In-situ real-time NIR monitoring of nitrogen in irrigated cotton northern NSW, Australia.

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Abstract

Achieving optimum yield in cotton (*Gossypium hirsutum* L.) requires pre-season soil nitrogen analysis and frequent in-crop monitoring. The current agronomic protocol requires petiole sampling at 3 critical stages during early crop development. Emerging technologies such as handheld near infrared spectrometers (NIRs) in combination with crop models (NutriLOGIC) can provide *in-situ* analysis of petioles to address nitrogen deficiencies in real-time. Petiole total nitrogen was shown to be accurately measured *in-situ* via a handheld NIRs. The results were comparable to conventional field petiole sampling and laboratory analysis methods. Therefore, portable near infrared spectrometers are a viable option to monitor in-crop nitrogen in real-time.

Keywords: NIR, nitrogen, irrigation, cotton.

1. Introduction

Cotton (*Gossypium hirsutum* L.) contributes approximately 2 billion dollars to the Australian economy (Cotton Australia, 2018) of which 99% is exported. Improving the efficiency and sustainability of nitrogen application, whilst continuing to produce high quality fibre, is imperative in order to maintain a competitive edge for Australian cotton.

2. Materials and Methods

A field experiment was established in October 2018 with zero nitrogen applied. The plot setup consisted of two Bollgard®3 varieties (Sicot 714 B3F and Sicot 746 B3F). Nitrogen fertiliser rates were determined using two methods of analysing petioles:

1. Hand-held near infrared spectrometer (NIRs) and
2. Conventional laboratory analysis.

The results from both methods were entered into the crop model NutriLOGIC (Rochester and Bange, 2016).

The NIRs captured near infrared wavelengths from 1350-2600 nm) and petioles were scanned initally at 650 day degrees (DD). (DD=(max. daily temp-12)+(min. daily temp.-12)/2).

3. Results

3.1 Nitrogen rates

The nitrogen rate determined at 650 DD from the NIRs in combination with the NutriLOGIC crop model was 262 kg N/ha. The laboratory analysis results from field sampled petioles also returned a rate of 262 kg N/ha from the NutriLOGIC crop model.

3.2 Yield 2018/19 cotton season

Understandably, the two methods were shown to achieve comparable yield results (Fig. 1). Nitrogen usage in cotton can therefore be monitored in real-time, matching demand

and reducing the overall total nitrogen usage through *in-situ* measurements. Currently, large rates of nitrogen are applied prior to sowing cotton. Real-time *in-situ* monitoring will improve the efficiency of applying nitrogen to meet plant demand.

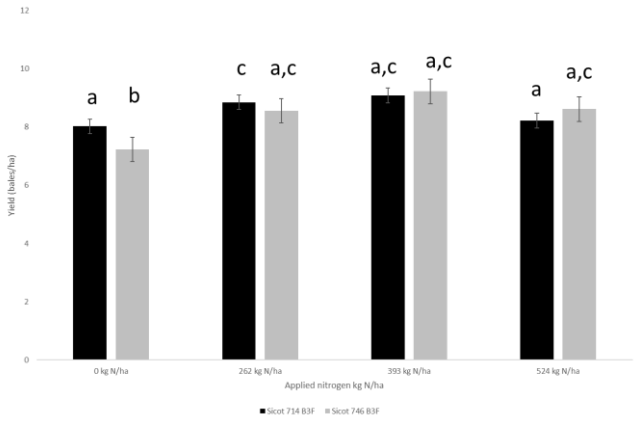

Fig. 1: Yield (bales/ha) comparison of two Bollgard® 3 varieties (Sicot 714 B3F and Sicot 746 B3F) following nitrogen management using handheld near infrared spectroscopy during the 2018/19 cotton season and conventional laboratory methods. (1 bale = 227 kg of lint fibre). Higher rates of N (393 and 524 kg N/ha) were applied to illustrate no gain in yield in comparison to *in-situ* real-time measurements with NIRs.

4. Conclusions

Portable NIRs provide *in*-situ real-time optimised analysis of nitrogen in cotton, allowing a more sustainable and efficient timing of application in cotton.

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