Biological Farming Round Table - John Kempf MASTER 1a.mp3

The principal fallacy that has been at the foundation of a very large misunderstanding of plant nutrition and how plants really work is the idea that plants primarily absorb nutrition in the form of simple ions from the soil solution in the form of calcium, potassium, magnesium and nitrate ions and so forth. This may be true in a hydroponic solution but it's not how real world agriculture actually works. It is not how plants actually grow. It is not how trees in the forest actually absorb nutrients from the soil. The way the natural ecosystem actually functions is that plants absorb entire microbial cells and living microbes from the soil and those microbial cells are their primary form of nutrition.

[00:00:58] The Biological Farming Roundtable podcast helps farmers explore innovative, low input, regenerative and profitable farming systems. Biological Farming Roundtable is sponsored by NutriSoil an award-winning biological liquid fertiliser made from a big worm farm. NutriSoil's purpose is to empower farmers to produce life-enriching food.

Nakala [00:01:22] Hello, everybody, my name is Nakala Maddock. I work at NutriSoil and I'm your host for today. I'm very excited to introduce our guest, fellow podcaster, John Kempf. John Kempf is the founder of Advancing Eco Agriculture, a plant nutrition and biostimulants consulting company in the US. He's an agronomist, host of the Regenerative Agriculture Podcast, a speaker and educator and now an author. So welcome to the show today, John.

John [00:01:50] Hi. Thank you for having me on. I'm very glad to be here.

Nakala [00:01:53] I'm a big fan of your podcast, by the way.

John [00:01:56] Thank you. I have a lot of fun on the podcast. I get to interview some really incredible people who see some of the most amazing things.

Nakala [00:02:03] John, your new book, Quality Agriculture, which is fantastic, I learnt so much from reading it. It's a book written directly from conversations you've had with guests on your podcast. Is that right?

John [00:02:14] Yes that is correct. I didn't set out to write a book when I originally started or didn't set out to write that book when I started the process but I did end up writing a book out of the podcast conversations, which is not the way that it's normally supposed to work, I think but that's the way that it worked this time.

Nakala [00:02:35] What I loved about it was that it was so easy to read. It was like listening to your podcast. I think so many times we hear a podcast and enjoy listening to it but miss so much of the information. Being in a book means we can read it, highlight it and go over it again. It just addresses all learning styles that we have other than your auditory. So listening to your podcasts, then reading the book, I feel like I've really had the information solidified in my mind and I could retrieve it much more easily from the folders of information I have in my head. What was your reason for putting this book together?

John [00:03:11] Many times when I completed a podcast interview, I would just be amazed by the wonderful things that people would say and that they would communicate. When I've been asked by many people to write a book and put a book together and I sat down to start this project and I started outlining all the different sections and all the different pieces that I wanted to include. I quickly realised that if I included everything, this

would be a very big book and a very big project. So then my next thought was, well, I have already recorded so many really great interviews and I've presented many webinars and I have a lot of audio recordings of presentations that I've done. Why don't I get those transcribed and turn them into a book or use those to fill in these various sections of the book that I was working on. When I started doing this I quickly realised how large an archive I had. We had an archive of 700,000 words of just podcast interviews alone. When I started reading the interviews and editing them, I was amazed. People had said really great things and shared really great information that I had forgotten and I realise that I wouldn't really be doing the conversation justice to try to pull segments out or pull snippets out of the conversation that people really needed. I personally gained a lot of value from going back and reading them again. So that is really how the book came to be. I realised that this is such great information and so valuable information that I would be doing a disservice to the guests that I had on and also to the listeners and the readers of any book that I would put together by not sharing the entire conversation. So that is how it came about. We took these conversations and edited them for clarity and published it as a book and that's how it came to be.

Nakala [00:05:13] When you're interviewing these scientists, it's direct information that farmers can use without having to wade through difficult scientific papers and journals. These scientists have been out on the farm and they've seen the science demonstrated in its holism rather than the reductionist experiments, which are only part of the whole. It's brilliant the way that they can speak so freely on your podcast and in the book about these examples. I think this book gives a fresh new vision for farmers to get toward.

John [00:05:43] My original intention for hosting the podcast is that I had developed relationships with many senior scientists within the USDA, within academia and farmers, very advanced and sophisticated farmers who had incredible knowledge and experience that was not written down and even within the academic and the science community, you can read many white papers. You can kind of begin piecing the dots together but the reality is that reading a lot of white papers and literature, it takes a lot of time. It's difficult reading and what I discovered is that in many cases, the best information was never written down. There were a lot of experiences and anecdotes that scientists had to share that were never published. So it was my desire to bring together these observations and experiences and make them more accessible to people and really to have these conversations about the things that weren't immediately obvious from reading the literature. I've sought to draw that out and the people that I have interviewed and I've been amazed. I've been really privileged to participate in some really incredible conversations about how agro-ecology really is designed to work, how soil and plant ecosystems really work together and it is really beautiful and really incredible how these ecosystems can function if we simply permit them in the way that they were designed to.

Nakala [00:07:20] I think your opening line really sets the scene of a free expression. Mainstream agronomy is based on a series of fallacies. I would agree that what we have based our decisions on in the past have been ill informed. Where do you think we could have done better?

John [00:07:37] Well there are several areas that we could have done much better in and I think to answer that question, well, we first have to first have to answer is what are the fallacies? There are several fallacies but I think the principal one in the context of agronomy and in the context of growing really healthy plants. The principal fallacy that has been at the foundation of a very large misunderstanding of plant nutrition and how plants really work is the idea that plants primarily absorb nutrition in the form of simple ions from

the soil solution in the form of calcium, potassium, magnesium and nitrate ions and so forth. This may be true in a hydroponic solution but it's not how real world agriculture actually works. It is not how plants actually grow. It is not how trees in the forest actually absorb nutrients from the soil. The way the natural ecosystem actually functions is that plants absorb entire microbial cells and living microbes from the soil and those microbial cells are their primary form of nutrition. They also have the capacity to absorb some of these nutrient ions and mineral ions that are released from these microbial processes that is entirely true but that's not their primary source of nutrition. So I think that is one foundational fallacy that has set the stage and set the framework for the ecological disaster that our modern mainstream agriculture has become.

Nakala [00:09:24] This is new science, John. What you're saying is that a plant's primary source of nutrition is not nutrients in ions but that a plant's primary source of nutrition is taking in whole microbes, including bacteria?

John [00:09:38] That is correct and this is a topic that I'm very excited by and have spent quite a bit of time studying and researching over the years. It was only in this last year that someone pointed me to the research of Dr. James White from Rutgers University here in New Jersey. He has had collaborators from around the world. He has been studying this process called rhizophagy for the last 17 years. They have published a number of peer-reviewed papers on it. I've written about it on the blog. I've interviewed him on my podcast and, he also teaches a course on the academy online. The concept of rhizophagy, rhizophagy is the term that describes root feeding. So rhizophagy means root feeding and what they have described in their research, which has been incredibly thorough and very well-vetted and replicated by other people, is that plant roots and growing root tips are absorbing entire microbial cells, particularly bacterial endophytes, in large quantities, in large numbers. Then when they absorb these bacterial cells. As the bacterial cells migrate back into the root, away from the root tip, they are exposed to superoxide within the plant and within the root. The root actually oxidises the cell membranes and strips the cell membranes off the cell. In many cases, it actually will absorb the entire microbial cell into plant cells through the process of endocytosis but not for all cells. For some of these cells, the cell membrane gets stripped off and then this naked bacterial cell moves on back through the growing root to tip away from the growing root tip. When enough of them accumulate, they trigger the formation of root hairs and then they move out through the root hair. They are sent out through the tip of the root hair back into the soil environment. Plants actually release a very specific cocktail of sugars and amino sugars and amino acids to provide the nutrients that these naked cells need to rapidly re-form their cell membranes. Then these naked cells, which have been sent out into the soil environment again now also carry the information. We know that there is horizontal gene transfer. They also carry that genetic information and various types of signaling of exactly the nutrients that the plant needs. They communicate this information to the rest of the microbial population, which then extracts, preferentially extracts and releases the nutrients that that plant needs. So in essence, plants are farming bacteria the same way that we farm livestock. This means that plants are not vegetarians. It's really interesting that the literature has described the historical literature for the last 60 or 70 years, there have been bits and pieces of research that have described the capacity of plants to absorb amino acids and amino sugars and so forth. What he is describing in his elegant research with his colleagues is that when plants are oxidising cell membranes and stripping the cell membranes off of these bacterial endophytes, the majority of the nitrogen in these cell membranes is in the form of amino sugars. So it is true these plants are absorbing amino sugars and they're absorbing more complex forms of nitrogen than just mineral nitrogen in the form of ammonium nitrate. It is occurring through this rhizophagy process.

Nakala [00:13:41] This is another layer of complexity to our ecological understanding, plants farming microbes. Essentially, what you're saying is that a plant consumes microbes, strips some of their nutrients, absorb some of them for growth and then spits out the rest. These regurgitated microbes then tell the story to the other community of microbes, what they learnt in terms of genetics and needs of the plant and then proceed to continue the whole cycle again. Is that a basic way of describing the process?

John [00:14:12] That's exactly correct.

Nakala [00:14:14] That's amazing.

John [00:14:15] It's really incredible.

Nakala [00:14:16] This is very new science. Yet you say scientists have been studying this for 17 years.

John [00:14:22] 17 years but it's been largely unknown until just the last several years, largely been completely underneath the radar. I asked Dr. White the question, what proportion of the nutritional requirements of a plant can this process provide? They haven't done the research for crop plants specifically. He didn't exactly know for sure but he said that in the wild, undomesticated plants that are not being farmed, the preliminary research suggests that greater than 90% of the plants total nutritional requirements are being supplied in this rhizophagy process. Then sometime later, I had a follow up conversation with Dr. Richard Mulvaney from the University of Illinois, where he was describing commercial corn production in Illinois and their capacity to absorb amino sugars. He is saying that in commercial corn production, 35 out of 75 test plots, which were field scale, hundreds of acres of test plots in Illinois produced no additional nitrogen response to applied nitrogen, which means that 35 out of 75 test plots, the rhizophagy process was supplying 100% of the nitrogen for a corn crop. Now, these are obviously very fertile, very healthy soils, deep topsoils that are four-foot deep black prairie topsoil. Most farmers around the world don't have topsoil like this but it still indicates the capacity and the potential that this is possible. It is possible to supply 100%, I believe, 100% of a crop's nutritional requirements, including its nitrogen requirement from this rhizophagy process. This is the foundation of plant health. This is the foundation of producing crops that are completely resistant to all diseases and all insects, including plagues of locusts and the like. It is the foundation of producing crops that have extremely high-test weight and high quality is making sure that the plant absorbs the majority of its nutrition in the form of living microbes and microbial metabolites.

Nakala [00:16:39] We have so much to unlearn and so much to learn when it comes to how a plant takes up its nutrition. Your interview with plant pathologist Dr. Michael McNeil, he's pretty clear. He's been through the transition into conventional agriculture. He says stop poisoning the soil. He strongly asserts that pesticides and herbicides are tying up micronutrients in the soil and that tillage is the better option over herbicides. What are your thoughts about cutting out herbicides in the near future for mainstream agriculture? We certainly have fear of tillage. Where is Michael going with this?

John [00:17:16] I have tremendous respect for Dr. McNeill's opinion. He is a good personal friend and I have visited him many times and have visited the farms that he has worked with and he has an extraordinary track record of success. He's been a leading agronomist, independent consulting agronomist for over 40 years in north central Iowa. So

he is certainly not an opinion to be discounted lightly. I think Michael has observed the negative effects of herbicides and insecticides and fungicides on the soil to a much greater degree than many people have because he's been paying attention, because he's been looking for them and because he has been researching and studying it even before working as an independent agronomist in his military career, where he was working with biological warfare agents in the agricultural sector and understanding pathogenicity of different microbial pathogens in the soil environment. So he understands these soil microbial dynamics and plant disease susceptibility from a very unique perspective. So I have tremendous respect for his opinion and he has been very successful at helping farmers to regenerate soil very quickly that has had tremendous pesticide exposure. So I'm less familiar with the context in Australia specifically but here in the American Midwest, there are now farms that have been applying glyphosate and fungicide insecticide applications on the same soil for almost 30 years. There are some of these farms, which have reached and some of these soils, which have reached a critical threshold where they are crashing. In one farm that comes to mind right now that Michael worked with yields went from typically being 220 to 250 bushel corn yields year after year to less than 70 bushels per acre. They stayed at 70 bushels per acre for several years until they were able to get it remedied and turned around and that occurred as a result of pesticide accumulation. So it is possible to and many farms are on this pathway right now and they are heading for the proverbial brick wall. So this is the reason for Michael's assertions that we need to stop poisoning our land. I completely agree with him on that in that context. However, when we look at the context of the environment that he is working in, he is working in an environment where they will get 25 to 30 inches of rainfall per year and soil that is deep enough and loose enough that they can till it. Without if it's managed well, they can till it and cultivate it without being concerned about excessive erosion and without being concerned about it becoming too dry that's a luxury that most ecosystems, crop production ecosystems don't have the advantage of. So I think in that context, I am cautious about endorsing the idea of using a lot of tillage for weed control. I'm very excited by some of the emerging technologies that are being developed with [00:20:50]Lawrence Duyen Loggi [0.7s] and some of the equipment manufacturers that are developing [00:20:56]in row [0.2s] crimpers and rollers for actually controlling weeds in a no till system between crop rows. This is specifically for corn and soybeans. So I think there is emerging technology and equipment that are being developed now that has the potential to completely replace herbicides. It is badly needed.

Nakala [00:21:16] Professor Don Huber, another wise plant pathologist, is very similar. He's a strong advocate for banning of glyphosate. We've had Don come here and speak at NutriSoil in Australia. Don talks about the importance of the crop planted prior to a cash crop for disease suppression. What are your thoughts about that? Can it be any crop or are there crops that really make a particular difference?

John [00:21:40] Yes, those are some of the types of tools that are rapidly being developed, I observed a robot this summer that was planting a cover crop into corn, into standing corn that was actually going down between [00:21:50]30 inch rows [0.3s] and planting cover crop seed. So I think there are there are rapidly emerging technologies in terms of robotics and in terms of different crop rotations and [00:22:03]relay[0.0s] cropping and so forth that have the potential to almost completely eliminate our need for herbicides, if not completely eliminate our need for herbicides in the near future.

Nakala [00:22:13] What you're saying is that a pathogenic fungus can actually be a nutrient providing organism if managed correctly.

John [00:22:21] This is an area that Don encouraged me to research and understand much more deeply. It was really his guidance and inspiration that guided me down a very fascinating rabbit hole of understanding what is happening in the soil microbial community to develop a disease, suppressive soils. I learnt that it is possible. I learnt that first; there is no correlation between the presence of a pathogen and that pathogen actually causing what we would call a disease. Dr. James White's work also describes this, where he actually says that when you have the desired bacterial endophytes associated with a growing root system, they will begin perhaps the right term is feeding on or they will begin extracting nutrients from these potential pathogens, such as physarum, rhizoctonia or phythium. When they begin extracting nutrients from this fungus, they weaken them. This weakened fungus now will develop an association with the crops root system but they don't cause disease. They actually become symbiotic organisms and they begin feeding the plant and providing nutrients to the plant instead of being a disease organism. So this also is a completely different way of thinking about soil biology. It's something that Don Huber and others have described historically is that there is no correlation between the presence of a disease organism and an actual disease expression in the crop. Instead, the correlation is between when you have a disease being expressed in the crop, you have the absence of suppressive organisms that would suppress these potential pathogens and this gets into a really interesting conversation about bacteria, which have a reducing effect versus bacteria, which have an oxidising effect. There's some really fun biochemistry that is going on in soils from in this regard but in essence, there are some specific crop species and cover crop species, which have an associated symbiotic microbial community that has a very strong reducing effect. Another term for this would be that they have a very strong nitrifying or de-nitrifying effect that they will convert nitrogen, mineral nitrogen in the soil to an ammonium form rather than to a nitrate form. Anyway without getting into all the biochemistry, we can simply say that there are some cover crops and some crop species, which produce a very strongly disease suppressive soil environment and not only do these microbial communities suppress disease, these are also the exact same communities, which provide the greatest trace mineral release and provide the largest quantities of manganese, iron, copper and cobalt in a form that the plants can utilise. So it's really a win-win. It's a win from a plant nutrition perspective. It's a win from a disease suppression perspective.

Nakala [00:25:53] This is the total opposite of what we are managing for when applying herbicides and fungicides. In actual fact, when we apply a preventative fungicide, we're actually killing off nutrient providing fungi that are essential to suppressing other pathogenic fungi and that using cover crops instead of herbicide can create a community of microbes that release abundant amounts of trace minerals, the minerals that the herbicide would otherwise have been tying up in the soil.

John [00:26:21] That is correct. Isn't that incredible?

Nakala [00:26:23] It is incredible. If you were a farmer and you had a problem with rhizoctonia, what would be a management tool that you would suggest?

John [00:26:32] Possible management tools would be planting specific reducing cover crops ahead of the crop that you are concerned about so crops that have what we call a reducing root system, which really means that they have a reducing bacterial community that is associated with them. Examples of these would be legumes, particularly forage legumes, such as alfalfa and clovers and so forth. Oats are very effective and very good. Buckwheat is very good and there's actually a list of these that I have put together in a webinar that is on YouTube that is titled How to Release Tied Up Manganese and Trace

Metal Reserves from the Soil Profile. I talk about how to use these cover crops to both develop disease suppressive soils and also to increase trace mineral availability. So there is a fairly short list of about a dozen or so species that we know for certain has this disease suppressive effect and this reducing effect and there are many more species for which we don't know the answer simply because no one has done the research. No one has done the homework but in general, any crops, which stimulate de-nitrification or in the case, as in the case of legumes, where you have this nitrogen fixation process, this nitrogen fixation process is essentially a reducing process that sets the soil environment to suppress all these potential pathogens.

Nakala [00:28:13] Is there a correlation between tied up trace minerals and pathogens?

John [00:28:18] The answer is yes, directly yes, in the soil particularly. It's not just the correlation. It is actually a causation so many of these organisms that we term pathogenic, which are really not pathogenic. If you have soil that is let's say you have a straw or a leaf mulch in a garden where you've applied a several inch thick layer of [00:28:48]mulch, [0.0s] it has been rained on a time or two. Once it becomes moist, you get this white mycelium growing all the way through it. Many people have observed this white mycelium going through the mulch. That white mycelium is, in most cases, verticellium in its beneficial function as a saprophyte, as a decomposer. So it is an interesting shift to think about rhizoctonia and verticellium and phythium and fusarium as being beneficial but they are not pathogenic unless they are in the correct environment with the absence of other organisms that they become pathogenic. So the interesting part is that these organisms, if we use fusarium as an example fusarium actively converts manganese from the reduced form to the oxidised form in the soil profile when it is in the correct environment that it can express itself as a disease. So if for fusarium or when fusarium infects a root system in a negative manner and it has the right environment to become infectious and to cause disease. This fusarium fungus actively converts manganese from the reduced form to the oxidised form from the plant available form to the plant unavailable form. It is a requirement for the fusarium to successfully infect a plant. It must convert the manganese that is in the plant and in the rhizosphere into the oxidised form. So the very presence of these on the environment that allows these pathogens to express themselves causes both the pathogenic fungus as well as other organisms to convert the minerals from the available to the unavailable state. This is, I think, one reason why or one aspect that Don has described of glyphosate negative impacts on soil that many people have not understood or have missed is that the application of glyphosate actively suppresses all of the organisms, which convert minerals to the available form and it enhances the microbial populations, which convert trace minerals to the unavailable form. So applications of glyphosate can shift as soil from disease suppressive to disease enhancing and they can as a result, they shift the soils and manganese supply from available to unavailable. It has a glyphosate application through the microbial process, actually has a strong oxidising effect. It enhances the oxidising organisms and suppresses the reducing organisms.

Nakala [00:31:42] Don also talks about the importance of micronutrients but also [00:31:46]metallonutrients, which are cofactors or needed for enzyme function and that if we don't have these proteins, it sits there spare and never has the opportunity to become an enzyme. This is big and a new concept for us. Can you explain this?

John [00:32:01] 80% of the nitrogen within a plant is in the form of enzymes. So enzymes are all crystalline proteins and the enzymes are, there are tens of thousands of different enzymes within a plant because each enzyme is needed to form and to catalyse a reaction to form specific bonds. So as proteins get built, you have one amino acid being combined

with another specific amino acid. Let's say for the sake of discussion, combining glycine with alanine and there is only one enzyme that can form one specific type of enzyme that can catalyse that reaction that can form that bond. So because there are hundreds of different compounds that are being formed and thousands of different bonds that are being built, there are tens of thousands of different types of enzymes within the plant and all of these enzymes are dependent on what is called an enzyme co-factor. So these enzyme co-factors can be magnesium, manganese, zinc or copper or they can be B vitamins such as vitamin B 12, cyanocobalamin, which is a metallic vitamin. So all of these proteins, all of these enzymes require the enzyme co-factor in order to function. If the enzyme co-factor is missing, if the plant doesn't have enough manganese or doesn't have enough cobalt in the case of vitamin B 12 and so cyanocobalamin then that means that these specific bonds the plant desires to build, it is incapable of building. So now you end up with a plant that has incomplete proteins. It has funny proteins and it has incomplete carbohydrates. Perhaps it doesn't develop as many lipids and has as many essential fatty acids in the plant profile because it doesn't have the enzyme co-factors that are needed to build complete proteins. So this is also a concept that is at the foundation of a great deal of disease and insect resistance. When we developed the plant health pyramid. We develop this diagram to describe how plants become resistant to different groups of insects and different groups of diseases, depending on what is happening with plant physiology. The first two levels, there's four levels in the plant health pyramid. The first two levels are simply a result of the plant becoming healthy enough, having all of the enzyme cofactors that it needs to form complete proteins and complete carbohydrates. Many of our insects, such as leafhoppers and all the other larval insects, such as alfalfa, weevil and cornier, worm and cabbage looper and tomato hornworm; there's a long list of these. All these larval insects are dependent. They can only utilise as a food source plants, which don't have all of the enzyme co-factors. So if you supply a plant with all the enzyme co-factors that it requires and it begins forming complete proteins, you no longer have any insect susceptibility because they can't utilise them as a food source anymore any more than we can use a grass or forages as a food source because our digestive system doesn't have a cellulose enzyme. We can't break down cellulose like a ruminant animal can and a larval insect cannot break down the complete proteins that our digestive system can because they have different digestive enzymes than we do. So this is really the foundation of the plant health pyramid is developing complete proteins, developing complete carbohydrates by having a completely functioning enzyme system with all of the needed enzyme co-factors and you remove disease susceptibility and insect susceptibility as a result of doing that.

Nakala [00:36:16] You mentioned funny proteins. I've heard that referred to in the top [00:36:21]dressing [0.0s] of nitrogen to achieve a higher protein, which gives a high price for grain. Is this related to incomplete proteins?

John [00:36:29] Yes, it is and I find it intriguing that many growers apply in nitrogen to increase the protein content of their grain because they're compensated for protein content, particularly for wheat here in North America. Yet there is no correlation between increased nitrogen applications and increased protein content. There is to a degree there. It does produce an initial spike but then it reaches a threshold where it doesn't go past this threshold anymore in spite of increasing nitrogen applications. This threshold is actually lower than the protein content that the wheat is really capable of and so it's interesting to observe that the growers who are producing really high protein content greens are the growers who are not just making sure that the plants have enough nitrogen but they're also addressing these metals that are needed as enzyme co-factors. Specifically now, in the case of producing high protein content grain, they are addressing molybdenum, sulfur

and magnesium. We find that when we address those in addition to nitrogen, our protein levels go up even more and often with less nitrogen applications.

Nakala [00:37:51] John if we summarize this, the application of herbicide ties up micronutrients, which are needed for proteins to become enzymes tied up micronutrients cause an environment for pathogens to then become disease-causing pathogens as opposed to nutrient-providing and protecting pathogens. The lack of micronutrient co-factors also means that proteins cannot form into hormones or signaling molecules. So a plant is more vulnerable even when we thought that applying the herbicides would remove the weeds, which we thought were stealing the plant's nutrients and water. We're basically putting plants in a less desirable position.

John [00:38:32] And as a result, it also creates insect susceptibility. Yes, you described the entire sequence. When you really understand the sequence of how this all works together, it becomes so obvious that the use of pesticides, the use of herbicides, the use of glyphosate actually tremendously increases the need for additional fungicides and insecticides and herbicides in the future because it compounds. It perpetuates this system of disease-enhancing and insect-enhancing ecosystem. So you're absolutely right. It is and this is why in the podcast interview with Michael [00:39:15]McNeil [0.0s] that you referenced, Michael takes a very unique approach with the growers that he works with when they are ready. It doesn't always happen in the first year but when they reach a certain point, he uses the language that they step off the cliff. They go from using a lot of herbicides and insecticides and fungicides to using zero in one year. They just stop completely and they replace them with managing nutrition, making sure that plants have all of the enzyme co-factors that they need and addressing all their micronutrients. They're very successful and of course, they have Michael there to coach them and guide them. This is also the consulting work that we do. They are very successful at immediately in the first year, increasing yields, increasing quality and eliminating all the pesticides and that is incredibly exciting and a lot of fun. Then it just continues to get better and better every year after that.

Nakala [00:40:17] John, to step off that cliff, there's a fine balance in nutrient management. We need to stop providing all of the nutrients that traditional agronomy recommends for that plant because the over application of nutrients is what is causing the need for herbicides, pesticides and fungicides because the nutrient cycles are open, they are not closed.

John [00:40:38] Again, you are exactly correct. We find that the one tool that we use a lot in our consulting work is plant SAP analysis. We also use beginning to use the Haney soil analysis and different types of soil and tissue analysis that we've used over the years. A foundational cause of many of these nutrient imbalances is the excessive application of nitrogen and potassium, in some cases, also phosphorus, but mostly, usually nitrogen and potassium. It's very common when we begin working with a grower to reduce nitrogen and potassium applications. Nitrogen, it's common to reduce from 30 to 70%. Potassium, it's common to reduce from 50 to 100%. We have the data. We now have a database with some over a million data points that clearly describes that we have every time we have these high potassium and high nitrogen levels; we have tremendously increased disease and insect susceptibility. Amazingly enough, we have reduced yield. This is the piece that I find so amazing. Mainstream agronomy has approached plant nutrition with a singular emphasis and a singular paradigm. The one emphasis has been to balance nutrtion, to get the highest yields possible. The paradigm has been that we use soil analysis or a tissue analysis and we look at whatever is low and we add what is missing that's the framework

that we have all been trained in. We simply add what is missing. We add what is low but and this is based on the law of the minimum thinking that and we've all seen the barrel with the broken off staves and we say that the nutrient that isn't the lowest supply and the least supply is the nutrient that is going to limit plant performance. I find it interesting, I haven't yet seen one of those barrels that included water and carbon dioxide but those are most commonly the limiting factors, not the attrition. This thinking completely excludes the other side of the coin. The other part of the equation is the law of the maximum and the law of the maximum is that it is the nutrient, which is in excess that creates a deficiency of something else, which is the greatest limiting factor to yield and quality. What we have actually observed is that it is the nutrients, which farmers apply in excess, specifically nitrogen and potassium that most generally limit crop yields and quality and overall performance. Nitrogen covers up a lot of imbalances and makes it look nice and green. So you don't actually know what's going on anymore.

Nakala [00:43:32] In Australia [00:43:33]tissue [0.0s] and [00:43:34]SAP [0.0s] tests are not understood or utilised as much as they could be and there are great learning resource and tool for use to identify and address the law of the maximum.

John [00:43:44] It is an extremely exceptional tool and it has the potential to save farmers tens of thousands or even hundreds of thousands of dollars. It is a tool that I believe; my own personal experience has been that every time growers begin using these tools, particularly SAP analysis, which is the one that I have the most experience with. They rapidly observe how much money it is saving them and they can't imagine trying to farm without them. In our consulting work, we will select a few example fields from a farm and test them every 14 days to the growing season. I believe this is imperative to do constant testing through the growing season, not just to test when there is a problem but also to test constantly through the growing season because then this allows you to see the nutrient curves. It allows you to see how effectively nutrients are being absorbed from the soil and whether the fertiliser you apply to the soil is actually effective or not when it's being absorbed compared to when the crop needs it. All of a sudden you begin to observe that when the crop approaches a certain growth stage, all of a sudden perhaps phosphorus or calcium just takes a deep dive and the numbers drop way down. It allows you to manage nutrients differently, not just in this season but also to think about how you might do apply different amendments for the following season. The most significant piece has been that when growers begin using SAP analysis in the great majority of cases, they begin reducing their nitrogen and potassium applications. The numbers that I mentioned earlier anywhere from as little as 30% to as much as 100% of potassium applications may be discontinued. Many times farmers are saving anywhere from 40 to 100 dollars an acre on saved fertiliser costs. All of a sudden, it makes the SAP analysis very inexpensive. In fact, it makes not doing it extremely expensive.

Nakala [00:45:56] It's not only the fertiliser costs, it's the hidden costs that over-application rolls on with, more use of herbicides, fungicides, the hardening of soils, the reduction of water infiltration, the health of the farm, the pollution of the water and the ecosystem, the nutrient integrity of food, the decreased profitability of farming, there's a big knock on effect from over-application of nutrients.

John [00:46:21] You're absolutely right. It's also causing one other thing. The over-application of these fertilisers directly suppresses the microbial community that we would seek to create to supply plants with nutrition during the rhizophagy process. So if we apply nitrogen at planting or as [00:46:42]a side dress, [0.4s] then I think what we often fail to think about and to understand is that these ionic salt fertiliser applications are actually

corrosive and oxidise cell membranes of microorganisms in the soil profile. They largely shut down this microbial symbiotic relationship that the plant is supposed to have with the soil microbial community. So the result is that these fertiliser applications actually create a dependency on more future fertiliser applications. What I've observed and it's really empowering and exciting and it creates a lot of responsibility at the same time, what I've observed is that these soil and plant ecosystems are always moving in a cycle. Either they are constantly improving where the plants are photosynthesising and producing large volumes of sugars, sending them out to the microbial community. The microbial community is extracting minerals from the soil a mineral matrix and providing them to the plant. The plant is becoming ever healthier, producing ever more sugars. This is a self-perpetuating regenerative cycle and then, on the other hand, you have the degrading cycle where plants are not healthy. They're not photosynthesising well because they've been exposed to toxins and to fertilisers and they are susceptible to diseases and insects. They are not producing very many sugars. They're not feeding their soil microbial community. The microbial community is suppressed and that creates the need for ever more fertiliser. So one of these cycles is regenerating health, it's regenerating soil health. It is regenerating plant health. It is regenerating livestock health and ultimately human health. The other system is going in the exact opposite direction. It's constantly degrading the ecosystem. The piece that I find interesting is that the only difference between these two systems, when I look at what is the leverage point? What's the tipping point that determines whether we are moving in one cycle or in the opposite cycle? Are we going clockwise or counterclockwise? The only difference between these two systems is the management decisions that the farmer makes. It's completely our responsibility. We have the capacity to guide the ecosystem in either one direction or the other. It's really our choice to move in the direction that we want.

Nakala [00:49:23] Dr. Jerry Hatfield, a plant pathologist, talks about this concept in the book Genetics by Environment By Management. What does he mean by this? Is it a bit like genetics loads the gun, but the environment we are managing for pulls the trigger?

John [00:49:39] Well, I would describe it a bit differently than that. Genetics describes the potential but an environment determines how much of that potential is actually realised. So we know that genetics, all the modern corn genetics that are available today have the capacity to produce 1,100 bushels per acre. We routinely harvest only I think the national average here in North America is 155 bushels or something like that. So we're harvesting about 15 or 20% of what that plant and what that seed is capable of and that is because it is suppressed by the environment. When we consider what is the environment in the agricultural context, it is really a climate mediated by nutrition, and that's a very important phrase, climate mediated by nutrition. It is so easy for us as farmers to immediately begin when things don't go well. We want to blame it on the weather. It was too dry, too hot, too wet, too cold, too this and too that. In reality, nutrition can mediate plants responses to climactic extremes to an extraordinary degree. Now, certainly it is entirely true that we can still have climactic extremes and hailstorms and so forth, fires that destroy our crops that we know that nutrition cannot overcome but nutrition can overcome much more than we give it credit for. We have learnt that with nutrition, when plants have really good nutrition, we can reduce the freezing temperature of either a freeze or a frost by at least six degrees Fahrenheit and in some cases, more. So it's possible to produce a lot of freeze resistance. It's possible to produce a lot of drought resistance. It's possible to produce a lot of heat resistance simply based on how we manage nutrition. So we can increase the system's resiliency or we can decrease it. So at the same time as you have a national average of 155 bushel corn production, you have some growers who are consistently doing 350 to

400. It is those growers who are managing the environment and they're managing the plants responses to the environment by managing nutrition.

Nakala [00:52:08] It really all comes down to providing an environment that enables the plant to access all of its nutrition.

John [00:52:16] Well, it's easy for us as farmers to understand that, well, we can have a variety of seed that comes out of the same bag and we can put it into two different fields with two different soil types and get two completely different types of plants. One field might have if we take a small grain crop such as barley or rice or wheat, as an example, in one field, it might be two metres tall and then the other field, it might be a one metre tall, but it's the same seed. So it's not the differences in the seed that produce the yield responses, it is the differences in the environment, specifically differences in nutrition and just continues on that pathway further out. Imagine what might it look like if plants had optimal nutrition? What if plants had perfect nutrition and the perfect microbial community? I should point out that I'm using the word nutrition. Historically in agriculture, when we use the word nutrition immediately, we start thinking about calcium, magnesium, zinc and copper and so forth but that's not what I'm talking about. I'm specifically talking about microbial nutrition. So it's really through this rhizophagy process, bacteria delivering nutrients to the plant. So when I talk about nutrition, you can't really separate that and disassociate it from biology. It is really mineral nutrition and biological delivery. So when you optimise those systems, all of a sudden it describes we now have a basis for understanding how some of these crops, as in with the example of rice and the system of rice intensification that has been popularised by Dr. Norman Uphoff at Cornell University. They've been increasing rice yields by a factor of four to five x four to 500% yield increases on the same soil side by side, simply by managing nutrition and plant physiology differently. So we know that our genetic potential of our agricultural crops is largely untapped. We know that we're consistently harvesting only 15 to 20% of what our genetics are capable of. This means that the future improvement of agriculture performance is unlikely to come about from further increasing genetics. Instead, we have to address the limiting factors right now, which are nutrition and biology, because right now our limiting factor is not genetics. It hasn't been our limiting factor for decades.

Nakala [00:55:01] Do you think we can get to a point where nutrition for crops via management is totally provided in the soil?

John [00:55:09] Yes, I believe that is possible because I've actually observed that in the field on a number of occasions, different farms. I am not keeping track. So I don't know exactly but I know that there are at least hundreds, perhaps thousands, but certainly hundreds of farms here in North America who are at least matching, if not exceeding yields in the local region with zero fertiliser applications.

Nakala [00:55:36] We really need to be treating plant health in the same way we treat human health. If a human is not able to access its required nutrition from its diet and management of things like water, sleep and stress, then proteins are not able to form the required enzymes and hormones that we need for optional health. We start to get autoimmune diseases like Parkinson's disease, thyroid malfunction and cancer. As an aside, there are studies that suggest we are getting these autoimmune diseases even if we do have a healthy diet because of the chemical load in our food, the environment and the nutritional integrity of that food. If we want healthy plants, we need to change our mindset to see them as we would our own body.

John [00:56:19] Yes, you are correct. I would add that I think most of us don't know what a healthy plant actually looks like anymore. We've forgotten what healthy crops actually look like. Michael McNeil actually pointed this out to me when he said that he helped to author some of the original Iowa corn [00:56:47]grower guides [0.0s] back in the 1970s. He said in the 70s, the photos of a mature corn crop in the Corn Growers Guide were photos of plants where the entire plant was dark green and the leaves were still photosynthesising from the bottom to the top and the ears had fully matured and dried down. He said for a really healthy corn plant and he still has growers who are doing this today, they're harvesting corn at 17 to 18% moisture content green when there is still moisture squirting out of the rollers on the combine. So the plants in the leaves are still green and actively photosynthesising. The green itself is physiologically mature, that doesn't happen today, with the exception of a few growers who are paying attention to these principles for the most part. What happens is a corn plant begins dying and it dries up from the bottom up and from the top down where the plant is sucking all the nutrients that it can out of the bottom and top leaves and moving them together into the ear. The result is a corn plant where the leaves are completely brown and hanging down and the stem is dry but the grain has a high moisture content of 25 to 30% moisture content. This is the difference between dry down and die down. Today, most corn doesn't dry down. It dies. So this is just one example. I've been speaking about green crops in my examples but the same also holds true for fruit and vegetable crops. Many of us don't remember what really healthy plants actually look like and the way they behaved before we started the widespread use of insecticides and fungicides 60 or 70 years ago.

Nakala [00:58:41] That's a perfect lead into the next interview in the book with Gabe Brown, who uses no fertiliser, pesticide or fungicides in his farming system; Gabe talks about soil being the key to a downward trend in human health and that it's the plant's secondary metabolites that move through the plant and into our bodies is the key to it all. Can you explain what a plant secondary metabolite is?

John [00:59:05] Plant secondary metabolite is the term that is used to refer to all of these more complex compounds that plants produce as plant protectors. So there are phytoalexins there, terpinoids, there are bioflavonoids in plain English; we could simply call them essential oils. All plants produce these compounds as protectors to protect themselves from ultraviolet light, to protect themselves from insect attack, from overgrazing. Examples that we might be familiar with might be tannins in oak or the oils that are found in eucalypt or resveratrol in red wine, lycopene in tomatoes, anthocyanins in blueberries. These are some very specific compounds that are generically referred to as plant secondary metabolites. There are tens of thousands, hundreds of thousands of these different compounds. So all plants produce these immune compounds to protect themselves. In essence, they are the foundation of the plant's own inherent immune system. Plants have immune systems much in the same way that we do. They produce their own immune compounds. These immune compounds that plants produce also enhance our immune systems, just as in the compounds that I just named, as in resveratrol and red wine or anthocyanins in blueberries. Blueberries are considered to be very good for your health and to enhance your immune system because of their anthocyanins content. It is this anthocyanin content within the blueberry that this plant actually produces to enhance its own insect resistance and disease resistance. So this is really at the foundation all plants produce these compounds at a minimum baseline level but when they become really healthy, the levels and the concentrations of these secondary metabolites can increase dramatically as much as 20 to 30 times. So you can have one container of blueberries that let's say you have two different containers that are a kilogram of blueberries each but one kilo of blueberries has 20 times higher anthocyanins content

that kilo of blueberries is going to have a much greater impact on your well-being and your immune system when you consume it, than a kilo of blueberries, which has greatly reduced anthocyanins content. So this is really the foundation for how we can have a legitimate conversation about growing food as medicine is when we grow plants that have these functional immune systems, robust immune systems and they're completely resistant to diseases and insects, not only are they resistant, but they also transfer that immunity to the people who consume these as food.

Nakala [01:02:03] Essentially, what we need to do is change the question we are asking of growers and what we are testing for to gain a premium price for regeneratively grown food. It's not does the way we grow food produce more nutrients, it's really does the way you grow food, produce more secondary metabolites.

John [01:02:22] You're exactly correct. This is a very important point because in our experience, we have not tested plants secondary metabolites a lot. There are very few people I don't know but very many people that have. What we have observed is that the healthiest plants, the plants, which have the greatest degree of disease and insect resistance, may not have the highest concentrations of, let's say, magnesium, sulfur or calcium. There is a very interesting reason why this is true because conventionally grown plants or maybe I should use the term plants where the nutrition is not balanced. When the nutrition is not balanced, it's possible to have really high levels of magnesium or really high levels of calcium and still have low levels of these secondary metabolites. So if you look only at the mineral content, the mineral content of an unhealthy crop can actually be very high but the secondary area metabolite content will be much lower.

Nakala [01:03:32] This is such a disputed area, especially in the grain price setting and market creation. It's proven nearly impossible to prove that regeneratively grown grain is higher in nutrient content. The variabilities, they're just too high. The market they're trying to build now is regeneratively grown grain that has a low or no chemical residue present but if we can test for secondary metabolites, it's a potential game changer for regeneratively grown food. We're having the wrong conversation.

John [01:04:03] We really are having the wrong conversation. Instead, we should be having a conversation. We should be asking the question, how do these foods influence our bodies? How do they influence our immune system? So in reality, there is even a question mark in my mind about whether we should be measuring the anthocyanins content of blueberries of variety A versus variety B. The question we should be asking ultimately is what response do these blueberries produce in the human body versus some that are grown in a different way or animal products, for example? We can do this across. Think about this across any different crop, species or type. So this actually reminds me of a fascinating interview and conversation that I had with a French organisation named Bleu-Blanc-Coeur. I interviewed Pierre Weill. I've had many incredible conversations and surely is close to the top of the list. They actually did the research on animal products. They studied meat, milk and eggs, meat from different livestock. I think both hogs, poultry and cattle. They were specifically measuring the omega-3 to 6 ratios and the impact that they had on human health. They discovered that when you have a broad omega-3 to 6 ratio, then you have a pro inflammatory response. It actually produces inflammation in our bodies. If you have a narrow omega-3 to 6 ratio, you have a very strong anti-inflammatory response. So they have published several hundred papers on their research so far and they have established a quality brand for animal products that is called Bleu-Blanc-Coeur and they are now, this brand is being used in 18 different countries in Europe. What is really fascinating for me, the most amazing accomplishment of all is that they have

developed this consortium of people within governments, academia, the medical community and laypeople, the consuming public that they have created so much and desire for healthy meat and healthy animal products that they are paying the farmers a premium to produce a higher quality product that actually gets measured and tested before it gets sold and yet the cost to the consumer is the same because the processors, shippers and packers have so much desire to have access to this market that they're willing to pay the difference. They're willing to pay the farmers more and charge the consumers exactly the same. So they've had this incredible success. They now influence, I believe, he told me, the neighbourhood of 20 to 30% of the total livestock supply chain in 18 countries in Europe. This to me, is an incredible accomplishment. They have gone straight to the end result. How does the quality of the meat influence human health? They have documented that, that is, I believe, what we need to do if we want to have a legitimate conversation about producing nutrient dense food or food that is better for you.

Nakala [01:07:26] It seems we need to be educating consumers once we have the evidence, secondary compounds, they can be antioxidants and phytonutrients. They're all buzzwords in human health and regenerative farming practises are what can produce these. It's like the evidence is there but we haven't quite joined the dots yet. It's not sustainable for a business to be absorbing the price or subsidise consumers buying health food. At what point can we pass this price onto the consumers?

John [01:08:01] That's a big conversation and I have a different perspective from most, I suppose, and my perspective is that to some degree, consumers today are paying what the product is worth. Farmers are having a difficult time making money and breaking even and they're producing junk. They're producing food that actually harms people's health and suppresses their immune system rather than enhances it. So then when you ask the question, I asked myself the question, if we really want to produce change in the agricultural landscape and we want farmers to begin farming differently, what is the pathway to bringing about that change? I believe the pathway to bringing about that change is to make sure that farmers can be more profitable, can be more successful financially. I believe that you achieve what you incentivise. If we can offer an economic incentive that is going to create significant change very quickly. However, I don't believe that giving farmers an economic incentive and showing them how they can be more profitable is going to come from consumers. I may be wrong about this. I would be happy to be mistaken about it. I have actively looked in the agricultural and food landscape to try to identify when has there ever been a wave of positive consumer demand that actually changed the food industry that caused the rapid change? There have been several small-scale changes, as in the case of organics here in North America. We now have, I think, maybe still less than 10% of the total food supply chain as organic certified. So that's been a small, incremental change that took 30 years to produce that's not the type of change that I would desire to see in the agricultural landscape. I would desire to see a tsunami of change where we change management practises on 50% or 80% of the farms rather than just on 10% of the farms. So that level of change there have been a few cases of negative demand where, for example, when Upton Sinclair wrote The Jungle, meat consumption here in North America dropped by 60% in a matter of weeks and stayed depressed for four months before they eventually started the inspection service. So there are a few cases of negative demand. Another case would be the inclusion of hormones in fluid milk where there was significant negative demand. When you think about positive demand producing change, I am producing a rapid, large-scale change. I have struggled to identify a single case where consumer demand produced significant large scale, positive change. In every case where there was large-scale change, it came about as a result of businesses creating that change by creating new products. You consider the use of

genetically modified corn, for example. There was no consumer demand for GMO corn when it was first introduced and yet, in a matter of a few years, 90% of the acres were planted into GMO corn. There was no consumer demand for the iPhone when it first came into being and yet smartphones are now in the significant majority. So I believe that to have regenerative agriculture become the mainstream quickly, we need to simply show growers that they can be more profitable and more financially successful by managing plant nutrition differently and by managing soil biology differently than the way they're doing today. This has become our marketing mantra at advancing eco-agriculture. Our tagline is very simple. We help you make more money and be more profitable by managing plant nutrition differently that's it. It's not uncommon for us to see significant yield increases and quality increases and help growers become a lot more profitable. I believe that's really how you drive change and then this whole conversation about healthy food and food as medicine that becomes a secondary outcome. It occurs naturally. It occurs organically, just simply as a result of changing the farmer's method of farming in the desire for greater profitability.

Nakala [01:12:50] In your interview with Dr. Khris Nichols, you tell her about your findings where healthy biological rhizosphere are producing these plants secondary metabolites in abundance. Chris says that they're finding their way into food. Then you interview [01:13:05]Matt Kleinhenz [1.1s] who talks about the quality of produce and the demand for it in the marketplace. He poses the question, how can a farm become an instrument of public health?

John [01:13:17] Well, I believe that is what we should desire to be and should be. I will go further to say that those farms, which actively seek to become instruments of public health, are certain to be those farms, which are the most financially successful and the most profitable. It's been our experience that when we begin managing plant nutrition differently, the highest, let me say it this way, when we developed this diagram of the plant health pyramid, it is the plants at the top of the pyramid that have the highest concentrations of these secondary metabolites, which have the greatest degree of disease and insect resistance. It is also those plants, which are the highest yielding and produce the greatest marketable yield and are the most profitable. I should offer some context when I talk about higher yielding. It is common in agriculture to expect that when we begin at managing plant nutrition differently, perhaps we get a 5% or a 10% yield increase or if we do exceptionally well, maybe we get a 15 or 20% yield increase and that is not an uncommon result even for us, when we're working with broad acre crops and crops that have been highly developed from an agronomic perspective. So when I talk about crops that are highly developed, an example of that would be a strawberry crop. Twenty years ago, the average yield for strawberries in California was 4,000 [01:15:02]flats [0.0s] per acre. Today, it's 10,000 [01:15:05]flats [0.0s] per acre. Yields have gone up in the last 20 years by 250%. So this is an example of a crop that is highly developed where for the last 20 years, many people have studied this plan's nutrition and how to optimise it. This increase in yield, some of it came about as a result of genetics but most of it came about as a result of optimising the environment. Going back to what we were speaking about with regarding Jerry Hatfield's comments earlier, it was not about genetics. It was about optimising the environment and optimising the nutrition specifically. So that would be an example of a highly developed crop. There are very few of our reproductive crops that are highly developed crops. Most of them are not developed to that degree. So it is quite common for us when we begin working with growers of some crops, such as a tree, fruit, stone fruit and nuts and so forth, to get 20, 30, 40 and 50% yield increases and in many cases, even higher than that. So when I talk about getting a yield increase and managing plant nutrition differently to become more profitable, I'm not talking about a 5% increase in profitability.

I'm talking about a significant increase in profitability and this is, I believe, the foundation of our success as a company here in North America is that we've focused intently on how can we help growers be more profitable by managing nutrition in a regenerative manner and that is what has led to the rapid adoption of these regenerative systems on a much larger scale.

Nakala [01:16:50] [01:16:50]Matt Kleinhenz [0.4s] hit the spot when he said what we need to do while we're working all of this out is we need to collect all of the reductionist science, which has taught us a lot and re-assemble the pieces into a holistic framework. When we talk about holism, it's not just the facts, it's intuition and spirituality. We know it's healthier in a holistic framework, agriculture, the environment, the healthcare system, it's more profitable for everyone.

John [01:17:21] Well, speaking about science is necessary and further developing the science of these regenerative agricultural systems is obviously a topic that I'm personally very passionate about and excited about but I think that the reliance on, "science" has been very damaging for agriculture for a few very important reasons. The first reason is that agriculture is inherently an ecosystem of ecosystems. There are so many connections between biology and plant health and different microbial communities that we still don't understand and that we may never understand or likely to never understand. There are so many dynamics at play that we can't comprehend them all. This is a challenge for the scientific method because one of the foundational paradigms of using the scientific method is the use of single factor analysis. What happens when we change one thing and when we understand ecosystems all of a sudden we realise that it's impossible to change just one thing because when you change just one thing, everything else also changes in ways that we don't even fully appreciate. To the degree that we can, it is useful to make our case using a scientific perspective and we also need to be very clear that there are aspects of the work that we are doing that science doesn't explain, not because it can't, but because we don't know the questions to ask or we don't know how to measure what we should perhaps be measuring. So we need to recognise our own inherent constraints within using the scientific method and to say that from a holistic perspective, there comes a time when we need to look at macro performance and macro results rather than single factor analysis and evaluate the overall system from that perspective.

Nakala [01:19:44] It's holism we need to embrace. This concept was the de-compartmentalised well before industrial agriculture came, when the early philosophers began to change our thinking of nature from a spiritual world to a more mechanical world. We saw nature as a machine. We need to reverse hundreds of years of building a new mindset and return to complex whole ecosystems that are dynamic and multifaceted.

John [01:20:11] I think if we used this perspective, this holistic perspective a bit more and we asked more questions, it would have revealed the fallacies in some of our mainstream agricultural thinking much earlier. I know that there have been many people who have asked these questions but we should have asked the questions much earlier. How is it possible for some of these plants take bamboo, for example, bamboo produces an incredible amount of biomass. It is a photosynthesiser that is as efficient as corn. Nobody is fertilising bamboo. We're not putting on nitrogen and potassium applications. Where is it getting its nutrition? I've seen and I've observed this personally, I have seen many photos of trees growing out of cliff faces and growing out of rocks. There is no soil present. There has never been any soil present. How is this tree getting nutrients? Where is it getting its nitrogen and potassium from? How is it accessing them? I think if we were to look at some of those examples from a big picture perspective and we would say, well, obviously this

tree growing in a cliff cannot possibly be absorbing nitrogen in the form of nitrate and ammonia from the soil profile because there is none present. So where is it coming from? So I think if we were to look to these natural ecosystems and think about what we could learn from them and then apply those to our agricultural ecosystems, we have only begun to scratch the surface of the possibilities. I described or mentioned Dr. Norman Uphoff's work in popularising the system of root intensification or system of rice intensification, as it was known, where they have simply begun managing the rice plant differently optimising its physiology and producing four or five times higher yields. I believe that we have that same future ahead of us with our agricultural crops where we will learn how to increase our yields by two to three times on many of our agronomic crops simply by managing them differently. Right now, we have these emerging phenomena here in North America of growing corn on 60-inch rows instead of 130-inch rows. So they have the exact same plant population per acre but the row spacing is twice as far apart. When the plant population is identical, the yields are identical. As long as there is no cover crop or no other competing plants but then if you plant another crop in between the 60-inch rows or a cover crop, for example, you now have these plants also photosynthesising and you get a slight yield loss. You might get a 10-bushel per acre or so yield bump or yield loss but that is a 10-bushel yield loss in exchange for a cover crop that is a metre tall across the entire field that can offer two or three months of grazing that's a very worthwhile trade off. So I think when we begin looking at some of these ecosystems differently, we will discover that managing plants for the optimal ecosystem performance rather than for the individual monocrop performance is going to give us compounded results and compounded returns.

Nakala [01:23:51] I have known many successful regenerative farmers and what stands out a lot of the time is their ability to reach a higher level of spirituality, which helps them farm the way that they do.

John [01:24:01] I think it's interesting that you bring up spirituality at this point in the conversation and that inspires me to share some thoughts and observations that I've been thinking about. I am a farmer. I grew up on a farm. I'm no longer actively farming today in the last couple of years and I miss it. I'm looking forward to getting back into farming again sometime soon. In our consulting work and our agronomy work, I try to deeply understand the root cause. What is the foundational root cause that allows certain disease or a certain insect to express itself? What's the root cause of the problems that we are facing because if we can identify that correctly and resolve it, then of course we resolve the disease or insect problem. Similarly, I have also tried to think in the same way about what is the root cause of how have we gone wrong in our thinking about agriculture What is the thinking that has allowed us to adopt a method of agriculture that is, in essence, raping and pillaging the planet? It's commonly described that it is this mechanistic paradigm as mechanistic worldview versus a more holistic worldview but that excludes the spiritual dimension from the conversation. I think that may actually be where the root cause lies and for the most part, I don't know if this is as true in Australia as it is here in North America, I suspect it might be, but I don't know for certain. We have our farming community comes generally from a very strong Judeo Christian worldview background. I believe that there are two paradigms or two aspects of this worldview that have not served us well in agriculture. In fact, they've been at the source of this method of agriculture that is really damaging to the planet that God has given us to be the stewards of. The first of these mind frames, these world views is the idea of having dominion over that we are to have dominion over the creatures and the landscape and that we are to dominate it and that we are to bring it underneath our control. This is a conversation that's perhaps longer than we have time for but when you look at the original Hebrew and what this truly meant and even English as a second language for me, I read it mostly in German. We also have

a different translation. The meaning of the original Hebrew is to be a minister of or to be a steward of where we are actually to minister to the creation and to steward it, which is a completely different perspective than to have dominion over it. So I think that is one that is a significant misunderstanding and the second is perhaps even bigger. The second one is the idea that the land is cursed that it shall always bear thorns, thistles and weeds and that we will always have pestilence, disease and insects. We have missed the verse in, I think, its Genesis 8:21 after Noah emerged from the ark and offered a burnt offering and God made a covenant with man and with Noah and Genesis 8:21. I'll paraphrase this a little bit because again I'm used to reading this in German. So I am mentally translating it but he said something to the effect of I will never again curse the ground for man's sake, for the thoughts and imaginations of a man's heart are evil from the days of his youth or something along those lines. You should look up the exact translation. We remember the second part of this verse but we completely forget the first. I will never more curse the ground for man's sake. This means that the soil is not cursed anymore unless we chose to believe that it is cursed and we create that reality, which actually brings me to one more point and then we can change topics. I believe that if we truly believe that we are the sons and daughters of God then that means we are his ambassadors here on Earth and we are here to co- create the reality that he would like to see here on Earth. Creation is not something that happened at one moment in time in the beginning. Creation is something that happens new each moment in time and as the sons and daughters of God, we are here to co-create the reality that He would like to see. So if we chose to co-create a reality that the soil is cursed, we need to be clear on the fact that that is a choice that we have made. It is not the choice that He intended for us. We have observed that almost invariably the farmers and the growers, which have extraordinary success on their operation are those growers, which develop a deep empathy for the landscape. It's fairly common to acknowledge that the good livestock producers have empathy with their livestock that a good dairy farmer can walk through a group of dairy cows and say there is something wrong with that cow when there is absolutely nothing visual that he can point to describe why he is sensing that to be true. He just feels it. He knows it. He knows there is something off with that cow and we think this is perfectly normal for livestock producers. For some reason, it hasn't become accepted to be. It's not as common for crop producers and yet we have observed that the most successful growers will walk into a field or into a block of trees and they will say there is something wrong with this block. There's something off. I don't know what it is but something doesn't feel right. This is a sense of developing empathy with the landscape. It's absolutely true that the most successful growers all share this characteristic.

Nakala [01:30:50] I loved learning in the book from the entomologists, Dr. Jonathan Lundgren [01:30:54]and Tom Dykstra, [1.2s] they give us the perspective from an insect and I think we can really learn from them. Any animal really, they know what plant is sick and what plant is healthy. What things do you think that we can learn from an insect?

John [01:31:10] I think what we can learn from insects, insects and diseases are really the messengers. They are here to tell us when plants are unhealthy. They are nature's survival of the fittest mechanisms. They are here to take the unhealthy plants out of the system before they can reproduce and before they can be consumed by animals. Then, of course, we, in our not so great wisdom, sprayed them with toxins and feed them to people, which is really not a smart idea. In reality, diseases and insects are simply nature's survival of the fittest mechanisms. They're here to take unhealthy plants out of the system so what this means is that when you have a plant or a crop that is susceptible to insects, it is not fit for human consumption. This is the important point because I've on occasion, I've heard fruit growers say that when people complained about worms being in the fruit, they say, well, if

it's good enough for the worms to eat, then it's good enough for people to eat because it doesn't have any toxins in it that couldn't be further from the truth. The exact opposite of the case, if it is fit for the worms to eat, it's not fit for human consumption because those insects are present as an expression of an unhealthy plant.

Nakala [01:32:31] John, it's time to wrap this conversation up. Fantastic book, I learnt so much from it. Where can we buy it?

John [01:32:38] The book is Quality Agriculture and you can buy it on Amazon Australia or I think anywhere on Amazon. You can also buy it from Acre's USA. If you would like to learn more about these various topics that I've been speaking about and writing about, the central hub where you can find just about everything is at my website, johnkempf

Nakala [01:33:04] Please follow the Biological Farming Roundtable podcast. Share it with your friends and networks. I'm Nakala Maddock and I work at NutriSoil, a liquid biological fertiliser made from a big worm farm whose purpose is to empower farmers to produce life-enriching food.