

Agriculturally

Soil and Crop

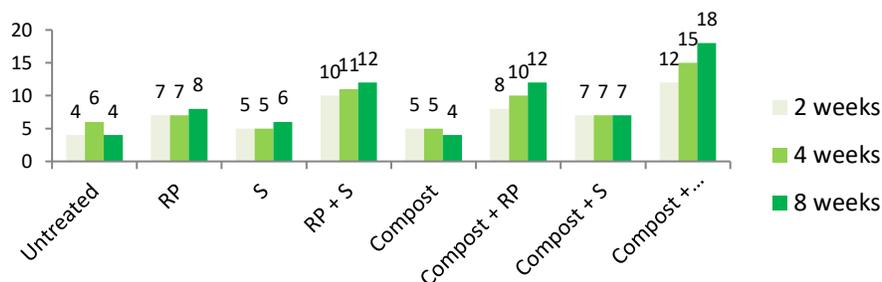
Rock Phosphate tends to stay where it is placed and continues to be available in the soil for many years, after application, building up the reserve levels if not required for plant use. With over 20% total phosphate content, approximately 25% to 30% of the total would be available each year for the next three years and beyond, if not utilized by the crop.

While commercial phosphate fertilizers have high levels of available phosphorus (water soluble), it has been widely shown that only 10 to 30 per cent of the P is recovered by the plant in the first year of application, depending on soil type and conditions, the crop grown and application method. The remainder binds to other soil minerals, or if it remains in the water soluble form may leach from the soil.

- **Organic matter** mobilizes bound phosphates and improves phosphorus release in the soil. Amending with humics, manure and compost improve soil organic matter.
- **Soil pH** is important - slightly acidic to neutral soils allow for maximum availability of phosphorus. In acidic (low pH) soils phosphorus is bound by iron and aluminum and in alkaline (high pH) soils phosphorus is bound by calcium. Add amendments that buffer soil pH for optimum phosphorus availability. Sulphur reduces pH and enhances phosphate release in higher pH soils and lime or gypsum can be used to buffer high acidic soils.
- **Soil moisture** enhances biological activity and encourages phosphorus movement in the soil.
- **Soil microorganisms** play an active role in the process of phosphorus de-mineralization and the consequential increase in extractable phosphorus.
- **Nutrient analysis** of phosphorus and calcium also determine availability released by rock phosphate application. Rock phosphate contributes to the calcium stores in the soil. In low calcium soil, calcium will bind with other minerals and store – thus releasing phosphorus from rock phosphate. Low soil exchangeable calcium also increases the level of free phosphate ions in the soil – preventing tie up. Low phosphorus levels in the soil also promote release of additional phosphorus from rock phosphate.

Rock phosphate is present in the form of apatite which is a sedimentary mineral blend of calcium, phosphorus and silica. The synthetic process for which phosphate is made available and more soluble from rock phosphate is through the addition of sulphuric acid, resulting in concentrated phosphoric acid. When applied to the soil, available phosphate ions from synthetic phosphate fertilizer quickly bind to positively charged ions (nutrients) in the soil locking up both the phosphorus and the nutrients. These reactions begin to occur before plants are able to access the phosphorus. Synthetic fertilizers only feed the crop within a short time frame from when they are applied, creating a need to apply fertilizer year after year and multiple times throughout the season. Alternatively - the soil has a unique ability to separate the phosphate from the calcium without chemical processing. Naturally, rock phosphate represents the stable form of phosphorus. Phosphate ions are freed through the conversion to soluble forms of phosphorus in the soil in slightly acidic environments, through mobilization by moisture and organic matter and with the help of soil microorganisms. Due to slower release of phosphate ions in the soil, plants are able to access nutrients at the rate in which they are required throughout the duration of the crops growth cycle. Less tie-up of cation nutrients such as calcium, magnesium and potassium is prevalent through the use of rock phosphate when blended with other nutrients and micro-nutrients. Rock phosphate not only supplies phosphorus to the crop, but also mineralizes the soil and improves soil structure.

Rock Phosphate has been globally tested, proving its release of plant usable phosphorus into the soil. Here is an example of an incubation trial done in pH neutral, phosphate deficient soil in Canada over 8 weeks under ambient temperature. Rock Phosphate was applied at 120 ppm.





Fertoz Rock Phosphate is an Effective Alternative to Commercial Phosphate Fertilizer

Calcium

The high level of calcium (<30%) in rock phosphate is also helpful for plant growth. In the soil, calcium helps with maintenance of pH and chemical balance, reduces soil salinity, and improves water penetration. Salinity is a major environmental issue limiting productivity of crops. Synthetic fertilizers are a source of salinity to the soil, often as nitrates or sulfates. Calcium is also very important in plant growth; specifically as it pertains to plant vigour since it is responsible for cell wall deposition. Because calcium cannot be remobilized from plant tissue once deposited, a consistent supply is required. Rock phosphate slowly breaks down in the soil, providing continual calcium when needed.

Agronomists may suggest the use of calcium carbonate but Rock Phosphate also provides a valuable source. Literature also suggests that when calcium is present in abundance in plants, a defense mechanism is triggered against external threats such as pathogens. Calcium prompts the plant to make salicylic acid which signals the plants defense. Rock phosphate also contains silica which reinforces the plant cell wall, further increasing resistance to disease and pests. Some other silica benefits include increased tolerance to drought and heavy metals as well as improved crop quality and yield.

Seed Safety

Unlike synthetic phosphate fertilizers, rock phosphate does not burn the seed and can be applied directly to the seed as a coating. Application of synthetic phosphate fertilizers in excessive rates can be toxic to the soil environment and burn seed, roots or shoot tissue depending on application method. Rock phosphate is considered as a non-toxic alternative.

Yield

Improved yields from Rock Phosphate application are documented through multiple research trials. The majority of studies reviewed show a statistically significant increase in yield from rock phosphate application. Fertoz calculated an **average yield benefit of 35.8% from RP applied** alone over 95 treatment comparisons. Additional crop yield benefits were observed in soils amended with sulphur, beneficial microorganisms, manure and compost. Additionally, multiple research studies have shown that blends of MAP with rock phosphate have resulted in crop yields similar or better than crop yields with MAP as the only source of phosphate.

Economically

Retail Cost Comparisons

Fertoz Rock Phosphate is competitively priced compared to other organic inputs and phosphate fertilizers, especially when managing a longer-term budget and considering all of the benefits associated with rock phosphate fertilization.

COST OF PHOSPHATE COMPARISON

11-52-0	0-20-0
Farmer Price: \$1020/MT \$0.89/lb P ₂ O ₅	Farmer Price: \$320/MT \$0.72/lb P ₂ O ₅
COST PER ACRE	
Recommended Rate: 50 lbs P ₂ O ₅ /acre	
11-52-0	0-20-0
Product application rate: 96 lbs/acre \$44.43/ac	Product application rate: 250 lbs/acre \$36.30/ac

A cost comparison based on total P reveals that powdered rock phosphate is cheaper than MAP.

Measuring the Value of other Nutrients

Nitrogen is a very important nutrient required for crop production; and is typically added soil fertility management programs. Although many other nutrients are importance for plant growth, such calcium, silica, iron, manganese, and sulphur. Unlike conventional fertilizers, naturally mined Rock Phosphate contains many of these valuable and important soil and plant nutrients that encourage soil health and diversity, promote healthy microbial populations, increase plant vigor, improve defense against pathogens, among many other benefits.

SUMMARY OF ELEMENTS FOUND IN ROCK PHOSPHATE

Phosphate	20-25%
Calcium	25%
Silica	1-10%
Sulphur	>1%
Iron	1%
Zinc	>100 ppm
Manganese	>50 ppm

Application of iron fertilizer to crops has proven effective at increasing yields. Recommendations of <10 lb/ac are common. At 300 lbs/ac of rock phosphate application (3 lbs/acre) of iron is being added to the soil.

Environmentally

Soil Degradation

Soil health is fundamental in the growth of agricultural crops. Industrial fertilizers, produced mainly from fossil fuels may have a longstanding impact on soil health causing acidification, salt build-up, heavy metal and radionuclide contamination and nitrate accumulation. Unfavourable soil environments decrease microbial diversity (bacteria and fungi), favouring pathogenic strains. Microbials are essential to plant indirectly, as they create the organic matter needed to sustain the soil nutrient status and feed the plant. Over time, soil can be amended through sustainable farming practices, like through the application of natural fertilizer such as rock phosphate and compost.

Water Pollution

Over fertilization by synthetic fertilizer promotes pollution to rivers, lakes and streams through runoff and leaching. Excess growth of plants in rivers and streams is the result – leading to eutrophication. Eutrophication is detrimental to the aquatic ecosystem, causing algal blooms capable of releasing toxic substances into the water, reducing aquatic fish species populations and lowering the quality of drinking water vital to all living organisms. Phosphorus is becoming an increasingly expensive resource and growers are losing this vital nutrient through excessive application of commercial fertilizer which is highly soluble and can leach and run off the land. Rock phosphate, applied in its natural form provides a solution to water pollution and prevents excessive loss of phosphorus while building soil reserves.

Sustainability and Future Planning

When seeking a high quality source of phosphorus for your soil, Fertoz rock phosphate may be the solution regardless of your preferred farming method. Suitable for organic, sustainable, regenerative, reduced till, and conventional agriculture. If you are considering a future switch from your current practice to a more regenerative or organic farming approach, rock phosphate can be used in the interim to help build the soil reserve of phosphorus. Keep in mind that a transition to organic requires a minimum of three years without synthetic fertilizer application. Because rock phosphate is natural and approved as an organic input, application of rock phosphate will not set you back in your transitional period.

Carbon Sequestration

Increasing focus on global climate change encourages the use of sustainable products like rock phosphate. Commercial fertilizers are 10-12% of total greenhouse gas emissions globally. Ammonia, urea and 11-52 are significant sources. Fertoz is helping producers calculate the carbon sequestration benefits accrued from the use of rock phosphate and sell the carbon credits generated by this practice. Fertoz rock phosphate promotes carbon sequestration by increasing yield, building soil organic matter, increasing soil health, and encouraging active tie up of carbon through minerals components added to the soil. Fertoz rock phosphate's simple manufacturing process, excavation, crushing, screening, granulation, releases 6 times less carbon into the atmosphere compared to conventional phosphate fertilizer. It is clear that use of direct applied rock phosphate, and blends with 11-52 significantly reduces your overall carbon footprint.

Conventional fertilizers containing nitrogen release greenhouse gasses (nitrous oxide) once applied to the soil. Using rock phosphate together with sustainably sourced nitrogen further reduces impacts related to climate change.