Universidade Federal Rural do Semi-Árido
Pró-Reitoria de Pesquisa e Pós-Graduação
https://periodicos.ufersa.edu.br/index.php/caatinga

ISSN 0100-316X (impresso)
ISSN 1983-2125 (online)
http://dx.doi.org/10.1590/1983-21252020v33n207rc

PROFITABILITY OF ORGANIC PASSION FRUIT PRODUCTION USING TALL SEEDLINGS AND LONG ROOT SYSTEM[1]

NILCILÉIA MENDES DA SILVA[2], LUÍS GUSTAVO DE SOUZA E SOUZA[2]*, THAYS LEMOS UCHÔA[2], SEBASTIÃO ELVIRO DE ARAÚJO NETO[2], SHYRLENE OLIVEIRA DA SILVA[2]

ABSTRACT - Passion fruit productivity in the state of Acre is lower than the national average, influenced by several factors, among them water stress in rainfed cultivation. Thus, aiming at alternatives for the drought period, this study aimed to evaluate the economic profitability of the use of tall seedlings and long root system in the cultivation of organic yellow passion fruit. Five root lengths were evaluated: 25 cm; 50 cm; 75 cm; 100 cm and 125 cm in a randomized block design, with four blocks and four plants per plot. The experiment was carried out in the municipality of Rio Branco, state of Acre, at the “Seridó” Ecological Site from November 2015 to July 2017. For economic analysis, all fixed and varied costs such as seed production, orchard planting, crop management, phytosanitary control, harvesting and capital depreciation were considered. Analysis of variance and regression analysis were performed for productivity and economic indicators. Plants with root system with estimated length of 1.14 m promote higher fruit yield (7,613 kg ha^{-1}), net revenue of R$ 17,665.44 ha^{-1}, benefit/cost ratio of 2.5, profitability of 177.5%, remunerating the family labor with R$ 211.75 day^{-1}. However, all treatments proved to be profitable.

Keywords: *Passiflora edulis* Sims. Financial analysis. Root depth.

RENTABILIDADE DA PRODUÇÃO DE MARACUJÁ ORGÂNICO UTILIZANDO MUDAS COM SISTEMA RADICULAR LONGO

RESUMO - A produtividade de maracujá nos campos do estado do Acre está abaixo da média nacional, influenciado dentre diversos fatores, o estresse hídrico em cultivo de sequeiro. Assim visando alternativas ao período de estiagem objetivou-se neste trabalho avaliar a rentabilidade econômica do uso de muda alta e de raiz longa no cultivo de maracujazeiro-amarelo orgânico. Avaliou-se cinco comprimentos de sistema radicular: 0,25 m; 0,50 m; 0,75 m; 1,00 m e 1,25 m no delineamento em blocos casualizados, com quatro blocos e quatro plantas por parcela. O experimento foi realizado em Rio Branco - AC, no Sítio Ecológico Seridó no período de novembro de 2015 a julho de 2017. Para análise econômica considerou-se todos os custos fixos e variados, com produção da muda, implantação do pomar, tratos culturais, controle fitossanitário, colheita e depreciação do capital. Foram realizadas análise de variância e análise de regressão para produtividade e indicadores econômicos. As plantas de sistema radicular com comprimento estimado em 1,14 m, proporciona maior produtividade de frutos (7.613 kg ha^{-1}), receita líquida de R$ 17.665,44 ha^{-1}, relação benefício/custo de 2,5, índice de rentabilidade de 177,5%, remunerando a mão de obra familiar em R$ 211,75 dia^{-1}. Porém, todos os tratamentos proporcionam lucratividade.

Palavras-chave: *Passiflora edulis* Sims. Análise financeira. Profundidade de raiz.

---

*Corresponding author
[1]Received for publication in 09/02/2019; accepted in 02/13/2020.
Paper extracted from the master's thesis of the first author.
[2]Agrarian Sciences Department, Universidade Federal do Acre, Rio Branco, AC, Brazil; nilcileia_ac@hotmail.com - ORCID: 0000-0002-1484-3717, gustavo_souza_fj@hotmail.com - ORCID: 0000-0001-8855-5163, thays_uchoa@yahoo.com.br - ORCID: 0000-0002-2176-8495, selviro2000@yahoo.com.br - ORCID: 0000-0002-1212-4989, shyrlenemonnerat@hotmail.com - ORCID: 0000-0003-2437-9214.

INTRODUCTION

Brazil stands out as the world's largest passion fruit producer (703,489 t), with 489,898 t produced in the northeastern region, followed by the southeastern (98,821 t) and northern regions (54,635 t), but export is still incipient and occurs on a small scale in the form of concentrated juice (76%) and fresh fruit (1.5%) (IBGE, 2017; MELETTI, 2011).

In the state of Acre, passion fruit productivity is low (8.27 t ha^{-1}) compared to the national average (14.10 t ha^{-1}) (IBGE, 2017), being influenced mainly by water stress in rainfed cultivation, low pollination during periods of high rainfall and other pollination problems. Water stress reduces growth and flowering (SILVA et al., 2019). However, passion fruit irrigation increases the fixed cost and requires greater investment capital, which according to Pimentel et al. (2009), accounts for 34% of the production cost.

Thus, the low supply increases the price in the off-season and forces the import of the fruit from other states. The negative effects of drought found in tropical regions are reduced with cultivation techniques that increase water and nutrient uptake using seedlings with vigorous root system with continuous growth (PERES et al., 2010).

Studies related to adaptation to the environment and the different water availability conditions contribute to decision making in crop management (SANTOS et al., 2012; SILVA; NEVES, 2011). The use of seedlings with roots at different depths aims to increase the absorption of nutrients and available water in deeper soil layers (LARCHER, 2004), avoiding the reduced flowering and fruiting of passion fruit (COSTA et al., 2009).

The production of passion fruit seedlings with long root system can be implemented as a new planting technology, since the volume of the substrate for their formation will allow sufficient time for growth, and in the field, plants will have greater resistance to periods of prolonged drought (SILVA et al., 2019) and viral diseases will be prevented (FURLANETO et al., 2011). This will reduce production cost and prolong harvest, with supply of fruits at stable prices in the off-season.

The economic return of passion fruit, as compared to other fruit trees, is rapid because the production cycle starts six months after planting (ARAÚJO NETO et al., 2008). Nevertheless, it is necessary to make a diagnosis of the investment and return of each crop cycle, especially when new technologies are applied, considering the high production cost and low prices paid for the fruit (HAFLE et al., 2010), in addition to the great oscillation in productivity, which has varied in organic system from 10,200 kg ha^{-1} (ARAÚJO NETO et al., 2009a) to 21,677 kg ha^{-1} (ARAÚJO NETO et al., 2014).

Labor is the main element of the production cost of organic passion fruit cultivation, ranging from 34% to 40% of the total cost (ARAÚJO NETO et al., 2008). However, this component is important in family agriculture, because although computed as a cost, family remuneration favors profitability and capitalization (PIMENTEL et al., 2009).

In family farming, the adoption of agroecological techniques is common, mainly for production diversification, which favors sustainable development and adds value to the product through processing, expanding market supply, reducing idle labor and generating employment and income in the field (CRAVIOTTI; PALACIOS, 2013; TEIXEIRA; PIRES, 2017).

Thus, the aim of this study was to evaluate the economic profitability of the use of tall seedling and long root system in organic yellow passion fruit cultivation.

MATERIAL AND METHODS

The experiment was conducted in the field between November 2015 and July 2017, in Rio Branco, Acre, at the “Seridó” Ecological Site (9º 53' 16" S and 67º 49' 11" W and 170 m a.s.l.). The climate of the region is hot and humid and Am type according to the Köppen’s classification, with annual average temperatures of 24.5 °C, relative humidity of 84% and annual rainfall ranging from 1,700 to 2,400 mm. The soil of the experimental area is classified as ARGISSOLO AMARELO Alitico piltossolico (Ultisol).

The experimental design was randomized block with five treatments and four replicates with four plants per plot. Treatments consisted of the production of seedlings in polyvinyl chloride (PVC) tubes of 0.075 m in diameter, with variations in the length of the root system: 0.25 m; 0.50 m; 0.75 m; 1.00 m and 1.25 m.

In the production of seedlings, substrate with the following composition was used: 30% of soil (from the superficial layer), 30% of organic compost (Brachiaria grass), 30% of Ouricuri palm stem conditioner, 1.0 kg m^{-3} of dolomitic limestone, 1.5 kg m^{-3} of natural thermophosphate and 1.0 kg m^{-3} of potassium sulphate. A synthetic variety of an F2 generation of yellow passion fruit (*Passiflora edulis* Sims), originated from the Germplasm Bank of the Federal University of Acre, progenies 2, 20, 22, 23, 33, 35, and 37 (NEGREIROS et al., 2008), was used.

Seedlings were kept for four months in nursery covered with 100-µm-thick transparent film, receiving irrigation twice a day, keeping the substrate within field capacity.

The preparation of the area for planting included the cut of the spontaneous vegetation and posterior opening of pits with depths according to the lengths of the root system. The labor yield for opening was 0.6; 1.9; 5.5; 11.6 and 13.5 man/day per hectare (MD ha^{-1}). Then, seedlings were transplanted at 3 m spacing between plants x 4 m between rows (833.33 plants ha^{-1}). For planting, MD ha^{-1} yield was: 3.8; 5.2; 5.7; 7.9 and 11.8. Plants were conducted on vertical trellis using No. 12 smooth wire, 2 m above the soil surface, fixed and stretched on concrete posts spaced 6 m apart.

Plants were conducted in single stake in nursery until 50% of them reached 2 m in height, considered as tall seedling (SANTOS et al., 2017). Apical pruning was performed when they reached 0.10 m above the wire and distribution of lateral branches until they reach 1.5 m on each side, being pruned in order to induce the formation of tertiary branches and these to form quaternary branches.

Pest control was carried out according to the Brazilian legislation for organic crop production, with applications of microbial insecticide based on *Bacillus thuringiensis*, specifically for defoliating caterpillars (*Dione juno juno* and *Agraulis vanilae vanilae*) at concentration of 60 g for 20 liters (120 L ha^{-1}) and 1% neem oil, for a total of five applications of each. For the control of the stem borer (*Philonis passiflorae*), 1% neem oil + 4% lime sulfur was weekly applied to the stem orifice with the help of syringes and, when necessary, recovery grafting for plants with severe damage levels according to methodology of Rezende et al. (2017).

For the control of anthracnose (*Colletotrichum gloeosporioides*), five lime sulfur (4%) and five Bordeaux mixture (1%) applications were alternated, spraying 80.29 liters of mixture per application per hectare, which corresponded to 0.5 MD.

Stem recovery grafts were performed in 30% of plants, and the time for each grafting was 5 minutes using and a total of 3.0 MD ha^{-1}.

Crowning was performed every two months, yielding 0.5 MD, totaling 6 MD for all months of cultivation.

For the calculation of the economic analysis, parameters of fixed investment, depreciation, profitability index, family labor remuneration, profit margin, net revenue, benefit/cost ratio and fixed, variable and total costs were used (CONAB, 2010).

The daily work was calculated considering expenses equivalent to monthly salary remuneration (R$ 937.00), plus 51.56% referring to charges, vacations, 13^{th} salary, accident insurance, FGTs (severance pay fund), which results in R$ 61.74 day^{-1} (CONAB, 2010).

Depreciation (D), which is the necessary cost for the substitution of capital goods when they become useless, was calculated using the linear method for each crop, which can be calculated by equation below, according to Reis (2007):

$$D= [(Cv - Rv)/Vu] P$$

Where:
D - depreciation, R$ / crop;
Cv - current resource value, R$;
Rv - residual value (resale value or final value of the good after rational use in the activity), R$;
Vu - useful life (period in cycles that the good is used in the activity);
P - Production cycle.

In this work, the following depreciations were considered: trellis, which lasts on average 25 years, considering crops of 2 years each and residual value of 20%; brush cutter and implements in 6,000 hours with final value corresponding to 5%; PVC tubes for production of seedlings with 5% final value; and 5 m x 15 m masonry shed using for 40 years, with 20% residual value (CONAB, 2010).

For this, 1% for machinery and 0.80% for implements with 100% inclusion in the variable cost were used as maintenance cost, observing the value of the new good, considering also expenses with filters and lubricants estimated at 10% of fuel expenses (CONAB, 2010).

Fixed and variable costs were added to the opportunity cost of 6%, adding the value of land that could be rented to another activity, considered in this work to be of beef cattle, corresponding to R$ 15.00 $month^{-1}$, equivalent to 0.92 A. U. (1.5 head per hectare) (INCRA, 2003) at the average price of R$ 12.5 head $month^{-1}$.

The administration costs of 3% of working capital refer to office expenses (electricity, telephone, printer, notepad, consumables, computer, internet), accounting and training services, all linked to the production process (CONAB, 2010).

Periodic mowing was performed to control spontaneous plants, in which 1 MD ha^{-1} was required every two months during the 24 months of cultivation.

There were 48 harvests, concentrated between April 2016 and July 2017.

Productivity was calculated by multiplying the mass of fruits per plant, the number of plants distributed in one hectare and values estimated in kg ha^{-1}.

The price of organic passion fruit or average revenue (AR), which is paid to farmers, at the time of the experiment, corresponded on average to R$ 4.00 kg^{-1}.

For statistical analysis, the presence of outliers by Grubbs test, error normality by the Shapiro and Wilk test and the homogeneity of variances by the Bartlett test were verified. After checking the assumptions of the experiment, data were submitted to analysis of variance using the F test and regression analysis was applied.

RESULTS AND DISCUSSION

Passion fruit cultivation using tall seedling and long root system influenced productivity, total break-even production (TBP) and total operational break-even production (TopBP) (Figure 1).

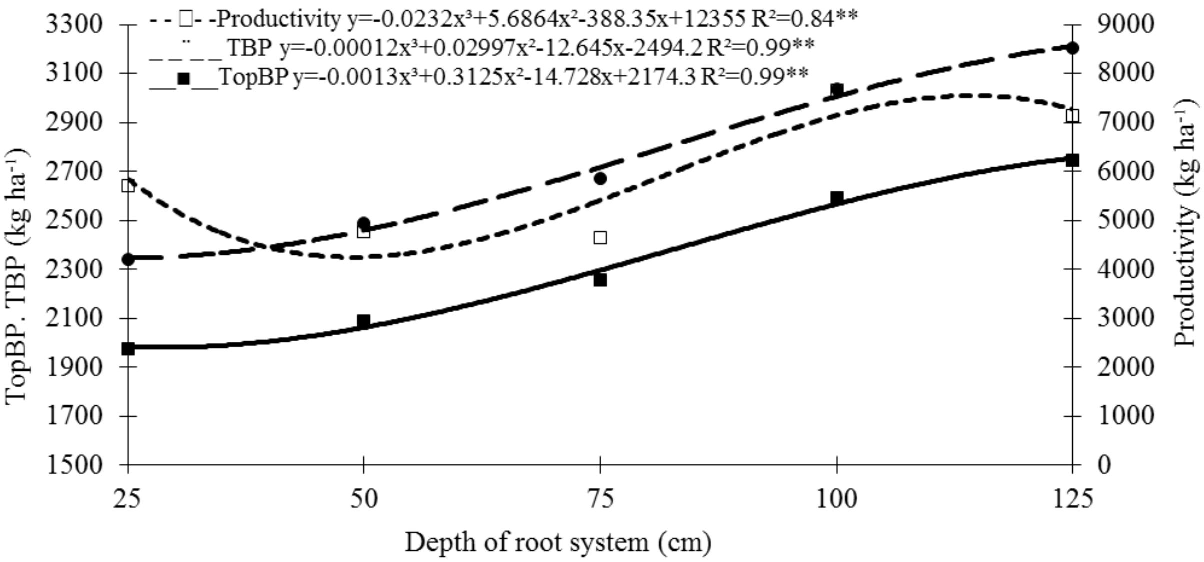

Figure 1. Productivity (PROD), total break-even production (TBP), total operational break-even production (TopBP) of organic passion fruit production with long root seedling.

The highest estimated productivity of both harvests was 7,613 kg ha^{-1} using seedlings with 114 cm of root system, lower than the productivity of other organic crops, which reached productivity of 10,200 kg ha^{-1} (ARAÚJO NETO et al., 2009a) and 21,677.2 kg ha^{-1} (ARAÚJO NETO et al., 2014).

The state of Acre has an average of 5 months of drought, concentrated between May and September. Thus, higher plant productivity with long root system and planting in deep pits may be related to higher water uptake due to the larger volume of soil explored by roots (BEYER et al., 2016) and also to the use of tall seedlings (above 1.50 m), which express shorter juvenile period, providing off-season crop beginning at six months after planting (FURLANETO et al., 2014; SANTOS et al., 2017).

Under conditions of low soil moisture, the root system grows permanently to exploit large soil volumes in search of water at distant sites (LARCHER, 2004). The yellow passion fruit has greater vigor and adaptation to short periods of drought, due to its subsurface water extraction capacity (SOUZA et al., 2018). Otherwise, water stress would reduce growth and flowering (SILVA et al., 2019), requiring techniques that increase productivity even in periods of water deficit.

Total break-even production (TBP) or minimum productivity to cover total production costs was 3,203 kg ha^{-1} (Figure 1). Total operational break -even production (TopBP) or minimum productivity to cover operation costs was 2,685 kg ha^{-1} (Figure 1). The total break-even productivity is low compared to conventional crops, which requires productivity of 28.3 t ha^{-1} as break-even point or total break-even production (FURLANETO et al., 2011). This low productivity to cover total costs is due to the low use of inputs in the organic cultivation of passion fruit and the price paid for the fruit (ARAÚJO NETO et al., 2008).

The variables average total cost (ATC), average fixed cost (AFC) and average variable cost (AVC) had no fitted curve for treatments and had similar trends of increase in crops with lower productivity (Figure 2).

In this case, even the fixed cost had this trend, since expenses with the depreciation of implements and stakes are remunerated in the medium/long term. Cost underestimation and productivity overestimation contribute to low passion fruit yields and activity abandonment (BAHIENSE; SOUZA, 2015). According to Majadas (2010), fixed costs are often neglected by farmers, hence compromising the activity and requiring more capital after the useful life period.

ATC was lower when using seedlings with 1.00 m of root system. According to indicators established by Reis (2007), the results of this experiment provided supernormal profit (AR> ATC), because with mean revenue (price) of R$ 4.00 kg^{-1}

and ATC of R$ 1.75 kg^{-1}, all invested resources were covered, providing additional profit.

The use of technologies increases productivity, increasing total cost, but reducing ATC and increasing net revenue (ARAÚJO NETO et al., 2009b). Profitability will be maintained according to production in subsequent years and the value paid for the fruit, and this activity may lead farmers to seek better alternatives for capital application (ARAÚJO NETO et al., 2005; HAFLE et al., 2010).

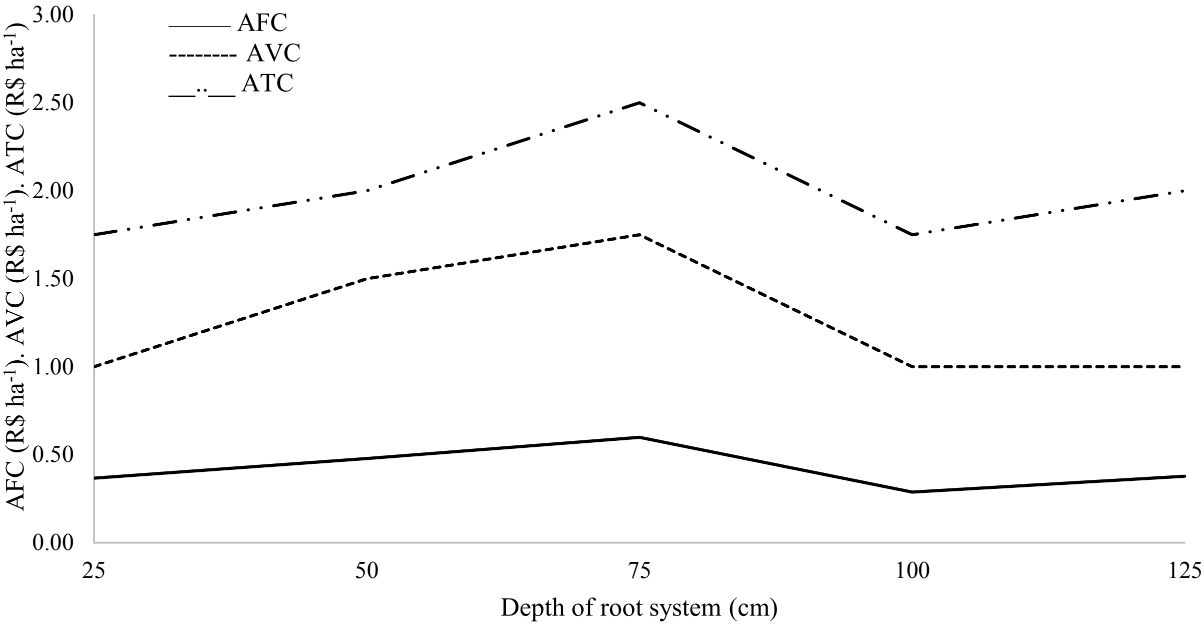

Figure 2. Average total cost (ATC), average variable cost (AVC), average fixed cost (AFC) of organic passion fruit production with long root seedlings.

Although the root system estimated at 1.14 m led to higher productivity, input and labor costs varied according to the increase in productivity (Figure 2), being related to AVC, which requires greater financial investments with increased productivity (ARAÚJO NETO et al., 2008).

AFC (R$ kg^{-1}) in passion fruit production varied little for all treatments, and this oscillation is also related to productivity. The larger the area, the greater the optimization of agricultural implements and administrative costs, contributing to reduce average production cost (PIMENTEL et al., 2009).

The benefit/cost ratio (B C^{-1}), average fixed operation cost (AFopC), average variable operation cost (AVopC) and average total operating cost (ATopC) were not statistically changed and therefore did not have fitted mathematical function (Figure 3).

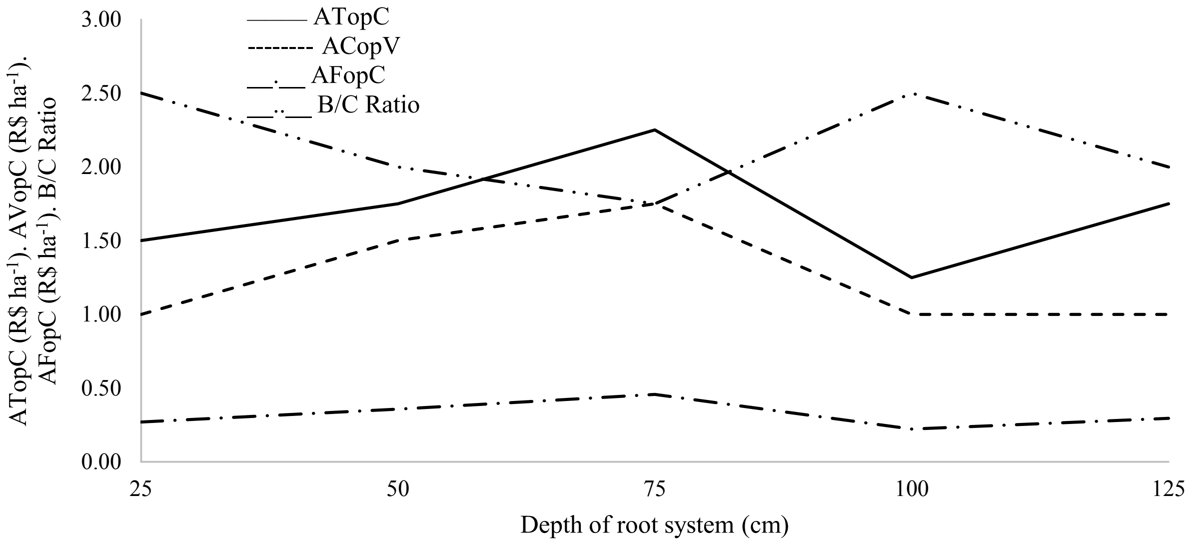

Figure 3. Average total operation cost (ATopC), average variable operation cost (AVopC), average fixed operation cost (AFopC) and benefit cost ratio (B/C) of organic passion fruit production with long root seedlings.

The average operation costs (ATopC, AVopC and AFopC) (Figure 3) are reasons for the relationship between operation cost (numerator) and productivity (denominator); therefore, in low productivity situations, cost is more significant in calculations and increases the value of this relationship, but when productivity increases, it becomes more significant, so there is an increase of average costs in treatments with root system of 0.25; 0.50 and 0.75 m, with lower productivity, but decrease in treatments with root systems of 1.00 and 1.25 m, so even at higher costs (Figure 4), their higher productivity (Figure 1) reduces the average cost.

The B C^{-1} ratio was economically feasible for all treatments (Figure 3). This indicator analyzes the financial return of the enterprise for each monetary unit invested, and when the quotient of this ratio is greater than 1 (one), it is understood that the activity is economically viable (SILVA et al., 2013). In the conventional system, operation costs, mainly costs with machinery (31.1%), labor (23.5%) and inputs (33.2%) are those that most increase production cost (FURLANETO et al., 2011). In the organic system, according to Araújo Neto et al. (2008), these costs are reduced because they do not use external inputs, such as pesticides and synthetic fertilizers, so even with productivity below national average, supernormal profit is obtained from this agricultural activity.

Total cost (TC), total revenue (TR) and net revenue (NR) were significantly affected by the length of the root system (Figure 4).

The total cost (TC) is represented by linear function, with increasing costs as the length of the root system of seedlings increased. This is because fixed costs (containers), inputs (substrate) and labor were increased to produce seedlings, as well higher labor for field planting, requiring more time for opening pits and planting seedlings.

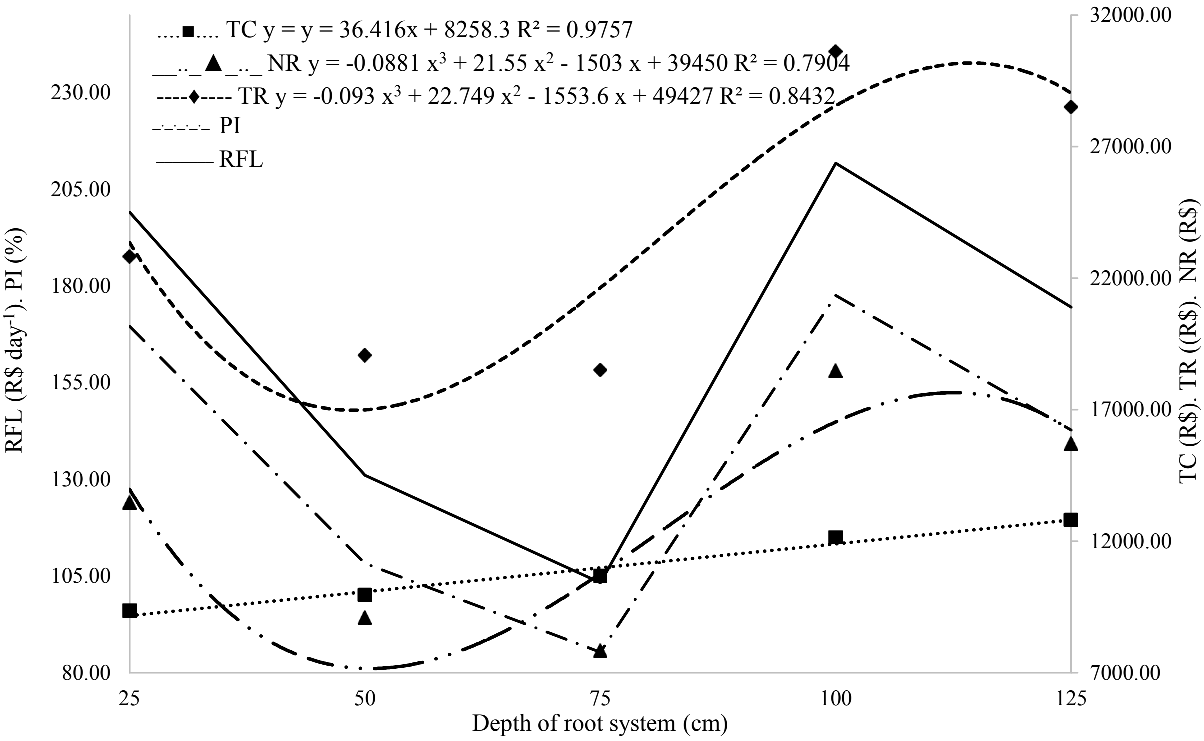

Figure 4. Remuneration of family labor (RFL), profitability index (PI), total cost (TC), total revenue (TR) and net revenue (NR) of organic passion fruit production with long-root seedlings.

In all treatments, the total revenue was higher than the total cost. The total estimated revenue was R$ 30,180.47 for plants with root system of 1.144 m and net revenue of R$ 17,665.44 ha^{-1} for root system of 1.125 m, and although costs were high, productivity contributed to make the activity profitable. This is different from passion fruit produced in the region of Marília, state of São Paulo, in which despite a productivity of 20 t ha^{-1}, its net revenue was negative at R$ 11,151.67, influenced by high costs in the acquisition and application of fertilizers and pesticides (FURLANETO et al., 2011). As organic agriculture does not use chemical fertilizers of high concentration and solubility and pesticides, costs tend to decrease.

Family labor remuneration (RFL) and profitability index (PI) did not differ among treatments and therefore did not have calculated mathematical function. RFL indicates how much the system pays for the family's work day. Using plants with 0.100 m of root system, passion fruit yielded R$ 211.75 man day^{-1} (Figure 4), only R$ 12.00 more than the use of plants with 0.25 m root system. The values obtained in treatment with 1.00 m were also influenced by the high net revenue, while for the 0.25 m root system, although a high net revenue was not obtained, its seedling production and transplant costs were smaller, becoming a safe option for family agriculture. Organic passion fruit produced in Acre, which comes from family farming, has presented good profitability indexes and high productive potential, allowing families to have an alternative income diversification, with less interference from market variations and greater autonomy, mainly by the internalization of production processes, reducing dependence on the input market (ARAÚJO NETO et al., 2008; SIMONETTI et al., 2013).

PI was up to 177.5% for treatments with 0.100 m, whereas treatment with 0.25 m provided profitability rate of 169.5%, justified by the lower total planting cost in 0.25 m pits, which certainly contributed for the investment's return in this treatment to be close to that with root system of 1.00 m. According to Araújo Neto et al. (2012), the profitability index is determinant for the acquisition of new technologies, and balance should be found with physical performance. In this experiment, despite the higher physical yield with root length of 1.14 m , the highest RFL was obtained with 0.100 m. However, because the profitability is similar to that of seedlings with 0.25 m in length, the lesser work used justifies the use of seedlings with short roots. The long-root seedlings are viable in regions with water restriction.

CONCLUSIONS

The cultivation of passion fruit using root system with estimated length of 1.14 m led to higher fruit yield (7,613 kg ha^{-1}) in two years of cultivation, with net profit of R$ 17,665.44 ha^{-1}, benefit $cost^{-1}$ ratio of 2.5, profitability index of 177.5%, remunerating family labor at R$ 211.75 day^{-1}.

The production of organic passion fruit, regardless of length of the root system, proved to be profitable.

ACKNOWLEDGMENTS

CNPq and CAPES for granting scholarships and financial assistance to authors.

REFERENCES

ARAÚJO NETO, S. E. et al. Adensamento, desbaste e análise econômica na produção do maracujazeiro-amarelo. **Revista Brasileira de Fruticultura**, 27: 394-398, 2005.

ARAÚJO NETO, S. E. et al. Organic polyculture of passion fruit, pineapple, corn and cassava: the influence of green manure and distance between espaliers. **Ciência e Agrotecnologia**, 38: 247-255, 2014.

ARAÚJO NETO, S. E. et al. Produtividade e vigor do maracujazeiro-amarelo plantado em covas e plantio direto sob manejo orgânico. **Ciência Rural**, 39: 678-683, 2009a.

ARAÚJO NETO, S. E. et al. Rentabilidade da produção orgânica de cultivares de alface com diferentes preparos do solo e ambiente de cultivo. **Ciência Rural**, 39:1362-1368, 2009b.

ARAÚJO NETO, S. E. et al. Rentabilidade da produção orgânica de alface em função do ambiente, preparo do solo e época de plantio. **Revista Ciência Agronômica**, 43: 783-791, 2012.

ARAÚJO NETO, S. E. et al. Rentabilidade econômica do maracujazeiro-amarelo plantado em covas e em plantio direto sob manejo orgânico. **Revista Brasileira de Fruticultura**, 30: 940-945, 2008.

BAHIENSE, D. V.; SOUZA, P. M. Incentivos ao desenvolvimento da fruticultura fluminense. **Pesquisa Agropecuária Tropical**, 45: 113-121, 2015.

BEYER, M. et al. A deuterium-based labeling technique for the investigation of rooting depths, water uptake dynamics and unsaturated zone water transport in semiarid environments. **Journal of Hydrology**, 533: 627-643, 2016.

BRASIL. INSTITUTO NACIONAL DE COLONIZAÇÃO E REFORMA AGRÁRIA - INCRA. **Instrução normativa nº 11, de 4 de abril de 2003**. 2003. Disponível em: <http://www.incra.gov.br/media/institucional/legislacao/atos_internos/instrucoes/instrucao_normativa/IN11_040403>. Acesso em: 16 Aug 2017.

COMPANHIA NACIONAL DE ABASTECIMENTO - CONAB. **Custo de produção agrícola: a metodologia da Conab**. Brasília, DF, p. 60, 2010.

COSTA, A. F. S. et al. Efeitos da ambiência, recipientes e substratos no desenvolvimento de mudas de maracujazeiro-amarelo em Aquidauana – MS. **Revista Brasileira de Fruticultura**, 31: 236-244, 2009.

CRAVIOTTI, C.; PALACIOS, P. La Diversificación de los mercados como estrategia de la Agricultura Familiar. **Revista de Economia e Sociologia Rural**, 51: 63-78, 2013.

FURLANETO, F. P. B. et al. Análise energética de novo sistema de produção de maracujá amarelo na região de Marília-SP. **Ciência Rural**, 44: 235-340, 2014.

FURLANETO, F. P. B. et al. Custo de produção do maracujá-amarelo (*Passiflora edulis*). **Revista Brasileira de Fruticultura**, 33: 441-446, 2011.

HAFLE, O. M. et al. Rentabilidade econômica do cultivo do maracujazeiro-amarelo sob diferentes podas de formação. **Revista Brasileira de Fruticultura**, 32: 1082-1088, 2010.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA - IBGE. **Produção agrícola municipal: culturas temporárias e permanentes 2016.** 2017. Disponível em: <www.ibge.gov.br/estatisticas-novoportal/economicas/agricultura-e-pecuaria/9117-producao-agricola-municipal-culturas-temporarias-e-permanentes.html>. Acesso em: 25 Oct 2017.

LARCHER, W. **Ecofisiologia vegetal.** São Carlos, SP: RiMa, 2004. 531 p.

MAJADAS, B. Faça de sua propriedade um negócio rentável. **Revista Produz**, 48: 56-61, 2010.

MELETTI, L. M. M. Avanços na cultura do maracujá no Brasil. **Revista Brasileira de Fruticultura**, 33: 83-91, 2011.

NEGREIROS, J. R. S. et al. Caracterização de frutos de progênies de meios-irmãos de maracujazeiro amarelo em Rio Branco - Acre. **Revista Brasileira de Fruticultura**, 30: 431-437, 2008.

PERES, J. G. et al. Avaliação dos efeitos da cobertura de palha de cana-de-açúcar na umidade e na perda de água do solo. **Engenharia Agrícola**, 30: 875-886, 2010.

PIMENTEL, L. D. et al. Custo de produção e rentabilidade do maracujazeiro no mercado agroindustrial da Zona da Mata Mineira. **Revista Brasileira de Fruticultura**, 31: 397-407, 2009.

REIS, R. P. **Fundamentos de economia aplicada.** Lavras, MG: UFLA/FAEPE, 2007. 95 p.

REZENDE, M. I. F. L. et al. Grafting for the recovery of yellow passion fruit stem in organic system. **Revista Brasileira de Fruticultura**, 39: e-745, 2017.

SANTOS, D. S. et al. Cultivares de trigo submetidas a déficit hídrico no início do florescimento, em casa de vegetação. **Revista Brasileira de Engenharia Agrícola e Ambiental**, 16: 836-842, 2012.

SANTOS, V. A. et al. Produção e qualidade de frutos de maracujazeiro-amarelo provenientes do cultivo com mudas em diferentes idades. **Revista de Ciências Agroveterinárias**, 16: 33-40, 2017.

SILVA, I. G. et al. Indicadores econômicos da produção de farinha de banana verde utilizando secadores elétrico e solar no estado do Acre. **Amazônia: Ciência & Desenvolvimento**, 8: 135-150, 2013.

SILVA, J. A. L.; NEVES, J. A. Produção de feijão caupi semi-prostrado em cultivos de sequeiro e irrigado. **Revista Brasileira de Ciências Agrárias**, 6: 29-36, 2011.

SILVA, N. M. et al. Organic cultivation of yellow passion fruit using tall seedlings with long root systems. **Comunicata Scientiae**, 10: 477-483, 2019.

SIMONETTI, D. et al. Diversificação da renda e agregação de valor na agricultura familiar: lições a partir de uma comunidade rural. **Revista de Extensão Rural**, 20: 132-144, 2013.

SOUZA, P. U. et al. Biometric, physiological and anatomical responses of Passiflora spp. to controlled water deficit. **Scientia Horticulture**, 29: 77-90, 2018.

TEIXEIRA, C. T. M.; PIRES, M. L. L. Análise da relação entre produção agroecológica, resiliência e reprodução social da agricultura familiar no sertão de Araripe. **Revista de Economia e Sociologia Rural**, 55: 47-65, 2017.