TPS Lab

1938 75 YEARS 2013

Originators of
ASK THE PLANT®
TO GET THE MOST FROM YOUR PLANTS
DYNAMIC CROP NUTRITION®
Your Crop's Dieticians®

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INTERPRETATION GUIDE TO SOIL TEST REPORTS

TPSL®'s Daubeny Carbon Dioxide *Plant Natural*™ Extraction Method

works with all types of soils and is the most accurate in the industry.

It is essential to provide full and detailed information requested on lab forms for most accurate recommendations. *Optionally, additional pages of detailed interpretations and recommendations are available.* See SAO-00 option.

TEXTURE 1 - Sand 2 - Sandy Loam 3 - Loam 4 - Clay Loam 5 - Clay 6 - Heavy Clay

CEC (Cation Exchange Capacity) – The higher the CEC, the higher the soil's nutrient and water-holding capacity. **TEXTURE** is determined by Feel Method and indicates approximate CEC range. The Bouyoucos Hydrometer Method is available as an option (% Sand - % Silt - % Clay). Organic Matter increases CEC about 3.5 for each percent increase in Humus.

ORGANIC MATTER % – Total (LOI [Loss On Ignition]) (optional) includes both Raw and Active O.M. The original material (leaves, twigs,etc.) of the Raw are easily discernable. **Active** has been decayed into Humus and the original material cannot be discerned. O.M. improves CEC, tilth (soil physical condition / structure), water and nutrient holding capacity - the more the better – and their original plant-forms cannot be discerned. However, high OM soils can be at higher risk of over-fertilization.

SOIL TEXTURE	1	2	3	4	5	6
SOIL TYPE	Sand	Sandy Loam	Loam	Clay Loam	Clay	Heavy Clay
SOIL CEC RANGE	3 – 8	6 – 12	10 – 20	15 – 25	20 – 35	30 – 50+
IDEAL % OM (Active)	2.8	3.1	3.6	4.1	4.5	4.8

Free Lime (CO_3) Calcium Carbonate – Excess Lime: Excess levels above rating medium (M) will reduce availability of phosphorous and other anions – mostly calcium and magnesium, it can also cause the soil to crust (in instances where high sodium levels are also present). **Rating**: L-Low M-Medium H-High VH-Very High

CO_2 *PLANT NATURAL*™ (DAUBENY) EXTRACTION – Plant roots produce CO_2 in the immediate root-zone which combines with soil moisture to produce **Carbonic Acid**. Therefore, TPSL® mimics that same extraction to obtain nutrient values that are much more realistic and **calibrate to actual plant uptake**. Most labs extract with much stronger reagents, thus usually report much higher numbers with ***no calibration.***

NO_3 (N) This highly-soluble nitrate ion moves easily up and down with water and is a constantly changing value. Plant uptake is rapid. Excess can be toxic.

P_2O_5 (P) Extracted with CO_2 - amount reported in lbs. per acre for the top foot of soil. Amount reported is **available** to a crop in a normal growing season. Responses can be expected below 40 lbs. per acre and high requiring crops may respond to additional phosphate up to 200 lbs. per acre test.

K Extractable Potassium (CO_2) - is the amount available to the crop in a growing season. 80 ppm minimum and up to 120 ppm for crops with high potash needs. Soil availabilities vary with texture, soil moisture conditions, interference from Sodium levels & ratios of Na to Ca and to Mg.

pH Acidity measurement is variable. Most crops prefer 6.5 - 7.3. Neutral is 7.0 -- above is alkaline, below is acid. TPSL® air-dries soil at 81°F to avoid altering soil chemistry for best accuracy. pH is nebulous, dynamic and highly variable due to many factors.

EC SALTS A measure of Total Water-Soluble Salts - expressed as mmhos/cm (equivalent to dS/m). **EC** = **E**lectrical **C**onductivity X 640 = **T**otal **S**oluble **S**alts (TSS) in ppm.

SALT CATIONS H_2O - Water-soluble cations determined with ICAP Spectrophotometer. Calcium is important - should exceed 100 ppm. CO_2-Extractable (Carbonic Acid equivalent), same as the plant root process. Sodium is the main extractable harmful element - should be below 180 ppm. The amount of extractable Calcium reserve in the soil is also reported and must be known to properly manage excess salts.

SAR **S**odium **A**dsorption **R**atio is the relationship between Sodium and soluble Calcium (and also, Magnesium). A high SAR requires the addition of large amounts of soluble Calcium.

SAR	RATING	SAR	RATING	SAR	RATING	SAR	RATING	SAR	RATING
0-3	LOW	3-6	UPPER LOW	6-9	MARGINAL	9-12	HIGH	12+	EX. HIGH

Na (CO_2) : Ca (H_2O) These ratios help evaluate salt problems and are indicators of the soil's physical condition for
Na (CO_2) : Mg (H_2O) water and root penetration.

Na:Ca should be less than **6**.
Na:Mg should be below **20** for regular crops and below **10** for sugar-producing crops such as melons, citrus, sugar cane, sugar beets, etc...

RATING GUIDE TO TPSL® *PLANT NATURAL*™ SOIL TEST REPORTS
CALIBRATED AGAINST PLANT (SAP) ANALYSIS (ACTUAL PLANT UPTAKE)

NITRATE NO_3 – N lb/ac **12" Sample: ppm = lb/ac ÷ 4** **6" Sample: ppm = lb/ac ÷ 2**	1 - 9	Very Low	**PHOSPHATE P_2O_5 – P lb/ac** **ppm P x 2.291 = P_2O_5** **CO_2 Extraction**	1 - 10	Very Low
	10 - 19	Low		11 - 19	Low
	20 - 29	Upper Low		20 - 39	Upper Low
	30 - 59	Medium		40 - 59	Low Medium
	60 - 89	High Medium		60 - 79	Medium
	90 - 139	High		80 - 139	Low High
	> 140	High -- Caution, seedling injury possible		140 - 199	High
				> 200	Extremely High - Micros may tie up.

POTASSIUM K – ppm	H_2O Extraction	CO_2 Extraction	Rating
12" Sample: lb/ac = ppm x 4	1-39	1-59	Very Low
6" Sample: lb/ac = ppm x 2	40-59	60-79	Low
ppm K x 1.205 = K_2O	60-79	80-99	Medium
	80-99	100-119	High Medium
	> 100	> 120	High

CALCIUM Ca - ppm	H_2O Extraction	CO_2 Extraction	Rating	MAGNESIUM Mg – ppm	H_2O Extraction	CO_2 Extraction	Rating
	< 19	< 149	Very Low		< 9	< 39	Very Low
	20 - 69	150 - 249	Low		10 - 12	40 - 59	Low
	70 - 89	250 - 399	Marginal		13 - 14	60 - 79	Marginal
	90 - 119	400 - 599	Medium		15 - 17	80 - 99	Medium
	> 120	> 600	High		> 18	> 100	High

Electrical Conductivity EC SALTS EC X 640 = ppm TSS	mmhos/cm ★	Rating
	< 0.49	Very Favorably Low
	0.50 - 0.99	Low
	1.00 - 1.59	Slight Accumulation
	1.60 - 1.99	Medium - Little Problem – But Caution.
	2.00 - 3.99	High - Affects many crops - Treatment Needed.
	> 4.00	Affects most crops - Treatment Essential.

★ mmhos/cm = dS/m

SODIUM H_2O Na should be over 50% of the CO_2 Na so it can leach through the soil profile.
Na – ppm The solubility of the Na is affected by Sulfur (acidity) and soluble Calcium.

When the H_2O Na is over 50% of the CO_2 Na and the EC (total soluble salt) is high, this indicates that better internal drainage is needed. Subsoils need testing.

When CO_2 Na is high (>180) and the H_2O Na is less than 50%, this indicates need for chemical treatment to increase soluble Na so it will leach. Also, test soil for soluble (H_2O) cations especially calcium and sodium to determine best salt management treatment.

Micronutrients – Balanced nutrition not only involves N-P-K but micronutrients and trace elements as well. Balanced micronutrients can lead to increased genetic yield potential, less disease and insect pressure and better macronutrient uptake efficiency for maximum economic yields.

Rating	ZINC Zn ppm DTPA	IRON Fe ppm DTPA	MANGANESE Mn ppm DTPA	COPPER Cu ppm DTPA	BORON B ppm Hot Water	SULFUR SO_4-S ppm Water Soluble	MOLY-BDENUM Mo ppm DTPA
Very Low	0 – 0.59	0 – 2.09	0 – 2.09	0 – 0.89	0 – 0.39	0 – 9	0 – 0.49
Low	0.60 – 1.09	2.10 – 5.09	2.10 – 4.09	0.90 – 1.29	0.40 – 0.59	10 – 21	0.50 – 0.99
Medium	1.10 – 3.09	5.10 – 11.09	4.10 – 10.09	1.30 – 2.59	0.60 – 1.29	22 – 36	1.00 – 1.49
High	3.10 – 6.09	11.10 – 18.09	10.10 – 15.09	2.60 – 3.59	1.30 – 1.99	37 – 51	1.50 – 1.99
Very High	6.10 – 10.09	18.10 – 30.09	15.10 – 30.09	3.60 – 5.10	2.00 – 2.99	52 – 69	2.00 – 4.99
Extremely High	>10.09	>30.09	>30.09	>5.10	>2.99	>69	>4.99

Rating	CHLORIDES Cl ppm Water Soluble	SILICON Si ppm $CaCl_2$ Soluble	COBALT Co ppm DTPA	SELENIUM Se ppm DTPA	ALUMINUM Al ppm $CaCl_2$ Soluble	NICKEL Ni ppm DTPA	*SOLVITA*® Soil Respiration CO_2-C Burst Dry / Re-Wet
Very Low	0 – 99	0 – 9	0 – 1.99	0 – 0.49	0 – 0.99	0 – 9.99	0 – 5
Low	100 – 199	10 – 19	2.00 – 4.99	0.50 – 0.99	1.00 – 3.99	10.00 – 19.99	6 – 30
Medium	200 – 299	20 – 59	5.00 – 14.99	1.00 – 1.49	4.00 – 9.99	20.00 – 34.99	31 – 60
High	300 – 499	60 - 99	15.00 – 39.99	1.50 – 1.99	10.00 – 14.99	35.00 – 49.99	61 – 100
Very High	500 – 699	99 – 150	40.00 – 59.99	2.00 – 4.99	15.00 – 24.99	>49.99	>100
Extremely High	>699	>150	>59.99	>4.99	>24.99		

MICRONUTRIENT FUNCTIONS IN PLANTS

ELEMENT	FUNCTIONS - COMMENTS
ALUMINUM Al	Can be highly toxic on soil pH levels less than 5.5. Tied-up in higher pH soils. As with Arsenic, may be essential for some plants in very small trace amounts.
BORON B	Essential for protein synthesis and is associated with increased cellular activity that promotes maturity with increased set of flowers, fruit, yield and quality. It also affects nitrogen and carbohydrate metabolism and water relation in the plant.
CHLORIDE Cl	Essential (working in tandem with K) to the proper function of the plant's stomatal openings, thus controlling internal water balance. It also functions in photosynthesis, specifically the water splitting system. Small grains such as wheat benefit from a chloride application which may prevent rusts or mildew.
COBALT Co	A plant "bio-stimulant", similar to molybdenum, as it is required by nitrogen-fixing bacteria. Component of vitamin B_{12}, which is synthesized in the rumen of livestock by bacteria. Contributes to resistance against parasites and infection in cattle. Typical signs are loss of appetite and poor growth.
COPPER Cu	Has an important role as an enzyme activator and as a part of certain enzymes which function in plant restoration. It is very important in the plant's reproductive stage of growth and plays a role in chlorophyll production.
IRON Fe	Essential for the formation of the chlorophyll and for photosynthesis. Iron is the activating element in several enzyme systems. It's also important in respiration and other oxidation systems of plants and is a vital part of the oxygen-carrying system (cattle).
MANGANESE Mn	Usually functions with the enzyme systems of the plant involved in breakdown of carbohydrates, nitrogen metabolism and other plant processes.

MICRONUTRIENT FUNCTIONS IN PLANTS - Continued	
ELEMENT	**FUNCTIONS - COMMENTS**
MOLYBDENUM Mo	Needed for the symbiotic fixation of nitrogen by legumes . It is vital for the reduction of nitrates and in the synthesis of protein by plants. Livestock producers should test for Mo deficiencies in soil and forage.
NICKEL Ni	Component of the enzyme, urease. Plants deficient in Ni can accumulate urea in the leaves. Grain viability is inhibited and limits germination in barley and other species when Ni deficiency exists. Nickel deficiency is most predominant in pecans, where the classic symptom is mouse-ear leaves.
SELENIUM Se	Increases tolerance of plants to UV-induced oxidative stress, delay senescence and promotes growth of aging seedlings. Aids in the regulation of water status of plants under drought conditions. Deficiency leads to calves developing white muscle disease. Typical signs: retained placentas after calving, weak calves or nutritional muscular dystrophy.
SILICON Si	The ultimate stress reliever. Impacts soil structure and fertility. Affects internal plant structure, growth and development. Stimulates microbial growth, bacteria and fungi. Increases resistance to biotic stress (fungal infections reduced), pests deterred, more tolerant to abiotic stress (drought, excess moisture, mineral imbalances and extreme temperatures).
SULFUR S	Plants absorb sulfur in the sulfate form. Constituent of proteins (increases protein in forages and grains). Controls nitrate build-up in forages. Involved in respiration and nodule formation of legumes. Acts as a soil conditioner to control sodium, calcium and salt build-up.
ZINC Zn	Essential for the transformation of carbohydrates and regulation of the consumption of sugar in the plant. It forms part of the enzyme systems which regulate plant growth. Aids in maximizing plant genetic potential.

SOLVITA® **(CO_2-C Burst) Soil Respiration Test** – determines the aspect of soil health relating to overall soil biology (microbial biomass) and carbon content.

Converting PPM to Pounds –

- Results for some major and minor elements are reported in ***parts per million*** (**ppm**).
- This unit of measurement is equivalent to pounds of nutrient per million pounds of soil.
- One acre of soil 6 inches deep weighs about 2 million pounds.
- Therefore, to convert ppm to lbs/ac, multiply by 2.
- So, if the client does not report to the lab his/her sample depth, the Nitrates (NO_3) and Phosphate (P_2O_5) will be calculated as a 12-inch sample.
- Therefore, the calculation used is a factor of 4.
- Thus, if your sample is only 6 inches, your results will be twice as high.
- This will only affect the Nitrate and Phosphate, since they are the only nutrients converted to pounds per acre on our soil report.
- To calculate the factor for the actual sample depth, you multiply the depth (in inches) by 0.33.
- This result will be the factor to use to multiply by ppm of nutrients to convert to pounds per acre.

Or to convert to pounds per 1,000 square feet, the factor is 0.33 ÷ 43.56 = 0.00758. (Per 100 square feet, 0.000758)

For example, a sample depth of 8 inches and 55 ppm of Magnesium per acre: 8 inches X 0.33 = 2.64.

Therefore, 55 ppm Magnesium X 2.64 = 145 lbs/ac of Magnesium.

Or, a sample depth of 8 inches and 55 ppm of Magnesium per 1,000 square feet: 8 inches X .00758 = 0.0606.

Therefore, 55 ppm Magnesium X 0.0606 = 3.3 lbs/1,000 sq. ft. of Magnesium.

Accordingly, it is

Very Important to accurately report the actual depth (interval) ***of your sample.***

THE MOST ACCURATE WAY TO PREDICT THE AVAILABILITY OF SOIL NUTRIENTS IS WITH

THE TPSL® DAUBENY *PLANT NATURAL*™ METHOD OF NUTRIENT EXTRACTION

(calibrated against actual plant uptake)

OF PLANT-AVAILABLE NUTRIENTS FROM SOILS.

WORKS BEST AND ACCURATELY WITH

ALL SOILS – ACID OR ALKALINE – SANDS OR CLAYS – ANYWHERE IN THE WORLD.

Ask The Plant ®

PLANT SAP or TISSUE ANALYSIS

is the only way to predict, determine and correct crop nutritional problems to achieve maximum crop performance under existing growing conditions.

PLANT NUTRIENT REQUIREMENTS can *change dramatically* with the age and development stage of your crop.

***ADEQUATE FIELD INFORMATION* IS NEEDED FOR PROPER INTERPRETATIONS OF THE ABOVE INFORMATION TO PROVIDE YOU WITH THE ANSWERS FOR THE MOST EFFICIENT USE OF YOUR FERTILIZER MONEY AND TO OBTAIN THE BEST FIELD PERFORMANCE WITH MINIMAL INSECT AND DISEASE INFESTATIONS UNDER YOUR PREVAILING GROWING CONDITIONS.**