

## SUMMARY

*Sustainable agriculture requires environmentally friendly technologies to increase crop yields with low risk of environmental damage. One promising approach is the use of nanotechnology materials, such as Carbon Quantum Dots (CQDs), which have nanoscale size, high fluorescence properties, and good biocompatibility. CQDs have the potential to be used as nanofertilizers because they can increase photosynthetic efficiency through their photoluminescence properties, thereby enhancing plant growth. Natural materials such as starfruit (*Averrhoa bilimbi* L.) can be used as precursors for the formation of CQDs. Therefore, this study aims to synthesize and characterize CQDs using starfruit precursors and evaluate their potential as nanofertilizers. This study aims to synthesize, characterize, and determine the activity of CQDs as an additional fertilizer for mung bean sprouts.*

*CQDs were synthesized using a hydrothermal method at 120°C for 12 hours. Material characterization was performed using UV-vis spectroscopy, fluorescence, FTIR, Raman, HRTEM, PSA, and zeta potential to determine the optical properties, structure, morphology, and stability of the particles. Photostability tests were conducted through UV exposure and storage for a specified period. Its activity as a nanofertilizer was evaluated by examining the growth of mung bean (*Vigna radiata*) sprouts, measuring root length, stem length, and leaf chlorophyll content.*

*The results showed that CQDs were successfully synthesized with nanometer-scale particle sizes (2-15 nm) and blue fluorescence. CQDs have UV absorption peaks at 244 and 310 nm, with a maximum fluorescence emission peak at 450 nm when excited at 360 nm. The quantum yield (QY) of CQDs reached 72.15%, indicating high emission efficiency. FTIR analysis revealed the presence of -OH, -COOH, C=O, and C-N groups, which support the stability and hydrophilic properties of the material. The results of the CQD photostability test showed a decrease in fluorescence intensity of 8.97% after UV exposure for 90 minutes and by 25.77% after storage for 30 days, which indicates good stability. The QY value of CQD was 72.15%. DLS data of CQD showed an average particle size of 5.4 nm (PDI = 0.32) and a zeta potential of +1.13 mV. The activity of CQD addition increased stem length, root length, and leaf chlorophyll content.*