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Development and quality of 'Cantaloupe' melon seedlings under the influence of *Chlorella* sp. via root

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ABSTRACT

The search for better quality inputs with lower environmental impact has been highlighted in agricultural technology research. Microalgae can improve soil fertility and seedling development. This study aimed to evaluate the influence of suspensions as a biostimulant based on the microalgae *Chlorella* sp. applied via root on the production of 'Cantaloupe' melon seedlings. The experimental design used was completely randomized, with ten replications, in a scheme of split plots in time. The plots consisted of three concentrations (0.0, 0.8, and 1.6%) and the subplots consisted of five evaluation periods (15, 18, 21, 24, and 27 days after sowing). The treatments significantly influenced the number of leaves, total leaf area, aerial part fresh mass, root fresh mass, and total fresh mass and dry mass ($p<0.01$), as well as plant height and stem diameter at 5% probability level by the 'F' test. The concentration of 1.6% was the one that showed the best performance for the increase in leaves, plant height, total leaf area, stem diameter, and fresh and dry phytomass of melon seedlings. The most significant accumulation of fresh and dry mass in the seedlings was obtained at the concentration of 1.6% of *Chlorella* sp.

Keywords: *Cucumis melo*; Soil fertility; Biostimulant; Microalgae; Propagation.

Desenvolvimento e qualidade de mudas de melão 'Cantaloupe' sob influência de *Chlorella* sp. via raiz

RESUMO

A busca por insumos de melhor qualidade e menor impacto ambiental tem se destacado nas pesquisas de tecnologia agrícola. As microalgas possuem a capacidade de melhorar a fertilidade do solo e o desenvolvimento de mudas. Objetivou-se avaliar a influência de suspensões como bioestimulante à base de microalga *Chlorella* sp., aplicadas via solo, na produção de mudas de melão 'Cantaloupe'. O delineamento utilizado foi inteiramente casualizado, com dez repetições, adotando-se o esquema de parcelas subdivididas no tempo. As parcelas foram constituídas por três concentrações (0,0; 0,8 e 1,6%) e as subparcelas por cinco períodos de avaliação (15, 18, 21, 24 e 27 dias após a semeadura). Os tratamentos aplicados influenciaram significativamente o número de folhas, área foliar total, massa fresca da parte aérea, massa fresca da raiz, massa fresca total, massa seca total ($p<0,01$), além da altura da planta e diâmetro do caule ao nível de 5% de probabilidade pelo teste 'F'. A concentração de 1,6% foi a que apresentou maior desempenho para o aumento de folhas, altura de planta, área foliar total, diâmetro do caule, e fitomassa fresca e seca das mudas de melão. O maior acúmulo de fitomassa fresca e seca das mudas foi obtido na concentração de 1,6% de *Chlorella* sp.

Palavras-chave: *Cucumis melo*; Fertilidade do solo; Bioestimulante; Microalgas; Propagação.

1. Introduction

The search for products from crops that cause fewer negative impacts on the environment has been intensifying. They are considered environmentally correct technologies, aiming to reduce environmental risks and optimize plant growth and productivity (Coppens et al., 2016; Vendruscolo et al., 2018). Microalgae biomass is a product of great relevance to the commercial sector. It can be applied as biostimulants, considered potential sources of chemical compounds, and can be used in agriculture, pharmaceutical products, nutraceuticals, and cosmetics, among others (Khoobka & Delavari Amrei, 2020; Tang et al., 2020).

Microalgae have high potential as plant stimulants, especially those produced under tropical climate conditions, due to the high levels of free amino acids, proteins, carbohydrates, lipids (Guedes et al., 2018), and nutrients such as nitrogen, phosphorus, potassium, and calcium (González-Pérez et al., 2022). Among the microalgae studied, one of the most used is *Chlorella*, characterized as green microalgae and found in aquatic 'habitats' (Natarajan et al., 2022).

Biostimulants are promising products to optimize agricultural productivity, with the potential to modify physiological processes in plants (Yakhin et al., 2017). These compounds, when applied in small amounts to leaves or soil, can improve physiological processes, increase nutrient uptake by crops (Barone et al., 2018), improve productivity and cultivation quality (Xu & Geelen, 2018; Li et al., 2021), assist in the formation of the root system, and consequently, in the development of seedlings (Calvo et al., 2014). When applied to seeds or in the initial phase of the development of a crop, they stimulate root growth, provide greater resistance to environmental stresses, higher dry mass yield, shoot length, and plant development (Deepika & Mubarakali, 2020; Jimenez et al., 2020).

Research carried out with the application of microalgae as biostimulants is of fundamental importance in evaluating the potential of biomass in developing crops of economic importance cultivated in the semi-arid region. Melon (*Cucumis melo* L.) is a short-cycle vegetable crop, commercially grown in tropical and subtropical regions, with significant economic importance for the northeastern semi-arid region due to the edaphoclimatic conditions that favor its development, being one of the main crops destined for export (Senhor et al., 2009; Sharifi, 2018).

However, alternative technologies are necessary to produce healthy and well-developed seedlings, which is essential for successful agricultural production (Ozden et al., 2021). The objective was to evaluate the influence of suspensions with biostimulant effects based on *Chlorella* sp. microalgae applied via root on the production of ‘Cantaloupe’ melon seedlings.

2. Material and Methods

The experiment was conducted in a greenhouse with a shading cover, 50% passage of light, and transparent plastic cover at the Center for Science and Agro-Food Technology at the Federal University of Campina Grande, campus of Pombal, Paraíba, Brazil. It is located at 6º48’16” S and 37°49′15″ W, at an altitude of 175 m. According to Köppen’s classification, the predominant climate in the region is of the ‘BSh’ type, that is, hot semi-arid, with annual precipitation around 750 mm year^{-1}. During the experimental period, the relative humidity of the air was collected daily with a digital thermo-hygrometer (J-Prolab) (Figure 1).

The dry biomass of *Chlorella* sp. microalgae used was provided by JH de Lima, Paraíba, Brazil, and its physicochemical composition is presented in Table 1. The ‘Cantaloupe’ melon seeds used were purchased commercially from Feltrin Sementes.

The design used was completely randomized (DIC), with ten replications, adopting the scheme of split plots in time. The plots were constituted by three concentrations (0.0, 0.8, and 1.6%) and the subplots by five evaluation periods (15, 18, 21, 24, and 27 days after sowing - DAS). The dry biomass of *Chlorella* sp. microalgae was weighed on an analytical scale at the concentrations and weights described: 0% - 0 g; 0.8% - 0.8 g; 1.6% - 1.6 g, then diluted in 100 mL of distilled water at 40 °C, under constant stirring for 15 minutes, forming the suspensions. The suspensions were homogenized and analyzed for their pH using a digital pH meter (Digimed DM -22) and electrical conductivity with a benchtop conductivity meter (TECNAL, 4MP) (at 25 °C) (Table 2).

The soil used as substrate was prepared from the surface layer (A horizon) of Chromic Luvisols, passed through a sieve with a 6 mm mesh and autoclaved for one hour at 127 °C and 1.5 atm pressure. Before the experiment, samples were taken from the substrates, and after the application of the microalgae *Chlorella* sp., physical-chemical analysis was carried out (Table 3) (EMBRAPA, 1997). 'Cantaloupe' melon seeds were sown in 120 mL tubes with two seeds per tube, in the late afternoon. Biomass-based suspensions of *Chlorella* sp. were applied directly to the soil at 10 mL per tube (180 mL) right after sowing at four and six DAS for three applications. Irrigation was carried out according to water needs, keeping the soil close to field capacity. At eight DAS, thinning was performed, leaving one plant per tube.

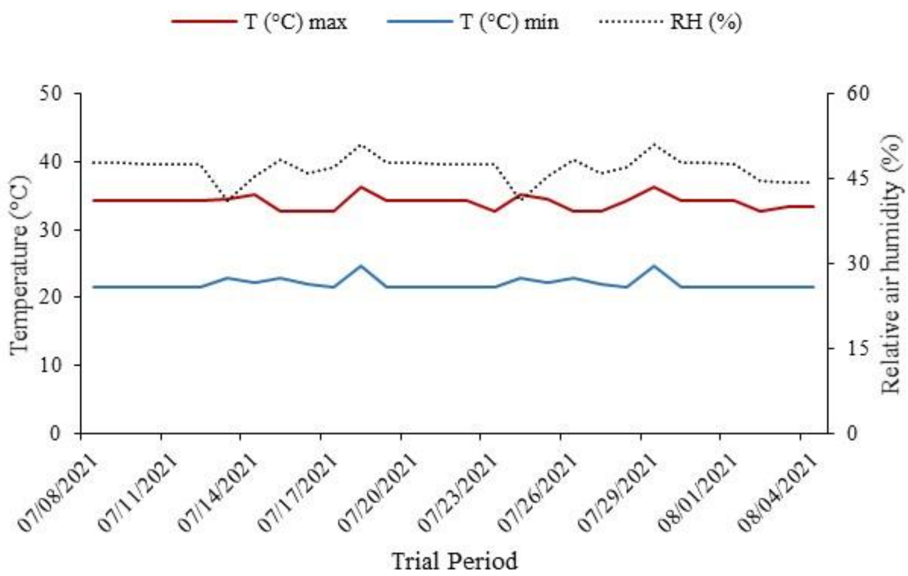

Figure 1. Temperature (°C) and Relative Humidity (%) during the experimental period in the greenhouse. CCTA/UFCG, Pombal-PB, 2021.

Table 1. Physical-chemical analysis of the microalgae *Chlorella* sp.

Component	Value	Total Amino Acids (g/100g)	Value
Ash (g/100g)	24.15	Aspartic Acid	1.33
Total lipids (g/100g)	11.48	Glutamic Acid	3.37
Total nitrogen (g/100g)	4.61	Serine	1.36
Protein (g/100g)	28.82	Glycine	1.26
Total carbohydrates (kcal/100g)	334	Histidine	0.60
Calcium (g/kg)	55.68	Arginine	2.42
Cobalt (mg/kg)	0.49	Threonine	1.58
Copper (mg/kg)	142	Alanine	1.44
Sulfur (g/kg)	4.29	Proline	1.62
Iron (g/kg)	355	Tyrosine	0.97
Phosphorus (g/kg)	14.54	Valine	1.43
Magnesium (g/kg)	22.54	Methionine	0.39
Manganese (mg/kg)	131	Cystine	0.13
Nickel (mg/kg)	0.76	Isoleucine	1.38
Potassium (g/kg)	10.04	Leucine	1.83
Sodium (g/kg)	4.87	Phenylalanine	1.24
Zinc (mg/kg)	11.83	Lysine	1.49
-	-	Tryptophan	0.16

Number of leaves (NL) was determined considering fully open leaves for counting. Stem diameter (SD) was measured at 2 cm from ground level using a digital caliper (150 mm, Mtx), with values expressed in mm. Plant height (PH) was measured from the plant's base to the main branch's apical bud using a ruler graduated in cm. Root length (RL) was measured as the distance from the plant’s collar to the main root’s apex with a ruler graduated in cm. Total leaf area (TLA) was determined according to the width of the leaves, according to Nascimento et al. (2002), with calculation performed individually for each leaf and the sum for the total leaf area. The individual calculation considers the following equation (1):

$$\mathrm{LA} = 0.826\, W^{1.89}$$

a) LA = Leaf area (cm^2);

b) W = Leaf width (cm).

Aerial part fresh mass and root fresh mass was obtained by weighing the fresh material on an analytical scale with four decimal places (M214AIH, Bel), and the results were expressed in g $plant^{-1}$. Before weighing, the roots were washed, placed in water to minimize water loss, and dried with a paper towel. Aerial part dry mass (ADM) and root dry mass (RDM) were determined after drying in a forced circulation oven at 65 °C until reaching constant weight, weighing on analytical scale with four decimal places, and the results were expressed in g $plant^{-1}$.

Total fresh mass (TFM) was determined by adding the aerial part fresh mass with root fresh mass, and the results were expressed in g $plant^{-1}$.

Table 2. Electrical conductivity and pH of aqueous suspensions from *Chlorella* sp. microalgae

Concentrations of suspensions (%)	Electrical conductivity (dS m^{-1})	pH
0.0	0.3	6.88
0.8	1.3	9.70
1.6	2.1	9.71

Table 3. Physical-chemical analysis of the soil used for the production of 'Cantaloupe' melon seedlings before and after application of the microalgae *Chlorella* sp. via root.

Physical analysis*						
Sand	Silt	Clay	Apparent Dens.	True Dens.	Porosity	Textural class
------g kg^{-1} ------			------g cm^{-3} ------		$m^3\,m^{-3}$	
636.8	97.2	266.0	1.36	2.64	0.48	sandy loam

Chemical analysis**							
	pH	EC	P-soluble	P-av	K^+	Na^+	OM
Substrate	H_2O	dS m^{-1}	------mg dm^{-3} ------	--$cmol_c\,dm^{-3}$ --			g kg^{-1}
Before use of *Chlorella* sp.							
Initial sample	5.9	0.03	0.03	14.78	0.12	0.38	5.4
After use of *Chlorella* sp.							
Chlorella sp. 0.0%	6.60	0.04	0.03	12.30	0.12	0.56	5.96
Chlorella sp. 0.8%	6.73	0.06	0.52	18.64	0.15	0.66	5.50
Chlorella sp. 1.6%	6.81	0.09	1.92	19.29	0.15	0.73	5.30

Note. Soil and Plant Nutrition Laboratory – LSNP, Pombal–PB. pH – Hydrogen potential; EC – Electrical conductivity of the saturation extract; P-soluble – soluble P; P-av – available P; Sodium – Na^+ and Potassium – K^+: Mehlich 1 extractant; OM – Organic Matter: Walkley Wet Digestion – Black.

Total dry mass (TDM) was obtained from the sum of aerial part dry mass and root dry mass, and the results were expressed in g $plant^{-1}$. Dickson Quality Index (DQI) was determined as a function of TDM = total dry mass, in g $plant^{-1}$; PH = plant height, in cm; SD = stem diameter, in mm; ADM = aerial part dry mass, in g $plant^{-1}$; RDM = root dry mass, in g $plant^{-1}$, using equation (2) (Dickson et al., 1960):

$$\mathrm{DQI} = \frac{(\mathrm{TDM})}{\left(\frac{\mathrm{PH}}{\mathrm{SD}}\right) + \left(\frac{\mathrm{ADM}}{\mathrm{RDM}}\right)}$$

The results were subjected to analysis of variance by the 'F' test. In cases of significant interaction or individual effects, regression analysis was performed for evaluation periods, and Tukey test was performed for concentrations of *Chlorella* sp. The tests were performed at a 5% probability level using the System for Analysis of Variance - SISVAR software version 5.8 (Ferreira, 2019), and the graphs were made in the Excel 2016 program.

3. Results and Discussion

The results of the analysis of variance showed a significant interaction between the factors concentrations of *Chlorella* sp. biomass and evaluation periods for the variables number of leaves, total leaf area, aerial part fresh mass, root fresh mass, total fresh mass, aerial part dry mass, total dry mass ($p<0.01$), plant height, and stem diameter ($p<0.05$). Significant differences were observed by the Tukey test for root length (RL) ($p<0.05$), root dry mass, and Dickson quality index ($p<0.01$). For the single factor evaluation periods ($p<0.01$), there was a significant influence on root length, root dry mass, and Dickson quality index ($p<0.01$). Number of leaves (Figure 2a) and plant height (Figure 2b) were described by quadratic regression equations when plants were subjected to the concentrations of *Chlorella* sp. applied via soil associated with the evaluation periods.

The highest NL was obtained in plants subjected to concentrations of 0.8% (3.12) and 1.6% (3.03) of *Chlorella* sp. over the evaluation periods. The 0% concentration (control) led to the lowest NL throughout the experimental period. Plants that received concentrations of *Chlorella* sp. were statistically similar. At 27 DAS, there was a reduction of 2.97% at the maximum biomass dose. Plants with 0.8% of biomass had the highest values of PH throughout the evaluation periods, 21 (2.56 cm), 24 (2.73 cm), and 27 (3.07 cm) DAS, which represented an increase of 8.09% when compared to the concentration of 1.6%. Given the high cost of seeds, producing seedlings is an option for most producers; therefore, producing superior-quality seedlings is an important step that directly influences vegetative development and final production (Vendruscolo et al., 2019).

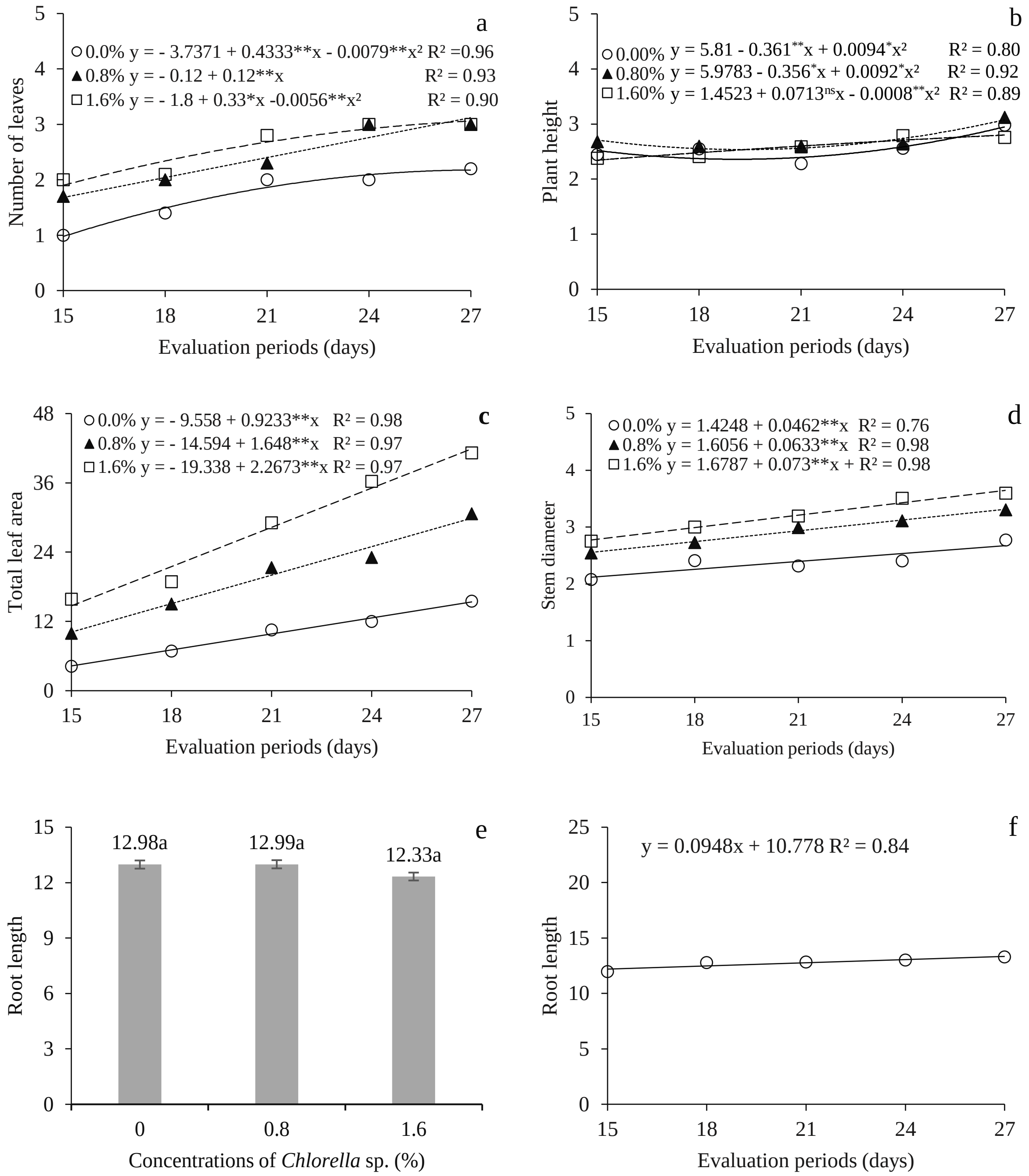

Figure 2. Number of leaves (a), plant height (b), total leaf area (cm²) (c), and stem diameter (mm) (d) of 'Cantaloupe' melon seedlings as a function of concentrations of *Chlorella* sp. biomass and evaluation periods. Effect of concentrations of *Chlorella* sp. (e), and evaluation periods (f) on root length (cm) of 'Cantaloupe' melon seedlings. ** significant at 1%; * significant at 5%; ^{ns} not significant at 5%; Lowercase letters indicate no difference between the concentrations of *Chlorella* sp.

The production of seedlings with a more significant number of leaves is of fundamental importance for the success of their establishment in the field, where light interception and absorption, gas exchange, and transpiration occur, resulting in a higher photosynthetic rate (Taiz et al., 2017). *Chlorella* sp. contains nutrients such as nitrogen, phosphorus, and potassium (González-Pérez et al., 2022), which are essential for plant growth, possibly the most significant in the suspensions applied to the soil (Table 1).

Plant height is one of the parameters used to classify and select seedlings (Navroski et al., 2016). Plant height in this study is similar to the results reported by Araújo et al. (2013), who tested different substrates (soil, soil + humus, washed sand, sawdust + soil, and rice straw + soil) in the production of 'Cantaloupe' melon seedlings and found PH values between 2 and 8 cm at 25 DAS.

The total leaf area (Figure 2c) and stem diameter (Figure 2d) of plants subjected to concentrations of *Chlorella* sp. were described by increasing linear regressions with evaluation periods. Plants subjected to the concentrations of 0.8% and 1.6% of *Chlorella* sp. applied via root had the highest averages, 29.90 and 41.88, respectively. The lowest values were obtained in control plants (0.0%) throughout the evaluation periods. The application of concentrations of 0.8% and 1.6% of *Chlorella* sp. promoted higher stem diameter values, regardless of the evaluation period. However, at 27 DAS, this increase corresponded to 24% and 36.7%, respectively, compared to the control (0.0%).

Leaf area is used as a productivity indication parameter. Plants with a larger leaf area tend to have more efficient photosynthetic rates, which promotes greater light assimilation, photosynthesis, and dry matter accumulation, thus favoring greater plant production (Albano et al., 2017). Therefore, the effect of microalgae biomass suspensions has been evaluated as a promoter of the growth and development of several cultivated species, ensuring a greater number of leaves and, consequently, more significant photosynthetic activity (Renaut et al., 2019; Ruiz-Sánchez et al., 2022).

Phosphorus is a nutrient of great importance in plant life, being essential in cell division (Malavolta et al., 1997); after applying concentrations of microalgae suspensions, an increase in the content of phosphorus in the soil was observes, since the *Chlorella* sp. based solutions have quantities of phosphorus in their compositions, as can be seen in Table 3, which possibly resulted in an increase in stem diameter. This characteristic is directly related to the ability of plants to survive, more significant growth activity, and formation of new roots (Taiz & Zeiger, 2013).

Aerial part fresh mass is related to the results of leaf area and stem diameter. Therefore, the aerial part is favored due to the translocation of nutrients and water through the stem, which causes biomass accumulation (Mazzoni-Viveiros & Trufem, 2004) from compounds present in the applied suspensions.

The averages for root length as a function of *Chlorella* sp. concentrations did not differ (Figure 2e). The melon root length values followed an increasing linear behavior in the evaluation periods. An increase of 7.73% (0.95 cm) was observed in the interval between 15 and 27 DAS (Figure 2f).

Aerial part fresh mass, root fresh mass, and total fresh mass were described by increasing linear regression equations, increasing with the evaluation periods (Figures 3a, b, and c). Melon plants cultivated at the concentration of 1.6% at 27 DAS had an increase in aerial part fresh mass, 3.01 g plant^{-1}, corresponding to a rise of 161.74%, compared to the control (1.15 g plant^{-1}) (Figure 3a). The 1.6% concentration of *Chlorella* sp. also stands out over the evaluation periods, with an increase in aerial part fresh mass from 1.30 g plant^{-1} at 15 DAS to 3.01 g plant^{-1} at 27 DAS, representing an increase of 131.54%.

Stirk et al. (2014) investigated the synthesis of endogenous hormones in *Chlorella minutissima* and verified that these hormones are responsible for the division and growth functions of the cells. Therefore, there is a synchronization of signaling for each growth event in the cell. It was observed that in the periods of culture illumination, the levels of synthesis of auxins and cytokinins were elevated, while gibberellin concentrations decreased. However, in addition to minerals in the biomass of *Chlorella* sp., phytohormones were also present, which stimulated the growth of melon seedlings.

In root fresh mass, the highest accumulation (1.39 g plant^{-1}) was obtained in plants subjected to a concentration of 1.6% at 27 DAS, with an increase of 120.63% when compared to the evaluation carried out at 15 DAS (0.63 g plant^{-1}) (Figure 3b). Among the tested concentrations, the increase obtained in root fresh mass, at 27 DAS, with the use of 1.6% of *Chlorella* sp., was 71.60% compared to the control (0.0%) (0.81g plant^{-1}) and 24.11% compared to the 0.8% concentration (1.12 g plant^{-1}). The highest accumulations of total fresh mass were obtained at a concentration of 1.6% of *Chlorella* sp. (4.40 g plant^{-1}), equivalent to an increase of 124.49% compared to control plants (0.0%) (1.96 g plant^{-1}) at 27 DAS (Figure 3c). The increment of the total fresh mass of melon plants, evaluated at 15 DAS and 27 DAS, was 126.80% in plants cultivated in soils with a concentration of 1.6% of *Chlorella* sp.

High concentrations of auxins can prevent or reduce plant root growth (Salisbury & Ross, 2012). This justifies the behavior observed in the root length of melon seedlings when higher concentrations of Chlorella sp. are applied. The melon crop develops better in soils with a pH between 6 and 7.0 (Sharifi, 2018). It was observed that the pH values after using *Chlorella* sp. suggest the development of melon seedlings (Table 3). In addition, phosphorus availability in the soil was observed after 27 DAS, which may have contributed to root growth. Phosphorus stimulates root development, which is fundamental for plant cell division, reproduction, and metabolism (Razaq et al., 2017).

Aerial part fresh mass and total fresh mass of melon plants subjected to concentrations of *Chlorella* sp. applied via soil and evaluated over the days after sowing were described by linear regression equations (Figures 3a and 3b). The 1.6% concentration of *Chlorella* sp. led to the highest averages for aerial part fresh mass over the evaluation period. There was an increase of 0.43 g plant^{-1}, corresponding to 166.67%, compared to 0.0% (0.18 g plant^{-1}).

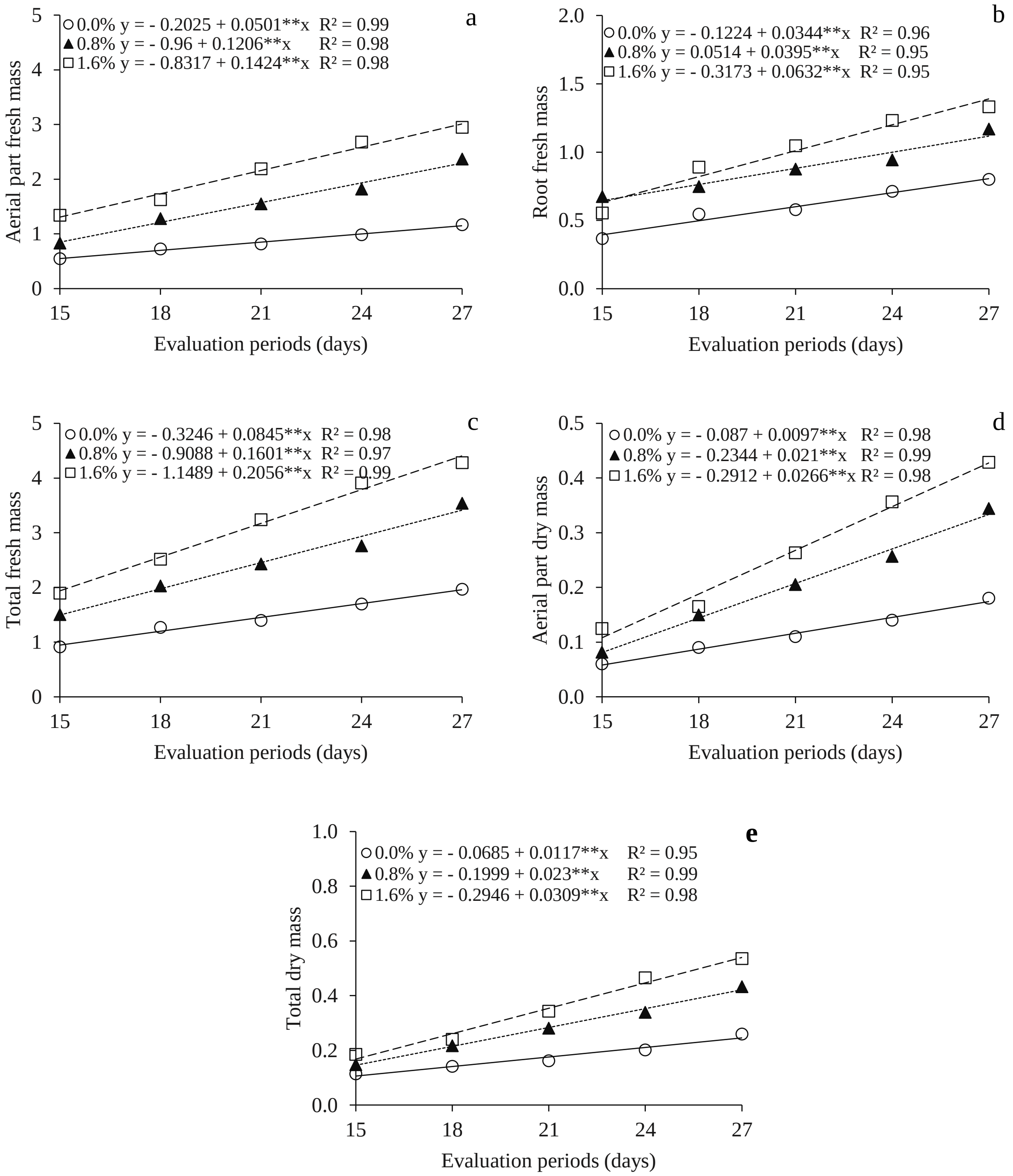

Figure 3. Aerial part fresh mass (a), root fresh mass (b), total fresh mass (c), aerial part dry mass (d), and total dry mass (e) of 'Cantaloupe' melon seedlings as a function of *Chlorella* sp. and evaluation periods. ** significant at 1%; * significant at 5%; ns not significant at 5%.

Applying 0.8% and 1.6% of *Chlorella* sp. in the soil resulted in the highest accumulation of total dry mass over the evaluation periods of melon seedlings compared to the control (0.0%) at 27 DAS.

The highest accumulations of aerial part fresh mass, root fresh mass, and total fresh mass were obtained in plants subjected to 0.8% and 1.6% concentrations of *Chlorella* sp. Throughout the evaluation period, the concentration of 1.6% of *Chlorella* sp. led to the highest values for aerial part dry mass and total dry mass. Root fresh mass may have been favored by the better supply of nutrients present in the soil (Table 3) and possibly a greater availability of phosphorus, which may have contributed to the growth of the roots (Figure 3b). The increase in total fresh mass may be associated with root growth and increased uptake of nutrients from the soil, which consequently have a positive effect on shoot growth. At the end of the experimental period, evaluations showed that the applications of suspensions in the soil raised its nutritional levels (Table 3).

The highest root dry mass of melon plants was observed at the 1.6% concentration of *Chlorella* sp. with

0.086 g per plant^{-1}, an increase of 46% compared to the lowest concentration (0.0%). Over the evaluation periods, the plants obtained a significant accumulation in RDM, from 0.06 g plant^{-1} at 15 DAS to 0.09 g plant^{-1} at 27 DAS, equivalent to a 50% increment.

The highest values of aerial part dry mass are related to the nutrients present in the suspension based on *Chlorella* sp., which stimulated the development of the aerial part. Thus, there was an increase in ADM. This may have occurred because *Chlorella* sp. biomass has in its constitution values of cytokinins and auxins that possibly stimulated cell division and cell strengthening, contributing to plant growth (Neumann et al., 2017). In addition, the amino acids present in the microalgae biomass cause biostimulant effects and favor plant growth (Pérez-Madruga et al., 2020); consequently, there is an increase in dry mass.

The observed results favored phytomass accumulation in the aerial part and root. These suspensions contain nutrients such as nitrogen, phosphorus, and potassium in their composition (Ronga et al., 2019), according to the analysis of the *Chlorella* sp. microalgae biomass (Table 1).

The increase in dry matter accumulation in the roots indicates an increase in seedling quality, which simultaneously promotes vigor and plant development (Cruz et al., 2011). Thus, when transplanted to the field, seedlings can be more resistant to adverse environmental and climatic conditions, resulting in a higher survival rate (Caldeira et al., 2014).

The DQI values also increased linearly during the evaluation period, starting with mean values of 0.058 at15 DAS and increasing to mean values of 0.093 at 27 DAS, corresponding to an increment of 60.35% in the DQI of seedlings subjected to the presence of *Chlorella* sp. (Figure 4b). Dickson quality index differed between concentrations of *Chlorella* sp. applied to the soil, with the highest average (0.09) at the highest concentration (1.6%), differing between 0.8% (0.079) and 0.0% (0.058) (Figure 4a).

In relation to the evaluation periods (Figure 4b), an average value of DQI of 0.058 was observed at 15 DAS, following progressive linear behavior, culminating in the value of 0.093 at 27 DAS, which is equivalent to an increment of 60.35% in the DQI of the seedlings.

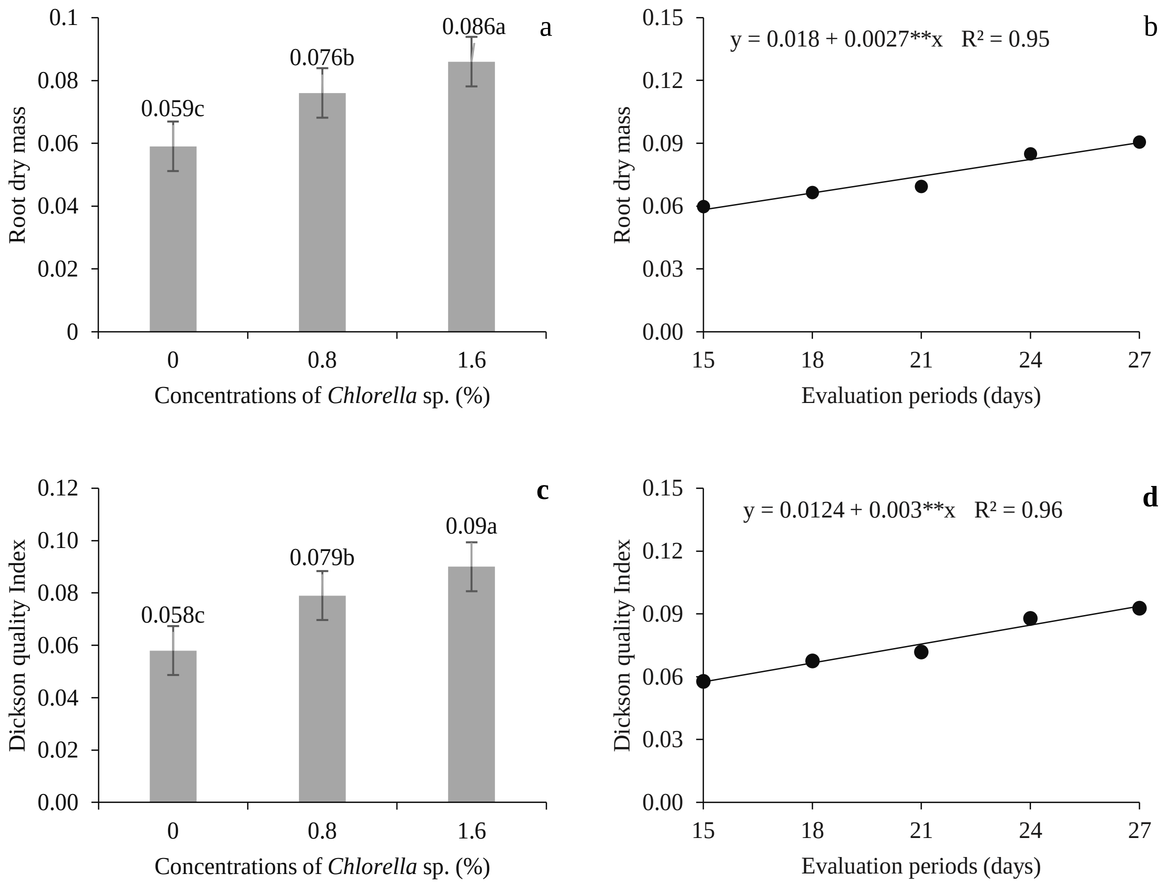

Figure 4. Effects of concentrations of *Chlorella* sp. (a) and evaluation periods (b) on root dry mass, and effects of concentrations of *Chlorella* sp. (c) and evaluation periods (d) on Dickson quality index of 'Cantaloupe' melon seedlings. ** significant at 1%; * significant at 5%; ns not significant at 5%; Lowercase letters indicate no difference between the concentrations of *Chlorella* sp.

Dickson quality index increased with the application of concentrations and evaluation periods. The highest DQI indicates the quality of the ideal seedlings to be transplanted, resulting in the best establishment and agronomic performance (Pelloso et al., 2020), considering plant height, stem diameter, and shoot and root phytomass (Cruz et al., 2006). It is also possible that the applied suspensions have reduced phosphorus adsorption, increasing its availability to the plant. The constituents of the microalgae acted as a “soil activator,” stimulating microbial populations and promoting more significant plant growth (Franco Junior et al., 2018).

Therefore, given the concentrations used, similar results were observed, so the producer can choose to use the lowest concentration (0.8%), which will lead to a reduction in production costs.

4. Conclusions

Increasing the concentrations of *Chlorella* sp. applied to the soil promoted a significant increase in the development of melon seedlings.

The seedlings' most significant fresh and dry phytomass accumulation was obtained at a concentration of 1.6% of *Chlorella* sp.

These results provide a basis for using microalgae biomass as a bio-input with potential for soil fertilization (1/18).

Authors’ Contribution

All authors contributed to the development of the research. Ana Paula Nunes Ferreira: Conceptualization, methodology, experiment conduction, data collection, laboratory analyses, data interpretation, preparation of graphs and tables, and writing of the manuscript. Kilson Pinheiro Lopes, Railene Hérica Carlos Rocha Araújo, and José Franciraldo de Lima: conceptualization, methodology, data interpretation, and manuscript review. Josinaldo Lopes Araújo: laboratory analyses and review of the manuscript. Rita Magally Oliveira da Silva Marcelino: laboratory analyses. Agda Malany Forte de Oliveira: Preparation of graphs and tables, data interpretation, and manuscript review. Kaikí Nogueira Ferreira and Kalinny de Araújo Alves: experiment conduction, data collection, and manuscript writing.

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