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Economic Viability and Profitability of Lettuce in Hydroponic System Using Different Effluents

Josilda de França Xavier[1], Carlos Alberto Vieira de Azevedo[2], Marcia Rejane de Q. A. Azevedo[3], Antônio Fernandes Monteiro Filho[3] & Carisa Rocha da Silva[3]

[1] Empresa Estadual de Pesquisa Agropecuária da Paraíba S. A., Estação Experimental de Lagoa Seca, Brazil

[2] Universidade Federal de Campina Grande, Campina Grande, PB, Brazil

[3] Universidade Estadual da Paraíba, Campus-II, Lagoa Seca, PB, Brazil

Correspondence: Josilda de França Xavier, Empresa Estadual de Pesquisa Agropecuária da Paraíba S. A., Estação Experimental de Lagoa Seca, Brazil. E-mail: josildaxavier@yahoo.com.br

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Abstract

The hydroponic cultivation *Lactuca sativa* L. can offer producers greater economic profitability, fast financial return due to sanitary and nutritional quality. The objective of this study was to analyze the economic feasibility and profitability indicators of three cultivars of curly lettuce in a hydroponic system using different effluents and well water. The experiment was conducted in a protected environment of the State University of Paraíba-UEPB, Campus-II, in the municipality of Lagoa Seca-Paraíba. Experimental design was in a randomized blocks with plots subdivided in a 7 × 3 factorial scheme, with three replications whose factors were 7 hydroponic solutions and three lettuce cultivars. Variables analyzed included gross revenue; gross margin effective and total operating cost; gross margin total cost of production; leveling point effective operating Cost, total production; operating profit and profitability index. The cultivars: Verônica, Vanda and Thais presented the highest gross revenue and profitability index when irrigated with the Furlani solution (S_1).

Keywords: hydroponics, vegetable production, wastewater

1. Introduction

The interest in using treated wastewater in irrigation is goal of more recent studies (Bonini et al., 2014), and became an attractive option, since it reduces the contamination by the direct discharge of sewage in water bodies, improving the conditions of potability, allowing the more rational use of water resources, being an alternative source of water available for agriculture (Martínez et al., 2013).

According to Cavalcante, Deon, and Silva (2017), polluted waters can recover their quality and return to aquatic systems using sewage treatment, they can have multiple uses. Therefore, sewage of essentially domestic origin or with similar characteristics, after treatment, which called effluents from sewage treatment plants, can be reused for purposes that require non-potable water, so the treated effluents present a proportion of nutrients that are generally not suitable for the production certain agricultural crops.

Wastewater reuse is an alternative form of pollution control and contributes to increasing water availability in arid and semi-arid regions, with a view to minimizing socio-environmental impacts and when used in agriculture can maximize food production (Araújo, 2012). However, the main salts Na^+, Ca^{2+} and Mg^{2+} dissolved in domestic effluents, may hamper agricultural activities, restricted the growth of plants, limiting the withdrawal of water through the modification of osmotic processes, or chemically by metabolic reactions such as caused by toxic constituents (Cavalcante, Deon, & Silva, 2017).

The lettuce (*Lactuca sativa* L.) is the larger-scale cultivation by hydroponic cultivation called NFT-Nutrient Film Technique (Potrich, Pinheiro, & Schmitd, 2012) and stands out in the national scenario of hydroponic crops, being responsible for approximately 80% of the Brazilian agricultural production of this system (Alves et al., 2011).

The cultivation of lettuce in hydroponic systems is already widely diffused in Brazil, especially by easy, combined with its short cycle Sarmento et al. (2014). According to Cova et al. (2017) who studied lettuce cultivation in a hydroponic system and observed that the choice of the hydroponic system and the recirculation interval for lettuce acculturation depends on the quality of the water used in the preparation of the nutrient solution.

The use of nutrient solution without hydroponic cultivation is of fundamental importance, the growth and development of the culture will depend on a suitable formulation (Oliveira et al., 2014). The choice of nutrient solution should be formulated according to the nutritional needs of the species (Furlani et al., 1999). Monteiro Filho et al. (2014) report that in the semi-arid region, lettuce cultivation in the hydroponic system is often made unfeasible by the lack of commercialization of soluble fertilizers, causing the producer to import these inputs from other regions, which significantly increases their costs. According to Santos (2012), the yield of lettuce grown in the soil is approximately 18 tons per hectare, while in hydroponic cultivation the same thing around 46 tons per hectare. Santos (2012) cites that hydroponic cultivation offer producers greater profitability due to product differentiation, sanitary, nutritional quality, visual aspect of hydroponic products can add greater value to the product with the consumer.

The temperature can significantly influence the lettuce crop, changing its production architecture, cycle and resistance to inflorescence (Diamante et al., 2013).

The present work had the objective of analyzing the economic feasibility and profitability indicators of three cultivars of curly lettuce in a hydroponic system using different effluents and well water.

2. Material and Methods

The experiment was conducted in a hydroponic system using the laminar nutrient flow technique (NFT), protected environment of the State University of Paraíba, Campus II, in the municipality of Lagoa Seca-PB with the following geographical coordinates: 7°10′15″S, 35°51′14″W, according to the Köppen-Geige climate classification (Brasil, Ministério da Agricultura, 1971). The experiment was carried out between May and August 2016.

In Figures 1 and 2 the distribution of the hydroponic system is observed, adopting the laminar nutrient flux technique (NFT).

Figure 1. Overview of the experiment with three days of transplanting lettuce cultivars

Figure 2. Overview of the experiment with twenty-eight days of transplanting lettuce cultivars

The experimental design was randomized blocks with treatments arranged in subdivided plots, with three replications. The plots consisted of 7 hydroponic solutions with a conductivity of 1.7 dS m^{-1}: S_1 = Furlani solution; S_2 = domestic wastewater; S_3 = optimized domestic wastewater; S_4 = well water; S_5 = optimized well water; S_6 = wastewater solution from the Upflow Anaerobic Sludge Blanket-UASB reactor and S_7 = wastewater solution from the optimized UASB reactor and the subplot for three lettuce cultivars from the curly group (Verônica, Vanda and Thais). Each subplot was composed of six plants (two of each cultivar) with spacing of 0.30 m × 0.30 m.

The lettuce seedlings of the cultivars were produced in phenolic foam using a table for germination, sowing a seed pelletized by cavity; after emergence of the seedling (ES), the supply water used in irrigation was gradually replaced by nutrient solutions (33.33%, 66.66% and 100% every four days); after 25 days of ES, the seedlings were transplanted to the definitive profiles.

The optimized nutrient solutions were formulated by taking as a reference the nutrient solution of Furlani 1999. For this purpose, the SOLVER tool was used, according to the methodology described by Monteiro Filho et al. (2014).

The water used in the experiment came from rainwater stored in tanks (for solution S_1), the raw sewage from the city of Lagoa Seca-PB, tubular well water in the rural area of the municipality Lagoa Seca-PB and wastewater from the UASB reactor of the Experimental Station for the Biological Treatment of Sanitary Sewers (EXTRABES) Campina Grande-PB. They were sent for physical-chemical analysis in the Laboratory of Irrigation and Salinity, Agricultural Engineering Academic Unit, Federal University of Campina Grande (LIS/UAEA/UFCG). Table 1 shows the results of the physicochemical characterization of the water used in the hydroponic irrigation, the methodology used (APHA, 1998).

Table 1. Physical-chemical characterization of waters used in hydroponic irrigation

Determinations	Well	Raw sewage	Extrabes
pH	7.7	7.4	7.2
Electric conductivity (dS m^{-1})	0.957	2133	2.502
Calcium ($mmol_c$/L)	3.62	3.98	5.98
Magnesium ($mmol_c$/L)	0.75	3.47	3.42
Sodium ($mmol_c$/L)	3.94	10.57	15.55
Potassium ($mmol_c$/L)	0.38	1.26	0.01
Chlorides ($mmol_c$/L)	6.42	9.99	23.23
Carbonates ($mmol_c$/L)	0.00	0.00	0.00
Bicarbonate ($mmol_c$/L)	1.31	10.95	3.25
phosphorus (mg L^{-1})	4.51	29.30	4.14
Nitrate (NO_3^-) (mg L)	16.73	0.00	1.03
Ammonia (NH_3) (mg L^{-1})	0.61	1.27	58.6
Sodium adsorption ratio (SAR)	2.57	6.93	8.53
Class of water for irrigation	$C_2S_1T_2$	$C_3S_1T_3$	$C_3S_1T_3$

The nutrient solutions S_3, S_5 and S_7 were prepared according to methodology proposed by Furlani (1995). Once formulated, the organic ingredients were mixed, when necessary, with mineral fertilizers so as to present chemical composition similar to the Furlani solution (Table 2). During the conduction of the experiment the S_1 and optimized solutions were calibrated by conducting electrical conductivity (EC) readings and potential of hydrogen (pH) using a portable conductivity meter, plus a peg; the EC was maintained at approximately 1.7±0.3 dS cm^{-1} and the pH was between 6.0 and 7.0; independently of the treatments, the nutrient solutions were changed in equidistant periods of 7 days.

Table 2. Quantitative of the fertilizers used in the preparation of mineral nutrient solutions from the physico-chemical characterization of the waters used in hydroponic irrigation

Ingredients	Quantity of ingredients used to prepare optimized solutions		
	S_3	S_5	S_7
EXTRABES	199.58 L	-	-
Well water	-	199.64 L	-
Raw sewage	-	-	199.64 L
Ammonium sulfate [$(NH_4)_2SO_4$]	23.66 g	22.31g	25.09 g
Calcium nitrate [$(NO_3)_2$]	238.24 g	237.53 g	193.54g
Potassium nitrate (KNO_3)	84.06 g	80.95 g	121.74g
Potassium chloride (KCl)	46.32 g	50.04 g	0.00g
Copper Sulfate ($CuSO_4$)	0.04 g	0.04 g	0.04g
Zinc sulfate ($ZnSO_4$)	0.11 g	0.11 g	0.11g
Manganese Sulfate ($MnSo_4$)	0.49 g	0.49 g	0.49g
Magnesium sulphate ($MgSO_4$)	2.19 g	4.27 g	0.00g
Ammonium molybdate [$(NH_4)_6Mo_7O_{24}$]	0.06 g	0.06 g	0.06g
Boric acid (H_3BO_3)	0.42 g	0.42 g	0.42g
Monoammonium phosphate (MAP)	3.14 g	10.43 g	5.14g
Iron sulphate ($FeSO_4$)	12.05 g	12.05 g	12.05g

The management of the nutrient solution was carried out daily by replacing the water consumed, monitoring the electrical conductivity (EC) and hydrogenation potential (pH), keeping it close to neutrality, using a solution of NaOH or HCL (1 mol L^{-1}).

For economic feasibility, cost of production analysis was performed according to the methodology suggested by Martin et al. (1998). The following costs were considered in production systems:

Effective Operational Cost (EOC): are the expenses incurred with manpower, machinery/equipment operations and vehicles and materials consumed throughout the production process;

Total Operating Cost (TOC): is the effective operating cost plus social charges (36% of the value of the labor expense);

Contribution to Rural Social Security (CSSR) (2.2% of gross income) and total cost of production (CTP): is the total operating cost plus land leases expenses (R$ 1.300.00/year).

In this research was carried out a simulation taking into account an initial investment of R$ 60.000.00; acquired by the producer from a financial institution with a charge of 6.5% p.y. (Banco do Nordeste, 2016). The settlement balance of the outstanding balance was five years, with annual installments in the amount of R$ 14.087.63. The final value of the structure was stipulated at 10% of the initial value and the useful life of the 10-year system was considered.

Depreciation of greenhouse and equipment: by the straight-line method, the annual depreciation rate was calculated by dividing the initial cost (purchase price or replacement price) minus a presumed final value of scrap by the number of probable years of duration.

$$D = \frac{Vi - Vf}{N} \tag{1}$$

Where, D = value of depreciation per year; Vi = initial value, in R$; Vf = final value, in R$; N = useful life, in years.

The profitability indicators analyzed were as follows:

Gross Revenue (GR):

$$\text{Gross Revenue (GR)} = P \times Pu \tag{2}$$

Where, P = production of the activity, and Pu = unit price of the product of the activity.

Gross Margin of Effective Operating Cost (GMEOC):

$$\text{GMEOC (\%)} = [(GR - EOC)/EOC] \times 100 \tag{3}$$

Where, GMEOC = gross margin in relation to EOC; GR = gross revenue and; EOC = effective operating cost.

Gross Margin Total Operating Cost (GMTOC):

$$\text{GMTOC (\%)} = [(GR - TOC)/TOC) \times 100 \tag{4}$$

Where, GMTOC (%) = gross margin in relation to TOC, and TOC = total operational cost.

Gross Margin of Total Cost of Production (GMTCP):

$$\text{GMTCP (\%)} = [(GR - TCP)/TCP] \times 100 \tag{5}$$

Where, GMTCP (%) = gross margin in relation to TCP, and TCP = total cost of production.

In addition to these concepts, we used the cost indicators in relation to the product units, called the break-even point, which determines the minimum production required to cover the costs, given the unit sale price for the product. Thus, the following equilibrium points were considered:

Point of Equilibrium (EOC) = EOC/Pu;

Point of Equilibrium (TOC) = TOC/Pu;

Point of Equilibrium (TCP) = TCP/Pu.

Operating Income (OI): The difference between gross revenue and total operating cost (TOC) per year.

$$OI = GR - TOC \tag{6}$$

Profitability Index (PI): This indicator shows the ratio of operating profit (OP) to gross revenue (GR), in percent (%).

$$PI = (OI/GR) \times 100 \tag{7}$$

For the unit sale value of the lettuce produced in this research, the methodology proposed by Monteiro Filho (2015), where the unit sale value of lettuce was stipulated correlating the average weight of the lettuce produced with those sold in the main supermarkets of the city of Campina Grande, Paraíba, following the following criteria:

Plants weighing less than 75 g = R$ 0.45;

Plants weighing between 76 and 100 g = R$ 0.75;

Plants weighing between 101 and 150 g = R$ 1.00;

Plants weighing more than 151 g = R$ 1.25.

3. Results and Discussion

Table 3 shows the average weight of curly lettuce cultivars produced with the mineral solutions S_1 = Furlani solution; S_2 = domestic wastewater; S_3 = optimized domestic wastewater; S_4 = well water; S_5 = optimized well water; S_6 = wastewater solution from UASB reactor and S_7 = wastewater solution optimized from the UASB reactor.

Table 3. Average weight of curly lettuce cultivars produced with mineral solutions S_1; S_2; S_3; S_4; S_5; S_6 and S_7

Cultivars	Nutritious solutions						
	S_1	S_2	S_3	S_4	S_5	S_6	S_7
	g						
Thaís	183.66	26.50	13.58	18.16	35.83	53.50	46.83
Vanda	205.83	43.00	34.50	20.50	49.83	60.66	54.50
Verônica	184.00	15.50	13.33	36.66	35.10	40.67	13.50

The implementation cost sheets (operation and consumption material), effective operating cost (EOC), total operating cost (TOC) and total cost of production (TCP) of the hydroponic lettuce are detailed in Table 4.

Table 4. Unit values of the items used in the production cost of the hydroponic lettuce as a function of the different nutrient solutions, S_1 = Furlani solution; S_2 = domestic wastewater; S_3 = optimized domestic wastewater; S_4 = well water; S_5 = optimized well water; S_6 = wastewater solution from UASB reactor and S_7 = wastewater solution optimized from the UASB reactor

	S_1	S_2	S_3	S_4	S_5	S_6	S_7
	g						
Fixed cost (A)							
Greenhouse	14087.63	14087.63	14087.63	14087.63	14087.63	14087.63	14087.63
Depreciation	5.400.00	5.40000	5.400.00	5.400.00	5.400.00	5.400.00	5.400.00
Variable costs (B)							
Seed	950.00	950.00	950.00	950.00	950.00	950.00	950.00
electricity	2.200.00	2.200.00	2.200.00	2.200.00	2.200.00	2.200.00	2.200.00
Foam	1.500.00	1.500.00	1.500,00	1.500.00	1.500.00	1.500.00	1.500.00
Maintenance	2.400.00	2.400.00	2.400,00	2.400.00	2.400.00	2.400.00	2.400.00
Labor	5.135.00	5.135.00	5.135,00	5.135.00	5.135.00	5.135.00	5.135.00
Nutrition solution	1.172.06	552.24	1.677,57	685.12	249.07	249.20	1.028.03
EOC (A+B)	32.844.69	32.224.87	33.350,20	32.357.75	29.921.70	31.921.83	32.700.66
Other Operating Costs (C)							
Social charges	3.699.64	3.699.64	3.699.64	3.699.64	3.699.64	3.699.64	3.699.64
CRSS	2.750.00	2.200.00	2.750.00	1.540.00	1.540.00	990.00	2.156.00
Business remuneration	26.100.00	26.100.00	26.100.00	26.100.00	26.100.00	26.100.00	26.100.00
TOC (EOC + C)	65.394.34	64.224.51	65.899.85	63.697.39	61.261.35	62.711.47	64.656.30
Other Fixed Costs (D)							
Property for sale (F)	1.300.00	1.300.00	1.300.00	1.300	1.300.00	1.300.00	1.300.00
TCP (A+B+C+D+F)	66.694.34	65.524.51	67.199.85	64.997.39	62.561.35	64.011.47	65.956.30

Note. EOC = Effective Operational Cost; TOC = Total Operating Cost; TCP = Total Cost of Production; CRSS = Contribution to Rural Social Security.

Observing Table 4, it can be observed that the use of S_3 solution resulted in the highest effective operating cost (EOC), totaling R$ 33.350.21, the use of other solutions provided a percentage reduction of 10.28; 3.37; 1.95; 1.95; and 1.52% for solutions S_5, S_2, S_6, S_7 and S_1 respectively. Monteiro Filho (2015) found in its research similar results with mineral solutions compared to organomineral solutions. The importance of the use of the biofertilizer in the preparation of the nutrient solution is due to the fact that it presents diverse chemical composition in macro and micronutrients and, in addition, its manufacture can have a reduced cost, since the majority of the farmers already own the organic ingredients used in its formulation and/or may include other ingredients available on its property at a reduced cost, which will further reduce producer's expenditure (Fernandes et al., 2011).

Also in relation to the reduction of costs provided by the nutrient solution, Cometi et al. (2008), after working with nutrient concentration on hydroponic lettuce growth, concluded that the use of less concentrated solutions and consequently lower fertilizer decreases the cost of production without altering crop productivity.

Table 5 shows the data of the profitability indicators obtained for the cultivars Verônica, Venda, Thaís and for the nutritive solutions. It was observed that the highest profitability index was 47.68% for all cultivars with the use of the Furlani solution (S_1).

Table 5. Profitability indexes of Verônica, Vanda and Thaís cultivar in function of the different nutritive solutions, S_1 = Furlani, solution; S_2 = domestic wastewater; S_3 = optimized domestic wastewater; S_4 = well water; S_5 = optimized well water; S_6 = wastewater solution from UASB reactor and S_7 = wastewater solution optimized from the UASB reactor

	UND	S_1	S_2	S_3	S_4	S_5	S_6	S_7
Cultivar Verônica								
GR	1.000 R$	125.000	45.000	45.000	45.000	45.000	45.000	45.000
GMEOC	%	280.58	39.64	34.93	39.07	50.39	40.97	37.61
GMTOC	%	91.15	-28.59	-29.84	-28.74	-25.88	-28.24	-29.12
GMTCP	%	87.42	-30.03	-31.23	-30.18	-27.43	-29.70	-30.55
LPEOC	1.000 UND	26.275.76	71.610.82	74.111.57	71906.11	66492.68	70937.41	72668.14
LPTOC	1.000 UND	52.315.47	140.032.25	142.532.99	140327.54	134914.10	139358.83	141089.57
LPTCP	1.000 UND	53.355.47	142.921.13	145.421.88	143216.43	137802.99	142247.72	143978.45
O.P.	1.000 R$	59.605.66	-18.014.51	-19.139.85	-18147.39	-15711.35	-17711.47	-18490.30
P.I.	%	47.68	-40.03	-42.53	-40.33	-34.91	-39.36	-41.09
Cultivar Vanda								
GR	1000 R$	125.000	45.000	45.000	45.000	45.000	45.000	45.000
GMEOC	%	280.58	39.64	34.93	39.07	50.39	40.97	37.61
GMTOC	%	91.15	-28.59	-29.84	-28.74	-25.88	-28.24	-29.12
GMTCP	%	87.42	-30.03	-31.23	-30.18	-27.43	-29.70	-30.55
LPEOC	1.000 UND	26.275.76	71.610.82	74.111.57	71.906.11	66.492.68	70.937.41	72.668.14
LPTOC	1.000 UND	52.315.47	140.032.25	142.532.99	140.327.54	134.914.10	139.358.83	141.089.57
LPTCP	1.000 UND	53.355.47	142.921.13	145.421.88	143.216.43	137.802.99	142.247.72	143.978.45
O.P.	1.000 R$	59.605.66	-18.014.51	-19.139.85	-18.147.39	-15.711.35	-17.711.47	-18.490.30
P.I.	%	47.68	-40.03	-42.53	-40.33	-34.91	-39.36	-41.09
Cultivar Thaís								
GR	1.000 R$	125.000	45.000	45.000	45.000	45.000	45.000	45.000
GMEOC	%	280.58	39.64	34.93	39.07	50.39	40.97	37.61
GMTOC	%	91.15	-28.59	-29.84	-28.74	-25.88	-28.24	-29.12
GMTCP	%	87.42	-32.53	-32.53	-32.53	-32.53	-32.53	-32.53
LPEOC	1.000 UND	26.275.76	71610.82	74111.57	71.906.11	66.492.68	70.937.41	72.668.14
LPTOC	1.000 UND	52.315.47	140032.25	142532.99	140.327.54	134.914.10	139.358.83	141.089.57
LPTCP	1.000 UND	53.355.47	142921.13	145421.88	143.216.43	137.802.99	142.247.72	143.978.45
O.P.	1.000 R$	59.605.66	-18014.51	-19139.85	-18.147.39	-15.711.35	-17.711.47	-18.490.30
P.I.	%	47.68	-40.03	-42.53	-40.33	-34.91	-39.36	-41.09

Note. GR = Gross Revenue; GMEOC = Gross Margin Effective Operational Cost; GMTOC = Gross Margin Total Operating Cost; GMTCP = Gross Margin Total Cost of Production; LPEOC = Leveling Point Effective Operational Cost; LPTOC = Leveling Point Total Operating Cost; LPTCP = Leveling Point Total Cost of Production; O.P. = operating profit; P.I. = profitability index.

It is also observed in Table 5 that the highest gross revenue (GR) was found when irrigated with solution S_1 = Furlani which reached R$ 125.000.00/year.

The increase in profitability is a positive factor for hydroponic activity, the data obtained in this work corroborates with Silva and Schwonka (2006), which studying the economic viability for lettuce production in the hydroponic system concluded that despite the high initial cost, the investment in benefits can be converted in the medium term.

In the investment analysis, a minimum attractiveness rate should be stipulated as the basis for the viability calculations, this is an interest rate that represents the minimum that an investor proposes to earn when making an investment. Dal'Sotto (2013) evaluating the economic feasibility of implementing a hydroponic system to produce lettuce suggested minimum profits equivalent to those provided by fixed income financial investments, such as bank deposit certificates (BDC). These rates tend to fluctuate throughout the year; thus, in this simulation and for practical effect, a minimum attractiveness rate of 12% p.y. The results obtained in this work show that the use of the mineral solution, independently of the cultivar used, showed a profitability superior to 12% p.y. In cases where there was economic unfeasibility with negative profitability indexes, since the consumer market would only pay R$ 0.45/plant, gross revenue would be sufficient to cover actual operating costs and, therefore, would not present a possibility of remuneration to the producer, making it an unfeasible investment.

In general, the prices of conventionally grown vegetables vary throughout the year, because their value is defined as a function of the quality of the product, which in turn is influenced directly by the climatic conditions. The hydroponic cultivation can offer producers greater profitability, because besides a greater control of the environmental conditions in the place of cultivation, there is the differentiation of the product in function of the sanitary and nutritional quality besides the visual aspect of the hydroponic products, adding a greater value to the product with the consumer (Olshe et al., 2001; Souza et al., 2008). According to a survey carried out in Frederico Westphalen, in the state of Rio Grande do Sul per Potrich et al. (2012), 94.4% of respondents would pay between R$ 0.5 and R$ 1.00 more for the hydroponic lettuce unit due to its visual appearance and less contamination by pesticides. Andrade and Silva (2010), hydroponic lettuce to obtain better prices in relation to the conventional one, in their research, carried out in the region of Uberaba, MG, the authors concluded that 61.29% of consumers are willing to pay R$ 1.00 more for hydroponic lettuce.

The leveling point of the activity so that no economic loss occurs when there is equality between gross revenue (GR) and total cost of production (TCP). According to Table 6 it can be seen that in the treatments where solutions formulated with residuary water were used, the point of leveling of the total cost of production (LPTCP) was greater than 100.000 units year^{-1}, the enterprise would become impracticable to present a production requirement above the projected annual capacity. A similar situation was reported by Geisenhoff et al. (2010), evaluating the economic viability of hydroponic lettuce production in Lavras, MG; in this case the authors proposed a 2.13% increase in production, from 6.000 to 6.128 in order for the total revenue to cover all the total production costs of the activity.

Table 6 shows that from the fifth year of the activity there was a reduction of production costs with the discharge of the financing and an increase in the profitability index for all cultivars. However, the solution that presented the best profitability index was the solution S_1 (58.95%) independently of cultivars.

Table 6. Profitability index of the cultivars Thais, Vanda and Verônica, produced without hydroponic system with different nutritive solutions nutritive solutions, S_1, S_2, S_3, S_4, S_5, S_6 and S_7, after the fifth year of implementation of the activity

Cultivar	Nutrition solutions						
	S_1	S_2	S_3	S_4	S_5	S_6	S_7
	---------- Profitability Index (%) ----------						
Thais	58.95	-8.73	-11.23	-9.02	-3.61	-8.05	-9.78
Vanda	58.95	-8.73	-11.23	-9.02	-3.61	-8.05	-9.78
Veronica	58.95	-8.73	-11.23	-9.02	-3.61	-8.05	-9.78

Note. S_1 = Furlani solution; S_2 = domestic wastewater (raw sewage); S_3 = optimized domestic wastewater (raw sewage); S_4 = tubular well water; S_5 = optimized tubular well brackish water; S_6 = wastewater solution from the UASB reactor (Estrabes) and S_7 = optimized solution of wastewater from the reactor UASB (Estrabes).

Increased profitability in the medium term is a positive factor for hydroponic activity, the data obtained in this work corroborate with Silva and Schwonka (2006) who studied the economic viability for lettuce production in the hydroponic system and concluded that despite the high initial cost, the investment in benefits can be converted in the medium term. In another search Monteiro Filho (2015) observed in his work, analyzing the economic viability of lettuce cultivated in hydroponic medium, profitability indexes similar to those found in this research with the use of nutrient solutions formulated with biofertilizers. The lower economic values obtained with uses of solutions prepared with wastewater are related to lower fresh mass production.

4. Conclusions

(1) The use of nutritious hydroponic solutions, for lettuce, using wastewater in its constitution, did not present economic feasibility, being necessary more studies for the reuse of effluent in the hydroponic lettuce production.

(2) The cultivars Verônica, Vanda and Thais showed the highest gross revenue when irrigated with the Furlani (S_1).

(3) All cultivars obtained higher profitability index (P.I.) when irrigated with the Furlani solution (S_1).

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