THE AGRONOMY COMMUNITY

Agronomic Insight

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Better dryland cotton yields with phosphorus

By Bede O'Mara - Subtropical farming systems agronomist

Dryland cotton growers may be missing out on yield if they plant without phosphorus fertiliser.

Applying some fertiliser phosphorus increased dryland cotton yields by as much as 20% in last year's trial at 'Colonsay' on the Darling Downs.

It took just 10 kg/ha of phosphorus to increase yields by a massive 1.5 bales/ha to 7.24 bales/ha compared with the nil phosphorus treatment.

The results were surprising because the amount of phosphorus in the soil's reserves was already above the level thought to be optimum for dryland cotton.

Phosphorus fertilisers would not usually have been recommended. This has prompted us to question the previous rules for phosphorus in dryland cotton.

All of the phosphorus rates tested (5, 10 and 20 kg/ha) yielded significantly higher than where nil phosphorus was applied.

These treatments also had the benefit of greater phosphorus reserves in the soil, thanks to years of previous applications in trials at the site where the same rates of fertilisers are repeated in various crops including summer and winter cereals, pulses and cotton.

Standard 0-10 cm Colwell P soil tests taken in July 2014 measured 8.9 mg/kg of phosphorus in the nil treatment, 27.5 mg/kg in the 5 kg/ha of phosphorus treatment (with a history of 15 kg/ha of phosphorus pre 1999). There was 28 mg/kg in the 10 kg/ha of phosphorus treatment and more than 60 mg/kg Colwell P in the 20 kg/ha of phosphorus treatment.

The cumulative improvement of soil phosphorus nutrition over 30 years may have had a major impact on the results.

Coarse-rooted cotton plants generally do not proliferate around phosphorus bands like fine-rooted cereals, so the higher soil phosphorus gained from repeated applications in the rotation along with the starter phosphorus applied pre-plant drove the results.

Nutrition research in dryland cotton

Location: 'Colonsay' Darling Downs, Queensland
Managed by: Kalyx Australia for Incitec Pivot Fertilisers

Timing and conditions

The dryland cotton planted in 2014 was preceded by wheat, harvested in 2013. Fallow was managed as per district practice.

Soil testing was conducted in early July 2014. Fertilisers were pre-sown in a band offset 5 cm to the side of the intended plant line on 22 July 2014. Urea was used for nitrogen, triple superphosphate for phosphorus and Gran-Am® for sulphur.

The crop was planted on 30 November 2014 and 81 mm of rain fell between planting and emergence.

A growing season rainfall (GSR) of 430 mm was recorded, including 124 mm of late rain following defoliation on 20 April which delayed harvest until 9-10 June 2015.

Snapshot of results

- Applying nitrogen improved cumulative yields throughout the rotation
- High levels of residual nitrogen improved yields
- Applying phosphorus with nitrogen improved the efficiency of nitrogen use
- All rates of phosphorus improved yields compared with none
- Higher soil phosphorus levels improved yields
- There were no significant responses to sulphur
- The highest yielding treatment was 120 kg/ha of nitrogen with 20 kg/ha of phosphorus

N rate (kg/ha)	P rate (kg/ha)				mean
	0	15/5	10	20	
0	5.57	7.05	6.58	7.26	6.61
40	5.97	7.51	7.31	7.29	7.02
80	5.62	7.32	7.46	7.92	7.08
120	5.74	7.54	7.59	8.05	7.23
mean	5.72	7.35	7.24	7.63	6.99

LSD (p=<0.05) 0.78 (N x P); LSD (p=<0.05) 0.39 (N or P rate)

Source: Incitec Pivot Fertilisers, dryland cotton trial at 'Colonsay' in Queensland, 2014-15.

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Because the season was particularly wet, crop root exploration was better than average and the plants had more time to explore the enriched phosphorus environment closer to the soil surface and use it to their advantage.

Banding phosphorus fertiliser followed through to yield results because it gave the plant roots the boost they needed to get into the shallow subsoil zone where they could then exploit phosphorus reserves from previous applications. This had a direct effect on yield.

The best results came from applying 20 kg/ha of phosphorus with 120 kg/ha of nitrogen under zero till, where 8.05 bales/ha were harvested.

Further, the addition of phosphorus at all nitrogen rates improved yields and the performance of nitrogen significantly. We saw that phosphorus was valuable for improving nitrogen fertiliser use efficiency (NFUE) of the crop.

Where 120 kg/ha of nitrogen was applied alone, it produced 11 kg lint/kg of nitrogen applied. This increased to 15.1 kg lint/kg nitrogen applied when 20 kg/ha of phosphorus was applied as well.

Cotton growers are used to seeing the results from nitrogen in their crops and they know applying urea or BIG N® is going to give them good 'bang for their buck'. But these results show it's even better when phosphorus is also applied.

Based on these results, I'd be recommending further soil testing prior to sowing dryland cotton using Colwell P and BSES analysis, at both the 0-10 cm and the 10-30cm depths.

While the previous calibration data suggests the critical level for phosphorus in dryland cotton at the 0-10 cm depth is around 15 mg/kg Colwell P, it could actually be as much as 25 mg/kg.

This was also found in the results of recent plot trials at the same site, conducted by Dr Brendan Griffiths from University of New England. He saw responses to banding phosphorus fertiliser in dryland cotton until soil levels reached 25 mg/kg Colwell P.

Previous Incitec Pivot Fertilisers guidelines on the value of a small amount of phosphorus fertiliser (also known as a 'pop up' or starter) in colder or wetter planting conditions or following long fallows would seem to hold true – and this is what the 2016-17 season is looking like.

These findings will prompt a review of the critical soil phosphorus levels and interpretation guidelines to ensure dryland cotton growers continue to receive the best advice and fertiliser recommendations.

However, if soil test results this season are showing less than 25 mg/kg, consider applying at least starter phosphorus to assist with crop growth and yields, as well as replacing the removal of nutrients by the crop and building soil reserves. Don't forget that at a minimum, long term fertiliser programs should aim to remove the nutrients removed in a rotation.

For example, this 8 bale/ha cotton yield would have removed around 20 kg/ha of phosphorus from the system which needs to be replaced at some stage in the rotation. That's similar to the phosphorus removal that would occur with a 5.5 to 6.5 t/ha dryland sorghum crop, so why wouldn't you replace it with fertiliser?

We are recommending that growers use a quality granular product such as Granulock® Z or MAP at rates of between 30 and 50 kg/ha for ease of application at planting and compatibility with other crops they may be planting in their rotations.

Growers need to be mindful of seed safety when applying fertilisers in the same furrow as seed, and given the various planting configurations for dryland cotton, it is best they consult with their agronomist.

Incitec Pivot Fertilisers is continuing to focus on phosphorus in dryland cotton and other rotational crops in its research programs with the aim of refining recommendations for growers.

In the meantime, don't ignore phosphorus in the dryland cotton crop within your rotation – it can make all the difference in a favourable season.

For further information, please contact Bede O'Mara on 0417 896 377 or bede.omara@incitecpivot.com.au.

Incitec Pivot Fertilisers appreciates the long-term support of FK Gardner & Sons and GD Farming at 'Colonsay'

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