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WATER LEVELS DEPLETION IN SUBSTRATE IN THE DEVELOPMENT OF *Heliconia psittacorum* L. F. CV. RED OPAL

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1 ABSTRACT

Flowers and ornamental plants cultivation in Brazil has grown over the years as economic activity. Pernambuco state is one of the major producers and exporters of *Heliconia sp*, a highlighting tropical flower in Brazil. However, detailed information regarding to the irrigation needed especially in semiarid conditions has been little studied. The objective was to evaluate different levels of water depletion in the substrate as indicators of irrigation time and its effects on growth and productivity of *Heliconia psittacorum* L.f. cv. Red Opal in pots. The experiment was conducted in a greenhouse covered with 50% shade cloth located at the Agricultural Sciences Campus in the Federal University of Vale do São Francisco in Petrolina, PE, Brazil. This is a semiarid region in Brazil where irrigation is necessary for the production of most crops. The experimental design was completely randomized, with six levels of water depletion in the substrate and five repetitions. The determination of the depletion level was performed by means of weighing lysimeters. The following parameters were evaluated: plants water consumption, the amount of macro and micronutrients applied and the number of tillers emitted. It was concluded that the water depletion level at 5% on the weight capacity of container allowed the increase in the number of tillers. However, the management of the crop under tiller free growth conditions inhibited the emission of floral stems from this crop, when grown in pots. The efficient use of water in semi-arid climate is a requirement for the sustainability and reduction of production cost.

Keywords: tropical flowers, irrigation, intensive cultivation, lysimeters

GERVÁSIO, E.S.; ISHIKAWA, F.H.; SILVA, V.D.; MELO JÚNIOR, J.C.F. EFFECT OF WATER LEVELS DEPLETION IN SUBSTRATE IN THE DEVELOPMENT OF H*eliconia psittacorum* L. F. CV. RED OPAL GROWN IN POTS

2 RESUMO

O cultivo de flores e plantas ornamentais no Brasil como atividade econômica tem crescido ao longo dos anos. O estado de Pernambuco é um dos principais produtores e exportadores de Heliconia sp, flor tropical que tem se destacado no Brasil. No entanto, informações detalhadas sobre a irrigação necessária, especialmente em condições semiáridas, ainda foi pouco estudada.

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O objetivo do presente trabalho foi avaliar diferentes níveis de depleção de água no substrato como indicadores de tempo de irrigação e seus efeitos sobre o crescimento e produtividade de Heliconia psittacorum L.f. cv. Red Opal cultivadas em vasos. O experimento foi conduzido em casa de vegetação revestida com tela de sombreamento de 50%, localizada no Campus de Ciências Agrárias da Universidade Federal do Vale do São Francisco, em Petrolina, PE, Brasil. Esta é uma região semiárida, onde a irrigação é necessária para a produção da maioria das culturas. O delineamento experimental foi inteiramente casualizado, com seis níveis de depleção de água no substrato e cinco repetições. A determinação do nível de depleção foi realizada por meio da utilização de lisímetros de pesagem. Foram avaliados os seguintes parâmetros: consumo de água das plantas, a quantidade de macro e micronutrientes aplicados e o número de perfilhos emitidos. Concluiu-se que o nível de depleção de água no substrato de 5% em relação à capacidade de container permitiu o aumento do número de perfilhos. No entanto, o manejo da cultura sob condições de livre crescimento de perfilhos inibiu a emissão de hastes florais dessa cultivar, quando cultivada em vaso. O uso eficiente da água em clima semiárido é um requisito para a sustentabilidade e redução do custo de produção.

Palavras-chave: flores tropicais, irrigação, cultivo intensivo, lisímetro

3 INTRODUCTION

Flowers and ornamental plants cultivation in Brazil has grown over the years as economic activity, with increasing emphasis in the Agribusiness (GONDIM, 2004). Tropical flowers production has increasing in higher temperatures, like temperate flowers that were previously imported from other milder climate regions and currently have greater local production (PAULINO et. al., 2013).

For cut flowers in general (including lilies, *Gerbera*, A*nthurium*, *Lisitantus*, *Celosias* and tropical flowers), the main importers destinations were the United States (38.74%), the Netherlands (36.42%), Portugal (13.77%), Chile (5.66%) and Canada (4.29%), followed by Angola, Germany, Bolivia, Cape Verde and Italy (JUNQUEIRA and PEETZ, 2010).

Heliconia cultivation in Brazil is performed mainly in the states of Pernambuco, Alagoas, Ceará, Bahia, Sergipe, Pará, Amazonas and Rio de Janeiro. The first three states were in the top as the main exporters of this flower. Regarding tropical flowers, Pernambuco stands out as one of the largest producers of *Heliconia* (*Heliconia spp.*) and presented increase in planted area and exportation in the last years (JUNQUEIRA and PEETZ, 2002).

Among *Heliconia* species, cultivars and hybrids of *H. psittacorum* L.F. are highlighted because they produce over the year, having terminal inflorescences, erect, with varying number and different colors bracts. Regarding to the suitability as cut flowers, inflorescences light, with bracts arranged in the same plane, facilitating packaging in boxes (LOGES et al., 2005). Work on the cultivation of potted *Heliconia* is still scarce in the national and international literature. Santos et al. (2012) evaluated the growth and nutritional status of Golden Adrian *Heliconia* irrigated with treated domestic wastewater using 20-liter pots and did not observe floral stem emission even after nine months of cultivation. Similar results were observed by Melo et al. (2002) in an experiment with 19 genotypes (species and cultivars) of *Heliconia* grown in pot and under conditions of free tillering even after 250 days of cultivation. According to Costa et al. (2007), the emission of floral stems should occur after 200 days of cultivation. Therefore, the results achieved were little satisfactory for the emission of floral stems.

Aspects related to the management of *Heliconia* irrigation are still scarce and restricted to field cultivation conditions (GONDIM, 2004). According to Lemaire et al. (1989), irrigation of crops in containers has the following features when compared to crops in soil: i) Instant high water requirements per unit of root mass; ii) reduced volume of substrate available to plant; iii) existence of an impermeable wall on the base of substrate; and iv) the relative importance of advection phenomena. These particularities involve risk of water stress, which must be prevented with higher control of irrigation.

The weighing lysimeters could be a good alternative to monitor the water consumption of the plants grown in containers. Aboukhaled, Alfaro & Smith (1982) and Howell, Schneider & Jensen (1991) consider the weighing lysimeters as the best equipment available to accurately measure the potential evapotranspiration of crops, as well as for calibration of models. According to Milner (2002), the weighing of containers was an excellent alternative for the management of irrigation substrates, allowing the determination of in situ of water consumption throughout the day. With continuous weighing data, it can be determined by experiments a weight that represent the time of irrigation. When certain weight is achieved, the irrigation system is triggered. Depending on substrate, container size and crop, it is possible to determine the correct time to start watering the plants in order to provide ideal conditions of moisture in the substrate for its full development. The weighing method still allows irrigation handle substrates using a factor called leaching rate. It is the percentage of water applied to the container in order to prevent accumulation of salts in the system. This percentage can be defined experimentally based on the value related to the container capacity. Therefore, we aimed to use the weight lysimeters for determination of levels of water depletion in the substrate and thereby allow defining the irrigation time of *Heliconia sp* grown in pots.

4 MATERIAL AND METHODS

4.1 Location and installation

The experiment was located at Agricultural Sciences Campus at Federal University of Vale do São Francisco (UNIVASF) in Petrolina, PE, Brazil (40.406256 W and 9.515603 S). This is a semiarid climate region with average monthly of maximum and minimum temperatures of 34.0 ºC and 22.1°C, respectively, and annual average rainfall of 549 mm.year^{-1}(Teixeira, 2010). The experiment was installed in a greenhouse with the following characteristics: 12 m long, 6 m wide, 2.5 m right foot, side cladding and covering with shade cloth 50%.

4.2 Cultivation and substrate properties

*Heliconia psittacorum L.*f. cv. Red Opal was used and rhizomes were planted in pots of 21.5 liters (37.5 cm diameter and 20 cm height). Pots were spaced 0.5 m between line and 0.85 m between rows measured from the center of the pot. Substrate used was coconut shell powder with the physical, hydrical and chemical properties presented in Table 1. Each pot was filled with 2 liters of gravel in order to improve drainage. Then the gravel was covered with geotextile blanket and finally completed the volume with the substrate. The final weight was 2.31 kg.

Table 1. Physical, hydrical and chemical properties of coconut shell powder used as substrate.

Physico-hydrical properties

Density (kg m^{-3})	73.29
Porosity (%)	73.53
Rate of thickness (%)	45.22
Aeration Capacity (m^3 m^{-3})	0.20
Easily available water (m^3 m^{-3})	0.17
Water reserve (m^3 m^{-3})	0.04
Water available (m^3 m^{-3})	0.21
Water not available (m^3 m^{-3})	0.33
Chemical properties	
EC $_{(1v:1v)*}$ (dS m^{-1})	7.93
EC $_{(2v:1v)}$ (dS m^{-1})	4.15
pH $_{(1v:1v)}$	5.52
pH $_{(2v:1v)}$	5.68
Chemical species	(mg L^{-1})
N - NO_3^-	< 2.00
Cl^-	978.00
SO_4^{2-}	< 1.00
P	18.79
K^+	1079.16
Na^+	107.55
Ca^{2+}	4.65
Mg^{2+}	12.52
Ba^{2+}	0.04
Fe	0.54
Al	0.62
Mn	0.07
Zn	0.05
Cu	0.05
B	0.28

* v:v = m^3 H_2O: m^3 substrate

According to Table 1, it was observed that the coconut shell powder had high concentrations of sodium and potassium, which contributes to increase the salinity.

Therefore, it was necessary to wash the material through successive watering in order to leach out the excess of ions present in the substrate. Six washes were performed by adding a volume of 10 liters of water for each pot. Therefore, it was possible to lower the salinity of the substrate from an initial value of 7.93 dS m^{-1} to a final value of 0.37 dS m^{-1}, a value appropriate to start the experiment.

4.3 Experimental design and installation

We used a completely randomized design with six treatments and five replications. Treatments were depletion levels of water in the substrate, which means, percentage of water consumption relative to the weight capacity of container (WCC) (5%, 10%, 15%, 20%, 25% and 30% of WCC).

WCC is the weight of container containing moist substrate. After it has been saturated with water and drained by gravity to reach equilibrium. The capacity of container was determined using six pots monitored by weighing lysimeters. In these pots were installed drains hose with a register at the end. When the registers were closed the pots were filled with water up to saturation of the substrate. After saturation, the pots were covered with plastic to prevent loss of water by evaporation and the registers were opened allowing free drainage. At the end of draining, the six pots were weighed to give an average weight of 15.85 kg, considered as the WCC. This weight was applied to the water depletion levels, then obtaining their respective critical weights (CW), indicators of each moment of irrigation according to the treatment.

A total of 96 pots with a capacity of 20 liters were used, six were monitoring in the weighing lysimeters, 60 pots distributed in 30 plots (two containers per plot) and 30 in the borders. Rhizomes of *Heliconia psittacorum* L. f . cv. Red Opal were planting on June 6th 2011. After that the rhizomes were irrigated daily and treatment was carried out by weighing lysimeters. The six lysimeters were programmed to trigger irrigation when the weight of the containers reached equivalent to 5% consumption of WCC. This procedure was carried out until the beginning of shoots (emission of the first tiller) on September 2nd 2011, characterizing the beginning of the experiment. From this moment, the six weighing lysimeters were reprogrammed to monitor irrigation as their treatments. Detailed information about irrigation system used in this experiment was described by Gervásio and Melo Júnior (2014).

After 30 days planting (DAP), the continuous fertirrigation using soluble fertilizer (macro and micronutrients) in the formulation 19-07-16 (Maxsol® MX-19) has started. At 120 DAP formulations of 20-05-20 (Maxsol® MX-07) and 10-14-28 (Maxsol® MX-01) were used alternately. A fertilizer solution was prepared by adding the fertilizer in a water tank of 500 liters, keeping the electric conductivity between 0.7 and 0.9 dS m^{-1}. At 45 DAP it was applied Algamax (Maxsol® AG-04) at a dose of 10 g pot^{-1} by repeating the application every two months.

4.4 Estimates and statistical analysis

To estimate the total dissolved solid present in the fertilizer solution the adapted equation of Rhoades, Kandiah & Mashali (1992) was used:

$$TDS = 640\,(ECs - ECw) \qquad (1)$$

where:
TDS = total dissolved solids (mg L^{-1});
ECs = electrical conductivity of the fertilizer solution (dS m^{-1});
ECw = electrical conductivity of irrigation water (dS m^{-1}).

By estimating the total dissolved solids and the percentage of each nutrient in the fertilizer formulation, it was possible to estimate the amount of each nutrient applied to container, at each level of water depletion evaluated.

In order to determine the amount of water and nutrients applied per treatment, the hydrometer was read daily. Meteorological variables were monitored by an automated weather station installed inside the greenhouse. By obtaining the values of daily mean air temperature and considering the lower basal temperature of 10 °C for *Heliconia*, we calculated the degree-day (DD) and the degree-days of development (DDD) through the following equations:

$$DD = T_M - T_B \qquad (2)$$

$$DDD = \sum_{i=1}^{DAP} DD_i \qquad (3)$$

where:
DD = degree-days (^{o}C);
T_M = mean air temperature (^{o}C);
T_B = lower basal temperature (^{o}C);
DDD = degree-days of development (^{o}C);
DAP = days after planting.

For crop management, there was free emission of tillers in each pot, which were counted every 15 days by noting the gain for the period. There was no need of phytosanitary control during the experimental period, because no pests and diseases were observed. Data were subjected to analysis of variance and means were compared by Scott-Knot at 5% probability.

5 RESULTS AND DISCUSSION

5.1 Meteorological data

Heliconia originated in regions of tropical and subtropical climates showed some requirements in relation to climatic factors. Monthly meteorological data obtained during the experiment are shown in Table 2.

Table 2. Meteorological data obtained from the automatic meteorological station installed inside the greenhouse.

Month	Temperature (ºC)			Relative Humidity (%)	Rainfall (mm)	Wind speed ($m\ s^{-1}$)		Wind direction[1]
	Max	Avg	Min			Avg	Max	
June/11	34.7	24.5	15.8	66.4	0.0	0.7	6.7	SSE
July/11	34.0	24.2	15.5	64.0	3.6	0.8	6.7	SE
Aug./11	35.1	25.3	16.3	59.4	0.2	0.8	6.7	SE
Sept./11	35.2	25.7	16.4	56.3	0.0	1.1	7.6	SE
Oct./11	36.6	27.5	19.3	58.9	16.4	0.7	6.3	SE
Nov./11	37.7	27.8	19.7	58.7	6.0	0.8	7.2	SE
Dec./11	38.6	28.6	20.1	56.9	18.8	0.6	7.2	SSE
Jan./12	37.7	28.7	21.6	52.3	13.0	0.7	8.0	SSE
Feb./12	37.2	27.0	19.8	63.9	81.6	0.6	7.6	SSE
Mar./12	38.3	28.3	19.1	55.4	0.6	0.6	7.6	SSE
Apr./12	37.5	28.1	16.8	54.4	1.0	0.7	6.3	SSE
May/12	35.8	26.7	18.5	60.5	0.0	0.9	7.2	SSE
June/12	35.0	25.7	16.8	61.9	2.2	0.7	6.7	SSE
July/12	34.2	24.3	16.1	64.6	0.6	0.8	8.0	SSE
Aug./12	34.9	24.3	14.7	61.2	0.2	1.1	7.2	SSE
Sept./12	38.1	26.2	16.0	55.0	0.0	0.9	7.2	SSE
Oct./12	38.2	27.8	19.4	53.3	0.0	0.8	7.6	SE

[1] SSE - south southeast; SE - southeast

Regarding to the air temperature, values are within the limits reported by Castro (1995) who reported the ideal air temperature range to produce *Heliconia* was between 21° and 35 ° C. When higher air temperature higher is the production and faster the plant development. Lamas (2002) mentioned that the range of air temperature for growing *Heliconia* is between 14 and 34 ° C, however, the ideal is the average night temperature of 21º C and 26º C daytime. In the case of tropical species, *Heliconias* are demanding in water and environments with high relative humidity (RH). Therefore, these conditions are essential to the development and production of *Heliconia*, with the relative humidity situated mostly between 60 and 80% (LAMAS, 2002) and annual precipitation situated in the range from 1100 and 3200 mm (MONTEIRO, 2007). The use of irrigation to supply water deficit of the plant is required since rainfall in the municipality of Petrolina is below the stated range for the production of *Heliconia*.

5.2 Depletion levels

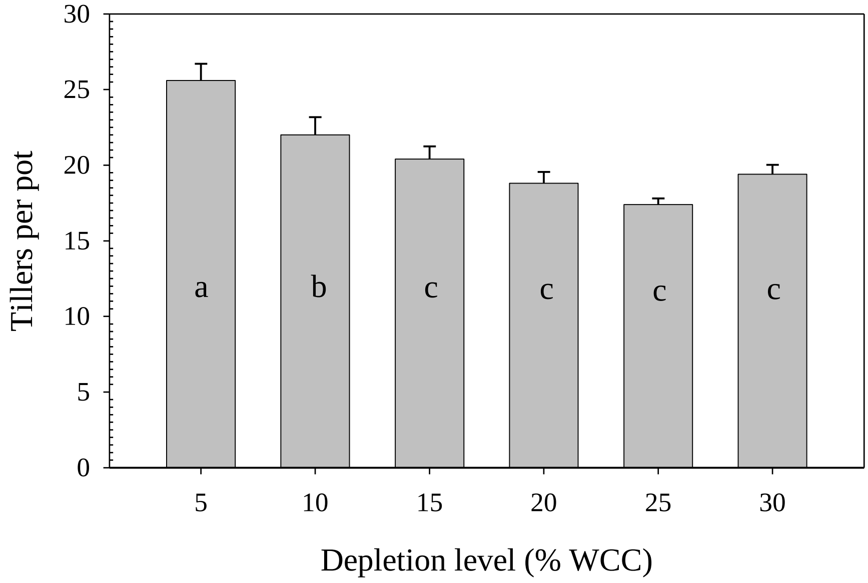
The plant response to soil water potential has been studied as a way to control irrigation, as deficit irrigation directly reflects in reduced productivity, while excessive irrigation affects the quality of the crop. Depletion levels studied in this work reflected different values of moisture in the substrate and indicated the moment of irrigation.

By Table 3, it was found that plants under level equivalent to 5% of WCC depletion received the largest volume of water per pot (803.37 liters). This treatment allowed a higher frequency of irrigation, keeping the substrate moisture close to the capacity of container. Furthermore, as fertirrigation was taken continuously, plants of this treatment also received higher amounts of macro and micronutrients quantified at 509 DAP. In these conditions, the plants had water for their full development. For *Heliconia*, this level of depletion (5%) allowed an increase in the numbers of shoots when compared to other levels of depletion studied (Figure 1), in other words, the maintenance of substrate moisture close to the capacity of container is a condition required in the management of *Heliconias* grown in pots.

Table 3. Volume of water, macro and micronutrients applied per pot at 509 DAP at each level of depletion measured.

Fertirrigation Data	Water depletion level in substrate (% WCC)					
	5	10	15	20	25	30
Water applied (L pot^{-1})	803.37	677.87	579.52	561.11	536.28	547.25
N (g pot^{-1})	64.82	53.78	55.16	44.56	42.83	45.03
P_2O_5 (g pot^{-1})	35.96	30.49	25.66	24.63	22.93	24.52
K_2O (g pot^{-1})	98.85	83.98	70.09	67.47	62.20	67.15
Mg (g pot^{-1})	3.75	3.17	2.71	2.59	2.46	2.58
S (g pot^{-1})	7.63	6.23	6.15	5.60	6.21	5.61
Zn (g pot^{-1})	0.375	0.317	0.271	0.259	0.246	0.258
Mn (g pot^{-1})	0.187	0.158	0.136	0.129	0.123	0.129
B (g pot^{-1})	0.112	0.095	0.081	0.078	0.074	0.077
Mo (g pot^{-1})	0.019	0.016	0.014	0.013	0.012	0.013

Figure 1. Number of tillers per pot at each water depletion level in substrate.



Means followed by same letter do not differ statistically by Scott-Knot test at the 5% level of probability.

To keep the moist substrate met the statement of Lemaire et al. (1989), in which the crops in pots had high instant needs of water per unit of root mass. Castro (1995) also suggested that irrigation made in abundance, particularly after the emission leaves, keeps the high water content of the soil. It was found that when lower interval of irrigation higher numbers of shoots per treatment were (Table 4).

Table 4. Frequency of irrigation and number of tillers (NS) at each water depletion level in substrate.

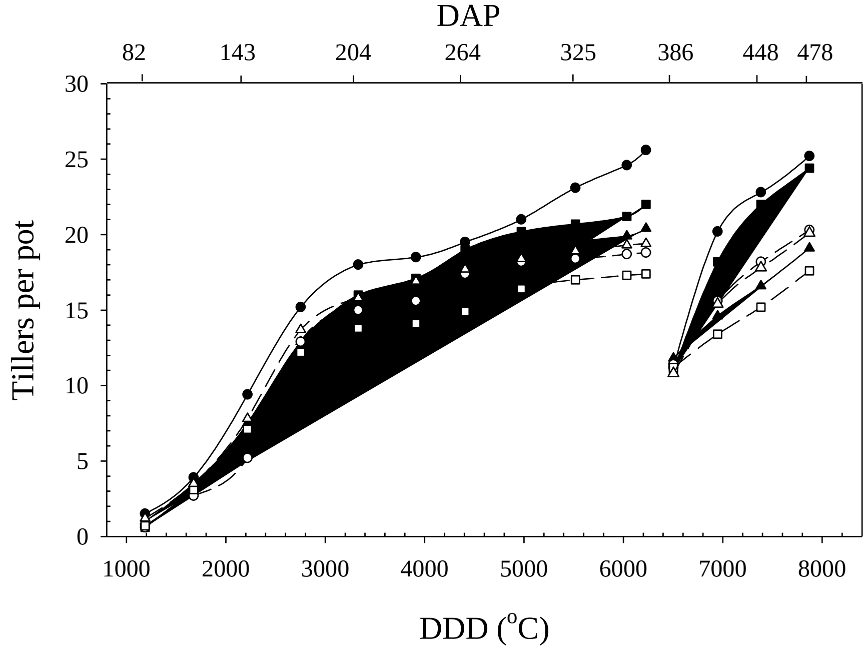
Month	Frequency of irrigation (day)						Number of tillers[1]					
	5%	10%	15%	20%	25%	30%	5%	10%	15%	20%	25%	30%
June/11 (1 - 20 DAP)	1.65	1.61	1.61	1.71	1.61	1.68	---	---	---	---	---	---
July/11 (21 - 51 DAP)	1.06	1.09	1.19	1.23	1.00	1.34	---	---	---	---	---	---
Aug./11 (51 - 82 DAP)	1.01	1.19	1.06	1.33	1.28	1.35	1.50	0.60	1.00	0.60	0.70	1.20
Sept./11 (83 - 112 DAP)	0.75	2.19	2.62	5.25	4.37	6.13	2.40	2.40	2.50	2.10	2.40	2.30
Oct./11 (113 - 143 DAP)	0.49	1.52	1.66	2.10	2.92	4.38	5.50	3.00	4.00	2.50	4.00	4.30
Nov./11 (144 - 173 DAP)	0.33	0.89	1.26	1.41	2.56	3.26	5.80	6.30	5.40	7.70	5.10	5.90
Dec./11 (174 - 204 DAP)	0.35	0.86	1.52	2.10	4.08	4.38	2.80	3.70	2.90	2.10	1.60	2.10
Jan./12 (205 - 235 DAP)	0.43	1.03	2.15	2.92	4.20	5.37	0.50	1.10	0.90	0.60	0.30	1.10
Feb./12 (236 - 264 DAP)	0.86	2.41	5.69	5.44	5.25	7.00	1.00	1.90	0.70	1.80	0.80	0.80
Mar./12 (265 - 295 DAP)	0.60	1.28	2.04	4.08	4.38	6.13	1.50	1.20	1.10	0.80	1.50	0.70
Apr./12 (296 - 325 DAP)	0.79	1.90	3.50	6.13	7.00	7.00	2.10	0.50	1.00	0.20	0.60	0.50
May/12 (326 - 356 DAP)	0.57	1.38	2.21	4.67	5.60	6.30	1.50	0.50	0.40	0.30	0.30	0.40
June/12 (357 - 386 DAP)	0.50	1.48	2.19	2.92	4.38	4.38	1.00	0.80	0.50	0.10	0.10	0.10
July/12 (387 - 417 DAP)	0.42	1.09	1.75	2.33	3.21	4.38	---	---	---	---	---	---

[1] Average of ten pots.

In November 2011 it was obtained the shorter interval of irrigation and greater numbers of shoots. This interval of irrigation varies according to climatic conditions. Therefore, in higher temperature there was shorter interval irrigation. Whereas in the months that there was precipitation or lower air temperature greatest intervals were observed, due the evaporation was lower in those months reducing the water demand for the plants development.

The emission of tillers throughout the experimental period is shown in Figure 2. It was observed that up to 112 DAP (1674.5 DDD), almost all plants, regardless of the level of water depletion in the substrate, had the same growth rate. At that stage, the plants from tillering were present in smaller and substrate moisture was able to meet the evapotranspiration. From this stage it was found that plants under to the level equivalent to 5% water depletion of the WCC presented differentiated growth. As previously shown, the highest frequency of irrigation has enabled the maintenance of substrate moisture at high levels. Under these conditions, there is no restriction of water for the plant allowing the same to evapotranspirate in its potential. Plants growing more, consume more water and nutrients, which explains the results shown in Tables 3 and 4 and Figure 1.

Figure 2. Number of tillers per pot issued throughout the experimental period at each water level depletion in substrate.



The rate of growth was marked up to 173 DAP (2751.9 DDD). From that time, it was noticed a reduction in the growth rate in all plants, regardless of the level of water in the substrate depletion. This reduction is characterized by the inflection points of the growth curves observed at 204 DAP (Figure 2). This stage is illustrated by Figure 3 (c), where notable overlap of leaves between plants in adjacent pots was observed. At this moment, a competition between plants for light, depending on the spacing used. According Argôlo (2009), solar radiation directly influences the metabolic processes that determine the growth and yield of *Heliconias*. Each specie has different needs of light to flower, but generally prefers full sunshine or partial shade. The inflorescence production in *Heliconia* can reduce significantly by decreasing brightness.

Figure 3. Development of *Heliconia psittacorum* L.f. cv. Red Opal throughout the experimental period. (a) Planting 06/13/2011; (b) stage of development to 119 DAP; (c) stage of development to 154 DAP; (d) stage of development to 230 DAP.

(c)

(d)

It was found at 230 DAP (3815.7 DDD) (Figure 3d) that plants were densely with clear narrowing of leaves. This may be caused by the free growth of tillers in the pot. Considering the experiment, the issuing of tillers began at 30 DAP and according to Costa et al. (2007), the beginning of the flowering of Red Opal cultivar occurred180 days after the issuance of tiller, on average. It was expected that in this experiment, the inflorescence emission occurred at around 210 DAP.

Emission of floral stem was not observed at 368 DAP (6226.8 DDD). Some plants that had more than four leaves were dissected from longitudinal cuts in pseudostem to characterize the development stage of the apical bud. Although it was observed differentiation of vegetative to floral stem, there was no the emission of the inflorescence. This remains, within the pseudostem. Atehortua (1998) stated that the flowering of *Heliconia* begins from given number of leaves and varies according to the species or cultivar. Number of leaves may indicate the beginning of flowering. However, climatic and environmental factors such as light and moisture influence the moment of leaves emission interfering applicability of counting the number of leaves as a marker for flowering in *Heliconia*. Costa et al. (2007) found that the emergence of the flower stem occurred after issuance of approximately seven leaves in Red Opal cultivar. Cropping practice adopted in this experiment was free emission of tillers in the pot. All the energy produced by the plant was distributed to all tillers, delaying their development. Consequently, during the period evaluated, no plant has issued a minimum number of leaves needed for the issuance of flower stem.

Because of the density, we decided to carry out a thinning with approximately twelve plants in each pot (Figure 2). This thinning was done at 368 DAP (6226.8 DDD). This procedure aimed to provide greater light input and certify whether the absence of emission inflorescence was associated with reduced brightness. After this procedure and keeping the management of free tillering, plants returned to issue new tillers and were recorded over twenty tillers per pot at 478 DAP in treatments with depletion levels of 5 and 10% PCC. In this period, also no issue of floral stem were observed.

Based on these results it was decided to conclude the experiment, however, it was continued managing of plants irrigating at the depletion level of 5 % PCC. At December 2012, it was performed thinning of plants in pots in order to test the hypothesis of maintaining a fixed number of tillers per pot. Based on the results, we observed that the higher growth rate in each pot occurred when there were approximately ten to fifteen tillers (Figure 2). After thinning and beginning of the shoots, we opted to leave fixed number of ten tillers per pot to see if that condition of management, the issuing flower stems could occur. With maintaining the fixed number of tillers per pot, plants began issuing flower stems and 164 days after thinning, on 06/06/2013, we observed considerable production of flowers. According to our results, we found that the luminosity is a factor that affects the emission of floral stems of the cultivar Red Opal, when cultivated in pot. The luminosity can be altered by the density of tillers in the pot or by the spacing between the pots, which must be investigated in future works.

6 CONCLUSIONS

Considering the results presented in this work it is possible to conclude that localized irrigation system, automated through weighing lysimeters, controls accurately the water consumption of *Heliconia* grown in pots; The use of water depletion level in the substrate in the amount of 5% PCC, as an indicator of time of irrigation, increased tillering of *Heliconia* Red Opal cultivar, grown in pots; The high irrigation frequency arising from the use of the level of 5% CC depletion causes the irrigation management in crops *Heliconia* in pot performed on our scale, which makes the use of weighing lysimeters a good alternative to indicate the moment for irrigations; The luminosity affects the emission of floral stems of the cultivar Red Opal under potting conditions.

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