WaterSOLV™ Analytical Necessities

Water, Soil and Tissue (Lab Analyses) 1/25/2021

Introduction:

It's not just for WaterSOLV™, it's agronomy in whole that needs to subscribe to these analytical necessities.

Understanding water and soil is a game changer in the world of agronomy. When you look at as many as we do; the sheer number of reports, the varying interpretations and recommendations, the actualities are stunning, so stunning that as we investigate and call to attention these things, the lab and agronomical recommendations and prescriptions appear to change for the better of our industry – the Grower! What we're saying is that there is a big change in the industry you'll see hereto. It's always been there we've just not been seeing it this way or dealing with it in a new way like HCT and the WaterSOLV™ technology have created.

Conventional modality is trying to make infiltration and available nutrition and a lot of resources have been put towards pH reduction, CEC and SAR, force feeding calcium by acidification and gypsum, and trying to keep lines clean from biology. The new added phase is keeping coliforms and E. coli off and out of the food chain. We're well versed in that in our Well-Klean© division, water chemistry and biology.

Background Highlights

Dr. Walworth, Professor and Associate Head, Department of Soil, Water and Environmental Science at the University of Arizona told me perhaps 5 years ago to look at soil as a filter. Well over 10 years ago another doctor of water chemistry from one of the largest industrial water treatment companies in the world told me if we'd come up with a way to deal with "evaporative salts" (water drying forming scale) we'd change the world. That didn't sink in for quite some time. Then we learned how scale crystals form (bicarbonate bonds, chloride bonds and valence bonds) and also ran across the study done at the University of California Davis (UC Davis) explaining the formation of insoluble evaporative salts with the use of sulfurous acids and gypsum. From there we learned about biofilms in soils, which we also experience in wells, and how they are formed, how they can block flow of water, nutrition and even oxygen, while the anoxic bacteria can exude deadly hydrogen sulfide gas – also toxic to vegetation. Lastly, of added significance, the over use of nitrogen to create crop vitality and yet when acidified can block oxygen, and the unsustainable means of dealing with chloride salts including sodium.

Chronic Challenges of Agronomy

These scenarios, and likely the sequences therein are likely and chronologic resemblance of what most growers have experienced over the past 6 years and it likely showed its most negative impact over the year of 2020 due to the lack of rain. Technically, due to the lack of water saturated with dissolved oxygen - rain. Note, rain does NOT flush salts that have already complexed, other than those salts that are extremely soluble – sodium, zinc and nitrogen). Rain mostly provides H_2O and dissolved oxygen, followed by the chloride toxins. The exchangeable salts built up in the soil do not typically reduce. The biofilms do not reduce either. Note also that dissolved oxygen and bacteria and biofilms are NOT in the analytical data we have subscribed to over decades.

Water Analyses

These are pretty straight forward and we classify them into specific buckets.

1. The Scale Formers – also known as cementation, bound nutrients, carbonate salts usually bound by bicarbonate (the gas that is released when dissolving scale) but also by valence, the natural magnetism between certain elements, like calcium phosphate and potassium phosphate, calcium silicate (trace amounts of bicarbonate participate in the complex).
2. The Toxins – Usually bound with chloride; sodium, calcium, zinc, iron (ferric), even ammonium chloride (an expectorant in cough medicine).
3. The Biological Food Sources – Food for bacteria primarily include sulfur, sulfate, iron and manganese.
4. The Metals – Iron, Manganese, Copper, Zinc, Aluminum.

Then there are the Transient Indicators (implied impacts)

A. pH – You want it but we don't need it. It is just an indicator of the hydrogen ion content implying acidity or alkalinity value but NOT nutrient availability.
B. TDS – the sum of the dissolved elements in the water. However, you could add a crystal of calcite and it would make no increase or decrease in the number. You can have the scale in the soil, but if it is not dissolved in the water then we assume it is not there, hence, an implied value.
C. Ec – the sum of electrical conductivity, implied water solvency. Similar to TDS.
D. CEC and SAR – definitely important when dealing in today's world of using elements to move other elements where they need to be. NOT nearly important whatsoever when dealing with solubilization chemistry – i.e., moving water and nutrition through clay.

What's missing! Oxygen content, Biomatter and Bacteria.

Water Analysis Interpretations

What's most important about all this criterion is how our soil is dealing with these elements. Is the plant getting the necessary nutrients through the plant, into the tissue, is it all the essential nutrients – the less soluble ones like Ca and P or just the extremely soluble toxins like Na and Cl? You'll likely see plenty of N in the tissue but what about the Fe and Al that tends to get stuck without sufficient lime uptake?

At this point, all we have is the water data, we do not know how the soil is dealing with it. We can gleam the tendency of the soil based on this water;

Minerals

Scale Formers – Cementation

The more HCO3, CO3, (gasses) Ca, Mg, P and K, (highly insoluble) the more likely the water evaporates to dryness and forms scale. Keep in mind these are also measured in totality as part of the TDS or EC, these items are nutrients. But once they evaporate to dryness and absorb the gas, they form crystals that typically water does NOT dissolve, nor does rain! If they are evaporated salts of sulfurous acid and calcium sulfate / gypsum, they are insoluble to added sulfurous acid.

Note: Water will dissolve Na, but usually the soil is cemented where the Na can't flush. Also remember Cl is usually complexed with Na, as well as Ca and Zn and I presume by valence is why B is usually almost always in the mix.

Microbes
Metals
Biology – Bacteria and Bio-films
We can be assured in the majority of cases when there is an exponent of 3 or more bacteria in the water, and sufficient food source in the water or soil of sulfur, sulfate, iron or manganese, and the soil has infiltration, challenges, there is likely problem of bio-films (and perhaps cementation) that has accumulated in the soil and hindering infiltration as well as vitality, efficiencies and sustainability.

Chlorides
Chloride Salts
Where sodium is the most soluble mineral, zinc is the most soluble metals, N and H_2O are perhaps more soluble than O_2, and yet O_2 is very soluble, surely, we are concerned with how much is in our water, but moreover how much of these soluble items concentrate in our soils to create toxicity. If they are so soluble, why are the concentrating in the soil? If we can't get them through the soil, how do we get them through the vegetation?

Zn and N
Both the levels of Zn (soluble metal) and NO_3-N (soluble N) are important to know in the water so that we can reflect on what they are doing within the soil. If they accumulate in the soil there are infiltration issues to be identified.

Soil Analysis – Part 1 of 2

<u>by Soil Paste Extraction (SPe) (Avail.)</u>

When it comes time to understand what water is solubilizing for the vegetation to drink, this is your best test to understand the nutritional "availability" and need. <u>But this is best case scenario when using lab water</u>, better case scenario using actual source water. A lot, more like a TON, depends on your infiltration depth of moisture and available nutrition throughout that soil profile. Then, here comes the big game changer! The "fate" of the water, nutrition and the added treatment, are they going to be "sustainable" or will they add to the saturated matter in the soil, further plugging your "soil/filter"? Will they all be consumed, now or eventually by the plant, or become more matter complexed on my soil to have to deal with later – bound by carbonate, chloride, valence or feed biology in a negative way leading to slimes or anaerobic conditions – as is usually the case when dealing with sulfur, sulfate, sodium and chloride products (including treatments into ponds, i.e., copper sulfate – not good).

Soil Paste Extractions are referred to as Avail. on analyses, and are a reasonably good indicator of the nutrition availability or deficiencies. However, it is best if they do the analyses using the untreated source water.

Buyer beware, these analytical reports subscribe to some pretty unique, individualistic practices for what is minimum, maximum, and necessary. It's truly startling the references labs give which may involve aquaculture studies done in Florida 20 years ago to acidifying water in the Pacific Northwest without considering the soil conditions prescribed in the manual (NCRS/USDA manual as well). The other caveat is their recommendations to water of gypsum and sulfuric acid without regard for the soils being completely, problematically saturated with it. SPe's are not thorough without looking at the total soil condition by Exchangeable, as well as considering the biology and oxygen.

Soil Analyses - Part 2 of 2

by Ammonium Acetate Extraction (AA) (Exch.)

While the soil paste extraction is done with water, lab, source or perhaps treated source water, the exchangeable method is done by ammonium acetate and also at a basic pH. That's right, the chemistry breaks down all the elements in the water without pH reduction! BUT, does it break down all the elements? NO, it does not and that was proven most recently. We'll show this further down.

If we have all these elements in our soil and they are "exchangeable", why are we not exchanging them? These are unused nutrients, that in excess the NCRS/USDA call Nutritional Pollutants. You might view them in many ways; purchased and unused nutrients, components in the filter (soil) hindering the flow of water, oxygen and nutrition deteriorating vegetation vitality - Cementation, things hindering CEC and SAR, compaction, clay. I'd say the biggest things we see disturbing is the addition of more sulfur, more N and Ca utilizing sulfurous acids and gypsum and pond treatment adding copper sulfate, and where sulfurous acids contain a tremendous amount of Sulfur and Urea (N).

Year over year, more and more saturation, followed by the collection of chloride salts – Chloride and calcium, iron, sodium and zinc, valence bonds of boron and the collection of excessive N. Lower pH values, excessive H percentages, black layer settles in, and still nobody looking at the biology, the bacteria and oxygen. We then result to topical applications, physical aerification and sanding, all the while leaving a gold mine of nutrition in the filter that can turn into a biological hazard (usually evidenced by turf slosh and water not going down).

Summary

You can look at the "buckets" in the SPe analyses the same as in the Exchangeables. We have to fix the Exchangeables for optimum, sustainable and efficient results. In most cases, the harvesting of excess exchangeables more than offset the current and long-term resources necessary to deal with the aftermath including frequency of aerification, sanding and tilling.

Additional Topics to be Considered

- Essential Nutrients & Replenish Rates
- Flushing versus water to water

Sampling

Water, Water Bacteria, Nutrition (SPe/Avail), Soil (Exch.) and Tissue

Water (1)

A. Ideally 16 fluid ounces
B. Clean water bottle (no Gatorade bottles)
C. Pull good fresh representative sample of untreated source water

Water Bacteria Analysis (2)

A. 8 fl. ounces of water sample
B. Keep sample for getting warm – just keep cool
C. Submit to your dealer or to HCT
D. Total Bacteria Analysis, CFU's exponent.

Soil (3 and or 4)

Much trickier. What are we trying to do, overall program, fix bad, assess good, can we get a probe into the ground, should we do tissue analysis to see what is getting through?

A. Most important, what do we have in this sample and what are we looking to accomplish?
B. Are we looking for soil conditions?
    a. (3) SPe – Avail Analysis
        i. If you can get a probe into the ground easily – take 12-inch samples
            1. Do good and bad spots separately
    b. (4) Exchangeable Analysis
        i. If you cannot get a probe into the ground easily
            1. Take 0-6 inch and 6-to-12-inch samples separately
            2. Take general conditions soil sample
            3. Be sure to take at representative majority grade – not a ridge or a low spot, general, overall, majority of surface area.
            4. If a problem area, note as such with detailed description

Tissue Analysis (5)

A. Usually not necessary. If taken, ppm / mg/L is preferred over % alone.

Other Extractions

HCl + H2O2 + Nitric (diluted in water significantly) revealed significant more iron in multiple analyses.

Water & Soil Analytes

	Parameter	Units	Testing: Water	Testing: Soil Paste Extraction	Testing: AA Extraction
			What Water?	Avail - What Water?	Exchangable
Scale	Bicrabonate	ppm - mg/l	Bicrabonate	Bicrabonate	
	Calcium	ppm - mg/l	Calcium	Calcium	Calcium
	Magnesium	ppm - mg/l	Magnesium	Magnesium	Magnesium
	Potassium	ppm - mg/l	Potassium	Potassium	Potassium
	Phosphate	ppm - mg/l	Phosphate	Phosphate	Phosphate
	Silicon	ppm - mg/l	Silicon	Silicon	
Bioogy	Total Bacteria	CFU Exponent	Total Bacteria		
	Sulfur	ppm - mg/l		Sulfur	
	Sulfate	ppm - mg/l	Sulfate		
	Iron	ppm - mg/l	Iron	Iron	Iron
	Manganese	ppm - mg/l	Manganese	Manganese	Manganese
Toxins, Scales	Chloride	ppm - mg/l	Chloride	Chloride	
	Sodium	ppm - mg/l	Sodium	Sodium	Sodium
	Zinc	ppm - mg/l	Zinc	Zinc	Zinc
	Boron	ppm - mg/l	Boron		
	Copper	ppm - mg/l	Copper	Copper	Copper
Indicator	Nitrate		Nitrate	Nitrate	
Indicators	pH	Units	pH	pH	pH
	TDS	ppm - mg/l	TDS		
	Ec	umhos	Ec		
	Organic Matter		Organic Matter		
	Saturation Index		Saturation Index		
	Soluble Salts		Soluble Salts		
	Excess Carbonates		Excess Carbonates		
	Percent Base Saturation				
	Ca	%			Ca
	Mg	%			Mg
	K	%			K
	Na	%			Na
Indicator	H	%			H
	CEC				CEC

HCT SOLUTIONS TO WATER