John Kempf Outlines the One-Day Seminar He'll Give at the Soil and Nutrition Conference on Thursday, February 9, 2012

For an audio version of this outline, click here [http://dl.dropbox.com/u/29628194/John%20Kempf%20outlines%20Soil%20and%20Plant%20Health%20Presentation%20set%20for%20February%209%2C%202012.mp3].

I start with a foundation and then I progress through the day from there. So I will start with the physiological differences between healthy and unhealthy plants. Why is one plant susceptible and not another? That relates to the different plant compounds – the proteins, carbohydrates, fats, oils, lipids, and the plant secondary metabolites – the phenolic compounds, and essential oils in the plant.

I will describe how a plant forms all of these different compounds through the energetic process of photosynthesis – how they absorb sunlight, energy, carbon dioxide from the air, water from the soil and form simple carbohydrates -- the primary one being glucose. And this glucose is the foundational building block for build all the rest of the plant's compounds – the carbohydrates first; and then the proteins, with the addition of nitrogen to the carbohydrates to form amino acids; and then lipids, fats and oils – the energy storage component; and finally onto the essential oils, which are the plant protectors. I'll describe how these compounds are created, what function the serve in the plant, and how they vary in health plants and unhealthy plants.

This will tie into protein synthesis and proteolysis. Proteolysis means protein break-down, by which we means that the plant does not have the ability for form complete proteins because of shortages of key trace minerals, enzymes, and co-factors. Moreover, environmental stress can make the plant break down proteins that it has previously formed. So we have a plant that has high levels of soluble amino acids and soluble nitrogen compounds, which is the food source that insects digest. They have a simple digestive system. They do not have the enzymes that are needed to break down complete proteins.

This will tie into the stages of plant health and the transitions between them. First, I'll talk about how the plant begins forming complete carbohydrates. In what I see as the first stage of plant health, the plant is photosynthesizing properly, and begins forming complete carbohydrates. Then, once it is forming complete carbohydrates, it will be resistant to all the soil-born fungi: Alternaria, Rhizoctonia, and verticillium wilt.

And then, as the plant becomes healthier, it progresses to stage two where it begins forming complete proteins, at which point it becomes resistant to the insects with a simpler digestive system that is not capable of digesting complete proteins and carbohydrates. They can only digest amino acids and monosacarides. Examples of insects with simple digestive systems include aphids, almost all larval insects such as army worm, cut worm, cabbage looper, corn ear worm, and tomato hornworm.

As plants become healthier and once we have a good soil digestive system functioning, we will transition into stage three where the plant has a surplus of energy and begins storing this surplus energy as fats and oils. It will first be formed and added to the cell membrane. As the cell membrane becomes stronger, the plants now become resistant to airborne pathogens including downy and powdery mildew,

late blight, and fire blight. This is because of the stronger cell wall membranes in the plant made possible by the additional lipid formation.

We will not achieve this level of plant health without having a functioning microbial system in the soil, which is serving as the plant's digestive system. If we don't have the functioning digestive system, the plant expends too much energy to absorb simple ions from the soil such as calcium, potassium, and nitrate ions and bonding these to build other cellular components. If we have a good digestive system, then a plant will absorb its nutrients as amino acids, and as soluble carbohydrates in an already partially-built form. It requires much less energy for a plant to use these compounds to build its own cells.

So, if we have a good digestive system working, the plant will have a surplus of energy. It will store this surplus energy as fats and oils, which is where the omega-3s, omega-6s, and omega-9s tie in. Omega-3s are formed in a lush green growing plant. Omega-6s are the storage fat because they do not become rancid as easily, so those are primarily stored in the seed grain.

These fats and oils are the component building blocks for building phenolic compounds, turpenoids – all these various aromatic compounds that are referred to as plant secondary metabolites (PSMs). And the plant builds these PSMs as plant protectants. They protect the plant from ultra-violet radiation, from attack by insects and diseases, and from over-grazing by herbivores. Many of these essential oils have anti-bacterial, anti-fungal, and anti-insect properties in and of themselves. They will kill on contact or upon ingestion in the case of insects. A good example would be tannin in oak.

So those are the stages of plant health. And then I'll back up and talk about the importance of the soil's microbial community as the plant's digestive system. The soil is to the plant as the rumen of a cow is to the animal. It is responsible for pre-digesting all of the nutrients and the carbon compounds in the soil and then forming soluble amino acids and soluble carbohydrates that can be absorbed by the plant. In a cow, the bacteria in the rumen breakdown the plant material into its basic constituents: first proteins, complete carbohydrates such as the lignins, cellulose, and pectins. Then those are broken down into soluble sugars – the monosacarides and soluble proteins, which are amino acids, which can then be readily transferred across the cell membrane and are then used to build the animal's cells and are used as an energy source to fuel additional growth and provide energy.

The same holds true in the plant: so if the soil digestive system is not functioning properly, then the plants are forced to absorb simple ions from the soil solution, and they are perpetually low in energy; they will not reach the final stages of plant health.

I'll finish with talking about maximizing a plant's genetic potential. Talking with university researchers, geneticists, and plant breeders – they all report that we routinely harvest only 10-15% of any given seed's genetic potential today. It is fairly well agreed that with corn genetics – almost all the corn varieties available on the market today – have the potential to produce 1,100 bushel corn to the acre. And soybean varieties have the potential to produce 550-600 bushel to the acre. We only harvest a small proportion of that because of the environmental stresses that impact that seed from the time it is planted to the time we finally harvest.

So from the day we plant, if we plant in unfavorable conditions, we lose some of our genetic potential. We might take the soybean seed from 550 to 500 bushel per acre. Perhaps fertilizers were not applied properly or were not applied at all, now we take the yield potential down to 350 bushel per acre. The seedling emerges and we have some unfavorable weather conditions, now we take it down to 300 bushel per acre. It was cultivated too deeply and the roots were disturbed, now we take it to 250 per acre, and so on until the point of harvest when we're only harvesting 10-15% of what that original genetic potential could have delivered in an ideal environment.

So I'll talk about how we can limit the impact of those environmental stress factors and how we can maximize the capability of the seeds that we plant in the soil. I'll talk about the practices and principles that we can take to the field – practical applications of what this information means for us as farmers and how we can generate disease and insect resistance with nutrition.