Over the past few weeks the extremely wet conditions have prompted many conversations about cotton nutrition and what options growers and consultants have with respect to pre and at-plant nutrition of cotton in these conditions. There is a lot of ground, particularly in the south, that has not been able to have much, if any, ground prep done since last season, and certainly very little, if any, applied nutrition. The principles of application and placement of immobile nutrients such as P and K, when there is a particularly wet lead up to the season, especially in a back to back situation, need to be carefully considered.

Know your soils

The focus for this article will be on application of P considering the various pools of phosphorus in the soil; how growers and consultants might determine the likelihood of running into P deficiency in the short term; and how they may contribute to plant P nutrition over time. Different applications methods will be discussed and their likelihood of being able to achieve the desired results with respect to application of fertiliser P.

In our recent nutrition tours of the cotton industry, and at the Australian Cotton Conference, I have spoken at length about the various pools of phosphorus in the soil and how they may contribute to plant P nutrition over time (see Figure 1).

The first pool of P in the soil is reflected by the ‘Colwell’ soil extraction method, which uses a base, bicarbonate, as the reagent. This is the method that we have become accustomed to relying on but critically doesn’t always reflect the complete nutritional status of the soil with respect to plant available phosphorus. The Colwell method is usually taken from the surface of the soil profile, usually 0–10 cm, and assumes the topsoil is representative of the entire soil profile P.

Over the past couple of years we have changed to using this ‘Colwell’ method in conjunction with another soil testing method, the ‘BSES P’ method, which uses a weak acid reagent, and reflects slower release P that is made available to the plant from another pool of P in the soil. This method is also usually employed looking deeper in the profile, from 10–30 cm.

BSES P is relevant for a couple of reasons. The first has been touched on – the Colwell method does not always reflect all of the plant available P in the profile. The second consideration is that we know our roots work from P deeper in the profile for a large portion of the growing season.
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season, and they also have the ability to ‘solubilise’ some of the less available forms of P held in compounds in the soil, such as calcium phosphate. This BSES P pool can also ‘trickle’ P into the Colwell pool over time, keeping the Colwell P pool topped up (providing there is sufficient P in the BSES P pool to do so).

It is important for growers and consultants to be aware of the soil levels of both of these pools of P, and their relevance, before any decisions are made about the application of fertiliser P in general.

Once the P status of the soil is determined we must then consider the method of application, and where we are likely to best place applied fertiliser P in order to give the plant the best chance of recovering as much as possible, bearing in mind that phosphorus, and potassium, are immobile nutrients when applied to the soil and will not move from where they are placed. The key consideration in achieving maximum recovery of these nutrients is understanding the interaction between nutrient placement and knowing where our roots are going to be most active at any given point during the season.

**Carefully consider placement of immobile nutrients**

There are a range of different scenarios that growers might use with respect to the application of fertiliser P, although given the current wet situation, the options are a little more limited.

The first scenario might be when tests reveal low Colwell P in the surface, and you have a lower BSES P at depth. In this instance, at the very least, an application of P with the seed, either as solid starter or as a liquid at sowing would be better than doing nothing. In saying this, an at-sowing application will not be sufficient to satisfy the demand for P by the crop for the season, and it is highly likely that plant P deficiency will be seen later in the season, if there are no further applications of P.

Another scenario might be if your Colwell P levels are above the critical response levels, and/or if you have reserve BSES P levels that are OK. In this case, it may possible to get away with running the gauntlet and not applying P for this season. In this situation the logistics of application and getting P to where it is needed for a response may outweigh the benefits or simply not be logistically possible.

I think in either instance the trap that we could fall into would be to apply our P shallow into the bed. Figure 2 illustrates the scenario of having your applied fertiliser in that part of the profile, where for a large part of the season, there is limited root activity.

**Understand the interaction between root activity and fertiliser placement**

In order to get a response to applied fertiliser P, and for that matter K, we must at least apply it to an area in the profile where we know our roots will be active. If fertiliser P is applied higher in the profile it is likely be in area that is dry for a large part of the season, and if the soil is dry our roots are not going to be working in that area. Applying P in this manner, even if your soil is deficient with respect to P, is unlikely to generate economically viable returns.

The next most commonly asked question is, can you side dress and achieve the desired result? In the work that Richard Flavel, Chris Guppy, Mike Bell, David Lester and I have done using the standard method of application with a side dressing shank and dropping the P into a slot at the bottom, I would have say the answer would be that it is fairly unlikely.

In all of our work, cotton doesn’t see bands of P in the soil, and so it seems fairly unlikely to use it, at least in the short term. But it does seem, anecdotally, that some of the southern soils do not always seem to behave chemically in the same manner as the northern vertisols that we are familiar with, and in which all of our research work has been done.

The other caveat to this topic is in either overhead or drip irrigation, or with consistent early season rainfall, where there will be greater proliferation of roots closer to the surface. In this case, the upper profile is wetter and for longer during the season so there is a greater chance of increasing your uptake of late applied fertiliser P, and K.

The scenarios referred to above relate to ‘possibly getting you over the line’ for this season.

There are some scenarios that may allow growers to get a crop through this season without a full replacement amount of applied fertiliser P, if the conditions do not practically allow for application of P.

But in some cases, the inability to apply P correctly may produce a deficiency with P the most limiting factor, and yield may be reduced. The other key consideration is that even if we can get away without applying P for this season, the plant will still be removing large amounts of P from the soil, and we need to be acutely mindful of the fact that we must at least replace what we are removing, as the correction of a P deficient soil is not something achieved quickly.

**Further reading:**


Bell, M., Lester, D., Griffiths, B., 2015, Cotton root systems and poor recovery of P and K fertilisers, poster.