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# Effects of different levels of irrigation suppression and fertigation on potato yield

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## Abstract

With the limitation in the availability of water for agriculture and the high costs of fertilizers, it is necessary to adopt strategies for water and nutritional management of agricultural crops. The objective of this study was to evaluate the morphological and physiological characteristics and productivity of potato under the influence of suppression of irrigation and fertigation in Jaboticabal, SP, Brazil. The experiment was carried out in randomized blocks, conducted in the field, using a 3 x 2 factorial scheme. Different times of irrigation suppression were studied at 80, 90 and 100 days after planting, along with forms of fertigation, following the rate of crop absorption and equivalent fertigation. The imposition of irrigation suppression at 100 days, linked to fertigation following the rate of crop absorption, showed a positive effect on the aerial fresh mass of the potato variety studied, especially promoting the increase in productivity, which was 47.82 t ha$^{-1}$, and efficiency in water use, which was 10.53 kg of tubers per cubic meter of water. This observation indicates that the application of fertilizers, in sync with the needs of the crop, can improve the efficiency of water use and increase productivity. These findings highlight the importance of integrated strategies to optimize potato cultivation and make it more resistant to adversity, seeking a more sustainable and productive agriculture.

**Keywords:** drip irrigation, nutrition, *Solanum tuberosum,* water scarcity

## Introduction

In Brazil, potato production reached a total of 3,910,068 tons, according to FAO data (2023). Among the main producing states, Minas Gerais stands out contributing with 1,382,480 tons per year, followed by São Paulo with 817,250 tons per year and Paraná with 805,900 tons per year, representing, together, about 76.9% of the national production (IBGE, 2023).

The potato crop demonstrates a good response to fertilization, as indicated by Li et al. (2019), however, it is highly sensitive to water stress, especially during stages III (stolonization/tuberization) and IV (tuber growth). This sensitivity can have a negative impact on productivity and anticipate plant maturation, as pointed out by Carvalho et al. (2018). To maximize yield and obtain potatoes of desirable quality and size, it is essential to ensure a regular supply of water from tuber formation to near physiological maturity (Taiz & Zeiger, 2013).

Understanding how this vegetable responds to water restriction and fertilization is essential for growers, as it helps them adjust management practices according to weather and soil conditions. This information is also relevant for the development of new technologies and management practices, aiming to improve efficiency in the use of water and fertilizers.

In addition, studies indicate that soil water deficit could drastically affect plant growth and development on more than 50% of farmland by 2050, resulting in reduced crop yields globally (Hasanuzzaman et al., 2019). Therefore, it is urgent to seek sustainable strategies to deal with water stress in agriculture, including management approaches specific to potato crops.

In this approach, the suppression of irrigation is considered a viable strategy in potato production, especially in the face of water scarcity during the crop development cycle. This technique is the result of periods


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of drought, which can negatively affect plant growth, especially when they occur during the phase most sensitive to water stress (Martin-Vertedor et al., 2011).

The lack of studies on the suppression of irrigation in stages IV and V of potato plants highlights the need for more research to understand its safe and effective application in potato production. Other crops such as sugar cane (Vieira et al., 2013), tomatoes (Lopez et al., 2009; Koetz et al, 2010; Moreira et al., 2012), and coffee (Mera et al., 2011) have already been studied to support agronomic practices in this water management system. Irrigation suppression can be adapted to each crop, improving nutrient distribution during harvest and increasing plant uptake through fertigation.

Drip fertigation has been shown to be a promising technique for potato cultivation, allowing precise control of the amount of fertilizers applied and increasing the efficiency in the absorption of nutrients by the roots. Studies conducted by Viana et al. (2020) in Jaboticabal - SP, and Zhou et al. (2018) in Denmark, showed high tuber yields when they combined drip irrigation with fertigation. This efficient systems approach is relevant to guide the integrated potato (GDP) program.

Due to the growing concern with water resources and fertilizers, this study aimed to evaluate the morphology, physiology and potato yield under the influence of irrigation and fertigation suppression in Jaboticabal, São Paulo, Brazil.

**Material and Methods**

Description of the area, climate and soil

The experiment was conducted from June to September 2020, under field conditions, at the Teaching, Research and Extension Farm (FEPE) of the Faculty of Agricultural and Veterinary Sciences – FCAV, São Paulo State University - UNESP, Jaboticabal Campus, SP, Southeastern Brazil (latitude 21°15'22, longitude 48°18'58" and altitude 570 m).

According to the Köeppen classification, the climate of the region is of the Aw type, characterized by average annual precipitation of 1,425 mm, with average precipitation for the wettest month of 255 mm (December) and 25 mm for the driest month (July) (Magalhães et al., 2021).

The climatic data were obtained by means of the automatic agrometeorological station. The maximum and minimum temperature for the experimental period were 29.8 and 14.7 °C, respectively. The average daily radiation for the period was 17.2 MJ m2 day$^{-1}$. The average temperature recorded in the experimental period was 21.9 °C, considered adequate for the optimal range of potato development which is between 10 and 22 °C (Li et al, 2020) (**Figure 1**).

The soil characteristics in the 0-20 cm depth layer, sampled before the installation of the experiment, contained pH in CaCl of 5.9; 18 g kg$^{-1}$ organic matter; 51 mg dm$^{-3}$ of P; 3.1 mg dm$^{-3}$ of K; 28 mmolc dm$^{-3}$ of $Ca^{2+}$; 11 mmolc dm$^{-3}$ of $Mg^{2+;}$ 0.00 mmolc dm$^{-3}$ of exchangeable acidity ($Al^{3+}$); 18 mmolc dm$^{-3}$ of potential acidity ($H^{+}$ + $Al^{3+}$); 42.1 mmolc dm$^{-3}$ sum of bases; 59.8 mmolc dm$^{-3}$ of effective CTC and 59.8% saturation per base. According to the saturation index by base and following the recommendations of Raij et al. (1997), there was no need to apply limestone for soil correction.

*Treatments and experimental design*

The experimental design used in the trial was

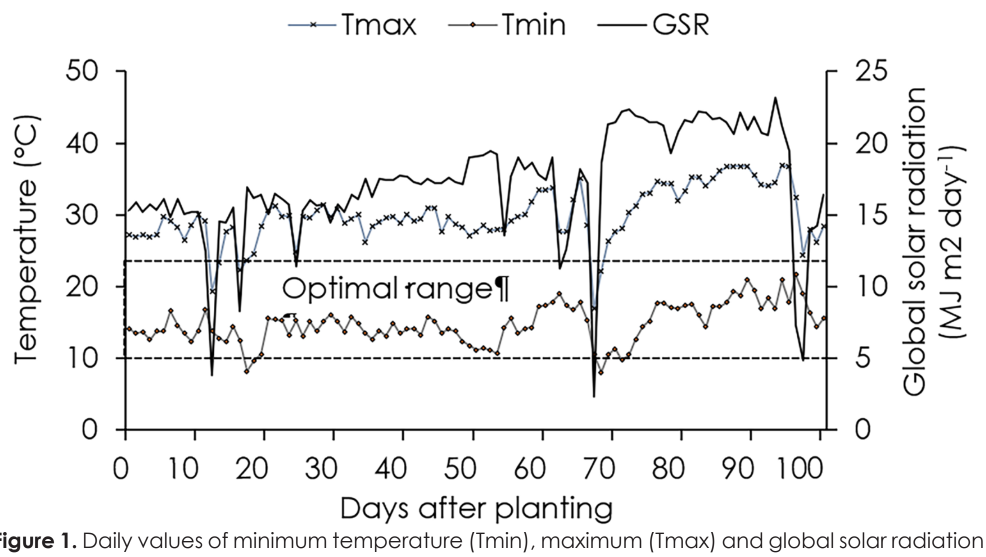


**Figure 1.** Daily values of minimum temperature (Tmin), maximum (Tmax) and global solar radiation (GSR) throughout the experimental period. Jaboticabal, SP, Brazil, 2020.

randomized blocks in a 3 x 2 factorial scheme, with 6 replications, and the treatments consisted of: three irrigation suppressions [(S1:80 days after planting, DAP), (S2:90 DAP) and (S3:100 DAP)]; and two levels of fertigation [(F1: Fertigation according to the rate of absorption by the crop) and (F2: equivalent fertigation: applying 50% at the beginning and 50% in the middle of each phenological stage of the culture of the fertilizer dose established for F1)].

*Crop management*

The area is historically cultivated with grains, quite uniform in relation to soil color and topography, in addition there are no records of soil spots. The preparation was initiated with the mechanical defragmentation of the cultural remains, followed by scarification, subsoiling and two grading gradations.

The test plant used was the potato, variety JB 2601, with high levels of dry matter and suitable for frying and chips. The seed tubers were planted on June 15, 2020, with groove spacing of 0.80 m and plant spacing of 0.30 m, at a depth of 0.15 m.

The plot was 9.6 m long (single row of cultivation) and 0.8 m wide, making a total area of 7,068 $m^2$. The useful area for data collection corresponded to 2.4 $m^2$ (10 plants).

With the results of the chemical analysis, fertility was corrected following Bulletin 100 (Raij et al., 1997), with application of 80 kg $ha^{-1}$ of N, 200 kg $ha^{-1}$ of $P_2O_5$ and 100 kg $ha^{-1}$ of $K_2O$ in all treatments. The emergence of tubers occurred at 17 days after planting (DAP).

The fertilizers applied in cover were performed via fertigation starting on the seventh day after the emergence of the tubers, in which the treatments under level F1 and F2 received 487.57 kg $ha^{-1}$of calcium nitrate + RNA and 117.65kg $ha^{-1}$of krista Sop (Viana et al., 2020) (**Table 1** and **2**).

The cultural and phytosanitary treatments were made with pre-emergent herbicide Metribuzin, 1.0L $ha^{-1}$ and 400 L $ha^{-1}$ of syrup, manual weedling heap at 35 days after planting, and application of fungicides and insecticides weekly.

*Irrigation management*

In the irrigation, the drip system with self-compensating emitters was used, with flow rate 1.0 L $h^{-1}$ and service pressure of 1.20 kgf.$cm^{-2}$. According to the test performed, Christiansen's coefficient was equal to 98.6%, following the methodology proposed by Gonçalves et al. (2017).

The determination of the total irrigation required

**Table 1.** Percentages of fertilizers applied according to the rate of absorption by the crop var. JB 2601. UNESP, Jaboticabal - SP, 2020

| Crop stage | DAE | Fertigation according to the rate of absorption by the crop | |
|---|---|---|---|
| | | Calcium Nitrate + RNA[a] (%) | Krista SOP[b] (%)[b] |
| Vegetative growth | 7 | 1.20 | 0.83 |
| | 14 | 1.21 | 0.84 |
| | 21 | 4.39 | 4.07 |
| | 28 | 6.40 | 6.10 |
| Tuberization | 35 | 8 | 11.87 |
| Tuber filling | 42 | 11.20 | 15.60 |
| | 49 | 20.40 | 30.52 |
| | 56 | 11.60 | 11.87 |
| | 63 | 10.80 | 6.11 |
| | 70 | 9.20 | 5.08 |
| | 77 | 7.60 | 4.06 |
| | 84 | 6.40 | 3.05 |
| Maturation | 87 | 1.60 | 0 |
| | 90 | 0 | 0 |

Calcium Nitrate + RNA (source de N 14.0%, Ca 18.5% and RNA 2%); b Krista SOP (source of K 51% and S 18%). DAE= Dyas after emergence. RNA = Amino Acid-Based Nutrient Release Additive. Viana et al. (2020).

**Table 2.** Percentages of fertilizers applied according to the Equivalent Fertigation of potato var. JB 2601. UNESP, Jaboticabal - SP, 2020

| Crop stage | DAE | Fertirrigation equivalent | |
|---|---|---|---|
| | | Nitrato de Cálcio + RNA[a] (%) | Krista SOP[b] (%) |
| Vegetative growth | 7 | 6.60 | 5.92 |
| | 19 | 6.60 | 5.92 |
| Tuberizacion | 29 | 4.00 | 5.94 |
| | 35 | 4.00 | 5.94 |
| Tuber filling | 42 | 21.60 | 28.99 |
| | 52 | 21.60 | 28.99 |
| | 63 | 17.00 | 9.15 |
| | 77 | 17.00 | 9.15 |
| Maturation | 91 | 0.80 | 0 |
| | 95 | 0.80 | 0 |

[a] Nitrato de Cálcio + RNA (fonte de N 14,0%, Ca 18,5% e RNA 2%); [b] Krista SOP (fonte de K 51% e S 18%). DAE= Dias após emergência. RNA = Aditivo de liberação de nutrientes baseados em aminoácidos. Viana et al. (2020).

(ITN) was estimated following the methodology proposed by Mantovani et al. (2009), which defines the replacement of the lost water depth as a function of crop evapotranspiration (ETc), calculated by the product between the reference evapotranspiration (ETo), the crop coefficient (Kc) and the correction factor (KL=0.85), divided by the efficiency of the irrigation system.

The climatological data used during the research were collected in an automatic meteorological station and subsidized the calculations of water balance. This uses the Penman-Montheit method, parameterized by FAO (Allen et al., 1998) in the estimation of reference evapotranspiration (ETo).

The estimate of the coefficients of the culture (Kc) was obtained by interpolation as a function of the phenological stages of the potato, being: Stage I (initial) – kc = 0.45-0.55 (0 to 17 days of duration); Stage

II (vegetative) - kc = 0.45-0.55 (18 to 35 days duration); Stage III (stolonization / tuberization) - kc = 0.75-0.85 (36 to 53 days duration); Stage IV (tuber growth) - kc = 1.00-1.10 (54 to 87 days duration) and Stage V (maturation) - kc = 0.65-0.75 with duration of the phenological stage of 87 to 100 days after planting (Marouelli & Guimarães, 2006).

The mean reference evapotranspiration (ETo) observed for the experimental period was 4.5 mm day$^{-1}$. The plants were submitted to a single water regime of 100% ETc, receiving 345.25 mm (S1); 410.75 mm (S2) and 452.55 mm (S3). Thus, the total depths (irrigation + precipitation) were 355.25 mm (S1), 421.05 mm (S2) and 473.15 mm (S3).

*Variables analyzed*

The variables analyzed were plant height (PH), number of stems (NS) and stolons (NST), stolon length (ST), fresh shoot mass (FSM), fresh root mass (FRM) and fresh tuber mass (FTM), evaluated at 45 days after emergence (DAE), in five plants per treatment. The PH was measured considering the base up to the last yolk of the apical meristem of the main stem, with the aid of a graduated ruler in cm. The variables NS and NST were determined by counting per plant. The ST was measured from the base of the stolon to the formation of the tubercle, using a graduated ruler in cm. The values of FSM, FRM and FTM were obtained with the aid of a precision balance of two decimal places, and this measurement was performed in the experimental area.

The canopy temperature was measured daily between 12h and 14h with the use of a portable infrared thermometer with a 30° angle of view, to calculate the degree of water stress (Gardner et al., 1981) (equation 01):

$$DDWS = DTPC - DAT \qquad \text{eq. 01}$$

where:

DDWS - Daily degree of water stress, ° C;

DTPC - Daily temperature of potato canopy, ° C;

DAT - Daily air temperature, °C.

The photochemical efficiency of photosystem 2 (PSII) was measured at 57 DAP, between 10:00 and 11:00h, using a modulated fluorometer model FMS$^{-2}$, Hansatech, King's Lynn, UK (Lichtenthaler et al., 2005), on the younger, fully expanded leaf of the second node below the apical bud. The environmental adaptation parameters evaluated were F0 (initial fluorescence), FM (maximum fluorescence) and FV/FM (maximum photochemical efficiency).

The measurements of total chlorophyll were performed before harvests, at 45 and 75 days after emergence (DAE), using a portable chlorophyllometer device of the brand ClorofiLOG,® model CFL 1030 (Falker Agricultural Automation®), which by means of sensors, analyzes two light frequency ranges and by the absorption ratios of different frequencies, provides measurements of the total chlorophyll content, expressed in dimensional units called LCI (Leaf Chlorophyll Index), considered in the research as TC (total chlorophyll) (Falker, 2008).

The relative content of water in the leaves (RCWL) was obtained according to the methodology proposed by Klar (1984) (equation 02), in which samples of 8 leaf discs with 0.6 cm in diameter were removed from the center of the leaf limb, being immediately weighed on an analytical balance for the measurement of fresh mass (FM). Afterwards, the samples were rehydrated in deionized water for 12 hours to obtain the turgid mass (TM), using a paper towel to extract the excess water. The dry mass (DM) was obtained after the discs remained in a forced air circulation oven at 80°C for 24 hours until the constant mass.

$$RCWL = \left[\frac{(FM - DM)}{TM-DM}\right] X\ 100 \qquad \text{eq.02}$$

Irrigation suppressions were performed at 80 days after planting (DAP), 90 DAP and 100 DAP. The samples were collected at 94 (S1), 104 (S2) and 114 (S3) DBH, fourteen days after each suppression, being the period necessary for fixation of the skin to the tuber, thus avoiding "skinning", being harvested the tubers of each plot and evaluated the characters: total productivity, tuber shape index and water use efficiency (WUE).

Yield was estimated based on the fresh mass of tubers obtained from 10 plants in 2.4 m$^2$ immediately after harvests between 7 a.m. and 11 a.m.

The tuber format index (TFI) was calculated using measurements of the longitudinal and transverse length of the tubers, using a digital caliper (Ortiz & Huaman, 1994) (equation 03).

$$TFI = \left(\frac{C}{L}\right) X\ 100 \qquad \text{eq. 03}$$

where,

C - longitudinal length of the tubercle, in mm;

L - transverse length of the tubercle, in mm.

The IFT classifies the tubers into: < 125 mm (round); 125 to 150 mm (oval) and> 150 mm (long). The water use efficiency (WUE), in kg m$^{-3}$, was calculated by the relationship between the production of tuber mass, in kg, and the volume of water applied in each irrigation suppression (Mantovani et al., 2014).

*Statistical analysis*

The experimental data were submitted to analysis of variance applying the F test, and when significant for qualitative variables, to Tukey's test, at 5% probability ($p<0.05$).

**Results and Discussion**

The interaction between the factors, IS x F, was significant for fresh root mass ($p<0.01$), productivity ($p<0.01$) and Water Use Efficiency ($p<0.01$). The parameters of plant height ($p<0.05$), number of stolons ($p<0.05$) and FV/FM ($p<0.05$) were influenced only by factor F (**Table 3**).

**Table 3.** Summary of the analysis of variance for the variables, plant height (PH), number of stems (NS), number of stolons (NST), stolon length (ST), fresh shoot mass (FMS), fresh root mass (FRM), fresh mass of tubers (FMT), total chlorophyll at 45 DAP (TC 45) and 75 DAP (TC 75), F0, FM, FV/FM, relative leaf water content (RLW), total yield (TY), tuber format index (TFI) and water use efficiency (WUE) for potato plants as a function of irrigation suppression (IS) and fertigation (F)

| Source of variation | Mean square | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PH | NS | NST | ST | FMS | FRM | FTM | TC 45 |
| IS | 0.85ns | 2.58ns | 0.37ns | 2.55ns | 13.52** | 2.47ns | 16.98** | 1.14ns |
| F | 4.25* | 0.61ns | 5.21* | 1.40ns | 2.46ns | 4.34* | 0.04ns | 0.41ns |
| IS x F | 0.36ns | 2.84ns | 1.01ns | 0.89ns | 3.06ns | 10.13** | 1.60ns | 0.29ns |
| CV (%) | 3.33 | 23.34 | 23.88 | 13.76 | 14.59 | 10.08 | 29.34 | 5.18 |
| Source of variation | Mean square | | | | | | | |
| | TC 75 | F0 | FM | FV/FM | RLM | TY | TFI | WUE |
| IS | 0.52ns | 0.11ns | 0.01ns | 0.25ns | 2.50ns | 32.61** | 1.59ns | 18.39** |
| F | 1.80ns | 0.46ns | 1.21ns | 7.81** | 0.35ns | 9.82** | 1.54ns | 4.52* |
| IS x F | 0.33ns | 1.31ns | 1.31ns | 1.86ns | 0.03ns | 16.00** | 2.72ns | 10.05** |
| CV (%) | 1.82 | 3.30 | 0.60 | 50.74 | 0.42 | 17.08 | 0.77 | 12.45 |

** e * significativos para 1% e 5% de probabilidade pelo teste F. respectivamente. ns não significativo.

In potato plants, only the isolated factor F had a significant effect on plant height ($p<0.01$), and the interaction between the factors, IS x F, was not significant ($p>0.05$). The application of fertilizers following F1 increased to the plant height, 46.67 cm, (**Figure 2**). These results are due to the water availability during the cycle in the treatments that presented adequate amount of nitrogen and supply of the requirements of this macronutrient in each phenological stage by the crop, which in addition to favoring transpiration, favored the evaporation of the soil that is accentuated in crops planted in line (Scalopi & Scardua, 1975), thus increasing the evapotranspiration of the crop. These results corroborate the reports of Oliveira (2000), in which potato when exposed to increased doses of N in the development of the crop, results in increased plant height.

The number of stolons had a significant effect only of the isolated factor F ($p<0.01$). In the presence of F3, the number of stolons was lower in 39.76%, 20.27 plant$^{-1}$ stolons, compared to F1, of 28.88 plant$^{-1}$ stolons, respectively. Thus, it is understood that the higher number of plant stolons for F1 (Figure 2), was due to the greater amount of axillary buds (horizontal growth), and the number of stolons is proportional to the numbers of buds (Abba, 2016), as well as the optimization of the use of fertilizers by the application of the required amounts of nutrients, N and K, in the different phenological phases of potato.

The potato variety JB 2601 presented higher value of fresh aerial mass for S3, 298.34 g plant$^{-1}$(Figure 2), which reflected in a higher fresh mass of tubers, since the photosynthetic area of the shoot is directly related to increased production of photoassimilates that culminate in the increase of tubers. This means that as water availability increases, potato better expresses the productive potential by increasing photosynthetic capacity. Similar results were found by other authors (Mantovani et al., 2013, Muchalack et al., 2014, Eid et al., 2017), corroborating the information that suppression of late irrigation has a positive effect on increasing the aerial fresh matter of the potato plant.

The mass of tubers of the JB 2601 variety was significantly higher, 28.57%, for S3 (565.07 g plant$^{-1}$) in relation to S1 (439.47 g plant$^{-1}$) (Figure 2). For this characteristic, it can be verified that the potato tree reached its maximum potential at 45 days after emergence (DAE), indicating that the prolongation of the cycle of this potato variety allows higher yield of tubers, opposing S1 treatment. Due to the importance in the development of the potato machine, the optimization of this parameter will increase the productivity of the potato (Mathan et al., 2016).

The use of fertigation contributed to the maximum quantum yield of PSII, estimated by the FV/FM ratio (Figure 2). The FV/FM ratio was higher in F1 (0.77) compared to F2(0.72) (Figure 2). This fact occurred because, in conditions of high temperature and low humidity there is a decrease in the photosynthetic activity of PSII (Ojeda-Pérez & Jeminy-Bremont, 2017). This result could indicate less severe damage to the PSII for the potato under F1, while the potato under the influence of equivalent fertigation had a more pronounced decrease in the FV/FM ratio, with a reduction of 7%.

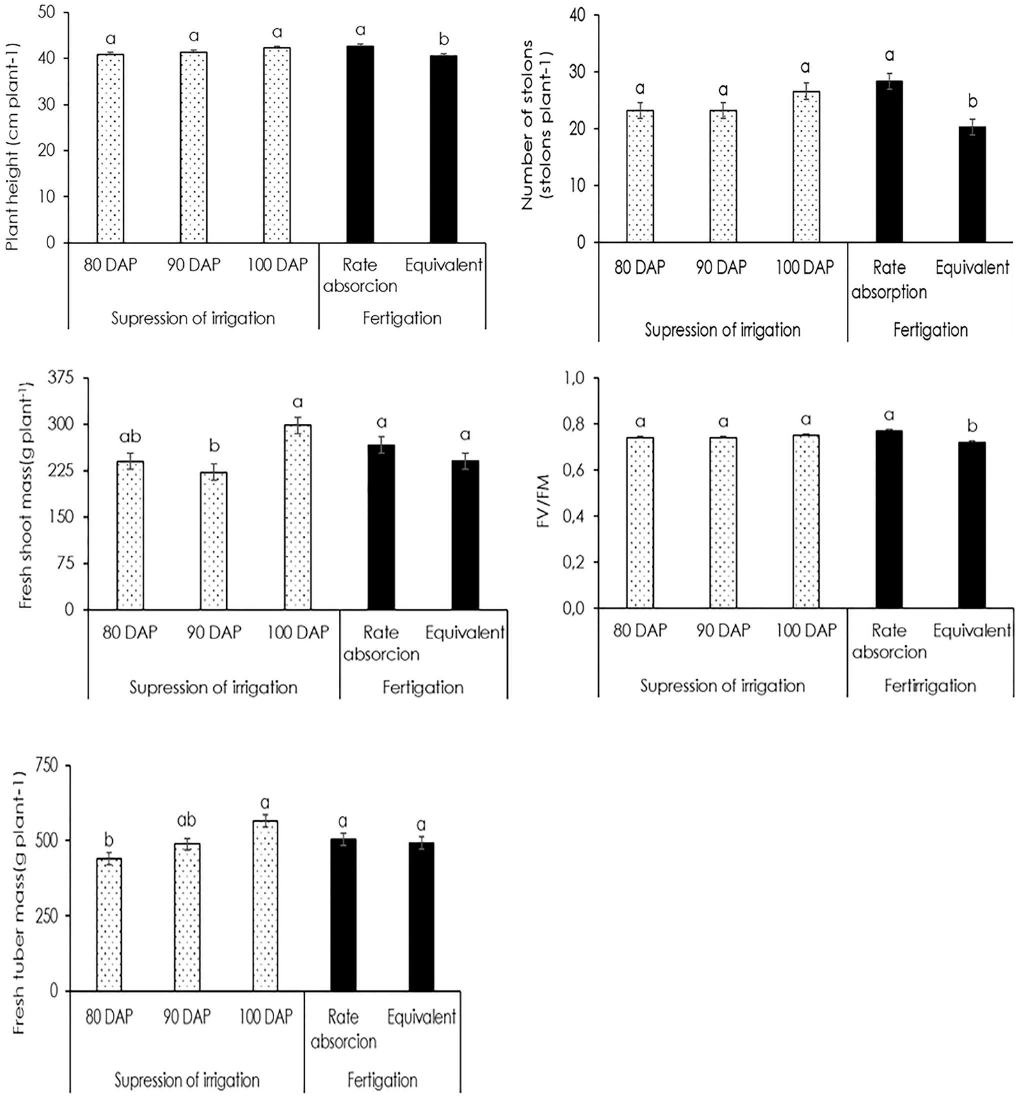


**Figure 2.** Mean values of plant height, number of stolons, fresh shoot mass, fresh mass of tubers and induction of chlorophyll fluorescence (FV/FM) in potato plants var. JB 2601 due to suppression of irrigation and fertigation. Jaboticabal – SP, 2020. Means followed by the same lowercase letters for irrigation suppression and fertigation do not differ by Tukey's test (p>0.05). The bars represent standard error of the mean.

The analysis of variance significant interaction (p<0.01) between IS and F for the variable fresh root mass (**Figure 3**), indicating that root development had already reached its peak at 45 DAE.

It is known that the phase of tuber formation usually occurs up to 40 days after planting and is directly related to the development of the root system, because in this phase the plant prioritizes the translocation and accumulation of nutrients, directing the photoassimilates produced in the shoot and investing in the growth of roots and tubers (Tavares, 2002).

According to the results obtained, the temperature difference between the plant and the air is a reliable indicator of the absence of water deficit during the potato development cycle, which reflected a variation in the degree of water stress from -1.90ºC to -22ºC (**Figure 4**). Such behavior is explained by the management of irrigation that provided water in the correct amount and at the right time, allowing the maintenance of the water endowment of the plant that converts into greater production of photoassimilates. These results corroborate those presented by Wang et al. (2010), in which potato under water deficit tends to increase leaf temperature, indicating the stress level of the plant that, correlated to other characteristics, can assist in irrigation decision making.

The yield of tubers of the potato variety JB 2601 was significantly affected by the interaction of IS x F factors (p<0.01) (**Figure 5**). Comparing the treatments in the SI, the average yield of tubers was 41.47% higher

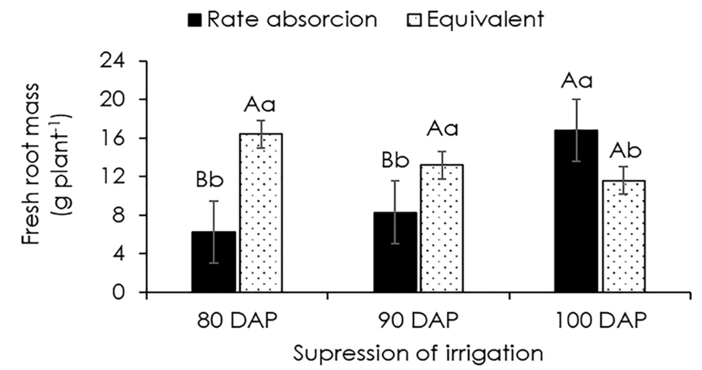


**Figure 3.** Average values of fresh root mass for potato plants var. JB 2601 due to suppression of irrigation and fertigation. Jaboticabal – SP, 2020. Lowercase letters show differences from fertigations, and uppercase letters from irrigation suppressions. The bars represent standard error of the mean.

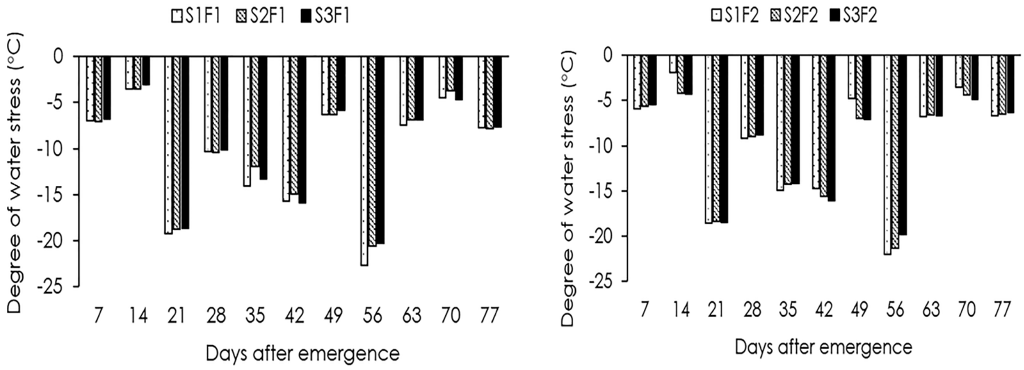


**Figure 4.** Mean values of degree of water stress for potato plants var. JB 2601 due to suppression of irrigation and fertigation. Jaboticabal – SP, 2020. S1F1: suppression of irrigation at 80 days after planting and fertigation following the rate of crop absorption; S2F1: suppression of irrigation at 90 days after planting and fertigation following the rate of crop absorption; S3F1: suppression of irrigation at 100 days after planting and fertigation following the rate of crop absorption. S1F2: suppression of irrigation at 80 days after planting and equivalent fertigation; S2F2: suppression of irrigation at 90 days after planting and equivalent fertigation; S3F2: suppression of irrigation at 100 days after planting and equivalent fertigation

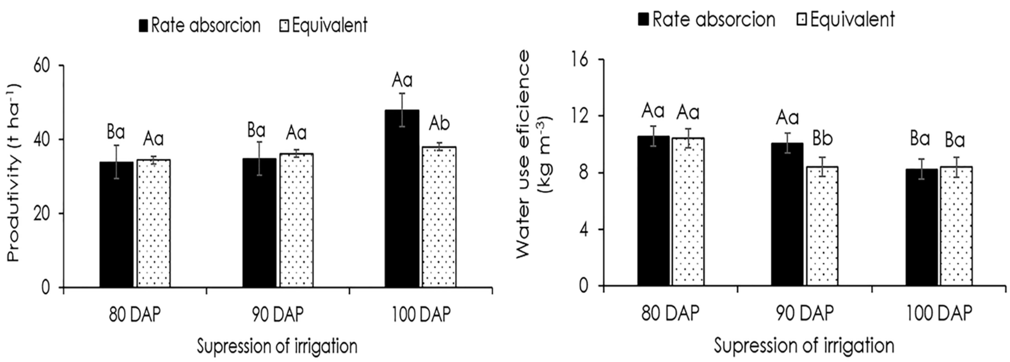


**Figure 5.** Average values of productivity and efficiency of water use for potato var. JB 2601 due to suppression of irrigation and fertigation. Jaboticabal – SP, 2020. Lowercase letters show differences from fertigations, and uppercase letters from irrigation suppressions. The bars represent standard error of the mean.

in S3F1 (47.82 t ha$^{-1}$) in relation to the same fertigation in S1 (33.80 t ha$^{-1}$) (Figure 5). This low productivity in the suppression of irrigation at 80 DAP may be related to the lower applied irrigation depth of 355.25 mm, variation in the amount of fertilizers, combined with high temperature and low precipitation, which affected the final yield of tubers. However, yield would not continue to increase or even decrease if fertilization exceeded a limit of 160 kg ha$^{-1}$ of N and 350 kg ha$^{-1}$ of $K_2O$ (Song et al., 2013, Wan et al., 2016, Yang et al., 2017, Zhou et al., 2018).

There was a trend of reduction in water use efficiency values (WUE) with the increase in IS (Figure 5). S3 was the one that provided the lowest WUE for fertigation F1 (8.38 kg $m^{-3}$) and F2 (8.33 kg $m^{-3}$), corroborating the results obtained by Song et al.(2013) et al. (2013), Gao (2017) and Yang et al. (2017), which indicate lower potato WUE due to the greater supply of water in the soil.

The reduction in WUE, in this study, is related to higher productivity and applied irrigation depth, linked to the precipitation of 20.6 mm that occurred during the 100 days of cultivation. Higher mean values of WUE, observed for S1 for both F, are justified because plants grown with lower volume of water required for their metabolic functions, develop deeper and denser root systems to exploit groundwater, becoming more adapted to water scarcity conditions (Taiz, 2017). The same behavior was observed by Fernándes (2008) and Muchalack et al. (2014) when analyzing the USA of the potato for drip irrigation depths in Santa Maria – RS and Chapadão do Sul – MS, respectively.

**Conclusion**

In the edaphoclimatic conditions of the present study, the suppression of irrigation at 100 DAP and fertigation following the rate of absorption of the crop allowed the obtainment of 47.82 t $ha^{-1}$ of tubers of the JB 2601 variety, in the region of Jaboticabal, SP. In the treatment suppression of irrigation at 80 DAP and fertigated according to the rate of absorption of the crop and equivalent, there was maximum Efficiency of Water Use with 10.56 and 10.53 kg $m^{-3}$.

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