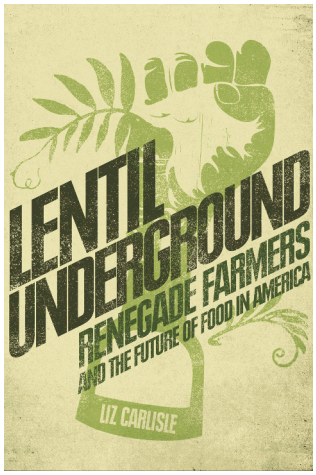
by Carla Curle and Terry Shistar, PhD

Lentil Underground

RENEGADE FARMERS AND THE FUTURE OF FOOD IN AMERICA

Liz Carlisle, PhD
New York: Gotham Books, 2015, 298pp.



The power of farmers to stand up to agribusiness is rarely depicted as vividly as it is in this book. In the summer of 2011, author Liz Carlisle, a UC Berkeley PhD student working on her dissertation, journeyed to Missoula, Montana to meet an organic farmer about whom she had heard compelling stories. Dave Oien, the organic farmer, started Liz on a journey to uncover the history of the organic farming movement in Montana and the Great Plains, while at the same time answering many of her questions about feeding the world without destroying it in the process.

The book opens with a depiction of Mr. Oien's trials and tribulations in the late 70s in converting his family's fossil-fuel based grain farm into a "self-supporting diversified farm that ran on manure." It goes on to describe the underlying hardships that Mr. Oien and many other farmers in this region were experiencing—from low grain prices to drought to pests. But, instead of continuing to subscribe to the "get big or get out" mentality perpetuated by Secretary of Agriculture (1971–76) Earl Butz's agricultural model, these farmers "saw an opportunity—and an imperative-to change the paradigm."

The author skillfully portrays the struggles and successes of this renegade group of farmers that eventually came together to establish Timeless Seeds, an organic lentils and specialty grains company. The four founding organic farmers, Dave Oien, Bud Barta, Jim Barngrover, and Tom Hastings, were all committed from the beginning to building soil health, reducing erosion, and creating natural fertilizer. Their original crop was black medic, a relative of alfalfa and a regionally adapted nitrogen-fixing legume. However, Mr. Orien soon realized that "biological wealth was not going to pay the bills. He needed a crop that farmers could use to build their soils—but also sell as food." Lentils were the answer.

This story captures the complexities between humans and the land on which our lives depend. By nurturing the soil, we nurture ourselves. As the author so eloquently states in the closing chapter, "To build biological fertility is to build community—to accept interdependence with other creatures and foster a common benefit."

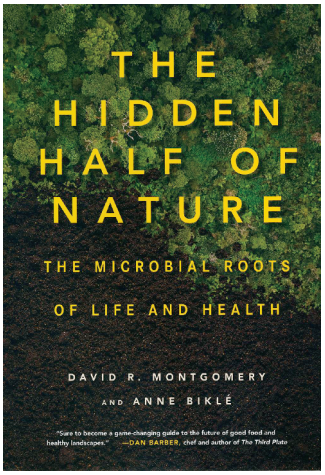
Lentil Underground engrosses readers in an account of an unconventional sustainable food movement where farmers challenge corporate power and succeed in reconnecting with their roots, both above and below ground. — *Carla Curle*

The Hidden Half of Nature

THE MICROBIAL ROOTS OF LIFE AND HEALTH

David R. Montgomery, PhD and Anne Biklé
New York: W.W. Norton and Company, 2016, 309pp.

Geologist David R. Montgomery, PhD and his coauthor and wife, biologist Anne Biklé, understand the importance of microbiota to the human organism and to the soil. Their book grows out of the authors' experience developing healthy garden soil and fighting Ms. Biklé's cancer, and becoming "intrigued by the parallel roles of microbes in maintaining the health of plants and people."



The authors describe their journey to understanding the emerging science connecting life at macro and micro scales. The topic of microbes in the human gut is introduced by Ms. Biklé's moving account of her experience with cervical cancer—a cancer caused by the human papillomavirus, which led her to investigate the roles of microbes in the human body and the influence of diet. The authors began to understand the gut as an ecosystem—or a "planet with a rich palette of ecosystems, as different as the Serengeti and Siberia, each hosting multitudes of microbes."

In both the human gut and the soil, microbes assist their hosts with their nutritional needs. In both cases, microbes participate in symbiotic relationships with their hosts. Bacteria in the human gut manufacture amino acids, vitamins, and other essential compounds that we cannot extract directly from our food. Bacteria provide plants with nutrients—most notably nitrogen through the process of nitrogen fixation—and they and mycorrhizal fungi extend the reach of plant roots. Besides helping plants and animal hosts (like humans) obtain the nutrition they need, microbes, especially bacteria, play an active role in the functioning of the immune system of their hosts. Soil

bacteria coat the roots of plants and exude chemicals that protect plants from disease and herbivores. Similarly, bacteria coat the guts of mammals and produce compounds that enhance the immunity of their hosts.

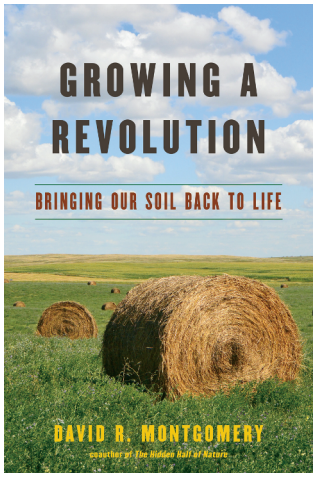
The authors compare the human colon, with bacteria "shoulder-to-shoulder" with our own cells, to a plant root, with mycorrhizal fungi squeezed between plant cells. "In both cases, the quality of the soil at the invisible frontiers of root and gut, and whether we poison, neglect, or cultivate it, are central to the health of plants and people." — *Terry Shistar, PhD*

Growing a Revolution

BRINGING OUR SOIL BACK TO LIFE

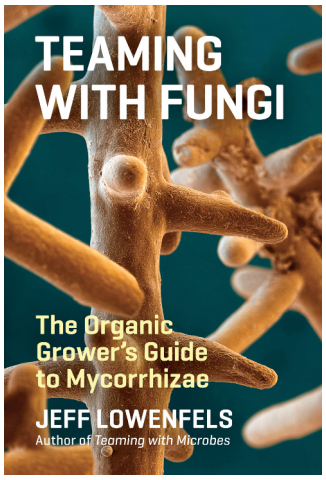
David R. Montgomery, PhD
New York: W.W. Norton and Company, 2017, 309pp.

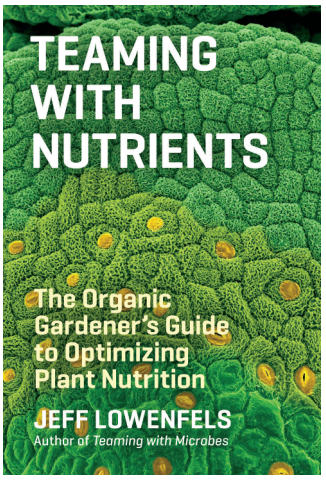
In this book, Dr. Montgomery takes readers in a practical direction. He begins by outlining the problem of soil degradation, which erodes global crop production capacity and contributes to pollution of air and water. Soil degradation has led to the collapse of civilizations—from the Roman Empire to Easter Island—and may threaten our own. Notably, soil depleted of microbiota results in its inability to sequester carbon, which contributes to global climate change. Restoring carbon to the soil, the author argues, "can help address the fundamental challenges of water, energy, and climate, as well as a number of important environmental and public health problems." As the author explains, plowing disturbs microbial communities and exposes them to faster decay and erosion by wind and rain. It also leads to pollution, as fertilizers and pesticides run off into streams or are carried by wind. Thus, protecting and growing soil biota depend on minimizing disturbance by plowing.



Research for the book took Dr. Montgomery across the globe to see examples of "conservation agriculture," which is defined by three principles: (i) minimum soil disturbance, (ii) growing cover crops and keeping crop residue so that the soil is always covered, and (iii) use of diverse crop rotations. He found many different versions, most of which did not incorporate all three practices, and identified a number of practices for building soil health and curing the addiction to agrichemicals, including no-till, intensive rotational grazing, permaculture, mulch, integration of crops and livestock, and use of biochar, compost, and microbial inoculants.

Although I would challenge the author's statement, "Organic agriculture is as unsustainable as conventional farming when tillage is a regular practice," Growing a Revolution demonstrates the need for conservation agriculture and, importantly, the benefits in yield and income that can be gained by any grower incorporating all three principles into an agricultural system. — *Terry Shistar, PhD*





Teaming with Nutrients

THE ORGANIC GARDENER'S GUIDE TO OPTIMIZING PLANT NUTRITION

Jeff Lowenfels
Portland, Oregon: Timber Press, 2013, 250pp.

Teaming with Fungi

THE ORGANIC GARDENER'S GUIDE TO MYCORRHIZAE

Jeff Lowenfels
Portland, Oregon: Timber Press, 2017, 172pp.

Once upon a time not so long ago, no one—not even organic gardeners and farmers—had much of an idea of how and why organic practices work. Organic practitioners spoke of the soil as being alive and knew that chemical pesticides and fertilizers kill the soil. They spoke about "feeding the soil to feed plants." We now have a much better understanding of what living soil is and how it feeds plants—knowledge that comes from science like that presented by David Montgomery and Jeff Lowenfels, and the practical on-farm research like that reported and used by Rodale Institute's Jeff Moyer (see below).

Teaming with Nutrients follows and expands upon the author's previous book, *Teaming with Microbes*, written with Wayne Lewis. Like the previous book, the illustrations—especially the scanning electron micrographs—are worth the price of the book. The author offers clear explanations of cell biology and biochemistry, and give us a greater understanding of fertility in organic systems, starting with two laws:

- **Von Liebig's Law of the Minimum**—plant growth is limited by the least abundant (relative to the plant's needs) mineral; and
- **Sir Howard's Law of Return**—plant and animal wastes must be recycled in order to keep the system healthy.

Coupled with an understanding of the symbiotic relationship between plants and soil organisms, the two laws explain how fertility happens in organic systems. Microbial and other soil organisms actively feed plants, who in turn feed soil life. Some, perhaps most, of the minerals needed by plants and soil organisms are abundant in the soil and are available under favorable conditions. Nitrogen can be replaced by legumes and their symbiotic microbes. Phosphorus, though plentiful, can be locked up in the soil unless freed by bacteria or mycorrhizal fungi. Iron and other micronutrients are made more available by microbial action. The task of the organic farmer or gardener, then, is to feed and create a favorable environment for the soil organisms, who make nutrients available to plants. Cover crops—especially when turned into mulch—provide a particularly good way of doing both. Nitrogen, the nutrient that receives the most attention, is also the easiest to replace by growing cover crops.

Teaming with Fungi is the third book in the Teaming trilogy. This book focuses on mycorrhizal fungi. Fungi may be grouped according to how they get nutrition. Saprophytic fungi, such as commercially-available edible mushrooms, assist in the decay of non-living organic matter. Parasitic fungi eat living organisms. Lichens are symbiotic relationships between fungi and algae. Endophytes live within plant tissues. Mycorrhizal fungi associate with plant roots, gaining carbon in exchange for other elements and colonizing plant roots, which greatly expands their effective surface area, thus increasing the plant's uptake of water and nutrients. Mycorrhizae also improve soil structure.

Fungal hyphae have a much higher surface area to volume ratio than root hairs and can extend into tiny pores in the soil to get nutrients. Mycorrhizae greatly increase access to phosphorus and nitrogen, especially when these nutrients are in short supply.

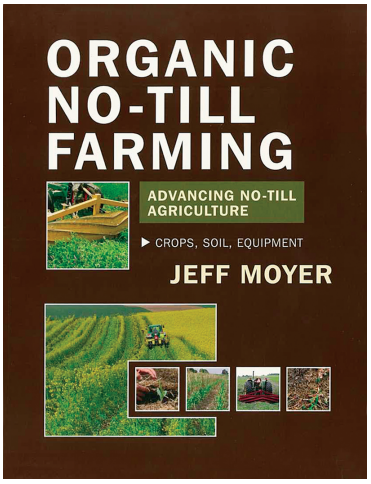
Organic farmers capture all these benefits, including increased nutrient availability to their crops, as well as greater (i) resistance to drought, pathogens, and other environmental stresses, (ii) biomass, and (iii) reproductive success. Organic crop production—especially practices like organic no-till—help to preserve mycorrhizae. Inoculants containing mycorrhizal fungi are available commercially, and this book also contains a chapter on growing mycorrhizal fungi. Conversely, in chemical-intensive farming, mycorrhizae are killed or inhibited by pesticides, fertilizers, and excessive tillage or compaction. — *Terry Shistar, PhD*

Organic No-Till Farming

ADVANCING NO-TILL AGRICULTURE

Jeff Moyer
Austin, Texas: Acres U.S.A., 2011, 204pp.

Jeff Moyer brings his 30-plus years of working on Rodale Institute's Farm Systems Trials to this book, which is a great companion to the books reviewed above. While loaded with research from around the globe, the author offers information for practitioners. Until recently, "no-till" meant using herbicides for soil preparation. It was, therefore, a system that was not used by organic farmers. Chemical no-till offers greater resistance to erosion than conventional tillage because crop residues remain on the surface, but actually contributes to groundwater contamination by facilitating the percolation of agricultural chemicals through the soil. Chemical no-till can also lead to surface water pollution, especially with chemicals like atrazine that move in solution, rather than attached to soil particles. As explained by Mr. Moyer, organic no-till is more properly called "rotational tillage" because tillage may be used as seedbed preparation for the cover crop.



Cover crops are the key to organic no-till. In organic no-till, a dense cover crop is grown, then killed mechanically—the favored device is a roller-crimper. The cash crop is sown or transplanted into a slit in the thick blanket of mulch—sometimes at the same time as the rolling operation. For the organic farmer, the method helps to solve several perennial challenges, offering almost complete control of weeds, reducing the need for fertility inputs, and building soil organic matter. It does all of these things while reducing the number of passes over the field to 2–3 per year, thus greatly reducing fuel usage. — *Terry Shistar, PhD*