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ADVISOR

CHEMICAL BALANCE

calcium | magnesium | potash | sodium | hydrogen | soil pH | phosphorus | sulphur

micro-nutrients | zinc | boron | manganese | molybdenum | copper | iron | cobalt | silicon

Soils have a rich diversity around the world and even within fields. There are sixteen main elements that are essential for good crop production and yet most nutrients supplied are nitrogen, phosphorus and potash commonly referred to as MPK fertilizers. Farmers should desire to seek the cause of the many problems that occur in their cropping programs. This link will take you so a table which will help you know your fertilizers. Many times framers will be treating symptoms in the crops caused by the previously applied inputs to their soil, which often is the main cause for the problem.

It is with this in mind, we have devised the Soil Balance Systems' soil analysis. Submission forms can be downloaded and sent to the lab with your soil samples.

As a starting point we will look at the five major Cations which form the Cation Exchange Capacity (CEC) which is the ability of your soil to absorb, hold and release nutrients, or a measure of the Cations of clay and humus in your soil. CEC therefore can be measured by the percentage level of each Cation in relation to 100%. This Cation exchange capacity balance in an important factor for a healthy soil and the correct balance as a percentage need to be maintained to ensure productive levels.

Calcium (Ca)
It is the prince of nutrients, approximately 70% Calcium in the base saturation. Proper amounts of calcium make a soil workable and well flocculated plus it makes for a good air to water relationship. Any nutrient that aids a good air to water relationship is a priceless asset. Some important facts about Calcium:

1. The lower the pH level in the soil (Ca level) the greater the leaching loss of potassium and NH4.
2. The percentage of CEC saturated with Calcium is more important than the total amount of Calcium in the soil (high percentage Calcium can stop toxic aluminum iron and sodium conditions).
3. Main studies have shown Calcium at the optimum levels decrease disease in most plants.
4. High content Calcium plants play a vital role in healthy animals and humans.

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Magnesium (Mg)
Its percentage base saturation is second place to Calcium approximately 10 - 12%. When it is at this level Magnesium will perform its duty in photosynthesis and protein formations.

1. If Magnesium is out of balance it can become a toxic poison to soil Calcium and plant life.
2. Excess Magnesium to Calcium forms a poisonous condition in the nucleus of plant cells affecting its health.
3. Nature often strikes the plant with diseases and Nature calls for other plants to take its place commonly called weeds and grasses.
4. Excess Magnesium can lead to deficiencies in Nitrogen, Phosphorus, Potash and Calcium.
5. Excess Magnesium will not allow Calcium and Potash to move into plant cells.
6. Excess Magnesium to Calcium causes your soil to release soil Nitrogen back into the atmosphere.
7. Farmers can fight excess Magnesium with natural sulfur in the form of Gypsum. The Sulfur combines with the Magnesium to form Magnesium Sulfate (Epson Salts) which is highly leachable and moves it out of the soil profile.

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Potash (K)
It makes up approximately 3 - 5% of the CEC. Potassium acts like sodium (two true acids) they are fast acting and there is no need to try and build a reserve with commercial fertilizer and is financially unfeasible. Most Potash is 100% water soluble on water contact therefore making it highly leachable on sandy soil and the remainder is fixed in the soil due to unbalanced conditions. Plants requirements for Potassium start out in small amounts in a small plant and increasing at the fruiting stage. Most of the Potassium that a plant will use is obtained by defusion which means the magnetic pull of the root draws the element to itself as needed and must be with in 6mm of the root to be exchangeable. This is why direct

seed placement and folia sprays can be very profitable at low rates.

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Sodium (Na)
Sodium is another true acid like Potassium. Excessive sodium is an enemy to soil life, animals and man. Potassium activates Sodium and for every pound of Potassium you add to your soil it can release from two and a half to three times the Sodium. For example desert land is sterile because of sodium.

1. Sodium produces water stress on a growing crop and actually has the pulling power to hold water from roots. The soil can have adequate moister and the crop actually starve of water.
2. Sodium has the strongest exchange capacity of any Cation (1.82 times more pulling power than Calcium).
3. To determine salt levels of commonly used products ask your fertilizer supplier or go to Sustainable Growing Systems Website (LINK).
4. Sodium should never exceed sulfate in a water-soluble test.

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Hydrogen (H)
The free exchange nutrient, soil that has no Hydrogen (acid) has a nutrient limitation. Acid in soil solution is what allows most nutrients to become exchangeable to plant roots. Most soil microbes thrive in these slightly acid conditions. Proper soil pH will normally be between 6.3 - 6.8. Optimum natural level of Hydrogen is 6 - 10%. If the soil has over 15% Hydrogen it becomes too acid. If Hydrogen is at 0 it tells you the Cations are out of balance of over saturation has occurred. Hydrogen should be watched very closely as your soil life/microbes depend upon it. This why keeping a proper balance of nutrient is much more important than dumping fertilizer.

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Soil pH
Soil pH is the measure of the degree of acidity of any soil. Hydrogen is the nutrient that causes soil to go acid, if one or more of the other four Cation levels drops. But in an age of salty acid fertilizers and deadly chemical the old time pH scale has little value. Your soil can have a perfect pH for most cropping systems and Cation balances can be destroyed by salts and acids. The pH reading throws all 5 Cations into one basket and tells you the acidity factor of the soil (it tells you nothing of its balance). Soil pH can be changed in various ways. NH3 takes pH sharply higher and then acid. Potassium Chloride, Sodium Nitrate raises pH. Super phosphate, ammonium nitrate, MAP, DAP and ammonium sulfate lower pH and make soil acid.

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Phosphorus (P)
It is the second most efficient nutrient after calcium. Most soils have a naturally good level of Phosphorus yet most of it is locked up chemically. Man made phosphates can create many problems.

1. These products are water soluble and in an unhealthy and unbalanced soil, the Phosphorus can be locked up within hours and is not available to the crop .
2. These Ammonium activated and high acid phosphorus products can suppress and kill soil life.
3. MAP requires three times the Calcium Carbonate to neutralize it as other Nitrogen products and can produce very acid conditions.
4. Phosphorus is the most important Anion (negative charged nutrient).
5. Phosphorus and its balance to Nitrogen is important to the health and vigor of plants. It is a basic part of the sugar - protein, energy - enzyme family chain. A minimum of 2:1 ratio.
6. In dead soil life soils, only 2 - 10% of the Phosphorus will be plant available.
7. A word to the wise who will listen, soil life and nutrient balance determines the amount of exchangeable Phosphorus in your soil NOT the amount of dry Phosphorus fertilizer you apply. Proven research shows only 10 - 30% of a crops requirements comes from their fertilizer applications, so build a humus rich soil with biological life and earthworms.
8. Phosphorus is essential for increased pest and disease resistance.
9. There are 5 types of Phosphorus essential in the photosynthesis process which produces sugars necessary for plant production (see photosynthesis chart).
10. Important factors with regard to Phosphorus are:
    - at high pH phosphate ties up with calcium.
    - at low pH phosphate ties up with aluminum iron and manganese, hence the importance of maintaining your pHs at the correct level.

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Sulphur (S)
Sulphur can be used to remove undesirable elements such as Magnesium. It is a vital nutrient in the natural soil balance program. Restoring soil humus levels is very important in the manufacturing of natural sulfates.

1. The Nitrogen: Sulphur balance is eight parts of Nitrogen to 1 part of Sulphur and is very important for a plants metabolism and energy level.
2. Proper Sulphur levels build higher and better enzyme complex systems.
3. Sulphur in the proper balance with nitrogen increases nitrogen efficiency in the plant.
4. Sulphur can increase protein in grain and grasses and controls nitrate build up within crops.
5. Sulphur can be used as a valuable tool to lower pH of alkaline soils therefore increasing the availability of other key nutrients and is a key nutrient to improve the physical condition of the soil.

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The Micro-Nutrients
We need to remember Leibigs Law of the Minimum these seven nutrients are a vital part of all the enzyme families and enzymes can work at an unbelievable rate of 7 million reactions per second. Also think of enzymes as specialized protein capable of creating chemical changes necessary for plant growth.

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Zinc (Zn)
Zinc deficient food has a variety of health problems and can lead to several health conditions. Zinc helps heal wounds and skin irritations, Zinc deficiency can lead to a deal in intestinal absorption of carbohydrates and protein, hair falling out sexual dysfunction, birth defects and retarded growth. Zinc is a component of insulin and is also necessary in the digestive enzymes produced by the pancreas. Zinc availability can be a problem as soil pH increases. Zinc is a necessary part of certain plant enzymes and is vital in the metabolic function of cellular respiration, this then indicates that a zinc deficient plant will have limited functions and will not be healthy. The preferred zinc to phosphate ratio is 1:10.

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Boron (Bn)
Boron is vital and calcium can't perform its job of stabilizing the metabolism process without it.

1. Boron aids the plants resistant against harmful fungi and diseases .
2. Boron allows sugars to trans-locate properly in the plant and aids in good sugar levels in lateral and terminal bud areas.
3. Boron aids in regulating cell division, salt absorption, hormone movement and Nitrogen assimilation.
4. For Boron to be available to a plant it must be converted into the nutrient anion level (Borate) This is done by soil microbes. **Caution: heavy applications of limestone can limit the amount of Boron for plant growth.**
5. Low pH soils increase Boron solubility and availability.
6. Boron can be very toxic particularly if Calcium is low.
7. Typical crop symptoms are hollow stems a woody taste, poor seed germination, lopsided fruit and growing tips die back.
8. Boron can affect pollination and flowering.
9. Boron plays a significant role in the movement of sugars with regard to photosynthesis.

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Manganese (Mn)

1. High pH combined with very high organic matter can create Manganese deficiency.
2. Low Sulphur levels can almost stop Manganese flow to a plant.
3. Flooding and soil compaction will decrease Manganese exchangeability, therefore don't work your soil wet.
4. Manganese is part of the complete amino acid complex, which is necessary in all healthy animal diets.
5. High pH soils above 7 can become a problem in Manganese availability.
6. Manganese accelerates seed germination and aids in photosynthesis.
7. Manganese deficiency has an impact on nitrogen assimilation (maybe the reason why pale green to yellow inter-veinal mottling is a symptom of Manganese deficiency.
8. Deficiencies usually occur in lighter soil types.
9. Liming can have an impact and magnify magnesium deficiencies.

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Molybdenum (Mo)

1. Molybdenum is an anion nutrient and exchangeability increases with a higher pH.
2. Molybdenum is essential in certain enzymes that clean and purge the plant system closely associates with oxygen.
3. Molybdenum deficiencies are similar to those of nitrogen deficiencies.

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Copper (Cu)

1. Copper is a weaker cation that is held in the humus store house and exchangeability to the plant is dependent on certain biological activity especially mycorrhizae fungi.
2. Copper is one of the nutrients that allow enzymes to work at excelled rates.
3. When Calcium and potash are in a natural balance plants can use copper to build antibiotics for disease control.

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Iron (Fe)

1. Iron is a cation needed in small amounts in plants.
2. In human health Iron is responsible for the production and function of red blood cells.

3. It is less available at high pHs and it can be unavailable by having excessive amounts of phosphorus calcium manganese copper and molybdenum.
4. Low organic matter levels can limit iron availability.

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Cobalt (Co)
It is not generally regarded as essential, however in the Nullabor region on soil samples taken where no Cobalt was present and after the application of half a kilo of Cobalt per hectare Lucerne was able to grow, indication how essential half a kilo of a particular nutrient is. Cobalt is essential as the metal component of vitamin B12. Cobalt stimulates beneficial bacteria in the soil.

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Silicon (Si)
Silicon has only recently been recommended as essential and much research has been done on this element.

1. Silicon is essential for cell wall strength which contains the activity of photosynthesis with a weak cell wall sugars are able to leak through the wall and become a calling card for insects and a food source for fungal pathogens.
2. It can be used to buffer against tonicities of heavy metals.
3. It can buffer against high sodium levels.
4. Silicon can help produce lodging in crops like rice, wheat and sugar cane, which have a high silicon requirement.
5. Silicon increases photosynthesis and provides better shelf life and flavor.
6. Silicon can increase brix levels and provide some measure of frost drought and salinity protection.

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