

Supplementary materials

# Incorporated biochar-based soil amendment and exogenous glycine betaine foliar application ameliorate rice (*Oryza Sativa* L.) tolerance and resilience to osmotic stress

Emad M. Hafez <sup>1</sup>, Salah M. Gowayed <sup>2</sup>, Yasser Nehela <sup>3,4,\*</sup>, Raghda M. Sakran <sup>5</sup>, Asmaa M. S. Rady <sup>6</sup>, Abdelmoniem Awadalla <sup>7</sup>, Alaa El-Dein Omara <sup>8</sup>, Bassam F. Alowaiesh <sup>9</sup>

<sup>1</sup> Department of Agronomy, Faculty of Agriculture, Kafrelsheikh University, Kafr El-Sheikh 33516, Egypt; [emadhafez2012@agr.kfs.edu.eg](mailto:emadhafez2012@agr.kfs.edu.eg)

<sup>2</sup> Department of Botany, Faculty of Agriculture, Suez Canal University, Ismailia 41522, Egypt; [salahgowed@yahoo.com](mailto:salahgowed@yahoo.com)

<sup>3</sup> Department of Agricultural Botany, Faculty of Agriculture, Tanta University, Tanta 31527, Egypt; [yasser.nehela@ufl.edu](mailto:yasser.nehela@ufl.edu)

<sup>4</sup> Citrus Research and Education Center, Department of Plant Pathology, University of Florida, 700 Experiment Station Rd., Lake Alfred, FL 33850, USA

<sup>5</sup> Rice Research Department, Field Crops Research Institute, Agricultural Research Center, Egypt; [raghdasakran@yahoo.com](mailto:raghdasakran@yahoo.com)

<sup>6</sup> Crop Science Department, Faculty of Agriculture (EL-Shatby), Alexandria University, Alexandria 21545, Egypt; [asmaa.mohamed@alexu.edu.eg](mailto:asmaa.mohamed@alexu.edu.eg)

<sup>7</sup> Department of Agronomy, Faculty of Agriculture and Natural Resources, Aswan University, Aswan 81528, Egypt; [abdelmonemomr@yahoo.com](mailto:abdelmonemomr@yahoo.com)

<sup>8</sup> Department of Microbiology, Soils, Water and Environment Research Institute, Agricultural Research Center, Giza 12112, Egypt; [ala.omara@yahoo.com](mailto:ala.omara@yahoo.com)

<sup>9</sup> Olive Research Center, Jouf University, Sakaka, Aljouf 72341, Saudi Arabia; [olive@ju.edu.sa](mailto:olive@ju.edu.sa)

\* Correspondence: [yasser.nehela@ufl.edu](mailto:yasser.nehela@ufl.edu)

Table S1. Physico-chemical properties of biochar (rice husk and corn stalk [1:1]) used in the two successive seasons 2019 and 2020.

Attribute	Biochar	Unit
pH (1:5 biochar:water extract)	$7.60 \pm 0.02$	-
EC (1:5 biochar:water extract)	$0.70 \pm 0.01$	dS m <sup>-1</sup>
CaCO <sub>3</sub>	$1.4 \pm 0.03$	%
bulk density	$0.20 \pm 0.03$	g cm <sup>-3</sup>
specific surface area	$37.0 \pm 2.13$	m <sup>2</sup> g <sup>-1</sup>
water holding capacity	$350 \pm 12.23$	%
moisture content	$11.4 \pm 1.09$	%
Nitrogen	$25.21 \pm 2.91$	mg kg <sup>-1</sup>
Phosphorus	$7.45 \pm 0.83$	mg kg <sup>-1</sup>
Potassium	$13.21 \pm 1.42$	mg kg <sup>-1</sup>
Sulfur	$90.25 \pm 5.35$	mg kg <sup>-1</sup>
Sodium	$8.36 \pm 0.89$	mg kg <sup>-1</sup>
Chloride	$35.47 \pm 2.02$	mg kg <sup>-1</sup>

Table S2. Soil physicochemical attributes used in the two successive seasons 2019 and 2020.

Season	O.M (%)	EC (dS m <sup>-1</sup> )	pH	Cations (meq L <sup>-1</sup> )				Anions (meq L <sup>-1</sup> )		
				Na <sup>+</sup>	K <sup>+</sup>	Mg <sup>++</sup>	Ca <sup>++</sup>	Cl <sup>-</sup>	HCO <sub>3</sub> <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>
<b>2019</b>	1.38	5.84	8.11	27.85	0.37	6.45	9.78	24.65	4.32	15.22
<b>2020</b>	1.42	5.73	8.24	23.74	0.36	5.75	7.55	18.47	3.45	11.25

O.M = organic matter, EC= electrical conductivity

