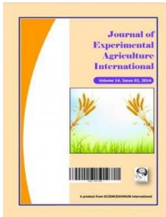

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Organic Fertilization and Hydric Reposition in the Initial Production of *Passiflora edullis. f. flavicarca Deg.*

Alex Serafim de Lima[1], Jackson de Mesquita Alves[1], Francisco de Oliveira Mesquita[2*], Evandro Franklin de Mesquita[3], Caio da Silva Sousa[1], Francisca Lacerda da Silva[1], Anailson de Sousa Alves[4] and Liliane da Silva Soares[5]

[1]Licenciature in Agrarian Science, UEPB, Campus IV-Catole do Rocha/PB, Brazil.
[2]Federal University of Cariri-UFCA, Campus-Crato/CE, Brazil.
[3]States University of Paraiba-UEPB, Campus IV-Catole do Rocha/PB, Brazil.
[4]States University of Maranhão-UFMA, Brazil.
[5]Soil Science by Federal University of Paraiba-UFPB, Campus II-Areia/PB, Brazil.

Authors' contributions

This work was carried out in collaboration between all authors. Author ASL performed the study or project and performed the statistical analysis. Author JMA managed the literature searches. Author FOM carried out the activities related at the results and discussions. Author EFM conducted the reading of the article. Author CSS realized the collection of data. Authors FLS and ASA participated of the collection and organization of data. Author LSS participated of the normalization of article and reference. All authors read and approved the final manuscript.

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ABSTRACT

The objective is to evaluate the effect of different doses of biofertilizer on initial production of seedlings of passion yellow under coefficients of organic matter and water depletion in the substrate. The study was conducted during the period from December 2016 to March 2017, in protected environment at the State University of Paraiba, Campus IV - Catole do Rocha PB. The

**Corresponding author: E-mail: mesquitaagro@yahoo.com.br;*

experimental design used was completely randomized design (CRD), with factorial scheme type 5x2x2, referring to the doses of bovine biofertilizer (0; 200; 400; 600 and 800 mL) diluted in proportion of 1:1, substrate levels. S1- 70% of soil (1400 mL) + 30% bovine manure (600 mL); S2 - 30% of soil (600 mL) + 70% of bovine manure (1400 mL) and two levels of water in the soil (LAS): L1 = 100% of the available water on the substrate (AWS) and L2 = 60% of water available in the substrate, with 4 repetitions, totaling 80 experimental units. After the sowing to 110 days after the emergency (DAE) we evaluated the plant height (PH); stem diameter (SD); water consumption index (WCI); relative water content in the tissues (RWCT); dickson quality index (DQI); water use efficiency (WUE) and soil electrical conductivity (SEC). The concentration of biofertilizer about the composition of the substrate, as well as the association with water blades, that influence the initial development of the yellow passion fruits seedlings. The concentration of biofertilizer on composition of the substrate, as well as your association with blades of water influence on the initial development of the seedlings of yellow passion.

Keywords: Biofertilizer; hydric depletion; seedlings production; environment.

1. INTRODUCTION

The yellow passion fruits (*Passiflora edulis* Sims. f. flavicarpa Deg) stands out as fruit tree of impressive socioeconomic importance in the generation of jobs and income [1,2]. The Brazil stands out as the largest producer and exporter of the yellow passion fruit, due to the large amount of agricultural areas under cultivation, soil natural fertility, soil and climate conditions favorable to the development of agriculture and the consumption of fruit fresh or processed [3,4]. Among the producing regions, the Bahia State is the largest producer of passion fruit, with a production of 386.173 tons, coming from the larger part of the state [5].

Despite the importance of passion fruit in the national scenario, crop productivity is limited by a number of factors, such as: phytosanitary problems, lack of adequate soil management, production of quality seedlings, use of corrective, fertilizers, irrigation techniques, monitoring of the soil water content of the crop, soil preparation and the input of organic matter content [6,7].

Among the factors mentioned, the seedling production with high quality is one of the essential factors for the producers, and there being great interest of these for technical information about obtaining seedlings of the desirable characteristics [8]. According to Oliveira et al. [9] organic sources are often used with frequency in the formulation of substrates, due to the contribution in physic-chemical attributes. Besides stimulating the microbial processes in the soil, the application of these organic inputs to soil brings advantages. The application of these organic inputs to the soil brings advantages, physical soil improvements, such as, increase in porous space, greater aeration of the soil, and water retention, contributing to higher plant growth [10]; chemical attributes, soil fertility; above all the population increase and diversification of microorganisms in soil representing an alternative reduction of the costs with synthetic fertilizers [11].

In midst at the organic inputs employed as source of organic matter, it stands out the bovine biofertilizer, emphasizing that the use of this organic fertilizer in agriculture is not recent, because, with the growth of agroecological agriculture and the organomineral fertilization, in the 1990s, the use of alternative inputs in the agricultural production systems has, in general, has increased significantly [4]. The bovine biofertilizer, when present on the soil surface, favors a series of chemical and biological reactions, presenting properties capable of exerting a conditioning effect, acting as fertilizer, corrective and microbiological inoculant, propitiating the reduction of the difference of osmotic potential between the plants and the medium [12].

The ideal irrigation blades to be applied should vary in function with the requirements of culture and the meteorological conditions of the place of production. In general, the irrigations are carried out with high frequency and in a quantity superior to the water requirement of the plants, causing water waste, besides, the excess water can cause losses of seedlings or of seedling quality, by the pathological agents, due to the high humidity in the substrate, provoking the leaf shading and chlorosis and negative geotropism of the roots [13].

Another important factor to be observed is that the water excess can cause the leaching of the nutrients present in the substrate [14,50]. The scarcity of water affects drastically the metabolism of the plants, inducing the closure of the stomata, in order to avoid the loss of water by the transpiration which entails the reduction of the photosynthetic activity and a series of other processes in the vegetables [15].

Given the importance of organic inputs to produce quality seedlings avoiding water scarcity in the semi-arid region, the work has the objective of producing yellow seedlings of passion fruits under organic fertilizer with different levels of substrates and hydric depletion in protected environment in the high sertão paraibano.

2. MATERIALS AND METHODS

The experiment was conducted during the period from December 2016 to March 2017, in protected environment (*greenhouse*), covered with nylon canvas of the type sombrite with 50% of luminosity, at the Center for Human and Agrarian Sciences - CCHA, State University of Paraiba, Campus IV in Catole do Rocha-PB, Brazil-PB. The county is situated under the geographical coordinates of 06º20'38' latitude south, 37º44'48' longitude west of Greenwich and an altitude of 272 m. The climate of the county, according to the Köppen classification, is of the type BSh, that is, hot and dry type steppe, characterized by hot semiarid, with two distinct seasons, a rainy seasons with irregular precipitation and another without precipitation. With average monthly temperature of 27°C. The mean, maximum and minimum internal temperatures of the greenhouse were set at around 34°C, 42°C and 19°C, with relative air humidity varying from 35 to 52% [13].

The preparation of the substrates was used as *Eutrophic Flubic Neosol*, predominant soil in the region and the micro-region of Catole do Rocha [16]. After collecting the soil samples in the surface depth (0-20 cm), they were placed to dry in the air, twisted and sifted with a sieve of 2 mm mesh, according to the methodology proposed by Santos et al. [16], this soil presented the following physical and chemical characteristics, such as: pH=6.70; Sand=640 g kg^{-1}; Silte=206 g kg^{-1}; clay=154 g kg^{-1}; textural classification=franc sandy; and how much the fertility, Ca^{2+}=1.49 $cmol_c dm^{-3}$; Mg^{2+}=0.54 $cmol_c dm^{-3}$; Na^+=0.10 $cmol_c dm^{-3}$; SB=3.85 $cmol_c dm^{-3}$; CTC=3.85 $cmol_c dm^{-3}$; H + Al^{3+}=0.00 $cmol_c dm^{-3}$ and V%=100%.

The experimental design used was completely randomized design (CRD), with factorial arrangement type 5x2x2, referring to the doses of bovine biofertilizer (0, 200, 400, 600 and 800 mL). Before application, the doses of biofertilizer were prepared and applied, after dividing in to two stages of application it was diluted in proportion of 1:2 (biofertilizer / non-chlorinated and non-saline water), after performing the first step of the biofertilizer application (50% for each biofertilizer dose), two days before sowing, via soil and the second application (50% referring to each dose of biofertilizer, except the control treatment), at 45 DAS, via soil; Substrate levels S1- 70% of soil (1400 mL) + 30% of bovine manure (600 mL); S2 - 30% via soil (600 mL) + 70% of bovine manure (1400 mL) and two levels of water in the soil (LWS): L1 = 100% of the water available in the substrate (WAS) and L2 = 60% of available water on the substrate with 4 replicates, totaling 80 experimental units. The chemical characteristics of the bovine manure is shown in Table 1.

The bovine biofertilizer was produced with water (non-saline and non-chlorinated water) and with fresh bovine manure in the relation of 1:1, where the same, presented the following physic-chemical compositions according to [17], such as: pH = 7.10; CE = 5.13 dS m^{-1}; Ca^{2+}= 1,75 $cmol_c L^{-1}$; Mg^{2+}= 1.20 $cmol_c L^{-1}$ and Na^+= 1.34 $cmol_c L^{-1}$.

The seeds of yellow passion fruit with 96% of purity were acquired in a commercial house, being used the cultivar IAC-277. The sowing was carried out in plastic bags of polyethylene with 15 cm of width, 30 cm of height and 0.008 mm of thickness with the capacity for up to 2000 mL of substrate volume. The thinning of the seedlings was done at the 15 days after sowing (DAS), when the seedlings were with one pair of leaves definitive, leaving the most vigorous per container.

The irrigation of the plants was performed with a volume uniform of water, in function of the evapotranspiration measured in the control treatment. The applied volume (AV) per container was obtained by the difference between the average of container weight in condition of 100% of the available water (AW) and the average weight of the containers in condition current before of the irrigation. The

Table 1. Chemical characteristics of bovine manure. Catole do Rocha-PB. 2018

N	P	K^+	Ca^{2+}	Mg^{2+}	Na^+	Zn^{2+}	Cu^{2+}	Fe^{2+}	Mn^{2+}	MOS	CO	C/N
................g kg^{-1}..........................						.........mg kg^{-1}...........				.... g kg^{-1}......		
Bovine manure												
12.76	2.57	16.79	15.55	4.02	5.59	60	22	8550	325	396.0	229.7	18:1

SOM=Soil organic matter; OC=Organic carbon; C/N=nitrogen carbon relation; Analyzes carried out in the EMPARN (2016) and UFERSA (2016);

Table 2. Chemical characteristics of water used for irrigation. Catole do Rocha-PB. 2018

pH	C.E	SO_4^{-2}	Mg^{+2}	Na^+	K^+	Ca^{+2}	CO_3^{-2}	HCO_3^-	Cl^-	SAR	Classification
		mL^{-1}	...............................mmloc L^{-1}.............................								
6,9	0,84	8,57	1,48	6,45	1,21	2,50	0,00	10,75	7,00	4,57	C_3S_2

EC (dS m^{-1} to 25°C) = Electric conductivity

weight of the container with the soil + the field capacity (100% of available water) was determined by saturating the soil and subjecting it to drainage, when the drained volume was reduced, where, the containers were weighed. Whereas they were reduced in 60% of water available in the soil (WAS) compared with the current condition.

Such the water of the semi-arid region presents variable salinity, which often affect the growth of plants; the water used in irrigation was analyzed in the Water and Soil Laboratory of Center of Agrarian Sciences of the Federal University of Paraiba, Areia-PB. The chemical characteristics of water is represented in Table 2.

After sowing at 110 (DAS), was evaluated the height of the plant (HP) graded in cm; Diameter of stem (DS) assessed with digital caliper model stainlees steel, of the brand ULTRA TECH®², in the same period established for measuring plant height, water consumption index (WCI); Relative water content in tissues (RWCT). The relative water content was obtained through equation 1, according to Nunes et al. [53], was quantified the dickson quality score (DQS). The dickson Quality Index (DQI) was obtained through equation 2, proposed by Hall et al. [18]; Efficiency of water use (EWU), obtained through equation 3, proposed by Hall et al. [18] and the Electrical conductivity of soil (SEC).

The water consumption index (WCI) was estimated by means of a regression equation for each one of the treatments, it using as an independent variable, 110 days after sowing. The relative water content in the tissues (RWCT) was determined essentially through of the water content of the plant tissue newly harvested (Fresh weight = FW), with the water content of the same tissue when Dry (Dry Weight = DW), it expressing the result on basis percentage, so that:

$$\mathrm{RWCT} = \frac{\mathrm{FW-DW}}{\mathrm{FW}}\ \mathrm{x}\ 100$$

The dickson quality index (DQI) is an indicator of seedling quality, and was determined through of the relation total dry matter (TDM) between the plant height (PH), stem diameter (SD), dry mass of aerial part (DMAP) and dry mass of root (DMR), by means of the following formula [19]:

$$DQI = \frac{\mathrm{TDM\ (g)}}{\frac{\mathrm{PH(cm)}}{\mathrm{SD\ (mm)}} + \frac{\mathrm{DMAP\ (g)}}{\mathrm{DMR\ (g)}}}$$

The water use efficiency (WUE) was obtained by the quotient between the total dry matter (TDM) and the total volume of water (TVW) applied during the experiment:

$$\mathrm{WUE} = \frac{\mathrm{TDM\ (g)}}{\mathrm{Water\ consumption\ (ml)}}$$

The obtained results were submitted to analysis of variance by the test "F", for diagnoses of significant effects of each source of individual variation and of their respective interactions and, quantitatively, to study the effects of different doses of biofertilizer, levels of substrates and water blades in the production of passion fruit seedlings, interpreted by polynomial regression [20]. For the processing of the data, was used the software statistical AGROESTAT [21,23].

3. RESULTS AND DISCUSSION

According to (Table 3), there was a significant effect of the interaction between the doses, water blades and biofertilizer substrates for plant height, stem diameter, relative content, water consumption, water use efficiency, dickson quality index and electrical conductivity of the soil evaluated at the 120 days after sowing in the initial growth of the yellow passion fruits seedlings (*Passiflora edulis* L.), evidencing dependence of the studied factors. Already for the isolated factors, the treatments with doses, water blades and levels caused an effect on all the variables studied at level of 1.0 and 5% of probability, according to the test F. Opting by the unfolding of the interaction according to steps of [22]. From the summaries of the variance analysis the parts different vegetative of the seedlings of both treatments respond differently to the effects of the doses of biofertilizer and water blades and of the interactions between the blades, substrates and the bovine biofertilizer applied in the liquid form.

Based on Fig. 1A, evaluating the treatments with 30% bovine manure, the plants grew in height to 11.78 and 13.48 cm, in the estimated doses of biofertilizer of 416 and 575 ml, in the blades with and without hydric stress, respectively. The beneficial and mitigating effects of biofertilizer on the production of yellow passion fruit seedlings corroborate with [12], when evaluating its action under substrate irrigated with salt water, as well as its positive effect can be confirmed in the initial growth of other fruit trees as recorded by [9] and [24] in papaya and in acerola seedlings.

The presence of humic substances contained in the biofertilizer promotes improvements in the soil and favor a greater absorption of water and nutrients for the plants, stimulating the growth and the cellular division, contributing for the increase in its aerial architecture [11]. In the substrate with 70% bovine manure (Fig. 1B), it is possible to evaluate that the treatments with and without water stress were inferior to 7.89 and 8.45% with respect to the substrate containing only 30% of organic compound, to which it was influenced by the additions of organic matter in the substrate, preventing the loss of water by evaporation and a subsequent vertical growth of the plant, but that could not inhibit the antagonistic effect of the high doses of the biofertilizer. This decline in most plants is due to the toxic effect of Na + and Cl^- ions in excess, which can cause reduction of water absorption, nutrients and imbalance in the cationic balance and plant metabolism, causing losses in growth and production [25,26].

It is worth noting that the 100% slide in the substrates with bovine manure levels inhibited the toxic effect of the biofertilizer exactly by the leaching of the soil with the optimal application of water, and that the yellow passion fruit according [27], is sensitive to the effects of salts, irrigation with waters that offer moderate restrictions (CEa> 2.01 dS m^{-1}) or severe (CEa> 3 dS m^{-1}), which with the dosages applied increased the content of organic compounds and acids in the soil. As the experiment was carried out in semi-arid conditions, in addition to the limitations exposed, the low organic matter content of the soil, usually less than 1.2%, was influenced by the use of organic sources for physical, chemical and biological improvement of soils.

The growth of the stem diameter it behaved of form quadratic (Fig. 2A) and with its stabilization in the treatment with a lower content of organic matter (30%) of the organic matter in the optimal doses of 470 and 487 mL $plant^{-1}$ in the blades without (4.07 mm) and with (3.27 mm) level of hydric reposition, indicates that with the high dosages of biofertilizer, the plants reversed their

Table 3. Summary of the variance analysis from plant height (PH), stem diameter (SD), relative water content (RWC), water consumption (WC), efficiency of water use (EWU), Dickson quality index (DQI) and soil electrical conductivity (SEC) in the yellow passion fruit submitted to levels of hydric reposition and organic fertilization. Catole do Rocha-PB. 2018

Cause of Variation	FD	PH	SD	RWA	WC	EWU	DQI	ESC
		Significance of average squares						
Doses of biofertilizer	4	5.39*	0.20*	488.18*	2372935.706*	0.73*	8.94**	8.07*
Blades	1	14.75*	15.50*	750.38*	20882706.46*	32.24*	7.99**	3.56*
Substrates	1	5.28*	0.002*	291.42*	12669043.61*	1.47*	0.86**	216.56*
Interation	4	2.52*	0.42*	649.53*	5819.22**	0.28*	9.03**	8.14*
Residue	80	0.11	0.007	3.88	2881.53	0.008	0.002**	0.03
CV (%)	-	2.89%	2.45%	2.47%	2.94%	7.18%	11.30%	4.63
General average	-	11.35	3.37	79.66	1827.90	1.27	0.41	3.70

** Significant at the level of 0.05 of probability by the test F. ** Significant at the level of 0.01 of probability by the test F.*

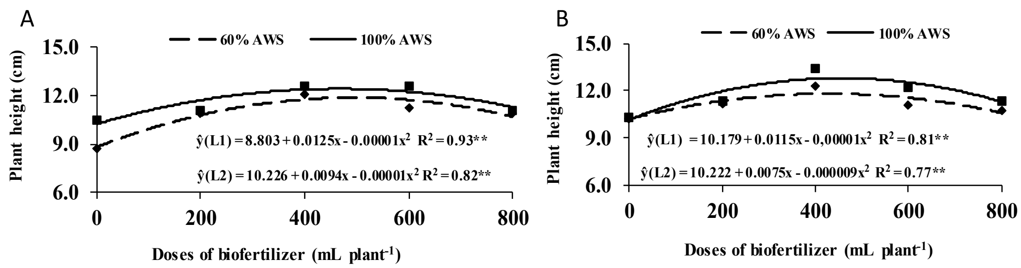

Fig. 1. Height plant (HP) of yellow passion fruit with 30 (A) and 70% (B) of bovine manure in the substrate, with (- - -) and without hydric stress (─) and biofertilizer doses. Catole do Rocha-PB. 2018.

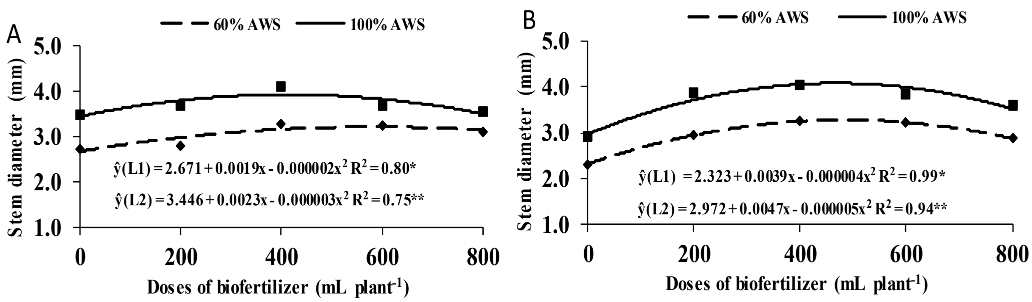

Fig. 2. Stem diameter (SD) of yellow passion fruit with 30 (A) and 70% (B) of bovine manure in the substrate, with (-- -) and without hydric stress (─) and biofertilizer doses. Catole do Rocha-PB. 2018

vegetative growth through the toxicity in their metabolism, at which, the fertilizer of bovine manure fermented in this experiment possessed an electrical conductivity of 5.13 dS m^{-1} (Table 3), in the biofertilizer threshold doses of 470 and 487.5, respectively.

In the threshold doses, it is verified that the nutrients absorbed by the plants in their initial growth were used and provided healthy seedlings contributing to their consequent reproduction phase, because the nutrients are allocated by the plants not only in their initial development, but also for their consequent phase reproductive [15]. The highest stem growth was obtained in the treatment with higher content of bovine manure (Fig. 2B), in blades of 100%, which reached an estimated value of 3.89 mm at the optimum dose of 383 mL $plant^{-1}$. The superiority observed in stem growth evidences greater availability of nutrients to the plants in the treatments with the common biofertilizer [27].

Being that the threshold dosage of 470 mL in this experiment affected positively the development of yellow passion fruit, [12] also obtained optimum values with 10% of percentage level of dilution with the dose of common biofertilizer in yellow passion fruit fertirrigated, which is more easily absorbed by the plants [28]. Situation also observed by Oliveira et al. [29] at the concluded that the biofertilizer, applied to the soil in intervals of 60-day (diluted in water to 33.3 and 66.6%) adequately supplied the passion fruit of plants in macronutrients, except the calcium. Once that as in intervals (15 to 20 days of decomposition), the biofertilizers can accelerate the availability of these nutrients to plants [30]. Thus, these levels and intervals may have been sufficient to nourish the plant with the essential elements, and above these doses may have had deleterious effect. Probably during the growth of the seedlings, the doses of bovine biofertilizer, together with the nutrients contained in the substrates, may have efficiently supplied the nutritional needs of the passion fruit seedlings.

Those results were similar to observed by Marrocos et al. [31], where studying the production of yellow passion fruit seedlings verified a response growth quadratic in the stem diameter (2.9 mm). It is important to emphasize that your application in agriculture is important due to the diversity of chelated mineral nutrients available in biological activity and as enzymatic activators of the plant metabolism [32].

This organic input also promotes a greater physical structuring of the soil, that it promotes a layer that avoids high losses of water by the evaporation [33]. The presence of humic substances contained in the biofertilizer promotes soil improvement and favors a greater absorption of water and nutrients by the plants, stimulating the growth and the cell division, contributing to the increase in the stem diameter [11].

The plants irrigated with 60% of WAS with the threshold dose of 445 and 413 mL presented the lowest values of RWC reaching to 83.54 and 86.28% in the treatments with 30% (Fig. 3A) and 70% (Fig. 3B) of manure bovine. Comparatively at the relative water performance in the yellow passion fruit, the blades of 100% WAS in the treatment with bovine manure, evaluated in the substrate at the levels of 30 and 70% reached values of 84.78 and 89.33%, observing himself once more the efficiency of bovine manure in the soil water retention, at which provided greater hydric availability for the plants under stress in comparation at the water reposition levels.

The decreases of RWC were from 12.98% and 3.43% in the blades of 60% with the maximum doses of biofertilizer (800 mL plant^{-1}) in comparison with the optimal doses and levels of 30 and 70% of the substrate, with the organic compounds, also in the blades of 100%, the decreases were also antagonistic for the development of the yellow passion fruits seedlings, at which reached deleterious values of 0.43 and 13.81% in the maximum dose of 800 mL plant^{-1} in comparison with the doses optimum to 30 and 70%, respectively, of bovine manure.

This small difference in the blades of 100% in the treatments with lower level of bovine manure proves that the use of organic inputs in the substrate allows a higher content of organic matter and consequently greater absorption in the soil micropores, being that the deleterious effect of 0.43% increased to 13.81% with the addition of bovine manure and of the maximum doses of biofertilizer, which provoked toxicity and high salt content impeded the natural translocation of solutes by the root system of the passion fruit seedlings, to which in both situations, the salts excess compromise the physiological and metabolic processes of the crops, but, always with less intensity in the plants with the organic input [15]. Freire et al. [34], Cavalcante et al. [35] also obtained negative results in the development of guava *'Paluma'* plants on growth in height, stem diameter, leaf area and biomass production as well as neem (*Azadirachta indica*) irrigated with saline waters, in the soil with bovine biofertilizer, respectively.

The water consumption of the yellow passion fruit seedlings irrigated with 60 and 100% of available water in the soil was reduced in function of the increase of the biofertilizer doses, to which, declined linearly with the increase of the biofertilizer doses of 0.0 still 800 mL, providing a consumption even lower with the increase of the bovine manure level, presenting a linear mathematical model in both the treatments. Being that in the dose without biofertilizer, the consumption was superior up to 60.54%, when compared with the maximum estimated dose of 800 mL plant^{-1} in the substrate with 30% bovine manure (Fig. 4A) in the blades of 60% of WAS.

In the substrate with higher content of organic matter (Fig. 4B), the consumption was even higher from the treatment without biofertilizer, but that the effect was deleterious with the maximum dose (60.25% lower in compaction with the minimum dose), in which the higher level of the organic matter impeded which the consumption from water being greater, mainly, by its high efficiency in the water retention, the reduction of the hydric consumption in function to the application of biofertilizer may be related to the physical and chemical improvements to the soil provided to the soil by the inputs, already that the organic matter acts as a binding agent between the components of soil, interfering of manner positive in its physical attributes, increasing the hydraulic conductivity and the water infiltration [36], besides its conditioning effect to with the same, promoting improvements in the redistribution of soil pores, increasing the soil permeability and consequently improving water movement in the soil [37,38].

The substrates with 30 and 70% of organic compound with the maximum dose of 800 mL of biofertilizer in the blades of 100%, obtained inferior water consumption in comparison with the treatment under hydric stress. However, the application of the biofertilizer in the soil can induce an increase of the osmotic adjustment to the plants by the accumulation of organic solutes, promoting by the water and nutrients absorption [39]. This positive effect of the biofertilizer may be related to the presence of organic matter in this fertilizer, which provides direct positive effects on the soil, such as diminution of compaction, increased water retention and better nutrient availability [40,41].

The quality of the seedlings measured by the dickson quality Index (DQI) was adjusted to the quadratic polynomial model, being verified optimal doses of biofertilizer of 350 and 357 mL plant^{-1} in the substrate with and without hydric reposition and in the treatment with lower levels of bovine manure (Fig. 5A), respectively, having the optimal doses of biofertilizer provided an estimated value of 0.40 and 0.48. Proving more once, the efficiency of the organic fertilization in seedlings, being that these overestimated values, in relation to that of the literature, the DQI less than 0.20 indicate that the seedlings are not apt for planting in the field [19].

Taking in consideration the value of 0.20 for the quality index of the seedlings according studied by Berilli et al. [42], the plants of yellow passion fruit fertilized with biofertilizer and bovine manure in the substrate with up to 300 and 333 mL plant^{-1} at level of 70% of the bovine manure (Fig. 5B) under 60 and 100% of WAs, the seedlings are considered of quality to be carried for the field, the input stimulated the production of seedlings with an estimated value of QDI well more above 0.21, with index maximum of 0.53, respectively. These values corroborate with [43], who obtained notorious results in neem seedlings under the water salinity, biofertilizer and soil drainage, with a superiority of 36.36% in the dickson quality index compared to treatments without the organic input, entailing seedlings with higher quality, suitable for the transplanting.

Being thereby, a good indicator of quality of the seedlings such as passion fruit in this experiment since the transplanting, considering that it is recommended for the rural producer the index above of 0.20 and overestimating the value of 0.40 when it using the bovine biofertilizer with optimal doses, because it considers various characteristics of the seedlings, especially the productions of biomass and quality, as found by [41] when evaluating the development and the quality of the yellow passion fruit seedlings, in function of the fertilization with different doses of biofertilizer. These authors observed a positive effect of biofertilizer on the dickson quality index up to threshold limits.

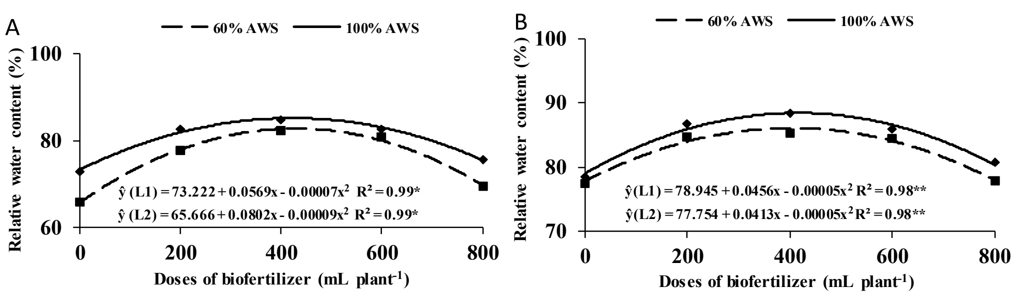

Fig. 3. Relative water content (RWC) of the yellow passion fruit seedlings with 30 (A) and 70% (B) of bovine manure in the substrate with (- -) and without hydric stress (—) and biofertilizer doses. Catole do Rocha-PB. 2018.

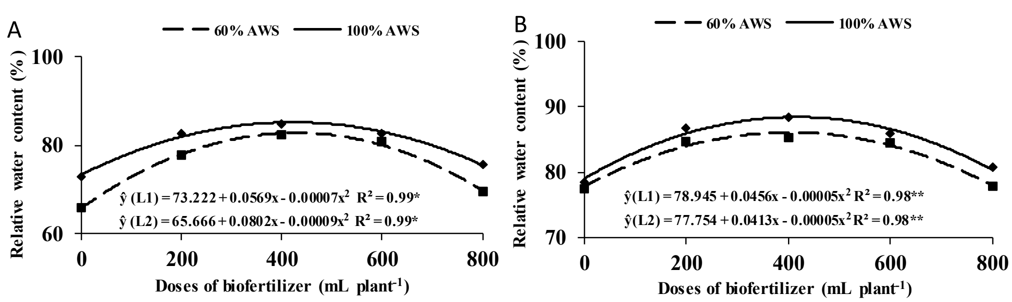

Fig. 4. Water consumption (WC) of the yellow passion fruit seedlings with 30 (A) and 70% (B) of bovine manure in the substrate, with (- - -) and without hydric stress (—) and biofertilizer doses. Catole do Rocha-PB. 2018.

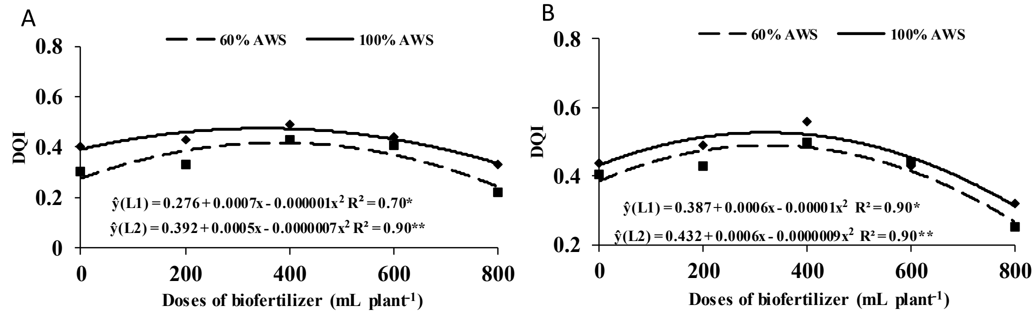

Fig. 5. Dickson quality index (DQI) of the yellow passion fruit seedlings with 30 (A) and 70% (B) of bovine manure in the substrate, with (- - -) and without hydric stress (—) and biofertilizer doses. Catole do Rocha-PB. 2018.

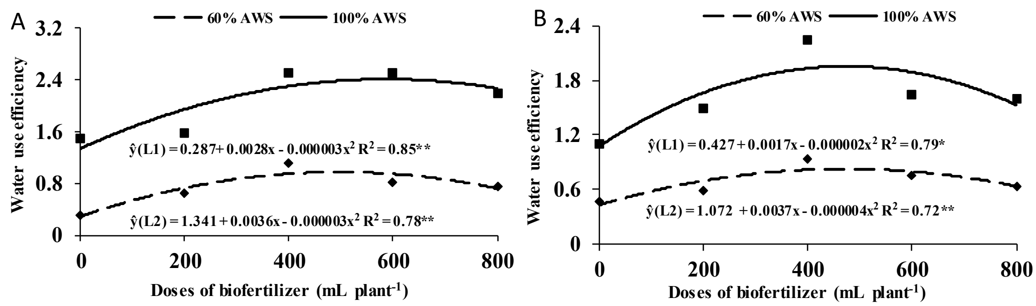

Fig. 6. Water use efficiency of the yellow passion fruit seedlings with 30 (A) and 70% (B) of bovine manure in the substrate, with (- - -) and without hydric stress (—) and biofertilizer doses. Catole do Rocha-PB. 2018.

The efficiency maximum of water use (1.92 g L^{-1}) understand the dose threshold of 462 mL $plant^{-1}$ for the substrate with lower organic compound content (Fig. 6A) with 100% of WAS, while that in blades of 60% of available water in the soil in the optimum dose of 425 mL $plant^{-1}$ provided a maximum efficiency of 0.79 g L^{-1}, indicating that the nutritionally adequate seedlings present lower hydric requirements.

Despite the fact that the level of 60% water available in the soil (WAS) to propitiate the lowest values in the treatment with lower level of bovine manure, it is observed higher values of the water use efficiency with the same levels of hydric replacement in the treatment with higher content of the substrate (0.93), with a superiority of 17.72% in the hydric efficiency of the yellow passion fruit seedlings (Fig. 6B). Results similar were observed by the [44], studying different levels of hydric reposition, was observed higher efficiency of water use in the treatments with lowers replacements of 25 and 50% REC and 50 and 70% WEC, respectively.

[45], to affirm that seedlings present greater efficiency of water use are extremely important when it speak in economics of the hydrics resources, because the same make it possible a higher yield per m^3 of water. Such differences can be caused by the low tolerance of the yellow passion fruit seedlings at the deficit water, which take along this crop to increasing losses of growth and dry phytomass, reducing thus, the EWU, thereby, the use of organic inputs in regions of semi-arid climate (RE_0), is high and with a period of greater insolation, comprehend between the months of July and December, and superior to 2500 mm $year^{-1}$ [46], can contribute significantly for the local fruit tree. Studies have shown that effect of the organic sources with and without hydric stress were reported by [47]. Was evidenced in this experiment that, when used as an organic source, the bovine biofertilizer, attenuates the effect of the hydric stress in the soil where, the seedlings were cultivated. It is worth to highlight that in addition the fruit tree, the positive effect promoted by the bovine biofertilizer on yield has already been verified in fruit type vegetables such as melon [54].

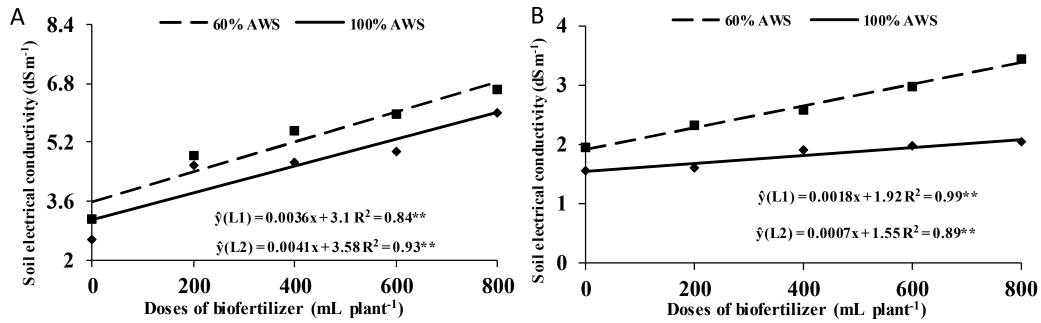

Fig. 7. Soil electrical conductivity (SEC), with 30 (A) and 70% (B) of bovine manure in the substrate, with (- - -) and without hydric stress (—) and biofertilizer doses. Catole do Rocha-PB. 2018.

At to consider that the soil, before the application of the treatments with the biofertilizer possessed the ECS of 1.92 (Fig. 7A) and 1.55 dS m^{-1} (Fig. 7B), it is verified expressive elevation of the non-saline character for still moderately saline (ECS = 2.11 and 3.36 dS m^{-1}) [26] in blades of 60 and 100% of WAs, with maximum dosages of biofertilizer in the substrate with lower content bovine manure.

The increase of biofertilizer provided an increase of salts in the soil with and without hydric stress, raising the electrical conductivity of the soil saturation extract (ECSE) of quadratic form in both the treatments with the organic substrate, but in the treatments with 70% of substrate with bovine manure, values were expressively higher (Fig. 7B), which may be related to the organic matter efficiency in the water retention, which after the mineralization [48] increases the availability of essential nutrients to the plants, but which in this experiment also retained the biofertilizer, which provided the superiority of the values, presented in the treatments with the applied dosages, in response at the increase of salts by the respective input that presented sodium content with 5.59 mg kg^{-1} before of experiment application (Table 2), which implies to report that the biofertilizer limited the vegetative development with a maximum value of the ECS in still 3.36 ds m^{-1} (Fig. 7A).

It is perceived, still, decline in the values of ECW in the blades of 100% WAS after addition of the doses in both the treatments, this is due to the fact that, in soils with added salts, there is an increase of the permeability, which facilitates the removal of salts from the profile by the daily irrigation water and application of the leaching blade [49]. Comparatively, the results presented corroborate with those obtained by Nivas et al. [25], which verified a significant variation of the soil salinity, in function to the presence and absence of biofertilizer, when irrigated with saline waters. However, of general form, besides the presence of the biofertilizer, the substrate with lower bovine manure content in the substrate, than with the addition by means of the organic matter to be a source of essential nutrients to the plants and to provide improvement in the infiltration and retention of water in the soil [13], the same absorbed a larger amount of biofertilizer and consequently increased the soil salinity to maximum values of 5.98 to 6.86 dS m^{-1} with the biofertilizer doses of 800 mL $plant^{-1}$ (Fig. 7B).

Araujo et al. [50], analyzing the influence of the salinity on the growth, absorption and distribution of sodium, chlorine and macronutrients in yellow passion fruit seedlings, concluded that this species presents moderate tolerance to salt stress. On the other hand, it was observed that, although the biofertilizer to increase more the saline character of the soil in relation to the treatments without the input, the plants presented height higher and stem diameter in the treatments with optimal dosages. Results similar, in which the biofertilizer stimulated the plant growth, were presented by Santos et al. [51], at evaluating the initial growth of noni (*Morinda citifolia*) and yellow passion fruit under irrigation with saline water in soil without and with bovine biofertilizer. It is verified, also, among the respective figures that, although the biofertilizer exerts positive effects on plant growth, the input does not eliminate the depleting effects of the salts to the plants, how did they conclude [52,53,54], in castor bean plants (*Ricinus communis*).

4. CONCLUSION

The concentration of biofertilizer in the substrate composition, as well as its association with water blades influence in the initial development of yellow passion fruit seedlings.

The optimum doses of biofertilizer in the substrate with low hydric reposition inhibit the deleterious effect of stress on the yellow passion fruit seedlings, while the high doses reduce these characteristics.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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