

# Phosphorus Recommendations

Though phosphorus is not needed in large quantities like nitrogen and potassium, it is vital to growth and is easily depleted. To prevent depletion and lower yields, you must first know the current phosphorus levels in the field and the optimum levels for the intended crop. The chart below shows some general guidelines for phosphorus fertility ratings.

Low Fertility		Optimum Fertility		High Fertility	
15	20	25	30	35	40
Phosphorus ppm					

## Phosphorus Fertility Ratings

In general, 25 to 35 ppm is an optimum range for most crops. However, this range can be shifted up or down depending on the crop value, yield potential, and field/crop management practices.

Once you have determined the optimum range and know the current phosphorus values for the field, you have three treatment options:

- If current levels indicate low fertility, apply phosphorus at a greater rate than what the crop will remove to build phosphorus soil-test levels over time.
- If current levels indicate optimum fertility, apply phosphorus to compensate for the amount of phosphorus that will be removed during harvest.
- If current levels indicate high fertility, apply phosphorus at a rate less than what the crop is removing; this number could be as low as zero.

In each of these scenarios, the amount of phosphorus fertilizer that is needed is based on how much phosphorus is removed during harvest.

## Phosphorus Crop-Removal Rates

A large percentage of the phosphorus used for plant growth is removed with the crop during harvest. For example, 75 percent of the phosphorus taken up by corn is put directly into the grain. When the grain is harvested and hauled off the land, the loss of phosphorus from the soil can be significant. In fact, for every bushel of corn produced, 0.41 pounds of phosphorus is lost from the soil. If you have a yield of 200 bushels, that's a total loss of 82 pounds of phosphorus per acre (200 x 0.41). In the table below, you can find the average crop-removal rates for various crops.

Average Phosphorus Crop Removal Rates

Crop	Unit	Pounds of Phosphorus Removal per unit
Corn (grain)	bushel	0.41
Corn (silage)	ton	3.40
Soybeans	bushel	0.80
Wheat	bushel	0.65
Sorghum	bushel	0.48
Barley	bushel	0.46
Sugar Beets	ton	2.55
Alfalfa	ton	10.50

To prevent depletion of soil phosphorus reserves, the phosphorus must be replenished. Going back to our corn example, with a loss due to crop removal of 82 pounds of phosphorus per acre, it would seem that an annual application rate of 82 pounds of P<sub>2</sub>O<sub>5</sub> per acre would maintain current soil fertility levels. Unfortunately, it's not quite that easy.

As you may know from experience, crops depend primarily upon preexisting phosphorus reserves for their phosphorus needs. On average, 85 percent of the phosphorus used by the crop comes from the phosphorus reserves in the soil; the other 15 percent comes from the phosphorus fertilizer that you apply. Remember the field that produced 200 bushels of corn? Of the 82 pounds of phosphorus removed by that crop, 69.7 pounds (85 percent of 82) came from the soil, and 12.3 pounds (15 percent of 82) came from the fertilizer. Therefore, when phosphorus levels are in the low fertility range described earlier, it is important to build phosphorus soil-test levels over time.

## Building Soil-Test Levels

In order to build soil-test levels, you need to know your current level, your target level, and how long you want to take to reach that target. AgSource Laboratories uses a nine-year time frame to build soil-test levels and recommends a target level of 25 ppm using a Bray or Mehlich test. On average, it takes 18 pounds of  $P_2O_5$  to increase the Bray soil test one ppm. For example, if your Bray soil test reveals a phosphorus level of 12 ppm, you would want to increase that level by an additional 13 ppm. Thus, to reach the target level of 25 ppm, it would take 234 pounds of  $P_2O_5$  ( $13 \text{ ppm} \times 18 \text{ pounds/ppm} = 234 \text{ pounds}$ ). Using the nine-year time frame, you would apply 26 pounds of  $P_2O_5$  per acre per year.

## Using Phosphorus Fertilizer Efficiently

Though it's typical for a crop to use only 15 percent of the phosphorus fertilizer, there are some ways to improve your odds.

- **Band vs. Broadcast** – Research shows banding can be twice as effective as broadcasting on low-testing soils. On average, crops use 15 percent of broadcast phosphorus and 30 percent of banded. If you are in a reduced-tillage situation and must broadcast, knifing in fertilizer will help the crops utilize the phosphorus.
- **Spring vs. Fall** – As with all fertilizer, spring application is more effective than fall. Crops use phosphorus 10 percent more efficiently when it's applied in spring, closer to the time of uptake.
- **Soil pH** – Soil pH affects the amount of phosphorus fixation. Thus, liming soils so that soil pH is close to neutral (pH 6.5) increases the effectiveness of the phosphorus fertilizer. Acidifying the pH of alkaline soils, on the other hand, is cost prohibitive unless you're growing a high-value, specialty crop.

## Conclusion

Low phosphorus levels can sneak up on you, so remember to do these three things:

- 1 If phosphorus soil-test levels are in the optimum fertility range, apply replacement fertilizer.
- 2 If phosphorus soil-test levels indicate low fertility, apply replacement fertilizer and build soil-test levels over time.
- 3 Use phosphorus efficiently.