

Assessment of different fertilizers and biostimulants on germination and seedling growth in sugarcane

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Abstract

Sugarcane (*Saccharum* spp.) is a widely cultivated crop with significant economic importance. The successful establishment of a healthy sugarcane crop relies on optimal germination and robust seedling growth. This study aims to assess the effects of different fertilizers and biostimulants on germination rates and seedling growth parameters in sugarcane. The study investigates the impact of various fertilizer formulations and biostimulant treatments on seed germination percentage, seedling vigor, and root and shoots growth. Results indicate that Dual Grow Kick-Off, Transit Re-Leaf, and CPPA treatments have a great influence on sugarcane germination and seedling growth including. Dual Grow Kick-Off, Transit Re-Leaf, and CPPA treatments improved the plant height, root length, and root architecture compared to the control and all other treatments. These findings provide valuable insights for optimizing fertilization and biostimulant strategies to enhance sugarcane germination and seedling growth. By selecting appropriate fertilizers and biostimulants, farmers can improve the establishment of healthy sugarcane crops, contributing to sustainable sugarcane cultivation practices.

Keywords: Fertilizers, Soil amendments, Germination, Seedling growth, Root development

1. Introduction

The Australian sugarcane industry plays a crucial role in the Australian agriculture sector, and it is a vital contributor to Australia's economy. It generates significant revenue, provides employment opportunities, and supports rural communities. Sugar is one of Australia's major agricultural exports (Linnenluecke et al., 2020). As the demand for sugar continues to rise, optimizing sugarcane germination and growth becomes increasingly important for sustainable and efficient cultivation practices. Among the various factors influencing sugarcane productivity, the judicious use of fertilizers stands out as a key determinant.

Fertilizers are essential for supplying essential nutrients to crops and promoting optimal growth and development. However, the selection and application of fertilizers need to be carefully evaluated, taking into account their impact on sugarcane germination, early growth, and subsequent yield. Understanding the specific effects of different fertilizer formulations on sugarcane is essential for improving agronomic practices and maximizing crop productivity (Crusciol et al., 2020; Koochekzad et al., 2009).

This study aims to investigate and compare the impact of different fertilizers and biostimulants on sugarcane germination and subsequent growth. In this study, three fertilizers (Dual Grow Kick-Off, Momentum ZnP, and common commercial

fertilizer products), four biostimulants (CPPA, DOM 80, Transit Re-Leaf, Amino Boost Transit Max), and one soil activator (Gyp A&B) were used. By analyzing the responses of sugarcane plants to various fertilizer treatments, we seek to identify the most effective formulations and dosage regimes for enhancing germination rates, early growth parameters, and overall crop growth.

2. Objectives

The specific objectives of this trial were to:

- Determine if applications of fertilizers and biostimulants on improving sugarcane germination
- Measure the shoot length in each treatment to check the impact of treatment application on seedling height
- Measure the root length in each treatment to check the impact of treatment application on root development
- Take comparative photos to visually observe the seedling growth

3. Materials and Methods

Site Selection and Trial Design

This trial was conducted in the greenhouse, in Robinvale, Victoria, on sugarcane. Pots were filled with topsoil, and then treatments were applied as per Table 1. There were ten treatments and four replicates in this trial. SRAW33 sugarcane variety was selected for this trial, and each cutting had one node. Pots were treated with each product, and then sugarcane cuttings were placed in each pot.



Figure 1: Sugarcane cuttings; variety SRAW33

Table 1: Applied products and application rate

Treatment	Rate (L/ha)
Control	N/A
Dual Grow Kick-Off	2L/100L
Cx - Commercial Product	2L/100L
CPPA	100ml/100L
DOM 80	100ml/100L
Momentum ZnP	4L/100L
Transit Re-Leaf	200ml/100L
Transit Re-Leaf	500ml/100L
Amino Boost Transit Max	5L/100L
Gyp A&B	5L/100L

4. Observations

Soil Nutrient Analysis

Soil samples were taken before the application by sending them to Analytical Laboratories & Technical Services Australia (AL TSA) for a full soil nutrient profile analysis. The soil was also tested for emersion classification, bulk density, soil color, and soil texture.

Germination

Sugarcane germination was recorded within ten days of planting and continued daily. Then the results were analyzed by using GraphPad Prism to check the impact of each treatment on sugarcane germination.

Shoot Length and Root Length

Sugarcane seedlings were uprooted after eight weeks of the treatment application to measure the shoot length and root length of each seedling.

Comparative Images

Comparative photos of seedlings were taken to visually observe any difference between treatments. Seedlings were first uprooted and washed carefully before taking photos. Then all replicates of each treatment were put together and compared against the control.

5. Results

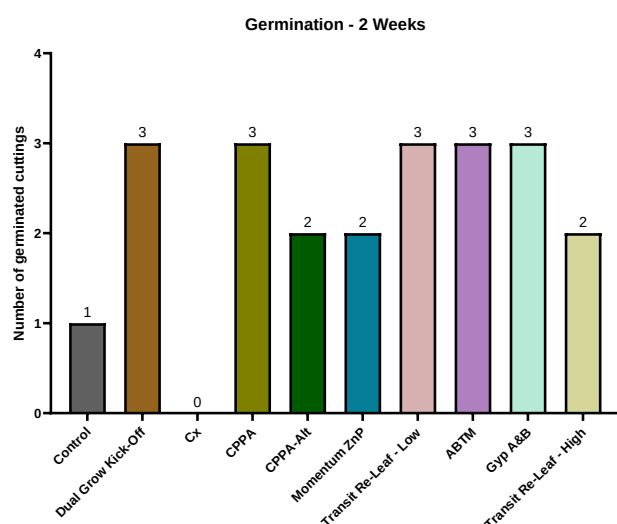


Figure 2: Effectiveness of treatment application on sugarcane germination in 2 weeks after planting.

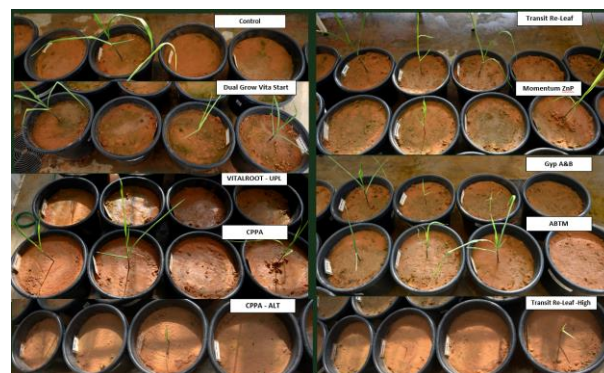


Figure 3: Sugarcane seedlings after 4 weeks of treatment application and planting

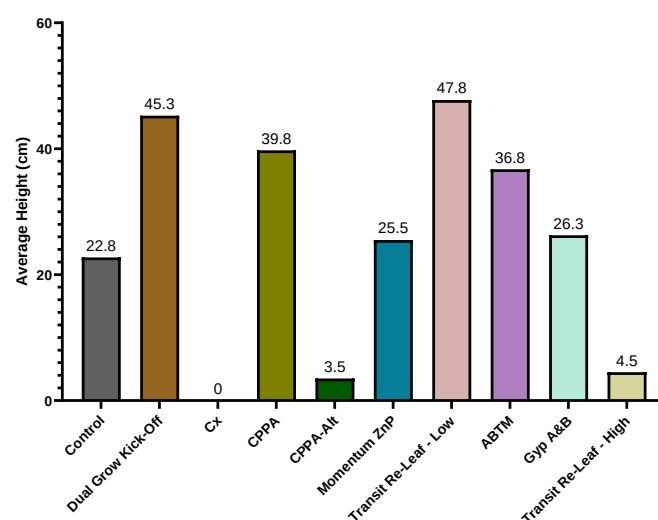


Figure 4: Average height of sugarcane seedlings after 8 weeks of planting

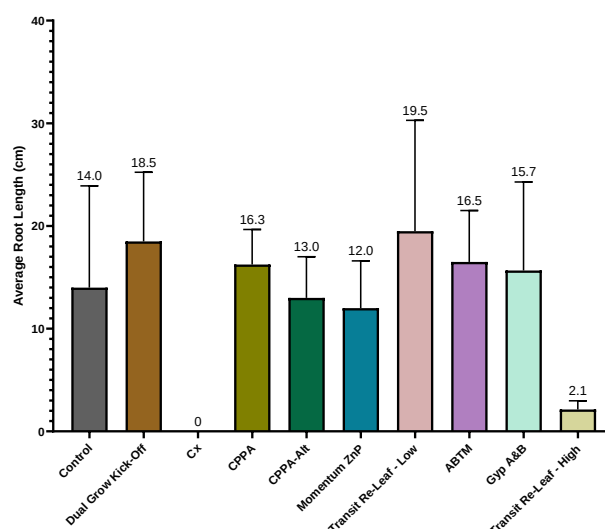


Figure 5: Average root length of sugarcane seedlings after 8 weeks of planting

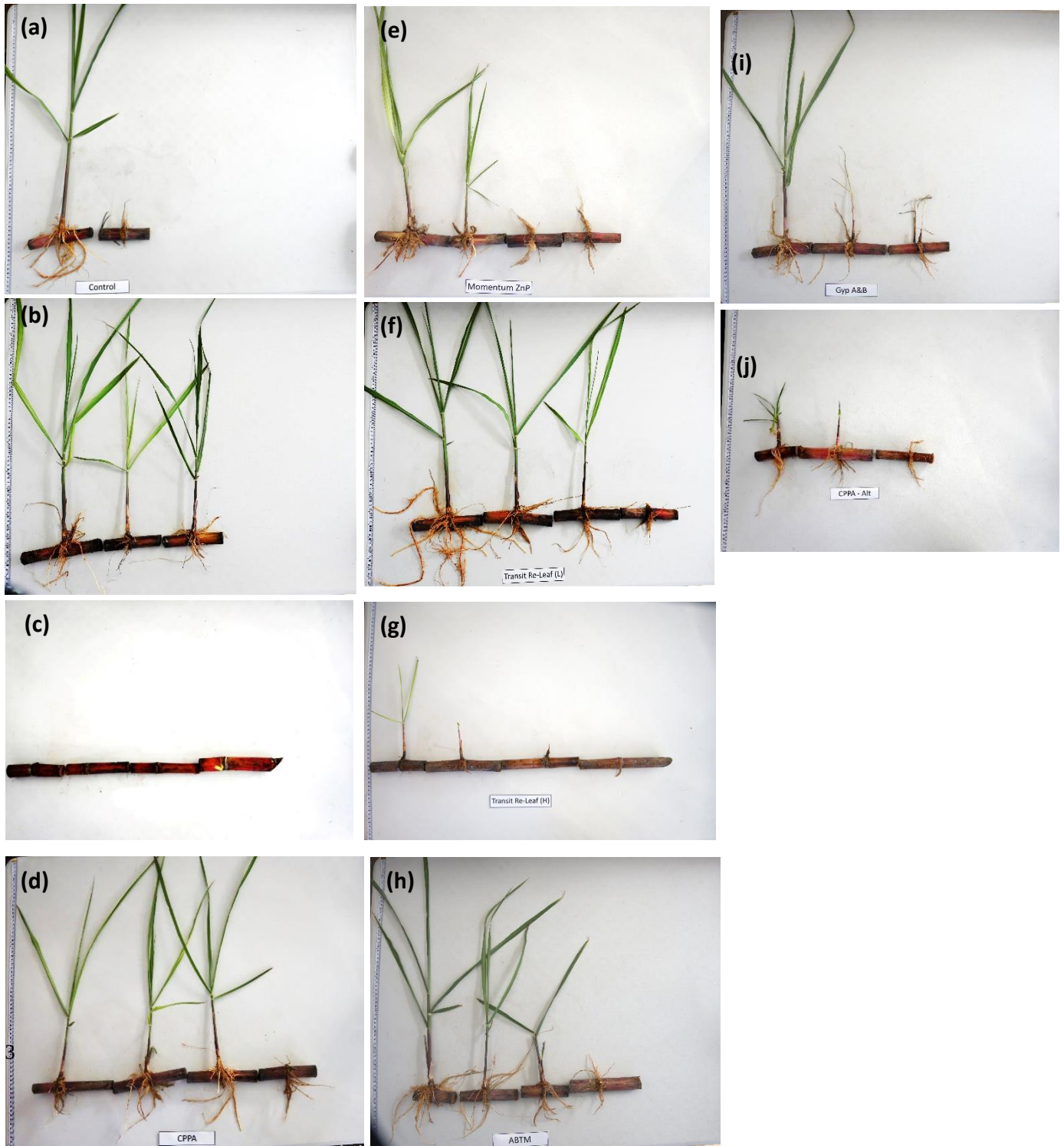


Figure 6: Visual comparison of sugarcane seedlings growth after 8 weeks of planting. (a) Control, (b) Dual Grow Kick-Off, (c) Cx; Commercial sugarcane product, (d) CPPA, (e) Momentum ZnP, (f) Transit Re-Leaf; low rate, (g) Transit Re-Leaf; high rate, (h) Amino Boost Transit Max, (i) Gyp A&B, (j) DOM 80

6. Discussion

This research aimed to investigate the impact of different fertilizers on sugarcane germination and growth. The results obtained from the experiments provide valuable insights into the effects of different fertilizer treatments on the germination and overall development of sugarcane plants. The germination results indicate that the application of Dual Grow Kick-Off, CPPA, Transit Re-Leaf at a lower rate, Amino Boost Transit Max, and Gyp A&B fertilizers greatly influenced the germination of sugarcane as the germination rate was notably higher in these treatments compared to the control and other treatments (Figure 2) suggesting that the nutrients provided by these fertilizers enhanced the germination of the sugarcane plants. This finding is consistent with previous studies that have reported positive effects of these fertilizers on seed germination in various plant species such as wheat, barley, canola, etc.

Furthermore, the shoot lengths of sugarcane seedlings were substantially improved in Dual Grow Kick-Off, Transit Re-Leaf (low), CPPA, and Amino Boost Transit Max compared to all other treatments (Figure 4). Dual Grow Kick-Off is a premium quality fertilizer with a highly effective combination of NPK together with unique biological simulants to provide high levels of Phosphorus for early growth throughout the growing season and post-harvest. Also, Transit Re-Leaf (low) and Amino Boost Transit Max are biostimulants. Biostimulants play a significant role in plant growth and development by enhancing plant physiological processes, improving nutrient uptake and utilization, increasing stress tolerance, and promoting overall plant health. These substances, derived from natural sources, are applied to plants to stimulate various beneficial responses that positively impact plant growth and productivity. In addition, CPPA is a naturally

derived patented organic activator with Mineral complexed Organic Matter for better seed germination and plant growth. Therefore, the application of Dual Grow Kick-Off fertilizer, these biostimulants, and patented organic activators likely played a crucial role in supporting the seedling growth of sugarcane plants (du Jardin, 2015; Roupheal & Colla, 2020).

Sugarcane root length was measured after eight weeks of planting to assess the effectiveness of each treatment on sugarcane growth and development. Results showed that Dual Grow Kick-Off, Transit Re-Leaf (low concentration), and CPPA had better results than all other treatments (Figure 5). Figure 6 shows the visual comparison of sugarcane seedling growth, including vegetative growth, root development, and root architecture. Transit Re-Leaf and CPPA are biostimulants, and these results can be explained by the roles of biostimulants. Biostimulants promote root growth and development, leading to improved nutrient and water uptake. They can stimulate the proliferation of root hairs, increase root branching, and enhance root length and density. Robust root systems contribute to better nutrient absorption, stronger anchorage, and improved overall plant health (Calvo *et al.*, 2014). Dual Grow Kick-Off is a premium quality NPK fertilizer with Calcium, Zinc, and biostimulants. Nitrogen, phosphorus, and potassium are known to be vital nutrients for plant growth, and essential minerals such as calcium (Ca) and zinc (Zn) play crucial roles in various physiological processes within plants, including root growth and development. Therefore, their presence in this Dual Grow Kick-Off fertilizer likely contributed to the observed improvements.

In addition, biostimulants offer valuable benefits for plant growth, development, and stress tolerance. They enhance nutrient uptake, promote root development, improve plant growth and productivity, increase stress resilience, and

contribute to sustainable agricultural practices. These findings align with previous research on the positive impact of fertilizer treatments on the growth of sugarcane and other crop species (Parađiković et al., 2018).

The specific fertilizer formulation used in this study was based on the recommended dosage for sugarcane cultivation. However, it is worth noting that different fertilizer formulations and application rates may yield varying results. Future studies could explore the optimization of fertilizer dosage to achieve maximum growth and yield while minimizing environmental impacts such as nutrient runoff and leaching. This study focused on the early growth stages of sugarcane, but it would be valuable to assess the impact of fertilizers on yield, sucrose content, and other agronomic parameters in subsequent growth stages. Understanding the long-term effects will provide a comprehensive understanding of the overall benefits and potential limitations of fertilizer application in sugarcane farming.

7. Conclusion

In conclusion, this research highlights the positive impact of the application of certain fertilizers and biostimulants on sugarcane germination and growth. The findings demonstrate that the judicious use of Dual Grow Kick-Off, Transit Re-Leaf, and CPPA fertilizers can enhance the sugarcane germination and initial growth stages, including plant height, root length, and root architecture. However, careful attention should be paid to fertilizer management to avoid potential negative environmental consequences.

8. References

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