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Economic Analysis of the Production of Yellow Passion Fruit in an Area With Virose Incidence and Fertilized With NPK

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Abstract

The objective this work was to evaluate specific economic data of the production of yellow passion fruit under influence of different doses of NPK, in the form of N, P_2O_5 and K_2O, in an area with incidence of virose in the city of Presidente Prudente, State of São Paulo. The following doses of NPK were evaluated: N (150 to 1200 kg ha^{-1}), P_2O_5 (200 to 1600 kg ha^{-1}) and K_2O (100 to 700 kg ha^{-1}). Miyake et al. (2016) describe the methodology used in the formation of seedlings, fertilization and cultural treatments of passion fruit. The data used in the economic analysis were: productivity, commercial production, percentage and fruits of each commercial classification, cost of production and profitability of passion fruit. At the economical part, structures of the COE and TOC and four indicators of profitability were used. It was observed percentage difference in the operational cost of production of 4.0% between the highest and the lowest dose of N, of 5.8% among doses of P_2O_5 and 1.7% among doses of K_2O. The total operating cost ranged from \$29,119.77 to \$31,113.09 per hectare. The profitability indicators were not favorable. It was concluded that the region of Presidente Prudente-SP, in areas with an incidence of viral infection, it is not recommended the plantation of passion fruits. However, at times with high selling price of fruit (average above R\$ 1.95 kg^{-1}), the dose of NPK indicated refers to 300 kg of N, 400 kg of P_2O_5 and 500 kg of K_2O ha^{-1}.

Keywords: *Passiflora edulis* Sims, passion fruit, *Cowpea aphid borne mosaic virus*, production cost, economic indicator, profitability

1. Introduction

The Brazil is the main producer of passion fruit worldwide, being the fruit cultivated and marketed throughout the country (AGRINUAL, 2017). There has been an increasing occurrence of pathogens in the areas of agricultural production destined to the cultivation of passion fruits. The following viruses stand out (*Passion fruit woodiness virus* and *Cowpea aphid borne mosaic virus*), fungi (*Fusarium solan*i and *Fusarium oxysporum*), bacteria (*Xanthomonas axonopodis*), nematodes (*Meloidogyne* spp.) and phytoplasms (Cavichioli et al., 2011; Cerqueira et al., 2014; Garcêz et al., 2015; Santos et al., 2017).

Among the pathogens, viruses, particularly the mosaic viruses of the fruits stands due to the severity that they cause to the culture, generating economical and social stalemates (Fischer et al., 2008; Ferreira, 2016). It is also highlighted, that there is no chemical method to control this disease.

Therefore, the mineral nutrition applied in an adequate way and quantity can contribute to the optimization of fruit productivity and quality in passion fruit cultivars (Sousa et al., 2014; Gonçalves, 2016). However, the quantities of N, P and K recommended for the cultivation of passion fruit are very variable. In Brazil, it is recommended the implementation from 94 to 235 kg ha^{-1} $year^{-1}$, 30 to 213 kg P_2O_5 ha^{-1} $year^{-1}$ and 50 to 530 kg of K_2O ha^{-1} $year^{-1}$ (Ripardo, 2010). In addition, nutritional studies in areas with presence of virus are scarce, even more restricted when measuring the results of fertilization and production from the economic point of view.

In this sense, the objective was to evaluate specific economic data of the production of passion fruit under influence of different doses of N, P_2O_5 and K_2O, in an area with incidence of virose aiming at better technical support of the production in this adverse condition.

2. Material and Methods

2.1 Characteristics of the Experimental Area

The experiment was carried out in a commercial area located in the district of Montalvão, in the municipality of Presidente Prudente, region of Alta Sorocabana, SP. The experiment was performed from February 2013 to July 2014 (Table 1). It is characteristic of the region present 64% of agricultural properties with areas of up to 72 hectares (LUPA, 2015).

The experiment was carried out in an area where the planting of passion fruits occurs periodically. The interval between the last planting and the study corresponded to 3 months. The incidence of viral infection at the site was identified prior to the installation of the study.

The climate is Aw according to the Köppen classification, with tropical summer rainy season and a dry winter and the coldest month with an average temperature above 18 ºC. The driest month has rains lower than 60 mm. The annual precipitation is approximately 1250 mm (CEPAGRI, 2017).

The predominant soil in the region is classified as dystrophic clayey soil, characterized by the form of soil relatively mild, still curled, by its nature not so cohesive in its surface and lower permeability in underground layers. It has a high susceptibility to erosion, which requires intensive practices to control erosion (IAC, 2016).

Table 1. Schedule of production of yellow passion fruit in the region of Presidente Prudente, crop 2013/2014

	Activity
Crop 2013	
February-March	Gathering fruits in the field to remove seeds
April-August	Sowing seeds
Setempber	Field-planting
Crop 2014	
January	Start of flowering
February-July	Harvest

2.2 Production of Seedlings of Yellow Passion Fruit

The plant material was yellow passion fruit of variety 'Sul-Brazil Afruvec'. The seeds used in the production of seedlings were removed from healthy plants and highly productive commercial plantations in the region in February 2013. The seeds removed from fruits were placed in a plastic container for the seeds fermentation process, this technique consists of stirring the seeds to explode for a period of 72 hours. The greater the number of times that the seeds are stirred by day, the more easily to remove the layer that surrounds the aril of seeds, consequently the greater potential of germination of the seeds.

After the fermentation period o, the seeds were placed in Styrofoam trays of 200 divisions to seeding and, after germination, seedlings were transplanted into plastic bags black with holes, with capacity for 2 liters of substrate. The substrate used in plastic bags was the commercial substrate Bioplant® composed of pine bark, coconut fiber, vermiculite, carbonized rice and nutrients. The seedlings were developed to a size of approximately 2 m in height when they were planted in the field.

2.3 Experimental Design

The treatments were performed in factorial NPK fractioned $4^3 \times 0.5$ split into two incomplete blocks with variations in the doses of N, P_2O_5 and K_2O (Table 2). The space among the plants was 2 m and 3 m between the lines (1515 plants ha^{-1}). The total area used of the experiment was 3801.6 m^2. The variations used for the dose of N,P_2O_5 and K_2O were based upon the recommended dose in the Technical Bulletin 100 (Manure et al., 1997) for the cultivation of passion, as well as for other nutrients. The doses of N, P_2O_5 and K_2O recommended by Raij et al. (1997) correspond to 140, 140 to 350 kg ha^{-1}, respectively.

Table 2. Doses of N, P_2O_5 and K_2O (Kg ha^{-1}) application in experiment of yellow passion fruit, Presidente Prudente, crop 2013/2014

Factor	Dose			
N-(N)	150	300	600	1200
P-(P_2O_5)	200	400	800	1600
K-(K_2O)	100	300	500	700

2.4 Fertilization Management

As sources of NPK, the following fertilizers were used: ammonium nitrate (32% N), triple superphosphate (42% P_2O_5) and potassium chloride (60% of K_2O). The phosphate fertilization was applied in the furrow in a single dose in all treatments. Already the nitrogen (N) and potassium fertilization (K_2O) were provided in topdressing, divided monthly in 7 applications, from October/2013 to April/2014, and provided in accordance with the development of plants in order to optimize the use of nutrients.

2.5 Characteristics Evaluated

The data were collected from February 2014 to July 2014 in 180 to 360 DAS (days after planting). To estimate the operational cost of production, it was used the methodology of the Institute of Agricultural Economics (IAE), described in Martin et al. (1998). The price of the rate of the United States dollar (USD) was obtained in the price of official rate of Central Bank of Brazil (PTAX 800), measured in fractions and national currency units in Brazil, which was $3.16 on 11/02/2015 (Central Bank of Brazil, 2016).

The structures used in the production system were: Fertilization costs (CF) = price and quantity of fertilizer applied at treatment; Effective operational cost (EOC) = spending on labor, operations of machinery/equipment and materials consumed in the production process; Total operating costs (TOC) = effective operational cost plus expenses with depreciation of machinery, social costs direct and indirect contribution of rural social security.

The activities studied included five steps: soil preparation, planting, formation of cultures, cultural practices and operations related to the harvest. Soil preparation operations, such as thinning, leveling, plowing, trenching, placement of pallets, liming (planting), planting (distribution of seedlings and replanting), handling of cultures (thinning and orientation of the plants, spraying for pest and disease control, preventing the proliferation of ants, the manual pollination and harvest were identical in all treatments.

In the manual operations, it was considered: (a) Labor: family farming, requiring two persons per hectare, (b) the equipment useful life: 10 years; (c)weight of fruits per box: 13 kg; (d) the dollar exchange rate: USD 1.01. The prices of materials and labor followed the values prevailing in the city of Presidente Prudente, for the month of August 2017. The cost per hour and the depreciation of machinery and implements were based on the data available in the Series statistical information on agriculture (2016) and were adjusted through field research.

The total production corresponded to the sum of the productivity of plants for each treatment. It was also carried out an estimate of production per hectare according to the productivity per plant. The economic assessment also took into consideration: per treatment, yield (tons ha^{-1}), commercial production (tons ha^{-1}) and the percentage of fruits of each classification (%). The sized 2 fruits were classified according to Ceagesp table and the sized 1 fruits were discarded. Table 3 shows the classification of the fruits according to the size and medium price of sale.

Table 3. Classification of fruits of yellow passion fruit, according to the gauge system, diameter of fruit (mm) and average price sale (USD kg^{-1}), Presidente Prudente, crop 2013/2014

Classification	Gauge	Diameter fruit	Average Price sale
1ª	1	≤ 55	-
2ª	2	≥ 55 to 65	0.47
3ª	3	≥ 65 to 75	0.57
4ª	4	≥ 75 to 85	0.65
Super	5	> 85	0.74

Source: Ceagesp, 2017.

2.6 Statistical Analysis

To calculate the economic analysis of collected data, the following formulas were used as described by Martin et al. (1998): The profitability indicators adopted were:

a) Gross Revenue (GR):

$$GR = Pr \times Pu \tag{1}$$

where, Pr = production of activity per unit of area (kg/ha^{-1}). Pu = unit price of the product of activity (USD/ha^{-1});

b) Operational Profit of Net Revenue (OP or NR):

$$OP = GR - TOC \tag{2}$$

where, TOC = total operational cost of production (USD/ha^{-1});

c) Profitability Index (PI):

$$PI = (OP/GR) \times 100 \tag{3}$$

d) Balance Point (BP):

$$BP = TOC/Pu \tag{4}$$

The data were analyzed by mathematical model:

$y = B0 + b11N + b22P^2 + B3K + b33K^2 + b12NP + b13Ni + b23PK$

subjected to analysis of variance by Statistical Analysis System (SAS, 2010) and the variables whose response was significant at doses were analyzed by regression testing for the significance level of $p < 0.05$, $< 0.01\%$.

3. Results and Discussion

In the present study, 100% of the plants showed visual symptoms characteristic of attack of viral infection of passion fruit after 120 days of installation of the experiment, which highlights the severity of the disease in the field. However, it was found that there was significant variation in productivity and in the production of marketable fruits in answers to the doses of N. The doses of K_2O influenced positively the quality of the fruits (Table 4).

The maximum productivity reached was 19.84 tons ha^{-1} of yellow passion fruit with the application of 300 kg N ha^{-1}, being that the use of this dose about 83% of the fruits were within the commercial standard of sale (> size 2), which represented a yield of commercial fruits of 16.36 tons ha^{-1}, even the variable being below the productive potential of culture regarding the areas without incidence of viral infections, it was superior to the average national production of 14 tons ha^{-1}. The low production observed in the work is due to the rapid entry and spread of Passion fruit woodiness virus, the incidence of the disease in the experimental area was observed already at 60 days after planting in the field, *i.e.*, the viral infection developed in the same period that the plants were in the plant formation stage. Miyake et al. (2016) obtained a medium productivity of 43 ton ha^{-1} in area without the presence of virus infection.

Cavichioli et al. (2011) observed in the city of Adamantina-SP the percentage of plants with symptoms of viral infection and the severity of symptoms in three rootstocks: *Passiflora edulis*, *P. alata*, *P. gibertii* and ungrafted plants. It was used as crown the yellow passion fruit (Passiflora edulis). It was noted that the plants with symptoms of viral infection occurred at 90 days after planting of seedlings in the field, reaching, at 180 days, 100% of plants with viral infection in *P. alata* and *P. gibertii*, and 97.5% in *P. edulis* and ungrafted plant.

This result for the parameter of productivity indicated that the dose of 200 kg ha^{-1} P_2O_5 and 100 kg of K_2O were sufficient to meet the demand of the nutritional culture of passion fruit. Probably, the residues of fertilization existent of previous crops supplied the needs of plants, since the area was with cultivation of the crop for the fourth consecutive year.

The percentage of production of marketable fruits was superior in the treatment where it was used 700 kg ha^{-1} of K_2O. There were no statistical variation in commercial production in the applied doses of N and P_2O_5 (Table 4). Even with no statistical difference, the nitrogen fertilization resulted in an increase in the number of fruits (from a dose of 300 kg ha^{-1} N). In addition, these fruits were classified in the size 4, *i.e.*, fruit with high commercial value of sale (USD 0.64 Kg).

Table 4. Productivity, total number of fruits, percentage of commercial fruit (PCF) and commercial fruit yield (CYF) of yellow passion fruit in response of doses of N, P_2O_5 and K_2O, per ha^{-1}, Presidente Prudente, crop 2013/2014

Factor	Dose	Productivity		Nº fruit	PCF	CFY
		kg $plant^{-1}$	ton ha^{-1}	Total	%	ton ha^{-1}
N	150	8.90	13.48	205	0,.83	11.33
	300	13.09	19.84	308	0.82	16.36
	600	12.46	18.88	305	0.81	15.54
	1200	11.51	17.44	307	0.77	13.36
Effect		Q**	Q**	NS	NS	Q**
P_2O_5	200	10.75	16.29	260	0.83	13.52
	400	12.16	18.43	298	0.81	15.08
	800	11.41	17.29	292	0.77	13.28
	1600	11.63	17.63	275	0.82	14.72
Effect		NS	NS	NS	NS	NS
K_2O	100	10.40	15.77	269	0.75	11.89
	300	12.31	18.66	305	0.81	15.08
	500	12.40	18.79	291	0.83	15.72
	700	10.84	16.43	259	0.84	13.90
Effect		NS	NS	NS	L**	Q**
CV (%)		27.65	27.89	27.38	5.41	29.89

Note. L: linear; Q: quadratic; NS: non significative:* significative ($p < 0.05$); ** significative: ($p < 0.01$).

In the work developed by Sampaio et al. (2008) was analyzed the quality of the fruits and the productivity of yellow passion fruit, in two annual cycles with seedlings of selection Afruvec. The first symptoms of the virus of passionfruit woodiness in the leaves were detected when the plants were already formed and in full flowering. The total production of the first year was 27.12 ton ha^{-1}, preventing the highest production of fruits with sizes 2 and 3. During the harvest period, the fruit industry type showed steady growth and above 10% of the fruits harvested from 40th harvest, reaching 33% at the end of the season and surpassing the 22% of the previous harvest. The progressive increase of these types of fruits is due to the onset of the virus infection.

Gioria (2000) found that, the earlier the plants are contaminated, the greater is the economic impairment of the activity. Losses both in number and weight reached 80% when the seedlings became infected at the age of 2 months. Whereas seedlings that became infected at 4 and 6 months, the losses were 74 and 44%, respectively. These results stress out the importance of the deployment of protected greenhouses in system of seedlings production of yellow passion fruit in different regions of Brazil.

Mello (2009) evaluated the productivity and the reaction of 12 genotypes of passion fruits to viral infection of passionfruit woodiness, in Federal District. It was identified that all the varieties were mildly susceptible. *Rubi Gigante* stood out with the lowest averages of severity and incidence of virus in leaf (56%), while the lowest incidence in plant (79%) was verified with the genotype MAR#19.

The difference in production and fruit quality (size) of passion fruit based on this study and in other studies (Sampaio et al., 2008; Gioria, 2000; Mello, 2009) depends on some factors like: the genotype used, realization of cultural treatments (nitrogen, windbreak, plant treatment, among others), but the main factor is the age of incidence of viral infection in plants in the field. It is known that the more previously there is the attack of the virus in the passion in the field, the greater its severity will be and the lower the production of the plant, as a result, the greater will be the reduction of economic profitability of the culture.

In the fertilizations with the variation of N and K_2O it is noticed the difference in fruits size. It was not identified any significant difference in fruit size 1, 2, 3 and 5, in doses of N. Whereas, the fruits of size 4 were bigger with use of the dose of 150 kg ha^{-1}. In different doses of K_2O, it was identified that the variation in sizes 2 (100 kg ha^{-1}) and 4 (500 kg ha^{-1}), as shown in Table 5.

The average total production of fruits size 1 in all treatments was approximately 1.4%, fruits of size 2, 16.9%, fruits of size 3, 38.5%; fruits of sizes 4, 38.2% of fruits of size 5, 4.6%.

Table 5. Percentage of classification of fruits of yellow passion fruit in response of doses de N, P_2O_5 and K_2O, Presidente Prudente, crop 2013/2014

Factor	Dose	Classification (%)				
		Gauge 1 < 55 mm	Gauge 2 55-65 mm	Gauge 3 65-75 mm	Gauge 4 75-85 mm	Gauge 5 > 85 mm
N	150	1.35	14.79	37.54	41.56	4.77
	300	1.41	16.13	37.62	39.93	4.89
	600	1.06	16.90	38.63	38.17	5.22
	1200	2.09	20.04	40.60	33.48	3.77
Effect		NS	NS	NS	Q	NS
P_2O_5	200	1.73	14.93	39.42	37.31	6.61
	400	1.37	16.49	36.14	42.33	3.64
	800	1.73	20.63	37.26	37.15	3.21
	1600	1.08	15.81	41.57	36.34	5.18
Effect		NS	Q*	NS	NS	NS
K_2O	100	1.81	22.38	40.36	32.61	2.84
	300	1.58	16.75	38.58	37.71	5.36
	500	1.31	15.23	35.02	43.11	5.30
	700	1.21	13.49	40.04	39.69	5.14
Effect		NS	L**	NS	Q**	NS
CV (%)		27.39	18.90	8.81	11.78	41.07

Note. L: linear; Q: quadratic; NS: non significative: * significative ($p < 0.05$); ** significative ($p < 0.01$).

The economic analysis pointed that there was percentage difference in the operational cost of production of 4.7% between the highest and the lowest dose of N, of 6.8% among doses of P_2O_5 and 2.5% among doses of K_2O. Whereas, the largest difference in cost of production among the doses used and the recommended dose was 4.0%, 5.8 and 1.7% for the different doses of NPK, per treatment, respectively (Table 6). The total operational cost ranged between USD 9,215.11 to USD 9,845.91 per hectare.

It was noticed that the production cost was increasing in virtue of the doses used of fertilizer, however, this additional economic cost did not reflect increased productivity per area. It was found, however, that there was variation in the commercial quantity of production. Thus, it was essential to analyze the profitability of the crop taking into account the cost of production in relation to the final value of the sale of the product generated in each treatment.

It is still highlighted, that Furlaneto et al. (2011) identified for the cultivation of passion fruit, in 2010/2011 harvest, in the region of Marília, São Paulo State, a total cost of production of R$ 37,751.67 ($23,743.19) per hectare or R$ 1.89 ($1.19) per kilogram of fruit. The indicators of profitability were unfavorable to the production system analyzed, due mainly to the high price of inputs and inadequate practices for disease control. The authors emphasized the need for adequate techniques relating to the management of plant health and nutritional status of culture for the reduction of total cost of production in order to make the activity profitable. Situations were ratified in the present study.

According to the Yearbook of Brazilian Agriculture (2017), in the Central West region of São Paulo, year 2016, the total operational cost for production of passion fruit irrigated land was $9,906.96 per hectare per year, taking into account a yield of 25 tones per hectare and the density of 952 plants per hectare. It is emphasized that in this locality there is intense involvement of the plantation related to phytosanitary problems.

Table 6. Cost of fertilization (CF ha^{-1}), total operational cost per hectare (TOC ha^{-1}), effective operational cost per treatment (EOC), percentage between the total operational cost per treatment the standard dose and the dose application in yellow passion fruit obtained in the experiment with doses of N, P_2O_5 and K_2O, held in Presidente Prudente, crop 2013/2014

Factor	Dose	CF	TOC	EOC	Percentage between the TOC of standard dose and the test dose
		USD ha^{-1}	USD ha^{-1}	USD $treat^{-1}$	% $treat^{-1}$
N	150	414.59 c	9,242.64 b	439.20 b	99 b
	300	486.21 c	9,305.23 b	442.18 b	100 b
	600	629.47 b	9,430.40 b	448.13 b	101 b
	1.200	916.93 a	9,680.75 a	460.02 a	104 a
P_2O_5	200	375.64 d	9,215.11 b	437.90 c	99 b
	400	476.77 c	9,305.23 b	442.18 bc	100 b
	800	679.03 b	9,485.45 b	450.75 b	102 b
	1.600	1, 083.54 a	9,845.91 a	467.87 a	106 a
K_2O	100	391.24 d	9,225.59 b	438.40 a	99 b
	300	481.49 c	9,305.23 b	442.18 a	100 b
	500	571.75 b	9,384.86 b	445.96 a	101 ab
	700	662.00 a	9,464.49 a	449.75 a	102 a

Note. The means followed by the same letter column non-statistical difference ($P < 0.05$), according to SAS test ($n = 4$). The standard dose of N, P_2O_5 and K_2O recommended by Bulletin 100 to yellow passion fruit corresponding of 140, 140 and 350 kg ha^{-1}, respectively.

To estimate the profitability of the fertilizations evaluated, it was discarded the production of fruits size 1. It was calculated the selling of fruits sizes 2 to 5. Due to the low productivity (mean 14.156 t ha^{-1}), the economic results were unfavorable. The best revenue, despite of negative, occurred in the combination of the following dose of fertilization: 300 kg of N, 400 kg of P_2O_5 and 500 kg of K_2O ha^{-1}. The same result occurred in the profitability index of the culture. For this combination of fertilization with NPK, the minimum selling price of passion fruit needed to be USD 0.61 per kg of fruit (Table 7).

Table 7. Gross revenue (GR Fr) from sale of fruit, according to the caliber, total gross revenues (Total GR), net revenues (NR), profitability index (PI) and balancing point (BP) for yellow passion fruit obtained in the experiment with doses of N, P_2O_5 and K_2O held in Presidente Prudente, crop 2013/14

Factor	Dose	GR Fr				Total GR	NR	PI	BP
		Cal. 2	Cal. 3	Cal. 4	Cal. 5				
		USD $treatment^{-1}$					USD Kg^{-1}		
N	150	1.08 a	14.36 b	41.57 c	52.39 c	109.41 d	-329.79 a	-301.40	0.81 a
	300	1.62 a	22.62 a	60.15 a	72.69 a	157.10 a	-285.07 b	-181.46	0.56 c
	600	1.16 a	22.51 a	58.67 a	66.00 b	148.36 b	-299.77 b	-202.05	0.60 c
	1.200	1.97 a	22.94 a	53.01 b	49.77 c	127.71 c	-332.10 a	-260.19	0.72 b
P_2O_5	200	1.65 a	17.30 b	52.09 b	56.13 b	127.18 b	-310.71 b	-244.31	0.68 b
	400	1.45 a	21.31 a	53.27 b	71.03 a	147.08 a	-295.10 b	-200.64	0.61 c
	800	1.62 a	23.48 a	48.36 c	54.90 b	128.37 b	-322.37 a	-251.12	0.71 a
	1.600	1.12 a	19.94 b	59.81 a	59.52 b	140.41 a	-327.46 a	-233.22	0.66 b
K_2O	100	1.52 a	22.81 a	46.90 b	43.14 c	114.38 d	-324.01 a	-283.27	0.77 a
	300	1.68 a	21.65 a	56.86 a	63.28 b	143.48 b	-298.69 b	-208.17	0.61 c
	500	1.45 a	20.52 a	53.81 a	75.41 a	151.20 a	-294.76 b	-194.95	0.59 c
	700	1.18 a	16.07 b	54.40 a	61.39 b	133.05 c	-316.69 a	-238.02	0.68 b

Note. The means followed by the same letter column non-statistical difference ($P < 0.05$), according to SAS test ($n = 4$). The standard dose of N, P_2O_5 and K_2O recommended by Bulletin 100 to yellow passion fruit corresponding of 140, 140 and 350 kg ha^{-1}, respectively.

It is stressed out that Miyake et al. (2016) analyzed economically different types of nutritional management in yellow passion fruit, with variations of N doses (150, 300, 600 and 1200 kg ha^{-1}), P_2O_5 (200, 400, 800 and 1600 kg ha^{-1}) and K_2O (100, 300, 500 and 700 kg ha^{-1}) in the municipality of Presidente Prudente, region of Alta Sorocabana. They concluded that there was no significant variation in fruit yield as a function of doses of NPK. However, there was differentiation in the quality of the fruits The operating profit and the profitability index were more satisfactory on the application of 300 kg of N, 400 kg of P_2O_5 and 500 kg of K_2O, per hectare. For this combination of fertilization, the minimum selling price of passion fruit needed to be USD 0.26 per kg of fruit (Table 7).

In another study, Lima et al. (2009) analyzed the profitability of passion fruit in six production Brazilian Centers (Benevides-PA, Araguari-MG, Itapuranga-GO, Integrated Development Region of the Federal District and surrounding areas, Bom Jesus da Lapa-BA and Vera Cruz-SP) and observed that the culture of yellow passion fruit is economically viable at the centers when productivity is greater than 19 tones per hectare/year. However, due to the sharp increase in the price of inputs and the price of a kilo of fruit in the last 05 years (average of R$ 1.61 kg^{-1}), it is necessary to increase the productivity per hectare, as well as minimize the cost of production and cause the activity to be sustainable economically.

4. Conclusion

In the city of Presidente Prudente, region of Alta Sorocabana, SP, under conditions of soil, management and climate evaluated and in lands with an incidence of viral infection, it is not recommended the planting of passion fruits due to the unfavorable profitability to agribusiness.

However, at times with high selling price of fruit (average above R$ 0.61 kg^{-1}), the dose of N, P_2O_5, K_2O indicated refers to 300 kg of N, 400 kg of P_2O_5 and 500 kg of K_2O per hectare.

It is therefore recommended to add more 160 kg of N, 160 kg of P_2O_5 and 150 kg of K_2O per hectare in relation to the indication of Technical Bulletin 100, for the culture of yellow passion fruit in order to obtain the economic optimization of entrepreneurial activity.

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