

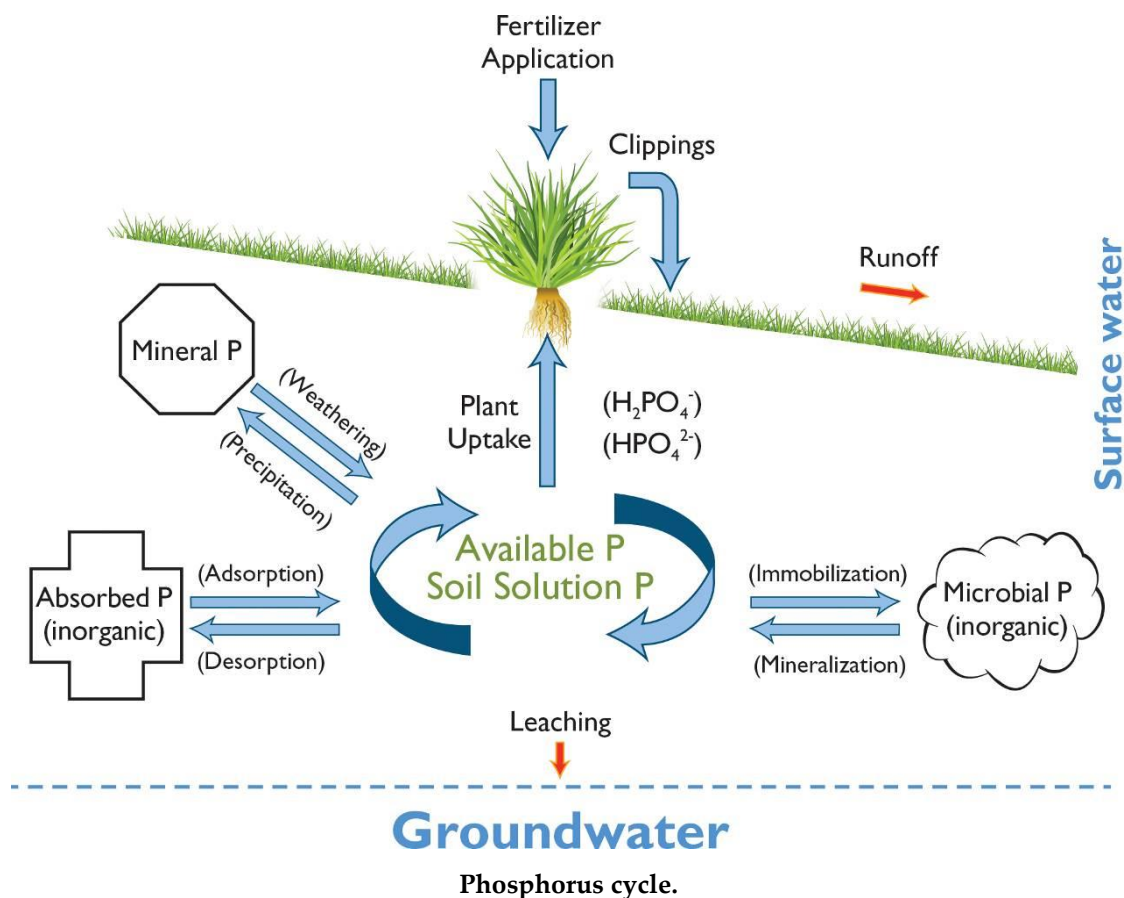


# Best Management Practices for New York State Golf Courses

## Phosphorus and Phosphorus Fertilizers

Phosphorus is a critical nutrient for turfgrass growth and development, playing important roles in energy transformations in plant cells and root development. Therefore, P enhances turfgrass establishment and is the most important nutrient in 'starter fertilizers'. On soils low in P, most of the enhanced establishment is from the N. Phosphorus management is focused on maximizing plant response to supplemental phosphorus, when required as based on soil test results, while minimizing offsite movement.

In the soil, P is generally in complex with other elements and is an insoluble (plant unavailable) nutrient. Phosphorus is slowly made available to plants on an 'as needed' basis by chemical reactions in the soil that convert it to either of two anionic forms, dihydrogen phosphate ( $\text{H}_2\text{PO}_4^-$ )-or hydrogen phosphate ( $\text{HPO}_4^{2-}$ ).



A soil is considered to have a phosphorus deficiency if it is at or below the medium sufficiency level. Research has often found that turfgrass shows signs of distress at P levels of 5 to 11 ppm (Mehlich III),

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a range considered Low or Very Low. The medium sufficiency ratings for each test method are shown in the table below.

## Medium sufficiency levels by test method.

Source: <http://nmssp.cals.cornell.edu/software/Morganequiv7.xls>

Test Method / Extractant	Medium Sufficiency	
	ppm	lbs/acre
Mehlich-3	26-54	52-108
Bray P1	15-30	30-60
Olsen	12-28	24-56
Morgan (for agronomic crops)	10-20	20-40
Modified Morgan/Cornell (for turf)	< 2	1-4

Testing labs provide recommendations for the amount of phosphorus fertilizer needed to correct the deficiency. Recommendations are made separately for fertilizing established turfgrass or for pre-plant fertilization to establish a new stand of turf with either seeded or sodded turfgrass.

## Phosphorus fertilizer recommendations for turfgrass (Petrovic 2012)

Established Turfgrass	Current Recommendations		P <sub>2</sub> O <sub>5</sub> Recommended lbs/acre
	Morgan lbs/acre	Mehlich-3 lbs/acre	
Low	< 1	< 3	80
Medium	≥ 1	≥ 3	40
High	> 4	> 12	0
Newly Seeded or Sodded Turfgrass	< 1	< 3	140
	≥ 1	≥ 3	100
	≥ 4	≥ 12	60
	≥ 8	≥ 24	40

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## Phosphorus Fertilizers

Phosphorus fertilizers are processed from rock phosphate mined from apatite mineral deposits around the world. The processing increases the availability of reactive and water-soluble P content. Many products formulations are available. The P content of any fertilizer is listed in the N-P-K ratio on the label as the percent  $P_2O_5$ .

Water solubility is a measure of the fertilizer's ability to dissolve into the soil solution. Some of the water-insoluble fraction of the fertilizer P can be extracted by citric acid. The remaining P is citric insoluble and remains in the soil until soil processes mineralize the insoluble P. The water soluble fraction and the citric acid soluble fraction comprise the total plant available P. The formulas to convert these factors are based on the molecular weight:

$$\%P = \% P_2O_5 \times 0.43$$

$$\% P_2O_5 = \%P \times 2.29$$

Using a higher solubility fertilizer, while perhaps best for the plant, increases the risk of leaching or runoff contamination. Phosphorus fertilizers are listed in the table below with the corresponding fraction of Total Plant Available P (water soluble and citric soluble fractions).

Phosphate fertilizers (Tisdale, 1993; Turgeon, 1985)

Fertilizer	%N	% $P_2O_5$	%P	% Total P Available	Cold Water Solubility (g/L)	Salt Index
Rock Phosphate	---	27-41	12-18	14-65	---	---
Single Superphosphate	---	16-22	7-9.5	97-100	20	0.4
Triple Superphosphate	---	44-52	17-23	97-100	40	0.2
Monoammonium phosphate (MAP)	11-13	48-55	21-24	100	230	2.7
Diammonium phosphate (DAP)	18-21	46-53	20-23	100	430	1.7
Ammonium polyphosphate	10-15	34-37	15-16	100	---	---
Urea ammonium phosphate	28	27	12	100	---	---
Nitric phosphates	14-28	14-28	6-10	80-100	---	---
Potassium phosphates	---	41-51	17-22	100	---	---
Sewer Sludge	4	6	0	0	---	---