www.powderriverbasin.org

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307-672-5809

POWDER RIVER BASIN
Resource Council

Resources for Soil Health

Websites with extensive information on soil health:

Soil Health | Farmers.gov: Resources for Farmers and Producers
https://www.farmers.gov/conserve/soil-health

Soil Health Management | NRCS Soils
https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/mgnt/

Printable Guide:

Reducing Risk through Best Soil Health Management Practices Lists multiple resources including some specifically for the western states
https://ofrf.org/wp-content/uploads/2019/09/OFRFRMAGuide.pdf

Video Resources:

Gabe Brown - Keynote at Farming For The Future 2020
Excellent video by Gabe Brown, farmer from North Dakota, featuring his journey from conventional, monoculture farming to a regenerative, healthy soils system. Gabe has become an expert on implementing soil health. He's the author of "Dirt to Soil" available through your local bookstore or online.

https://youtu.be/ExXwGkJ1oGI

Northern Plains Resource Council's recent Soil Summit Focusing on Policy and Financing Tools Featured speakers focused on how policy and financing tools can promote soil health and the adoption of soil health practices:
Wayne Honeycutt of the Soil Health Institute, and Duane Hovorka of the Izaak Walton League who presented on a comprehensive soil health soil health strategy and federal policies impacting soil.
Brian Shobe of the California Agriculture and Climate Network, Liz Moran-Stelk of the Illinois Stewardship Alliance, and Isabelle Jenniches of the New Mexico Healthy Soil Working Group, shared what their respective states have achieved on soil health policy and how it's making a difference.

https://northernplains.org/2020-soil-summit/

Kiss The Ground A recently released documentary available on Netflix on the importance of soil health here and across the world and the importance of grazing animals in achieving and maintaining soil health.
https://kissthegroundmovie.com/#watchonnetflix

Soil Function, Health, and Management

Caitlin Youngquist
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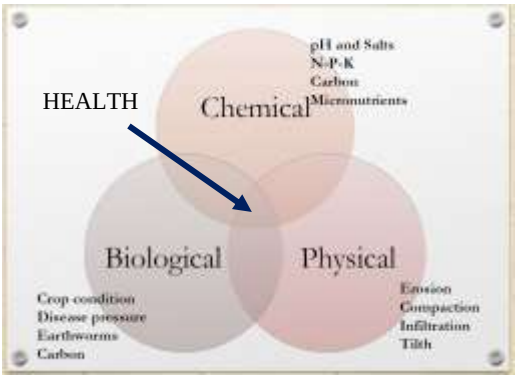
Soil Health = the capacity of soil to function in terms of:

- Biological productivity (plant growth, decomposition, nutrient cycling)
- Environmental quality (filter/transport water, resist erosion)
- Plant, animal, and human health (reduce pathogens and pollutants)

Healthy soils are profitable and productive soils.
Healthy soils are more resilient in the face of environmental and production stresses.
Healthy soils usually require fewer nutrient inputs to maintain profitable production.
Healthy soils are more drought resistant, and better able absorb and store water during extreme rainfall events.

To start managing soils for greater health, resiliency, and profitability, consider the following:

1. Reducing disturbance and bare soil are the most important first steps
2. Healthy soils are managed to account for the complex interactions of biological, physical, and chemical factors.
3. Improving soil health takes time – soil organic matter is lost more quickly than it can be restored.



RESOURCES:

- YouTube play list, including farmer/rancher interviews: https://www.youtube.com/channel/UCgzaHXAnS6QpDv_snx0ibGg/playlists
- Collection of extension bulletins on numerous topics related to soil management: https://www.dropbox.com/sh/vkvs8r8be1unqbm/AACQTfsqgKzp33vQbJkUTzqLa?dl=0
- SARE cover crop topic room: http://www.sare.org/Learning-Center/Topic-Rooms/Cover-Crops
- SARE "Building Soils for Better Crops": http://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition

Caitlin Youngquist
Caleb Carter

Many Wyoming landowners are no stranger to the challenges of saline (sometimes called "alkali") soils.

Saline soils are high in **water soluble salts,** which can severely limit plant growth. In extreme cases, the salts accumulate on the soil surface leaving fine white crystals. Saline soils are most often found in arid or semi-arid climates such as ours, where potential **evapotranspiration** is greater than precipitation. Saline irrigation water can compound the problems associated with saline soils.

Chemistry Lesson

People often confuse the term "salinity" with common table salt, or sodium chloride (NaCl). But salinity is actually a measure of **water soluble salts**. These are simply positively and negatively charged ions dissolved in water. While this can include table salt, it also includes many other ions. For example, epsom salt (magnesium sulfate) is made from a magnesium ion (Mg^{2+}) and sulfate ion (SO_4^{2-}) bound together. When dissolved in water, magnesium and sulfate ions are free and can interact with other ions and molecules. Ammonium nitrate ($NH_4^+ + NO_3^-$) and potassium sulfate ($2K^+ + SO_4^{2-}$) are common fertilizers and also salts. The ions that most commonly accumulate in soils are calcium, magnesium, potassium, sulfate, chloride, sodium, and carbonates. With the exception of the last two, all of these ions are essential plant nutrients.

Salinity is typically measured by electrical conductivity (EC). This can be measured by a laboratory or using a handheld meter. Units for measuring salinity can vary, though deciSiemens per meter (dS/m) is the preferred unit. EC can tell you the total water soluble salts, but it does not provide specific information on **which** salts. A telltale sign of saline soils are the white crystals that form on the surface of the soil, especially in low-lying areas. A more thorough lab analysis can help identify which salts are present. Contact your local UW Extension office for help collecting a sample for a lab or interpreting results.

Effects on Plants

Plants absorb water and dissolved nutrients through their roots. When the soil water solution that contains these dissolved nutrients becomes saline (in other words, has too many dissolved ions), the plant has to use more energy to get the water needed to thrive. This condition is known as **physiological drought,** and the symptoms include stunted growth, wilting, yellowing in older leaves, and "burned" leaf margins. While there may be plenty of water in the soil, the plants simply cannot use it. This condition is also common in houseplants.

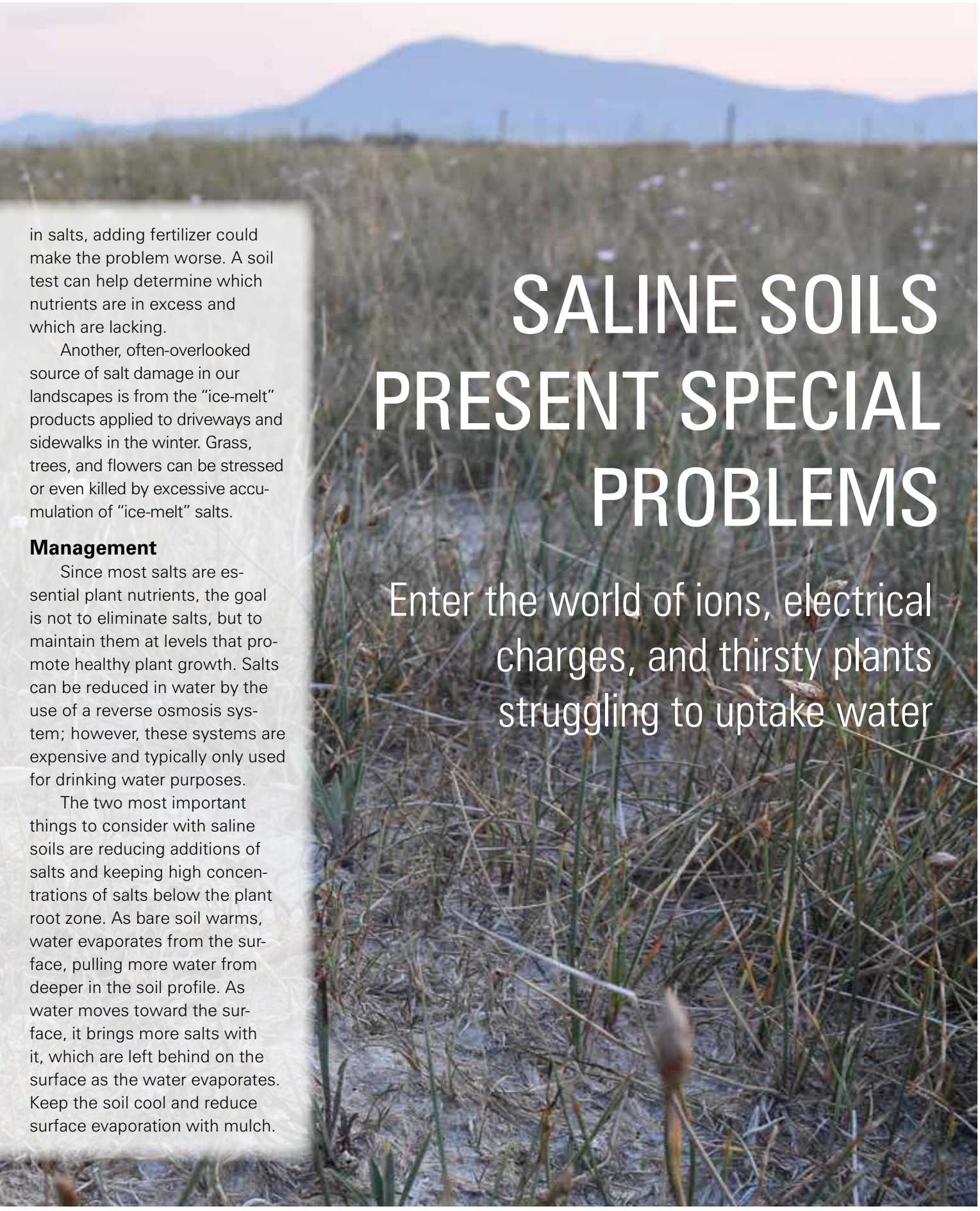
Some plant species are more tolerant to saline conditions than others. For example, beets and squash are among the most salt tolerant vegetables, while beans, peas, carrots, and onions are very sensitive. Seedlings are more sensitive than mature plants. Russian olives and junipers are more tolerant than fruit trees and aspens.

Sources of Salts

Without any help from us, salts can accumulate in the soil from weathering rocks in regions with very low precipitation or poor drainage; however, many common farming and gardening activities make the problem worse.

Irrigation water (even city water) contains dissolved ions (salts) that can accumulate in soil faster than they are used by plants. Fertilizer, manure, and compost all contain some level of salts. Remember, most salts are also essential plant nutrients but will cause plant stress when present at high concentrations.

Manure and manure-based composts typically are higher in salts (nutrients) than yard waste compost. Use caution when adding raw or composted manure to the garden or landscape if your soils or irrigation water are already high in salts. Synthetic fertilizers are concentrated sources of nutrients and therefore salts. If your garden soil or irrigation water is already high



in salts, adding fertilizer could make the problem worse. A soil test can help determine which nutrients are in excess and which are lacking.

Another, often-overlooked source of salt damage in our landscapes is from the "ice-melt" products applied to driveways and sidewalks in the winter. Grass, trees, and flowers can be stressed or even killed by excessive accumulation of "ice-melt" salts.

Management

Since most salts are essential plant nutrients, the goal is not to eliminate salts, but to maintain them at levels that promote healthy plant growth. Salts can be reduced in water by the use of a reverse osmosis system; however, these systems are expensive and typically only used for drinking water purposes.

The two most important things to consider with saline soils are reducing additions of salts and keeping high concentrations of salts below the plant root zone. As bare soil warms, water evaporates from the surface, pulling more water from deeper in the soil profile. As water moves toward the surface, it brings more salts with it, which are left behind on the surface as the water evaporates. Keep the soil cool and reduce surface evaporation with mulch.

SALINE SOILS PRESENT SPECIAL PROBLEMS

Enter the world of ions, electrical charges, and thirsty plants struggling to uptake water

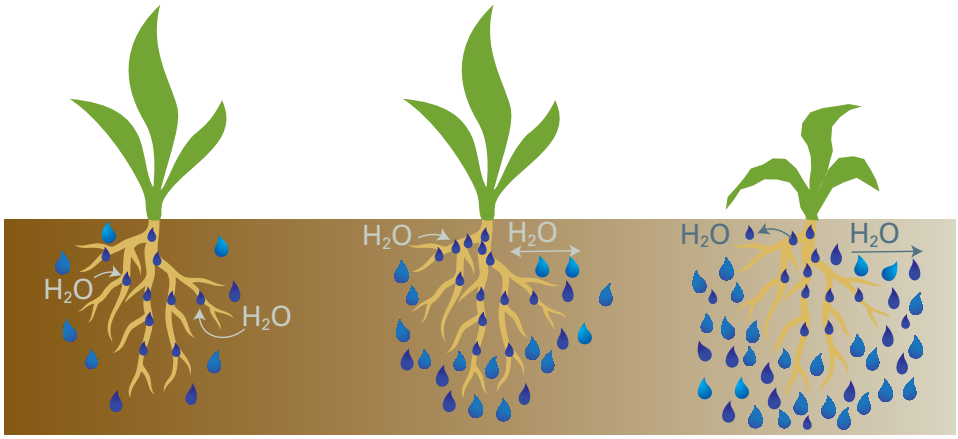
Grass clippings work well for this, as do wood chips, straw, and leaves. Mulch will also reduce weeds in your garden, add nutrients to the soil, and keep your plants happier!

If you have access to water that is low in salts and the soil is well drained, you can leach some of the salt deeper into the soil and below the plant rooting zone. Keep in mind that 6 inches of low-salt water will leach about half of the soluble salts as long as the water can move down through the soil and carry the salts below the rooting zone of the plants.

While saline soils and water can be challenging, they are not impossible to manage. Here are a few tips:

1. Establish raised beds and fill with clean soil low in salts.
2. Grow salt-tolerant varieties of vegetables, turf, and landscape plants.
3. Use transplants when possible; they are more tolerant of saline conditions than seedlings.
4. Keep the garden well-watered to make up for the fact plants are working a lot harder to get the water they do need.

When planning gardens or landscapes, we often talk about soil fertility, what varieties to plant, or how much water to use. Don't overlook potential negative effects from soil or water salinity. Soluble salts can be a problem in many areas of Wyoming, and addressing these issues early in your planning can help you be a more successful gardener!



Increased salts in root zone can result in decreased water uptake by plant.

Irrigating with water high in soluble salts can also damage plant leaves, cause desiccation (burn) of the leaf material and discoloration of fruit. Table 1 shows general guidelines for evaluating the potential for effects on plant growth based on the electrical conductivity (EC) of irrigation water.

Table1. General guidelines for salinity hazard of irrigation water based electrical conductivity[a]

Limitations for use	Electrical Conductivity (dS/m)
None	≤ 0.75
Some	0.76 - 1.5
Moderate[1]	1.51 - 3.00
Severe[2]	2 ≥ 3

[1]Leaching required at higher range.
[2]Good drainage needed, and sensitive plants may have difficulty at germination.
[a]Adapted from: http://extension.colostate.edu/topic-areas/agriculture/irrigation-water-quality-criteria-0-506/

Evapotranspiration is the transfer of water vapor from the land to the atmosphere and includes evaporation AND transpiration. Transpiration is the biological process by which cell water in plant leaves evaporates.

Sodic describes soils high in sodium, specifically. These soils are much more challenging to manage and are sometimes called "black alkali." They typically have very poor drainage caused by a loss of soil structure. A soil test is the only way to diagnose sodic soils. Leaching salts without the addition of calcium can make sodic soil conditions even worse.

For more information see:

- bit.ly/salinesoils
- bit.ly/irrigationwater
- bit.ly/salinitysalt
- bit.ly/salinityturf

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GROWING HEALTHY SOIL IN THE GARDEN

Caitlin Youngquist

Just like location, location, location for real estate, it's soil organic carbon, soil organic carbon, soil organic carbon for soils.

Most farmers and gardeners understand the importance of having enough nitrogen, phosphorus, and potassium, but the value of soil carbon is often underappreciated.

Plants get carbon from the air through photosynthesis, but the carbon in the soil plays an important role in plant health by supporting soil microbial life, contributing to good soil structure and tilth, and increasing water holding capacity.

Soil is a living system, and increasing soil carbon levels is one of our best opportunities for increasing soil health.

Soil health is the capacity of soil to function in biological productivity (plant growth and decomposition); environmental quality (water filtration and erosion resistance); and plant, animal, and human health. Carbon is the most important unifying factor for all of these and also the primary ingredient of soil organic matter. Organic matter is what gives healthy soil its dark-brown color and rich, earthy smell.

When managing for soil health, it is actually the organic soil carbon that's of interest. Soil organic carbon was or is part of a living organism – microbes, earthworm castings, compost, decaying roots and leaves, manure, and humus. In contrast, soil inorganic carbon includes things like charcoal and calcium carbonate (ag lime).

Soil organic matter (SOM) and soil carbon are often used interchangeably, and while one is a component of the other, they are not the same.

SOM encompasses all organic components of the soil system. SOM consists of approximately half carbon while the rest is nitrogen, phosphorus, potassium, and other minerals. It includes living and dead plant and animal tissue as well as plant root excretions and soil microorganisms. SOM is typically a small percentage of the soil (less than 3 percent in most Wyoming soils) but plays a very important role in soil health, plant resistance to disease, water holding capacity, and soil tilth. SOM is a source of all essential plant nutrients in varying proportions (with the exception of carbon and oxygen, which

Scorpp - Shutterstock.com

come from air and water). Most fertilizers, on the other hand, provide only a few plant nutrients.

SOM sources include manures, compost, dead plants, and even living plant roots. All of these contain different forms of carbon-rich materials, including lignin, cellulose, sugars, lipids, and humic acids.

Soil Food Web

Plants do not absorb a significant amount of carbon from the soil, but SOM is the food and energy source for the soil food web. Larger soil organisms like worms and arthropods are the "shredders." They break down organic matter into smaller pieces and help aerate and mix the soil while they work.

Next come the soil microbes (bacteria, fungi, protozoa, and nematodes). There are billions of these little recyclers in a single shovel full of healthy soil, and they rely on organic matter for energy and nutrients. As they break down complex carbon-based molecules like lignin and cellulose in dead plants and manure into smaller components, many plant-available nutrients are released as byproducts. Plants would not be able to get the nutrients they need from the soil without soil microbes.

As all of these soil organisms, large and small, are eating and reproducing, they are also improving the tilth of the soil making it a more hospitable place for plants to grow.

There are many soil functions directly or indirectly affected by soil carbon.

1. **Soil microbial activity:** increases plant nutrient availability, enhances degradation of pollutants, and helps with plant disease suppression.
2. **Soil structure:** improves water infiltration, increases rooting depth, helps soil resist erosion and compaction, and improves oxygen availability for roots and microbes.
3. **Soil water holding capacity:** increases drought resistance and plant available water.

All of these soil functions help increase seed germination, root development, resistance to disease, and crop quality and yield.

Cost of Tillage

Many of the microbes involved in decomposition are aerobic, and create carbon dioxide as a byproduct (just like humans). Tillage introduces a large amount of oxygen into the soil very quickly. This stimulates microbial activity, which leads to rapid organic matter decomposition in the soil. As a result, valuable soil carbon is lost as carbon dioxide. This is why too much tillage is a primary factor in loss of SOM and declining soil health worldwide.

Tillage is also very damaging to soil structure, leads to long-term subsoil compaction, increases the risk of erosion, and discourages earthworms and beneficial soil fungi. Reducing tillage in a garden will improve the health of the soil over the long term. Consider using a shovel instead of a rototiller when you can and leaving the soil undisturbed as much as possible.

Showcake - Shutterstock.com

Rototilling in the fall leaves the soil bare and unprotected all winter. Let undiseased plants stay on the surface as mulch to protect the soil and feed the underground food web.

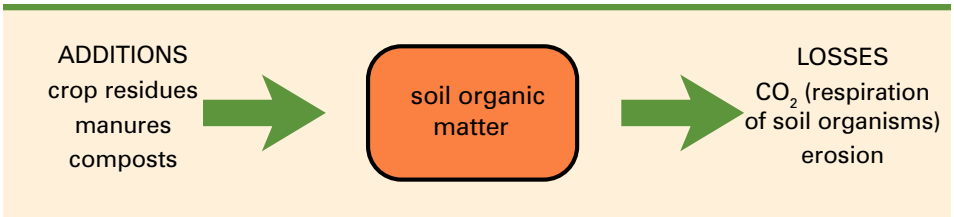
Some weeds like thistle and bindweed are spread by tillage as well.

Managing for Soil Carbon

Improving soil carbon status is a matter of increasing gains and decreasing losses (see chart page 13).

Using composts and manures is the simplest way to add carbon to soil. These can be added on top of the soil as mulch or incorporated before planting. Leaves and grass

Reduce Tillage	Add organic materials
Reduce losses	**Increase gains**
• Avoid excess tillage - use only when and where it's necessary • Dig garden beds by hand • Build "no-till" garden beds • Don't rototill the garden in the fall • Never leave soil bare - mulch with leaves, straw, grass clippings, etc.	• Mulch gardens and landscapes • Add compost or manure to the garden • Use sheet mulching to build no-till garden beds • Leave undiseased stalks and leaves in the garden as mulch to protect soil and feed the worms and microbes • Use annual weeds that have not yet gone to seed as mulch • Compost or bury vegetable kitchen scraps in the garden • Save your coffee grounds and add them to soil



Additions and losses of organic matter from soils.
From: Building soils for better crops: Sustainable soil management/by Fred Magdoff and Harold van Es. – 3rd ed.

clippings make great compost or mulch and don't have the same risk of high salt that manure does. Don't burn those leaves; use them to feed the soil!

Never leave the soil bare. Always use mulch to conserve water, protect the soil, and make a more hospitable habitat for soil organisms.

Alfalfa hay is also a good mulch or compost addition, as well as grass hay baled before it went to seed. Straw and wood chips make great mulch to help conserve water, protect the soil, reduce weed pressure, and provide food for the worms and soil microbes.

And don't forget coffee grounds and vegetable scraps; these can be added to the compost pile or buried directly in the garden.

Sheet mulching or lasagna gardening can be a great way to get rid of the rototiller in the garden, add carbon, prevent soil erosion, stop weeds, and use water more efficiently. Organic materials like leaves, grass, manure, coffee grounds, straw, and hay are added to the soil surface in alternating layers (with plenty of water). If kept reasonably moist,over time, these will decompose in place and create a lovely garden bed.

Keep in mind this process takes time and a lot of organic materials, so starting in summer or fall is best. For more information on this process, including photos and videos, visit bit.ly/notillgarden.

Living plant roots are another source of soil carbon. Plants secrete polysaccharides (complex sugars) into the soil that feed the microbes. Perennial plants shed dead roots and grow new ones as they go through cycles of growth and dormancy. These dead roots become food for soil microbes and are recycled, continually adding more carbon and nutrients to the soil. This is why soil under pastures, lawns, or prairie grasses can be so productive when converted to a garden or farm.

This process is also called carbon sequestration – taking the carbon out of the atmosphere (as carbon dioxide) and storing it in the soil as organic matter (note photo page 12).

Cover crops can be a great way to capture carbon and nitrogen from the atmosphere and store it in your soil. For more information about using cover crops in the garden, visit bit.ly/gardencovercrops

Reducing tillage, adding organic matter, and keeping living roots in the soil can keep more of the carbon in the soil where it is useful.

Soil specific

Humus is the highly decomposed portion of soil organic matter. Humus is made of humic and fulvic acids. These are very large, complex molecules that hold nutrients and water in the soil, making them more available to plants.

Soil tilth is a term used to describe the favorability of soil conditions for growing plants. A soil with good tilth has good structure, nutrients, and water holding capacity.

Tillage is the mechanical disturbance and mixing of soil. The degree and results of disturbance depend on the implement used. For example, a shovel causes much less disturbance and damage than a rototiller.

Measuring Change

Changes in soil carbon can be measured. The simplest method only requires a shovel, while more advanced methods involve laboratory analysis (more information bit.ly/soiltestgarden).

A lot can be learned by digging a small hole and taking note of the color, smell, and structure of the soil. Soil with more carbon will typically be darker in color, have a stronger earthy smell (humus), and better tilth.

You may also notice more earthworms and deeper roots. Observing changes in color, smell, and structure over time can tell a lot about the effects of the current management on soil health and carbon status. Compare your garden or pasture soil to the soil along a fence line or other undisturbed area. Which one looks and smells better?

As you manage nitrogen, phosphorus, and potassium for a healthy thriving garden, consider ways to manage carbon, too. The long-term benefits will be well worth the time and effort.

Caitlin Youngquist *is a University of Wyoming Extension educator specializing in agriculture and horticulture serving northwest Wyoming. She can be reached at (307) 347-3431 or at cyoungqu@uwyo.edu. See www.uwyoextension.org/drcaitlin for her blog!*

GARDEN COVER CROPS

bolster soil nutrients, organic matter

And that means more produce for you

Caitlin Youngquist

You have probably heard about the benefits of cover crops on farms, but what about in gardens?

Cover crops can improve soil health, add nitrogen, attract pollinators and other beneficial insects, discourage weeds, and break disease cycles.

A rotation system is the simplest way to use cover crops in a garden. Plant half or one-third of a garden space with cover crops in the spring and plant the rest of the garden with annual vegetables and flowers.

Each year, rotate the ground that has been in cover crops back into garden crops. Designate a separate spot in the garden for perennial crops like herbs and strawberries, and keep them out of the cover crop rotation.

Selecting Cover Crops

Cover crop species selection depends on your goals, location, the time of year of planting, and seed availability. Legumes (clover, peas, vetch) "fix" nitrogen from the atmosphere with the help of symbiotic bacteria living in their roots. This means they take nitrogen from the air (unavailable to plants) and put it into the soil (available to plants). For this reason, most cover crop mixtures will include at least one legume.

Mustard and **buckwheat** attract pollinators and beneficial insects to their flowers and can help reduce weed emergence if they are tilled into the soil.

Many grains and grasses tolerate cool, early spring temperatures, rapidly outcompete weeds, and provide structure for vining legumes. Grain seeds like **wheat**, **barley**, and **oats** are often readily available and inexpensive. **Millet** is well-adapted to the warm summers (in some areas) and alkaline soils of Wyoming.

Radishes and **turnips** can help loosen soil and will continue to grow beyond the first light frost. Table 1 on page 9 provides a few examples of cover crop mixes to get started.

A **cover crop** is a crop grown specifically to protect and improve the soil, or break disease or weed cycles. Unlike cash crops, cover crops are not harvested for market, although in some cases they are grazed by livestock. Common cover crop species in Wyoming include peas, barley, radishes, turnips, sunflowers, and grasses.

Planning, Planting Cover Crops

A cover crop may need watered at establishment, and periodically during the summer, depending upon where you live. In areas that receive at least 14 inches of moisture per

year, some cover crop species may not need watered at all (growth may be significantly less than when watered).

When planting cover crops, the goal is to quickly establish a thick, healthy, cover crop stand that can out-compete and smother weeds.

The timing and method of planting will depend on location, garden size, available tools, and goals. Cover crops can be planted in rows, broadcast, or drilled. Seeding depth and rate will depend on the species being planted. Larger seeds like **peas** can be planted up to 2 inches deep, while smaller seeds need to be closer to surface. Carefully follow instructions on the package, if included. If purchasing seed in bulk to make your own mix, ask the seed company for seeding rate and planting depth recommendations.

A perfect seed bed is not required, and seeding rates can be increased to accommodate rough ground; however, keep in mind smooth ground will make life easier if trying to get a lawnmower through the cover crop later in the year.

Mow the cover crop a few times during the year to keep it from going to seed. This is very important. Cover crops in the wrong place are still weeds! The goal is to prevent the cover crop from going to seed, while also getting the maximum soil benefit. Mowing can be done with a lawnmower, weed eater, hand scythe, or even small livestock, like goats. The residue left after mowing will protect the soil and discourage weeds.

White mustard

Wyoming winters are cold enough to kill many common cover crops; however, some vetches, clovers, and grains are hardy enough to survive winter in some parts of the state. Do your research to avoid any surprises if counting on winter to terminate your cover crop.

Getting Ready for Growing Season

Some soil prep work will be required in early spring to get the area that was under a cover crop ready for this year's garden crops. When plants die, they become a valuable mulch that continue to protect the soil and discourage weeds until the next spring when time to plant again.

If transplanting, consider leaving the cover crop mulch in place and simply clearing a small area for each transplant. This mulch will continue to suppress weeds and conserve water throughout the summer.

If a smooth seedbed is needed, the cover crop residue can be incorporated with a rototiller several weeks before planting. Tilling the soil will increase weed seed germination and remove your protective mulch. Be sure to add a thick layer of straw or leaves after planting to protect the soil, suppress weeds, and conserve water. Leave the straw mulch in flakes or use heavier mulch like wood chips in windy regions of the state.

Other Methods Grow Benefits

There are other ways to benefit from cover crops in the garden that

require more precise planting, termination dates, methods, and more careful management. For example, planting a cover crop in the summer after early spring crops like **lettuce** have been harvested, but before fall crops like **kale** and **spinach** are planted, reduces weed pressure and adds nutrients.

Fall cover crops can be planted in garden beds after summer harvest and allowed to grow until they are winter-killed (just don't let them go to seed!). Annual cover crops like wheat or barley between garden rows can reduce weeds and protect the soil. Regular mowing helps keep the growth short and thick.

Another method, called relay seeding or inter-cropping, establishes cover crops before garden crops are harvested. This requires a careful choice of species and timing of planting but gives the advantage of establishing a cover crop early enough in the fall to allow good growth before a killing frost.

For example, a cover crop is planted in between rows of a well-established garden crop, and once the crop is harvested, the cover crop will continue to grow.

Cover crops can add nutrients and organic matter to soil, improve tilth and workability, suppress weeds, break disease cycles, and feed soil microbes. Start with a small section and try a few different seed mixes to find one that does well in your region. And remember, don't let them go to seed!

For more information

The following bulletins provide more information about using cover crops in a garden, including recommended seeding rates. For links to these bulletins and other resources:

- http://bit.ly/drcaitlin
- http://bit.ly/soilsandfertilization, *Methods for Successful Cover Crop Management in Your Home Garden*. Washington State University Extension. FS119E. February 2014.
- http://bit.ly/morecovercrops, *Cover Crops for Utah Gardens*. Utah State University Extension. June 2010.

Cover crops, trap crops, vegetable crops – **Caitlin Youngquist** *knows her peas and cukes. She is a University of Wyoming Extension educator based in Washakie County and serving northwest Wyoming. Contact her at (307) 347-3431 or at cyoungqu@uwyo.edu.*

Table 1: *Here is a simple way to get started creating your first garden cover crop mix. Simply choose one species from each column and plant at the rates specified. Document your experience, take notes, and adjust the seeding rates for future plantings. Additional species like buckwheat or mustard can be added as you gain more experience with cover crops.*

COLUMN A		COLUMN B	
Grains	**Seeding rate per 100 sq ft**	**Legumes**	**Seeding rate per 100 sq ft**
Oats	¼ lb	Field peas	¼ lb
Wheat	¼ lb	Crimson clover	⅛ lb
Barley	¼ lb	Vetch	⅛ lb

Fall soil prep turbocharges garden for 2020 bounty

Spring weather makes us think about getting soil ready for gardening, but smart gardeners know fall prep is the key to next year's success. Fall is the best time to add organic matter.

Organic materials such as manure, compost, leaves, hay, and grass clippings add valuable carbon and plant nutrients to soil. They also feed the worms and microbes that keep the soil system functioning and healthy. Adding these materials in the fall gives all the soil critters plenty of time to work – releasing nutrients into the soil and creating the perfect home for plant roots.

Leave it messy

If you love your soil, don't leave it bare! Think about tucking the garden in under a cozy blanket instead of leaving it naked and cold all winter. Cut and leave the annual weeds (no seeds!), small plants, and any unharvested and undiseased veggies to recycle back into the soil. Remove larger, woody plants like corn stalks and sunflowers. Cut these off near the surface of the soil and leave the roots in the ground. In the spring, you will be amazed how

photos: Caitlin Youngquist

Using a lawn mower to shred and pick up leaves makes a perfect blend for composting.

Woven wire fencing can be used to make simple, portable compost bins.

Fill these with grass clippings and leaves, coffee grounds, garden trimmings, vegetable scraps, etc. Put larger plants and woody stems through a wood chipper before composting so they will break down quickly. Layer materials as you fill the bins or mix on a tarp first.

Water is critical for all compost microbes. Make sure all raw materials are damp when the bins are filled and set the hose or sprinkler on the compost every couple of weeks to keep the microbes working.

many worms are living (and feasting) on these root balls.

Large, woody stems can be chipped for the compost pile or burned. If burned, put the ashes in the compost pile.

Mulch

Grass clippings and fall leaves are wonderful for soil, but you may find they blow away in the wind. Alfalfa hay makes great winter mulch, or clean grass hay without seeds. The flakes hold together and usually stay where you put them! Moldy hay works well, and you can often get it for free. Mulch will protect the soil from heat during the growing season, conserves water, and reduces time spent weeding.

Manure and compost

Add 1-2 inches of manure or compost if available to your garden in the fall but don't rototill! Work your soil gently with a shovel or garden fork before planting in the spring. You can also make your own compost from leaves, grass clippings, coffee grounds, vegetable waste, garden clippings, etc.

Caitlin Youngquist is the University of Wyoming Extension agriculture and horticulture educator based in Washakie County and serving northern Wyoming. She is on a mission to retire all of the roto-tillers in Wyoming and can be reached at (307) 347-3431 or cyoungqu@uwyo.edu.

The Worland Community Garden under a cozy blanket of mulch. Note the bags of leaves collected for compost.

Sample of inspiring and challenging resources for a rancher on the High Plains.

(THE GRAND UNDERTAKING TO REGENERATE AND TAKE BACK RURAL AMERICA)

10/29/20

Mac Mcartney Why are we here in the first place? Mac helps us discover the why and some of the "how". There is a link to his Ted Talk. Please watch one of them.

https://embercombe.org/mac-macartney-2/

Gabe Brown ***"Dirt to Soil"*** www.brownsranch.us

Nicole Masters ***"For the Love of Soil"*** (brand new) www.integritysoils.co.nz

https://drive.google.com/drive/folders/1deDAT5KsB5Qqhb2aavCnez6AtfXIepVZ

David Montgomery ***"Growing a Revolution: Bringing our Soil Back to Life"***

Judith D Schwartz : Her most recent is fantastic with stories of real time large scale restoration around the globe. ***"The Reindeer Chronicles"*** And her two excellent previous books ***"Cows Save the Planet"*** ***"Water in Plain Sight"***

Jim Gerrish ***"Kick the Hay Habit"***

Christopher Leonard ***"The Meat Racket"***

Fred Provenza ***"Nourishment"*** www.youtube.com/watch?v=jwSdKDj5JZs **Links to pieces of the puzzle**

Thinking differently

Robert Chadwick: ***"Finding New Ground"*** teaches how to find consensus without compromise. You read that right. His work is showcased in the story of Jeff Geobel in "***The Reindeer Chronicles"*** We can think and act differently!

Rob Hopkins: ***"From What is to What if"*** Unleashing the Power of Imagination to Create the Future WE Want. A very inspiring book about the power of collective imagination. How we can work together to really make a difference for our children and grandchildren.

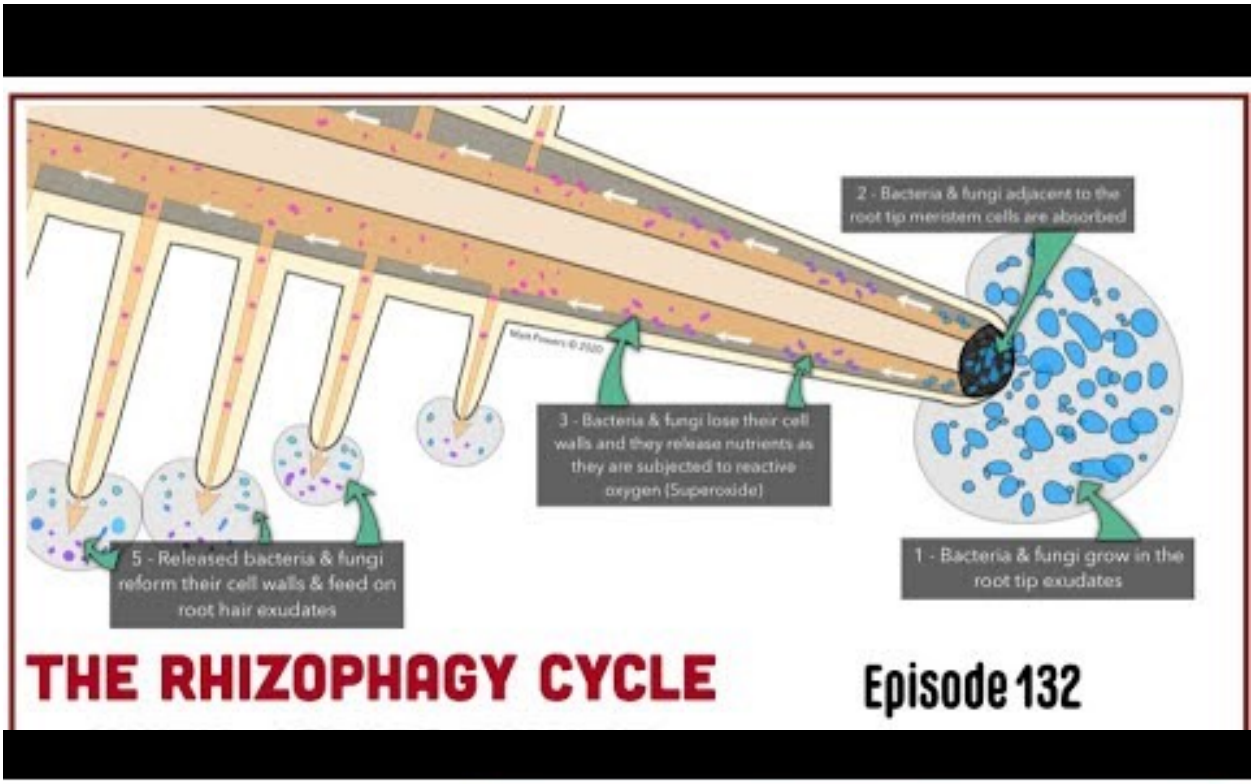
Doug Pow and Dung Beetles (some of the most exciting work) http:// www.futuredirections.org.au/publication/doug-pow-dung-beetles-eco- engineers/ and https:// www.youtube.com/watch?v=_JPoItRWYSQ

Amazing Benefits of Bio-char https://peerj.com/articles/7373/? fbclid=IwAR3cvvI19fEYZk5BCN-mvKNAlflj-GOWA1rSXgQ6WZvSxRr8LzFjjKy1wmA

Mike Callicrate mikecallicrate.com

Christine Jones quorum sensing https:// www.youtube.com/watch? v=NqV1b4ps-sE&feature=share

Matt Powers Watch Matt interview some of the very leading discoveries of what happens in the sun-plant-microbe community. If you don't fall helplessly in love with life after



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A Regenerative Future

watching this, there is some more work to be done. Here are a couple of my favorites.

John Kempf Here is another from John's own site. He is really doing it on the land - and lots of it! He has lots of very good interviews that will really stretch us!

Bob Kinford Low Stress awakening herding instinct. Interviews: https:// workingcows.net/ep-107-riki-kremers-getting-started-with-migratory-grazing/ http://bobkinford.com/

Virtual Fence - a game changer. https://www.agersens.com/ Bionutrient Food Association https://bionutrient.org/site/

White Oak Pastures https://www.whiteoakpastures.com/meet-us/about-white- oak-pastures/

Kathryn Bedell and Rancher owned coop in formation in Colorado https:// mountainswestlivestock.com

Podcast with lots of good interviews workingcows.net

Chris Newman Growing and marketing co-op https://medium.com/ sylvanaquafarms/small-family-farms-arent-the-answer-742b6684857e https://www.sylvanaqua.com/

Keyline plowing: Circle Ranch http://circleranchtx.com/tag/subsoiling/
Walter Jehne https://www.youtube.com/watch?v=3nC6j80sLZo&feature=push-

u&attr_tag=JJlAthR7qnn9denu-6

Zach Bush, Md. Zach is the one of the founders of farmersfootprint.us which is absolutely inspiring. His work with Glyphosate is what got him on the path to regenerative ag. Very prolific speaker. Check him out now that winter is here. https://zachbushmd.com/ A recent interview https://www.youtube.com/watch? v=UhwO28J_nsE&feature=youtu.be

Ellen Brown https://www.truthdig.com/articles/the-key-to-solving-the-climate- crisis-is-beneath-our-feet/

Changing water cycles in Slovakia https://www.tamera.org/article-water-the- missing-link-for-solving-climate-change/

Water cycle shifts https://www.tamera.org/article-water-the-missing-link-for- solving-climate-change/

Alan Savory: https://www.ted.com/talks/allan_savory_how_to_fight_desertification_and_reverse_climate_change