Phosphorus

Second to nitrogen, phosphorus (P) is typically the next most yield limiting nutrient for corn production in Colorado. However, the amounts of P necessary for optimal production are two to five times lower than N. Phosphorus availability is strongly affected by soil pH and often is limited by Colorado's alkaline (high pH) soils.

P transformations

- Most P in soil is unavailable for plant uptake (less than 1% available).
- 85% of P is in mineral form (less than 1% of this is available).
- 15% P is in organic form (40-50% available).
- Maximum P availability is at pH 6.2 (slightly acidic).
- Most Colorado soils greater than 7.0 pH.
- High pH soil will fix applied P and naturally occurring P, making it unavailable to plants.

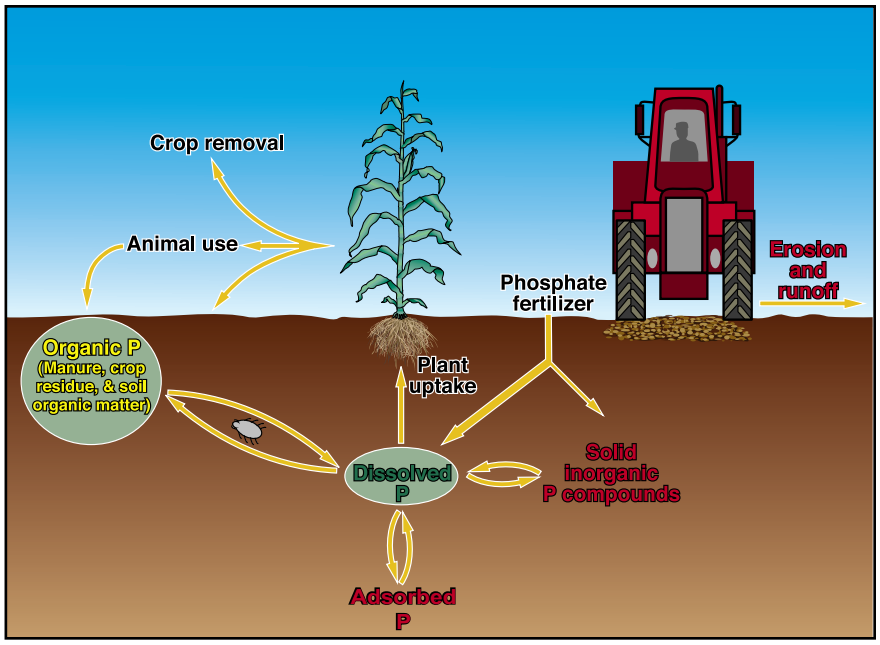


Figure 20. The phosphorus cycle in soils.

Phosphorus in corn

- Plant energy transformations
- P is available to plants as $H_2PO_4^-$ and HPO_4^{2-}
- P is mobile within the plant, but immobile in soil
- Corn removes 0.16 lb P/bu and 4 lb/ton of silage

Phosphorus deficiency in corn. Symptoms appear as leaf purpling, particularly along leaf edges of young plants, slower growth and stunted plants.

Photo California Fertilizer Association

BMP

Divide large, non-uniform fields into smaller fertility management units based upon yield potential or soil type and fertilize according to P levels determined through soil analysis.

Incorporate surface applied P fertilizer or manures into the soil where any potential for surface runoff or erosion exists.

Maintain a buffer (where fertilizer and manure is not applied) a safe distance from surface water and drainage channels.

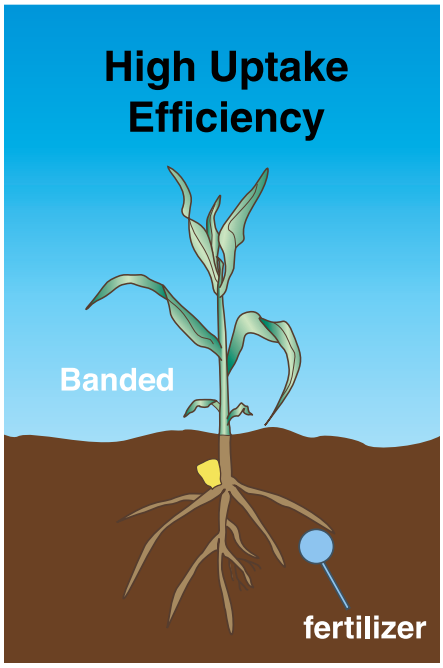
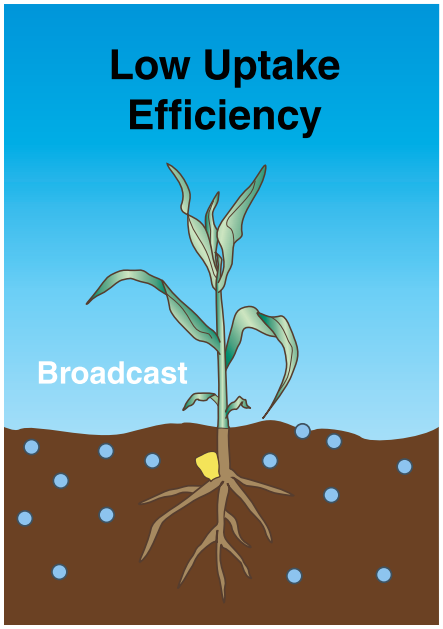


Figure 21. Banding phosphorus fertilizer (above) is more efficient than broadcast (below) applications. When banded, less P is lost to fixation in high pH soils or becomes available for runoff.

Because P is immobile in soils, young corn plants with limited root systems often show deficiency, especially in cool, wet soil. Therefore, placement near the roots ensures maximum uptake. Subsurface band placement is also critical for no-till situations.



Phosphorus Rate and Placement

Table 12 provides phosphorus fertilizer application rates for two soil test procedures (AB-DTPA and $NaHCO_3$) performed on neutral to high pH soils. Other extraction methods (Mehlich & Bray) are better suited for neutral to acidic soils and are used by some commercial laboratories.

The relative levels provided in Table 12 are based upon the probability of a yield increase to P fertilization. Low testing soils have a high probability that P fertilizer will produce higher yields, but the probability decreases rapidly as soil test P increases. However, a band application of 10 to 20 lbs P_2O_5/acre with 5 to 10 lbs N/acre may increase early growth of corn plants on some high testing soils, but may not result in a yield increase.

Table 12. Suggested phosphorus application rates for irrigated and dryland corn. For more precise rates, use the equations below. Notice that rates can be reduced by half through band application.

	----------Relative Soil P Level----------			
Soil Test Method	Low	Medium	High	Very High
	--------ppm P in top 12" of soil--------			
AB-DTPA*	0-3	4-7	8-11	>11
$NaHCO_3$**	0-6	7-14	15-22	>22
Bray P-1+	0-5	5-15	11-30	>30
Mehlich-3++	0-10	11-31	31-56	>56
Application Method	---------Fertilizer Rate (lbs P_2O_5/A)---------			
Banded	40	20	0	0
Broadcast	80	40	0	0

*Ammonium bicarbonate (DTPA) extraction for basic calcareous soils
P rate (banded, lb P_2O_5/A) = 48 – 5x (AB-DTPA-P)
**Sodium bicarbonate (Olsen's) extraction for basic calcareous soils
P rate (banded, lb P_2O_5/A) = 48 – 2.5x ($NaHCO_3$-P)
+Bray & Kurtz P-1 for acid and neutral soils, recommendation source: University of Nebraska, NebGuide G74-174-A
++Mehlich extraction for acid and neutral soils. Soil P level source: Servi-Tech Labs