BODEN

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TB UNTERFRAUNER GMBH

PHOSPHORUS

Analysis and mobilization instead of fertilization!

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Phosphorus Pools

The P content of soils is in the range of tons / ha. The forms and variety of chemical bonds (pools) are diverse. By evaluating the pools, focused measures for mobilization can be derived. TB Unterfrauner GmbH therefore routinely analyses and evaluates 5 different phosphorus pools:

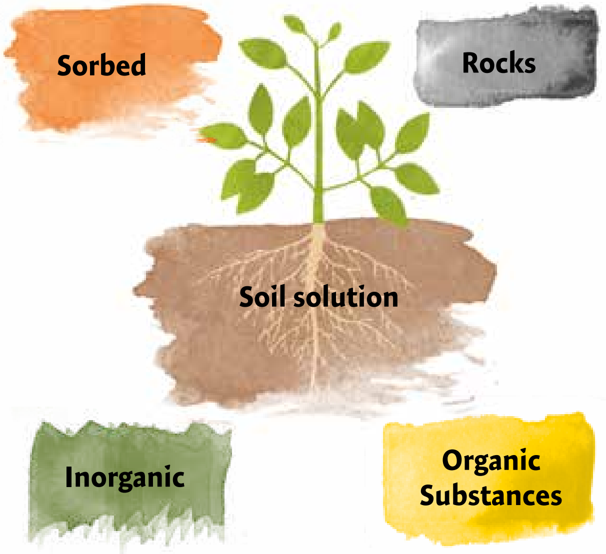
Water soluble phosphorus

Sorbed phosphorus

Inorganic phosphorus

Organic phosphorus

Total phosphorus

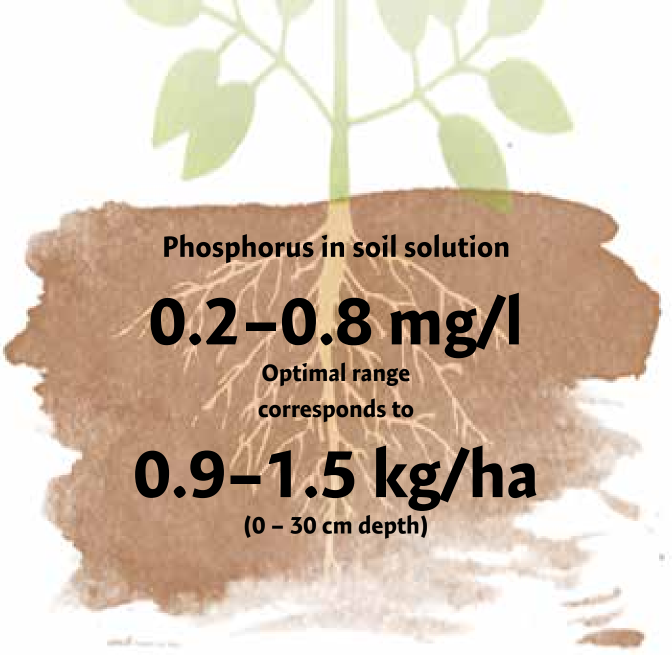


Phosphorus dynamics

General: P is an essential nutrient. The stocks of the natural deposits will run out in the foreseeable future. It is therefore essential to understand the P dynamics of the soil and to mobilize reserve pools instead of fertilizing P.

Agriculture: Soils that have been intensively used for decades have mostly high total P contents (P: 1500 to 3000 kg / ha, 0-30 cm depth). The P comes from the bedrock and mainly from mineral and organic fertilizers applied in the past.

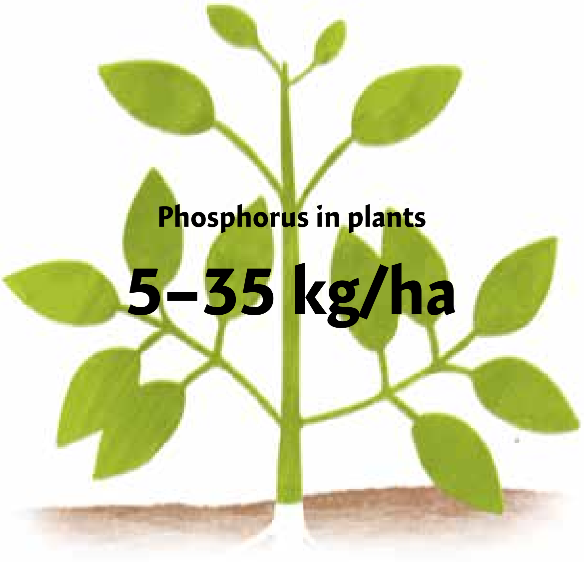
Reserve pools: The plant's utilization of the fertilized P is low. A large part is stored in the soil's inorganic reserve pool.



Phosphorus in the soil solution

Concentration: The amount of P in the soil solution is usually small. P concentrations of 0.2 to 0.8 mg/l are sufficient for the nutrition of our cultivated plants. It is important that the subsequent delivery works and the absorbed P is supplemented from different pools.

Uptake: The absorption of P takes place in the form of phosphate ions from the soil solution. At pH values (water) between 6.5 and 7.5 the phosphate ion is present as dihydrogen phosphate ($H_2PO_4^-$). This is the most favourable form regarding plant nutrition. The energy for uptake is ~ 10% of that which would be necessary for the uptake of phosphate species in other pH ranges.



Phosphorus in plants

Requirements: Absorbed P is bound relatively quickly to organic molecules; a small part remains dissolved in the cell sap. The maximum requirement of P is in the youth stage (root development) and for the generative phase (seed formation).

Function: P has central tasks regarding energy transfer, the synthesis of organic substances and as a component of e.g. DNA and phytin. If there is a deficiency, growth is inhibited, root formation and tillering are weak, and flowering and ripening are delayed. Older leaves are first dark green, then reddish due to anthocyanin formation.

Extraction: The extraction with the harvest is between 5 and 35 kg / ha, so the reserves in the soil will last for a very long time!

sorbed phosphorus

5–120 kg/ha

(0 – 30 cm depth)

Sorbed phosphorus

Exchanger: The phosphate anion can be exchaged on positively charged particles in the soil. As a result, P is protected from leaching and stored in an easily mobilizable form.

Competitor ions: By increasing the concentration of competing ions in the soil solution, sorbed P can be displaced from the exchanger and taken up by the roots. In practice, the anion from silicic acid has proven to be useful.

Mobilisation: The naturally occurring silicic acid in the soil is not suitable for this. Special silicate products that have undergone a highly thermal change can mobilize P (e.g. zeolites, metallurgical limes).

Phosphorus in organic substance

400–2000 kg/ha

(0 – 30 cm depth)

60–120 kg/ha

in microorganisms

Phosphorus in organic substance

Organic reserves: The organic matter of the soil is a perfect P-storage. This pool contains 30 to 75% of the total P but is currently completely ignored in routine agricultural analysis.

Phytin: Organically bound P is mostly in the form of phytin and cannot be absorbed by the roots. Phytin is not acid-soluble and can only be broken down by enzymes.

Mobilisation: Enzymes for splitting phytin are produced by microorganisms. Therefore, the promotion of biological activity also leads to a better supply of P from this pool!

Inorganic phosphorus

400–2500 kg/ha

(0 – 30 cm depth)

Inorganic phosphorus

Reserves: The inorganic P reserves were mainly increased sharply due to the fertilization strategy of the last 50 years. Much more P (~ 1300 kg / ha) was added than was carried away by the crop harvest!

Chemical bonding form: This pool is only available to a limited extent for plant nutrition since inorganic P is a poorly soluble triphosphate.

Mobilisation: By adjusting the pH_{KCl} value to 5.9 - 6.9, the availability of the triphosphates is increased. Plants such as buckwheat and white lupine can use strong acids to dissolve and absorb triphosphates. If the biomass remains in the field, the P is reintegrated into the cycle. Mycorrhiza also have a similar function.

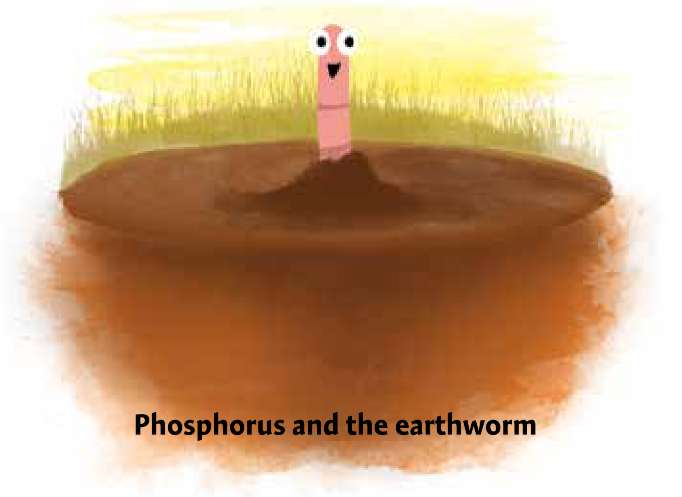
Phosphorus in rocks

0.03–0.12 %

Phosphorus in rocks

Minerals containing P: Parent rocks can contain minerals containing phosphorus (e.g. apatites). Through natural processes of soil formation and weathering, this P is converted into a soluble form. It can now be taken up by roots, sorbed on exchange surfaces or precipitated through the formation of triphosphates.

Soils: Soils developed on granite and gneiss, but also limestone-rich sediments have higher P contents than soils formed on sandy deposits.



Phosphorus and the earthworm

Digestion: The digestion of organic and mineral substances increases the availability of P compounds in the feces (due to microbiological processes and changes in the acidic environment of the stomach / intestines).

Drilling: Earthworm tunnels promote gas exchange and drain away rainwater. Airborne microorganisms can therefore continuously release P from organic compounds.

Mixing: By mixing organic and mineral substances, P is distributed in the soil profile, can be mobilized and taken up by plants.

Phosphorus fertilization

The P-fertilization is often applied sweepingly. This can shift the ratio of nutrients in the soil unilaterally and affect soil fertility.

Mineral P-fertilizers: Contain 7.9 to 22.7% P with a widely fluctuating availability. Soluble fractions increase the P concentration in the soil solution, other substances become blocked (see zinc deficiency in maize). P-fertilizers are subject to an aging process in the soil, the utilization is approx. 15%. The rest goes to the inorganic pool.

Organic P-fertilizers: In manure, compost, straw, etc., P is mainly bound in phytin. Phytin must first be split up by microorganisms so that roots can absorb P.

Conversion factors

$PO_4 = P \times 3.067$

$P = PO_4 \times 0.326$

$P_2O_5 = P \times 2.291$

$P = P_2O_5 \times 0.436$

$P_2O_5 = PO_4 \times 0.747$

$PO_4 = P_2O_5 \times 1.334$

P

Atomic weight: 30.97 g/mol **Charge:** 3-, 3+, 5+

Karner Düngerproduktion

Phosphorus Mobilisation

By using AKRA products, phosphorus can be mobilized from the various pools in the soil and therefore under normal conditions there is no need for fertilization.

www.duenger-akra.at

Ecological & Economical

AKRA Strategy

AKRA Kombi: The silicic acid mobilizes the sorbed phosphorus, which can then be absorbed by the roots.

DGC (Dolomite Gypsum Lime): Carbonates neutralize acids in the soil and create favorable pH conditions for soil life. Calcium stabilizes the aggregates in the soil, air and water balance improves. Calcium, magnesium and sulfur are important substances for plant nutrition. The phosphorus dynamic of the soil is promoted.

Megaterium Phosphaticum: The bacterium promotes the mobilization of organic P reserves, which make up 30 to 75% of the total phosphorus!