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Effect of Plasma Activated Water Application on the Growth of Canola and Barley Microgreens

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INTRODUCTION

Cold plasma technology is an innovative tool with diverse applications, ranging from the food and agriculture industry to medicine and material sciences. One of the most notable uses of cold plasma and plasma-activated water (PAW) in agriculture and plant sciences is the treatment of seeds and enhancement of plant nutrition, due to the activity of the highly reactive species present in it.

On the other hand, recently, there has been growing interest in the consumption of small plants known as microgreens. These tiny plants are an intermediate stage between sprouts and baby greens and can be considered immature plants. They typically range in size from 5 to 10 centimeters and can be harvested in about two weeks. Microgreens are notable for their high content of bioactive compounds, making them appealing from a health perspective. Additionally, they are easy to cultivate on a small scale and can be grown using liquid substrates.

The aim of this research was to determine the plant growth improvement by the utilization of PAW.

METHOD

Seed Sterilization and germination: Canola and Barley seeds were sterilized by adding seeds into 4% bleach solution, vortex it for 2 minutes, discarding the bleach and vortex the seeds again with 70% alcohol for 3 minutes and then rinsing with deionized water for 6 times. Once the seeds were sterilized, they were transferred onto a petri plate containing filter paper and water for germination for 3-4 days.

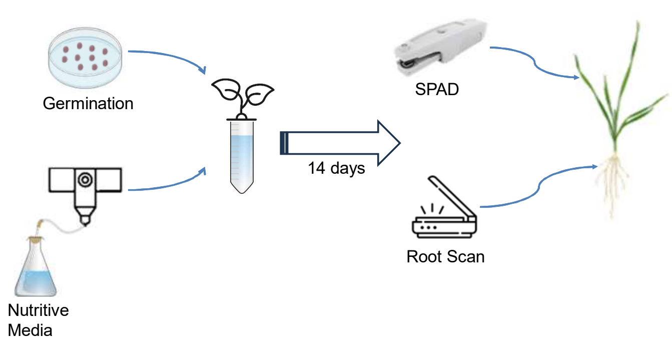
Nutritive Solutions: Hoagland's Solution without Nitrogen 25% as control, KNO_3, PAW was prepared using deionized water activated with a plasma jet and air as a carrier gas with a flowrate of 1.00 liter per minute.

Cultivation tubes preparation: Falcon tubes for the experiment were prepared using 50 ml of nutrient solution containing a pipette tip in the cap

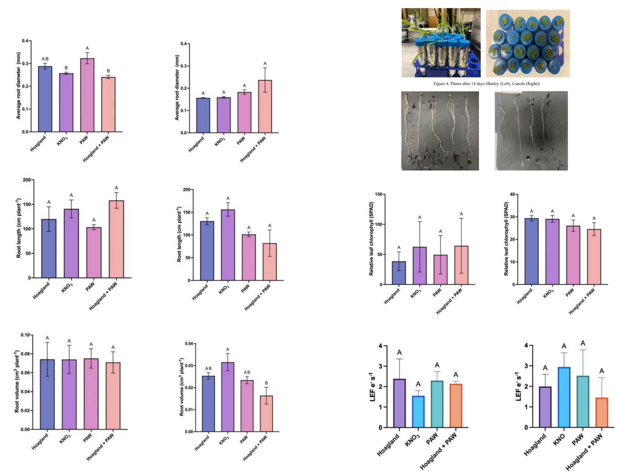
Root parameters: Root Diameter, Root Surface Area, Root Length, Root Volume were measured using winRHIZO software

SPAD and Linear Electron Flow: These parameters were determined using PhotosynQ. The plants were analysed using MultispeQ V 2.0 instrument.

Figure 1 contains a schematic diagram of the experimental procedure.



RESULTS & DISCUSSION



The results indicated that there was no significant difference between PAW and Hoagland's solution for all the characteristics among both the plants system. The Hoagland's solution root length, root surface area and light intensity values had higher mean values for Barley whereas PAW showed higher values for root volume, root diameter and SPAD value. However, the Hoagland's solution treated with plasma jet showed higher mean values than both the Hoagland's solution and PAW for root length, root surface area and light intensity. As for Canola, the Hoagland's solution showed higher mean values for root length, root surface area, root volume, SPAD and PAR values. It can be concluded that for a better growth performance of Barley, plasma jet can be utilized, whereas Hoagland's solution should be utilized for Canola samples. As no significant difference was observed between PAW and Hoagland's solution, PAW can be utilized as alternative of Hoagland's solution, but further studies on effect of RONS on plant growth needs to be evaluated.

CONCLUSION

This study evaluated the effects of plasma activated water (PAW) on the growth of canola and barley. Results showed no statistically significant differences between PAW and Hoagland's solution in most growth parameters. While Hoagland's solution generally performed better, PAW maintained plant development at comparable levels, particularly in barley, where it improved root diameter and SPAD values. In canola, Hoagland outperformed PAW in root metrics and chlorophyll content. The limited nutrient profile of PAW, especially the absence of key elements like phosphorus and manganese, may explain its lower performance. However, combining PAW with nutrient-rich solutions (e.g., plasma-activated Hoagland) showed potential synergistic effects. Overall, PAW demonstrates potential as a supplemental component in nutrient management strategies, though species-specific responses and long-term impacts require further investigation.

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