Production of calla lily in NFT system [(1)]

PAULO ROBERTO CORRÊA LANDGRAF[(2)*], DOUGLAS JOSÉ MARQUES[(2)], JOSÉ RICARDO MANTOVANI[(2)], ADRIANO BORTOLOTTI DA SILVA[(2)], PATRÍCIA DUARTE DE OLIVEIRA PAIVA[(3)], ELKA FABIANA APARECIDA DE ALMEIDA[(4)], RODRIGO SÉRGIO DA SILVA[(2)]

ABSTRACT

The objective of this study was to evaluate the production of calla lily in an NFT system. The experiment was carried out in a greenhouse, using a 2 x 2 factorial scheme in a completely randomized design (CRD), with fifteen replications. The treatments were a combination of two hydroponic profiles (100 and 150 mm of height) and two nutrient solutions. Calla lily plantlets obtained from rhizome buds in trays containing nutrient solution, were transferred to a laminar flow of nutrients, and the experiment lasted 12 months. The height of stems and inflorescences were evaluated, as well as the length and diameter of the inflorescence, the number of flowers per plant and number of flowers per m^2. Growing calla lily plants in an NFT system is feasible. The nutrient solution with the highest concentration of nutrients, particularly N and K, and the profile of 150 mm, are the most suitable for the production of calla lily as a cut flower in a laminar flow of nutrients.

Keywords: *Zantedeschia aethiopica*, floriculture, hydroponics.

RESUMO

Produção de copo-de-leite cultivado em sistema hidropônico-NFT

Objetivou-se avaliar a produção de copo-de-leite em sistema hidropônico-NFT. O experimento foi conduzido em casa-de-vegetação, em esquema fatorial 2x2, delineamento inteiramente casualizado (DIC) com quinze repetições. Os tratamentos foram constituídos da combinação de dois perfis hidropônicos (100 e 150 mm de altura) e duas soluções nutritivas. Mudas de copo de leite obtidas das brotações de rizomas em bandejas contendo solução nutritiva foram transferidas para sistema hidropônico de fluxo laminar de nutrientes, e o experimento foi conduzido por 12 meses. Foram avaliados: a altura das hastes e da inflorescência, o comprimento e o diâmetro da inflorescência, o número de flores por planta e o número de flores por m^2. O cultivo de plantas de copo-de-leite em sistema hidropônico NFT é viável. A solução nutritiva com maior concentração de nutrientes, particularmente N e K, e o perfil de 150 mm são os mais indicados para a produção de copo-de-leite como flor de corte em sistema hidropônico de fluxo laminar de nutrientes.

Palavras-chave: *Zantedeschia aethiopica*, floricultura, hidroponia.

1. INTRODUCTION

Floriculture is characterized as one of the most promising segments of the Brazilian agribusiness. In the year 2014, the sector reached R$ 5.64 billion with 97.54% of the production was destined to the home market, growing 8% as compared to the results of previous years (JUNQUEIRA and PEETZ, 2015). The segment is dynamic and stands out as an alternative for small farmers, since it requires small areas, relatively low initial investment and, in most cases, provides fast economic return and high yield per cultivated area.

Calla lily is one of the cut flowers most traditionally appreciated in Brazil, widely used in flower arrangements, especially in wedding decorations (PAIVA et al., 2012). However, for the success of this crop, some technical aspects must be observed in its establishment and management, which will ensure greater production and best flower quality (ALMEIDA et al., 2009).

One of the major problems in the soil cultivation of calla lily is the high incidence of diseases, especially soft rot, caused by the bacterium *Pectobacterium carotovorum*, infecting the rhizome and the plant stem base, making the tissues soft and moist, which can compromise the whole cultivation area. In this context, the nutrient film technique, or NFT system, is a viable alternative for growing calla lily, as it avoids plant exposure to soil bacteria, significantly reducing the incidence of diseases, the need for spraying with pesticides, and providing best quality flowers (CHANG et al., 2013).

There is still scarce information on the cultivation of flowers in a hydroponic system, particularly calla lily. In hydroponic cultivation, Landgraf et al. (2015) observed that the use of phenolic foam with dimensions 5.0 x 5.0 x 3.8 cm provided a higher dry matter accumulation in the shoot and in the rhizome of calla lily plants, as well as higher photosynthetic rates. Thus, the objective of this study was to evaluate the production of calla lily in an NFT system.

DOI: http://dx.doi.org/10.14295/oh.v23i4.1098

[(1)] Received in 04/07/2017 and accepted in 20/09/2017

[(2)] Universidade José do Rosário Vellano, Alfenas-MG, Brazil. *Corresponding author: paulo.landgraf@unifenas.br

[(3)] Universidade Federal de Lavras, Lavras-MG, Brazil.

[(4)] Universidade Federal de Minas Gerais, Instituto de Ciências Agrárias (ICA), Montes Claros-MG, Brazil.

2. MATERIAL AND METHODS

Calla lily (*Zantedeschia aethiopica* L. Spreng.) plantlets were obtained from rhizome buds in trays containing nutrient solution A, described in Table 1, diluted with 150 mL L^{-1} water, using phenolic foam as support. The rhizomes were kept in a greenhouse with polyethylene cover (150 micra) and shade cloth providing 50% shade (Sombrite®). After 60 days under these conditions, calla lily plants were standardized at approximately 30 cm in length and two pairs of leaves, and transferred to an NFT system.

The experimental design was completely randomized (CRD) in a 2x2 factorial scheme. The treatments consisted of a combination of two hydroponic profiles (100 and 150 mm of height) and two nutrient solutions (A and B) and (Table 1), totaling four treatments, with 15 replicates. The experiment was carried out for 12 months. In the period, minimum, average and maximum temperatures were 17.5; 25 and 30 °C, respectively.

The plants were kept in an arc model greenhouse, with 126 m2 (6.0 m wide by 21 m long) and right foot of 3.0 m. The structure was covered with polyethylene film (150 microns), as well as an 80% shading screen on the top and sides.

Table 1. Nutrient solutions A and B used for the hydroponic cultivation of calla lily.

Nutrient	Solution A	Solution B
	mg L^{-1}	
$N\text{-}NO_3^-$	167	236
P	64	62
K	316	430
Ca	153	161
Mg	43	24
S	50	32
B	0.2	0.3
Cu	0.03	0.05
Fe	4.3	5.0
Mn	1.1	0.4
Mo	0.5	0.05
Zn	0.3	0.5

Two growing benches with 1% slope, according Furlani et al. (1999), were used, one for solution A, and one for solution B. Each bench was 9 meters long with 12 cultivation channels, in which treatments were arranged, and the spacing used was 0.3 x 0.5 m (0.15 m^2) (Figure 1).

Figure 1. Plants with 12 months of age beginning to flowering.

The nutrient solutions used were derived from the one described by Postali et al. (2004) and adjusted by Landgraf et al. (2015). The following fertilizers were used in these solutions: potassium nitrate (36% K and 13% N), calcium nitrate (17% Ca and 12% N), magnesium sulfate (10% Mg and 13% S), monobasic potassium phosphate (29% K and 23% P), boric acid (17% B), copper sulphate (24% Cu and 12% S), manganese sulphate (25% Mn and 21% S), zinc sulfate (22% Zn and 11% S), sodium molybdate (39% Mo) and ferrilene (6% Fe).

Each nutrient solution (A and B) was maintained in a 250-liter asbestos fiber reservoir. Irrigations were performed every 15 min and controlled automatically by timer. In the night period, the timer was programmed to make three irrigations: at 20:00, 01:00 and 04:00. Hydroponic solution management was performed daily, and the volume of the solution was completed until the initial one. In the early morning, the electrical conductivity was measured and adjusted to 2.0-3.0 mS and the pH to 5.8 in both solutions.

Stem harvest began 150 days after the transfer of the plantlets to the NFT system, and harvest time was defined when the inflorescence was fully open. At harvest, the following parameters were evaluated: the height of stems and inflorescence, the inflorescence length and diameter, the number of flowers per plant and number of flowers per m^2.

The results were subjected to analysis of variance, and the means were compared by the Scott-Knott test, using the software SISVAR (FERREIRA, 2011).

3. RESULTS AND DISCUSSION

Nutrient solutions and hydroponic profiles affected the height of stems and inflorescence, inflorescence length and diameter ($p \leq 0.05$). There was also a significant interaction effect of the studied factors on the evaluated biometric parameters.

The hydroponic profile of 150 mm, nutrient solution B with the highest concentration of N and K and electric conductivity around 3 ds m^{-1}, provided calla lily flowers with longer stem lengths. It was also observed that the inflorescence height and the length and diameter of plants were higher with the use of nutrient solution B. However, for these parameters, there were no differences ($p > 0.05$) in the hydroponic profile height used (Table 2).

Calla lily stems for commercialization should have a length between 30 and 80 cm (VEILING, 2017). In this way, it was verified that in all the treatments evaluated the calla lily stems presented standard for commercialization. However, as longer stems are more valued, the use of the nutrient solution B and the hydroponic profile of 150 mm in height provided the best inflorescences of calla lily.

Table 2. Stem length, inflorescence height, length and diameter, as a function of profile (100 and 150 mm) and nutrient solutions (A and B).

Hydroponic profile --------mm--------	Stem length		Inflorescence height	
	----------------------------**cm**----------------------------			
	Nutrient solution		**Nutrient solution**	
	A	**B**	**A**	**B**
100	50.35 Bb	67.05 Ab	4.82 Ba	6.00 Aa
150	57.58 Ba	72.52 Aa	5.00 Ba	6.60 Aa
CV%	**5.36**		**6.07**	
	Inflorescence length		**Inflorescence diameter**	
Hydroponic profile	----------------------------**cm**----------------------------			
--------mm--------	**A**	**B**	**A**	**B**
100	10.65 Bb	11.00 Aa	10.70 Aa	10.23 Aa
150	11.70 Aa	11.95 Aa	9.94 Ba	11.00 Aa
CV%	**4.59**		**2.38**	

Means followed by the same uppercase letter in the row and lowercase in the column, do not differ by the Scott-Knott test at 5% significance.

Similar results were obtained by Backes et al. (2008), who also found an adequate growth of *Lisianthus* sp. using the NFT system. Cally lily stem heights and inflorescence lengths and diameters obtained in this experiment were similar to those obtained by Almeida et al. (2012) under field conditions.

The production of calla lily stems was affected by both the height of the hydroponic profile and the solutions used.

It was observed that the use of nutrient solution B and the hydroponic profile of 150 mm provided a higher number of flowers per plant (13 flowers plant^{-1}) and flowers per square meter (5 flowers m^{-2}) (Figure 2). These results can be explained by the higher N and K uptake by plants of nutrient solution B, as verified by Landgraf et al. (2015).

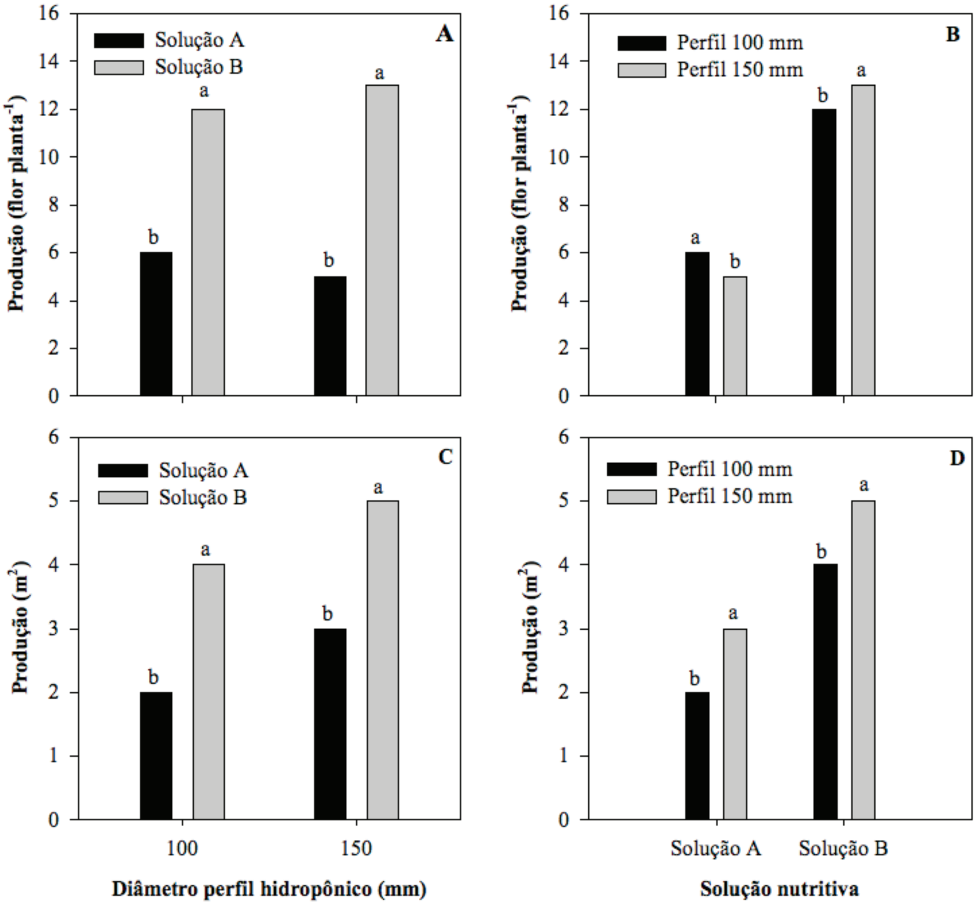

Figure 2. A) Production of calla lily flowers (flowers plants^{-1}); B) production of flowers per area (m^2), as a function of profile (100 and 150 mm) and different nutrient solutions (Solutions A and B). Means followed by the same lowercase letter do not differ by the Scott-Knott test at 5% significance.

The results of the number of calla lily flowers per plant obtained in this experiment were 2.2 times higher than those observed by Almeida et al. (2012), in an experiment with calla lily cultivation in soil, during a similar evaluation period. Backes et al. (2008) also obtained an adequate production of *Lisianthus* sp., considering stem height and number of stems per plant, in NFT cultivation.

With the results obtained in this experiment, it was verified that the cultivation of calla lily in an NFT system is possible and viable.

4. CONCLUSIONS

The nutrient solution B and the profile of 150 mm are the most suitable for the production of calla lily as a cut flower in a laminar flow of nutrients.

ACKNOWLEDGEMENTS

The authors are grateful to the Fundação de Amparo à Pesquisa de Minas Gerais (FAPEMIG) for funding this research and to National Council for Scientific and Technological Development (CNPq) for the scholarship.

AUTHORS CONTRIBUTION

P.R.C.L.: orientation of the work, conception and design of the research, writing and discussion of the manuscript. **D.J.N.:** statistical analysis of data. **J.R.M.:** writing and discussion of the manuscript. **A.B.S.:** writing and discussion of the manuscript. **P.D.O.P.:** important suggestions incorporated to the manuscript. **E.F.A.A.:**

important suggestions incorporated to the manuscript. **R.S.S.:** experimental installation and conduction of the experiment, evaluation of the experiment, data collection, analyze and interpretation of data.

REFERENCES

ALMEIDA, E.F.A.; PAIVA, P.D.O; LIMA, L.C.O.; SILVA, F.C.; RESENDE, M.L.; NOGUEIRA, D.A.; PAIVA, R. Diferentes conservantes comerciais e condições de armazenamento na pós-colheita de rosas. **Revista Ceres**, v.56, n.2, p.193- 198, 2009.

ALMEIDA, E.F.A.; PAIVA, P.D.O.; FRAZÃO, J.H.M.; SANTOS, J.E.M.; RESENDE, F.A.; CAMPOS, M.L. Produção de copo-de-leite em resposta à adubação com NPK e esterco bovino. **Revista Brasileira de Horticultura Ornamental**, v.18, n.2, p.129-134, 2012.

BACKES, F.A.A.L.; BARBOSA, J.G.B.; MARTINEZ, H.E.P.; BACKES, R.L.; FINGER, F.L Concentração e conteúdo de nutrientes em lisianto, cultivado em hidroponia, em sistema NFT. **Acta Scientiarum Agronomy**, v.30, n.4, p.495-500, 2008.

BACKES, F.A.A.L.; BARBOSA, J.G.B.; MARTINEZ, H.E.P.; BACKES, R.L.; FINGER, F.L. Cultivo hidropônico de lisianto para flor de corte em sistema de fluxo laminar de nutrientes. **Pesquisa Agropecuária Brasileira**, v.42, n.11, p.1561-1566, 2007.

CHANG, H.S.; CHAKRABARTY, D.; HAHN, E.J.; PAEK, K.Y. Micropropagation of calla lily (*Zantedeschia albomaculata*) via in vitro shoot tip proliferation. **In Vitro Cellular and Developmental Biology-Plant**, v.39, n.2, p.129-134, 2003. DOI: <10.1079/IVP2002362>

FERREIRA, D. Sisvar: a computer statistical analysis system. **Ciência e Agrotecnologia**, v.35, p.1039-1042, 2011.

FURLANI, P.R.; SILVEIRA, L.C.P.; BOLONHEZI, D.; FAQUIN, V. Estruturas para o cultivo hidropônico. **Informe Agropecuário**, v.20, n.200-201, p.72-80, 1999.

JUNQUEIRA, A.H.; PEETZ, M.S. 2015. **Panorama da cadeia produtiva de flores e plantas ornamentais do Brasil**. Hórtica Consultoria. Available in: http://jornalentreposto.com.br/noticias/75-negocios/637-producao-de-flores-eplantas-ornamentais-no-brasil. Accessed on: February, 20th 2015.

LANDGRAF, P.R.C.; MARQUES, D.J.; MANTOVANI, J.R.; SILVA, A.B.; SANTOS, B.R.;PAIVA, P.D.O.; SILVA, R.S.. Teor de nutrientes e trocas gasosas em plantas de copodeleite cultivadas em sistema hidropônico. **Pesquisa Agropecuária Brasileira**, v.50, n.11, p.1027-1032, 2015.

PAIVA, P.D.O.; ALMEIDA, E.F.A. **Produção de Flores de Corte**. Lavras: Editora UFLA, v.1, 2012. 679p.

POSTALI, L.G.B.; SILVA, E.C. da; MACIEL, G.M. Produção de híbridos comerciais de tomateiro do grupo cereja cultivados no sistema hidropônico com diferentes números de hastes**. Horticultura Brasileira**, v.22, p.12-18, 2004.

VEILING. 2017. **Critério de classificação de produtos:** Zantedeschia (calla). Available in: <http://http://veiling.com.br/uploads/padrao_qualidade/criterios/zantedeschia-calla-fc.pdf>. Accessed on: August 28th 2017.