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Agriculture and Natural Resources | UC Master Gardener Program

Using Soil Amendments in Yolo County Gardens

Defining Soil Amendments

A soil amendment is a material that can improve soil physically or chemically, making it more suitable for plant growth. Fertilizers are materials that contain useful amounts (as defined by state regulation) of one or more plant nutrients. There is some overlap between these two categories. Some soil amendments – gypsum and chicken manure are two examples – contain plant nutrients and may even be registered with the state as fertilizers. Other soil amendments – wood chips, peat, sand, and vermiculite, for example – do not contain significant levels of plant nutrients or do not contain them in plant-available forms.

Amendments, including those that improve soil physical properties, may work by chemical, biological, and physical modes of action. Lime and elemental sulfur used to modify soil pH are amendments but do not affect soil physical properties. For example, gypsum acts chemically by supplying calcium (a "goodsalt"), which helps counteract the harm that excessive sodium (a "bad salt") can cause to soil physical structure.Compost and other organic materials improve soil physical structure by two distinct mechanisms – by stimulating microbial activity, which helps with soil aggregate formation, and, at high application rates, by directly decreasing soil density.

Choosing the Right Soil Amendment

The most common major soil limitations for gardening in the western part of the Sacramento Valley are thefollowing: (1) high clay content "rice soils" that drain slowly and are poorly aerated when wet and concrete- like when dry, (2) sandy loam or loam soils with low humus content that tend to be droughty due to low water holding capacity (if easy to till), (3) alkaline soils with high sodium levels, (4) shallow soils with very dense subsoil layers, and (5) soils with moderately high or high boron levels. Soil amendments properly used can help address the first four of these situations – see Table 1. The jury is still out on using amendments to help with excess boron.

Mulch consists of organic materials that are left on the surface of the soil rather than incorporated. Mulching reduces evaporation, protects shallow roots or seeds from direct sun, keeps the surface of the soilfrom forming a crust during intense rains or sprinkler irrigation, and inhibits weeds. Suppression of weeds usually requires a much thicker layer than is needed for the other mulch benefits.

Adding organic materials like compost, well-decomposed manure, leaf mold, earthworm castings, and grassclippings, along with incorporation of cover crops, will feed soil microbes that produce polysaccharides, whichare tremendously beneficial to soil structure. This is a short-lived effect, so amendments or plant residues should be added to soil several times/year.

More stable organic materials, such as peat, fir bark, and rice hulls, also improve soil structure by directphysical action and don't decompose as quickly as manure, grass clippings and other plant residues.

Improvement of soil tilth is a long-term project. Use a combination of practices including amendments, cover cropping, raised beds (for heavy clay and poorly drained conditions), and take care not to till or walk onsoils when they are too wet.

Table 1. Suitability of soil amendments for improving soil.

		Inorganic amendments				Organic amendments			
Y=yes, M=may be suitable, depending oncause of the problem	Soil Problem	Gypsum	Lime[1]	Elemental sulfur[2]	Sand, perlite, vermiculite	Mulch	Incorporated organics[3]	Covercrop, green manure	Nutrients[4]
1	Low water-holding capacity, droughty					M	Y	Y	
2	Prone to crusting, poor infiltration,weak aggregates	M			M	Y	Y	Y	
3	Erodible					Y	Y	Y	
4	Susceptible to compaction				M		M	M	
5	Poor aeration, slow internal drainage,clayey				M		M	M	
6	Hard to till, clayey				M		Y	Y	
7	Low fertility due to loss of topsoil					M	Y	Y	Y
8	Alkaline, high sodium	Y							
9	Very high pH (but not high in sodium)			Y					M
10	Excessively saline	M							
11	Acidic, low pH		Y						M
12	Excessive boron	***----amendments not likely to help ----------***							

[1]Liming materials, e.g., limestone (calcium carbonate), dolomitic limestone (calcium-magnesium carbonate), calcium hydroxide, crushed oyster shells

[2]Also ferric sulfate, aluminum sulfate

[3]Compost, livestock and poultry manure, leaf mold, peat moss, fir bark, rice hulls, straw, and other plant residues

[4]Inorganic fertilizers, and nutrient-rich organic materials, e.g., poultry manure, blood meal, cottonseed meal

Some Myths about Soil Amendments

Myth #1. Gypsum softens clay or loosens compacted soil. Gypsum (calcium sulfate dihydrate) is effective in counteracting the effects of sodium, which in excess (in soil or in irrigation water) causes soil aggregates to disperse, sealing the soil surface and reducing water infiltration. The calcium in the gypsum replaces the sodium, making for more stable soil aggregates, which do not disperse and form a seal so readily. This processis the basis for the misleading claim that gypsum "loosens" the soil. Gypsum does not reduce or prevent soil compaction, dissolve hardpan, soften clay soils, or convert clay to loam.

Myth #2. Gypsum lowers the pH of alkaline soils. In very high pH soils (pH > 8.5, characteristic of high-sodium soils), gypsum will lower the pH, but only slightly. At lower, though still alkaline, soil pH values, gypsum has little or no effect on pH. Chemically, calcium sulfate is a "neutral salt", i.e., when it dissolves in water, it does not change the pH of the solution. If the objective is to lower soil pH, elemental sulfur, iron sulfate, or aluminum sulfate should be used.

Myth #3. Inoculating soil with microbes or microbial preparations, will improve "dead" or infertile soil. A wide variety of "microbial" products that contain (or claim to contain) microorganisms are commercially available for farm and garden use. A review of the claims made for such products is beyond the scope of this bulletin. Keep in mind that most soils, including soils that have been fertilized only with synthetic fertilizers, orhave suffered years of abuse (compaction, erosion, loss of organic matter) still contain a great diversity of microbial species. To establish or re-establish a healthy soil food web, all that is needed is to apply a variety of organic amendments and ensure that pH and nutrient levels are adequate for plant growth.

For More Information

California Master Gardener Handbook. 2002. University of California Division of Agriculture and Natural Resources Pub. 3382. Oakland, CA.

Abiotic disorders of landscape plants. 2003. University of California Division of Agriculture and Natural Resources Pub. 3420. Oakland, CA.

Organic fertilizers and soil amendments. 1992 . University of California Division of Agriculture and Natural Resources Pub. 21505. Oakland, CA.

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