

Growing super food

by Tracy Frisch

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An inquisitive second-generation organic farmer named Dan Kittredge, 34, advocates moving beyond organic. He has put together and is popularizing a system for "Bionutrient-Rich Crop Production," often abbreviated as "nutrient-dense farming." His method strives to give plants all the nourishment they need to reach their full potential, a premise that makes sense intuitively, scientifically and in the field.

The nutrient-dense approach explains how to achieve more robust, resilient and productive plants with crops of superior quality. Anecdotal evidence indicates that nutrient-dense crops are better equipped to fend off pests, compared to other plantings. Proponents also say that nutrient-dense produce is more flavorful, stores longer (and will dehydrate rather than rot) and contains much greater levels of vitamins, minerals and antioxidants than commonly found in today's foodstuffs.

This fall and winter, his fourth year offering instruction and consulting, Kittredge taught about 20 two-day practical workshops for farmers and gardeners in eastern New York and throughout New England, mostly under the banner of the Real Food Campaign. For the foundation of his program, Kittredge draws heavily on science carried out in the era before the early 1950s, when the chemical industry hijacked university agricultural research. He also borrows extensively from contemporary biological farming experts like Arden Anderson.

These principles are quite distinct from those of conventional agriculture, where generous helpings of chemical fertilizer can make crops grow very fast and large, but leaves them lacking in nutritional elements and susceptible to infestation and disease. They're also frequently less appealing to our tastebuds--witness those giant California strawberries.

Kittredge believes few gardeners and farmers have the knowledge or tools to reach the objectives of nutrient-intensive growing, so he has created an integrated program to help them do so. It's a tall order that flies in the face of the dominant paradigm in today's agriculture.

Six years ago, Kittredge started experimenting with nutrient-dense principles on Many Hands Organic Farm in Barre, Massachusetts, where he grew up. He collaborated with his mother, Julie Rawson, who runs the farm and serves as executive director of the Northeast Organic Farming Association/Massachusetts. In their first trial, they amended half of a broccoli patch with rock powders and observed positive results. In each subsequent year, they honed their practice. "It's been uphill ever since," Rawson says.

Many Hands Farm grows three acres of vegetables, plus some fruit trees and a mixture of pastured livestock. The huge jump in the farm's budget, from \$55,000 in 2006 to a projected \$139,000 in 2012, reflects the enormous increase in productivity unleashed since Rawson began applying nutrient-dense principles. She says the system gives a farmer "a lot of opportunity to be a better farmer." CSA members and natural food--store customers acknowledge that Many Hands Farm's food tastes better and has a better shelf life, and pasture production and animal health have improved. On her diet of nutrient-rich foods raised on the farm, Rawson says she also feels noticeably better physically.

Today, Kittredge farms and continues to learn on his own 15-acre homestead where he focuses on growing baby greens for upscale Boston restaurants. He also raises grassfed beef, goat, sheep and a full spectrum of vegetables. Practicing what he preaches "to the best of my ability," he says, "I find it very easy to make good money growing vegetables."

Kittredge, who has farmed all his life, says he was spurred to explore the nutrient-dense paradigm after reflecting on the mediocre yields and predictable insect and disease outbreaks on his parents' small organic farm--outcomes that contradicted the rosy picture of organic agriculture that he had grown up believing in. Yet the situation at this farm was hardly unique.

Rawson locates the root of the problem in the organic farming movement's beginnings. Founder J.I. Rodale, she notes, believed that practices like mulching and cover cropping were sufficient for growing healthful food. Since Rodale didn't understand soil chemistry, the insights of renowned university scientists like William Albrecht, who made many pertinent discoveries about soil mineralization during

Rodale's lifetime, were not incorporated into the popular organic paradigm. Her son's project is addressing this omission. "What's exciting to me is we can have food that's both nutrient-dense and certified organic. You can have your cake and eat it, too," she says.

To start with, accidents of geology and climate didn't endow the Hudson Valley, nor much of the New England region, with the deep, rich, black soils typical of the Midwest. Here, the last glaciers scraped away many layers of soil, then, year after year, precipitation leaches away soluble nutrients. Acid rain speeds up that process.

Centuries of farming also have impoverished much of the soil. Cultivation oxidizes (burns up) valuable organic matter, which aids nutrient and moisture retention. Row crops, like corn, contribute to the quantitative loss of soil through erosion. Many chemical fertilizers, as well as herbicides and pesticides, do their own damage to soil life (anhydrous ammonia, a nitrogen fertilizer, for example, famously hardens dirt into something resembling concrete). Further, with every harvest, minerals taken up by the crops are removed from the land.

Kittredge emphasizes several aspects of nutrient-dense farming in his workshops:

- Developing a healthy soil ecosystem with beneficial bacteria, fungi and other organisms.
- Correcting soil mineral deficiencies and imbalances.
- Monitoring the needs of crop plants throughout the growing season and feeding them directly when they are not receiving adequate nutrition from the soil.
- Using agricultural practices that provide an appropriate environment for the desired soil biology and crops to flourish.

Inoculating seeds, potting soil or transplants with beneficial microbes and fungi is a simple, inexpensive procedure with significant payback. Scientists (and growers) have documented impressive results from introducing mycorrhizal fungi in this way. As occupants of the plant root zone, these fungi boost plants' ability to extract water, phosphorus and other minerals from the soil. In the bargain, they ingest some of the sugars and other energy-rich molecules exuded by plant roots.

Mycorrhizae are widely found in symbiotic relationship with trees and other plants in natural settings. Unfortunately, these mushroom kingdom organisms are very sensitive to soil disturbance (such as tillage) and generally do not survive well under normal vegetable-production field conditions. To minimize disruption to the fungal communities, Kittredge suggests mulching with straw, hay or leaves and growing green manure crops like winter rye, oats and clover to protect soil from direct exposure to sun, rain and wind. And, he says, minimize tillage--it causes massive die offs of the microbes and fungi that give soil better tilth.

Until soil is properly amended and "alive," or when weather or other conditions mandate extra support, farmers and gardeners usually turn to stopgap measures to "feed" their crops--soil drenches and foliar sprays are the common means of delivering readily absorbed liquid nutrients. The choice of what type of nutrient solution to apply depends on the plant symptoms and underlying soil conditions.

In Nyack, two physicians calling themselves Hook Mountain Growers were early practitioners of nutrient-dense growing principles. In 2008, Pamela Yee and Charlie Paolino got serious about growing food on a quarter of their one-acre property, modeling their bio-intensive garden on Paths to Freedom, a fifth of an acre micro-farm in Pasadena, California, that produces 6,000 pounds of food.

A couple of years ago, Yee says, "We were going to take the Biodynamic [farming] course at the Pfeifer Center, but as physicians, [nutrient-dense growing] appealed to us much more." She and her husband are both open to different approaches in medicine, and felt an affinity with nutrient-dense practices "because of the science behind it."

A specialist in integrative medicine, Yee often treats patients with intractable conditions in part with food and nutrition, including micronutrients. "People assume, if they're eating kale, that it's high in nutrition," she says. But appearances can be deceiving. The vitamin and mineral content of fruits and vegetables, grains and other whole foods has been undergoing a dramatic decline for at least 80 years, since the USDA began keeping such records. Measurable drops in certain nutrients, including total protein and minerals in wheat and corn, have been well documented. Recent meta-data analyses of scientific studies in the United States and the United Kingdom confirm similar

trends in many types of food. These changes seem to correlate with advances in the industrialization of agriculture. "These declines also correlate with increases in degenerate diseases in the human population," Kittredge adds.

Growing good crops demands adequate levels of all necessary nutrients, not just the famous "NPK trio" (fertilizer shorthand for nitrogen, potassium and phosphorus), typically supplied through manufactured chemicals. "In nutrient-dense growing, we are taught to view minerals [including micronutrients] as a 'barrel,' with each mineral representing a stave," Paolino explains. "If one mineral is low, the barrel can only be filled to the height of its lowest stave." In contrast, in a conventional NPK system, "many of the micronutrient deficiencies are not addressed, leading to suboptimal growth potential as well as suboptimal nutrient potential of your crop."

Once, the core of organic farming and gardening principles could have been summed up by the adage, "Healthy soil makes healthy crops." In recent decades, however, the idea that organic agriculture can be a means of remediating soil ecosystems and producing food that is more nutritious has receded into the background, and organic agriculture has morphed into a production system defined by what it rejects. The National Organic Program, an arm of the USDA, codifies these prohibitions--among the prohibited substances and processes are synthetic chemical fertilizers and pesticides, sewage sludge, artificial growth hormones, genetic engineering, cloning and irradiation.

To foster healthy soil, nutrient-dense theory also stresses the importance of balancing soil nutrients. "Both mineral excesses and deficiencies can cause dysfunction in the biological system," Kittredge explains. When a soil test showed Hook Mountain Growers had an excessive level of potassium (abundant in compost), Paolino and Yee refrained from adding any compost for a whole year.

In addition to their multi-year project of building up and balancing their soil's mineral reserves (two of their key deficiencies are calcium and sulfur, critical macronutrients that are often overlooked), Paolino and Yee are being careful not to neglect the crops in the ground--while adding rock powders for long-term soil repair, they address plant nutrient needs with regular foliar sprays and root drenches.

The couple finds the results very satisfying. Both they and their seedling customers are delighted with the vigor and rapid growth of their vegetable starts. In their greenhouse, they had seven-foot-tall pepper plants, and when farmers and interns from a new Biodynamic farm nearby toured their gardens, "We were very flattered and surprised by their reactions to our chard and kale and tomatoes," Yee says.

As an enthusiastic advocate of the nutrient-dense approach, Yee is careful to explain that she also finds value in other farming philosophies, from bio-intensive to Biodynamic. "The art and beauty of growing food is that there is no one way," she says.

Across the river, Deb Taft is passionately motivated to grow food that contains its fullest complement of nutrients. "It's my perception that people in the U.S. are so overweight because they are starving," she claims. "The food we have is lacking in nutrients, so they keep eating, looking for them. How can people have creative thoughts or any kind of vitality if they are merely surviving, not thriving?"

She describes her one-acre enterprise, Mobius Fields, as either "a really tiny farm or a very big garden." On the field she rents at no cost in Waccabuc, in northern Westchester County, she is attempting to put nutrient-dense growing methods into practice on land overgrown with aggressive perennials like goldenrod and milkweed (plants that tolerate exhausted soils). Her project of rehabilitating land that has been ignored for over 70 years will take a lot of work and loving care.

Another convert to nutrient-dense growing is Liz Taggart, now owner of Amba Farm in Bedford Hills, also in Westchester. The lifelong gardener fondly remembers an idyllic agrarian childhood with her extended family in Ohio. Immigrants from Slovenia over a century ago, Taggart's grandparents and four great uncles settled into a close-knit farming community that, from our contemporary vantage point, seems almost inconceivable. Each of the brothers bought about five acres and practiced a specialty—one grew fruit trees, another had a vineyard and chickens, Uncle Ludwig helped develop seed varieties for Burpee. Everyone ate homegrown food and swapped for what they didn't produce themselves. Raising and eating good food were at the center of life.

At midlife, Taggart decided to turn to the business of growing for market. In 2011, the farm's third, with two nieces and a niece's boyfriend as part of the workforce, her family farm grew ten acres of organic vegetables, berries and tree fruit. Three of those acres, plus 100 fruit trees, are at Taggart's home in Bedford Hills, while the rest is leased from a Somers horse farm in a match arranged by the Westchester Land Trust.

When starting her farm, Taggart enrolled in Kittredge's six-part class on nutrient-dense farming, among other courses to round out her education. As homework, she sampled her soil and had it analyzed at the recommended laboratory. She followed through with soil

amendments corresponding to the needs indicated by the test reports. She also took up foliar sprays and soil drenches and started making aerated teas using compost and worm castings.

In response to her interventions Taggart watched the health of the soil "take a quantum leap," affecting both the quantity and taste of her crops. "People marvel at the flavor of our vegetables," she boasts.

Extrapolating from her own experience, Taggart predicts that this approach also could improve the economics of growing healthier plants for other farmers. Beyond the improvements in quality, she said it enabled her to produce a larger volume of vegetables for a longer period of time.

Amba--the farm's name--is the Sanskrit word for "universal mother," and Taggart says it's a good fit, as she draws parallels between nurturing children and growing healthful food. "Every time we plant that little seed, how do you work with nature to bring out its full potential?" she asks. Kids thrive with good food, clean water and exercise, and plants do best in a nourishing environment, she observes. "You don't need to lay on the chemical fertilizers and pesticides. "It's like with our own health—focusing on prevention rather than [treating] symptoms. I was reading my soil test results at the kitchen island and looking at the minerals in my teenage son's multivitamin when it clicked," she says.

Looking at the larger picture, Taggart suggests that bringing life back to the soil could heal some of the damage our species has inflicted on the earth as well as make better food available more widely. "More and more, we see organic gardening as a human right," Taggart says. Acting on this belief, she started a sizable garden at her son's school and is working with Northern Westchester Hospital to incorporate nutrient-dense foods into their menu.

Benjamin (B.R.) Shute began farming at Hearty Roots Community Farm in the Tivoli area about eight years ago. He signed up for a nutrient-dense farming course because, when it came to soil fertility, he admits, "I didn't feel I had all the pieces of the puzzle." Shute says he appreciates the "super-practical" perspective that Kittredge brings to his teaching, working within a farmers' economic constraints and stressing the importance of addressing the biggest problem first to leverage the greatest impact possible, rather than using a scattershot approach with minimal diffuse effects.

Farming entirely on rented fields under five-year leases had made Shute reluctant to "dump a lot of slow-release nutrients" on the farmland he intended to leave when he could purchase suitable property of his own (a milestone that he finally achieved this winter). Kittredge, agreeing that sinking a lot of money as purchased inputs into short-term land was foolish, opened Shute's eyes to other ways to ensure his crops got sufficient nutrients. Shute purchased a \$200 fertilizer injector for his drip irrigation system and was able to feed his plants micronutrients, liquid humates, seaweed and fish emulsion. He also increased his use of foliar sprays. Shute said his crops were doing better than normal until late August. "After Irene, I stopped doing foliar sprays and fertigation. The plants certainly didn't need any water," he recalls.

But Kittredge analyzed the situation from another angle: With 12 inches of rain leaching out nutrients and suffocating soil microbial life, he argued that adding another quarter inch of water to supply the nutrients that had washed away was worthwhile.

Many farmers express skepticism about the nutrient-dense approach, and it's difficult to counter criticism because contemporary research hasn't been looking into the significance of nutrient-dense practices for plant health and productivity, crop vitamin and mineral content and soil ecology. Christopher Kemnah, a young farmer who's excited about the nutrient-dense paradigm, attributes the lack of enthusiasm to the influence of "the synthetic fertilizer and pesticide industries" that, he says, "are huge."

In the absence of long-term, sophisticated scientific studies, a small grower near Red Hook (Dutchess County) is pursuing research of her own. Marina Michalhelles operates a market garden, keeps chickens and honeybees and makes maple syrup at Shoving Leopard Farm (a spoonerism for "loving shepherd") on acreage owned by her family. In graduate school at the University of Vermont, she had discovered her love for soil science, particularly "the dynamic biology of the root zone."

After taking Kittredge's course, Michalhelles did some informal trials on three crops using nutrient-dense inputs, as he suggested. The results suggested meaningful benefits, Michalhelles says. Treated cabbages "looked as if they were planted two or three weeks ahead" of the other ones, and the lettuce grew larger, too. Her cherry tomato plants lasted an extra two weeks and didn't die with the first frost (as the untreated plants did), she reports. In addition, the levels of brix in the sap of the treated tomato plants were "definitely higher." ("Brix," usually

associated with the wine and grape industry, is a measure of the sugar or solids content of a plant's fruit, sap or foliage. High brix readings are often used as a surrogate for greater nutrient density.)

Intrigued by this anecdotal result, Michalhelles wrote a proposal to do more scientifically rigorous field trials on her farm. The Northeast Sustainable Agriculture Research and Education (SARE) awarded her project a \$3,500 farmer grant. With it, Michalhelles will analyze the effects of several nutrient-dense practices in her potato crop in 2011 and 2012. In addition to taking various measures of plant growth and yield, Michalhelles is monitoring soil and plant health weekly, using a refractometer to measure brix in the plants and an electrical conductivity meter to quantify "changes in nutrient availability in the root zone in real time." She also is taking advantage of a multifaceted soil health test offered by Cornell every spring.

Five years ago, Chris Kemnah and his wife, Samantha, started Otter Hook Farms in the tiny river town of New Baltimore. The farm became available through a farmer Kemnah had worked for since boyhood, but the clay soils were damaged by a legacy of over-farming. Last year, the Kemnah family moved to a Greenville farm with more potential—better soils, a barn and a house—all pluses for their 75-share vegetable CSA.

Even before the two 30-somethings left their white-collar careers to take up farming and childrearing, the couple was attentive to what they felt to be true "quality" in food, and they had clarified their agrarian values, affirming that health trumped profit and convenience. This led Kemnah to establish criteria for his farming methods that exceeded even certified organic standards—he determined that all pesticides, even ones permitted under organic standards, would be off limits. "Being an environmentalist and naturalist, 'organic' wasn't enough for me," he asserts.

Formerly on track to become a research scientist, Kemnah sought solutions to technical farming challenges in the writings of eco-agricultural practitioners ignored by the mainstream, and as soon as it was offered, he took Kittredge's nutrient-dense farming course. Kemnah soon set up an experiment to test the processes and methods himself: In two adjacent 250-foot rows, he grew identical tomato varieties. Both sets of plants received normal applications of North Country Organic fertilizer and fish emulsion sprays. Every week, Kemnah irrigated the treated plot with a concentrated mineral solution of micronized, chelated micronutrients plus additional calcium and phosphorus. He didn't apply anything extra to the control plot.

During the growing season, "I was stunned by the unbelievable differences," Kemnah notes. "I thought the organic fertilizer would be enough—that's where I think a lot of organic farmers are at." Kemnah says the nutrient-dense treated plants responded by developing much denser and greener foliage and, even more strikingly, they stayed free of insect and disease problems for the entire growing season, whereas by midseason, "a crazy amount of tomato hornworms" infested the control plants. These giant, prehistoric-looking caterpillars devour tomato leaves and fruit with an unstoppable appetite.

Nutrient-dense farming encourages curiosity about why destructive insects gravitate to some plants but not others. Though mainstream science has typically dismissed such queries, Kittredge considers them central—for him, the entire universe of our plant foes—from tomato hornworms to tomato blight—function as "nature's garbage disposal." (In one of his classes, Kittredge asked what an "antenna" is—in telecommunications systems and invertebrates alike, antennae are sensory apparatus or organs that receive signals—radio waves, infrared radiation or other frequencies. Researchers have discovered that insects are able to detect wavelengths that humans cannot perceive that help them distinguish between sick or malnourished plants and healthy ones. By gravitating toward the weaker hosts, plant-munching insects and other pathogens serve as clean-up crews in the ecological scheme of things.)

Where insects may prefer inferior crop specimens, deer (and other mammals, including human beings) express the opposite preference, as deer demonstrated in their nightly invasions of Otter Hook fields a couple Septembers ago. "They would walk over the other seven tomato rows to get to the nutrient-dense planting," Kemnah recalls sadly. Tired of his prize tomatoes getting hammered, he erected a fence to deter the hoofed gourmands, and was astonished how quickly the tomato plants put on new growth and resumed blossoming. After the fence, the deer pretty much ignored all of his tomatoes.

With that experience under his belt, at the new farm site in 2011, Kemnah decided to irrigate practically all of his crops with the same nutrient-dense drench he had used in his most productive tomato bed the year before. He bought 10 gallons of nutrient concentrate and kept up with the weekly program—until the back-to-back tropical storms hit. Once again, dramatic positive results vanished after he stopped the program—the first several plantings of broccoli yielded exceptionally sweet, solid heads, while the last of his broccoli plantings produced

spicier heads with hollow stems. Another sign to Kemnah that he is on the right path are the compliments he receives from CSA members about the taste of Otter Hook vegetables.

Kemnah estimates it will take five years to get his soils up to the desired mineral levels. This year, he plans to apply a couple tons of high calcium lime per acre, plus several tons of soft rock phosphate. Once the demand for soil supplementation levels off, a more modest maintenance program should suffice.

Some of the supplements that Kemnah applies are expensive to begin with, to say nothing of the cost of trucking high-volume materials. To help cover the costs of the soil treatments, CSA members at the Kemnah farm can contribute to a special fund--and thus live up to what may be the ultimate purpose of a CSA: to invest in the farm's long-term sustainability. Summing up his agricultural odyssey and adventure into nutrient-dense farming, Kemnah acknowledges that it's been an interesting ride that's not over yet. "I've had this crazy evolution from the way I was taught to farm to where I am now and where I want to be," he says.

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