WESTERN LABORATORIES
P.O. Box 1020 • 211 Highway 95 • Parma, ID 83660 • 800-658-3858
westernl@westernlaboratories.com

Useful Conversions and Tables

SMALL CONCENTRATIONS

ppm = parts per million
ppm = parts per million = pounds/million pounds
ppm ÷ 10,000 = percent
ppm = percent x 10,000
ppm = milligrams/liter
ppm x 0.00136 = tons/AcFt of water
ppm x 0.0584 = grains/gallon
ppm = 17.12 x grains/gallon
ppm x 8.345 = pounds/million gallons
ppm = 640 x soluble salt reading
ppm x 1.7 = pounds/Ac furrow slice
ppm x 3.0 = pounds/AcFt
ppm Ca ÷ 200 = 1 meq Ca
ppm Na ÷ 230 = 1 meq Na
ppm K ÷ 390 = 1 meq K
ppm Mg ÷ 120 = 1 meq Mg

WEIGHTS AND VOLUMES

1 acre foot of soil = approximately 3,200,000 pounds
1 acre-furrow slice = approximately 1,700,000 pounds
1 square acre = 43,560 Ft^2
1 acre foot of water = about 2,722,500 pounds
1 acre foot of water = 325,851 gallons
1 acre inch of water = 27,154 gallons

CONVERSIONS

To convert from ppm to pounds:

NO_3 x 3.0 = lbs N / AcFt
ppm P x 2.3 = lbs P_2O_5
ppm P x 6.9 = lbs P_2O_5/AcFt
ppm K x 1.2 = lbs K_2O
ppm K x 3.6 = lbs K_2O/AcFt
ppm S x 3 = lbs SO_4
ppm S x 10.5 = lbs SO_4/AcFt
ppm SO_4 ÷ 3 = ppm S
lbs SO_4 ÷ 3 = lbs S

SOIL pH – Hydrogen Ion Concentration

The soil is measured on a 1:2 soil to water solution. The pH indicated on the report measures the active soil alkalinity or acidity.

pH below 5.5	strongly acid soil
pH 5.5 to 5.9	moderately acid soil
pH 6.0 to 6.5	slightly acid soil
pH 6.6 to 7.2	neutral soil
pH 7.3 to 7.7	slightly basic soil
pH 7.8 to 8.4	moderately basic soil high in free lime
pH above 8.5	strongly basic soil high in total salts

SOLUBLE SALTS – Electrical Conductivity

Scale of Conductivity in mmhos/cm

0	2	4	8	16
Salt effects mostly negligible	Yields of sensitive crops may be restricted	Yields of many crops restricted	Only salt tolerant crops yield satisfactory	Only a few very tolerant crops yield satisfactory

ORGANIC MATTER – Walkley-Black Tritation Method

Organic matter is the storehouse of nutrients, increases soil tilth and friability, and contributes to the soil water holding capacity of the soil.

% Organic Matter	Evaluations
0 to 0.9	very low
1.0 to 1.5	low
1.6 to 2.5	medium
2.6 to 4.9	high
above 5.0	very high

Organic Matter Release of Nitrogen/Acre/Year
% OM x Factor = pounds Nitrogen/Ac/Yr

Factors:	60	S.E. Washington – N.E. Oregon
	55	Winnemucca, Nevada
	50	E. Oregon – S.W. Idaho
	40	Magic Valley, Idaho
	35	E. Idaho – N. Utah
	30	W. Wyoming

NITRATE-NITROGEN, Buffered Extraction Method

The measurement of NO_3-N determines residual nitrogen. The following range reflects average soil levels and does not suggest nitrogen requirements for particular crops.

NO_3 – N, ppm	Evaluation
0 – 5	very low
6 – 10	low
11 – 25	medium
26 – 40	high
41+	very high

PHOSPHORUS-P
Sodium Bicarbonate Method

P, ppm	Evaluation
1 – 4	very low
5 – 11	low
12 – 25	medium
26 – 45	high
45+	very high

POTASSIUM-K
Ammonium Acetate Method

K, ppm	Evaluation
0 – 100	very low
101 – 200	low
201 – 450	medium
451 – 750	high
750+	very high

CALCIUM – Ca

Ca, ppm	Evaluation
0 – 900	very low
901 – 1500	low
1501 – 4000	medium
4001 – 5000	high
5000 +	very high

MAGNESIUM – Mg

Mg, ppm	Evaluation
0 – 150	very low
151 – 350	low
351 – 600	medium
601 – 1200	high
1200 +	very high

SODIUM – Na

Mg, ppm	Evaluation
0 – 30	very low
31 – 60	low
61 – 175	medium
176 – 450	high
450 +	very high

FREE LIME
$CaCO_3$, 1N HC1 Method

% Lime	Evaluation
0 – .25	very low
.25 – .5	low
.6 – 2.9	medium
3.0 – 8.0	high
8.1 +	very high

Element	Low to Deficient	Adequate
SO_4-S (sulfate water sol)	less than 10 ppm	10 to 30 ppm
Zn (zinc by DTPA-TEA)	less than 0.8 ppm	.9 to 4.0 ppm
Mn (manganese by DTPA-TEA)	less than 2.0 ppm	3 to 7 ppm
Cu (copper by DTPA-TEA)	less than 0.3 ppm	.7 to 4.0 ppm
Fe (iron by DTPA-TEA)	less than 5.0 ppm	5 to 10 ppm
B (boron by hot water sol)	less than 0.5 ppm	.5 to 2.0 ppm

Element	Excessive to Toxic
SO_4 (sulfate water sol)	–
Zn (zinc by DTPA-TEA)	15 + ppm
Mn (manganese by DTPA-TEA)	150 + ppm
Cu (copper by DTPA-TEA)	20 + ppm
Fe (iron by DTPA-TEA)	–
B (boron by hot water sol)	3 + ppm

Approximate Relation of Cation Exchange *Capacity to Soil Texture*

CEC	Soil Texture
0 – 8	sand / loamy sand
8 – 12	loamy sand / sandy loam
12 – 16	sandy loam
16 – 20	silt loam / loam
20 – 24	loam / silty clay loam
24 – 30	clay loam
30 +	clay

Sulfur Required to Neutralize the Free Lime

% Lime	Lbs Free Lime / Ac Ft	Lbs S Required to Neutralize the Free Lime
0.5	17,500	5,933
1.0	35,000	11,667
1.5	52,500	17,500
2.0	70,000	23.333
2.5	87,500	29,167
3.0	105,000	35,000
3.5	122,500	40,833
4.0	140,000	46,667
4.5	157,500	52,500
5.0	175,000	58,333
6.0	210,000	70,000
8.0	280,000	93,333
10.0	350,000	116,667
15.0	525,000	175,000
20.0	700,000	233,333

Approximate Pounds of S (Based on 99% S) Needed to Lower the Soil pH of One Acre Foot of Soil

	Pounds of Sulfur / Acre		
Change in pH	Sand	Loam	Clay
8.5 to 6.5	3,500	4,375	5,250
8.0 to 6.5	2,450	2,625	3,500
7.5 to 6.5	875	1,400	1,750
7.0 to 6.5	175	275	525

Calculations for Salt Problem Soils

Ca–ppm ÷ 200 = meq Ca, Na-ppm ÷ 230 = meq Na, Mg-ppm – 120 = Meq Mg, K-ppm ÷ 390 = meq K

To calculate the percent sodium of the Cation Exchange Capacity:

$$\frac{\text{meq Na}}{\text{CEC}} \times 100 = \%\ \text{Na of the CEC}$$

Base Saturation:

$$\text{Meqs}\quad \frac{\text{Ca + Mg + K + Na}}{\text{CEC (measured not sum of CEC)}} \times 100 = \%\ \text{BS}$$

1 meq of Ca/100g = 200 ppm or 400 lbs/AFS or 700 lbs CA/AcFt
1 meq of Mg/100g = 120 ppm or 240 lbs Mg/AFS or 420 lbs Mg/AcFt
1 meq of K/100g = 390 ppm or 780 lbs K/AFS or 1365 lbs K/AcFt
1 meq of Na/100g = 230 ppm or 460 lbs/AFS or 805 lbs Na/AcFt

Crop Tolerance for Percent Na of the CEC

0 to 5%	5 to 10%	10 to 15%	15 + %
Beans	Wheat	Crested Wheat	Barley
Strawberries	Oats	Fescue	Salt Grass
Carrot	Spearmint	Perennial Rye	
Radish	Alfalfa	Sugar Beets	
Onions	Turnip	Tall Wheat	
Lettuce	Sweet Corn	Birdsfoot Trefoil	
Fruit Trees	Field Corn		
Potatoes	Pasture		
Hops	Cotton		
Orchard Grass			
Cabbage			
Most Clovers			
Celery			
Tomatoes			
Peppermint			
Peas			

% Na of the CEC Based on Different Sodium Concentrations and Cation Exchange Capacities

CEC in meq/100g of soil

Soil Sodium in ppm-Na	8	10	12	14	16	18	20	22
	% Sodium of the CEC							
100	5.4	4.3	3.6	3.1	2.7	2.4	2.2	2.0
200	10.9	8.7	7.3	6.2	5.4	4.8	4.4	4.0
300	16.3	13.0	10.8	93	8.1	7.2	6.5	5.9
400	21.8	17.4	14.5	12.4	10.9	9.7	8.7	7.9
500	27.1	21.7	18.1	15.5	13.6	12.1	10.9	9.9
600	32.6	6.1	21.8	18.6	16.3	14.5	13.1	11.9
700	38.0	30.4	25.3	21.7	19.0	16.9	15,2	13,8
800	43.5	34.8	29.0	24.9	21.8	19.3	17.4	15.8
900	48.9	39.1	32.6	28.0	24.5	21.7	19.6	17.8
1000	54.4	43.5	36.3	31.1	27.2	24.2	21.8	19.8
1500	81.5	65.2	54.3	46.6	40.8	36.2	32.6	29.6
2000	108.8	87.0	72.4	62.1	54.4	48.3	43.5	39.5
2500	135.9	108.7	90.6	77.6	67.9	60.4	54.4	49.4
3000	163.0	130.4	108.7	93.1	81.5	72.4	65.2	59.3
3500	190.3	152.2	126.8	108.7	95.1	84.6	76.1	69.2
4000	217.4	173.9	144.9	124.2	108.7	96.6	87.0	79.0

Saline soil – pH below 8.5, sodium less than 15%, soluble salts less than 4. Sodic soil – pH greater than 8.5, sodium greater than 15%, soluble salts less than 4. Saline–Sodic soil – pH less than 8.5, sodium greater than 15%, soluble salts greater than 4.

Converting Foliar Micronutrient Materials From Percent to Pounds per Gallon

Liquid % Metallic X weight/gallon = pounds metal/gallon

Dry % Metallic X 1 pound = pounds metal/pound

John P. Taberna, Soil Scientist
Western Laboratories
Useful Conversions and Tables -1974