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ORGANIC CARROT PRODUCTIVITY IN DIFFERENT SHADE SCREENS, NOVA XAVANTINA-MT

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Abstract: The market demand for unconventional foods is growing, and the consumer is increasingly concerned about consuming healthier and pesticide-free foods, which denotes the importance of alternative cropping systems that consider such aspects. Among the most cultivated vegetables in organic production systems, the carrot has great relevance in this form of cultivation. The use of shading screens has been increasingly used to reduce the direct incidence of sunlight on different species, which can be an option for the cultivation of carrots in the region, and when tested we can reach results that can guide the farmer in decision making regarding its cultivation, since, among the factors that affect carrot productivity, luminosity and temperature are the main ones. The objective of this work was to evaluate the development and yield of organic carrot cv Brasília in different shade screens. The experimental design was completely randomized, with five treatments and ten replications. The treatments consisted of 35% and 50% black, 35% aluminized and 35% red shading screens. The 50% black shading screen is the most suitable for the cultivation of organic carrot cv Brasília in the edaphloclimatic conditions of Nova Xavantina-MT.
Keywords: *Daucus carota* L. Alternative. protected environment.

INTRODUCTION

Carrot (Daucus carota L), belonging to the Apiaceae family, is a vegetable crop that stands out for having great nutritional and social potential. From the nutritional aspects, this vegetable stands out for being rich in provitamin A (carotenoids), essential for tissue maintenance and with antioxidant function, thus being essential for human growth and development (PEREIRA, 2013). In relation to social and economic aspects, its cultivation provides positive impacts on the development

of the regions of Minas Gerais, São Paulo, Rio Grande do Sul, Paraná, Bahia and Goiás, with advances in production and increasing income generation for the producer (CEASA – PR, 2019).

Carrots are the fifth most cultivated vegetable in Brazil, but their average national productivity is low, reaching 32.1 t/ha, even though in some regions of the country they reach values above 80 t/ha (CEPEA, 2021). This reduction in productivity can be explained by the fact that cultivars not adapted to the various environments found in Brazil are planted in many regions (PEREIRA et al., 2015).

According to the Brazilian Vegetable Yearbook (2017), Brazilians consume an average of 5.3 kg of carrots per capita per year. Brazil occupies the seventh position in the world in the horticultural trade, when it comes to exports. In 2016, the main producing states, in order of greater relevance, are: Minas Gerais, São Paulo, Rio Grande do Sul, Paraná, Bahia and Goiás, together, they are responsible for 90% of national production.

The Midwest and South are responsible for almost 90% of production, the Northeast close to 10% and the North less than 1%. The carrot production poles in the State of Minas Gerais are the following municipalities: São Gotardo, Santa Juliana and Carandaí; in São Paulo: Piedade, Ibiúna and Mogi das Cruzes; in Paraná: Marilândia; in Bahia: Lapão and Irecê; in Goiás: Planaltina (CEASA, 2019).

It is originally a mild climate species, but it can be grown all year round in both winter and summer. Each cultivar has its own characteristics and nutritional requirements for cultivation, such as root shape, planting and harvesting time, resistance or not to some insect or disease (RESENDE; BRAGA, 2014).

The traditional way of cultivating carrots is in the field in a conventional open system of production. On the other hand, food from an organic farming system has been increasingly valued by consumers, who take into account aspects related to healthy eating and care for the environment (PINTO, 2020).

The market demand for unconventional foods is growing and the consumer is increasingly concerned about consuming healthier and pesticide-free foods, which denotes the importance of alternative cropping systems that consider such aspects. Among the most cultivated vegetables in organic production systems, carrots are highly relevant in terms of production (PAULUS et al., 2012).

Some cultural practices can influence the good productivity of vegetables, such as the use of low tunnels with meshes or shading screens, especially in regions with high temperatures and incidence of solar radiation that end up affecting the development of vegetables such as carrots (OLIVEIRA, 2019). Among the most used meshes are red, black, white, silver, among others, with studies already carried out in the production of vegetables (HIRATA, 2015), medicinal plants (BRANT et al., 2009) and flowers (NOMURA et al, 2009).

The use of shading screens has been increasingly used to reduce the direct incidence of sunlight on different species, which can be an option for the cultivation of carrots in the region and when tested it is possible to reach results that can guide the farmer in decision making regarding its cultivation, since, among the factors that affect carrot productivity, luminosity and temperature are the main ones.

There is great interest in the cultivation of carrots on the part of farmers in the Nova Xavantina region due to its offer throughout the year and the good acceptability of the consumer, however, its cultivation comes up against edaphoclimatic factors. There are no researches in the municipality of Nova Xavantina and region related to the

productivity of organic carrots in shading screens that meet the demands of family farmers, in order to guarantee alternatives to their cultivation. Given this context, the present work aims to evaluate the development and yield of organic carrot cv Brasília in different shade screens.

MATERIAL AND METHODS

The experiment was installed in August 2019 at the Experimental Farm of the Universidade do Estado de Mato Grosso, Nova Xavantina Campus, located at coordinates 14º 40' 0" S and 52º 20' 45"W. The climate of the region is classified according to Köppen, as Aw tropical with a pronounced dry period and average annual precipitation of 1498 mm and average annual temperature of 25.1ºC (CLIMATE-DATA, 2020), with the highest water deficits during the months of August and September, due to scarce precipitation and low relative humidity (ALVARES et al., 2013).

The experimental design was completely randomized, with five treatments and ten replications. The treatments consisted of 35% and 50% black, 35% aluminized and 35% red shading screens. Each experimental unit consisted of a 3.0 x 1.0 m bed with six rows of plants, spaced 0.15 x 0.06 cm, making a total area of 3.0 m2.

Soil preparation consisted of cleaning the area by manual weeding and lifting the beds to a height of approximately 0.20 m. Soil was collected in the 0-20cm layers to analyze the chemical and physical characteristics of the soil (Table 1) and organic fertilization was carried out before sowing with cattle manure, according to the recommendations of Cavalcanti et al. (2008) and the need for culture.

The organic carrot cultivar used in the experiment was Brasília (TopSeed®), whose seeds were purchased from Empório de Sementes Orgânicas LTDA. The choice of this cultivar was mainly due to its ability to adapt to high temperatures (typical of the region), as indicated by Resende et al. (2016).

Sowing was carried out manually in the transversal direction of the bed in holes of approximately 2.0 cm in depth, spaced at 6.0 cm, placing 3 to 4 seeds per hole. The thinning was performed 25 days after sowing (DAS), leaving one plant per hole. Irrigation was performed manually daily with the aid of a watering can. The harvest carried out when the older leaves yellow and dry and the younger leaves bend downwards, as described by GOMES (2019). The total period of the experiment was 4 months from August to December 2019.

The evaluations were made after the harvest, for the following parameters:

- Area fresh matter (FM): the aerial part (leaves) were separated from the roots, washed and weighed.
- Dry matter of aerial part (DM): part area (leaves) were packed in paper bags and placed in a forced air circulation oven, with temperature regulated at 65º C, until reaching constant mass and later they will be weighed.
- Root Weight (PR): the roots were weighed using a scale.
- Root Diameter (RD): the roots were evaluated with the aid of a digital caliper.
- Root Length (CR): it was determined with the aid of a tape measure, measuring the roots, from the bottom to the end.
- Total productivity (t ha-1): total mass of roots expressed in t ha-1

The collected data were submitted to analysis of variance (ANOVA), and the means were compared by the Tukey test at 5% with the aid of the SISVAR 5.7 software.

pH H_2O	P	K	Ca	Mg	Al	H+Al	SB	CTC	MO	V%
	mg/dm³	---------- cmolc/dm³ ----------					-- cmolc/dm³ --		g/dm³	
6,1	2,69	0,25	1,43	0,82	0,19	2,86	2,5	5,36	13,9	47

Note: Extractor: Mehlich 1; pH H2O; P – Phosphorus; K – Potassium; Ca – Calcium; Mg – Magnesium; Al – Aluminum; H+Al – potential acidity; SB – Sum of Bases; CTC – Cation Capacity; ; V% - Saturation by Bases; MO – Organic Matter. Source: Own authorship (2021).

Table 1. Result of soil analysis (0-20cm) of the carrot growing area. Experimental Farm of Unemat, Nova Xavantina.

Treatments	MF (Kg)	MS (Kg)	PR (Kg)	DR (mm)	CR (cm)	PT (t ha^{-1})
Black Screen 50%	0,071a	0,011a	0,065a	32,92a	15,50a	56,4a
Black Screen 35%	0,041b	0,008ab	0,034b	24,29b	15,90a	45,9b
Aluminized Screen 35%	0,010c	0,006b	0,007c	12,29c	14,60a	40,3b
Aluminized Screen: 50%	0,013c	0,006b	0,018bc	16,53c	14,60a	40,7b
Red screen: 35%	0,009c	0,005b	0,009c	12,20c	16,11a	25,9c
DMS	0,028	0,004	0,023	7,52	2,90	12,33

Note: Means followed by the same letter, for the same variable, do not differ from each other by Tukey's test at 5% probability. **Source:** Own Author (2021).

Table 2. Mean values for shoot fresh matter (MF), shoot dry matter (MS), root weight (PR), root diameter (DR), root length (CR), and total root yield (PT) of organic carrot cv Brasília as a function of shading screens. Nova Xavantina, MT.

RESULTS AND DISCUSSION

Table 2 presents the mean values for all parameters evaluated in this experiment. The cv. Brasília presented the highest average values in black shading screens of 50%, followed by 35%, with the worst values in the Red screen of 35%.

The values of fresh matter (MF) and shoot dry matter (DM) ranged between 0.071 and 0.011 kg (black screen 50%) and 0.009 and 0.005 kg (red screen 35%), respectively. The amount of foliage produced by the carrot (aerial part), according to Lima et al. (2010), although not of great economic importance, it is a good indicator of root growth, since there is a positive correlation between this and an adequate photosynthetic surface, so the 50% shading screen provided a greater amount of MF, which is desirable for root growth and production.

Corroborating the results of this work, Resende and Braga (2014) working with several carrot cultivars, among them, cv. Brasília in an organic cropping system in the São Francisco Valley found similar values for MF and DM of 0.082 and 0.014 Kg for this cultivar, using the 50% shading screen. Results contrary to those found by Teófilo et al. (2009) when evaluating the cultivars Brasília, Esplanada and Alvorada, found higher values of MF and DM, with an accumulation of dry matter of leaves growing throughout the experimental period.

Regarding the root weight (PR), the highest value (0.065kg) reached with the 50% shading screen and the lowest value (0.007kg) with the 35% aluminized screen. This is an important feature, since direct sales to the consumer are carried out using this parameter. This effect is possibly associated with the best conditions for plant growth and development during the experiment (August to December period) provided by the 50% shading screen and the characteristic of the cultivar itself. This fact was also pointed out by Gomes (2019) in an experiment carried out with different carrot cultivars in Mossoró (RN), according to this author, this probably occurred due to a greater resilience of the cultivars to adverse weather conditions, taking advantage of the high amount of energy, in the form of light radiation, available during the experimental period to increase root weight.

The root diameter (RD) varied between 32.92 mm (50% black mesh) and 12.20 mm (red mesh). Terto (2019) carrying out an experiment with the cv Brasília using different shading screens, in the municipality of Redenção-PA, concluded that the screened environment with 50% showed superiority in 47.9 and 35.3%, respectively, in relation to the field environment open.

For the root length (CR) the values were very close (with an average difference of 1.51 cm) with no difference between the screens used, which can be explained by the low influence of spectral variations caused by the covering material for the growth of roots. Resende et al. (2016), working with several varieties of carrots under organic system and high temperatures, points out the need to test doses of organic substrates, since there may be an influence of this on the increase of foliage, which can provide the desirable leaf surface, taking into account that the root growth depends on adequate photosynthetic surface (PAULUS et al., 2012).

For the total productivity (PT) the cultivar Brasília had better yield in the shading screen of 50%, with 56.4 t. ha-1 and the lowest in the red screen of 35% (25.9 t. ha-1). It can be inferred that the shading screen of 35% reflected negatively on the initial development of the plants and, consequently, on the total productivity of roots at the end of the crop cycle. Perhaps because of the cultivar's characteristic (adapted to high temperatures) combined with the red screen that, unlike the black screen, which only reduces the incidence

of sunlight, the red screen alters the light spectrum and also acts on thermal control (LI, 2006), which under the edaphoclimatic conditions of the experiment, it triggered different results, impairing the performance of the cultivar in terms of productivity.

For the summer cultivars Brasília, Brazlândia and Alvorada, in the Federal District, Clemente; Resende; Vieira (2006) reported total productivity averages varying between 36.6 and 51.5 t ha-1, similar to the values found in this experiment. Lower values for the same parameter for the cultivar Brasília were found by Paulus et al. (2012) in an experiment in Paraná, where they obtained a total productivity of 20 t ha-1.

In Mossoró, Lopes et al. (2008) verified average yields ranging from 31.39 and 39.13 t ha-1, the latter value for the cultivar Brasília. Therefore, it can be said that, in terms of total productivity, the average values observed in the present study were higher than those observed by other authors in different regions, which demonstrates the adaptation of this cultivar to the management used.

Comparing carrot cultivars and populations in organic cultivation in the Federal District, Saminêz et al. (2002) found that two populations (POP. 22 and 26) stand out in the summer season, mainly due to the lower rate of root discard and the consequent number and production of commercial roots. These populations were significantly superior to the cultivar Brasília in some characteristics. In turn, Reghin; Duda (2000) commented that in Ponta Grossa, PR, the highest yields were obtained for the October sowing, with emphasis on the cultivars Brasília (54.3 t ha-1) and Kuronan (43.9 t ha-1).

These data point to the need for further research related to the selection of cultivars with quality root production under high temperature conditions (as in Nova Xavantina-MT), and also demand a more accurate analysis at different planting times to aid in taking decision on the cultivation of carrots in the region.

CONCLUSION

The 50% black shading screen is the most suitable for the cultivation of organic carrot cv Brasília in the edaphoclimatic conditions of Nova Xavantina-MT.

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