

## Mulch as a technique to improve the production of cherry tomato in conventional planting system

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**Abstract** – The cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) is one of the most common crops in the world, being an important commercial source for small and medium farmers, and an excellent nutritional vegetable, containing a high number of nutrients, such as lycopene, vitamin C and phenolic acids. Considering that its fruits are the most important and commercialized part of the plant, the non-commercialized part can be used as a dead organic material for the soils cover, characterizing the mulch, which serves as an excellent conservationist method and important tool for degraded horticulture areas. The main objective of the present article was to verify the production of cherry tomato in the conventional planting system, with added mulch or without it, comparing the leaf area, plant height and fruit weight in both systems. The obtained results showed that mulch might be an efficient technique to improve the productive indexes of the cherry tomatoes, significantly affecting the growth indicators, which are directly responsible for increasing productivity.

**Keywords:** Cherry tomato. Mulch. Production. Soil management. *Solanum lycopersicum*.

## Mulch como técnica para aumentar a produtividade do tomate cereja em sistema de plantio convencional

**Resumo** – O tomate cereja (*Solanum lycopersicum* var. *cerasiforme*) é uma das culturas mais comuns do mundo, sendo importante fonte comercial para pequenos e médios agricultores e uma excelente hortaliça no aspecto nutricional, contendo nutrientes essenciais tais como licopeno, vitamina C e ácidos fenólicos. Considerando que a parte mais importante e comercializada são os frutos, a parte aérea não comercializada pode servir de material orgânico morto para cobertura do solo, caracterizando a cobertura morta, a qual é excelente método conservacionista e ferramenta importante para áreas degradadas de horticultura. O principal objetivo do presente artigo foi verificar a produção do tomate cereja no sistema de plantio convencional, sendo acrescido de cobertura morta ou não, comparando a área foliar, altura de plantas e peso de frutos produzidos em ambos os sistemas. Os resultados obtidos mostram que a prática da cobertura morta pode ser uma técnica eficiente de melhoria nos índices produtivos da cultura do tomate cereja, afetando significativamente os indicadores de crescimento, os quais são diretamente responsáveis pelo aumento da produtividade.

**Palavras-chave:** Tomate cereja. Cobertura do solo. Produção. *Solanum lycopersicum*.

### Introduction

The tomato (*Solanum lycopersicum*) is one of the most common crops in the world, being an important commercial source for small and medium farmers. Among the different types of tomatoes, the cherry type (cerasiform variety), introduced in Brazil in the 1990s, is an excellent

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vegetable in a nutritional aspect, providing essential nutrients such as lycopene, vitamin C and phenolic acids (MONTEIRO *et al.*, 2018).

Knowing that agriculture is an area where anthropic actions are massively significant, soil and water quality have a tendency to be affected by both natural factors and impacts of human activities. In this regard, Pereira *et al.* (2016) affirms that the soil and water quality needs to be preserved with techniques that can reduce the human impact and use of natural resources by conventional agriculture.

According to Novak *et al.* (2018), it is known that inadequate soil management can generate serious consequences, depleting its organic and mineral reserves and resulting in low fertility lands, acidic soils and saturated by aluminum, thus reducing productivity and making adopt practices to minimize those problems necessary. This degradation is associated with the soil's productive capacity and management, being evaluated by his physical properties, which are influenced by factors such as climate, soil class, granulometry, mineralogy and the use to which the soil is subjected (SALES *et al.*, 2016).

The same kind of soil, submitted to different management practices, can present significant differences in its properties and in the formation of its aggregates, as well as in his chemical composition. Farooq *et al.* (2018) says that the soil protection using mulch, which is characterized as the use of dead organic material, such as straw or leaves, has been an effective practice, protecting it from climatic agents and providing a continuous increase of organic material.

Mulch brings an improvement to the production, protection of the soil surface, humidity increase, maintenance of its structure, conservation of aeration, dissipation of kinetic energy of raindrops and erosion, reduction of water runoff and, consequently, lower soil moisture variability on the superficial soil layer, with higher root concentration and less irrigation need (ROCHA *et al.*, 2018).

The main objective of this article was to verify the influence of mulch on cherry tomato production, comparing the leaf area, plant height and fruit weight.

## **Material and methods**

The experiment was conducted at the Catarinense Federal Institution - Camboriú Campus (IFC-CC), in the Horticulture Sector, located in the city of Camboriú/Santa Catarina, 27° 01' S, 48° 39' W, 8.0 m high. The culture used was cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) cultivar *Perinha*, with the germination of 90%, produced in the 2011/2012 harvest and free distributed by EPAGRI Experimental Station of Ituporanga.

The seeds were implanted in polyethylene trays, with substrate in a proportion of 40% charcoal rice husk, 40% mineral soil and 20% organic compost, with the trays conditioned in a greenhouse with 50% shading after planting, in which they received regular irrigation until the soil was visually saturated.

To determine the soil granulometric characteristics of the experimental area, eight undisturbed samples from the 0.00 to 0.20 and 0.20 to 0.40 meters (m) layers were collected, as instructed by the methodology described by Nikkel e Lima (2019). The sample was sent to the Laboratory of Soil Physical Analysis, of the Santa Catarina State University, Lages/Santa Catarina, being classified, according to the results showed in Table 1, as a "frank texture" for both layers.

Table 1 – Soil analysis of the Horticulture Sector of the Catarinense Federal Institution - Camboriú Campus

Layer (m)	Clay (%)	Silt (%)	Total sand (%)	Coarse sand (%)	Thin sand (%)
0.00-0.20	25.16	37.27	37.57	7.67	29.92
0.00-0.20	24.77	37.66	37.57	7.21	30.36
0.20-0.40	27.45	32.17	40.38	7.25	33.13
0.20-0.40	27.85	34.04	38.11	6.59	31.52

Source: Personal data (2015)

The used area for the experiment was 72.0 m<sup>2</sup>, consisting of 8 plots 1.2 m wide by 7.5 m long, of which all of them were prepared according to the conventional planting system and 4 plots were added with mulch.

The initial preparation of the area was performed by plowing and raising the beds in a mechanized way, and then it was manually done in a weekly basis. The soil cover used in the beds originated from cultural remains from the Horticulture Sector, implanted at a height of approximately 15 cm after being dried in the sun for 72 hours (MAIA JÚNIOR *et al.*, 2019). The fertilization of the beds was carried out before the transplant, with a total of 300 kg of the formula NPK 05-20-20 and the transplantation to the final area was carried out 44 days after sowing in trays, spacing 0.5 m between plants, making up one cultivation line per plot.

The experimental number was chosen based on the experimental design, which was characterized as a completely randomized design, with eight plants selected per treatment (n = 16). All plants were thinned to develop in the form of a single central stem, being tutored and moored by means of bamboo cuttings with plastic strips.

The irrigation water was collected from the rainwater and stored in a water tank of 10,000 liters, built in a drip system with a central line in each plot. The measurement for the irrigation management was made through tensiometers installed between 15 and 30 cm deep (SOUZA *et al.*, 2015), in which the current moisture was monitored through the soil matrix potential.

Plant height (PH) and production per plant (PP) were determined by 2 plants per plot. The determination started 38 days after transplant (DAT) and then performed again on days 45, 52, 60, 97, 113 and 125 after transplant.

The leaf area was determined by the non-destructive method by measuring the length and width of all leaves of the marked plants. The length was defined as the distance between the insertion point of the petiole in the leaf limb and the opposite end of the leaf, while the width was considered the largest dimension perpendicular to the axis of the length, with a form factor equal to 0.59 (REIS *et al.*, 2013), according to Eq. 1.

$$LA = L \times W \times f \quad (1)$$

In which:

LA – leaf area (m<sup>2</sup>);

L – leaf length (m);

W – leaf width (m);

f – form factor (0.59).

The plant height was determined by measuring the vertical distance between the first and last node of the stem, as shown on Eq. 2 (MARTINEZ *et al.*, 2007).

$$PH = A \leftrightarrow B \quad (2)$$

In which:

PH – plant height (m);

A – first node;

B – last node.

The production per plant was determined by weighing its visibly ripe fruits on a precision scale (kg), according to the methodology suggested by Queiroga *et al.* (2002), when the stages of flowering and fruiting started.

In order to evaluate the LA and PH, according to the number of days after transplantation, a third-order polynomial equation was used, during the period of highest plant development, on randomly seven selected days (HEIKAL, 2017).

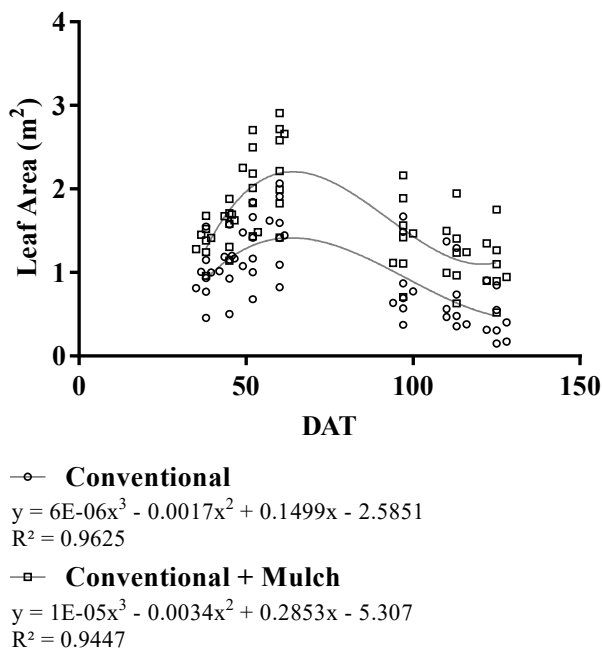
Data statistical analysis was done using the GraphPad Prism 7 statistical program, first subjecting all data to the Shapiro-Wilk normality test, and then using Two-way ANOVA (Sidak for multiple comparisons) and Student's t-test, both assuming  $p < 0.05$ .

## Results and discussion

All analyzed data sets were under normal distribution in the Shapiro-Wilk normality test.

The highest growth occurred in the 60 DAT, as seen in Figure 1, in which the average values of leaf area in the mulch treated plants reached 2.29 m<sup>2</sup>, while the average value of the untreated plants was 1.49 m<sup>2</sup>, about 34.9% lower, in the same period.

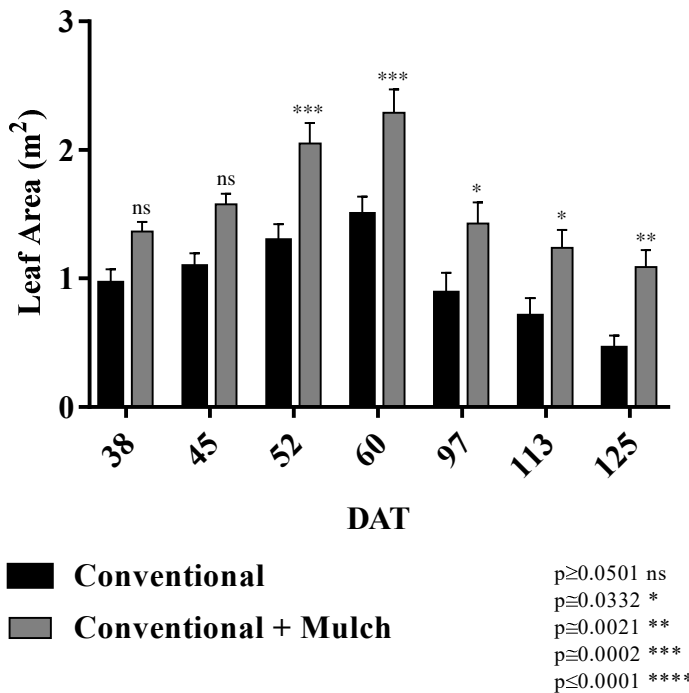
Figure 1 – Distribution and polynomial curve of leaf area of tomato plants grown in the conventional planting system with and without mulch. Points on the graphic are staggered.



Source: Personal data (2019)

The leaf area data did not present statistical difference at the beginning of the monitoring, but deferred in the analyzed periods from 52 DAT, considering the 7 analyzed periods, according to Figure 2.

Figure 2 – Leaf area of tomato plants, grown in conventional planting system with and without mulch. Each bar represents the mean  $\pm$  S.E.M. (Standard error of the mean) of 8 plants.

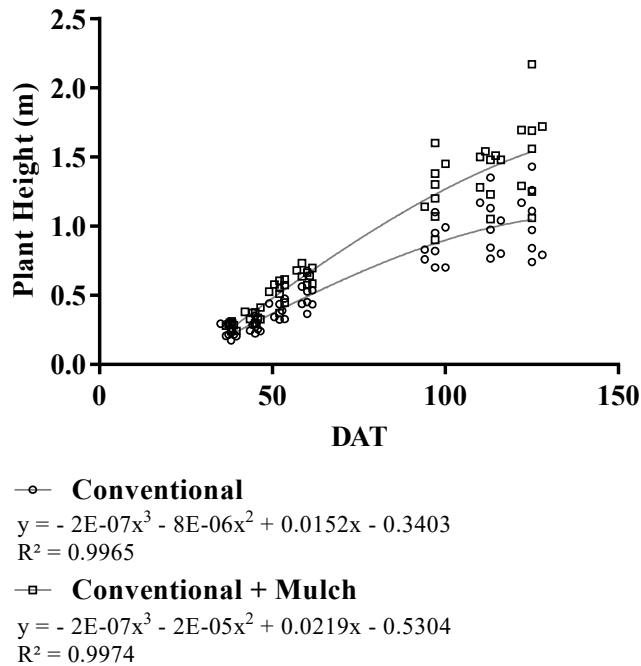


Source: Personal data (2019)

These data agree with those already found by Boyd, Gordon and Martin (2002), that affirm the fact that leaf area index is highly correlated with soil cover, with its Pearson correlation coefficients varying from 77 to 94% in experiments with potato (*Solanum tuberosum* L.). Soil cover prevents competition, thus leaving more nitrogen available in the soil for the main culture, which increases leaf production and, consequently, the uptake of photosynthetically active radiation, that reflects positively in the fruit production (MUKHERJEE; SARKAR; SARKAR, 2017).

The highest height occurred in the 125 DAT, as seen in Figure 3, in which the average values of plant increases when treated with mulch reached 1.55 m, while in the same period, the mean value of the untreated plants was 1.04 m, about 32.9% lower.

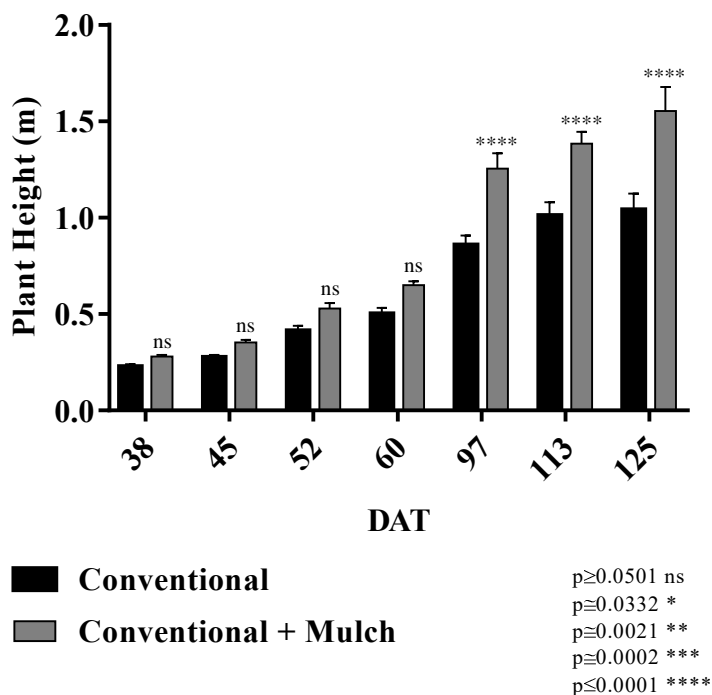
Figure 3 – Distribution and polynomial curve of plant height of tomato plants, grown in the conventional planting system with and without mulch. Points on the graphic are staggered.



Source: Personal data (2019)

The data of PH did not show statistical difference at the first measurements, but had a significant divergence from 97 DAT, considering the 7 analyzed periods, according to Figure 4.

Figure 4 – Plant height of tomato plants, grown in conventional planting system with and without mulch. Each bar represents the mean ± S.E.M. (Standard error of the mean) of 8 plants.

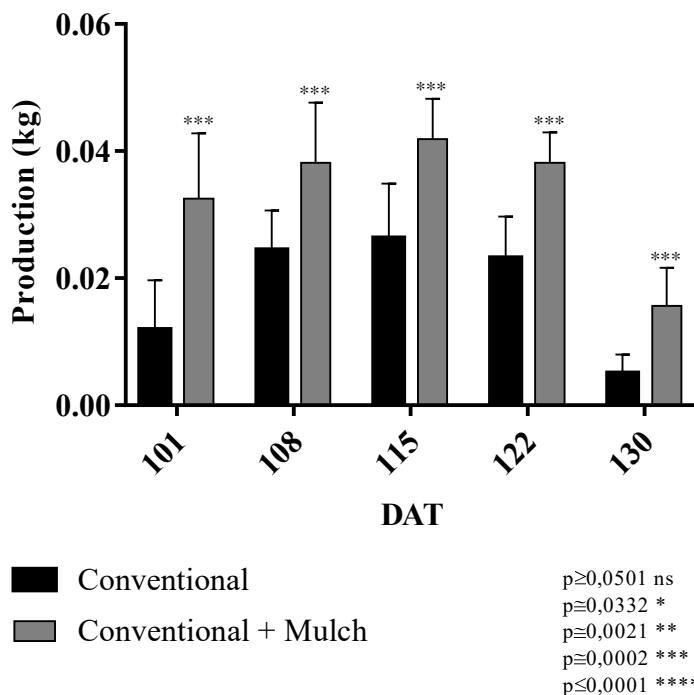


Source: Personal data (2019)

These data are alike to those already found by Martinez *et al.* (2007), which confirms the fact that well fertilized plants, as an effect proportioned by mulch, grown higher, by the high values and direct effect of correlation in this variables, based on studies with coffee cultivars (*Coffea arabica* L.).

The plant production (PP) values demonstrated overall statistical difference in both cases, as between the conventional and conventional plus mulch as in the paired groups, assuming each of the 5 measurements as an individual pair. As seen in Figure 5, the highest production occurred in the 115 DAT, in which the weight of the fruits produced by mulch treated plants was about 41.8% higher than that produced by the untreated ones.

Figure 5 – Production of tomato plants, grown in the conventional planting system with and without the use of mulch. Each bar represents the mean  $\pm$  S.E.M. (Standard error of the mean) of 8 plants.



Source: Personal data (2019)

These data agree with those already found by Queiroga *et al.* (2002), which verified that the number of fruits per plant had the most expressive effect on the increase of the chili crop (*Capsicum annuum* L. *Yolo Wonder*) production when mulch was used. These studies also verified that the improvement of the environmental conditions works favorably on the quantitative characteristics of the fruits produced.

The use of straw as mulch was an effective management in the conventional planting system (CPS), since it better controlled soil moisture and soil temperature. It resulted in a higher grain production, water use efficiency and increased economic benefits for the wheat culture (*Triticum aestivum* L.), when compared with the control group, which one did not use mulch treatment (LIU *et al.*, 2018).

The growth increase of the plants treated with mulch in experiments performed by Moura, Albuquerque and Aguiar (2008), which LA and PH are indicators, increases the photosynthetic area and consequently, but not as a rule, the production. In studies with corn (*Zea mays*), a difference was observed in the weight of 100 grains, with mulch being the main factor contributing to higher production.

The Pearson correlation found in our experiments, according to Table 2, shows that the PP has a positive correlation with FA and negative correlation with PH.

Table 2 – Correlation between Plant production (PP) and Leaf area (LA) or Plant height (PH)

	LA Conventional	LA Conventional + Mulch	PH Conventional	PH Conventional + Mulch
<b>PP Conventional</b>	77.85%		- 55.34%	
<b>PP Conventional + Mulch</b>		60.96		- 79.96

Source: Personal data (2019)

These data agree with those already found by Martinez *et al.* (2007), which confirms the fact that PH has a negative effect in the production, meaning that the tallest plants have less fruit weight on their production, caused by the deviation of energy for the knot stretching. On the other hand, the LA had positive effect in the production, which is a similar result to other data already found by Boyd, Gordon and Martin (2002), stating that leaf area index and soil cover have high Pearson correlation and explained 74 to 79% and 74 to 87%, respectively, of production in experiments with potato (*Solanum tuberosum* L.).

## Conclusions

Mulch, consisting of the use of dead vegetable matter as a soil cover, may be an efficient technique to improve cherry tomato crop productive rates. This conservationist practice leads to a significant increase in leaf area in 34.9% and plant height in 32.9%, being the leaf area the prevailing indicator, according to the positive Pearson correlation and the obtained production results.

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