SOIL SOLUTION ANALYSIS *INTERPRETATION*

To maintain optimal plant growth, health, and yield, soil nutrients must be balanced, abundant, and available. Apical's Soil Solution Analysis replicates plant root uptake to reveal real-time nutrient availability as well as pH, EC, and ORP. It is also important for nutrients to be distributed evenly across soil strata. As plant roots penetrate into different soil layers, they need ongoing access to vital nutrients. The Apical report reveals the mineral availability of soil at different layers to the grower. A balanced report with analyte readings in target ranges indicates a healthy soil environment with available nutrients for plant growth across soil horizons. A large gradient between nutrient levels in soil strata is an indication of Leaching (nutrients moving from upper to lower strata) and/or Translocation (nutrients moving from lower to upper strata). For example, if Nitrogen is lower in shallow soil compared to deep, it may be being over applied and leaching into the subsoil. Conversely, if higher levels of a nutrient are found in shallow soil compared to deep, the plant may be exhausting the soil's available reserves of that nutrient at the point of root uptake in deeper soil. Leaching and Translocation, along with real-time nutrient availability, inform critical soil management decisions and offer potential solutions for growers in a variety of crops.

For best results, be sure to upgrade your reports to include Apical's *Detailed Recommendations* - a prescribed nutritional and biological plan based on lab results.

pH

Generally, the desired soil pH is crop dependent, see desired pH by crop guidelines listed in the chart on page 2.

EC (ELECTRICAL CONDUCTIVITY)

- Soil EC is a measurement of how well a soil can transmit an electrical current; more ions mean a higher EC and vice versa.
- Soil EC should rise gradually during the crop cycle, starting from its lowest during planting to its highest at harvest.
- Low soil EC can cause root decay and is often due to compaction, overwatering, under-fertilizing, or low microbial activity.
- High soil EC can cause root burning and is often due to high salinity, overfertilization, or drought conditions.

ORP (OXIDATION-REDUCTION POTENTIAL)

- ORP indicates the degree to which soils are capable of absorbing or donating electrons to the soluble fraction of the soil solution. ORP is measured in millivolts (mV).
- A positive ORP reading indicates an oxidizing soil. Oxidizing soils are good at absorbing electrons from the soil solution.
- A negative ORP reading indicates a reducing soil. Reducing soils are good at donating electrons to the soil solution.
- For most crops, Soil ORP should be between -100 and +100 mV. The ORP chart on page 2 highlights how some nutrients are affected at various ORP ranges.

NITROGEN

Ammonium (NH4): For most crops, when NH4 in soil is 1-5 ppm, NH4 levels in the plant are found to be sufficient.
Nitrate (NO3): For most crops, when NO3 in soil is 10-25 ppm, NO3 levels in the plant are found to be sufficient.

MAJOR NUTRIENTS

Phosphorous: For most crops, when P in soil is 4-8 ppm, P levels in the plant are found to be sufficient.
Potassium: for most crops, when K in soil is 50-150 ppm, K levels in the plant are found to be sufficient.

- *K should make up 3-5% of the Cations Pie Chart and be in ratios of K:Mg~1:4, K:Ca~1:15, and K:Na>6:1.*

SECONDARY NUTRIENTS - CATIONS

Calcium: For most crops, when Ca in soil is 850-1000 ppm, the Ca levels in the plant are found to be sufficient.

- *Ca should make up 75-80% of the Cations Pie Chart and be in ratios of Ca:Mg~6:1, Ca:K~15:1, and Ca:Na~40:1.*

Magnesium: For most crops/soils, when Mg in soil is 150-250 ppm, the Mg levels in the plant are found to be sufficient.

- *Mg should make up 16-20% of the Cations Pie Chart and be in ratios of Mg:Ca~1:6, Mg:K~4:1, and Mg:Na~10:1.*

Sodium: For most crops, when Na in soil is below 30 ppm, the Na levels in the plant are found to be sufficient and non-excessive.

- *Na should make up 1-2% of the Cations Pie Chart and be in ratios of Na:Ca~1:40, Na:Mg~1:10, and Na:K~6:1.*

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SECONDARY NUTRIENTS - ANIONS

Sulfur: For most crops, when S in soil is 5-10 ppm, the levels in the plant are found to be sufficient.
Chloride: For most crops, when Cl in soil is < 1 ppm, the levels in the plant are found not to be in excess and are sufficient.
Silicon: For most crops, when Si in soil is 10-20 ppm, the levels in the plant are found to be sufficient.

MINOT NUTRIENTS - CATIONS

Iron: For most crops, when Fe in soil is between 1 and 2.5 ppm, the levels in the plant are found to be sufficient.
Manganese: For most crops, when Mn in soil is between 0.25 and 0.5 ppm, the levels in the plant are found to be sufficient.
Zinc: For most crops, when Zn in soil is between 0.7 and 1.2 ppm, the levels in the plant are found to be sufficient.
Copper: For most crops, when Cu in soil is between 0.4 and 0.8 ppm, the levels in the plant are found to be sufficient.
Cobalt: For most crops, when Co in soil is between 0.35 and 0.75 ppm, the levels in the plant are found to be sufficient.

MINOR NUTRIENTS - ANIONS

Iodine: For most crops, when I in soil is between 0.5 and 1 ppm, the levels in the plant are found to be sufficient.
Boron: For most crops, when B in soil is between 0.75 and 1ppm, the levels in the plant are found to be sufficient.
Molybdenum: For most crops, when Mo in soil is between 0.5 and 0.75 ppm, the levels in the plant are found to be sufficient.
Aluminum: For most crops, when Al in soil is < 1 ppm, the levels in the plant are found not to be in excess and are sufficient.
Selenium: For most crops, when Se in soil is between 0.5 and 0.75 ppm, the levels in the plant are found to be sufficient.

TARGET pH & EC RANGES FOR VARIOUS CROPS		
Crop	pH	EC
Beans/Legumes	6.0-6.4	0.7-1.4
Corn	6.2-6.4	1.2-2.0
Vine Vegetables	6.2-6.5	1.5-3.0
Strawberries	5.9-6.2	0.8-1.4
Cane Fruit	5.8-6.1	0.8-1.2
Blueberries	5.0-5.5	0.5-1.2
Tree Fruit	5.7-6.2	0.75-1.5
Nuts	5.7-6.2	0.75-1.5
Potatoes	6.0-6.4	0.8-1.8
Root Vegetables	6.2-6.4	1.2-1.6
Grapes	6.0-6.2	0.7-1.2
Pasture	6.2-6.4	0.5-1.1

ACTIVITY IN SOLUTION AT VARIOUS ORP RANGES		
Category	ORP	Biological Effect
Oxidized Soils	+300 to +750	Oxidation
Absence of free O2	+350	Biological O2 Demand
O2>H2O	+320 to +380	Carbonic Acid
Moderately Reduced Soils	+200 to +400	
NO3>N2	+220 to +280	Biological Phosphorus Absorption
Mn4+>Mn2+	+220 to +280	Mn Reducing Bacteria
Fe3+>Fe2+	+150 to +180	Fe Reducing Bacteria
Reduced Soils	-100 to +100	Denitrification
Highly Reduced Soils	-100 to -300	Biological Phosphorus Release
SO42->S2	-120 to -180	Fermentation
CO2>Methane	-200 to -280	Methane