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Non-Thermal Plasma Treatment for Enhancing Seed Germination and Growth in Selected Vegetables

D. P. Subedi[1], R. P. Guragain[1], H. B. Baniya[2], B. P. Pandey[3]

[1]Department of Physics, School of Science, Kathmandu University, Dhulikhel, Kavre, Nepal

[2]Department of Physics, Tri-Chandra Multiple Campus, Tribhuvan University, Kathmandu, Nepal

[3] Department of Chemical Science and Engineering, Kathmandu University, Dhulikhel, Nepal

e-mail(speaker): dsubedi@ku.edu.np

Plasma treatments have emerged as a promising technology for enhancing seed processing in agriculture, aiming to improve the germination and seedling growth of various crops [1,2]. In this review, we focus into the current progress of plasma treatment techniques applied to seeds of cucumber (*Cucumis sativus*), beans (*Vigna unguiculata*), carrot[3] (*Daucus carota*), radish[4] (*Raphanus sativus*), fenugreek (*Trigonella foenum-graecum*), and coriander (*Coriandrum sativum*). The review encompasses detailed discussions on plasma treatment methods, the physical and chemical effects incurred, and the molecular mechanisms underlying the impact of non-thermal plasma (NTP) treatment. The study employed a cost-effective power supply operating at line frequency to generate the discharge, revealing electron density and excitation temperature on the order of 10^{11} cm^{-3} and 1 eV, respectively. The investigation highlights the intricate relationship between plasma and seed germination, elucidating phenomena such as seed coat modification and reactive species interactions. Furthermore, the results demonstrate that optimal exposure to NTP significantly enhances germination parameters, including germination percentage, mean germination rate, germination index, and vigor. However, prolonged NTP treatment exhibits a decline in these parameters. Additionally, seeds subjected to NTP exhibit an increased imbibition rate, enhanced surface roughness, and a substantial reduction in water contact angle. These findings underscore the nuanced response of seeds to NTP, emphasizing the critical role of exposure duration in determining outcomes. In conclusion, this review aims to present the underlying mechanisms of plasma treatment effects and discusses the potential applications of plasma as a powerful tool and priming agent for improving seed germination and growth in agricultural practices. The study provides valuable insights for researchers and practitioners seeking to leverage plasma technology for enhanced seed processing and crop productivity.

Fig1. Photograph of NTP during the treatment of seed.

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