Enhancing Seed Quality in Vegetables Using Low Temperature Plasma

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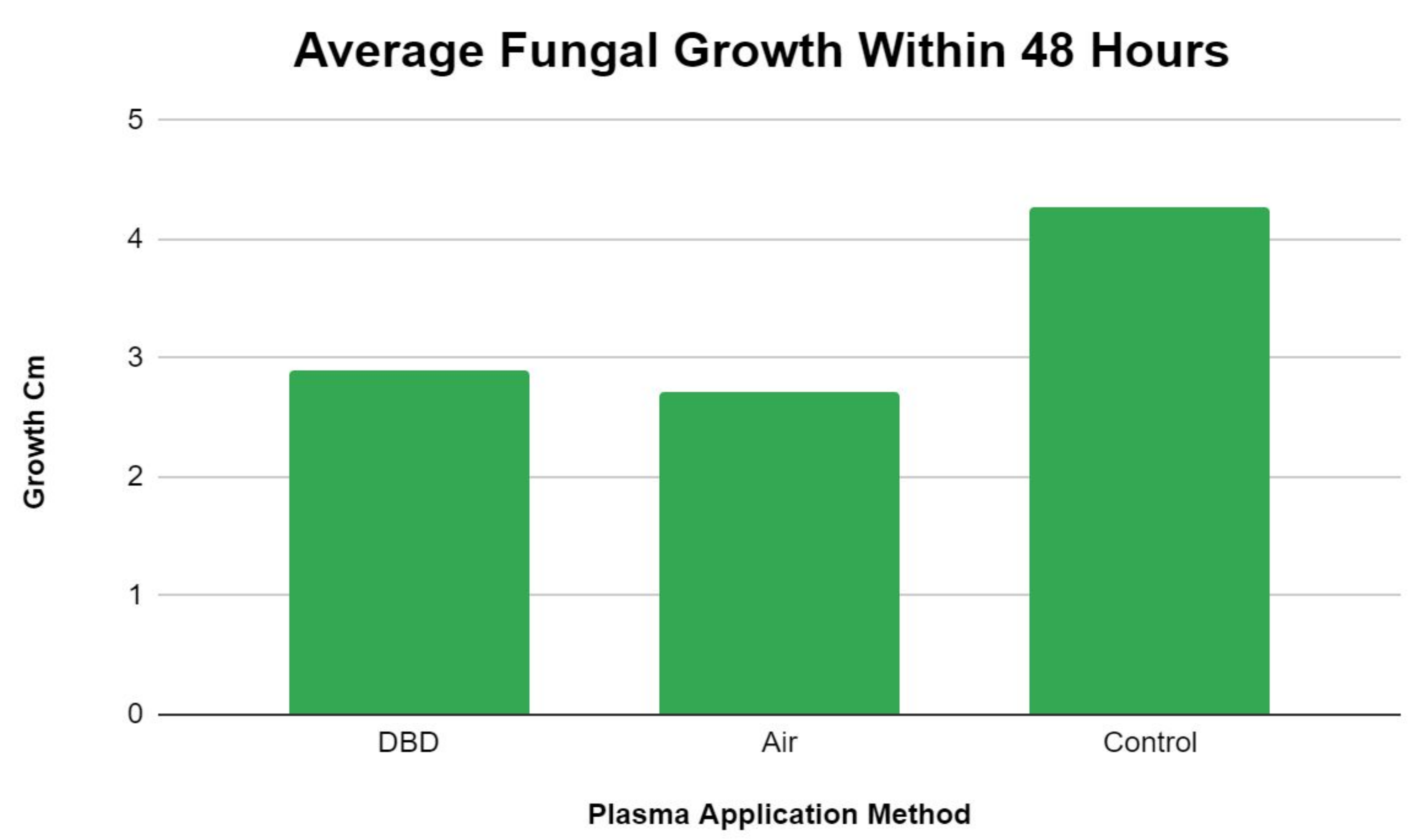
Abstract

Low temperature plasma (LTP) is gaining more attention as an alternative to chemical disinfectants, due to its demonstrated applications of harm in agriculture. The objective of this research was to assess the effectiveness of LTP in suppressing Stemphylium botryosum, a seedborne fungal plant pathogen infecting spinach seeds and plants. LTP was generated with Dielectric barrier discharge (DBD) and Air plasma jet method using helium (8kV, 6kH, pulse width - 1s) and applied directly on mycelia of Stemphylium botryosum strains. The fungal strains were exposed to LTP at 0, 30, 60, and 120 s at the University of Alabama, Huntsville. Both plasma-treated and non-treated mycelial cultures were incubated at 25 C under continuous white light and their growth determined.

Introduction

Low-temperature plasma (LTP) is a non-equilibrium, weakly ionized gasses consisting of ions, electrons, excited neutrals, free radicals, and photons generated in the open air. Different types of plasmas *viz*., plasma jets, corona jets or microwave plasma are generated by exciting and removing bound electrons with electric fields (Von Keudell and von Der Gathen, 2017; Adamovich et al., 2017). Cold or Low Temperature Plasma technology is emerging as a chemical-free biocide, surface disinfectant of plant seeds and other propagules, fresh leafy vegetables, poultry meat, and plant growth enhancer.

Results



Mycelia in V8 agar before plasma treatment seen in Figure (A)

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FIGURE (A)

FIGURE (B)

Shown in Figure (B) is the growth of Mycelia after the Air plasma jet treatment

Fungal Growth After Dielectric Barrier Discharge & Air Plasma Jet Treatments

Exposure Time	DBD (A)	DBD (B)	Air (A)	Air (B)
48 hours after treatment				
30 sec	0.9 cm	0.8 cm	0.8 cm	0.8 cm
60 sec	0.7 cm	0.5 cm	0.8 cm	0.9 cm
120 sec	0.6 cm	0.8 cm	0.6 cm	0.6 cm
Control	1.5 cm	1.4 cm	1.3 cm	1.6 cm
96 hours after treatment				
30 sec	2.5 cm	2.5 cm	1.9 cm	1.9 cm
60 sec	1.8 cm	2.6 cm	2 cm	2.2 cm
120 sec	2.2 cm	1.5 cm	2.3 cm	1.5 cm
Control	2.7 cm	2.9 cm	2.6 cm	3.3 cm

Methodology

Multiple fungal strains of Stemphylium botryosum were successfully grown using V8 agar medium.The number of fungal strains was then narrowed down to one (strain 005) to further analyze the growth effects of low temperature plasma.Agar blocks containing mycelia of Stemphylium botryosum were aseptically cut to roughly (5x5 mm) sizes. They were then exposed to LTP at four different durations which were 0 (control), 30, 60, and 120 seconds. The treated fungi and the controls were transferred onto fresh V-8 agar medium overlaid with sterile filter paper (Whatman # 42) discs and incubated at room temperature under constant white light. Fungal mycelial growth was measured by the radius of the circle formed by the advancing edge of the mycelia in centimeters(cm).

Discussion

There was a significant difference in growth between the treated and non treated samples. Air plasma jet methods resulted in more growth suppression of Stemphylium botryosum after 96 hours. DBD and Air jet plasma treatments resulted an overall suppression for mycelial growth in S. botryosum.

References

Von Keudell, A., and V Schulz-von der Gathen. 2017. Plasma Sources Sci. Technol. 26 (2017) 113001 (16pp). https://doi.org/10.1088/1361-6595/aa8d4c

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