

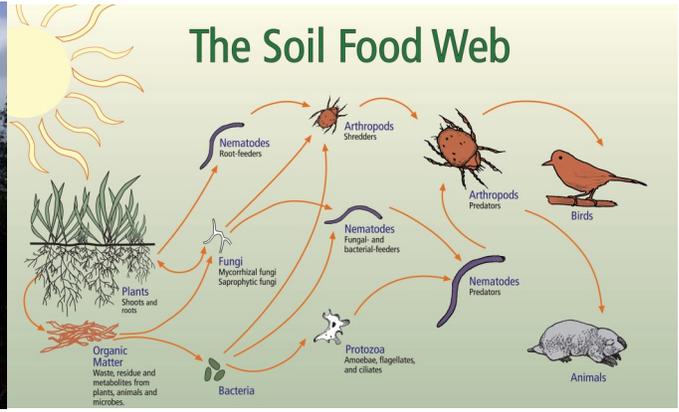
Soil Management in the Mid Klamath Region

by Mark DuPont



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Soils of the Mid Klamath

Contents

Soils of the Mid Klamath (Klamath-Trinity Region)	3
Soil Management—The Basics	4
Amendments	5
Cover Crops.....	6
Mulch.....	7
Resources.....	8
References	9

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Soils of the Mid Klamath

The Mid Klamath region encompasses a wide array of elevations, soils and topography, resulting in some of the most diverse flora and fauna of any temperate zone on earth. This same complexity yields a range of opportunities and challenges for farming and gardening. The alluvial soils adjacent to rivers and the clay soils found upslope can be very fertile and productive, while ultramafic and serpentine soils that make this region unique are ill-suited for crop production and best left to the unique native plant communities adapted to them.



You can explore the Web Soil Survey website of the Natural Resources Conservation Service at <http://websoilsurvey.nrcs.usda.gov/app/>, but you won't find many details on soils in the mid Klamath because of our remote location. At the risk of oversimplifying a complex science, this publication divides regional soils into four simple groups and discusses them from the perspective of growing a garden or farm. The soil in your particular site may or may not fit precisely into one of these categories:

Alluvial Soils, River Bars - Alluvial soils have been deposited by a river and are composed of a mix of the parent materials upstream. Some alluvial soils contain a lot of gravel and are low in fertility, but many are the best agricultural soils in the region, with lots of fertile silt from previous floods. Alluvial soils tend to be light in texture and easy to cultivate, they drain freely and will often leach out nutrients quickly so they require ongoing mineral fertilization and cover cropping.

Upslope Clay Soils - Many of the upslope clay soils of the mid Klamath area are fertile, with good retention of water and nutrients, supporting the large conifer and hardwood forests. From a gardening perspective, they can be sticky when wet and hard when dry, so be sure to cultivate only at the proper moisture level. You can tell it's time to cultivate if you can form a ball of soil in your hand that can be easily broken down with the push of a finger. These soils benefit from lots of organic matter to loosen them up and make them more tillable. Cover crops are a good way to introduce more organic material.

Decomposed Granite - or DG, is weathered granitic rock that forms a light or white soil that is very loose and highly erosive. While DG does contain some nutrients from the granitic parent material, it is still fairly low in fertility from a gardening perspective and will need a lot of amending with mineral fertilizers and organic matter to be productive (see chart). DG is not very good garden soil. If it is all you have then consider raised beds. Whenever possible, avoid disturbing DG on steep slopes (i.e. road building or extensive cultivation) as it is unstable and will erode quickly.

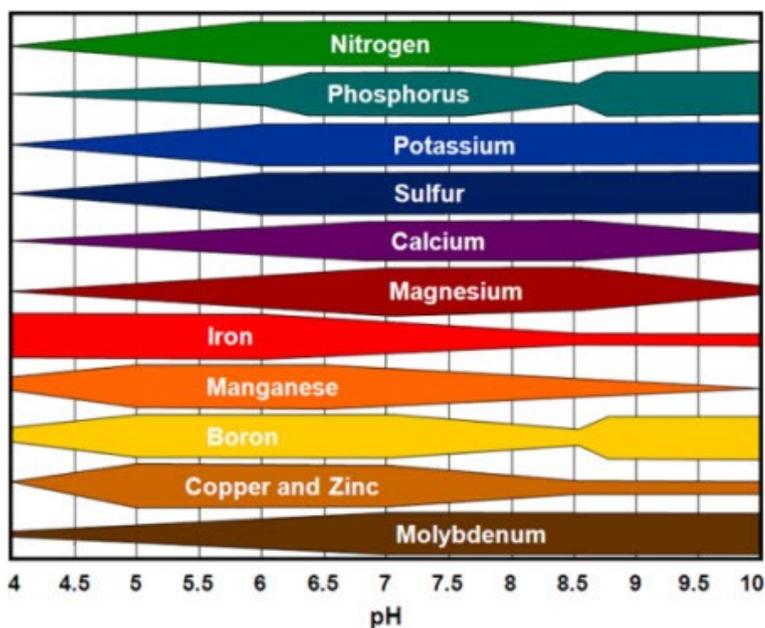
Ultramafic and Serpentine Soils - One of the things that makes the Klamath region so unique is ultramafic soils - soils that are high in Magnesium (Mg), Iron (Fe) and other micronutrients which sometimes occur at levels that are toxic to plants. The collision of tectonic plates that formed the Klamath mountains brought the earth's mantle material to the surface. The mantle is high in Magnesium, Iron, Nickel, and other micronutrients, and low in Calcium and Phosphorous. It's very common to find soils in our region with this particular imbalance of nutrients. When the Magnesium and Iron levels are extreme the result is a **serpentine** soil, which yields a sparse vegetation, often consisting of Jeffrey Pine, Incense Cedar, and buckbrush (*Ceanothus cuneatus*). Trees growing on serpentine are likely to be dwarfed. **It is not advisable to try to garden on serpentine soils; these soils and the unique ecosystems they support are best left undisturbed.** They are highly erosive, host a high number of endemic species and tend to be so infertile that attempting a garden is futile.

Soil Management—The Basics

It all starts with soil. There are many gardening products available to increase the health and productivity of your farm or garden. You could spend a lot of money and not get the results you are looking for because you may not be giving your soil and plants what they need. Before investing time, energy and money on products you may or may not need, it is a good idea to get to know your particular soil. Soil testing can be a simple, cost effective investment that will inform and guide you on how to best improve fertility and productivity of your farm or garden. Soil testing is also a useful way to diagnose problems that could be coming from your soil.

Soil science is infinitely complex, but the basics of managing soil fertility can be boiled down to a few simple guidelines:

- **Maintain high organic matter** through composting, cover cropping & mulch. Organic matter is the engine that drives a fertile, healthy soil. Organic matter retains water, improves soil structure, stimulates biological activity thereby releasing nutrients, and buffers soil pH. The single most important and effective thing you can do for your soil is to add and maintain organic matter. Ideally soil organic matter should be between 3-10%.
- **Stimulate biological activity** through cover cropping, composting and mulching. Not all organic matter is created equal. The best methods for increasing organic matter and stimulating biological activity are cover cropping, composting and mulching. It's important to understand the carbon to nitrogen (C:N) ratio of organic matter. Adding organic matter with a high C:N ratio such as sawdust will consume nutrients such as Nitrogen, making it unavailable for plants.
- **Maintain soil pH between 6.5-6.8.** Soil pH effects the availability of nutrients (see graph). When a soil becomes too acidic (low pH), Phosphorus, Sulfur, Potassium and Magnesium become unavailable, while some micronutrients become unavailable in an alkaline soil (high pH). The effects of pH below or above this range can be moderated by high organic matter. The best way to determine pH is through laboratory analysis (see below).
- **Have your soil tested by a lab.** A complete nutrient analysis of your soil costs between \$30 - \$40 and is an excellent investment if you plan to farm or garden for more than one season. A good soil analysis will include soil pH, soil texture, complete nutrient analysis, cation exchange capacity, and organic matter content. A&L Labs is a reputable laboratory that offers a comprehensive soil fertility analysis for a reasonable price. [This booklet](#), offered by Peaceful Valley Farm Supply, is an excellent guide to interpreting your soil fertility analysis results from this lab.



Courtesy USDA.

Amendments

It's best to amend your soil based on lab results, but without a soil analysis you can use the following as a guide for amending soils in the Mid Klamath region:

- **Add Calcium and Phosphorus every 2-4 years.** Many soils of the Mid Klamath region are deficient in Calcium and Phosphorus (see Ultramafic Soils). If you add these amendments in mineral rather than chemical form there is no danger of burning crops or damaging the soil. The best forms of mineral Calcium are oyster shell flour and mined limestone, apply 2-5 LB per 100 square feet , or 1,000 - 2,000 LB/acre. The best form of mineral Phosphorus is colloidal soft rock phosphate - be sure to use colloidal form for best availability. Apply 2-3 LB/100 square feet, or 500-1,000 LB/acre.
- **Organic matter**—add high quality organic matter ever year in the form of compost, cover crops and/or mulch.
- **Nitrogen** is a highly mobile plant nutrient that requires continual replenishment via compost and/or cover cropping, often supplemented with a concentrated form such as blood meal, fish meal, cottonseed meal, alfalfa meal, or feather meal.

A Rough Guide for Amending Soils in the Mid Klamath Region			
Add every 2-5 years:		Rate	
Nutrient	Source	LB/ 100 ft2	LB/ acre
Calcium	Mined limestone or oyster shell flour	2-5 LB	1,000 - 2,000 LB
Phosphorous	soft rock colloidal phos-	2-3 LB	500 - 1,000 LB
Add every year (choose one, or combine):			
Nitrogen, choose one:	bloodmeal	4 LB	500-1,000 LB
	fishmeal	6 LB	750 - 1,000 LB
	cottonseed meal	8 LB	1,000 - 2000
	alfalfa meal	5 LB	500 - 1,000 LB
	composted chicken ma-	25 LB	10 yards/ acre
Organic Matter	compost, cover crop, mulch		

Note: Based "Understanding Your Soil Analysis" by Peaceful Vally Farm Supply, 2011

Cover Crops

Cover crops are grown specifically to improve soil texture, organic matter and fertility. Legumes (bell beans, fava beans, vetch, Austrian field peas, clovers) are popular cover crops as they harbor bacteria on their roots that fix atmospheric Nitrogen into the plant, up to 100 LBS/acre. The Nitrogen and organic matter are added to the soil when the crop is tilled under. Grasses and grains, such as barley and oats, add organic matter to the soil and reduce erosion. Buckwheat is a warm season annual grown in the summer that does not fix Nitrogen, but does concentrate Phosphorus and add organic matter. In addition to improving soil fertility, cover crops can reduce weeds and attract beneficial insects.

Fall/Winter cover crops—Sowing a cover crop in the fall is one of the best things you can do for your garden. It will protect your soil from erosion and compaction from harsh winter rains, add up to 100 LBS of Nitrogen/acre, increase organic matter, improve soil tilth (tilling) and attract beneficial insects - what more could you ask for? Be sure to plant your cover crop by mid October in order to get some growth before the winter cold sets in - cover crops planted later may not grow enough to protect the soil through the winter and are likely to develop less biomass and fix less Nitrogen.

Inoculate your cover crops for the right bacteria!—Legumes host beneficial bacteria in nodules on their roots. It is these bacteria that do the important work of capturing Nitrogen from the air and fixing it in a form the plant can absorb and use. If the proper bacteria are not present in your soil then legumes will not fix nitrogen, but just use up Nitrogen that's already present. Some cover crops come inoculated ("rhizo-coated"), others require an inoculant. It's best to inoculate your cover crops for the first two years of planting them, after that the beneficial bacteria should become established in your soil. You can test your legumes by pulling up the green plant before it has set seed and inspecting the root nodules. When the proper bacteria are present the crushed nodules will have a pink color. Nodules that are pale or white on the inside lack the proper bacteria and are not fixing nitrogen.

Cover Crops for the Mid Klamath Region

Buckwheat is a great warm weather cover crop - sow any time between May and August when the soil is warm. It grows quickly, out-competes weeds, concentrates phosphorous, and attracts beneficial insects. Buckwheat does not fix nitrogen, so the main benefits are building organic matter, protecting the soil and smothering weeds.

Bell Beans are actually a type of fava bean bred to be round (to fit in mechanical seeders), more cold tolerant, and develop a lot of biomass. Bell beans yield the most Nitrogen of any cover crop, up to 100 LB/acre. A good healthy crop can be five to six feet tall. Plant 1-4 LB/100 ft², or 80 - 125 LB/acre.

Austrian field peas sprout and grow in cool conditions, tolerate heavy soil, and are hardy to 10 degrees F. The tendrils and flowers are excellent in winter salads. Plant at 2-4 LB/100 ft², 70-120 LB/acre.



Tilling in a winter cover crop.



Buckwheat cover crop.

Vetch is a leguminous vine that is cold tolerant, provides excellent livestock forage and attracts beneficial insects. Plant with upright crops such as oats, barley or bell beans for support. Plant at 1-3 LB / 100 ft², 30 -60 LB/acre.

Annual grains, i.e. barley & oats - Annual cold weather grains such as barley and oats have fibrous root systems that protect the soil and scavenge extra nutrients, especially Nitrogen, that was not utilized by summer crops, fixing it in the plant so that it is not lost to winter rains. Barley is an allelopath, which inhibits the germination of competing weed seeds. Annual grains do not fix Nitrogen, but improve soil texture by adding organic matter. Plant at 2-3 LB/ 100 ft², 60 -90 LB/acre.

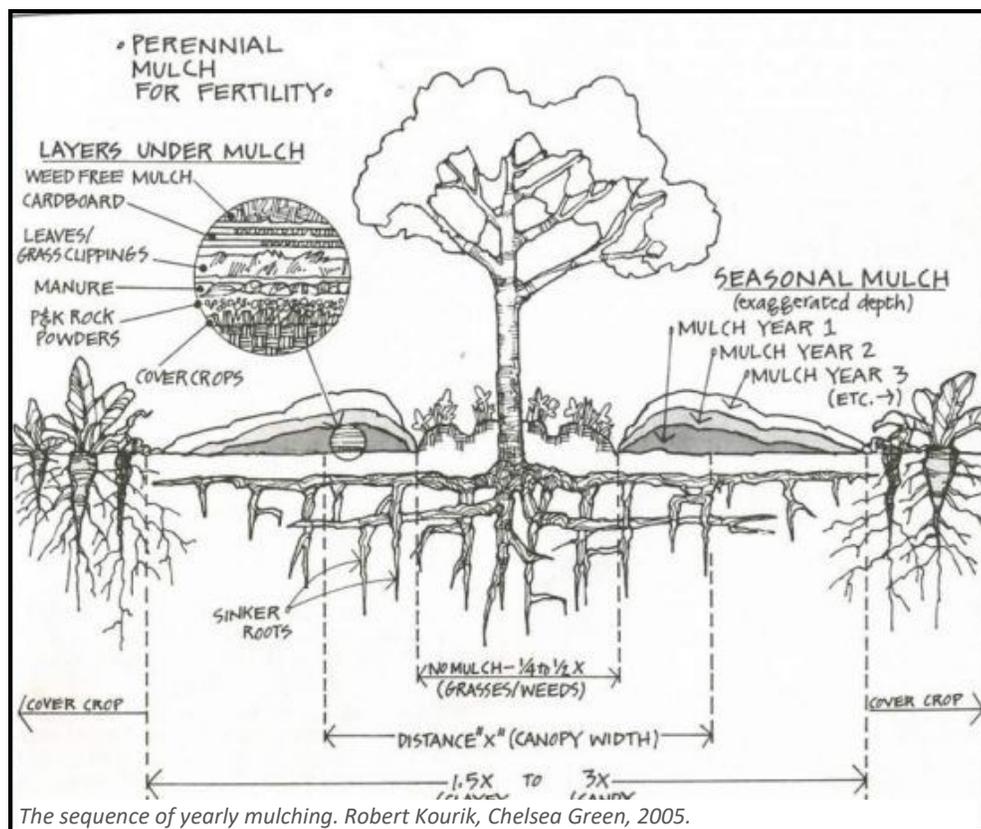
Cover Crop Mix - You can combine all of these cover crops into a mix to get the cumulative benefit of each. Here's a suggested mix that uses 50% bell beans, 25% Austrian field peas, 15% vetch and 10% barley or oats, for a mix that is lighter on the grains and heavy on the nitrogen fixers. Feel free to change the proportions to fit your specific site needs.

COVER CROP MIX FOR MID KLAMATH REGION					
	LB/100ft ²	LB/acre	enough for 1 acre	enough for ½ acre	enough for ¼ acre
Bell beans	2-4 LB	80-125 LB	50 LB	25 LB	12.5 LB
Austrian Field Peas	2-4 LB	70-120 LB	25 LB	12.5 LB	6.25 LB
Vetch	1-3 LB	30-60 LB	7 LB	3.5 LB	1.6875 LB
Barley or Oats	2-3 LB	60-90 LB	7.5 LB	4 LB	2 LB

Seed application rates based on *Peaceful Valley Farm and Garden Supply catalog and website, 2017.*

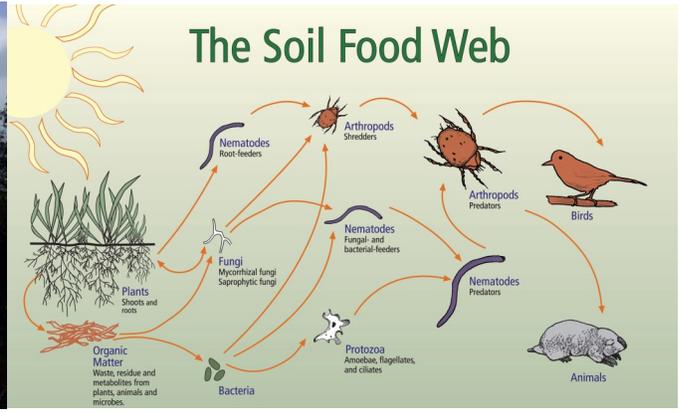
Mulch

A good, thick layer of mulch can smother weeds, improve the fertility of the soil, increase your yields and reduce the amount of watering you need to do, all at the same time. You can bury drip irrigation line underneath the mulch to make watering easier (though more difficult to spot leaks). Mulch in layers, with nutrient rich materials (lawn clippings, garden weeds, animal manure, rock powders, etc.) near the bottom and rougher materials (such as cardboard, rice straw and wood chips) near the top. You can lay one year's mulch right on top of the previous year's.



The sequence of yearly mulching. Robert Kourik, Chelsea Green, 2005.

Be sure to use weed free mulch material, such as cardboard, lawn clippings, wood chips and rice straw. Hay and straw other than rice straw may contain noxious weeds that will cost you more labor than the mulch saves you!



Resources

Composting

New York State Department of Environmental Conservation. (n.d.). Everything You Have Always Wanted to Know About Home Composting—But Were Afraid to Ask! Online at http://www.dec.ny.gov/docs/materials_minerals_pdf/compost.pdf

Cooperband, L. (2002). The Art and Science of Composting. Center for Integrated Agricultural Systems, University of Wisconsin-Madison. Online at http://mkwc.org/files/8413/8906/0917/www.cias.wisc.edu_wpcontent_uploads_2008_07_artofcompost.pdf

Cover Crop

Sullivan, P. (2003). Overview of Cover Crops and Green Manures. by Appropriate Technology Transfer for Rural Areas (ATTRA). Online at <http://mkwc.org/files/5713/8906/0912/covercrop-ATTRA.pdf>

Soil Analysis

We recommend:

A & L Western Laboratories, Inc. <http://www.al-labs-west.com/services.php?section=Soil%20Analysis>

A soil analysis is a worthwhile investment if you plan to garden a site for more than a season. The Complete Analysis soil test package gives the most detailed report. Print and fill out the submittal form and follow the directions for pulling and sending a sample. The graphical analysis report is highly recommended.

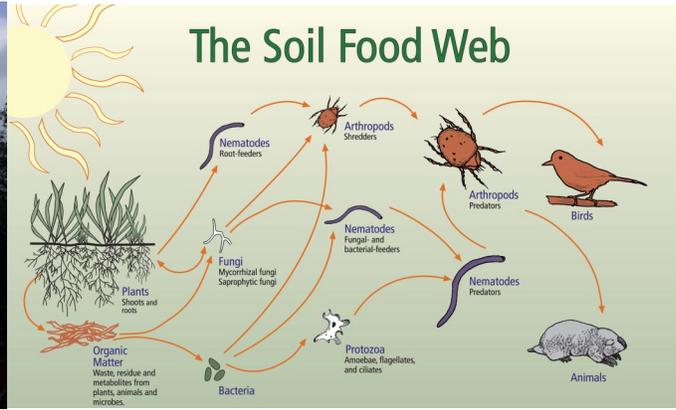
Peaceful Valley Farm Supply. (2011). Understanding Your Soil Analysis Report. Grass Valley, CA: Peaceful Valley Farm Supply. Online at http://mkwc.org/files/3813/8906/0914/PVFS-Soil_Analysis_Booklet.pdf

This is the best reference for when it's time to interpret the results. This thorough and informative publication is highly recommended.

Soil Management

Smillie, J. & Gershuny, G. (1991). *The Soul of Soil*. White River Junction, VT: Chelsea Green.

Lowenfels, J. & Lewis, W. (2010). *Teaming with Microbes: The Organic Gardener's Guide to the Soil Food Web*. Portland, OR: Timber Press.



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Kourik, R. (2005). *Designing and Maintaining Your Edible Landscape Naturally*. White River Junction, VT: Chelsea Green.

Peaceful Valley Farm Supply. (2011). *Understanding Your Soil Analysis Report*. Grass Valley, CA: Peaceful Valley Farm Supply.

[Peaceful Valley Farm and Garden Supply catalog and website](#). (2017). Grass Valley, CA: Peaceful Valley Farm and Garden Supply.