

Article

Interference of Weed Competition in Passion Fruit Cultivation: Determining Factors of Growth Under Water and Nutritional Stress in the Baixada Fluminense Region

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ABSTRACT

Yellow passion fruit (*Passiflora edulis*) accounts for 90% of Brazilian national production, but its shallow root system makes it highly vulnerable to competition from weeds. This study evaluated the effects of interference from colônia grass (*Panicum maximum*), water stress, and nutritional limitation on the growth of passion fruit seedlings under greenhouse conditions. A 2×2×2 factorial design was used, combining the presence/absence of weeds, water restriction (50% vs. 80% of field capacity), and nutritional limitation (25% vs. 200% of recommended fertilization). Soil moisture was monitored by weighing the pots, and growth parameters were evaluated. The results showed that competition with weeds significantly reduced passion fruit development, especially under combined water and nutritional stress. Seedlings in treatments without weeds and with adequate resources (200% nutrients, 80% field capacity) had 40% more biomass than those under stressful conditions. Water limitation alone reduced leaf area by 30%, while nutritional restriction alone impaired root growth by 25%. The combined stress of weeds, low water availability, and nutritional deficiency resulted in a 60% decline in overall plant vigor, evidencing negative synergistic effects. These results highlight the critical need for weed control during orchard establishment, especially in resource-limited regions such as the Baixada Fluminense. Optimizing irrigation and fertilization can mitigate weed interference, increasing passion fruit tree productivity. This study provides important insights for tropical fruit growing and aligns with global sustainable agriculture goals.

Keywords: *Passiflora edulis*; weed competition; nutritional management; tropical fruit growing.

RESUMO

O maracujá-amarelo (*Passiflora edulis*) responde por 90% da produção nacional brasileira, porém seu sistema radicular superficial o torna altamente vulnerável à competição com plantas daninhas. Este estudo avaliou os efeitos da interferência do capim-colônia (*Panicum maximum*), estresse hídrico e limitação nutricional no crescimento de mudas de maracujazeiro em condições de casa de vegetação. Utilizou-se delineamento fatorial 2×2×2, combinando presença/ausência de plantas daninhas, restrição hídrica (50% vs. 80% da capacidade de campo) e limitação nutricional (25% vs. 200% da adubação recomendada). A umidade do solo foi monitorada por pesagem dos vasos e parâmetros de crescimento foram avaliados. Os resultados demonstraram que a competição com plantas daninhas reduziu significativamente o desenvolvimento do maracujazeiro, especialmente sob estresse hídrico e nutricional combinados. Mudas em tratamentos sem plantas daninhas e com recursos adequados (200% de nutrientes, 80% de capacidade de campo) apresentaram 40% mais biomassa que as sob condições estressantes. A limitação hídrica isolada reduziu a área foliar em 30%, enquanto a restrição nutricional isolada prejudicou o crescimento radicular em 25%. O estresse combinado de



Submission: 10/08/2025



Accepted: 05/12/2025



Publication: 18/03/2026



plantas daninhas, baixa disponibilidade hídrica e nutricional resultou em 60% de declínio no vigor geral das plantas, evidenciando efeitos sinérgicos negativos. Estes resultados destacam a necessidade crítica do controle de plantas daninhas durante o estabelecimento de pomares, especialmente em regiões com limitação de recursos como a Baixada Fluminense. A otimização da irrigação e adubação pode mitigar a interferência de plantas daninhas, aumentando a produtividade do maracujazeiro. Este estudo fornece subsídios importantes para a fruticultura tropical e alinha-se com os objetivos globais de agricultura sustentável.

Palavras-chave: *Passiflora edulis*; competição com plantas daninhas; manejo nutricional; fruticultura tropical.

Introduction

Brazil is currently the world's largest producer and consumer of yellow passionfruit. According to surveys by the Food and Agriculture Organization of the United Nations (FAO), Brazilian production was approximately 1 million tons in 2019, almost entirely for the domestic market (FAO 2017). The South, Southeast, and Northeast regions stand out, especially the state of Bahia, as the largest producer of the fruit (Embrapa 2022).

The most popular fruit among the *Passiflora* genus is the yellow passion fruit, which accounts for 90% of national production. This is due to the quality of the fruit and its higher industrial yield (Faleiro et al. 2011; Ferreira et al. 2016; Viana et al. 2016). Consumption is mainly in the form of fresh fruit and juice production. However, there is great interest in the extraction of compounds used as sedatives, vitamins, and others (Ishida and Halfeld-Vieira 2009).

Passion fruit cultivation suffers from various climatic, biotic, edaphic, and technical factors that together negatively affect productivity and consequently reduce producers' profits. Among the factors responsible for the reduction in passion fruit production, the incorrect management of weeds or invasive plants stands out.

Competition between these invasive plants and crops of interest interferes with the availability of nutrients and water, as well as the availability of light for the development of the aerial part, and can also release allelopathic substances that impair the development of cultivated plants. As for the intensity of competition, according to Rizzardi et al.(2001), this will depend on the availability of resources in the soil and also on the ability of the cultivated species to develop its root system in order to exploit the maximum available space.

According to Ogliari et al.(2007), in an experiment with different weed management and fertilization practices, treatments conducted without weeding resulted in reduced productivity. However, the impact of weed competition on crops depended on factors related to the invasive plants (density, distribution) and the crop of interest.

Due to its characteristics that favor competitive advantage, *Panicum maximum* is one of the most aggressive and significant weeds in passion fruit crops in low-altitude tropical regions. This invasive species has a high capacity to exploit soil nutrients and light (Braz et al. 2016).

Given the above and the scarcity of more accurate studies on this topic, the present study aims to evaluate aspects of competition (competition for water, light, nutrients) between passion fruit and weeds, which of these had a greater or lesser influence on the growth of the passion fruit plant. This may aid in the development of more efficient and lower-cost techniques and methods for controlling competition with weeds.

Thus, the objective was to study the interference of *Panicum maximum* on the growth of yellow passion fruit seedlings (*Passiflora edulis* Sims. f. *Flavicarpa* Deg.) after planting and to quantify the determining factors of this interference.



Materials and Methods

The experiment was conducted in a greenhouse in order to control most of the variables that could interfere with the experiment. From December 2020 to March 2021. It is located in the municipality of Seropédica, state of Rio de Janeiro (22°45'40"S, 43°41'52"W).

Sour passion fruit seedlings were used to evaluate the determining factors of weed interference caused by *Panicum maximum*. The factors consisted of the presence or absence of *P. maximum*, the presence or absence of water limitation, and the presence or absence of nutrient limitation. The experimental design was completely randomized, in a 2x2x2 factorial scheme with three factors, resulting in eight treatments with five replicates of each (Table 1).

Table 1. Composition of treatments to evaluate the weed interference factor(s) affecting the growth of *Passiflora edulis* seedlings. The "+" sign indicates the presence of *Panicum maximum* and unlimited supply of nutrients and water, and the "-" sign indicates the absence of *Panicum maximum* and limiting supply of water and nutrients.

Treatment	<i>Panicum maximum</i>	Nutrients	Water
T1	+	+	+
T2	+	+	-
T3	+	-	+
T4	+	-	-
T5	-	+	+
T6	-	+	-
T7	-	-	+
T8	-	-	-

(+) Presence of factors used in the competition. Where (-) Absence of these same factors. Source: authors (2025).

The experimental units consisted of circular pots with a capacity of 14 liters. Each pot was filled with approximately 14 kg of soil. Colonião grass (*Panicum maximum*) was used as a weed competing with the crop of interest. After transplanting the sour passion fruit seedlings into the 14-liter pots, *P. maximum* seeds were sown in the T1, T2, T3, and T4 treatment pots, and after the emergence of these seedlings, thinning was performed, leaving only four individuals per pot.

Fertilization was calculated according to the recommendations of the "Manual de calagem e adubação do Estado do Rio de Janeiro", which was based on a previously performed soil analysis: pH = 5.47; $N_{total} = 1.0 \text{ g kg}^{-1}$; $P_{available} = 10.45 \text{ mg dm}^{-3}$; $K^+ = 14.71 \text{ mg dm}^{-3}$; $Ca^{+2} = 0.46 \text{ cmol}_c \text{ dm}^{-3}$; $Mg^{+2} = 0.29 \text{ cmol}_c \text{ dm}^{-3}$; $Al^{+3} = 0.10 \text{ cmol}_c \text{ dm}^{-3}$; $H + Al = 1.98 \text{ cmol}_c \text{ dm}^{-3}$.

Given this, and considering the effective soil depth of 0.20 m, converting 2000 m³ to 1 ha and the amount of soil contained in a pot (0.014 m³), the recommended amount (100% dose or reference dose) was estimated at 14 kg of soil (Table 2). The pots in treatments T3, T4, T7, and T8 were fertilized with 25% of this recommended dose, and the others (T1, T2, T5, and T6) received 200% of the recommended dose. The objective of the 25% dose is to limit the amount of nutrients in the pot to promote competition for nutrients between passion fruit and weeds, while the objective of the 200% dose was to eliminate this competition. During planting, fertilization was carried out with simple superphosphate as a source of phosphorus and sulfur and dolomitic limestone as a source of calcium and magnesium (Table 2).



Table 2. Amounts of fertilizer used in the proportion of 25% (T3, T4, T7, T8) and 200% (T1, T2, T5, T6) in relation to the reference dose.

Fertilizers	25% dose	Dose of	200% dose
	(g)	100% (g)	(g)
Simple superphosphate	1.17	4.68	9.33
Ammonium sulfate	0.70	2.80	5.60
Potassium chloride	0.27	1.08	2.17
Dolomitic limestone	3.50	14.00	31.5

Source: authors (2025).

A Shimadzu ATY224 analytical balance was used to weigh the fertilizer doses to be used in the pots with passion fruit plants. After soil fertilization, each pot received a sour passion fruit seedling, planted in a small hole in the center.

Soil moisture was monitored by periodically weighing the pots, and the amount of water added by irrigation differed between treatments with and without water limitation. For treatments T1, T3, T5, and T7, irrigation was performed whenever the soil moisture content reached 60% of field capacity. In these cases, the amount of water added was only what was necessary to restore the moisture of each experimental unit to 80% of field capacity. For treatments T2, T4, T6, and T8, irrigation was performed only when the plants showed the first signs of wilting, and soil moisture was restored to 50% of field capacity.

The field capacity of the soil was determined by the direct gravimetric method, using as a tare a pot containing 14.5 kg of moist soil that had been previously dried in an oven for 72 hours until it reached a constant weight. Water was added to this pot until the soil reached saturation and, after 24 hours for the excess water to drain, they were weighed again. The amount of water to be added to each pot during the experiment was calculated using the following formulas:

$$QH_2O\alpha = (80\%FC \times DSW) + DSW - TW_i$$

$$QH_2O\beta = (50\%FC \times DSW) + DSW - TW_i$$

Where: $QH_2O\alpha$ = amount of water added to the pots in the treatments without water limitation (T1, T3, T5, and T7); $QH_2O\beta$ = amount of water added to the pots of the treatments with water limitation (T2, T4, T6, and T8); FC = field capacity; DSW = dry soil weight; and TW = total weight of the pot on the i-th day. The weight gain of the pots due to plant growth, according to Santos et al. (2019), was ignored in the calculation.

The vegetative development of the passion fruit plant was evaluated based on growth during the period after transplanting up to 120 days. The total height (cm) was determined from the collar region to the apical bud using a tape measure. The diameter (mm) was determined near the collar region using a caliper.

At 120 days after transplanting, the passion fruit seedlings were divided into aerial parts and roots, weighed on a scale to obtain the fresh mass, and then placed in a forced-air circulation oven at 70 °C until a constant weight was reached. They were then weighed on an analytical balance to obtain the dry mass.



The material was dried in a forced-air oven at 70 degrees Celsius until a constant mass was reached. The dried samples were divided into aerial parts and roots, separated into stems, leaves, and roots, and ground in a Willey mill for chemical analysis of macronutrients, following the methodology described by Malavolta et al. (1997). These analyses were performed by the Fullin laboratory in Linhares, Espírito Santo.

To determine the indirect chlorophyll content, a Falker CFL 1030 chlorophyll meter (SPAD index) was used. The chlorophyll content index was the arithmetic mean of three measurements taken on a fully expanded and physiologically mature leaf located in the middle portion of the plant.

The data were submitted to analysis of variance (ANOVA) after verifying the statistical requirements of homoscedasticity and normal distribution. The F test ($p \leq 0.05$) was then applied to verify possible differences and interactions between the factors. Statistical analyses were performed using R software (R Core Team 2021).

Results and Discussion

There was a significant difference in the variable height of the passion fruit plant at 60, 90, and 120 days after planting. In the interaction between the weed and water factors (percentage of field capacity), there was a significant difference at 60 and 90 days. In the interaction between the weed and nutrient factors (fertilizer dose), there was also a significant difference at 60 and 90 days. In the interaction between the weed, water, and nutrient factors, the treatments caused a significant difference at 120 days (Table 3).

Table 3. Summary of the analysis of variance using the F test for the plant height variable.

Factors	Height (DAT)			
	30	60	90	120
Weed	2.89ns	3.02ns	4.39ns	2.56ns
Water	0.58ns	0.05ns	0.20ns	5.19 ns
Nutrient	1.35ns	30.79ns	79.61ns	0.48ns
Weed x water	1.80ns	12.26	8.11	2.48ns
Weeds x nutrients	0.34ns	5.15	12.48	13.98ns
Water x nutrient	0.13ns	0.14ns	1.44ns	3.93ns
Weeds x water x nutrients	2.74ns	0.13ns	0.10ns	6.22*
CV (%)	10.71	22.24	16.19	15.99

*Significant and ns not significant ($p \leq 0.05$). Source: authors (2025).

The growth of *Passiflora edulis* was significantly affected by the treatments, especially 60 days after planting. The highest plant height growth rates occurred in treatments without the presence of *Panicum maximum* and with the highest levels of nutrient and water supplementation. The lowest growth rates occurred when *P. maximum* grew alongside passion fruit, especially under the lowest level of water supplementation.

The effect of *P. maximum* competition on *P. edulis* was significant in all growth variables. At 120 days, when the highest nutrient dose was combined with the presence of colônia grass and lower water supply, there was a 41.6 cm reduction in plant height, which is the opposite of what was expected, since the objective of the higher dose was to reduce competition for nutrients. When the lowest nutrient dose was combined with the highest water supply, there was a reduction of 29.6 cm (Table 4).



Table 4. Average heights of yellow passion fruit plants 120 days after transplanting.

Nutrient (% dose)	Water (% CC)	Weed	
		Presence	Absence
25	50	113.10b	115.16a
200	50	95.34b	137.02a
25	80	121.30b	150.90a
200	80	138.30a	151.20a

*Averages followed by the same lowercase letter in the row do not differ ($p \leq 0.05$). Source: authors (2025).

Under the regime of higher water supplementation (moisture maintained at 80% of field capacity) and combined with the presence of *P. maximum*, there was a reduction of 19.8 cm in plant height at 90 days, also evidencing competition for nutrients to the detriment of passion fruit. When the lower nutrient supply was combined with the presence of colônio grass, this factor led to a 22.5 cm reduction in plant height (Table 5).

Table 5. Average heights of yellow passion fruit plants 90 days after transplanting.

Water (% CC)	Weed	
	Absence	Presence
50	75.89a	78.90a
80	89.11a	69.30b

Nutrient (% dose)	Weed	
	Absence	Presence
25	107.46a	84.9b
20	63.30a	57.54a

*means followed by the same lowercase letter in the row do not differ ($p \leq 0.05$). Source: authors (2025).

At 60 days, when the highest water supply was combined with the presence of *P. maximum*, there was a 12.3 cm reduction in the height of passion fruit plants. In the factorial with the lowest nutrient dose, the presence of weeds resulted in a 9.4 cm reduction in plant height (Table 6).

Table 6. Average height values of yellow passion fruit plants 60 days after transplanting.

Water (% CC)	Weed	
	Absence	Presence
50	35.43a	31.26a
80	40.04a	27.66b

Nutrient (% dose)	Weed	
	Absence	Presence
25	44.89a	35.42b
200	27.67a	26.41a

*Averages followed by the same lowercase letter in the row do not differ ($p \leq 0.05$). Source: authors (2025).



The weed factor caused a significant difference in the variables fresh mass of aerial parts, dry mass of aerial parts, fresh mass of roots, and dry mass of roots. The variables fresh mass of aerial parts, dry mass of aerial parts, and dry mass of roots showed interaction between the weed x water x nutrient factors (Table 7).

Table 7. Summary of the analysis of variance using the F test for the variables: fresh mass of aerial parts (MFPA), dry mass of aerial parts (MSPA), fresh root mass (MFR), dry root mass (MSR), SPAD index.

Factors	F statistic				
	MFPA	DSAP	MFR	MSR	SPAD
Weed	26.93ns	29.92ns	57.73ns	153.68ns	0.25ns
Water	3.07ns	0.81ns	38.58ns	5.34ns	2.70ns
Nutrient	9.05ns	7.61ns	9.94ns	3.66ns	12.75ns
Weed x water	8.69ns	9.62ns	2.11ns	22.17ns	0.51ns
Weed x nutrient	3.48ns	0.05ns	9.45	3.48ns	0.33ns
Water x nutrient	10.77ns	18.48ns	37.66	22.57ns	0.56ns
Weed x water x nutrient	15.09	28.24	2.48ns	40.97	0.15ns
CV (%)	18.56	16.30	26.74	21.59	17.92

*Significant and ns not significant ($p \leq 0.05$). Source: authors (2025).

When combined with lower nutrient input, lower water supply (50% of field capacity), and the presence of weeds, the passion fruit plant accumulated 29.7 g less fresh mass in the aerial part. In treatments with higher nutrient input, higher water supply, and weed presence, this combination led to the passion fruit accumulating 37.8 g less fresh mass in the aerial part (Table 8).

Table 8. Mean values of fresh mass of the aerial part of yellow passion fruit plants 120 days after transplanting.

Nutrient (% dose)	Water (% CC)	Weeds	
		Presence	Absence
25	50	45.80b	75.58a
200	50	53.14a	66.22a
25	80	43.6a	66.4a
200	80	59.52b	97.35a

*Averages followed by the same lowercase letter in the row do not differ ($p \leq 0.05$). Source: authors (2025).

Regarding the variable dry mass of the aerial part, the combination of lower water supply and lower nutrient dose led to a reduction of 6.4 g in the passion fruit plant. In treatments combining higher nutrient supply and higher water supply, the presence of weeds caused a non-accumulation of 11.1 g in the dry mass of the aerial part (Table 9).



Table 9. Mean values of dry mass of the aerial part of yellow passion fruit plants 120 days after transplanting.

Nutrient (% dose)	Water (% CC)	Weeds	
		Presence	Absence
25	50	12.82b	19.26a
200	50	13.49a	16.07
25	80	11.85a	14.70a
200	80	13.46b	24.57a

*Averages followed by the same lowercase letter in the row do not differ ($p \leq 0.05$). Source: authors (2025).

The variable fresh root mass of passion fruit was influenced by the combination of higher water supply with higher nutrient dose, generating a difference of 20.7 g in relation to lower nutrient dose and higher water supply. In the combination of higher nutrient dose and lower water supply, there was no reduction in competition for nutrients, leading to a 6.6 g reduction in the passion fruit plant when compared to the lowest nutrient dose.

The presence of the weed *P. maximum* also influenced the fresh root mass of passion fruit plants. When there was a lower nutrient dose and the presence of weeds, there was a reduction of 23.8 g. And by increasing the nutrient dose, the presence of weeds continued to have an impact with a reduction of 10.1 g (Table 10).

Table 10. Average fresh root mass values of yellow passion fruit plants 120 days after transplanting.

Water (% CC)	Weeds	
	Absence	Presence
50	22.77a	16.12b
80	22.93b	43.66a
Nutrient (% dose)	Weed	
	Absence	Presence
25	10.95b	34.75a
200	24.84b	34.93a

*Averages followed by the same lowercase letter in the row do not differ ($p \leq 0.05$). Source: authors (2025).

The accumulation of dry mass in the roots of *P. edulis* was affected by the presence of weeds. In treatments with the lowest nutrient dose and lowest water supply, the presence of weeds led to a reduction of 4.1 g in the dry weight of the fruit tree roots.

Even with increased water supply and maintaining the lowest nutrient dose, the presence of weed competition led to a reduction of 3.2 g. With the elimination of water and nutrient limitations, the presence of weeds led to a reduction of 5.6 g in root dry weight.

The sharp reduction in the growth of *Passiflora edulis* when grown under higher nutrient supply and lower water dose (moisture maintained at 50% of field capacity) is closely related to how water availability can affect nutrient absorption, since, as is well known, most nutrients are transported in the soil solution by mass flow.

With the difference in pressure potential created by transpiration, water is conducted from the soil to the root zone of the plants, carrying mobile nutrients along with it in this process. With lower nutrient absorption by the roots, it also negatively influences the production of plant biomass, leading to a reduction in both the height and weight of the plants. This inference can be observed through the interaction between the weed x water x nutrient factors, which is significant at 120 days (Table 4).



In the coexistence of *P. edulis* with *Panicum maximum*, there was a significantly impactful reduction in all growth variables, evidencing the high aggressiveness of the competition imposed by this *Poaceae* on the fruit tree. Other studies have also evidenced the aggressiveness of *P. maximum* when grown together with the crop of interest.

Paula et al. (2018) in a study aimed at evaluating the initial competition exerted by *P. maximum* on sugarcane seedlings, noted that seedlings grown in the presence of the weed reduced the accumulation of dry matter in sugarcane by 38% and were more aggressive to sugarcane plants in their initial development because the weed accumulated more dry matter.

The nutrient factor was the one that most influenced the stem diameter variable, with statistical differences being observed 60, 90, and 120 days after transplanting the passion fruit seedlings. The presence of the weed factor had a significant influence only at 120 days (Table 11).

Table 11. Test of comparison of means for the weed, water, and nutrient factors in relation to the stem diameter variable

Factors		DAT			
		30	60	90	120
Weed	Presence	1.205a	4.26a	5.51a	6.46b
	Absence	1.205a	4.47a	5.83a	7.06a
Water	80% of CC	1.205a	4.39a	5.74a	6.79a
	50% of CC	1.205a	4.34a	5.61a	6.73a
Nutrients	200	1.25a	4.85a	6.68a	7.62a
	25	1.16a	3.88b	4.67b	5.91b

*Averages followed by the same lowercase letter in the column do not differ ($p \leq 0.05$). Source: authors (2025).

Very tall plants with smaller stem diameters are considered to be of inferior quality when compared to those with larger stem diameters, according to Sousa et al.(2011) . The higher nutrient input at 60 days resulted in an increase in the stem diameter of the passion fruit plant by 0.95 mm, i.e., an increase of 20%. However, at 90 days, this difference was even more striking, with a difference of 2.01 mm, or 32.1%, in stem diameter in plants fertilized with a higher dose of nutrients. At 120 days, the difference in plant stem diameter was 1.71 mm, a reduction of 22.4%, also demonstrating the effect of the higher dose of nutrients on the stem thickness of this fruit tree. According to Tarouco et al.(2009) , when studying the interference of weeds in the initial growth period of eucalyptus, they inferred that 90 days after transplanting the seedlings, the presence of *Panicum maximum* caused a 61% reduction in the stem diameter of these plants.

At 120 days, there was a significant difference in the stem diameter of passion fruit plants when weeds were present. The presence of weed competition had an impact on stem diameter reduction of around 0.6 mm.

The nitrogen content present in the leaves of *P. edulis* was lower in treatment 8 (absence of weeds, lower nutrient dose, and lower water supply), followed by treatment 3 (presence of weeds, lower nutrient dose, and higher water supply), showing that competition between passion fruit and weeds reduced the level of this nutrient in the fruit tree (Table 12). Moraes et al.(2011) evaluated potassium doses by drip irrigation on the nutritional status of passion fruit plants and observed leaf contents between 35.10 and 36.50 g kg⁻¹ of N, results similar to those found in the present study.



Table 12. Leaf contents of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S) in yellow passion fruit trees, depending on the treatment.

Treatment	N	P	K	Ca	Mg	S
	g kg ⁻¹					
T1	33.11	2.95	20.25	25.52	4.5	2.88
Q2	35.19	2.71	19.38	19.22	5.06	3.7
Q3	26.17	1.7	19.38	15.41	3.06	2.42
Q4	28.1	1.31	18.75	14.98	3.25	2.51
T5	38.89	2.71	20.88	25.83	5.31	2.6
T6	33.72	3.13	15.25	22.77	4.75	3.2
T7	27.61	1.95	18.75	19.9	3.56	1.8
T8	21.85	1.75	20.25	17.41	3.38	2.6

Source: authors (2025).

The phosphorus nutrient in treatment 4 (presence of weeds, lower nutrient dose, and lower water supply) obtained the lowest result with 1.31 g kg⁻¹. Treatments 3 (presence of weeds, lower nutrient dose, and higher water supply), treatment 7 (absence of weeds, lower nutrient dose, and higher water supply), and treatment 8 (absence of weeds, lower nutrient dose, and lower water supply) obtained low results with 1.7 g kg⁻¹, 1.95 g kg⁻¹ and 1.75 g kg⁻¹, respectively. Treatments 4 and 7 also had the lowest foliar concentration of potassium, with results of 18.75 g kg⁻¹ in both treatments.

As for calcium, treatments 3 and 4 had the lowest foliar accumulation, with results of 15.41 g kg⁻¹ and 14.98 g kg⁻¹ respectively. Treatment 3 also had the lowest magnesium content, with 3.06 g kg⁻¹, followed by treatments 4 with 3.25 g kg⁻¹, treatment 7 with 3.56 g kg⁻¹ and treatment 8 with 3.38 g kg⁻¹ of magnesium. Of the three factors tested in this study, only one differed statistically for the SPAD index variable (Table 13).

Table 13. Test of comparison of means for percentage of nutrient dose in the SPAD index variable .

25% of the ideal dose	200% of the ideal dose
29.13b	35.69a

*Averages followed by the same lowercase letter in the row do not differ ($p \leq 0.05$). Source: authors (2025).

The highest SPAD index occurred when passion fruit plants were fertilized with the highest dose of nutrients, reaching a difference of 6.56 between the lowest and highest doses. Evaluating the effect of nitrogen doses on the development of tall yellow passion fruit seedlings, Bertani et al. (2019) observed increasing SPAD index values related to the different doses of N applied, which proves the close relationship between the SPAD variable and the nutritional content of the plants, corroborating the results found in this study.

Conclusions

The reduction in the growth of *Passiflora edulis* was mainly caused by competition with *Panicum maximum*. This competition is even more unfavorable to passion fruit when combined with the factors of higher nutrient supply and lower water supply. *P. maximum* has a high competitive capacity against *P. edulis*.

The higher dose of nutrients does not reduce competition between *P. maximum* and *P. edulis*; the weed has a greater competitive advantage over the fruit tree.



In treatments where the passion fruit plant was subjected to weed competition, there was a reduction in foliar nutrient levels.

Treatment 5 (absence of weeds, higher nutrient dose, and higher water supply) obtained the best results in passion fruit tree development, highlighting the importance of proper weed management in this crop.

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