



Make Your Garden More Climate-Resilient: Soil

Earth is undergoing a warming trend that results in melting glaciers, rising sea level, increasing ocean acidity, and more frequent and severe droughts and floods. The Pacific Northwest has seen prolonged drought, increasing wildfire incidence and severity, heat waves, insect outbreaks, and tree diseases. Reduced snowpack results in earlier peak flows in rivers and streams which reduces water supplies. In addition to these trends, climate change brings erratic, extreme weather events (heat wave, heavy rain) in greater frequency. Oregon Climate Assessments <https://blogs.oregonstate.edu/occri/oregon-climate-assessments/>

How do we garden in these times? This handout offers ideas for building resiliency into the garden soil.

What We Know

- By volume, healthy soil is 50% space which makes room for air and water. This allows roots to breathe and water to be absorbed. Examine a clump of healthy soil. We should see chunks loosely held together with voids between them. When soil is compacted, space becomes scarce causing problems for water penetration and root growth.
- Soil structure relies on fungi and bacteria acting as biological glue, aided by electrical charges in organic matter, to hold sand, silt and clay particles together. This structure is tenuous and can be damaged by disturbance such as digging and tilling.
- Fine-textured clay soil is easier to damage, especially when wet. It takes time to repair damaged soil. See steps below under 'How to Build Resiliency into Soil'.

Potential Climate Mitigation

- Soils capture carbon to reduce greenhouse gas in the atmosphere. Earth's atmosphere contains 750 billion tons of carbon while earth's soil contains twice the amount of carbon.
- Reduce soil disturbance. Tilling releases sequestered carbon into the atmosphere.
- Reduce loss of soil moisture to lessen drought stress on plants.
- Increase water absorption rate and soil's water holding capacity to adapt to prolonged rain.

How to Sequester Carbon

- Plants, soil microbes, woody products and aquatic environments all capture and store carbon.
- By growing a garden, planting trees, and not disturbing the soil, gardeners help remove carbon dioxide from the atmosphere and hold them in plants and in soil.
- When plants die and decompose, carbon is released back into the atmosphere. Growing long-lived plants, especially those with large biomass, such as trees, yields greater benefit.

How to Get Healthy Soil

- Rethink the traditional approach of adding organic matter for instant soil improvement. In a small area, such additions can create short-term benefits, but the act of amending destroys soil texture. Over time, organic matter breaks down to reduce the benefit.

- For the landscape, plant after breaking up native soil and removing large rocks. Cover newly planted areas with organic mulch, such as arborist wood chips, to improve soil over time.

How to Build Resiliency into Soil

- Minimize disturbance of soil: Dig only as needed for planting or weeding to reduce damage to soil structure. Work soil only when it's not too wet. Whenever possible, abandon the traditional method of working soil by digging or tilling; instead make vertical, deep channels with a spading fork and leave the mixing to earthworms.
- Keep soil covered: Plants shade soil surface to moderate temperature fluctuation, reduce moisture loss and suppress weed germination. Plant roots feed soil microbes with root exudates. Where no plants are grown, cover soil with mulch.
- Grow diversity: Plants discharge root exudates – each species has its own formula and attracts and feeds a unique group of soil microbes. In return, microbes seek out and deliver water and minerals to plants. Diversity of the plant community above ground leads to diverse soil life.
- Keep living roots year-round: Living roots feed soil life. Recent studies reveal that root exudates play significant roles in belowground plant defense against pathogens. Growing year-round provides sustenance to soil life year-round.
- Keep garden debris to feed soil microbes: Leave the leaves and, where aesthetics permits, chop and drop branches to compost in the garden bed.
- Say 'no' to chemicals that are designed to kill (i.e., herbicides, fungicides, insecticides, etc.) to protect soil life.
- Be purposeful about adding organic matter (OM): Test your soil before amending. Aim for 5 % of OM in garden soil and amend only if a test shows a need. Before amending, assess the pros and cons. Amending requires digging and mixing which destroys soil structure. While annual vegetables and ornamental plants benefit from amendment, perennials, shrubs and trees grown in clay-based soil may not need it. To amend new beds for annual plants, apply 2-4" of compost (one-time only); the vegetable garden can gain OM from cover crops; mature beds may be top dressed with a thin layer (1/2") of compost.
- Be selective with fertilizers: Synthetic fertilizer in high concentration speeds breakdown of OM. Use organic fertilizer or synthetic slow-release formulation only if soil test shows deficiency and poor plant performance warrants action.

Resources

Soil Organic Matter as a Soil Health Indicator, Oregon State University EM9251

<https://extension.oregonstate.edu/sites/default/files/documents/em9251.pdf>

The Dirty Secrets of a Living Landscape, Oregon State University EM9204

<https://extension.oregonstate.edu/sites/default/files/2023-10/em9304-update-100223.pdf>

Carbon Sequestration in Soil, Ecological Society of America

<https://www.esa.org/esa/wp-content/uploads/2012/12/carbonsequestrationinsoils.pdf>

Eisenhauer, N., Lanoue, A., Strecker, T. et al. Root biomass and exudates link plant diversity with soil bacterial and fungal biomass. *Sci Rep* 7, 44641 (2017). <https://rdcu.be/dpDv4>

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