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Productivity of determinate growth tomato lines tolerant to heat under the organic system

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ABSTRACT

The objective of the present work was to evaluate the productive response of heat tolerant lines of determinate growth tomato under the organic production system. The experiment was carried out in the Instituto de Ciências Agrárias of UFMG, Montes Claros, Minas Gerais state, Brazil. The experimental design was of randomized complete blocks with eight treatments and four replications. The treatments consisted of eight heat tolerant processing type tomato lines obtained from the Asian Vegetable Research and Development Center (AVRDC), China: CLN1621L, CLN1621F, CLN1621E, CLN1466P, CLN2026E, CLN2026D, CLN2026C and CLN2001C. There was an inverse relationship between the average weight of the fruits and the number of fruits per plant. The highest average fruit weight of some lines was compensated by the lowest quantity of fruits, in such a way that there were no significant differences among the lines. Symptoms of nutritional deficiency and incidences of pests and diseases were not verified in any of the studied lines. All lines presented potential for genetic improvement research and cultivation using organic production systems under higher temperature conditions.

Keywords: *Solanum lycopersicum*, production, fruit quality.

RESUMO

Produtividade de linhagens de tomate rasteiro tolerantes ao calor sob o sistema orgânico

O objetivo do presente trabalho foi avaliar o desempenho produtivo de linhagens de tomate rasteiro tolerantes ao calor sob o sistema orgânico de produção. O experimento foi realizado no Núcleo de Ciências Agrárias da UFMG, Montes Claros-MG. Foi utilizado o delineamento em blocos casualizados com oito tratamentos e quatro repetições. Os tratamentos consistiram de oito linhagens de tomate do tipo rasteiro tolerantes ao calor obtidos na Asian Vegetable Research and Development Center (AVRDC), China: CLN1621L, CLN1621F, CLN1621E, CLN1466P, CLN2026E, CLN2026D, CLN2026C e CLN2001C. Houve uma relação inversa entre o peso médio dos frutos e o número de frutos produzidos por planta. O maior peso médio de frutos de algumas linhagens foi compensado pelo menor número de frutos, de tal forma que não houve diferenças significativas entre as linhagens. Não foram constatados sintomas de deficiência nutricional e incidências de pragas e doenças nas linhagens estudadas. Todas as linhagens apresentam potencial para pesquisas de melhoramento genético e cultivo em sistemas orgânicos de produção em condições de temperatura mais elevada.

Palavras-chave: *Solanum lycopersicum*, produção, qualidade de frutos.

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The tomato is one of the most consumed vegetables in Brazil and of great economical importance, having great versatility in human alimentation and constitutes an important source of vitamins and mineral salts. It is grown in a wide variety of regions. However, for optimum yields, this culture requires appropriate climatic conditions. In hot areas, at altitudes under 400 m, the best production is obtained in the cold period (Makishima & Miranda, 1995). Out of season, the climatic conditions are considered adverse for tomato cultivation, since it facilitates, the development of pests and diseases (Souza & Rezende, 2003), resulting in the intensive and systematic use of pesticides on the culture.

Among climatic factors, temperature is prominent in the tomato culture. According to Filgueira, (2000), the ideal temperature for tomato production varies between 21-28°C during the day and 15-20°C during the night. Under excessive day and night temperature, damages in the fructification may occur. When the temperature deviates from optimum, occurs lower fructification, small fruits with few seeds, a small liberation and germination of the pollen grain (Fontes & Silva, 2005), burns of the fruits and the transformation of the lycopene in carotenoids, with reduction of the of red color intensity (Silva Júnior & Prando, 1989).

Analyzing the conventional system of tomato production, the producers, in order to guarantee better productivity, use excessive amounts of fertilizers, defensives for the control of pathogenic agents and fuel, sometimes making the obtaining of profits from the production unfeasible (Teixeira *et al*., 2005).

The cultivation of the tomato under the organic system has been expanding more and more in Brazil, basically in function of the growing concern about the dangers of agrochemicals in food. The production of tomatoes, differentiated in terms of quality, has been a goal of most producers. Furthermore, the organic market is already considered one of the agribusiness branches with higher growth demand in the context of the international market.

In spite of the organic tomato being considered a good investment opportunity for the producer (Melo & Vilela, 2005; Tamiso, 2005), there are few options of selected genotypes for this system, even in traditional areas of cultivation. According to Martins *et al*. (2006), the research has addressed tomato cultivation under the traditional production system, including the improvement of varieties adapted to the use of input chemicals.

Some authors had evaluated the performance of tomato varieties under the organic production systems. Melo *et al*. (2009), under greenhouse conditions and Toledo *et al*. (2011), in field conditions, evaluated the productive characteristics of genotypes of tomatoes for organic production.

The development of heat tolerant tomato varieties could contribute to extent the cultivation period and to incorporate new exploration areas, but also to the selection of genotypes for cultivation under organic production systems.

The objective of the present work was to evaluate the productive response of heat tolerant lines of determinate growth tomato under the organic production system in Montes Claros-MG.

MATERIAL AND METHODS

The experiment was conducted in the period from June to October 2004, at the Universidade Federal de Minas Gerais regional campus in Montes Claros.

The municipality of Montes Claros is located in the north of the state and is considered within the "drought polygon", at an average altitude of 648 m, presenting a hot and dry climate with an average annual temperature of 24.2°C. The average temperatures (°C) and precipitations (mm) in the months of June, July, August, September, October and November 2004 were 19.4 and 26.2; 18.9 and 12.8; 20.6 and 0; 23.1 and 0; 25.5 and 24.1; 25.2 and 98.9 respectively.

The cultivation of the tomato was carried out in Typic Hapludalf soil, cultivated for 2 ½ years under organic cultivation, whose physic-chemical characteristics were: pH-water (6.1), P-Mehlich (6.0 mg dm^{-3}), K (6.0 mg dm^{-3}), Ca (6.80 $cmol_c$ dm^{-3}), Mg (1.70 $cmol_c$ dm^{-3}), Al (0.0 $cmol_c$ dm^{-3}), H + Al (1.76 $cmol_c$ dm^{-3}), Organic matter (2.24 dag kg^{-1}), thick sand (11.00 dag kg-1), fine sand (27.00 dag kg^{-1}), Silt (40 dag kg^{-1}) and clay (22.00 dag kg^{-1}).

The experimental design was randomized complete blocks with eight treatments and four replications. The treatments consisted of eight heat tolerant lines of tomato of determinate growth obtained from Asian Vegetable Research and Development Center (AVRDC), China: CLN1621L, CLN1621F, CLN1621E, CLN1466P, CLN2026E, CLN2026D, CLN2026C and CLN2001C. Each plot was composed of nine plants, spaced at 1.0 m between rows and 0.5 m among plants.

Before the transplant of the seedlings, an application of organic compost was done (50 t ha^{-1}) and calcinated bone meal (1.9 t ha^{-1}). The organic fertilization was based on the recommendation of Penteado (2004) for the tomato crop. The amount of bone meal was calculated according to the requirements of phosphorus in the soil, based on recommendations for the use of corrective and fertilizer in Minas Gerais, 5ª Aproximação, for determinate growth tomatoes (Filgueira *et al*., 1999). Chemical fertilizers and liming were not used in this area.

The sowing was done in polystyrene tray with 128 cells, having a substrate composed of vermiculite. The seedlings were taken to a greenhouse. For the irrigation of the seedlings, a Fogger Tietze micro sprinkler nebulizer, blue nozzel at 7 L h^{-1} with a pressure of the 40 mca coupled to a low pressure antidrip Tietze valve was used. The intervals of irrigation were in agreement with the environmental conditions of the local. The transplant was done when the seedlings reached 3 pairs of definitive leaves. After the planting, all the area of the experiment was mulched with dry grass. During the development period of the culture, three foliar pulverizations with biofertilizer (2.5 L of raw bovine milk + 1.5 kg of vegetable ash + 1.5 kg of bovine manure + 1.5 kg of sugar + 100 L of water) were done, in which the first was at the beginning of flowering and the others spaced at 10-day intervals.

The irrigation of the experiment was done through microaspersion and with a volume of water according to the hydric needs of the culture. The control of pests and diseases was not necessary.

The harvest of the fruits was made every five days in stadium of physiological maturity. The following characteristics were evaluated: number of fruits per bunch, number of bunches per plant, number of fruits per plant, average fruit weight (g), fruit productivity (t/ha), pH and total soluble solids of the different tomato lines studied.

The results were submitted to the variance analysis, the averages compared by the Scott-Knott test at 5% of probability.

RESULTS AND DISCUSSION

The different heat tolerant lines of processing tomato, when cultivated under the organic system, presented variation in relation to productive characteristics (Table 1). The lines of the CLN1621group presented in general greater number of fruits per bunch, greater number of bunches per plant and, consequently, greater number of fruits per plant, however, with smaller average fruit weight, when compared to the other studied lines. There was an inverse relationship between the average fruit weight and the number of fruits produced per plant. The lines with smaller average fruit weight (CLN1621L and CLN1621F) produced a greater number of fruits, while the lines with higher average fruit weight produced a smaller number of fruits, with that, the total productivity was the same for all the lines and it was inferior to that found in the literature for determined growth tomato (Marouelli *et.al*., 1991; Faria

Table 1. Average values of tomato fruits obtained from different heat tolerant tomato lines (valores médios de frutos de tomate de diversas linhagens estudadas, tolerantes ao calor). Montes Claros, UFMG, 2005.

Lines	Fruits/bunch (n^0)	Bunches/ plant	Fruits/plant (n^0)	Fruit weight (g)	Fruit yield (t/ha)	pH	TSS (%)
CLN1621L	5.33a	24.17a	129.30a	13.15b	36.33a	4.30a	6.26a
CLN1621F	5.79a	19.83a	115.05a	8.53b	20.96a	4.06a	4.60a
CLN1621E	4.57b	18.33a	85.21b	18.73a	33.80a	4.01a	3.84a
CLN1466P	3.48c	12.17b	42.75c	30.50a	27.11a	4.22a	3.10a
CLN2026E	4.43b	20.58a	92.15b	20.25a	31.51a	4.19a	3.89a
CLN2026D	3.97c	14.25b	56.81c	27.56a	33.09a	4.19a	3.96a
CLN2026C	4.33b	15.92b	70.14b	23.53a	33.78a	4.33a	3.76a
CLN2001C	4.50b	18.17a	81.88b	20.23a	35.49a	4.08a	3.63a
CV (%)	21.56	7.26	15.11	19.88	26.33	9.82	26.03

Average values followed by same letter in column don't differ among themselves by Scott-Knott test at 5% probability (valores médios seguidas da mesma letra na coluna não diferem entre si pelo teste de Scott-Knott a 5%).

et.al., 1996; Aragão *et.al*., 2004). Bettiol *et al*. (2004), comparing the organic and conventional production system using Débora and Santa Clara cultivars, concluded that the productivity of the organic tomato corresponds to 36.5% of the conventional production system.

In the research of Salgado *et al*. (1998), a productivity of 34.1 t/ha was obtained in the organic cultivation of the UC 82 cultivar conducted from the period of November to December in the municipal district of Seropédica in the state of Rio de Janeiro, a result very similar to that found in this work. However, Toledo *et al*. (2011) evaluating the cultivars Chadwick Cherry, Pitanga Vermelha, Marguerita, Santa Clara, Santa Cruz Kada, Nícolas, Ellen, Dominador and Majestade under organic production systems reported an average production between the cultivars from 13.91 to 28.48 t/ha. In our study only lines CLN1621F (20.96 t/ha) and CLN1466 (27.11 t/ha) had a lower yield than the cultivar Marguerita (28.48 t/ ha). Silva *et al*. (2011), using the same organic production system of this work obtained a high production and fruit quality of cherry tomato.

In relation to the fruit quality, there was no statistical difference among lines in relation to the pH and total soluble solid percentage. The pH values of fruits of all the lines are below 4.5, a value below which the tomato fruits are classified as acidic by Gould (1974). The low pH in tomato fruits is important for its processing, since it reduces the risk of bacterial growth. Besides, the higher acidity is related to better fruit flavor and aroma (Panagiotopoulos & Fordham, 1995).

Borguini (2002), analyzing the Carmem and Débora cultivars under organic and conventional cultivation, obtained a pH value of 4.3 and 4.2 and total soluble solids 4.2 and 4.9 in the respective cultivars under the organic system. Ferrreira *et al*. (2010) observed that tomatoes cultivated in the conventional system presented mean values close to that found for tomatoes cultivated under organic conditions, showing no great difference between the systems in relation to the TSS.

According to Chitarra & Chitarra (1990), the total soluble solids represent one of the best ways to evaluate the degree of sweetness of the product, and the sugar level usually represents from 65 to 85% of the total soluble solid levels present in the food (Borguini, 2002).

The most factors that determine the quality of plant products is controlled genetically and is also influenced by other factors such as soil fertility and climatic conditions such as temperature, humidity and light intensity (Ferreira *et al*. 2006). The use of some cultivars few adapted to environmental conditions may result in loss of yield and fruit quality, increased susceptibility to diseases and pests, degeneration, physiological disorders, low capacity for storage, and obtaining products atypical compared to consumer preferences (Silva Junior *et al*., 1995). However, it is of great interest to determine the best cultivars adapted to climatic conditions in the region resulting in greater efficiency of production and less use of inputs, therefore more profitable with less damage to the environment (Peixoto *et al*., 1999).

Symptoms of nutritional deficiency and incidences of pests and diseases were not verified in any of the studied lines.

Considering the potential of these lines, we concluded for their recommendation for research in genetic improvement, because those lines will be important tools in the selection of new superior genotypes, for cultivation under organic systems of production in regions under higher temperature conditions.

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