Assessing the Effectiveness of Different Zn Fertilizer Products on Early Seedling Growth in Lentil

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Abstract

Lentil plays a crucial role in Australian grain production. The yield and the quality of the yield is highly depended on crop management practices and crop nutrition management. Phosphorous and Zinc are the most crucial nutrients in wheat nutrition management. This trial was conducted to analyse how liquid injection of commonly used Zn fertilizer products at seed sowing improved plant growth parameters such in wheat seedlings. It was found that lentil seeds treated Momentum ZnP, Dual Force Zn and EDTA Zn treated lentil plants showed highest shoot weight than all of other treatments. Also, EDTA Zn treated plants had the highest root length than other treatments. Moreover, EDTA Zn, Zn Oxide and Dual force Zn had the significantly highest fresh weight of plants. Therefore, it can be concluded that the application of Dual Force Zn and EDTA Zn as seed treatment has a great influence on lentil plant growth and development.

Keywords: Lentil, Zn Fertilizer, Plant height, Root Length, Root architecture

1. Introduction

Grain industry is the Australian second largest agricultural industry which contributes 27% of the gross value of production (Our industry, 2022). Lentil is an important pulse crop in the world. Australia is one of the major lentil producers in the world and contributes to around 10%of the world's lentil production. Yield and the quality of the lentil yield are highly dependent on macro and micronutrient management (Sadras et al., 2021). Zinc and phosphorous are the key nutrients for a 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 which increases production of energy molecules, plant growth hormones and facilitates photosynthesis and nutrient transport.

It is well documented that application of Phosphorous greatly influenced for the yield maximizing in wheat (Grant and Baile, 1989). Phosphorous is the key nutrient for better root and shoot growth specially in 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. Slow-release form of phosphorus allows for better nutrient utilization and absorption during the season (Talboys et al., 2015).

Zinc is a critical element for a 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. Numerous studies have demonstrated that Zinc is responsible for a higher and a quality wheat yield (Arshad *et al*. 2016). In addition, it was found that the

foliar application of Zn is beneficial for improving plant growth and crop yield (Pal, Mondal, & Samanta, 2019).

Dual Chelate Fertilizer Pty Ltd has developed a premium quality fertilizer product called Momentum ZnP. It 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 with 18% Phosphorous, 14% Zinc, 2% Potassium and patented organic activators. Dual Force Zn is a new patented IDHA chelate technology which is the only environmentally-friendly, synthetically produced chelate on the market. In this study, lentil seeds were treated with different Zn products at seed sowing through direct injection. In this trial, analyses were done on plant height, root length, fresh weight of plants.

2. Objectives

The specific objectives of this trial were to:

- Measure plant heights of each treatment.
- Uprooting plants for taking the root length and for comparing root structures in each treatment.
- Get the fresh weight of plants in each treatment
- Visual comparison of plant growth in different treatments

3. Materials and Methods

Site selection and Trial Design

This trial was conducted on a farm in Meatian, Victoria. PBA Highlander variety was used for this trial. Trial design was Randomized Complete Block Design (RCBD) and each treatment had 4 replicates (Figure 1). At sowing, treatments were applied to seeds at planting through direct injection to ensure that the application was made in contact with the lentil seeds. Measurements and data collection for each treatment was done after 6 weeks of the treatment application.

Table 1 shows the application rates and dates for the Momentum ZnP trial. The application was only made once at seed sowing. For the rest of the growing season, the orchards regular fertiliser program was applied.

Table 1: Application rates of different Zn products

Treatment	Rate (L/ha)
Grower Practice	40 kg/ha MAP
Momentum ZnP	2L/ha
Dual Force Zn	1kg/ha
EDTA Zn	1kg/ha
Zn Oxide	200ml/L
Zn Sulphate	2L/ha

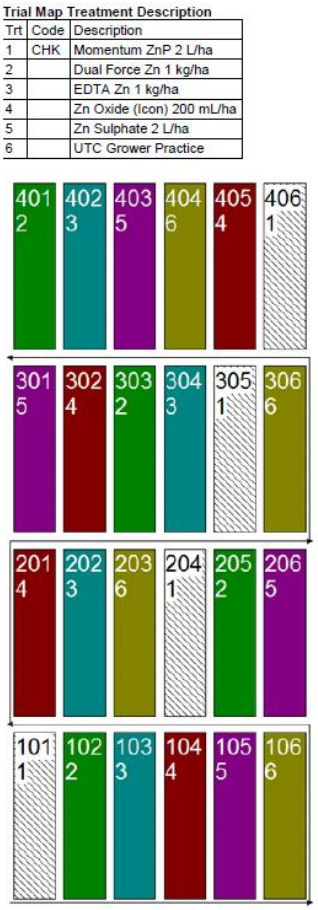

Figure 1: Trial Design

4.Observations

Plant Height

In each treatment, 10 randomly selected plants were measured from the soil surface to the point of the longest leaf in each of the 3 treatments using a ruler. The results were then analysed using GraphPad Prism software to determine any significant differences in plant height between the treatments.

Fresh weight of plants

Ten plants were randomly uprooted from each treatment and fresh weight was recorded.

Comparing root length and root systems

Ten plants were randomly selected from each treatment and carefully uprooted to analyse the root systems between each treatment. These plants were washed in clean water and then carefully laid out on a white board to take the root length.

Also, comparative images of each of the treatments were then made to visually observe any differences in the root systems of the lentil plants.

5. Results

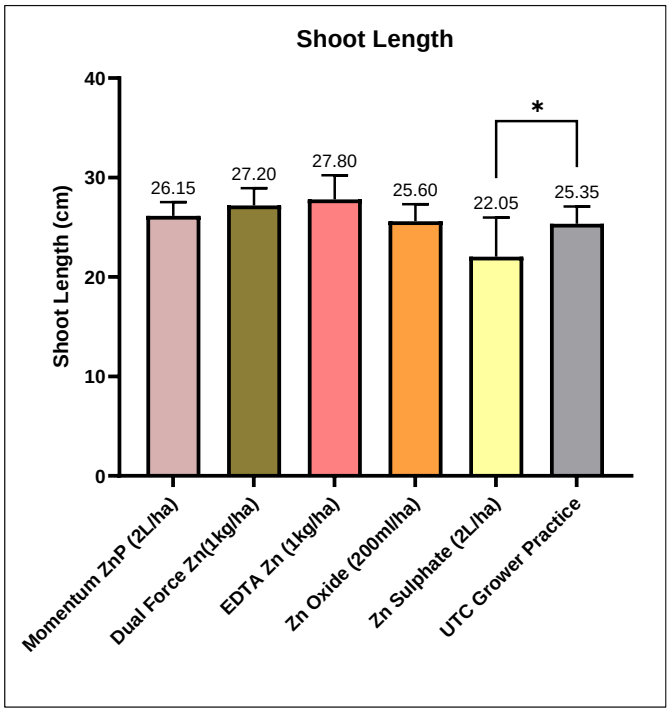

Figure 2: Plant height (cm) lentils after 6 weeks of the treatment application. Significant difference between treatments (*P<0.05)

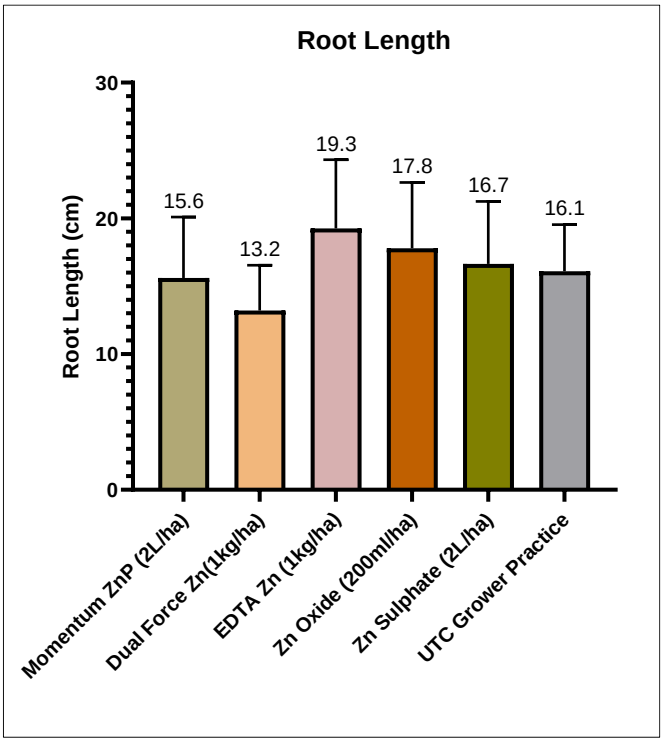

Figure 3: Comparison of root length (cm) of lentil after 6 weeks of treatment application and planting.

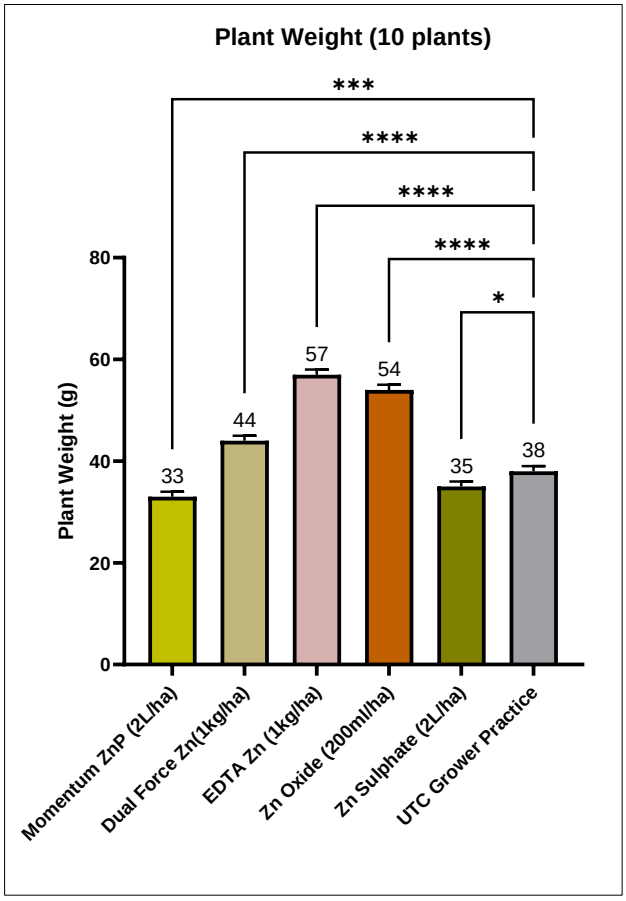

Figure 4: Fresh weight of 10 lentil plants after 6 weeks of the treatment application.

Figure 5: Comparisons of plant vegetative and root growth after 6 weeks of the treatment application. a: Grower Practice, b: Momentum ZnP, c: Dual Force Zn, EDTA Zn, Zn Oxide, Zn Sulphate

6. Discussion

After six weeks of the treatment application, Dual Force Zn, Momentum ZnP and EDTA Zn lentil plants gained a significantly higher average plant height compared to control and all other treatments (Figure 2). Figure 3 shows the average root length of each treatment. According to that, EDTA Zn has the highest root length than all other treatments. 10 plants were randomly selected from each treatment to get the fresh weight of plants and EDTA Zn, Dual Force Zn and Zn Oxide had the significantly highest fresh weight than control and other Zn treatments (Figure 4). Figure 5 shows the visual comparison of plant vegetative growth and root development in each treatment.

Zinc is a crucial micronutrient for a better and vigorous plant 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 towards 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 greatly influenced for the yield maximizing in wheat (Grant and Baile, 1989). Phosphorous is the key nutrient for better

root and shoot growth specially in 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. Slow-release form of phosphorus allows for better nutrient utilization and absorption during the season (Talboys et al., 2015). Therefore, the increment of plant growth parameters in Momentum Znp treated lentil plants should be due to the role of Phosphorous and Zinc. 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).

Dual Force Zn treated lentil plants have gained an improved plant growth compared to other Zn treatments and this difference can be explained by the benefits of IDHA chelated Zn. IDHA (Iminodisuccinic acid) is a new patented biodegradable chelating agent which is highly soluble and improves nutrient uptake compared to other traditional chelating agents. It is a fully biodegradable chelating agent making it the only environmentally-friendly synthetically produced chelate on the market and leaves zero residue. In addition, Dual force Zn is designed to supply plants with available zinc to improve enzymatic activity necessary for plant metabolism, photosynthesis and plant growth hormone production.

7. Conclusion

This trial was conducted to assess the effectiveness of different Zn products on lentil plant growth and development. Momentum ZnP, Dual Force Zn and EDTA Zn treated lentil plants showed highest shoot weight than all of other treatments. Also, EDTA Zn treated plants had the highest root length than other treatments. Moreover, EDTA Zn, Zn Oxide and Dual force Zn had the significantly highest fresh weight of plants. Therefore, it can be concluded that Dual Force Zn and EDTA Zn have a great influence on lentil plant growth and development.

8. References

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