Original Research Article

Intensity of Pruning With and Without Heading in Fig Tree in the Semiarid Region of Potiguar, Brazil

Abstract

Aims: The fig tree produces in branches of the year through the emission of fruits born in the armpits of the leaves and the system of dawn is one of the most common practices among the producers of green fig, in which, they seek to increase the production. The present work had as objective to evaluate the intensity of pruning, with and without detachment of fig plants in the semiarid region of Potiguar, Brazil.

Study Design: The design used was 3x2 factorial (3 pruning intensity 5, 10 and 15 cm and with and without heading) and 4 replications, each repetition consisted of 5 plants and only 3 were useful.

Methodology: The treatments consisted of: pruning of 5cm and without pruning, pruning of 5cm and with pruning, pruning of 10 cm and without pruning, pruning of 10 cm and with pruning, pruning of 15 cm and without pruning, pruning of 15 cm and with pruning. The following variables were analyzed: fruit weight (g), fruit length and diameter (cm), firmness (N), soluble solids (ºBrix), titratable acidity (%), vitamin C (mg 100g^{-1}) of fruit plant^{-1} and yield (kg tree^{-1})

Place and Duration of Study: The experiment was conducted in the didactic orchard of the Federal Rural Semiarid University (UFERSA), Mossoró-RN.

Conclusion: The use of pruning intensity and shoot height influenced the physical, chemical and productive characteristics of the fig tree in the semiarid region of Potiguar, Brazil

Keywords - *Ficus carica* L., fruitculture, handling, production.

1. INTRODUCTION

The fig tree (*Ficus carica* L.) is of great importance in the world scenario among temperate fruit trees, however, many management techniques need to be improved.

According to data from [13], the Southern and Southeastern regions of Brazil are the large fig producing centers for both in natural consumption and for industry, where the area planted with fig trees corresponds to 2,591ha, where the Southern states (1,766ha) and Southeast (825ha) are the largest producers, with an average production of 7,521 and 15,274 kg ha^{-1}, respectively.

Although the fig tree is considered a plant of temperate regions, it has shown good adaptation in tropical regions, in this way, the semiarid becomes an alternative for the productive chain and exploration of new agricultural areas of fig.

In the ~~production of~~ production, an intensity of pruning, is one of the factors external which higher influence in production and quality of the ~~same to the same, the same to the~~ same that, for a certain intensity of pruning, one must take into account the local edaphoclimatic conditions [16].

And a procedure widely used by fig producers in order to obtain a prolongation of the productive period and increase of production for a longer period of time is the use of the dawn, which according to [4] is one of the practices among the fig producers in which they seek to increase plant production.

This technique favors the emission and growth of new branches, besides the containment of the canopy, thus maintaining a luminosity in its interior [3].

However, it must be done when the shoots have eight pairs of leaves, and the first shoot (cutting of the apical bud) is done, after which the two new shoots are left at the apex of the branch [7].

Although the fig tree is a rustic plant that can grow, develop and produce in semi-arid conditions, the management data of this crop are still scarce in these conditions, besides, it is not possible to use the same technologies that are used in the South and Southeast regions because they are often conditions of temperature, humidity, insolation and precipitation are totally adverse.

In this way, the objective of this work was to evaluate the intensity of pruning with and without heading in fig trees in the semiarid region.

2. MATERIAL AND METHODS

2.1 Experimental site and climatic data

The experiment was conducted in two production cycles, where the first cycle occurred from April to July 2016 and the second cycle from April to July 2017, in the didactic orchard of the Federal Rural Semiarid University (UFERSA), located in the municipality of Mossoró-RN, with a geographical coordinates 5º11 'south latitude, 37º20' long W.Gr., with 18 m altitude, with annual average temperature around 27,50°C, relative humidity of 68,9%, mean annual cloudiness of 4,4 tenths and average annual precipitation of 673,9 mm, with hot and dry climate, located in the semiarid region of the Brazilian Northeast [10].

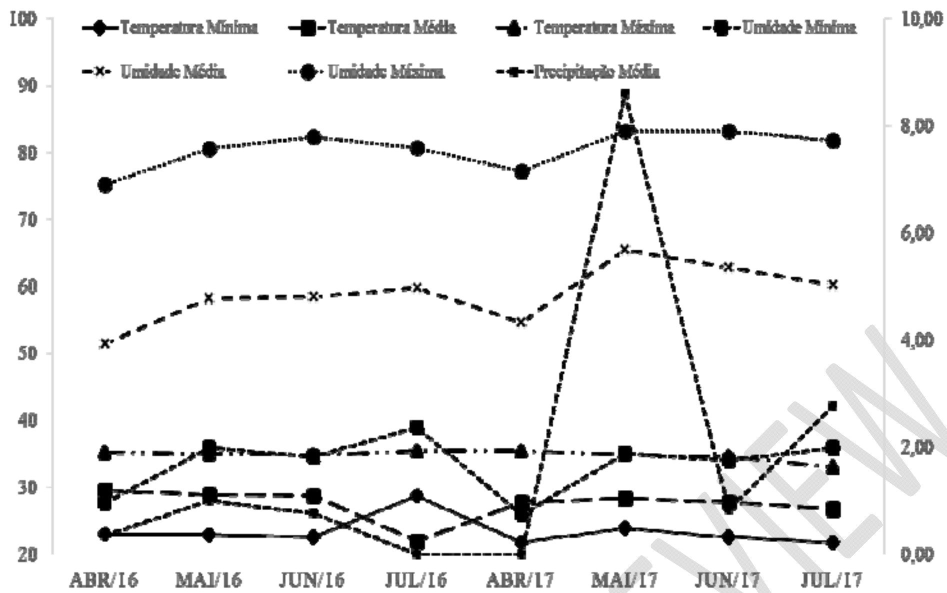

Figure 1 - Climatic data of temperature, humidity and precipitation of cycle 1 and 2 of fig production, conducted under different pruning intensities, with and without rise. UFERSA, Mossoró-RN, 2018.

2.2 Treatments, experimental design, and plant growth conditions

A fruiting pruning was performed to start a new production cycle. The plants were driven with 3 legs (3 secondary branches) throughout the vegetative cycle, and 2 branches per leg, totaling 6 plant^{-1} branches.

The plants were pruned in three pruning intensities (5, 10 and 15 cm) in the new branches, which emerged above the secondary branches, and when these branches presented 8 pairs of leaves, the shoot was performed, others were conducted without shoots.

The experiment was carried out in a 3x2 factorial scheme, where the first factor corresponds to the different pruning intensity (5, 10 and 15 cm), and the second one, with 4 replications and 5 plants per treatment, being 3 useful plants.

2.3 Physical and physico-chemical characteristics

The vegetative characteristics of the plants were evaluated at the end of the experiment: fruit weight (g), length and diameter of fruits (cm), number of fruits plant^{-1}, and yield (kg plant^{-1}).

Post-harvest evaluations of fig fruits were carried out at the Post-Harvest Physiology Laboratory of the Department of Plant Sciences of the Federal University of the Semiarid (UFERSA).

The physico-chemical analyzes of the fig fruits, such as: soluble solids (ºBrix), firmness (N), titratable acidity (%) and vitamin C (mg 100^{-1} g pulp) were performed according to the methodology [2].

2.4 Statistical analysis

Data were submitted to analysis of variance, followed by Duncan's multiple comparison test for means using the SPSS software. The data were submitted to analysis of variance by the F test at 5% probability and in case of significance the means were grouped using the Tukey test at 5% probability.

3. RESULTS

It was verified that at the level of $P<0.05$ of probability by the test of Tukey, that the variables: fruit mass, fruit length and diameter, firmness, soluble solids, titratable acidity and vitamin C, were not influenced by the different intensity of pruning applied, however, the variables total number of fruits plant^{-1} and total plant^{-1} production, presented significant responses in cycle 1 (Table 3), then the data were submitted to the unfolding.

However, evaluating the splitting system, the physical-chemical variables showed to be significant when submitted or not to the rise. In cycle 2, it is verified that the variables firmness, titratable acidity and vitamin C, were significant when submitted to different pruning intensity, whether or not they were conducted in a clearing system. The other variables were not influenced by the intensity of pruning, nor of the emergence in cycle 2.

The results obtained with the fig plants show that when the plants were submitted to different intensities of pruning, there was no influence of pruning intensity on fruit mass (Table 1), however, showed a significant effect on cycle 1, when it was conducted in the system with no rise. In this way, fig trees driven without, presented the best fruit mass values, where the maximum value reached was 30g. In cycle 2, there was no significant effect independent of the intensity of pruning and whether or not it was conducted with rise.

Table 1 - Fruit mass (MF), length, diameter, firmness and soluble solids (SS) of fig fruit cv. Roxo de Valinhos submitted to different intensities of pruning, with and without detachment, conducted in two productive cycles. UFERSA, Mossoró-RN, 2018.

	MF (g)		Length (cm)		Diam (cm)		Firm (N)		SS (ºBrix)	
	Cycle I	Cycle II	Cycle I	Cycle II	Cycle I	Cycle II	Cycle I	Cycle II	Cycle I	Cycle II
Pruning a 5 cm	27,09a	29,90a	3,59a	3,49a	3,96a	4,19a	12,74a	5,03b	19,03a	14,59a
Pruning a 10 cm	28,34a	29,24a	3,67a	3,49a	4,08a	4,15a	12,44a	4,06a	18,96a	14,66a
Pruning a 15 cm	25,91a	30,44a	3,64a	3,53a	4,00a	4,25a	13,57a	7,17b	18,20a	14,53a
Mean	27,11	29,86	3,63	3,5	4,01	4,2	12,91	5,42	18,73	14,59
With rise	24,23b	29,13a	3,47b	3,51a	3,86b	4,13a	13,91a	4,90b	17,07b	14,59a
No rise	30,00a	30,58a	3,79a	3,49a	4,17a	4,26a	11,92b	5,94a	20,39a	14,59a
Mean	27,11	29,86	3,63	3,5	4,01	4,2	12,91	5,42	18,73	14,59

CV (%)	13,08	12,37	8,05	4,64	6,32	3,6	9,63	13,86	6,61	2,23

Means followed by different letters in the same column differ significantly according to the Tukey test at 5% probability. NS: not significant; *, **: significant at 5% or 1% probability, respectively, according to test F.

For the length of fig fruits (Table 1) independent of pruning intensity, both cycle 1 and cycle 2, there was no effect of the evaluated treatments. However, in cycle 1, when the plants were conducted without staggering, a maximum value of 3,79cm was obtained.

According to Table 1, the diameter of the fig fruit in cycle 1 and 2 did not show statistical difference when submitted to different pruning intensity and the maximum value reached corresponded to 4,25cm. However, a significant effect was observed in plants with no emergence in cycle 1, where it presented the highest values of fruit diameter (4,17cm).

According to Table 1, the firmness characteristic of fruits, in cycle 1 of production, did not find an effect when the plants were submitted to different pruning intensities.

While in cycle 2, plants with pruning intensity of 15cm presented the highest firmness value, 7,17N. However, when the plants were submitted to emergence (cycle 1), there was a significant effect where a maximum value of 13,91N can be observed.

For the solid soluble characteristics (Table 1), there was no significant effect under the treatments evaluated regardless of the pruning intensity and the production cycle, where the means corresponded to 18,73 and 14,59ºBrix. However, when evaluating the emergence effect, plants conducted without emergence (cycle 1) had a maximum SS value of 20,39ºBrix.

Evaluating the titratable acidity characteristic (Table 2), there was no difference between the treatments of pruning intensity, nor when submitted or not to the rise in cycle 1, and the average corresponded to 0,18%. In cycle 2, there is a significant effect, so the variable was submitted to the data unfolding.

According to Table 2, the vitamin C variable showed no significant effect on cycle 1, when submitted to different pruning intensities and conducted with and without rise, where the mean value corresponded to 22,11 mg $100g^{-1}$ of pulp in both factors. While in cycle 2, there was a significant effect of the evaluated treatments, thus, the variable was submitted to the data unfolding.

Table 2 - Titratable acidity (AT) and vitamin C, of fig tree fruits cv. Roxo de Valinhos submitted to different intensities of pruning, with and without detachment, conducted in two productive cycles. UFERSA, Mossoró-RN, 2018.

	AT		Vit C	
	Cycle I	Cycle II	Cycle I	Cycle II
Pruning a 5 cm	0,18a	0,23	22,06a	16,83
Pruning a 10 cm	0,19a	0,16	22,51a	20,58
Pruning a 15 cm	0,18a	0,15	21,75a	23,88
Mean	0,18	0,18	22,11	20,43
With rise	0,18a	0,15	22,05a	21,5
No rise	0,18a	0,21	22,16a	19,36
Mean	0,18	0,18	22,11	20,43
CV (%)	13,67	4,68	14,15	6,62

Means followed by different letters in the same column differ significantly according to the Tukey test at 5% probability. NS: not significant; *, **: significant at 5% or 1% probability, respectively, according to test F.

From the unfolding of the studied variables, it was verified that the fig plants (Figure 2), when they were conducted without the shoot and in the pruning intensity of 5 cm, reached approximately 0,30% of acidity, while the plants conducted with rise and independent of pruning intensity, presented mean values of 0,18% (cycle 2).

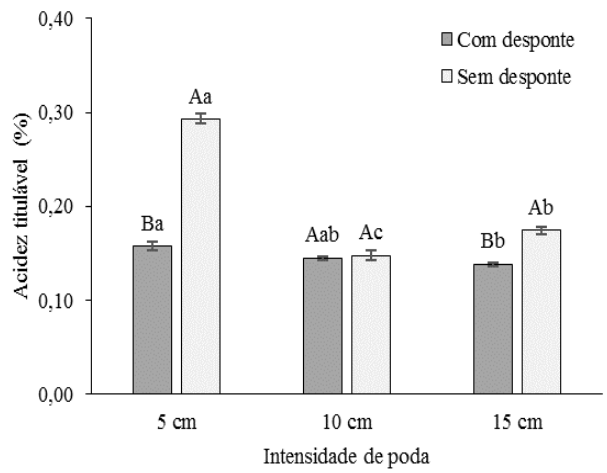

Figure 2 - titratable acidity content, unfolding of the interaction of fig fruits conducted under different pruning intensity, with and without rise, in cycle 2 of production. UFERSA, Mossoró-RN, 2018.

*Uppercase letters compare the type of dawn. Lowercase letters compare averages between pruning intensity. Tukey test at 5% probability

With the unfolding of the variables, it was verified that the fig trees, conducted with rise and in the intensity of pruning of 10cm, reached the highest vitamin C values, about 27 mg $100g^{-1}$ pulp (Figure 3). While the plants pruned with 5cm and conducted with and without detachment, presented the lowest values of vitamin C.

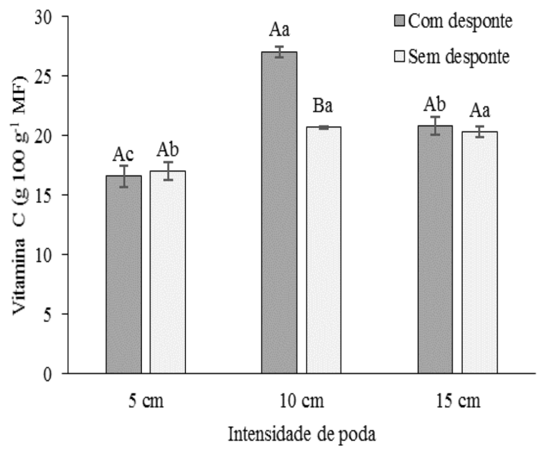

Figure 3 - Vitamin C content after unfolding of the interaction of fig fruits conducted under different pruning intensity, with and without rise, in cycle 2 of production. UFERSA, Mossoró-RN, 2018.

*Uppercase letters compare the type of dawn. Lowercase letters compare averages between pruning intensity. Tukey test at 5% probability.

For the characteristic total number of fruits plant-1, hove significant interaction between the treatments evaluated in cycle 1, thus, the variable was submitted to the data unfolding, both in the characteristic pruning intensity, as well as to the emergence effect.

In cycle 2, no effect of the evaluated treatments was observed, and the maximum value found was 238,63 and 254, $plant^{-1}$ fruits, when they conducted the plants in pruning intensity of 15cm and without rise, respectively.

Table 3 - Total number of fruits and total production plant^{-1}, fig cv. Roxo de Valinhos submitted to different intensities of pruning, with and without detachment, conducted in two productive cycles. UFERSA, Mossoró-RN, 2018.

	NTF		PTF	
	Cycle I	Cycle II	Cycle I	Cycle II
Pruning a 5 cm	55,13	228,75a	1,445	4,845a
Pruning a 10 cm	87,75	230,63a	2,812	4,281a
Pruning a 15 cm	84,75	238,63a	2,538	4,715a
Mean	75,88	232,67	2,264	4,613
With rise	26,92	211,33a	0,814	4,150a
No rise	124,83	254,00a	3,715	5,077a
Mean	75,88	232,67	2,264	4,613
CV (%)	6,63	22,35	28,28	23,64

Means followed by different letters in the same column differ significantly according to the Tukey test at 5% probability. NS: not significant; *, **: significant at 5% or 1% probability, respectively, according to the F test.

Figure 4, shows the results of the data and it is verified that the fig trees, when they were conducted without detachment and in the pruning intensity of 10 cm, reached the highest values of plant-1 fruits (160 fruits), followed by intensity of 15 cm (130 fruits) and 5cm (80 fruits), respectively.

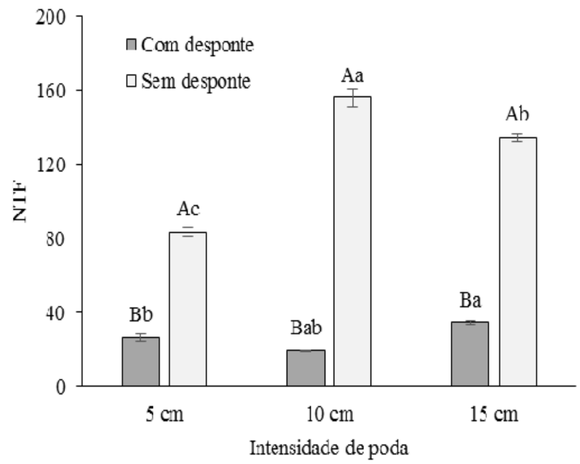

Figure 4 - Number of total fruit plant-1, after unfolding of the interaction of fig fruit conducted under different pruning intensity, with and without rise, in cycle 1 of production. UFERSA, Mossoró-RN, 2018.

* Uppercase letters compare the type of dawn. Lowercase letters compare averages between pruning intensity. Tukey test at 5% probability.

According to Table 3, for the variable total production of plant-1 fruits, it was verified that there was no significant effect on cycle 2 of production when the plants were submitted to different intensities of pruning, nor for the presence or absence of the to rise. However, at the end of the experiment the average production value of 4,61 kg plant-^{1} was obtained.

The significant effect on cycle 1, provided the unfolding of the data studied (Figure 5), and as a result, fig trees independent of the pruning intensity and in the absence of emergence obtained a maximum value of 5,07 kg plant-1 in plants of fig trees conducted in pruning intensity of 10cm and without rise.

The plants conducted with emergence and in the different intensity of pruning, showed results of production below 1kg.

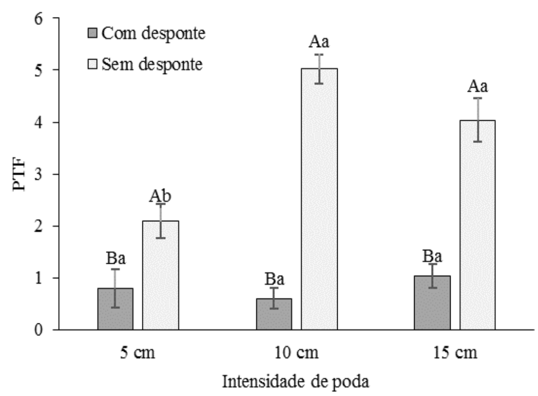

Figure 5 - Production of total fruit plant^{-1} (kg), after unfolding of the interaction of fig fruits conducted under different pruning intensity, with and without rise, in cycle 1 of production. UFERSA, Mossoró-RN, 2018.

*Uppercase letters compare the type of dawn. Lowercase letters compare averages between pruning intensity. Tukey test at 5% probability

4. DISCUSSION

These same physical characteristics (weight and length of fruits) were studied by [17], which found corresponding values of 38,56g and 5,30cm, respectively, when evaluating the selection of fig leaf mutants of the cultivar Roxo de Valinhos, which are higher than those found in the present study.

The values obtained in the present work are similar to those found by [6], when they studied the system of emergence in the production of green figs 'Roxo de Valinhos', where it obtained a length of 3,77cm in plants without rise and 3,81cm in plants with rise.

According to [6] the characteristics of fruit size can be influenced by the appearance that occurs in the plants, thus, as the number of shoots in the plants increases, the average diameter of the fruits increases, due to the uniformity generated by this system of driving.

The results found are contrary to the comparisons made, because in the semi-arid conditions, the use of the rise, provided fruits of smaller diameters.

For the chemical characteristics, we verified that the values are superior to those found by [14] found average values of firmness for fig fruits of 10,58N.

In the soluble variable, studying different fig varieties, [19] obtained results close to those found here, which ranged from 17º to 18,43ºBrix.

While [12] evaluating fig trees with and without deponde did not find statistical difference on the evaluated variables, agreeing with the data found in this work in cycle 2.

These differences are explained by [6] that highlight the factors cultivar, climatic conditions and harvesting season, that can cause changes in the values of SST.

The values found here for titratable acidity are similar to the values found by [12] that ranged from 0,20% to 0,23%, when the plants were pruned at different times. While [17] obtained inferior results (0,15%) in mutant selections of the cultivar Roxo de Valinhos.

According to [8] the acidity is modified by changes in the concentrations of the organic acids that occur during the growth and differentiates in each type of fruit.

In fig and greenhouse cultivation, [11]found vitamin C values of only 12,12 and 10,39mg 100g^{-1} of pulp, respectively, and according to the same author, figs did not present high levels of vitamin C as occurs in other fruits such as cashew, acerola others.

According to [1], the reduction of the vitamin C content, which occurs during fruit maturation, is due to the action of the enzyme ascorbic acid oxidase (ascorbate oxidase), which occurs in fruits in a higher way.

Because it is a fruit that quickly ripens, the fig fruit becomes highly perishable, in this way, as they mature there is the loss of the vitamin C content.

Regarding the productive aspect, it was verified that in studies of [9] a number of fruits-plant^{1} superior to those obtained in this work in cycle 1, where the production ranged from 138,16 to 184,25 plant^{-1} fruits, already in cycle 2, the data were higher than the values obtained by same.

On the other hand, [15] obtained a higher number of plant^{-1} fruits (203) in cycle 2, when the plants were pruned in August and conducted with 8 branches, however, when compared with the present work, it is verified that it is greater than Cycle 1, however, is less than production cycle 2.

While [5] when evaluating the system in the production of green figs Roxo de Valinhos, obtained a production of 189,94 plant^{-1} fruits, which represents a production below the values obtained here.

The values obtained by [9], when they submitted the fig plants to different pruning seasons (April to September), are inferior to those obtained in the present work in both cycle 1 and cycle 2, where it obtained a production varying from 1,25 to 2,00 kg plant^{-1}.

[15] when planting fig trees at different pruning times, but in a protected environment, similar results were obtained to the present work, since the plants presented a plant^{-1} production of 4,50 and 5,73 kg in May and August, respectively.

This high difference in number of fruits and fig production in semi-arid conditions may be related to the fact that the plants that did not show rise, obtained a greater growth of the branches, thus implying a larger production in number of nodes, and consequently greater number of fruits plant-^{1} and production^{-1}.

Corroborating with [5], because it mentions that the plants without emergence have a lower final length of the branches and that of the internodes (as they are blossomed) in comparison with the non-emergent plants, resulting in lower final growth of the vegetative parts.

While the plants that suffered the emergence, suffered a stress and were not able to recover and to have a normal development due to the climatic conditions, since a very high maximum temperature (above 35°C), according to Figure 1, in the which is harmful to the culture.

It is also worth noting that the use of fig trees without a rise results in lower labor costs in the plant's operations [5]

The high precipitation in cycle 2, favoring a good water availability for the fig plants, may have contributed to high yield. The low production in cycle 1, avoided exaggerated expenses of accumulated reserves in the plants, which may have favored once again the high production in cycle 2.

[18] Points out that the branches that form the canopy of fig trees are reserve organs, which can increase productivity, and factors such as water and soil cover also contribute to the productive increase.

This high yield in number of fruits plant-1 and plant-1 production, in cycle 2 in relation to cycle 1, may be related to the fact that the fig tree presented high relative humidity, high temperature and, especially, good availability of water in the soil , as can be seen in Figure 1.

[20] Mentions that a good availability of water and nutrients favors the growth and development of the crop, making it much more efficient, thus obtaining a higher productivity. And according to this same author, the climatic aspects are very variable according to each region, thus influencing the growth, development and production of the fig trees.

5. CONCLUSIONS

The use of pruning and pruning intensity influenced the physical-chemical characteristics of the fig tree in the western Potiguar conditions.

The management of unpeeled fig trees with 10cm pruning intensity in semi-arid conditions is the most suitable for the number of fruits plant^{-1} and fig-tree (kg plant^{-1}).

The use of the top is not efficient for fig driving in the West Potiguar.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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