Chapter 7
Atmosphere Non-Thermal Plasma for Seed Treatment

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ABSTRACT

Cold plasma has attracted lots of attention among researchers because it has a wide range of applications, such as the automotive industry, textile industry, microelectronics, packaging, biomedical technology, food preservation, and agricultural sectors. Scientists have shown a great interest in non-thermal plasma because of its advantages such as low temperature, scalable size, low operation cost, flexible operation, and high electron and reactive specie density. Also, non-thermal plasma can be operated at atmospheric pressure, which is an advantage in the agriculture industry rather than operating in a vacuum. Recently atmospheric cold plasma pressure was selected as one of the plasma technologies applied in the agricultural industry for treating the surface of the seed with environmentally friendly technology that produces no hazardous waste. DBD plasma is one of the cold plasma techniques, which can be easily triggered at atmospheric pressure and room temperature.

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INTRODUCTION

Recently, non-thermal plasma has been widely used in biotechnology, medical treatment, food preservation, and agriculture. This is because non-thermal plasma does not cause hermal damage to living organisms, and it is also a green technology (Matra, 2016). Non-thermal plasma, which consisting of electrons, molecules, excited atoms, ionized gases, radicals, and a strong electric field considered as one of the physical methods for seed treatment (Lotfy,2017). A new approach is being proposed to assist germination and survival in the plasma treatment of seeds. Plasma-based treatment methods have been considered environmentally safe as used reactors were low energy consuming, the treatment process did not cause additional contamination, amounts of generated oxidants were low, and they did not retain in the ecosystem (Pawlat et al., 2018). It plays an important role in a wide range of plant developmental and physiological processes, including reducing the bacterial seed-bearing rate, altering seed coat structures, increasing seed coat permeability, and stimulating seed germination and seedling growth (Ling et al., 2014).

Based on preliminary investigations, it was verified that plasma pre-treatment of seeds of important agricultural crops is an effective tool for improvement of germination, shoot, and root growth because plasma has good fungicidal and bactericidal effects and increased water permeability by surface coat etching and stimulation of germination and seedlings growth (de Groot et al., 2018). Research on the active plasma-generated species such as ions, electrons, radicals, as well as heat and electromagnetic radiation and their effect on various materials, including plant tissues and microorganisms, produces promising results. Research on the effects of accelerated ions on plant tissue structures and even on microorganisms produces promising results (Pawlat et al., 2017). Many studies have been carried out using plasma treatment, and, surprisingly, most of them have shown positive results. For example, Sera et al. investigated the effect of plasma treatment on wheat and oat germination and early growth. They concluded from their studies that plasma treatment affected plant growth, improved footstalk on wheat seed, and accelerated rootlet generation on oat seeds (Park et al., 2018). Agun et al., (2021) studied the efficiency of DBD cold plasma pen treatment on the oyster mushroom bacterial decontamination. Their results show increments of exposure treatment times up to 3 min shows none growth of bacteria colonies. This because the bacteria cell wall was disrupt and destruction by the plasma bombardment. Thus able to extend the lifetime of the mushroom.