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REDUCTION OF ORTHORTROPIC BRANCH IN *Coffea arabica* L. AFTER PRUNING USING PGR TO CONTROL THE BUDS

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Trabalho de conclusão de curso
apresentado à Universidade Federal de
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Curso de Agronomia, para a
obtenção do título de Bacharel.

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TO MY BELOVED PARENTS, LUCIENE AND GÊ

MY EXAMPLES OF HONESTY AND CHARACTER

DEDICATED

ACKNOWLEDGMENT

Firstly, I would like to thank God, for all the strength in my paths, Nossa Senhora Aparecida for always accompanying me and illuminating my mind.

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RESUMO

A cultura do café no Brasil é fundamental para a economia do país, uma vez que apresenta a maior produção do mundo. O crescimento de novos ramos ortotrópicos em cafeeiros é comum, contudo, após a poda é possível observar uma intensificação que não é a ideal, uma vez que os novos ramos drenam a energia que poderia ser alocada nos frutos, flores ou outras estruturas vegetativas. Atualmente faltam funcionários para realizar o corte desses galhos, pois é muito demorado e caro para os proprietários. O objetivo desta pesquisa foi avaliar o crescimento desses ramos, normalmente chamados no Brasil de "Ramo ladrão" sob diferentes tipos de aplicações de produtos e podas. O experimento foi implantado em uma área de pesquisa da UFLA (Lavras-MG), os tratamentos foram: (1) H_2O, (2) Poda da copa + poda das pontas dos galhos (poda total) + H_2O, (3) poda de pontas dos galhos + H_2O, (4) poda total + auxina, (5) poda total + Protex + auxina, (6) poda total + Protex, (7) total poda + Stimulate e (8) poda das pontas dos galhos + Stimulate, os quais foram aplicados semanalmente, durante 10 semanas. Foi dividido em 24 parcelas com 3 plantas cada, a pleno sol. A cada 15 dias foram coletados dados e avaliado o número de novos ramos ortotrópicos durante 57 dias. O número de novos ramos ortotrópicos não apresentou diferença estatística. É possível observar que a aplicação de AIA (auxina) ou Protex teve em média 2 novos ramos por planta. Quando aplicadas em conjunto tiveram em média 6 novos ramos por planta, enquanto as plantas controle, que tiveram a poda total com H_2O tiveram em média 5 novos ramos por planta. É possível notar que a pulverização de AIA ou Protex, individualmente, em cafeeiros após poda total, diminuiu o crescimento de novos ramos ortotrópicos em comparação aos demais tratamentos testados.

Palavras-chave: Ramos ladrão. Pulverização. Manejo do cafeeiro.

ABSTRACT

The coffee culture in Brazil is critical to the economy of the country, once it is the biggest production in the world. The growth of new orthotropic branches in coffee plants is common, however, after the pruning, it is possible to observe an intensification that it is not ideal, once the new branches will drain the energy that could be going to the fruits, flowers or other vegetative part. Nowadays, it is missing employees to conduct the cutting of those branches, because it takes a lot of time and it is expensive for the owners. The objective of this research was to evaluate the growth of these branches, normally called in Brazil, "Ramo ladrão" under different types of products applications and pruning. The experiment was implemented in a research area of UFLA (Lavras-MG), the treatments were: (1) H_2O, (2) Pruning of the top + pruning of the branches tips (total pruning) + H_2O, (3) pruning of the branches tips + H_2O, (4) total pruning + auxin, (5) total pruning + Protex + auxin, (6) total pruning + Protex, (7) total pruning + Stimulate and (8) pruning of the branches tips + Stimulate, they were applied, weekly, for 10 weeks. It was separated into 24 blocks with 3 plants each, in full sun. Every 15 days data was collected, and the number of new orthotropic branches was evaluated for 57 days. The number of new orthotropic branches did not show statistical difference. However, it is possible to observe that the application of AIA (auxin) or Protex had an average of 2 new branches per plant. But, when applied together had an average of 6 new branches per plant, while control plants that had the total pruning with H_2O had a medium of 5 new branches per plant. It is possible to notice that the pulverization of AIA or Protex, individually, in coffee plants after total pruning, decreased the growth of new orthotropic branches compared to other treatments tested.

Keywords: Ramos ladrão. Pulverization. Coffee management.

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SUMMARY

1 INTRODUCTION

The introduction of coffee in Brazil started in 1727, when the Sargent-mor Francisco de Melo Palheta introduced some seeds and seedlings in the North of the country. The coffee was taken later to São Paulo, Minas Gerais and Paraná (Mendes *et al.*, 2008). Brazil started with *Coffea arabica*, nowadays it is still the main production but in Espirito Santo, the Canephora has the focus. Nowadays, the biggest production of coffee in the world belongs to Brazil, which impacts positively the Brazilian commercial balance (Coelho *et al.*, 2009). Given this importance to the economy, it is important to research and improve the production of coffee.

The coffee can be described as a bush, a perennial plant that when adults can have between 2 and 6 meters. It has 2 types of branches, the orthotopic that is the vertical axle, produces leaves and branches with radial symmetry patterns, in all directions; and the plagiotropic that is horizontal, and new branches grow on it, has flowers and leaves, with bilateral symmetry, as the branch, in one plan (Barthelemy and Caraglio 2007). The aerial part of the plant grows on one orthotopic branch, until the plant has 8 to 10 pairs of leaves. The fact of not having plagiotropic or new side branches in this stadium of development is related to the strong dominance of the apical bud above the other buds, in that case, can be leaf or branch, or even fruit. Those buds, normally in 5 to 6, are denominate serial buds, and the first bud is called head of series (Alvez, 2008).

The buds nominated serial buds are the responsible to the new orthotopic branch, which is not desired, in the perspective of the productor, once new orthotopic branches take energy to grow competing with the production of fruits and new plagiotropic branches. The new orthotropic branches are nominated as “ramos ladrões” (Assis, 2018).

The coffee field is full of challenges, control of plagues, weeds, diseases, problems with climate and nutrition. The mechanisms to control all these problems can be distinct or even the same can be applied to more than one, pruning is an example of a mechanism. With pruning it is possible to stimulate the plant that is not strong enough to grow better, to control plagues like miner bug and when a climate problem affects the field it is also helpful (Winston, Laak, 2005).

Pruning can be a mechanism that solves a lot of issues, renew the productive branches and the architecture of the plant, maintain an ideal number of leaves per fruit (20 cm^2), promotes

more light and wind, reduce the favorable environment for diseases and plagues, eliminate dead branches caused by plagues, diseases, climate and after a big productive year (Thomaziello, 2013). That are 3 types of pruning which are more used in the coffee field, they are called “Recepa”, “Decote” and “Esqueletamento”. Recepa is a drastic cut of the plant from 30 to 60 cm of the soil, used to eliminate mostly of the aerial part. Decote is a high pruning, cutting the orthotropic branch from the top of the plant, depending on how high it is, but normally between 2m and 2,2m. Esqueletamento is a pruning of the plagiotropic branches, 30 to 40cm from the tip of the orthotropic branch, normally it is used to do the decote and the esquetetamento together. The best time of year to proceed with pruning in Brazil is between July and August. It is usual to do it after a year with a big production (Thomaziello, 2013).

The plant growth regulators (PGR) are synthetic compounds that influences important physiological process in the plant growth and development. The interaction of the plant x environment has a reflect on the growth and development of the plants, involved in architecture, cycle time and productivity, all those conditions are influenced by the plant hormones. The application of PGR can change the molecules and have a bigger resistance and productivity (Pennacchi, 2023).

Auxin is one of the most well-known vegetal hormones, with the capacity to induce cell stretching. IAA (3-Indoleacetic acid) is considered one of the best to the roots development (Loss *et al.*, 2008). The auxin has as important function on plants to regulate and influence the growth, elongation of the stem and coleoptiles (Taiz; Zeiger, 2004; Ramos, 2011).

The objective of this project was to use pruning techniques and PGR to control the new orthotropic branches, called in Brazil “ramos ladrões”, on *Coffea arabica* of cultivar Paraíso MG H 419-1.

2 LITERATURE REVIEW

2.1 Domestication and Dispersion of Coffee

The oldest mention of coffee was found on a manuscript in the year of 575, describing the fruit found for a man in Ethiopia. The coffee was originated in the African northwest region, where plants where grown adapted to the arid and tropical climate (Martins, 2008).

The Ethiopians consumed the fruit from different forms. They ingested the sweet pulp, that could be macerated or mixed in hurries during meals. In addition, chewed the leaf and then chewed the leaves and used them in the preparation of infusions. They also created a fermented juice that was converted into an alcoholic drink (Martins, 2008).

The Arabs was the responsible for the beginning of the techniques of cultivation and preparation of coffee. The infusion of coffee was discovered around the year 1000. That time, the monks ingested as a stimulant, it helped them to be awake for long periods. The process of toasting the grain was introduced in the XIV century, it gives the drink the flavor and it is the form of use of nowadays (Martins, 2008).

The coffee spread quickly in the hot fields of the Arabic peninsula. In Turky started the ritual of consuming coffee in open spaces, then the first shops dedicated to this drink occurred there (Martins, 2008).

Coffee has its origins in Africa, nowadays the Arabic coffee is cultivated all around the world, including the central and south America, Occidental Africa and Oriental Asia (Taques; Dadalto, 2017). The discovery of the drink that maintained people alert, promoting more concentration during praiers, soon start being part of the monks' rituals (Rodrigues *et al.*, 2015).

2.2 The importance and influence of coffee in the history of Brazil

Francisco de Melo Palheta, Sargent-Mor, was responsible for bringing the coffee culture to Brazil. That are different versions of the details, but Palheta was who travel to French Guiana, brought to Brazil seeds and seedlings which began the culture in the North of the country (Martins, 2008).

Since the rise of coffee culture in Rio de Janeiro, between 1760-1808, with the Cort in Brazil, the new plants expanded the plantation. The plants had some principal destines: São Gonçalo, Rezende, Mata Mineira and Plateau Paulista (Martins, 2008).

"A economia cafeeira foi fundamental para a formação da estrutura capitalista no Brasil, gerando capital que foi posteriormente investido em indústrias e infraestrutura." (Furtado, 1959, *Formação Econômica do Brasil*).

The transfer of the Court to Brazil in 1808, to the economy aspect opened the commercial port to international commerce, it was possible to show the new country through the coffee (Martins, 2008). The coffee is one of the most important crops on Brazilian agriculture. Nowadays, Brazil has an area bigger than 2 million of hectares of coffee plantation (CONAB, 2016).

2.3 Morphology and Physiology of the coffee plant

The genetics of the *Coffea arabica* L. is narrow, the commercials cultivars show a huge variability on the morphology because of the mutations, natural or artificial crossing and phenotype differences (Alvez, 2008).

Normally, the coffee tree is a perennial shrub that can have between two and six meters, and in the wild it can archive up to ten meters. It has a cylindrical canopy and lateral branches emerging from the main trunk. The leaves are dark green, shiny, elliptical, and have wavy edges. The inflorescences that develop in the axil leaf develop more than 4 flowers. The fruits are oblong, yellow or red when ripe (Alvez, 2008).

The aerial part of the coffee plant growth on one orthotropic branch, the development of the embryonic axis, until the formation of 8 to 10 leaf (Carvalho at al., 2008). Due to the strong dominance exerted by the apical bud over the lateral ones, lateral shoots and branches do not develop. The buds located in the leaf axils can differentiate into leaves or branches, and very rarely into fruits. These buds are called seriated buds and usually number between 5 and 6 (Alvez, 2008). The buds are located between 2 knots, that will be branches and fruits, and the first bud will promote the plagiotropic branches, they are responsible for the production of the fruits (Rena; Maestri, 1986). There is only one terminal bud in the axil of each leaf, thus forming

only one pair of lateral branches. In adult plants, leaf sprouting occurs symmetrically, opposite to each other (DaMatta *et al.*, 2008).

The growth of coffee plants varies throughout the year. During periods of mild temperatures and rainfall, vegetative growth occurs. The dormancy phase, however, happens during the dry and cold period, causing the growth rate to become negligible. There may be a pause in growth in January, which is suggested to be associated with high temperatures and intense solar radiation (DaMatta *et al.*, 2008).

2.4 Unwanted Orthotropic branches (Ramos ladrões)

Besides reducing productivity, plant canopy closure also enhances the incidence of pests such as the "borer" and diseases like "rust" (Matiello, 2005). The triggers the growth of lower auxiliary buds, resulting in a multi-stemmed plant. Along the main stem, there is only one bud available to form lateral branches from the leaf axils. Pruning is necessary to rejuvenate the plant and encourage the growth of new young lateral branches near the ground. This stimulates the growth of new orthotropic shots from the stump, which then develop into new lateral branches (Malavolta, 1993).

The presence of serial buds is what promotes new orthotropic branches. There are more buds of new orthotropic branches than plagiotropic. The amount of growing orthotropic branches gives to that, and the need of taking off (Alvez, 2008).

2.5 Influence of auxin and the breaking of apical dominance

Plant hormone or phytohormone is a biologically active chemical substance produced by a plant that regulates specific physiological processes at low concentrations. It is typically synthesized in one part of the plant and translocated to exert its effects in another part (Biasi, 2002).

The discovery of plant hormones and growth regulators (the synthetic molecules) has led to major advances in physiology, particularly in understanding cellular differentiation control. This has enabled the development of *in vitro* culture of isolated plant cells and tissues, which is one of the key tools for agricultural development (Torres *et al.*, 1998).

3-Indoleacetic acid (IAA) is the primary auxin in plants, with the amino acid tryptophan accepted as its precursor in synthesis. While IAA was the first auxin isolated from plants, other compounds with auxin activity have also been found (Epstein *et al.*, 1989).

Plant growth regulators, also known as plant hormones or bioregulators, are all substances, whether natural or artificial, that affect the growth and development of plants (Davies, 1995).

The IAA applied soy culture, could see that the growth regulator was located on the bottom of the plant, suggesting an involvement on the stem growth and cellular stretching (Cassel *et al.*, 2021).

A study was realized, (Shi *et al.*2018), suggesting the transport of the top of the plant to the bottom of the plant, the auxin, looking for a critical point to growth a lateral branch.

IAA induce flower stalk elongation on a Chinese study, whereas stalk elongation was stimulated by the IAA treatment, after the cut off the top of the plant and applying IAA the results were better than the one with applying H_2O (Kou *et al.* 2021).

2.6 Pruning on coffee plants

In modern coffee farming, pruning is considered a crucial management practice. Among pruning techniques, "recepa" stands out—a drastic, low-cut pruning that promotes almost complete canopy renewal in coffee trees. It is recommended for plantations or individual plants that have lost their lower productive branches due to advanced canopy closure. Additionally, it is advised for rejuvenating depleted coffee trees recovering from periods of neglect or adverse weather conditions (Matiello *et al.*, 2007).

After pruning (removal of the above-ground part of the plant), apical dominance is lost because the removal of the apical bud leads to reduced levels of auxin and increased levels of cytokinin in the lateral buds. This promotes the activation of these buds, resulting in the growth of numerous shoots that will form the new canopy of the plant (Pio *et al.*, 2006).

A study demonstrated that approximately 60 days after pruning, the shoots reach a size of 15-20 cm, and the first shoot thinning begins. Depending on the crop spacing and row distance, about 1-2 shoots per plant are left, selecting those with better vigor (Matiello *et al.*, 2007). Types of pruning:

- Decote: A less drastic pruning focuses on removing the upper part of the plant. This is recommended when the field is starting to grow but has not lost many lower branches. The technique can be managed by maintaining the coffee tree at the desired height by removing all the shoots. Some plants may require trimming the upper part to control undesirable height. Periodic shoot thinning is necessary. This method, known as "decote", is simple and cost-effective, and it does not result in significant production losses (Mesquita *et al.* 2016).

- Esqueletamento: In addition to pruning the main orthotropic trunk, there is also pruning of productive lateral branches, commonly referred to as “esqueletamento” and “desbaste”. “Esqueletamento” involves cutting the top of the trunk followed by trimming lateral branches 20-30 cm from the trunk. “desbaste” is less drastic compared to “esqueletamento”, involving cutting only the tips of lateral branches 40-60 cm from the trunk (Mesquita *et al.* 2016).

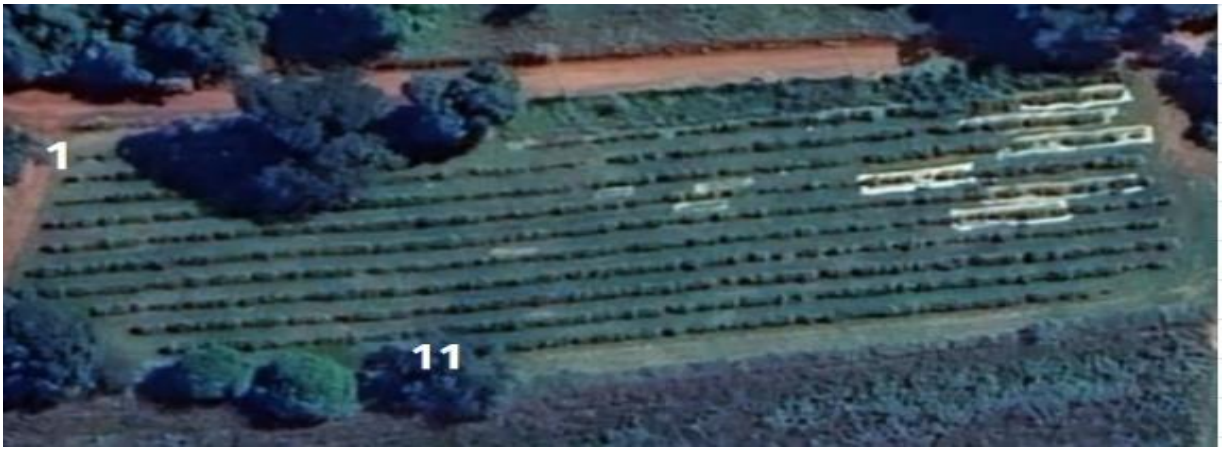
- Recepa: It is the most drastic method, removing almost all of the trunk. There are some consequences: the field will need time to regrow, and many of the roots will die. However, over time, they will grow back as the trunk develops. The main point is to cut at a height of 20 to 40 cm above the ground. This process is commonly referred to as "safra 0" and is done when the plants are not strong and not producing (Mesquita *et al.* 2016).

3 METHODOLOGY

3.1 Location and characteristics of the area

The project was made on experimental field of Federal University of Lavras – Lavras/Minas Gerais, located on 21º13’40” of latitude south and 44º57’50” of longitude west, with medium of 900 meters above the sea level. The climate is described by Vilela & Ramalho as cwb of Kooper. The cultivar used was Paraíso MG H 419-1, in soil clay texture. The area had 11 lines of planted coffee (Figure 1).

Figure 1 –Experimental area.



Source: Google earth (2023)

A soil analysis (Table 1) was conducted on the field used; however, it was not possible to make the necessary corrections. Nevertheless, all plants were subjected to the same environmental conditions. There was also a rapid growth of weeds in the area, mainly due to the experiment taking place during the rainy season.

Table 1 –Soil analysis from experimental area.

Protocolo	Identificação Amostra	pH(KCl)	pH	K	P	Na	Ca	Mg	Al	H+Al
				----- mg/dm³ -----			----- cmolc/dm³ -----			
1861	1-(00-20 CM)	-	5,9	183,26	33,41	4,00	4,32	1,52	0,10	5,00
1862	2-(20-40 CM)	-	4,6	51,77	9,96	5,00	1,10	0,40	0,60	6,90
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

Protocolo	SB	t	T	V	m	M.O.	P-Rem	Zn	Fe	Mn	Cu	B	S
	----- cmolc/dm³ -----			----- % -----		dag/kg	mg/L	----- mg/dm³ -----					
1861	6,31	6,41	11,31	55,79	1,56	4,01	21,30	3,60	37,70	7,40	2,37	0,04	18,30
1862	1,63	2,23	8,53	19,14	26,91	3,15	14,50	0,90	39,50	2,70	1,40	0,04	79,50
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: UFLA soil lab (2023).

3.2 Experimental design

It was used the randomized block design (DBC). The research had 8 treatments, with 3 replicates each, with a total of 24 parcel (Table 2). Every parcel had 3 plants, a totality of 72 plants were used. The experiment with 8 different treatments was separated as the following: 5 of them with the cutting the top of the plant and on the lateral branches, this pruning will be called “poda”, 2 with the cutting only on the lateral, this will be called “esqueletamento” and 1 without pruning to be the control. It was applied 90mg/dm^3 of IAA (Indole acetic acid), 5mL/dm^3 of Protex (a product based on calcium) and 1,5 mL/dm^3 of Stimulate (a product of Stoller). The experiment started in September, after harvesting and before rain started.

For pruning it was used a mechanical tool. To apply the products, a costal pump with a snozzle number U8118.00.00.

The treatments:

T0) H_2O, Parcel 1, 11 and 22;

T1) Poda + H_2O, Parcel 2, 12 and 19;

T2) Esqueletamento + H_2O, Parcel 3, 16 and 20;

T3) Poda + IAA, Parcel 4, 13 and 21;

T4) Poda + Protex + IAA, Parcel 5, 14 and 24;

T5) Poda + Protex, Parcel 6, 15 and 23;

T6) Poda + Stimulate, Parcel 7, 9 and 18;

T7) Esqueletamento + Stimulate, Parcel 8, 10 and 17;

Table 2 – Map of the treatments with the lines that were used in the field 5, 7 and 9.

Lines																							
5	17	18	19	58	59	60	75	76	77	85	86	87	90	91	92	99	100	101	110	111	112	118	119	120
7	8	9	10	14	15	16	24	25	26	40	41	42	60	61	62	80	81	82	88	89	90	94	95	96
9	24	25	26	60	61	62	67	68	69	83	84	85	89	90	91	98	99	100	106	107	108	124	125	126

Colors: T0 – Gold, T1- Dark green, T2- Pink, T3- Yellow, T4- Purple, T5- Green, T6- Blue, Ty- Orange; Numbers: Where each plant was located. Source: From author (2024).

Figure 2 – Types of prunings.

(1) No pruning (control) (2) Poda (3) Esqueletamento

Source: From author (2024).

3.3 The plants, pruning and spraying

The plants were chosen considering the uniformity of them, in each block, also making sure that all plants were in full sun. It was selected 3 plants for each block, total of 24 parcels, all by random. It was chosen 3 lines in the middle of the field, lines 5, 7 and 9. After that, plants were marked with tapes with different colors and parcels numbers. All the pruning was realized with a semiautomatic “motopoda”, with a pattern, the orthotropic branches were cutted below 20cm of the top (“decote”) and the plagiotropic 30cm from the orthotropic (“esqueletamento”) (Figure 2).

The treatment with the products was using 100mL of solution including the products diluted in water, each one with the dose recommended. The spraying was applied every week, for 10 weeks, the first spray was done in September 23th and the last in December 1st.

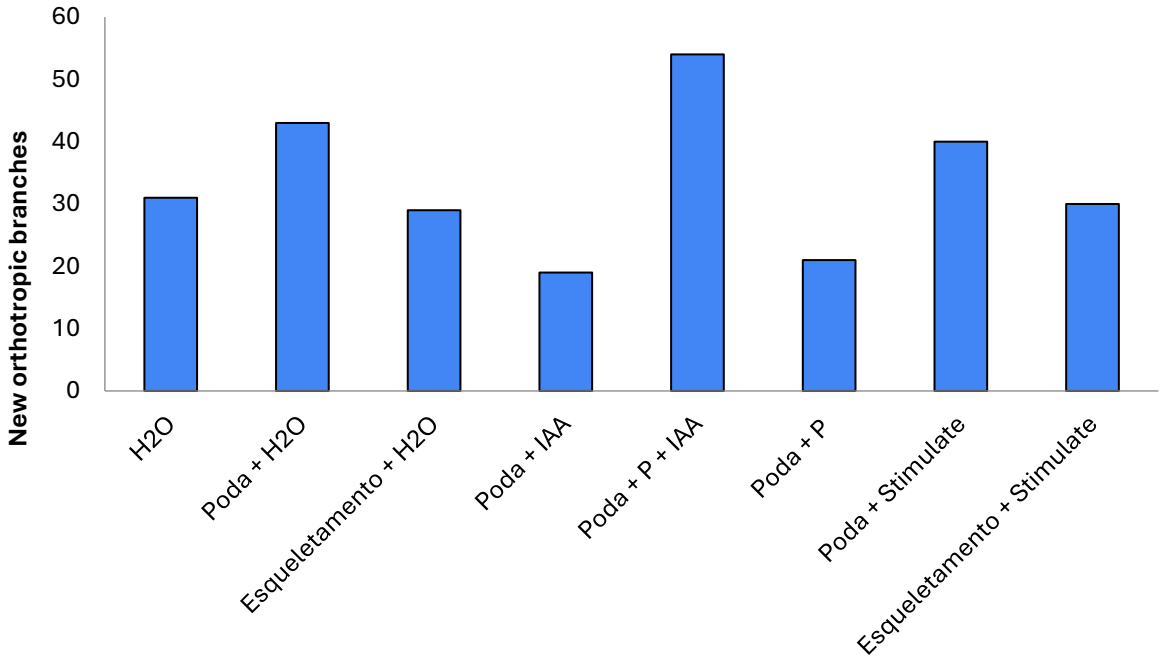
4 RESULTS AND DISCUSSION

The treatments did not have significant results in statistics. However, it is possible to observe the slight difference between the control treatments with the others, Poda + IAA and Poda + P.

The evolution began 1 month after the pruning. The action of cutting was done in 09/23/2023, the same day that had the first application. Meanwhile the counting of the new orthotropic branches started 10/21/2023, same day that had the 4th application. The counting was held every 15 days, after the fifth time, the last one 12/16/2023, at a total of 5 counting at the end. All the counting were cumulative, in other words, all the branches on the plant were considered during all evaluations.

It was possible notice that even without external intervention the plant tended to produce new branches (Figure 3). In that way, it is possible the interpretation that has a capacity for autoregulation and growth, can be a way to adaptation, to absorbs more light. Otherwise, those new orthotropic branches normally aren’t controlled, it will spend more energy than produce, necessarily to remove.

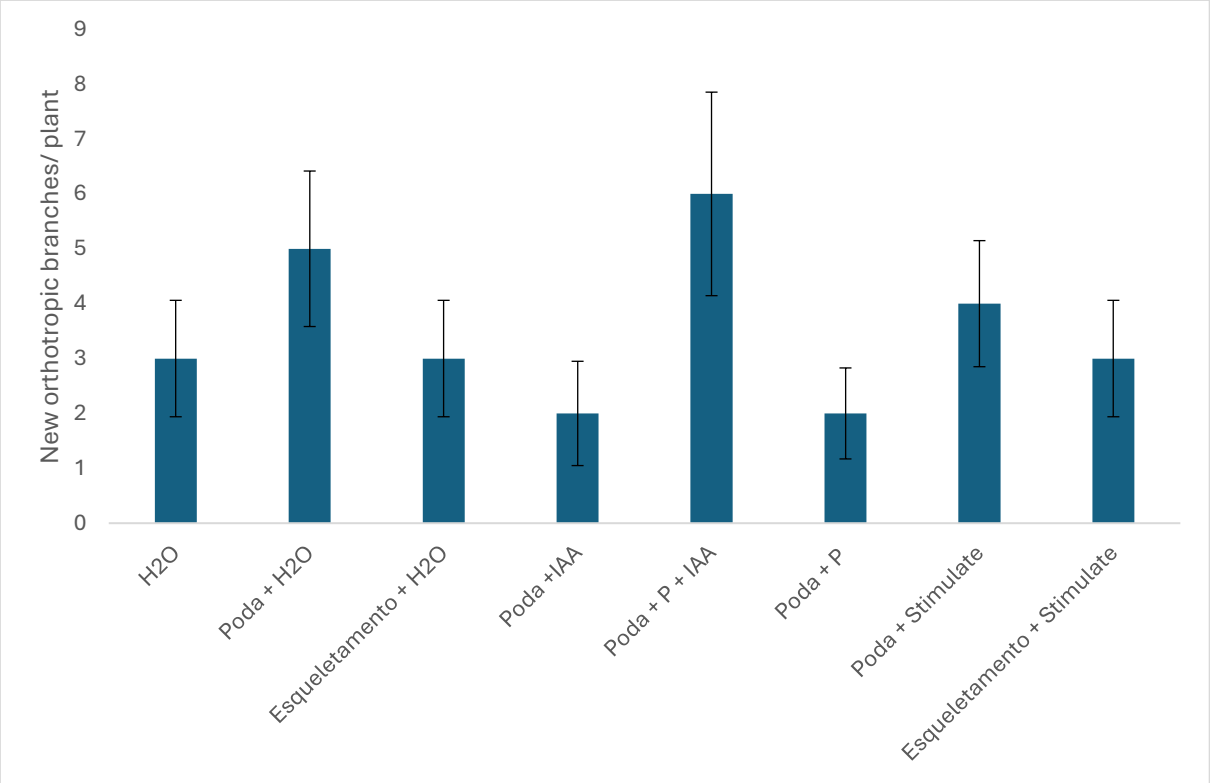
Figure 3 –Representation of new orthotropic branches for all the treatments. Bars represent the absolute number of new orthotropic branches



Source: From author (2024).

Comparing different treatments after pruning, we could observe that Poda + IAA and Poda + P maintain a low medium of new branches, 2 per plant (Figure 4). Those results are near control, suggesting that the application of those treatments had an influence to control the buds. The AIA, an auxin, acts on control of dominance apical, promoting a balance on the plant development, acting on new branches' regulation (Cao *et al.*, 2023).

Figure 4 – Number of new orthotropic branches per plant after pruning and product application. Bars represent the average (n= 3) with standard error



Source: From author (2024).

4.1 Poda + H_2O and Esqueletamento + H_2O

With the Poda + H_2O was possible to observe an increase in the new branches. The possible effect is the cutting of meristem apical, the principal point of growth. Without the point of auxin to inhibit growth in the laterals, the plant responds with a proliferation of many new branches. That answer is a natural substitution, the plant trying to find the growth point that was lost (Muller; Leyser, 2011). The pruning shows really an increase in the number of orthotropic branches.

4.2 Poda + IAA

The IAA increases the growth to the active development parts, taking high the plasticity of cells facilitates expansion; it regulates cell elongation and maintains apical dominance. However, when this dominance is removed (such as through pruning), auxin (IAA) redistributes growth to the buds (Kou *et al.* 2021).

It was possible to see that this application had a good answer, 3 times less than one treatment, it is possible to reduce the incidence based on IAA application.

4.3 Poda + P

Product P has in the formulation high concentration on calcium, it plays an essential role in structuring cell walls, contributing to their formation and supporting the stability and rigidity of plant tissues (Marschner, 1985). This treatment also had a low new branch, had the same as IAA.

It is necessary to conduct other researches to understand why these products had such an effect, since that just the product reduces the incidence.

4.4 Poda + IAA + P

Product P contains a high concentration of calcium in its formulation, which, when applied alongside auxin (IAA), shows a synergistic effect that may explain the intense growth of new branches. When applied together with auxin (IAA), which is involved in cell growth and division, this available calcium becomes a resource for cell construction and expansion, while IAA stimulates cell division and elongation (Hopkins,1999). With calcium readily accessible, the environment becomes ideal for the formation of new cell walls and vigorous cell expansion, accentuating branch growth.

With the highest number of orthotropic branches, this treatment has the recommendation of be conducted again, to see what could happened.

4.5 Poda + Stimulate and Esqueletamento + Stimulate

The comparation of those two treatments is possible to observe the difference between them. As the way the control of each of them, the esqueletamento for not take off the top of the plant, the part where has more concentration of auxin, presents a better answer to the results.

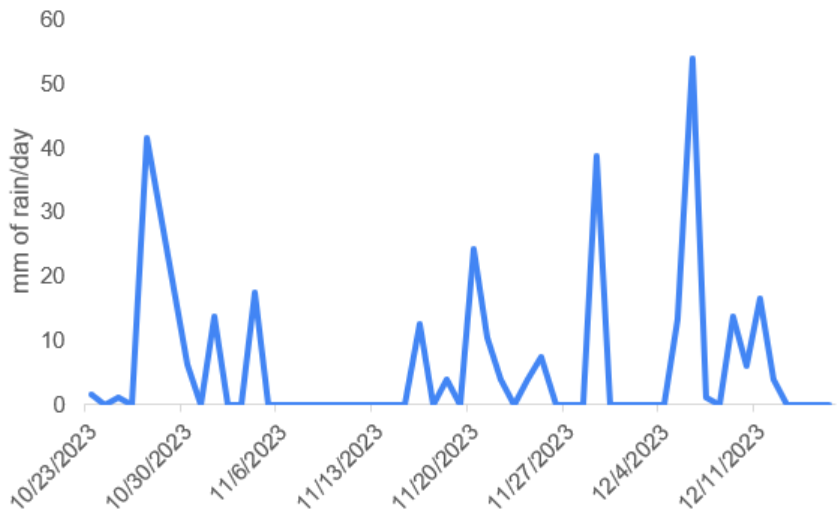
When using Stimulate after esqueletamento, the natural of the plant was sprout branches in answer to the loss of the apical meristem. With the cut and the disorder of the hormones, the

application of the product helped to stabilize. This product was tested with this purpose on research to see if an existing product made for another purpose could help to reduce new branches, once the formula has cytokinin, auxin and gibberellin on it.

4.6 Interaction of the environment

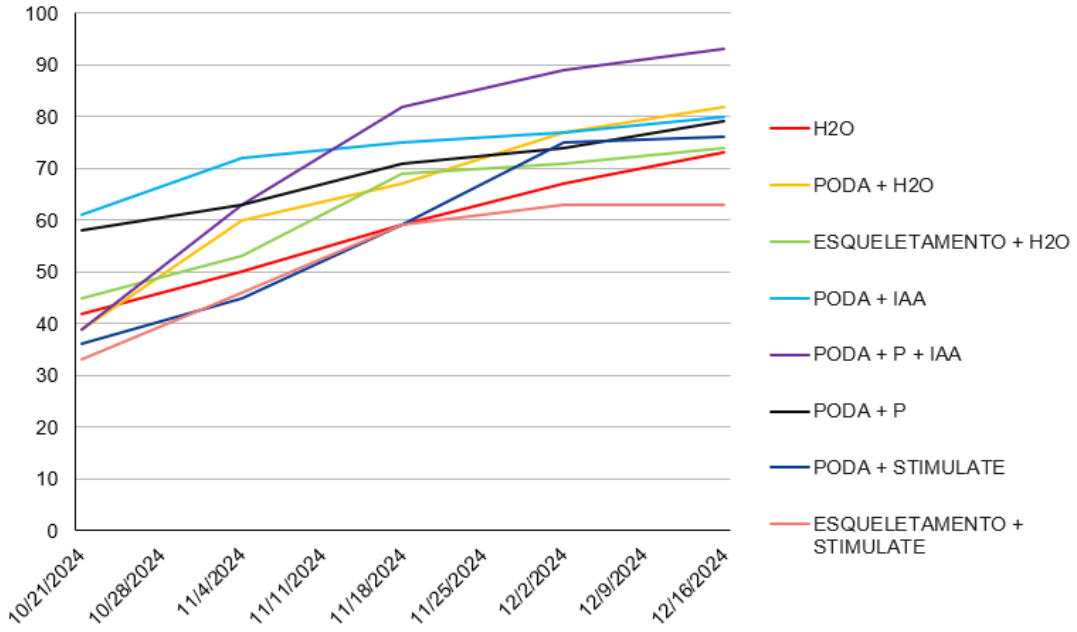
It was possible to see that the period of the new branches is between the second and third counting, 11/04/2023 – 11/18/2023. After the investigation and analysis of the data of the Wheater station of Lavras-MG (83687), it was possible to see a veranico during this period, a lot of days with 0mm of precipitation (Figure 5).

Figure 5 –Precipitation observed during the experiment



Source: From author (2024).

Figure 6 –New orthotropic branches observed along the experiment. The numbers were accumulative



Source: From author (2024).

Based on the formula Phenotype = Genotypes + Environment + Interaction genotypes x environment, it is a base to analyze the graphic of precipitation in a way that the coffee plants could had the period without rain as a stimulus to produce new buds, and growth more branches than the other periods of the experiment.

To exemplify the relevance of the results, an example of a farm with a big production. Coffee farms with advanced technology and with a few people to do the work, once the mechanical doesn't need a lot of people, normally has a big area, taken a farm with spacing 3,5x0,8m could fit around 2285 plants/ha, a farm with 50ha, have 115.250 plants. Using the average of this work to the Poda + H_2O, 5 per plant, on 50ha would have 576.250 new orthotropic branch. If using the treatment Poda + IAA, it would have 230.500 new orthotropic branch.

In other words, when looked at in a small part it can't have a statistical difference, but on the field is possible to reduce a lot the manual work. The difference between then was 345.750 new branches, if considering the medium of 4,44/plant, would reduce around 34ha of

manual work, just to apply the growth regulator after pruning, and the application is with pulverization, and it can be done with mechanical equipment.

5 CONCLUSION

Even though the treatments applied did not showed a significant difference in statistical analysis, it is possible to see a tendency in sprouting, suggesting that interventions such as poda, with the esqueletamento type and with the use of growth regulators have an effect on plant development. Additionally, the influence of climate conditions and the plants' response to water stress are essential factors to consider.

Based on the interpretation of the results, relating it to a real case in the field, the application of IAA+Pruning could reduce labor by approximately 34 ha in a 50ha field with a spacing of 3.5x0.8. Thus, reducing one of the major problems in the field today, which is human labor, since it is not possible to take off the new orthotropic branches with machinery. It was also possible to see that pruning really revitalized the plants, as well as the use of pruning increased the number of sprouts, information already existing in literature.

Moreover, to achieve more reliable results, it is recommended to repeat the experiment with greater control and a larger sample size.

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