

CONDUCTION SYSTEMS IN FIG TREE WITH TWO CULTIVARS, EVALUATING FRUITS QUALITY AND YIELD

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ABSTRACT - The fig tree is rustic and one of the fruit species with great economic importance, because it adapts easily to different climate and soil types. The objective of this study was to evaluate the influence the branches number and the fig tree cultivar on yield and fruit quality. The orchard implanted with two cultivars, Roxo de Valinhos and Pingo de Mel, and conducted with different numbers of productive branches, being: 16, 24 and 32. The utilized lineation was completely randomized, with three replicates, each replicate being composed of four plants. The analyzed variables were: branches length (cm), number of fruits per plant, number of fruits per branch meter, yield of mature fruits (Kg ha⁻¹), yield of green fruits (Kg ha⁻¹), accumulated productivity (Kg ha⁻¹), fruit size (cm³), average fruit weight (g), soluble solids (°Brix) and fruit dry matter (%). The daily elongation rate and the mean length of the branches did not influence the different treatments. For productivity, noticed superiority on cultivar Roxo de Valinhos, with the higher the number of productive branches in the plants. Fruit quality, relative to soluble solids and dry matter, also did not influence the treatments. Fruits in larger caliber and size found from plants of the cultivar Roxo de Valinhos. Both for the production of fruits for fresh consumption and for the industrialization it is recommended the conduction with greater number of productive branches being between 24 and 32, for the greater productive yield.

Keywords: *Ficus carica* L., number of branches, Roxo de Valinhos, Pingo de Mel.

SISTEMAS DE CONDUÇÃO DE FIGUEIRA COM DUAS CULTIVARES, AVALIANDO QUALIDADE DOS FRUTOS E PRODUTIVIDADE

RESUMO - A cultura da figueira é rústica e uma das espécies frutíferas de grande importância econômica, pois adapta-se facilmente a diferentes tipos de clima e solo. Objetivou-se com este estudo avaliar a influência do número de ramos e da cultivar de figueira na produtividade e qualidade dos frutos. O pomar foi implantado com duas cultivares, Roxo de Valinhos e Pingo de Mel, e conduzido com diferentes números de ramos produtivos, sendo: 16, 24 e 32. Utilizou-se o delineamento experimental inteiramente casualizado, com três repetições, sendo cada repetição composta por quatro plantas. As variáveis analisadas foram: comprimento de ramos (cm), número de frutos por planta, número de frutos por metro de ramo, produtividade de frutos maduros (Kg ha⁻¹), produtividade de frutos verdes (Kg ha⁻¹), produtividade acumulada (Kg ha⁻¹), tamanho de fruto (cm³), peso médio de fruto (g), sólidos solúveis (°Brix) e massa seca dos frutos (%). A taxa de alongamento diário e o comprimento médio dos ramos não foram influenciados pelos distintos tratamentos. Para a produtividade observou-se superioridade da cultivar Roxo de Valinhos sendo maior quanto maior o número de ramos produtivos nas plantas. A qualidade dos frutos, relativa a sólidos solúveis e massa seca, também não sofreu influência dos tratamentos. Os frutos de maior calibre e tamanho foram encontrados em plantas da cultivar Roxo de Valinhos. Tanto para a produção de frutos para consumo in natura como para a industrialização recomenda-se a condução com maior número de ramos produtivos sendo entre 24 e 32, pelo maior rendimento produtivo.

Palavras-chave: *Ficus carica* L., número de ramos, Roxo de Valinhos, Pingo de Mel.

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INTRODUCTION

The fig tree (*Ficus carica* L.) is a rustic plant, and of great economic importance, due to its appearance and flavor, it can be consumed fresh consumption or industrialized, presenting in its nutritional composition numerous health benefits, since it is rich in minerals and vitamins (DIAS, 2014). Besides being a crop that adapts easily to different types of climate and soil (ANDRADE et al., 2014).

The quality of fruits and vegetables is expressed by a set of sensory properties such as appearance (color, size, shape and defects), texture (firmness, hardness) and flavor (sweetness, acidity, taste and aroma), nutritional and multifunctional value (CHITARRA and CHITARRA, 2005). Soluble solids content is directly related to taste and is a fundamental parameter for fig quality (LEÃO et al., 2006). The wholesale market price for figs is mainly given by color, size and appearance (CHALFUN, 2012).

There are hundreds of fig tree cultivars described in the literature, with different agronomic and pomological characteristics (BISI et al., 2016). However, still there is no large number of rustic cultivars adapted to the Brazilian conditions of cultivation (SILVA et al., 2017).

For commercial cultivation, currently there is cultivate only Roxo de Valinhos cultivar, which hav high economic value and is characterized by rusticity, vigor and productivity. With good adaptation to different types of climate, and still supporting the drastic pruning system (KOTZ et al., 2011). The cultivar Pingo de Mel is not considered a cultivar in high rusticity when compared to Roxo de Valinhos, however, it is characterized by producing very sweet fruits, demonstrating high vigor and productivity, with good adaptation to the drastic pruning system (CHALFUN, 2012).

The distribution ratio of photoassimilates in the plant is through the source-sink relationships, in which the source organs (mainly leaves) produce the photoassimilates as a result of photosynthesis, and these can be stored in some other reserve organs, such as roots, meristems and fruits, thus being called sink. The balance between production and demand for photoassimilates is important for improving production, and this is possible through proper distribution of the source-sink relationship (DUARTE and PEIL, 2010). Cultural management such as pruning, for example, affects the balance between vegetative and reproductive growth of the plant by the distribution of resources such as carbohydrates (MYERS, 2003).

For plants that produce in branches of the year, such as the fig tree, pruning is decisive, being that fruiting occurs in flowers that grow on branches sprouted in spring and bloom abundantly (FACHINELLO et al., 2009). For a commercial system in which drastic pruning is used, the

number of branches varies between 12 and 36, depending on the training systems, and the purpose of production (fresh consumption market or industry) (Dias, 2014). On this, the objective of this work was to evaluate the influence of the number by branches on two fig tree cultivars, fruit yield and quality.

MATERIAL AND METHODS

The experiment was done in 2015, in fig tree orchard with one year of implantation, located at latitude 27° 07' 11" S, longitude 52° 42' 30" E and altitude of 610 m. The soil analysis in the area showed the following characteristics: pH 5.8, 3.5% organic matter, P content of 5 mg dm⁻³, K 72 mg dm⁻³, Ca 5.8 cmolc dm⁻³ and Mg of 2.9 cmolc dm⁻³. Two cultivars, Roxo de Valinhos and Pingo de Mel, used in planting spacing of 5 m x 2 m (rows x plants) and were conducted with different numbers of branches, from the fruiting pruning. The plants, in the evaluated cycle, were in their first year of cultivation, so it was still running in the pruning formation, aiming at the end of the third year to reach the desired number of branches for each treatment.

Winter pruning or fruiting pruning was done on August 22nd, 2015, and in mid-September there was a strong frost that caused damage to some shoots. Climate data concerning the period driving period are available in Figure 1. The utilized lineation was completely randomized, with three replicates, each replicate being composed of four plants, in a 2 x 3 bifactorial scheme, two cultivars (Roxo de Valinhos and Pingo de Mel), three different numbers of branches (16, 24 and 32 branches plant⁻¹).

The variables analyzed were: the branches length, considering the base by branch to the tip of the apical bud of the same branch, the measurements were carried out weekly, being the beginning of the emission of fruits and the end of the productive cycle, number of fruits: determined by the final count of fruits per plant (at 119 days), yield of mature fruits, yield of green fruits, accumulated productivity: obtained by summing between mature fruits and green fruits (expressed in kg ha⁻¹). Then fruit size: measured with the aid of a pachymeter, average fruit weight, soluble solids (°Brix): determined by reading in a digital refractometer, fruit dry matter: determined by oven drying with forced air ventilation, heated to 65°C±2 until constant weight.

The data were submitted to analysis of variance by the F test and compared to each other by the Tukey test, at the 5% level of significance, and the analyzes performed through the WinStat statistical program (MACHADO and CONCEIÇÃO, 2005).

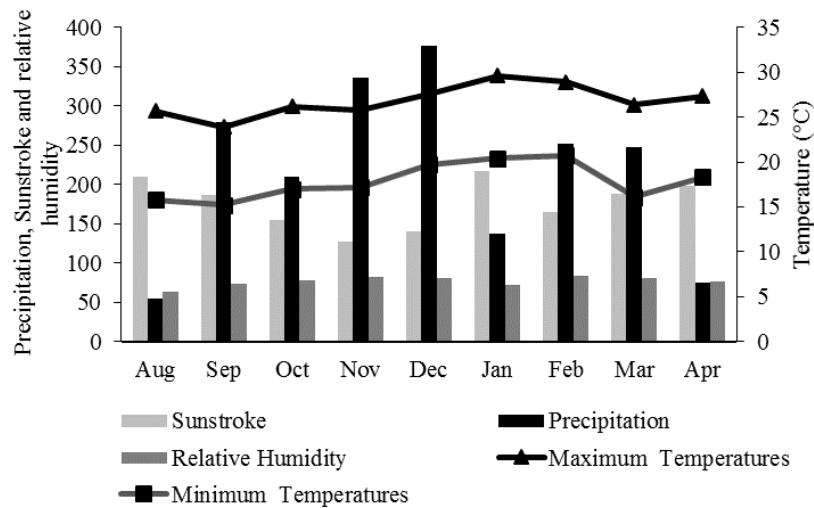


FIGURE 1 - Climatic data in the conduction period of the experiment. National Institute of Meteorology, Brazil (INMET) (2017).

RESULTS AND DISCUSSION

As it is shown in Figure 2, the average daily stretching rate of branches, adapted as described by Chapman and Lemaire (1993), depending on the cultivars and the days of evaluation, that the interaction between them occurred, and the plants of the cultivar Roxo de Valinhos showed a growth of 14% higher, however, there was no statistical difference between the cultivars. Vegetative development is dependent on the ability of plants to absorb and process the essential elements for their growth, such as water, CO₂, energy and soil nutrients, and their mobilization is directly linked to climatic events, mainly moisture and temperature, influencing linearly growth (CELEDONIO et al., 2013).

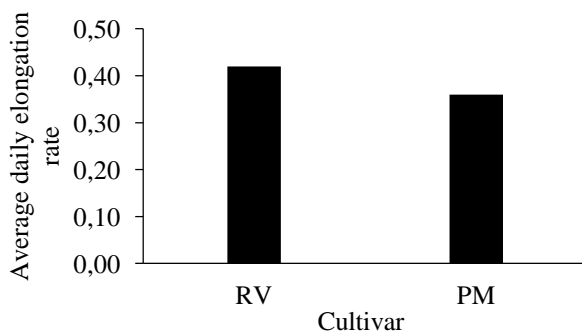


FIGURE 2 - Average daily elongation rate of fig tree branches of the cultivars Roxo de Valinhos (RV) and Pingo de Mel (PM). ns = not significant by the Tukey test, at 5% probability. CV(%) = 22.69.

The final branches length (Figure 3) did not influence by the branches number conducted in the plant, regardless of the cultivar. These data differ from those observed by Dalastra et al. (2011), which evaluates the number of branches in the production of green figs, reports that branch length tends to decrease with increasing number of branches per plant. Caetano et al. (2005) did not

observe significant differences for the length of branches when conducted with different number of branches per plant. The results of the present study corroborate the results found by Nava et al. (2015), where the authors mention that the vegetative growth is not affected by the number of branches of the fig tree.

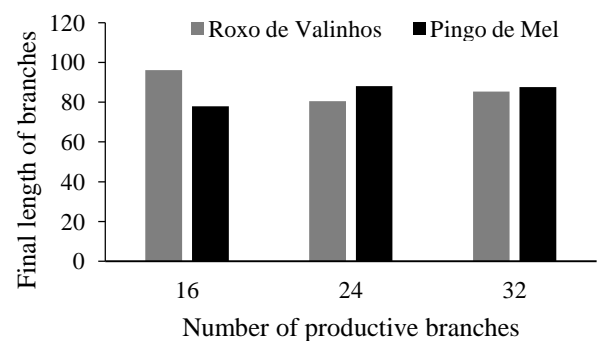


FIGURE 3 - Final length of branches for the cultivars Roxo de Valinhos and Pingo de Mel conducted with different number of branches. ns = not significant by the Tukey test, at 5% probability. CV(%) = 31.82.

The number of fruits per plant (Table 1) was higher in the plants with the highest number of branches, and for the cultivar Roxo de Valinhos there was no statistical difference between 24 and 32 branches and for the cultivar Pingo de Mel the fruit emission was superior when in the conduction of the plants with 32 branches. When comparing the cultivars, no significant difference was found. A lower yield in plants cultivated with conduction systems of the lower number branch can be explained by the low leaf area index of these plants (NAVA et al., 2015).

Corroborating with the results of this work, Nava et al. (2015) evaluating the removal of branches in the productivity and quality of the fig tree, they observed that

when the number of productive branches per plant increased, the number of fruits produced also increased. Dalastra et al. (2011) studying the branches number in the

production of green figs, observed that with the greatest number of productive branches in the plant, the number of fruits was also higher.

TABLE 1 - Number of fruits per plant depending on diferents number of branches conducted.

Number of branches	Cultivars	
	Roxo de Valinhos	Pingo de Mel
16	30 bA*	43 bA
24	54 aA	41 bA
32	47 abA	71 aA
CV(%)	32.00	

*Means followed by the same letter do not differ statistically from each other, by the Tukey test, at 5% probability. Lowercase letters represent the columns and uppercase letters represent the rows.

About fruits number per meter of branch, it was observed that it remained satisfactory independently of the treatment. When comparing the cultivars in each number of productive branches, the superiority of the cultivar Pingo de Mel is found in plants submitted to 16 and 32 branches, and cultivar Roxo de Valinhos was only superior in plants with 24 branches (Figure 4). When comparing the different numbers of productive branches, no significant difference was found.

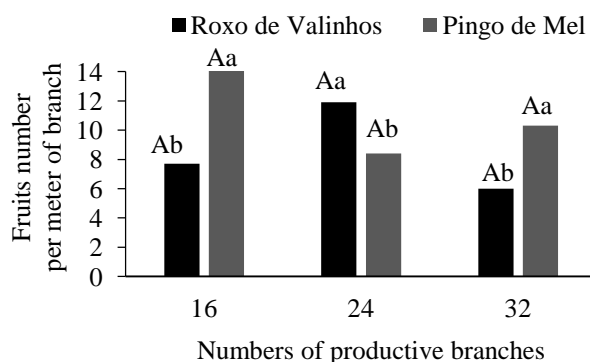


FIGURE 4 - Fruits number per meter of branch for the cultivars Roxo de Valinhos and Pingo de Mel. *Averages with different lowercase letters in each branch length and upper case within the cultivar, differ from each other by the Tukey test, at 5% probability. CV(%) = 42.00.

For the cultivar Roxo de Valinhos, it was observed lower yield of mature fruits when the plants were conducted with 24 productive branches. For driving with 16 and 32 branches there was no statistical difference between them (Figure 5). For the cultivar Pingo de Mel, the three treatments did not present significant differences between them. The same was verified when the different cultivars were compared.

The source:sink relationship can be manipulated in two ways by increasing or decreasing the source strength or the sink strength (DUARTE and PEIL, 2010). This may explain the results obtained in this work, because when we observed the cultivar Roxo de Valinhos, the yield was higher in plants that were submitted to treatment with 24 branches, that is, possibly in this density there was a balance between the source and the sink of

photoassimilated. In the 16 branches density, it is possible that a source strength was restricted, not enough to supply the effects of the sinks, and the 32 branches density of the drain strength was much higher, allowing the explanation of the lower observed use in both cases.

The yield of green fruits in the plants with 32 productive branches was superior to the other treatments in both cultivars, however, when compared to each other, the cultivar Roxo de Valinhos showed superiority in all treatments, presenting approximate productivity of 32, 34 and 45% higher than the Pingo de Mel for the plants with 16, 24 and 32 branches, respectively.

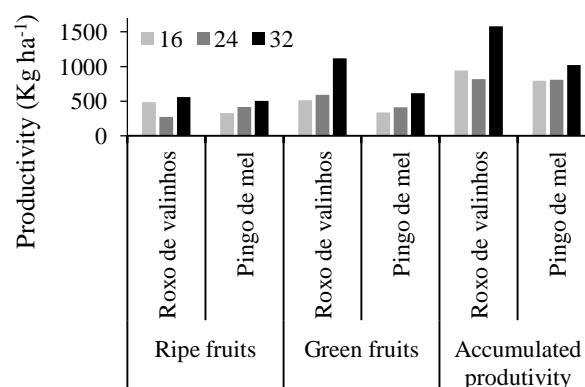


FIGURE 5 - Productivity of ripe fruits (kg ha^{-1}), green fruits (kg ha^{-1}) and accumulated productivity (kg ha^{-1}) for Roxo de Valinhos and Pingo de Mel with different numbers of branches. Averages followed by the same letter do not differ statistically from each other by the Tukey test, at 5% probability. Equal lowercase letters in the columns within each cultivar in the group evaluated and upper case among the cultivars in the same numbers of branches in the evaluated group did not differ significantly. Mature fruits CV (%) = 43.50, green fruits CV(%) = 21.60, cumulative productivity CV(%) = 26.10.

For the accumulated productivity the plants conducted with 32 branches were approximately 40% more productive than the other treatments in the cultivar Roxo de Valinhos, while the cultivar Pingo de Mel did not differ between the treatments. Among the cultivars was verified difference only for the plants conducted with 32

productive branches and Pingo de Mel was about 35% less productive.

Nava et al. (2015) studying the thinning of branches for the quality and productivity of fig Roxo de Valinhos, also observed an increase in productivity per plant with an increase in the number of productive branches. Nienow et al. (2006) evaluating different pruning seasons and number of branches in fig, for the variable yield of mature fruits also observed that in the plants with the highest number of branches there was an increase in productivity. The number of productive branches has a great influence on productivity (CAETANO et al., 2005), and with the highest number of productive branches in the plant the tendency is that there is consequently higher productivity, however, the plant

spacing and the climatic conditions of the also become decisive for this increase to take place.

When evaluating the average weight of the fruits (Table 2), it was observed that the cultivars did not present differences in relation to the number of branches studied, however, when compared to each other the cultivar Roxo de Valinhos stood out, producing heavier fruits, independently of branches number with which the plants were conducted. Nienow et al. (2006) evaluated the average weight of figs grown in protected environment and submitted to different periods of pruning and branches number, observed fruits of the cultivar Roxo de Valinhos with 57.50 g. Chalfun (2012) cites that the fruits of the cultivar Pingo de Mel present weight around 35 g, resembling the observed results, being that the average weight of the fruits for this cultivar was of 35.80 g.

TABLE 2 - Effect of the different number of fig tree branches Roxo de Valinhos and Pingo de Mel on average fruit weight, fruit size, soluble solids and dry matter.

Cultivars	16	24	32
Average weight of the fruit (g)			
Roxo de Valinhos	46.72 aA*	41.69 aA	46.33 aA
Pingo de Mel	37.23 bA	34.56 bA	35.66 bA
CV(%)	18.50		
Fruit size (cm ³)			
Roxo de Valinhos	20.05 aA	21.42 aA	23.05 aA
Pingo de Mel	15.72 bA	14.86 bA	15.77 bA
CV(%)	14.00		
Soluble solids (°Brix)			
Roxo de Valinhos	11.65 aA	12.18 aA	12.04 aA
Pingo de Mel	11.85 aA	12.43 aA	12.00 aA
CV(%)	8.10		
Dry matter (%)			
Roxo de Valinhos	16.46 aA	18.00 aA	17.22 aA
Pingo de Mel	17.00 aB	19.50 aA	18.34 aAB
CV(%)	13.10		

*Averages followed by the same letter do not differ statistically from each other by the Tukey test, at 5% probability. Lowercase letters represent the columns and uppercase letters represent the rows.

The fruit size variable (Table 2), for both cultivars there was no difference between the number of branches. However, when comparing the cultivars, the cultivar Roxo de Valinhos maintained the superiority, in agreeing with the data observed by Rodrigues et al. (2009).

The evaluation of soluble solids (Table 2) did not present significant difference for the different treatments. Rodrigues et al. (2009) evaluating mutant selections of Roxo de Valinhos fig tree showed minimal variation among the treatments studied. Turk (1989), characterized the Brazilian fig as having soluble solids around 11.08°Brix, similar to the values observed in this work.

About the dry matter contents (Table 2), the cultivars did not differ statistically among themselves. In relation to the number of branches plant⁻¹, the Pingo de Mel cultivar presented superiority of dry mass in its fruits when the plants were conducted with 24 productive branches, but did not differ from the treatment with 32 branches.

It is possible to observe that the cultivar Roxo de Valinhos presented larger fruit size and higher fruit weight, but this did not reflect the higher content of dry matter and soluble solids. In general, there is an order for the destination of the photoassimilates for their sinks, firstly they are destined for the formation of roots, later for the fleshy fruit parts and shoot apices and leaves, followed by the cambium, roots and finally the storage (MINCHIN et al., 1997). The cultivar Roxo de Valinhos translocates more carbon to the meristematic parts, followed by the fruit destination (SILVA et al., 2011).

Despite the good indications that we obtained in the first productive year of the plants, to obtain more consistent results it is necessary to evaluate these practices for more productive cycles. In addition, another important aspect is to assess the quality of the fruits more thoroughly, by determining the influence of each management on the nutritional and nutraceutical composition of the fruits.

CONCLUSIONS

The different numbers of branches did not influence the quality of the fruits.

The cultivar Roxo de Valinhos has larger fruits.

Both for the production of fruits for fresh consumption and for the industrialization it is recommended the conduction with greater number of productive branches being between 24 and 32, for the greater productive yield.

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