

Physical-chemical quality and bioactive compounds of red bell pepper, under soil cover and fertilization

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ABSTRACT: Bell pepper crop is among the ten most important vegetables in Brazil. Using organic fertilizers as an alternative to mineral fertilizers is an integral part of the search for safe food from organic production systems. The objective of the present study was to evaluate the quality of red bell pepper fruits, grown under soil cover and organic and or mineral fertilization. Treatments consisted of three soil cover types [no cover; covered with carnaúba straw (*Copernicia prunifera*) and covered with weeding] and fertilizers [100% organic (OF) and 0% mineral (MF); 100% OF and 50% MF; 50% OF and 50% MF; 50% of OF and 100% of MF and 0% of OF and 100% of MF], the design used was randomized blocks with a split plot arrangement of 3 x 5 and 4 replicates. Analyzed variables were color, firmness, pH, soluble solids (SS), titratable acidity (TA), ratio (SS/TA), vitamin C, carotenoids, total flavonoids and phenols. For bell pepper fruits, soil cover with carnaúba straw provided better carotenoid content. Organomineral fertilization increased carotenoids and phenols accumulation and the treatment with only organic fertilization resulted in lower contents of these bioactive compounds.

Key words: *Capsicum annuum* L.; mulch; nutraceutical value; organomineral

Qualidade físico-química e compostos bioativos de pimentão vermelho, sob cobertura de solo e adubação

RESUMO: A cultura do pimentão está entre as dez hortaliças de maior importância econômica no Brasil. A utilização de adubos orgânicos, alternativamente ao uso de adubos minerais, é parte integrante da busca por alimentos seguros provenientes de sistemas de produções orgânicas. O objetivo do trabalho foi avaliar a qualidade de frutos de pimentão vermelho, cultivado sob cobertura de solo e adubação orgânica e ou mineral. Os tratamentos foram compostos por três tipos de cobertura de solo [sem cobertura; coberto com palha de carnaúba (*Copernicia prunifera*) e coberto com capinagem] e adubações [100% orgânica (AO) e 0% de mineral (AM); 100% de AO e 50% de AM; 50% de AO e 50% de AM; 50% de AO e 100% de AM e 0% de AO e 100% de AM], o delineamento utilizado foi blocos ao acaso, com arranjo de parcelas subdivididas 3 x 5 e 4 repetições. As variáveis analisadas foram: coloração, firmeza, pH, sólidos solúveis (SS), acidez titulável (AT), relação (SS/AT), vitamina C, carotenoides, flavonoides totais e fenóis. Para os frutos de pimentão a cobertura do solo com palha de carnaúba proporcionou melhor teor de carotenoide. A adubação organomineral incrementou o acúmulo de carotenoides e fenóis e o tratamento com apenas adubação orgânica resultou em menores conteúdos destes compostos bioativos.

Palavras-chave: *Capsicum annuum* L.; cobertura morta; valor nutracêutico; organomineral

Introduction

Bell pepper crop has enormous relevance, standing out among the ten most important vegetables in Brazil in terms of economic value. In the survey of socioeconomic data of the vegetable production chain, in 2012, the value of bell pepper production was of R\$ 567.00 million; reaching R\$ 1,132.10 and R\$ 2,012.30 million in wholesale and retail, respectively (ABCSEM, 2014).

Due to its versatility and nutritional properties, it can be commercialized in natura and integrated into agribusiness, making this crop one of the most consumed vegetables by the Brazilians. According to Moura et al. (2013), the estimate is that the area cultivated with the genus *Capsicum* in Brazil is 5 thousand hectares annually, allowing an average production of 15 tons per hectare, thus resulting in employment and income for its producers (Trecha et al., 2017).

Inorganic fertilizers are used in vegetables cultivation; however, these fertilizers do not promote improvements in the soil, unlike the organic fertilizers, which have the advantage of keep structuring the soil. Moreover, inorganic fertilizers can cause long-term damage to the soil, since they can be leached and thus contaminate groundwater (Batista et al., 2013; Liang et al., 2013). Therefore, alternatives that make agricultural production feasible without reducing the harvested products quality and that also provide a good quality of life for the rural producers by increasing their financial return are extremely relevant (Vendruscolo et al., 2017).

Using organic residues such as straw and organic fertilizers of animal or vegetable origin (manure) are viable alternatives to the producer, as they guarantee the necessary nutrients to the plants. They can also supply organic matter to the soil and reduce the amount of inorganic fertilizers added to it. In addition to this, organic residues makes it possible maintaining soil quality as well as avoid problems with nutrient degradation and leaching (Hernández et al., 2016; Sediyaama et al., 2014).

Vegetables require macro and micronutrients that organic fertilizers do not have in sufficient quantity, requiring external supply in the form of chemical fertilizers. These fertilizers allow plant growth and development, when used in correct amounts. There is a lack of studies related to using mineral fertilizers linked to organic fertilizers, as well as its influence on the functional quality of agricultural products.

One of the alternatives in providing greater crop yield and better fruit quality are the organomineral fertilizers, which are composed of a mixture from mineral and organic fertilizers and have good potential for agricultural use, since they tend to have a lower cost in relation to mineral-only fertilizers (Malaquias & Santos, 2017).

Studying the interaction of soil cover with organomineral fertilization is a necessity because, in vegetable cultivation, techniques of using organic fertilizers have been favored by the producers (Farias et al., 2017), mainly for inhibiting the weeds infestation, which can cause significant losses in yield when not controlled. In addition, it can minimize soil problems due to erosion, making it more productive and providing greater production and quality of vegetables (Souza et al., 2016).

Content of phenolic compounds and antioxidant activity of bell pepper fruits are of great relevance, thus accentuating its nutraceutical potential, a factor interconnected with the development of the plant grown in an environment favorable to a balanced fertilization. Porto et al. (2016), describe that when there is a reduction in the ascorbic acid levels, in the flavonoids concentration, in the phenolic compounds content and in the antioxidant activity, the functional quality of the fruits is impaired.

This study aimed to evaluate the physical-chemical characteristics and the content of bioactive compounds of the cultivated 'Melina' red bell pepper, under organic, mineral and organomineral fertilization and different soil covers.

Materials and Methods

The experiment was conducted in a greenhouse at the facilities from the Federal University of Campina Grande (UFCG), Center for Science and Technology Agrifood (CCTA), at the experimental farm in the municipality of São Domingos-PB, from December 2016 to June 2017. The location of the city is at the coordinates 6°48'51.7" South latitude and 37°56'13.8" West longitude, with an altitude of 190 m.

The experimental design used was in randomized blocks. Tested treatments were three soil cover types: no cover; covered with crushed straw of carnaúba (*Copernicia prunifera*) and covered with weeding, associated with five fertilizations: 100% of the organic fertilizer recommended dosage and 0% mineral fertilizer; 100% of the organic fertilizer recommended dosage and 50% of mineral fertilizer; 50% of the organic fertilizer recommended dosage and 50% of the mineral fertilizer recommended dosage; 50% of the organic fertilizer recommended dosage and 100% of the mineral fertilizer recommended dosage and 0% of the organic fertilizer recommended dosage and 100% of mineral fertilizer.

The treatments were allocated in 3 x 5 subdivided plots, totaling 15 treatments, where the plots constituted from the soil cover and the sub plots from the proportions of fertilizer sources, and each combination of treatments had four replicates.

Dosages of organic fertilizer and mineral fertilizers (phosphorus, nitrogen and potassium) were calculated according to the recommendations for the crop. Bovine manure was used for organic fertilization, with the following characterization: DM = 95%; N = 2.53%; P = 2.9%; K = 1.56%; OM = 45% and pH = 7.89 according to the analysis performed in the CCTA/UFCG soil and plant laboratory. The 100% dosage was calculated according to the methodology of Furtini Neto (2001).

For determining the 100% mineral fertilizer dosage, the recommendation for the crop from the state of Pernambuco was used (Cavalcanti, 2009). For mineral fertilization, urea was used as a source of nitrogen, simple superphosphate as a source of phosphorus and potassium chloride as a source of potassium.

The soil was prepared by plowing with an animal-drawn moldboard plow and the plots construction, allowing a

greater restructuring and aeration of it, since this was the first experiment after the earthwork held for installing the physical structure of the greenhouse. Soil from the first 30 cm of surface was collected for analysis (Table 1).

Each block consisted of three cultivation lines, 10 m long each, representing the three plots with 25 plants, spaced 1.30 x 0.40 m apart, totaling 75 plants per block, subdivided into five subplots containing five plants, with the three central plants considered as useful for data sampling.

The irrigation system was of the localized type, having adjustable drippers with flow rates of 1.6 L h⁻¹ spaced at 40 cm. Two daily irrigations of one hour each were held during the experiment.

For planting fertilization, 500 g of bovine manure was applied per plant 15 days before transplanting the seedlings. The mineral topdressing fertilization was carried out in three parts at 25, 45 and 60 days after transplanting the seedling, meeting the recommendation for the crop from the state of Pernambuco (Cavalcanti, 2009), in each application were used 2.5 g of N; 3.5 g of P₂O₅ and 0.87 g of K₂O. In planting and topdressing fertilizations, for mineral fertilization, urea was used as a source of nitrogen, simple superphosphate as source of phosphorus and potassium chloride as source of potassium.

After incorporating the planting fertilizer, the soil was covered according to the pre-established treatments, receiving a 15 cm layer of the plant materials. In its preparation, the crushing of the carnaúba straw was carried out in a Tr200 organic material crusher from Trapp. The weeding cover consisted of remnants of dry vegetation from the clearing of areas near the greenhouse.

Seedlings were obtained from bell pepper seeds of the Melina cultivar commercialized by Sakata, rectangular shape, with large caliber fruits, of reddish color, predominance of 4 locules, thick walls and commercialization ease due to the fruits attractiveness (Sakata, 2017). Sowing was carried out in 162 cell polyethylene trays, filled with commercial agricultural substrate Basaplant®. The transplant to the final location was held at 35 days after sowing (DAS).

Staking was carried out when the plant reached approximately 20 cm in height, by sticking two stakes in the furrow center at both ends of the subplots. Two polyethylene strips were tied at a 60 cm height of the stakes, which then

intertwined the plants, one on each side, helping to guide them, thus preventing them from falling with the fruits weight.

Eight weekly harvests were held, with the first at 120 days after transplantation (DAT), collecting from four to six fruits that displayed 100% of their color as red, free from defects, pests and rot.

The fruits were sent to the UFCG Food Analysis Laboratory, where they were washed in running water, in order to remove residues from the field and, later, sanitized in sodium hypochlorite solution at 100 mg L⁻¹ for 10 minutes, and then rinsed under running water. Afterwards, the fruits were placed on a bench with paper towels for drying.

The firmness of the fruit was evaluated aided by a digital Penetrometer, by pressing it twice on the fruit at its both ends. For the color variable, the CIELab method was used, by employing the Minolta colorimeter CR-200b model, with two readings per fruit.

Subsequently, the bell peppers were cut and the locular content was discarded. With the pericarp, an extract was made using a mixer and then it was placed in duly identified plastic pots, covered with aluminum foil.

The pH was determined directly in the crushed pulp plus 100 mL of distilled water, by using a digital potentiometer (AOAC, 1995). The titratable acidity was determined according to the methodology recommended by the Adolfo Lutz Institute (2005), obtained from the titration with the 0.1 mol L⁻¹ NaOH solution, using phenolphthalein (1%) as an indicator. The reading was performed in duplicate and the results expressed as a percentage.

Soluble solids content was determined through liquid extract from bell pepper, using the digital refractometer with automatic temperature compensation, expressed in °Brix; soluble solids/titratable acidity ratio (SS/TA), performed by dividing soluble solids content by titratable acidity obtained in samples; vitamin C was obtained according to the methodology of Terada et al. (1978), expressed in mg 100g⁻¹; phenols were determined by using Folin-Ciocalteu spectrophotometric method (Horwitz, 1995); total flavonoids were quantified according to methodologies described by Awad et al. (2000), Results were calculated according to rutin calibration curve and expressed in mg of 100g⁻¹ rutin of sample. Carotenoids were determined by using the method validated by Sims and Gamon (2002).

Table 1. Chemical and physical compositions of the soil taken from the 0-20 cm layer.

Chemical characteristics		Physical characteristics	
pH (H ₂ O)	7.7 A	Sand (g kg ⁻¹)	770
Organic matter (g kg ⁻¹)	28.38 M	Silt (g kg ⁻¹)	95
Ca (cmol _c dm ⁻³)	12.8 A	Clay (g kg ⁻¹)	135
Mg (cmol _c dm ⁻³)	3.3 A	Bulk density (g cm ³)	1.43
P (mg dm ⁻³)	209.25 A	True density (g cm ³)	2.54
K (cmol _c dm ⁻³)	0.34 B	Total porosity (m ³ m ³)	0.32
Na (cmol _c dm ⁻³)	0.25 B	Available water (g kg ⁻¹)	54
SB (cmol _c dm ⁻³)	16.7 A	Natural clay (g kg ⁻¹)	121
CEC (cmol _c dm ⁻³)	16.7 A	Flocculation degree (g kg ⁻¹)	174
V%	100 A	Mpa Humidity 0.01 (g kg ⁻¹)	97

Letters (A) for high, (M) for medium and (B) for low indicate the value interpretation in the chemical contents of the soil, according Sobral et al. (2015).

Data were subjected to analysis of variance (ANOVA) at 5% probability, in order to study the effect of treatments that were arranged in a subdivided plot, where the plots represented the types of soil cover and the subplots were the types of fertilization. The means that showed a significant difference were compared by using the Tukey test at 5% probability. For the statistical analysis, the program Sisvar, version 5.6, was employed (Ferreira, 2011).

Results and Discussion

Regarding the variables of physical analysis of the fruits, the statistical analyzes showed only significant isolated effects of the different cover types, at the level of 5% probability, by the F test, on the hue angle (h°) and of the fertilization on the color intensity by chromaticity (C^*) (Table 2).

Fertilization with 100% organic fertilizer without the addition of mineral fertilizer promoted the highest chromaticity value (C^*), 40.56; this said value indicates greater color intensity of the bell pepper fruits. However, when increasing the proportions of mineral fertilizer, there was a reduction in the chromaticity saturation index (C^*), reaching the lowest value (36.29) in the organomineral treatment with a higher mineral fertilization percentage (Figure 1A).

Using organic fertilizers associated with the lowest doses of mineral fertilization was probably beneficial for fertility, promoting improvements in the soil, and consequently higher quality bell pepper fruits (Figure 1A), as it is possible that soil cycling nutrients have contributed significantly to their improvement, due to its positive effects and in particular, by the increase in the levels of organic matter, Ca, Mg, in the sum of bases and the CEC in soil (Silva et al., 2013). Therefore, as

they are well nourished, the plants obtained fruits with more intense colors, since the addition of organic matter in the soil in greater proportions increased the nutrients availability to the plants and, thus, met their nutritional requirements.

It is observed that the hue angle (h°) had higher values in the bell pepper fruits grown in soil with no cover, attaining 24.52° , a higher value than those of the fruits from plants grown in soil covered with carnaúba straw, which had an angle of 22.90° . High values in the hue angle in both situations indicate the strongest red fruit color (Figure 1B).

Carnaúba straw cover provided to the fruits statistically lower values, but ideal for the hue (h°), characterizing a greater pigmentation presence. Intense reddish tones can occur due to higher carotenoids proportion (Pedó et al., 2014). This reduction may be possibly associated with the greater soil structuring due to the cover use, with greater water retention efficiency in the soil, with it available for longer periods when the carnaúba straw is used, which in turn enhanced the purple hue of the red bell pepper fruit. Moreover, this improvement can be attributed to the absence of water, light and nutrients competition from invasive plants with bell peppers, providing less competition and, consequently, greater supply of water and nutrients to the plants (Souza et al., 2016). Preczenhak et al. (2014), when evaluating the agronomic characteristics from genotypes of mini tomatoes found hue angle ranging from 25.76 to 85, values higher than those found in this study.

For the chemical variables of bell pepper fruits, statistical analyzes revealed only significant effects for the interaction between cover types and fertilization for the soluble solids content and demonstrated an isolated effect of fertilization types on the SS/TA ratio (Table 2).

Table 2. Summary of analysis of variance for the following characteristics: firmness, color (L^* , C^* and h°), pH, soluble solids (SS), titratable acidity (TA), soluble solids/titratable acidity ratio (SS/TA), vitamin C, carotenoids, flavonoids and phenols in 'Melina' bell pepper fruits submitted to different proportions of organomineral fertilization and soil cover types.

VF	DoF	MS					
		Firmness	L^*	C^*	h°	pH	SS
Block	3	1.052 ^{ns}	16.162 ^{ns}	21.570 ^{ns}	18.749*	0.014 ^{ns}	4.829 ^{ns}
Cover (C)	2	3.601 ^{ns}	18.432 ^{ns}	9.106 ^{ns}	14.627*	0.002 ^{ns}	8.698 ^{ns}
Residual (a)	6	0.878	8.406	17.564	2.271	0.051	10.247
Fertilization (A)	4	0.345 ^{ns}	2.136 ^{ns}	34.518*	5.154 ^{ns}	0.036 ^{ns}	7.468 ^{ns}
Interaction C x A	8	1.480 ^{ns}	4.628 ^{ns}	16.067 ^{ns}	5.372 ^{ns}	0.044 ^{ns}	10.218*
Residual (b)	4	1.303	6.758	9.578	7.231	0.051	4.469
Mean		8.69	30.40	38.03	23.87	5.01	8.51
CV (%) – C	-	10.79	9.54	11.02	6.31	4.53	37.62
CV (%) – A	-	13.14	8.55	8.14	11.27	4.52	24.84
		TA	SS/TA	Vitamin C	Carotenoids	Flavonoids	Phenols
Block	3	1.275*	22.308 ^{ns}	53.486 ^{ns}	37.798*	0.069*	0.518**
Cover (C)	2	0.116 ^{ns}	0.250 ^{ns}	74.106 ^{ns}	10.281 ^{ns}	0.016 ^{ns}	0.129 ^{ns}
Residual (a)	6	0.254	14.879	19.763	3.993	0.012	0.050
Fertilization (A)	4	0.150 ^{ns}	27.864*	22.680 ^{ns}	1.675 ^{ns}	0.060 ^{ns}	0.446*
Interaction C x A	8	0.481 ^{ns}	17.968 ^{ns}	19.003 ^{ns}	19.838*	0.051 ^{ns}	0.253 ^{ns}
Residual (b)	4	0.225	9.927	20.757	8.146	0.029	0.130
Mean		1.37	7.30	24.26	42.40	1.16	1.86
CV (%) – C	-	36.72	52.81	18.32	4.71	9.35	12.03
CV (%) – A	-	34.52	43.14	18.78	6.73	14.74	19.45

ns, *, **respectively non-significant, significant at $p < 0.05$ and at $p < 0.01$.

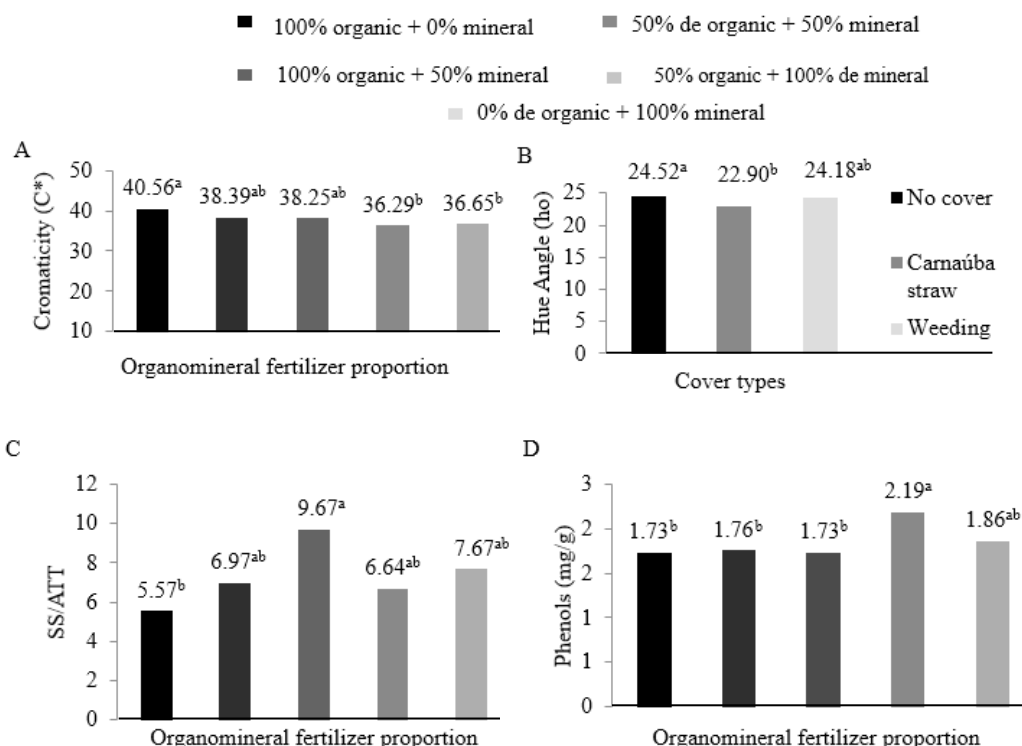


Figure 1. Chromaticity (A), hue angle (B), soluble solids/titrable acidity ratio (B) e phenols (C) in Melina bell pepper fruits subjected to different proportions of organomineral fertilization.

For the soluble solids content of bell pepper fruits (Table 3), it was observed that the fertilization of 50% of organic fertilizer added to 50% of mineral fertilizer associated to with carnaúba straw cover provided the highest values, displaying the SS content of 13.18 °Brix.

This result may have been favored by the time the soil was under the cover with carnaúba straw, which according to Linhares et al. (2014) has a C/N ratio of 40/1, a determining factor for the material decomposition, thus the soil is kept for a longer time without thermal and water oscillations. Moreover, especially when in addition to the soil cover, the environment is enriched with a balanced fertilization with nutrients in mineral form, which is readily available, and in organic sources that beyond allowing a slow release of nutrients, acts as a physical conditioner of the soil. In this created environment, plants develop roots with greater water and nutrient absorption capacity that favors the quality of all stages of the cycle and its organs.

Fruit quality can occur in plantations with organomineral fertilization, when the organic part improves the soil properties, increasing absorption and supply of nutrients to the plants, since organic fertilizers alone can have low concentrations of N, P and K. Then, in this type of fertilization, nutrients are supplemented with mineral fertilization, in order to favor the release timing throughout the growth of the plants (Silva et al., 2013).

Values found in this present study ranged from 6.66 to 13.18 °Brix and are higher than the values verified by Braga et al. (2013) when analyzing the physicochemical characteristics of *Capsicum frutescens* L., in which soluble solids values of 10.38 °Brix were obtained.

The relation between the soluble solids content and the titrable acidity from bell pepper fruits (Figure 1C) showed greater value with the use of fertilization with 50% organic fertilizer added to 50% mineral fertilizer, attaining in this treatment the value of 9.67. On the other hand, plants that

Table 3. Soluble solids content (°Brix) in Melina bell pepper fruits subjected to different proportions of organomineral fertilization and soil cover types.

Soil cover type	Fertilization type				
	100% organic fertilizer + 0% mineral fertilizer	100% organic fertilizer + 50% mineral fertilizer	50% organic fertilizer + 50% mineral fertilizer	50% organic fertilizer + 100% mineral fertilizer	0% organic fertilizer + 100% mineral fertilizer
No cover	7.65aA	8.27aA	8.68bA	7.92aA	9.06aA
Carnaúba straw	8.95aAB	7.08aB	13.18aA	9.52aAB	7.48aB
Weeding	6.66aA	8.56aA	7.42bA	8.66aA	8.55aA
LSD row	3.10				
LSD column	2.47				

Means followed by the same uppercase and lowercase letters in the rows and columns, respectively, do not differ statistically from each other by the Tukey test at 5% probability ($p \geq 0.05$); LSD: least significant difference.

received only 100% organic fertilization had the lowest value in SS/TA (5.57). High values in the SS/TA ratio provide better fruit flavor, as they indicate less acidity. Concomitantly, lower titratable acidity is reflected in sweeter fruits and with better market acceptance (Pedó et al., 2014).

It was also observed by the analysis of variance for the bioactive compounds that the interaction between the cover types and organic and/or mineral fertilization treatments showed a significant behavior on the carotenoid content and also isolated effect of the fertilization types on the phenol content in the fruits (Table 2).

When analyzing the proportions effect of organomineral fertilization and the soil cover types on carotenoids content in bell pepper fruits (Table 4), emphasizing the dependence between the two factors, the fertilization containing 100% of organic fertilizer and 50% of mineral fertilizer associated with carnaúba straw had the best result, providing fruits with 45.43 mg 100 g⁻¹ of carotenoids.

This fact evince that the use of mulch (dead cover) also favors the development of beneficial microorganisms to the plant, since when decomposed, they probably may have provided essential nutrients to it. Coupled to this is the fact that the greater amount of organic matter promotes improvements in physical, chemical and biological characteristics of the soil, as the nutrients provided by mineral fertilization are more efficiently retained in the soil colloids, which possibly allowed this interaction to provide an improvement in nutritional efficiency and, consequently, in the fruits quality.

High carotenoids values are desired because in addition to them being a visual attraction, these compounds have functional properties, as they act on the immune system, associated with a lower risk of heart disease and some types of cancer, as well as protection against age-related macular degeneration (Gul et al. 2015; Liu et al. 2016).

Values found in this study are higher than those obtained by Pedó et al. (2014) who, evaluating the physicochemical characterization of sweet cultivar bell peppers submitted to different sources and organic fertilizer dosages, obtained values of 14.27; 11.78 and 12.08 mg g⁻¹ of carotenoids. Porto et al. (2016), when evaluating the quality and antioxidant activity of tomatoes grown under different sources and doses of nitrogen, found an increase from 3.33 to 4.47 g of 100 g⁻¹ in the carotenoid content, when the N doses were elevated from 0 to 420 kg ha⁻¹.

Fertilization with 50% of organic fertilizer added to 100% of mineral fertilizer provided to bell pepper fruits a phenolic contents of 2.19 mg of gallic acid 100g⁻¹ (Figure 1D), superior to other treatments and statistically equal to the fruits value that received only mineral fertilization. This indicates that the decrease in the manure percentage in the organomineral fertilization did not cause reductions for this variable, possibly the mineral fertilization favored a higher production of total phenols in the bell pepper fruits.

Pedó et al. (2014), when evaluating the physicochemical characterization in bell pepper cultivars submitted to different sources and dosages of organic fertilization, found values in the accumulation of phenol levels ranging from 6.37 to 6.96 mg g⁻¹ and from 5.61 to 6.39 mg g⁻¹, for the doce and volcano cultivars, respectively.

Conclusions

Organomineral fertilization applied under carnaúba straw provides greater accumulations of soluble solids and phenols in the 'Melina' red bell pepper.

Covering the soil with carnaúba straw provided to bell pepper fruits a greater presence of purple-red tones.

Fertilizing only with organic fertilizers promoted fruits with a more attractive visual aspect; however, they presented lower physical-chemical quality and bioactive compounds content in the red bell pepper.

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Table 4. Carotenoids content (mg g⁻¹) in Melina bell pepper fruits subjected to different proportions of organomineral fertilization and soil cover types.

Soil cover type	Fertilization types				
	100% organic fertilizer + 0% mineral fertilizer	100% organic fertilizer + 50% mineral fertilizer	50% organic fertilizer + 50% mineral fertilizer	50% organic fertilizer + 100% mineral fertilizer	0% organic fertilizer + 100% mineral fertilizer
No cover	44.33aA	40.64bA	40.36aA	41.80aA	41.87aA
Carnaúba straw	43.52abA	45.43aA	43.88aA	40.79aA	42.35aA
Weeding	39.13bA	40.81abA	44.66aA	43.22aA	43.20aA
LSD row	1.93				
LSD column	3.34				

Means followed by the same uppercase and lowercase letters in the rows and columns, respectively, do not differ statistically from each other by the Tukey test at 5% probability (p ≥ 0.05); LSD: least significant difference.

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