



Starter Phosphorus Fertilizer for Corn

Importance of phosphorus for corn

Phosphorus (P) is a macronutrient belonging to the group of 17 nutrients that are essential for plant growth and crop production. In plants, P plays a critical role in photosynthesis, respiration, N fixation, root development, maturation, flowering, fruiting, and seed production. A P deficiency can curb plant growth, delay maturity, and reduce crop yield. Because P is mobile in the plant, deficiency symptoms are expressed in the older leaves. In corn and some other grass species, P deficiency symptoms can be recognized by a purple discoloration of the leaves or leaf edges (Figure 1) although some corn varieties exhibit similar symptoms when stressed.



Figure 1: Phosphorus deficiency in corn is recognized by purple discoloration of leaves or leaf edges for corn plants.

An excess of P in the soil can increase the risk of P runoff and leaching (environmental concerns). In addition, high P availability can induce Zn deficiency in soils that are marginally Zn deficient.

As many other nutrients, P is in its most available form when the pH of the soil is between 6 and 7 (see Agronomy Fact Sheet 5: Soil pH). At lower pH, various forms of iron, aluminum, and manganese fix P, making it less

available for plant uptake. At high pH, P is mostly fixed in calcium phosphate forms. Thus, it is important to maintain optimum pH levels.

Soil testing for phosphorus

Phosphorus fertilizer guidelines are based on agronomic soil tests. These soil test results do not reflect the total amount of plant available P, but give an indication of P availability. Soil test results can help us determine which nutrient is limiting crop yields and together with field trial data, how much fertilizer needs to be added for optimum yield. Yield benefits from an applied nutrient are greatest for soils with a low agronomic soil test for that particular nutrient. Little to no yield response is expected for soils testing high to very high. For further information on soil sampling, see Agronomy Fact Sheet 1 (Soil Sampling for Field Crops).

Phosphorus soil test interpretations

Cornell's P guidelines for New York are based on the soil P level extracted with the Morgan solution (sodium acetate). If soil tests are conducted at a laboratory other than Cornell University's Nutrient Analysis Laboratory (CNAL), a Cornell Morgan equivalent needs to be determined (for more information see Agronomy Fact Sheet 15: Phosphorus Soil Testing Methods). The soil test report rates soil test P levels of <1 lb P/acre (Morgan extractable P) as "Very low", 1-3 lbs P/acre as "Low", and 4-8 lbs P/acre as "Medium". Soil test levels of 9-39 and ≥40 lbs P/acre are classified as "High" and "Very High" (Table 1).

Table 1: Classification of phosphorus status using the Cornell Morgan soil test.

Cornell Morgan Test P	Classification*	Chance of an economic crop response from added P
<1	Very Low	Very High
1-3	Low	High
4-8	Medium	Medium
9-39	High	Low
≥40	Very High	Very Low

*Cornell P test classifications differ for winter grains (high is 9-20 and very high is ≥20 lbs P/acre).

Once a soil tests high in P, minimal P fertilizer is required to support optimum yields. For corn (and most other field crops), Cornell guidelines suggest limited fertilizer additions to fields with soil test P levels of 40 or higher for two reasons: 1) P addition to these soils is not likely to result in yield gains (and hence a poor investment); and 2) continued enrichment may increase P losses to surface and ground waters and as a result contribute to environmental degradation.

The P guidelines for soils with STP levels less than 50 lbs/acre are presented in Figure 2. The solid line is the "average" recommended fertilizer P application. The dashed lines imply that recommendations are ranges rather than absolute values. Practical guidelines on farms, given that the use of more than 2 blends may not be feasible, are given in Table 2.

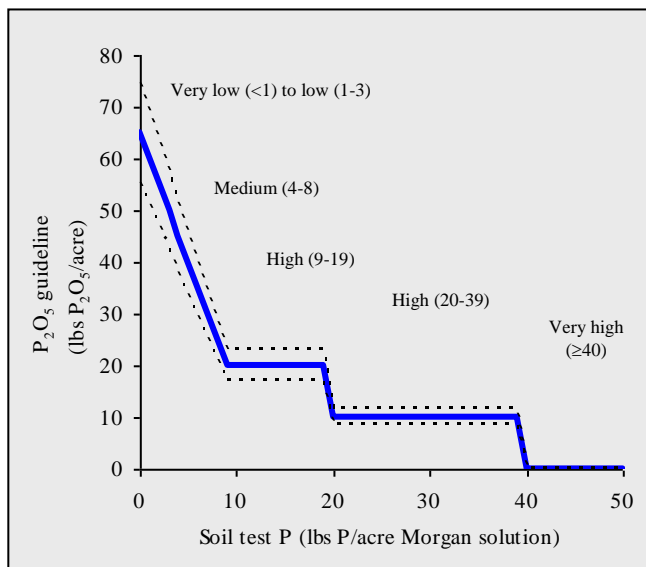


Figure 2: Cornell guidelines for P application for corn.

Table 2: Practical phosphorus guidelines for corn in NY.

Soil Test P	lbs P ₂ O ₅ /acre	
	With manure ¹	Without manure ²
Very Low	20-30	60-70
Low	20-30	50-60
Medium	20-30	25-50
High	0	less than 25
Very High	0	0

¹ Assumes an application of 10 tons manure/acre.

² Put 25 lbs P₂O₅/acre in the starter fertilizer band; balance may be included in the band or broadcast.

Fertilizer blends

Fertilizer guidelines are expressed in lbs of P₂O₅ per acre. A fertilizer blend characterized as "10-20-20" contains 10% N, 20% P₂O₅ and 20% K₂O on a weight basis. If we apply 200

lbs/acre of this fertilizer to a field, the actual application will be 20 lbs of N (200*10%), 40 lbs of P₂O₅ (200*20%), and 40 lbs of K₂O (200*20%) per acre.

Fertilizer or manure?

Manure is an excellent source of phosphorus (and other nutrients) for fields that test low or medium in P. However, losses off the fields need to be minimized because P is often the most limiting nutrient for the growth of aquatic plants in freshwater lakes and streams. Too much P in the water can cause eutrophication, resulting in oxygen deficiency and fish kills, so careful application of fertilizer and manure is advised to prevent P from being transported to surface waters. For P requirements of 25 lbs P₂O₅/acre or less, the guideline is to meet the requirement by banding (2 inches below and 2 inches besides the seed) the P as starter fertilizer. For higher application rates and where manure is available, target 25 lbs P₂O₅/acre in the fertilizer band at planting and supply the rest with manure.

Additional resources

- Cornell Guide for Integrated Field Crop Management: <http://ipmqguidelines.org/FieldCrops/>.
- Cornell Agronomy Fact Sheet #1 (Soil Sampling for Field Crops) and #5 (Soil pH for Field Crops): nmsp.cals.cornell.edu/guidelines/factsheets.html.
- Cornell Nutrient Guidelines for Field Crops: nmsp.cals.cornell.edu/guidelines/nutrientguide.html.
- Cornell Nutrient Analysis Laboratory: www.css.cornell.edu/soiltest/.

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information



Cornell University
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