

Doping in the desert: *Rhanterium epapposum* seed priming for enhanced germination and ecological restoration

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Rhanterium epapposum is an important native desert shrub species in AlUla, Saudi Arabia. It is known for its use in ecological restoration and desert landscaping. Its propagation is complicated because of difficulty in seed germination. Therefore, it is important to address such a problem to enhance its germination potential. Carbon dots (CDs) are one of the most promising carbon nanomaterials because of their low cost, simple synthesis, good biocompatibility and good water solubility. Recent studies have indicated seed priming as a way to enhance plant growth and production. However, the use of nitrogen-doped carbon dots (N-CDs) with green-light-emitting fluorescent features has not been tested for this purpose. Therefore, the aim of the current study was to investigate N-CDs prepared from Meyer lemon juice for the priming of *R. epapposum* seeds. N-CDs were prepared at carbonization temperature of 210°C for 2 hours. The fabricated N-CDs exhibited strong green light emission under UV light at 365 nm and the UV-Vis spectral showed peaks at 333 nm confirming formation of N-CDs. After confirming good properties, N-CDs were used for priming *R. epapposum* seeds at different concentrations (50, 100, 200 mg/L) for 24 hours, then transferred to filter paper in petri dishes, and the germination was monitored for two weeks. Priming in water was used as a control. Results indicated that the uniformly dispersed nanomaterials were efficient in enhancing seed development since N-CDs-primed seeds started growing from day 3, but seeds from the control started at day 6. Higher germination rate was observed for the seeds primed at concentrations of 50 and 100 mg/L N-CDs compared to other treatments. Interestingly, the primed seeds showed green fluorescence, indicating that N-CDs could be the perfect material for labelling the cells, and potentially used as nano-fertilizer for increasing seed germination for plant production.