

ROCKY MOUNTAIN



Biological... Beyond Organic

**Soil Testing Guide
For Biological Agriculture**

3045 Aerotech Parkway, Unit 6, Montrose, CO 81401

Main: (970) 623-2281 • Toll Free: (877) 874-2334
soil@rockymountainbioag.com • www.rockymountainbioag.com

HOW DO WE CREATE BETTER SOIL?

In a biological soil program, the farmer will pay the most attention to the soil, for it is a major influence on growth, health, yield, quality animal performance and farm profitability.

Some good practices may include...

- Improving soil structure with a soil balancing program
- Recycling organic matter
- Maintain a good balance of available crop nutrients.
- Use only products that improve the microbial life in the soil as well as feed the crop.

Following these practices will produce nutrient dense high yielding crops. You can't do much about the weather, but you can fix your soil!

QUESTIONING OUR PAST

A great deal of our typical soil treatment rests upon a series of ideas which are not true in the experience of those who work ecologically with the soil.

These misconceptions include...

- Bigger is better.
- Food can be standardized.
- Soil fertility only changes yield, not quality
- Irrigation is vital to successful farming.
- Humus levels cannot be rebuilt.
- Humus and organic matter are the same thing.
- Plants feed only on dissolved nutrients.
- Weeds, insects, and diseases only exist to plague man.
- Lime is used only to fight soil acidity.
- Without toxic chemicals... mass starvation
- Toxic chemicals are safe if properly used.

Each of these misconceptions needs to be reviewed and re-evaluated by any person determined to do the best for Mother Earth's soil. But what is wrong with these widely accepted ideas? Let's look!

WHY SOIL HEALTH MATTERS

You Have More at Stake Than Next Year's Yield

WHAT IS HEALTHY SOIL?

We believe healthy soil is the firm foundation needed for a healthy food system. Healthy soil produces healthy crops, healthy livestock, and ultimately healthy people! Yet there is no standard definition of healthy soil. But as a farmer, you likely recognize healthy soils when you see them.

Some common characteristics of healthy soil...

- They drain and warm up quickly in the spring.
- They don't crust after planting.
- They soak up heavy rain with little run-off.
- They store moisture for dry spells.
- They resist erosion and nutrient loss.
- They support teeming populations of microbes.
- They don't require ever increasing fertilizer rates to maintain good yields.
- They produce healthy, high-quality crops.

The condition of the soil is at least as important as its fertility. The productivity of the soil can never be greater than the plant food element in the least supply. This means your concern with what is missing from the soil as well as with what is wrong with it and how to correct it should be of the utmost concern in your operations.

WHAT IS IN A SOIL TEST?

The Reams Method of Testing

When you send a soil sample off to be tested using the Reams Method you will find that the results may not be what you expected, or what you have received in the past from traditional testing. First, all soil testing is conducted utilizing the Morgan extracting solution; traditional soil testing is also available for those who desire. Second, you will find several factors listed on the results sheet that you may not be used to seeing, see the sample below.



INTERNATIONAL AG LABS A BIOLOGICAL APPROACH TO AGRICULTURE

NAME:	Rocky Mountain BioAg®	DATE:	
ADDRESS:	3045 Aerotech Pkwy, Unit 6	SAMPLE TESTED:	COMPLETE SOIL TEST
CITY/STATE:	Montrose, CO 81401	2021 CROP GROWN:	
		2022 CROP:	
		LAB TEST#	SAMPLE

SOIL ANALYSIS REPORT

Nutrient	Measure	Desired Ratio	Desired Level	Lab Results	Soil Index
Humus			30-40	15	29
Nitrates	lbs. / Acre		40	80	
Ammonia	lbs. / Acre		40	60	
Phosphorus	lbs. / Acre	1P:1K	174	540	0.44 : 1 P to K Ratio
Potassium	lbs. / Acre		167	1232	
Calcium	lbs. / Acre	7Ca:1Mg	3,000	1863	6.8 : 1 Ca to Mg Ratio
Magnesium	lbs. / Acre		429	276	
Sodium	PPM		<35	126	
ERGS	µS/Centimeter		200	1613	
ORP			28	29	
pH			6.5	7.3	
Copper	PPM		0.8-2.5	0.5	
Iron	PPM		10-25	33.2	
Zinc	PPM		1-6	2.6	
Manganese	PPM		8-30	3.6	
Boron	PPM		0.8-1.2	1.6	
Sulfur	PPM		30	240	
Formazan	PPM		600	353	

C.E.C. Test

Phosphorus				
Bray 1	(ppm)			65
Olsen	(ppm)			34.8
Potassium	(ppm)			544
Calcium	(ppm)			2321.79
Magnesium				536.04
Sodium				126
Organic Matter	%			5.82
pH				7.3
K	%		2-5%	7.7
Ca	%		60-70%	64.4
Mg	%		10-20%	24.8
Na	%		0.5-3%	3.0
C.E.C	meq/100g			18.0
Acidity	meq/100g			0.0

HUMUS

Humus is a portion of what we call Organic Matter. Humus is a thick, sticky, opaque colored glue that is made by microbes digesting organic matter. Humus attaches the silty soil particles together and makes soil granulate or flocculate. Soil with a high humus level should not blow or erode easily.

PRODUCTS THAT PROMOTE HUMUS PRDUCTION...

- Quantum Growth®
- Perfect Blend® Biotic Fertilizer

OPTIMUM HUMUS LEVELS

- 20 – 40

SODIUM

Sodium is an element which is quite territorial, which means certain parts of the world have too much and some parts have too little. Salt-affected soils may inhibit seed germination, retard plant growth and cause irrigation difficulties. Crop losses may occur with irrigation water containing as little as 700 to 850 mg/L TDS (total dissolved solids) or EC>1.2 dS/m.

PRODUCTS THAT HELP WITH SALT-AFFECTED SOILS...

- Quantum Growth®
- Perfect Blend® Biotic Fertilizer
- Gypsum

OPTIMUM SOIL LEVELS

- 20 – 30 ppm

NITROGEN

Some potential benefits of nitrogen may include increased plant growth, higher protein content, increased ear size in corn, better chlorophyll production and increased enzyme functions.

SOURCES OF NITROGEN...

- Ammonium sulfate (21-0-0-24S)
- Liquid 28%
- Manure
- Legume plow-down
- Quantum Growth® (nitrogen fixing bacteria)
- Perfect Blend® Biotic Fertilizer
- Urea (prilled)
- Ammonium Nitrate
- Ammonium thio-sulfate (12-0-0-26S)
- Calcium Nitrate

OPTIMUM SOIL LEVELS

- 40 lbs. Per acre – Nitrate N
- 40 lbs. Per acre – Ammoniacal N

NN: NITRATE NITROGEN (40-50 lbs/acre)

Nitrate nitrogen is the primary element to start the formation of a cell. Ideally, one should maintain 40 lbs. throughout the growing season. In low organic-level soils, it is easily washed out of the root zone.

AN: AMMONIACAL NITROGEN (40-50 lbs/acre)

Here we like to see 40 lbs. per acre for seed crops at seed-set time. Before that, readings of 10-20 are quite adequate.

PHOSPHOROUS

Phosphorous acts as a catalyst in the translocation of nutrients. Some potential benefits of phosphorous may include more vigorous and rapid growth, early root growth, better development and quality of grain, hastened maturity, increased nitrogen uptake, increased mineral content and a higher sugar level in the plant. Phosphorous also promotes energy release in cells, cell division and enlargement and photosynthesis.

SOURCES OF PHOSPHOROUS...

- Mono-Ammonium Phosphate (MAP 11-52-0)
- Idaho Phosphate
- Manure / Compost
- 0-20-0 AKA Super Phosphate
- Soft Rock Phosphate

OPTIMUM SOIL LEVELS

- 174 lbs. Per acre
- 1 to 1 ratio (P to K) For Row Crops
- 2 to 1 ration (P to K) For Grass Crops

P: Phosphorous (174 lbs/acre)

The density of soluble phosphate lbs/acre determinations the sugar content and nutrient content of your crop. (This cannot be done with acid-treated phosphates). All nutrients, except nitrogen must be in phosphate form to be taken into the plant. Multiply the phosphorous lbs/acre reading on your soil test X 2.3 to convert phosphorous to phosphate. Always keep your P to K ratio in line.

POTASSIUM

Some potential benefits of potassium may include better stalk strength and lodging resistance, improved winter hardiness, more resistant to disease, increased protein and carbohydrate production, better sugar translocation, enhanced enzyme functions and cell division.

SOURCES OF POTASSIUM...

- Potassium sulfate (0-0-50-17S)
- Potassium Hydroxide
- Potassium Nitrate
- Sul-Po-Mag
- Compost / Manure

OPTIMUM SOIL LEVELS

- 167 lbs. Per acre

COMMENT

- All excess can cause problems.

K: POTASSIUM (167 lbs/acre)

Potassium is very important for the opening and closing of the stomata to get more nutrients from the air such as carbon dioxide. Its three most vital contributions to healthy plants are the caliber (thickness) of the leaves and stalk, the size of the fruit produced, and the number of the fruit which set on a plan. In seed crops potassium should be maintained in a maximum 1:1 P to K ratio with phosphorous; in grass crops, that ratio should be 2:1.

CALCIUM

Some potential benefits of calcium may include improved soil structure, stimulate growth of soil microbes and earthworms, mobilization of nutrients into the plant, increased nitrogen utilization and protein content, increased root growth, leaf growth, cell wall building and cell division. Calcium promotes enzyme functions, increases the sugar content of the plant, and enhances overall plant health resulting in high quality grain or fruit.

SOURCES OF CALCIUM...

- Calcium Sulfate (Gypsum)
- Calcium Phosphate
- High Calcium Lime (Ca Carbonate)
- Chelated Calcium
- Idaho Phosphate

OPTIMUM SOIL LEVELS

- 3000-4000 lbs. Per acre

Ca: CALCIUM (2000-4000 lbs/acre)

Calcium is the main element to provide resistance against the organic acids in the soil, thereby creating the energy to grow a crop. With this testing method, the minimum level of calcium should not be allowed to dip below 1 ton per acre. It is not advisable to use bacterial and enzymatic products when calcium is below recommended levels unless you are adding high calcium-lime, calcium sulfate (gypsum) or calcium nitrate at the same time. Calcium solubility and availability is determined by three things... proper aeration, active bacteria, and mesh size of added limestone. Calcium should be in a 7:1 ratio with magnesium. IF the ratio is less than 4:1 it indicates a biologically deficient soil unless in a high magnesium area.

MAGNESIUM

Magnesium is a key element in chlorophyll. Some potential benefits include increased protein production, enzyme functions and energy release in cells. Magnesium aids phosphorous uptake, oil formation and starch translocation.

SOURCES OF MAGNESIUM...

- Chelated Magnesium
- Magnesium Sulfate
- Sul-Po-Mag

OPTIMUM BALANCE

- 429 lbs/acre
- 1:7 ratio with calcium

COMMENT

- All Excess Can Cause Problems

Mg: MAGNESIUM (300-570 lbs/acre)

Magnesium is very important in the process of photosynthesis; however, it is not needed in great quantities in the soil. Most of the plants' needs can be met by obtaining magnesium from the air through the stomata. It helps control nitrogen levels in the plant. Excesses of magnesium can cause soil compaction and loss of aeration. Magnesium should be kept in the correct ratio to calcium (Ca 7:1 Mg)

ERGS

ELECTRICAL CONDUCTIVITY

(150-500 micro-Siemens (μ S)/cm)

ERGS is a unit of conductance equaling the amount of energy given off per gram of soil per second. The reading on your sample means the resistance of the reciprocal alternating current between two probes on the conductivity tester. Small and highly mobile ions with the most concentration will be the ones represented in the display. The display is reading the charge that is transferred. If the reading gets above 1,200 micro-Siemens per centimeter, crop production will be affected; over 2,000 and there will be NO crop in the average soil.

ORP

OXIDATION-REDUCTION POTENTIAL

(Ideal: 28)

ORP is the measurement of the level of hydrogen ions versus oxygen ions in the soil. If the ORP reading is above 30, there is evidence of excessive oxidation causing dehydration and loss of organic matter. A reading below 27 indicates the soil has excess hydrogen ions causing anaerobic breakdown of crop residues leaving toxic metabolites.

SOIL pH

The pH scale runs from
0 - most acidic to 14 - most alkaline, with 7 being neutral

A misconception about pH is that if your pH is 6.5-6.8 you do not need any calcium... **WRONG!** The fact is your soil may not need pH adjustment, but you can still be low in available calcium. This can be corrected using limestone in the proper amount and type.

pH: ACID OR ALKALINE (6.4-6.8)

pH is the measure of hydrogen ion activity in the soil. It is an indirect measurement of the speed of the hydrogen ions. pH is affected by temperature, water, and the time of day. In most crops, the pH should be just slightly acidic. Factors that force pH down include sulfate, air, aerobic bacterial activity, 0-20-0 (Super Phosphate), and 11-52-0 (MAP). Factors that force pH up include calcium, magnesium, ammonia, potassium, and sodium.

COPPER

BENEFITS...

- Controls Mold & Fungi
- Photosynthesis
- Releases Energy in Cells
- Enzyme Function
- Normal Leaf Growth
- Increases Stalk Strength
- Animal Health

BEST SOURCES

- Copper Sulfate, 25%
- Chelated Copper, 7.5% (Liquid)

IDEAL BALANCE

- 1-2.5 ppm (Average to High) or 2 lbs/acre

Cu: COPPER (1-2.5 ppm or 2 lbs/acre)

In plants, copper acts as an activator of several enzymes, converts amino acids and may be involved in Vitamin A production. It also gives the outside of the plant the ability to stretch when the plant is growing fast. Copper deficiency symptoms appear as stunted growth, pale younger leaves, lack of flower production and possibly wilting and death of leaf tips.

IRON

BENEFITS...

- Chlorophyll Production
- Energy Release in Cells
- Needed By Nitrogen Fixing Bacteria
- Produces A Thicker Leaf

BEST SOURCES

- Chelated Iron
- Iron Sulfate

IDEAL BALANCE

- 8-30 ppm or 30 lbs/acre

Fe: IRON

In plants, iron is essential for the formation of chlorophyll and therefore, photosynthesis. It also serves as an activator for respiration, photosynthesis, and symbiotic nitrogen fixation. It makes a thicker leaf that will collect more sunlight. Deficiency symptoms for iron are most notably interveinal chlorosis of younger leaves. In severe cases, the limbs of plants may die, or even entire plants may die. Normal levels in young corn should be around 170 ppm.

ZINC

BENEFITS...

- Contributes To Test Weight
- Increases Ear Size in Corn
- Promotes Silking in Corn
- Hastens Maturity
- Chlorophyll Formation
- Enzyme Functions
- Regulates Plant Growth

BEST SOURCES

- Zinc Sulfate 25%
- Chelated Zinc 9%

IDEAL BALANCE

- 1-6 ppm or 10 lbs/acre

COMMENT

- Very important in crop production, overuse may cause weed problems.

Zn: ZINC

Zinc is important in controlling growth regulators in the plant, especially the production of indoleacetic acid. It is an important part of the enzyme system in plants. Zinc should always be applied with a phosphorous fertilizer. Deficiency symptoms of zinc are expressed as interveinal chlorosis, striping or white banding of leaves, resetting of terminal buds, reduced fruit bud growth and stunted plants.

MANGANESE

BENEFITS...

- Normal Growth & Photosynthesis
- Oil Production
- Energy Release in Cells
- Enzyme Functions

BEST SOURCES

- Manganese Sulfate 28%
- Chelated Manganese 6% (Liquid)

IDEAL BALANCE

- 6 ppm or 10 lbs./acre, it is an absolute requirement in seed production.

Mn: MANGANESE

In plants, manganese serves as an enzyme activator which helps to break down carbohydrates and metabolizes nitrogen. In a seed it is the spark of life, a seed with no manganese in it will not grow. Manganese deficiencies usually appear as interveinal chlorosis. The deficiency will first appear on younger leaves and appears like an iron deficiency.

BORON

BENEFITS...

- Promotes Flowering & Pollen (Silk and Tassel In Corn)
- Seed Development
- Root & Leaf Growth
- Cell Wall Formation
- Protein Production
- Sugar Translocation
- Energy Release in Cells
- Improves Quality
- Increases Calcium Uptake

BEST SOURCES

- Calcium Borate
- Chelated Boron

IDEAL BALANCE

- .8-1.2 ppm or 1.6-2.4 lbs/acre

B: BORON

Boron affects the rate of cell division in plants, regulates translocation of sugars across membranes, starch production and promotes maturity and seed development. Boron deficiencies appear in plants as a “witch’s broom” effect on terminal bud growth. Tuber or root crops develop soft or necrotic spots and pollination can also be affected. Normal levels of boron in corn tissue are about 20 ppm in young corn and 13 ppm in the leaf opposite and below the ear.

FORMAZAN

The method used to calculate formazan levels is a commonly used test for the measurement of dehydrogenase activity. Biological utilization of organic compounds is generally a dehydrogenase process. Soil microorganisms contain many dehydrogenase enzymes that catalyze this process; therefore, the dehydrogenase activity is a measurement of microbial activity. This is known as the formazan test. The higher the readings of formazan, the greater the soil microbial activity. Typical formazan levels for conventionally farmed soil range from 100-200 and biologically farmed soil will range from 300-600. Formazan levels of over 1,000 are required to effectively utilize the nutrients in rock powders.

IDEAL BALANCE

- Formazan Levels From 600-1,000

SULFUR

Sulfur is an important nutrient needed by plants in the synthesis of protein and oil. Sulfur is no longer adequately supplied by rainfall. For plant growth, sulfur needs to be in the sulfate form. Application of elemental sulfur is not recommended due to the lengthy microbial process of converting sulfur into sulfates. Sulfates are important components of organic matter and stimulate microbial activity in the soil. Sulfur is the primary nutrient used to react against high pH nutrients in the soil. This reaction releases energy that plants use to grow.

BEST SOURCES

- 0-20-0 (Superphosphate)
- Gypsum (Calcium Sulfate)
- Ammonium Sulfate
- Potassium Sulfate
- Sol-Po-Mag

IDEAL BALANCE

- 30 ppm In Water Soluble Sulfate Form