

Nutri-Facts

Agronomic information on nutrients for crops

Nutri-Facts #2

It's Essential — Phosphorus Is Required by Plants

THERE IS NO WAY AROUND IT: phosphorus (P) is essential for plant growth. The element P is present in every living cell, both plant and animal. No other nutrient can be substituted for it.

Phosphorus is one of the 16 essential nutrients that plants need for growth and reproduction. Phosphorus is considered one of the three major nutrients along with nitrogen (N) and potassium (K). They are termed major nutrients because of the relatively large amounts utilized by plants (**Table 1**) and the frequency with which their deficiencies limit plant growth.

Table 1. Phosphorus uptake by crops.

Crop	Yield level	P ₂ O ₅ taken up in total crop, lb
Alfalfa	8 tons	120
Coastal bermudagrass	8 tons	96
Corn	160 bu	90
Cotton	1,500 lb lint	63
Grain sorghum	8,000 lb	84
Oranges	540 cwt	55
Peanuts	4,000 lb	39
Rice	7,000 lb	60
Soybeans	60 bu	58
Tomatoes	40 tons	87
Wheat	60 bu	41

Note: To convert P₂O₅ to P, multiply by 0.434.

Phosphorus must be physically added to the soil to increase the supply available to plants. Phosphorus cannot be fixed from the atmosphere.

Phosphorus in Plants

Phosphorus is a vital component in the process of plants converting the sun's energy into food, fiber and oil. Phosphorus plays a key role in photosynthesis, the metabolism of sugars, energy storage and transfer, cell division, cell enlargement, and transfer of genetic information.

Phosphorus promotes early root formation and growth, promotes early shoot growth, hastens ground cover for erosion protection, affects the quality of fruit, vegetable and grain crops, and is vital to seed formation. Adequate P increases plant water use efficiency, improves use efficiency of other nutrients such as N, contributes to disease resistance in some plants, helps plants cope with cold temperatures and moisture stress, hastens plant maturity, and protects the environment through better plant growth.

Deficiency Symptoms

The first sign of a P shortage is an overall stunted plant. Leaf shapes may be distorted. With severe deficiency, dead areas may develop on leaves, fruit and stems. Older leaves are affected before younger ones because of the movement of P in the plant (mobility). Some plants, such as corn, may display a purple or reddish color on the lower leaves and stems. This condition is associated with accumulation of sugars in P-deficient plants, especially during times of low temperature. These effects combine to lower crop yields, crop quality, crop value and crop profitability.

Where Do Plants Get Phosphorus

Plants take up P from the soil, specifically from water in the soil. Only very small amounts of P are present in the soil water, however, and the supply must be continually replenished by P released from minerals and organic matter in the soil. Soil pH or acidity greatly influences the availability of P to plants and determines the forms that plants can utilize (**Figure 1**). All P is absorbed by plant roots as inorganic orthophosphate ions. Phosphorus in

soil organic matter is not available until soil microbes break the organic matter down into simple forms releasing inorganic phosphate ions.

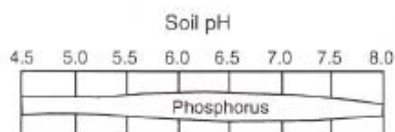


Figure 1. Effects of soil pH on P availability.

Factors that affect P availability to plants include the type and amount of clay minerals in soils, P levels in the soil, soil aeration, soil compaction, soil moisture content, temperature, soil pH, the availability of other essential plant nutrients, and the crop being produced.

Determining Plant Needs for Phosphorus

Soil and plant analysis can predict the need to supplement the soil's ability to provide P for plants.

Research has established the relationship between P levels in the soil and critical levels for optimum plant growth. Similarly, research has identified critical levels of P concentrations in plants which change with the stage of plant maturity.

If more P is being removed from

the soil than is being replaced, soil test levels and availability will decline over time. On the other hand, if more P is supplied than is removed, soil test levels and availability will increase.

Meeting Plant Needs for Phosphorus

Phosphorus must be added to the soil as commercial fertilizers, animal wastes, sewage sludge, crop residues or other by-products. Phosphorus recycling of wastes of all types has been practiced for centuries, but demands for supplemental sources of P outstrip these supplies.

The P fertilizer industry was developed to provide for that need and to provide readily available forms of P which can be easily transported and applied. Several procedures are used to convert mined phosphate rock into usable fertilizers. The final product may be a dry granular material or a liquid.

Some soils react readily with P fertilizers, reducing their availability to plants (fixation). Those conditions can be offset by applying P fairly close to the time of crop utilization or applying fertilizer in concentrated bands which diminish these reactions. Environmental stress

conditions which depress P availability to plants can be countered by placement of P close to the seed of crop plants (starter fertilization)... even when soil availability is high.

Crop Response to Phosphorus

Phosphorus fertilization increases yields and increases farmer profits.

Data in **Table 2** illustrate the importance of P for increasing crop yields, improving N use efficiency, lowering production costs per unit, and increasing crop profitability.

Table 2. Adequate P increases wheat yields, improves N use efficiency, lowers production costs per bushel, and improves crop profits.

N	P ₂ O ₅	Yield,	N use	Pro-	Net
-lb/A-	-lb/A-	bu/A	efficiency,	duction	profits,
			bu/lb N	\$/bu	\$/A
75	0	35	0.47	3.91	-14.30
75	20	51	0.68	2.84	33.66
75	30	56	0.75	2.64	48.16
75	40	61	0.81	2.49	61.61
75	50	64	0.85	2.42	69.12

Soil test P, low; P₂O₅, \$0.22/lb;
Wheat, \$3.50/bu

There's no doubt about it — phosphorus is essential. ■

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