Australian Government
Cotton Research and Development Corporation

CGA FINAL REPORT

Part 1 - Summary Details

Please use your TAB key to complete Parts 1 & 2.

CRDC Project Number: **CGA1706**

Project Title: Counteract High Sodium Uptake and Nitrogen efficiency by Stimulate Soil Health

Project Commencement Date: 1/10/2016 **Project Completion Date:** 1/5/2017

Part 2 – Contact Details

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Part 3 – Final Report

(The points below are to be used as a guideline when completing your final report.)

Background

1. Outline the background to the project.

Boron and Potassium have overlapping roles to play in plant physiology and hence are synergistic. Like Potassium, Boron is also involved in some aspect of flowering and fruiting processes, pollen germination, cell division, nitrogen metabolism, carbohydrate metabolism, active salt absorption, hormone movement and action, water metabolism and the water relations in plants.

The presence of high levels of sodium in the soil (which is common in most cotton growing areas) is determinantal to the growth of any crop. This is due to reverse osmosis created due to high negative water potential around the rhizosphere. This leads to desiccation of plants and improper or highly reduced mineral and water uptake due to the impact on the roots. This will have its adverse effect on the total photosynthetic potential of the plants causing yield and quality decline.

This trial has been conducted in collaboration with the CRDC and leading cotton grower, Vitonga Pty Ltd in identifying why some paddocks are producing 16 bales/Ha of cotton and on the same farm, other paddocks drop off to 11-12 bales/Ha under the same management practices.

In soil analysis, the paddocks producing 16 bale crops consistently, the Potassium:Sodium ratio is believed to be a critical factor impacting the yield. In those high yielding paddocks, the ratio in meq/100g soil for the Potassium:Sodium ratio was 2:1, while in field 7 where the trial was conducted, the ratio was 1.05:1 (ideal would be 1.4:1). In addition, soil analysis found that the Calcium:Boron ratio at in field 7 was 4038:1. This Calcium:Boron ratio indicates a significant Boron deficiency exists in the soil.

Objectives

2. List the project objectives (from the application) and the extent to which these have been achieved.

I. Effect of high Potassium application in-crop on yield in fields where there are high Sodium to Potassium levels which have caused early senescence of cotton growth.

As part of the trial two rates of Potassium nitrate were applied, 150 and 300 kg/ha. The objective was for the potassium to replace the excess sodium and reduce its uptake and negative effect on plant growth and around the rhizosphere.

II. To increase the enzyme urease activity in the soil at plant and stimulate soil health and counteract nematode effect on plant growth. Better Nitrogen efficiency.

It was not possible to test the impact of the Potassium Nitrate on the activity of the enzyme Urease, or whether there were any impacts on nematodes. However, it is anticipated that by addressing the nutrient imbalance in the soil through the addition of high rates of Potassium that the plants will be producing more efficiency and as such there should be an improvement in Nitrogen use efficiency.

III. Effect of Boron application (slow release before plant) with high Potassium application and the effect on yield when soil health is increased measuring Nitrogen efficiency and yields.

Treatment four involved the addition of a slow release Calcium and Magnesium Borate product [35 kg/ha Organibor (10% B as a Slow Release Ca+Mg- Borate)] in combination with the Potassium Nitrate (150kg/Ha). The intention was to test the synergistic effect of Boron and Potassium and to address both the excessive Sodium and the deficiency in Boron. The trial found that there was a yield increase from the addition of the Boron.

Methods

3. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related projects.

Trial design: Randomized complete bock design with four treatments and six replications.

Treatments –

T1	BMP(360N)
T2	BMP Plus 150 Kg KNO3
T3	BMP Plus 300 Kg KNO3
T4	BMP Plus 150 Kg KNO3 and 3.5 kg Boron as 35 Kg Organibor

Assessments

Assessment required	Assessment date	Assessment method
OmniSap® analysis	Dec/Jan	From each rep
Routine & non-routine soil analysis	Planting/harvest	From each rep

Yield	At harvest	Minimum of 150 length of strips were harvested

Statistical analysis: Yield was determined for treated and control strips at harvest and were subjected to Two Sample T-test using the NCSS statistical programme.

Outcomes

4. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.

The Economic Benefits:

a. Higher sustainable yields by counteracting the high Sodium effect on plant growth with Potassium Nitrate during peak water usage in summer.

The trial has demonstrated that yields were improved through the addition of both rates of Potassium Nitrate and further still from the addition of the slow release boron product. The cost benefit analysis suggests that there was not additional income from the applications of Potassium Nitrate alone, but that where it was applied in combination with the slow release Boron that there was a net income increase.

b. Lower Nitrogen Usage due to better Soil Health, by stimulating Beneficial Fungi and reducing the effect of Plant Parasitic Nematodes. Increase of Urease Enzyme Activity- Currently measured at 40Units out of minimum 100.

It was not possible to test this objective or measure the economic benefit.

c. Higher sustainable yield by addressing the Calcium:Boron ratio at the site.

It was not intended to test if a higher sustainable yield was possible by addressing the Calcium:Boron ration in combination with addressing the Potassium:Sodium ratio. However, the trial has suggested that it is possible to cost effectively address this when Potassium Nitrate is applied in combination with a slow release Boron product.

The Environmental Benefits:

Planned Outcome: Lower Nitrogen application and better soil health promotion of beneficial fungi and nematodes. Nitrogen efficiency of 40%, aim to increase to 75-80%, which means applying 140 Kg Units of N less. Crop removal is around 200 Units of N for 16 bale/Ha, industry applying 360-400 Units.

Actual Outcome: Potential to reduce the total Nitrogen applications made possible by addressing the nutrient imbalance in the soils. Addressing the high levels of sodium and the calcium and Boron ratio would improve soil health and thus enable the plant to produce more efficiently producing more sustainable yields.

The Social Benefits will be: Sustainable cotton based on economical production, by better addressing plant nutrition and soil health benefits. Understanding the micro biology in the soil would be of major benefit.

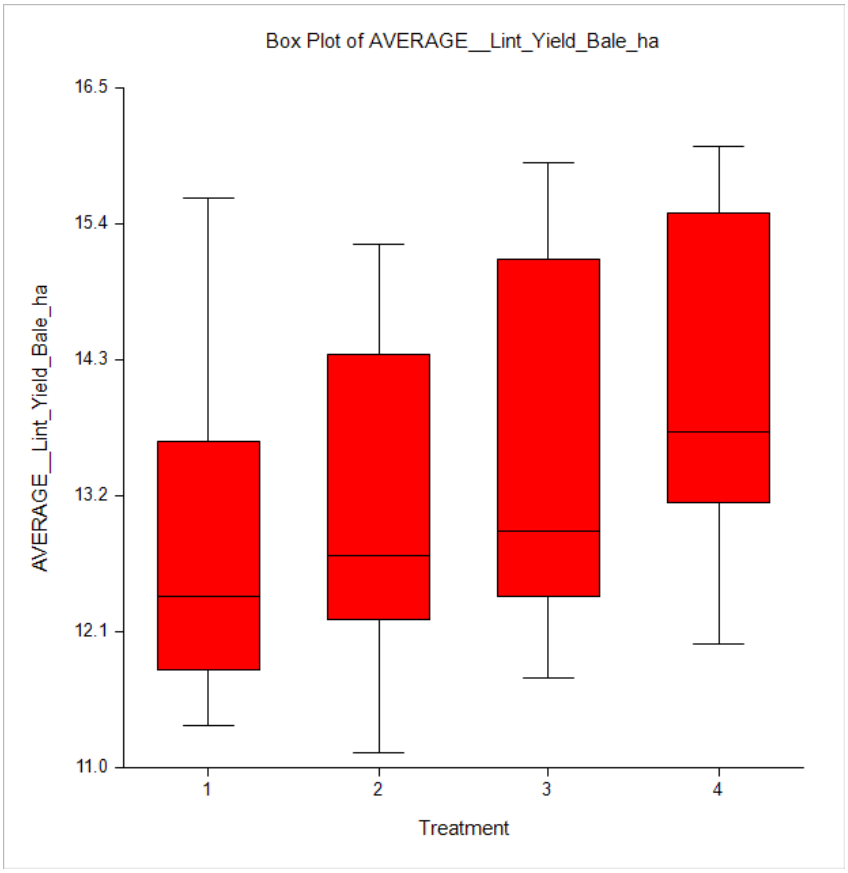
Actual Outcome: The trial has shown that by addressing nutritional imbalance it is possible to enhance yield and the return to the producer.

5. Please report on any:-

a) Feedback forms used and what the results were
b) The highlights for participants or key learnings achieved
c) The number of people participating and any comments on level of participation

b) Highlights:

Treatment 4 (360N + 150 Kg KNO3 + 35 Kg Organibor) gave a significantly higher average lint yield bales/Ha compared with the control at 80% significance level. The average lint yield increase was 9.95%



Cost Benefit Analysis

Costings of Product

Landed Price Moree	BMP-Best Practice	T1	T2	T3	T4
$1,600.00	150 Kg Kno3		240		
$1,600.00	300 Kg KNO3			480	
$1,600.00	150 KNO3 Plus				240
$1,750.00	35 Kg Organibor				61.25
	Extra Cost + Application		$ 240.00	$ 480.00	$ 301.25
	Extra- Lint/ha		63.8	154.17	277.17
	Cotton Lint@$530/227 Kg		2.335	2.335	2.335
	Total Income extra		**$ 148.97**	**$ 359.99**	**$ 647.19**
	Net Extra Income		**$ (91.03)**	**$(120.01)**	**$ 345.94**

Net extra income for Treatment 4 (Best Practice + 150 Kg KNO3 + 35 Kg Organibor) is $345.94/ha. This benefit coupled with 80% significant level is a good result

c) Participation:

The trial was managed at a field level by the Vitonga staff, the principle contact was Craig Estens. Vitonga staff were supported with the in-field assessments by the Omnia Nutriology team. The final report was completed by the Gwydir Valley CGA, using the material provided in the report on the trial by Omnia Nutriology. The Report by Omnia Nutriology is attached for further reference.

Conclusion

6. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?

In the current trial, an attempt was made to apply potassium and boron to alleviate the negative effects of sodic soils. The results indicated that there is a yield benefit associated with the application of potassium nitrate. Yield increases were observed at both the 150 and the 300 kg/Ha rates of Potassium Nitrate. The highest average yield was recorded from the lower Potassium Nitrate rate in combination with a slow release boron product, [BMP (360N) Plus 150 Kg KNO3 and 35 Kg Organibor].

This illustrates the synergistic effect between Boron and Potassium. It highlights that yield limitation is often not due to any single nutrient imbalance, and that a full assessment if nutrients and ratios is important to address yield limitations.

Extension Opportunities

7. Detail a plan for the activities or other steps that may be taken:

(a) To tell other CGAs/growers/regions about your project.
(b) To keep in touch with participants.
(c) For future projects.

Extension:
The results from the trial will be included in an upcoming Gwydir Valley CGA newsletter and on the websites of both the Gwydir Valley CGA and the Gwydir Valley Irrigators Association (GVIA).

Possible Future Projects:
This is a single trial, to increase the confidence growers and consultants have with the use of nutrient combinations similar to those used in this trial further data needs to be collected.
The treatments provided encouraging results, but higher yield potential may be possible if additional stress management strategies had been applied to alleviate the extreme Sodium levels in the SAP.