Science Societies

The Drought Resilience Calculator

Free web application gives farmers, advisers insights into impact of soil health practices

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Home page of the free Drought Resilience Calculator (https://drc.soilhealthinstitute.org/).

Can healthier soils help crops withstand drought? The free Drought Resilience Calculator gives farmers and advisers a powerful way to see how practices like residue management and increasing soil organic carbon can improve water availability during dry periods. Built on decades of research and local soil and weather data, this easy-to-use tool helps visualize the real-world drought resilience benefits of soil health management.

Can soil health practices provide more water for crops during drought? This is an important question that the Drought Resilience Calculator helps answer for farmers and advisers.

Drought events can cost billions of dollars in economic loss, and many farmers report large yield losses from drought events. In much of the United States, the frequency and severity of droughts is projected to increase. Decades of research have shown that soil health practices can increase the amount of water available for crops. In water-stressed rainfed systems, this increase in water availability can mean the difference between a good yield and crop failure.

However, soils vary in their ability to store water, the severity of drought varies across climates, and crop types have different sensitivities to drought. The Drought Resilience Calculator (DRC) is a free web application that gives farmers and advisers locally relevant insights into the impact of soil health practices on drought resilience. The DRC

accounts for multiple levels of variability—from soils, to climates, to crop types—to demonstrate the impact soil health management can have on drought resilience.

Soil health is improved by following principles including minimizing disturbance, maximizing living roots, maximizing soil cover, and maximizing biodiversity. These principles have both short- and long-term impacts on water flow through soils and plants. The DRC focuses on two parts of the soil water balance where these principles have an effect that can benefit drought resilience: changes to soil evaporation from soil cover and changes to soil water storage from the long-term influence of adopting practices that minimize disturbance and maximize living roots.

The Drought Resilience Calculator...allows users to link practices that increase residue cover...to their impact on water movement during the growing season.

In soil health management systems, residue acts as a barrier, reducing the amount of energy available for evaporation at the soil surface. During the early parts of the growing season, this is especially impactful since there is no plant canopy and much of the soil surface is exposed. The Drought Resilience Calculator accounts for the impact of residue cover, allowing users to link practices that increase residue cover, such as reduced tillage and cover cropping, to their impact on water movement during the growing season.

Over time, soil health management practices have been shown to increase soil organic carbon (SOC) and improve soil structure. In the DRC, users can control the amount of SOC to model in a soil health management scenario. The amount of SOC, along with soil texture, are inputs to equations that calculate the amount of water that can be stored in soil. These equations were developed from hundreds of measurements taken across North America. If you think of soil as a bucket that stores water, by increasing the available water-holding capacity, you increase the size of the bucket. A larger bucket can capture more rain when it comes. Later, this extra water can be used by plants to buffer the impact of drought.

A simple tool built from complex data

The DRC is a web application for farmers and advisers, but in the backend, it is running AquaCrop-OSPy, an open-source version of the FAO AquaCrop model (Kelly & Foster, 2021). AquaCrop models evapotranspiration and crop growth on a daily timestep, including the impact of residue on evaporation.

Data sources used to provide local insights include soil information from Soil Landscapes of the United States (SOLUS) and historical weather data from NASA's Daymet (Soil Survey Staff, 2024; Thornton & Devarakonda, 2011). The relationship between soil organic carbon and available water-holding capacity comes from research conducted by the Soil Health Institute (Bagnall et al., 2022).

The DRC models a drought period for the specific location and planting window provided by the user. The drought period is identified from 30 years of historical weather data using a drought index called the Standardized Precipitation Evapotranspiration Index (SPEI; Vicente-Serrano et al. 2010).

The novel part of the DRC is bringing all these sources together, giving users the ability to compare two hypothetical management scenarios: conventional management (no residue cover, typical levels of SOC) and soil health management (residue and higher levels of SOC) for their soil type and weather patterns. The DRC is best used as an educational and planning tool, not as a substitute for local field observations or site-specific agronomic recommendations.

Showing how soil health can buffer drought

Using the DRC is as simple as (1) selecting a location, (2) choosing a crop and typical planting date, and (3) setting the amount of residue cover and level of soil organic carbon increase to compare against conventional management (Figure 1).

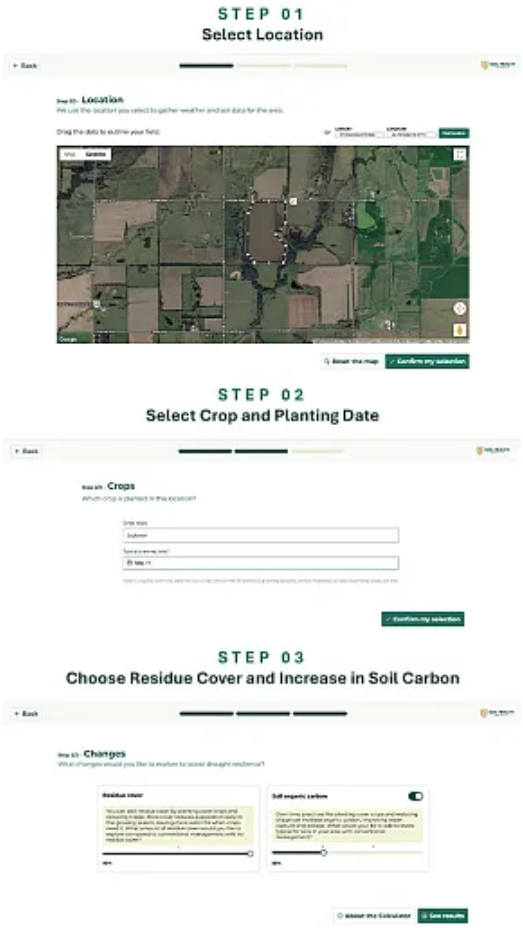


Figure 1. *Three steps to compare conventional and soil health management using the Drought Resilience Calculator.*

The DRC results page shows simulated outputs for the specific location selected by the user (Figure 2). For the selected soil type and weather year at a location, the results show the reduction in evaporation from residue cover, the increase in water storage capacity resulting from higher soil organic carbon levels, and the additional water utilized by the crop under soil health management. Transpiration represents water taken up and used by the crops, so higher transpiration during a drought period can

indicate that more water was available to support crop growth.

The figure on the results screen shows each week during the growing season and the amount of plant-available water in the conventional and soil health management scenarios. One common pattern you can observe is greater plant-available water in the soil health management scenario in the early part of the growing season. This is because more water can be stored and less water is lost to evaporation. This may be followed by similar levels of plant-available water later in the growing season after the additional water is utilized by the crop. The output is not a field-specific yield guarantee; rather, it is a scenario comparison that helps users visualize how changes in residue cover and soil organic carbon can affect evaporation, plant-available water, and transpiration during a drought period.

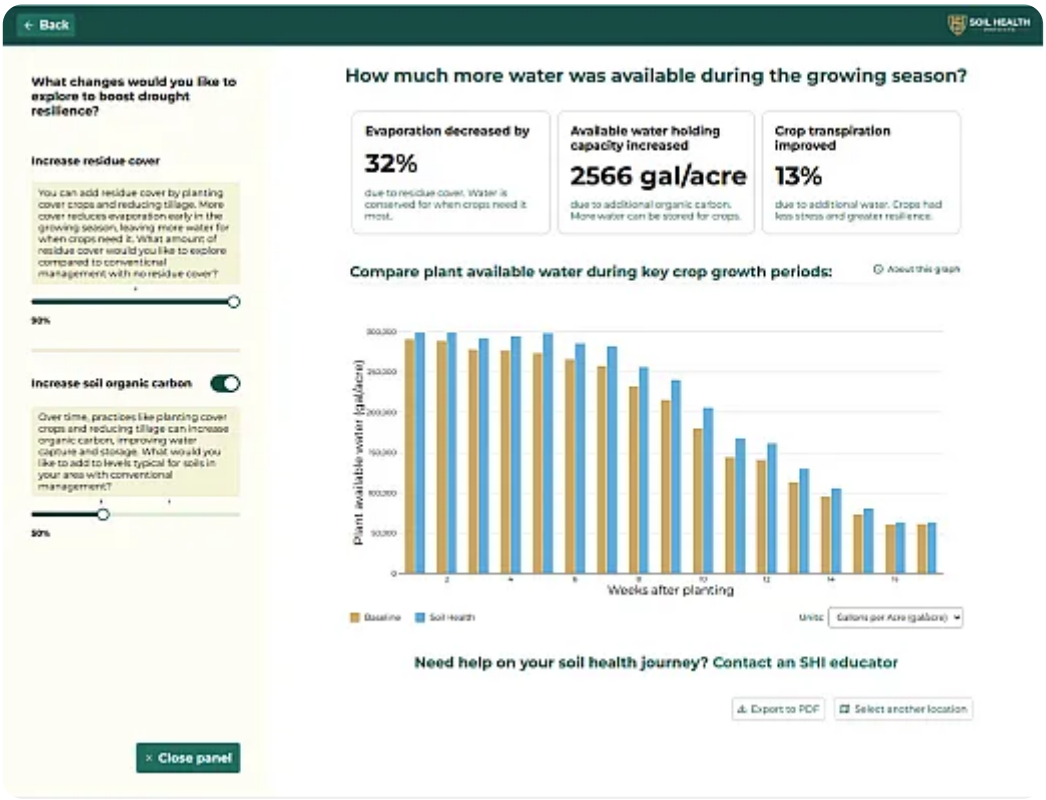


Figure 2. *Results page of the free Drought Resilience Calculator.*

For advisers, the DRC can support conversations with farmers about residue management, soil organic carbon, drought risk, and the potential water-related benefits of soil health systems. The Drought Resilience Calculator is available at drc.soilhealthinstitute.org. You can learn more about this tool and access a fact sheet about it by visiting this page. Future updates will include a regional version that creates the same simulation for common and drought-prone soils, allowing users to see the range of impact across counties rather than selecting specific fields.

Further reading

Bagnall, D.K., Morgan, C.L.S., Cope, M., Bean, G.M., Cappellazzi, S., Greub, K., … & Honeycutt, C.W. (2022). Carbon-sensitive pedotransfer functions for plant available water. *Soil Science Society of America Journal*,*86*(3), 612–29. https://doi.org/10.1002/saj2.20395

Kelly, T. D., & Foster, T. (2021). AquaCrop-OSPy: Bridging the gap between research and practice in crop-water modeling." *Agricultural Water Management*,*254* (August), 106976. https://doi.org/10.1016/j.agwat.2021.106976

Soil Survey Staff. (2024). *Soil landscapes of the United States*. USDA Natural Resources Conservation Service. https://storage.googleapis.com/solus100pub/index.html

Thornton, M. M., and Devarakonda. R. (2011). Daymet Single Pixel Extraction Tool. ORNL DAAC. https://doi.org/10.3334/ORNLDAAC/2361

Vicente-Serrano, S.M., Beguería, S., & J.I. López-Moreno. (2010). A multiscalar drought index sensitive to global warming: The standardized precipitation

evapotranspiration index. *Journal of Climate*, 23 (7), 696–718.

https://doi.org/10.1175/2009JCLI2909.1

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