



Phosphorus Sources for Field Crops

Introduction

Phosphorus (P) is one of six macronutrients essential for plant growth. To manage P for optimal crop production, it is important to determine the right form to use, to apply it at the right rate, at the right time, and using the right method. This is known as the “4R Nutrient Stewardship approach” in the fertilizer industry. The first commercial P mineral fertilizer was single superphosphate (SSP), followed by triple superphosphate (TSP). Both fertilizers are excellent P sources but their use declined when other P fertilizers became available. This fact sheet covers the most common P fertilizers used in New York.

Plant Available Phosphorus

Both the liquid and granular sources of fertilizer listed in Table 1 provide the same inorganic forms of P: $H_2PO_4^-$ or HPO_4^{2-} . These two forms are commonly referred to as orthophosphate and are the form of P that is used by most crops. The choice of P fertilizer source depends on economics, equipment availability or farmer preference, and local fertilizer supply. The source of P makes no difference to plants.

Monoammonium Phosphate (MAP)

Monoammonium phosphate is a common granular fertilizer with a high P content (48-61% P_2O_5) that also contains nitrogen (N). It has an N content of 10 to 12% and an acidic pH that ranges from 4.0 to 4.5. The most common blend is 11-52-0 (11% N, 52% P_2O_5 , and no K_2O).

Monoammonium phosphate is water soluble and rapidly releases both N and P to the soil solution in moist soils. Its acidic nature limits N volatilization. Monoammonium phosphate is a good starter fertilizer because it does not injure seedlings. It can also be broadcast applied with or without tillage-based incorporation. Additionally, it can be dissolved in water for foliar application. Foliar MAP should not be mixed with magnesium or calcium containing fertilizers to avoid precipitation.

Table 1: Common phosphorus (P) containing fertilizer materials and their characteristics.

Fertilizer	Pro	Cons
Monoammonium phosphate (MAP) 11-52-0	<ul style="list-style-type: none"> • High P content • Rapid release • Liquid or granular • Good starter fertilizer • Low pH-(4.0-4.5) limits volatilization 	<ul style="list-style-type: none"> • Cannot be mixed with calcium or magnesium fertilizers in foliar sprays • Acidifying
Diammonium phosphate (DAP) 18-46-0	<ul style="list-style-type: none"> • Higher N content than MAP • Fast release 	<ul style="list-style-type: none"> • Can damage seedlings if used as starter fertilizer
Polyphosphate: 10-34-0 or 11-37-0	<ul style="list-style-type: none"> • Liquid • Can be mixed with other fertilizers • Rapid and slow release P 	<ul style="list-style-type: none"> • Specialized equipment and storage required (pumps and tanks) • Temperature and moisture impact timing of release
Manure or compost N-P-K varies	<ul style="list-style-type: none"> • Can be produced on farm • Can replace synthetic fertilizers • Can be used in organic production 	<ul style="list-style-type: none"> • Most sources are not nutrient dense (poultry litter is an exception) • P content varies • Can lead to high soil P levels when applied to meet N needs • Long distance hauling is expensive
Phosphate rock	<ul style="list-style-type: none"> • Can be used in organic production 	<ul style="list-style-type: none"> • Low P content • Very slow release • High cost

Diammonium Phosphate (DAP)

Diammonium phosphate contains 18% N, 46% P_2O_5 , and has a pH of 7.5 to 8. Like MAP, DAP is both an N and P source, but it contains about 60% more N than MAP. It is easy to store and handle and its high nutrient content helps reduce handling and application costs per unit of nutrient. However in contrast to MAP, DAP is not the best choice as starter fertilizer. If DAP is used as a banded starter fertilizer, its

application rate should be limited to no more than 30 lbs/acre actual N from urea and/or DAP. The initial soil reaction after application of DAP can produce free NH_3 , which can cause seedling injury. Fertilizer companies rarely keep large quantities of DAP in stock so DAP can be harder to find than MAP or polyphosphate.

Polyphosphate

Polyphosphate is a liquid source of P. Liquid fertilizers offer convenience and ease of handling over dry materials. Liquid fertilizers allow mixing to meet the needs of the crop. For polyphosphate, the most common addition is K. The level of added K needs to be monitored closely for nutrients settling to the bottom of the container in solid form ("salting out"). The most common compositions of polyphosphate are 10-34-0 (pH of 5.9; density of 11.6 lbs/gallon) and 11-37-0 (pH of 6.1; density of 11.9 lbs/gallon).

Polyphosphate fertilizers contain two forms of P. Orthophosphate is readily available to crops while polyphosphate has to be broken down first before conversion to orthophosphate can take place. Typically, at least 50% of the polyphosphates are converted within 1-2 weeks. Polyphosphate is broken down by soil microbes that favor warm, moist soil conditions.

Manure

A portion of the P in manure is in organic form and not readily soluble. However, there is also a portion that is orthophosphate and is thus readily available to crops. The P content of a manure source varies depending on animal species, diet and the handling and storage of the manure. Manure testing is recommended to determine the P content of the manure.

Manure should be carefully managed as it contains many other macronutrients and micronutrients as well. Applying manure as the main source of N for crops like corn may result in a P (and K) application in excess of crop removal. Rotating the fields that receive manure to a crop that does not require N (such as alfalfa) provides a way to draw down soil test P levels over time without the need for fertilizer or additional manure.

When injected or incorporated directly after application in the spring, nitrogen (N) loss to the air can be reduced, allowing for reduced manure application rates that are more in line with rates that equate crop removal for P.

Organic Phosphorus Options

Phosphate rock is a low-P material that is permitted for use by many organic farming certification agencies. It is unprocessed rock that releases P very slowly, sometimes over a period of many years. Phosphate rock is also a difficult fertilizer to obtain. It has to be trucked in because fertilizer companies do, typically, not have it in stock. As a result, the purchase cost of rock phosphate can be high. Because of the slow release of P from rock phosphate, advanced application is necessary. Finer grinds of the rock will have a greater speed of release.

Manure and compost are also P containing sources that are permitted for use by organic certification agencies. Compost can be made on the farm or purchased from other farms. Long-term application of compost at rates that approach the N needs of crops will increase soil test P levels over time. Regular soil testing is recommended to avoid buildup of soil test P to excessive levels.

Summary

There are many options for P fertilizer. Independent of fertilizer source, all plants take up P in the same form, as orthophosphates. The fertilizer source to use to address a potential P deficiency will depend on the crop production system, the nutrient needs of the crops, grower preferences, and equipment available at the farm for transport and application of the fertilizer.

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
Cooperative Extension**

Nutrient Management Spear Program
<http://nmssp.cals.cornell.edu>

Ethan Robertson, Quirine Ketterings, Mike Hunter,
Karl Czymmek, and Tom Kilcer

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