An introduction to Remineralization

Improving the flavor and quality of home grown food
Achieving a balanced soil, healthier plants, healthier people

Ever wish you could...

- depend on your garden to be productive regardless of the condition, hot or cold, wet or dry
- consistently produce nutrient dense fruits and vegetables
- learn how to manage soils without an advanced degree in horticulture

Garden writers ahead of the curve
Read portions from their books (pg14-18)

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nature's footprint
naturesfootprint.com
Remineralization of soils is a natural reoccurring process that nature does on a global scale. It is the replacing of minerals in depleted soil through the application of finely ground rocks.

Nature uses two types of rock dusts to remineralize the land. However, nature carries out the process on a massive and sometimes violent scale. On May 18, 1980, Mount St. Helens erupted and sent ash skyward. That ash plume deposited fine ash particles over millions of acres of forest and farmland. While crops were devastated the first year, subsequent years saw substantial crop improvements as the new source of nutrients from volcanic rock dust was exploited by living organisms.

During the last ice age massive glaciers ground underlying rocks into a fine dust called rock flour. As glaciers retreated and the dust was released winds carried it aloft. It eventually settled back to earth providing a fresh layer of minerals to nurture future plant growth. In some areas the dust settled hundreds of feet thick and later became known as loess soil deposits, some of the richest soils in the world.

When you add rock dust to your garden or put it in your potting soil you take on the role of the volcanoes and glaciers and, in a controlled fashion, remineralize the soil. The event may be smaller but the results can be amazing.
**All Soils Contain Minerals**

The very definition of soil necessitates the presence of minerals. One dictionary characterizes soil as “a mixture of organic remains, clay, and rock particles.”

Soils vary widely from region to region and their mineral composition results directly from the underlying rock and in some locales alluvial, volcanic, or glacial deposits. Forests typically have a very thin layer of soil, undisturbed grasslands can have incredibly thick layers of humus rich soil, but canyon floors, flood plains, and deltas have the richest soils in any region. Rains bring mineral laden sediments by streams and rivers from the source in the hills and mountains and deposit them downstream year after year. In ancient times the great civilizations arose in river deltas where deposits of organic matter and minerals resulted in rich soils. In these places, high levels of agricultural production were possible.

Over thousands of years natural processes have removed key mineral content from soils all over the world. Rain leaches away valuable minerals. Poor soil conservation strategies certainly have added to the problem. Decades of heavy agricultural use has depleted fertility and removed minerals that were once in the soil. The rocks below the soil are weathered in a slow process that cannot keep up with the current rates of mineral extraction. Added to that is the heavy use of chemicals and synthetic fertilizers that cause depletion of microbes and their ability to extract minerals.

Deltas such as the Yellow River, the Nile, and Mississippi gave birth to ancient civilizations because the land supported the food production that supported them.

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“to obtain the very best results we must replace simultaneously the organic and mineral portions of the soil”

Sir Albert Howard

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**From Rocks to Life**

Grade school science classes teach kids about environmental weathering. This process of erosion by the action of wind and water slowly loosens rocks from hills and mountains and breaks those rocks into smaller and smaller pieces until you have sand, then silt, and finally clay.

Since the discovery of microbes scientists have observed them on the surface of rocks and in soils. These tiny organisms have a big role to play in erosion and the decomposition of rocks. Microbial-weathering’s role is a fairly recent discovery. Scientists are now isolating the bacteria and fungi that extract individual minerals from the smallest particles of clay to the hard surfaces of sheer cliff.
faces and incorporate them into the soil food web. With these minerals and the elements of oxygen, hydrogen, and nitrogen from the air we have the foundation of all life.

**The Organic Method**

From the dawn of civilization until the beginning of the Industrial Revolution all agriculture was organic. In 1840 German chemist Justus Von Liebig incorrectly identified NPK as the sole nutrients plants needed in abundance. That led to the creation of the agrochemical industry. Twenty years later Von Liebig recognized his error, but by then the industry was such a financial success there was no stopping it.

In 1909, Fritz Haber, also a German chemist, developed the chemical process for fixing atmospheric nitrogen which led the way for mass industrial production of cheap nitrogen fertilizers. This was the final step in supplying the most readily used plant nutrients in synthetic form.

A German chemical factory in the 1880s used to manufacture nutrients.

It wasn’t until 1940 that Lord Northbourne, an Englishman, coined the term “organic” in an attempt to define the difference between the natural processes and the new synthetic fertilizers. In 1942, J.I. Rodale began publishing Organic Gardening Magazine to promote the idea that garden health would be achieved by liberal applications of compost and a select set of amendments as well as avoiding a list of banned substances. He insisted this would give the best results in any soil and produce the best possible vegetables.

In the 1930’s Dr. William Albrecht, a pioneering researcher in the relationship of soil fertility and human health, developed the idea of mineral balancing. He contended that mineral balancing is merely a natural extension of organics, not a disagreement with it. However, Rodale's movement focused on compost additions and Albrecht’s work went largely unnoticed.

Today the emerging interest in the values of balanced soil and nutrient-dense foods are gaining wider interest. Many studies have been conducted in Europe, Australia, and Brazil. However, in recent years no significant academic research in the value of adding rock dusts has been conducted in the US, largely based on the influence of the agro/chemical industry.

**Remineralization**

When minerals are applied in the form of natural rock dust, we call that remineralization; the restoring of minerals to substances that have been demineralized. It is the replacement of minerals that have, over time, been depleted from the soil either through leaching or crop removal.

In the mid-sixties scientists in Brazil observed that when fresh rock was present in fields, crops always did better. They backed those observations up with scientific research in the mid-eighties using depleted tropical soils and applications of finely ground rocks, including basalt. They consistently demonstrated that rock dusts improved plant production.

When artificial chemical inputs are used, we call it fertilization. Through chemical reactions and leaching away with rain and irrigation water, most of the nutrients in fertilizers are wasted.

Another term that is important to understand is immobilization. It is used to describe minerals/
nutrients that are in the soil but unavailable to plants. The elements of organic materials that have yet to break down are immobile. Minerals locked away in the interior of a rock are also immobilized. However, bacteria and fungi can access the minerals on a rocks surface and have the ability to make them available to plants.

**A Perfect Soil**

Unfortunately there is no perfect soil for farmers. In all the most lush and biologically dense regions of the world the native flora has adapted to perfectly utilize the varied soils below them thereby making them perfect, but for farmers and gardeners we must make do with the dirt beneath our feet and coax it towards what our crops desire; a well balanced soil having a high level of organic matter along with an abundance of varied minerals in sufficient levels. Availability of minerals provides a foundation for compost to work and for the soil biology to thrive.

The closest examples of perfect natural farmland we find are deltas such as the flood plain of the Nile River. For over 6,000 years it supported the great civilizations of Egypt. Annual floods delivered massive amounts of organic matter and fresh rock dust in the form of silts carried down by every brook, creek, and river tributary along its entire 4,258 mile length. Every mountain, every hill, and every valley of the Nile’s drainage contributed to Egypt’s wealth and stability until the Aswan Dam destroyed the natural process.

**Particle Size Matters**

Certain microbes have the ability to scavenge a wide variety of minerals from rock surfaces. If you have ever broken open a rock and observed that the newly exposed surface has a ring of stone a different color around the edge, you have observed the results of natural and bacterial weathering.

Now think about surface area. That rock you broke may only have a few square inches of surface, but grind it into dust and you have hundreds of square yards of surface. The more surface you provide the microbes, the greater the potential release of nutrients from the rock. The breakdown of

*Ancient depiction of Egyptian agriculture.*
rocks into usable nutrients is a slow geologic process that goes faster with finer rock material and increased surface area.

**Frequency of application**

The effects of rock dust are cumulative. Each successive application builds your soils reserve of minerals. In most cases a yearly application is enough. It is like putting money in the bank. A regular deposit over time will help make your soil rich in plant nutrients.

As plants require specific nutrients, they will produce exudates that feed the bacteria or fungi that will release those nutrients from the minerals and organic matter in the soil. And because it is natural and plants only extract what they need, it is impossible to use too much. Unlike chemical fertilizers, rock dust will not harm your plants or the living organisms in your soil.

**Growing Nutrient-Dense Food**

In The Omnivore’s Dilemma, Michael Pollan points out that those running our industrial food supply system are more concerned with reducing production costs, obtaining more tons per acre, and increasing corporate profits than the nutrient quality of food you feed your family. When it comes to the food shipped to your store, nutrient content is cheerfully sacrificed for the convenience of shipping and handling. As consumers, we are left with little or no choice at all.

Even organically grown food has been shown to be lacking in ideal levels of nutrient, particularly the minerals and trace elements necessary to the formation of vitamins and amino acids.

Foods grown organically on remineralized soils have been shown to contain greatly elevated levels of proteins, vitamins, and other elements essential for animal and human health.

This chart can be used to determine your soil type with the Mason Jar Test.

**Who can Benefit from Remineralization?**

Just about everyone can benefit from remineralizing their gardens with rock dust; whether you have a small container garden on your porch or a large plot in your yard or community garden. Rock dust remineralization works for organic gardeners but conventional gardeners can see results, too. The benefits are many, from lower fertilizer needs, to reduced pest damage, and a noticeable surge in plant vitality, yield, and nutrition content.

Rock dust remineralization helps restore natural soil balance the way nature intended. A healthy, balanced soil will result in healthy, balanced plants which, in turn, will result in healthier animals and people who consume those crops.
Remineralize for flowers and ornamentals too

Ornamentals and annual flowers benefit just as much from rock dust as vegetables. Gardeners report that after the application of rock dust to flower beds and landscaped areas, plants showed a remarkable change. They report brighter colors, more blooms, and healthier plants.

Even lawns benefit from applied rock dust. You can use it as you would a fertilizer, or better yet, apply 2.5 to 5 lbs. of rock dust per 100 sq. feet of lawn when you over-seed in the fall. Newly seeded turf grasses root better with basalt dust, and green up to a more intense color in the spring.

Where to Start

First, become a keen observer of your own garden and plants. Take note of beneficial insects, bloom dates, overall plant health, and germination rates and times. Keep a journal so you remember.

Become familiar with the type of soil you have. Is it predominately sand or clay? Does it contain organic matter?

Locate your neighborhood on the USDA Web Soil Survey. Read what information they have about soils in your area. You can find it at the following web site: (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm)

You can do a simple test using a clear container like a straight sided vase or Mason jar to determine the type of soil you have. You can find out how at the following web site: (http://www.ext.colostate.edu/mg/gardennotes/214.html).

We suggest you also have your soil tested. A soil test will give you a baseline of the minerals in your soil and let you know what may be in short supply. This will help you determine which rock dust you may want to apply first. There are many different extraction methods used in soil testing, and all will give you different results. Pick one lab and one method and stick to it. That way comparing your test year after year will show the improvements you make.

Next, make sure your soils have adequate organic matter. It is the carbon in organic matter that

“Earth is not a planet with life on it; rather it is a **LIVING** planet.”

Michael Dowd
feeds the bacteria and fungi that will extract the minerals from your rock dust. You should use good compost. Because of the potential for municipal or commercial compost to contain residual herbicides you are always better off making your own compost.

Now apply rock dust to your garden. Remember, rock dust is not a quick-fix cure all. Nature has no deadlines yet she always arrives on time. When you add rock dust to your garden you are replicating nature. Patience pays big dividends. You may not see instant results, but you will see slow steady improvements over time.

If you have the curiosity to do so, conduct your own trials in a small section of your garden. Treat one area and leave another for a control. For container gardeners, side by side trials are easily done. This is a common practice among botanical researchers and can make differences readily visible. Note plant health factors and look for increased adaptability to stresses such as heat, cold, drought, pests and disease. Prove it to yourself.

**Composting with Rock Dust**

If you have a nutrient deficiency in your soil and you make compost with plants grown from that soil, then logically you will have the same deficiency in the compost you make. You also lose the nutrient value of the plants that are removed from this cycle, the crops you eat and flowers you give your friends.

Adding a healthy portion of rock dust to the mix not only puts the nutrients from your garden waste back into your soil, you will also be giving all your plants a veritable smorgasbord of additional nutrients to choose from. Good compost is teeming with microbes, and many of those microbes will gladly break nutrients free of the rock dust. And if you do worm composting, a sprinkle of rock dust with their food will boost the nutrient quality of your castings too.

If you make aerated compost teas, a small amount of rock dust in the brewer can have a very positive impact on the number of trace minerals made available to your plants.

Adding Glacial Rock Dust to a Worm Factory 360

**How to apply minerals**

In addition to mixing rock dust into your compost, you can spread rock dust directly on your garden soil, lawn, or flower beds. A tablespoon or two per gallon of mix in a container works wonders for potted plants, too. Each dust will have its own recommended application rate or if a soil test has been done, spread according to the determined rates.

Rock dusts usually come as a very fine, flour-like dust. A word of caution, many rock dusts contain silica. All plants take up silica. It’s great for the plants, but you should wear a dust mask when applying rock dust. You can use a drop spreader or just cast the rock dust using a scoop or cup. A low slinging side-arm action works best. Spread rock dust when there is no wind. Often the best time of day is early in the morning.

You want the rock dust to cover the area evenly. Rake the rock dust into the first few inches of soil. It does little good to bury it so deep that the microbes can’t get to it. You can also mix rock dust
with compost and apply both together. Apply rock dust in the spring when preparing the garden or the fall to allow overwintering microbes a chance to colonize the particles.

Some rock dusts are fine enough to be suspended in water and applied to leaf surfaces or soil. Add the dust to water and agitate well. Put the solution in a pressure sprayer and apply liberally.

**Frequency of Application**

The effects of rock dust are cumulative. Each successive application builds your soils reserve of minerals. In most cases a yearly application is enough. It is like putting money in the bank. A regular deposit over time will help make your soil rich in plant nutrients.

As plants require specific nutrients, they encourage the bacteria or fungi that will release those nutrients from the minerals and organic matter in the soil. And because it is natural and plants only extract what they need, it is impossible to use too much. Unlike chemical fertilizers, rock dust will not harm your plants or the living organisms in your soil.

**The Next Step**

We suggest you expand your overall knowledge of soil science by further reading. Rock dust is not something you read about or hear about through traditional gardening magazines or television shows, at least not yet. Our reference list contains works from various authors who helped shape current thinking on rock dusts and their use as a safe, effective, all natural fertilizer as well as contributing to modern thought on organic gardening and sustainable agriculture. We have also included references to some of the scientific papers supporting some of the statements you read previously.

In addition to our recommended reading list we included excerpts from two of our favorite garden writers, Jeff Lowenfels and Steve Solomon, who explain nutrient interactions and soil testing in depth in their works. We hope you will enjoy them.

**A Final Thought**

In your continued reading about rock dusts and the benefits and science behind remineralization you will undoubtedly encounter tales of the Hunza. In Pakistani Kashmir there is a place called the Hunza Valley. The forbears of the industrious peoples that call the valley their home set their descendants up for success by implementing a system of agriculture that utilized the slopes of the hill, the natural irrigation, to deliver what has been termed “glacial milk.” This mineral rich water supplies a renewed source of essential elements year after year to the soils and drinking water. The balanced health of these people astounded visitors a century ago and inspired many books. While we may not all be able to live in Shangri La we can potentially increase our health by nourishing our soils.

*The Ultar glacier, source of the Hunza’s mineral rich water.*
References

Websites:

- Soil and Health Library, http://soilandhealth.org/
  Vast and varied online library. Free downloadable e-books about radical agriculture, health (especially in relation to soils), and much more. Many valuable resources that are out of print.

  This website allows you to get a bird’s eye view of the soil types in your neighborhood.

- Logan Labs, http://www.loganlabs.com
  We recommend getting started with soil testing by sending a sample to Logan Labs located in Lakeview, OH. The Standard Test currently runs $25. Use Steve Solomon’s worksheets to find your target application rates.

Books:

- Julius Hensel, Bread From Stones, Forgotten Books, 2012
  Originally published in 1894, considered to be the grandfather of using rock dusts to increase soil fertility in modern times.

  An in depth look at the result of soil mineral depletion and it effects on the animals that those soils support. Based on decades of study in India and the UK. His concepts are at work in many parts of the world; from the Indian subcontinent, to South East Asia to Central America.

- Harvey Lisle, The Enlivened Rock Powders, Acres USA, 1994
  Provides practical usage info on rock dusts and interesting explanations of other things at work in the garden.

  Excellent resource for learning technical aspects of nutrient, microbe, and plant interactions in the soil.

  This book lays out the argument against conventional industrial food production and how to rectify your own health through remineralizing your soil.

  Originally published in 1938, a short book that offers interesting insights into health based on well mineralized soil with the Hunza as a prime example.

- Peter van Straaten, Rocks for Crops: Agrominerals of sub-Saharan Africa, University of Guelph, 2002
  The first half of this book draws from the scientific schools of geology and agronomy to provide detail on many different types of rocks and their applications. The second half give specific information for the predominate soils in sub-Saharan Africa.
Mineral balancing provides a great foundation for compost to work and for the soil biology to thrive.

Peer-Reviewed Articles:


- Suzi Theodoro et al. Stonemeal of amazon soils with sediments from reservoirs- a case study of remineralization of the tucurui degraded land for agroforestry reclamation, 2012.


A Brief Summary of the Role of Nutrients in Plant Growth

When you add broad spectrum rock dusts to your soil you may be applying more than 60 elements at one time. There are 17 elements are needed for all plant growth. These are known as the essential elements. Many other elements may play roles in plant growth or in the life functions of soil microbes. Within the plant these elements work together to perform the functions of growth. This section will give you a basic understanding of why your plants need them. The macronutrients are used in relatively large amounts while the micronutrients are commonly referred to as trace elements because they are needed in very small amounts. That is not to say they are unimportant. They are still, in fact, essential.

Macronutrients

The gas and liquid forms of hydrogen (H), oxygen (O), and carbon (C) provide for the vast majority of a plant's structure. Despite this and their essential roles in photosynthesis they are not considered fertilizers.

Nitrogen (N): Bonds with other elements to create amino acids which are essential precursors to proteins and drives growth in the plant. Nitrogen is one of the elements in the chlorophyll molecule, the green part of plant leaves that capture the energy of the sun by photosynthesis.

Phosphorus (P): Responsible for storing and releasing energy. Phosphorus is commonly associated with flowers and fruits and is most concentrated in seeds as it is required for rapid growth of seedlings. It is also essential for the movement of other elements within the plant.

Potassium (K): Used for regulating water and air exchange as well as signaling growth functions. Potassium also promotes storage of energy created during photosynthesis.

Calcium (Ca): Key structural component in plants and all forms of life on Earth. Calcium is also important in signaling and transfer of other elements within the plant.

Magnesium (Mg): Central element in chlorophyll and therefore necessary for conversion of sunlight to sugars. Magnesium is also utilized in the transfer of these sugars.

Micronutrients

Sulfur (S): Plays a role in structural and metabolic activities. Sulfur also is used in transferring energy during photosynthesis and air exchange. It is well known for its role in the development of flavor molecules which affect the way plants smell and taste.

Silicon (Si): One of two elements on this list that many plants can go without and yet still sprout, grow, and set seed. When silicon is available plants will incorporate it into cell walls to form more complete barriers to pests and disease and become more drought tolerant.

Boron (B): Another element used by plants for air exchange and transferring other elements and sugars. Also, it is essential to flower production and stimulates root growth.

Chlorine (Cl): A counter balance to potassium in controlling air exchange. Chlorine is needed in the part of the photosynthesis process that uses water as well as the plant's ability to hold water. It can also reduce susceptibility and severity of fungal diseases.
**Copper (Cu):** Yet another element involved in photosynthesis and therefore essential to plant life.

**Iron (Fe):** Used by plants to transfer elements from molecule to molecule during many plant functions. Although not a part of the chlorophyll, it is used in its creation and that of several proteins.

**Manganese (Mn):** Forms bonds with hydrogen to release the oxygen from water during photosynthesis. Manganese activates several processes throughout the plants systems and breaks apart sugars to convert them for various purposes.

**Zinc (Zn):** Zinc is involved in protein development, the ability of the plant to grow, as well as the regulating of growth by helping to form hormones. Zinc has also been shown to help plants withstand cold temperatures.

**Molybdenum (Mo):** Needed for taking in phosphorus and nitrogen, allowing these elements to perform their tasks. Molybdenum is essential for soil microbes that take nitrogen from the air and make it available to plants.

**Nickel (Ni):** Regulates forms of nitrogen in plant tissues.

**Sodium (Na):** Supports the task of drawing water into cells. Because this is done by potassium as well and can be performed by other elements some do not consider sodium to be an essential element. It is especially useful for some fast growing staple crops.
ABOUT GLACIAL ROCK DUST

Glacial Rock Dust is made from a wide variety of rocks which contain a broad spectrum of trace minerals that are collected and pulverized by the expansion and contraction of glaciers. As the glacier recedes, it leaves behind deposits of glacial moraine. These jumbled piles of debris are processed into dusts. Nature has already done the work of mixing and much of the grinding.

Glacial Rock Dust is an excellent source of readily available calcium, iron, magnesium and potassium plus trace elements and micronutrients. It also increases phosphorus availability to plants.

Typically applied at 10-20 pounds per 100 ft² of garden space or 1 cup per cubic foot of potting soil.

MINERAL CONTENT

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<th>Element</th>
<th>Content</th>
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<td>Molybdenum (Mo)</td>
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<tr>
<td>Silica (Si)</td>
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ADVANTAGES

- Raises pH in acidic soils
- Increases phosphorus availability
- Corrects mineral balance in the soil
- Provides an excellent source of macro and micro nutrients
- Increases moisture holding properties in the soil
- Improves the cation exchange capacity
- Improves soil structure and drainage
ABOUT BASALT ROCK DUST

Basalt deposits are formed by the rapid cooling of magma during volcanic events. Our source is the ancient lava fields of central Oregon. Basalts are mined for a wide variety of applications.

A large diversity of minerals are found in the ground dusts of these rocks. Basalt contains high levels of phosphorous as well as potassium along with generous portions of calcium, magnesium, manganese and iron. Another often neglected but essential element found in high levels in basalt rock dust is silica. Silica strengthens cell walls aiding in resistance to stress factors.

Typically applied at 10-20 pounds per 100 ft² of garden space or 1 cup per cubic foot of potting soil.

ADVANTAGES

Provides an excellent source of macro and micro nutrients
Increases moisture holding properties in the soil
Enhances the cation exchange capacity
Improves soil structure and drainage

MINERAL CONTENT

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<tr>
<td>Silica (Si)</td>
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ABOUT GARDEN LIME

Limestone has been used more extensively for adding soil fertility than any other type throughout modern agricultural history. Garden Lime (also known as Agricultural Lime) is composed predominantly of calcium carbonate. Around the world large deposits of these sedimentary stones can be found. They are composed of the remains of ancient sea life that incorporated calcium into their shells and in many cases are surprisingly pure in calcium content. Agricultural Lime raises and buffers the value pH in acidic soils helping to balance the availability of other nutrients while also adding the benefit of extended calcium release. We recommend using Agricultural Lime for those needing pH adjustment and additional calcium, a welcome addition to the mineral makeup of most garden soils.

Typically applied at 5-10 pounds per 100 ft² of garden space or 1/2 cup per cubic foot of potting soil.

MINERAL CONTENT

Agricultural Lime  
Calcium Carbonate (CaCO₃).............................96.00%  
Total Calcium (Ca)................................................38.00%  
Magnesium (Mg)....................................................0.50%

ABOUT GYPSUM

Gypsum is a limestone that is comprised primarily of calcium and sulfur. This sedimentary stone can also be found in abundance in many regions. They are the result of ancient sea life calciferous remains and sulfuric water conditions.

Gypsum can sometimes be especially helpful in areas that were predominately grassland or for adding sulfur due to crop demands. Sulfur is especially important for quality factors such as sugar content and flavors in food. Gypsum has been shown to increase calcium availability and in some instances lower pH.

Typically applied at 5-10 pounds per 100 ft² of garden space or 1/2 cup per cubic foot of potting soil.

MINERAL CONTENT

Gypsum  
Calcium (Ca)...........................................................22.00%  
Sulfur (S)..............................................................17.00%
**ADVANTAGES**

Steady release of iron and magnesium  
Strengthens plant cell walls  
Long term improvement of specific element deficiencies  
Increase pest and disease resistance  
Increase yields and quality

**ABOUT OLIVINE ROCK DUST**

Olivine is another type of volcanic rock. It is classified along with basalt as mafic, meaning that the dust will be high in magnesium and iron. Unlike basalt, which typically has around 2-3% magnesium, olivine will have composition percentages upwards of 50%.

This dust should be used sparingly and for the express purpose of adding magnesium to a potting mix or garden soil. The magnesium, along with the other trace elements will release slowly and does not easily leach away.

Typically start with 2.5 - 5lbs per 100 ft² of garden space or 1/4 cup per cubic foot of potting soil.

**MINERAL CONTENT**

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<tr>
<td>Boron (B)</td>
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<tr>
<td>Chlorine (Cl)</td>
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<tr>
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<tr>
<td>Iron (Fe)</td>
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<td>Copper (Cu)</td>
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<td>Zinc (Zn)</td>
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<tr>
<td>Molybdenum (Mo)</td>
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</tr>
<tr>
<td>Silica (Si)</td>
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ABOUT AZOMITE ROCK DUST

Azomite rock dust is a naturally mined volcanic rock composed of over 70 minerals and trace elements that are essential for optimal plant health. The rock formation in Utah from which Azomite is mined was formed when volcanic ash merged with sea water an estimated 30 million years ago. This mixture of volcanic ash and sea water created a unique source of trace minerals and elements that moist soils are void of. Just like humans, plants require many minerals to reach peak health and vigor.

Scientists have long recognized that adequately nourished plants and animals are resistant to infectious diseases. There is a growing recognition that healthy plants may effectively resist insects. There is speculation that the nutrient-dense sap of healthy plants provides protection against freeze damage. Based on research studies, reporting higher trace element levels, we believe your plants will show trace element and nutrient improvement with AZOMITE® use.

MINERAL CONTENT

<table>
<thead>
<tr>
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</tr>
<tr>
<td>Silica (Si)</td>
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</table>

ADVANTAGES

- Improve root systems
- Increase plant vigor
- Increase yields
- Excellent source of macro and micro nutrients
- Increases germination rate
- Enhanced pest and disease resistance
ABOUT ROCK PHOSPHATE

Rock Phosphate is similar to other mineral rich sedimentary rocks such as Garden Lime and Gypsum. The cycling of phosphorus in the environment results in deposits in low lying areas such as flat tidal zones and estuaries which turn to stone through compaction over millenia. Although less commonly occurring than the other useful sedimentary rocks, there are large deposits in several areas of the world.

MINERAL CONTENT

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</tr>
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<tr>
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<td>Molybdenum</td>
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<td>0.34%</td>
<td>53%</td>
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Comparison of Our Broad Spectrum Rock Dusts

Available Phosphorus (P2O5)..........................3%
Total Phosphorus (P)......................................16%
Calcium (Ca).....................................................20%
Iron (Fe)................................................................1%
Zinc (Zn)...........................................................0.1%

ADVANTAGES

Provides steady release of phosphorus and calcium
Encourages fruit and seed production
Facilitates mobility of other nutrients within plant
Stimulates root growth
About the Author

Steve Solomon is the founder of Territorial Seed Company. He has been growing most of his family’s food for over 35 years, and is the author of several landmark gardening books including *Gardening When it Counts* and *Growing Vegetables West of the Cascades*. A lifelong advocate for the value of self-sufficiency, his writing, lectures, and classes are focused on helping people become financially independent through producing their own necessities. He currently homesteads in Tasmania.

Praise for *The Intelligent Gardener*

“This is an excellent book which concentrates on the mineral content of soils. In it the author makes the case for growing nutrient-dense food, critiques compost only growing strategy, describes what different minerals do for plants, and then explains how to bring the minerals in your soil into optimum balance. The explanation also includes how to send a soil sample for testing, how to analyze the result and then, using worksheets and information that he provides, how to formulate an amendment strategy that is specific to your soil. For those who don’t want to test their soil there is a recipe for a Complete Organic Fertilizer that will help to provide a full range of minerals.

Perhaps more important than a list of what the book contains is what it does. For me it opened up a ‘Pandora’s Box’ of questions: What minerals are in my soil, in what ratio; and if there are deficiencies, how do I correct them? Finally, what are the consequences to my health of not doing so? I have since had my soil tested and using the worksheets provided, am now amending my soil with exactly the minerals it needs to bring it to an optimum balance. I also have a soil test report to use as a baseline to see how successful I have been when I next test my soil.

“For some time the Organic Gardening movement has concentrated almost exclusively on compost as the solution to gardening problems. Including soil mineral balancing as part of your food growing strategy, will complement the use of organic matter, and should improve the nutrient content of your food. This book is the ideal guide to doing so.” - Deano Martin
“If your intention is to produce nutrient-dense food on a scale that means a great deal to the family economy, do a soil test, and amend the soil in the direction that maximizes nutritional outcomes. That’s the best way. Thinking just in terms of money, if you’re growing a large-enough garden that its output makes a financial difference, and if its fertilization requires the purchase of anything at all, why not add another $20 to your annual cost and do a soil test first? Then you can buy only what the garden really needs. The test could save you more than its cost. And, if you think of it in terms of your family’s health, there is no choice at all. (pg. 83)

“Better-mineralized vegetables … gently improved our health a few notches, with one slight drawback: Annie and I started gaining weight even though we were consuming vegetables; we hadn’t yet learned to adjust our intake down to match the increase in how much we were eating because the vegetables all tasted so great!

After remineralizing, we had even less interest in buying treats, meats, cheese and other things from the supermarket. In other words, homegrown veggies became a larger fraction of our total intake than they already had been. This shift was effortless; we’re eating what we enjoy most. I think improved vegetable nutrition has enabled me to mostly give up our excellent Tasmanian cheeses (much of the time); consequently, I am not having as much discomfort at night. I also have more energy – important when a bloke gets to age 70.

The English language has few words to accurately describe flavor. But how about this attempt: we have long enjoyed eating zucchini splosh. To make splosh, you steam or simmer chunks of zucchini until they are soft enough to mash. Then you mash. While mashing, add a big pat of butter and a little black pepper. Salt if you must. That’s it. This year, our splosh tastes nearly as rich as a savory pumpkin soup. It’s incredible. We want to eat a big bowl of zucchini splosh every night. We were sad last autumn when we ate the last serving the garden would provide until the next summer.

And our sweet corn! I hadn’t tasted corn that good since coming to Australia. I’d been complaining about the lack of good flavored sweet corn varieties in Australia. I discovered that one reason was a quarantine restriction on corn seed imports. The main result of this restriction has been to create a protected market in which our domestic seed producers can charge several times the price Americans have to pay; to add insult to injury, we home gardeners are offered only a handful of second- or third-rate varieties. While in Australia, I’ve done trials that included every corn variety legally available, but remembering the corn trials I did when I had Territorial Seed Company, I would say that in Australia I have never tasted a variety I would have scored over 7.5 out of 10 because I still remember the flavor of Jubilee, or Sugar Dots, which I generally awarded a 9.5. After remineralization, a variety I scored 7.0 last year tastes like an 8.0 this year. And I’m expecting 8.5 next summer as more nutrients leach into the subsoil. Remineralized soil! (pg. 81-82)

“I wrote this book to function like “Analysis for Dummies.” I will tell you only what you absolutely need to know – in the simplest possible terms. I cover only the bare essentials, leaving out all that fascinating (or boring) background information enthusiastic writers usually can’t keep to themselves. For me, personally, the study of soil
chemistry and the contemplation of what might constitute the ideal soil and how one can create it is a marvelous puzzle that can endlessly occupy my thoughts. It’s possible you don’t feel the same way about it.

However I’m pretty certain that when you taste the result, you will be inspired to learn more. And that’s why I include mentions of some of the other interesting books out there as often as I think I can get away with it. For me, there’s always endless heaps of fascination to delve into. But learning that much is entirely unnecessary if all you want to do is successfully produce nutrient-dense food. (pg. 93-94)

“An archery target usually consists of concentric rings with a bull’s-eye in the center. When balancing soil, the target is the relationships among six elements: Calcium, magnesium, potassium, sodium, sulfur, and phosphorus. The other plant nutrients – boron, iron, copper, zinc and manganese – are equally important, although they are not added in large quantities, and we are not as certain about where their bull’s-eye are.

There are a handful (or maybe a hatful) of other elements that plants don’t seem to absolutely require but do pick up in tiny traces; and there are a few elements plants do absolutely require for their own internal chemistry, but only in the slightest of traces, like molybdenum and cobalt. Rest assured, I don’t overlook any of these elements, because even if the plants don’t seem to require them, your body does.

Growing nutrient-dense food requires bringing nutrients in soil to target levels that are in balance with other nutrients, while at the same time making sure there is a healthy soil ecology helping the process along. Creating maximum soil fertility is not necessarily about having more; it is about achieving balance; often, it is about having less. My underlying strategy is to present both the plants and the soil ecology with a luxurious abundance of everything they can use… (pg. 96-97)

“When assaying soil, a sample is soaked in an extractant solution; then, the elements removed from the soil by the extractant are analyzed. This book focuses on a type of soil test that uses Mehlich 3 (M3) extractant. A standard soil test using the M3 method accurately measures the availability quantity of 11 essential plant nutrients. To adjust for differences from spot to spot in any field or garden, several samples are thoroughly blended before the extraction is done. The test result will be accurate only if each soil sample going into the blend is the same size. For gardening purposes, we usually analyze the top six inches of topsoil because that is where most of the biological activity happens. It’s where the crop does the majority of its feeding, and it’s also where we can conveniently mix in fertilizer with a shovel, fork or tiller… Soil varies from spot to spot, so you need to take several samples and blend them to determine average values. An established home garden will have different fertility profiles from bed to bed…” (pg. 97)
About the Author

Jeff Lowenfels is the former president of the Garden Writers of America, a Garden Writer’s Fellow and was inducted into the GWA Hall of Fame. He is founder of Plant A Row for The Hungry, a national program that encourages gardeners to plant one row in their gardens dedicated to feed the hungry. Jeff hosted a popular statewide TV gardening show, for Alaska and gardeners above the Arctic Circle. Today, Jeff has a popular radio show where he plays The Germinator. He now lectures around the world, explaining the science behind organics and how plants grow.

About Teaming with Nutrients

In Jeff’s new book Teaming with Nutrients, he writes for the gardener who is fascinated by plants and wants better understanding and visualization of the world of soil nutrients, molecules, and root hairs, of hydrogen ions, covalent bonds, and nutrient movement through the phloem. His explanations are clear, accompanied by abundant illustrations from over twenty contributors. His motivation is to bring the average gardener into the world of plant chemistry and nutrient bio-availability.

The first chapters, which profile all of the nutrients and their function in plant growth, provide the basis for the next chapters that describe soil test results, how to interpret them, and how to acknowledge and troubleshoot visual nutrient deficiency symptoms. Teaming with Nutrients adjusts our lens to the microscopic level, giving us a tour of the unseen system of plants and soil.
“Unless you’re a scientist who deals with mycorrhizae, you’ve probably never given much thought to how plants eat. Most gardeners think that growing a good tomato is all about photosynthesis and mixing in some nitrogen, phosphorus, and potassium (N-P-K). Jeff Lowenfels shows how wrong this assumption is. Jeff’s book is timely as it is informative. Too many gardeners think they are taking the modern path by blindly pouring on synthetic N-P-K fertilizer in accordance with a picture on the label or an ad on television. We let chemistry take over. We know little about what we’re doing, but we do it anyway. The result has been an alarming spike in phosphorus and nitrogen pollution. (pg. 7)

“How do plants eat? I am pretty sure this is an age-old question. It probably came up 10,000 years ago after some early gardener noticed that rotting fish did wonders for plants. The observation that one’s urine had a beneficial impact on plants could not be missed, either. These and other natural fertilizers not mentioned in public helped trigger the Neolithic Revolution, the transition from hunter-gatherer to farmer-gardener. Even in ancient times, feeding an ever-growing population required horticultural advances. The Aztecs and Mayan civilizations, for example, were all about growing food to support burgeoning populations. They offered their gods sacrificial blood to ensure a good harvest. Perhaps this practice arose from their observation that soil bloodied from butchering an animal or as a result of some mortal blow during a heated battle grew better plants. I come from a long line of natural fertilizer users. My grandfather and dad taught me to bury the uneatable bony fish we used to catch every summer under roses and tomatoes. We had a horse for a while, too, and chickens, geese, ducks, and rabbits. We knew about the wonders of manure. I won’t go into my use of urine as a fertilizer, but with three boys growing up on eight acres, you can bet it was applied liberally, with varying impacts on the plants. Today, gardeners use homemade and commercial fertilizers composts, and mulches. Many simply follow the directions with little or no thought about what those powders and liquids really do. We’re just glad they do it. After more than 50 years of gardening, I realized that I didn’t know much about fertilizers other than what I had picked up from my family and my own observation over the years. When I started to ask my gardening friends what they could tell me about fertilizers, I discovered a startling fact: I couldn’t find one gardener who could tell me how they work. It seems today’s gardeners are just as clueless about how fertilizers work as were our early ancestors. We rely on the same principle, observation, which, sad to say, includes advertising. Still, how plants eat has been the subject of discussion probably ever since the early days. (pg. 11-12)

“Most gardeners can name many of the essential nutrients. The macro nutrients are the ones required in the greatest quantities. Three of these are always represented on fertilizer packages as the N-P-K trilogy: nitrogen (N), phosphorus (P), and potassium (K). Because it often comes up, the symbol K is used for potassium not because the letter P was already taken, by phosphorus, but because it comes from the Latin name kalium. Beyond this trilogy, some gardeners are familiar with other macro nutrients, such as sulfur, calcium, and magnesium. These are also used by plants in large amounts. Carbon, hydrogen, and oxygen are also macro nutrients.
The second category is micro nutrients, which are sometimes called trace minerals. The lack of iron, manganese, zinc, copper, molybdenum, boron, chlorine, or nickel can cause plants to do poorly. Although the name micro nutrient might suggest they are less important than the macro nutrients, they have the same degree of importance. They are essential but only tiny amounts are required. The micro nutrients are present in most soils and don’t have to be added very often unless there is something way off balance. But they have to be there or the plant will not survive and reproduce.

The list of essential plant nutrients is not a very long one, and most should be familiar to you because they are in your own daily diet (just check your vitamin and mineral supplements bottle). If you’re going to be a really good gardener, though, you need to really understand a lot more about them. (pg. 94-95)

“If simply ensuring there was a sufficient and continuing supply of the essential nutrients to plants was all there was to gardening, we could all be prizewinners. Unfortunately, even if all the right plant nutrients are present in unlimited quantities, there are other factors that affect their availability to plants.

What makes a gardener a good one is understanding how plant nutrients work and how to supply them. However, what makes a better gardener is also being able to identify and deal with the special conditions required to ensure the essential plant nutrients are most efficiently taken up by plants.

“The ability of your soil to maintain aerobic (oxygen-rich) conditions is another major factor that affects plant nutrients. Well-aerated soils have lots of microscopic pore spaces that allow for air and water exchange. This water replenishes the supply of nutrients to depleted root zones, and it carries nutrients up into plant roots. If soils are not well aerated, there can be less water and consequently lower root pressure and less mass flow and nutrient uptake. In addition, carbon dioxide produced by cellular respiration in roots can build up in poorly aerated soils. Carbon dioxide chemically reacts with water to form an acid, and it often combines with organic matter to form cell-killing alcohols and fermented products that are not good for plant roots or some of the beneficial members of the soil food web. Well-aerated soils can absorb and then help release the carbon dioxide produced by cellular respiration in roots into the atmosphere. These soils also contain oxygen, which mixes with water and enters roots. When soils are anaerobic (oxygen-poor), microbes that require oxygen often replace this element and use other nutrients instead. Thus, soil compaction affects the availability of iron, sulfur, and manganese because microbes use these nutrients, reducing amounts available for uptake by plants.

And, of course, soils need to have ample oxygen to sustain the free-living microbes that fix nitrogen, as well as the plants that house many of them. Moreover, the microbes that like anaerobic conditions include many that unfix nitrogen at the plant’s (and gardener’s) expense. Finally, mycorrhizal fungi, which are important for the uptake of phosphorus, nitrogen, copper, and other essential nutrients, require aerobic conditions.

Aside from oxygen, the uptake of potassium is the nutrient most affected by compacted soils. A whopping 50 percent reduction can occur in compacted soils. Because potassium is required for the regulation of carbon dioxide and water levels, which are both important for photosynthesis, it is no wonder plants become stunted in anaerobic soils. (pg. 187)
“The ability of nutrients to move through soil to roots depends on the characteristics of the soil. Organic and clay particles in the soil have lots of negative charges on their surfaces that hold positively charged mineral nutrients. These nutrient cations can be exchanged with plant produced cations. The number of cations that soil is capable of holding is the cation exchange capacity (CEC).

Clay is made up of sheets of molecules, and some molecules hidden in the layers hold positive charges. When these become exposed, they attract anions that are exchanged with hydroxyl ions (OH-) in the water solution. Likewise, the number of anions that a soil is capable of holding is its anion exchange capacity. Because most anions are already in the water solution and available to plants, however, this is not as important as the CEC.

Soils with a low CEC won’t hold nutrients well, so the gardener needs to mete out nutrients over an extended period of time so they won’t all leach away. If your soil has a good CEC, then you can dump in large amounts of nutrients and expect them to be held. If your soil is sandy, you may need to add compost full of organic matter and clay to increase the CEC of your soil. CEC may also influence the timing of fertilizer application. For example, you wouldn’t want to put fertilizers down in the autumn with low CEC soils, because there would be nothing left by spring due to runoff. However, if your soil has a high CEC, amending it in autumn might be a good practice.

In short, CEC has a lot to do with the mobility of nutrients in soil. Assuming an adequate CEC, the anions chlorine, nitrate, molybdenum, and sulfur are mobile in soil. In contrast, the cations ammonium, calcium, copper, iron, magnesium, and manganese are much less mobile, depending on the amount of organic matter and clay, which increase CEC and decreases their mobility. Nickel, phosphorus, potassium, and zinc are relatively immobile in soils. Mobile elements have to be replaced more frequently than the immobile ones because they are both readily taken up by plants and more quickly leached out of the soil.

Obviously, the amount of water in the soil can have the ultimate impact on the availability of nutrients. Water influences pH, mass flow, and root pressure, all of which affect nutrient uptake. As water moves out of the soil, it leaches away the nutrients dissolved in it. It can also wash away soil that contains nutrients, which is a major source of phosphorus loss. Of course, water can also increase nutrient availability by releasing nutrients, both chemically and by weathering. Once again, too little or too much water has a direct impact on populations of microbial symbionts. If there is too much water and anaerobic conditions develop, our Rhizobia and Frankia bacterial friends won’t produce nitrogen. This can cause a decrease in the production of sugars in leaves and reduce the numbers of soil food web organisms that rely on exudates, including mycorrhizal fungi. The result is little or no nitrogen, phosphorus, copper, and other nutrients being delivered biologically to the plant.

"Unlike chemical fertilizers, natural fertilizers foster the health of the soil food web which builds all important soil structure. Biofertilizers are living organisms that are added to the soil to promote plant health. These include nitrogen-fixing bacteria, phosphate-solubilizing bacteria and fungi, and mycorrhizal fungi." (pg. 194)
Plant a Row for the Hungry was started in 1995 by Jeff Lowenfels in Anchorage, AK. Over 20 million pounds of produce providing over 80 million meals have since been donated by American gardeners.
**What is Coir, and where does it come from?**

Coir is a by-product of coconut harvesting. For centuries, rope, twine, and mats have been made from the fiber in the husk of coconuts. These fibers are obtained by husking or breaking up the hard shell, then soaking it in water-filled pits to soften the fibers.

60% of the world’s Coir fiber is produced in the state of Kerala on the western coast of India. Sri Lanka and India together produce 90% of the annual coir production worldwide.

Nature’s Footprint Coir has already been screened, washed and graded as a premium horticultural product.

**Coir as a growing medium**

Coir contains no nutrients, unlike your backyard garden compost which contains fungi and bacteria.

Compost and Coir have many of the same characteristics, such as a spongy texture, expanding air space, and high moisture holding capability.

Backyard/garden compost breaks down rapidly in the soil and must be re-applied annually. Coconut Coir, on the other hand, will last in soil for years.

Coir has a high lignin content. Lignin is an organic substance that, along with cellulose, forms a chief part of woody tissue. It is the lignin that resists rapid breakdown in the soil, and is the source of Coir’s longevity. After adding Coir to soil it has an estimated lifespan of 5 to 10 years before it begins to break down. Coir out performs peat moss, rockwool, vermiculite, and perlite as a soil amendment.

Most commercial bagged potting mixes contain chemical wetting agents. Coir is a 100% organic wetting agent. Its ability to rehydrate repeatedly as soil moves from wet to dry with little loss in yield is remarkable. In addition, wet

Coir holds around 1000 times more air than soil, making Coir the superior choice for creating potting mixes.

With its high water-holding capacity, Coir provides plant roots with excellent drainage. Coir’s high air-to-water ratio is extremely valuable for healthy root development. Coir has the ability to store and release nutrients to plant roots for extended periods of time. With better nutrient absorption, coir fosters excellent growth and plant formation.

Coir reduces plant disease. Trichoderma is a naturally occurring fungus in Coir that works in symbiosis with plant roots to protect them from pathogenic fungi such as pythium.

**FEATURES:**

- **High water holding capacity**
  Up to 10 times its weight

- **Retains and releases nutrients**
  Over an extended period of time

- **Naturally weed free**
  Absence of weeds, seeds and pathogens

- **Disease resistant**
  Significant reduction of root diseases

- **Spongy texture**
  Similar to traditional compost

- **Excellent air space & drainage**
  Similar to traditional compost

- **Develops elaborate root systems**
  Unmatched medium for seed starting

- **Neutral to slightly acidic pH**
  Unlike peat moss which has high pH acidity

- **Soil amendment & conditioner**
  Excellent in both clay or sandy soils
Coir as a soil amendment

Soil texture is described by scientists in terms of the particle size: sand, silt, and clay.

Sandy soil is by far the largest of the three and can be seen with the naked eye. Soil sand however must be small enough to hold some water, unlike gravel for paths. Even so, most of the water will readily drain out along with nutrients, leaving lots of air space.

Silt soil is much smaller than sand - will need a microscope to see individual particles. Silt soil holds more water and has the appearance of flour, yet still contains air spaces.

Clay soil on the other hand is much, much smaller. In fact you will need an electron microscope to see a single clay particle. Clay holds lots of water, is slippery when wet, rock hard when dry and has little air space between the particles.

Of the three soil types, clay is by far the best soil for gardening, containing large amounts of minerals which plants need.

However, many gardeners will disagree because the clay is difficult to cultivate and is so compacted that it provides little air to plant roots.

When mixed with clay soil, Coir breaks up the clay particles, adds air space and loosens the soil making it easy to till. It also adds porosity to the mix similar to garden compost. However, coir stays in the soil mix for many years, unlike garden compost which breaks down quickly.

Coir also improves sandy soil by adding organic matter which aids in water retention as well as nutrient retention and release.

Coir as a seed starting mix

For many gardeners starting seeds is a challenge prone to failure.

Garden writers suggest two important things to consider:

1. A disease free growing medium.
2. A medium that retains moisture but avoids becoming wet or soggy.

Coir is free of weed seeds, diseases, and pathogens. Coir is easy to wet, holds seven times its weight in water, cannot be compacted, fosters root development and does not waterlog.

Coir replaces all other recommended soil amendments for creating your own seed starting soil, including peat moss, rockwool, vermiculite, perlite and wetting agents like polymers. Add moisture using a fine spray as the top surface dries out. Make sure there is sufficient light.

Remember seeds don’t require fertilizer for germination, begin to add fertilizer once the plant’s leaves have developed.

Once your seeds have reached 3” or 4” in height and have true leaves, it is time to transplant into a container which has fertilizer or add fertilizer to the container your plants are in.

Transplants

When transplanting any size plant adding Coir is recommended below the plant. In containers coir can comprise 20-25% of your total potting mix. It allows plants to build strong root structures and will insure your transplanted plant will adapt its roots into the new location.

Available Sizes

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SoilKey’s natural and organic fertilizer blend increases the biological activity in organic soils and composts. Designed to work synergistically with vermicompost, it enhances the natural biological processes.

**Performance**

SoilKey® has continually been proven successful. Growers across the spectrum of horticultural disciplines report a profound increase in plant vitality.

**Unique Natural Blends**

SoilKey® is formulated using the finest natural, organic and mineral inputs to ensure a complex mix of nutrients. SoilKey® is an alternative to synthetic fertilizer and pesticides as it contains no synthetic chemicals.

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**Guaranteed Analysis**

- Total Nitrogen (N) .................. 4.00%
- .... 0.52% Water Soluble Nitrogen
- .... 3.48% Water Insoluble Nitrogen
- Available Phosphate (P2O5) .... 2.00%
- Soluble Potash (K2O) .............. 3.00%
- Calcium (Ca) ........................ 3.7%
- Sulfur (S) ............................ 1.8%
- Iron (Fe) .............................. 0.7%
- Manganese (Mn) .................... 0.1%
- Sodium (Na) .......................... 0.2%

**Derived from**

- Alfalfa Meal, Bat Guano, Glacial Rock Dust, Potassium Sulfate, Greensand, Kelp Meal, Gypsum, Rock Phosphate

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**Kickstart Compost Activity**

SoilKey™ Accelerator provides a comprehensive nutrient blend for enhanced microbial activity.

Pair this product with a quality compost, clean water, and air to Accelerate actively aerated compost tea! It’s all you need to realize exponential growth. Applying AACT can increase growth rates, build soil health, and encourage microbe diversity.

SoilKey™ Accelerator can also increase conversion of organic wastes in any composting system.
Better Drainage - Healthier Roots - Happier Plants

Extend Plant’s Life!
• AIR enables roots to extract more water and nutrients
• AIR protects roots from pathogen attacks
• AIR at the root level “burns off or prunes” circling roots
• AIR produces highly branched roots

for both Indoor and Outdoor Container Plants

Permanent airspace at the root level

Fits pots with bottom dimension 5” to 7”

with the SUB-IRRIGATION option container watering the way nature intended.
Worm Factory®

Trash to Treasure!

- Convert kitchen waste
- Biologically active
- Easy to operate
- Worms self-sort
- Odorless
- Expandable

Vermicompost
“by far the best compost for your garden”
- Dr. Ted Radovich, University of Hawaii

By adding Rock Dust to your worm composter
mineral content is transferred to the finished vermicompost.

Increase the nutrient content of your vermicompost exponentially by aging your finished vermicompost

Read the results of research conducted at the University of Hawaii by Dr. Radovich and his students.

For a free copy of *Tea Time in the Tropics*