles will absorb between 60 and 400 times their dry weight in water, again depending on the specific type.

The first generation of hydrogels were marketed in the early 1970s. As starch-based products, their usefulness was limited by a susceptibility to rapid decomposition by enzymes and bacteria in the soil as well as ultraviolet light. This led to costly and time consuming repeat applications. Later refinements resulted in a second generation of polymers of newer materials claimed to have improved absorption rates in both pure and impure water and a more consistent water-release rate.

There are three main chemical families among the hydrogels available today: starch copolymers, polyvinyl alcohols, and polyacrylamides. Manufacturers recommend that hydrogels be incorporated into growing media, containers and baskets, tree and shrub planting holes, and hydroseed mixtures, and that bare-root nursery stock be dipped in a hydrogel slurry. In all cases, the hydrogel should increase water availability to the plant and either reduce the frequency of irrigating or increase the chance of plant survival.

A growing number of research reports have shown that when hydrogels absorb fertilizer salts such as iron (Fe2, magnesium *[Mg],* or calcium [Ca2]), they break down and lose their structure. In soil, this breakdown results in decreased pore space and insufficient air to the roots. In other words, the hydrogel becomes a slimy mass in the soil that fills the pore spaces and suffocates the roots — conditions worse for the plants than if no hydrogel had been incorporated. One exception to this general problem could be in the use of hydrogel slurries for bare-root dips. In this use, the hydrogel increases the short-term availability of water to the roots. Early studies showed that they may increase plant survival rates by 20%.

A second specialty use for hydrogels is in hydroseeding slurries. In such mixtures, grass seed, straw (or other bulking agent), fertilizer, and water are kept in suspension for spraying onto sites to be seeded. The hydrogel may provide improved seed-to-water contact until germination occurs.

For other uses, where the hydrogel is incorporated directly into the soil or a growing medium, caution is advised. If you plan to try one of the hydrogels currently on the market, you will probably increase their usefulness by using only slow-release fertilizers and irrigation water low in soluble salts, but this frequently is not possible. The first two generations of hydrogel products have their shortcomings; now we just have to wait for further improvements.

Using Amendments in Landscape Plantings:

Garden Bed Preparation — Ideally, amending garden beds should be done before any plants are installed. The material can be spread on the soil surface and then tilled into the top 6-8 inches.

To amend planted beds, one approach is to localize the amending to particular plants as described for sand or Turface®. Alternately, organic matter can be spread over the surface and worked into the top couple of inches of soil. Be careful not to disturb roots of existing plants.

Green manures or cover crops are grown solely to till back into the soil. The benefits of this practice include improvement of the physical structure of the soil, an increase in organic matter content, and higher soil fertility. Clover, alfalfa, and ryegrass are commonly grown as green manures.

Tree or Shrub Planting — When the soil dug from a tree or shrub planting hole has adequate structure and drainage, there is no need to amend the backfill when completing the planting. If the native soil is heavily compacted and drains poorly, however, several solutions are possible.

One approach is to create a raised bed consisting of equal parts of soil, coarse sand, and organic matter.

A second method of improving drainage is to dig a wide planting hole with a depth equal to the root ball or root mass. Backfill this wide area with the same mixture described for raised beds. If neither alternative is possible, consider selecting a different planting site with better drainage, or select a plant that will tolerate the wet conditions.

Topdressing Lawns — Organic matter, especially finely milled compost or peat humus, can be used to topdress lawns before seeding, when spot seeding, or to simply improve the thickness and quality of the turf. To produce a fine-particled, uniform compost, select a pile that has completely decomposed and run it through a 1 inch wire-mesh screen. Spread the peat humus or compost with a drop or rotary spreader set at the widest opening.

Summary: Plants that have germinated and grown in native soils do not have a need for soil amendments. Most plants grown in ornamental landscapes, however, are far from their native conditions and would benefit from amendments that increase aeration or water-holding capacity in the soil, and improve soil structure or the availability of nutrients.

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