Supplemental material for submission to Journal of Applied Phycology as a Research Article (September 2023)

Arthrospira maxima hydrolysate as a high value biofertilizer in basil (*Ocimum basilicum*) seedlings

Camila Andrea Marín-Marín[1,*], José Alberto Estrada[1], Juan Martín Delgado Naranjo[2] and Paola Andrea Zapata Ocampo[1]

[1]ICIF Research Group, Faculty of Science and Biotechnology, CES University, Medellín, Colombia.
[2]Bioprocesos Research Group, Department of Chemical Engineering, Faculty of Engineering, Universidad de Antioquia, Medellín, Colombia.
*Corresponding author. e-mail: marinm.camila@uces.edu.co

Online Resource 1

Table 1 Example selection of studies evaluating the biofertilizing effect of cyanobacteria and microalgae on various crops.

Crop	Microorganism	Reference
Aloe (*Aloe barbadensis Mill*)	*Oscillatoria annae*	(Moorthy and Malliga 2012)
Basil (*Ocimum basilicum* L.)	*Arthrospira* sp., *Nostoc* sp., *Anabaena* sp., *Tolypothrix* sp., *Leptolyngbya* sp., and *Synechocystis* sp.	(Hristozkova et al. 2018; Santini et al. 2022)
Basket willow (*Salix viminalis*)	*Microcystis aeruginosa*, *Anabaena* sp., and *Chlorella* sp.	(Grzesik and Romanowska-Duda 2015)
Bean	*Chlorella vulgaris, Tetradesmus dimorphus,* and *Arthrospira platensis*	(Refaay et al. 2021)
Broadleaf plantain (*Plantago major* L.)	*Cylindrospermum michailovskoense* and *Anabaena vaginicola*	(Chookalaii et al. 2020)
Cucumber (*Cucumis sativus*)	*Nostoc* (SAB-M612)	(Toribio et al. 2020)
Chinese chives (*Allium tuberosum*)	*Chlorella fusca*	(Kim et al. 2018)

Lettuce (*Lactuca sativa)*	*Chlorella vulgaris, Anabaena spp.*	(Bhalamurugan et al. 2018)
Maize (*Zea mays*)	*Chlorella vulgaris* and *Spirulina platensis*	(Dineshkumar et al. 2019)
Okra (*Abelmoschus esculentus*)	*Anabaena* sp.	(Manjunath et al. 2016)
Onion (*Allium cepa*)	*Spirulina platensis* and *Chlorella vulgaris*	(Dineshkumar et al. 2020b)
Pea (*Pisum sativum*)	*Nostoc entophytum* and *Oscillatoria angustissima*	(Osman et al. 2010)
Rice (*Oryza sativa* L.)	*Anabaena variabilis* and *Gloeocapsa* sp.	(Araujo Vidal et al. 2018; Bao et al. 2021)
Roma tomato (*Solanum lycopersicum* 'Roma')	*Acutodesmus dimorphus*	(Bhalamurugan et al. 2018)
Spearmint (*Mentha spicata*)	*Nostoc* sp. and *Anabaena* sp.	(Ortiz 2015)
Spinach (*Spinacia oleracea*)	*Chlorella fusca*	(Kim et al. 2018)
Tomato (*Solanum lycopersicum*)	*Nannochloropsis oculata*, *Chlorella vulgaris*, *Scenedesmus* sp.	(Coppens et al. 2016; Simbaña 2019)
Wheat (*Triticum aestivum* L.)	*Chroococcidiopsis* sp. and *Anabaena* sp.	(Hussain and Hasnain 2011)

Araujo Vidal DR, Hernández Benítez RH, Vanegas Guerrero J (2018) Efecto de la inoculación de cianobacterias en cultivos de interés comercial en zonas semiáridas de La Guajira - Colombia. *Revista Colombiana de Investigaciones Agroindustriales*, *5*(1), 20–31. https://doi.org/10.23850/24220582.889

Bao J, Zhuo C, Zhang D, Li Y, Hu F, Li H, Su Z, Liang Y, He H (2021) Potential applicability of a cyanobacterium as a biofertilizer and biopesticide in rice fields. Plant Soil 463:91-112. https://doi.org/10.1007/s11104-021-04899-9

Bhalamurugan GL, Valerie O, Mark L (2018) Valuable bioproducts obtained from microalgal biomass and their commercial applications: A review. Environ Eng Res. 23(229–241). https://doi.org/10.4491/eer.2017.220

Chookalaii H, Riahi H, Shariatmadari Z, Mazarei Z, Hashtroudi MS (2020) Enhancement of total flavonoid and phenolic contents in *Plantago major* L. with plant growth promoting cyanobacteria. J Agr Sci Tech, 22:505–518.

Coppens J, Grunert O, Van Den Hende S, Vanhoutte I, Boon N, Haesaert G, De Gelder L (2016) The use of microalgae as a high-value organic slow-release fertilizer results in tomatoes with increased carotenoid and sugar levels. J Appl Phycol 28:2367–2377. https://doi.org/10.1007/s10811-015-0775-2

Dineshkumar R, Subramanian J, Gopalsamy J, Jayasingam P, Arumugam A, Kannadasan, S, Sampathkumar P (2019) The Impact of Using Microalgae as Biofertilizer in Maize (*Zea mays* L.). Waste and Biomass Valorization 10:1101–1110. https://doi.org/10.1007/s12649-017-0123-7

Dineshkumar R, Subramanian J, Arumugam A, Ahamed Rasheeq A, Sampathkumar P (2020b) Exploring the Microalgae Biofertilizer Effect on Onion Cultivation by Field Experiment. Waste and Biomass Valorization 11:77–87. https://doi.org/10.1007/s12649-018-0466-8

Grzesik M, Romanowska-Duda Z (2015) Ability of cyanobacteria and green algae to improve metabolic activity and development of willow plants. Pol J Environ Stud, 24:1003–1012. https://doi.org/10.15244/pjoes/34667

Hristozkova M, Gigova L, Geneva, M, Stancheva I, Velikova V, Marinova G. (2018) Influence of mycorrhizal fungi and microalgae dual inoculation on basil plants performance. Gesunde Pflanzen 70:99–107. https://doi.org/10.1007/s10343-018-0420-5

Hussain A, Hasnain S (2011) Phytostimulation and biofertilization in wheat by cyanobacteria. J Ind Microbiol Biotechnol 38:85–92. https://doi.org/10.1007/s10295-010-0833-3

Kim MJ, Shim CK, Kim YK, Ko BG, Park JH. Hwang SG, Kim BH (2018) Effect of biostimulator *Chlorella fusca* on improving growth and qualities of Chinese chives and spinach in organic farm. Plant Pathol J 34:567–574. https://doi.org/10.5423/PPJ.FT.11.2018.0254

Manjunath M, Kanchan A, Ranjan K, Venkatachalam S, Prasanna R, Ramakrishnan B, Hossain F, Nain L, Shivay YS, Rai AB, Singh B (2016) Beneficial cyanobacteria and eubacteria synergistically enhance bioavailability of soil nutrients and yield of okra. Heliyon, 2. https://doi.org/10.1016/j.heliyon.2016.e00066

Moorthy K, Malliga P (2012). Effect of cyanospray fertilizer on plant morphological, biochemical characteristics and leaf gel yield of *Aloe barbadensis* miller (*Aloe vera*) in pot experiment. Int J Environ Sci 2:1512-1520.

Ortiz G (2015) Evaluación del valor como biofertilizantes de *Nostoc* sp. y *Anabaena* sp. en plántulas de menta (*Mentha specata*). BS Thesis, Universidad Santo Tomás, Colombia.

Osman MEH, El-Sheekh MM, El-Naggar AH, Gheda SF (2010) Effect of two species of cyanobacteria as biofertilizers on some metabolic activities, growth, and yield of pea plant. Biol Fertil Soils 46:861–875. https://doi.org/10.1007/s00374-010-0491-7

Refaay DA, El-Marzoki EM, Abdel-Hamid MI, Haroun SA (2021) Effect of foliar application with *Chlorella vulgaris*, *Tetradesmus dimorphus,* and *Arthrospira platensis* as biostimulants for common bean. J App Phycol 33:3807–3815. https://doi.org/10.1007/s10811-021-02584-z

Santini G, Rodolfi L, Biondi N, Sampietro G, Tredici MR (2022) Effects of cyanobacterial-based biostimulants on plant growth and development: a case study on basil (*Ocimum basilicum* L.). J Appl Phycol 34: 2063–2073. https://doi.org/10.1007/s10811-022-02781-4

Simbaña A (2019) Evaluación de un fertilizante microalgal en tomate (*Solanum lycopersicum L.*) BS Thesis, Universidad Central del Ecuador, Ecuador.

Toribio AJ, Suárez-Estrella F, Jurado MM, López MJ, López-González JA, Moreno J (2020) Prospection of cyanobacteria producing bioactive substances and their application as potential phytostimulating agents. Biotechnol Rep 26. https://doi.org/10.1016/J.BTRE.2020.E00449