SOIL SOLUTIONS

for the Home Garden

By Kimberly Bell

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Cover design by Kimberly Bell

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DO WE TAKE SOIL FOR GRANTED?

I have noticed there are many things in life that most of us do not give a second thought to. Whether it is the assumption our roof will keep us dry through the rain storm or that our car engine will turn over without delay; until a problem presents itself and the car engine does not start, or the roof begins to leak, we take things a bit for granted. I am guilty of this in many areas of my life … even in gardening and landscaping.

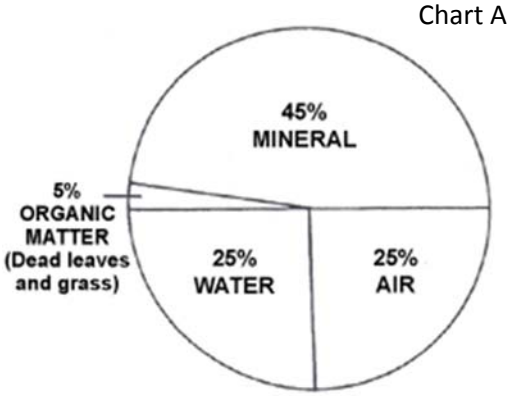
For years, we had grown flowers, vegetables, berries, grapes and fruit trees in our backyard and then my family moved to a new town. We were anxious to put in our own lawn, flower beds, trees, and garden, but a problem presented itself. The new home had been recently built, the topsoil had all been removed, the soil was terribly compacted, and the contractors had recklessly left their gravel and cement debris everywhere. Our soil at our former home was excellent, and we never had difficulty growing any plant, shrub or tree. But this new home with poor, hard-packed, clay soil challenged us with an obvious problem: how can we create healthy, productive soil?

It has been 10 years since my husband and I faced the problem with our barren property. Over those 10 years we have successfully, though not without mistakes, turned an empty, ugly, yard into a lovely productive landscape, and it all started with the soil. Since that time, I also began the training and then volunteering as a Master Gardener through my local county extension office. I have had the opportunity to learn a great deal more about soil, and I actually have found I can get excited out it!

Problems and challenges with soil are nearly universal. My goal in writing this manual is to give clear understanding and simple suggestions to a rather complicated subject. This is not a textbook, but the information is all thoroughly researched and gleaned from university research. This garden solutions manual may not create feelings of love for soil, but I sincerely hope it sheds some useful light on the mysteries of its nature and maybe even help develop a deep appreciation for its significant contribution to our lives.

WHAT IS SOIL?

Chart A



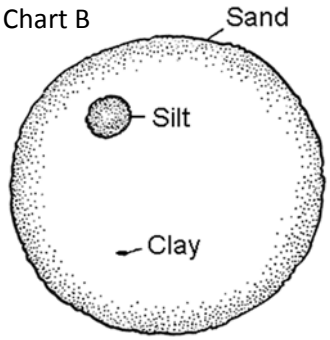
General Ingredients of Soil

Soil is a unique habitat specifically designed to support plant life. Soil helps to provide moisture, nutrients, heat, and support to all plants. Pie chart A illustrates the breakdown of ingredients. Soil is 50% solid and 50% pore space. Of the solid portion, 45% is decomposed rock (minerals) and 5% is organic matter. Ideally, the pore space has equal portions of air and water.

Productive soil allows water to permeate it and then supplies water to the plants. Pores can be created by earthworm and root channels as well as by the aggregation of soil particles. Pores can be large (they let water permeate) and they can be small and hold water against gravity making it available to the plant roots. Soils with a balance of large and small pores have the ability to both allow water in and the ability to hold water for supply as needed by plants.

Porosity is of huge importance to maintaining plant health, and there are factors affecting soil porosity. The texture of the soil is one factor; there are coarse and fine particles that make up soil. Sand is the largest particle and is visible to the eye. Silt is a smaller particle that is similar in size to an individual particle of white flour. Clay particles are the smallest, and they can only be seen with a microscope. Chart B illustrates the differences in particle size. Both sand and silt are rounded and look like little rocks, but clay is flattened and the particles stick together like slices of buttered bread. These particles all seem small, but the relative difference in their sizes is very large. If a clay particle were the size of a penny, a sand particle would be the size of a house!

Chart B



So, pore sizes in sandy soils tend to be large and in silt or clay soils, the pores are smaller due to the particles size differences. Sandy soils are easy to permeate, but they are fast-draining and not able to retain water. Silt or clay soils allow water to be held, but they do not allow permeability.

The perfect combination of pore sizes and particle sizes would be created with roughly equal parts of sand, silt and clay. This ideal soil is called loam. Most garden soils are not ideal but a combination of sand, silt and clay in other ratios that might make the soil more challenging to work with.

Good soil structure is also vitally important to allow water and air movement. Structure is the aggregation of individual particles of sand, silt and clay. The particles will bind together with "glue" from organic matter and provide structure to the soil. If the structure is good, the soil is acting like a sponge, allowing water to enter and soak in, and letting excess water drain down. However, structure is fragile and can be damaged or destroyed by compaction. Compaction will cause the soil structure to resist water movement and root penetration as well.

What causes compaction? Compaction often occurs during site preparation or house construction. It is often difficult to establish a garden and landscape in a new housing development; although it is not just large earth-moving equipment that damages soil structure. Excessive tilling or tilling when the soil is too wet can cause compaction. Heavy foot traffic or running a heavy wheel-barrow over and over will cause compaction. Even rainfall can cause the soil to become compacted.

So, where does all this information lead? You want productive soil that is permeable to water and is able to supply water to plants when it is needed. But, maybe you live in an area where your soil is sandy, and water soaks in, but your plants dry out quickly. Or maybe you just remodeled your home, and trucks hauling building supplies drove over your garden space several times. Sometimes there are just circumstances beyond your control.

One very important action you can take to improve the porosity of your soil is to add organic matter. Adding organic matter will:

- Stabilize soil structure. Humus is actually what holds particles together.
- Increase water holding capacity in sandy soils.
- Improve pore space in clay soils making it more permeable.
- Provide nutrients to plants once it decomposes.
- Provide a food source for beneficial micro organisms.

To keep soils from compaction:

- Do not till or spade soil when it is too wet—it must be dry and crumbly before tilling.
- Do not overwork soil with a rototiller—one pass is usually enough.
- Use raised beds and paths—by using paths you limit the area being walked on and the plant roots are never walked on.
- Grow a cover crop, especially one that produces deep roots like annual rye.
- Increase or maintain applications of organic matter.
- Aerate the soil, especially lawn areas with heavy foot traffic.

4 FACTORS THAT INFLUENCE THE PRODUCTIVITY OF SOIL

First, soil is full of life! There are live plant roots, earthworms, insects and a whole host of microorganisms that cannot be seen. In ¼ teaspoon of soil, there can be as many as 1 billion microorganisms, and they are the most abundant in the root zone. Their main function is to break down plant remains, and this break down process releases nutrients and creates soil organic matter. It is a diverse population, and many of the organisms are beneficial such as mycorrhizae fungi and rhizobia bacteria. Others are not beneficial and can cause disease and damage. Microbial populations are the highest in soils that are warm, moist, and have organic matter. Good practices to keep the microorganism populations high and performing well are adding organic matter annually and growing a winter cover crop each year.

Second, soil pH measures the acidity or alkalinity of a soil. Why is the pH important? It affects the availability of plant nutrients and it affects the activity of soil microorganisms. In arid climates, soils tend to be alkaline, and in rainy areas, soils tend to be acidic. The middle of the pH range, 5.5 to 7.5, is where most plants perform the best (with a few exceptions) and where microbial activity is the highest. Chart C illustrates the effect of soil pH on the availability of plant nutrients.

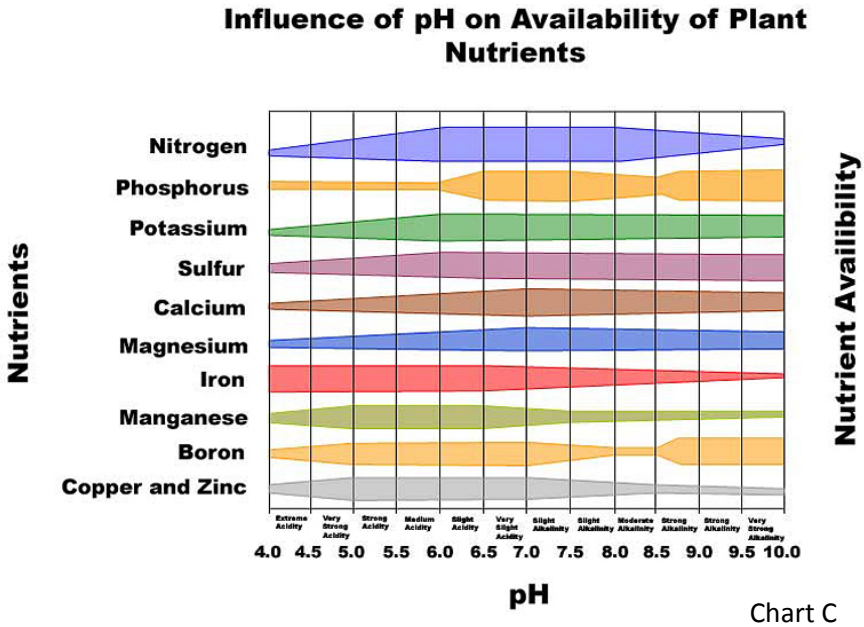


Chart C

Soil pH is important, and getting the pH tested can be done easily and inexpensively. Once your soil is tested, and you have determined if the pH needs to be increased or decreased, you can purchase the recommended amendment and apply it to the soil. To increase the soil pH, lime is most commonly used. To decrease the soil pH, elemental sulfur, ammonium sulfate fertilizer or urea can be used.

Third, soil salinity is another factor that can especially be a problem in arid climates. Salts can accumulate from fertilizers, composts, and manure applications. If the amount of salt reaches a certain level, there can be potentially harmful effects on plants. In areas of more rainfall, salts are leached from the soil each winter and are not accumulated in the root zone. Soil salinity can

be tested for, and if the level is considered to be too high, the salt can be leached from the soil by irrigating more than the holding capacity of the soil. The excess water, draining downward will carry the salts out of the root zones.

Lastly, the fourth area is soil nutrients. Chart D provides a list of essential plant nutrients. To know what your soil has and what it needs, a soil test is highly recommended as well as repeating the test every 3 – 5 years.

Where do the nutrients go? Nutrients are lost when there is soil erosion, when a crop is harvested, and when there is too much rainfall or irrigation and the nutrients leech from the soils. Fertilizers are then added to increase the amount of nutrients that will improve plant growth and yield of produce.

The primary nutrients needed by plants are nitrogen, phosphorous, and potassium. The most common deficiencies are for these primary nutrients. As a general rule, these nutrients support:

- Nitrogen: leafy top growth.
- Phosphorous: root and fruit production.
- Potassium: cold hardiness, disease resistance, and general durability.

WHAT IS FERTILIZER?

Fertilizer is simply a substance that contains one or more essential nutrients for plants. Fertilizers that are commercially sold must be accurately labeled with grade, weight, and manufacturer. The grade is what gives the breakdown of minimum guaranteed percentages of nitrogen, phosphorous and potassium. Fertilizers can also be broadly classified as inorganic or organic.

What's the difference between the two? Chart D explains the differences:

	Organic Fertilizer	Inorganic (Processed) Fertilizer
Source	Natural materials; little or no processing	Manufactured or extracted from natural materials
Examples	Manure, cottonseed meal, rock phosphate, fish by-products	Ammonium sulfate, processed urea, potassium chloride
Nutrient availability	Usually slow-release; nutrients are released by biological and chemical processes in soil	Nutrients usually are immediately available to plants
Nutrient content	Usually low	Usually high

Chart D

Here are some basic do's and don'ts when using fertilizer:

- Always read the label!
- Apply fertilizer before anticipated plant growth.
- Nitrogen applications have its greatest effect for 3 – 4 weeks after application.
- Use a liquid fertilizer when starting plants to provide phosphorous to new roots.
- Do not apply fast-release fertilizers prior to heavy rainfall or over irrigate after application.
- Do not apply fertilizers around wells or where run-off could carry into waterways.
- Calculate how much is needed (based on soil test and plant needs) and do not use more than needed.

Some natural practices to maintain nutrient rich soil:

- Add organic matter, 1 – 2 inches to soil each year. Organic matter is a long-term, slow-release storehouse of nutrients that continuously becomes available as the soil microorganisms break it down.
- Make your own compost or purchase commercial compost for your source of organic matter.
- Make use of green manure or a cover crop each fall. Plant them as early in the fall as possible to achieve enough growth to cover the soil. Use legumes to supply nitrogen to the soil. In the spring, if it is too wet to till under before the crop flowers, cut if off and compost the foliage for later use. The benefit of organic matter from the crowns and roots will be available when the soil can be turned under.

COMPOSTING – CREATING YOUR OWN ORGANIC MATTER

Having already touched on the importance of adding organic matter to the soil, just to re-cap some of the benefits that come from adding organic matter to your soil:

- Organic matter is a natural soil conditioner, creating humus, which is the "glue," to give soil structure.
- Organic matter makes sandy soil hold more water – structure building.
- Organic matter makes clay soil drain better – structure building.
- Organic matter helps to buffer against extreme pH levels.
- Organic matter is a source of nutrients for plant use.
- Organic matter is a food source for microorganisms.

Composting is a wonderful way to carry out nature's cycle of growth and decay. The material remaining from the decaying process is organic matter. Ideally, your garden soil should contain 5% organic matter. Mulching 1 – 2 inches each year of organic matter into the soil is a perfect way of sustaining soil health. Composting is free and reduces the amount of yard waste going into your land-fills, so it truly is a win-win practice!

There are two composting methods -- fast (hot) composting and slow (cold) composting. Hot composting is simply speeding the decay process up by balancing the contents of the pile, water, and air to favor microbial activity. When the conditions are just right, heat is produced and compost piles quickly reach temperatures of 120 – 150F (killing weed seeds and pathogens). Here are some of the basics for hot composting – 4 important rules:

- Pile size – the more volume, the faster the decomposition. A pile the size of 1 cubic yard is recommended for year-round composting. See Diagram E.
- What to put in the pile – simple vs. complex materials. The ideal carbon to nitrogen ratio is 25:1 – 40:1.
    - Brown stuff is high carbon.
    - Green stuff is high nitrogen.

- Adequate moisture – water the pile—the material should feel moist, but you should not be able to squeeze water out of it with your hands.
- Aeration – turn the pile (weekly) with airflow in mind. The high carbon matter can act as a bulking agent to make the pile porous and pull outside air inside.

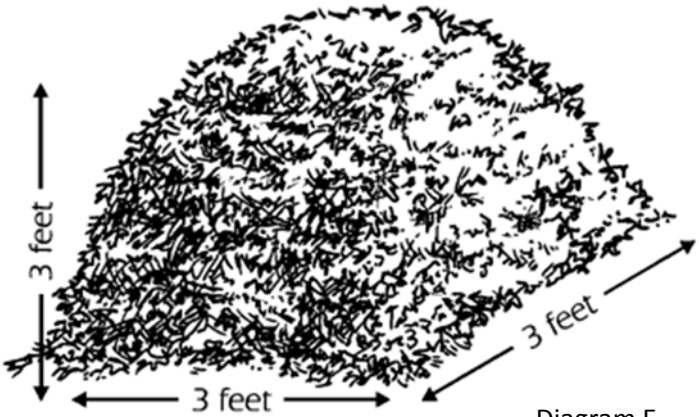


Diagram E

Cold composting is for people who do not have the time to tend to a hot compost pile nor the amount of waste materials to create a large pile. It is a convenient way to turn wastes into organic matter. Simply mix non-woody yard wastes and food wastes into a pile and let them sit for a year or so. Add fresh wastes by opening the pile in the center and then covering them. Burying fresh wastes, especially fruit and vegetables, will help to not attract pests (flies, rats or raccoons). Cold composting does not kill weed seeds, so it is best to not put weeds in the compost pile that have gone to seed. Turn the pile occasionally throughout the year.

Do you need to build a bin for composting? Containers look neater and shield the compost from pests, but they are not necessary. Piles work well. If you do want to create a bin, make them from materials such as old pallets, lumber, mesh fencing or cinder blocks.

Can manure be used in compost piles? Because fresh animal manure can contain pathogens such as bacteria (*Salmonella* and *e. coli*), there is some risk in adding manure to cold compost piles. In hot compost piles that are maintained with the high temperatures, the pathogens are destroyed. If your compost is going to be used on fresh garden crops and you are cold composting, limit the potential risk by not adding manure into the compost.

What wastes can be composted?

Bread	Paper (shredded)	Sawdust
Coffee grounds	Eggs shells	Sod
Evergreen needles	Straw	Leaves
Fruit peels and rinds	Tea leaves	Wood ash

Grass clippings	Vegetables	Wood chips
Cow, horse, poultry manure	Garden wastes	Corn stalks

What wastes should be avoided?

Bones	Fish scraps	Meat
Cheese or milk	Noxious weeds	Oils
Fat	Cat or dog manure	

Composting is such a great way to make the most of what is already headed to the garbage can. With a little thought and effort, composting can become a natural way to recycle wastes and create a beneficial organic matter to feed your soil. When the soil is healthy, your gardens, flowers and landscapes THRIVE!

BENEFITS OF PLANTING A COVER CROP

I enjoy October for the simple fact that the garden is done for the season, and I can turn my thoughts to other matters. However, just because I am "done" doesn't mean I should just walk away from the garden, leaving it empty and bare. The garden has given generously to me, so is there something I can do for it?

A friend gave me this great illustration: Each time I harvest garden crops or pull weeds, I make a "withdrawal" from the soil's pool of nutrients and organic matter. If I continue to make "withdrawals" year after year, the soil is eventually going to be depleted of the resources plants need to thrive and produce a yield of fruit and vegetables. So, what is an easy and inexpensive practice that home gardeners can use at the end of the growing season to make a "deposit" back into the soil's resource pool? Plant a cover crop!

Whether you have a full size garden, raised beds or a few rows here and there in the landscape, a cover crop can make a big difference in maintaining the health of the soil. Another term for cover crop is green manure. The two terms can be used interchangeably as cover crops inevitably are added to the soil becoming green manure. Cover crops play an important role in successful, sustainable gardening practices.

What are the benefits of the cover crop?

- Soil quality improvements – a cover crop loosens the soil and improves soil structure. A cover crop's roots penetrate deeply into the heavy, compacted soils.

When the soil is loosened and water infiltration is improved, next season's plantings will develop strong roots, become healthier and be able to withstand heat and drought conditions better. Also, organisms in the soil, such as earthworms, thrive when green manure is decomposing. These organisms also do their part in improving soil structure.

- Erosion control – a cover crop keeps the top soil in place. Barren soil is vulnerable to winter rains and winds that can blow or wash away the top layer of soil. The top soil is often the soil that is richer in nutrients. By having soil held in place by a cover crop during the fall, winter and early spring, the loss of soil from erosion is greatly reduced.
- Fertility improvements – a cover crop adds nitrogen and other nutrients to the soil. Legumes can add substantial amounts of available nitrogen to the soil. Non-legumes can be used to recycle nitrogen as well as available phosphorus and potassium to the following crop. A cover crop planted after a manure application can also help reduce leaching of nutrients. Here in Oregon with the heavy winter rains, cover crops are sometimes referred to as catch crops. They "catch" the nutrients rains would easily leach away.
- Suppress weeds – a cover crop cuts down on next year's weeds. Growing a dense stand of an annual cover crop fills the soil and lessens the chance of runaway weeds blowing in and germinating in the garden soil. Cover crops also can suppress weed growth by allelochemicals. Allelopathy refers to the harmful effect of one plant on another through the release of a chemical compound. The chemicals present in some cover crops can inhibit germination and growth of weeds. Allowing 3 weeks for decomposition of the cover crop at the time of tilling ensures that garden seed will be able to germinate.
- Insect control – a cover crop may attract and provide habitats for beneficial insects. Growing a cover crop encourages beneficials like lady beetles or ground beetles to stay in your garden. If beneficial insects stay, it means they will be offering their help in controlling the population of unwanted pests.

WHAT SEED SHOULD BE PLANTED FOR A COVER CROP?

The answer to that question depends somewhat on the condition of your soil and what benefit you need from a cover crop. One single planting of a cover crop cannot provide all the potential benefits listed, so each gardener must prioritize what desired benefit is the most important. Only legumes provide free nitrogen, but they are not as competitive with weeds. Deciding what the end goal is will help you decide what type of crop to plant.

Cover crop species fit into 4 main categories: grasses, other non-legumes, legumes, and mixtures.

Grasses are usually chosen when adding nitrogen to the soil is not the priority. Grasses tend to grow rapidly and are better for providing weed suppression. Annual ryegrass produces a fairly dense root system, so if an application of manure is applied to the soil, or there is nitrogen left over in the soil, grasses are good for capturing nitrogen and minimizing leaching.

Some examples of non-legume cover crops would be oats, buckwheat and cruciferous crops. Oats can be planted in late summer, and enough growth can be expected to protect the soil through the winter. Oats are frost-killed, but the residues left on the soil provide both a physical barrier to weeds and also allelochemical suppression of weed seed germination. Buckwheat is a fast-growing annual that also decomposes well and is easily worked into the soil. Cruciferous crops would include rape, forage turnips and oilseed radish. These crops help to break up compacted soils with their tap roots.

Legumes are planted when soil fertility needs to be supplemented. Inoculated legume seeds generally require good drainage and fertility. They do not grow as quickly as grasses, and they do not provide weed control until they are well-established. Some examples of legume seeds are: clovers (white or red), hairy vetch, and winter peas.

A cover crop mixture is simply that – a mix of seeds to provide a mix of benefits as well. A mix might resemble the Gardenway Cover Crop Seed Mix Outsidepride.com offers.

- 39.33% Ryegrain.
- 24.80% Forage Peas.
- 19.97% Yamhill Wheat.
- 5% Crimson Clover.
- 5% Common Vetch.
- 4.99% Annual Ryegrass.

This mix offers fast establishment to help with weed suppression, dense root development to catch minerals and prevents leaching, and legumes to fix additional nitrogen into the soil. The biomass that is produced from a seed mix is often more than a single species planted alone. The large amount of biomass is simply more green manure to turn under in the spring.

I highly recommend using your local extension offices for resources on what types of seeds to use, when to plant, and how to plant. It is very possible they will have specific instructions for the areas you live in. Here is a helpful chart that Oregon Extension Office publishes, and similar publications are in county extension offices all around the United States.

Some Suggested Cover Crops for Garden Soils—Oregon State Extension Office (FS 304-e)

TYPE	LEGUME/ NONLEGUME	AMOUNT TO SOW/ 100 SQ FT (OZ)	WHEN TO SOW	WHEN TO TURN UNDER	EFFECTS	NOTES
Alfalfa	L	1/2	Spring Late summer	Fall Spring	Fixes 150-250 lb N/ac/yr. Deep roots breakup hard soil, trace elements to surface.	Loam, fairly fertile soil; needs warm temps for germination. Lime if pH is low. Hardy. In mountains sow by Aug.10. Drought-tolerant. Inoculate.
Austrian field peas	L	3	Fall	Spring	_	Rank growth; may need to mow before turning under.
Barley	N	4	Fall Spring	Spring Fall	Adds organic matter; improves soil aggregation.	Prefers medium-rich loam soil. Lime if pH is low. Not as hardy as rye. Tolerates drought.
Buckwheat	N	2 1/2	Spring Summer	Summer Fall	Mellows soil; rich in potassium.	Must leave part of garden in cover crop during season. Grows quickly. Not hardy.
Crimson clover	L	1/3	Spring Fall	Fall Spring	Fixes 100-150 lb N/ac/yr.	Not reliably hardy. Sow before mid-Sept. Not drought-tolerant. Lime if pH is low. White clover somewhat hardier.
Fava beans	L	Plant 8" apart	Early spring Late summer	Early summer Fall	Some types fix 70-100 lb N/ac in as little as 6 weeks. Use small seeded rather than large seeded table types.	Will grow on many soil type. Medium drought tolerance. Like cool weather. Good for mountain areas. If planted in early spring, can grow late vegetables. Inoculate with bacteria as for hairy vetch.
Garden peas	L	3	Fall	Spring	_	Use for edible crop and winter cover.
Oats	N	4	Spring Fall	Summer Spring	Add organic matter; improves soil aggregation.	Need adequate manganese. Not hardy. Tolerates low pH.
Rye, annual	N	3 1/2	Fall	Spring	Add organic matter; improves soil aggregation.	Very hardy. Can plant until late October.
Vetch, hairy	L	2 1/2	Early fall	Spring	Fixes 80-100 lb N/ac/yr.	Inoculate; slow to establish. Fairly hardy. Till under before it seeds; can become a weed.
Wheat, winter	N	4	Fall	Spring	Add organic matter; improves soil aggregation.	Same as barley.

Chart F

HOW TO PLANT AND TILL IN A COVER CROP

Here are some simple steps in planting and tilling the cover crop:

Preparing the soil:

- For grasses and cereal grains, use a complete fertilizer such as a 15-15-15 or manure.
- For legumes, they need little nitrogen, so add a low-nitrogen formulation of fertilizer.
- For soils with a pH of 5.6 or less, apply lime.
- Till the seedbed or hand spade to loosen the top 6 inches of soil. Work in the fertilizer, manure or lime and rake to break the soil into a fine seedbed.

Planting the cover crop:

- Time the planting so there will be 4 weeks of growth before cold weather will stop growth. This can be anywhere from late August through the first of November, depending on the location and the type of seed used.
- Once the soil is prepared, plant large-seeded cover crops (peas, vetch, and wheat) in shallow, closely space furrows.
- Broadcast small-seeded crops (ryegrass, buckwheat, clover) over the surface and cover with a light raking.
- If the soil is dry, irrigate often enough to keep the soil damp for germination to occur. Irrigate during any prolonged period of drought.
- If the garden still contains crops such as cool season vegetables like broccoli, plant the cover crop seed around the edges of the vegetables or in-between rows.

Tilling the cover crop:

- In the spring, once the ground is dry enough for tilling, turn the cover crop under.
- If the cover crop is too tall for tilling, mow or use a weed-whacker first. Leave the clippings to decompose or carry them off for composting.
- Allow 3 weeks for decomposition of the organic matter after tilling before intending to plant the garden. Decomposition must occur for the allelochemicals to not inhibit the germination of garden seeds.
    - Cover crops that produce allelochemicals: Oats, mustard, radish, buckwheat, barley, sweet clover, cereal or winter rye, sorghum, sorghum-sudangrass hybrids, sudangrass, clover (red, white and subterranean), wheat.
- It is best to till the cover crop under before it flowers or sets seed as it will become woody and more difficult to break down with maturity. Do not allow cover crops to go to seed. This could produce a weedy situation (as with vetch) in the garden.

- If the soil is too wet to till and the cover crop is setting seed, cut down the crop and compost. Till in the bottom of the plants when the soil is dry and still get the major benefit.

Putting your gardens to bed with a cover crop can help to grow, capture and recycle nutrients that would otherwise be lost during the winter and spring. Cover crops also add plenty of green manure that can be turned under in the spring. Organic matter additions to the soil are a continual necessity, and an annual planned program of cover crop planting and management is one way to ensure the soil stays nutrient rich and productive.

Healthy soil = healthy plants: when you build and maintain soil that is nutrient rich, you literally lay the foundation for plants to thrive. It is rather exciting to learn how to do your part!

Lastly, I would like to leave you with a mental picture of the soil on this planet and how important it is that we all do our part to protect it and keep it productive.

- Imagine the earth as an apple.
- Cut the apple into 4 equal pieces.
- Three of the 4 pieces represent all the bodies of water on the earth.
- The last quarter piece represents the land of the earth.
- Cut this quarter in to 2 pieces.
- One of the 2 pieces represents land that cannot be used for agriculture or growing – like desserts, mountains, arctic.
- The piece that remains is 1/8 of the apple (earth) and this is what is available for people to live on and grow food on.
- Slice that remaining last piece into 4 slivers.
- Three of the apple slivers represent the land that is too poor for agriculture or filled with cities and roads.
- The remaining sliver of apple is 1/32.
- Trim the peel off of the sliver and lay it out on the table.
- That tiny peel represents all the topsoil that we have to grow food on.

This simple illustration really makes a point. That tiny strip of apple peel is what we all have to work with and take care of to make sure that it continues to provide for the present and future generations. Soil is definitely not something to be taken for granted. It is a resource that is worth learning about, depositing back in to, and protecting. Each of us, individually, can play a role in keeping our soil healthy and productive.

Resources used:

OSU Master Gardener text book, Sustainable Gardening

Chart A: Diagram of soil ingredients from: http://www.vanaturally.com/guide/soil.html

Chart B: Diagram of soil particle size from: http://pnwmg.org/mgsoils.html

Chart C: Diagram of availability of soil nutrients from: http://www.eatcology.com/index/

Chart D: Comparison between organic and inorganic fertilizer, information take from Sustainable Gardening.

Diagram E: Illustration of compost pile from: http://whatcom.wsu.edu/ag/compost/fundamentals/needs_placement_structures.htm

Chart F: Chart on cover crop options from: http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/17462/fs304-e.pdf

Here is another quick resource for creating a hot compost: http://extension.oregonstate.edu/gardening/how-encourage-hot-compost-pile

http://ohioline.osu.edu/agf-fact/0142.html

http://extension.udel.edu/kentagextension/2009/04/09/small-grain-cover-crop-weed-suppression-by-allelopathy/

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