

Regulation Mechanisms of Carbon Dots in the Development of Lettuce and Tomato

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Number of pages: 5

Number of figures: 7

Number of tables: 1

Characterizations of CDs

High-resolution transmission electron microscopy (HRTEM) images were collected in a JEOL-2010 electron microscope. The Fourier transform infrared (FT-IR) spectra were measured by a Nicolet Avatar 360 FT-IR spectrophotometer. X-ray photoelectron spectroscopy (XPS) spectra were obtained by employing an X-ray photoelectron spectroscope (AXIS ULTRA DLD, Kratos). UV-Vis absorption spectra were taken on a JASCO V-570 spectrophotometer. Photoluminescence spectra were recorded with an F-7000 Hitachi fluorescence spectrofluorometer. Laser scanning microscopy (LSM) was performed with LSM 710, Zeiss. FLS980 Edinburgh Instrument spectrofluorometer measurement system was used for the measurement of the absolute quantum yield, and then the QY is determined by $QY = L_{\text{Sam}} / (E_{\text{Ref}} - E_{\text{Sam}})$. Zeta potentials were determined by a Zeta potential analyzer (Brookhaven Instruments Corporation).

Properties of CDs

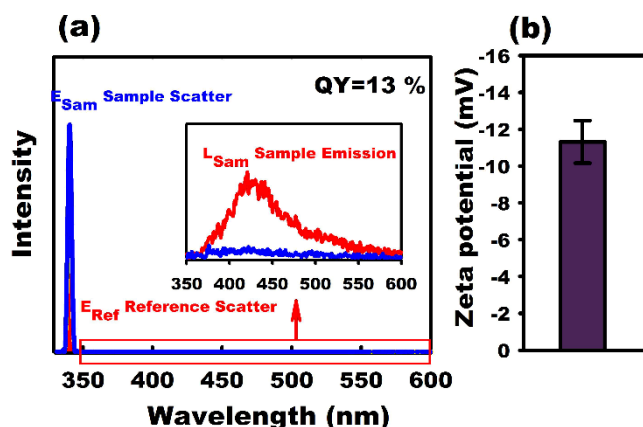


Figure S1. (a) The absolute quantum yield (QY) of CDs upon 340 nm excitation in water. (b) Zeta potential of CDs (0.066 mg/mL)

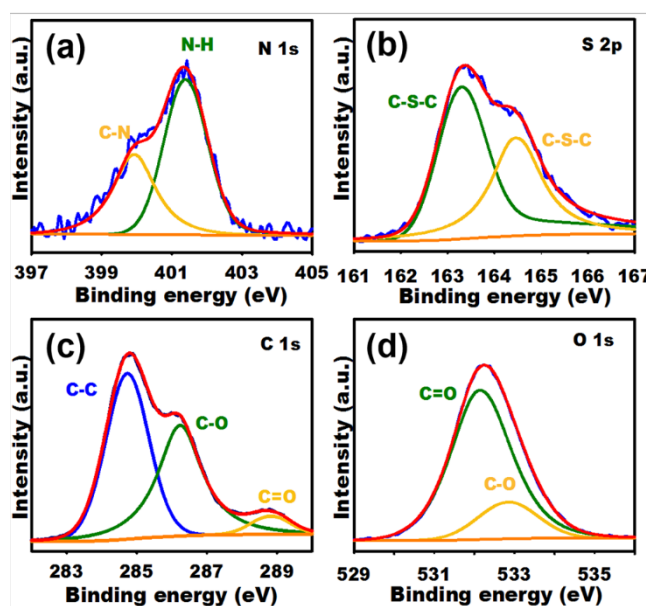


Figure S2. High resolution XPS spectra of C 1s (a), N 1s (b), O 1s (c), and S 2p (d).

The biocompatibility of CDs

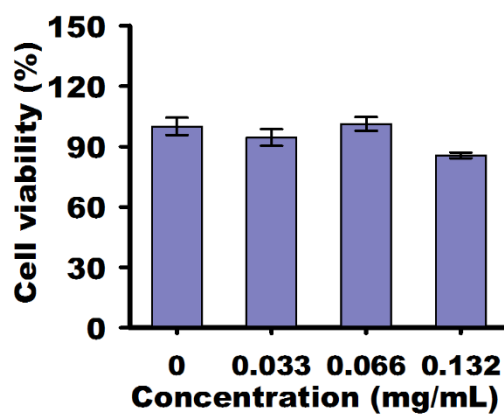


Figure S3. Viability of cells after 24 h treatment with different concentrations of CDs. Error bars indicate standard errors of four biological replicates.

The uptake of CDs in plants

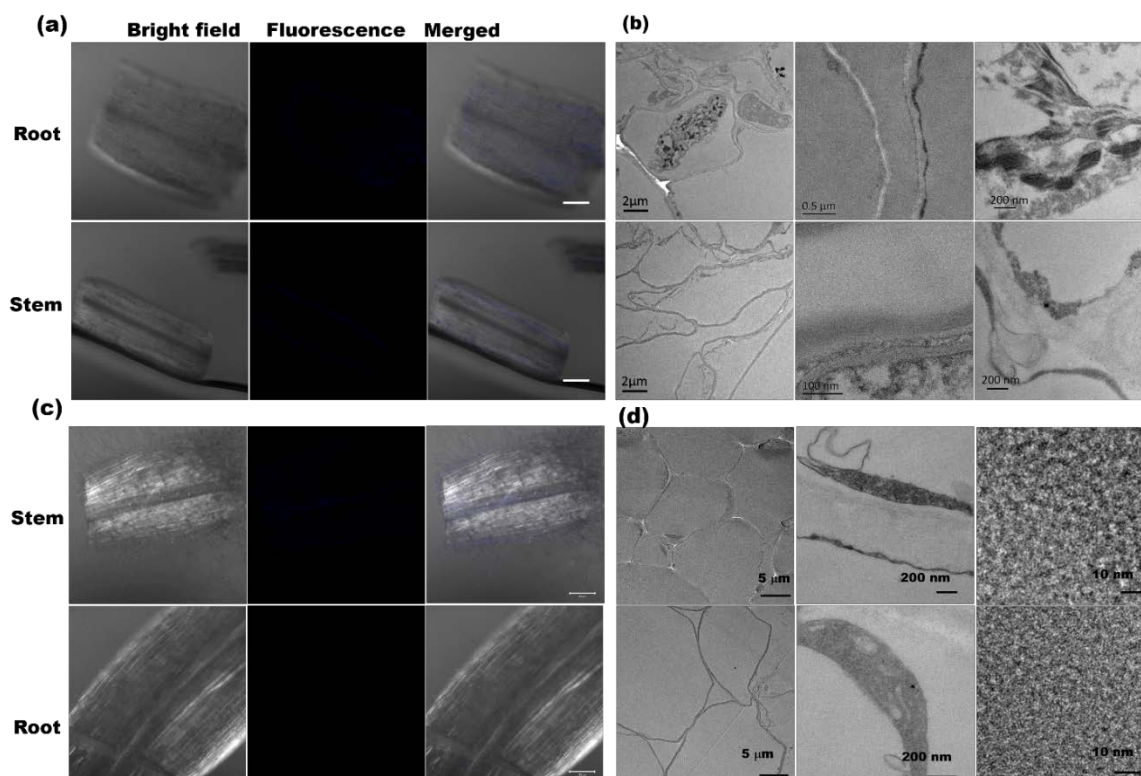


Figure S4. Penetration of CDs into plant cells. (a) and (c) are confocal images of stem and root of lettuce and tomato, respectively, in $\frac{1}{2}$ MS medium without CDs. (b) and (d) are HRTEM image for the root and stem of lettuce and tomato, respectively, cultured in $\frac{1}{2}$ MS medium without CDs.

CDs accelerates germination of seeds and elongation in seeding roots and hypocotyls

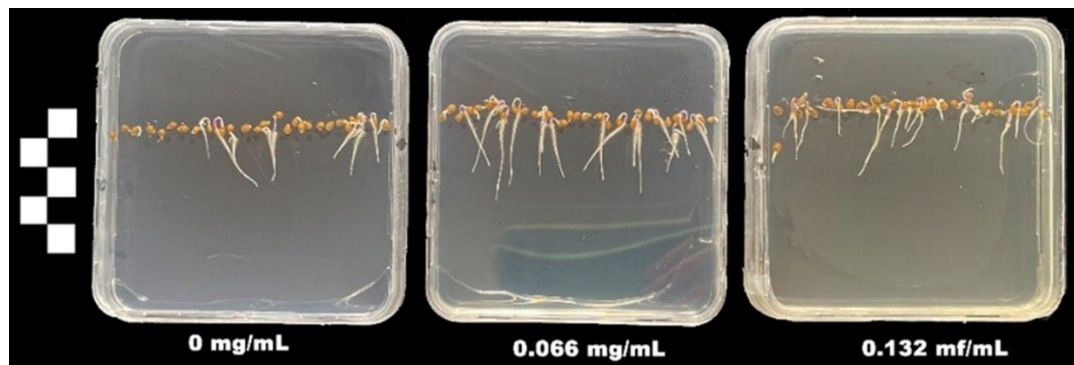


Figure S5. Tomato seeds germination after cultured four days in $\frac{1}{2}$ MS medium with and without CDs.

CDs enhanced the yield and nutritional quality in mature plants

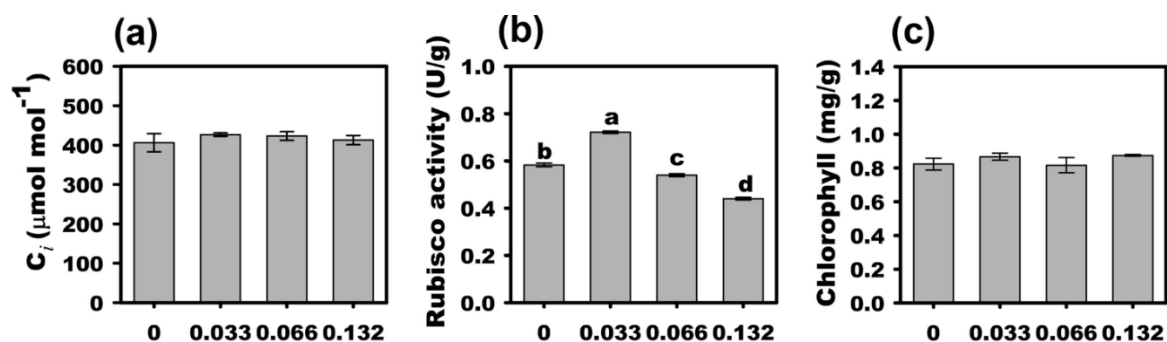


Figure S6. The intercellular CO_2 concentration (C_i) and Rubisco activity (b) and the content of total Chlorophyll in mature lettuce leaves. Values with different letters indicate significant differences at $p < 0.05$ according to Duncan's multiple-range tests. Error bars indicate standard errors of three biological replicates.

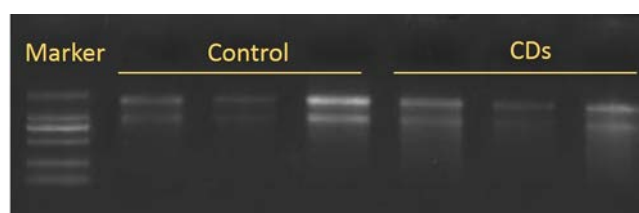


Figure S7. Electrophoretograms gel image of tomato seedling hypocotyl total RNA exposure to $\frac{1}{2}$ MS medium with and without CDs (0.066 mg/ml) after ten days duration of incubation.

Table S1. Primer sequences

Primer name	Primer sequence (5' ~ 3')
SlAqp2-F	AGGATGTGAAGGTTGGAGCA
SlAqp2-R	GTGGTGCCTCCTTGTAGTCC
SlPIP2-1-F	GGAGCCATTTGTGGTTGTGG
SlPIP2-1-R	GGGTAGAGGCGCAAGTACAG
SlPIP2-5-F	TCCAGCACCACTTATTGACCC
SlPIP2-5-R	CACCAAAGGCCCAAGCAATG
SlPIP2-7-F	ACCGTTGCTCGATTTTGCTG
SlPIP2-7-R	TCATGCCTCCAAAAGCCCAA
SlTIP2-1-F	ATTCGGATTGGCTCTCGGTG
SlTIP2-1-R	CCATTCCTCCGGTCACAACCT
SlTIP2-3-F	GTCACCTCTGGGATTGGCTGT
SlTIP2-3-R	CACTCATCCCAGCAGCAACT
SlUBI3-F	CGTGAAAACCCTAACGGGGA
SlUBI3-R	GAGCACGAGATGGAGAGTGG