The Top Seven Plant Blunders

by Graeme Sait, Nutri-Tech Solutions

In part one of this series I looked at some of the costly mistakes associated with the soil. In this second installment, the emphasis is upon the growing crop and how to avoid those profit-sucking shots in the foot.

1 FORSAKING FOLIARS

Foliar fertilisers are twelve times more efficient than soil-based nutrient delivery and this promotes more effective chlorophyll management. Chlorophyll is the green pigment where all the production happens within the plant. This productive capacity diminishes as stripes, blotches and pale colours reduce chlorophyl density, so the more rapid the correction, the bigger the gain. Foliar fertilising increases in popularity each year as growers discover that you get more than just a nutrient correction. When chlorophyll density is increased with foliars, there is more sugar production and an associated increase in the sugars the plant donates to the army of microorganisms surrounding its roots. These creatures return the favour by fixing more nitrogen, solubilising more phosphate and releasing more beneficial exudates to stimulate their host. The end result commonly exceeds expectations.

It is common to see growers choose the easier option of fertigation to deliver nutrition but this can be a mistake. If you have mineral excesses (which is more often than not in intensive horticulture), their antagonistic effect can nullify the benefits of mineral correction in the soil. For example, if you have a soil containing 250 ppm of phosphorus, due to the extended over application of inexpensive chicken manure, then you will often see crop shortages of zinc, copper or iron induced by this excess. Addressing these shortages via fertigation will often not do the job because the excess P continues to impact the uptake of these minerals. The answer is to bypass the soil and deliver the minerals directly into the leaf. Timely foliars will always offer more effective crop nutrition, even if they require a little more effort than fertigation.

2 SHUTTING DOWN THE FREEBIES

There are two key minerals that are supplied free of charge when mineral and microbe balance are in place. These minerals are amongst the most expensive inputs so it is never productive to shut down these freebies. Phosphorus and nitrogen together account for the majority of the average fertiliser budget but their cost can be minimised if natural delivery is optimised. In both cases, microorganisms can generate and deliver these minerals but the plant plays a major role in the equation. The plant varies its root exudates depending upon its requirements. If phosphate is required to initiate reproduction, then the plant will add some extras to the 30% of its glucose production that is allocated to soil life in the root zone. In a process not unlike a fisherman changing bait, the plant attracts phosphate solublilising organisms to supply P when it is needed. Nitrogen-fixing organisms are similarly stimulated when extra N is required. If we over supply N and P in fertiliser programs, the satiated plant has no motivation to encourage the natural supply. As a result, the grower misses his share of 74,000 tonnes of nitrogen gas in the atmosphere and access to ten billion dollars of locked up phosphate in the soil.

There is a fine line between a shutdown based on over supply and a balance that maximises production with the best of both worlds, but it is a line worth walking. Starter fertilisers, for example, are often over supplied. No tiny plant requires hundreds of kilos of DAP/MAP flooding the soil with soluble N and P. Growers are better advised to reduce the amount of this early nutrition and to include slow release fertilisers with their soluble inputs. Granular guano has a great role to play here as phosphorus and calcium are released throughout the crop cycle rather than all in one rush. Manures can offer a similar benefit in relation to nitrogen but a good N stabilising strategy using soluble humates or zeolite can be equally productive.

Understanding nutrient requirements in relation to the crop cycle can also be helpful. The major drawdown time for phosphate, for example, occurs during the reproductive stage and applied P has often locked up by then. Stabilising soluble phosphate with soluble humate granules reduces the lock up potential and minimises the flood of P which can otherwise cripple the biological supply of this mineral.

3 MISSING OUT MONITORING

Precision nutrition is the key to maximum productivity and profitability and there is little room for guess work. A combination of regular leaf analyses and the use of in-field monitoring tools ensures insight into nutrient requirements at any given time. If you have reached the point where you can accurately read your crop without these tools then you have achieved master grower status, but even then there will always be a need for your footsteps in the field. We need to be part of the growing process to pick up changes rapidly. Check the roots for mychorrizal colonisation. Check legumes for nodulation and pinch the nodules to test for the inner pink that signals good nitrogen fixation. Check leaf size and thickness and stem strength and learn to recognise the missing minerals linked to stripes, blotches and pale colour. When your leaf test reveals a zinc deficiency, go to the crop and photograph that deficiency with your mobile phone. You now have a record of that specific chlorosis and, the next time it appears, you won't need to wait till the leaf test data comes back.

It is a common excuse to miss out on the monitoring due to other priorities but this can be a serious mistake. I always recall a visit to a corn farm in Kununurra, in Western Australia, during a national tour with American author/consultant, Gary Zimmer. The grower complained of repeated poor pollination and was intending to introduce bee hives the following season. Gary and I both recognised a boron deficiency and alerted the grower to the problem. He insisted that his starter fertiliser contained boron so this could not be the problem. However, the small amount of boron in the starter had leached out in these low carbon soils by the time the plant had moved into the reproductive stage and this is the time that boron is desperately required to fill out the cob. We suggested a leaf analysis to confirm this diagnosis, even though it was too late to correct the problem that season. The tissue test revealed the lack of boron and the grower realised the enormity of his oversight. He had lost 20% of his yield in 1000 acres of corn for several seasons for the sake of a $60 leaf analysis. This simple test, taken before flowering would have identified the problem at the start. A leaf analysis before flowering is a critically important strategy to make sure that everything is right for the business end of the season.

The key in-field monitoring tools include a refractometer and a pH meter that allows sap analysis. The refractometer is a guide to your skills as a chlorophyll manager (the central role of all growers). High brix levels mean less pest pressure, higher nutrient density, greater shelf life, more frost resistance and less weed pressure. Brix levels also offer a guide to nutrient balance within the plant (there should be minimum variation from top to bottom), calcium and boron nutrition and specific gravity.

Sap pH is also a guideline to yield, quality and potential pest pressure, but it offers more insight into the likely culprits when things are not right. If sap pH is lower than 6.4, then the likely deficiency will be either calcium, magnesium or potassium of a combination of these. Low sap pH spells an increased likelihood for fungal disease. Conversely, if the sap pH is higher than 6.4, then it is often related to an excess of nitrate nitrogen within the plant or it could be a shortage of the acid-forming minerals, phosphorus or sulfur.

4 MESSING UP THE TIMING

Timing is everything when it comes to comedy and the same thing applies to crop production. There is a right time to test, plant, fertilise, protect and harvest, and messing up the timing can be costly. Leaf tests should be conducted in conjunction with soil tests. It is important to consider them together as it gives a far better idea of how mineral balance (or lack of it) is impacting the crop. Often the leaf test will highlight lockups where you may need to bypass the soil and use foliar nutrition. The other important time to leaf test is immediately before flowering to ensure everything is right.

There are several ideal times to foliar fertilise. Young tissue is particularly responsive so it is a good plan to apply the first foliar as early as possible. There are also issues about the time of day that is best suited. Early morning or late afternoon is considered best. The early morning slot ties in with increased stomatal opening when the plant is accessing dew. The middle of the day is unsuitable because the stomates close in the heat of the day.

There are also critical crop stages where nutrition is most needed. In the corn crop, for example, there are two stages that will be most productive. They are linked to a decision making process where the plant audits its chlorophyll content to determine the sugar making potential during seed formation (the time of greatest sugar requirement). At five weeks after spiking the corn plant determines the number of rows of kernels on the cob. Chlorophyll density in this crop is often determined by nitrogen, so there can be considerable gain in foliar spraying urea at four and a half weeks after spiking (when the first leaf spike emerges). This involves a foliar application of 20 kg of urea with 1 kg of NTS Soluble Humate Granules per hectare. At nine weeks after spiking another decision is made. This time it

involves the number of cobs per plant. An astute grower, aware of this timing, can literally double yield with another foliar application of urea and humic acid, at the same rate, at eight and a half weeks after spiking.

A recent innovation in relation to the timing of foliar sprays involves environmental conditions. Delta T involves temperature graphed against relative humidity and it relates directly to droplet life time and target accuracy. Many tractors are now fitted with equipment to monitor Delta T so growers can optimise their spray performance.

There is also a strong argument to plough, plant, prune and fertilise in accord with appropriate moon cycles. Farmers have worked by the moon for centuries and there really was no evidence to abandon this practice other than a belief that science could solve all of our problems. Biodynamic growers grow by the moon but there is no reason why anyone can't gain by utilising lunar cycles. I have seen a tremendous difference in on-farm trials where growers have foliar sprayed one patch on any of the 6 days leading up to a new moon and compared response in a second patch that was sprayed on any of the six days leading up to a full moon. There was a huge difference over time, where the full moon timing proved vastly superior. If you are an orchardist conducting one foliar spray each month, you would be well advised to mark your calendar to coincide your timing with any of the six days leading up to a full moon. These are simple, free strategies that can be profoundly effective.

5 MEDDLING WITH PLANT IMMUNOLOGY

It is now understood that the plant has an immune system not unlike ours. Plants produce phytoalexins that equate to antibodies in the human immune system. The higher the production of phytoalexins and similar compounds, the greater the protective potential of the plant, the lower your chemical bill and the healthier your working environment. There are various promotants that sponsor production of phytoalexins and several factors that reduce their production. It is important to understand this process to avoid a major plant blunder where you actually help generate increased reliance upon expensive chemicals. A small amount of pest and disease pressure is desirable as this activates the plant's defence mechanisms. There are two systems involved. Systemic activated resistance (SAR) is like a fight or flight response based on a direct cue. An insect attacks, the plant sensory system identifies the invader and there is a rapid production of foul tasting chemicals to discourage the pest. Similarly, if a fungal disease is the invader then biochemicals are immediately produced to ward off the attack. There are signalling molecules that can trigger a SAR response and these include salicylic acid and chitinase. Aloe Vera is the richest plant source of salicylic acid and hence its increasingly popular use in agriculture.

The second protective system in the plant is called Induced Systemic Resistance (ISR) and this is a vaccination-type response where beneficial microorganisms produce biochemicals responsible for inducing a systemic response. Two of the most researched organisms in this regard are Trichoderma harzianum and Bacillus subtillus. However, cytokinins can also produce this systemic protection. This is one of the many benefits linked to the regular use of kelp.

The problem is that chemical protection regimes involving regular applications of fungicides and pesticides, regardless of the level of pest pressure, can backfire. When all of the insects, pathogens and beneficials are regularly poisoned off the leaf surface, there are no longer any cues. Plant immunity no longer works and you have effectively increased your requirement for toxic chemicals. Interestingly, many of the protective biochemicals are also responsible for flavour and they also serve as powerful antioxidants for humans so, not only do chemicals beget chemicals but we get to eat contaminated, substandard food into the bargain. Winemakers have become the first industry to fully understand this phenomena and hence the plethora of international awards for biological and biodynamic wines in recent years. Hopefully food producers will also come to understand that it is not possible to grow nutrient dense, medicinal food with a full-on chemical regime. Perhaps this recognition amongst consumers will help drive the necessary change.

6 IGNORING THE BRIX BUILDERS

Brix is a measure of dissolved solids within the plant and it is a direct measure of photosynthetic potential. Photosynthesis is the most important aspect of crop production as it is responsible for 95 % of plant growth. The key minerals involved in photosynthesis are calcium, phosphorus, magnesium and boron. We often refer to this quartet as "the big four" due to their critical importance. It is a major blunder to ignore these nutrients and yet over 30% of the thousands of leaf tests we analyse each year, are deficient in all four minerals. Ideally, these minerals should be maintained at luxury levels in the leaf but over one in three tests reveal that all are lacking.

Calcium is directly responsible for the uptake of seven other minerals and boron determines whether calcium does this job. Phosphorus is the main mineral involved in sugar production and magnesium is a phosphorus synergistic. Magnesium is also the centrepiece of the chlorophyll molecule and is to this green pigment what iron is to blood.

The best way to build plant levels of calcium and magnesium is to use high analysis, Micronised Mineral Suspensions (MMS) which deliver the target minerals without the tag-ons associated with calcium nitrate or magnesium sulfate. Even phosphorus can be addressed with this technology, using micronised guano. This ancient bird manure is also an exceptional source of calcium (25 – 30%) and a rich source of plant available silica. Boron is best addressed with soluble sodium borate (Solubor or Dissolvabor) combined with a little humic acid to form a much more stable and effective boron humate.

7 JUMPING TO CONCLUSIONS

There are several faulty conclusions linked to misinterpretation of leaf tests and monitoring tools and they need to be understood to be avoided. It is common to assume, for example, that low levels of magnesium in the leaf spells a similar situation in the soil, but this is not always the case. High soil magnesium can generate low levels of this mineral in the leaf and in this case there is no point in applying more magnesium to the soil to exacerbate the lockup. This situation calls for foliar application of magnesium, usually as magnesium sulfate combined with a little fulvic acid.

The battle to build luxury leaf levels of calcium can actually be linked to a lack of beneficial fungi in the soil. These are the creatures that have been most hammered by conventional agriculture and they are sadly lacking in most soils tested for soil life. You can watch your levels of calcium in the plant increase in line with the fungal counts in your soil. Fungal dominated compost is invaluable in this context as are the two most powerful fungi promotants, humic acid and kelp. It is a great idea to include humates or compost when applying lime for this reason.

A lack of phosphorus and zinc in the plant can sometimes reflect a lack of mycorrhizal fungi rather than missing minerals. The chief role of these creatures is to deliver these otherwise immobile minerals to the plant and if you have killed them off with herbicides, fungicides and nematicides, you will struggle with delivery of phosphate and zinc, regardless of your soil levels of these minerals.

If you test your brix levels following a prolonged dry period, you can jump to the conclusion that you are an amazing grower because you have achieved such good levels. Unfortunately, the moisture-stressed plant concentrates solids within the sap and this is called a "false brix", reflecting stress rather than health. If your leaf analysis reflects a lack of zinc and an excess of manganese, and these imbalances are not reflected in soil tests, then you may have detected a potassium deficiency and no amount of zinc or manganese antagonists will correct the situation. When you apply some potassium you will see the zinc come up and the manganese will fall.

There is one further faulty conclusion that is also linked to potassium. If your nitrogen levels are high on your leaf test and potassium levels look OK, this may not necessarily be the case. Potassium is such a mobile mineral that it may have moved up to the area tested (the first fully developed leaf) and the leaf test is not a reliable guide. An undetected potassium deficiency will always be costly as this mineral governs size so it is a huge player in determining yield. The best way to monitor potassium involves a Horiba Potassium Meter. When you test and compare the K levels in the lower leaves with those in the upper leaves there should never be more than 10% variance. If the lower leaves exhibit significantly less potassium then you have detected a deficiency that can be immediately addressed to avoid yield loss.

IN CONCLUSION

Food production is fraught with pitfalls and if we understand these problems we are more likely to avoid them. The successful management of the plant involves regular monitoring, timing and the nurturing of soil life. It also requires an understanding of the profound role of nutrition in plant health and associated disease resistance. I trust than you may now be better equipped to avoid some of these problems and that you will enjoy greater profitability and find more pleasure in your journey towards sustainable farming.

Agriculture Solutions
Fertility for Life

Agriculture Solutions, Inc., 403 Irvine Street Elora, ON N0B1S0
(855) 247-6548 www.agriculturesolutions.ca