



Growing Nutrient Dense Food

*A Home Gardener's Guide to Why and
How to Grow Nutrient Dense Food*

Kay Baxter
A Koanga Institute Booklet

Growing Nutrient Dense Food

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Introduction

This journey has been a huge challenge for me. I have been a staunch part of the organic movement in NZ for 40 years. I am still committed to 'organics', however I have had, as you will see, huge lessons around the fact that being 'certified organic' does not necessarily mean 'nutrient dense'.

Bob and I were driven to follow up this whole field of the connections between our soil, our food and our health by our own health issues. The more we learned, the more it felt right, and the more I could see that this information is out there now, it is being taught all around the globe, but somehow the organic movement in NZ has not taken it up and home gardeners do not have access to it. It is being taught in ways that mean those without a science background (like me), find it extremely difficult to understand.

And so I felt that both the organic movement in NZ as a whole, and ordinary home gardeners, are totally missing out on something that has so much potential impact on our health and the health of the planet. After 5 years of persistently picking the brains of others I feel that my humble beginnings in this area may help others to see where I believe we are badly missing out or getting it wrong, and may enable you to glimpse a beginning of how and where to begin.

I understand that your 'buttons' may be pushed, as mine have most certainly been. However, I strongly believe that "if we do as we've always done, we'll get what we've always got". I can see that this is not good enough if we care about surviving as a species and about our Mother Earth... Stick with it!!!

Growing Nutrient Dense Food

My journey around 'growing nutrient dense food' began in my Kaiwaka garden. That garden held many lessons for me over the years, but this was one of the biggest. It was my special home garden of 22 years, and had always been organic - loads of compost, mulch, seaweed, dolomite lime, vermicast, the lot. I'd read all the books on organics, the garden was certified organic... and I knew somewhere inside that all was not right. I was having to work too hard to keep things growing, with constant applications of liquid comfrey, fish or manure tea etc.

If compost held the answers then there must have been something wrong with mine, and I could not find the answers, even though I was actively looking and asking.

I was also feeling that if 'organic' was the ultimate way to live to keep our own bodies strong and healthy, then both Bob and I should not have had some of the health issues in our lives that we did have. Our family had been eating basically all of our own organically grown food, for 20 years. In some ways we were really healthy, our children were the healthiest children I knew, but I could still see issues that I didn't think should have been there - if organics was 'it'.

After years of research, beginning with John Jeavons' book *How To Grow More Vegetables...*, and later with studying the work of Reams through Arden Anderson, A.F. Beddoe and others, I realized that my many compost heaps that were making beautiful looking compost, contained such low levels of biologically active carbon that I was not maintaining the carbon levels in my beds. When plants grow they use humus, so if the compost does not contain high humus levels and you are doing nothing else to maintain the humus then you will strip your soil of carbon and ruin the structure and life in the soil. I did that, in a certified organic garden.

I was making my heaps with kikuyu hay from our own farm, and loads of weeds and vege plant material that came from the garden. Not only did the kikuyu hay contain very little carbon because it is dried grass and not straw, but vegetable waste and weeds have very low amounts of carbon as well.

As well as that I now understand that I was not applying anywhere near enough calcium, and what I was putting on was not effective because it was not available calcium - it is calcium that is actually available to plant roots that we need! When you apply general garden lime, such a tiny fraction of it can be used straight away that it isn't actually considered 'available'; it takes years for all of it to become available, maybe up to 5-10 years.

There was not enough available calcium in the soil to kick start any of the major soil processes, all of which are totally dependant on having available calcium at all times, which I didn't understand at the time. And then to add insult to injury, I was doing what many organic gardening books say to do - use dolomite instead of agricultural lime. Adding dolomite meant I was also adding magnesium, so in soils where the available calcium is way too low and the calcium-magnesium ratio is way out of balance (not enough calcium), adding magnesium just makes things worse. In fact, for every kilo of extra magnesium I was adding, I was removing a kilo of nitrogen, because that is what happens. As a result I was having to work so hard to keep the nitrogen up to my plants to keep them growing.

It wasn't until an apprentice of Bob's, James Andrews, who was sponsored to do one of Arden Anderson's 3 day 'Biological Agriculture' courses, came home and said he wanted to begin his own garden rather than work in mine, and we both began testing our plants with a refractometer, that I began to get a glimpse of what the rest (or at least some more) of the problems were and began my journey of figuring out what I needed to do about it.

I listened to James and we both learned to use a refractometer (a simple hand held tool that measures the Brix levels of your plants). You just put one drop of plant sap on the refractometer, extracted usually by rubbing several leaves in the palm of your hand and then putting the crushed leaves into a strong garlic crusher to extract that drop of juice. The Brix levels represent the plant sap sugar levels, and those sugar levels basically tell us the mineral levels, or 'nutrient density' of our plants.

I now understand that when a plant has a Brix reading of less than 12, the sugars in the plant are simple sugars - in nature simple sugars are food for insects, fungi, bacteria and viruses. These simple sugars are the only sugars digestive systems of insects and most microbes can digest. When the Brix reading is over 12 we find that the sugars are complex sugars, and the proteins tend to be complete proteins, not just amino acids. It is complex sugars and proteins our cells need to be nourished. A pest problem does not mean you have a deficiency of pesticides, whether organic or not; **it means you have a deficiency of minerals in the best ratios and in the best forms.**

Essentially, if the readings are less than 12 then we have not provided the plants with the minerals they need in the right relationships to enable our plants to grow to be nourishing food for us. It is my understanding that if our soil does not contain the correct minerals in the correct relationships, then the microbial life can not flourish, and our plants will not either. The implications are also that food grown on demineralised soils, low in carbon and microbial life, can not nourish humans anywhere near fully, even if it is certified organic!

About this time I also came into contact with the Weston A. Price Foundation which provides information clearly showing that indigenous peoples eating their

traditional diets, were incredibly, almost unbelievably healthy, AND they all followed the same principles in their diets - even though they did not usually know of each other or communicate in any way, and all lived in different environments and situations. For more information see www.westonapricefoundation.org. Here I just want to mention that Weston Price tested all the food these traditional peoples were eating, and found by the 1920's that those of us eating a Western diet were only getting 25% of the minerals found in traditional diets, and only 10% of the fat soluble vitamins traditional peoples' diets contained.

There is evidence to show that we are still continuing to lose minerals and vitamins in our food. My guess from the evidence I have seen is that we are maybe getting around 5% of the minerals we need to maintain human health at its peak on a cellular level, and maybe if we're lucky 1-3% of the fat soluble vitamins A and D. These vitamins are only absorbed into our bodies in the presence of fat, and are responsible for the health of our bones, eyes, skin, hormones and normal brain function among many other things. The big lesson from Dr Weston Price's research is that to be super healthy, and for our DNA to remain strong, we need **Nutrient Dense Food**.

This brochure is largely about how to grow nutrient dense food in your home garden. To learn more about how to choose your food so that you not only get nutrient dense vegetables, but also more broadly an overall 'nutrient dense diet', see the Weston Price Website listed above, or read *Nourishment and Human Degeneration* by Weston Price. See also the leading edge books *Primal Body - Primal Mind* by Nora Gedgudas, and *Deep Nutrition* by Catherine and Luke Shanahan. These books explain very simply, exactly how our food nourishes us, and what we need to eat to fully nourish our bodies on a cellular level. This is the first time I have ever seen this information and it's very exciting stuff. It basically reinforces what our bodies are telling us - that we need food grown from heritage seeds in highly mineralized, microbially active soils to enable our DNA to express in a healthy way in our lifetime, and to be passed on as strong DNA!

Within the Permaculture Design Courses that Bob and I teach, we base everything around a simple pattern of designing. From big picture and patterns through to detail, we use a structure of: ***Ethics - Principles - Patterns - Strategies - Techniques***. Throughout the course we stress the importance of understanding principles and patterns before we jump into strategies or techniques.

Within this understanding, I had come to feel that much of my design for growing healthy food, consisted of following a whole lot of strategies and techniques, that didn't necessarily have a strong connection to principles (the laws of nature), i.e. I didn't understand or know enough about the principles and patterns in Nature to be able to make intelligent decisions about strategies and techniques. Increasingly I have found myself asking: **What are the 'Laws of Nature'???**

Nourishment Home Grown

This is where Sandy Beddoe's book *Nourishment Home Grown* came in. It is not an easy book to read - it needs to be studied. However, he has become one of my most important teachers ever.

Principles

The main principles (of Biologic Ionisation/creation) he begins with are that:

1. Creation is the putting together of light/energy into matter.
2. If we study this we discover how healthy cells can be built in plants, animals or humans and how to supply that healthy cell with the energy needed to sustain it, on its frequency in a best functioning condition.
3. Once we know that we can co operate with nature/creation through laws/patterns that build healthy productive gardens, farms and body temples.
4. Fundamental building blocks are the basic atomic elements as described by traditional science in the Periodic Tables.
5. These elements combine to form various molecular structures that make up all biologic life.
6. These elements all have certain chemical, physical and electromagnetic properties.
7. These properties are expressions of energy that are contained within the atoms of these minerals.
8. This energy is available and exchangeable in the growth process of plants and animals.
9. The plant uses 84 different minerals. When any of these are missing or in short supply or when something interferes with its proper uptake or combining into organic plant structure, the plant will begin to experience deficiency.
10. If the deficiency is prolonged or severe enough, the symptoms will manifest as plant disease or insect problems.
- 11. ALL DISEASE IS THE RESULT OF A MINERAL DEFICIENCY OR LOSS OF MINERAL ENERGY, WHETHER PLANT, ANIMAL OR HUMAN.**
12. As long as the energy coming into the living structure is more than enough to replace those parts that wear out, quality regeneration and length of physical life are maintained. However, when the needs of life-giving energy

- (heat, electricity, mineral) are not being supplied, degeneration sets in.
13. Soil is a living system, it must be fed a proper diet. That diet must include the right types and amounts of calcium, along with phosphate, potassium, iron, copper, manganese, vanadium, chromium, cobalt, zinc, molybdenum, iodine etc. When the soil is nourished and balanced, it will produce healthy plants and the plants will maintain physically healthy people - so long as they eat following principles/patterns of traditional peoples.
 14. Animals knew how to choose the best food for themselves, and so did our ancestors.
 15. We cannot assume that if a plant grows and develops normally (according to our eyes) that all the necessary vitamins, minerals etc. have been available in the soil.
 16. The differences in mineral content can be as much as 1000:1, and yet plants look identical.
 17. The true measure of the mineral supply coming from the soil is the sugar content of the juice of those plants, while long term proof is the state of health of the animals and people consuming food grown on that soil.

Patterns

Out of these basic understandings (principles), we begin to see the patterns or 'Laws of Nature' we must work with. Beddoe lists 29 Patterns or 'Laws of Nature', which come out of his principles and become the base upon which we build our strategies and techniques.

Without an understanding of these patterns I believe we are floundering and without an understanding of what we are really doing - which is how I see it was for me over the past 30 odd years.

It's all very well to be making compost and one's own liquid fertiliser (looks like a great technique), and lots of vermicast (another great technique) etc., because that's what the books say. But how do we know we are adding the minerals the soil needs right now, to grow nutrient dense food crops? We mostly have no idea. We are just copying techniques that look and feel good.

At this point in time I believe the best way for home gardeners to judge the quality of their produce is with a refractometer. I'm fully aware that our ancestors did not have refractometers, however I believe they had skills and senses more developed than we have right now in the culture we have all been born into. As time goes by and we sit in nature again, we may find we can do without refractometers as well!

We'll look at a few of Beddoe's patterns and see how we can integrate these understandings into strategies and techniques for growing soil and food.

'Laws of Nature' or Patterns à la Beddoe

(All words in italics are Beddoe's, from his book *Nourishment Home Grown*)

I learned a lot by just getting a basic understanding of Beddoe's first 'Law of Nature' which is as follows:

Carbon - The Moisture Regulator

Carbon can hold as much as four times its weight in water. The lower the carbon, the less water should be applied to the soil at any time, but more often.

Carbon forms the basis of your soil's mineral energy savings account. It holds onto soil nutrients until the plant can use them both before and after soil bacteria have worked on them. Ideal levels is 10% soil weight.

It's important to make a distinction between carbon and humus. Technically we don't want just carbon in our soils - we want bio-active carbon in the form of humus and all its complex humic, fulvic and ulmic acids. With their high cation exchange capacities and basic life energies, these acids are the patterning energy for all of life. Being the most complex substances on earth AND the final breakdown product of everything that has ever been alive, humic substances hold the basic blueprint for all life. They are astonishingly powerful chelators, growth promoters and microbe/plant foods. When Beddoe talks about carbon above, technically he is meaning what we call 'humus'.

I understand now that:

- The higher the humus levels in the soil, the less our minerals will be washed away by rain, watering or gravity, and the happier our soil micro-organisms will be, because they are dependent on the minerals held by the carbon for their food. Higher carbon means more reliable food for the micro-organisms, which means higher micro-organism number, which means higher levels of minerals available to plant roots on a constant, ongoing basis (based on the understanding that it is the energy releases that occur when microbes feed on minerals that then feeds our plants in an optimal way).
- The higher the humus levels, the less minerals have to be applied each year to achieve the same results, because less is wasted, and because it goes further when you have high microbe populations.
- The higher our carbon levels, the more water we can apply each time without washing away nutrients, and the more water we need to apply to fully moisten the soil to enable the micro-organisms to work effectively.

- The more carbon we have in our soils, the less often we will be affected by drought. E.g. in the Waikato we have lost around 30-40 tonnes of carbon per ha over the last 30-40 years (according to Waikato University and other figures). This gives us some idea of how much more affected by drought we are compared to the past, and how much harder it will be to hold minerals and microbes, and to grow nutrient dense food.

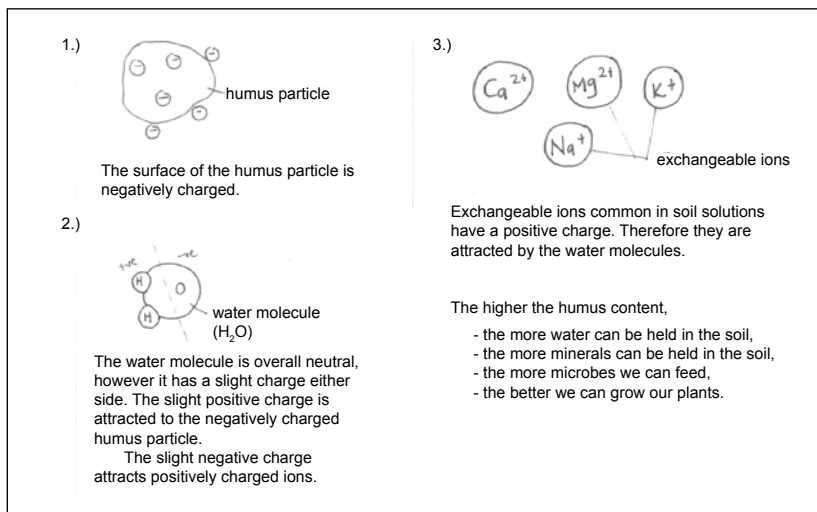


Diagram 1) Water Holding Humus

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Nature Follows the Line of Least Resistance

The greater the mineral content in the top soil, the less the resistance in that soil and the greater likelihood the current will stay flowing in the soil. The greater the mineral content within a plant, the easier it will be for the plant to have electric current flow in it.

It will have better magnetism or attraction for more mineral energy. Therefore the plant will draw in more electromagnetic energy and be a top quality plant in every aspect.

I think the analogy of the plant and its sap as a battery is a good one – to carry charge between the two poles of a battery you need a mineral solution for the electrons to move through. The less salt/mineral in the battery fluid/electrolyte, the less charge can be carried. In the case of a plant this means the less mineral/building blocks that can be accessed. We measure soil electrical conductivity (EC) to determine what the state of the ‘battery fluid’ is in the soil. Below 200 microsiemens there is low capacity to carry charge, and above 800 there is too much energy moving through the system (usually in agriculture this comes from excess water-soluble fertilisers) and you get crop burn.

- The plant can be seen as the battery fluid in the overall earth growing system
 - the two poles of opposite charge are the earth and the sun and the plant is the manifestation of the energy released when you get current flowing between the two poles.
- Plant growth is the result of the energy released from biochemical reactions. The pure concept is that no matter is created or destroyed in life. All growth and decay is simply the result of the energy released and reformed from chemical interactions of minerals. Microbes, plants and animals don't actually 'consume' minerals, they simply live off the energy released when those molecules of elements interact with each other by donating or receiving electrons. Once again it comes back to the patterns of energy accrual or release.
- The better we can provide the conditions needed for high energy release, the higher the brix of our plants will be. I understand that to mean high levels of the right minerals in the right relationships, and highly aerobic and moist, well drained, microbially active soil.

Phosphate Controls Sugar Content

Phosphate, the phosphorous-oxygen complex, is the carrier of the mineral from soil to plant, also the catalyst in the sugar making process, called photosynthesis that takes the place in the leaf of the plant.

Water and oxygen are brought together in the chloroplast during the heat of the day to make crude sugar. Phosphate is the catalyst for the process. The mineral elements carried in the phosphate are left behind when sugar is formed. This is why the higher the sugar the higher the mineral content.

- Phosphate is recycled in this process. It is the 'usher' as Arden Anderson puts it – it can continue going back to get wedding guests at the door and seat them in the appropriate places in the church.
- A major reason that phosphate is low in most agricultural systems has been the use of super and triple-super phosphate, which locks up with the soil iron, aluminium and calcium as soon as it's applied to soils - only microbes can break those bonds and make the phosphate available. Using highly concentrated, processed phosphates also shuts down mycorrhizal fungi, the very things we need to support our production of nutrient dense food.
- Going over this one many times, especially once Caitlin drew me a diagram as you can see opposite, helped me heaps to understand what is really going on. To understand that phosphate is 'only' a catalyst was hugely relieving because I had not been able to see until then how I was going to find a sustainable way of coming up with phosphate all the time. I could see how critical it was,

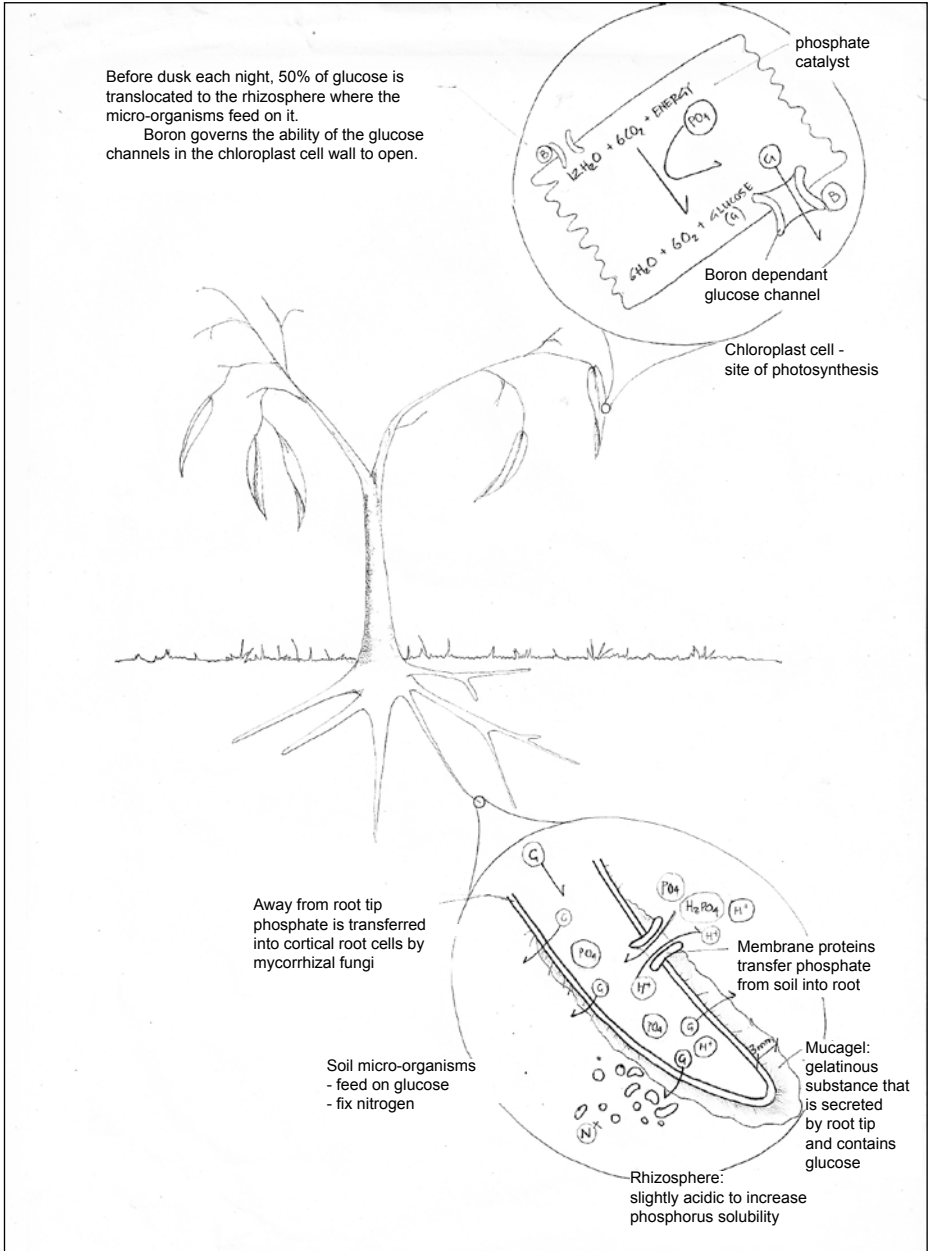


Diagram 2) Photosynthesis

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but not that we actually need to add very little because it is constantly being recycled in the soil and the plant, so long as you have adequate humus there to hold onto it. The problem is that we have run the humus levels down so that the phosphate (and other minerals) does not remain in the microbe/plant root zone, and also that we often apply water soluble forms of phosphate. I can now see that if we focus on raising humus levels to hold onto everything we have, and then use forms of phosphate that are complexed to carbon as well, we will need to use less and less, and may even be able to think about being self-reliant once we achieve highly biologically active conditions, and make good choices around our carbon crops and compost material sources, choosing plants that concentrate phosphate.

- It's also very clear from this Law of Nature that if we do not have enough available phosphate in the soil we will never achieve high brix crops. Most of us in this land have very low available phosphate levels, especially in relation to potash, and we must do something about that if we are to achieve our goals.
- The challenge is to find a way to make sure there are high levels of phosphate in a sustainable way.

Getting the Ratios Right

For a plant to be in proper health all minerals must go into the plant in the phosphate form except nitrogen. If nitrogen becomes the carrier we will have low brix food that contains well known carcinogens, the nitrates.

- Our plant roots will choose nitrogen as a carrier for the minerals needed for photosynthesis if there is not enough available phosphate, or the available nitrogen is not complexed to a carbon source. This understanding gives us even more incentive to make sure we have available phosphate in the correct ratio to potassium at 2:1 in crops and 4:1 in pastures, and available calcium to magnesium 7:1. We also need nitrogen in a form that is complexed to carbon so that the plant can choose phosphate for catalysing the photosynthesis process rather than nitrogen. The most sustainable sure way for home gardeners to make sure the phosphate and nitrogen are available for plants in the correct forms are to put your minerals through the compost heap. It's kind of like the difference between humans eating vitamin and mineral tablets for nourishment rather than nutrient dense food. When we eat our minerals in the food form, our bodies recognise it as nutrition and take what they need. However, Dr Natasha Campbell-Mcbride says that in tablet form over 90% of it goes straight through because it is not complexed in a way our bodies recognise.

- Pouring on Urea means the plants will choose nitrogen as the carrier for other minerals to enter the plants and we will grow low brix carcinogenic food. Those of us using liquid fish without a carbon source, and who have low phosphate levels, may be ensuring that our plants carry their minerals in with nitrogen as the carrier, leading to low brix crops! If you aren't applying your nitrogen through the compost heap, or in the form of composted manure, then make sure you add either humus from a good compost heap, or some other carbon source with it, i.e. sugar, honey, molasses, humic acid, fulvic acid...

The Importance of Calcium

Calcium is used in plants by weight and volume more than any other mineral element. The result of all the functions of calcium is the manufacture of amino acids for the making of plant protein and human food.

Thus the more calcium that is transported into the plant, the greater the plant's ability to attract nutrients out of the air – chiefly carbon dioxide, nitrogen, potassium and magnesium.

- My understanding of this attraction phenomenon is that it is adequate levels of calcium in cell structure that creates the ideal capacitance that makes it possible, electrical charge wise, for the cells on the leaf surface to attract, hold and absorb mineral elements from the air.
- It is now clear to me that available calcium is the 'key', the missing link for most of us, and putting our energy here first will give us the greatest results. It is critical to understand that there is a big difference between 'calcium' and 'available calcium'. If the plant roots can't access the calcium because it is chemically locked up or biologically inactive, then it is no use at that point to the plants. It may be eventually, but right now we may need an available calcium source to get things going (details on how we can do this later).
- According to Phil Wheeler PH.D. in Acres USA July 2010, the first mistake being made by commercial and home gardeners alike the world over is "not liming because of neglect, lack of knowledge or the mistaken concept of pH as the basis for liming rather than percent base saturation. Since calcium is the prime nutrient in all living systems, this mistake has caused immeasurable loss of production and incredible amounts of economic and environmental damage when rescue chemistry had to be applied. The fact that calcium is not biologically available (as indicated by LaMotte oil tests) to the extent needed for nutrient dense food under conventional farming techniques adds to the problem. The lack of fungi in general prevents the 'holding' of calcium in the root zone."

Nitrogen is the Major Electrolyte

This means that the nitrogen is responsible for carrying electrical charge (or current) into the plant. Nucleic acids are what make up the fundamental formation of protein structures. This means the electrical flow and magnetic attraction come through and begin and end with nitrogen.

- If our plants stop growing and they aren't drought stressed or waterlogged, then it's highly likely they are out of nitrogen. We need to add it to keep the plants growing, but we must add it with a carbon source, so it stays in the plant root zone, is not washed away to cause pollution somewhere else or burn up our precious humus.
- Nitrogen maybe the major electrolyte, but it is critical how we apply it or we do more damage than good. Phil Wheeler PH.D. in Acres USA again says that the second most critical mistake made by most growers is "using high applications of nitrogen and potassium (from KCl) to push/force a plant to grow instead of creating healthy biological soils. The excess nitrogen shuts down the natural processes of the cycle that fix atmospheric nitrogen. The KCl interferes with soil biology. Excess nitrogen also interferes with the most basic function of nutrient exchange involving mycorrhizal fungi. The fungi exude sugars to soil bacteria that exchange the sugars for macro- and micronutrients back into the plant. Again loss of the fungi or their function does not allow for nutrient dense food."
- Well composted, highly mineralised cow manure and other manures (but especially cow manure when it's vege gardens we're talking about) contain humus with both types of nitrogen bonded to the humus, so they act as high quality, slow release nitrogen fertiliser.

Poor Mineral Energy Reserves Can Be Made Worse by Cultivating Too Deep

As you are building up the soil energy levels, work the depth in proportion to the amounts of plant foods used.

- I had a first hand example of this in my Whitianga garden. I was working with very poor soil (low in minerals, having been stripped by commercial corn production for many years) and I added the amount of high quality fertiliser that I was recommended. Then in one bed I double dug after fertilising, and the other I forked the fertiliser into the top 5cm. If I had been following my BioIntensive instructions carefully I would not have put the fertiliser on until after the double digging, however it served to show me just what happens

when you put the same amount of fertiliser through a far larger volume of soil. It means there is way less electrical current happening and the ergs are too low to create energy exchanges - and my plants didn't grow in that bed. I had to add more fertiliser to the top 3cm and then they took off, whereas in the other bed they grew well.

Energy Release

Plants live off the energy release from the elements interacting as the elements synchronize in ionic molecular form in the soil. The interaction of the minerals within the soil solution is similar to the reaction seen when putting vinegar and baking soda together. There is a profuse fizzing and foaming reaction. The gas that comes off the reaction would represent the energy that is available to the plant.

- The point being that we want the energy release to happen in the soil when we use fertilisers so that microbes can feed off of that energy release.
- Phil Wheeler PH.D. says that the fourth most common mistake made by growers is “assuming that plants grow from the nutrients, rather than the energy produced by the nutrients, the biology, the sun, the moon, the lightening, and the cosmic forces. many growers don't realise how much oil based energy went into the production of those NPK fertilisers and that this energy is released back into the soil.”

Magnesium is the Enemy of Nitrogen

Because in New Zealand our home garden soils are generally OK for magnesium in relation to calcium, we tend to need more calcium rather than more magnesium. If we use dolomite rather than lime we are adding a lot of extra magnesium, which counteracts the effect of nitrogen, making our soils deficient in nitrogen and slowing growth – one of the basic mistakes I was making in my Kaiwaka garden. Magnesium is also key for chlorophyll formation, without which you don't get sugar production. The key is making all minerals available to the microbes in balances that are as close as we can get to ideal and let THEM choose what goes into the plant – they know best, they've been at it a LONG time.

So - we need the available calcium in a 7:1 relationship with magnesium, but we also then need high levels of both so the plants can grow to their potential. We need to make sure that we have high calcium crops in our compost heaps, and also plants that concentrate magnesium there too, with the minerals complexed to the humus so that they stay in the plant root zone for the microbes to feed on as needed and the plants to use as needed as well.

And Another Pattern

(that has not come from Beddoe but various other sources)

When you select or breed a plant for one aspect of its whole, you change everything, in ways we do not necessarily understand.

That is what happens when we genetically engineer food plants, but it also happens when we use traditional plant breeding methods. Traditional breeders were aware of this and knew that seeds were complex things and that changes needed to be made in relation to the whole. However, modern plant breeders who are hybridising seeds for very selective and narrow qualities have as a result changed (lost) much of the nutrition, in ways they probably have no idea about. We can easily tell by tasting the food that the nutrition has changed, and modern science can show us that too. We now know why that is so.

Nutri-Tech Solutions, Graeme Sait's biological fertiliser company in Australia, found that hybrid cucumber plants were not taking up manganese, even when it was abundantly available in the soil. This seems like the same trend in the drop off of minerals in food since we started using hybrid seeds and NPK soluble fertilisers during the 'Green Revolution' 60 years ago. Herbicides like glyphosate reduce the plant's ability to take up minerals as well and the effect can last for years.

Phyllis Tichinin explains it like this: *“Hybrid seeds, in the course of hybridization, can lose their ability to take up key minerals, leaving ‘gaps’ in the enzyme profiles of the plants – they are genetically incapable of soil uptake of some metal trace elements needed to create the enzymes that govern plant metabolism, which in turn contribute to secondary metabolite levels in the plant tissue – in other words... the plants are lacking in vitamins, minerals and antioxidants because their pathways for absorbing them through the roots have been genetically cut off.”*

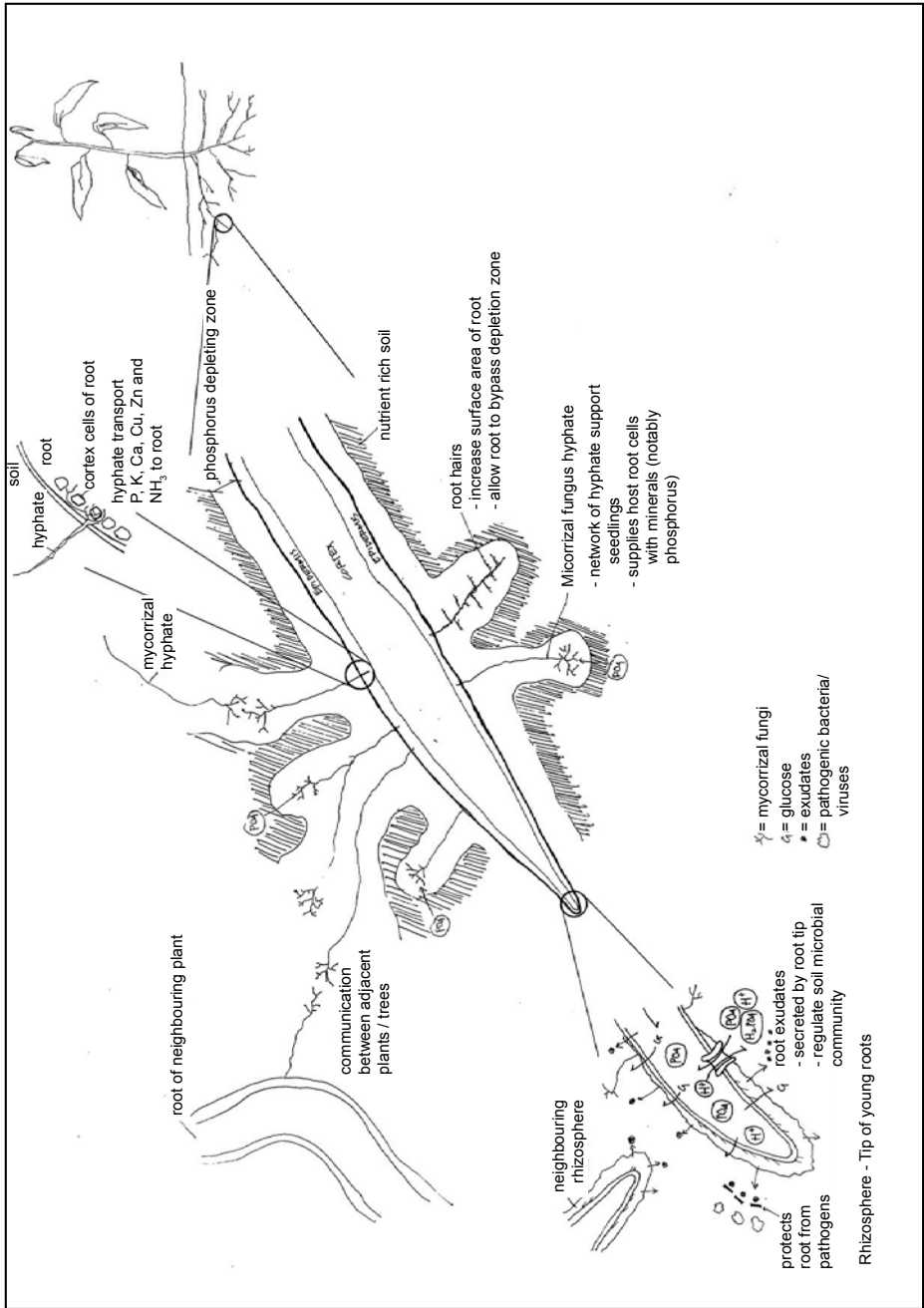


Diagram 3) Connections between, minerals, microbes and plant health

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Where To Begin

Obviously that list of patterns will take years for us to fully understand and even more to integrate into our gardening systems, and many of us will never fully understand them all or all the implications. However, we can always use the advice of those people in NZ who have already been studying this knowledge and integrating it into their programs and fertilisers for some time, if we feel a need to do things faster than we can integrate this information. Here are some of my ideas on where to go to from here.

I can hear so many people saying and thinking things (that are also going on in my head) like “Why does it have to be so hard?” or “It shouldn’t have to be this complicated” etc. Remember that for over 150 years now we have been seriously systematically demineralising our soils; our food probably has less than 10% of the essential minerals in it than it used to have in the pre-industrial days. There may have been a time when we could recycle what was in our environment, but - they were days when we took care of the whole ecology. We have ruined it and now I believe we must pay the price, or not survive as a species.

... You will by now see that this is not something you can pick up and simply just do, unless you are extremely lucky to be on very good soil to begin with. Gardening to grow Nutrient Dense, High Brix food is an art and a science... but don’t be put off, it is an amazing journey and there is beginning to be support out there.

It All Comes Down to... the Minerals and the Microbes

The more we get the right minerals in the right relationships, the more potential there is for interactions for both the building up and breaking down of mineral compounds, the more microbes we can feed and the more energy there is released that is available for plant growth.

Practically, we are setting out to provide as close to ideal conditions as possible for the microbes. It all comes down to: the better the microbes are able to do their job, the stronger our plants will be, the more sustainable and efficient our systems will be and the higher Brix they will be. The higher the Brix of our food, the more clearly it can communicate with our cells, the more we will be able to fulfill our human potential and the stronger our DNA will be as we pass it on down the line!

We are the Ancestors It is our Responsibility!

1. Refractometer

First of all, either buy, borrow or beg a refractometer from somewhere so you can actually tell where you are now on a scale of bad to good to excellent with your plant health, soil health, and to a certain extent by inference healthy microbe populations! And you have something to measure your successes by.

This is not just a matter of doing one test, you need to follow the instructions inside your refractometer case and establish a weekly (or daily) routine and build up the evidence. You will see that readings vary with sun hours, rain, time of day, and it is best to do your tests at the same time each day (or week) to get a feel for what is going on.

To Achieve Ideal Conditions for the Microbes:

2. Aeration

Around 50% air spaces in the soil (of which around $\frac{1}{3}$ - $\frac{1}{2}$ will become filled with well drained moisture). In a home garden situation this can easily be achieved by following BioIntensive growing. See *The Sustainable Home Garden, How To Grow More Vegetables Than You Ever Thought Possible*, both by John Jeavons, or *Koanga Garden Guide* by Kay Baxter. You may need to double dig occasionally; in between, using a U bar will be the easiest way to maintain deep soil aeration.

3. Moisture

Ideal moisture levels mean around 30% of the soil/air spaces will be filled with moisture, created by having enough air spaces and good drainage, and intelligent watering systems.

How many techniques for watering in organic gardening books have you seen that do not have this understanding behind them? In BioIntensive Gardening John Jeavons says to water with a rose or nozzle, which means the water falls gently like rain (and so will be negatively charged like rain, and have as little compaction effect as possible) until you have a shiny soil surface for three seconds after stopping watering. This technique comes from the understanding that any more water than that washes away the nutrients, because until nutrients are bonded with humus, they are essentially water soluble. Any less water than that and the humus will not be moist enough to function effectively as a home for the microbes to be fully active and releasing minerals to the plants, or the minerals to be interacting and releasing energy.

Watering following BioIntensive instructions also means you will cause the least compaction of the soil, meaning you have less work to do to reinstate the air within the soil, in a home garden situation.

4. Humus

The higher the humus levels, the more microbes and minerals the soil can hold, the higher the electrical current you will have the more action you will get!!! Humus is the home and pantry of the microbes. When conditions get tough, too wet, too hot, too dry, too cold, the microbes survive in the humus.

It is also in the humus that the microbes find their food as this is where the minerals will be as well. The higher the humus levels the more even the moisture levels will be which will support the microbe populations, and the electrical current as well. The Biointensive compost making instructions are also the best, most effective, simple instructions I've found anywhere, and you are probably more likely to be able to make high quality compost if you follow these instructions than any others I've seen.

Learning to make high quality aerobic compost is a vital part of this equation, this is where the humus comes from. (Although I am aware there are many other ways of building humus this one appeals to me as the best long term sustainable solution for low tech home gardeners.) In BioIntensive growing we make sure around 60% of our garden area over 12 months is dedicated to growing high carbon crops which become the basis of our high quality compost. The easiest way to achieve that is to grow corn and other grains in Summer, and grains like wheat rye, oats and broadbeans, lupins etc. over Winter. For more info see any of the BioIntensive booklets listed at the end of this brochure. You can tell if your compost is good by taking a handful and crumbling it up and smelling it. It should be moist but very crumbly, not wet, and smell just like the forest floor!

Once you have the basics sorted and can make a great aerobic heap, check out Ecology Action's advanced *Grow BioIntensive Composting and Gathering Composting Materials* booklet, which shows us how to make compost in ways that retain maximum humus, maximum microbes, concentrate the specific minerals our soil needs - all in the most efficient way.

Don't underestimate the vital importance of getting the air in your soil, the moisture levels right and high quality compost production going before spending money or energy on minerals and microbes... which is what many of us do.

Be very wary of using commercially produced compost, mespecially municipal compost. Most of it is 'putrefied organic matter' anaerobically brewed, not compost. After having had to live with the 20m³ of certified organic compost I put on one of my gardens, I know the negative results... they last for years. If you're not confident of the quality of commercial composts, it is best to avoid them.

5. Minerals

The right minerals in the right relationships: specifically available calcium in a ratio of 7:1 with available magnesium (which mostly means we need to work hard to get the available calcium levels up in our soils), and available phosphate in a 2:1 ratio with available potash (which mostly means we need to work hard to hold the available phosphate in the soil and get the available levels up as well).

We have many choices at this point:

5. A) Buy Them Already Mixed and Apply to Your Soil

We're looking to make sure our first steps are a success! The most expensive, but by far the easiest and fastest way to get a good result is to buy a product from somebody who knows how to make fertiliser based on the principles of Biological Agriculture as expounded by Dr Carey Reams, and follow the instructions on the bags. It is critical to be adding the right minerals in the right relationships to grow high Brix food, and I know from experience that most of us simply will take a few years to learn enough to be able to figure out how to get all of the minerals we need in the correct relationships without this level of help/support.

'Law of the Minimum' by Baron Justus von Liebig

The following is such a great quote for both growing plants and healthy bodies:

"Plants (and I think one can assume animals, and people!) will use essential elements only in proportion to each other, therefore the element that is in the shortest supply, in proportion to the rest will determine how well the plant uses the other elements." In other words - if you miss one, there is no over-compensating with something else.

I've been doing this for five years now, using Environmental Fertilisers (EF) products, and the key is to follow instructions and just keep adding more each time you plant. I've had amazing results with these products, it's pretty amazing to watch the brix go up from 3 to 16, as you follow instructions over time!

EF Nature's Garden is the basic product containing composted calcium and phosphate plus a humic and fulvic acids, sea minerals, seaweed, fish, many microbe populations, and minor minerals such as boron and zinc. Until you get your brix readings over 12-14, you will also need to add the **EF Active Calcium**, a composted highly biologically available calcium product, following instructions on the bags. Many of us will also need the **EF Fish Plus**, which is a form of nitrogen that is bound to a carbon source, so does not burn up the soil carbon or wash away to pollute your water source etc. You can tell if you need this by looking to see if your plants are actively growing after other fertilisers have been applied.

If they still don't grow, you probably need nitrogen. The refractometer will tell you. We are aiming for a Brix of over 12, so if any of these three products help raise your Brix then use them, according to instructions on the packaging.

Once you get a Brix reading of over 8-9, you will find that your plants begin to respond really well to foliar feeding. You can test your own foliar sprays using the refractometer, however you can buy them too. Environmental Fertilisers make a very good one, **EF Growth Foliar** if you are looking for vegetative growth, and **EF Fruit Foliar** when you want to encourage fruit set or seed set etc.

So - there are products out there that you can buy to get you going while the highly mineralised compost heap is brewing. And to be honest, paying around \$2 per square metre a year to use these products is money well spent in my book. What could be more important than our health...

5. B) Through the Compost Heap

(or both **A**) and **B**) until you have the compost right)

So, we're on the path, the next step surely is to find more local efficient ways to continue the process. Composting the minerals is the most efficient way to apply them, and the cheapest once you have your brix's up. We must understand, however, that if this technique is to produce high brix food then our aim must be to use the compost heap to apply highly mineralized, biologically active, high humus compost in small amounts regularly to our gardens.

If we don't have high quality compost, we will be making our problems worse, as the following quote from highly respected Jon Frank of International Ag Labs says when asked by Acres USA in the July 2010 issue what he thought were the 5 worst mistakes made by growers in relation to achieving high brix crops. His third mistake is:

“Organic gardeners fertilising soils with far too much compost or manure. This is a classic problem with garden scale growers. Since people know compost is good for the soil, most put on 100 times too much. The result is cumulative poorer quality, insect pressure and dropping brix - all because gardeners put on what they have plenty of rather than what the soil needs.”

Assuming our compost heaps are by now aerobic and producing light crumbly sweet smelling compost (as described in 4. above), we now have to look at how to make sure we are getting the right minerals in the right relationships.

- I. The simplest way to begin with may be to buy the minerals already mixed (remember, recycling your own deficiencies by using only plant and animal material from your property or others if it is not high Brix, can not produce nutrient dense food). To make this easy for you, **Koanga Gardens** (www.koanga.co.nz) is now selling 3kg bags of these minerals especially designed to provide the right minerals in the right relationships for a home garden compost heap of around 1.2m x 1.2m and as high as you can make it. This will be far cheaper than A) above, but also take longer to achieve high brix crops, and so it is ideal to do both for maximum short term and long term gains. You will also be able to buy products from the companies listed at the end of this brochure to achieve the same goals.
- II. The next step from there is of course to be able to source our minerals for our compost heaps from our own homes and gardens, and local Bio-regions. It is my current understanding that those we need to focus on initially, are **calcium, phosphate and iodine!**

a) Calcium

Available calcium is the most badly needed mineral in all of our gardens, and that one is relatively easy to provide - either in the form of agricultural lime from your local quarry or garden centre, or even better, from the bones and shells out of your kitchen. We have been doing this now for 3 years - I believe that if we eat following the Weston Price Foundation principles (www.westonaprice.org), based on his 1920's studies of all the super healthy indigenous peoples, and recycle all the shells and bones that come through your kitchen, we will have enough calcium going back into the soil to maintain optimal available calcium levels once we get them back up, as long as you are not exporting significant amounts of your food.

We do this by crushing the oyster and paua shells, and burning the rest after having used them several times in bone broths! We make a small fire and pile the bones on the fire (the word 'bonfire' comes from the old word 'bonefire'). Both the crushed and burnt bones are then added a little at a time in layers through the compost heap, which will at least begin the process of making the calcium bio-available, and bind it to the humus which will help keep it where the microbes and plant roots need it, rather than have it washed down in the soil with the water. You can of course just buy agricultural lime as well, but using our own bones creates a powerful circle, that feels very good! Getting the calcium right will ensure your plants can actually begin to function effectively to their potential and take up other

minerals they need from the soil and the air.

We must be conscious while adding calcium that if we are to achieve the right minerals in the right relationships we are aiming for 7:1 available calcium:magnesium, so we must also be looking to add magnesium in this ratio to our heaps. Dolomite lime is the easiest way to do this, but we must only add 1 kg of dolomite (dolomite is a mix of calcium and magnesium) for every 5 kgs of calcium (lime, lime flour, burnt shells and bones crushed shells and bones etc.).

b) Phosphate

Finding local sources of phosphate is far more of a challenge. It is my understanding that when we have high humus soils, phosphate is held in the humus and recycled in the plant growth process. Phosphate is not used up when plants grow, but just acts as an 'usher' to bring other minerals into the plants. After that it goes back down into the roots and out into the soil as part of the root exudates that plants give back to the soil (that feed the micro-organisms, and help give our soil structure, and is part of what gets destroyed when we use rotary hoes). That means that if we focus on raising the humus levels we will have to bring in far less phosphate, and we will have a far greater chance of creating a sustainable long term solution. My long term 'own back yard' solution is to make sure I provide my animals (chickens, ducks, geese, cows and sheep) with optimal minerals so that their manure and their bones are highly mineralised and can be useful for creating highly mineralised compost.

Traditional, slow, low heat composted, high quality animal manures (using manure from cows on high Brix pasture and/or being fed minerals from a recommended source), are another way to provide biologically active carbon, biologically available calcium, phosphate and high levels of micro-organisms, as well as high quality slow release complex nitrogen. The old time farmers knew composted animal manure was excellent for the trees and garden and other crops, and usually had manure piles behind every cow shed or bale on small farms, slowly turning to humus to apply each autumn to the farm, garden or orchard. If you are wanting to use cow manure that has come from animals on low brix pasture being fed minerals, then compost the manure with the same minerals that we are using for the compost heap! Do not put large amounts of manure in your compost heap however, because it will heat your heap up and you will lose your efficiencies - we do not want our carbon back up in the atmosphere or our micro-organisms killed and our nitrogen released either. We're aiming for maximum efficiencies and the best possible return of humus, minerals and microbes (see **4. Humus** page 17).

The Bio Intensive system shows that the most efficient (retaining the highest levels of carbon, nitrogen, humus and micro organisms) composting systems are 45-60:1 carbon:nitrogen, and at a maximum temperature of 55-60°C.

I also consciously choose compost crops for my Winter garden that are able to unlock and so concentrate phosphate or even pull in phosphate from the air (e.g. lupins, oats, alfalfa). I will also continue to plant shelter and hedgerow trees that concentrate phosphate where possible, e.g. Cassurina trees continually drop needles, creating an easy to collect mulch that is relatively high in phosphate and great in the compost heap.

c) Minor Minerals

There are now a range of more minor minerals that are also critical to the fully functioning whole - remember the quote of Baron Justus von Liebig on page 18? The easiest way to begin with will be to use a product designed to supply the right minerals in the right relationships. Without buying products, you need to make sure you use lots of seaweed in your heap, either fresh straight from the beach, or in a dried powdered form. All sea products contain these water soluble minerals that constantly wash from our soils into the sea, not just seaweed. Fish guts etc. are great in the compost heap and, so long as you add plenty of carbon at the same time, will not smell. Sea water is also being used more commonly as a garden mineral additive, and as it contains all of the life giving minerals in the correct ratios, using it is an excellent way of supporting your own mineralising program. You can water it over your compost heap straight from a very clean part of the ocean, at a rate of maybe one 10 litre watering can for each 30cm of heap as you build it, or dilute it 1:10 with water and pour over the garden/plants on a monthly basis. You can also buy sea minerals if you harvest your own clean water. Don't forget to use your refractometer to measure gains and act accordingly.

Iodine

A critical minor mineral that a lack of is wrecking havoc to our human and animal health is iodine. Iodine ends up in the ocean and in our seaweeds and shellfish. Making sure we recycle shell fish waste and especially seaweed through our compost heaps over a period of time will mean we begin to bring the iodine levels back up to where we need them to be. I recommend you read a book called *Iodine - Why You Need It and Why You Can't Live Without It* by David Brownstein MD if you have connections with breast cancer, prostate cancer etc. Incidentally, paua 'guts' is a traditional food for some Maori, and is delicious in small doses. Guess what? It's fermented seaweed!

Using stock iodine (available through all farm supply stores) in stock troughs will help ensure iodine is in our meat, eggs and animal manure. I also believe using stock iodine in a dilute form in our compost heaps will be a great way to bring levels up in our veges too. I recommend pouring 3 x 10 litre watering cans, each with ½ a cup of stock iodine through each 1.2 x 1.2 compost heap at intervals as it is made.

d) Humanure

Another way of making sure we recycle as many of our minerals as possible, and avoid having to focus as much on bringing them into our systems is to use both or either of our urine and human manure. Urine is safe to use as it is, although it is very strong nitrogen and needs to be diluted to a 10% solution. To ensure you aren't going to have it run away and burn up your humus or pollute the waterways, you need to add it with a carbon source, e.g. humus from the compost heap, humic acid, or fulvic acid.

Human manure has been recycled over the centuries by those gardeners who took care of their soil the best - the Chinese. That strategy is one we can also use, however we must follow strict health precautions - the best book to read to understand how we can simply use our human manure is the book called *Humanure* by Joseph Jenkins.

6. Microbes

The next area we need to look at is the microbes. We have by now created a 'Garden of Eden' for the microbes - aerated, moist, highly mineralised soils perfect for the sorts of microbes we need to support our plants and animals to be high brix, and so our own health and the health of our DNA! Once again there are many roads one can go down, from buying the premixed 'ready-to-go' microbes selected for whatever situation you can think of, from nitrogen fixing to disease control etc.

Koanga Gardens - Centre for Sustainable Living sells a blend of microbes for use as a seedling inoculant, one of the cheapest and simplest ways for home gardeners to inoculate their soil. Once these microbes are living in association with your seedling roots, you will transplant them around your well prepared aerobic and moist garden beds and they will thrive, then make it to your compost heap on the weed roots etc. and become part of the circle.

Many microbes lie dormant in the soil for many many years waiting for the right conditions to become active again. (Roundup, all pesticides, copper sprays, DDT, Superphosphate, Urea, etc. all kill the microbes.) You may find your brix's continue to rise without actually bringing microbes in, which is a sign they are there and becoming active.

Another option is to learn to make your own microbe brews. Check out www.localgarden.us for some great ideas on how to begin with ones own brews! Once your compost heaps and garden beds have been populated and you are making top quality compost, then you can make your own compost tea to continue strengthening the web of life in your garden.

More ideas of things you can easily do at home to increase your microbe populations are:

- **Worm Farming.** High quality vermicast is easy to make. With lime flour or crushed egg shells added for calcium and something that is high in phosphate for the worms to eat (rock phosphate, cassurina needles etc.), you will have excellent fertiliser for your seed raising mix or garden, that is already complexed with carbon. Vermicast is also super full of microbes. Putting minerals through the worm gut increases the microbe populations hugely.
- **Compost Tea.** Once you can make high quality aerobic compost with the minerals needed, you can also make your own compost tea. We make ours by hand the way I learned from Peter Procter years ago in a bucket, or you can use a small aerator.

I use a large wide topped 20 litre bucket, sitting on the ground with a stool for me to sit on. I put ½ a litre of high quality compost in the bucket and 2/3 fill with warm (luke warm) water. I then use my bare arm to stir the mix first one way, until a deep vortex forms, then stop the hand, create chaos in the water and then turn it the other way to create a vortex flowing in the opposite direction. This is like a meditation and after around 30 minutes you will notice the water qualities changing. It becomes more silky and less resistant to the touch. I continue for another 10 minutes and then take a natural bristle hand brush of any kind and walk around the garden dipping the brush in a small bucket containing some of this brew, then flicking it out over all the garden, plants and soil. It feels like a very special thing to do. You can also use a backpack sprayer so long as it's a home gardeners one and not a high pressure sprayer.

You can make aerobic brews with any of your liquid teas, comfrey, cow manure etc. Just keep using the refractometer to see what your plants need, and always add a carbon source to the brew before activating, e.g. sugar, honey, molasses, humic or fulvic acid, or high quality high carbon compost. Compost tea adds beneficial micro-organisms to your soil and plant leaves, flowers and fruit.

- **Raw Milk** is a wonderful source of antibacterial and antifungal micro-organisms. If you have blight in tomatoes or potatoes, raw milk will kill the bad boys and compost tea will replace and encourage the good guys again.

7. Seeds

Finally, if we are to be growing the most nutrient dense food possible to ensure the cells of our bodies are able to read and communicate with our food, we must use heritage seed lines. That does not mean open pollinated seed lines currently being grown by the multinationals, being bred for modern commercial situations. It means ancient lines of seeds that our ancestors evolved with and whose DNA our own human DNA is able to read and communicate with. Because we actually co-evolved with our food plants, our DNA is able to communicate far better and express in a more healthy way if we eat food grown from these seeds. (See *Deep Nutrition* by Cathryn and Luke Shanahan)

As we saw on page 14, eating food grown from hybrid seed makes it even harder for our DNA to communicate with because of the inherent mineral deficiencies in our food.

Finally -

I realise that this information will bring up more questions than it answers for some of you, but do not let that immobilise you. Maybe you also could study this through books or workshops, field days, discussion groups etc. There are a lot of wonderful books. Those that have been most useful to me are listed below.

Each of us will find a different way, but I feel it is vital for the future of the human race that we learn now to take care of our soil and to grow high Brix food. Let's not be hung up by ideology or dogma - what most of us are doing and/or have been doing does not do it. Check that out with a refractometer!?! Let's go for life.

If you are keen to get together with others in your area to share ideas and discuss your Growing Nutrient Dense Food journey, we are willing to publish your contacts on our website so you can contact each other. Let us know your name and a contact that tells people what area you are in. This is a journey for all of us, and sharing experiences and information is a great place to begin. If you have a local Weston A. Price Chapter, you may find a group of people there who would love to share this journey with you as well. (See www.wapfwellington.org.nz to check where NZ chapters are.)

Recommended Reading

This range of reading material brings you all the best information I have found so that you can do the best possible job, in the fastest and most efficient way of growing highly mineralized soil that is capable of producing high Brix crops and healthy people. It is a combination of many people's life work.

Nourishment Home Grown by A.F. Beddoe

Nutrition and Human Degeneration by Weston A. Price

The Sustainable Home Garden by John Jeavons and Carol Cox

How To Grow More vegetables Than You Ever Thought Possible on Less Land Than You Ever Imagined by John Jeavons

Koanga Garden Guide by Kay Baxter

Acres USA The Voice of Eco Agriculture

Primal Body - Primal Mind by Nora Gedgaudas

Deep Nutrition by Catherine and Luke Shanahan

Teaming With Microbes by Jeff Lowenfels and Wayne Lewis

Humanure by Joseph Jenkins

Booklets produced by the Koanga Institute

Growing Nutrient Dense Food

by Kay Baxter

Save Your Own Seeds

by Kay Baxter

200m² Urban Garden

by Kay Baxter, Joanna Cathie and Koanga Interns

Beginner Gardener

by Kay Baxter

Building a Rocket Stove

by Tim Barker

Check out our website for more information on workshops

www.koanga.org.nz