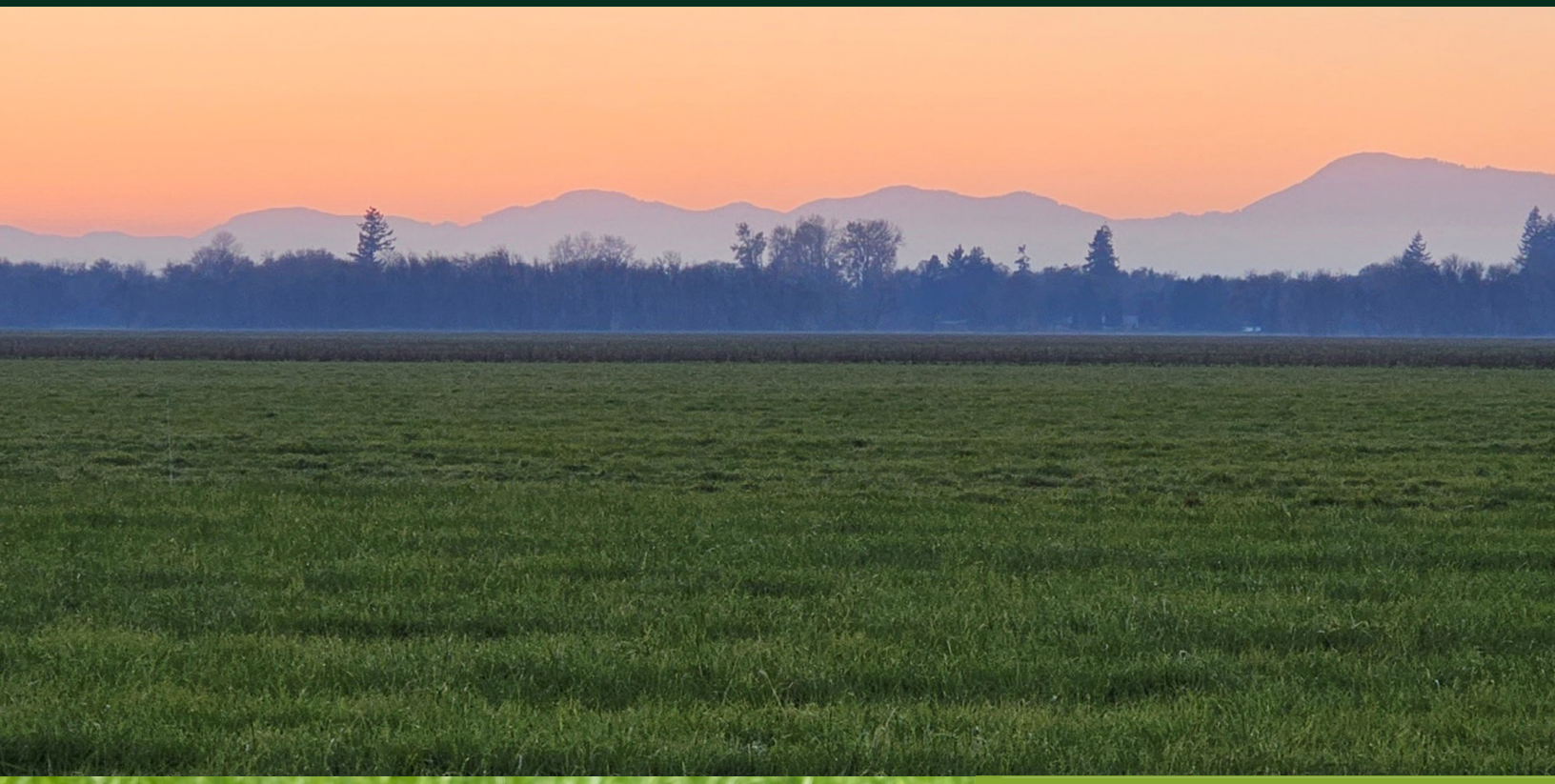
GRASS SEED CROPS

STEWARDING THE LAND BY SUSTAINING THE SOILS



Seed Crops Build Soil Health By:

- keeping the ground covered
- moving carbon from the atmosphere to the soil
- providing forage for livestock
- reducing the need for annual tillage
- providing carbon and nutrients to support soil life

A healthy soil is a living ecosystem that supports a diverse and active biological community.

Healthy soils aid crop production, maintain or enhance water and air quality, and promote plant and animal health.

SEED CROPPING PRACTICES BUILD & PRESERVE SOIL HEALTH

Grass seed production is an example of a complete soil health management system that implements practices in support of the four soil health principles —maximize soil cover, living roots, and diversity and minimize disturbance, These practices support soil health and provide high quality forage, turf, and cover crop seeds to global markets.

KEEPING THE SOIL IN PLACE

Erosion is a serious hazard to healthy soils. Plants and plant residue provide a continuous cover that keeps the soil in place. Grass seed crops provide year-round soil coverage, even during periods of dormancy. After the seed crop is harvested, the residual organic material is often returned to the field, which protects the soil, providing food for microbes and nutrients for crop growth.

MINDFUL TILLAGE MINIMIZES DISTURBANCE

Intensive or frequent tillage leads to loss of soil carbon and destruction of soil structure. Soil disturbance can be minimized by no-till drilling during transition crops, using surface tillage to prepare seed beds, and using vertical tillage to reduce tractor wheel compaction in target zones. Perennial seed crops can persist for several years, naturally preserving soil structure by extending the time between tillage events.

LIVING ROOTS FEED MICROBES

Living roots inject carbon into the soil, contributing to a healthy ecosystem. Grass seed crops have living roots that remain in the field year-round, feeding the soil microbial community and sequestering carbon.

LIVESTOCK AND CROP ROTATIONS MAXIMIZE DIVERSITY

Proper livestock grazing benefits soil health by distribution of urine and manure, which stimulates microbes. Grazing benefits plant vigor by encouraging root growth. Carbon from roots build soil organic matter and help form stable aggregates that facilitate water and root penetration deep into the soil profile. Growers team up with cattlemen and herders in a synergy where grass fields receive the benefits from proper grazing and the livestock benefit from a winter source of high-quality forage.

Biodiversity is further enhanced through crop rotations where brassicas, legumes, or other grains are grown between the grass seed crops. Different crops attract beneficial organisms such as pollinators and natural predators of pests. The diverse inputs, via root exudates and aboveground crop residues, further stimulate the microbial community and often increase soil carbon and nutrient cycling.

HOW DOES ORGANIC CARBON MAKE SOILS AND FARMS HEALTHY?

BUILDS & MAINTAINS AGGREGATE STABILITY

Soil organic matter and microbes release substances that help soil particles stick together. These stable aggregates resist erosion, facilitate infiltration of water, and increase water storage and availability For plants, this provides a better environment for growth and improves drought resistance.

BUILDS & PROTECTS SOIL CARBON POOLS

Adding organic carbon to the soil combats climate change, increases system resiliency, and provides food and habitat for soil organisms. Increases in soil carbon help stabilize yield and allows for earlier entry into fields by improving water infiltration.

ENHANCES BIOLOGICAL DIVERSITY

Organic matter is the foundation of the soil food web, supporting microbes, earthworms and other organisms that are important for soil function. Having a diverse microbial population can reduce the need for pesticides and fertilizers and can reduce plant stress.

CYCLES & CONSERVES SOIL NUTRIENTS

Organic matter acts like a sponge to absorb and slowly release nutrients, including nitrogen, phosphorus, and sulfur. Organic matter also feeds soil microbes that turn organic forms of these nutrients into forms that are available for plant uptake. Adding organic matter can therefore help reduce fertilizer costs and the energy it takes to apply them.

Plants move carbon from the atmosphere into soil through roots and residues. This carbon is the foundation of the soil food web that provides nutrients and energy for worms, insects, and soil microbes that decompose complex materials into nutrients that plants use to grow.

About half of soil organic matter is composed of carbon. Soil carbon exists in several forms, all of which contribute to different aspects of a healthy agricultural soil. Some forms of carbon feed microbes and other soil life, which improves biodiversity and supports nutrient cycling. Other forms of carbon become trapped between clay particles, forming and stabilizing soil aggregates. Soil aggregates are important for giving the soil structure and forming pores for air and water. In this way, soil carbon can help improve drought resistance by increasing plant available water and improving drainage.

Organic matter, in addition to supporting nutrient cycling by microbes, can hold onto nutrients, which keeps them on the farm and out of our rivers. Organic matter also acts like a sponge for water, holding 10-20 times its weight in water, and slowly releasing it to plants. When organic matter in soil increases, the amount of water and nutrients that can be stored and released increases, helping support high yields and high quality crops, which increases both ecosystem and economic stability for farmers.

In addition to the on farm benefits, soils are an enormous reservoir for carbon, reducing the greenhouse gases in the atmosphere that contribute to a changing climate.

Seeds of Change: How No-Till Practices Revived the Ruddenklau Farm

Bruce and Helle Ruddenklau. Photo by: Lynn Howlett

When Bruce and Helle Ruddenklau purchased their farm in the early 1990's, they were not aware that the ground was infested with herbicide-resistant annual ryegrass. In their first wheat harvest, the grain had to be separated from the ryegrass, producing low yields and diminishing seed purity. For a few years, they continued to plow the soil to prepare their seedbeds for autumn crops, and they continued to reap similar results: low yields and low seed purity. After learning about research that demonstrated annual ryegrass seeds can be viable in the soil for seven years, they knew that something had to change.

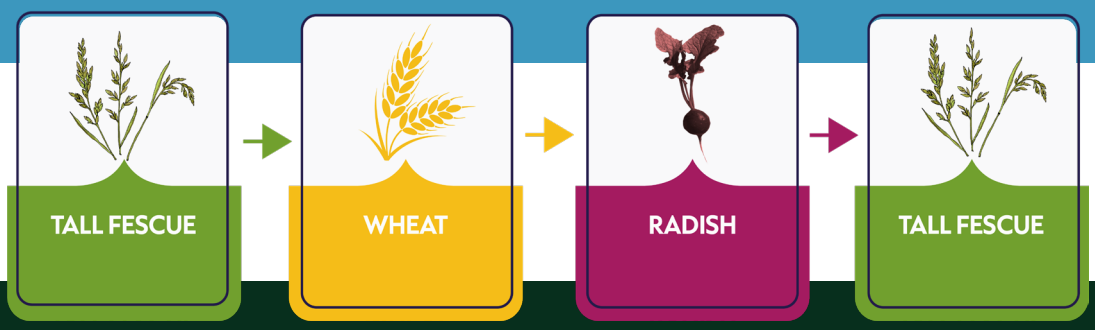
For the Ruddenklaus, that something was tillage. Rather than perpetuating the herbicide-resistant annual ryegrass infestation by burying the seeds in the soil, Bruce and Helle switched to no-till. By leaving the soil undisturbed, the seeds germinated on the surface, where they could be controlled with glyphosate, before reseeding. After several years of this, the cache of herbicide-resistant annual ryegrass seeds in their seed bank was depleted and the Ruddenklaus were able to profitably produce wheat, grass, cover crop, and specialty seed.

Switching to no-till had other benefits, too. Keeping the ground covered and undisturbed allowed the Ruddenklaus to enter the field with a no-till drill to plant spring crops - despite the wet, mucky soils that the Oregon spring creates. It also allowed them to plant a more diverse rotation of seed and vegetable crops, which also helped manage weeds. According to Bruce, "100% of the farm is a grass seed system, at any one time 40-50% of it is actively producing grass seed while the rest is rotating, ready to go back to grass. In order to have quality, weed-free seed tests that seed companies require, doing more than that would be a real challenge. Anytime you have a monocultural system, that will lead to problems. Crop rotation is key to having that quality that (seed companies) want".

A typical rotation sequence (shown below), is made possible by using combine-mounted straw choppers and no-till drills. Their system has allowed them to effectively control weeds while saving time and money by avoiding tillage. The soil health benefits of this system have also led to noticeable improvements in the structure of their soil, crop performance, and abundance of earthworms, and a reduced need for mineral fertilizer.

Bruce says, "It's been an eye-opening experience, the concept of being able to directly seed crops into tall fescue sod. When you look at it this time of the year (August) you think 'there's no way in the world I can put a seed into something like that and expect it to grow', but it works. Especially when you give it time to decompose and break down some of that material, it works phenomenally well."

The Ruddenklaus' journey from struggling to harvest wheat to mastering a no-till, crop rotation system highlights their resilience and innovation in sustainable farming.



STUDIES THAT LINK SOIL HEALTH AND SEED CROP MANAGEMENT PRACTICES

Photo by: Helle Ruddenklau

Although farmers have been cultivating seeds in the Willamette Valley for over a century, only a handful of studies have examined the effects of different cropping practices on soil health.

Two studies, one conducted in 2019 and one conducted in 2020, by researchers from Oregon State University and the USDA Agricultural Research Service (ARS) agreed that removing straw did not cause a statistically significant change in soil carbon stocks. However, both studies noted an increase in soil microbial activity with straw residue return. This microbial activity can help support nutrient cycling and other processes that improve soil health.

Baling straw can also lead to a depletion in potassium. The decision to bale therefore requires decisions that balance nutrient needs, soil health, and pest management.

Other studies are examining the impact of tile, or artificial drainage, on soil health. It is not known if adding more oxygen to the soil increases the amount of carbon in soils by encouraging root growth or if oxygenating the soils allows microbes to turn existing soil carbon into carbon dioxide.

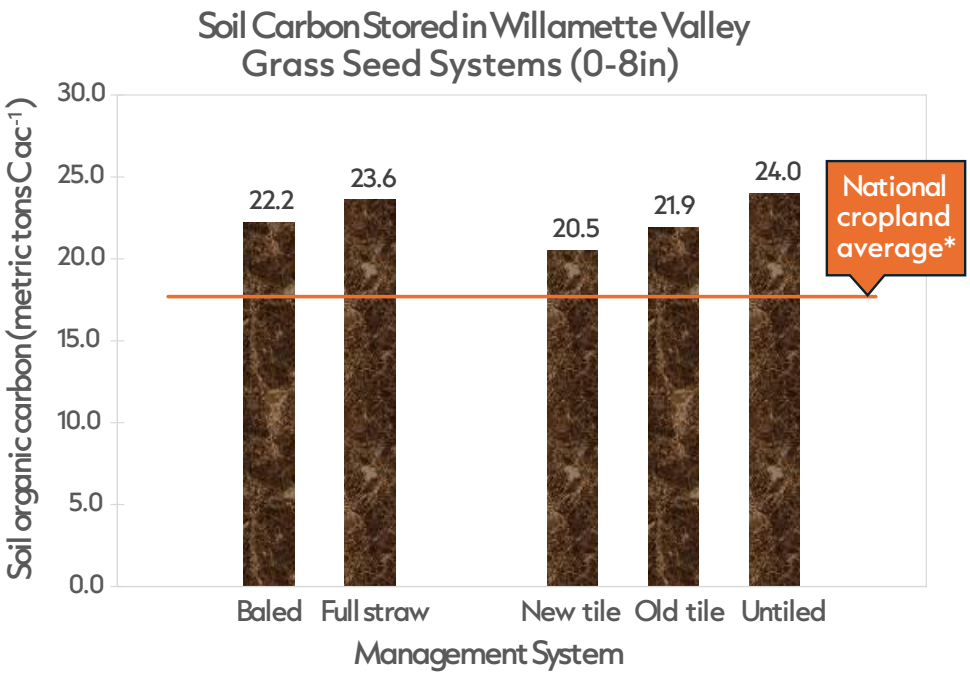
To study this, USDA ARS and OSU researchers examined fields in the north and the south Willamette Valley to determine if naturally drained soils had more soil carbon than fields that were recently tiled or that had been tiled for several years. They found that despite trends of slightly lower soil carbon in newly tiled fields, soil carbon recovered to levels measured in untiled fields. This is great news for farmers that want to install tile drainage to improve crop diversity, which can increase soil health and help sustain farm profits.

Research conducted at the USDA ARS and Oregon State University consistently demonstrates that grass seed production promotes and sustains healthy soils.

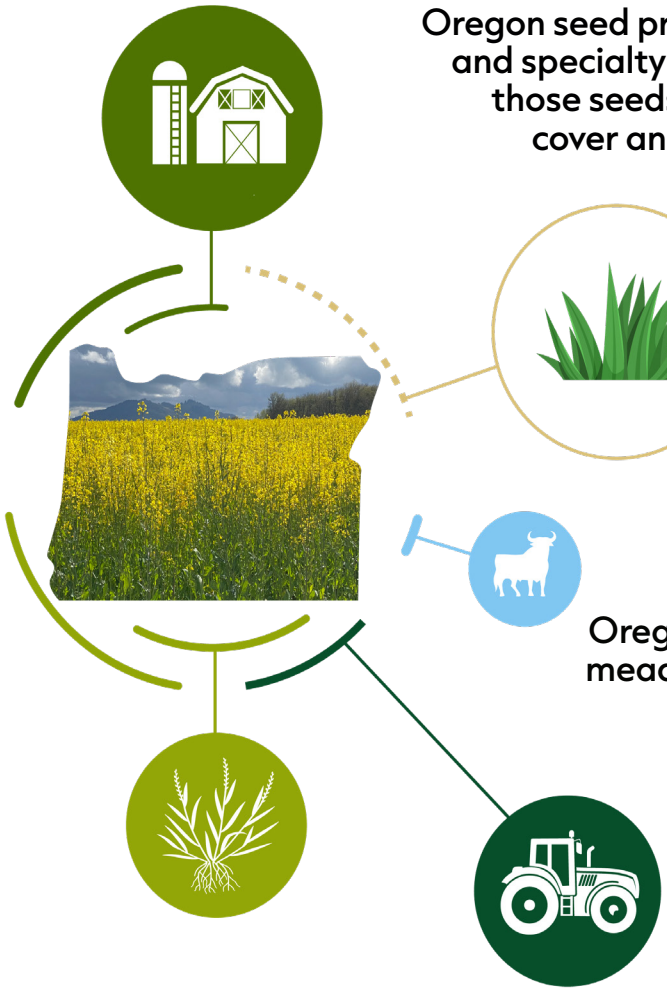
In the Willamette Valley, grass seed crops are commonly rotated with clover, wheat, meadowfoam, and mustard (shown here).

DO GRASS SEED CROPS STORE MORE CARBON THAN OTHER CROPPING SYSTEMS?

USDA ARS and OSU studies have demonstrated that despite small changes brought about by geography or cropping practice, soil carbon stocks in grass seed cropping systems are similar to, or exceed, the national cropland average!



HOW DO OREGON SEEDS CONTRIBUTE TO HEALTHY SOILS AROUND THE WORLD?



Oregon seed producers provide seeds for forage, turf, cover crops, and specialty crops to national and international markets. When those seeds are grown, they improve soil health by maximizing cover and living roots, increasing biodiversity, and providing perennial crops that don't require tillage.

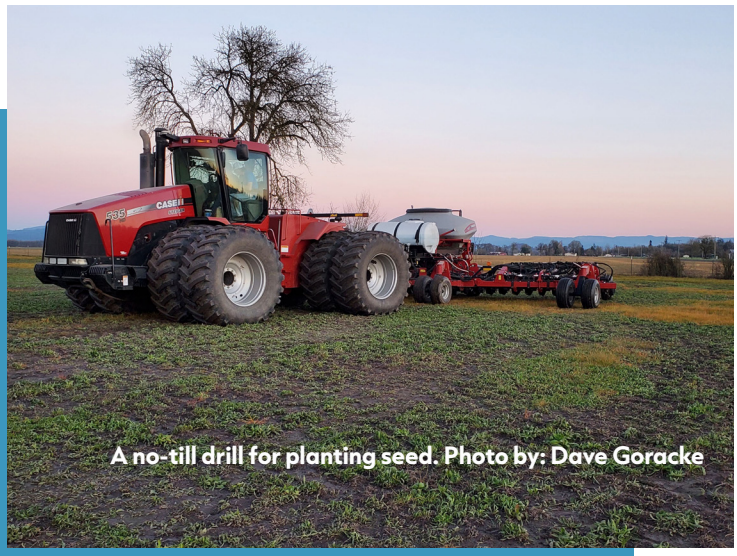
Oregon is the largest producer of cool season grass seed in the world! Seeds are exported to build lawns and sports fields providing recreational opportunities, aesthetic appeal and environmental benefits as it cools inner city temperatures and stores carbon .

Oregon seed and straw is used to plant and provide forage crops for livestock production.

Oregon farmers grow specialty seed like radishes, peas, meadowfoam, and other crops for food and oil markets.

Oregon is a leading producer of cover crop seeds, especially grasses and legumes, including varieties like annual ryegrass, crimson clover, and hairy vetch. Cover crops are an essential practice for creating healthy soils, storing soil carbon, and creating sustainable farms across the globe.

Cala Farms: Cultivating Innovation & Sustainability



A no-till drill for planting seed. Photo by: Dave Goracke

Cala Farms is a family-owned farm nestled in the heart of the Willamette Valley. For nearly 75 years, they have kept pace with the changing landscape of agriculture by continuously evolving their practices. Today, Cala Farms stands out for cultivating not only seed and food crops but also for cultivating soil health.

Like most seed farms, Cala Farms historically practiced conventional tillage and field burning, managing a rotation of annual ryegrass, tall fescue, meadowfoam, and clover. However, as concerns about sustainability grew, and the ability to burn straw phased out, the farm recognized the importance of adopting new methods — methods that maintain productivity and yield and preserve the land for future generations.

Twenty years ago, Dave Goracke started using a no-till drill to plant crops, a practice that has become a cornerstone of the farm's approach to sustainability. Instead of multiple field passes to prepare the soil, Dave now uses a single-pass no-till drill for crops like wheat. For smaller-seeded crops like clover, he uses a cover crop disk and a light harrow to create a shallow seedbed, making a few additional passes to ensure germination. Livestock play a vital role too, grazing down tall fescue and ryegrass while naturally fertilizing the fields.

Another significant shift at Cala Farms has been crop diversification. By installing artificial drainage, the farm can grow wheat, peas, kale, mustard, radish, turnip, vetch, chicory, and hazelnuts. Cala Farms now uses rotation sequences like following clover or brassica with wheat or tall fescue. "Grasses and grains respond really well to brassica and legume rotations," he says. Diverse crop rotations have enhanced the soil nutrient profile, reduced reliance on chemical inputs, and boosted crop performance. They have also decreased pest populations like crane fly larvae, cutworms, and wireworms, and an increase in beneficial insects like carabid beetles, spiders, and ladybugs.

Cala Farm's practice of leaving crop residues on the field to decompose naturally has also had surprising benefits, significantly reducing the need for insecticides and fungicides. For example, after several years of returning diverse residues to the soil, rust populations have decreased without fungicide application. Dave believes this is due to the diversity of residues returned to the soil, promoting a soil microbial community that suppresses individual pests from becoming dominant. "[Soil microbes] need a balanced diet just like we need a balanced diet," he explains. While challenges like slug and vole infestations remain, Cala Farms manages them with targeted applications, maintaining yield benefits and system sustainability.

The long-term commitment to soil health is paying off for Cala Farms. Economic benefits have emerged as the farm has saved on inputs like lime and mineral fertilizers —thanks to the enhanced nutrient retention and buffering capacity of healthier soil. Potassium application requirements have dropped by 60-75%, and the reduced wear and tear on equipment have lowered maintenance costs.

As Dave Goracke and his team continue to explore new ways to improve their practices, Cala Farms remains a shining example of how farming can evolve to meet the needs of both today and tomorrow.

This work was supported by the USDA ARS, an award from USDA-NIFA through the Western Sustainable Agriculture Research and Education Program (SW23-945) and by the Oregon Grass Seed Commissions. For more information, contact Jennifer Moore or Kristin Trippe at the USDA Forage Seed and Cereal Research Unit, Corvallis, Oregon.

Suggested citation: Trippe, K.M., Moore, J.M., Baschieri, R., and Anders, A. Grass Seed Crops, Stewarding the Land by Sustaining the Soil. 2024. Available at: https://bit.ly/OSCSoilStewardship.

SUGGESTED READING & FEATURED CITATIONS

Breza, L.C, Moore, J.M., Tomasek, A.A., and Trippe, K.M. The effect of subsurface drainage in grass seed fields on soil carbon stocks. In: 2022 Seed Production Research Reports. Oregon State University Extension and USDA-ARS, Corvallis, OR, 2023. p. 15-20. https://cropandsoil.oregonstate.edu/sites/agscid7/files/crop-soil/breza_drainage_carbon.pdf

Breza, L.C, Moore, J.M., Tomasek, A.A., and Trippe, K.M. Soil Carbon Stock Response to Subsurface Drainage in the North Willamette Valley. 2023 Seed Production Research Reports. Oregon State University Extension and USDA-ARS, Corvallis, OR, 2024. p. 11-15. https://cropandsoil.oregonstate.edu/sites/agscid7/files/crop-soil/breza_carbon.pdf

Gonzalez Mateu M., Trippe K.M., Moore A., Anderson N., Verhoeven, E. Soil Carbon Storage in Willamette Valley Grass Seed Systems: A review. Prepared for the Oregon Seed Council. 2022 Dec 7. https://doi.org/10.1002/essoar.10512940.1

Gonzalez Mateu, M., Domnariu, H., Moore, A. D., and Trippe, K. M. Soil health, microbial communities, and annual ryegrass yield under contrasting management practices. Agronomy Journal, 2023; 116:1, 380-393. https://doi.org/10.1002/agj2.21484

Guo, Y., Gong, P., Amundson, R., & Yu, Q. Analysis of Factors Controlling Soil Carbon in the Conterminous United States. Soil Science Society of America Journal . 2006. 70 (2), p. 601-612. https://doi.org/https://doi.org/10.2136/sssaj2005.0163

Trippe, K.M., Gonzalez Mateu, M., Moore, A, et al. Postharvest straw management practices do not impact carbon stocks in tall fescue produced for seed. 2021 Seed Production Research Reports. Oregon State University Extension and USDA-ARS, Corvallis, OR, 2022; p. 8-11. https://cropandsoil.oregonstate.edu/sites/agscid7/files/crop-soil/trippe_carbon_stocks.pdf

Verhoeven, E.C., Jessie, W.P., Moore, A.D. and Sullivan, D.M., Effects of straw removal on soil health in tall fescue seed production (year 1).2018 Seed Production Research Reports. Oregon State University Extension and USDA-ARS, Corvallis, OR 2019. p. 13-18. https://cropandsoil.oregonstate.edu/system/files/verhoeven_straw_soil.pdf