

Understanding Your Soil Analysis Report

Compiled & Edited by
Peaceful Valley Farm & Garden Supply

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Introduction:

The purpose of this publication is to help you interpret your Soil Analysis Report. Understanding Your Soil Analysis Report is designed specifically for the Soil Analysis you have purchased from Peaceful Valley Farm Supply. It may be useful for interpreting results from other labs, but since testing methodologies vary from lab to lab, the guidelines outlined here may not be reliably applied to other lab test results. If you have soil test results from other labs and want to compare your current test results with these past results, you may not get an accurate picture of your soil's progression for the same reason. It is always best to rely over time on results from the same lab so that results will be consistent. To maintain relative consistency sample at the same time each year. Farmers should test annually and home gardeners should test at least once every three years.

We will cover all of the basics needed to interpret your Soil Analysis Report and make decisions about improving your soil. We do not explain the complexities of soil fertility. Several excellent books we carry for further study in soil fertility are: *The Soul of Soil (BF840)*, *Feed The Soil (BF250)*, and *Building Soils for Better Crops (BF100)*. These books will take you beyond the narrow focus of the chemical component of soil fertility this test covers.

There are three types of soil analysis: physical, chemical, and biological. This booklet is directed at chemical analysis. The adjustments you make to your soil's elemental components will also have an impact on the physical structure and biological balance of your soil.

When viewing the graphical representation of your Soil Analysis Report, the bar graphs show the laboratory's interpretation of the levels relative to what *they* consider appropriate. Our interpretations do not always agree. The bar graph height and the symbols VH (Very High), H (High), M (Medium), L (Low), or VL (Very Low) should be evaluated while keeping in mind our recommendations.

Results and What they Mean:

Even if the recommendations provided seem specific, they are not meant to be exact. Soil science is not perfect because it is not completely understood and even experts don't always agree. Once you have determined what your soil needs, you will be making decisions about specific amendments. We have a fertilizer solution chart available for download at www.groworganic.com to help you make an informed fertilizer selection. You may find certain fertilizers work better for your situation or that you prefer certain types of fertilizer. Each of the items indicated on your Soil Analysis Report will be discussed with a brief description and recommendations for each possible scenario. Double the suggested application rates if you are growing "intensively" (double-dig), a method where plants are grown tightly spaced and require higher than normal nutrient levels. Acre rates assume broadcasting over the entire area, so reduce these application rates to 1/2 or 1/3. if banding your application.

Organic Matter

Organic matter is material that was once living, usually from plants but also animals. Organic in this sense means “contains carbon” and since plants are great accumulators of carbon, organic matter from plant material is an excellent choice, although organic matter varies in quality.

The many benefits of organic matter include improving soil tilth, improving drainage in tight soils, improving water retention in sandy soils, increasing air penetration into the soil so that microbes can flourish, loosening soil for better root penetration, providing food for soil microbes, and more. You can have too much organic matter - especially if it is of low quality.

Use the chart below for adjustments in organic matter levels. Both percentage organic matter and CEC are used (CEC is explained later in its own section) to determine the appropriate action, because together they better demonstrate the *quality* of your organic matter, whereas percentage organic matter alone only indicates *quantity* of organic matter. Descriptions of the actions to take follow below.

Organic Matter Reading	C.E.C. Reading	Action to Take
Less than 2	Any	Add organic matter
2 to 5	Under 20	Add high quality organic matter
2 to 5	Over 20	Maintain organic matter
Above 5	Under 20	Promote biological activity
Above 5	Over 20	Don't add organic matter

Add organic matter: Add compost (10 tons per acre or 50-100 pounds per 100 square feet) or cover crops. You can also use manure, sawdust, or rice hulls, but these will take longer to break down and may reduce nitrogen availability in the short-term. However, in some low organic matter soils, the need is so desperate almost any organic matter will help the situation.

Add high quality organic matter: Apply only high quality compost (10 tons per acre or 50-100 pounds per 100 square feet) such as Peaceful Valley Farm & Garden Supply brand Compost (F621). You may also grow cover crops and till them into the soil, giving you quickly decomposable organic matter.

Maintain organic matter: Add compost (5 tons per acre or 25 -50 pounds per 100 square feet) or cover crops. Avoid using high-lignin materials (such as straw, sawdust, rice hulls, etc.) and only use manure that is relatively low in straw content (apply at least 6 months before planting).

Promote biological activity: No additional organic matter is needed, but you need to take action to encourage the decomposition of the existing organic material into humus. To ensure microbial populations are present in your soil to break the organic matter into humus, add small amounts of compost (2 tons per acre or 15 to 25 pounds per 100 square feet) or apply a 1/2” - 1” layer of Arctic Humus (ISA315) and work it into the soil. As decomposition occurs, carefully monitor to assure that adequate nitrogen levels are maintained, as the nitrogen may be sequestered during the decomposition process.

Don't add: Do not add organic matter, but continue to monitor levels with regular soil testing.

Nitrogen

“N” in “N-P-K”

Nitrogen is a primary nutrient for plant growth, and is responsible for plants’ green foliage. Over-applying nitrogen can “burn” plants (root damage that shows symptoms above ground), so stay within recommended application rates. Excessive nitrogen in your crops can actually lead to nitrate poisoning if you or your animals eat these greens.

Some of your nitrogen needs may be met by organic matter as it decomposes. Because this nitrogen is difficult to test chemically it can only be taken into account as an estimate. In general, higher organic matter means higher potential nitrogen release. In soils with over 5% organic matter, consider reducing nitrogen amendments by 1/4. Add liquid forms of nitrogen during the growing season if observable deficiencies occur. If nitrogen levels are higher than 40 ppm, the soil needs to be “devigorated”. Plant “heavy feeding” crops such as corn or grass-only cover crops.

Nitrogen Level	Amount of Nitrogen to Apply		
	Vegetable Crops	Orchards, Vineyards, & Lawn	Grasses & Grains
Under 10 - Very Low	Heavy	Heavy	Moderate
11-20 - Low	Heavy	Moderate	Light
21-30 Medium	Moderate	Light	Do Not Add
31-40 - High	Light	Do Not Add	Do Not Add
Above 40 - Very High	Do Not Add	Do Not Add	Do Not Add

How to use the following charts: The fertilizer and rate suggestions are based on the recommended amount of *nitrogen* to apply. If you are using another fertilizer, base your rate on the fertilizer listed that has a nitrogen content closest to the one you will be using. The rates per acre are very approximate and depend on row and plant spacing.

Per Acre Application Rates:

Fertilizer	Heavy	Moderate	Light
F101 Blood Meal (14% nitrogen)	600-1,200 lb	500-1,000 lb	350-700 lb
F1055 Fish Meal (10% nitrogen)	1,000-2,000 lb	750-1,500 lb	500-1,000 lb
F790 Cottonseed Meal (6% nitrogen)	1,200-2,400 lb	1,000-2,000 lb	700-1,400 lb
F940 Feather Meal (12% nitrogen)	800-1,600 lb	--	--

Per 100 Square Feet Application Rates:

Fertilizer	Heavy	Moderate	Light
F101 Blood Meal (14% nitrogen)	5 lb	4 lb	3 lb
F1055 Fish Meal (10% nitrogen)	7 lb	6 lb	4 lb
F790 Cottonseed Meal (6% nitrogen)	10 lb	8 lb	6 lb
F940 Feather Meal (12% nitrogen)	6 lb	--	--

Phosphorus

“P” in “N-P-K”

Phosphorous is the key element plants need for flowering, fruiting and rooting. You see this compound primarily in the form of bones (bone meal) or ancient bone piles (rock phosphate). It is normally found in nature combined with calcium in the form of calcium phosphate. In this form, the phosphorus tends to remain “locked up” with calcium (not available to plants) so it must be “unlocked” in the soil through natural microbial and chemical processes. It is crucial to have phosphorous in adequate quantity and a healthy, balanced, bio-active soil to make it available to the plants. Because of the stability of the calcium-phosphorous bond, burning does not occur even with high phosphorous applications. Very large applications, though, may result in an upward shift in pH toward alkalinity due to the calcium content of phosphorous amendments. Keep well ahead of your phosphorus applications because just about all products for organic agriculture that contain phosphorus do not supply it in a readily-available form. This means that it will release very slowly, sometimes over a period of years.

There are two readings for phosphorus on your Soil Analysis Report. Refer to the Phosphorus Weak Bray to determine your level on the chart below. Phosphorus NaHCO₃ represents your long-term phosphorus reserves, and should be monitored over time as you follow-up with subsequent tests.

Phosphorous is not a very water mobile element. Soft rock phosphate should be worked into the soil, if possible. Since it does not tend to leach out of the soil one application at the rates below will usually be adequate for 2 to 3 years.

Application Rates for Calphos Soft Rock Phosphate (F2101):

Phosphorus Level	Per Acre	Per 100 Square Feet
Under 10 - Very Low, Low	2000 lb	5 lb
11-20 - Medium	1,000 lb	3 lb
21-30 - High	500 lb	2 lb
Over 30 - Very High	Don't Add	Don't Add

Potassium

“K” in “N-P-K”

Potassium, or Potash, exists in most types of organic matter and is critical for plant vigor as it regulates metabolism. Too much potassium can lead to a high pH. Wood ash is often suggested as a source of potassium, but we do not recommend its use as it is very difficult to know just how much potassium is in the ash, and it also may not be considered a legal organic source of potassium.

Application Rates for Sulfate of Potash (F2260):

Potassium Level	C.E.C. Level	Per Acre	Per 100 Square Feet
100 or Less - Very Low	Under 5	100 lb	.5 lb
	5 to 10	250 lb	1 lb
	Over 10	500 lb	2 lb
100 to 150 - Low	Under 5	Don't Add	Don't Add
	5 to 10	100 lb	.5 lb
	10 to 20	250 lb	1 lb
	Over 20	500 lb	2 lb
150 to 250 - Medium	Under 15	Don't Add	Don't Add
	Over 15	100 lb	.5 lb
250 or More - High/ Very High	Under 20	Corrective Action	Corrective Action
	Over 20	Don't Add	Don't Add

Corrective Action: The soil has too much potassium for its CEC level, so add F1153 Diamond K gypsum at 2,000 lb per acre or 5 lb per 100 square feet) to leach out the excess potassium.

Magnesium (Mg)

Magnesium is naturally found in some types of clay soils. Clay soils with extremely high magnesium are composed of the type of clay that can be used for pottery because the magnesium binds the clay together. Like potassium, magnesium is important for plant metabolic processes, especially in chlorophyll production and in the uptake of phosphorous. Too much magnesium can “bind up” your soil so that water and nutrients do not penetrate well. Excessive magnesium can cause high pH. You can add magnesium either with or without calcium depending on the amendment you use.

Magnesium with Calcium Only add Dolomite if you need Calcium

Application Rates for Dolomite (F850):

Magnesium Level	C.E.C. Level	Per Acre	Per 100 Square Feet
100 or Less - Very Low	Under 5	Don't Add	Don't Add
	5 to 10	200 lb	.5 lb
	11 to 15	400 lb	2 lb
	16 to 20	600 lb	3 lb
	Over 20	800 lb	4 lb
100 to 150 - Medium	Under 5	Don't Add	Don't Add
	5 to 10	100 lb	.5 lb
	11 to 20	200 lb	1 lb
	Over 20	400 lb	2 lb
150 to 250 - High	Under 15	Don't Add	Don't Add
	Over 15	100 lb	.5 lb
300 or More - Very High	Under 20	Corrective Action	Corrective Action
	Over 20	Don't Add	Don't Add

Corrective Action: The soil has too much magnesium for its CEC level, so add F1153 Diamond K gypsum at 2,000 lb per acre or 5 lb per 100 square feet to leach out the excess magnesium. Add gypsum annually until the soil test for magnesium is at an acceptable level.

Dolomite Notes: If you add dolomite, reduce your lime application by the same amount.

Magnesium without Calcium

Application Rates for K-Mag (F2360):

Magnesium Level	C.E.C. Level	Per Acre	Per 100 Square Feet
100 or Less - Very Low	Under 5	Don't Add	Don't Add
	5 to 10	250 lb	.5 lb
	11 to 15	500 lb	2 lb
	16 to 20	750 lb	3 lb
	Over 20	1000 lb	4 lb
100 to 150 - Medium	Under 10	Don't Add	Don't Add
	10 to 20	250 lb	.5 lb
	Over 20	500 lb	2 lb
150 to 250 - High	Under 15	Don't Add	Don't Add
	Over 15	250 lb	.5 lb
300 or More - Very High	Under 20	Corrective Action	Corrective Action
	Over 20	Don't Add	Don't Add

Calcium (Ca)

Calcium is a very abundant element in nature. Calcium is a critical element in cell wall structure. But, when calcium is too high, you end up with an “alkaline” condition (high pH) which can impede plant absorption of some nutrients. In this case you may want to add sulfur. Look at your sulfur reading to determine if sulfur amendment is necessary.

Application Rates for Oystershell Lime (F1850) or Bulk Mined Lime:

Calcium Level	C.E.C. Level	Per Acre	Per 100 Square Foot
1,000 or Less - Very Low	Under 5	Don't Add	Don't Add
	5 to 10	1,000 lb	2 lb
	11 to 15	2,000 lb	5 lb
	Over 15	4,000 lb	10 lb
1,000 to 1,500 - Medium	Under 10	Don't Add	Don't Add
	10 to 15	1,000 lb	2 lb
	16 to 20	2,000 lb	5 lb
	Over 20	4,000 lb	8 lb
1,500 to 2,500 - High	Under 15	Don't Add	Don't Add
	15 to 20	1,000 lb	2 lb
	21 to 25	3,000 lb	6 lb
	Over 25	4,000 lb	8 lb
2,500 or More - Very High	Under 20	Don't Add	Don't Add
	Over 20	1,000 lb	2 lb

Sodium (Na)

Sodium is found in common table salt (sodium chloride) as well as in the salt found in sea water. Sodium should always be under 100 ppm. If it is too high, add F1153 Gypsum at 1 ton per acre (5 lb per 100 square feet). Sodium that is too high causes the pH to rise and impedes other nutrients from being taken up by the plants. Make the gypsum addition annually until the soil test no longer shows too high a level. If your water is high in sodium, you may always need to add gypsum. There is no known level that is too low.

ECE (Electrical Conductivity)

This measurement rates the soil's ability to conduct electricity. You may have heard before that salt (sodium chloride) water will conduct electricity better than fresh water. Although high sodium often accounts for high ECE levels, a high level may also indicate the presence of other salts frequently present in irrigation water. If your ECE is high but your sodium is not, consult with a specialist to determine your course of action.

Sulfur (S)

This important nutrient is often forgotten as a needed element in the soil's mineral bank. Though it exists as elemental sulfur in some places on earth, sulfur is usually found as a natural compound, such as gypsum. Like nitrogen, it is also an important ingredient for the fabrication of proteins. A soil very high in sulfur can be acidic, but it takes an extremely high amount to cause damage to plants.

Sulfur Level	Amount of Sulfur to Apply
Under 5 - Very Low	Very Heavy
5-10 - Low	Heavy
11-15 Medium	Moderate
16-20 - High	Light
Above 20 - Very High	Do Not Add

Per Acre Application Rates Diamond K Gypsum (F1153) or Soil Sulfur (F2210):

pH Level	Ca cation Saturation	Heavy	Moderate	Light
Under 7.5	Over 80%	500 lb Gypsum	300 lb Gypsum	300 lb Gypsum
	Under 80%	500 lb Gypsum	300 lb Gypsum	300 lb Gypsum
7.5 - 8.0	Over 80%	600 lb Soil Sulfur	600 lb Soil Sulfur	600 lb Soil Sulfur
	Under 80%	500 lb Gypsum	300 lb Gypsum	300 lb Gypsum
8.1 or Over	Over 80%	1,000 lb Soil Sulfur	1,000 lb Soil Sulfur	300 lb Gypsum
	Under 80%	500 lb Gypsum	300 lb Gypsum	300 lb Gypsum

Per 100 Square Feet Application Rates Diamond K Gypsum (F1153) or Soil Sulfur (F2210):

pH Level	Ca cation Saturation	Heavy	Moderate	Light
Under 7.5	Over 80%	2 lb Gypsum	2 lb Gypsum	2 lb Gypsum
	Under 80%	2 lb Gypsum	1 lb Gypsum	1 lb Gypsum
7.5 - 8.0	Over 80%	2 lb Soil Sulfur	2 lb Soil Sulfur	2 lb Soil Sulfur
	Under 80%	2 lb Gypsum	1 lb Gypsum	1 lb Gypsum
8.1 or Over	Over 80%	3 lb Soil Sulfur	3 lb Soil Sulfur	3 lb Gypsum
	Under 80%	2 lb Gypsum	1 lb Gypsum	1 lb Gypsum

Trace Elements or Micronutrients

These elements are critical for plant metabolic functions, but is not needed in the soil in very large quantities. Even though minute quantities are used, absence of any of these crucial elements can have devastating effects on your crops. The way these elements perform, and how they interact, is not completely understood. You should treat them like the minerals you get from a vitamin supplement, consuming tiny amounts relative to all the food you eat. The elements we address here include zinc, manganese, iron, copper and boron.

The complete soil analysis (SVS200) includes micronutrient lab readings for zinc, manganese, iron, copper, and boron. Our NPK Soil Analysis (SVS100) does not.

Amendments of these elements come from various mining processes and are usually treated in some way to make the nutrients plant available (frequently they are sulfated). You surely could put an iron skillet in your soil for iron, but it may be a long time before the iron gets to the plant! Be careful in amending your soil with trace elements as excessive levels can impede the plant's ability to take up other nutrients.

Application Rates for Zinc Sulfate (F2565) or Azomite (F040):

Zinc Level	Per Acre	Per 100 Square Feet
Under 1 - Very Low	15 lb Zinc Sulfate	5 lb Azomite
1 to 3 - Low	10 lb Zinc Sulfate	3 lb Azomite
4 to 5 - Medium	6 lb Zinc Sulfate	2 lb Azomite
6 to 8 - High	3 lb Zinc Sulfate	1 lb Azomite
Over 8 - Very High	Don't Add	Don't Add

Application Rates for Techmangam Manganese Sulfate (F1676) or Azomite (F040):

Manganese Level	Per Acre	Per 100 Square Feet
Under 5 - Very Low	20 lb Manganese Sulfate	5 lb Azomite
6 to 14 - Low	16 lb Manganese Sulfate	3 lb Azomite
15 to 29 - Medium	8 lb Manganese Sulfate	2 lb Azomite
30 to 49 - High	4 lb Manganese Sulfate	1 lb Azomite
Over 50 - Very High	Don't Add	Don't Add

Application Rates for Copper Sulfate* (F1060) or Azomite (F040):

Copper Level	Per Acre	Per 100 Square Feet
Under 0.3 - Very Low	12 lb Copper Sulfate	5 lb Azomite
0.4 to 0.8 - Low	8 lb Copper Sulfate	3 lb Azomite
.9 to 1.5 - Medium	4 lb Copper Sulfate	2 lb Azomite
Over 1.5 - High to Very High	Don't Add	Don't Add

* *Special Order. Considered Hazardous Material.*

Application Rates for Iron Sulfate (F1260) or Azomite (F040):

Iron Level	Per Acre	Per 100 Square Feet
Under 3 - Very Low	10 lb Iron Sulfate	5 lb Azomite
4 to 11 - Low	10 lb Iron Sulfate	3 lb Azomite
Over 11 - High	Don't Add	Don't Add

Application Rates for Fertibor (F210) or Azomite (F040):

Boron Level	Per Acre	Per 100 Square Feet
Under 0.3 - Very Low	7 lb Fertibor	5 lb Azomite
0.4 to 0.5 - Low	3 lb Fertibor	3 lb Azomite
0.6 to 2 - Medium	Don't Add	Don't Add
Over 2 - High	500 lb Gypsum	2 lb Gypsum

Percent Cation Saturation

Cations are the positively charged ions of certain elements. The four shown here, potassium (K), magnesium (Mg), calcium (Ca) and sodium (Na), represent the vast majority of the cation volume in soil. Actions to take for these elements have already been explained in previous sections. You do not need to completely understand this concept or know much about chemistry for these numbers to be useful. In the soil, these four elements are in somewhat of a competition, and your job is to assist them in reaching a proper balance. The percentage results shown on your Report indicate their relative proportions with the total of the percentages equaling nearly 100%. In other words, each percentage shown will depend on the levels of the other three cations - think of a pie being split among these four elements. The small remaining percentage is comprised of hydrogen - its presence is what determines pH. Typically, the larger this remainder, the lower the pH.

A well balanced soil will have the cations in the following ranges: 4-7% Potassium (K), 10-20% Magnesium (Mg), 65-75% Calcium (Ca), less than 3% Sodium (Na) and the balance of Hydrogen (H) cations in the range of 5-10%. It may take several years of corrective actions to bring your soil into proper balance.

CEC (Cation Exchange Capacity)

Your CEC result indicates the soil's ability to hold and release cations (which were explained above in Percent Cation Saturation). CEC ranges from 0 to 100, with 100 representing a capacity of pure humus. The higher this number, the greater the soil's ability to hold on to cation elements so they can be released for later use. For example, cations will easily leach out of sandy soil which has a very low CEC. Typically, you will always want to increase CEC. In the thousands of soil tests Peaceful Valley Farm Supply has seen over the years, CEC results under 20 are common.

For example, you may have a low pH due to low calcium. Adding lime will increase calcium and pH, but in a low CEC soil, a large application of lime may be wasteful because the soil cannot hold on to all of the calcium. This excess calcium can be easily leached away by water before it can be used by the crops.

To increase CEC, add good quality compost or cover crops. This will increase the humus content and lead to a higher CEC. Don't expect this number to climb rapidly. It may take many years of humus building to get this number above 20.

EX Lime (Excess Lime)

This indicates excess lime usually left over from a lime application. If this is High (H), it usually means you should no longer add lime. See recommendations for lime application rates for Calcium (pg. 8).

pH

Most people have heard of pH which literally means “potential Hydrogen”. A pH over 7 is referred to as “alkaline”, and you find this alkaline condition typically in low rainfall areas such as deserts or at the alkali or salt flats of Utah and Nevada. A pH under 7 is referred to as “acid” and you see this condition more frequently in high rainfall areas such as the Northern California coast where “acid-loving” plants such as Coastal Redwoods and azaleas flourish. A pH at 7 is referred to as “neutral” which is the pH of distilled water. Many people add lime or sulfur based on the pH and while this may be somewhat useful, it is not accurate. A high pH can be caused by elements other than calcium and a low pH may not mean you need to lime your soil. We use the nutrient levels of the cations explained above to determine the course of action. While a pH level may be helpful to indicate generally where your soil stands, it is only part of the picture and should not be used alone to determine what you need to adjust in your soil.

Conclusion

While our customers often request that we tell them exactly what to add to their soil, we can only provide guidelines because the organic management of soil fertility is not a simplistic system. The more you know about this method, the greater your success will be in growing organically. Don't be afraid to apply your own common sense and develop your skills of observation. The status of your soil and your plants will constantly be in flux due to many different factors including soil chemistry, microbial population, temperature, water, native soil, and the plants you are growing. Thank you for growing organically!

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