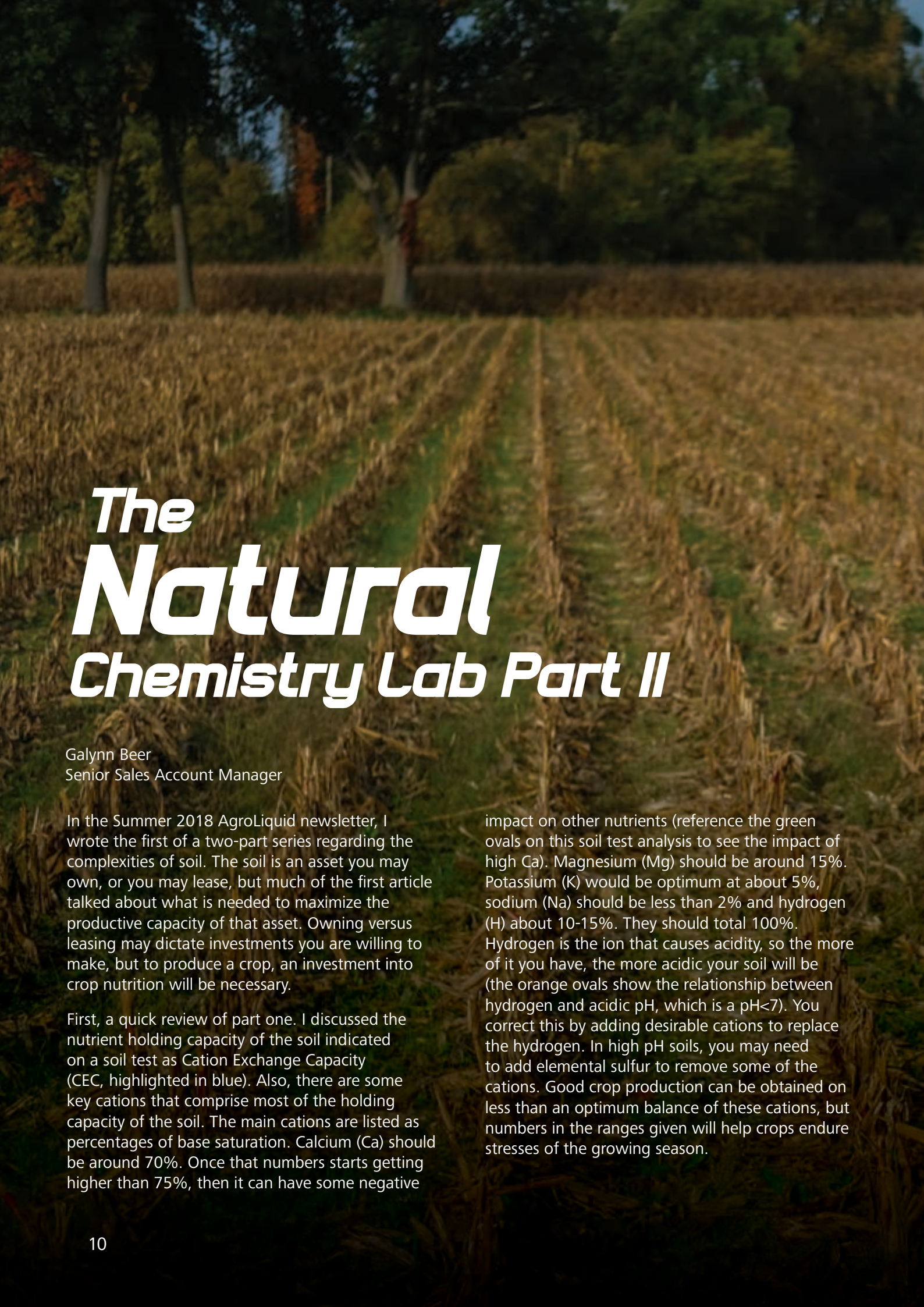

The Natural Chemistry Lab Part II

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In the Summer 2018 AgroLiquid newsletter, I wrote the first of a two-part series regarding the complexities of soil. The soil is an asset you may own, or you may lease, but much of the first article talked about what is needed to maximize the productive capacity of that asset. Owning versus leasing may dictate investments you are willing to make, but to produce a crop, an investment into crop nutrition will be necessary.

First, a quick review of part one. I discussed the nutrient holding capacity of the soil indicated on a soil test as Cation Exchange Capacity (CEC, highlighted in blue). Also, there are some key cations that comprise most of the holding capacity of the soil. The main cations are listed as percentages of base saturation. Calcium (Ca) should be around 70%. Once that numbers starts getting higher than 75%, then it can have some negative impact on other nutrients (reference the green ovals on this soil test analysis to see the impact of high Ca). Magnesium (Mg) should be around 15%. Potassium (K) would be optimum at about 5%, sodium (Na) should be less than 2% and hydrogen (H) about 10-15%. They should total 100%. Hydrogen is the ion that causes acidity, so the more of it you have, the more acidic your soil will be (the orange ovals show the relationship between hydrogen and acidic pH, which is a pH<7). You correct this by adding desirable cations to replace the hydrogen. In high pH soils, you may need to add elemental sulfur to remove some of the cations. Good crop production can be obtained on less than an optimum balance of these cations, but numbers in the ranges given will help crops endure stresses of the growing season.

LAB NUMBER *240*	SAMPLE IDENTIFICATION	ORGANIC MATTER	PHOSPHORUS			POTASSIUM	MAGNESIUM	CALCIUM	SODIUM	pH		CATION EXCHANGE CAPACITY C.E.C.	PERCENT BASE SATURATION (COMPUTED)				
			P (Bray P1)	P (Olsen)	OLSEN BICARBONATE P	K	Mg	Ca	Na	SOIL pH	BUFFER INDEX		% K	% Mg	% Ca	% H	% Na
		percent RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE	1:1		meq/100g					
53650		1.6 L	18 M	38 M		369 VH	436 VH	2078 M	23	6.0	6.7	17.6	5.3	20.4	58.4	15.3	0.6
53651		1.2 VL	27 H	41 H		301 VH	364 VH	1396 L	22	5.1	6.7	17.6	4.4	17.2	39.7	38.2	0.5
53652		1.7 L	6 VL	40 H	7 L	430 VH	321 VH	4127 VH	21	8.4		24.5	4.5	10.9	84.2	0.0	0.4
53653		1.0 VL	23 H	61 VH		339 VH	229 VH	1134 M	14	6.0	6.8	10.0	8.7	19.1	56.7	14.9	0.6
53654		0.5 VL	26 H	32 M		172 VH	123 M	484 VL	21	4.5	6.8	9.5	4.6	10.8	25.6	58.1	1.0
53655		0.6 VL	37 VH	44 H		166 VH	101 M	500 L	16	4.7	6.8	7.7	5.5	10.9	32.5	50.2	0.9
53656		0.6 VL	32 VH	58 H		288 VH	210 VH	1008 M	19	5.5	6.7	10.3	7.2	17.0	48.9	26.1	0.8
53657		0.7 VL	5 VL	58 H	7 L	228 VH	120 L	2600 VH	20	8.2		14.7	4.0	6.8	88.6	0.0	0.6
53658		0.6 VL	25 H	31 M		157 H	128 M	701 L	18	4.8	6.8	9.6	4.2	11.1	36.5	47.4	0.8
53659		1.6 L	19 M	110 VH	12 M	608 VH	424 VH	3744 H	17	7.5		23.9	5.5	14.8	78.4	0.0	0.3

LAB NUMBER *240*	NITRATE-N (FIA) SURFACE ppm	SURFACE lbs/A	SURFACE depth (in)	SUBSOIL 1 ppm	SUBSOIL 1 lbs/A	SUBSOIL 1 depth (in)	SUBSOIL 2 ppm	SUBSOIL 2 lbs/A	SUBSOIL 2 depth (in)	Total lbs/A	SULFUR S ppm RATE	ZINC Zn ppm RATE	MANGANESE Mn ppm RATE	IRON Fe ppm RATE	COPPER Cu ppm RATE	BORON B ppm RATE		SOLUBLE SALTS 1:1 mmhos/cm RATE
53650	16	29	0-6							29	18 M	0.6 L	30 VH	29 VH	1.0 M	0.6 L	L	0.3 L
53651	25	45	0-6							45	19 H	0.4 VL	49 VH	39 VH	1.0 M	0.5 L	L	0.2 L
53652	5	9	0-6							9	12 L	0.3 VL	8 L	10 L	1.0 M	1.0 M	M	0.3 L
53653	28	50	0-6							50	12 L	0.4 VL	14 H	16 M	1.0 M	0.5 L	L	0.2 L
53654	16	29	0-6							29	15 M	0.6 L	20 H	39 VH	0.5 L	0.5 L	L	0.2 L
53655	27	49	0-6							49	18 M	0.8 L	17 H	48 VH	0.5 L	0.6 L	L	0.2 L
53656	28	50	0-6							50	14 M	0.8 L	25 H	32 VH	1.0 M	0.5 L	L	0.2 L
53657	27	49	0-6							49	17 M	0.2 VL	4 VL	7 L	0.5 L	0.9 M	M	0.2 L
53658	23	41	0-6							41	18 M	0.4 VL	11 M	26 VH	0.4 L	0.4 VL	L	0.2 L
53659	53	95	0-6							95	26 VH	0.6 L	10 M	11 M	1.2 M	1.2 M	L	0.5 L

With that overview, you can see that when looking at a soil test, there are many relationships that exist among nutrients and you shouldn't just evaluate each nutrient on its own, or address it according to the number listed. In the example shown, you'd be tempted to look at the weak bray phosphorus (P1) test and apply a very high amount of phosphorus. But if that phosphorus is broadcast, the excess Ca represented by the 84.2% is just going to tie it up, rendering it unusable by the crop you are intending to feed. So when you are thinking about fertilizing your crop, you need to stay focused on what the crop will be able to use and not what you are applying to the soil. Much of the phosphorus that is in the soil on the test with the high Ca will never be used by the crop. The calcium-phosphorus bond is too strong for the plant to be able to extract the phosphorus from the calcium. This just illustrates one of many possible reactions that can limit the ability of a crop to utilize nutrients in the soil. Over time, some of the phosphorus will separate when Mother Nature provides rain and a fractional amount will be released.

Now for another critical area of a soil test, which often growers don't focus on or even have tested for . . . micronutrients. At the bottom of the test shown, these levels are listed. It is common to think that soils either have them or they don't. Certainly, there is some truth to that. Soils in some areas of the country are naturally high in specific nutrients. Minnesota soils typically have very high

iron levels, which is interesting because at one time much of the Nation's iron ore originated there. But also impacting micronutrient levels significantly is the balance of the soil. High levels of Ca, Mg, K and Na can crowd out micros. Often, zinc, manganese, and iron are the most common to have limited availability with excesses of cations. This can easily be seen when crops that have a high demand for these micronutrients are grown on these soils. Soybeans grown on the soil test with 84.2% calcium would be highly likely to exhibit a chlorotic look because iron and manganese are limited in availability as shown on the example soil test. Soybeans have a higher need for these nutrients than a crop like corn. Citrus is another crop that demands a lot of iron and manganese and would suffer in this soil.

The valuable part of a soil test, the reason you should routinely have your soil analyzed, is that this overview will help you prioritize investments into your asset of land. If you own the land, you can embark on measures that are longer-term fixes, such as implementing some practices to correct imbalances. Over time, the elevated calcium in the example could be lowered. But if your asset is rented, a long-term investment to correct imbalances can be a difficult decision; you are fixing someone else's asset. If it can result in a fast payback, then maybe it is worth it. If your investment increases the productivity, then the owner may decide to try to grab more value as a result of improved productivity by increasing rent. So your improvement may actually cost you twice on a rented asset; once for the improvement and a second time if rent is raised. The overall soil test can help tremendously with making these decisions, or even having a conversation with the owner of your land to ensure you can recover your investment into their asset.

Decisions regarding crop nutrition can be complex as yield expectations rise and economics remain challenging. AgroLiquid takes measures to mitigate the impact of imbalances that exist by protecting our nutrition from many of the reactions that can occur. The purpose for using fertilizer is to feed the crop. Thinking about fertilizer in terms of how much is used by the plant rather than how much is applied to the soil is a critical step. A complete soil test is a good indicator of how much efficiency can be expected with applied crop nutrition. AgroLiquid's unique protection improves efficiency dramatically. Couple that with a staff that has a thorough understanding of the nutrient relationships in the soil and you will receive a value that goes beyond the return on your investment.

The fall is the most popular time to soil test. Crops are harvested and attention can turn to the future. Future investments into fertilizer should begin with a soil test; they should end with a decision to get the most value out of your fertilizer dollar by adding skilled interpretation of the test with protected nutrition. AgroLiquid is where you will find both.