Workshop Title: Plant Signals: Nutritional Deficiencies & Disease

Speaker: Av. Singh, Ph.D., P.Ag.

Executive Summary

A detailed explanation of how to identify nutritional deficiencies and disease was given in this workshop. The central thesis is that farmers should take a holistic approach to farming that focuses on optimizing fertility instead of maximizing it. Av recommends that instead of fixing problems with band-aid solutions, farmers should try to figure out what the root causes are and address them to ensure long-term viability. In order to use systems to our benefit we must begin by understanding them better. Details of how to identify deficiencies are therefore explained at length below.

Detailed Notes

Central thesis: the biggest issue is that we still have conventional mindset in terms of fertility issues.

Holistic farming is the mantra of talk – “Problem avoidance by design” by Ann Clark. Designing your farm to avoid problems.

Most people have a linear approach to farming. The conventional mindset is that we should maximize yield. The best way to do is by adding organic nutrients. This brings costs onto the farm. Nutrients lead to weeds, which lead to increased tillage/labour, and more costs. Tillage also breaks down soil organic matter, which results in unhealthy soils. This leads to diseases and unhealthy plants that attract insects. Poor soil structure and yields are the result of this method. A common response in conventional farming is to add more nutrients. For organics it means shortening the rotation, moving from one cash crop to another. Time is not allowed for land to replenish.

This is linear thought about organics – we tend to use band-aids as a society instead of getting to root cause of problems. However, band-aids come at a cost - in terms of economics and the way we think about farming, having faith in nature etc.

Av tries to encourage a move from this linear thinking to a more holistic view. By looking at what in the system is causing the problems you can come to casual based solutions.

This workshop is not concentrated on quick fixes for nutritional deficiencies. Instead, Av advises that farmers should mimic nature when they can – optimizing nature rather than maximize it for resources.

When taking a system-based approach, farmers must realize that nature can provide the answers. We must take the system we are given and use it in our benefit.

The maximum yield myth is not sustainable. We do not have a good system that supports it. Go from maximizing yield to optimizing it. This will require a mind-shift to occur. Yield must be viewed as production per cost of input.

The idea of holistic farming is based on tested theories and farmers lived experiences. It is also about being connected to your land - small scale and site-specific farming where farmers who work the land know best. What works on one might not work on another; however, it is important to share your knowledge.

Anthropomorphization is encouraged – putting human characteristics on non-sentient beings. This means putting yourself in the plant/animals shoes and using your experiences to guide your decisions and planning for plants.

For example, if humans are in poor work environments they do not work well; plants placed in poor growing conditions are not going to either. Also, humans under stress get diseases. The same goes for plants – they will have poor immune systems and be susceptible to disease. Further, too much of a product is not good for plants (or us).

Nutrient Mobility
Observing where the plant deficiencies are occurring will help to narrow the possibilities and give you an idea of addressing the problem. Mobile nutrients – you see them at the bottom of your plant and they get transferred up to the new growth, top of plant.

Bottom – P (phosphorus), K (potassium), N (nitrogen)

Middle: Z (zinc), Mo, Mg (magnesium)

Top = S, Ca, Fe, S, B Cu –immobile nutrients. If trying to treat you should use foliar solutions. Should not apply something to soil, as it will take a long time to reach the top of plant.

Inverse true for lower deficiencies – do soil drench instead.

Mobile nutrients – flow charts are used, ease you through the process and show you what to identify (Handout).

N Deficiency:
N is one of the most common nutrient deficiencies. Yellowing leaves – in typical pattern - tip of leaf first, then going back towards stem. Typically comes when using a mulch or compost that has a high carbon to nitrogen ratio. 12 carbon atoms for 1 nitrogen atom are normal. Mulch could be 200 to 1. Mulch will therefore take nitrogen away from plant.

Excessive N:
Most common on organic and small scale farms. It keeps plant in very vegetative state. They look good, but don't fruit. It is common in potatoes or tomatoes. They are rich in above ground growth but not in lower (not growing underground). Excessive N creates lots of sugars and amino acids. They collect within the cell to the point that the cell is weakened and they start excreting out, which makes it easier for bacteria to get in. It weakens the cell wall. Excessive N also limits the amount of calcium that can be taken up. It is important to find the cause of this problem.

P Deficiency:
Look for purpling of leaf. There is a challenge now with new and heirloom varieties, as it's difficult to know what is a nutrient deficiency and what's the actual genetic colour. Might be common to see earlier in spring (purple colour). When you have cold clay soils there is not a lot of active life so you'll see the purple. As temperature rises activity rises, the purpling will go away. If you are getting blue-ish green on plants (potatoes) it's a P deficiency too.

Excessive P:
For many new farmers there's often a P deficiency in soils (esp. clay soils). Soils tests don't show them. As you progress as an organic farm (animal based manure in system) you get excess in P. If you see algae blooms it means excess. It will limit uptake of other nutrients – you might have zinc or iron deficiency as well.

K Deficiency:
Mobile nutrient – it is very critical to pathogens. K plays an important role in cell wall structure, therefore you want to have good levels of it. If you have a deficiency the outside of leaf margins will curl. When you see the leaf turn white along leaf margins it means K deficiency.

Mg Deficiency:
Is common, especially in potatoes and peppers. We have high levels in soils in Nova Scotia. Mg is not as mobile of a nutrient. Recommends foliar spray (Epsom salts) to cure. Mg is important in photosynthesis. You start to see yellowing in between the veins – chlorosis. In tomatoes you'll see leaf curling.

Question: Will these show up in transplant production?
Answer: Typically no. Maybe in tomatoes and peppers.

Immobile Nutrients (handout)

Mn Deficiency:
Interrupts photosynthesis. It leads to inter-veinal yellowing (chlorosis).

Zinc Deficiency:
High levels of N are often the cause of Z deficiency. See spotting on potato leaf. Can identify by spots of chlorosis and zebra stripping.

Mo Deficiency:
Mo is important in the fruiting aspect. See stunted development of flower and irregular growth occurring. A small amount can cause problems - if you are deficient by 2 ounces per acre you can see increased incident of disease. Harder to see mineral deficiency - they aren't apparent unless you have dead soils. Not common to see these deficiencies.

Cu Deficiency:

Cu is important in building immune systems of plants. In wheat you will see irregular fruiting of head; leaf roll with potatoes. This is similar to P deficiency, white around fringes. Work within the plant and make antioxidants that help boost immune system.

Nutrient deficiencies will be seen over broader scale because they are problems starting in your soil. If they are only in one plant there could be another problem, very specific. It would be deficiency within the plant, an insect virus or disease.

Question: Does copper harm soils or plants?
Answer: Not sure about copper residuals in scientific studies. If trying to lower ph in blueberries, do not add more than 400 tons of sulphur per acre. You have to do soil test to make sure levels are fine.

S Deficiency:
S is essential in growth. Now that there is less S in rain we are seeing this problem more. Looks similar to N deficiency (difficult to tell which one). Soils in the Maritimes will hold on to sulphur.

Fe Deficiency:
Main aspect to remember is that it is not lacking in soil, but rather that plant can't take it up because of high phosphorus levels. Must lower phosphorus to fix. Iron is important in the transfer of nutrients and amino acids.

B Deficiency:
In strawberries – looks like "cat face". Celery – cracking stem (linear). Boron plays important role in the immune system. There is a fine line between toxic and deficient levels. Add, but not liberally. It leads to weaker cell walls, not stacked up as well, allows more disease susceptibility. Also leads to less being produced. With boron toxicity it looks like a burn in strawberries. Soil test results needed.

Ca Deficiency:
Calcium regulates water transport. In cabbage / lettuce– tip burn – see it at the top, new part of plant. See cavity spots in carrots, black heart in celery, bitter pit in apples.

Addressing disorders

The hard part is to find out what the cause is. Using a band-aid is okay until you figure out the real cause.

Quick fix solutions include Epson salts for Mg; Borax for B, Baking soda etc. Immobile nutrients will require frequent foliar sprays; while mobile nutrients can be addressed through a drench.

However, the 'fix' may only be temporary or may not work if there is an underlying reason for the deficiency like a virus, root pest, or nutrient imbalance.

If it is a simple nutrient deficiency rich in rock powders, seaweeds, fish emulsion and molasses sprayed into a living soil should allow a plant to address its deficiencies.

Horsetail tea (high in silica content) works as great fungicide. Other teas – compry or nettle tea also work.

Question: Is there a time factor in nutrient deficiency?
Answer: It depends on the nutrient; time specific depending on which one.