Organic Farming Produces Better Yields During Droughts, Higher Profits for Farmers, 40-Year Report Shows

Organic systems achieve 3-6 times the profit of conventional production and 40% higher yields during stressful drought periods, according to the longest-running investigation comparing organic and conventional grain-cropping approaches in North America.

By Beyond Pesticides

The longest-running — four-decade — investigation comparing organic and conventional grain-cropping approaches in North America is reporting impressive results for organic.

Recently announced in the Rodale Institute's Farming Systems Trial — 40-Year Report are these outcomes:

- Organic systems achieve 3-6 times the profit of conventional production.
- Yields for the organic approach are competitive with those of conventional systems (after a five-year transition period).
- Organic yields during stressful drought periods are 40% higher than conventional yields.
- Organic systems leach no toxic compounds into nearby waterways (unlike pesticide-intensive conventional farming), use 45% less energy than conventional and emit 40% less carbon into the atmosphere.

Beyond Pesticides reported in 2019 on similar results, from the institute's 30-year project mark, which have been borne out by another three years of the trials.

The current report builds on results from the Farming Systems Trial that were shared in the Rodale Institute's 2020 white paper, Regenerative Organic Agriculture and Climate Change: A Down-to-Earth Solution to Global Warming," which integrated the newest research data and offered action steps for consumers, policymakers, farmers and others.

That report asserted that a global switch to a regenerative food system could not only provide sufficient food for the world's population, reduce chemical exposures and improve biodiversity, but also, could be key to mitigating the climate crisis.

Through its longitudinal Farming Systems Trial, the Rodale Institute has collected data that measure differences in soil health, energy efficiency, crop yields, water use and contamination and nutrient density across test plots of grains grown in organic and conventional systems and using different levels of tillage.

The project focuses on grains (including wheat, corn, soy and oats) because they represent 70% of U.S. crops.

On its 12-acre Pennsylvania parcel, the institute's Farming Systems Trial uses 72 experimental plots, across which are applied three broad approaches:

- Organic manure, representing a typical organic dairy or beef operation, featuring long rotations of annual feed grain crops and perennial forage crops, fertilized through legume cover crops and periodic applications of composted manure and using diverse crop rotations as primary defense against pests.
- Organic legume, representing a typical cash grain operation, featuring mid-length rotations of annual grain crops and cover crops, deploying leguminous cover crops as the sole fertilizers and using only crop rotations as pest defense.
- Conventional synthetic, representing a typical U.S. grain-producing enterprise, using synthetic nitrogen fertilizer and controlling weeds with synthetic herbicides (according to recommendations of Penn State University Cooperative Extension).

Each of those three is further divided into "no-till" and "tillage" strategies (tillage being the practice of digging up, turning over, or otherwise agitating the soil with mechanical tools — typically a plow or disc). This yields six different systems in the Farming Systems Trial.

The Rodale Institute notes that, "No-till and organic no-till are not created equal. Conventional no-till utilizes herbicides to terminate a cover crop, whereas organic systems use tools like the roller-crimper.

"We have found that organic no-till practices year after year do not yield optimal results, so our organic systems utilize reduced tillage, and the ground is plowed only in alternating years."

The Rodale Institute website adds that, in order to model standard agricultural approaches, genetically modified crops and no-till were introduced to the conventional plots in 2008 when those techniques became common in the U.S.

Beyond Pesticides has covered the adverse impacts of conventional no-till, which, as noted, generally uses herbicides to knock down cover crops (in addition to using them on the crop plants).

This additional herbicide use can actually cancel out any greenhouse gas emissions saved through not tilling, and can accelerate the development of weeds' resistance to the herbicide compounds.

To what to attribute these demonstrated benefits of organic over conventional approaches? All these results, as Beyond Pesticides and the Rodale Institute have asserted for decades, begin with soil health.

"Healthy soil is that which allows plants to grow to their maximum productivity without disease or pests and without a need for off-farm supplements.

“Healthy soil is teeming with bacteria, fungi, algae, protozoa, nematodes, and other tiny creatures. Those organisms play an important role in plant health [by helping plants fight diseases and pests].

“Soil bacteria produce natural antibiotics that help plants resist disease. Fungi assist plants in absorbing water and nutrients. Together, these bacteria and fungi are known as ‘organic matter.’ The more organic matter in a sample of soil, the healthier that soil is.”

Healthy soil retains more moisture, boosting plants’ ability to survive periods of drought; it binds together, supporting soil structure that more successfully wards off soil erosion and runoff into waterways.

And because organic systems don’t use chemical inputs, toxic compounds are not deployed into the environment, and fewer fossil fuels are used (because synthetic pesticides and fertilizers are derived from petrochemicals).

It is well known that organic practices increase organic matter in soils; but Farming Systems Trial data show that organic matter (and thus, soil health) in organic systems increases continuously over time, whereas in conventional agricultural systems, this does not happen, and soil health remains essentially unchanged.

According to the Rodale Institute, such healthy, organically managed soils allow “15–20% more water to percolate through soils, replenishing groundwater and helping organic crops perform well in extreme weather. More organic matter also means more total microorganisms that make nutrients available to plants for strong growth.”

The metrics used to determine a soil’s health include: the number of microorganisms present in the soil; the ability of the soil to retain water during drought or dry periods; the number and variety of nutrients present and the quantity of carbon the soil is able to hold.

By contrast, a more conventional view of soil sometimes sees it as little more than an “empty matrix” to which (chemical) inputs are added so that plants can survive, rather than as a living, evolving and interactive ecosystem that provides a rich growing environment for plants and many other life forms.

The Farming Systems Trial stands out as a singular research approach for multiple reasons, but chief among them is its longevity.

The Rodale Institute explains, “Short-term studies that take place over only a few years can’t measure longer-term weather effects, like drought, that will inevitably occur, or biological changes to the soil, which can happen slowly. We need long-term studies to find real solutions to problems affecting the future of global food production.”

These results were good news three years ago; they emerge as even more important as the world grapples with a constellation of intersecting environmental and health crises.

Many of those are related to the use of synthetic pesticides and fertilizers, and are showing up as degraded soils, biodiversity loss, widespread chemical pollution and compromised human and ecosystem health.

These toxic compounds also play a role in the exacerbation of the climate crisis. These realities challenge governments, institutions, businesses and human populations to change "business as usual."

Yet we must change, and must influence decision-makers at every level and in every institution if we are to rescue the future of human life on the planet.

Regeneration International has issued a dire warning: at current rates of soil destruction — via erosion, desertification, decarbonization and chemical pollution — public health will be seriously damaged within 50 years.

Soil scientists are predicting, the organization says, health damage from a food supply with reduced nutritive value (including loss of important trace minerals), as well as no longer having "enough arable topsoil to feed ourselves."

"Without protecting and regenerating the soil on our 4 billion acres of cultivated farmland, 8 billion acres of pastureland and 10 billion acres of forest land, it will be impossible to feed the world, keep global warming below 2 degrees Celsius, or halt the loss of biodiversity."

Regenerative organic agriculture has a potentially enormous role to play in the needed changes to business as usual in the agricultural sector, according to the Rodale Institute.

Regeneration International defines such agricultural practices as "farming and grazing . . . that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity — resulting in both carbon drawdown and improving the water cycle."

Such systems center soil health and, organically executed, remove toxic chemicals from agricultural production, whether of crops or livestock.

The organization adds, "Regenerative agriculture leads to healthy soil, capable of producing high-quality, nutrient-dense food while simultaneously improving, rather than degrading land, and ultimately leading to productive farms and healthy communities and economies. It is dynamic and holistic, incorporating permaculture and organic farming practices, including conservation tillage, cover crops, crop rotation, composting, [and] mobile animal shelters and pasture cropping, to increase food production, farmers' income and especially, topsoil."

The Rodale Institute posits, in its 2020 report, Regenerative Agriculture and the Soil Carbon Solution, that humans could sequester more than 100% of global, annual human-caused CO2 emissions if all global arable and grasslands were transitioned to regenerative systems, and that "stable soil carbon can be built quickly enough to result in a rapid drawdown of atmospheric carbon dioxide."

The organization adds to that the importance of shifting to organic regenerative systems, a distinction Beyond Pesticides has emphasized.

The Rodale Institute makes the case:

> "Healthy soil is the foundation of our global food system, but currently, it's at risk. The United Nations reports that using current practices, we have fewer than 60 years of farmable topsoil remaining. Every organic farming practice contributes to healthy, resilient

soil that can support abundant life both below and above ground, making organic farming a powerful tool for soil conservation."

Beyond Pesticides' bold goal is to transition off of synthetic, petroleum-based pesticides and fertilizers within the next decade, and transition to a society and world committed to organic practices.

This will require massive public engagement — and, as Beyond Pesticides' Executive Director Jay Feldman says, "outrage" — that we are not moving fast enough to embrace that goal across all sectors.

Everyone — consumers, producers, advocates, legislative and executive government branches, federal and state agencies (and their analogues in other countries), businesses and others — has a part to play.

We must advance, rapidly, on-the-ground work to make the transition to organic regenerative practices a mainstream expectation.

For additional discussion of the relationship between climate and the pesticides and fertilizers of chemically intensive, conventional agriculture, and what transitional change can look like, see Beyond Pesticides' recent seminar, Tackling the Climate Emergency.

The presenters included Rodale Institute's Andrew Smith, Ph.D. and coauthor of several landmark reports on soil biology and carbon sequestration — including the just-released Farming Systems Trial — 40-Year Report and Rachel Bezner Kerr, Ph.D., a Cornell University professor, and a coordinating author of the United Nations report of the Intergovernmental Panel on Climate Change, Climate Change 2022: Impacts, Adaptation and Vulnerability.

Dr. Smith shared information about the potential for organic regenerative practices, as short- and long-term strategies, to offset greenhouse gas emissions by sequestering massive amounts of carbon in soils over the next two-to-three decades.

With livability of the planet on the brink, the seminar speakers make the case for rapid reversal of the increasing release of greenhouse gases into the atmosphere (primarily carbon dioxide, methane and nitrous oxide) to arrest the heating of our planet's atmosphere and oceans and the alarming climate impacts we are starting to experience.

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The views and opinions expressed in this article are those of the authors and do not necessarily reflect the views of Children's Health Defense.

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Beyond Pesticides

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