BACK PADDOCK SoilMate

Which fertilizer? MAP or DAP?

Chris Dowling
Back Paddock Company

The relative merits of different phosphorus fertilizers for winter crops can be easily misunderstood. Most confusion surrounds monoammonium phosphate (MAP) and diammonium phosphate (DAP), especially when technical information is used to promote one of these fertilizers over the other.

Sales pitches of the benefits of MAP and DAP tend to focus on their different pH of dissolutions. pH of dissolution refers to the pH of the solution in and immediately around fertilizer granules. The pH (water) of dissolutions for MAP and DAP are approximately 4 to 5 and 7 to 8 respectively (http://frec.cropsci.illinois.edu/1990/report7/index.htm).

Any theoretical benefits of MAP or DAP based on different pH of dissolution are rarely transferred to consistent performance in the field. At best, only small differences in phosphorus efficiency have been measured across most experimental conditions and crops. The exception is highly calcareous soils where it is now widely recognized that acidic phosphorus sources from MAP generally out performs phosphorus from DAP .

In the field it tends to be other differences in chemical and physical properties that determine whether MAP or DAP produces the better plant response in any given set of conditions. The key property differences are:

- nitrogen content: usually 10 to 11% for MAP and 18% for DAP.
- salt index: compares the increase in osmotic potential brought about by addition of a fertilizer compared to the increase when an equivalent weight of sodium nitrate is added to water. Depending on source, the salt index for MAP is normally about 30 and DAP is more salty at about 34 but at similar product rates the difference is negligible.
- potential to cause ammonia toxicity: primarily related to ammonium concentration, pH of the reaction product with the soil solution and product solubility. High ammonium concentration, high pH and high product solubility can all create conditions in the area of application that are favorable for the generation and maintenance of concentrations of ammonia that are toxic to germinating seeds.
- product solubility: an important characteristic, not only in relation to nutrient availability to plants, but also on the rate of chemical reactions that can be detrimental to plants. Higher solubility increases salt index and potential for ammonia toxicity. The solubility (at 20^{o}C) of MAP is approximately 35 to 40 kg/100L while DAP is 65 to 70 kg/100L (National Fertiliser Solutions Association: Liquids Manual 1986)

Differences between MAP and DAP are smallest and mostly nonexistent when the fertilizers are broadcast and incorporated into the soil, and when they are drilled preplanting into neutral to acid soils. However because DAP contains about twice as much ammonium-nitrogen as MAP, and because its pH of dissolution is more alkaline than MAP, DAP has greater potential for nitrogen loss through ammonia volatilization when broadcast onto neutral to alkaline soils. Nitrogen losses from DAP can be 0 – 20% higher than MAP when broadcast on neutral to alkaline soils.

Differences in the key properties listed above are much more important when MAP and DAP are applied with or near the seed, or in close contact with living plants.

Applied at the same rate, DAP is more likely than MAP to reduce germination and restrict root growth through ammonia toxicity because of its higher potential to release free ammonia. In laboratory conditions, release of free ammonia from DAP has been measured as 300% higher than from MAP.

The decision on whether to drill MAP or DAP with or near seed is largely determined by the likelihood of crop establishment damage, which in turn is influenced by crop susceptibility and type and setup of application equipment. Crops like canola, soybean and linseed are more sensitive to establishment damage that is more likely with DAP than MAP. Changes to application equipment, like wider row spacing and narrower tines, will exacerbate any establishment problems caused by fertilizer.

Trace elements are sometimes included in or on granules during manufacture of MAP and DAP so the fertilizers can be carriers for the trace elements and even to differentiate otherwise fairly generic products. Research suggests that trace elements are likely to be more effective in MAP based fertilizers than DAP based fertilizers, and that for the best response to trace elements in the year of application, water solubility of trace elements in compounded products should be at least 40%.

In summary, there is little agronomic difference between MAP and DAP as sources of phosphorus. However caution should be exercised when using DAP under some soil and environmental conditions to avoid establishment damage.

About the author:
Chris Dowling is Technical Services Manager, based in Brisbane, Queensland.
Email: cdowling@backpaddock.com.au
Phone: 0407 692 251