Evaluating the Benefits of Transit Kelp® Against other Commercial Kelp Fertilizers to Assess Root Development

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Kelp is a type of seaweed that grows in nutrient-rich, shallow saltwater. It is rich in nutrients including vitamins, minerals, antioxidants, and plant growth regulators. Also, it includes Alginic acid and Amino acids which help in stress relief and provides building blocks for proteins (Černá, 2011). Kelp contains cytokinin as plant growth regulator and cytokinin is important for cell division and root apical dominance (Taylor, Harker, Robertson and Foster, 1990). Therefore, kelp is crucial for root growth and overall plant growth. In agriculture, there are m any varieties of kelp bio-stimulant products. This trial was done to assess the different commercially used kelp bio-stimulant fertilizers against Dual Chelate Fertilizer® Transit Kelp® to assess differences in root development using Soybeans. It was found that soybeans treated with Transit Kelp® significantly improved the root fresh weight compared to the other kelp treatments with an average weight of 3 grams. Transit Kelp® also significantly improved the root length of soybeans compared to the other treatments with an average length of 22.3 cm. Images also show that Soybeans treated with Transit Kelp® also visually produced a better root system that other treatments. The primary roots were longer and the lateral roots were thicker creating more surface area.

Key words: Kelp, root growth, plant growth regulators, soybeans, root weight, root length.

Introduction

The addition and use of kelp in fertilizers has been a popular choice amongst the agricultural industry, especially in horticulture, as a bio-stimulant which enhances plant nutrient uptake and helps reduce plant stress to conditions such as droughts, frosts and water deficient areas (Khan et al., 2009). Kelp has been proven to have high levels of plant growth stimulants (hormones) such as cytokinin and auxin which together help plants in creating new growth in their shoots and roots promoting the uptake of key macro and micro nutrients. In conjunction with growth stimulants, kelp also has a diverse range of macromolecules and compounds such as proteins, amino acids and carbohydrates which all greatly assist in numerous plant growth areas (Nabti, Jha and Hartmann, 2016). As kelp becomes a more popular choice amongst Australian agriculture, it is extremely important to understand the direct benefits towards the Australian horticultural sector. This study is focused on comparing different commercially available kelp and seaweed plant bio-stimulants in an effort to show case Dual Chelate Fertilizer Transit Kelp® as a premium and more advanced bio-stimulant formulation in comparison to other commercial kelp/seaweed brands in order to promote root growth.

Australian agriculture is constantly being hindered by stressors such as high demands for horticultural goods, unfavourable weather conditions such as heatwaves, droughts and frost and also having to battle against extreme water limitations. These stressors can cause severe damage to crop yields and also reduce farm return on investments (Francini and Sebastiani,

2019). The use of kelp is now being adopted amongst farmers in the irrigation sector. Dual Chelate Fertilizer has created a highly pure kelp enriched bio-stimulant – Transit Kelp. Transit Kelp contains 8% highly concentrated kelp derived from the *Laminaria japonica*. This formulation is highly refined and highly pure making it a premium product for both foliar and fertigation in horticulture.

In this study, different commercially used fertigated kelp and seaweed products will be applied to soybeans in an effort to compare their direct effect on root growth and development. 5 different kelp products, including Transit Kelp will be applied to soybeans and compared to assess root weight and root length. At the end of the experiment, the plant will be dug up and carefully examined with particular attention to their root structure. Comparative photos will be taken of each treatments root structure to gain a visual comparison.

Objectives

1. Assess the differences observed between each different kelp products on root development
2. Measure fresh root weight and root length and make graphs for comparisons.
3. Visually compare the root system of all treated soybeans 1 month after the beginning of the experiment to compare any visual differences.
4. Determine which kelp product is the most effective on plant growth in terms of root development.

The outcome of this trial will assist in showcasing the direct benefits of Dual Chelate Fertilizer Transit Kelp® in comparison to other competitive seaweed/kelp fertilizer products.

Materials and Methods

Site Selection and Trial Design

The trial will be conducted in the greenhouse located at Dual Chelate Fertilizer. This site was selected as this trial will be undertaken using hydroponics as the trial will need to be monitored daily for measurements and kelp applications.

In total, there will be 5 different treatments of kelp bio-stimulants, Transit Kelp® and 4 other commercially available seaweed/kelp products. For each of the treatments there will be 3 replications of each treatment and 3 plants in each replicate to allow for accurate statistical analyses (see figure 1 for trial layout). A control will not be used as it won't provide an accurate comparison between treatments. Below shows the layout for this trial.

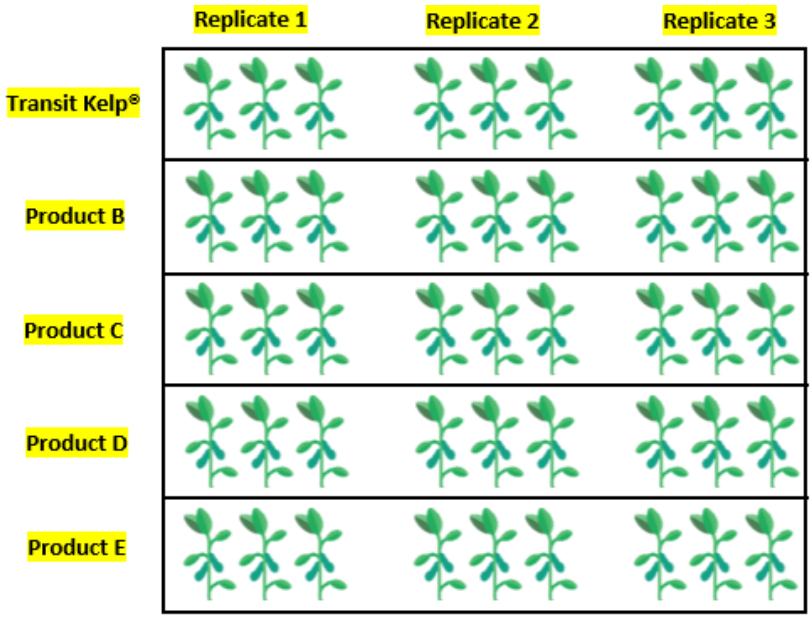

Figure 1: Trial set up comparing various kelp/seaweed treatments on Soybean's (Glycine max).

The trial will be run over the span of 1 month with treatments being applied to the Soybeans every 3 days. The reason the application rate is high is because a positive reaction is going to be induced to see the direct effects that different commercial kelp has on growth.

The medium used to plant the soybeans in is vermiculite. This substance will allow for easy root exploration and also allow the roots to be removed and examine without damage. Vermiculite also has no added nutrients which stops any variable factors which other potting mediums such as potting mix may have. It is important to note that since the Soybeans only had applications of kelp and no other added nutrients, the soybeans were chlorotic towards the end of the trial as they were very nitrogen deprived.

Kelp Treatment	Application rate
Transit Kelp®	**0.137ml/pot**
Product B (Ax)	**0.005g/pot**
Product C (Sx)	**0.33g/pot**
Product D (Fx)	**0.027g/pot**
Product E (Nx)	**0.0687 g/pot**

Application Rates

Table 1: Application rates of different commercial kelp products. Names of the commercial products cannot be disclosed due to legal reasons. Application rates were calculated from the actual rates advised by each company's kelp product.

The application rates of each kelp product were based on the application rate on the respective labels. The rate was then used to work out how much kelp was needed to be applied to each pot. Every 3 days kelp was applied to the pots with the rates highlighted in table 1.

Observations

Root measurements will be taken at the end of the experiment. Measurements include root weight and root length with comparisons also being taken at the same time.

Root Weight

At the end of the experiment, fresh root weight will be measured from each soybean plant. To keep a consistent measurement, the roots will be cut at the point where the roots turn into the base shoot of the plants. These roots are then dried with some paper towel and then weighed.

Root Length

Once the roots are removed and weighed, a ruler will be used to measure the length of each soybeans root from the top of the root system to the longest point in the root system.

Comparative Photos

Once the roots have been measured, each treatments roots will be collected together and a photo will be taken to compare the root system of each treatment.

Results

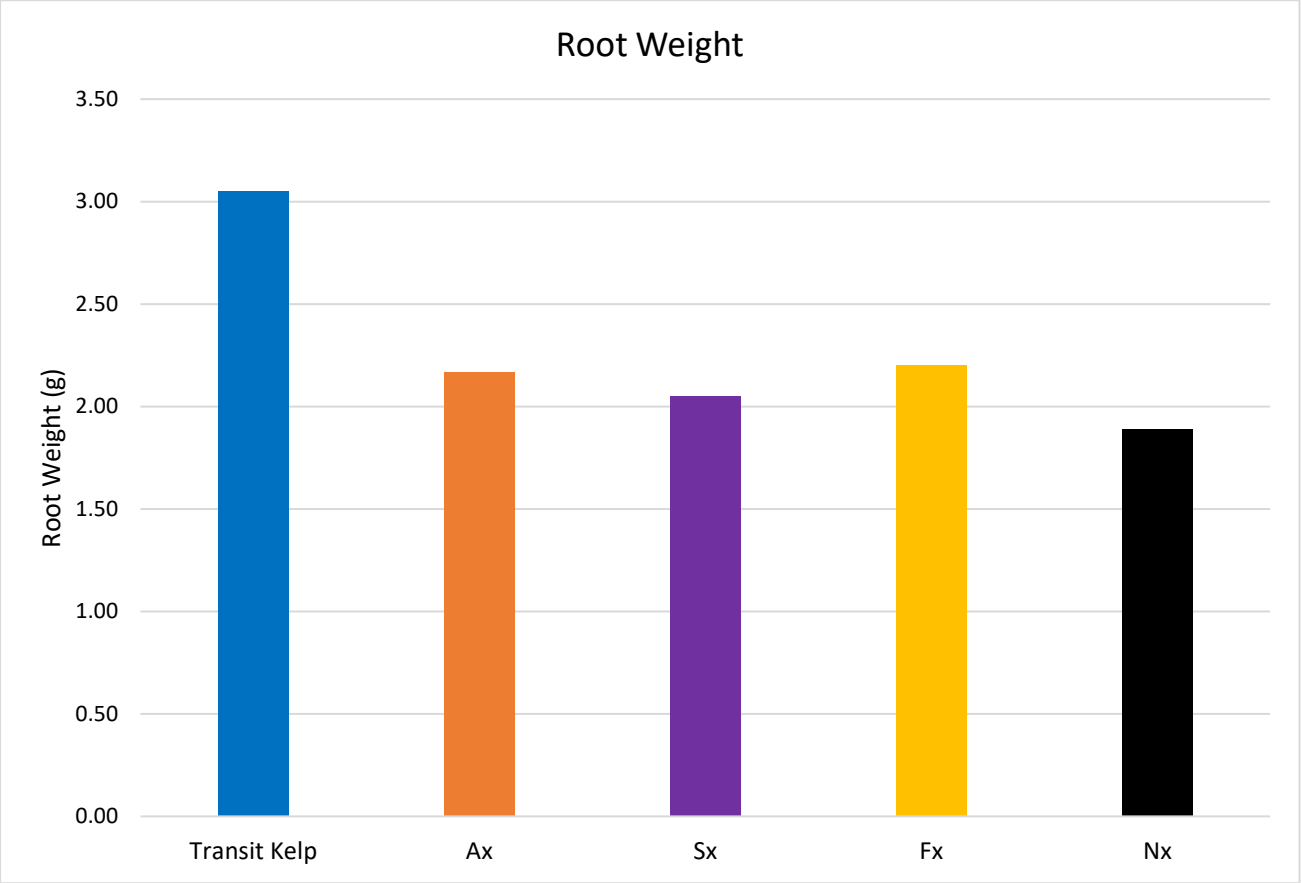

Figure 2: Average fresh root weight of soybeans treated with different types of kelp treatments. These measurements were taken at the end of the experiment on the 15/07/20.

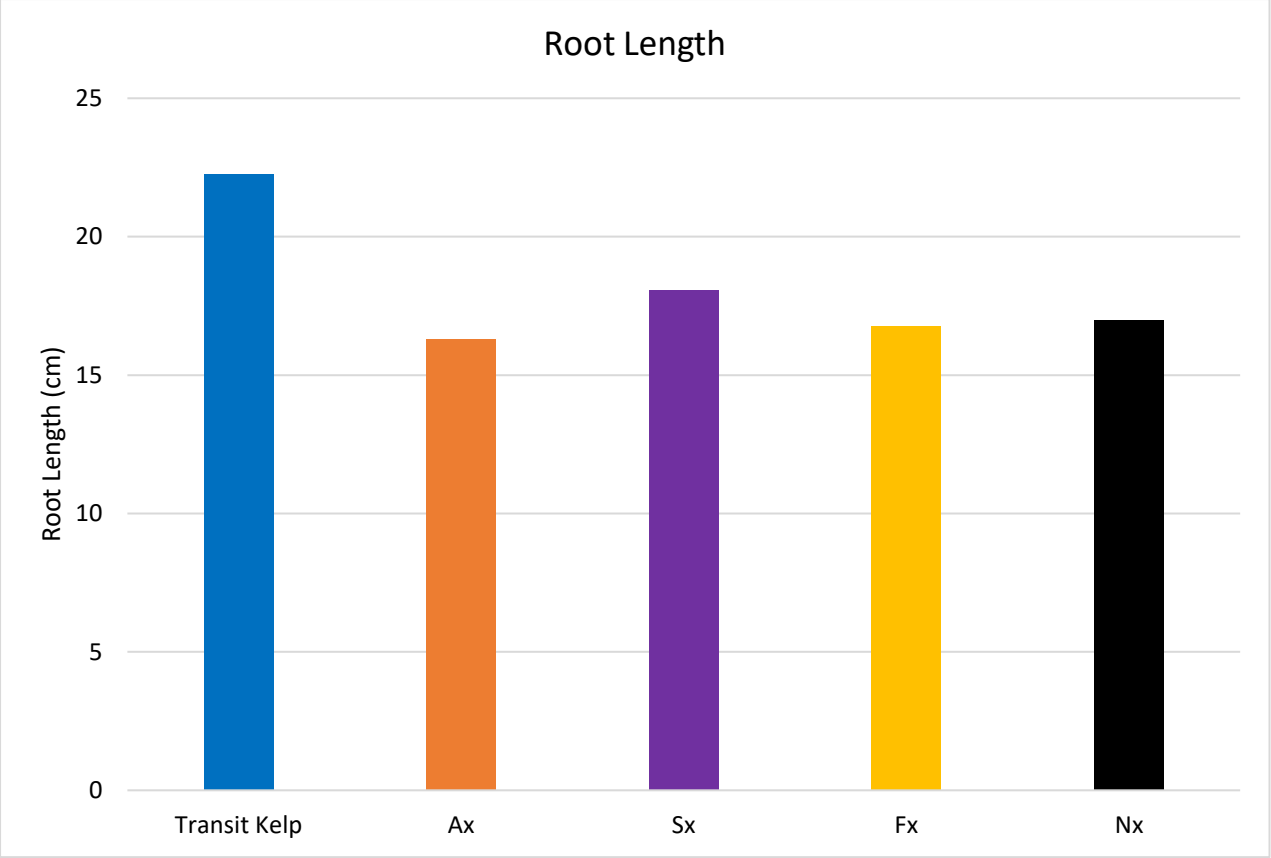

Figure 3: Average fresh root length of soybeans treated with different types of kelp. These measurements were taken at the end of the experiment on the 15/07/20

Figure 4: Root structure of soybeans treated with Transit Kelp®

Figure 5: Root structure of soybeans treated with Ax

Figure 6: Root structure of soybeans treated with Sx

Figure 7: Root structure of soybeans treated with Fx

Figure 8: Root structure of soybeans treated with Nx

Discussion

When looking at figure 2, it can be seen that Transit Kelp® treated soybeans had the highest average fresh root weight overall compared to all the other treatments. It was calculated that Transit Kelp® treated soybeans were significantly heavier than all other treatments ($P<0.05$). The reason why Transit Kelp® treated soybeans had the largest root mass is because Transit Kelp® contains a large concentration of the plant growth regulator Cytokinin. Cytokinin is involved in cell growth and differentiation, effects apical dominance, axillary bud growth and prevents leaf senescence (Akhtar, Mekureyaw, Pandey and Roitsch, 2020). When applied directly to the root system, the Cytokinin's assist in the development of new roots and also the development of lateral roots as well. This is seen in figure 4 where Transit Kelp® treated soybeans produced a large root system with lots of lateral root development and also long primary root development.

Figure 3 shows the average fresh root length of soybeans treated with different types of commercially available kelps. It was found that soybeans treated with Transit Kelp® on average has significantly longer roots compared to the other kelp treatments ($P<0.05$). Soybeans treated with Transit Kelp® had an average root length of 22.3cm compared to other treatments which averaged between 16.3 cm and 18.1 cm. This high root length displayed in the Transit Kelp® treated soybeans is again correlated to Transit Kelp® containing high levels of the plant growth regulator Cytokinin. Cytokinin is a hormone used to increase root apical dominance which is the increase in length of the main root or primary root produced by the soybeans. When looking at figure 4, it can be seen that the main root is much longer and more defined compared to other kelp treatments. These other treatments do not display as much root apical dominance and more lateral root dominance making the root system look short and stumpy. Transit Kelp® treated soybeans are at an advantage due to the increase in root apical dominance. Longer root systems are able to access water and nutrients at a much deeper depth compared to the other treatments which displayed less root apical dominance.

Conclusion

In conclusion, this trial was conducted to evaluate the benefits of Transit Kelp® against other commonly used commercial kelp fertilizer to assess root development. A number of different root growth parameters were measured between each treatment to assess which treatment was the best at growing the root system of young soybeans plants with limited nutrition. The measurements taken were fresh root weight, root length and a visual analysis of root growth with comparative photos.

When studying the figures presented above, it can be found that soybeans treated with Transit Kelp® had the following improvements compared to other commonly used commercial kelps in horticulture.

- Soybeans treated with Transit Kelp® produced the heaviest fresh root weight compared to other treatments. On average, Transit Kelp® treated soybeans had a fresh root system which weighed 3 grams. This was statistically significant compared to other kelp treatments.
- Transit Kelp® treated soybeans produced the longest root system of all treated soybeans with an average length of 22.3cm. This was also statistically significant compared to the other kelp treatments
- When looking at the comparative images of treated soybean root systems it can be seen that Transit Kelp® treated soybeans had more root apical dominance and thicker lateral root development compared to other treated soybeans.

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