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PRODUCTION OF CRISP HEAD LETTUCE CULTIVARS IN HYDROPONIC SYSTEM UNDER RED PIGMENTED MESH

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ABSTRACT

This study aimed to evaluate the production of twelve crisp head lettuce cultivars (Solaris, SVR 2005, Vera, Vanda, Invicta, Cristal, Alcione, Caipira, Camila, Thais, Brida and Bruna) in a hydroponic cultivation system. The experiment was conducted in a protected environment under red screen (ChromatiNet® Leno). The characteristics analyzed were: total and commercial fresh mass, stem and root fresh mass, stem length and diameter and total number of leaves. All evaluated cultivars reached the commercial weight for the market in natura, with Brida and Bruna cultivars showing higher total and commercial fresh mass.

Keywords: CromatiNet, Hydroponic cultivation, *Lactuca sativa* L., Plasticulture, Growth

INTRODUCTION

Lettuce (*Lactuca sativa* L.) is the most consumed leafy vegetable in the world (Maciel et al., 2020) with great economic importance in Brazil and in the world (Ferreira, 2015) being consumed mainly in natura as a salad.

ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

In Brazil, six groups of lettuce are cultivated, which are classified according to their morphological characteristics (Filgueira, 2008), with emphasis on the loose and smooth groups, which are cultivated in open fields and in greenhouses.

The lettuce of the loose curly group has very consistent, curly and loose leaves, not forming head (Filgueira, 2008). According to Sala and Costa (2005), this group has a preference for the Brazilian consumer, representing about 70% of consumption, and those of the American group and smooth have 15% and 10%, respectively, while others (red, mimosa, Roman) account for 5% of the market.

In regions with high rainfall seasons, the higher relative humidity of the air favors a higher incidence of diseases in the lettuce culture and can generate, according to Vargas et al. (2015) losses of up to 60% of production. An alternative for quality lettuce production throughout the year is the adoption of the protected crop associated with hydroponic cultivation. Paulus et al. (2012), hydroponics allows obtaining high quality products with higher productivity and lower consumption of water, agricultural inputs and labor.

Aiming to increase the profitability of vegetable crops in a protected environment, plastic films of various compositions have appeared on the market, which aim to alter the spectrum of light incident on plants in order to improve their development, production and quality.

Pinheiro (2013) reports that the use of meshes with different spectral characteristics in the cultivation of olericulture has become very common in recent years. The author evaluated different meshes in the hydroponic cultivation of curly lettuce and verified that the meshes present spectral differences of transmittance, absorbance and reflectance, which may result in modifications in the development of the plants.

Studies on the behavior of these materials in management systems and climatic conditions of non-traditional regions in lettuce production, such as the Cerrado, are still scarce. Thus, considering that, according to Gualberto et al. (2009), the choice of cultivar is decisive for the success of the adopted cultivation system, this study aimed to evaluate the behavior of lettuce cultivars of the crespa group under hydroponic cultivation in a red mesh covered tarpaulin.

MATERIAL AND METHODS

The experiment was conducted on a rural property in the municipality of Jataí-Goiás (17º53'12" S,1º40'12"W; 789 m a.s.l.), Brazil. The region's climate is of the Aw type classified as mesothermal and defined by two well-defined seasons with dry winter and rainy summer (Alvarez et al., 2014).

ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

The climatic data of Jataí during the conduct of the experiment are found in Figure 1, with only 0.6 mm of rainfall with minimum and maximum temperatures of 5.1°C and 36.0°C, respectively.

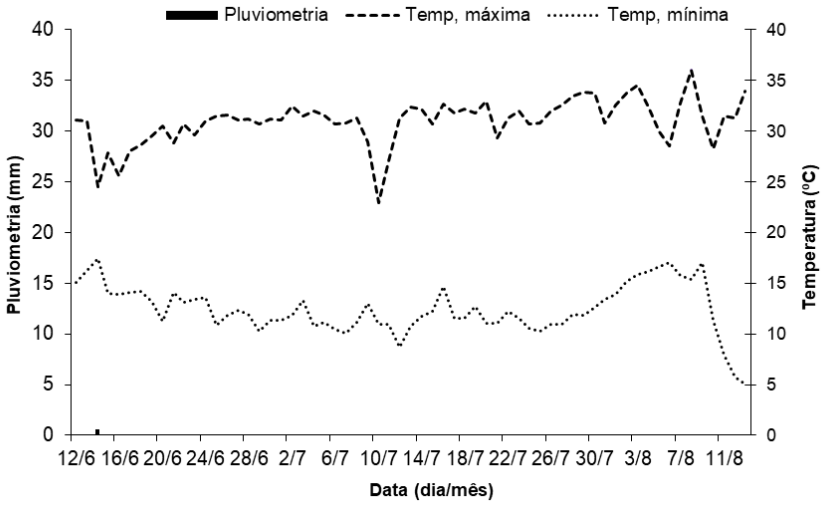

Figure 1: Maximum and minimum temperature and rainfall data during the experiment. Jataí-GO, 2018.

Source: Inmet (2018).

The experimental design used was of randomized blocks, with three repetitions, being the treatments composed by 12 lettuce cultivars of the loose group: Alcione; Brida; Bruna; Caipira; Camila; Cristal; Invicta; Solaris; SVR 2005; Vera; Vanda and Thais.

The sowing was done in plates of phenolic foam with dimensions of 2 cm x 2 cm x 2 cm. In each cell of the phenolic foam a pelletized seed was inserted and irrigated until the complete hydration of the plate, where, later, they were taken to a covered environment under low luminosity, remaining so for 24 hours. After the emergence of the seeds, the plates were taken to a germination table (nursery) where they received nutritive solution under intermittent irrigation every 10 minutes.

Later, at 42 days after sowing, the seedlings were transferred to the pre-growth benches, remaining during the 14-day period, when they reached four to six definitive leaves, and were transplanted to growth canals where they remained until the harvest totaling 66 days.

The seedlings were kept during all development phases under a roof covered with red mesh (ChromatiNet® Leno), with 30% shading, both in the upper and lateral parts with dimensions of 45 m long by 7 m wide, with 3.8 m of right foot.

ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

The technique used for hydroponic cultivation was the laminar nutrient circulation technique (Nutrient Film Technique - NFT), which consisted of intermittent pumping of the nutrient solution, forming a thin layer of the nutrient solution that supplied the roots of the plants with water and nutrients.

The NFT system consisted of a hydraulic set of growing benches, a 5000 L capacity nutrient solution storage tank, and a 1 hp motor pump set, connected to a timer programmed to remain on for seven minutes and off for 15 minutes during the day (6:00 a.m. to 7:30 p.m.) and with three 15-minute drives (9:00 p.m., 00:00 p.m. and 3:00 a.m.) at night.

The nutritive solution was conducted from the reservoir to the culture channels, through the motor-pump set, passing through the roots in the form of a water blade, enabling the plant to absorb the water, nutrients and oxygen it needed, and return by gravity to the reservoir, thus forming a closed system. This system was divided into three distinct production phases: seedling production (nursery), pre-growth and final growth.

In all phases of the experiment the composition of the nutritive solution used was the same. For the preparation of 1000 L of the nutritive solution, it was used: 414 g calcium nitrate (15,5 % N and 18 % Ca), 276 g potassium nitrate (12 % N, 43 % K_2O, 1 % S and 1 % Mg), 219 g magnesium sulphate heptahydrate (1 % K_2O, 11,8 % S and 9 % Mg), 81 g crystal monoammonium phosphate (12 % N and 61 % P_2O_5), 15 g iron chelate (6 % Fe with EDDHA chelating agent) and 4,8 g micronutrient mixed fertiliser (4,10 % B, 4,09 % Cu EDTA, 4,09 % Mn EDTA, 0,916 % Mo, 0,814 % Ni and 1,60 % Zn).

The management of the nutritive solution was performed daily by replacing the water absorbed by the roots of the plants or evaporated, monitoring the electrical conductivity, which was maintained in a range of 1.2 to 1.5 mS cm^{-1}, and correcting the pH, which was maintained between 6.2 and 6.5.

When the plants reached commercial standards, four central plants were collected from each plot, where the following characteristics were evaluated: Total fresh mass (TFF), the plants were cut close to the root system and weighed on a digital scale with a precision of 0.05 g; commercial fresh mass (CFM) obtained by weighing the plants without the leaves that visually impaired the marketing of the plant; root fresh mass (RFF), the roots were cut from the plants and weighed; fresh stem mass (FCM), the leaves were removed and the stems weighed; stem length (CC) obtained with the aid of a graduated ruler; number of leaves (NF), which consisted of defoliation and counting of the leaves of each lettuce stalk; and stem diameter (DC), which was assessed in the middle third with the aid of a digital pachymeter.

ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

The data obtained, after meeting the statistical assumptions (homogeneity of variances and normality), were analyzed by analysis of variance and for significant effects the Scott-Knott test was performed, at 5% probability of significance.

RESULTS AND DISCUSSION

Lettuce cultivars produced in the hydroponic system under red screen showed differences for all the characteristics evaluated (Table 1).

Table 1: Average test for total fresh mass (MFT), commercial fresh mass (MFCo), root fresh mass (MFR), stem fresh mass (MFC), stem length (CC), number of leaves (NF) stem diameter (DC), per lettuce plant grown in the hydroponic system under red pigmented mesh.

Cultivar	MFT	MFCo	MFR	MFC	CC	NF
	----------(g planta^{-1})----------				(cm)	(un)
Alcione	289.5 b	273.5 b	43.8 b	19,3 d	7,1 b	25,1 c
Brida	377.9 a	350.4 a	48.8 b	30,9 a	8,1 a	29,1 a
Bruna	358.6 a	335.1 a	58.6 a	29,1 a	7,8 a	30,4 a
Caipira	279.9 b	266.8 b	33.8 c	17,9 d	5,7 b	30,5 a
Camila	274.3 b	252.0 b	45.6 b	22,2 c	7,5 a	22,3 c
Cristal	310.1 b	291.5 b	39.1 c	24,5 b	6,7 b	26,4 b
Invicta	265.8 b	247.7 b	45.5 b	21,6 c	6,7 b	23,7 c
Solaris	270.4 b	245.0 b	46.4 b	19,1 d	6,5 b	22,1 c
SVR 2005	269.4 b	255.8 b	34.6 c	13,2 e	5,5 b	20,8 c
Thais	241.6 b	220.5 b	43.1 b	14,5 e	6,4 b	23,8 c
Vanda	253.7 b	238.3 b	34.2 c	26,9 b	8,9 a	28,0 b
Vera	274.8 b	257.8 b	40.4 c	18,5 d	7,0 b	22,5 c
CV (%)	8.3	8.3	9.5	6.6	11.1	6.1
Media	288.8	269.5	42.8	21.5	7.0	25.4
F	8.73*	8.88*	9.27*	45.48*	4.62*	14.80*

Significant at 5% probability by F test.Averages followed by the same letter in the column do not differ by the Scott-Knott test ($\alpha = 0.05$).

For the characteristics for total and commercial fresh mass, two groups were formed, Brida and Bruna showed superior performance in relation to the other cultivars with averages of 377.91 and 358.64 (g plant^{-1}) for total fresh mass and 350.41 and 335.08 (g plant^{-1}) for commercial fresh mass, respectively, and all the evaluated cultivars showed, standard for the market in natura.

ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

Sousa et al. (2018) evaluating 14 cultivars of wild lettuce grown in the soil in Jataí-GO, found variation from 291.8 to 397.3 (g plant^{-1}) for total fresh mass and 224.8 to 324.8 (g plant^{-1}) for commercial fresh mass, and for the Bruna cultivar, the values of total and commercial fresh mass were 297.8 and 234.0 g plant^{-1}, respectively.

The effects of shading screens under eight cultivars of American lettuce were evaluated by Aires et al. (2020) which obtained for varieties grown under red screen, total fresh mass production ranging from 182 to 347 g plant^{-1} and commercial fresh mass from 0 to 168 g plant^{-1}.

Regarding fresh root mass, three groups were formed (Table 1), ranging from 33.75 to 58.64 g plant^{-1} and higher mass obtained by the Bruna cultivar. The fresh root mass in lettuce root cultivars grown in the hydroponic system (NFT) presents some doubt, because at harvest the excess root is discarded and as the nutrients are available in the water lamina being absorbed by the roots and translocated to the plant, the excess root mass probably does not present advantages for the production of the plant.

The fresh stem mass was higher for Brida and Bruna cultivars (Table 1). There are few studies on the fresh mass of lettuce stem, because Brazilians do not have the habit of consuming lettuce stem, so we want a lower fresh mass of the stem, because when the plant is defoliated for its hygiene, for consumption in the form of salads, the stem is discarded and only the leaves are used. They are crispy and can also be eaten as a salad.

Luz et al. (2006) and Fonseca et al. (2015), studying the competition of lettuce varieties in hydroponic cultivation, also found significant differences between cultivars for fresh mass production, demonstrating the agronomic behavior of the cultivars. This behavior is ratified by Blat et al. (2011) who verified that fresh mass values (total and commercial) are influenced by genetic and edaphoclimatic factors when evaluating lettuce cultivars in two growing environments (acclimatized and non-climatized house of vegetation) in NFT hydroponic system.

It is observed by the several experiments on lettuce cultivation, that the cultivars present a differentiated response to the edaphoclimatic conditions, which result in a very discrepant production from one region to another. It is necessary that the grower or research organs test these materials throughout the year and in different conditions, to obtain the result desired by the grower also meeting the demands of the consumer market.

The stem length varied from 7.63 to 8.88 cm, with higher values obtained with the cultivars Bruna (8.08 cm); Brida (7.77 cm); Vanda (8.88 cm) and Camila (7.46). None of the evaluated cultivars showed signs of early pendoamento during the harvest, and all the cultivars were recommended for commercialization, for the market in natura.

ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

The stem length should be evaluated according to the final destination. For the group of lettuce for industry (American cultivars), the stem length should be quite reduced, providing less losses during processing, that is, stems with up to 6.0 cm would be the most adequate, being still acceptable up to the level of 9.0 cm and unacceptable or less recommended for processing above this index, because cultivars with excessively long stem do not present good compactness and make processing difficult, affecting the final quality of the product (Yuri et al., 2004).

It should be noted that high stem lengths become a negative aspect, suggesting that the cultivar has greater susceptibility to early peeling. According to Flôres et al. (2016), the shorter the stem length, the greater the tolerance to high temperatures, thus presenting a greater resistance to peeling.

During the experiment, temperatures varied between 5.1 and 33.7 ºC (Figure 1). Lettuce is very sensitive to temperature and photoperiod, temperatures above 20 ºC can cause early peeling (Silva et al., 1999; Luz et al., 2009). Therefore, the stem size of the lettuce plant, a result of the high temperature effect, associated with the sensitivity of the cultivar provides important information so that the grower can make a selection of the most resistant or suitable cultivars during the year.

Regarding the number of leaves, the cultivars Brida (29.1), Bruna (30.4) and Caipira (30.5) had the highest number of leaves. Plants with larger quantities of leaves provide a greater accumulation of biomass, being the largest and most desirable for sale (Blind and Silva Filho, 2015)

The number of leaves is an important variable in the evaluation of the performance of lettuce cultivars and is closely related to the temperature of the growing environment, and for the marketing of lettuce for the market in natura, for hydroponic lettuce, the packaging must contain a weight of more than 300g, although, for this, it is necessary to pack two plants together (Oliveira et al. 2004). It should be noted that the domestic consumer buys lettuce per unit and not weight, and the larger the plant or packaging, the greater the interest of the consumer market.

CONCLUSION

All lettuce cultivars evaluated presented a commercial pattern for in natura consumption. Brida and Bruna were the cultivars with the highest total and commercial fresh mass in hydroponic cultivation under red screen.

ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

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ISSN: 2455-6939

Volume: 06, Issue: 05 "September-October 2020"

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