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Phosphorus

Roles of phosphorus in plants

Phosphorus (P) is essential for plant growth. No other nutrient can be substituted for it. The plant must have phosphorus to complete its normal production cycle. The amounts of phosphorus taken up from the soil by some crop and pasture species are shown in **Appendix 1**.

Plants absorb most of their phosphorus as the primary orthophosphate ion (H_2PO_4^-). Smaller amounts of the secondary orthophosphate ion (HPO_4^{2-}) are taken up. When the text refers to soil solution phosphorus or available P, it means these two phosphate ions. Soil pH greatly influences the ratio of these two ions taken up by the plant. Other forms of phosphorus may also be used, but in much smaller quantities than the orthophosphates. The highest concentration of phosphorus in young plants is found in tissue at the growing point, and since it moves readily from older to newer tissue, deficiencies of phosphorus first appear on the lower parts of plants. As plants mature, most of the phosphorus in the plant moves into the seeds and/or fruits (see **Table 4.1**).

Phosphorus plays a role in photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement and several other processes in the living plant. It promotes early root formation and growth. Phosphorus improves the quality of fruit, vegetable and grain crops, is vital to seed formation and is involved in the transfer of hereditary traits from one generation to the next.

In annual crops, it is particularly important that their roots have access to readily available phosphorus in the early stages of crop development. Phosphorus helps roots and seedlings develop more rapidly and improves cold tolerance. It increases water use efficiency, contributes to disease resistance in some

Table 4.1 P content of plant parts. Seed contains more phosphorus than other parts of the plant.

Crop	Plant part	Yield t/ha	P content %
Maize	Grain	9.4	0.26
	Stover		0.17
Cotton	Seed	2.2	0.60
	Stalks		0.24
Peanuts	Pods	4.5	0.35
	Vines		0.26
Rice	Grain	6.7	0.29
	Straw		0.09
Soybean	Grain	3.4	0.62
	Straw		0.18
Wheat	Grain	4.0	0.31
	Straw		0.12
Lupin	Grain	2.2	0.30
	Straw		na
Canola	Grain	3.0	0.50
	Stalks		na

Note: Phosphorus content of seed/grain will vary with a number of factors such as season, variety and soil fertility.

plants and hastens maturity, and is important to harvest yield and crop quality. **Table 4.2** shows declining yields for P applications over 40 kg/ha.

Table 4.2 Yield response and grain moisture with P applied.

P applied kg/ha	Yield t/ha	Grain moisture %
0	6.2	31.8
20	8.2	27.8
40	8.8	27.0
60	8.5	26.9
80	8.7	26.5

(Illinois, USA)

An important aspect of soil phosphorus fertility is its influence on uptake of phosphorus by plants during periods of moisture stress. **Figure 4.1** shows that the uptake of phosphorus by maize seedlings is reduced