IPNI Plant Nutrition TODAY
Better Crops, Better Environment...through Science

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PHOSPHORUS FERTILIZER SOURCES

Questions are sometimes asked about the effectiveness, composition, and plant availability of various phosphorus (P) fertilizer sources. Questions such as, "Is liquid more available to the crop than dry P fertilizer? Is one source better than another in alkaline soils? Can the optimum P rate be reduced with certain sources?" are not uncommon. A simple review of the fundamentals of P fertilizer sources can help address such questions.

Practically all inorganic P fertilizers come from phosphate rock (PR) which is a naturally occurring sedimentary rock composed largely of calcium phosphate minerals called apatite. Most conventional commercial P fertilizers are made by reacting PR with sulfuric acid to produce phosphoric acid (green or wet process acid). The phosphoric acid is further reacted with ammonia (ammoniation) to produce ammonium phosphate fertilizers such as diammonium and monoammonium phosphate (DAP and MAP). Production of ammonium polyphosphate fertilizer (APP) requires dehydration and polymerization of phosphoric acid prior to ammoniation.

The most common commercially available inorganic P fertilizers are DAP, MAP, and APP. These sources have the advantage of high water solubility (≥90%) and high plant food content. DAP and MAP are both ammonium orthophosphates. Orthophosphate is the form of P that is absorbed by plant roots, so after these granular materials have dissolved, their P is available for crop uptake. Although both of these sources perform similarly on a "per unit P" basis, there are differences worth noting. An important difference is in the potential for ammonia production when placing P in the seed furrow. In-furrow DAP has somewhat greater potential for seedling ammonia damage than does MAP, especially in alkaline and/or calcareous soils. Therefore, in-furrow recommendations for MAP are generally more lenient than for DAP. Another difference between the two sources is the pH of the initial soil reaction-- with DAP it is about 8.5, whereas with MAP it is 3.5. There have been some reports of improved crop response with MAP compared to DAP on calcareous and high pH soils, but most agronomists agree that there is generally little practical difference in the performance of these two sources.

The term polyphosphate refers to two or more orthophosphate ions combined together. This polymerization is accomplished by the dehydration of phosphoric acid. Liquid APP fertilizers are produced by ammoniation of polyphosphates. Before plants can utilize polyphosphate it must be converted to orthophosphate via a hydrolysis reaction. This conversion occurs rapidly enough in soils that it does not affect the value of APP as a P source. One unique and advantageous characteristic of APP is its chelating or sequestering ability. Relatively high concentrations of micronutrients can be maintained in APP solution through sequestration.

When selecting a P fertilizer source keep in mind that i) it is generally accepted that 80% water solubility is sufficient for most crops; ii) common P fertilizer sources perform similarly when equal rates are applied and method of application is comparable; iii) except where P fertilizer is to be placed with seed, the source that is the best will usually be determined by factors such as product availability, preference, dealer service, and price.

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