DEVELOP AND INTEGRATE AN IN-FURROW INJECTION SYSTEM TO USE AT PLANTING FOR THE PINEAPPLE INDUSTRY

Research Topic 2: Ground Prep, Fallow Management, Bed Formation, Planting

Trial number: 02-WB-02

CONTENTS

INTRODUCTION

There are a number of farming systems that involve the injection of liquid into the furrow to provide operational efficiency, crop protection, soil improvement and yield improvement benefits. Precision in-furrow liquid injection has the potential to deliver products to improve soil conditions and optimise the establishment of healthy crops.

The effectiveness of nearly all in-furrow liquid applications is dependent on the precision and accuracy of the equipment being used. To ensure every plant gets the required amount of liquid, in-furrow liquids need to be delivered evenly across the blocks. Without accuracy plants may suffer from over or under application which can impact germination, plant growth and ultimately crop yields. These impacts may be more pronounced at very low application rates. It is critical to ensure the liquid injection systems are accurate to achieve the desired crop outcomes.

HYPOTHESIS

In dry conditions, water injected into the furrow at planting will improve plant establishment.

OBJECTIVE

The primary objective is to develop, build and integrate a precision in-furrow injection system into the pineapple planting operation to improve plant establishment and uniformity.

1) To develop, build and integrate a machine to apply precision in-furrow injection at planting.
2) To improve root establishment in the critical first six months of growth.
3) To improve plant establishment under drought conditions.

METHOD

Develop a practical in-furrow injection system that can be integrated into the pineapple planting operation, test it out and measure its impact on plant and root establishment in the first six month after planting.

Location and grower

The work was undertaken in collaboration with Amaryllis Farming Company, Gooburrum north of Bundaberg. Amaryllis Farming Company is owned and managed the Hubert family and they have been growing pineapple for ten years. The Hubert family have been farming for three generations in the Goomburrum area and have been involved in the development of the sugarcane industry in Bundaberg.

Dates

- February 2020 – machine planned, materials ordered.
- March to April 2020 - machine constructed and initial field tests completed.
- May 2020 – site selected, treatments applied.
- May to September 2020 – root establishment data collected.

Crop details

The demonstration site on Amaryllis Farming Company was planted with the hybrid 73-50 pineapple variety. Previously, the site was planted with sugarcane. The soil was a sandy loam on a 1% slope.

Figure 1: Demonstration site – Goomburrum Rd

Description

Amaryllis Farming Company designed and upgraded their own planter with injection capabilities using their own expertise. The planter was retrofitted with injection outlets located on the spades on the planter. A forklift tower was fitted to the front of the planting tractor. A reservoir carrying the liquid for injection was a recycled 1,000L shuttle mounted on the forklift tower and plumbed to the planter with quick release fittings.

The injection mechanism is designed to squirt liquid into the hole as it is being dug by the spade. The injection action is control by a solenoid connected to the planter's computer. The planter's computer controls the digging action of the spade. The pump and plumbing are standard equipment used on a boomsprayer. The injection rates are 350ml per plant and can cover approximately 2,800 plants for every 1000L tank. The tanks can be replaced quickly by releasing the plumbing connectors and reloading prefilled shuttles onto the forklift.

Figure 2: Injector attached to spade on planter (left). Reservoir on front of planter (right).

RESULTS

During this trial Bundaberg was in the midst of a five-year drought. Soil conditions at planting were extremely dry. Other plantings across the farm experienced major issues with limited root establishment and growth due to lack of soil moisture. This was exacerbated by extreme temperatures throughout the spring and summer seasons.

On successful completion of the retrofit it was trialled in the field. Water was injected at 350 mL per planting hole during the planting operation and root growth was monitored monthly over the following six months. The experimental practice was compared to standard industry practice (control) which received no water injection. The comparative results are presented in Tables 3 and 4.

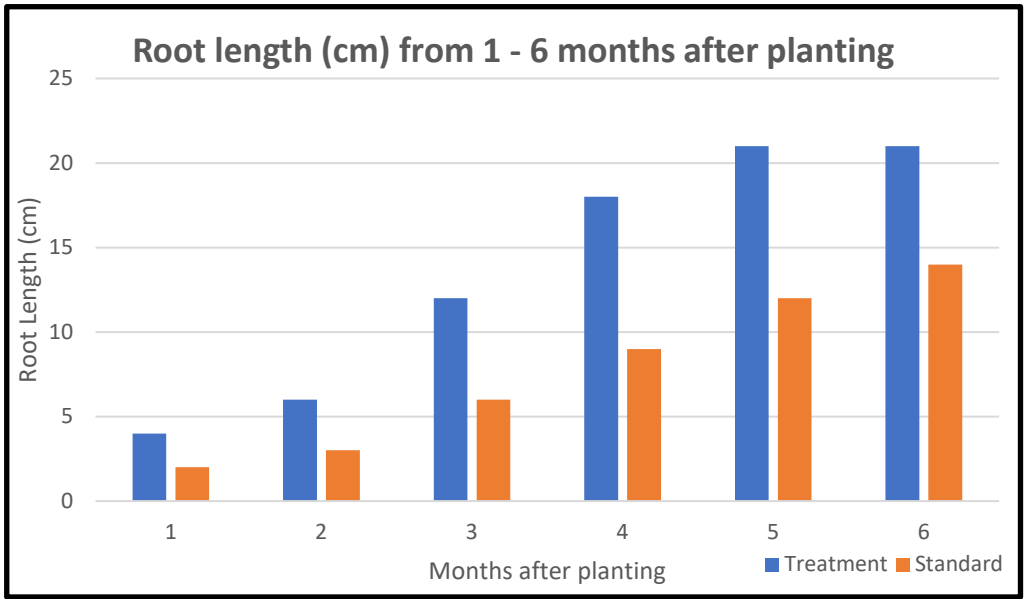

Figure 3: Root length one to six months after planting

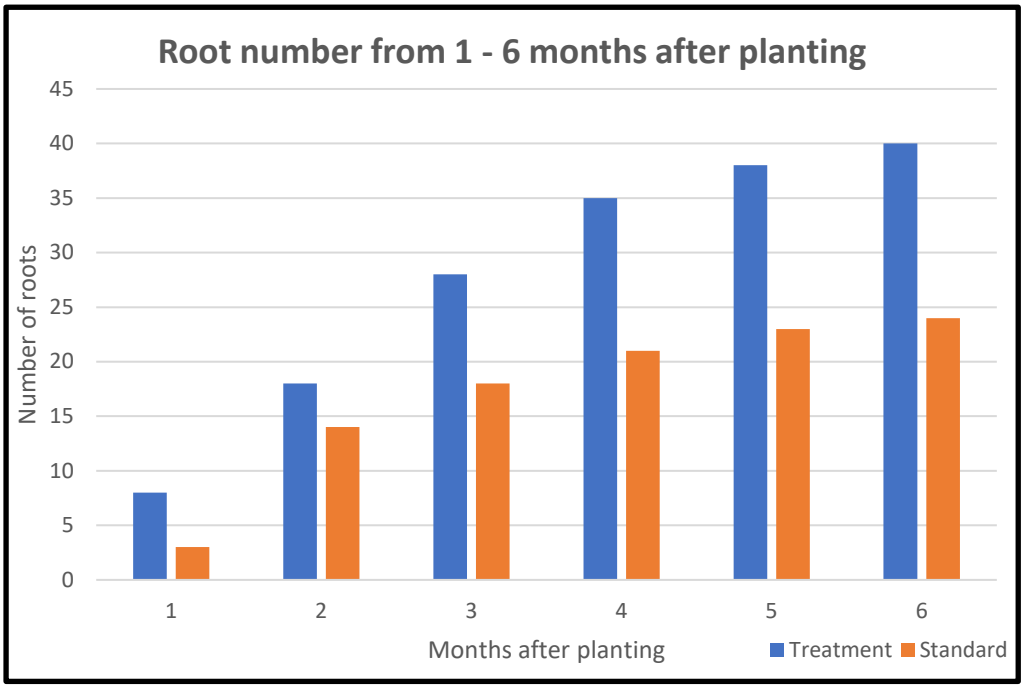

Figure 4: Root numbers one to six months after planting.

The total cost required to retrofit a precision in-furrow injection system into an existing tractor and planter is approximately $1500. This included all development, labour from Amaryllis Farming Company and components.

DISCUSSION

In-furrow injection at planting is being adopted in other agricultural and horticultural crops not only to provide moisture but also to introduce chemicals. The technology has the potential to provide better operational efficiency, crop protection, soil improvement and yield improvement and thus contribute to the sustainability of the industry.

Sound plant establishment and root health in the first six months is the foundation for good plant and ratoon crop yields in pineapple. The equipment developed for this trial showed how it can help during drought. It gives growers another tool to use when conditions demand it. Pineapple plants provided with water through injection produced 60 - 70% longer roots and 40 - 50% more roots than plants receiving no water injection (standard practice).

This evaluation only compared water injected into the furrow in drought conditions. Further work evaluating the injection of soil conditioners, roots stimulators, liquid fertiliser and pesticide products could achieve greater gains in root health.

This demonstration highlighted the capacity of the technology and suggests that there may be potential for other precision farming operations in pineapples. There is also the potential for combining in-furrow injection with other technology such as electro-magnetic (EM) soil scanning and variable rate control, this will enable variations in soil type, crop nutritional needs or pest and disease requirements to be catered for better by tailoring application rates across the paddock.

Economic and environmental benefits are an incentive for these systems to be adopted since growers are under pressure to reduce their production costs and meet governance requirements such as fresh care and environmental certification.

ADOPTION AND IMPACT

The results of this work have generated a lot of interest from growers. Currently, there is focus on improving plant establishment and maximising root health. The ability to establish a good root system in the first six months after planting will have major impacts on the health, uniformity and yield of plant and ratoon crops.

The rising costs of labour, fertiliser and pesticide inputs have put a brake on growers' capacity to upgrade equipment. Grant opportunities through Growcom's Farm Business Resilience (FBR) program or South East Queensland Water Quality project funded by the Department Environment and Science (DES) are helping to drive adoption of new ideas in the pineapple industry.

CONCLUSIONS

There is great potential for the use of in-furrow injection systems at planting especially in drought conditions. There is also an opportunity for further research to evaluate the injection of root stimulants, liquid fertilisers, soil conditioners or pest and disease products on pineapple production systems using this application method. Much of the equipment and components for precision applications are commercially available. Further research is required to adapt, integrate and develop systems for the pineapple industry. The technology has the potential to grow the pineapple industry, reduce its environmental footprint, and improve its profitability and sustainability into the future.

ACKNOWLEDGEMENTS

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