Assess the Effectiveness of Zinc Fertilizers and Organic Activators on Cotton Germination

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Abstract

Cotton is an important fibre crop in the world. Different internal and external factors affect seed germination and seedling growth. Nutrients play a crucial role in seed germination. This trial was conducted to assess the impact of different Zinc products and organic activators on improving seed germination in cotton. It was found that the application of Amino Boost Transit Max, Momentum ZnP, Momentum ZnP with amino acids and CPPA, Momentum ZBM trio, Transit Re-Leaf, Transit Zn and CPPA improved the cotton seed germination. Therefore, it can be concluded that all of these products except the combination of Momentum ZnP and Transit Re-Leaf are beneficial as seed treatments in improving cotton germination.

Keywords: Cotton, Germination, Zinc Fertilizers, Organic Activators

1. Introduction

Australian cotton industry plays a crucial role in Australian economy which contributes AUD $2 billion annually (Cotton Australia, 2023). Australia is the third largest cotton exporter in the world and it contributes 3% (Australian Grown Cotton Sustainability Report, 2014). Yield and the quality of the cotton yield are highly dependent on macro and micronutrient management (Sadras et al., 2021).

Seed germination is a fundamental process which affected by different external or environmental factors such as temperature, pH, and soil moisture and external factors as well as internal factors such as phytohormones, nutrients, etc. In addition, seed germination is regulated by different genes (Koger, Reddy, & Poston, 2004, Xue et al., 2021). Macro and micronutrients play a crucial role in seed germination, plant growth, and development. Zinc and phosphorous are the key nutrients for better crop growth and yield (Arshad *et al*. 2016). Phosphorus and Zinc are readily absorbed leaves allowing rapid uptake and optimizing Zn and P levels at crucial early growth stages before soil-applied P is available. Moreover, Adequate delivery of Zinc & Phosphorus increases the production of energy molecules, and plant growth hormones and facilitates photosynthesis and nutrient transport. Zinc seed treatments have a great impact on improving seed germination, seedling growth, and development (Montanha et al., 2020). Prom-u-thai, Rerkasem, Yazici, & Cakmak found that seed priming with Zinc has a great influence on improving seed germination, root development, and dry weight in rice.

Zinc is a critical element for better and more vigorous wheat growth. It is both an activator and component of many enzymes and also influences auxin development (plant growth hormone) which promotes strong crop growth. Numerous studies have demonstrated that Zinc is responsible for a higher and a quality wheat yield (Arshad *et al*. 2016). It is well documented that the Zinc content in seeds is highly affected by seed germination and seedling vigor in different broadacre crops such as wheat and barley (Imran, Mahmood, Neumann, & Bolt, 2021). Also, wheat seeds with high Zinc content can develop more shoots and roots at the early seedling stages and facilitates the uptake of more Zn in Zndeficient soil (Graham & Rengel, 1993). Numerous studies have proven the impact of Zn seed treatment on seed germination, seedling growth, and yield. Harris, Rashid, Miraj, Arif, & Shah revealed that the seed treatment with 1% Zinc Sulphate improved the plant growth and yield in maize grown in Zn deficiency soil.

Dual Chelate Fertilizer Pty Ltd has developed a premium quality Zn fertilizer product called Momentum ZnP, Momentum ZBM Trio, Transit Zn as well as some other organic activators such as Transit Re-Leaf, Amino Boost Transit Max, and CPPA. Amino Boost Transit Max assists in increasing root growth, improving the translocation of nutrients, and enhancing the establishment of young plants. Amino Boost Transit Max® (ABTM) contains 10% Amino Acids, 6%, Kelp, 4% Fulvic Acids, 1.5% organic activators, and 1.4% Nitrogen (Amino Acid derived Nitrogen). Momentum ZnP is a plant-available liquid Zinc & Phosphorus fertilizer designed to provide plants with optimal nutrients to promote early crop growth and establishment. Momentum ZnP consists of 18% Phosphorous, 14% Zinc, 2% Potassium, and patented organic activators. CPPA (Complex Polymeric Polyhydroxy Acid) is a group of organic acids that enhance various plant physiological functions such as nutrient absorption, shoot, and root growth. In this study, cotton seeds were treated with a 10% solution of each fertilizer product and organic activators to study the effectiveness of each product on cotton seed germination.

2. Objectives

The specific objectives of this trial were to:

- Study the impact of treatments for seed germination.
- Visually compare the treatments to see any difference in appearance.
- Compare the benefits of treatments for cotton seed germination.

3. Materials and Methods

This trial was conducted in the greenhouse located at Robinvale. There were 8 treatments and 4 replicates in this trial. Bollgard 3 cottonvariety was selected for this trial and seeds were treated with 10% solution of each fertilizer product. Seeds were then placed in Petri dishes and each petri dish had 10 seeds. Petri dishes were misted, covered with lids, and then placed in a dark area. Germination count was recorded daily starting from day 3. Seedling measurements were taken after 12 days of treatment application.

Table 1: Application rates and product analysis of Zinc fertilizers and other organic activators.

Treatment	Rate	Product Analysis
Control	N/A	N/A
Amino Boost Transit Max	10%	10% Amino Acids, 6% Kelp, 4% Fulvic Acids, 1.5% Organic activators, 1.4% N
Momentum ZnP	10%	18.10% P, 2% K, 14% Zn
Momentum ZnP with Amino Acid and CPPA	10%	18.10% P, 2% K, 14% Zn + Amino Acid + CPPA
Momentum ZBM Trio	10%	5.30% B, 5.01% Zn, 0.24% Mo, 0.15% Mg + Amino acids
Transit Re-Leaf	10%	Fulvic acids, Amino acids, CPPA
Transit Zn	10%	3.67% N, 10.40% Zn, CPPA + Amino acids
CPPA	10%	Patented Organic
Momentum ZnP + Transit Re-Leaf	10%	18.10% P, 2% K, 14% Zn & Fulvic acids, Amino acids, CPPA

Figure 1: Cotton seeds; variety Bollgard 3

4. Observations

Germination Count

From day 3 onwards, the germination count was recorded daily and comparative photos were taken to visualize the impact of Zn products and organic activators on seed germination.

Comparative Photos

Comparative photos were taken to visually compare the seedling growth and root development.

5. Results

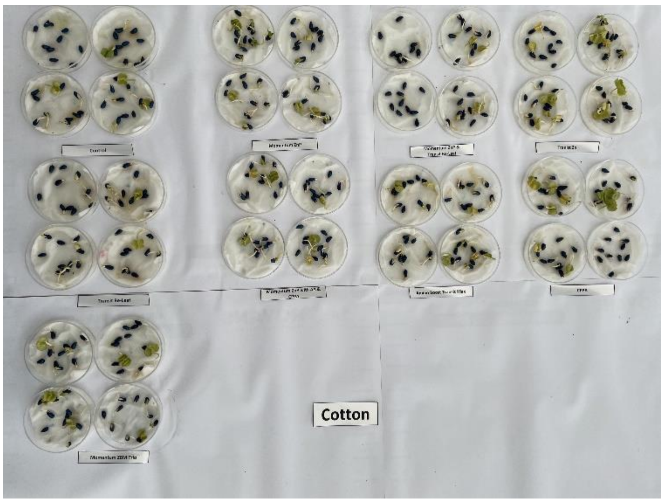

Figure 2: Visual comparison of seed germination in different treatments in day 4

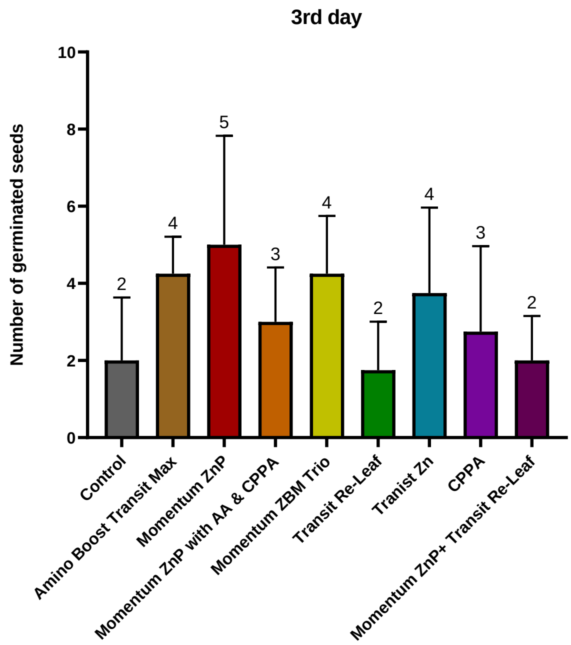

Figure 3: Effects of different Zn fertilizer products and organic activators on cotton seed germination in day 3.

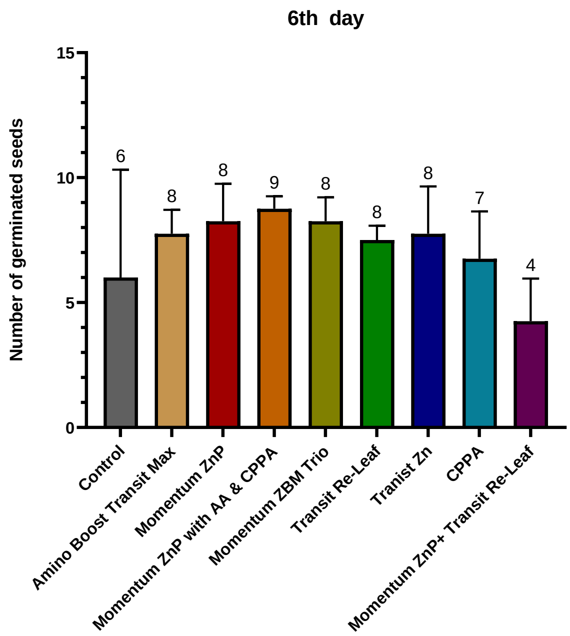

Figure 4: Effects of different Zn fertilizer products and organic activators on cotton seed germination in day 6.

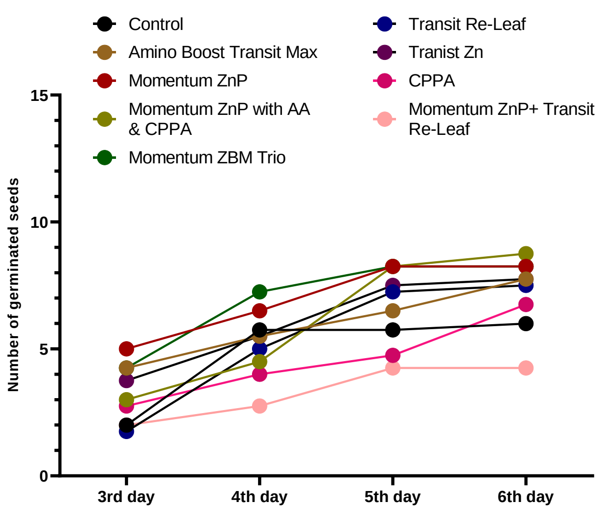

Figure 5: Changes in germination count with time starting from day 3 to day 6

6. Discussion

Germination data were collected from day 3 of the seed sowing and Momentum ZnP had the highest germination count than all other treatments (Figure 3). Amino Boost Transit Max, Momentum ZnP with amino acids and CPPA, Momentum ZBM trio, Transit Zn and CPPA had higher germination counts than the control. Figure 2 shows the visual comparison of seed germination in different treatments in 4. By the day 6, all treatments except the combination of Momentum ZnP and Transit Re-Leaf had highest germination count than the control (Figure 4). Figure 5 shows the changes in germination count with time starting from 3 days of treatment application and seed sowing to day 6.

These results can be explained by the impact of Zinc, Phosphorous, Amino acids, and CPPA on seed germination as well as plant growth and development. Zinc is a crucial micronutrient for better and vigorous wheat growth. It is both an activator and component of many enzymes and also influences auxin development (plant growth hormone) which promotes strong crop growth (Begum et al., 2016). Numerous studies have demonstrated that Zinc is responsible for a higher and a quality wheat yield (Arshad et al. 2016). Similarly, Auxin promotes stem elongation and guides shoot tips toward light sources which is a movement known as phototropism. Auxin also plays a role in maintaining apical dominance which explains the significant increment in plant growth parameters between the treatments and the control.

Furthermore, the application of Phosphorous is greatly influenced by yield maximizing in wheat (Grant and Baile, 1989). Phosphorous is the key nutrient for better root and shoot growth, especially in the early stages (Boring et al., 2018). Moreover, Phosphorus is incorporated into many organic compounds such as DNA, proteins, lipids, and enzymes. These organic compounds assist in energy transfer, nutrient uptake, and transport. A slow-release form of phosphorus allows for better nutrient utilization and absorption during the season (Talboys et al., 2015). In addition, Zinc and Phosphorous have a great impact on plant root growth and several studies have demonstrated the importance of these nutrients on root growth in different plants such as Zea mays L. and rice (Hajabbasi and Schumacher, 1994, Phuphong et al., 2020). Therefore, this difference should be due to the influence of Zinc on seed germination and photosynthesis (OHKI, 1976).

Amino acids play a crucial role in plant growth and development. There are numerous studies have been conducted to assess the importance of amino acids on plant growth and development. Amino acids can, directly and indirectly, influence plant growth and development by affecting plant physiological activities. It was found that the foliar application of amino acid is beneficial for vegetative and reproductive growth as well as the yield quality of grapes (Khan et al; 2012). CPPA (Complex Polymeric Polyhydroxy Acid) is a group of organic acids that enhance various plant physiological functions such as nutrient absorption, shoot, and root growth.

7. Conclusion

This trial was conducted to assess the effectiveness of different fertilizer products on seed germination in cotton. The results revealed the application of Amino Boost Transit Max, Momentum ZnP, Momentum ZnP with amino acids and CPPA, Momentum ZBM trio, Transit Re-Leaf, Transit Zn and CPPA improved the cotton seed germination. Therefore, it can be concluded that all of these products except the combination of Momentum ZnP and Transit Re-Leaf are beneficial as seed treatments in improving cotton germination.

8. References

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