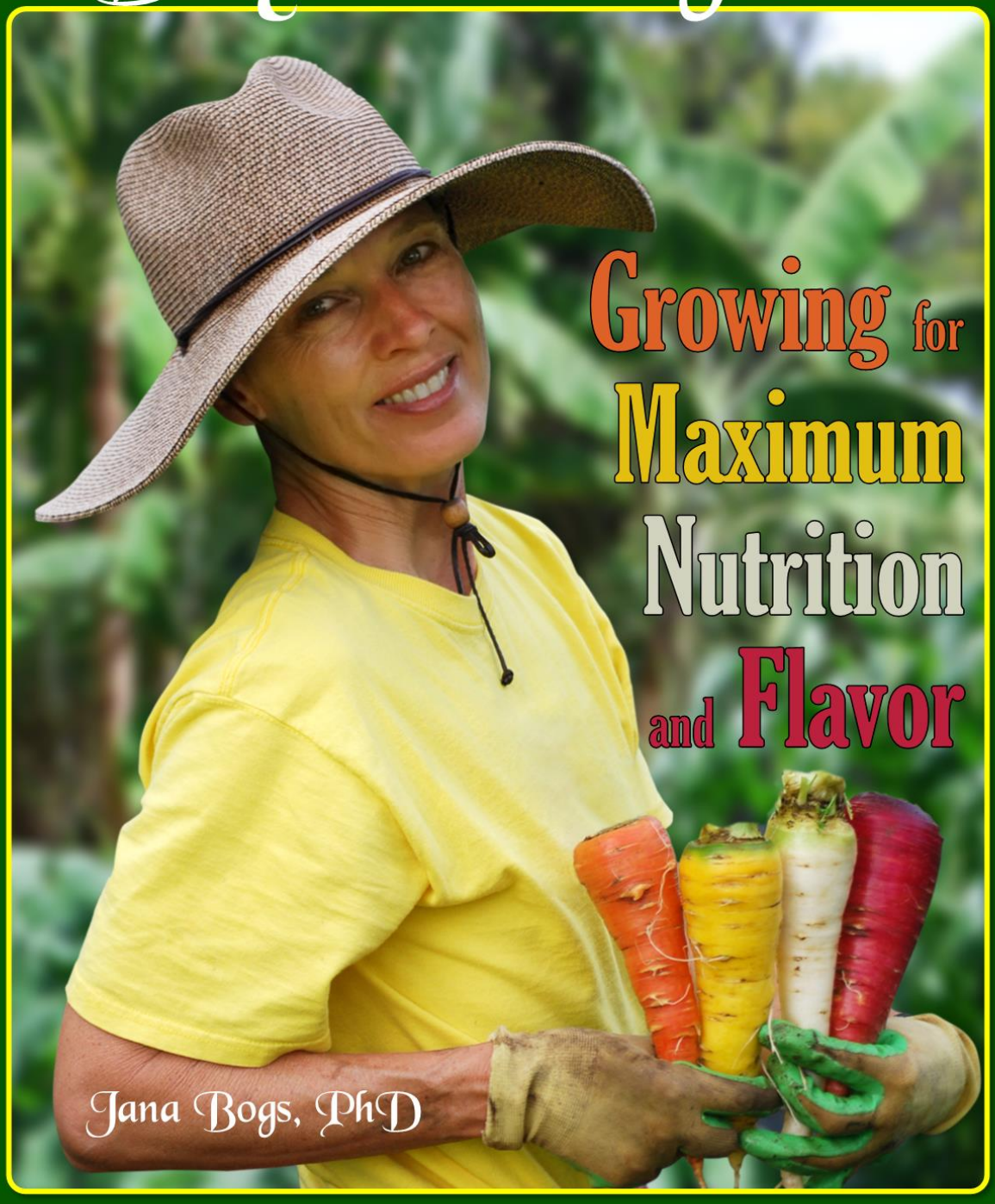
Beyond Organic



Beyond Organic…

Growing for Maximum Nutrition

Dr. Jana Bogs

Beyond Organic… Growing for Maximum Nutrition
Keywords: organic gardening, vegetable gardening, organic farming, nutrition, natural health, soil analysis, nutrient dense food, Nutrition Grown, Beyond Organic

Manufactured in the United States of America.

www.BeyondOrganicConsulting.com

Dedication

To those who have long sought
the best nutrition.

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This book is for you if...

~ You wish to enjoy optimal health and a happy long life.

~ You are interested in maximizing your physical and/or mental performance.

~ You choose to eat the most nutritious food possible.

~ You want to grow the best fruits, vegetables, and/or other crops.

~ You are a farmer or market gardener who wants a new marketing edge for greater economic prosperity.

~ You are concerned about the impact of chemical farming practices on our environment.

~ You are a nutritionist, dietitian, physician, or other healthcare practitioner.

~ You would like to have a meaningful career centered around optimal quality foods.

~ You are a businessperson or investor interested in the next big wave in the food and nutrition marketplace.

~ You aspire to make a positive difference in the world.

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What you will learn from this book:

~ A major, yet unrecognized, reason why our population is suffering and dying from degenerative diseases.

~ What has happened to food nutritional quality over the last several decades.

~ How food nutritional quality can be vastly improved with a step-by-step proven program.

~ Refreshing ideas for making a better living doing something you love that is good for people and the planet.

~ A new paradigm in farming practices which may eliminate the need for toxic chemicals to control plant pests and diseases.

~ How consuming nutritionally optimal foods can benefit your life in unexpected ways.

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About the Author

Dr. Jana Bogs is a nutritionist (BSci) who became a horticulturist (PhD) to grow the best food possible. Now she is introducing a new paradigm to the worlds of agriculture and nutrition by going “beyond organic” to Nutrition Grown in the quest for the best food ever.

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Section 1: A New Paradigm in Food Production

An Alarming Predicament

Degenerative diseases are wreaking havoc on our health and, subsequently, our dreams of what could be. One in three people die from cardiovascular disease. Cancer rates continue to rise. Now one in three women is expected to develop cancer in their lifetime; for men, it is one in two! The incidence of diabetes has risen 90% in the last 10 years. One in three children born since the year 2000 is expected to have diabetes in their lifetime. This horrific disease can lead to blindness, kidney failure, and amputations.

The diabetes epidemic parallels the rise in obesity. One-third of Americans are now considered obese…not just overweight, but obese. Obesity is considered a disease because it is not just about one's physical appearance; it profoundly affects one's health. Obesity is part of an inflammatory process that leads to various degenerative diseases. Fortunately, there is something we can do about these problems, because they are all diet-related.

"You Are What You Eat"

It's an old adage that makes a lot of sense, but how many people ignore that wisdom? What has the collective "we" been eating? And, just as important, what have we *not* been eating?

When we eat something, we expect, consciously or unconsciously, that we will get the nourishment we need. We expect that the vitamins, minerals, phytonutrients, proteins, essential fatty acids, and all other nutrients our bodies need will be there, or if not, we will pop a few nutritional supplements to make sure. But are we sure?

"50% of people taking multivitamins are still nutritionally deficient."

Dr. William Shive, an eminent nutritional scientist for many years at the University of Texas, said that 50% of people taking multivitamins are still nutritionally deficient. The World Health Organization (WHO) estimates that over 3 billion people suffer from micronutrient deficiencies, such as vitamins and minerals. That is half of the world's population! And the deficiencies are not limited to developing countries.

As shown by several scientific studies of food nutrient databases, agricultural practices have resulted in a significant decrease of nutrient density in foods, with losses as great as 75% of some essential minerals. A concomitant increase in toxic chemical content, not only from agricultural chemicals, but also from poor plant metabolism may result in harmful constituents, including non-protein nitrogen and mycotoxins (from mold and fungal organisms). Unfortunately, foods produced under certified organic systems are often no more nutritionally dense or mycologically clean than their conventionally-grown counterparts.

"…create health from the soil up"

As a clinical nutritionist, I became keenly aware of these problems. This ignited my passion to "create health from the soil up". To accomplish this, it was necessary to delve into how soil science, horticulture, and food science affect human and animal nutrition. The synthesis of these fields represents the "bleeding edge" of what is possible in nutrition, for example, examining the differences in blood glucose response from fruits grown under varying cultivation systems. Exciting preliminary data shows lowered blood glucose response to fruits grown under a carefully balanced cultivation system, *even though the fruits have higher levels of sugars* and other soluble solids, which improve flavor and shelf life.

Optimal cultivation systems produce healthy soils, subsequently producing healthy and nutrient rich plants, which produce healthy humans and animals. As

Hippocrates said thousands of years ago, “Let food be your medicine.” The first step is the selection of plant varieties which have the ability to uptake large amounts of minerals and produce a large array of healthful phytochemicals (also known as phytonutrients). Techniques are then used which help these plants fully express their inherent genetic capacities. Use of comprehensive soil and plant tissue analyses to determine the exact needed amounts of an array of specific nutrients is crucial.

Optimal growing practices allow for a natural, fuller genetic expression, resulting in greater production of a larger variety of plant tissue compounds. There are literally thousands of these phytonutrients, some with extraordinary human health benefits. This growing system can be described as “nutritional farming” in which practices go beyond just “organic” to nutrient-enhanced, always in harmony with nature.

“…a larger percentage of the nutrients in plants grown in optimally-balanced soil versus poorly-balanced soil may be incorporated into body tissue...”

Nutrients which are bio-complexed by plants may be better utilized at the human cellular level. For example, mined calcium products may contribute to calcification of soft tissue—aging(!), whereas calcium complexed through plant metabolism may be properly utilized by the body. The calcium performs certain functions in the plants, helping the plants form healthful compounds for their consumers, which the consumers cannot make for themselves. Beyond the resulting fuller-spectrum, balanced nutrition, additional benefits include improved flavor and greatly extended shelf life of the produce. Furthermore, a larger percentage of the nutrients in plants grown in optimally-balanced soil versus poorly-balanced soil may be incorporated into body tissue as opposed to being excreted. It just may be that “the cure is in the garden”.

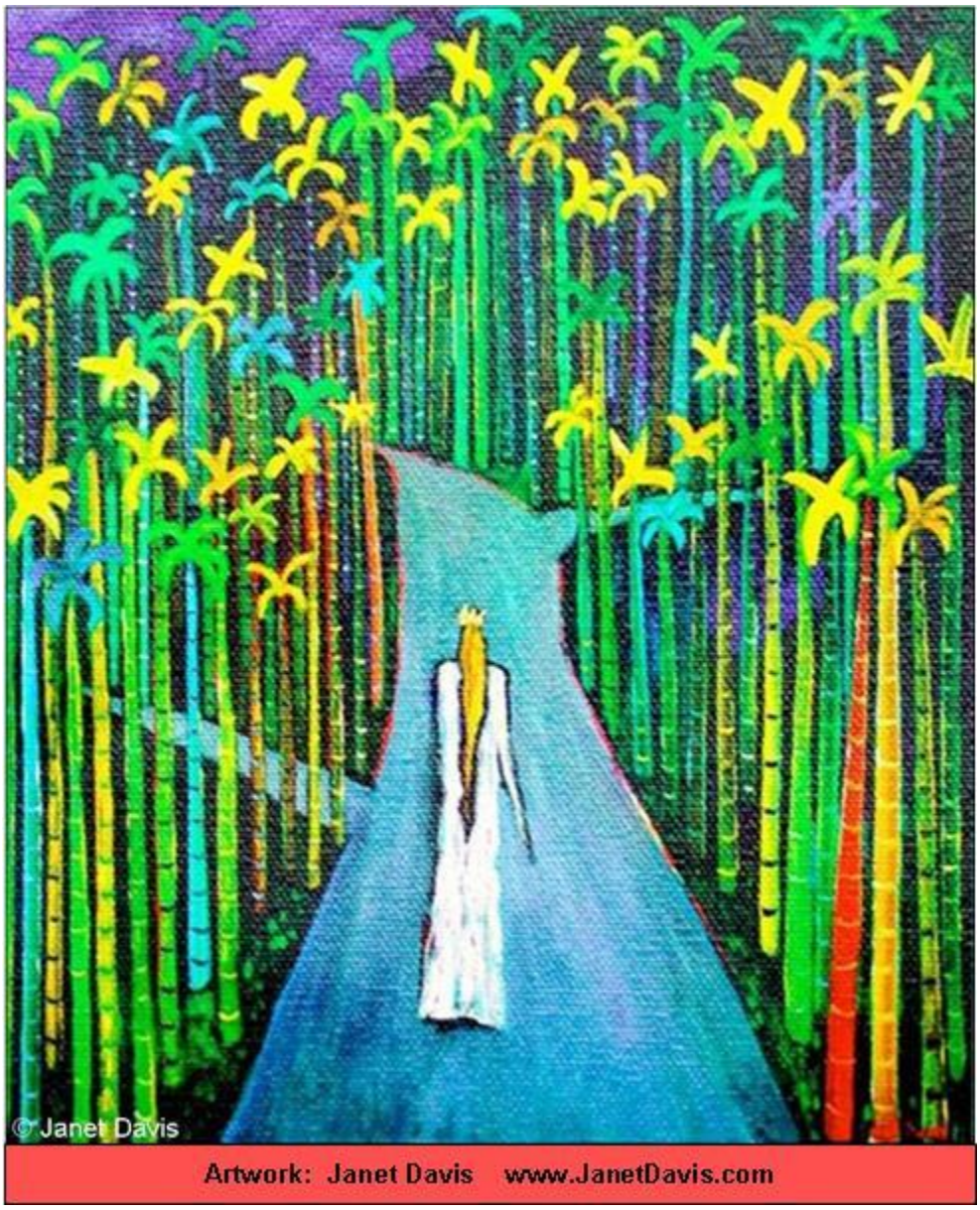
“…the best way to get the nutrients one’s body needs is from foods, not supplements.”

Many nutritionists and nutritionally-oriented medical doctors have come to realize that the best way to get the nutrients one’s body needs is from foods, not supplements. In a recent interview with David Wolfe, Dr. Sangeeta Pati of the SaJune Institute of Restorative and Regenerative Medicine in Orlando, Florida, stated that the better way to get nutrients for our bodies is in the form of foods and superfoods. She explained that this is so because the way that nature has put the nutrients together in foods is the way the nutrients are actually used in the body. This is why smart consumers are trending away from so-called “functional foods” which are “fortified” with ground up rocks or chemically-produced vitamins. Instead, they are trending toward naturally functional foods which contain a large array of naturally-occurring nutrients.

With proper growing techniques, plant pests and diseases are naturally decreased without the use of toxic chemicals, resulting in cleaner food and a cleaner environment. So it is truly a win-win-win-win situation for all concerned—the food producers, the marketers, the consumers and the environment.

With the advent of the continually growing market awareness of the value of organic nutritional products, truly the time has come for the next step—going "beyond organic" to "Nutrition Grown" foods.

Author's Note: The term and concept of "Beyond Organic" was originally coined and copyrighted by Mr. Gene Nolin, a crop consultant who has focused for many years on improving food nutrient density. The term is used by this author with express permission of Mr. Nolin.



My Journey—My Story

I have been on a journey to find better health since I was old enough to realize that what we eat does affect our health. Having my own health concerns and seeing loved ones suffer and die from degenerative diseases such as cancer and cardiovascular disease made me think about what could be done differently.

A Rough Start

I was not breastfed at all because it was not the "in thing" at the time. Back in the day when I was born, doctors were ignorant of benefits of breast feeding. I didn't get one drop of precious colostrum, which would have helped to build my

immunity. Instead, I was put directly on homogenized, pasteurized cows' milk. That milk, which was meant for baby calves, was overwhelming to my delicate little system and caused a lot of congestion. My mom told me that I had a terrible "cold" when I was 2 years old. She had to prop me up on pillows to help me breathe. This experience carried over to a fear of suffocation and claustrophobia.

As a child, I remember the simple act of pulling a dress over my head sending me into a panic because I felt like I couldn't breathe. The thought of crawling into playground equipment that was at all enclosed was also a huge challenge. Even as an adult, there have been some residual claustrophobic effects. I have to work at calming down feelings of panic when I get in tight spaces, such as crawling through a lava tube.

To this day, consumption of dairy products makes me congested. I am thankful I do not suffer from insulin-dependent Type 1 diabetes, which researchers now see connected to early consumption of cows' milk. Fortunately, we now have La Leche League, which promotes breast feeding, and a lot more wisdom about natural child-rearing. Pediatricians today, at least in the USA, recognize the value of breast feeding.

S.A.D.

I grew up eating the SAD—**s**tandard **A**merican **d**iet. It was "what's for dinner", along with desserts with every meal. The donut shop was a regular stop. We had lots of ice cream, cakes, pies, cookies, candy… No wonder I became sick often—colds, Chicken Pox, mumps. The dental office also became a regular, albeit unpopular, stop. I had a lot of cavities, filled with mercury-containing amalgam, of course. Some of this mercury was released through the normal chewing process, thereby contaminating cells throughout my body with the toxic heavy metal. Mercury is now associated with memory loss and Alzheimer's Disease due to its neuron-damaging ability. To this day, I have to deal with the aftermath of an early diet of poor quality foods.

By age 10, I started to integrate healthier foods into my diet. The first shift was changing from white bread to brown bread because it was "better for you". It was a bit of a shock at first, but soon I liked it better than the white bread. Small changes were better than none.

I did "eat my vegetables". My grandparents even had gardens, but by about age 12 it was decided that I needed to have my tonsils removed due to recurring infections. In reality, my tonsils were just working hard to try to keep me healthy. They should never have been removed. Instead, it would have been prudent to look at why they were becoming infected, and correct the cause. But I was a child… By the way, I still remember the pain of the surgery. I was awake because it was performed with local anesthetic. The doctor grabbed a tonsil with

his forceps and began cutting the connecting tissue. I moaned, “Owww!”, as well as I could with a mouth full of metal instruments. “You can still feel that?” the surgeon asked. “U-huh.”

At one point, I developed pus pockets in my skin. I dealt with these things for years, usually just puncturing and draining them. The doctor diagnosed them as boils, and prescribed oral antibiotics. Later, I learned that the use of antibiotics can kill beneficial bacteria in the body, thus leading to other conditions, such as intestinal tract disorders and yeast infections, with which I suffered for years.

Around this time in my life, my grandmother, aunt and cousin traveled to see Ann Wigmore—famous for the Hippocrates Institute wheatgrass cure—to seek help for my grandmother’s heart condition. With my extended family looking for health alternatives to the typical medical route, I continually gained interest in nutrition throughout my teenage years. I did a lot of reading and started experimenting with various diets and nutritional supplements.

“There had to be a better way.”

In my late teens, I had my wisdom teeth removed. More surgery. All surgeries are extremely stressful to the body. Resulting scars can block energy flow, and, unknowingly result in more health problems. Anesthesia chemicals may remain imbedded in body tissues for many years, also disrupting metabolic processes. There had to be a better way. I was determined to find it.

Nutritionist Career

After high school, I worked in health food stores and nutritional supplement outlets which further familiarized me with the world of nutrition. In my 20’s, I took correspondence courses in holistic health and nutritional therapy which gave me a broad background. However, I wanted to have a degree from a fully accredited university, so the decision was made to pursue a bachelor’s of science degree in Nutrition at the University of Texas Health Science Center at Houston.

The dietetics didactic program was offered as part of the curriculum so a student could qualify as a registered dietician (RD) while working on their degree. After a series of disappointing encounters with “real world dietetics”, I decided I didn’t want to be a dietitian and dropped out of that portion of the program. The deciding day came when our class visited M D Anderson Cancer Hospital’s isolation unit for children on chemotherapy. The children were in a germ-free “bubble” room where they could not touch their family or friends due to their immune systems being weakened by the chemotherapy. The children were being fed corn chips and hot dogs. AAAGGGHHH! I had had enough! So I got my bachelor’s degree in nutrition and left to do better things in the world.

Child in isolation unit
due to compromised immune system

Illustration: A. Frederick Kennedy

I worked for myself as an independent nutritionist and also worked with holistic physicians. There were excellent results with some of the patients who implemented my nutrition advice, while other patients were not so successful. It seemed very difficult for most patients to change their dietary habits. Some of the patients the doctors sent to me did not even want to try. That was disheartening.

"…I tried many types of diets…"

Through the years, I personally tried many types of diets, including vegetarian, macrobiotics, vegan, fruitarian, fasting, juice diets, raw food, the Hunza diet, even the Atkins Diet (what a misadventure that was!). Because of recurring candida yeast infections, I nearly always had to be on some sort of candida diet ("can't-eat-it" diets). Some diets worked well for a while, but ended up causing other problems and/or just being too difficult to stick with for long.

A Different Direction

I have loved horses since I was a child. At age 9, I learned to ride on Ginger, a horse that belonged to my cousins. Soon I was galloping across the fields bareback and dreaming of the day when I could have my own horse. That day came as I approached my 11th birthday. We had just moved to the country, and

this horse-crazy girl's dream came true—my parents blessed me with my very own horse! My cousins who owned Ginger told me that I probably wouldn't care much about my horse after the newness wore off in a couple of weeks. Well, many years later, the love for horses has not waned.

I feel very fortunate to have had a number of wonderful steeds. At one point, I raised an Andalusian filly from pre-birth to maturity. Hazana had some developmental problems with her legs. A farrier said that it was due to a mineral imbalance in her diet—too much calcium compared to phosphorus. That got me thinking a lot about equine nutrition, which eventually led to pursuing a master's degree in Animal Science with a focus on equine nutrition. Now I was able to combine my interest in nutrition with my love for horses. Fortunately, horses *relish eating their greens*, unlike many humans!

In my work as an equine nutritionist, I tested horses for nutrient imbalances and formulated customized feed and supplement mixes. There were some good results; however I was not seeing the consistently positive results I wanted to see. This was similar to what I noticed in my clinical nutrition work with humans.

Even though my grandparents had gardens and fruit and nut trees, they still did not obtain optimal nutrition. They still suffered from chronic, degenerative diseases. One of my grandmothers died at the young age of 66 from cardiovascular disease. A first cousin, who I was very close to when growing up, died at age 40 from breast cancer.

A Realization

"…foods are not what they could or should be."

Having heard about depleted soils for many years, the realization of the problem finally dawned on me in a big way. ***I came to clearly realize that feedstuffs and foods are not what they could or should be.*** Several scientific studies confirm significant drops in the nutrient density of foods, up to an 80% drop in nutrient content over the timespan of only 50 years. Soil nutrient depletion is not only real—it's a really big problem. If the nutrients are not in the soil, they are not in the food grown in the soil.

There seemed to be no alternative other than going back to the soil and "getting it right" to be able to grow more nutritious foods. I pursued a PhD in horticulture and food science while concomitantly studying holistic alternative methods of soil management outside of the universities, also known as eco-agriculture. My dissertation research compared cultivation systems from soil through plant tissue to effects on human blood (research that, to my knowledge, has never been done before). I enjoy applied research, especially research that has practical applications for improving nutrient density of foods grown right in our backyard gardens and those at the farm down the street.

Having finished my formal studies, yet never ceasing to learn, I now have a new mission and vision for a more perfect agricultural system and its ultimate grand purpose of supporting human and animal health.

Dr. Jana Bogs in her research garden

Dr. Bogs collecting apples for research

Mission, Vision & Values

Mission

To introduce a new nutrition-based agricultural paradigm which produces nutritionally superior foods within sustainable organic systems.

To provide advisory guidance to food growers and food product manufacturers in creating these Nutrition Grown foods and food products.

To educate consumers about the benefits of consumption of Nutrition Grown foods for themselves and the environment.

To expand research on growing nutritionally-optimal foods, continually refining the "Beyond Organic Growing System" (BOGS).

To raise the bar on the nutritional quality of foods by setting new standards for food nutrient content.

To document the effects of consumption of Nutrition Grown foods on human and animal health and well-being.

Vision

To decrease the incidence of disease and improve quality of life for a multitude of people and animals by instituting a paradigm shift in food cultivation practices which produce high yields of delicious, nutritionally-optimal foods in an environmentally-friendly manner.

Values

Environment: Well-being extends from our environment to ourselves.

Cooperation: Working together with the spirit of openness and transparency for the good of all is key to a successful future.

Harmony: Working in harmony with nature is the only sustainable path.

Oneness: The well-being of all is dependent on the well-being of each. We are all in this together.

*(Did you notice the **E C H O** ? I hope you will join with me in the quest for a better agricultural system, and ECHO these concepts throughout the world.)*

A Carrot is Not a Carrot is Not a Carrot

You can look up the nutritional content of a carrot in a nutrient content handbook, and it will state that 100 grams of raw carrots contains a certain amount of calcium, iron, potassium, etc. So, if a carrot grows, a carrot has what a carrot has, right? Not necessarily. Those figures are averages based on some number of testing replications of carrots of some undisclosed varieties that came from some undisclosed farms that raised the carrots in some undisclosed ways. While having averaged figures can be helpful, the truth is that produce can vary tremendously in nutrient content…not by just 10 or 20 percent, or even a two-fold difference.

"…produce can vary tremendously in nutrient content…"

A study by Rutgers University researchers reported mineral variation as great as 1,938 ppm (parts per million) iron in some tomatoes as opposed to only 1 ppm of iron in other tomatoes of the same variety. This is nearly a 2000-fold difference! This study focused on differences in soil from the eastern part of the USA to the Midwest and Colorado. The eastern soils had been more weathered (minerals leached out) and did not produce foods with as great of nutrient densities as the more western soils. (Reference: Variation in mineral composition of vegetables, by Firman E. Bear, Stephen J. Toth, and Arthur L. Prince. 1948. Soil Sci. Soc. Am. Proc. 13:380-348.)

Huge Variations in Mineral Content

Vegetable	Mineral	Highest	Lowest
Lettuce	Calcium	71.0 ME	16.0 ME
Snapbeans	Magnesium	60.0 ME	14.8 ME
Cabbage	Molybdenum	24.1 ppm	0.0 ppm
Spinach	Boron	88 ppm	12 ppm
Lettuce	Manganese	169 ppm	1 ppm
Tomatoes	Copper	0.63 ppm	0.00 ppm
Tomatoes	Iron	1938 ppm	1 ppm

Source: Variation in Mineral Composition of Vegetables by F E Bear, S J Toth and A L Prince (Rutgers University Extension)

Drop in Food Nutrient Values

There are a number of studies comparing food nutrient values over a time period of about 50 years.

Reference Papers:

~ Mayer, AM. (1997) Historical changes in the mineral content of fruits and vegetables. Br Food J 99 (6):207-211. (20 vegetables, 20 fruits)

~ Davis, DR, Epp, MD, Riordan, MD. (2004) Changes in USDA food composition data for 43 garden crops, 1950 to 1999. J Am Col Nutr 23 (6):669-682. (39 vegetables, 3 melons, strawberries)

~ White, PJ and Broadley, MR. (2005) Historical variation in the mineral composition of edible horticultural products. J Hort Sci Biotech 80 (6):660-667. (26 vegetables, 38 fruits, 8 nuts)

This type of comparative work has been done in the USA and the United Kingdom. The scientists used food nutrient databases compiled by the United States Department of Agriculture (USDA) and UK authorities:

The Chemical Composition of Foods (UK), London, 1940
Analysis of Foodstuffs, 1929-1944 (UK)
Composition of Foods, (UK) 2002
Composition of Foods, USDA, 1950
USDA Nutrient Database for Standard Reference, 1999

"Up to an 81% decrease!"

What did the scientists find? Significant drops in all seven mineral elements tested, as well as two of the five vitamins tested. How significant? Up to an 81% decrease! The protein content was also found to be significantly lower in vegetables, while the fat, carbohydrate and energy content was found unchanged. What does that mean? We still get all the calories, but with much less real nutrition.

Mineral Changes Over 50 Years							
Study Location & Authors	K	Na	Ca	Mg	P	Fe	Cu
UK Mayer	↓	↓	↓	↓	–	↓	↓
UK White & Broadley	↓	↓	–	↓	–	↓	↓
US White & Broadley	↓	n/a	↓	–	–	↓	↓
US Davis et al.	n/a	n/a	↓	n/a	↓	↓	n/a

The mineral elements examined in these studies were potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), phosphorus (P), iron (Fe), and copper (Cu). All of these minerals, and many more, are needed by humans. With the drops in calcium, magnesium and phosphorus content, we are experiencing increasing problems with osteoporosis and dental decay, among other problems. Copper helps prevent graying of hair, is needed for blood cell formation, and energy metabolism. Iron deficiency is considered by many authorities to be the most widespread mineral deficiency problem in the world. Iron deficiency results in anemia, which is a lack of oxygen-carrying hemoglobin in the blood. This causes fatigue, and hence, poor work performance. Potassium deficiency is also a significant problem causing a variety of health concerns from acne and dry skin to muscle cramps, nervousness, and weakness.

The vitamins examined in Davis' study were vitamin A (equivalents), thiamine (vitamin B1), niacin (vitamin B3), riboflavin (vitamin B2), and vitamin C. These five vitamins comprise less than half of the vitamins needed by humans. Of these five, two were found to have significantly decreased over the 50-year period—riboflavin (vitamin B2) and vitamin C. Riboflavin dropped 38%. Vitamin C dropped 15%. Vitamin A equivalents appeared to drop 18%, but due to the smaller sample size of 28 foods measured (as opposed to 43) and the greater variability of the data, the statistical analysis does not show this as being officially significant. However, an overall coarse estimate indicates that approximately

half of the vitamins in garden crops have significantly decreased in only a 50-year time span.

There is an interesting story about some canned peaches that were found frozen in a continuously snowy area. They were estimated to have been canned in the late 1800's. Curiosity led to having the peaches analyzed for nutrient content and then comparing the results to the nutrient content of recently-canned peaches. Even though sitting in a can for over 100 years, the old peaches still had significantly more nutrients than those recently canned!

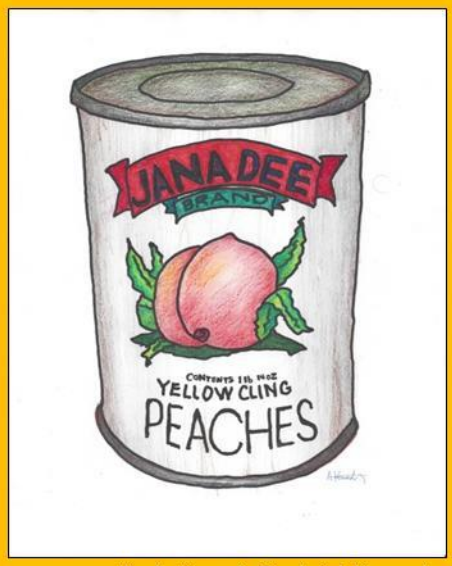


Illustration: A. Frederick Kennedy

Australia's national science agency, the Commonwealth Scientific and Industrial Research Organization (CSIRO), has measured food nutrient values since 1948. A comparison study covering 43 years, from 1948 to 1991, revealed large drops in various nutrients in a number of foods. For examples, vitamin C in apples dropped 80%, magnesium in broccoli dropped 82%, iron in potatoes dropped 75%, and calcium in potatoes dropped 89%. Food nutrient decline appears to be an extremely widespread concern affecting many countries.

"…nearly one-half of the world's population suffers from micronutrient deficiencies."

According to the World Health Organization (WHO), nearly one-half of the world's population suffers from micronutrient deficiencies. Close to two-thirds of all deaths of the world's children are attributed to malnutrition, as reported by Benjamin Caballero of the Center for Human Nutrition at Johns Hopkins University in Baltimore, Maryland, USA. Children are going blind from lack of Vitamin A. Zinc and iron deficiencies retard development and learning ability. Nutrient deficiency occurrences are not limited to developing countries, but are prevalent throughout the world.

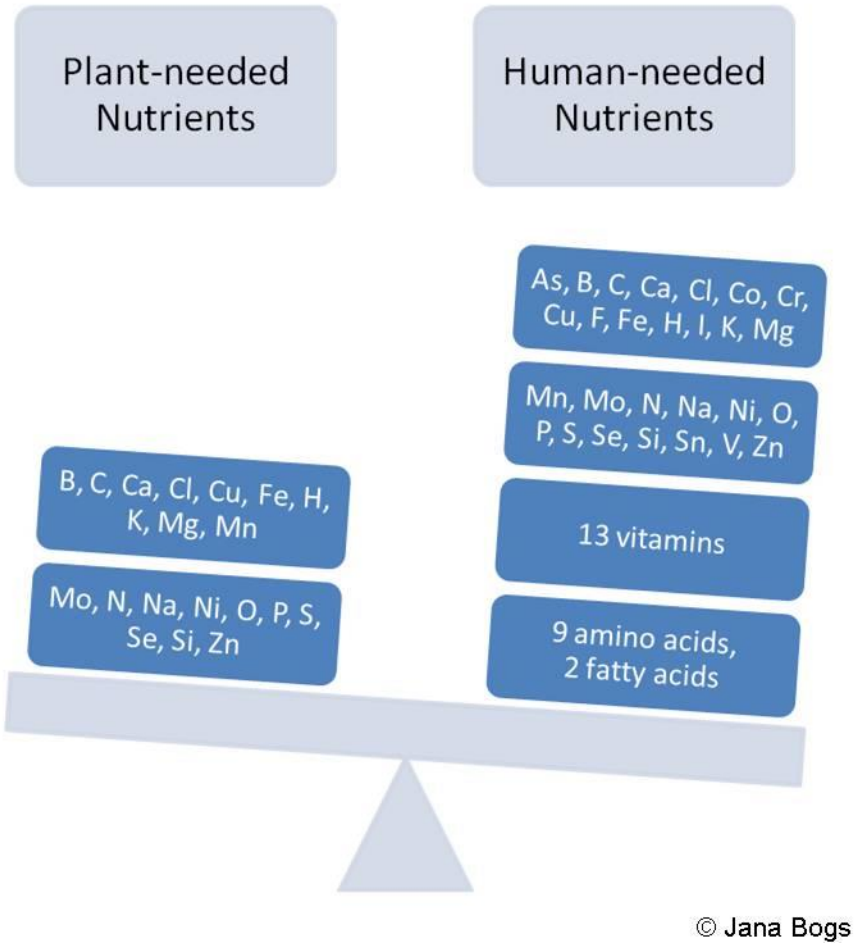
The Copenhagen Consensus brings together some of the world's most brilliant minds for "think tank" conferences in an effort to solve the world's biggest challenges. In each conference to date, malnutrition and diseases ranked at the top of the challenge lists. The proposed solutions include providing micro-nutrients and developing better agricultural technologies, including biofortification. Biofortification involves increasing the nutrient density of plants. The conferences' participants recognized that providing micro-nutrients would have an exceptionally high ratio of benefits to cost.

Albion Laboratories, Inc., based in Clearfield, Utah, USA, leads the world in patents on supplemental chelated minerals. The following are their estimates of the prevalence of some human mineral deficiencies in the USA population:

Chromium: 50%
Copper: 81%
Iron: 58%
Magnesium: 75%
Manganese: 50%
Zinc: 67%

Some of the elements tested in the nutrient comparison studies are regularly added by farmers to the soil, and still there were significant drops in these nutrients in foods. What about the many other elements needed by humans which are rarely added to agricultural soils? These may be still more deficient. These elements include, for example, chromium and vanadium, which humans need for blood glucose regulation, i.e. preventing diabetes and hypoglycemia. Boron and strontium are essential for bone strength. Zinc is needed for many enzymatic processes, including tissue repair, growth, sexual function, and immunity. Selenium, germanium and iodine play key roles in preventing cancer. These are only a few of the trace elements, each of which has multiple roles to play in the body.

Plants can live and reproduce with far fewer nutrients than the number of nutrients which are needed by humans to sustain life. Plants are typically thought to need about 20 nutrients, though some estimates run as high as 42. Humans are thought to need approximately 50 nutrients to survive, though some researchers say 90 or more. However, even if plants need only 20 nutrients to survive, the plants can uptake many more elements and manufacture many more compounds which are healthful for us, as the consumers. For example, hydroponic systems typically use only a very limited number of elements in their solutions. The plants may or may not miss having additional elements, but the consumers will. Yes, the plants grow, but they certainly cannot supply the full spectrum nutrition that humans need. The produce probably does not taste as good as it should either. Full spectrum nutrition for the plant allows fuller expression of its genes to make flavor compounds.



Part of the approximately 50 essential nutrients needed by humans for survival are vitamins, amino acids and essential fatty acids, many of which are manufactured by plants. The term "essential" means not only that a nutrient is needed by a human, but also that it cannot be manufactured by the human body for itself, and, therefore, needs to be obtained through the diet.

"There are many more nutritional substances which are manufactured by plants and found to be very healthful for humans."

There are many more nutritional substances which are manufactured by plants and found to be very healthful for humans. Polyphenolic antioxidant compounds are good examples of these. Antioxidants quench free radical molecules which would otherwise damage our cells, leading to premature aging and a host of degenerative diseases, including cancer and cardiovascular disease. Giving plants optimal nutrition will help them produce antioxidant compounds in types

and amounts equal to their genetic potentials. It's a matter of surviving versus thriving, for plants as well as humans.

My dissertation research on Braeburn apples included comparisons of biologically-enhanced organic apples and conventionally-grown apples. The orchards were immediately adjacent, so the soil type and weather conditions were identical. The biologically-enhanced organic apples contained significantly more polyphenolic (antioxidant) compounds than the conventionally-grown apples.

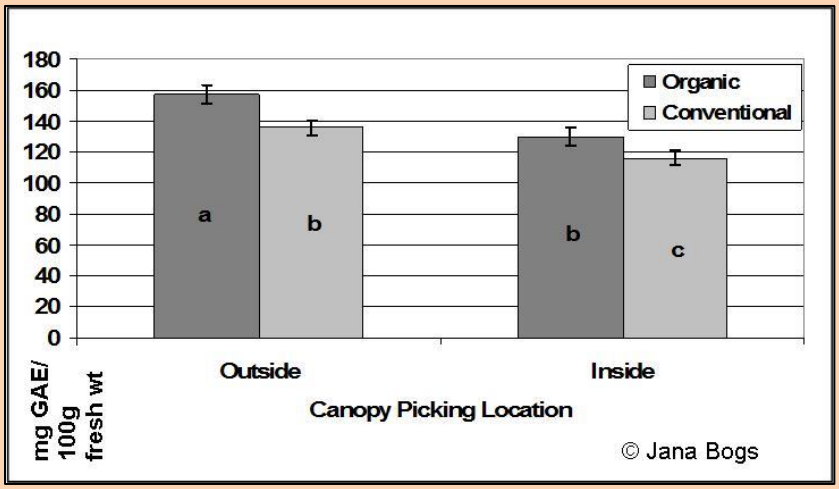


Fig. 3.2 Effects of orchard management and canopy location on 'Braeburn' apple Total Phenolics (TP), measured in mg Gallic Acid Equivalents (GAE) per 100g fresh weight of apple. Overall, biologically-enhanced organic apples contained more phenolic compounds than conventional apples ($P = 0.003$). Overall, outside-canopy apples contained more phenolic compounds than inside-canopy apples ($P = 0.0001$). There was no interaction between orchard management and canopy location ($P = 0.488$). Treatments with the same letter are not significantly different at $P < 0.05$ level. Error bars indicate SEM; $N = 48$, $n = 12$ (four rows, three reps each).

Reference: Dissertation by Bogs, Jana D. Effects of organic, biological and conventional production methods on apple antioxidant levels, sensory qualities and human glycemic response. 2009. Colorado State University. This information was also published in 2012 in the scientific journal, Organic Agriculture, under the title, Influence of biologically-enhanced organic production on antioxidant and sensory qualities of (Malus x domestica Borkh. cv Braeburn) apples, by Jana Bogs, Marisa Bunning, and Cecil Stushnoff.

The Earth Waxes Old Like a Garment

The nutrient density of foods has dropped significantly over the past 50 to 60 years. This is largely due to depletion of nutrients in the soil and decreased

nutrient availability. When crops are continually taken off of land without replenishing the full spectrum of soil nutrients, the soil ends up with deficiencies. There is a drop in the overall nutritional content of foods, and consumers suffer the consequences.

Conventional farmers usually put back some nutrients, primarily manufactured sources of NPK (nitrogen, phosphorus and potassium). Some add lime, a calcium source, to raise the pH of the soil. Rarely are other nutrients considered. Little, if any, thought is given to beneficial soil microflora. The non-organic sources of NPK used are typically harsh chemical forms which harm beneficial microflora and result in burning out the carbon in the soil. The carbon ends up in our atmosphere and nitrates end up in our water—the opposite of preserving our environment and supporting human health.

In the 1960's, we had something called "The Green Revolution". This is not at all what is referred to as "green" today—in fact it was quite the opposite. The 1960's version of "The Green Revolution" started just after World War II. When the war was over, there were a lot of chemical manufacturing plants which had produced chemicals used for making explosives. A brilliant, but short-sighted, business strategy turned the explosive war chemicals into fertilizers and sold them to farmers to put on their fields. Now we wage war on the soil's beneficial microorganisms.

The chemical fertilizers did increase (explode!) the volume of production (yields) for a while, but at the expense of the soil, the environment and crop quality. When the chemical nitrogen fertilizers burned out the carbon in the soil, the carbon was sent into the atmosphere resulting in increased global warming. Without sufficient carbon, beneficial soil microorganisms were no longer able to thrive and perform their functions, such as making nutrients available to plants or binding soil particles together to prevent erosion. It's an unnatural system, and Mother Earth is not laughing.

A lot of those farmers aren't laughing their way to the bank anymore either. As the soil was damaged it took more and more chemical fertilizers to get the same yields. Excessive nitrates in the soil led to large amounts of weeds and unhealthy plants. Like unhealthy humans, unhealthy plants are more susceptible to diseases. They also attract pests. As the weeds, crop diseases and pests got worse, the farmers were sold more types of chemicals—herbicides, fungicides and pesticides. Some soils are so damaged that they will no longer produce crops. It's a downward spiral that only benefits the producers of the chemical fertilizers, herbicides, fungicides, and pesticides.

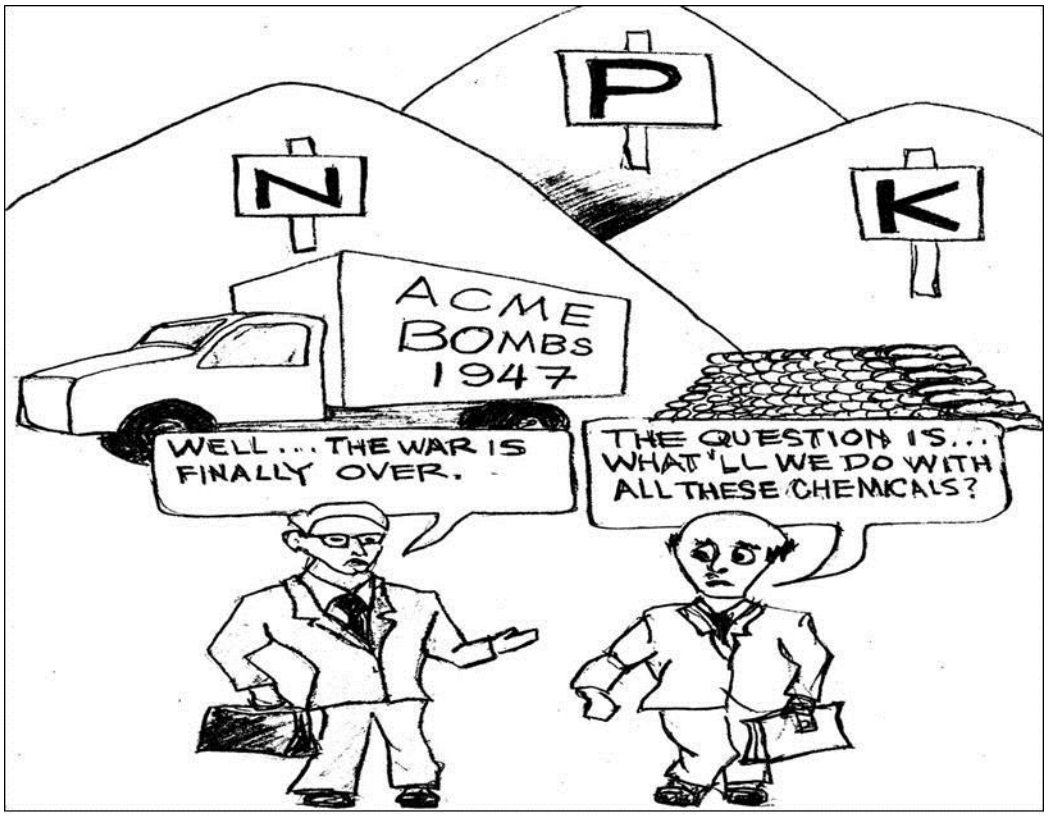


Illustration: A. Frederick Kennedy

Besides the chemical NPK fertilizers, the pesticides, herbicides and fungicides are also detrimental to beneficial soil microorganisms and leach through the soil into ground water. Chemical poisoning of well water is commonplace in many farming regions. Conventional farmers also have a higher than average rate of cancer and other degenerative diseases which may be due to exposure when applying these chemicals to their crops and soil.

The findings of one researcher, Dr. Charles Northen, were presented to the United States Senate. Dr. Northen, a physician, estimated 99% of Americans to be mineral deficient. He felt that North America's soils were significantly lacking in mineral content. To get a clearer understanding, Dr. Northen performed crop experiments in which he restored the mineral balance to one area of a crop and left another area unamended to serve as a control for comparison. Plants grown in the mineral-rich soil consistently yielded healthier crops, free of pests and fungus. What year was this? 1936! There were already severe soil mineral depletion issues in that era! Remember that Dr. Northen was already seeing widespread mineral deficiencies in humans before the more current research showing nutrient drops in foods over the 50-year time span from the 1940's to the 1990's.

Soil depletion seems to be as old as history itself; with stories of native peoples farming certain areas until the land would no longer produce crops well, and then moving on to more fertile ground. However, some cultures did discover methods to replenish their soils. Cultures living in the area of Brazil's Amazonian basin between 450 BCE and 950 CE created rich soils called *"Terra preta de indio"*, translated "Indian black earth". These were created by burning logs underground to make charcoal, and waste products being placed in the ground. Of course, their waste products were not the chemical waste products we generate today. Other cultures around the world also came to understand nutrient cycling, and added fish, manure and/or compost to their soils. These items supplied nutrients to the plants via the beneficial soil microorganisms.

Soil-depleting agricultural methods in the mid-1800's began with Justus von Liebig who discovered that plants grew well when only nitrogen, phosphorus and kalium (potassium), today known as NPK, were added to the soil. These were easy make, cheap to purchase, and easy to use, so the old methods of fertilizing with manure and compost fell out of style. Problems arose as other soil components became depleted. Justus von Liebig did come to see the error of his theory, but the "big lie" which Liebig "justified" at the outset had become too heavily entrenched to be easily corrected. The world's agriculture is still groaning under the weight of this big lie.

"Justus von Liebig <u>just</u> told <u>us</u> a <u>big lie</u>."

There are more data to support soil mineral declines from that era. In 1992, the official report of the Rio Earth Summit concluded--"There is deep concern over

continuing major declines in the mineral values in farm and range soils throughout the world". This report was based on data covering the previous 100 years showing the average mineral levels in agricultural soils had fallen worldwide.

So what has happened to the soil since the 1990's? The International Plant Nutrition Institute has been carefully tracking soil fertility over the past decade. In 2010, they compiled results from 4.4 million soil samples from across the continental USA and Canada. They found--

~ A 4% decrease in potassium (K) since 2005. 41% of these samples tested below critical levels of potassium.

~ A 20% decrease in phosphorus (P) since 2005. 47% of these samples tested below critical levels of phosphorus.

~ It was their first time to compare zinc (Zn) levels, however, 37% of samples tested below critical levels of zinc.

Those are huge drops in such a short period of time! Also, please note that ***critical levels of elements are far below optimal levels*.** Potassium and phosphorus are commonly added by farmers, yet we are still experiencing massive drops. Other elements that are not being added may be even more deficient.

What is the reason behind these drops in soil potassium and phosphorus even though these elements are being added to the soil? The soil lacks the ability to hold onto the elements, and hence the elements subsequently leach from the soil. Some elements, like phosphorus, can get chemically locked into insoluble complexes. Soil is a lot more than just a bunch of ground up rocks. Soil, as opposed to just "dirt", is alive. It contains organic matter in various stages of decomposition which supports beneficial microbes. These microbes "glue" soil together into aggregates, enabling the soil to hold onto nutrients, thus improving soil tilth.

These microbes live symbiotically with plants, each making nutrients available to the other. When the microflora in the soil is damaged by unnatural inputs such as pesticides, herbicides, fungicides and/or chemical fertilizers, it dies or goes

dormant and, consequently, the soil becomes more like lifeless dirt. Its ability to function is greatly impaired. Do you remember hearing about the “Dust Bowl” of the 1930’s? Poor farming practices contributed to wind erosion of untold millions of pounds of top soil. Also gone with the wind were millions of farmers who could no longer make a living.

When soils can no longer function properly, nutrients and chemicals are leached by water down past the plant root zone and can end up contaminating the water table. Surface runoff and erosion by water are also greatly increased. This runoff water takes organic matter and nutrients to rivers and, eventually, to the sea.

A hypoxic, marine dead zone in the Gulf of Mexico near the mouth of the Mississippi River has been created by agricultural chemical runoff and soil erosion. The dead zone covers approximately 6,000 square miles! The Mississippi River Basin drains the Great Plains, which is also known as the “Breadbasket of America”. This very important agricultural land has lost an estimated one-half of its topsoil since farming began there in the 1800’s. If agricultural practices do not change to honor Mother Earth, the breadbasket will turn into a beggar’s bowl.

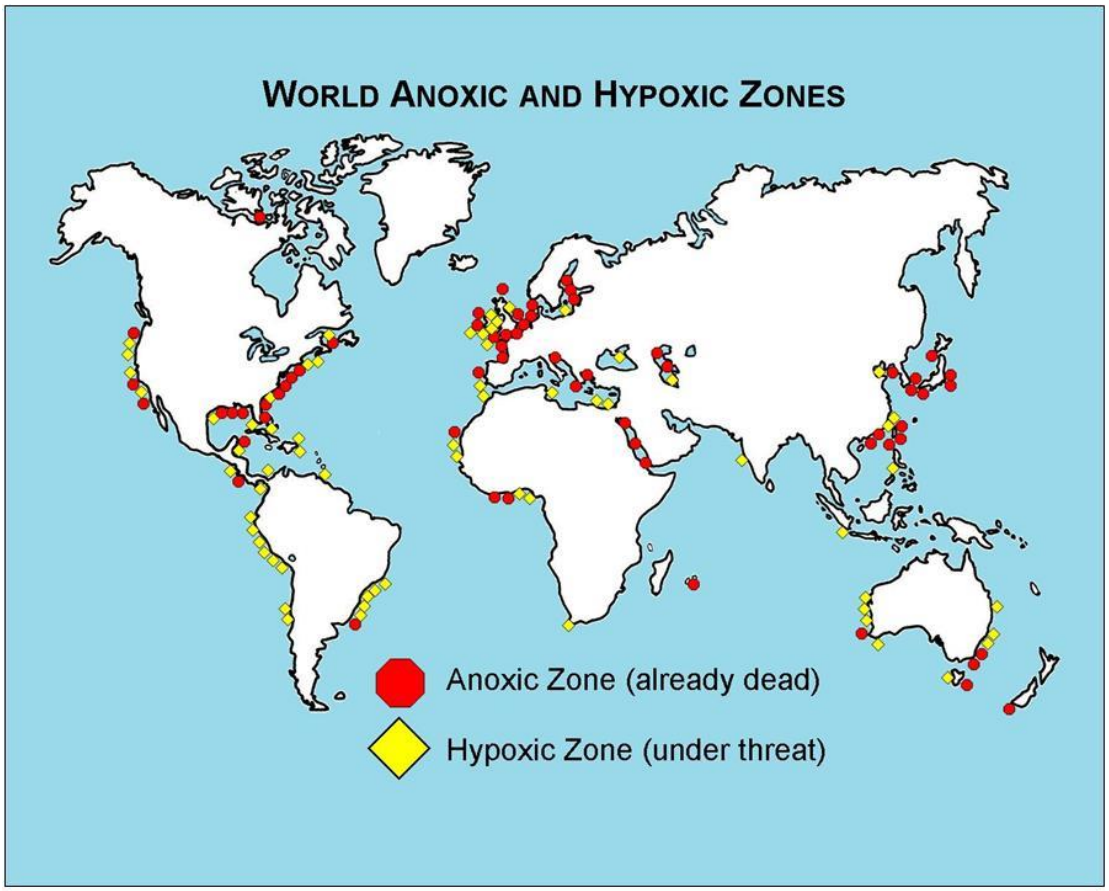


Illustration: A. Frederick Kennedy

The focus of plant breeding is on increasing yields. With this focus on crop yield as opposed to nutritional quality of foods, much of plant breeding and crop seed selection has contributed to even less nutritional density. Plants are bred and selected to produce larger volume crops on poorer quality soils. This is sometimes referred to as "the dilution effect", where crop nutrient density drops even farther.

So what about certified organic foods? They are richer in nutrients, right? The answer is "maybe". Quite a bit of research has been done comparing the nutrient density of conventionally-grown produce versus organically-grown produce.

An often-quoted review by Virginia Worthington, published in 2001, compiled data from 41 studies comparing nutrient content of organic and conventionally-grown foods. Differences were statistically analyzed for 12 nutrients, including vitamin C, magnesium, calcium, potassium, zinc, copper, sodium, manganese, iron, phosphorus, beta-carotene, and nitrates. Organic foods had statistically higher amounts of vitamin C (27%), iron (21.1%), magnesium (29.3%), and phosphorus (13.6%). Conventional foods were higher in nitrates (15.1%)--simple nitrogen compounds which are not able to be converted to proteins by humans.

In July 2009, there was a systematic review of scientific studies which compared conventional and organic foods for nutrient content by Alan Dangour and associates published in the American Journal of Clinical Nutrition. Eleven nutrient categories were statistically compared using data from 55 studies. Most categories, including vitamin C, phenolic compounds (antioxidants), magnesium, calcium, potassium, zinc, total soluble solids (Brix) and copper showed no differences. Conventional produce contained 6.7% more nitrogen, but not necessarily in the form of protein. Organic produce was higher in phosphorus (8.1%) and titratable acidity (6.8%), which can affect flavor, usually favorably.

More recently, in the fall of 2012, Stanford University researchers Dena Bravata and Crystal Smith-Spangler published a similar meta-study in which they reviewed well over 200 scientific studies comparing organic and conventionally-raised foods for nutritional content and other factors. The findings were similar to those found in Dangour's study, with phosphorus being the only tested mineral showing slightly higher levels in organic produce. They also found organics to have statistically higher levels of total phenols, which are antioxidant compounds.

*"Organic standards tell farmers more about what they **can't do** than what they **need to do** to produce a nutrient-rich crop."*

Sometimes the organic foods showed greater nutrient content, and sometimes not. Why is that? It largely depends on the nutrient richness and microbial

activity of the soil. Organic standards tell farmers more about what they *can't do* than what they *need to do* to produce a nutrient-rich crop. There is a lot of emphasis on adding organic matter to the soil, which is a good thing to a point, but if that organic matter is lacking in mineral nutrients, the minerals need to be added or the crops will be mineral deficient. Too much organic matter can actually interfere with nutrient uptake. The wrong types of organic matter--those which do not supply or support an appropriate array of beneficial microorganisms for the desired crop can be detrimental. Please notice from the above example that even when organic produce was statistically higher in nutrients, the differences were not huge. For example, a 29% increase in mineral density from typical organic methods pales in interest when one compares that to a potential 229% (or more) increase in mineral density that can be achieved with organic nutritional farming methods.

Something (Bad) has Happened to our Food…
Greed and Power, Money and Control

Corn and soybeans are used to produce many food products and food additives. Approximately 70% of processed foods in your grocery store contain corn- and/or soy-derived ingredients, some hidden by deceptive labeling. What's so bad about that? Most of this corn and soy is transgenic. Transgenic organisms are also known as genetically-engineered (GE), genetically-modified (GM) or genetically-modified organisms (GMOs). These plants have been genetically engineered in a laboratory by the unnatural process of inserting genes from one type of organism, such as bacteria, into another organism, such as corn. This would never happen in nature.

According to Jeffrey Smith, founder of the Institute for Responsible Technology, a scientifically published human feeding study involving GMO soybeans resulted in genetically modified material from these soybeans transferring into the intestinal bacteria and remaining active. Mr. Smith also relates that animal studies show transference of DNA (genetic material) from foods to organs in the body.

Top researchers who have studied the effects of these genetically-engineered "foods" on laboratory animals found serious health risks associated with the consumption of these foods, such as tumors, lung damage, inability to reproduce, altered DNA function, immune responses commonly associated with diseases, significant organ disruptions, autistic-like behavior and early death. Humans are also reported to have had serious negative consequences from GMOs. For example, some people have allergic reactions to GMO soybeans, but not to non-GMO soybeans. The American Academy of Environmental Medicine asks physicians to advise patients to avoid GMOs due to associated health risks.

The scientific article, *A Comparison of the Effects of Three GM Corn Varieties on Mammalian Health*, was published by Professor Gilles-Eric Seralini and

associates in the International Journal of Biological Sciences in 2009. The corn varieties used in the study are commonly available in the marketplace in food and feed. Besides causing massive tumors, the GMO corn damaged organ tissues, including liver, kidney, heart, adrenal gland, and spleen.

Laboratory rats fed genetically-engineered feed (GMO), genetically-engineered feed cultivated with Roundup® (GMO+R), or Roundup® alone in water (R); showing large tumors. These photos are from the study, *Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize*, performed by Seralini and associates, published in the scientific journal, Food and Chemical Toxicology, in 2012. For more information see http:// www.criigen.org (Photos used by permission.)

Why is this type of production allowed? Why aren't these foods labeled as genetically engineered? Follow the money. You will find corporate money infiltrating politics in the greedy attempt to control food production, and hence, the people. A number of key players in GMO biotech companies, such as Monsanto, have gone on to hold influential governmental positions. For example, Michael Taylor was an attorney for Monsanto, and then worked for the FDA. While at the FDA, he created a policy allowing GM foods to be marketed without any safety studies. Subsequently, Michael returned to the ranks of Monsanto as vice president.

You may find it interesting to know that, in at least one cafeteria for employees at a Monsanto factory, GM soy and corn have such a bad reputation that they are not served.

The corporate whitewashing used to "sell" GMO to governmental authorities and the public claims that genetic modification is a good and necessary action to

produce more and/or higher quality foods to feed a hungry world. Often the genetic modifications are an attempt to circumvent a disease condition in the plants. Unfortunately, what has been seen is other plant disease conditions, which used to be minor concerns, becoming more serious due to the plants' overall diminished cellular integrity. I contend there is nothing wrong with the natural plant genetics; it is the soils which have not been properly managed to supply the plants with nutrients they need to be healthy and resist diseases. These same nutrients are needed in the plants for humans to be able to consume them and be healthy as well. The bottom line is we do not need genetically engineered foods to feed the world; we need well grown food.

According to the Organic Consumers Association (OCA), genetic modification of crops has not increased yields. They cite a report sponsored by the United Nations (UN) and the World Bank, compiled by 400 scientists and endorsed by 58 countries which concluded, "GM crops have little to offer to the challenges of poverty, hunger, and climate change". Furthermore, the OCA states that scientists warn of potential dangers from the use of GMOs such as:
-- harming beneficial insects, i.e. honeybees
-- producing dangerous toxins
-- increasing the use of toxic pesticides and herbicides
-- creating super-pests, super-weeds, and new plant viruses
-- producing antibiotic-resistant pathogens
-- damaging soil fertility
-- contaminating organic and non-GMO crops

Due to the inherent dangers, more than 40 countries require labeling of GMOs, including European Union countries, Japan and Australia. Some countries, including Japan, New Zealand, Ireland, France and Switzerland, ban production of GMO crops. In the USA, the home of genetic engineering, all attempts at getting the foods labeled as GMO have been quashed. The companies that produce this "Franken food" know that labeling would be their death knell. Corporations claim that the GMO foods should not be required to have labels because the crops are "not significantly different" from non-GMO crops. On the other hand, the corporations have received patents for their seeds because they *are significantly different.* It can't be both ways. An examination of the laboratory animal research studies indicates that the crops certainly are different in their ability to support health.

What foods are genetically engineered?
Soybeans—including edamame, soy milk, soy protein, soy protein isolate, soy oil, soy sauce, shoyu, tamari, soy lecithin, soy flour, tofu, tempeh, more items
Corn—corn meal (i.e. tortillas, tortilla chips, corn chips, corn muffins, cornbread), corn flour (i.e. corn flakes), fructose, high fructose corn syrup (often in soft drinks and fruit juice blends), corn oil (may be hidden as "vegetable oil"), corn starch, modified food starch, dextrose, glucose, cat food, dog food, many more items
Cottonseed oil—a commonly used food oil, i.e. for salad dressing

Canola oil—another very commonly used cooking and salad oil
Sugar—from sugar beets
Papayas—some commercial varieties from Hawaii
Squashes—some varieties of zucchini and crookneck squash
Animal foods—Unless animals are raised organically, most beef, pork, chicken and eggs come from animals that are fed GMO corn and soybeans. Besides being feed GMOs, many dairy cows are given recombinant bovine growth hormone (rBGH), which is GMO-derived, to increase their milk production. Most horse feeds also contain GMO ingredients.
Alfalfa—In 2011, genetically-engineered alfalfa was allowed on the market. Alfalfa constitutes a large portion of feed for horses, cattle, and other farm animals. It is also used for humans in nutritional supplements and as alfalfa sprouts in salads or on sandwiches.
Nutritional supplements—i.e. vitamin B-12 (cobalamin), vitamin E (tocopherols), many amino acids (made with GM microorganisms). Did you hear the story about people dying from GMO tryptophan? In 1989, 37 people died and 1500 more became chronically ill due to poisoning from GMO-derived tryptophan.
Sugar alcohols—erythritol, maltitol, mannitol, sorbitol
Artificial sweeteners—(These are not really foods, but since people eat them, I will list some here.) Aspartame, also known as NutraSweet®, Equal®, AminoSweet®, Equal Spoonful®, Canderel®, E951, BeneVia® (named as if it is beneficial for life). Dr. Joseph Mercola, a well-known holistic physician, states that aspartame is the most dangerous substance in the food market. It accounts for most of the reportings of adverse food reactions received by the FDA; yet the "powers that be" keep it on the market. It is used in 6000 food products.

Back in the 1980's when aspartame first appeared on the market, I tried it in a variety of food products. I started having gastrointestinal upsets and did not know why, so I kept a food diary. It took a while, but I came to clearly realize I was reacting adversely to aspartame. I contacted G. D. Searle company, the manufacturer at the time. (The company was since bought out by Monsanto.) When I asked the representative if they had had any complaints about their product causing gastrointestinal upset, she said, "No." I told her I would like to register a complaint about the product causing gastrointestinal problems. She then stated that they didn't take complaints. So, they had no product complaints because they didn't take complaints!

Where else do genetically engineered items show up in our lives?
Cotton—clothing, ropes, bedding. Many GM cotton farmers have skin, eye, and respiratory tract reactions. Thousands of grazing animals have died after grazing on GM cotton fields.
Gasoline containing ethanol—This is touted as renewable energy, but abusing good farmland is an inefficient and environmentally-unsound way to provide energy. Besides, this fuel is bad for engines. It breaks down over time and gums up the works.

Pharmaceuticals—Examples include insulin, vaccines, interferon, spermicidal antibodies, and antithrombin (blood plasma protein). The latter is produced by goats that have been genetically engineered. This is called "pharming". Is it getting spooky yet? A number of people have died due to problems encountered in GMO pharmaceutical trials.

One of the major genetic modifications was performed to increase the tolerance of plants to doses of herbicide (weed killer) that would otherwise kill the food-producing plants. This herbicide, glyphosate, also commonly known as Roundup®, is manufactured by Monsanto. It is the largest-selling agricultural chemical in the world. "Roundup Ready®" genetically-engineered seeds are also manufactured by Monsanto. The Roundup Ready® plants allow the use of more glyphosate than would be possible without the genetic modification, so we have much more glyphosate in our environment and in our foods. The use of large amounts of glyphosate is resulting in "super-weeds", which are no longer suppressed by glyphosate and have become much harder to manage.

The feeding of these glyphosate-treated, GM crops is associated with high rates of infertility and spontaneous abortions in farm animals and, most likely, in humans as well. It has also caused abnormal aging in beef cattle. The carcass of a two-year old, which should be prime beef, appears like that of a 10-year old cow. What does this imply for humans?

Glyphosate is not just on the outside of a plant. It cannot be washed off. It is absorbed into the plant tissues, so it is eaten by the plant's consumer. The method of action of glyphosate to kill weeds is that of chelation of needed mineral elements. The glyphosate is absorbed by the weed and complexes with minerals, making these minerals unavailable to the weed's enzyme systems. Then the weed dies. The problem is that similar action also happens in the genetically-engineered food plants. The glyphosate-chelated mineral elements are not available for use by the plant or the consumer of the plant. The minerals still appear on a food analysis, but they are not usable by consumers. Here we have the opposite of good nutrition!

How pervasive is the GMO food problem in the USA? Unfortunately, it is extremely pervasive, for example, 93% of soybeans are transgenically modified, 86% of corn, 93% of cotton, and 93% of canola.

How does one avoid these foods? Consume certified organic foods. Organic certification guidelines still disallow the use of transgenic materials, though some in authoritative positions would like to change that. You can also look for food labels which state, "non-GMO", "not genetically modified", "we source ingredients which are not genetically altered", or some similar language.

GMO is not only pervasive, it is invasive. When the wind blows, GMO pollen is blown onto neighboring farms contaminating their crops. This is particularly

troublesome if one is trying to grow organically, or just non-GMO. Monsanto has even prosecuted farmers for "using their GMO technology without paying for it" when it was due to pollen drift contamination, not because the farmer wanted to use it! Allowing these GM crops out into the environment is like opening Pandora's Box—once loose, how does one recapture the GM pollen and prevent it from contaminating the entire world?

For more information on transgenics, also known as genetically-engineered (GE), genetically-modified (GM) or genetically-modified organisms (GMO), see http://www.criigen.org, www.OrganicConsumers.org, www.ResponsibleTechnology.org and www.SeedsOfDeception.org.

Toxic agricultural pesticides, herbicides and other chemicals are also produced by large corporate interests. These toxic chemicals have no rightful place in our foods or on our planet. There are much better ways to manage our food production.

Fungus Among Us

According to the FAO (Food and Agriculture Organization of the United Nations), 25% of the world's agricultural production is contaminated with mycotoxins. Mycotoxins are toxic substances produced by fungi. The category of fungi includes molds, yeast and mushrooms. Not all fungi produce mycotoxins, for example, *Penicillium roqueforti* mold spores are added to milk to make blue cheese. However, mycotoxins occur in many types of foods and feeds, and may be a serious threat to consumers. Molds and mycotoxins are not always visible or detectable by smell or taste, and, therefore, may be consumed unknowingly.

Animals may reject moldy feed due to its off flavor, or they may eat contaminated feeds because "that's what's for dinner" and they have no other choice. Chronic ingestion of even low levels of mycotoxins may result in serious health problems, including lowered immune function and colic (the number one cause of equine deaths). The mycotoxins may pass from livestock feed into meat and milk, thereby potentially affecting human health as well.

Perhaps you remember hearing the ancient story about the firstborn sons in Egypt dying suddenly and rapidly. Some scholars now believe this to have been due to mycotoxin poisoning from stored grain. The firstborn sons were given premier access to food supplies as well as greater portions.

The USA suffers grain crop losses of approximately $1 billion annually due to mycotoxin contamination. Realizing the health concerns, over 100 countries have placed regulatory limits on allowable mycotoxin levels. European countries enforce strict maximum limits. The United States Food and Drug Administration

(FDA) is much more lax on the issue, typically just setting recommendation and guidance levels.

There are thousands of types of mycotoxins which arise from the various fungal sources, types of foods, and production conditions. Mycotoxins occur in all types of grain/grain products (especially corn and wheat), beans, vegetables, nuts, peanuts, fruit, spices, cottonseed, palm kernels, meat and dairy products.

Mycotoxins are very heat stable which means that cooking the food will not destroy them. Health problems arising from consumption of mycotoxins include hormonal disorders (resulting in infertility), stunted growth, delayed development, cancer, liver disease, diarrhea, immune system dysfunction, neurological disorders, kidney damage, and pulmonary edema.

You may have heard about aflatoxins, which are produced by *Aspergillus* species of fungi. They are often found on peanuts, and also occur on other oilseeds, grains, spices, nuts and milk from animals fed contaminated feed. While there are regulations in many countries to help keep aflatoxins levels low, be aware that some peanut butter manufacturers combine just enough good peanuts with bad ones to pass the test and avoid destroying the contaminated lots. Some peanut butters have been sold with claims of being aflatoxin-free. Research indicates that regular consumption of apiaceous vegetables such as carrots, celery, parsley and parsnips may reduce the carcinogenic effects of aflatoxins. (Reference: Peterson S, Lampe JW, Bammler TK, Gross-Steinmeyer K, Eaton DL 2006 Apiaceous vegetable constituents inhibit human cytochrome P-450 1A2 (hCYP1A2) activity and hCYP1A2-mediated mutagenicity of aflatoxin B1. *Food Chem. Toxicol.* 44 (9):1474–84.)

To decrease mycotoxin consumption, consumers can take obvious measures of selecting fresh foods and consuming them while fresh, storing foods in cold conditions (refrigerator/freezing), and discarding moldy foods. However, efforts should be made from field to fork to decrease mycotoxins. It starts with how food is grown.

Foods grown in poor quality soil will not have the ability to ward off fungal diseases. Copper and sulfur are particularly needed in optimal amounts to decrease fungal problems. Chemical control with fungicides can cause increased problems in the long run due to the destruction of beneficial microflora, not to mention polluting groundwater and threatening the health of agricultural workers. Beneficial fungi are antagonistic to harmful fungi by attaching to the plant without harming it and crowding out the plant-eating fungi. Beneficial fungi, such as mycorrhizal fungi, also help make nutrients available to plants, resulting in greater cell wall integrity for fungal and insect resistance.

"The prudent solution is to produce nutrient-balanced crops which have structural integrity and internal chemistry which does not attract crop-damaging insects."

Insects carry fungal spores and damage seed coats, creating openings for fungal attack. We don't want to use expensive chemical insecticides which harm beneficial insects (i.e. honeybees) and the environment in general. GMO insect-resistant varieties were proven ineffective. The prudent solution is to produce nutrient-balanced crops which have structural integrity and internal chemistry which does not attract crop-damaging insects.

Human Implications—The Bad, The Ugly, and The Good

Consuming foods produced on depleted, damaged soils has led us into a tailspin of health problems. Having all the nutrients one needs in the proper amounts allows the body to function optimally. Excellent nutrition builds healthy cells which resist disease. Let's look at an example: Think about ten people in a small room. Someone comes in who has a cold, shakes hands with everyone in the room, serves them lunch, and spends the afternoon there, coughing and sneezing. The next day, half of the people come down with a cold, and half don't. What was the difference? Some peoples' immune systems were stronger and able to resist the infection.

What about cancer? It's the same type of situation. Cellular integrity and a properly working immune system make the difference. We could point to almost any disease and see the connection to the lack of optimal nutrition. Dr. Linus Pauling, winner of two Nobel Prizes, stated, "You can trace every sickness, every disease and every ailment to a mineral deficiency." Traditionally long-lived, healthy populations consumed non-industrialized diets which are estimated to have contained approximately four times the mineral content of the average diet of today.

In modern society today, cancer and cardiovascular disease vie for the #1 position as the cause of mortality. Diabetes is rising fast—paralleling the obesity epidemic. These are all *diet-related* degenerative diseases. They decrease longevity, and increase suffering and health-care costs. This is the first generation, at least in recent history, which is expected to have a shorter lifespan than their parents. The "war on cancer" has apparently done nothing to decrease cancer rates, because these rates have only risen—significantly!

Health-care costs in the USA are spiraling upward out of control, currently more than 17% of gross domestic product, double that of 35 years ago. There is a lot of money being spent on health care, yet we are sicker as a nation. Perhaps "health-care" would better be termed "sick care".

In the USA, twice as much money is spent on health care compared to the amount spent on food. Perhaps if we spent twice as much purchasing superior, nutrient-rich food, we would only need to spend half or less of that on health care.

Obesity and Overweight—A Deeper Understanding

Obesity is increasing at an alarming rate, with incidence rates in the USA tripling since the 1960's. The Center for Disease Control (CDC) estimates 36% of adult Americans are obese, and an additional 38% are overweight. The incidence of obesity and overweight in children and teenagers continues to rise as well, now at nearly one-third of this population in the USA.

This condition of excessive adiposity increases the incidence of other degenerative diseases. Metabolic Syndrome, or Syndrome X as it is sometimes called, refers to a group of increasingly prevalent health problems including obesity, high blood pressure, insulin resistance, glucose intolerance, high LDL cholesterol and inflammation, which lead to serious degenerative diseases.

Many reasons are pointed to as the causes of obesity. Usually the first are eating too many calories and exercising too little. While these are certainly two potential causes, it is good to delve deeper to understand what else is occurring.

"…'hidden hunger'…drives one to eat more food in an attempt to satisfy the underlying nutrient needs."

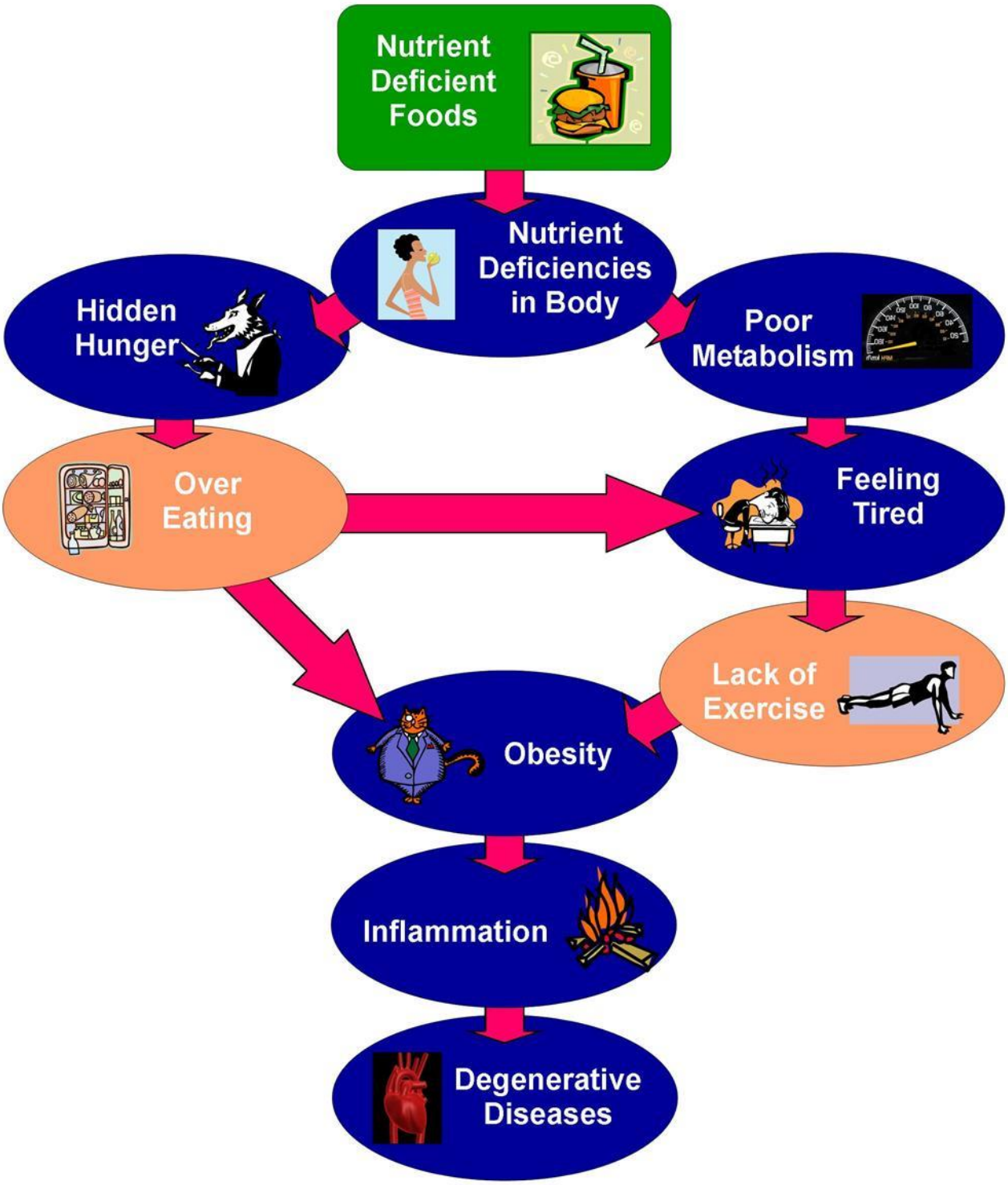
Foods that are not grown well, heavily processed or refined may contain a lot of calories, but lack the nutrients our bodies need. Consuming these foods results in improper nutrition. This can cause "hidden hunger" which drives one to eat more food in an attempt to satisfy the underlying nutrient needs. As long-time gardening authority, Steve Solomon, says, "Health = Nutrition/Calories". Perhaps a corollary would be "Overweight = Calories/Nutrition".

Not getting the nutrients one needs results in poorly functioning metabolic processes, such as hormonal imbalances. The symptoms of insulin resistance and glucose intolerance can be corrected through dietary means. With swings in blood glucose, one may feel tired and hungry—certainly not feel like doing something physically active.

This lack of exercise, besides the immediate effect of not burning as many calories, results in poor muscle tone and a change in body composition to a proportionally greater percentage of fat. This further slows metabolism, because even at rest, muscle burns more calories than fat tissue.

Some people are genetically predisposed to obesity, while others seem to be able to eat anything they want and not gain weight. Fortunately, this predisposition does not have to be expressed. However, greater care must be taken to keep the body in balance and functioning correctly. Beyond eating well-grown, minerally-rich foods which have excellent quality protein, meal timing and meal composition can help keep the body's fat metabolism working well. Spacing meals five to six hours apart and not eating within three hours of going to sleep helps to keep the fat metabolizing hormones functioning correctly. Ensuring adequate, high quality protein (with the optimal array of amino acids) while minimizing simple carbohydrates (sugars) and poor quality fats, such as hydrogenated oils, is also very important.

Toxins, from any source, whether from food, the environment or our own metabolism, can build up in the body. The metabolic toxin load can be increased by emotional or physical stress and inflammatory processes such as allergic reactions. It is a good idea to get tested for food, inhalant and contact allergies. Genetically engineered foods are particularly suspect for causing allergic reactions. The body often sequesters toxins in adipose tissue to isolate them from vital functional tissues, making it difficult to lose weight. A detoxifying diet featuring high quality, nutrient-rich produce can give the body the nutrition it needs to release the toxin-containing body fat and normalize metabolism, therefore helping one to achieve a healthy weight.



Obesity Flow Chart

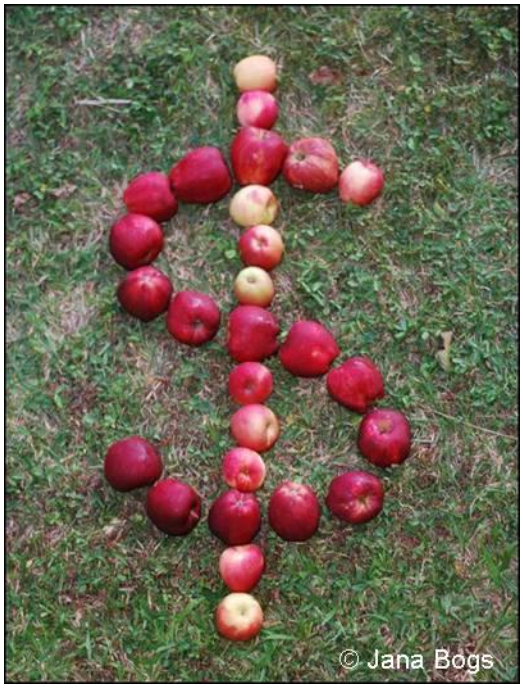
Illustration: A. Frederick Kennedy

Choose Wisely

The old saying, “You are what you eat”, was mentioned earlier. It rings true, and maybe we should add, “You aren’t what you don’t eat. Choose wisely.” Didn’t your mother tell you to eat your vegetables? Now the government tells us to eat our vegetables!

Image: Produce for Better Health Foundation

Researchers have published many scientific studies that prove the benefits of fresh fruit and vegetable consumption for decreasing incidence of disease. The “5 A Day for Better Health” and, the more recent, “Fruits & Veggies—More Matters” programs promoted by the United States Department of Agriculture (USDA) have worked to educate the populace to consume a minimum of five servings of fruits and vegetables each day. The actual recommendations are to consume up to 13 servings each day, largely depending on body weight. Any guesses as to how many servings are consumed by the average American? Only three a day. Hmmm…Why is that? Reasons include high cost, poor flavor, lack of availability, lack of consumer education, and inconvenience.



The cost of fruits and vegetables can be higher than other foods, especially if one is buying certified organic produce. The certification is expensive, and a lot of paperwork, for farmers. Beyond that, the higher cost of produce is partially due to these crops not being subsidized by the government, whereas commodities such as corn and soybeans are subsidized, at least in the USA. This basically means that the government pays farmers to grow these commodity crops so they cost less.

Most of the corn and soybeans are used to feed livestock, keeping the prices of meat, dairy products and eggs artificially low. However, cattle aren't meant to eat corn and soybeans; they are *grazing* animals, meant to eat grass. They become unhealthy due to an unnatural diet. Most of this corn and soy is also genetically engineered, increasing the stress levels. Many cattle suffer from liver abscesses and acidosis. Bacterial food safety issues have been caused by the unnatural conditions. Yet, this feedlot meat is preferred by most beef consumers over grass-fed meat. Feedlot beef is higher in fat content, especially saturated fats, and calories. Feedlot cattle are also more likely to be given routine antibiotics, due to their compromised conditions, and growth hormones, to get them ready for the slaughter house sooner. Furthermore, the feedlot system is inefficient, using 10 to 16 pounds of grain to produce one pound of beef. It is also environmentally damaging due to the concentration of waste products polluting air, water and soil.

Government agricultural subsidies (if we are going to have subsidies at all) could be switched from GMO corn and soybeans to fruits and vegetables to make them more affordable so people would be more encouraged to buy them. The USDA is encouraging Americans to eat more fruits and vegetables, so why don't they

support that with subsidies? Or, at least, end the subsidy funding on other crops to level the playing field and decrease taxes? For the health of humans, animals and the environment, it would be prudent to end subsidies on GMO crops and switch the funds to subsidize organic, highly-mineralized crops of fruits and vegetables.

The subsidies for fruits and vegetables could be done on a temporary basis to help growers switch their production to more healthful crops. It is estimated that the USA will need 13 million additional acres put into production of fruits and vegetables to meet the need for each American to eat the USDA recommended number of servings. Once fruit and vegetable production is ramped up enough to supply the needs, the subsidies could be discontinued.

How can the high cost of produce being a factor for the consumer be addressed right now? It can get expensive to buy enough produce so that each family member can consume the typically recommended 5 to 9 servings per day. Juicing fresh vegetables is one of the healthiest practices I know of, yet, because it takes a lot of produce to make juice, the cost can be a deterrent for many. This cost factor is another great reason to grow your own!

When Does 3 = 5 ?

Fruits and vegetables grown on depleted, unbalanced soils don't have full flavor; therefore, people are less apt to eat them. I don't blame children for not wanting to eat their vegetables given that much of the produce doesn't taste good. As was stated earlier, the average American consumes only 3 servings of fruits and vegetables a day—only about one-third to one-half the typically recommended amounts of 5 to 9 servings per day. What if the produce tasted better and had two to three times the amount of vitamins and minerals than the produce typically available? I believe people would want to eat more of it. Even if one still ate only 3 servings a day, but of the more nutrient-rich produce, one may be getting approximately the equivalent nutrition as consuming the recommended 5 to 9 servings per day of typical produce.

Furthermore, involving children (and even adults!) in the growing process encourages greater consumption of produce. This has been clearly seen in school gardening programs.

The problems with low consumption and production of fruits and vegetables are not limited to the USA. The World Health Organization (WHO) has documented low production and consumption of horticultural produce throughout the world, with especially low supplies in some countries in South America and Africa. One reason for this is that big corporations have been pushing their genetically-engineered commodity products into these countries, even against the wishes of the people.

An area that needs to be addressed is increasing the availability of a wide variety of produce for all sectors of the populace. In the USA, the inner cities tend to suffer most in this regard. They often don't have stores which carry good selections of fruits and vegetables. Part of the problem is the cost of produce, part of the problem is lack of demand. More education is needed on the benefits of fruits and vegetables, as well as how to prepare them. Fortunately, some inroads are being made in education with school and community nutrition and gardening programs.

Stores will not carry products on which they lose money. Fresh produce has the downside of short shelf life. Produce which is grown well with the full spectrum of balanced nutrition has a much longer shelf life.

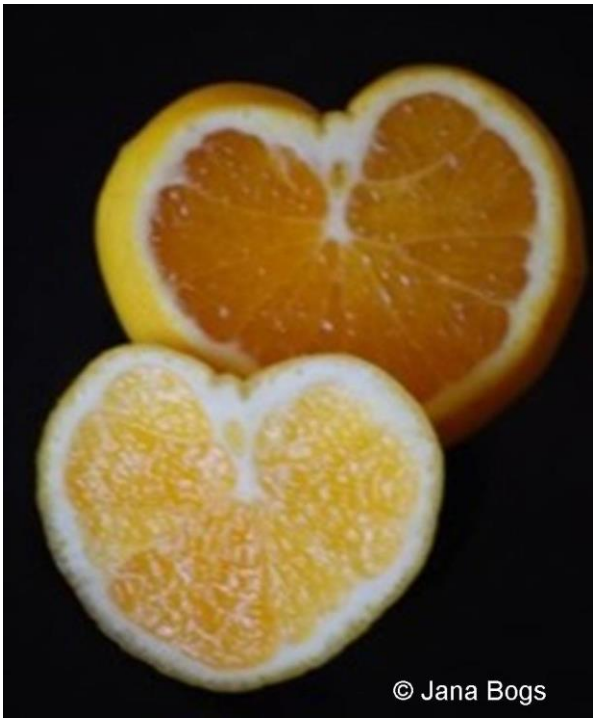
One grower I know has award-winning onions which have a 5-month shelf life. Less well-grown onions of the same cultivar (a variety which is cultivated) have only a 3-week shelf life. The increased shelf life of produce stems from enhanced integrity of the cell walls due to increased content of needed minerals such as calcium. This grower was new to the area of the country, and long-term local growers told her she wouldn't be able to grow onions without certain toxic chemicals. She said, "We'll see," and went about getting her soil analyzed and amended. The naysayers were shocked when she got second place at the fair competing with farmers who had been growing onions in the area for 30 years.

A grocery store chain manager in South Africa has come to realize the difference that proper cultivation makes in the shelf life of produce, and hence, his bottom line profits. This manager is now contracting only with growers who are implementing improved growing standards.

The inconvenience factor of preparing fruits and vegetables is being addressed by pre-washed, pre-cut fruits and vegetables packaged in various sizes of convenient containers. Fortunately, even some fast food establishments are making it easier to consume fresh fruits and veggies.

"…good health from good food grown in nutrient-rich soil"

So, there are some attempts to correct our poor health situation with the encouragements to consume more fresh produce, but, as was elucidated in a previous chapter, the produce is not as nutrient rich as could or should be due to depleted soils and less-than-optimal agricultural practices. One gets good health from good food grown in nutrient-rich soil.


© Jana Bogs

Section 2: Going Beyond Organic to Nutrition Grown

How can we Grow more Life-Supporting, Nutrient-Rich Foods?

There are four basic actions that need to be taken to grow more nutrient-rich, nutrient-balanced foods. These are…

#1—using comprehensive soil analyses and organically-approved amendments to develop full-spectrum nutrient-balanced soils. This includes achieving the optimal balance of the various types of beneficial microorganisms for maximizing nutrient availability to the plants and suppressing diseases.

#2—selecting optimal plant cultivars (cultivated varieties) for maximum nutrient uptake and production (typically heirlooms), and growing these in the optimally balanced soil.

#3—analyzing plant tissue to determine the plants' specific needs followed by feeding the plants with customized nutritional and microbial foliar sprays.

#4—selecting "the best of the best" of these plants for propagation while harvesting the rest of the crop. Repeat the above steps to further improve the crops with each generation. This process, described here in this abbreviated format, is called the Beyond Organic Growing System™ (BOGS™).

Beyond Organic Growing System (BOGS)

Illustration: A. Frederick Kennedy

I always wondered why I had come into the world with the last name of Bogs, which, by the way, is pronounced with a long “o” sound. I had long known that bogs are wetland sources of peat and Sphagnum moss. These organic matter materials are used as soil amendments to improve soil structure and modulate the moisture in soil. Peat is also used for fuel, water filtration, and spa treatments, among other uses. Worldwide, bogs sequester an estimated 200 billion metric tons of carbon, keeping it out of our atmosphere where it would contribute to global warming.

Well, it is nice that horticultural products come from bogs, and that could have been enough, but one day when I was thinking about "Beyond Organic" I realized that the words started with B and O, the same as my last name. A few more neuron firings resulted in "Beyond Organic Growing System"—BOGS!

There are other "good production method" factors to consider when growing nutrient-rich crops, such as optimal amounts of water and sunlight. However, the above named action items seem to be the missing puzzle pieces which can make big differences in food nutrient density when added to a conscientious growing program.

"…scientifically measurable improvements in nutrient density…"

How is BOGS different from other food growing systems? There are many food growing systems, such as conventional (chemical-based), certified organic, biodynamic, Korean Natural Farming, permaculture, hydroponic, aquaponic, and others. Many of the proponents of the various growing systems talk about improved nutrient density of foods, but as discussed earlier, there are little or no data showing major differences in nutrient content. Some of the systems are almost religious in character, based on philosophies instead of science. BOGS focuses on scientifically measurable improvements in nutrient density and other parameters. Objectivity is maintained by the use of independent laboratories for analyses. BOGS attempts to use the best techniques of each type of growing system, remaining open to new, sustainable ways of holistically improving the quality of foods, instead of getting blocked by dogma.

While a focus on nutrient density is the main difference between BOGS and other growing systems, secondary aspects include improving the flavor and shelf life of produce. Improving natural pest and disease resistance of the plants through improving the health of the plants is another important aspect. Decreasing weed pressure by tailoring soil to the plant of interest and away from what weeds desire is yet another aspect. All work is done with great concern for the environment and can be accomplished within organic certification requirements.

An Apple is Not an Apple is Not an Apple

I did my PhD dissertation research on apples, so I learned a lot about apples. There are wide variations in the antioxidant contents of the various cultivars. Guess which apple commonly available in the USA is highest in antioxidants. It's the Red Delicious! It is unfortunate that this common cultivar has dwindled in popularity, which was most likely due to growers picking the apples before they had ripened sufficiently. A good Red Delicious is just that, delicious!

Being an apple researcher, I find the following story particularly intriguing… Back around 2003, Mark was on a long road trip driving through the Wanganui countryside in New Zealand. He stopped for a break to "stretch his legs" and noticed an apple tree in the brambles. It was the largest apple tree he'd ever seen—very old, judging by its huge girth. Even though obviously not cared for, the tree seemed remarkably healthy and disease resistant. But how do the apples taste? So Mark took a bite. Yum! The apple had good flavor too! Mark, knowing quite a bit about apples, realized that this apple may have high levels of beneficial compounds. When tested, it turned out that he was right! This apple variety has the highest levels of cancer-preventing phytochemicals of any apple variety in the world! Compared with Red Delicious, it had two to four times more of the selected important phytochemicals. "An apple a day keeps the doctor away"—indeed!

The variety was named Monty's Surprise, after an old gentleman in the district. This variety is now being studied extensively for its anti-cancer properties. Completed trials show excellent anti-proliferation of cancer cells. Monty's Surprise is also being propagated and distributed around New Zealand. As of this writing, it has been imported to the USA, but it is just at the propagation stage. Hopefully we will soon be able to get them growing in other countries around the world.

As with the apples, we need to grow all of our foods starting with the best genetic material available. This is accomplished by selecting plants which have the ability to uptake large amounts of soil nutrients and manufacture nutrient-rich compounds that we like to eat. Concentrations of various nutrients can vary greatly due to cultivar differences.

Some species of plants are known to "hyper-accumulate" various trace elements. This means they can take up and store trace elements in their tissues in greater concentration than is average for plants. An example of this are mustard plants from the classification known as *Brassicaceae* or, more simply, brassicas. Some work has been done to make nutritional supplements using mustard plants. Feeding relatively large amounts of specific nutrients, such as iron or copper, to the plants results in an accumulation of the desired elements in the plant tissue. The plants are then dried, powdered and encapsulated for use as dietary supplements.

Much more research needs to be done to determine which cultivars of the various types of produce have the abilities to uptake and bio-complex (chelate/integrate/incorporate) large amounts of minerals, and produce the highest levels of phytonutrients. It is not just a matter of the plants up-taking nutrients, but also their abilities to create a wide array of phytonutrients which are healthful substances for humans or animals. Heirloom or other open-pollinated (OP) cultivars, as opposed to hybrid cultivars, seem to be the best bet for

maximizing nutrient density. Hybrid cultivars were developed to be easier to grow on poorer quality soils, for one reason. Some people get frustrated trying to grow heirlooms because they won't perform well on typical soils. While heirlooms often have the ability to produce more flavorful and nutrient-rich produce, they need the support of good soil to do so. Hint: This doesn't mean just adding organic matter.

The production of good quality seeds, whether heirloom or hybrid, is an area which needs more attention. Seed stock plants need to be raised generation after generation on excellent soil to produce vigorous seeds. Enhancing seed-producing plants with custom-formulated foliar nutritional sprays can further boost seed quality. By selecting and growing the largest, heaviest, best quality seeds from only the most vigorous plants, the quality of seeds will improve over time. Note: You won't want to save seeds from hybrids because they will not reproduce true to type like open-pollinated varieties.

$$$ Income Opportunity Idea $$$

Produce high quality seeds using the Beyond Organic Growing System (BOGS), and sell them to customers wanting to grow nutrient-dense foods.

Studies on organic cultivation versus conventional cultivation often show higher levels of antioxidants in the produce cultivated with organic methods; however, this does not always hold true for other needed food components. Why is that? **Organic certification guidelines tell a farmer more about what is *not allowed* than *what needs to be done* to produce a nutrient-rich crop.**

Many organic farmers think that applying compost made from locally-available, on-farm materials is all that needs to be done. However, all compost is not created equal. Making excellent compost is a science as well as an art. Many farmers don't even bother with a soil test, much less a compost analysis. What if there are major nutrient deficiencies in the soil? What if there are major excesses of certain elements? How will these be corrected by adding compost, which was probably made from plants grown on unbalanced soil? The answer is, "*They won't.*" And the plants will not be able to supply humans or animals with the best quality nutrition either.

Inherent Genetic Potentials and Possibilities

In order to achieve maximum nutrient density in our foods, we need ensure our plants have the *correct* amounts of everything they need to be able to express their genetic potentials. This means supporting their potential to grow, to build strong cell walls, to produce a full array of nutrients and beneficial

phytochemicals (which include flavor compounds), and to reproduce abundant, vigorous offspring.

However, it's not just the genome (the DNA material) that is important. There are also epigenomes which sit on top of the genes and regulate their expression. Epi- means "above". So epigenome means "above the genome". The epigenome is influenced by many things such as nutrition and stress. Having ideal nutrition can change plant genetic expression and may result in more and/or different beneficial compounds being produced.

Epigenetics is the study of epigenomes and their effects on gene expression. Epigenomes are not limited to plants, but also active components in many life forms including microorganisms, insects, and even humans. To give you an example of the power of the influence of nutrition on the epigenome, let's consider the bees. Female bees start out the same in life. Some are fed a special food called royal jelly, which influences the epigenome. These bees develop into queens, which are able to reproduce. The young female bees which did not eat royal jelly develop into sterile worker bees.

"There is no longer a reason to feel limited by one's genes."

There is a so-called "80-20 rule" which states that the human phenotype (outwardly-expressed appearance) is influenced only 20% by the actual genes and 80% by the epigenomic control of gene expression. Some researchers in the USA have found decreased cancer risk markers associated with epigenomic changes brought about with nutritional means and changes in lifestyle. (Reference: Ornish, D; Magbanua, MJ; Weidner, G; Weinberg, V; Kemp, C; Green, C; Matttie, MD; Marlin, R et al. (2008) "Changes in prostate gene expression in men undergoing an intensive nutrition and lifestyle intervention". *Proceedings of the National Academy of Sciences in the United States of America* 105 (24): 8369–8374.)

Swedish researchers observed changes in gene expression in fat tissue with low calorie diets. (Reference: Dahlman I, et al. Changes in adipose tissue gene expression with energy-restricted diets in obese women. *Am J Clin Nutr.* 2005;81:1275–1285.) Researchers in Finland measured significant changes in gene expression in fat tissue in relation to specific dietary intakes. (Reference: Kallio P, et al. Dietary carbohydrate modification induces alterations in gene expression in abdominal subcutaneous adipose tissue in persons with the metabolic syndrome: The FUNGENUT Study. *Am J Clin Nutr.* 2007;85:1417–1427.)

Change your diet, change your gene expression! Now there is no longer as much of a reason to feel unduly limited by one's genes! Just as one can feed a plant or a bee to help it express its potential, you can feed your epigenome a

healthy, influential set of food compounds and help yourself live to your real potential.

Let's start back at the soil and think about an interesting scenario. First we balance the soil with nutrients and beneficial microbial life in specific ways for the plants we wish to grow. The beneficial soil microorganisms are supplied with what they need to optimize their genomic/genetic potentials. These microbes, in turn, help make a balanced array of soil nutrients available to the plants so they can optimize their genomic/genetic potentials. Finally, humans and animals then eat these fabulous plants to optimize their genomic/genetic potentials. It's the spiral of life!

Going Beyond Organic to Nutrition Grown

More is not always better. To quote Dr. Elaine Ingham, a famous soil microbiologist, "Don't be a more-on." Just adding more soil amendments and fertilizers is not the path to nutrient-rich produce; balance is the key. How do we know what the plants need? We test. Through comprehensive soil and plant tissue analyses, which are interpreted for maximizing nutritional density in the produce, we can create health from the soil up for our plants and for ourselves.

Be aware that "All laboratories are not created equal." Neither are soil analysis procedures, interpretations of analyses, or fertilizer recommendations created equal. It seems a lot of people don't distinguish between an inexpensive soil test covering only a few elements and a comprehensive analysis (with a much larger array of elements) performed with the final nutrient density of the produce in mind. This is a case of getting what you pay for. Excellent soil and tissue analyses pay for themselves in the benefits they generate. If there were no advantages to testing, no farmer would bother with it. Soil and plant tissue analysis fees are some of the least expensive costs of farming. Good testing will save the grower money because only the right amounts of the right types of amendments and fertilizers will be purchased and applied. The crops will perform optimally, making more profits for the growers, as well as more nutritious food for the consumers.

I've done side-by-side soil analysis comparisons to prove the vast differences in interpretations. For example, I sampled some soil from a yard in the Ka'u district of the Big Island which was proposed to become a new vegetable garden. I took soil samples from the area according to protocol, thoroughly mixed them together in a bucket, and sent half of the soil to each of two laboratories. One was a local lab; the other was a lab known for focusing on food nutrient density.

The analyses came back with very different recommendations. The one from the local lab reported 4,339 ppm of calcium. The report interpreted the level of

calcium to be sufficient to high, well over the “expected” level of 3,500 ppm, so there was plenty of calcium and no additional calcium amendment was needed.

Notice the term used by the local lab—”expected level”. I don’t really care what the lab “expected” the calcium content of the soil to be (probably averaged from previous soil tests in that area). I want to know what the ideal level of calcium should be to grow the best quality food!

The report from the other lab stated that the calcium level was quite low at 4,603 lbs/acre of calcium, with the desired level of calcium being 6,392 lbs/acre. It was recommended that calcium amendments be added at a rate of 1,789 lbs/acre. Quite a difference! By the way, this had nothing to do with trying to correct the pH level of the soil, because the pH was perfect. It was for maximizing the quality and nutrient density of the crop. Any guesses as to why our foods are dwindling in mineral content and why people are having ever-increasing problems with osteoporosis?

A papaya tree nearby on this same property confirmed the lack of soil calcium, especially in relation to the excessive soil potassium level. The papaya fruit was having a problem with soft spots. Once the mineral levels were corrected, the soft spot problem ceased. Calcium is very important for plant cell integrity and, hence, shelf life.

Soil needs to have the right balance of a large array of mineral elements, but great soil is not just a bunch of elements; it is a living, functioning web of life. Soil should contain a wide array of active, beneficial microbes and macrobes, i.e. earthworms, which are supported by an array of different types of organic matter. This soil biota breaks down the organic matter and mineral compounds, making them available to plants.
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“…beneficial microbes keep harmful microbes at bay.”

The plant root zone is actually a synergistic, symbiotic system in which the plants give back to the soil web through root exudates. These exudates help to customize the beneficial bacterial population for the plant’s own needs. The beneficial microbes keep harmful microbes at bay. They are able to out-compete the disease-causing microbes if given what they need—air, food, water, and comfortable temperature. Notice that these are the same things that humans need.

Beneficial microbes are aerobes (“air loving”), so they don’t do well in compacted soil due to the lack of oxygen. While they need a moderate amount of water, too much water will also cause a lack of oxygen. The harmful microbes are anaerobic, so they thrive under these low oxygen conditions. Here’s where the earthworms come into play. Earthworms open channels in the soil, aerating it and allowing water to penetrate, while at the same time allowing excessive water to drain better. The plant roots are then able to delve deeper.

Plants want to send their roots deeply into the soil, but are often prevented from doing so. Roots that go deep can access more nutrients and water. This results in a healthier plant as well as a more care-free plant that doesn’t have to be constantly watered and tended. Accessing stored soil water also reduces irrigation costs.

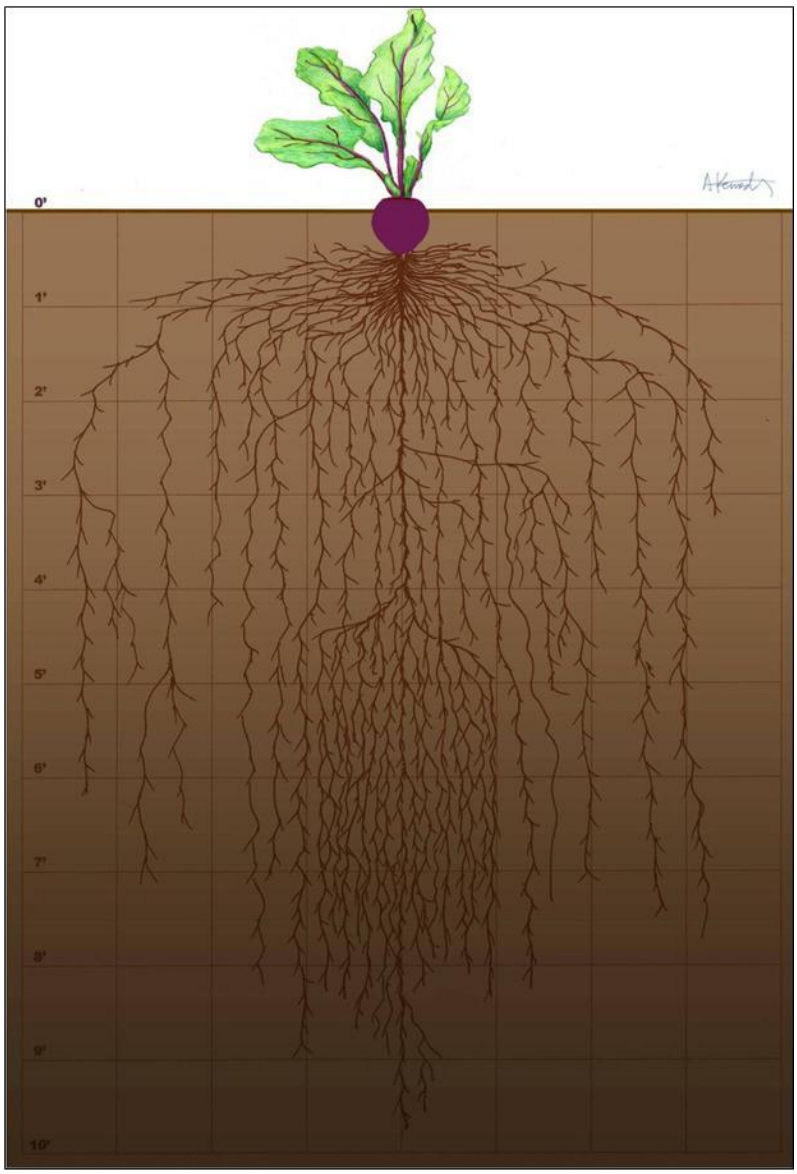

Illustration:: A. Frederick Kennedy

Roots want to penetrate deeply into the soil. This vegetable root system (in this case a beet) is 10 feet deep and 8 feet in diameter. This grid is marked in 1-foot increments

Soils can become severely compacted when driven on by cars, trucks or tractors. Heavy foot traffic by humans and animals also compacts soils. Plowing can create a hard layer in the soil termed a “hard pan”. The depth of the hard pan is usually just below the depth the field has been plowed in the past because the plow presses down as it cuts through the earth. Clay soils tend to compact most easily, but even sandy soils can suffer severe compaction. Working the soil when it is wet is most detrimental.

Destroying the soil biology with chemicals is a sure way to create a hard soil. Anhydrous ammonia, a commonly used agricultural chemical, has the effect of hardening the soil so much that it has been used to create airplane runways in jungles. Every year there are accidents where tanks or hoses explode. Anhydrous ammonia is so deadly that it kills trees and every other living entity in its way, including people. There is a news clip on the Internet reporting on a 38 year old woman driving her car down a road and being suddenly engulfed in a cloud of ammonia. She died at the scene.

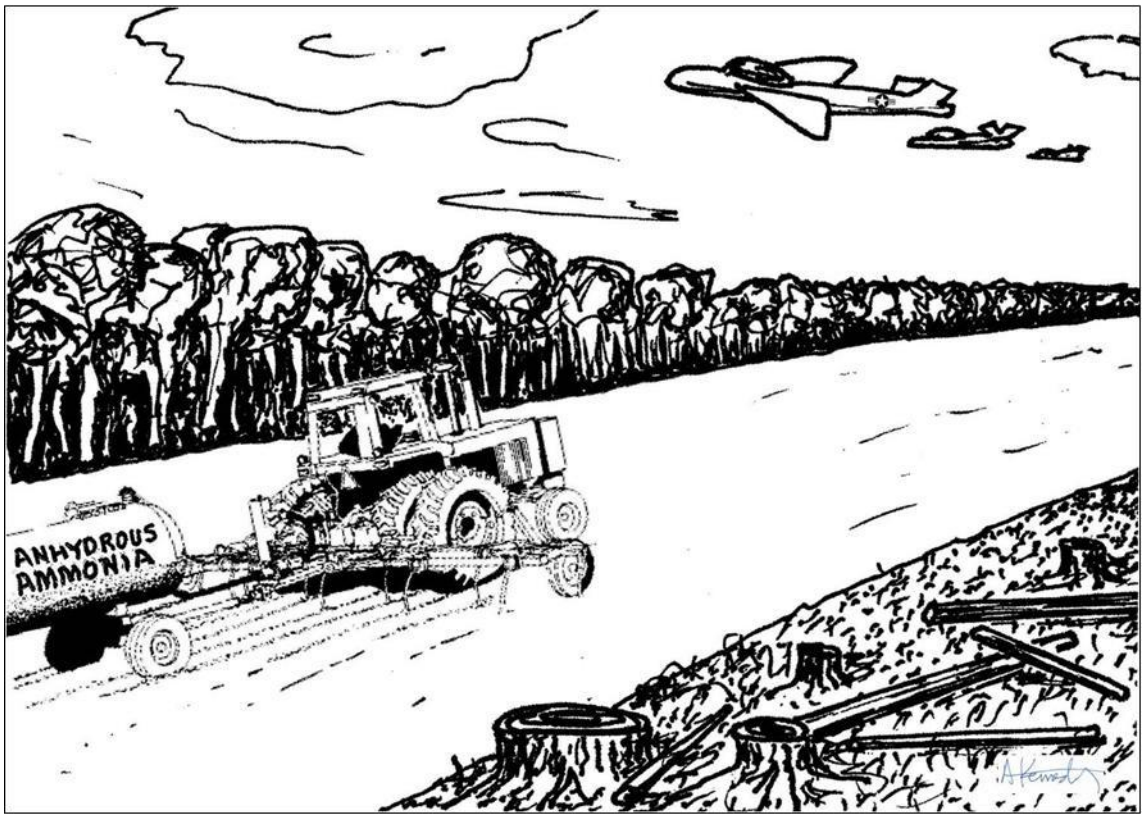

Illustration: A. Frederick Kennedy

One may determine the extent of compaction using a soil compaction meter, also known as a soil penetrometer. When one has a severely compacted soil, it may be necessary to loosen the soil with a ripper attached to a tractor. Rippers can go down three to four feet, which is usually plenty to get through the hard pan.

Soil Compaction Meter

For small areas, an effective hand digging procedure called “double digging” done with a spade and spading fork is recommended. This procedure involves digging out the top 6 inches of soil, loosening the subsoil, and then replacing the topsoil. Double digging is hard work, but can be very useful for compacted soils. One can mix amendments into the soil during the procedure. It provides an excellent opportunity to get hard-to-dissolve amendments, such as phosphorus, deep into the soil.

You may hear some controversy around the concept of double digging, like many other concepts. Some people say that you never should till any soil, because it destroys the soil structure and the beneficial microorganisms. While this thought may be valid in certain situations, heavy compaction is not the soil structure we need for growing food, and heavily compacted soil does not contain a large beneficial array of microorganisms. Loosening and properly amending the soil is what is needed to begin to reestablish the correct soil structure and its beneficial microbial life.

Double Digging Procedure for Compacted Soils

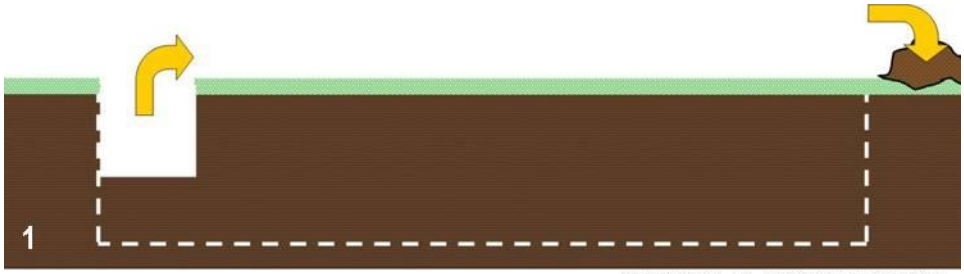

Illustration: A. Frederick Kennedy

Mark out an area for your new planting bed. Soak the soil by watering for a couple of hours. Allow it to sit undisturbed for two days to achieve an even moistness. Then remove as much vegetation as possible from the surface without removing large amounts of topsoil. Evenly spread the amendments called for on your soil analysis over the top of the bed. Starting at one end of the bed, loosen the top 6 inches of soil across the width of the bed with a spading fork. This will begin the process of mixing amendments into the soil. Next, remove the loosened 6 inches of soil with a spade and place at the other end of the bed. Remove any remaining vegetation from the soil in the process. Using the spading fork, loosen the soil as deeply as possible at the bottom of the trench you have created.

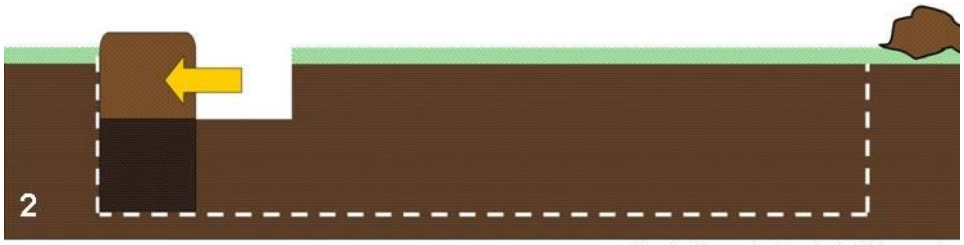

Illustration: A. Frederick Kennedy

Now continue the process of loosening, digging, moving, and loosening the bottom each section of soil as illustrated until you reach the end of the bed. The soil from the first trench which you moved to the far end will fill the last trench.

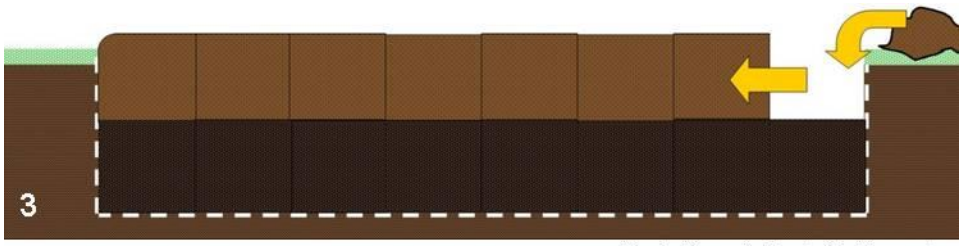

Illustration: A. Frederick Kennedy

Congratulations! You just had a great workout and are on your way to a fantastic garden.

For established orchards where extensive digging is impossible, one can drill holes under the drip lines of the trees, drench with compost tea, and then fill the holes with a mixture of active compost and sand. The microbes will work to loosen the soil.

A Great Soil Analysis & Why this is Important for Humans

The balance of minerals and other nutrients in the soil is key to healthy and health-giving plants. This is not a case of "if a little is good, a lot is a whole lot better". Balance is the key because plants are not able to selectively take only certain, ideal amounts of the various elements needed for optimal function. Too much of one element will disrupt the uptake of another element.

The soil analysis from one organic farmer client showed high levels of calcium, magnesium and potassium, which are all positively-charged cations. He thought this was great--"more is better". No, not necessarily. The soil analysis showed low levels of several trace elements. The high levels of the cations raised the pH excessively and exacerbated the imbalances with the trace elements. High pH levels decrease the phytoavailability of trace elements such as iron, zinc or copper. Furthermore, according to research by Professor William Albrecht, the elements present in nutritionally-imbalanced plants, even if absorbed by the intestinal tract, may not be utilized well by our bodies at the cellular level.

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So far, researchers have demonstrated that plants need approximately 17 elements, the exact number depending on the plant species, in order to be healthy enough to complete their life cycle. The 17 essential elements include carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), sulfur (S), potassium (K), magnesium (Mg), calcium (Ca), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), boron (B), chlorine (Cl) and nickel (Ni). Some of these, such as carbon, hydrogen and oxygen are largely obtained through air and water; therefore, you won't find them on a soil test *per se*.

Additional elements which are well recognized as being beneficial include sodium (Na), cobalt (Co), selenium (Se) and silicon (Si). A few elements being considered to add to the above listings include vanadium (V), chromium (Cr), and titanium (Ti). Some growers have proposed that certain plants may perform better with a fuller spectrum of elements, the number of which may rise as high as 90 elements.

Most of the essential and known beneficial elements should be included in a comprehensive soil analysis. If the plants being grown need the elements, then those elements should be monitored to make sure they are there in the proper amounts and in plant-available forms. One cannot manage what one has not measured.

A great soil analysis will start with the soil's **total cation exchange capacity (TCEC)**. This is a measure of the soil's ability to hold nutrients. Cations are positively charged ions, such as calcium and magnesium, which have +2 valences, and potassium and sodium, which have +1 valences. Due to structural characteristics which provide more negatively charged sites which "hold on to" the positively charged cations, clay soils can typically hold more plant-available nutrients than sandy soils. Determining the TCEC will help the soil scientist determine the correct amounts of the various mineral elements to recommend for application to the soil. Low TCEC, i.e. sandy, soils should be tested for nutrient needs by a specific soil test known as a paste test. A low TCEC soil should be amended to increase its ability to hold nutrients, for example, by adding humic materials.

You may sometimes see CEC (cation exchange capacity) listed on a soil analysis, instead of TCEC (total cation exchange capacity). They are similar, but TCEC includes the cation sodium in the calculation.

My dissertation research on apples compared the soluble solids content (Brix) of juice from conventionally-grown Gala apples from orchards established on two different soil types. One orchard's soil had a CEC of 7.1 meq/100g (considered low) versus the other orchard's soil with a CEC of 11.3 meq/100g (considered high). The higher CEC soil produced apples with significantly higher Brix measurements.

The **soil organic matter percentage (SOM%)** is another important consideration for one's soil. SOM consists of carbon-containing, non-living substances in various stages of decomposition, such as the breakdown products from previous crops. Some people confuse SOM% with TCEC thinking that they are the same or closely related. However, high levels of soil organic matter do not necessarily mean there is a good cation exchange capacity. Often, soil analyses show low TCECs even though the SOM percentage is high.

Organic matter supplies food for the microbes so they can proliferate and do their jobs of making nutrients available to plants. For vegetable production, the organic matter level should be at least 5%, but ideally 10% or more, especially for supplying adequate nitrogen to heavy feeding crops like corn. Plowing under cover crops of legumes, which fix nitrogen from the air, is an excellent way of increasing soil organic matter. Mixing in manure or, preferably, good quality compost, is another way of increasing SOM.

Good quality compost contains many thousands of types of beneficial microorganisms with broad categories of bacteria, fungi, protozoa and nematodes. "Nematodes, aah!", I hear you screaming. Relax, there are some *beneficial* nematodes. The beneficial bacteria and fungi suppress diseases, hold nutrients, build soil structure, stabilize soil, and decompose toxins. The beneficial protozoa and nematodes also build soil structure plus make nutrients available to plants.

Soil **pH** is the measure of alkalinity (base) versus acidity. It is critical to nutrient uptake by plants due to the changes in solubility of mineral elements at different pH levels. What does "pH" stand for? Potential hydrogen—the capacity for a solution to hold hydrogen, which is considered acidic. The technical definition of pH is "the negative log of the hydrogen ion concentration". On a simpler, more practical level, pH is the degree of acid versus alkaline. On the pH scale, which ranges from 0 to 14, 7 is considered neutral—having just as much acid as alkaline. Pure water (HOH) is pH 7. It is hydrogen (H), pure acid, plus hydroxide (OH), pure base. Below pH 7 is considered acid and above 7 is considered alkaline. It is an exponential scale, so pH 5, for example, is ten times more acidic than pH 6. Ideal soil pH may vary slightly depending on the type of plant being grown, however, 6.4 pH is considered excellent in most situations.

Calcium (Ca) is a very important cation (positively charged ion with a +2 valence), which greatly influences soil pH, but it is much more important than just as an element for adjusting pH. In plants, calcium is needed for nitrate uptake and metabolism, enzyme activity, starch metabolism, and cell growth and development. Calcium is critical for plant metabolism and gives strength to plant cell walls, allowing them to maintain their structural integrity. Cellular integrity is key to increasing shelf life of produce, as well as pest and disease resistance.

Deficiency symptoms include blossom end rot in tomatoes, black heart in celery, "burned" leaf tips in lettuce and cabbage, hollow sections inside cucumbers, bitter pit and cork-spots in apples, cracking in cherries, and rotting of fruit during storage.

"Attaining the correct percentages of the various elements allows the plants to uptake the correct amounts of each mineral for optimal functioning."

A 68% base saturation of calcium is a good level for most soils and crops. Base saturation percentages are measures of the relative amounts of basic cations, including calcium, magnesium, potassium, sodium, exchangeable hydrogen, and certain trace elements. Attaining the correct percentages of the various elements allows the plants to uptake the correct amounts of each mineral for optimal functioning.

Organically-approved calcium amendments for soil include calcium sulfate, also known as gypsum, calcium carbonate, also known as limestone, dolomitic limestone, which also contains magnesium along with calcium, and others, such as chelated forms of calcium. These products come in various physical forms from coarse grind to fine powders to prilled (powder made into tiny balls for ease of application). A good soil analysis interpretation should tell you exactly what type and form of calcium to buy, if indeed your soil needs any at all.

Calcium may also be applied as a foliar spray. A well-made chelated form is generally the most completely absorbed and utilized, though micronized particle liquid suspensions are excellent as well.

Getting calcium in the correct, food-matrixed form is essential for the health of humans and animals. Most people know that calcium is important for strong bones and teeth, and decreases the risk of osteoporosis and tooth decay. However, calcium is also necessary for cell signaling which controls nerve impulse transmission, muscle contraction, hormone secretion, and blood vessel contraction and dilation. Calcium activates enzymes and stabilizes proteins, which in turn perform other activities such as making energy available for muscle contraction or allowing blood clotting when one suffers a laceration, for example. Calcium also helps maintain the blood pH level by neutralizing acid.

Deficiency of calcium may result in dental decay, heart palpitations, insomnia, muscle cramps, nervousness, numbness in arms and legs, colorectal cancer, osteoporosis, loosening of teeth, kidney stones, preeclampsia (pregnancy-induced hypertension), premenstrual syndrome (PMS), and high blood pressure.

To be correctly absorbed and utilized by the body, calcium should be in a food matrix, not just ground up rocks. Poor calcium utilization can result in cataracts, kidney stones, and arteriosclerosis (hardening of the arteries), while never making it to the bones and teeth where it is needed.

Back when I worked as a clinical nutritionist, I had the opportunity to see some records of osteoporotic patients at a particular doctor's office. These patients had had regular bone density scans to track their progress. The doctor had prescribed daily supplements of 1500 mg calcium in tablet form. These patients had not gotten better, only worse. It is very important to have other nutrients such as magnesium, boron and strontium balanced in a food matrix along with the calcium for proper utilization.

Magnesium (Mg) is another important cation which can also influence pH upwardly. Magnesium is the central ion in the green chlorophyll molecule, which is critical for photosynthesis. Photosynthesis is the conversion of light energy by plants to food (stored molecular energy). Plants are amazing! We depend on them for life. They are far more genetically complex than we are. For example,

plants convert sunlight, air and water to fuel, but humans cannot create personal energy compounds like plants do.

Magnesium is an enzyme activator for a large number of enzymes with vital functions such as sugar synthesis and lipid formation. This element carries phosphate and starches, and regulates uptake of other nutrients. It aids plant respiration and stimulates seed production.

Deficiency of magnesium results in pale green leaves, advancing to interveinal chlorosis (yellowing) or yellow spots on leaves. The leaves fall prematurely, stalks weaken and produce quality is adversely affected.

Too much soil magnesium, especially in relation to calcium, will cause soil compaction. Often there is no true magnesium excess, just a need for more calcium and other minerals to balance the soil. A 12% base saturation of magnesium is a good level for most soils and crops, with sandy soils possibly needing up to a 20% base saturation level to help tighten the loose sand for better holding capacity. You can check your soil's compaction using a soil compaction meter, mentioned earlier. The reading should definitely be less than 300 PSI (pounds per square inch).

Organically-approved magnesium sources include dolomitic limestone, magnesium sulfate (Epsom salts), and potassium magnesium sulfate, also known as langbeinite, k-mag, or sul-po-mag. For those not concerned about being certified organic, magnesium oxide may be a good choice. It is derived from mined magnesium carbonate and is a relatively inexpensive, readily plant available source.

Magnesium is woefully lacking in the diet of many humans. Like calcium, most of the body's magnesium is found as a structural element in the skeleton. However, it is necessary as an enzyme activator for over 300 essential metabolic reactions. These include production of energy from food, synthesizing needed molecules, such as proteins, lipids and antioxidants, cell membrane ion transport, and cell signaling.

Deficiency of magnesium may result in confusion, disorientation, nervousness, rapid pulse, tremors, migraine headaches, diabetes, cardiovascular disease, eclampsia (toxemia of pregnancy), hypertension (high blood pressure), and osteoporosis.

In one holistic medical clinic where I used to work, we checked patients for magnesium deficiency using magnesium intravenous (I.V.) load tests. We also administered magnesium I.V. "pushes", using 60 mL syringes. I vividly remember a patient coming into the clinic experiencing a heart attack. We gave him a magnesium I.V. push, and he was feeling fine in 15 minutes.

The typical advice is to consume twice as much calcium as magnesium, based on the ratio in bones. However, another school of thought promotes the opposite--using twice as much magnesium as calcium. The higher level of magnesium is thought to improve the utilization of calcium. Getting calcium and magnesium in a food matrix with a full spectrum of minerals and other nutrients seems preferable.

Potassium (K) is widely recognized as needed by plants for development of stalks, leaves and fruit. It is critical for proper fruit set, sizing, sugar content (Brix) and color. Adequate potassium allows sap to act similar to antifreeze helping plants endure cold temperatures. Relatedly, it also is critical for cell wall development, and plant cell turgor (maintaining moisture content), helping the plant to better tolerate drought stress.

You will see potassium listed on fertilizer bags as part of the NPK analysis, not as the P, but as the K. This is due to its Latin name, Kalium, which comes from "alkali". The term "potassium" comes from potash ("pot ashes"), derived from a leachate of wood ashes. The listing for potassium on a fertilizer bag is actually for potash (K_20) equivalents. The most commonly used form of potassium by conventional agriculture is potassium chloride, also known as muriate of potash—a salt. This is a very harsh chemical form which is highly detrimental to soil microflora and leaches calcium from the soil. You will want to source potassium sulfate, which is organically approved.

Potassium deficiency appears in the plant leaves as marginal chlorosis (yellowing). Plants are more likely to wilt and succumb to diseases. Fruit is prevented from developing its full flavor and quality. Yield losses may result before any outward symptoms are seen.

Excessive potassium can displace needed minerals such as calcium or phosphorus, resulting in poor quality produce with lower quality protein, excessive carbohydrates, and symptoms such as black spots. A 4% base saturation of potassium is a good level for most soils and crops.

For humans, potassium is a critical electrolyte maintaining fluid balance and allowing nerve impulse transmission. Potassium is needed as an enzyme activator for carbohydrate metabolism. Potassium deficiency is associated with increased incidence of stroke, high blood pressure, slow irregular heartbeat, osteoporosis, kidney stones, acne, dry skin, constipation, general weakness, nervousness, insomnia, weak reflexes, and continuous thirst.

Excessive potassium in feedstuffs for horses has been seen to exacerbate blood glucose regulation dysfunction. An acquaintance of mine had two horses on medication for blood glucose problems. Soil tests of her pastures and hay revealed excessive potassium levels. Correcting the soil mineral balances with

the proper amendments corrected the forage mineral levels and her horses got well.

Sodium (Na) seems to be shunned by farmers and considered unnecessary for most plants, except for blue-green algae, by many. Excessive sodium in soil is indeed a problem in certain areas; however some plants, such as beets and celery, thrive on a bit of extra sodium, more than many soils provide. Oceans are salty because rain has washed sodium and other minerals out of the soil, down the rivers, and into the ocean. Evaporation leaves the sodium behind, thus concentrating it in the ocean water. Ocean water or dried sea solids can be used in a diluted form to bolster low sodium soils. Natural ocean water also contains a vast array of trace elements in small amounts.

"Test for soil and plant needs before applying amendments or fertilizers."

Some young, over-zealous farmers I met had heard about the benefits of using ocean water on crops and proceeded to put it on some plants. Soon the plants were dead and they were left with a hard-earned lesson—"Test for soil and plant needs before applying amendments or fertilizers."

Sodium levels above 70 ppm can be problematic, resulting in hardening of the soil and poor water availability for plants. Some farmers leach excessive sodium out of the soil with water, but one must be careful to check the sodium level in the water since that is often the source of the excessive sodium levels. Adding calcium may help to balance the high sodium and loosen the soil, but a detailed soil analysis is needed to avoid guessing what might be needed, and thus avert wasting money on unneeded amendments which may compound problems. A 2% base saturation of sodium is a good level for most soils and crops.

Humans also need sodium, though, like with farming, it suffers from a maligned reputation. This is due to excessive consumption of refined salt, consisting of highly-heated sodium chloride without other trace elements, mainly because of its copious addition to many foods. Sodium is an essential electrolyte for proper fluid balance. It is integral to nerve and muscle function. Sodium in excess of what can be cleared by the kidneys can build up in the blood and result in hypertension (high blood pressure).

Sulfur (S) is an anion, with a negative charge. Sulfur is needed for production of methionine and cysteine, the sulfur-bearing amino acids which are building blocks of protein. When the plant lacks sulfur, these particular amino acids cannot be made. A commonly used test for protein in food, termed "proximate analysis", determines only the nitrogen content and calculates the protein content from that. It does not take into account the actual amino acids present. Nitrogen present in other forms will be calculated as protein when it is not. Humans

cannot manufacture methionine or cysteine, which are considered essential amino acids that must be obtained through the diet. Therefore, a lack of sulfur in plants may cause a lack of essential proteins in humans and animals.

Sulfur is needed by plants for various metabolic functions, including the formation of some vitamins and flavor compounds, and activation of certain enzymes. Sulfur enhances drought and cold tolerance, as well as pest and disease resistance. Another need for sulfur in plants is the formation of sulfolipids. Sulfolipids (sulfur-containing fats) are integral parts of chloroplasts, which are plant cell organelles where photosynthesis takes place. Therefore, plants lacking sulfur will be pale in color instead of a vibrant green.

If your soil lacks sulfur, you can use organically-allowed 90-92% agricultural sulfur. It typically comes in a tiny pellet form which releases over time. Often enough sulfur will be obtained from other needed amendments such as calcium sulfate. Wettable sulfur powder is often used as a foliar spray for combating pests and diseases, especially fungal diseases.

"Don't guess, test!"

Sulfur added to the soil decreases soil pH. But don't make the mistake one of my friends made. Before I became acquainted with her, Mary had a pH test done on her soil. It showed her soil as being too alkaline. She had heard that sulfur lowers pH; so she bought a bag and put it on. Mary was trying to grow tomatoes, but they kept rotting on the vines. This was when I came in. I did a comprehensive soil test and found her soil's sulfur to be four times higher than it should be. No wonder she was having blossom end rot! The take-home messages: "Don't guess, test!" and "It's all about balance."

Sulfur is the third most abundant mineral in the human body as a percentage of weight. Besides methionine and cysteine, there are other sulfur-containing compounds in the human body, including cystine, glutathione (GSH), homocysteine, homocystine, S-adenosylmethionine (SAMe), and taurine which play various metabolic roles. Collagen fibers and fibrin blood clots are strengthened by disulfide bonds (two sulfur ions connecting a molecule).

According to the American Institute for Biosocial and Medical Research, sulfur compounds may be used in the treatment of bladder disorders, depression, fibromyalgia, congestive heart failure, diabetes, cancer and AIDS. Optimizing sulfur intake may decrease joint discomfort, inflammation, allergies, muscle pain, fatigue and stress. Sulfur is reported to aid cell regeneration, improve joint mobility, and help heal strains and sprains of ligaments and tendons.

Phosphorus (P) is a major anionic element needed for energy systems in all living organisms. Adenosine triphosphate (ATP) is the "energy currency" due to

its high energy phosphate bond which, when broken, supplies energy to drive metabolic processes. This is true for plants and people.

In plants, phosphorus is also needed for photosynthesis, cell division and enlargement, and seed and fruit production. Besides ATP, phosphorus is a structural component of proteins, enzymes, nucleic acids and DNA. Deficiency symptoms include stunted growth, delayed maturity, reduced seed production, and discolorations, i.e. normally green plant leaves turn purple.

Phosphorus is a mined product which has been used extensively in agriculture for many years. It shows up as the P of the NPK analysis numbers on fertilizer bags. The number corresponding to P on the bag is typically referring to phosphate (P_2O_5) equivalents, not actual phosphorus—at least in the USA. The original rock phosphate product dug from the mine is excellent for the soil, is harmless to the soil microbial life (actually stimulates it), and does not pollute waterways. It is stable in the soil and becomes available to plants slowly over time. Trouble comes when natural rock phosphate is reacted with acid to produce manufactured chemical fertilizers, such as triple super phosphate. These are immediately plant-available, but come with the downsides of damaging soil microbial life and soil tilth, and leaching into waterways, ultimately killing fish. Nutrient Flow Task Group, a Dutch research organization, estimates that 11.4 million tons of phosphate are lost every year due to water runoff and erosion.

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There are finite supplies of phosphorus, with some authorities claiming humanity may run out of concentrated sources. The International Fertilizer Development Center estimates that worldwide sources may be exhausted in 100 years. Most of the phosphate reserves are held in Morocco. A large mine in Florida supplying excellent quality soft rock phosphate, commonly known as CalPhos, may be emptied in as little as 30 years. For the sake of our children and grandchildren, changes need to be made quickly in how phosphate is used.

CalPhos, in its original soft rock phosphate form from Florida, is almost a secret soil-improving amendment used by long-time farmers who were "doing organic" before organic growing was "cool". They realized what a "gem" this amendment was and used it to produce the most fabulous, award-winning fruits, vegetables and hays. When shopping for this amendment, try to get the finely ground type.

Beyond making ATP, phosphorus is needed by humans for bone and tooth formation and maintenance. Approximately 85% of phosphorus in the human body is in the bones. Phosphorus is also needed for cell structure, for example, phospholipids in cell membranes. Muscle contraction, nerve activity, kidney function and vitamin utilization (vitamins A, D and riboflavin) also require

phosphorus. Fortunately, most people get enough phosphorus in their diets, however, depending on their diet, pregnant and lactating women may be at risk of deficiency.

Nitrogen (N) is also an anionic element. It is the N of the NPK, the first number listed on a fertilizer bag. Nitrogen, along with carbon, hydrogen, oxygen and sulfur, makes up protein. Nitrogen is also one of the main components of the nucleic acids, DNA and RNA, which store genetic information and use it to build proteins. These statements hold true for the proteins and nucleic acids in both plants and humans.

While plants need and can utilize simple nitrogen-containing molecules, humans need fully-formed amino acids, which will typically come to us in the form of proteins. This is one of the plant world's services gifted to us. Our service to the plants can be to give them an excellent growing medium which supplies them with an optimal amount of nitrogen among other needed items.

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A soil rich in organic matter and beneficial microbes can supply nitrogen in a slow, steady stream. Unlike manufactured nitrogen fertilizers which are easily leached into ground water, this natural slow release is environmentally friendly. In addition to microbes which colonize root nodules of leguminous plants and fix atmospheric nitrogen, certain soil microorganisms, such as Azotobacter chroococcum and Azotobacter vinelandii, can fix atmospheric nitrogen, thus supplying additional nitrogen to plants. The air we breathe is approximately 78% nitrogen and 21% oxygen, so there is plenty of (free) nitrogen for microbes to fix and then make available to plants if our growing systems are working correctly.

Chemical fertilizers, herbicides, pesticides, and fungicides can damage the microbial life in the soil, making farmers more dependent on purchased nitrogen. For some heavy feeders, like sweet corn, natural fertilizers like fish, composted manures or feather meal can be used. For those who wish to have vegan gardens, items such as seed meals and alfalfa can be used. Leguminous cover crops, which fix nitrogen from the air with the help of bacteria, can be plowed under to supply excellent, nitrogen-rich organic matter to the soil.

Nitrogen deficiency in plants typically shows up as chlorosis of the older leaves, slower growth, and smaller plants.

For humans, nitrogen deficiency is not a nitrogen deficiency *per se*, it is a protein deficiency or, more precisely, an essential amino acid deficiency. This manifests

as a wasting disease as muscles and other tissues are sacrificed in an attempt to maintain the integrity and function of the organs vital to life. We have probably all seen horrible pictures of starving children with protein-calorie malnutrition known as marasmus and kwashiorkor. Less severe cases may manifest as decreased ability to heal, depressed immune function, water retention, dizziness, nausea, infertility, fatigue, weakness, and/or lack of muscle tone.

Boron (B) deficiency in plants may appear as stunting, leaf discoloration, hollow stems, and hollow sections inside produce such as cucumbers. Have you ever cut a cucumber and seen holes in the middle of the slices? A lack of boron can also result in black heart, which, for example, exhibits as dark areas inside potatoes. Boron is essential for cell wall, pollen and seed formation, as well as translocation of sugars and starches within the plant. Boron makes nitrogen more available to plants, helps plants form the amino acid tryptophan, and assists with nodule formation (for nitrogen fixation) in legumes.

In addition to the hollow areas inside produce mentioned above, deficiency symptoms manifest in a variety of ways. In apples, deficiency symptoms include water core (where the interior of the apple appears translucent), corky areas inside the fruits (sometimes associated with bitter pit disease), fire blight, and rough and split peels. Boron deficiency shows up in carrots and beets as root cracking and splitting. In celery, the stem cracks and the heart blackens. With pistachios, the nuts fail to split open. This author has seen all of these symptoms in purchased produce.

Boron sources include borax and Solubor, which has a higher ratio of boron to sodium than borax. Chelated boron solutions are available for foliar applications.

Boron easily leaches from soil, so regular testing and amending every six months is suggested for optimizing production. Caution: "Just adding some extra boron" once in a while by guessing what might be the correct amount can be dangerous because it is easy to overload the plants with a toxic level.

"…boron is protective against damaging radiation, an increasing concern…"

Humans need adequate boron for metabolism of other minerals, energy and nitrogen metabolism, proper brain function, hormonal regulation (including insulin), and antioxidant function. Some say that boron is protective against damaging radiation, an increasing concern in this nuclear-powered world in which we find ourselves. Perimenopausal women have reported cessation of hot flashes when supplementing their diet with boron. Some studies show plant-derived boron complexes to exhibit antibiotic properties. Boron is reported to help hold magnesium in the body and assist with bone metabolism. In horses, it has been observed to relieve arthritis and stop clicking of the joints, also known

as “joint mice”. Maintaining excellent levels of magnesium and tryptophan with the help of boron may decrease nervous irritability.

Iron (Fe) is needed for chlorophyll development and production, so when lacking, one will see chlorosis (yellowing) of the leaves. Iron is needed as an enzyme catalyst for many vital reactions in plant chemistry such as energy transfer in respiration, nitrogen fixation and lignin formation. Deficiency in pome fruit trees, such as apples and pears, results in leaf chlorosis, which affects growth, flowering, and fruit sizing and quality.

When soil needs an available iron source, iron sulfate in the heptahydrate form is a great choice. This form will appear as a light color, often bluish, never black or brown. Never apply it to green leaves. Iron chelates are available for foliar application.

“It is estimated that over 60% of the world’s population is iron deficient.”

For humans, iron deficiency anemia is the most common micronutrient deficiency in the world. It is estimated that over 60% of the world’s population is iron deficient. Anemia pictures outwardly as paleness and fatigue. Iron deficiency may also manifest as brittle nails, constipation and/or breathing difficulties.

Manganese (Mn) regulates the uptake of carbon, magnesium and phosphorus. It is needed for assimilation of carbon dioxide for photosynthesis and electron transport during photosynthesis. It regulates growth hormone supply, aids respiration, accelerates germination and hastens maturity. Manganese catalytically activates enzymes which form fats, riboflavin (vitamin B2), ascorbic acid (vitamin C), and carotenes (precursors to vitamin A). Unfortunately, humans are not as talented as plants that can make their own vitamins with the help of manganese.

Manganese deficiency in pears and other pome fruits causes interveinal chlorosis in older leaves. This yellowing is due to a lack of chloroplasts, of which manganese is a component. Photosynthetic ability is diminished, not only due to the lack of chloroplasts, but because manganese is also needed as an enzyme activator for the photosynthetic process.

In spite of all the many wonderful things that manganese does, we must remember that, like the other elements, it must be present in the right amount. Many soils have too much manganese, particularly in regard to the amount of iron. If your soil does need manganese, manganese sulfate is a good choice. Manganese chelates are available for foliar use and are often the best way to correct imbalances.

One farmer I work with was concerned about adding manganese to his soil when he read an article about manganese causing neurodegenerative diseases in Aboriginal people living in the remote outback of Australia. It turns out that a corporation came in and established a manganese mining operation there in the 1960's. Manganese dioxide dust soon covered the region and this excessive exposure to "non-food form" manganese resulted in the disease conditions. The article's author hinted that manganese overload may also be responsible for Mad Cow Disease, also known as Bovine Spongiform Encephalopathy (BSE). Cows, and all beings, need an optimal balance of nutrients obtained through their natural food sources. Cows will succumb to many diseases when forced to eat an unnatural diet, such as when "cows were fed to cows" and came down with BSE.

Humans need manganese (in the food-matrixed form) as activators for enzymes, reproduction, growth, hormone production, tissue respiration, and vitamin metabolism. Manganese deficiency can manifest as muscular incoordination, dizziness, tinnitus (ringing in the ears), and hearing loss.

Copper (Cu) aids in chlorophyll synthesis and photosynthesis. It acts as an enzymatic catalyst enhancing nitrogen utilization and stimulating protein synthesis. Copper also assists with respiration and root metabolism. Because of these basic functions, copper levels will affect Brix (sweetness), flavor and shelf life, as well as various aspects of nutritional content.

Copper deficiency in plants may result in chlorosis (yellowing due to lack of chlorophyll). Wilting and disease, especially fungal disease, susceptibility are increased due to cell wall weakness, which is due to lack of lignin synthesis. Yield is reduced by various means, including male sterility. Copper, along with boron, can be helpful in controlling fire blight, which is caused by the bacterium *Erwinia amylovora*. Currently, growers use antibiotics on their trees to control fire blight, but soon, due to changes in legislation, organic growers will no longer be allowed to use this means of control.

Copper sulfate is used for soil applications. It needs to be carefully applied in the correct amounts so as not to damage soil microflora. Often it needs to be "spoon-fed" in small amounts over a period of time, gradually building the soil levels to optimal amounts. Retesting soil at appropriate intervals, i.e. every six months, before applying more copper or other amendments is very important. Chelated copper is available for foliar applications.

"…numerous reports of grey hair turning back to the original color when the individuals consumed adequate copper…"

For humans and animals, copper is needed for formation of hemoglobin and red blood cells, as well as bones. Copper is needed for proper utilization of iron. As in plants, copper is an enzyme catalyst and thus affects many critical chemical

reactions. It is very important for hair and skin color. There have been numerous reports of grey hair turning back to the original color when the individuals consumed adequate copper in assimilable forms. Some have also supplemented it for treating baldness.

I once had a horse that was losing pigment in his skin. It turned from a dark grey to pink. Besides looking ugly, the pink skin spots were more prone to sunburn. I found a supplement which contained a natural, plant-matrixed source of copper and, thankfully, after feeding it for several weeks my horse's skin color returned.

Deficiencies of copper in humans and animals result in general weakness and slowness to heal. Skin sores and infections are common, and of course, greying hair!

Zinc (Zn) is needed as an enzyme catalyst in a large number of chemical reactions, including those involved with chlorophyll production, carbohydrate transformation, water absorption, energy production, growth regulation and protein synthesis. Adequate zinc in plant tissues helps the plant to endure cold temperatures without damage. Zinc is needed for production of essential growth hormones called auxins.

Zinc deficient plants exhibit slow growth and small leaf size. They can also be susceptible to powdery mildew, a problem often seen on squashes. Zinc deficiency in apples and other pome fruits causes interveinal leaf chlorosis at branch tips, resulting in small, deformed fruits.

Zinc sulfate is a good choice for supplying needed zinc to the soil. Like copper sulfate, it is added in conservative amounts over time as indicated by soil analyses. Zinc chelates are available for foliar sprays.

Some agricultural testing laboratory consultants have made the mistake of repeatedly recommending zinc applications to the soil from only looking at leaf tissue analyses, without also looking at soil analyses. This resulted in zinc toxicity of the soil. Seeing low zinc in the leaf tissue does not necessarily mean that the soil is low in zinc. It could be an availability issue. Getting the full array of minerals balanced in the soil along with balancing the microflora is key to proper uptake of all needed nutrients. One needs to test both soil and leaf tissue to determine how to best help the plants. A leaf tissue analysis should be used to determine foliar spray needs, not what is to be added to the soil.

Zinc is an essential enzyme component and is important for gene regulation, therefore affecting many aspects of human and animal health. It is estimated that over 30% of the world's population is zinc deficient. Zinc is needed by humans for wound healing, reproductive organ growth, development and function, and metabolism of vitamin B1 (thiamine), phosphorus, and protein. Zinc deficiency out-pictures as white spots on the fingernails, loss of the ability to taste

and smell, delayed sexual maturity, sterility, retarded growth, prolonged wound healing, and/or poor appetite.

Horses need zinc, in combination with copper and manganese, in bioavailable forms, along with adequate high quality protein and biotin, for strong hooves. The ideal ratio is approximately 1 part copper: 4 parts zinc: 4 parts manganese. Many feedstuffs are exceptionally nutritionally deficient and unbalanced, resulting in cracked hooves and thrush (a hoof infection), among other problems.

Silicon (Si) assists plants during stressful times. It helps prevent powdery mildew and strengthens cell walls against insect attacks. While soils contain a large amount of silicon, it is often unavailable to the plants. Beneficial soil fungi help make it available, so we must care for these and other beneficial microorganisms in the soil. Supplying adequate boron and balancing the other elements needed in the soil will also help make silicon available to the plants. Hugh Lovel, of Biodynamics fame, asserts that boron activates silicon which then carries all other nutrients within the plant sap, starting with calcium.

"[Silicon] is considered a 'beauty' element which may improve wrinkled, aging skin…"

For humans and animals, silicon is important for strong bones and connective tissue, including collagen. Some nutrition researchers have found it useful to prevent or improve osteoporosis. Silicon has been seen to assist in wound healing. It is considered a "beauty" element which may improve wrinkled, aging skin due to its connection with collagen and tissue elasticity. Silicon may help prevent atherosclerosis, hypertension and Alzheimer's disease. Rudolph Steiner, the founder of Biodynamics, claimed silicon to be involved with nerve transmission and strength of will. He felt nutritional deficiencies to be the root cause of unloving emotionally-based acts.

Chlorine (Cl) is an anionic element needed by higher plants as a catalyst for photosynthesis. Deficiency symptoms in tomatoes, for example, include wilting, chlorosis, bronzing and necrosis of the leaves. Probably more common, toxicity appears as scorching, browning, bleaching or yellowing of leaf tissue starting from the tips and margins progressing toward the center of the leaf, as well as interveinally. As with all elements, balance is key. Chlorinated water can be harmful, especially to microbial life. Many forms of inorganic fertilizer are chlorine-based, such as the commonly used potassium chloride. It is a less expensive source of potassium, but can damage soils. Sea solids (mainly sodium chloride) must be used cautiously.

Humans and animals also need some chloride. It is one of the elements which helps maintain cellular fluid balance. Chloride, along with hydrogen, makes up hydrochloric acid which aids digestion by assisting with the breakdown of proteins. Common table salt is 60% chloride, 40% sodium.

Cobalt (Co) is the central atom in the vitamin B-12 molecule, also known as cobalamin. Notice how the name describes its content—cobalt plus amine (like amino acid—protein). Vitamin B-12 is produced by actinomycetes (rod-shaped bacteria with antibiotic properties) in microbiologically-active soil. Cobalt is needed for fixing nitrogen from the air, and for the formation of cellulose, bark, and seed coats. This trace element works with fluoride and molybdenum to provide strength and hardness.

Cobalt may be added to the soil in the form of cobalt sulfate. Only very small amounts are needed. Be sure to test first.

Vitamin B-12 is an essential vitamin for humans, which we cannot typically produce adequately for ourselves. It is needed for blood cell formation, metabolism of carbohydrates, fats and proteins, and a healthy nervous system. Vitamin B-12 deficiency is common. It presents as pernicious anemia, general weakness, nervousness, and damage to peripheral nerves resulting in tingling and numbness in the extremities.

Vitamin B-12 is primarily available from animal sources, though certain nutritional yeasts also contain it. Just because one eats animal products does not guarantee adequate B-12 levels, nor does being a vegan automatically mean one is at risk of deficiency. Dietary supplementation is prudent, especially considering that naturally-occurring B-12 can be difficult or impossible for some individuals to absorb. There is no concern about toxicity as it is water soluble.

Selenium (Se) is beneficial for some plants. It plays a key role in certain enzymes which act as antioxidants in certain plants and also in mammals. Combined with proteins in the form of selenoproteins, selenium regulates thyroid function and bolsters the immune systems of humans and animals. Adequate selenium intake is associated with decreased risk of cancer and HIV/AIDS.

It is estimated that 15% of the world's population is selenium deficient. Optimal selenium intake occurs in a narrow window. Too much can easily become toxic. Some soils have naturally-occurring toxic levels while others are deficient. It's a good idea to check your soil at least once. Selenium can be added to the soil in the form of sodium selenate or sodium selenite, if the selenate form is not available.

Molybdenum (Mo) is an enzyme catalyst for changing nitrate (NO_3^-) to ammonium (NH_4^+), a plant-useable form of nitrogen. This trace element also enhances protein formation. Molybdenum is needed for atmospheric nitrogen fixation by bacteria growing symbiotically with legumes as well as non-symbiotic nitrogen-fixing bacteria. Molybdenum is used in the conversion of inorganic phosphorus to an organic form and is necessary for ascorbic acid (vitamin C) metabolism. Deficiency symptoms include chlorosis of leaf margins, distortions in leaves and flowering bodies, and decreased fruit set due to less viable pollen.

Ultra-trace elements such as molybdenum and others following in this section can be supplied to soil with applications of naturally-occurring rich sources of trace elements such as Azomite, greensand, seaweed (i.e. kelp), and ocean fish. Seaweed and fish hydrolysates are often used as ingredients in foliar sprays.

For humans, molybdenum is needed as a cofactor to enable certain enzymes to work. The activated enzymes are responsible for some aspects of amino acid metabolism and the oxidation of sulfites to prevent neurological damage and allergic/asthmatic symptoms. Sulfites are added as preservatives to many foods.

"Rejoice, Hawai'i residents! Help with the vog is on the way!"

Sulfites are also present in smog and vog (volcano smoke and fog), which is a real concern for some Hawai'i residents. Dr. Carl Pfeiffer, a biochemist and physician who helped run the Princeton Brain Bio Center, felt that sulfite sensitivity may be due to molybdenum deficiency since he had seen consistently low blood levels of Mo in his patients. Molybdenum is needed to activate the enzyme sulfite oxidase which changes toxic sulfite to harmless sulfate. Rejoice, Hawai'i residents! Help with the vog is on the way!

Iodine (I) is not considered necessary for plant health, but is essential for humans and animals; therefore, it is good to have it in the soil for the plants to take up. For growing health-giving plants, fertilizers and foliar sprays containing seaweed or fish are good sources of this element.

Iodine is a component of the thyroid hormones, triiodothyronine (T3) and thyroxine (T4). These hormones, in turn, regulate a variety of functions including protein synthesis and enzyme activity. Iodine deficiency can result in goiter (an enlargement of the thyroid gland), hypothyroidism (which results in fatigue and weight gain), mental retardation, and other developmental problems. Adequate iodine may bolster the immune system, protect against breast disease and even fend off some types of cancer. It is estimated that 30% of the world's population is iodine deficient. The deficiency, which used to be even more common, has been lessened by the use of iodized salt. However, it seems preferable to avoid processed salt and get iodine from properly-raised food sources.

Chromium (Cr) is beneficial for plant growth; however, it is not considered essential for plants to complete their life cycle including reproduction. Chromium is, however, needed for humans and animals—in the correct form, of course!

You may remember the movie, Erin Brockovich, which is about a town whose water was polluted with hexavalent (-6) chromium, a toxic form of chromium. Chromium, in food form from plants, has a valence (ionic charge) of +3. As part of a molecule called the Glucose Tolerance Factor (GTF), it increases the action

of insulin. Chromium act in other roles as an antioxidant, an enzyme activator, and a stabilizer of proteins and nucleic acids. It also influences lipid (fat) metabolism. Chromium seems to be a very popular supplement for those working to decrease their body fat percentage.

Vanadium (V) is also not considered essential for plants, however, it may enhance the plant's ability to photosynthesize. Vanadium uptake by plants is beneficial to the humans and animals who eventually eat the plant.

In humans, vanadium appears to be important for blood glucose and hormonal regulation, fat metabolism, and enzyme regulation. It stimulates proliferation and differentiation of cells. In goats, deficiency of vanadium resulted in increased abortion and a decrease in milk production. Similar effects may or may not be seen in humans. There is a limited amount of research from which to draw conclusions.

Other beneficial trace elements include fluoride (F), strontium (Sr), cesium (Cs), yttrium (Y), lithium (Li), indium (In), and iridium (Ir), among others. Fluoride helps prevent dental caries and stimulates new bone formation. Strontium is needed for bone strength. Experiments with cesium showed it to support the immune system and suppress cancer. Yttrium has reportedly increased the lifespan of experimental animals as much as three-fold. Lithium is most commonly recognized as needed for proper neurological function, leading to emotional stability. Indium helps the body to assimilate other trace elements and supports hormonal systems. Iridium and other platinum group elements are thought by researchers to act as superconductors in the brain, possibly enhancing the ability to achieve states of super-consciousness.

Aluminum (Al) is considered a toxic element, an excess of which can damage plant roots. The poor root development hampers the plant's ability to uptake sufficient water and phosphorus. Restoring the correct pH level in the soil will usually prevent problems of aluminum toxicity.

Other potentially toxic elements in the soil include arsenic (As), cadmium (Cd), and lead (Pb). Arsenic was used on orchards and sugarcane fields for many years, so be careful if you are trying to plant on old orchard or sugarcane land. Lead may come from paint eroded or scraped from old buildings on a property. It is a good idea to check your soil for toxic elements at least one time. These will be more of a potential threat if your soil is overly acidic. Balancing your soil with needed minerals will correct the pH and help to "crowd out" the toxic elements by providing the plants and beneficial soil microbes with an array of healthy nutrients.

"…mercury, more than aluminum, damages brain neurons, thereby leading to memory loss and Alzheimer's disease."

In a similar way, having a good supply of beneficial minerals in your body will "crowd out" and replace toxic elements you may have acquired, such as mercury (Hg) from dental amalgam fillings and cadmium from cigarette smoke. Some researchers have recently discovered that mercury, more than aluminum, damages brain neurons, thereby leading to memory loss and Alzheimer's disease. When one's body is mineral deficient, there are open spaces in enzyme systems which need their specific activating minerals. If the mineral of choice is not available, toxic metals are much more likely to occupy the space. The problem is that the toxic metal does not allow the proper functioning of the enzyme. The enzyme is not only inactive, it is blocked and must be cleared before the correct mineral element can get into position and activate the enzyme.

Some Beyond Organic, Nutrition Grown Research Results

There have been many dedicated people working on improving nutrient density since Dr. Northen, and, undoubtedly, some before him. As with other fields, it's an evolving science. Dr. William Albrecht did extensive work in universities starting in the 1930's toward improving food nutrient density. After World War II, large and powerful chemical corporations realized the profitability of agricultural chemicals and manufactured fertilizers, thus giving birth to the so-called "Green Revolution". To push their agenda, the corporations "bought off" the universities through huge amounts of grant money, resulting in biased research to support their claims. In the process, Dr. Albrecht and other nutrient-density researchers were terminated from their university positions in the 1950's because their research philosophies were not aligned with the profit-driven corporations.

As the "Green Revolution" proceeded to burn out the humus from the soil, there was the period of "the Dark Ages" in which very little recognized research work was performed toward the goal of improving food nutrient density. The late Charles Walters, editor and publisher of AcresUSA magazine and books, worked hard to bring ecoagriculture, including nutrient-dense farming, to light. AcresUSA has organized conferences for decades now, hosting many brilliant speakers each year. The work continues, mainly on a practical farm level, in various locations around the globe, but is greatly hampered by the lack of research funding.

"Protein levels have doubled and tripled."

There is some ongoing research by various individuals comparing nutrient levels of crops grown under "Beyond Organic" guidelines to published USDA nutrient values for the same crops. The results have proven to be quite spectacular! Protein levels have doubled and tripled. This is particularly important for vegetarians, especially vegans. It is common to see a doubling of mineral element content, and often much greater increases. For example, a 10-fold increase of calcium in beets and a 70-fold increase of iron in sweet potatoes!

Fresh Blueberries Nutrient Comparison

	"Beyond Organic" (Data: Bob Wilt, Sunset Valley Organics)	Cultivated Organic	% diff.
Vitamin A	65 IU/100g	32 IU/100g	103%
Vitamin E	1.4 IU/100g	1.1 IU/100g	23%
Calcium	8.84 mg/100g	6.29 mg/100g	40%
Zinc	0.224 mg/100g	0.146 mg/100g	53%
Potassium	117 mg/100g	66.4 mg/100g	76%
Magnesium	6.47 mg/100g	4.98 mg/100g	30%

Blueberry Nutrient Comparison—5 Sources

	"Beyond Organic"	Conventional	Wild Organic	"Sustainable"	Cultivated Organic
Vitamin A	40 IU/100g	5 IU/100g	17 IU/100g	18 IU/100	10 IU/100g
Vitamin C	3 mg/100g	4 mg/100g	4 mg/100g	4 mg/100g	3 mg/100g
Vitamin E	1.4 IU/100g	0.4 IU/100g	0.4 IU/100g	0.4 IU/100g	0.4 IU/100g
Calcium	19.8 mg/100g	11.5 mg/100g	17.1 mg/100g	10.8 mg/100g	11.9 mg/100g
Zinc	0.22 mg/100g	ND	0.17 mg/100g	0.11 mg/100g	ND
Potassium	110 mg/100g	93 mg/100g	73 mg/100g	104 mg/100g	92 mg/100g
Magnesium	7.8 mg/100g	5.9 mg/100g	6.8 mg/100g	5.6 mg/100g	5.3 mg/100g
Protein	0.80%	0.50%	0.50%	0.80%	0.60%

Data: Bob Wilt, Sunset Valley Organics

Crop tested: (enhanced) Brussels Sprouts
(Data: Ron Poitras)
Brix : 11 (cabbage/broccoli good=10 excellent=12)

Nutrient	USDA Avg A	This Sample B	Difference B – A=	Difference %
Protein g/100g (N x 6.25)	3.38g	6.67g	+3.29g	+97%
	mg/100g	mg/100g	mg/100g	
Ca	42	138	+96	+229%
Fe	1.40	1.55	+0.15	+11%
Mg	23	44	+21	+91%
P	69	111	+42	+61%
K	389	659	+270	+69%
Zn	0.42	0.78	+0.36	+86%
Cu	0.07	0.09	+0.02	+29%
Mn	0.34	0.56	+0.22	+65%

Crop tested: (beyond organic) Beets "Detroit Dark Red"
Brix of Crop: 11 (12 is excellent)
(Data: John Myser)

Nutrient	USDA Avg A	This Sample B	Difference B – A=	Difference %
Protein g/100g (N x 6.25)	1.61g	4.70g	+3.1g	+193
	mg/100g	mg/100g	mg/100g	
Ca	16	165	+149	+931
Fe	0.80	0.75	-0.05	-6
Mg	23	51	+28	+122
P	40	71	+31	+77
K	325	663	+338	+104
Zn	0.35	0.88	+0.53	+151
Cu	0.075	0.18	+0.10	+140
Mn	0.329	0.43	+0.10	+31

Crop tested: (beyond organic) Beets "Cylindra"

Brix of Crop: 10 (good)

Nutrient	USDA Avg A	This Sample B	Difference B – A=	Difference %
Protein g/100g (N x 6.25)	1.61g	3.28g	+1.7g	+106
	mg/100g	mg/100g	mg/100g	
Ca	16	30	+14	+88
Fe	0.80	1.45	+0.65	+81
Mg	23	37	+14	+61
P	40	46	+6	+15
K	325	333	+8	+2
Zn	0.35	2.21	+1.86	+531
Cu	0.08	0.2	+0.12	+150
Mn	0.33	1.67	+1.34	+406

Crop tested: (beyond organic) Sweet Potatoes

Brix of Crop: 11 (10 is good)

Nutrient	USDA Avg A	This Sample B	Difference B – A=	Difference %
Protein g/100g (N x 6.25)	1.57g	1.75g	+0.38g	+24
	mg/100g	mg/100g	mg/100g	
Ca	30	48	+18	+60
Fe	0.61	43	+42.3	+6934
Mg	25	18.4	-6.6	-26
P	47	64	+17	+36
K	337	478	+141	+42
Zn	0.3	4.4	+4.1	+1367
Cu	0.15	2.3	+2.15	+1433
Mn	0.26	2.53	+2.27	+873

Brix, AKA Soluble Solids Content

A general indicator of nutrient density is the soluble solids content (SSC) of the sap in plant tissue, particularly the leaves. Soluble solids include sugars, minerals and proteins. The SSC is easily measured by placing several drops of plant sap or juice on an instrument called a refractometer. These instruments are easy to use and relatively inexpensive, ranging in price from about $100 to $300 for home-use models.

Dr. Bogs looking through a standard-type refractometer. Sometimes, this type of refractometer proves difficult for discerning an exact reading.

A digital refractometer is more expensive, but gives an exact number. Here it is being used to test Nutrition-Grown sweet corn, which came out to an excellent Brix of 28.5.

To get juice or sap from plant tissue, one needs an extraction press. Simple-to-use hand presses work well for most fruits and vegetables, whereas a hydraulic press is needed for drier materials like tree leaves.

Hand-held press

Hydraulic Press

The soluble solids content is reported in degrees Brix. Refractometers have been used in the grape industry for many years to indicate when crops are at their prime for harvesting. Some produce buyers use refractometers to make purchasing decisions. Recently, certain grocery stores have begun posting Brix readings of their produce as a marketing angle, because high Brix produce tastes sweeter and has a longer shelf life. They “buy on Brix and sell on Brix”.

The idea of using Brix as a measure of nutrient density was popularized in the 1970’s by the late Carey Reams, a crop consultant and researcher in Florida. He compiled a chart of various fruits, vegetables, and forages, giving Brix ratings for four categories for each produce item—poor, average, good and excellent.

It has been claimed that plants with Brix readings of 12 or higher in the sap of leaf tissue will be healthy enough to resist diseases and pests. This is a concept for which there is some anecdotal evidence, but has yet to be fully elucidated in a scientific manner. High Brix plants are less prone to frost damage because the higher sugar content in the plant acts similarly to anti-freeze in a car engine.

My PhD dissertation research on apples included comparisons of the soluble solids content (Brix) of biologically-enhanced organic Braeburn apples and conventionally-grown Braeburn apples. The biologically-enhanced organic apples had significantly higher Brix levels than the conventionally-grown apples.

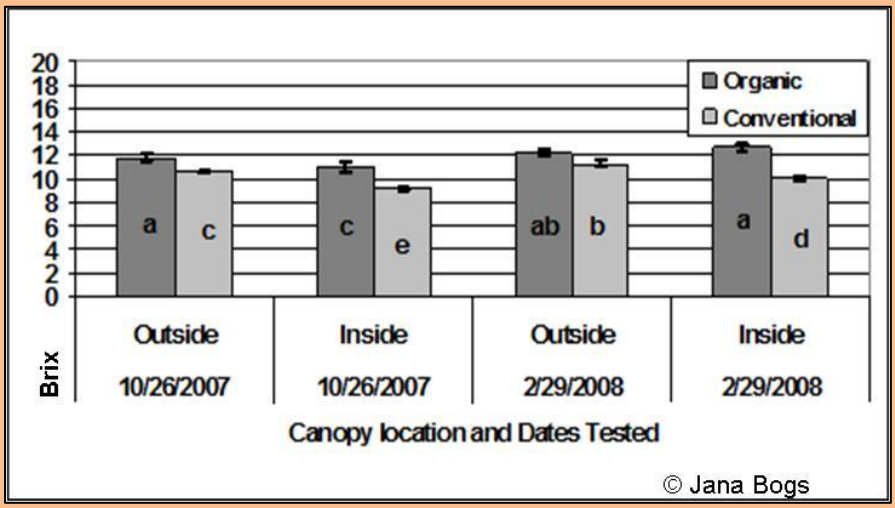


Fig. 5.0 Effects of orchard management, canopy location and time on 'Braeburn' apple soluble solids content (SSC), measured in degrees brix. Overall, biologically-enhanced organic apples had a higher SSC than conventionally-managed apples ($P < 0.001$). Overall, outside-canopy apples had a higher SSC than inside-canopy apples ($P = 0.002$). Overall, SSC increased over time ($P < 0.001$). Treatments with the same letter are not significantly different at $P < 0.05$ level. Error bars indicate SEM. Per testing date, $N = 48$, $n = 12$ (four rows, three replications each).

Reference: Dissertation by Bogs, Jana D. Effects of organic, biological and conventional production methods on apple antioxidant levels, sensory qualities and human glycemic response. 2009. Colorado State University. This information was also published in 2012 in the scientific journal, Organic Agriculture, under the title, Influence of biologically-enhanced organic production on antioxidant and sensory qualities of (Malus x domestica Borkh. cv Braeburn) apples, by Jana Bogs, Marisa Bunning, and Cecil Stushnoff.

Table of Brix Ratings

	POOR	AVERAGE	GOOD	EXCELLENT
VEGETABLES				
Asparagus	2	4	6	8+
Beets	6	8	10	12+
Bell Peppers	4	6	8	12+
Broccoli	6	8	10	12+
Cabbage	6	8	10	12+
Carrots	4	6	12	18+
Cauliflower	4	6	8	10+
Celery	4	6	10	12+
Corn Stalks	4	8	14	20+
Corn (Young)	6	10	18	24+
Cow Peas	4	6	10	12+
Endive	4	6	8	10+
English Peas	8	10	12	14+
Escarole	4	6	8	10+
Field Peas	4	6	10	12+
Green Beans	4	6	8	10+
Hot Peppers	4	6	8	10+
Kohlrabi	6	8	10	12+
Lettuce	4	6	8	10+
Onions	4	6	8	10+
Parsley	4	6	8	10+
Peanuts	4	6	8	10+
Potatoes, Irish	3	5	7	8+
Potatoes, Red	3	5	7	8+
Potatoes, Sweet	6	8	10	14+
Romaine	4	6	8	10+
Rutabagas	4	6	10	12+
Squash	6	8	12	14+
Sweet Corn	6	10	18	24+
Turnips	4	6	8	10+

Chart data originated from the late Carey Reams

Plant Sap pH

Another test that can be run at home on your leaf tissue sap is a pH test. According to the late Bruce Tainio, a plant researcher, you should aim for a leaf tissue sap pH of 6.4. A lower pH may indicate a cation deficiency of potassium, sodium, magnesium and/or calcium, whereas a higher pH may indicate an anion deficiency of nitrogen, sulfur and/or phosphorus. The lower the pH drops below 6.4, the greater risk for disease attack on the plants by bacteria, fungi, and/or viral agents. The higher the pH rises above 6.4, the greater the risk for insect attack. Once insects attack, the tissues are damaged, lowering the pH in these localized areas. These areas then become susceptible to disease.

This sap pH test is a useful tool to monitor your crops. Even a pH change of 0.5 away from the ideal of 6.4 pH can leave your plants open to insect or disease attack. To correct the leaf sap pH and to improve Brix levels, laboratory analyses of soil and plant tissue are used to determine a coordinated program of appropriate soil amendments and customized nutritional foliar sprays. (See the appendix and/or the website www.BeyondOrganicConsulting.com .)

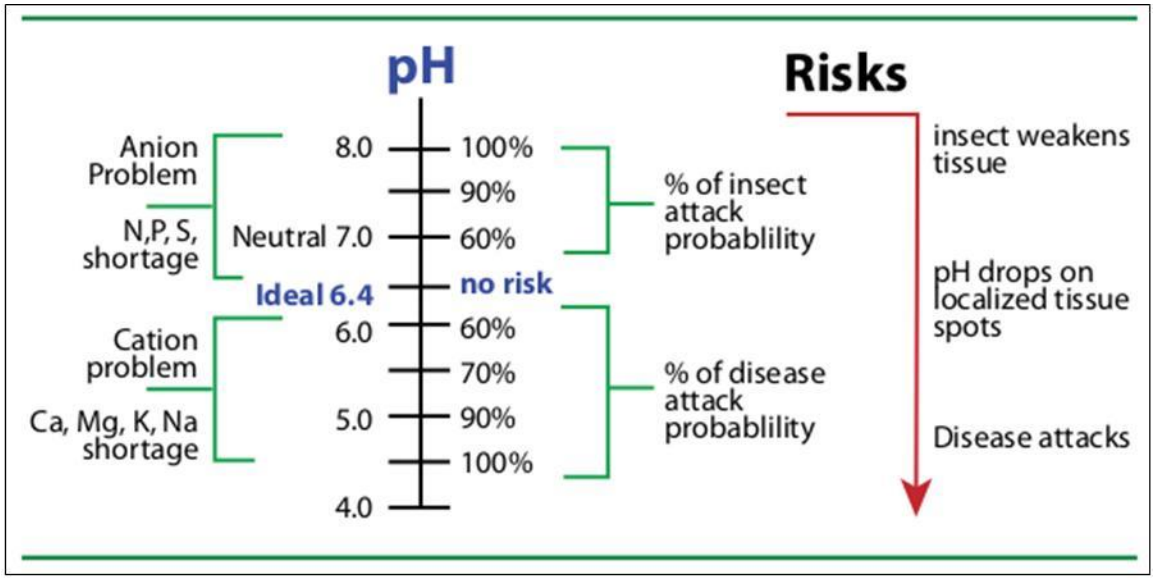


Chart Credit: Bruce Tainio

Section 3: Benefits of Nutrition Grown Foods

Benefits of Nutrition Grown Foods—for Consumers

"…isn't nourishing people what food production should be about?"

Nutrition Grown food is, first and foremost, produced for the good of the consumer. Quality nutrition for the consumer must be the first goal. After all, isn't nourishing people what food production should be about? Typical agribusiness farming focuses so much on increasing yields to increase profits that it loses sight of quality nutrition. Of course, farmers need to make a fair profit, and with Nutrition Grown foods *they will*—because they first focused on nutritional quality.

Nutrition Grown foods supply the full spectrum of nutrition to consumers. This means a full supply of naturally-complexed minerals, vitamins, antioxidants and other phytonutrients according to each plant's inherent ability. "Phyto" is the Greek word for "plant". Therefore, phytonutrients are plant-generated nutritional compounds, each of which has its own characteristics, nutritional properties, functions and health benefits. Nutrition Grown plants are given what they need to express their genetic potentials, resulting in greater quantities of important, health-building nutrients for humans in a given volume of food, not just watery carbohydrates. Current growing practices, both conventional and typical commercial organic, emphasize production or yield---quantity over quality.

Nutrition Grown plants are grown in soils which are amended to have the full, balanced array of many elements—macro-elements, trace elements and micro-trace elements. Macro-elements include not just the typical NPK (nitrogen, phosphorus and potassium), but more, such as calcium, magnesium and sulfur. Trace elements, needed in relatively "trace amounts", include elements such as boron, iron, manganese, copper, and zinc. Micro-trace elements, typically needed in even smaller amounts, include elements such as cobalt, chromium,

vanadium, selenium, strontium, lithium, indium, and molybdenum, to name a few. All of these micro-trace elements may or may not be needed by the plants, but can be beneficial to humans.

Perhaps you've heard of the importance of pH-balancing one's body. Human blood is held in a narrow range near 7.4 pH (slightly alkaline) by homeostatic mechanisms in the body. Urine pH varies widely, but some health practitioners monitor it to give an indication of the pH of the body tissues. While there is some controversy over what the ideal pH of urine should be, 6.4 (slightly acidic) is a good level for which to aim. Saliva pH is also sometimes monitored, with the ideal also near 6.4. An over-acid condition of the body has been correlated with an increase in disease, from acute to chronic and degenerative disease. Many people become over acid due, at least partially, to consuming too many acid-forming foods compared to alkaline-forming foods. This is not based on how acidic the food tastes. The basis of this is the elements contained in foods. Calcium, magnesium, potassium, and sodium are considered the major alkaline elements, while phosphorus, sulfur, iodine and chlorine are considered acidic.

"Foods which are grown with nutritional content in mind will have optimal levels of all needed elements…"

Foods which are grown with nutritional content in mind will have optimal levels of all needed elements, including the alkaline elements. Current typical agriculture does not focus on getting the optimal balance of these alkaline elements. The published USDA food nutritional values reflect this. Human health also reflects this. According to the International Osteoporosis Foundation, osteoporosis is estimated to affect 75 million people in the USA, Europe and Japan. Dental decay is also a continuing concern. These alkaline elements are essential for many functions in the body including blood clotting, heart rhythm, nerve transmission, and muscle contraction. In horses, a severe lack of calcium results in Big Head disease (Osteodystrophia fibrosa), which appears as large, permanent swellings of the bones of the head and insidious shifting lameness. I've seen this condition here on the Big Island of Hawai'i. It is not a pretty picture.

Getting the mineral balance right in the soil does much more than just affect the quantities of minerals in the plants. It can also affect protein content and quality, and the production of beneficial phytochemical compounds, such as vitamins, antioxidants, and other compounds with unique metabolic effects. Dr. William Albrecht studied the effect of adding calcium to soils on the protein content of wheat. He found a 27% increase just from that one factor alone. (Please realize that various soils' needs are different, but these soils were obviously calcium deficient.) Dr. Albrecht went on to perform animal feeding studies on the feeds grown on the calcium-enhanced soil. With rabbits, he found increases in litter size, body length, carcass dry matter content (weight), carcass nitrogen (relating to lean muscle tissue), and carcass ash (mineral content).

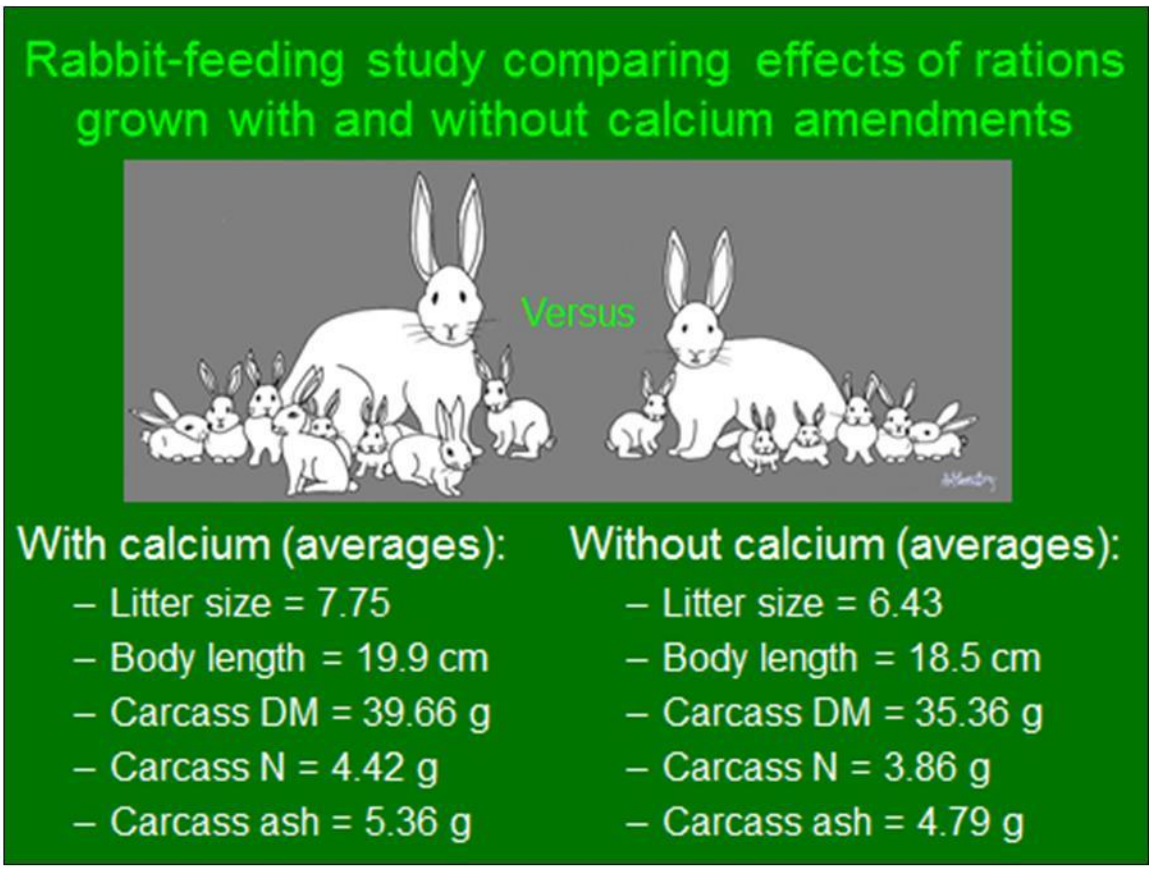


Illustration: A. Frederick Kennedy

"…calcium, phosphorus and nitrogen from feed grown on the unamended soil were lost to a high degree in the urine."

What is perhaps most fascinating to people interested in nutrition, is a metabolic rabbit study Dr. Albrecht performed with the enhanced feed versus the non-enhanced feed. He compared fecal analyses for absorption of calcium, phosphorus and nitrogen from the feeds in the gut. He found high removal (good absorption) of the elements from both feeds. Then Dr. Albrecht examined urine analyses to determine retention of the nutrients in the animals' tissues. Here's the shocker—the calcium, phosphorus and nitrogen from feed grown on the unamended soil were lost to a high degree in the urine. There was more complete absorption and synthesis into the animal's tissues of the nutrients from the feed grown on calcium-amended soil.

Exciting News for Diabetics!

Getting the soil right can have other metabolic influences. I heard about a diabetic in Washington State who enjoyed eating some of the wonderful fruit

produced there. However, the edict was proclaimed by his doctor, “Fruit will spike your blood glucose. Don’t eat it!”

“Well-grown fruit did not spike his blood glycemic level!”

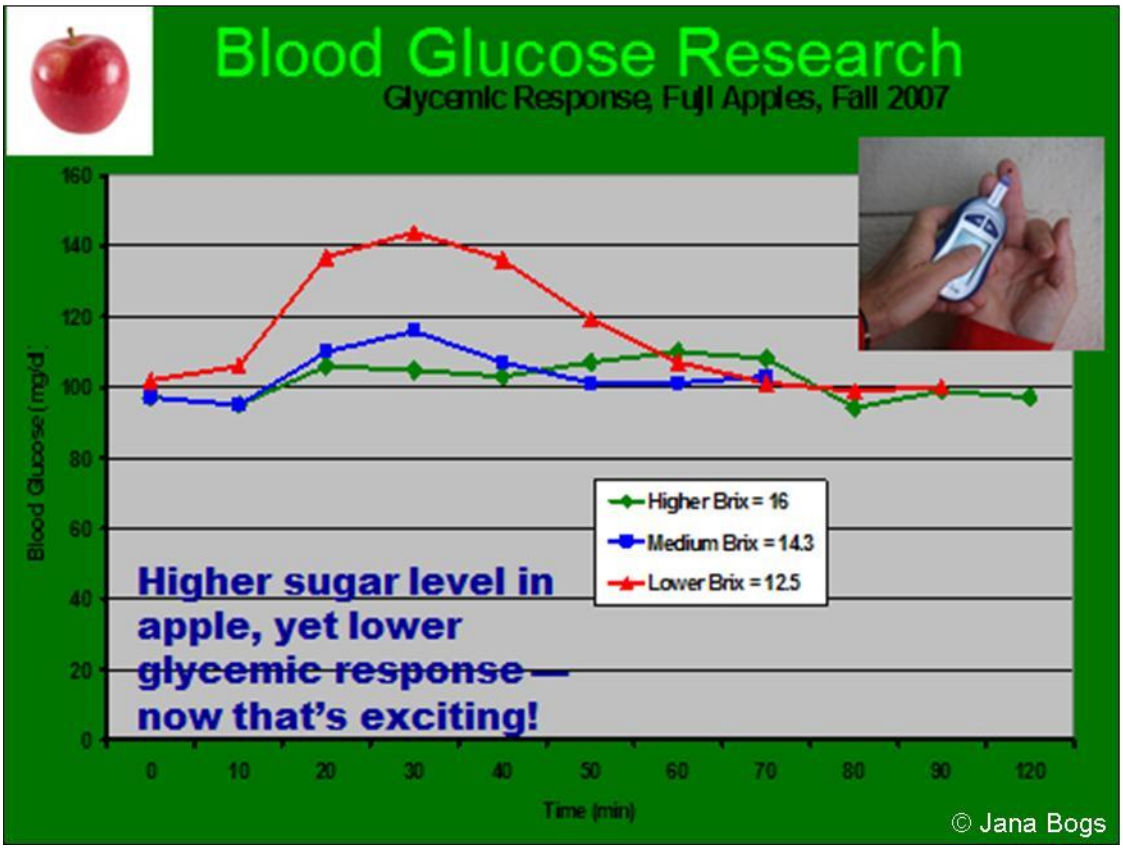
The patient regularly checked his blood glucose with his own meter at home. He came to realize that he felt different eating the same cultivars of fruits when they were grown in different orchards. He checked his blood glucose responses and found that, indeed, he reacted differently to fruit that was grown in a nutrient-balanced way. Well-grown fruit did not spike his blood glycemic level! He was excited and wanted to show his doctor! So he sat in the doctor’s office, ate nutrient-balanced cherries, and got his blood checked every few minutes to prove that these well-grown cherries did not cause his blood glucose to spike.

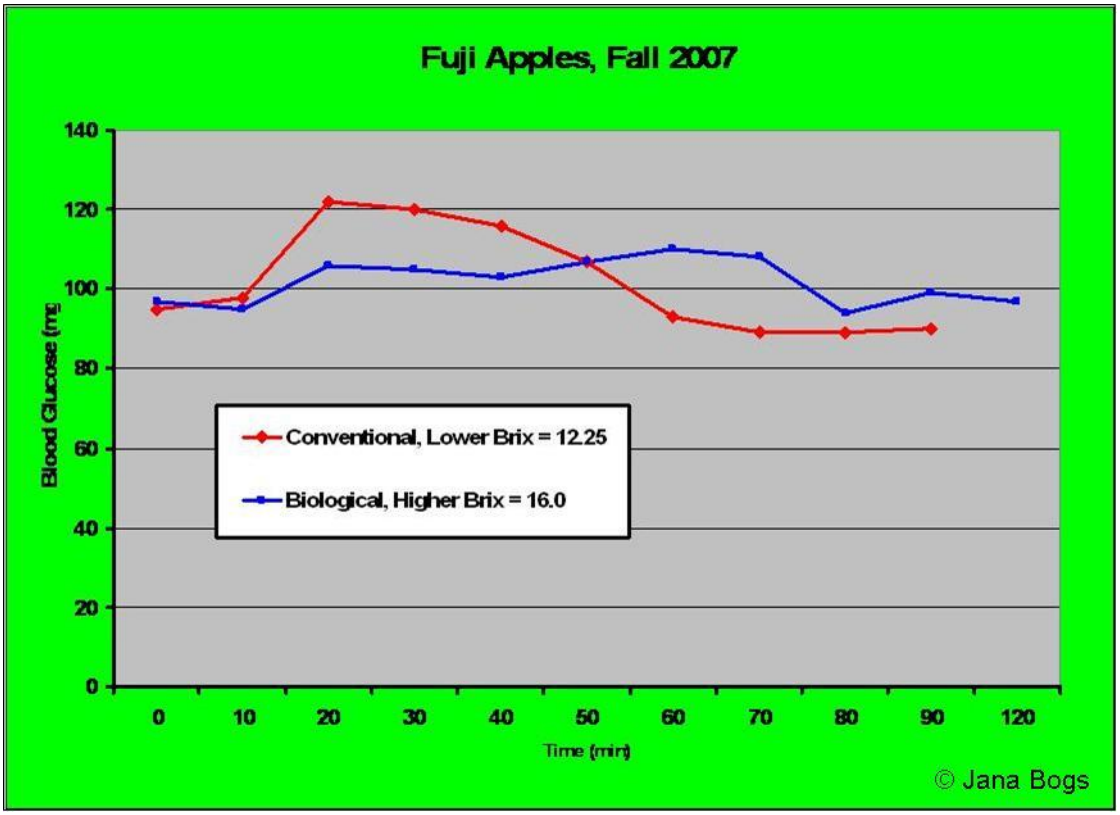
When I heard this story, I questioned the researcher who told me the tale, “Are you sure?” “Yes, I’m absolutely positive!” was his response. I was very excited to do my own research on this!

“Why did apples higher in sugar have a lower glycemic response?”

I bought my own blood glucose meter and contacted some orchards for the fruits. The fruits were delicious, and higher in Brix (sugars) than typically available fruits of the same cultivars. When tested in vivo, the higher Brix fruits did not have as large of glycemic rises as the lower Brix fruits! Why did apples higher in sugar have a lower glycemic response? That question will only be answered with further research. Speculation includes differences in nutrient content, fiber, and/or types of sugars, as well as the possible enhanced production of phytochemicals in the fruit, such as phloretin and phlorizin, which lower blood glucose response.

Note: I did a lot of testing with various apples, organic and conventional, which had widely varying Brix levels. Just because an apple has a high Brix reading does not necessarily mean it is low glycemic; it has to be grown in a nutritionally balanced way.


Blood Glucose Research
Glycemic Response, Fuji Apples, Fall 2007
Blood Glucose (mg/dl)
160
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
120
Time (min)
Higher Brix = 16
Medium Brix = 14.3
Lower Brix = 12.5
Higher sugar level in apple, yet lower glycemic response — now that's exciting!
© Jana Bogs


Fuji Apples, Fall 2007
Blood Glucose (mg
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
120
Time (min)
Conventional, Lower Brix = 12.25
Biological, Higher Brix = 16.0
© Jana Bogs

Savor the Flavor

The flavors of food come from a vast array of compounds created by the plants. This is dependent on the plants having the nutrients they need to be able express (make) these compounds. Plants, like humans, need raw materials with which to work. If there is a lack of a critical element, production stops. Plants bred to produce what looks like food on a limited number of elements do not have the genetic capacity to create a tasty array of flavor compounds. Even if plants have the genetic capacity for good flavor, if they don't have the raw materials to work with, they won't be able to produce to their inherent potential.

Gala Apple Research

My dissertation research on Gala apples compared the human sensory perception of conventionally-grown Gala apples from orchards established on two different soil types. As stated previously, one orchard's soil had a CEC of 7.1 meq/100g (considered low) versus the other orchard's soil with a CEC of 11.3 meq/100g (considered high).

The apples were judged by 100 human panelists (considered the "gold standard" in sensory evaluation) for flavor, texture, and appearance. The higher CEC soil produced apples which were significantly preferred by humans.

Braeburn Apple Research

My dissertation research on Braeburn apples also included comparisons of human sensory perception of biologically-enhanced organic apples and conventionally-grown apples. As stated previously, the orchards were immediately adjacent, so the soil type and weather conditions were identical.

Again, the gold standard of 100 human panelists was used to evaluate flavor, texture, and appearance. The biologically-enhanced organic apples were significantly preferred by humans.

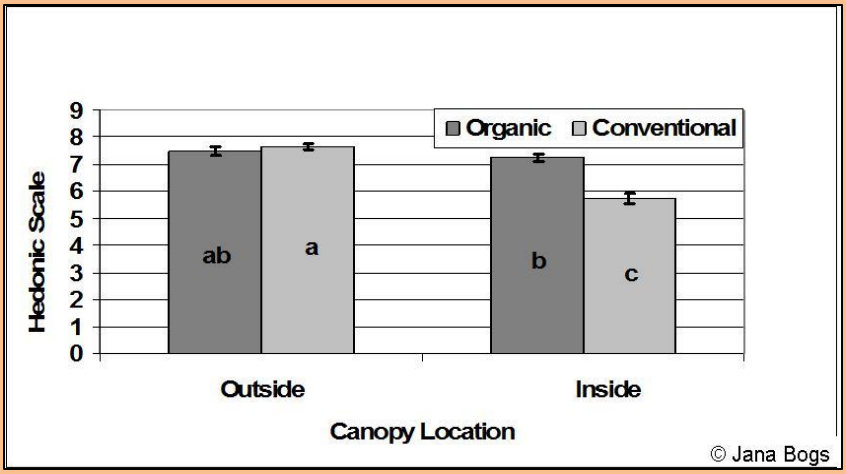


Fig. 5.4 Effects of orchard management and canopy location on 'Braeburn' apple human sensory perception of flavor. Overall, biologically-enhanced organic apples had higher scores for flavor than conventionally-managed apples ($P < 0.001$). Overall, outside-canopy apples had higher scores for flavor than inside-canopy apples ($P < 0.001$). There was interaction between orchard management and canopy location ($P = 0.001$). Treatments with the same letter are not significantly different at $P < 0.05$ level. Error bars indicate SEM; N = 100.

Reference: Dissertation by Bogs, Jana D. Effects of organic, biological and conventional production methods on apple antioxidant levels, sensory qualities and human glycemic response. 2009. Colorado State University.

Extend the Shelf Life

"Excellent quality produce does not rot, it merely dehydrates."

Have you ever bought a bunch of fresh produce, taken it home and put it in the fridge thinking you were set for a bunch of healthy meals, only to find that it went bad after a few days? Plants which don't have the full complement of nutrients do not have long shelf life. Their cell wall structure is compromised.

Have you had apples which were mealy and/or brown in the centers? Some apple packing houses drench their apples with calcium chloride to enhance the calcium in the cell walls of the peels. This calcium should have come from the soil and been "grown into" every apple cell. Instead you get an apple with a bitter, tough peel and mush on the inside. Excellent quality produce does not rot, it merely dehydrates.

Soil Quality Affects Shelf Life

My dissertation research on Gala apples also compared the shelf life of conventionally-grown Gala apples from orchards established on two different soil types. As stated previously, one orchard's soil had a CEC of 7.1 meq/100g (considered low) versus the other orchard's soil with a CEC of 11.3 meq/100g (considered high).

The apples were evaluated for loss of firmness with a fruit penetrometer over a 4-month period in normal atmosphere, refrigerated storage. The higher CEC soil produced apples which had a significantly extended shelf life compared to the low CEC soil.

Reference: Dissertation by Bogs, Jana D. Effects of organic, biological and conventional production methods on apple antioxidant levels, sensory qualities and human glycemic response. 2009. Colorado State University.

Let Us De-"Cide"

"…conventional apples are typically sprayed with 30+ chemical applications each year."

Just as important as what is in food, is what <u>is not</u> in food. Conventionally-grown foods contain a large array of "cides"—pesticides (including antibiotics), herbicides and fungicides. For example, conventional apples are typically sprayed with 30+ chemical applications each year. These chemicals are not what the average person can purchase from the local garden store. These chemicals are so toxic that the people purchasing and applying the chemicals must have special certification and training. While some people discount the danger of such chemicals, the incidence of cancer continues to rise. Scientific studies prove that children fed organically-grown foods have significantly fewer toxic chemicals in their blood than those fed conventionally-raised foods.

These highly toxic chemicals affect more life forms than just humans. Choosing Nutrition Grown foods over conventionally-produced foods helps consumers feel good personally as they do something good for our environment.

That's Heavy! (Heavy Metals)

"If there is a lack of beneficial elements in the soil, the plants will tend to pick up more toxic elements."

There is also rising concern about toxic heavy metal contamination of foods. Heavy metals include lead, mercury, cadmium, and others. These toxic elements interfere with enzyme function, which is a big deal because enzymes

are the catalysts in the body which cause crucial chemical reactions to proceed in a timely manner. In other words, they make things happen in our bodies. No enzyme function = no life.

If there is a lack of beneficial elements in the soil, the plants will tend to pick up more toxic elements. The same is true for humans; if they have a lack of beneficial elements, they will tend to pick up more toxic elements. Now you have at least one reason for not buying edible plants grown with sewage sludge, also known as bio-solids. This sludge can contain high levels of toxic heavy metals, because many types of materials from industrial sources go down the drain and end up in waste water treatment plants. I know it sounds awful, and it is more common than you might think. Recycling nutrients back onto the fields is a good thing, but let us be more careful in how it is done. The good news, on the other hand, is that foods grown on soils replete with a balance of beneficial elements will contain more of these helpful elements that one needs and less of the toxic elements.

About Protein…Especially for Vegans

Vegans have, perhaps, the biggest challenges with obtaining optimal, body-building nutrition, particularly protein. Being a nutritionist, experiencing veganism first-hand (at times 100% raw), and conversing with others about their joys and frustrations with veganism has gotten me excited about the potential of Nutrition Grown foods to help vegans have greater success with their diets.

A mainly raw, vegan diet can be a very healing diet. However, with long-term adherence, one of the challenges of veganism can be obtaining enough quality protein (with the full complement of balanced essential amino acids) while not overindulging in fats and/or carbohydrates. Nuts and seeds tend to be considered “protein staples” in a vegan diet, but they are very high in fat calories compared with the amount of protein calories. Nuts, seeds and grains typically have lysine as their limiting essential amino acid. A limiting amino acid is the one that is in shortest supply as proteins are built. When there is a lack of a needed amino acid, the protein building simply stops.

Estimated Average Requirements (EAR) of Essential Amino Acids for Adults 19 years and older (USDA data)

11 mg/kg/d of histidine
15 mg/kg/d of isoleucine
34 mg/kg/d of leucine
31 mg/kg/d of lysine
15 mg/kg/d of methionine + cysteine
27 mg/kg/d of phenylalanine + tyrosine
16 mg/kg/d of threonine
4 mg/kg/d of tryptophan
19 mg/kg/d of valine

Beans and peas have a fair amount of protein, but also a lot of starch. Legumes, such as beans and peas, typically have the essential amino acid methionine as their limiting amino acid. Combining legumes with nuts, seeds or grains in one's diet may be beneficial for supplying a more balanced amino acid profile. Historically, cultures around the world have come to understand, probably through trial and error, about combining plant protein sources—rice and beans, tortillas and frijoles. While the theory of needing to do "protein combining" or "protein complementing" at every meal has been refuted as unnecessary, observing vegans' challenges, the high incidence of digestive problems, and the recent decline in protein quality in foods impresses this author that efforts to assure optimal amino acid balance in our foods is very beneficial.

Greens may contain 50% of their calories as protein, but there are so few calories in greens that the amount of protein in a green salad turns out to be quite small. According to the American Institute for Biosocial and Medical Research, vegan athletes may be particularly vulnerable to deficiencies of the sulfur-bearing amino acids, methionine and cysteine. This stems from sulfur-deficient soils which are unable to supply sufficient sulfur to the plants to allow them to manufacture these amino acids in the optimal amounts. A lack of sulfur decreases the production of all of the essential amino acids, not just methionine and cysteine.

To review, proteins are large molecules made up of amino acids, which in turn are composed of nitrogen, carbon, oxygen, hydrogen and, sometimes, sulfur. In food science labs, the amount of protein (also known as "crude protein") in foods or feeds is typically calculated from the amount of nitrogen present. The calculated figure may not represent true protein made from an array of amino acids. It may instead include non-protein nitrogen (NPN) compounds such as ammonia, nitrites, and/or nitrates, which are not useable by humans. In fact, this NPN is treated by the body as a waste product and appears in the blood as blood urea nitrogen (BUN). Elevated levels of BUN can result in problems such as decreased magnesium availability and increased susceptibility to disease. To

get a rough estimate of NPN in a food, one can examine the ratio of the calculated protein figure with the sulfur level. It should not be greater than 10:1. The sulfur present is expected to be part of the sulfur-bearing amino acids, methionine and cysteine.

"…lowered production of…essential amino acids by more than 50% with soil deficiencies..."

Limiting amino acids are typically lysine, methionine, threonine, and tryptophan. The production of these in any given food can vary widely depending on the mineral balance in the soil on which it is grown. Research has shown lowered production of these essential amino acids by more than 50% with soil deficiencies of elements such as calcium, phosphorus, boron, sulfur, manganese and iron.

Some of the "popular" vegan literature extols the benefits of a low protein diet. Such a diet seems to work fine for some people, but others appear gaunt, and yet others gain too much weight. Some vegans have related that they work out diligently with weights at fitness centers, but still remain flabby. Few vegans seem able to maintain a lean, muscular physique. Furthermore, vegans, as a whole, do not seem to have significantly increased longevity which one would expect from a diet which is touted to be extremely healthy.

Some vegans use expensive protein powders and "super foods", such as spirulena, chlorella, and Klamath Lake blue green algae, to help themselves obtain sufficient protein and other nutrients. Besides the high cost, unfavorable flavors and textures can also be an issue. One vegan friend told me that she feels she should be able to get optimal nutrition from fresh, local foods, and not have to rely on something in a bottle purchased from far away. Hear, here!

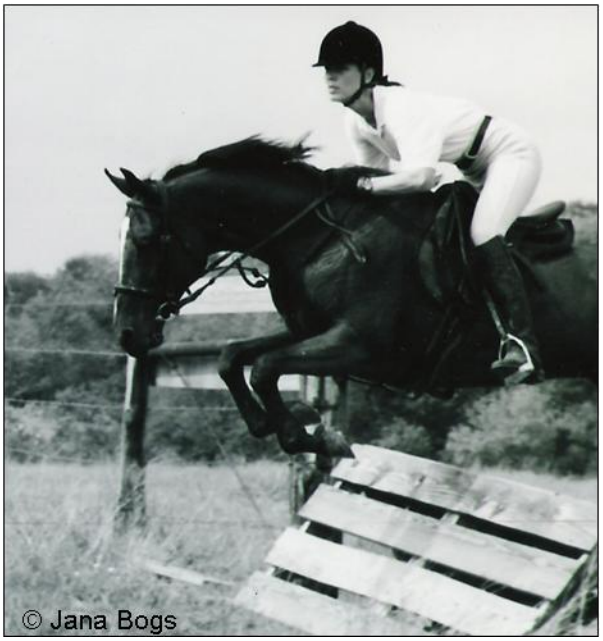
"Research on Nutrition Grown foods… shows doubling and even tripling of the protein content over typical USDA values."

Nutrition farming may help solve some of the problems vegans face by providing foods which are richer in many of the needed nutrients. Research on Nutrition Grown foods, with nutrient analysis reports by third-party independent laboratories, shows doubling and even tripling of the protein content over typical USDA values. If most of one's vegan diet consisted of Nutrition Grown foods, obtaining sufficient, high quality protein should pose no problem whatsoever. With calcium values two- to ten-fold greater in these Nutrition Grown foods, one should have no concerns about calcium deficiency either.

Consuming foods in the most natural, "live-food" state possible, i.e. raw, allows one to consume more intact enzymes and vitamins because these compounds

have not been damaged by heat. Of course, some foods, like beans and tubers, benefit from cooking to make them more palatable and digestible. A predominately raw diet of Nutrition Grown foods may be the most healing diet on the planet!

For our 4-Legged Horse Friends



Even if you aren't interested in livestock, this section contains interesting information, much of which also applies to humans, so read on!

Most of the same principles of growing the best quality food for humans also apply to growing the best quality feedstuffs for livestock. There are some minor modifications in soil mineral balance for growing various crops, such as fruit versus grass.

Horses are not designed to eat large quantities of grains; they are meant to primarily graze on pastures of mixed leafy forages and, secondly, browse on trees and shrubs. When one changes the natural diet away from the one with which the animal evolved, a host of problems can ensue. Supplying a horse with a mix of forages grown well with the full mineral complement in the soil may supply it with all of the energy it needs as well as essential body-building nutrients. "Hard-keepers" (horses that tend to be underweight) will be easier to maintain if given balanced feedstuffs. If one still finds a need for some grain products for more energy, then let us at least grow them well.

Hard keeper

Horse feed manufacturers often add essential amino acids to their feeds, including lysine, methionine, tryptophan, threonine and cysteine. This was done because research showed better growth and/or performance with these added nutrients.

Lysine is low in grains, particularly corn. Lysine levels have been shown to be affected by sulfur, calcium, phosphorus and potassium. If corn and other feedstuffs were grown with enough mineral elements, perhaps addition of biotech-manufactured lysine would not be found as beneficial.

Soybeans and alfalfa are legumes fed to many horses as part of their rations. In one research study, biologically-grown alfalfa contained 46% more lysine than conventionally-grown alfalfa. This same study also showed 80% more threonine in the biologically-grown alfalfa than in the conventional. These legume crops tend to have sulfur-bearing methionine as the limiting amino acid. Supplying optimal sulfur to the soil has been seen to double methionine production.

"Boron deficiency, alone, may drop tryptophan production to one-third of normal."

Tryptophan production in these crops is greatly affected by calcium, phosphorus, sulfur, boron, manganese and iron soil deficiencies. Boron deficiency, alone, may drop tryptophan production to one-third of normal. Tryptophan is a precursor to serotonin, a neurotransmitter which tends to have a calming effect, at least for humans.

Cracked hoof

Remember, horses need the mineral elements in their feedstuffs for other reasons besides essential amino acid production. Basic cellular metabolism is basic cellular metabolism, and horses have many of the same needs for the various elements as were discussed earlier for humans. Zinc and copper deficiencies are very common. Lack of zinc usually shows up as **cracked hooves**. Copper deficiency can result in **loss of skin pigmentation** and make horses more susceptible to fungal infections such as **thrush (hoof rot)** and **rain rot**.

Loss of skin pigmentation

Thrush in hoof

Imagine the disappointment of breeding your beloved mare to a fine, prize stallion, waiting 11 months for the foal to be born, raising the foal until it comes of training age in about 2 or 3 years, then after a few months of training it suffers from chronically swollen joints. You've invested thousands of dollars, years of your life, and countless hours of work. Your hopes and dreams are dashed when the veterinarian diagnoses your horse with OCD.

Osteochondritis dissecans/osteochodrosis dissecans (OCD) is a developmental bone disease which affects the joints of many horses. According to the American College of Veterinary Surgeons, OCD is due to improper bone and joint cartilage formation which is associated with trace mineral imbalances, particularly a lack of copper. There was a horse farm in Australia which had a high incidence of this type of leg problems. They had their soil tested and implemented the amendment recommendations. Soon they had no more problems of this sort.

Another common **developmental orthopedic disease (DOD)** is known as **contracted tendons**. This is a painful condition in which the horse cannot stand or move normally. The joints often buckle forward. The incidence of contracted tendons is associated with imbalanced mineral intake, particularly the calcium to phosphorus ratio. Alfalfa hay, cubes, and pellets are commonly fed as a large portion, or even the entirety, of horses' diets. Alfalfa tends to have a high amount of calcium in relation to phosphorus and copper, the excessive feeding of which is associated with contracted tendons.

Feeding large amounts of grain, with its high level of carbohydrates, is also associated with DOD. Researchers believe that the excessive carbohydrates interfere with hormonal regulation of insulin and thyroxine. Grain grown on minerally-balanced soil may have a different nutritional composition and, therefore, different effects in the body.

"…800 North American race horses die annually from racing injuries."

You've probably seen it on television—a famous racehorse, at the top of his or her game breaks a leg in a big race. Soon the beautiful animal is dead. An estimated 800 North American race horses die annually from racing injuries. Why is this happening? Besides the fact that race horses are trained and raced before they have had a chance to fully mature, feeding nutritionally-inferior feedstuffs can have a large impact on the durability of their bodies.

Laminitis is a painful inflammatory condition of the hoof laminae, the connective tissue between the hoof wall and the underlying structures. If the condition worsens, the hoof wall pulls away from the underlying bone structure, and then is typically termed **"founder"**. This is similar to plywood, in which two or more layers of wood are glued or *laminated* together. If the glue deteriorates, the wood layers come apart.

There are a number of factors which can be pointed to as causes of laminitis. However, an underlying factor is the integrity of tissue structure and functionality, which is heavily influenced by nutrition or the lack thereof. For example, a lack of sulfur-bearing amino acids or zinc will result in weak connective tissue. Non-protein nitrogen (NPN) in feedstuffs, i.e. nitrate, typically resulting from the use of synthetic nitrogen compound fertilizers, has been associated with laminitis. Nitrate can block oxygen flow to tissues. Other agricultural chemicals, such as herbicides, are also implicated as increasing susceptibility to laminitis. This, of course, stands to reason considering that these chemicals block nutrient utilization.

Arthritis, a degenerative joint disease in horses, is considered the most common cause of lameness. In osteoarthritis, cartilage is lost more rapidly than it is replaced. There may also be changes in the joint capsule and surrounding tissues. There are various suspected causes; however the bottom line is that the tissue cannot repair quickly enough to prevent degeneration. Optimal nutrition can supply the building blocks needed to heal. Glucosamine sulfate, a basic nutritional building block of connective tissue and fluids, has often been used as an effective treatment. Had the feedstuffs contained adequate sulfur and essential amino acids, perhaps the condition would have never manifested in the first place.

Navicular syndrome is another degenerative hoof condition related to arthritis which causes lameness. The navicular bone and its surrounding tissues in the hoof become inflamed and may degenerate. Again, while there are a number of contributing factors, increasing tissue structural integrity through proper nutrition is key to prevention and treatment. Interestingly, the trace element, gallium, is sometimes used to treat the condition as it greatly reduces inflammation. The

best nutritional source of gallium is seaweed, which contains an average of 0.14 mg/g. (Reference: T. Yamamoto, et al. Gallium content in seaweeds. Journal of the Oceaniographical Society of Japan, 1976. 32(4):182-186.) It is for these types of ultra-trace elements that I recommend amending soil with seaweed and/or seawater (or seawater solids), the choice of which depends on the soil analysis.

Glucosamine sulfate is also a recommended nutritional supplement for navicular syndrome horses. Getting metal shoes off of the horse's feet and keeping the feet trimmed with the natural hoof trimming method has been seen to be extremely helpful. Rubber hoof boots, possibly with heel lifts, can be used when more support or protection is needed.

Equine Metabolic Syndrome (EMS), also known as **Equine Syndrome X**, is caused primarily by insulin resistance. This condition is similar to Type 2 Diabetes in humans where the action of insulin is impaired. Horses with this condition become obese easily and develop fatty deposits in various areas of their bodies, especially on the neck, loins and area near the tail head. These horses tend to develop laminitis, a separation of the tissues in the feet, causing lameness. Mineral-balanced feedstuffs are key to prevention and recovery. Pasture grass, hay, and other feedstuffs are often too high in potassium while lacking other essential nutrients.

Equine Cushing's Disease is an endocrine (hormonal) disorder caused by enlargement of the pituitary gland. This gland, located near the base of the brain, is considered the master controller of endocrine secretions. When enlarged, the pituitary gland pumps out larger than normal amounts of various hormones which result in high levels of blood glucose, as well as immune system suppression. Symptoms include shaggy coats, abnormal fat deposits, laminitis, excessive sweating, pot-bellied appearance, increased appetite and water consumption, muscle loss, and lethargy. Optimal nutrition from mixed forages grown in mineral-balanced fields, including a good supply of mineral elements such as chromium, sulfur and magnesium, can be helpful.

Melanoma, skin cancer, is frequently problematic in older, grey horses. Lesions (lumps) generally first occur near or under the tail. Carefully check your horses' skin periodically. Just as humans become more susceptible to cancers when they do not receive the best quality nutrition, the same holds true for horses. Get your pastures and hay fields tested and amended to help heal or prevent this potentially devastating disease.

Melanoma

Equine Protozoal Myeloencephalitis (EPM) is an infection of the horse's central nervous system by a protozoan called *Sarcocystis neurona*. As a horse trainer, I have noticed early warning signs such as a horse stumbling often and its inability to canter consistently on a given lead, typically "taking a bad step" in the rear and becoming disunited. Clinical symptoms include limb weakness, muscle atrophy, loss of reflexes, loss of sensation, depression, head tilting, vision loss, seizures, abnormal behavior, and, eventually, death. As with any infection, the health of the animal's immune system plays a major role in its susceptibility to exposure to the pathogen. An estimated 98% of horses exposed to *Sarcocystis neurona* do not become infected. Proper nutrition, along with minimization of stresses, will optimize the horse's immune system to defend against EPM and other infections.

Equine Polysaccharide Storage Myopathy (EPSM or PSSM) is a disease in which polysaccharides (complex sugar molecules) build up in the muscles, causing cramping and pain. Management of this condition involves removal of grain and molasses, instead feeding *properly-grown* hay (or grass) along with a high quality fat (oil) source which is balanced with a high level of omega-3 fatty acids. Regular exercise is also imperative.

Hyperkalemic Periodic Paralysis (HYPP) is a genetic disorder which adversely affects the cellular membranes causing muscle cramping. The disease can be managed by keeping the horse's diet low in potassium. Grass and hay should be grown on properly balanced soil to maintain a low level of potassium. High levels of potassium in soils are common, especially in heavily-used horse pastures that have recycled nutrients from urine and manure over many years. It is critical to

balance these soils with other elements, such as calcium, which “compete” with potassium for uptake in the grass.

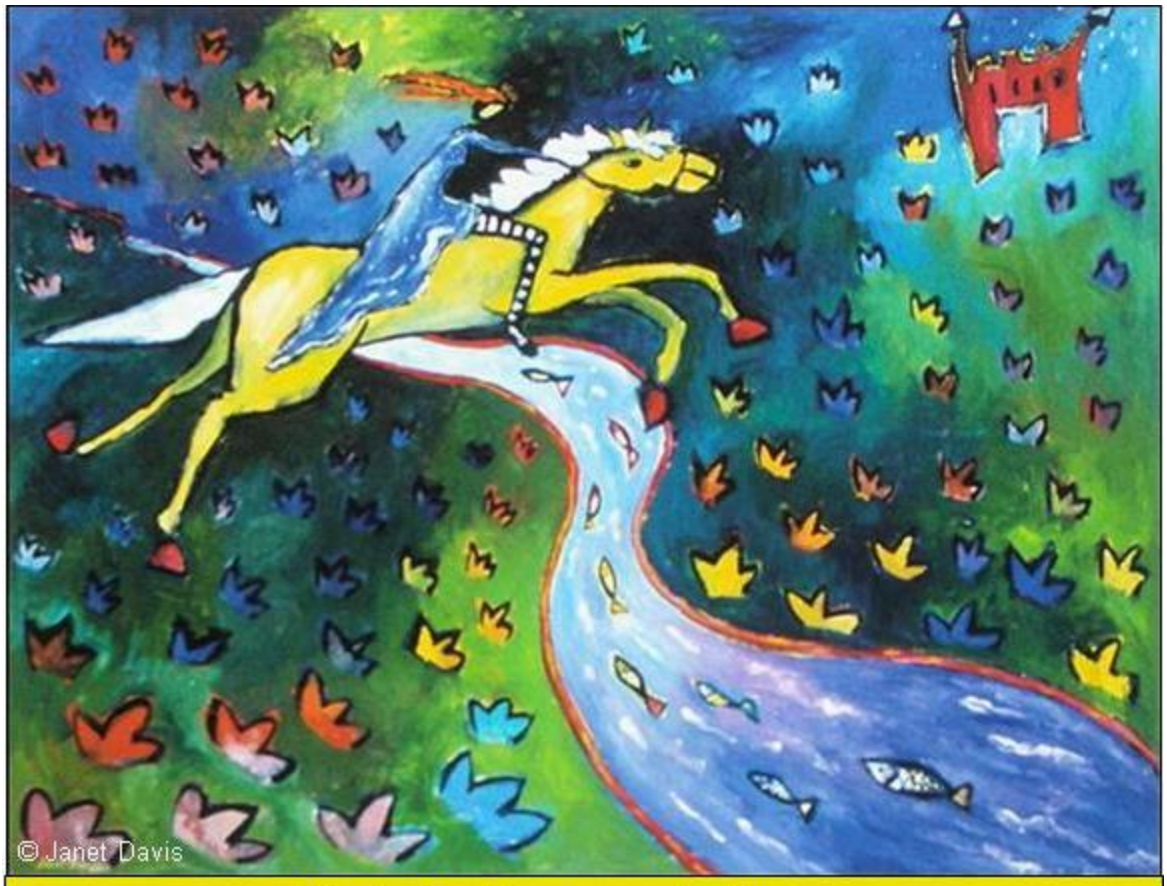
Feeding moldy hay and feed can cause serious illness, including **respiratory problems** and **colic**. Colic is the most common cause of equine deaths. Mycotoxins are produced by the mold. One example is corn mold/fungus which produces a mycotoxin called Fumonisin, among others. This poison causes **leukoencephalomalacia**, a condition affecting the central nervous system which ends in death of the horse. Feedstuffs grown with the full complement of nutrition are much less likely to mold due to their increased cell wall integrity.

The feeding of genetically-engineered (GMO) feed is associated with **reproductive problems**. Most commercial horse feeds contain GMO corn and soybean meal. Beet pulp is now largely genetically modified. Alfalfa, a mainstay of many horses, has also been genetically engineered. Glyphosate, also known as Roundup®, is used extensively on GMO crops. This chemical blocks the utilization of minerals. Even if the plant tissue test shows that the minerals are present, the ability to actually use the minerals has been diminished.

While this horse-crazy author is admittedly biased toward nickering equines, the principles of quality forage production can certainly be applied to other grazing animals. Increases in growth, milk production, milk and meat quality, herd health, ease of reproduction, and longevity have all been witnessed and are to be expected.

“…*fertilize for the crop, against the weeds.”*

Concerns with pasture management such as uneven grazing behaviors and toxic weeds can also be addressed with plant nutrient management. Getting livestock to graze in pasture areas they deem undesirable can be achieved by making those areas more desirable. This is achieved by improving the soil nutrient balance in the undesirable area to make the forage more palatable. Soils that are nutritionally balanced and biologically balanced for a particular type of crop will discourage the growth of unwanted plant species, i.e. weeds, while encouraging the desirable plant species to thrive and crowd out weeds. To put it more simply—fertilize for the crop, against the weeds.



Artwork: Janet Davis www.JanetDavis.com

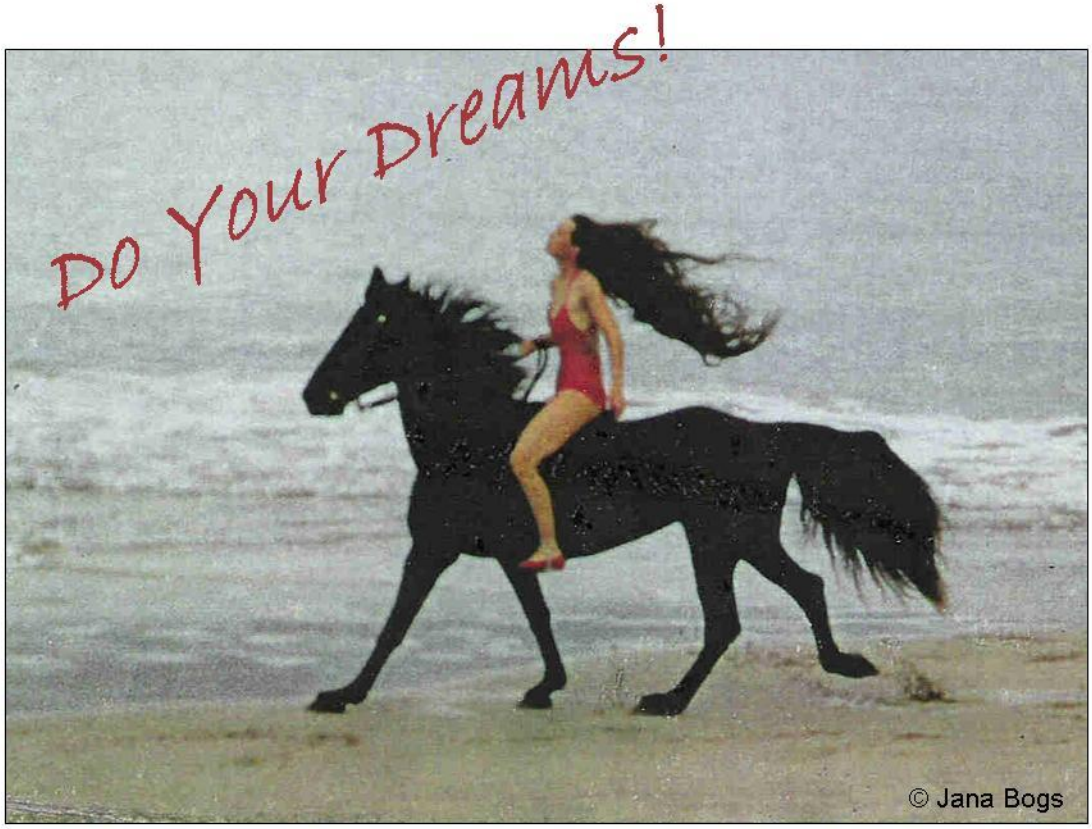
Entertaining some "Out-of-the-Box" Possibilities

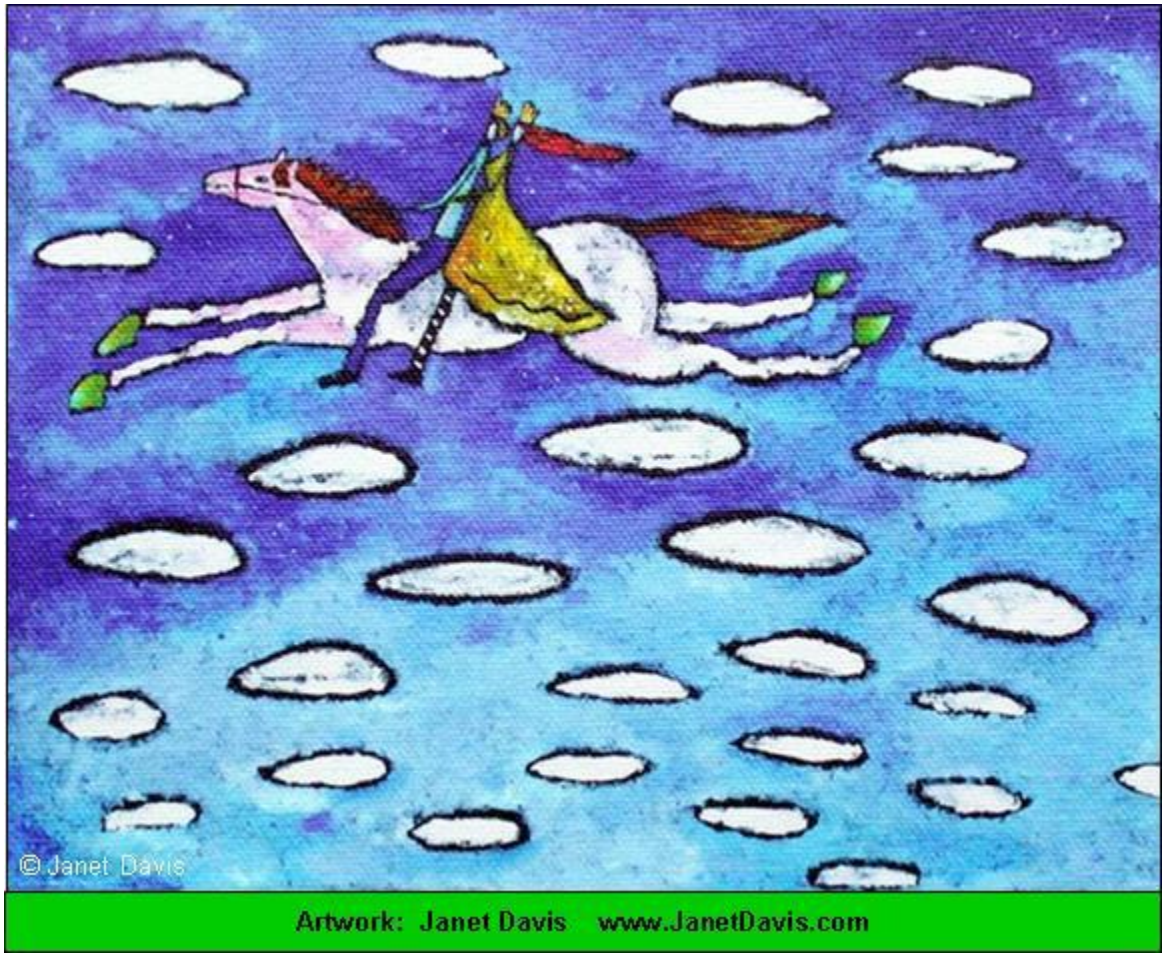
"First they ignore you. Then they ridicule you. And then they attack you and want to burn you. And then they build monuments to you."

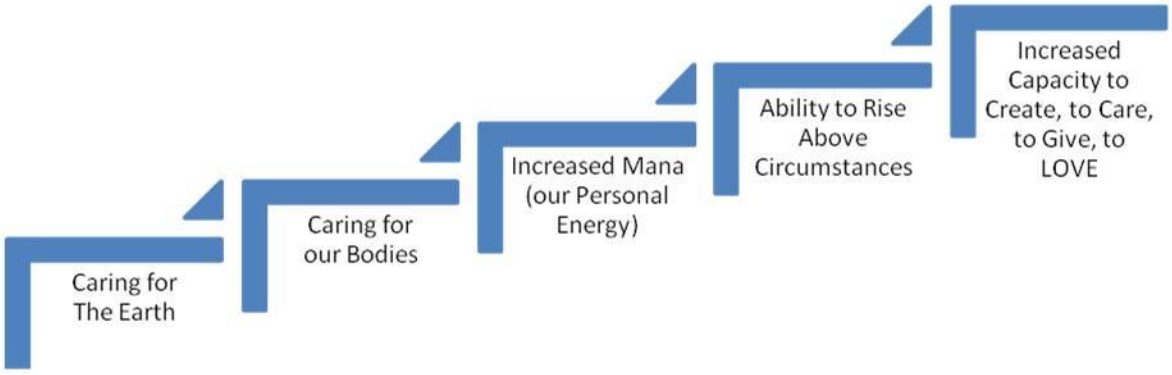
– Nicholas Klein

Food plants, grown with the optimal balance of nutrients to allow their full genetic expression, when consumed by humans, allow *us* to express our full genetic potentials. We can expect:
~ Chronic and acute disease prevention and recovery
~ Improved athletic performance
~ Improved mental function
~ Increased longevity
~ Increased quality of life

It is this author's contention that people and animals given the nutrition they need will not only be physically healthier, but also smarter and *more noble*. When strength and energy within oneself is realized, one does not experience the fears of a lesser mortal. One can be more generous and loving because one has an overflowing abundance of life energy.


Do Your Dreams!
© Jana Bogs





Rising Above

Spiral of Harmony

Illustration: A. Frederick Kennedy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Vandana Shiva, from India, is considered one of this decade's most influential women in the world. She has dedicated her life to food biodiversity and the preservation of the integrity of seed sources. In a recent speech, she said, "It is our food that shapes every cell of our body, every bit of our organs. And, at least the elder women in my country say, 'It shapes our thinking too.' You eat bad food, you have bad thinking. You eat good food; your mind works fresh, creative, beautiful."

Life energy has been recognized throughout the world for centuries by different names, for examples, prana, chi, qi, ki, vitality, life force, mana. A living system with strong energy fields is healthy, balanced, and free of disease. Its life energy is noticeably and measurably high.

In the 1970's, German professor Fritz-Albert Popp established the term biophotons (biological emission of photons), which are highly organized, subtle light energy emissions from cells. This coherent biophoton energy occurs in the visible and ultraviolet light spectrum, and is measureable. These biophotons affect cellular communication and metabolic processes, including gene regulation. Some recent biophoton-related work has been focused on cancer diagnosis and treatment. (Costa et.al, 2011, Pokorny et.al, 2011)

These energy fields represent the innate intelligence which infuse and surround all living systems (plant and animal). Dr. Gabriel Cousens, director of the Tree of Life Rejuvenation Center in Patagonia, Arizona, calls these "Subtle Organizing Energy Fields" (SOEFs). They are thought to be responsible for creating and energizing templates on which molecules gather to manifest physical forms. Albert Einstein's Unified Field Theory emphasizes that the energy field creates the physical form, not that the energy field simply emanates from the physical form. What came first, the chicken or the egg? Perhaps neither—perhaps it was an energetic template.

Some research work has attempted to measure life energy in plants, foods, and even human bodies. One instrument with which I was privileged to work for a brief period displayed digital frequency read outs measured in mega-hertz (MHz). A normal reading from a human's forehead is approximately 70 to 78 MHz during wake state and prior to eating a meal. This reading could go over 100 MHz at certain times in some individuals. Lower than normal readings were correlated to disease states. For example:

58 MHz – flu symptoms
55 MHz – viral infection
42 MHz – cancer

The instrument's inventor and I measured the energetic frequency fields of plants and various foods. I had a beautiful, large organic apple with me that day. It had a 90 MHz reading. The inventor looked at me and said, "I would eat that apple if I were you." When he measured points on my head, the readings exceeded 100

MHz. He was a bit surprised and then reasoned that the readings were that high because of the relatively large amounts of high quality, raw foods I consume.

Energetic aspects of the form and structure of nutritional components and their subtle energy fields may influence the life energy of our bodies. Consuming a nutritious plant with strong energy fields enhances the body's energy field, raising the mega-hertz frequency of the body, which equates to an increased ability to heal. Whereas consuming food with low energetic frequencies depletes the body's life force energy, increasing disease susceptibility. Young, living plants, organically grown on nutritionally-balanced soils have very strong energy fields.

Could it be that the individual nutrients in Nutrition Grown foods also have higher vibrational frequencies, and are, therefore, more easily absorbed and properly utilized by the body? Cooking can destroy some of this life energy. I believe this is one reason why raw food diets can be so powerfully healing.

The Kingdom of Heaven is Within You

While we're out here exploring possibilities beyond the edge of the establishment's accepted paradigm of existence, I will suggest another possibility—that of Nutrition Grown foods enhancing spiritual unfoldment, intuition and psychic abilities.

The pineal gland is thought by some to be the "seat of spiritual consciousness". It is associated with the "third eye". The pineal gland is also known as the epiphysis. Perhaps this is hinting at something important. Let's examine a related word, epiphany.

The following is from Dictionary.com—
e·piph·a·ny [ih-pif-uh-nee] –noun
~ A sudden, intuitive perception of or insight into the reality or essential meaning of something.
~ A moment of revelation and insight.

Perhaps one experiences more epiphanies—more "aha moments"--when one's epiphysis is working optimally. Such is taught by David Wilcock and others. As people age, their pineal glands tend to calcify—as do some other soft tissues in the body. This may decrease functionality. It seems that people dream less as they age, and general cognitive ability declines.

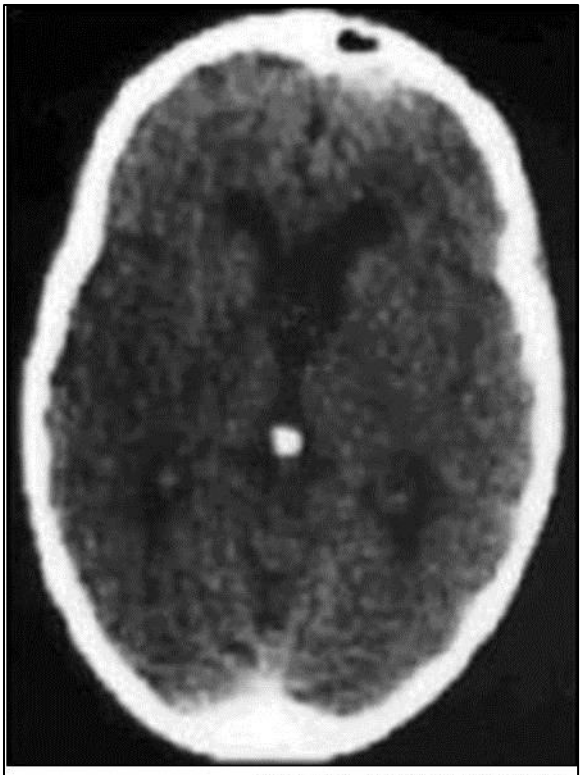


Illustration: A. Frederick Kennedy

This is an x-ray of a human skull, looking down from the top. The white dot in the center is the pineal gland, which has become calcified.

The pineal gland is sometimes known as the "Seat of the Soul", and also "The Third Eye", as it is reported to contain rods and cones like our other eyes. Some believe that the pineal gland is the "eye of the needle" and the "lamp of the body" about which Jesus spoke.

Are there certain nutrients that may impact pineal gland functionality? David Wolfe, among others, has explored the use of mined calcium supplements claiming that they cause calcification of soft tissue, such as the pineal gland. This is thought to be due in part to nanobacterial contamination in the calcium sources. Certain forms of calcium, such as calcium phosphates, may prove more hazardous than others. Unfortunately, various forms of calcium phosphates (i.e. monocalcium phosphate, dicalcium phosphate, tricalcium phosphate) are added to many food products, such as nutritional bars, as well mineral supplements. Calcium carbonate is another form of calcium often seen added to food products, such as soy milk. Obtaining calcium from food sources, not mined rocks, is the way nature intended for us to be nourished. We need to be getting high vibrational frequency calcium from optimally-grown foods so that it may be utilized properly by the body.

Some researchers and practitioners claim that certain elements, such as iridium, gold and other platinum group elements, when in high spin states (electrons are highly energized) help to open one spiritually through enhanced function of the endocrine system. Foods raised in conscientious ways contain these ultra-trace elements and these high spin states may be achieved in the growing process. It all starts by balancing the soil with the full spectrum of nutrients so our food and medicinal plants can express their full potentials. We, the lucky consumers, are in turn supported in our own amazing potentials.

Back Down to Earth—Nutrition Grown Benefits for Food Growers

Many farmers and gardeners are drawn to growing foods because of the deep satisfaction it brings. When the soil is balanced and performing optimally, producing food becomes an even ***greater joy!***

Producing Nutrition Grown foods has many advantages:

~ The plants thrive with full-spectrum, balanced nutrition, growing steadily and giving **bountiful crops**. The plants have the building materials (made available by beneficial microbes) they need to be able to grow well and produce excellent food.

The Tale of Three Papayas

The three papaya plants in the picture below were planted at the same time, yet performed quite differently. They are on the edge of a "Beyond Organic" amended garden space. The closer the papayas were to the amended area, the better they performed, because their roots could pick up the needed nutrients.

~ Plants are **hardier** because they are healthier. They can better withstand hot and cold temperature variations. Their more extensive root system makes them more resistant to drought. They can better tolerate wind because of their greater structural integrity.

~ Plants grown with the full complement of nutrition are able to **produce high quality seeds**. These seeds have excellent germination rates, meaning that a high percentage of the seeds will grow into plants, instead of rotting in the

ground. These seeds produce young plants that grow vigorously because they have the nutrient stores needed to support the growth. Furthermore, healthy seeds remain viable longer and, thus, are able to be stored longer before planting than poor quality seeds.

Producing high quality seeds is crucial to ensuring genetic biodiversity for subsequent generations. This biodiversity is important because the various cultivars have different attributes which allow them to survive under varying growing conditions and climates. The various cultivars produce varying phytochemicals which help them survive against pests and diseases. Some of these phytochemicals possess unique health benefits for consumers as well.

An estimated 95% of genetic biodiversity of food plants has been lost in the last 100 years. Even carefully stored seeds do not maintain viability forever. They must be taken out of storage and grown to seed periodically. Maintaining genetic biodiversity in this way through many generations is a huge undertaking which can be partially eased by having seeds which store for longer periods while maintaining viability and vigor.

~ **"Nutritious is delicious!"** Yes, Nutrition Grown foods taste great! The plants are able to more fully express their **flavor** compounds because they have the needed raw materials available to them. These foods have not only outstanding flavor, but also excellent texture and color. This means more appealing foods for the consumers. Children love to eat these healthy foods. Chefs and other "foodies" are willing to pay premiums to be able to obtain this exceptional quality.

~ Fruits achieve better and more even **color**. This is not only visually appealing, but the improved color often means a greater content of antioxidants for the consumers.

~ Fruits fill to ideal **size**. Small fruits occur because the tree could not supply the nutrients needed for the fruits to size properly.

~ Plants and trees develop stronger weight-bearing tissue enabling them to **hold and mature more fruit** without breaking. This woody tissue development can take years to achieve in established orchards, yet it is certainly possible for dedicated producers.

~ There is less year-to-year fluctuation of fruit crop volume. So-called "alternate bearing", when trees produce a normal size crop one year and very little the next, is largely due to trees lacking the nutrients they need to produce good **consistent crops** every year.

~ Crops are more **drought and flood resistant**. The soil, and hence the plants, becomes more tolerant to fluctuations in rainfall. The right balance of soil nutrients, with calcium being a key player, improves the tilth of the soil, which in turn optimizes water balance. Soil structure is improved by beneficial microbial and macrobial (i.e. earthworms) life in the soil. Microbes "glue" the soil particles together, decreasing erosion, while earthworms open channels deep into the earth for air and water.

~ **Water-use efficiency** is increased. Soil Conservation Research in Missouri performed water-use efficiency research trials on corn crops grown with and without calcium amendments during drought periods in that state. Dr. William Albrecht reported that soils with added calcium used 16 inches of stored soil water and produced 79 bushels of corn per acre. That is approximately five bushels of corn per inch of stored soil water. In contrast, soils in the same area without added calcium used 14 inches of stored soil water, but produced only 18 bushels of corn per acre. That works out to only about one and one-quarter bushels of corn per inch of stored soil water. The soil with added calcium was four times more efficient in using water.

~ There are fewer problems with plant diseases. Just as a person who is well nourished is less susceptible to getting sick, so also a plant which is well nourished is **less susceptible to disease**. Beneficial microorganisms in the soil make nutrients available to plants. They also control the population of harmful microorganisms. When the natural order is upset by the use of harmful chemicals and/or soil compaction (which results in a lack of oxygen), detrimental (anaerobic) microorganisms tend to get the upper hand and cause problems. This is also true for the population of microorganisms in the human intestinal tract. Keeping beneficial microorganisms well fed in the soil and in our bodies will result in greater nutrient uptake into the plants and, subsequently, into our body tissues. The nutrients can then be used to strengthen the plant and also build our immune systems to ward off diseases.

~ **Insect pests are decreased**. Insects are more attracted to unhealthy plants. Why? Following is an explanation based on the works of a former USDA scientist, Dr. Philip Callahan, and Francis Chaboussou, author of *Healthy Crops: A New Agricultural Revolution*. Unhealthy plants have relatively large amounts of fragmented or simple molecules which are the preferred food of insects. Each type of molecule gives off a distinct "signature frequency pattern" which the insects are able to detect. Insects use their antennae sensilla (sense organs) to pick up the frequency signals from the molecules, determining which plants are the best foods for them. This can be likened to antennas being used on televisions, radios or cellular telephones to pick up frequency signals.

This hypothesis becomes more palatable when one realizes that scientists study the atomic structure of molecules by using nuclear magnetic resonance

(NMR) spectroscopy to detect frequency patterns. Insects are attracted to small molecules, such as amino acids instead of fully formed proteins, because they are easier to digest. Relatively large quantities of free amino acids and other small molecules, such as nitrate, ammonia and reducing sugars build up in plant cells when the plant has diminished ability to convert these small molecules into fully-formed proteins and polysaccharides. This diminished ability can stem from application of simple nitrogen fertilizers, such as ammonium nitrate. Other reasons include lack of needed micronutrients, application of pesticides, lack of sunshine, flooding, soil compaction, and/or other stressors.

The differences in insect pressure between a crop in a well-cared-for field versus the same crop in an adjacent typically-managed field can be dramatic. Just walk four feet to go from healthy, pest-free plants to unhealthy, insect infested plants.

Insects are actually doing us a service by removing plants that are not worthy of reproduction. In this way, healthy plants breed with healthy plants to evolve improvements over time.

~ **Weeds become less of a problem**. Soils are nutrient balanced and biologically balanced for the crops we wish to grow, helping these crops to outcompete the weeds. In an experiment performed at the University of Illinois, hay crops were grown with and without calcium amendments to the soil. Hay grown without added calcium contained 67% weeds, whereas hay grown with calcium (limestone) added to the soil had only 28.5% weeds. Furthermore, the hay grown with calcium had higher nitrogen levels (higher in protein).

Weeds out-compete crops of choice in anaerobic, minerally-unbalanced soils. They better tolerate the low oxygen conditions present in compacted soils. Weeds thrive in high nitrate conditions which favor bacterial growth over fungal growth. They like bacterially-dominated conditions because of the lower carbon to nitrogen (C:N) ratio. Weeds particularly thrive in disturbed soils because the disruption has damaged the beneficial fungi and allowed bacteria to become dominant. They thrive with a low 0.1 to 1 ratio of soil fungal biomass to soil bacterial biomass (F:B ratio), whereas vegetable crops need an F:B ratio of 0.75 to 1. Fruit trees need a much higher ratio of beneficial fungi to bacteria.

Weeds are not all bad. They are one of nature's ways of decreasing erosion while rebalancing the soil, if one can wait for hundreds of years!

The top selling agricultural chemical of all time is Monsanto's herbicide called Roundup® (chemical name glyphosate). It used to be touted as so safe that one could drink it. Now, after decades of deception, the truth comes out that

it is a deadly chemical which persists in our environment for up to 3 years, according to a study from Sweden. When it does break down, it converts to an even more persistent toxic chemical. Indian farmers, who have lost their farming livelihoods after being deceived by the lies of chemical agricultural methods, often commit suicide by drinking the poisons they put on their fields. It takes only seven ounces (200 mL) of Roundup® to kill a person. According to Vandana Shiva, a quarter of a million farmers have committed suicide in India.

GMO Roundup Ready® crops, also brought to you by Monsanto, have encouraged ever greater use of this toxic chemical. These crops have been genetically engineered to withstand the use of Roundup® on them. Unfortunately, the Roundup® doesn't just kill the weeds; it is also absorbed by the crop of choice. Studies show that even if the crop is planted four months after the application of Roundup®, it still absorbs the chemical. Once absorbed it cannot be washed off, so people eat the chemical along with the food. Cooking does not destroy it either.

When taken internally, glyphosate kills our beneficial microflora, damages DNA and causes cellular mutations. Health problems associated with glyphosate and/or its breakdown products include cancer, Parkinson's Disease, liver damage, decreased sperm count, miscarriages, premature births, low birth weight, and kidney damage. In California, where chemical exposure illness is required to be reported, glyphosate is the third most common cause of illness in farm workers. It ranks number one for landscape gardeners.

Besides the detrimental health effects, the use of glyphosate is counterproductive for farmers in the long run because it has led to the evolvement of super weeds which are herbicide resistant. Glyphosate kills the food source of beneficial microflora in the soil which help make nutrients available to plants and ward off disease-causing organisms. Glyphosate is also highly toxic to rhizobium, which are microorganisms needed in legume root nodules to fix nitrogen from the air. Studies from New Zealand show its detrimental effects on earthworms, which are integral to healthy soil.

By the way, Roundup® is used for much more than agricultural crops. It is widely used on roadsides, lawns, school yards, parks, walking paths, and forests. Use of glyphosate has decreased populations of wildlife, including birds. Concentrations of only 10 parts per million of Roundup® in runoff water can kill fish.

I once questioned a holistic medical doctor about his use of Roundup® on his lawn. He was under the impression that it was safe to use to get rid of the dandelions while not hurting his little children who played on the lawn. I'll take the dandelions! They are a healthy food, and I think they look cute on the lawn.

Besides, they are there by the order of Mother Nature to bring up to the soil's surface nutrients which are deep in the soil.

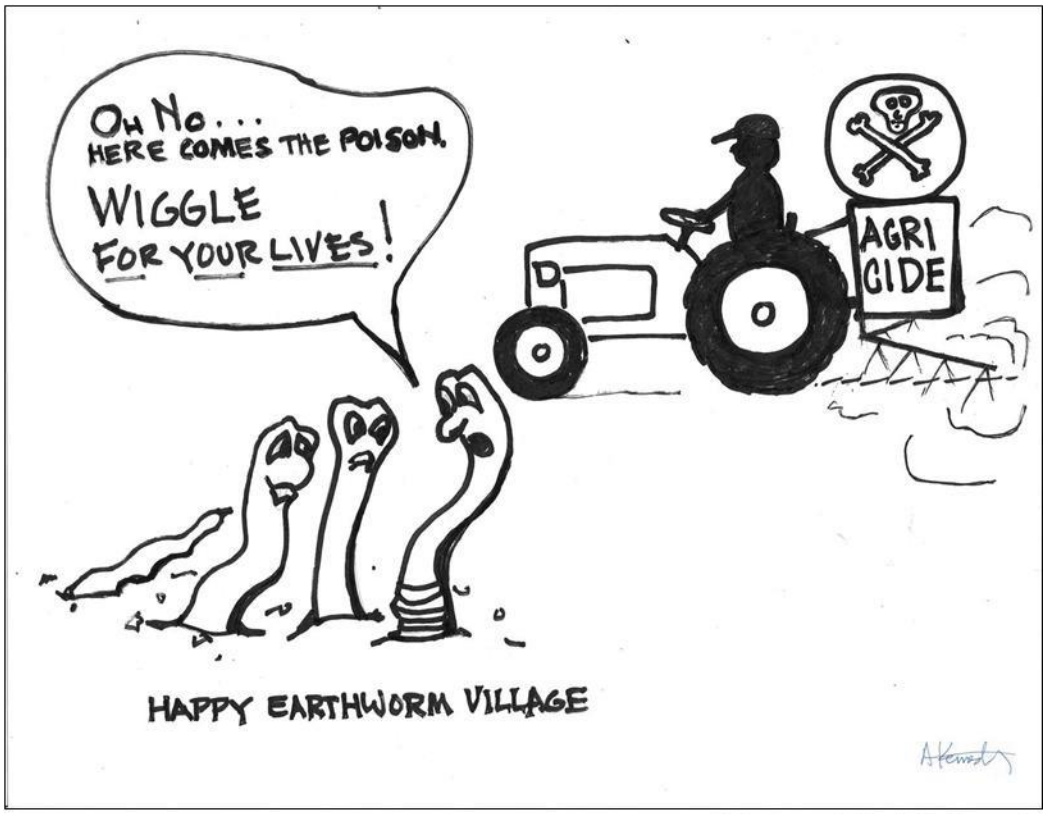


Illustration: A. Frederick Kennedy

~ **No toxic chemicals** are used in the production of Nutrition Grown foods. The farmer does not have to "suit up" with a full body suit and a gas mask to spray the crops. The growers and their communities enjoy cleaner food, air and water, which equates to better health.

There is less and less need over time for even organically-approved pesticide "rescue chemistry". Some people think "organically-approved" equates to "entirely non-toxic", but that is not necessarily the case.

I personally came to know an Iowa commodity crop farmer who suffered from Parkinson's disease due to chemical exposure. We had some interesting conversations about the highly toxic chemicals he had used on his farm and the time he was burned in a huge explosion. His Parkinson's disease progressed rapidly and my farmer friend died a few months later.

~ Farmers can realize **long-term lower input costs** due to spending less money on "remedies" for their crop problems. Input costs for needed amendments and fertilizers become less and less with each growing season as the soil becomes balanced and works properly.

~ Nutrition Grown food producers have the **best nutrition on the planet** available to them right outside their doors. You're going to have maximum nutrition which will be far superior to typically-raised, harvested and shipped produce. Produce develops its nutrient content over time as it matures on the plant. If it is picked before it is ripe, which is typical in commercial situations, it has less nutrition than it would if it was allowed to mature naturally. Also, long storage results in nutrient losses. Therefore, being able to pick produce at its peak of nutrition and flavor, and being able to eat it absolutely **fresh**, before it has lost any of its vitamin or enzyme content, is key to providing your body with the best possible nutrition.

~ This fresh food nutrition is incredibly more effective at nourishing your body than trying to get the nutrition you need from pills and powders. Those pills and powders can be very expensive. You'll **save a lot of money**, or even make a lot of money, by growing your own amazing food.

I was shocked the other day when I was in the produce section of a grocery store and saw a few small kale leaves being sold for $4. A little twig of an herb was 3 bucks! The USDA recommends an average of 7 servings of fruits and vegetables per day. If you're a smart shopper, you might be able to buy 7 servings of organic produce for as little as $10. Still, that alone that adds up to $3650 a year! And how many people are in your household?

Juicing vegetables is one of the healthiest practices I know. However, it takes a relatively large amount of vegetables to make a nice glass of juice. So your out-of-pocket expenses for vegetables just went way up—unless you have your own garden!

If you grow your own food, you are more likely to eat more fruits and vegetables, because they are there; you don't have to go buy them. Children are much more likely to eat something they grew themselves versus some vegetable that came out of a can.

~ The nutrition you grow in your garden can literally **save your life**. According to the non-profit organization, Partnership to Fight Chronic Disease, 45% of Americans have a chronic disease. The good news is, the body can often heal itself when given what it needs. Excellent nutrition leads to excellent health. Can you put a price on health? Not that this is an accurate valuation, but the average hospital stay in the US is over $33,000. Besides potentially saving thousands upon thousands of dollars in medical care, you will have much more joy in your life when you are healthy. The cure just may be in the Nutrition Grown garden!

~ The growers are engaged in a **great service for humanity** by supplying healing foods. The greater nutritional density and higher energetic

frequencies, as well as potentially enhanced cellular utilization may be crucial factors in healing various conditions.

~ Growing your own food is a smart thing to do to enhance your family's **food security**. What if food truckers suddenly went on strike, or there was some natural or man-made disaster that interrupted the food distribution channels? This is of particular concern in densely populated areas, as well as in certain remote areas. What if the ships and planes which bring 85% of the food to Hawaii suddenly stopped running? There would be major food shortages in two weeks or less.

~ The **shelf-life** of these foods is significantly increased due to enhanced cell wall integrity. Often produce is picked green, before it has a chance to ripen, so that it can be shipped and sold before it rots. Nutrition Grown foods can be picked at maturity, when they have fully developed their nutrition and flavor, and still have a very long shelf life. The enhanced cell wall integrity decreases losses on each step of the journey from field to table. This also makes it possible to ship the fresh produce to more distant locations. (Now we just need an ecologically-sustainable way to achieve the transportation.)

~ The **growing season can be extended**. Due to increased beneficial microbial activity, soil temperature stays more constant (warmer in winter, cooler in summer). This extended growing season helps make a wider variety of fresh foods available locally for more weeks of the year.

~ Nutrition Grown foods have a **clear marketing edge** which sets them apart in the marketplace, making them easier to sell. Chefs and other "foodies", especially those concerned about nutrition, want the very best quality foods and are willing to pay for them. Check out the documentary film called "Ingredients". You'll see how the top chefs are all about obtaining the best quality food ingredients for their recipes. This marketing edge is for the food growers and also for retailers such as grocery stores and other markets. Of course, the restaurants which promote these foods also have a clear marketing edge.

These foods are more valuable than typical organic produce, so they can sell for **premium prices**. Better flavor and greater nutrient density are inherent "valued-added" aspects which are easy to sell, especially if backed by a Nutrition Grown certification program. The "beyond organic" blueberries you saw in a previous comparison chart sell for ten times the price of other organic blueberries.

~ Farms can certainly remain within certified **organic** standards while producing Nutrition Grown foods. Growers may be able to get double premiums, or at least appeal to broader markets, if their foods are certified organic and also Nutrition Grown.

~ Growing the best food possible is **intellectually stimulating and fun**!

~ People in the organic farming industry are on a passionate mission to **make the world a better place**. It's not a profession one enters just to make money–it's about doing things right. Organic farmers *feel good* about what they grow, organic product companies *feel good* about what they produce, and consumers *feel good* about using these products. Now conscientious farmers who are growing "beyond organic", Nutrition Grown foods have even more reasons to **feel great** about what they do!

Being Pono—With Our Environment

Pono is the Hawaiian word for harmony, or doing things the right way. Hawai'i is a particularly beautiful place that we wish to preserve by living pono with the 'Aina (the land). In Hawai'i, the ancient peoples understood the importance of caring for (malama) the 'Aina. They considered this their kuleana—their privilege and responsibility. As special as Hawai'i is, the world is full of beauty wherever one turns. All of Mother Earth needs to be cared for, because she takes care of us.

Artwork: Janet Davis www.JanetDavis.com

Growing our food in a pono way with Nutrition Grown methods will result in many environmental benefits, including:

~ **Cleaner air,** because we are not spraying toxic chemicals on our plants.
~ **Increased carbon sequestration in our soil** (the holding of carbon in the soil) results in keeping carbon out of our atmosphere where it creates greenhouse gases which contribute to global warming. Increased soil organic matter (organic = carbon) and beneficial soil microorganisms sequester carbon naturally while improving the soil for the plants growing there.
~ **Healthier soil** that is nutritionally balanced using organically-approved amendments. Balanced soils function properly and support beneficial microorganisms as well as helpful earthworms. This soil biota, in turn, lives synergistically with plants to help them grow.
~ **Decreased erosion,** because beneficial microbes bind soil particles together. Under optimal growing conditions, plant root systems become more complex with longer roots, many fine root hairs and beneficial fungi which hold soil in place.
~ **Cleaner water,** because we are not putting toxic chemicals on our crops which may run off into surface water and/or leach into ground water. Soil microorganisms hold nutrients in the soil instead of allowing those nutrients to contaminate water.
~ **Greater water-use efficiency,** because the soil is nutrient balanced, contains optimal amounts of organic matter, teems with helpful earthworms and beneficial microbial life, and supports extensive plant root systems —all of which optimize water-holding capacity and water use by plants.

A lot of consumers are aware and concerned about the planet. "Sustainability" is a buzzword with a lot of meaning for conscious, thinking individuals. Sustainability is often equated with organic farming practices, and can now be extended to "beyond organic" growing systems. Nutrition Grown methods follow the spirit of organic in that the methods work with nature instead of against it.

With conscientious production systems, the environment is spared the consequences of toxic chemical production methods—water contamination, soil degradation and erosion, air pollution. No room here for nasty chemical sprays or genetic engineering brought to agriculture by big chemical corporations. Instead, Our World is refreshed with wholesome, natural products produced with thoughtful practices in an environmentally-conscious manner.

Section 4: Opportunities for Meaningful Investing and Careers

Laying the Foundation

Research and demonstration farms are needed to further refine techniques and physically ***show*** people the differences that can be achieved with the Beyond Organic Growing System™ (BOGS™). These farms will be used to perform side-by-side research trials comparing various cultivation systems, with statistically-relevant replications. This is important for ongoing scientific verification and documentation of differences in nutrition, yield, water-use efficiency, pest and disease resistance, and shelf life. **Publishing** scientific articles and other educational materials for international distribution is key to bringing about a paradigm shift in agricultural methods around the globe.

These showcase farms will allow visitors to ***taste*** the differences! They will provide venues to *teach farmers* how to grow abundant, supreme quality produce with *fewer problems* and *greater income.* The farms will provide venues to educate consumers on **nutritional** qualities of foods and their importance to health.

Hawai'i, a major vacation destination for the world, is a spectacular location for at least one of the farms. The farm can offer *fun* and educational tours year-round. This increased agri-tourism will benefit the local economy. Local residents, including school children, will also be encouraged to enjoy educational visits to the farm.

Artwork: Janet Davis www.JanetDavis.com

One research aim will be to set *nutritional quality standards* for produce for the world. These standards can be used to establish "Beyond Organic" certification guidelines for farmers so that consumers can buy from retailers with confidence. This certification also helps farmers receive premium prices for the unique selling edge, just as certified organic farmers have been able to do for many years. The certification program could be designed similarly to organic certification programs, but with nutrient analyses added.

The research and demonstration farms can be set up with **Nonprofit** status to encourage generation of needed funding. Any contributions will then be tax-deductible.

Concept drawing of Nutrition Grown Research and Demonstration Farm

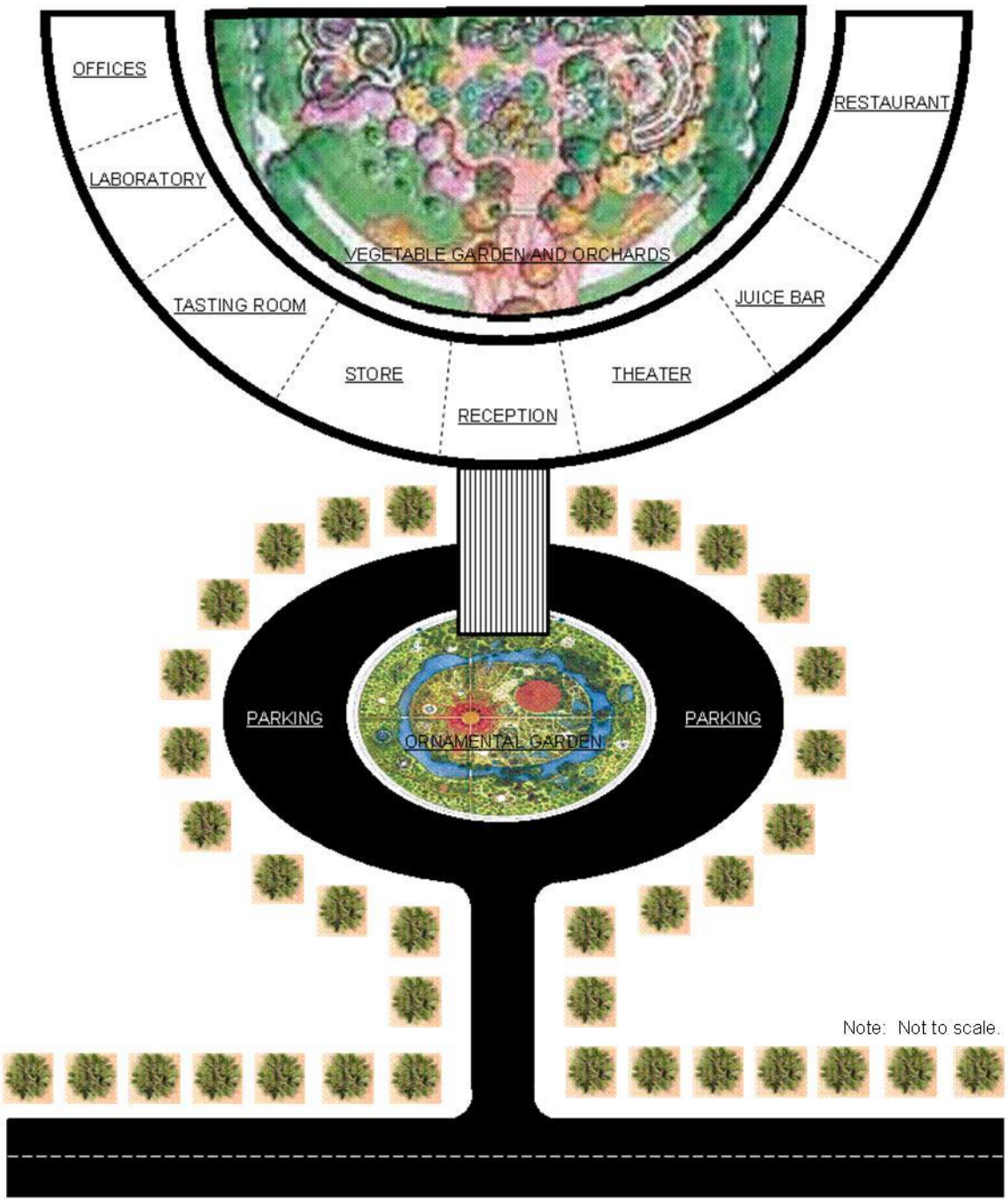


Illustration: A. Frederick Kennedy

Ramping up Production

Developing more **"For Profit" Production Farms** utilizing the Beyond Organic Growing Systems around the world will demonstrate that this type of farming can be a viable, profitable business. Nutrition Grown products have a clear marketing edge for certain population segments, such as health conscious, flavor conscious and environmentally conscious consumers. Health conscious consumers frequent natural food stores, making these stores an obvious market outlet for Nutrition Grown fresh produce and value-added products. Natural food stores welcome these items because they are aligned with the stores' values and offer a marketing edge over typical organic produce which is now widely available at large chain supermarkets. Flavor-conscious individuals such as chefs and "foodies" are willing to pay top dollar for the best quality foods. Nutrition Grown foods also please environmentally conscious consumers due to their "light, green footprint".

Farmers do not have to worry about overproducing and having no place to sell their produce. Consumers in this information age are becoming better educated about the importance of good nutrition. For example, the USDA is actively encouraging Americans to consume at least 5 servings of fruits and vegetables each day. An estimated 13 million additional acres need to be developed for growing produce to meet these demands in the USA alone.

One way to make it easier for small farmers to be successful with Nutrition Grown production is to establish agricultural communities where knowledge and equipment are shared. Cooperatives will allow for sharing large equipment and facilities such as tractors, centralized cleaning and packing sheds, refrigerated storage, processing (commercial kitchens), and dehydrators. Purchasing in bulk will decrease costs of amendments and shipping charges. Working together could also facilitate marketing opportunities.

Do you want to farm, but don't have land? There are many people who have land and would like it to be used for a good purpose. Various arrangements can be made for getting land into production, including leases and share cropping in which expenses, labor and profits are shared.

I once met some young, urban-dwelling farmers in Colorado who made agreements with nearby homeowners to farm their yards. The homeowners got to keep some of the fresh produce, while the majority went to the farmers who sold it locally. On most days, the farmers bicycled to the various plots to take care of them!

"Lots of Green" Career and Income Opportunities

Are you looking for your true purpose in life? How about a fulfilling career where you can put your talent to use in meaningful ways and help to make the world a

better place while earning a living? Besides being a full-fledged, food production farmer, there are many opportunities to earn money with various aspects of Nutrition Grown food production and distribution. You can be a…
~ Producer of high quality seeds for growing Nutrition Grown Foods
~ Nutrient-dense plant researcher or breeder
~ Nutrition Grown plant nursery owner or manager
~ Soil and plant tissue analyst
~ Crop consultant
~ Fertilizer and amendment supplier
~ Compost and compost tea manufacturer or supplier
~ Garden installer, including installation of irrigation equipment
~ Garden maintenance
~ Nutrition Grown Foods teaching/demonstration farm owner or manager
~ Nutrition Grown Foods distributor or retailer
~ Nutrition Grown Foods restaurant owner, manager or chef
~ Nutrition Grown Foods personal chef or caterer
~ Value-added Nutrition Grown Food products company owner or manager
~ Health Retreat owner, director, nutritionist, or chef

Riding the Next BIG Wave in the Nutrition Marketplace

After it is grown, the produce will have to be distributed. Here is where **Big Players** such as fresh produce distribution houses, raw materials suppliers, natural food product manufacturers, nutritional supplement manufacturers, food distributors, and natural food and grocery store chains come into play. The health and wellness sector of the massive food market is one of the hottest areas for new product development breakthroughs and represents exceptional growth opportunities.

"…clear marketing edge…"

Food and nutritional supplement companies clamor to produce *innovative* products in an effort to stay on top. The clear marketing edge of Nutrition Grown foods will enable these food companies to ride the next BIG wave in the nutrition marketplace. Just as the world organic food market share has increased 20% per year for the last 20 years, Nutrition Grown foods can realize the same explosion of growth.

With today's communication technologies encouraging rapid dissemination of information, consumers are more akamai (smarter) than ever. Consumers these days want more than just lunch; they want excellent quality and life-enhancing nutrition. The stressful world in which we find ourselves spurs us to seek deep nourishment—just to keep up. "Baby Boomers", who are feeling the aging process, want powerful healing and energizing foods. As cancer rates rise, consumers look for ways to decrease their personal toxic loads. The extra cost

is absolutely justified, and the buying public votes "organic" with their money, and even their food stamps! Next, we can let them vote “beyond organic”.

“Great tasting food is easy to sell.”

Younger people too, who’ve perhaps indulged a bit too much in junk food, are now realizing why it was called “junk”. These consumers prefer foods with significant, provable nutritional differences. Furthermore, consumers are becoming more sensitive to environmental issues and many make buying choices with environmental preservation in mind. While consumers want to feel they are getting a good value, they demand great flavor and are willing to pay for it. Great tasting food is easy to sell.

Some grocery stores are getting very excited about the longer shelf life of fresh produce. This attribute alone can make it worthwhile to contract exclusively with growers who use Nutrition Grown farming methods due to cutting their losses on produce that must be discarded.

Nutrition Grown foods can be considered “value-added” by their intrinsic nature alone. Yet minimal processing of these foods can result in products with additional value added. Low temperature dehydration methods can be used to dry fruits, vegetables, herbs, nuts and seeds, thus naturally preserving them. These items can be consumed “as is”, or combined, naturally flavored, and/or naturally colored to create fun, healthy products such as spicy zucchini chips and exotic fruit “leathers”. Dried fruit and nut snack bars are a popular treat which can now be even healthier. Dehydrated fruit, vegetable, and herbal powders can be marketed the nutritional supplement and beverage industries (think “smoothies”). The marketing edge advantages come from starting with superior, nutrient-rich quality “grown in” from the soil up.

How About a Nutrition Grown Foods Restaurant?

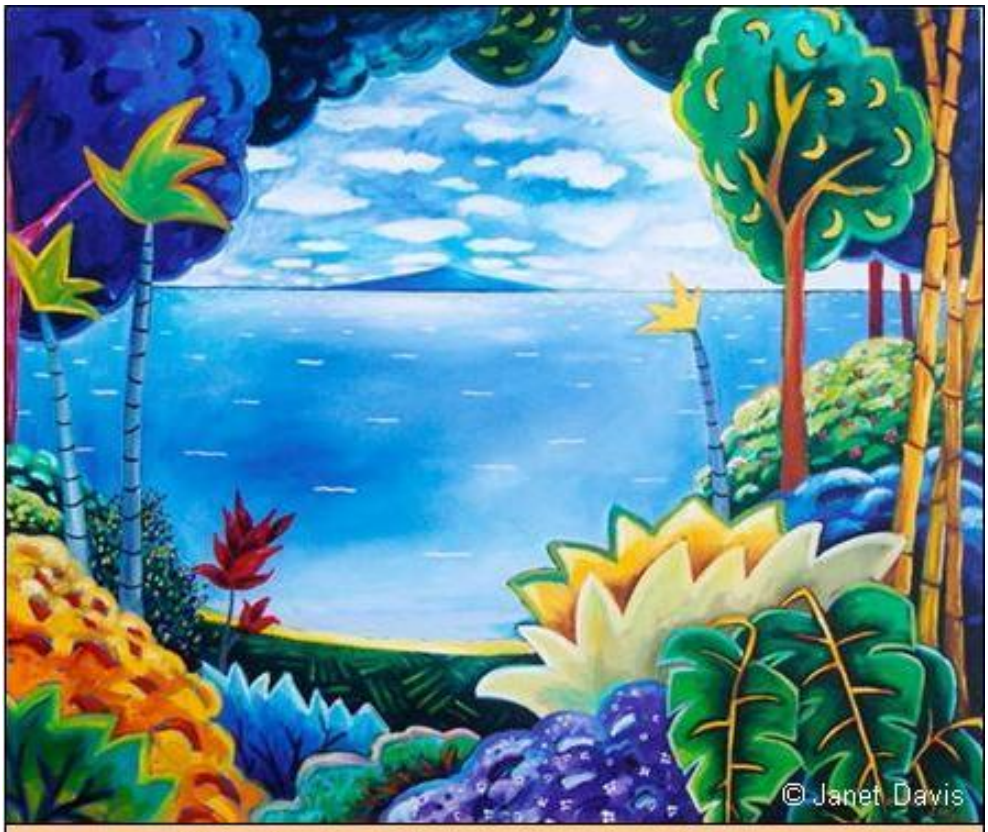
Almost everyone enjoys eating out at a good restaurant. Chefs know that the best food comes from starting with the finest ingredients. That’s what Nutrition Grown Foods are!

There are many forms a restaurant can take--from a small juice or smoothie stand to a moveable lunch wagon to a cute café to a superb fine dining restaurant. Other options include supplying delivered meals (“Meals-on-Wheels”), especially for seniors, being a personal chef, or catering food for meetings and parties. Dream big and think about franchising!

The *Ultimate* Health Resorts

Imagine~~you're at a beautiful retreat in Hawai`i, known around the world as THE place to…
~ Experience the absolute best quality food
~ Personally see how it's grown
~ Understand agricultural sustainability
~ Relax in nurturing luxury
~ Be healed in body, mind and spirit

Health resorts and retreats similar to this could be established in many places around the globe. These wellness retreats and healing centers could range from glamorous to practical to clinical, but all would be centered around the most healing food on the planet. They could be patterned after the likes of The Golden Door, Canyon Ranch, Miraval, Dr. Gabriel Cousens' Tree of Life Rejuvenation Center, the Hippocrates Institute, Optimum Health Institutes, and/or the Gerson Clinics.



Artwork: Janet Davis www.JanetDavis.com

Section 5: Practical First Steps

Obtaining Nutrition Grown Foods

How does one obtain “Beyond Organic”, Nutrition Grown foods? Grow your own, get someone to grow them for you, and/or buy them from someone who is conscientiously producing them.

If you grow food, feedstuffs or even flowers, you can implement Nutrition Grown principles. (Yes, beautiful flowering plants want good nutrition too. They will be able to produce more and better flowers, which have a much longer shelf life after cutting.) It all starts with a comprehensive soil analysis interpreted for nutrient density along with specific recommendations for growing the BEST PLANTS EVER.

If you’re not a grower, you can support those who are implementing this type of agriculture by purchasing their produce and feedstuffs. Vote with your money! That’s how things change. If there are no farmers in your local area who are using the Beyond Organic Growing System™ (BOGS™), find some conscientious farmers and introduce them to the system by giving them a copy of this book and encouraging them to begin. It is not a difficult transition for organic farmers. It begins with a comprehensive soil analysis.

Ready, Soil Test, Action!

“The plants are given the nutrition they need to express their full potentials, so that when we eat them, we can express our full potentials.”

Beyond Organic soil analysis is done according to a very specific protocol. The interpretation and recommendations are aimed at maximizing the nutritional qualities of the plants. Soil analysis laboratories are definitely “not created

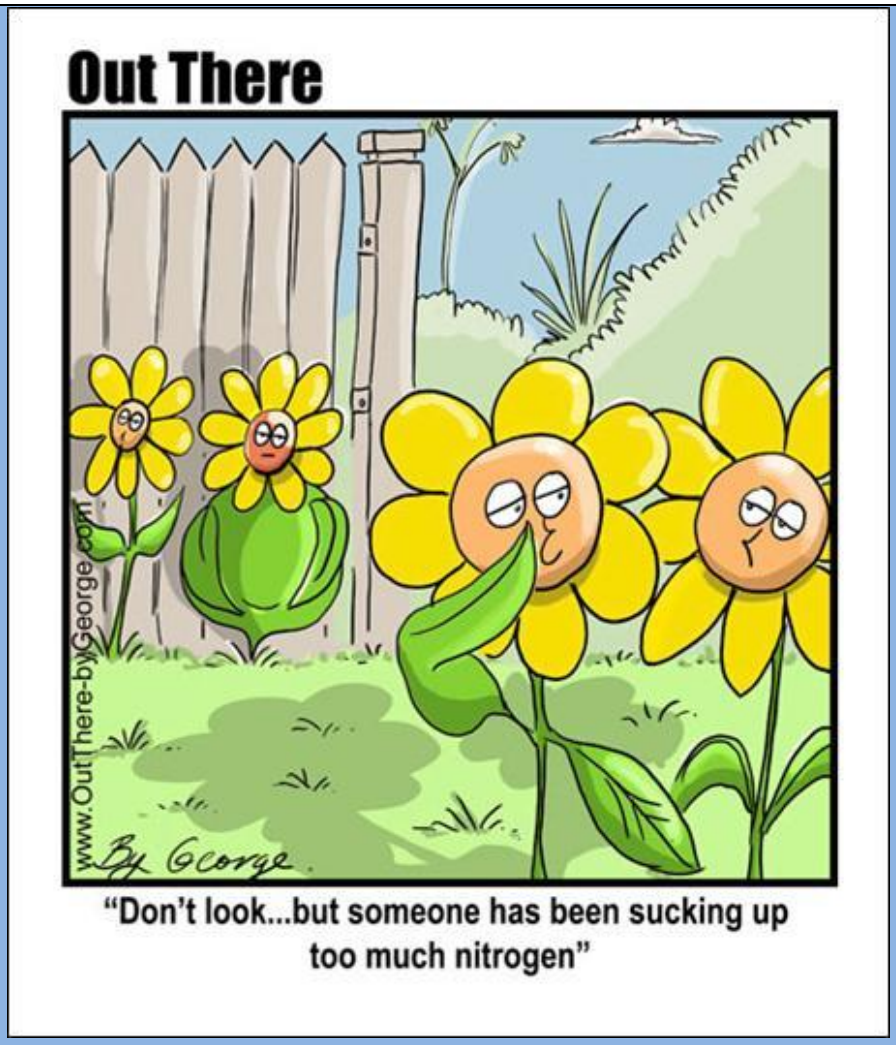
equal". Neither are consultants and recommendations. Whereas most crop consultants focus on increasing yields, BOGS™ focuses on maximizing nutritional quality. The plants are given the nutrition they need to express their full potentials, so that when we eat them, we can express our full potentials. Fortunately, plants that are given what they need can give back to us more than superior nutrition–they can also return high yields and great flavor, all while achieving longer shelf life and greater pest and disease resistance.

Earlier in this book I gave you an example of the vast differences in soil analysis results between two different laboratories. Here's another example of soil analyses "not being created equal":

I did a soil analysis for my local Master Gardeners' group. Soil was also sent to a local lab for comparison. The soil samples were equivalent, meaning that the samples came from the same bucket of mixed soil cores.

I found the calcium and potassium to be slightly low, whereas the local lab found these to be slightly high. We agreed that the phosphorus was very low, and that the magnesium and pH were good. My test included 18 items, whereas the local lab included 11 items. Unfortunately, the local lab offered no interpretation or recommendation for the four trace elements (iron, manganese, zinc and copper) that were tested by them. My test showed the zinc level as being very high, and the other trace elements, boron, iron, manganese and copper, as low or very low. I recommended appropriate types and amounts of organically-approved amendments to address all of the low items and begin to bring balance to the excessive zinc level.

The only fertilizers the local lab recommended were mono-ammonium phosphate (11-52-0) and treble superphosphate (0-46-0), which are conventional fertilizer sources of nitrogen and phosphorus. The problem with many conventional fertilizers is that, while they are readily plant available when they are applied, they can be quickly tied up into insoluble complexes and/or washed away into ground or surface water. This results in major pollution. These products have a boomerang effect in that they over-supply nutrients when applied, and then soon there is an under-supply again. One ends up creating a soil that is sort of like a drug addict which comes down after a high and needs another fix. The readily-available phosphorus diminishes the activity of beneficial microorganisms, especially the mycorrhizal fungi, causing further problems of "addiction". This is the opposite of sustainability. Furthermore, the nitrogen tends to "pump up" the plants so they are watery (less nutrient dense) and much more susceptible to insect attack, the details of which are discussed elsewhere in this book.



I can give you many more specific examples of side-by-side comparisons of soil analyses and recommendations, however I don't want to bore you. In general, it has been my experience that many labs give little thought to trace elements, which, although they are needed in small amounts, are extremely important. Comparison after comparison has come back with a client's local soil test lab report showing "sufficient" on trace elements, whereas my analyses show the soil trace elements to be seriously deficient or sometimes seriously excessive.

A soil analysis can be compared to blood testing performed on a human being. The tests will show problems that need correction. Items in a comprehensive soil analysis include:

- pH
- total cation exchange capacity (TCEC)
- percentage of organic matter (OM%)
- sulfur (S)
- phosphorus (P)
- estimated nitrogen (N) release

- calcium (Ca)
- magnesium (Mg)
- potassium (K)
- sodium (Na)
- boron (B)
- iron (Fe)
- manganese (Mn)
- copper (Cu)
- zinc (Zn)
- aluminum (Al)

Also included are base saturation percentages of:

- exchangeable hydrogen (H)
- calcium
- magnesium
- potassium
- sodium
- other bases

Exact calculations are made, along with balancing ratios between various elements. I make recommendations in keeping with the USDA's organic certification guidelines so that those who wish to be certified organic can be.

Soil Analysis Example--Page 1

Client: Example

Location:

Soil Test #:

Date:

"Creating health from the soil up!"

Soil Report and Recommendations

		Lab Results		Recommendations		
	Total Exchange Capacity (M.E.)	21.8	OK	Use these rates if tilling 6" into soil; otherwise use half rates.		
	pH of Soil Sample	6.6	H		Add per	
	Organic Matter %	14.16	OK	Amendment	1000 sq ft	Comments
ANIONS	SULFUR S Value Found ppm	12	L			In other amendment items.
	Value Found lbs/acre	24				
	Desired Value lbs/acre	55				
	Deficit (-) or Excess	-31.0				
	PHOSPHORUS P P2O5 Value lbs/acre	235	L	Soft Rock Phosphate	2 lbs	
	P Value Found lbs/acre	103			CalPhos (from Florida) is the best type.	
	Desired P Value lbs/acre	110			Place deep in root zone.	
	Deficit (-) or Excess	-7			Best applied mixed with manure compost.	
	Estimated NITROGEN Release lbs/acre	127	L	Feather Meal	19 lbs	
CATIONS	CALCIUM Ca Value Found lbs/acre	5738	L	Gypsum	19 lbs	
	Desired Value lbs/acre	5930		(Calcium Sulfate)		
	Deficit (-) or Excess	-192				
	Base Saturation (Ideal 60 to 70%)	66%				
	MAGNESIUM Mg Value Found lbs/acre	1088	H			
	Desired Value lbs/acre	628				
	Deficit (-) or Excess	460				
	Base Saturation (Ideal 10 to 20%)	21%				
	POTASSIUM K Value Found lbs/acre	271	VL	Potassium Sulfate	35 lbs	
	Desired Value lbs/acre	1190		0-0-50-18(S)		
	Deficit (-) or Excess	-919				
	Base Saturation (Ideal 2 to 7.5%)	1.6%				
	SODIUM Na Value Found lbs/acre	101	OK			
	Desired Value lbs/acre	201				
	Deficit (-) or Excess	-100				
	Base Saturation (Ideal 0.5 to 3%)	1.0%				
	OTHER BASES (Fe, Mn, Cu, Zn, etc.)					
	Base Saturation (variable)	4.8%	OK			
	Exchangable HYDROGEN Base Sat.	6.0%	L	H Base Saturation Ideal is 10 to 15%. (This is a function of pH.)		

Key: VL = Very Low L = Low OK = Good Level H = (too) High VH = Very High (excessive)

Soil Analysis Example--Page 2

				Amendment	Add per 1000 sq ft	Comments
TRACE ELEMENTS AND OTHER	BORON B	Value Found ppm	0.93	L	Granubor (14.3% B)	0.34 lbs OR	
		Value Found lbs/acre	1.86			6 oz	Split over 3 applications.
		Desired Value lbs/acre	4.00			Best applied mixed with compost.	
		Deficit (-) or Excess	-2.14			Will need more later. Recheck in 6 months.	
	IRON Fe	Value Found ppm	123	OK			
		Value Found lbs/acre	246				
		Desired Value 200-600 lbs/acre	246				
		Deficit (-) or Excess	0				
	MANGANESE Mn	Value Found ppm	39	L	Manganese Sulfate	0.3 lbs OR	
		Value Found lbs/acre	78		(32% Mn)	5 oz	
		Desired Value lbs/acre	82				
		Deficit (-) or Excess	-4			Check plant tissue levels for accuracy.	
	COPPER Cu	Value Found ppm	17.98	VH		This is excessive!	
		Value Found lbs/acre	35.96			Possibly from manure put	
		Desired Value lbs/acre	9.00			on in past.	
		Deficit (-) or Excess	26.96				
	ZINC Zn	Value Found ppm	15.48	H			
		Value Found lbs/acre	30.96				
		Desired Value lbs/acre	18.00				
		Deficit (-) or Excess	12.96				
	COBALT Co	Value Found ppm	1.82	L	Cobalt Sulfate (21% Co)	21 g	
	MOLYBDENUM M	Value Found ppm	0.65	L	Na Molybdate (39% Mo)	6 g	
	SELENIUM Se	Value Found ppm	0.12	VL	In other amendments		
	SILICON Si	Value Found ppm	146	OK			
	ALUMINUM Al ppm (Ideal <1000ppm)		848	OK			
	Conductivity (EC)		0.16 mmhos/cm	OK			

ADDITIONAL ITEMS	Microbial mix with emphasis on beneficial fungi. Need microbiological test for more specifics.				Contact Dr. Bogs for this.
	Azomite	For ultra-trace elements		5 lbs	
	Kelp Meal	For iodine and other ultra-trace elements		5 lbs	
	Humates, dry	Chelator–helps hold nutrients and make available		6 lbs	Optional
	Ground Spray--Mix these 4 items		GSR Growing Calcium	1/4 tsp (1g)	Spray on soil once a week
	in at least 1/2 gal of water:		Liquid Kelp	1/2 Tblsp (5g)	for one month, before
	(Mix in order from top to bottom.)		MSR Phosphate	3 Tblsp (1 oz)	putting on compost or mulch.
			Fish Emulsion	2 Tblsp	Agitate while spraying.
	WOODY Finished compost (preferably) and/or WOODY mulch (on top)			1/2 inch thick	over top of amended soil.

Due to significant imbalances which are not able to be corrected at one time, a reassessment in 6 months is advised.

Key: VL = Very Low L = Low OK = Good Level H = (too) High VH = Very High (excessive)

Don't worry if you don't understand all of the items on the soil analysis. The recommendations for amending the soil will be made clear and easy to implement. The analysis comes with a tip sheet, and phone support is available. Think of your soil amending process like following a recipe to make a pie. You get all of your ingredients and tools together, then follow the step-by-step instructions. Did you ever make mud pies as a child? Here's your chance to make the best mud pie ever!

Comprehensive soil analyses for increasing nutrient density of produce are available for the USA and other countries through www.BeyondOrganicConsulting.com. See the website or this book's appendix for instructions on how to take accurate soil samples for analyses.

Microbiology—"Great Small Things"

Plants need soil which has a large array of beneficial microorganisms. Ideally, the soil has many thousands of species of beneficial microorganisms, with multiple roles to play such as making nutrients available to the plants, suppressing diseases, and structuring soil to allow for optimal amounts of air and water. Certain microbes can fix atmospheric nitrogen thus making it available to plants. Mycorrhizal fungi connect to plant roots and function as extensions to the roots, supplying nutrients to the plant. Plant leaves also have microbes living on them, and they can benefit from having more microbes applied, especially when fending off diseases.

Ideally, soil for vegetable crops has 75,000 species of beneficial bacteria and 25,000 species of beneficial fungi in one teaspoonful. Soil for trees should have even more species of fungi. Soils also need to have large numbers of these microbial species in *actively working modes*. In addition to beneficial bacteria and fungi, healthy soil has some protozoa and beneficial nematodes which cycle the nutrients in bacteria and fungi, making them available to plants. The accompanying chart shows you the vast differences in the fungi to bacteria ratio requirements for various types of plants.

Beneficial microbes can be added to the soil as concentrated, broad-spectrum inoculants applied with non-chlorinated water, by adding quality compost, or by applying good quality compost tea.

Soil Fungi to Bacteria (F:B) Ratio Chart

Crop Grown	F:B Ratio
Old Growth Forest	100:1 to 1000:1
Conifers	100:1 to 1000:1
Deciduous Trees	5:1 to 100:1
Fruit/Nut Trees	5:1 to 100:1
Bushes/Shrubs	2:1 to 5:1
Vines	2:1 to 5:1
Row Crops	1:1
Most Pastures	0.75:1 to 1:1
Vegetables	0.75:1
Early Annuals	0.3:1
Brome/Bermuda Grasses	0.3:1
Weeds	0.1:1

Data: Rodale Institute, Dr. Elaine Ingham

Making and Applying Compost

When making compost, realize that various microbes prefer different types of foods. Fungi thrive on foods with a high carbon to nitrogen (C:N) ratio like wood chips, cardboard, humates, dry leaves, and straw. Bacteria like foods with a lower C:N ratio and simpler carbohydrate sources, such as grass clippings, green leaves, sugars, and kitchen scraps. Keep this in mind when making compost, as you will want to customize it to your plants' needs. For example, when growing vegetables versus growing fruit, you will need more nitrogen per unit of carbon to feed the greater volume of bacteria needed for vegetable soils compared with fungi. Take a look at the Carbon to Nitrogen Ratio (C:N) chart to gain a better understanding. It may seem like there is excessive carbon in the foods compared with the ratio in the microbial bodies, but the carbon compounds are needed largely as energy sources. Some higher nitrogen food sources, such as fish or legumes, are needed to balance the carbon. The more variety you have in food sources and microbial inoculants, the better.

Cautionary Notes: Be sure that your sources of composting materials are free of herbicides. Yard and farm waste, such as grass clippings and straw, may be contaminated with broad-leaf herbicides which can create havoc in your garden for years. If unsure, check it first by growing two potted broad-leaf plants of the same cultivar side-by-side with some of the new composting material mixed into the soil in one of them.

Be careful to not use materials with toxic ingredients, such as chemical dyes, inks used for printed materials or allelopathic plants such as Black Walnut tree, Eucalyptus tree, or Ironwood tree mulch.

Here is a basic recipe for compost:
Make a pile by layering the following chopped materials (one inch and smaller chunks) in many small layers…
35% "brown/woody" materials (C:N > 50:1) See the following chart.
35% "green" materials (C:N ~ 25:1)
25% high nitrogen materials (C:N ~ 10:1)

5% of your best garden soil. If your soil has little or no clay, add a few pounds (about 2% of pile) of some good quality clay such as Azomite or Redmond Conditioner. Adding soft rock phosphate, which has a clay base, is excellent if your soil needs phosphorus. Clay with a high cation exchange capacity (CEC) helps in the formation of humus which has the ability to hold anions.

Broad-spectrum microbial inoculants mixed in non-chlorinated water, sprinkled on the various layers

Minerals—These are optional, but you can use very small amounts based on the volume of compost, according to the soil analysis for the area where you plan to apply the compost. Be careful to not overdo this. You do not want to amend the compost with the same amounts of amendments recommended for amending your entire garden space. If you do, you will end up with large excesses, causing imbalances. The amounts used are based on the square footage of your compost pile.

Carbon to Nitrogen (C:N) Ratios			
Slaughter waste	3 : 1	Vegetable scraps	25 : 1
Blood meal	3 : 1	Pea straw	29 : 1
Fish scraps	4 : 1	Garden waste (trimmings)	30 : 1
Soybean meal	5 : 1	**Protozoa**	**30 : 1**
Bacteria	**5 : 1**	Fruit scraps	35 : 1
Chicken manure	7 : 1	Nut shells	35 : 1
Soil microbes (as a group)	**8 : 1**	Fresh tree leaves	50 : 1
Cottonseed meal	10 : 1	Peat moss	58 : 1
Pig manure	14 : 1	Corn stalks	60 : 1
Legume hay	15 : 1	Brown tree leaves	70 : 1
Grass clippings (fresh)	15 : 1	Straw (from grain crops)	80 : 1
Kitchen scraps (with meat)	17 : 1	**Nematodes**	**100 : 1**
Seaweeds	19 : 1	Rice hulls	120 : 1
Fungi	**20 : 1**	Humates	150 : 1
Farmyard manures	20 : 1	Deciduous wood	300 : 1
Grass clippings (dried)	20 : 1	Cardboard (average)	450 : 1
Green weeds	20 : 1	Conifer wood	500 : 1
Microbial diet (average)	**24 : 1**	Newspaper (average)	600 : 1
Coffee grounds	25 : 1	Heartwood of cedar	1000 : 1

You can start composting with just a pile on the ground or on a hard surface, i.e. concrete. Ideally, the compost pile needs to be at least five feet high (preferably six feet high) and seven feet wide at the base. That is a starting volume of about three cubic yards. The size will greatly decrease over time, but it should end up being enough to lightly cover a 1000 square foot garden. You will need to have a large supply of the various materials on hand to layer into a pile. You can

stockpile bags of dry leaves, dry grass clippings, etc. in preparation to make a compost pile.

Using a bin tends to work better for those who have smaller amounts of materials. You can buy fancy compost bins or make your own. Use heavy-duty wire mesh to make a circular bin, or fasten together wooden pallets to make a square bin. To work well, the bin should be at least four feet across and approximately as tall as it is broad. Be sure to make it so that it can be easily opened later.

Place a thick layer of coarser materials, such as old plant stalks, at the bottom to help provide air in the pile. Wet the materials as you layer the pile, preferably with non-chlorinated water. (You can get a hose filter, catch rain water, or fill a bin with tap water and let it outgas for 24 hours.) Try to coat all of the particles, so that they are damp. Don't use so much water as to cause drainage from the bottom of the pile. You will need to maintain the moisture level similar to a wrung out towel or sponge—damp, but not dripping wet. If you are in a very rainy area, cover the pile. A shed would be nice, but even a tarp will work.

Obtain a compost thermometer at least 20 inches (50 cm) long. Check the temperature of the middle of the pile daily. It needs to come up to a minimum of 131 degrees F (55 C) for 3 days to kill bad bacteria (pathogens), weed seeds and pests. If the temperature goes over 155 degrees F (68 C), turn the pile immediately with a pitch fork. Higher temperatures damage the good microorganisms, and…

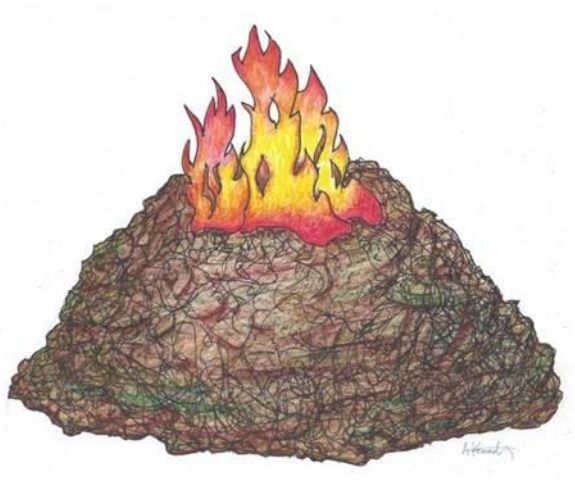


Illustration: A. Frederick Kennedy

COMPOST PILES CAN CATCH ON FIRE, SO PLEASE BE CAREFUL ABOUT THIS.

Ideally, you will keep your pile in the desired temperature range for two weeks, turning the pile every 3 days, and have finished compost in 21 days. The turning mixes the materials so that all of the materials get processed.

If your pile is not getting up to the desired temperature range, check the moisture level first. It should be damp, but not wet. If that is OK, then you may possibly need to add more high nitrogen materials (microbe food). You may also need a larger pile, which retains heat better. Or you may need a "fluffier" mixture with more pore space that can hold the necessary amounts of moisture and oxygen.

You can also make a large compost pile with the static method, in which case you do not turn the pile, but it takes an average of three to six months to compete the processing. Start by making a base layer of large branches for the bottom, which will allow air and thus oxygen, to be drawn into the pile. Put most of the green materials (low C:N bacterial foods) in the middle and cover the pile with the woody materials (high C:N fungal foods). Securing a tarp over the pile will help it to maintain the correct moisture level and prevent the materials from blowing away. Alternatively, you can use a thick layer of straw over the entire pile.

Do check the pile to keep the moisture at the correct level, and water as necessary. Do check the temperature of the middle of the pile regularly (particularly the first few days) to make sure it will not catch on fire, and open or turn the pile as necessary to allow it to cool down.

In the end, whichever way we make the compost, we are looking for the final C:N ratio to be 12:1. We also want to have an abundance of a very large array of beneficial microorganisms, including aerobic bacteria, beneficial fungi, "good guy" nematodes, and protozoa.

Vermicompost from "Wonder Worms"

Vermicompost is a special type of compost made by specific varieties of composting worms as they consume and process organic matter. It has unique properties, such as plant growth regulators. Vermicompost has a finer structure and a higher level of nutrients, including plant-available nitrogen, than typical compost. The components are somewhat variable depending on the type of worms used, what they are fed, and the age of the compost.

Vermicomposting works well for those who don't generate large amounts of organic matter, such as people who have only small gardens and kitchen waste. The worms like to be fed small amounts regularly. They are similar to pets! They enjoy most kitchen scraps, but not many citrus peels. Don't expect them to eat woody materials. Don't let them freeze.

There are a lot of fine points to composting and vermicomposting which are not covered here—books are written on the subjects. Please remember, "Compost is not compost is not compost." Using appropriate amounts of excellent quality compost will help you to grow higher quality food.

Compost Tea

Compost tea "brewing" is a method of multiplying beneficial microbes in high quality compost (or vermicompost) by suspending a sachet of this excellent quality compost in a container of clean, non-chlorinated water and bubbling air through the system for 24 hours. Vermicompost is often the compost of choice due to the variety and complexity of microorganisms that it contains. Some people add various microbial growth stimulants such as sugars, molasses, humic acid, minerals, fish and/or seaweed. Compost tea brewing machines are available with prices ranging from about $200 for home units to tens of thousands of dollars for large commercial units. Some industrious people have been successful making their own tea brewers, but diligent effort is required to develop the systems to work well.

The tea can be sprayed on soil and plants with a low pressure sprayer and/or applied through a drip irrigation system. Application rates range from 50 to 300 gallons per acre (one to seven gallons per 1000 square feet). It is typically applied once per week. Be certain to clean all compost tea equipment very thoroughly to avoid contaminating the brew with harmful organisms.

Microbiological Analysis

Microbiological analyses can be performed on your soil, compost, compost tea, and plant tissue. The analyses will tell you what species of microorganisms (good and bad types) are present, how many there are, and how active they are. This will be compared to what would ideally be present and suggestions given for how to correct imbalances for your crop. See the appendix or the website www.BeyondOrganicConsulting.com for instructions on how to take accurate soil samples for microbial analyses.

Plant Tissue Analysis and Nutritional Foliar Sprays

Once your plants or trees have mature leaves, you can have the plant tissue analyzed. Plant tissue analysis is a laboratory procedure which is used to determine the mineral content of a plant's leaf tissue. It will reveal deficiencies and excesses so that an appropriate foliar spray can be designed to supply nutrients immediately to the plant. The plant can absorb nutrients directly

through its leaf stomata. Foliar feeding is almost like giving an I.V. solution to the plant!

Foliar feeding doesn't take the place of soil balancing, but it can be a short-term solution while you are working on improving your soil. Even after balancing the soil, foliar feeding can be used to maximize quality food production. Foods from growing systems which do not have soil, such as hydroponics and aquaponics, may be greatly improved with foliar nutritional sprays. Done correctly, foliar feeding can improve the nutrient density, flavor and shelf life of your crops. By giving plants the nutrition they need, disease problems decrease and crop yields increase.

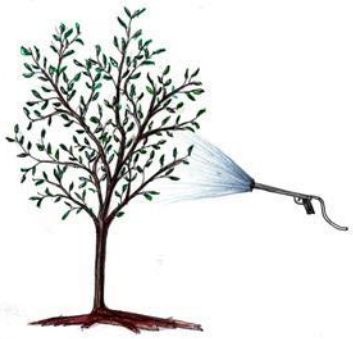
A comprehensive plant tissue analysis includes calcium, magnesium, potassium, sodium, sulfur, phosphorus, boron, iron, manganese, copper, zinc and nitrogen. Once plant nutrient deficiencies have been determined, a foliar spray recipe can be custom formulated. These nutrient sprays are very easy to apply with an inexpensive sprayer for small areas or a tractor spray rig for large areas. Spraying is best done either early or late in the day when the leaf stomata are open. Be sure to spray the underside of the leaves thoroughly because most of the stomata are on the underside.

Plant Tissue Analysis Example

Analyzed Results

N	S	P	K	Mg	Ca	Na	Fe	Al	Mn	B	Cu	Zn
			(%)							(ppm)		
1.96	0.24	0.20	0.91	0.48	2.99	0.11	68		12	68	7	13
Optimal Ranges												
2.20	0.20	0.12	0.70	0.26	3.00	Less Than	60	Less Than	25	30	5	25
2.60	0.30	0.16	1.10	0.60	5.50	0.160	120	200	200	100	16	100

Nutrient Level	Mineral Name	Nutrient Index
Very Low	Nitrogen (N)	-37
Low	Zinc (Zn)	-19
	Manganese (Mn)	-16
	Calcium (Ca)	-13
	Iron (Fe)	-8
	Copper (Cu)	-6
Optimum	Sulfur (S)	3
	Potassium (K)	8
	Boron (B)	9
	Magnesium (Mg)	13
Very High	Phosphorus (P)	67



Recommendations

1 oz/1000sf Foliar Fish Emulsion Concentrate, diluted according to label directions (Nitrogen source)
9 g/1000sf Zinc Amino Acid Chelate Powder, diluted according to label directions
5 g/1000sf Manganese Amino Acid Chelate Powder, diluted according to label directions
5 g/1000sf Calcium Amino Acid Chelate Powder, diluted according to label directions
Mix together and apply as foliar spray every 2 weeks through season. Retest next season.

Plant tissue analysis requires obtaining specific sections of plants. This is usually leaf tissue, but this can vary depending on the type of plant. See the website www.BeyondOrganicConsulting.com for further information and instructions.

With soil analyses and addition of amendments, plus tissue analyses and foliar sprays, you are on the fast track to growing incredible, nutrient-rich food. Soon you'll have happy plants and the best food ever!

In Summary

Nutrition Grown foods represent a new paradigm in food quality, which includes maximum nutrient content, excellent flavor and texture, extended shelf life, and naturally-enhanced pest and disease resistance. Food is supposed to nourish us, giving us what our bodies need to function optimally. This is the promise of Nutrition Grown foods. They are cultivated with sustainable, even organic, methods with the primary focus on balanced, optimal nutrient density for supporting the health of the plants and the health of the consumer.

Much of the world's population is suffering from chronic, degenerative diseases such as cancer, cardiovascular disease, obesity, and diabetes, all of which are heavily influenced by diet. Mental and emotional health are also influenced by diet. In addition to our disease crisis, our society is facing a number of problems, such as environmental degradation, which need to be solved. To begin to solve these problems, we, as a society, need to be healthy and functioning optimally so we can exercise our brilliance.

"Good health comes from good food grown in nutrient-balanced soil."

Good health comes from good food grown in nutrient-balanced soil. While there are certainly other factors, such as clean air, social interactions and lifestyle choices, giving our bodies the optimal amounts of needed nutrients is absolutely essential to health and longevity.

While fruit and vegetable consumption offers a multitude of scientifically-supported nutritional health benefits, the nutrient content of fruits and vegetables has significantly decreased over the last 70 years with changes in the food system and agricultural methods. How much? Up to 75% for some vital nutrients. Even much certified organic produce has little more nutrient density than its conventionally-grown counterparts.

To make matters worse, the average American consumes only 3 servings of fruits and vegetables per day, far below the recommended 5 to 9 servings. To give a fuller perspective of the problem, the World Health Organization (WHO) published a report showing the remainder of the countries in the world generally lagging behind the USA in production and consumption of fruits and vegetables. The WHO estimates that over 3 billion people—half of the world's population—suffer from nutrient deficiencies. These deficiencies are not limited to developing nations, but include developed countries as well. Clearly, changes are needed in our global food system to increase nutrient levels in the diets of people all around the world.

The good news is that the negative trends can be reversed through improved agricultural practices utilizing environmentally-friendly techniques. Beyond Organic Growing Systems can produce Nutrition Grown foods with double, triple or even greater amounts of vital nutrients than typical growing methods. It is all about giving the plants what they need so that they may express their full potentials.

"…when we consume these Nutrition Grown foods, we will then be able to express <u>our own</u> full potentials."

The hope is that when we consume these Nutrition Grown foods, we will then be able to express *our own* full potentials. This fuller expression will manifest on physical, mental, emotional and spiritual levels, leading us to experience more noble, fulfilling lives, and to bring to reality the better world of which we have dreamed.

This new food production paradigm of "creating health from the soil up" includes:

~ Improved production practices, utilizing comprehensive soil and plant tissue analyses for balancing soil and plants with optimal amounts of a wide spectrum of needed minerals, organic matter, and beneficial microorganisms. It is possible to increase nutrient density greatly, even while remaining within certified organic growing guidelines. We can take food production to the next level by "going beyond organic to Nutrition Grown".

~ Growing better cultivar (cultivated variety) selections which are not genetically engineered, but have the natural ability to uptake and complex larger amounts of critically-needed nutrients, as well as produce larger amounts of health-giving phytonutrients. There can be many-fold differences in nutritional content between cultivars.

~ Creating a clear marketing edge for those who produce and sell Nutrition Grown foods by branding and differentiating them from similar foods produced with other methods. Besides increased nutrient density, other attributes include improved flavor, texture and shelf life. Increased plant

health equates to less disease and insect pests, and therefore decreased need for even organically-approved pesticides, while maintaining excellent yields.

~ Increased production of Nutrition Grown produce in a fair market system--one which is not biased toward and unfairly subsidizing commodity crops.

~ Consumer education to increase awareness of food nutritional qualities, proper diet and meal preparation. Fortunately, consuming fruits and vegetables grown to provide greater nutritional density will improve dietary nutritional adequacy even if the volume of produce consumed remains constant.

To facilitate the process of changing the current paradigm of food production, initial steps include:

~ Establishing non-profit research and demonstration farms as venues for refining techniques, scientific documentation of benefits, and showcasing nutrient-enhancing food production methods to the world.

~ Food producer education to, first of all, get the needed nutrients into the crops using environmentally-friendly methods and then to maintain high nutrient levels in the foods until they reach their consumers.

~ Establishment of a large Nutrition Grown Alliance, which includes an online listing of venues for purchasing Nutrition Grown foods.

~ Increasing the number of “for profit” production farms which focus on nutrient density through producer education and support.

~ Establishing a certification program for Nutrition Grown foods. Certification of Nutrition Grown foods will allow consumers to purchase with confidence.

~ Establishing health resorts, retreats and clinics which serve these superior quality foods and document health benefits.

~ Creating an array of value-added Nutrition Grown food products for variety and longer-term shelf stability.

~ Educating consumers about Nutrition Grown foods through a marketing campaign to drive demand and, hence, supply.

Farmers and gardeners growing Nutrition Grown foods are providing a beautiful service to humanity by supplying the very best quality foods which help people live happier, healthier, more productive lives—please support them and consider becoming one yourself!

Happy Farmers

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~ My many mentors through the years, both living and deceased. I stand on the shoulders of giants, and hope to “do you proud”.

~ The farmers and gardeners who are conscientiously producing Nutrition Grown food for the good of humanity.

Artwork: Janet Davis www.JanetDavis.com

APPENDIX

How to take Soil Samples for Nutrient Analyses

Soil analyses may be ordered online at www.BeyondOrganicConsulting.com .

Assess your Property: Before ordering soil nutrient analyses, you will need to assess your property to determine the number of soil analyses you will need. Taking representative soil samples is critical to obtaining accurate, helpful soil analyses. Sample each soil type area separately. It is often necessary to take 4 to 6 different soil samples, even from a residential property, because of the differences in soil types, soil treatments, previous crops, etc. in the various areas. Farms may need many more.

Soils at different elevations on the property are nearly always different in composition. Often soil has been moved—either graded for leveling, which exposes subsoil, or brought in from an outside source, i.e. potting soil. Soil areas have often been fertilized or amended differently, had animal pens on them, etc. These areas must be tested separately, as they will vary greatly in composition. You may need to make a map of your sampled areas with names and/or numbers for each.

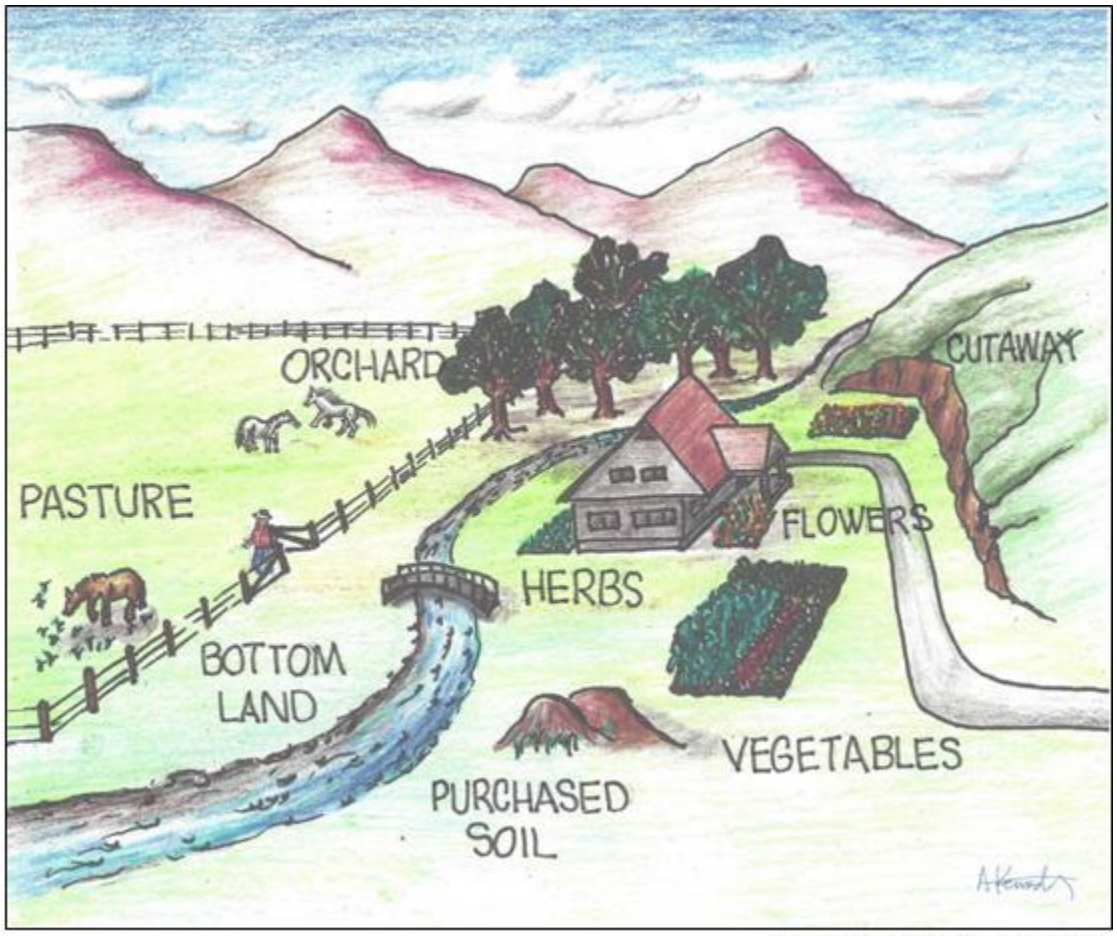

Illustration: A. Frederick Kennedy

Collecting Soil: Once you have determined how many soil analyses you need to have done, the next step is to collect soil samples. When collecting soil samples, use non-rusty, clean tools and equipment, preferably made from stainless steel or plastic. Avoid touching the sample soil cores with your bare hands. Using gloves is a good idea.

Ready with clean equipment and gloves

You will need to sample to a depth of six inches (15 cm). For each soil type area, take multiple soil cores around the area. A soil core is a "plug" of soil of even width, typically about one inch (2.5 cm) wide, from the surface to six inches (15 cm) deep. The volume of approximately 2 cups (500 mL) of soil should be sufficient. Mix these together in a bucket to make a composite sample. You will need to send the volume of <u>two</u> 8 oz. (250 mL) cups of soil per analysis (a total of 16 oz., also known as a pint, or 500 mL).

Soil sampling can be accomplished using different methods:

<u>Soil Sampling Method #1</u>: Probably the most efficient way is to use a soil probe or soil auger designed for this purpose. This should be made from stainless steel so you will not contaminate the sample with rust (iron). Some people use a piece of stainless steel pipe, driving it into the ground with a hammer. Mark your instrument at six inches (15 cm), so you know how deep to send it into the soil.

Clear the surface of the spot you wish to sample of all organic matter, i.e. grass, weeds, leaves, etc. Push and twist the probe/auger as necessary to get it 6 inches into the ground. If the soil is hard, try getting the core soil sample out of the ground an inch or two at a time until you've penetrated the entire 6 inches.

Clear the organic matter
off of the soil surface

Push the stainless steel soil probe 6" down into the ground.

It may help to wet the soil, especially if you can water the area the day before attempting to take samples. If the soil in the probing holes is very dry and/or sandy so that it falls out of the probe before getting it into your mixing bucket, just add a little water to the hole. If the soil sticks in the probe, use a non-rusty screw driver or similar tool to help push it out.

Using a screwdriver to push soil out of soil probe

With very hard soils, try using a drill with a long drill bit to loosen the compacted soil core. If the soil is extremely rocky, use a pick to loosen the soil and do your best to get representative “cores”.

Battery-powered drill with long, wide-tip drill bit for difficult soils

A hand-pick can be helpful
with rocky soils

Soil Sampling Method #2: Use a non-rusty shovel. Dig a hole, then take a one–inch slice of soil from the side of the hole to a depth of 6 inches from the surface. Using a knife, cut away the soil near the sides of the shovel, leaving a one-inch wide strip down the middle. Place this in your bucket and repeat the process in several different spots until you have at least two cups of soil.

Get a one-inch slice of soil from the side of a hole

Cut away the edges leaving a 1” wide, 6” long strip down the middle.

Put the resulting strip of soil into your collection bucket

Collect several cores,
then mix thoroughly

Use a measuring cup to get 16 oz. by volume (500 mL)

Once you've gotten the volume of at least two "8-ounce" cups (500 mL) of soil into your bucket, mix the soil and remove obvious rocks and organic matter, such as roots or grass. Pour or scoop into a plastic bag. Repeat the process for each of your soil type areas. Be sure to label each sample so they do not get mixed up. If the sample(s) is extremely wet, allow it to air dry in a place where it will not become contaminated.

Pour into labeled plastic bag without touching the soil with your hands.

Packing the Soil for Shipment: Place the soil sample in a leak-proof zip-lock plastic baggie, tape it closed, and label the baggie well with a permanent marker. Each sample should be labeled with Dr. Jana Bogs, as your consultant, your name, address, phone number, and an identifiable name and/or Sample ID number.

Examples:

Dr. Jana Bogs, Consultant
Your Name
Your Address
Your Phone Number
Vegetable Garden 01

Dr. Jana Bogs, Consultant
Your Name
Your Address
Your Phone Number
Fruit Orchard 02

Make a map of your property with Sample ID names and numbers as your key, so when you get your report back you will know which report goes with each area. Multiple plots on large properties are often tracked by GPS (global positioning system) coordinates.

When you order your soil analysis online at www.BeyondOrganicConsulting.com, you will be sent a soil sample worksheet from Dr. Bogs by email. The worksheet comes with instructions on how to fill it out. It's very easy to do. All you should need to put on the worksheet is your name, contact info, number of samples submitted and the Sample IDs. Include this worksheet in the shipping box with your samples that you are sending to the lab.

Place the bagged samples into a plastic, leak-proof container(s), such as a disposable food container(s) or large plastic jar(s), and tape it shut. Then pack the container(s) in a sturdy box, not a mailing envelope. The flat-rate boxes work well. The boxes themselves are free. You'll usually see them displayed in the post office reception area, or you may need to ask the clerk. Add packing paper or packing "peanuts" as necessary to keep the contents from shifting in the box. Write your return address and the laboratory's address on the box (it's on the worksheet). Put the worksheet on top of the packing materials, then close and tape the box well.

If you are sending soil from Hawaii, Alaska, or otherwise outside of the 48 contiguous states of the USA, you will need to put a USDA soil permit label on the front of the box. This tells the post office that the soil is going to an approved facility where it will be handled safely. A copy the label below will come on your worksheet instructions; cut it out, and tape it securely on the front of the box to the left of the laboratory address.

USDA soil shipping label used when shipping from Hawaii, Alaska or otherwise outside of the 48 contiguous states of the USA

Now the box should be ready to send to the laboratory. The laboratory will send the raw numbers to Dr. Bogs, who will interpret them and send you the completed analysis, interpretation and recommendations.

Disclaimer: Any recommendations provided by Beyond Organic Consulting, Inc./Dr. Jana Bogs are advice only, as no control can be exercised over storage, handling, mixing application or use, or weather, plant or soil conditions before, during or after application (all of which may affect the performance of the program). No responsibility for, or liability for any failure in performance, losses, damages, or injuries (consequential or otherwise), arising from such storage, mixing, application, or use will be accepted under any circumstances whatsoever. The buyer assumes all responsibility for the use of any of our products.

How to take Soil Samples for Microbial Analyses

You can use similar tools and methods as described above in how to sample for soil nutrient analyses, but you only need to sample to a depth of 3 inches (7.5 cm). Most of the same guidelines apply. Be sure to remove organic material from the soil surface before taking samples. Because you need only 3-inch deep cores, you can use an apple corer, if that is easier for you. These corers can be found in kitchen supply sections of department stores.

Apple Corer

If sampling under plants, take core samples half-way between the stem/trunk and the drip line.

(Green) apple corer in soil

Take enough samples to make up a volume of one 8 oz. cup (250 mL) of soil. Be careful to not expose the samples to extreme temperatures.

Microbial analyses can also be performed on compost and compost tea. For compost, take several small samples throughout your compost pile and combine into a composite sample. If all of your piles are uniform, you will need to send only one composite sample. If your piles are different, they will need to be sampled and tested individually as results can vary widely.

You can order these analyses on the website: www.BeyondOrganicConsulting.com . The microbiological analyses are performed at a different lab than the soil nutrient analyses. You will receive a different worksheet for these. The bagging, labeling, and boxing instructions are similar. Be sure to include the special USDA shipping label (on the worksheet) if sending from outside the contiguous United States of America. Ship the package in such a way that the samples reach the laboratory within a few days. If you are in an extremely hot area or a very long way from the lab, you will want to pack it with “reusable cold packs” to keep it reasonably cool.

Tips for Applying Amendments

1. It is best to gather all needed materials before starting the amending process. **Do not substitute** different forms of amendments for the ones specified. The recommendations are very precise, and substitutions will not result in the same outcome.

Put the amendments on as directed. Putting on only some items, instead of all of the recommended items may result in worse imbalances than if you had done nothing. It is better to amend a small section of land completely, according to the full program, than to amend a larger area incompletely. That being said, start your weekly ground spraying as soon as possible. The ground spray can be applied to bare soil or mowed ground cover. It won't work well sprayed on to mulch. (The ground spray is listed at the bottom of your soil analysis report.)

2. For safety and comfort when handling amendments and fertilizers, I suggest wearing an air-filtering mask over your nose and mouth, and gloves.

Amendments, fertilizers, etc. come in different physical forms. Some are prilled in little balls, some are fine powders, some are granular. Some are best applied mixed with water. Also, certain elements bind with other elements. That being stated, it is appropriate to mix some items together for ease of spreading. Only mix items of like physical form for consistency of spreading. Break up any lumps before mixing, especially those in the trace elements. For ease in mixing small amounts of items, use a bucket with a tight-fitting lid. Load it no more than half full, secure the lid well, and then roll and flip it end-over-end for several minutes to mix the contents well. Sit it upright and wait a few minutes before opening it to allow the dust to settle inside.

There are various types of spreaders, such as spinner spreaders or drop spreaders (preferred), which can help make the process of applying the dry amendments easier and more consistent. Spreaders should have adjustments for fine and coarse materials. With any spreader, it is important to check the application rate to be certain that you are applying the appropriate amounts of amendments consistently over the entire plot. One way to do this is to weigh the full spreader, then run the spreader over a measured area, and reweigh the spreader to determine how much has been applied over that area. Adjust from there.

For very small areas, amendments may be "hand applied". Just be sure that you have correctly determined the square footage and have calculated and weighed out the exact amounts to be applied. With any application, err on the side of caution by applying less instead of more. One can go back and add more, but it is difficult to remove excesses.

3. Microbes are extremely important for making nutrients available to the plants. Microbial inoculants are typically best applied by mixing with <u>non-chlorinated</u> water and applying with a low pressure sprayer, or a watering can for small areas. If all you have to use is chlorinated water, allow it to sit uncovered for a

minimum of 24 hours to allow the chlorine to dissipate before using it. Be careful to make sure that any item to be sprayed will dissolve completely so as not to clog your sprayer. If there is any doubt, use a paint strainer. This is a fine mesh bag available at hardware stores.

Applying 250 lbs of humates (with a combination of large and fine particles) per acre (6 lbs per 1000 sq ft) is helpful to give the microbes a good start. This is especially important if the soil has a low CEC (cation exchange capacity) and/or low organic matter. These would be tilled in four to five inches deep if possible (not around trees where the roots would be damaged). If humates are not available, biochar may serve as a reasonable substitute.

Alternatively, or in addition to using humates or biochar, a mixed cover crop such as oats, Sunn Hemp, and/or legumes, such as peas or peanuts, could be grown to a height of six to eight inches, sprayed with microbes, and then tilled under. If a cover crop is used, allow the plot to sit unplanted after tilling for three weeks before planting your garden. In the case of established trees, just mow the cover crop and use it as mulch.

For areas to be tilled--

Tilling has been getting a bad reputation lately, but sometimes it is beneficial, especially when starting a new plot. Getting the needed minerals tilled into the soil can improve its structure, and feed the microbes and the plants.

If you are applying a ground spray, you can start with that. You can do it weekly before and/or after amending. However, it won't work well after you put the mulch on.

Putting on all of the needed amendments in one day is fine if you are tilling them into the soil. Phosphorus, ideally mixed with composted manure or other compost, should go at least six inches deep (up to 18" deep when planting trees). Add all the other needed items, except major calcium products, by mixing them thoroughly with good quality, fine compost (the resulting mix should be at least 50% compost), then spread evenly and till in 6 inches. Finally, the calcium goes on and till lightly (no more than six inches deep). If it's too much trouble to apply the minerals mixed with compost, just put them on straight and till them in.

Now that you are finished with the mineral amendments, spray or sprinkle on the microbial inoculant mixed with <u>non-chlorinated</u> water. You can mix in a little liquid seaweed and/or fish emulsion (microbes love these). Next, put ¼ inch to 1 inch of high quality compost on the surface, and rake it in lightly. If it is a new garden or has a low percentage of organic matter, you will need the higher amount. A well-established garden should need only ¼ inch of good compost with a carbon to nitrogen ratio (C:N) of 12:1, certainly no greater than 15:1.

Once you finish the ground spraying, cover the soil with some type of woody mulch or weed barrier cloth which allows water to penetrate easily with woody mulch over it. You may add up to four inches of mulch which will help smother weeds and maintain soil moisture. Shredded/chipped tree limbs with leaves or old hay/straw work well. Straight wood chips or bark chips are not preferred due

to the high C:N ratio. If you put on the mulch before planting, just pull sections back when planting and then carefully push it back up to the plants as they grow.

If you have put on a lot of minerals, such as the first time you amend a new plot, you need to wait for the soil to assimilate and integrate the minerals. Wait at least a week before transplanting seedlings. Wait three weeks to plant seeds. In the meantime, keep the soil damp by watering with non-chlorinated water (there are hose filters available on the Internet) to keep the microbes healthy, actively working and reproducing.

For areas which are NOT tilled (established vegetation)--

With trees or established perennials, it is good to fertilize from near the trunk to at least three feet beyond the drip line to encourage roots to grow out farther. This practice is also good for boosting the nutrition in your ground cover which can be mowed and used as mulch for the trees. Several small holes, six to eighteen inches deep, may be made with a soil probe, pipe or large drill near the drip line for placing some amendments, especially phosphorus, down into the root zone. This will encourage the roots to grow deeply, making for a healthier tree. Core aeration with machinery which removes many small cores of soil ½" to ¾" wide up to a depth of three inches can be useful for allowing air and nutrients to get deeper into the soil. Be careful to not damage large roots by keeping the aerator at the drip line and beyond.

For best results with surface applications <u>where tilling is not possible or not desired</u>, follow these tips:

- First, spray on the "ground spray" mixture, if one was recommended. (It will be listed near the bottom of your soil report.)
- Next put on phosphate mixed with the humates/biochar (if shown on your report). Phosphates work best if mixed with manure compost before applying. (It is ideal to add phosphate to the compost pile as the compost is being made.) Rock phosphates (i.e. CalPhos) work best if placed deeply into the soil, if possible, by drilling holes as described above. Alternatively, you may use a rake to carefully incorporate the amendments into the surface. Water in well with non-chlorinated water, if possible (hose filters are available on the Internet).
- Put on iron at least one good rain or spray irrigation before calcium. Iron sulfate in the heptahydrate form is the type recommended. This is white to yellow, or possibly blue, in color. Do not use the brown or black type. Don't get the iron on the leaves of actively growing plants. It will turn them black. Add in all the other amendments at this time except calcium. Mix the trace elements, especially boron and copper, with compost before putting on. Work all into the soil, if possible, though a good watering in will help get the nutrients down into the soil to the root area.
- Then the calcium (mixed with compost) goes on. This can go on top, or lightly rake it in. It will move down into the soil when watered.

In established orchards, if you can, add up to one inch of extra soil over the amended area. Put on at least ¼" of good compost. Apply the microbes to the compost using non-chlorinated water. Keep the microbes working by supplying

them with sufficient water (keep damp, not wet). Finally, cover with some type of mulch which allows water to penetrate easily. You may add up to four inches of mulch which will smother weeds and maintain soil moisture. Shredded/chipped tree limbs with leaves or straw work well. Lawn clippings or bark chips are not preferred. Be sure to not allow the mulch to touch the tree trunks, as this may lead to fungal disease and pest problems.

4. Foliar sprays can also be helpful to add trace elements (while in the process of fully balancing the soil) and other natural plant boosters. For example, copper and sulfur foliar sprays can be helpful to decrease some diseases such as powdery mildew. Various liquid foliar sprays are available for purchase which are made from natural items such as fish, seaweed and beneficial bacteria. Just follow the manufacturer's suggested application guidelines. I can help you with leaf tissue analyses to determine the best foliar sprays (which will be customized) for your plants.

5. Heirloom seeds tend to be the best choice for maximizing nutrient density. Most seeds on the market have been bred for characteristics other than food nutrient density. Look for non-hybrid, open-pollinated seeds. Generally speaking, darker colored foods have higher levels of antioxidants. Try to grow a variety of food plants to supply yourself with the full spectrum of nutrients and healthful phytochemicals.

6. Mark your calendar with what you've put on and mark the dates ahead when you need to apply more amendments and retest. Retesting the soil is good to do every six months for best results. Most soils cannot be completely corrected with one round of amendments. Usually, they have to be "fed" limited amounts of nutrients over time so the microbial life is not overwhelmed. Expect your production to improve over time as the soil becomes better balanced. Even after fully balancing the soil there will be some losses of nutrients from the soil due to leaching and removal of crops, so periodic retesting is a very good idea.

Take pictures and mark them with the crop and date, so you can track your progress and show off to your friends! ;-) Happy Growing!

Artwork: Janet Davis www.JanetDavis.com