Growing Your Own Nutrient-Dense Vegetables

15th Annual International Conference of the Weston A. Price Foundation®

Calvin F. Bey, Ph.D. Fayetteville, Arkansas
CFBey1936@cox.net * www.harmonygardens.blogspot.com **

Summary

Nutrient-dense produce is generally not available in grocery stores and markets. Why? Conventional agriculture farmers generally use practices that promote the use of chemical fertilizers, pesticides, and genetically modified seeds and they are mainly concerned about yields, not high nutrition.

Fortunately, information on how to grow nutrient-dense produce is available. The core practices for growing nutrient-dense produce revolve around understanding and following the laws of Nature, and using gardening techniques that go beyond growing organic produce.

Learning the gardening techniques and why they work requires considerable effort for new gardeners. Reaching the nutrient-dense goal is most often a long-term process, often done in small increments. The practices are not super complicated and nutrient-dense production can be achieved by most devoted gardeners.

Other gardeners and professionals are available to offer advice. We have the energy needed to make the switch to growing nutrient-dense produce and change the world. Leaders are needed at every level to help others accept the new human vocation -- to heal the earth, and the people.

None of us can outsource our responsibility to take care of the earth and ourselves. As we work to breath life back into the soil, we take one big step to improving our health, and that of others. Our mind-set should be to consider the whole world as a garden, and taking care of it as our stewardship goal. We each have a limited opportunity -- one chance, one lifetime to do it right.

*** Calvin Bey is available for courses, teaching others about growing Nutrient-Dense produce. He will design and teach courses for specific geographic areas. Full-day courses are available.**

**** See the web site for more detailed information on this subject.**

Introduction

The Issue. We all want assurance that there are high levels of nutrients in the fruits and vegetables that we eat, and that the produce we eat will make us healthy. Unfortunately, there are some serious problems in this area. Over many decades, much of the farmland in the US and the world has become depleted of top soil, organic matter, and minerals. As a rule, this means the fruits and vegetables in our markets are not nutrient-dense. It is important that we look at this issue. Nutrient-dense food is an important energy package that can push us toward improved health. The higher the nutrient density, the higher will be the energy available in our bodies.

Hippocrates, in 400 BC, said it best, **"Let Food Be Your Medicine."** The issue of health starts with the production of a healthy soil. Soil problems are not new. In the United States, already in the early 1930s, scientists were seriously addressing the soil mineral deficiency problems in the US. If you want details of the seriousness of the human health and soil problems in 1936, see what was written into 74th Congressional Record, Document No. 264. It's an article written by Rex Beach, on the work of Dr. Charles Northern (M.D.), who had expertise in biochemistry, nutrition, and soils. He shows how soils deficient in minerals are the cause of human diseases.

In 1941, the government recognized the need for better food, and passed the Public Health Law, which permitted food enrichment. By 1946, we had the National School Lunch Program, derived in part from observations of physical and mental deficiencies in WWII recruits.

Unfortunately, our agriculture industry did not rise to the occasion to solve the soil problems. Instead they put increased emphasis on synthetic fertilizers, chemical pesticides, and Genetically Modified Organisms (GMOs) which only exacerbated the problems. In conventional agriculture, there has been very little emphasis on nutrient-dense production. This has contributed to the relatively poor human health condition we have in the US today.

The Definition. Nutrient-dense produce has high levels of minerals, and the appropriate nutrient balance. Although you won't find this information on the labels of the produce in the local grocery store, the mineral content can be measured. Produce that is grown in toxin-free soils, with ideal mineral, organic matter, and biological diversity conditions will generally be nutrient-dense. In addition to the higher mineral content, the produce will have higher sugar content, higher protein content, and a greater specific gravity. These factors will contribute to longer produce shelf life, and increased resistance of the plants to insects and disease. The higher sugar content will also impart increased frost resistance. The plants will have stronger stems (more solid), with less lodging, and have improved flavor.

How Do We Measure Nutrient Density? The refractometer is the instrument used to measure the nutrient-density level. It measures the solids, i.e. the density of the minerals in the plant juice. Specifically, it's the amount of sucrose, fructose, vitamins, minerals, amino acids, proteins, and other solids that are found in the juice of the produce.

As a rule, you measure the part of the plant that you eat (if it is ripe), or the most recent mature leaves that have been in full sunlight for at least two hours. Measuring the nutrients contained in produce is not something new. The use of the refractometer is similar to using a hydrometer, which has been used in looking at the sugar content of grape juice for wine making for centuries.

We call the readings the Brix levels, named after a German chemist, who developed it, working on grape juices in the mid 1800's. In the early-mid 1900's, Charles Northern, MD and Dr. Carey Reams saw the need for improving the quality of food, and they worked out the Brix levels for most food crops. Most importantly, they both worked a life-time to help define the agriculture practices needed to get high Brix readings for many crops.

What Is Associated With A High-Brix Reading?

- Greater carbohydrates for better metabolic function.
- Greater mineral density, e.g. increased calcium and more trace minerals such as copper, iron and manganese. Trace minerals function as the co-enzymes in the digestive process.
- Better taste. Taste is built on the carbohydrate and mineral levels in the produce.
- Increased shelf life. Dr. Reams took the same watermelon to the State Fair, three years in a row.
- Increased insect and disease resistance. Plants in poor health emit an electro-magnetic frequency that draws in insects. This is not true of healthy plants. Nature designed insects to get rid of poor quality plants that are susceptible to disease. Professor of Agronomy, an eminent soil scientist, William Albrecht put it this way, "Insects and disease are the symptoms of a failing crop, not the cause of it. It's not the over-powering invader we must fear but the weakened condition of the victim."

Testing for Nutrient Density.

Testing the produce for nutrient density is relatively simple. Getting the organic matter, microbial populations and all the minerals in the proper amounts and ratios is far more challenging. You will need a refractometer and will need to do many tests to get a good estimate of the nutrition of your produce. Unless you do a Brix test (or other expensive type of nutrient analysis) you will not know the nutrient density value for your produce. Note in the examples below the big differences in nutrient content between the entries and the USDA Composite Standard.

Butternut Squash	**Bey Entry**	**Nutrient Dense Standard**	**USDA Composite Standard**
Brix Level	**12.9**	12.5	8.4
Dry Matter %	**25.6**	20.0	13.6
Protein, grams	**4.4**	2.5	1.0
Free Nitrates	360	**150**	210

Ca, mg	53	**55**	48
P	**166**	75	33
K	**1025**	685	352
Mg	**51**	40	34
Cu	**.50**	.20	.07
Fe	.80	**.85**	.70
Zn	.48	**.50**	.15
Mn	.10	**.15**	.20
Final Score, Weighted by Minimum Daily Requirements:			
	132.8	96.6	61.7

A Green Bean Example: Brix readings will vary with the specific fruit or vegetable, but are often in the 4 to 12 range. The following example with green beans shows why the nutrient density issue is so critical. It was reported in June, 2007 Acres U.S.A. magazine by Jon Frank.

Rating or Content	Sample #1	Sample #2
Brix Level	4.2	6.1
Dry Matter	8.1%	16.6%
Protein	1.75 g	3.34 g
Calcium	70 mg	130 mg
Magnesium	30 mg	50 mg
Phosphorus	40 mg	80 mg
Potassium	190 mg	580 mg
Copper	0.1 mg	0.4 mg
Iron	1.3 mg	2.1 mg
Zinc	0.7 mg	2.3 mg
Manganese	0.29 mg	0.35 mg

Tests were conducted by International Ag Labs, PO Box 788, Fairmont, MN 56031
Note that **going from Brix readings of 4.2 to 6.1 made a big difference in nutrition.** For green beans, Brix ratings of 4 and 6 would be considered poor and average. Moving up to 8 or 12 would certainly make some additional gains in nutrition. Much of the commercial, store-bought produce that I have tested is in the poor range. Although the ultimate key value is certainly improved nutrition for better health, there are many associated values that come with growing nutrient dense produce.

Choosing the Fruits and Vegetables that You Will Grow

We know that there are differences in nutritional value among the many fruit and vegetable choices that we have available. Beans, corn, melons, and broccoli are not alike in nutritional value. It's important that we eat a variety of foods to get a full complement of minerals.

Before you begin learning and using techniques for growing nutrient-dense produce, recognize that your selection of what you can grow is dependent on your geographic location. Summer and winter temperatures, length of growing season, winter chilling requirements, basic soil types, and other factors, all influence what you can grow. Especially if you are new at gardening, it is wise to see what is available at local Farmer's Markets and visit with long-time local gardeners and farmers before deciding what to grow and when to plant.

Your aim should be to start or continue on the path to get the most minerals/nutrients possible into whatever crops you are growing. The more nutrients you get in all your produce, the more efficient is your gardening effort. Besides the efficiency issue, we need to understand that the more nutrition we have in our produce, the healthier will be all the consumers. This concept applies to your livestock and pets, as well as to people.

Basic Gardening Considerations

First, plan and grow mainly the amount of produce that you will eat fresh and store. The exception to this is growing crops that you are using for sale, sharing, and/or for bartering. Many people have limited gardening space, so plan, plan, plan. Although garlic is a wonderful, easy-to-grow crop in many ways, it's not likely you will eat several pounds of garlic each day. On the other hand, Irish potatoes, sweet potatoes, and butternut squash might very well be a mainstay item that is eaten several times a week. They are relatively easy to grow and can be stored for many months. Deciding how much of each to grow will become easier, as you get gardening experience.

For health reasons you will want to eat a variety of fruits and vegetables, but be a bit cautious of trying to grow too many things. Each crop has unique germination, transplanting, watering, and other maintenance requirements, and until you are experienced, management of a garden with 30 to 40 varieties can seem overwhelming. Start small and grow into the more complex garden.

Everyone will not have a site for growing a garden. If you have a big area that requires more work than you can do by yourself, consider asking others to join you in the endeavor. Choose only those who are willing to do hard physical work under all kinds of conditions and throughout the year. Everyone involved needs to feel "full ownership" in the project. Work together from the beginning in planning, and in defining individual work and financial responsibilities.

Second, grow crops that store well. Some fruits and vegetables will store fresh under the correct conditions. Many crops can be canned, frozen, dried, or fermented and will safely last at least a year. In areas where you can grow a spring, summer, and fall garden, it is not difficult to have a supply of produce that will last for a year or more. Weather disasters may severely limit what you can produce in any single year. Put considerable emphasis on drying your fruits and vegetables. When done properly, most dried produce will last for several years. Excellent home-size, fruit and vegetable driers are available. Under certain climatic conditions, sun drying can be used and is advised.

If you don't know the nutritional value of the different fruits and vegetables, your best choice is to grow and eat a big variety. Think of growing and eating leafy greens (like kale, spinach, and lettuce); common vegetables (like peas, beans, tomatoes, and okra); root crops (like potatoes, beets, carrots, garlic, and turnips); and dried seeds (like the beans and grains) -- perhaps some of each every day. A wide variety of crops will help you in getting a broader array of minerals/nutrients. Of course fresh produce is best, but it may not always be available.

Third, plan for year-around gardening. Year-around gardening is relatively simple in the south. However, as you move north it requires different season-extension techniques. These techniques are available, and it is wise to become familiar with them, and be prepared to implement them when needed. Under some conditions, growing your own vegetables may be a necessity. Eliot Coleman's book, *Four-Season Harvest: Organic Vegetables from Your Garden All Year Long,* offers excellent advise on this topic for backyard gardeners.

Techniques for Growing Nutrient-Dense Produce

It is the soil that primarily determines the nutrient density of fruits and vegetables. Weather, including rainfall, is important, but the soil must be healthy if it is to perform its primary functions. A healthy soil functions effectively in water infiltration and storage, digestion of organic matter, recycling of nutrients, and feeding the plants the needed water and nutrients. Healthy soils must also contain major and trace minerals at the proper levels. The techniques that help the soil fulfill these functions are explained in the 7 steps listed below. John Jeavon's book, *How To Grow More Vegetables*, is an excellent source for details on gardening (growing soil) in a sustainable manner.

If you follow the 7 steps that follow, you will be on your way to more successful gardening. You will be able to measure your success by growing produce with improved, intense flavors. If you grow nutrient-dense produce, you will taste the difference. Some folks say, "It's like I remember vegetables tasting from my grandmother's garden." Use a refractometer to get an index of sugar/mineral content of fruits and vegetables, so you can monitor progress, and adjust fertilization of the garden accordingly. The refractometer reading is called the Brix value. Ideal Brix values vary with the individual fruit or vegetable. See www.highbrixgardens.com for information on helping to improve your health by growing high quality produce.

1. Select the Best Garden Site Possible. Most people won't have a lot of options on this, but as a rule, go with the area with the most sun. Stay back away from the drip line of trees and find the area with the deepest top soil and fewest stones. If the site is entirely shaded, you might have to sacrifice some trees for the sake of food production. Ideally, you also want an area that has not had pesticides and chemical fertilizers applied in the past.

Use non-contiguous areas. The garden can be a single plot or many small plots. Produce can be grown right up next to buildings. Consider replacing shrubbery with annuals and/or perennials that provide a source of food. Some berries and vegetables, figs, and many herbs will do just fine around the periphery of buildings.

2. Use a No-Till or Minimum-Till Approach to Produce a Living Soil. No-till makes sense from the viewpoint of reducing energy costs, but even more importantly, no-till is best for improving the soil and increasing productivity. All gardening activities should result in protecting and improving the soil. Soil quality determines the productivity and nutritional quality of your produce.

Soil quality depends on many factors, but on the top of the list is the soil biological activity. Tilling can reduce the biological activity in the soil. Beneficial bacteria, fungi, earthworms, etc. are the organisms that are continuously digesting and relocating organic matter. Without this workforce of micro-organisms, the soil becomes dead. Dead soils are the result of applying toxins (chemical fertilizers and pesticides), but can be converted to healthy soils over time. The chemical approach should be avoided at all cost. Stay primarily with the organic approach for the sake of the soil and your health.

Tilling can negatively impact the physical properties of the soil by destroying the soil structure. Good soil structure implies individual soil components of sand, silt and clay are held together with the natural glues secreted by soil microbes. These soils are not subject to erosion and they have good tilth, meaning they are easily worked, and have the capacity to hold water.

3. Grow Diverse Crops. Growing many different species of plants, over time and space, increases the number and varieties of soil microbial populations and is an insurance program against disease and pest problems. Sugars, made from the diversity of plants, are released from plant roots into the soil. In the soil, the sugars serve as food for soil microbes, which in turn decompose organic matter into nutrients that support plant growth. It is the way the natural soil development process works.

Use crop rotation, i.e., avoid growing the same vegetables in the same place year after year. Depending on your geographic location, you may have 2 to 4 different crops on the same bed within a year. That may include a cover crop (generally a non-vegetable) designed only for improving the soil. Cover crops (e.g. oats, Austrian winter peas, buckwheat, clover, and rye) should be an essential part of the rotation system. The cover crops that are classified as legumes have the ability to "fix" nitrogen on the plant roots in the soil. This can be sufficient nitrogen for the year. Always keep a cover crop on the garden over the winter.

4. Grow Crops Throughout the Year. For a healthy soil you need to be continuously feeding the soil microbes, primarily by growing plants that are providing live roots that freely exude sugars. Providing plenty of sugars means easily accessible food for soil microbes and a plethora of benefits for plant growth. Maintaining a suitable habitat for the myriad of soil food web creatures (the microbes) is the key in suitable soil development. One teaspoon of healthy soil can easily contain more individual microbes than there are people on earth. It is so clear: we need to be gentle and kind to the soil, and the soil will be good to us.

5. **Keep the Soil Covered.** I tell visitors to my garden that what they can **not** see, is the most important aspect of my garden. It's my precious soil. A garden where the soil is covered by growing plants and/or their residues is likely a garden as nature intended. Soil covers protect the soil aggregates from beatings by the rain, suppress weeds, keep the soil cool and moist in warm summers, and promote soil microbial activity.

The five practices listed above are aimed at maximizing the physical and biological activity in the soil. In essence, they are speeding up the natural soil development processes and will lead to healthy soils, healthy plants, healthy produce and healthy consumers. These are steps that take little or no input from outside the garden area. While not entirely free, they are low-cost gardening techniques, that move us in the direction of being sustainable gardeners.

6. Mineral and Nutrient management. Beyond the five steps described above, one major topic in gardening remains. It's that of adding supplements to the garden. The kind and amount of supplements to add will depend primarily on the original rock material (e.g. sandstone, limestone, etc) and past uses.

The degree to which you address this topic will depend on resources available. Here are a list of things to do, all which will likely lead to improved nutrient density in your produce.

** **Grow high carbon plants, make and use compost.** If you have to, grow grains and other plants strictly for the carbon for making compost. You will not get sufficient compost from wastes and table scraps for a garden the size that supplies most of your family's food needs. Yes, collect organic matter from the kitchen vegetable refuse, garden area, and other sites and make compost for use on the garden, but plan to grow some plants for making compost. Plan for 50% of your garden in carbon crops for making compost.

Use the compost sparingly and wisely. Don't use excessive amounts of compost. Too much compost can lead to higher than necessary nitrogen levels in the soil, excess nitrates in the produce, and encouragement of insects. When compost is used wisely, it will not increase minerals to the point of being in excess. Four to five percent organic matter in the soil is sufficient. Once at that level, and assuming you are following the five steps above, 20 to 40 gallons of compost per hundred square feet per year may be sufficient to maintain the desired nutrient level. Bear in mind that compost derived from garden plants will be similar in nutrients to what is in the soil.

** **Increase the diversity of bacteria and fungi** in your garden. If you have some adjacent prairie and/or woodlands, collect some soil/humus from it and add it to your compost pile and/or sprinkle it directly on your garden. This is simply an insurance program to add microbial diversity to your garden. Natural environments will likely have new, desirable microbial species that will be helpful in the garden. You can also find bacterial and fungal inoculants available for sale from many sources.

** **Add mined and minimally processed rock and organic minerals.** Determining what to add, and how much, goes beyond what we can specify here. In short, this is the place for contacting a laboratory that specializes in making recommendations for organic gardeners. There is some room for your own garden diagnostics, but only if you know the plant symptoms for deficiencies for the various nutrients. Materials like alfalfa meal, soft rock phosphate, lime, kelp, wood ashes, epsom salts (for Magnesium), borax, and many others may help to correct mineral shortages, but do not add them until you have some indication they are needed. It is possible to have excess minerals in the soil system.

7. Other Practices can also be Helpful.

** **Raised beds** are an optional, but very useful technique. In essence, it means developing beds that are 8 to 12 inches higher than the adjacent walkway. I use four-foot beds and two-foot walkways. I recommend that you do not use any sideboards. Unless you use treated material or expensive redwood, wood sideboards will rot or succumb to termites in a few years. One exception -- if you have a garden plot on a steep slope, sideboards on the downhill side might be needed to prevent erosion.

Raised beds have several advantages. They drain more quickly after heavy rains and they warm up faster in the spring. Early and more timely plantings are critical to maximizing production and nutritional quality. As a rule, raised beds have better aeration, which promotes better microbial activity and increased growth. Follow the John Jeavon's book, *How to Grow More Vegetables* for recommendations on starting seeds, transplanting, and close plant spacing for maximum yields.

** **Double-digging** is the process of loosening the soil to a depth of 16 to 24 inches, depending on specific soil conditions. In short, the top layer of soil is removed, a little compost is added, the lower layer is then loosened, and finally the top layer is replaced. The top layer of the pathway is then added to the bed. This process creates raised beds.

Double-dug beds are better aerated, more biologically active, and promote deeper plant root penetration. All this translates into increased production and better nutritional quality.

** **Energy enhancement.** Plants require energy to grow. Obviously, the sun is a major energy source, but don't ignore energy enhancements that come from planting by the signs of the moon. Likewise, take advantage of enhancing magnetic energy (required for all living things to grow), through the use of **paramagnetic rock** (sometimes called lava sand) for increased growth rates, earlier maturity, and improved cold hardiness in all plants. Though not a common practice, my experience is that, if it is available in your area, paramagnetic rock is one of the first things I would recommend adding to your soil.

Another excellent enhancement, is to use **structured water**. Simple, but effective devices that create vortices, is all that is required for adding energy to water. These flow-forms have been used for centuries. In short, water molecules that flow through these devices becomes less clustered (thus softer), the energy of any "pollutants" is neutralized, and the energy of the good minerals in the water are enhanced. As a result, plants grow faster and remain more healthy than plants with city water, often loaded with chlorine. See harmonygardens.blogspot.com for details on experiments with these water structuring units.

** **Use heirloom seeds and save seeds.** Heirloom seeds exist for the major garden crops. Once you have them, take the extra effort to save seeds or vegetative starts for subsequent years. The fruits and vegetables from the heirlooms will generally be more nutrient dense. Do not use seed from any Genetically Modified Organisms (GMOs). There is ample evidence with studies in rats that GMOs can compromise the immune system, and they promote the development of cancer.

Work with neighbors and friends and plan for sharing seeds. Also, consider a more general cooperative garden sharing plan. Use the knowledge of all involved.

Conclusions

If you have the impression that all gardening practices and biological processes are interrelated, you have it correct. Interconnectedness is the way Mother Nature has designed the system to work. That may be disconcerting to you as you try to understand what is happening in your garden, or it may be troubling as you try to prioritize your gardening activities. Do not become overwhelmed with understanding all the interconnections. Just remember, they serve as an insurance program for how your plants grow and survive. Nature's system is designed so that life might flourish. Our job is to work in harmony with Nature, to help the world move to the goal of living sustainably and providing people with 3 healthy meals a day. With diligence and persistence, all those who share in the adventure will be blessed.