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# Prohexadione calcium as a tool to reduce winter pruning in peach tree cultivar Eragil

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## Abstract
This work evaluated the efficiency and feasibility of applying calcium prohexadione (PCA) at different times to control the vegetative growth and qualitative aspects of the peach tree cultivar Eragil. The experiment was carried out in the 2021/2022 season in a commercial orchard in the municipality of Ipê, RS. Treatments consisted of applications of PCA at a fixed dose of 20 mL·100 $L^{-1}$ at different stages of development, as shown: T1 – control (no application); T2 – application in petal fall; T3 – application at petal fall + application 30 DAA (days after the first application); T4 – application after green pruning; T5 – application after green pruning + application 30 DAA; T6 – application at petal fall + application 30 DAA + application 60 DAA. The experimental design was in randomized blocks, with six treatments and four replications. Each plot consisted of four plants; the two central plants were considered useful. Effective fruiting increased in T3. In the evaluations of the number of pruned branches, length of branches, and weight of branches per plant, all results were smaller in T2. In the assessments of number of buds, internode length, and pruning time per hectare, there was also a significant difference, and in the number of buds, T6 had the smallest number. The internode length was the greatest in T3, and the shortest pruning time stood out in T4. Calcium prohexadione effectively controlled the vegetative growth of Eragil peach and can be directed to large areas of the peach crop when labor for pruning is scarce.

**Palavras-chave:** Branch growth; growth regulators; production; *Prunus persica*; Viviful®.

## Resumo
**Uso de proexadiona cálcica como ferramenta para reduzir a poda invernal em pessegueiros cultivar Eragil**
Este trabalho avaliou a eficiência e viabilidade da aplicação de proexadiona cálcica (PCA) em diferentes épocas para controlar o crescimento vegetativo e aspectos qualitativos do pessegueiro cultivar Eragil. O experimento foi conduzido na safra 2021/2022, em pomar comercial no município de Ipê, RS. Os tratamentos consistiram em aplicações de PCA na dose fixa de 20 mL·100 $L^{-1}$ em diferentes estágios, sendo: T1 – controle (sem aplicação); T2 – aplicação na queda das pétalas; T3 – aplicação na queda das pétalas + aplicação 30 DAA (dias após a primeira aplicação); T4 – aplicação após poda verde; T5 – aplicação após poda verde + aplicação 30 DAA; T6 – aplicação na queda das pétalas + aplicação 30 DAA + aplicação 60 DAA. O delineamento




Revista Eletrônica Científica da UERGS

experimental foi em blocos casualizados, com seis tratamentos e quatro repetições. Cada parcela foi constituída por quatro plantas; as duas centrais foram consideradas úteis. A frutificação efetiva aumentou em T3. Nas avaliações do número de ramos podados, comprimento dos ramos e massa de ramos por planta, todos os resultados foram menores em T2. Nas avaliações de número de gemas, comprimento dos internódios e tempo de poda por hectare também houve diferença significativa, e no número de gemas, T6 apresentou o menor número. O comprimento do entrenó foi maior em T3, e o menor tempo de poda se destacou em T4. A prohexadiona cálcica controlou efetivamente o crescimento vegetativo do pessegueiro Eragil e pode ser direcionada para grandes áreas da cultura do pessegueiro quando a mão de obra para a poda é escassa.

**Keywords:** Crescimento de ramos; produtividade; *Prunus persica*; reguladores de crescimento; Viviful®.

## Resumen

**Prohexadione calcio como herramienta para reducir la poda de invierno en durazno cultivar Eragil**

Este trabajo evaluó la eficacia y viabilidad de la aplicación de prohexadiona cálcica (PCA) en diferentes momentos para controlar el crecimiento vegetativo y aspectos cualitativos del cultivo de durazno Eragil. El experimento se realizó en la temporada 2021/2022, en un huerto comercial en Ipê, RS. Los tratamientos consistieron en aplicaciones de PCA a una dosis fija de 20 $mL \cdot 100\ L^{-1}$ en diferentes etapas, así: T1 – control (sin aplicación); T2 – aplicación en la caída de pétalos; T3 – aplicación cuando caen los pétalos + aplicación 30 DDA (días después de la primera aplicación); T4 – aplicación después de la poda en verde; T5 – aplicación después de la poda en verde + aplicación 30 DDA; T6 – aplicación en la caída de pétalos + aplicación 30 DDA + aplicación 60 DDA. El diseño experimental fue de bloques al azar, con seis tratamientos y cuatro repeticiones. Cada parcela constaba de cuatro plantas, de las cuales se consideraron útiles las dos del centro. La fructificación efectiva aumentó en T3. En las evaluaciones del número de ramas podadas, longitud de las ramas y peso de las ramas por planta, todos los resultados fueron menores en T2. En las evaluaciones del número de yemas, longitud de los entrenudos y tiempo de poda por hectárea también hubo una diferencia significativa, y T6 presentó el menor número de yemas. La longitud del entrenudo fue mayor en T3, y el menor tiempo de poda se destacó en T4. La prohexadiona cálcica controló eficazmente el crecimiento vegetativo del durazno Eragil y puede ser una opción para grandes áreas de cultivo de durazno cuando la mano de obra para la poda es escasa.

**Palabras clave:** Crecimiento de ramas; productividad; *Prunus persica*; reguladores del crecimiento; Viviful®.

## Introduction

The peach tree (*Prunus persica* L.) is a temperate fruit that has stood out in the world economy due to its high productivity in subtropical regions, such as southern Brazil. Brazilian peach production is characterized by high profitability, job creation, and good acceptance in the fresh fruit market (Severo *et al*., 2020). Rio Grande do Sul, Santa Catarina, Paraná, São Paulo, Minas Gerais, and Espírito Santo states are the main producing regions. Rio Grande do Sul stands out as the largest producer, representing 66 % of the total production, with a planted area of 15,555 ha and a total output of 199,000 t (IBGE, 2022). Most of the peach production in Rio Grande do Sul is concentrated in two producing regions, the South Region, and the Serra Gaúcha. However, it is worth remembering that peach cultivation has also been intensifying in the metropolitan region of Porto Alegre. Approximately half of the peach production in Rio Grande do Sul is produced in three main municipalities: Pelotas, Canguçu, and Pinto Bandeira (Severo *et al*., 2020).

The main peach cultivars cultivated in Brazil are early PS, late PS, Douradão, Aurora, Tropic Beauty, BRS Kampai, BRS Rubimel, BRS Fascínio, Chimarrita, BRS Regalo, Coral, Eragil, Xiripá, Della Nona, and Barbosa (Dini *et al*., 2021). According to Ministry of Agriculture (MAPA) National Cultivar Registry (RNC), there are 172 registered peach cultivars. Still, there are ancient cultivars that are planted and not registered, in addition to the existing registered cultivars that were not planted.

The Eragil cultivar is classified as late due to the high winter cold requirement, around 600 cold hours (temperatures below 7.2 ºC), adapting well to the climate of Rio Grande do Sul, especially in colder regions, such as Serra Gaúcha (Almeida *et al*., 2014). The plants have medium vigor and semi-open growth habit. The average production in Serra Gaúcha is 30 $t \cdot ha^{-1}$, with soluble solids content in the range of 12 ºBrix (Anzanello; Menin, 2018). The fruit harvest in this region occurs in January (Almeida *et al*., 2014).

The intense vegetative growth of this cultivar during the spring (September to December) and summer months (January to March) makes it inevitable to use cultural practices such as green pruning, necessary to remove vigorous shoots facing the inside of the crown, which cause shading of the fruits and the plant. In addition, green pruning prepares the plant to form reproductive structures during the summer and reduces the time for winter pruning (Conesa *et al*., 2019).

The intense vegetative growth needs to be controlled for an adequate balance between the vegetative and reproductive parts of the plants. However, in the productive system of peach trees in family farming, it is necessary to reduce pruning costs since qualified labor is increasingly scarce. According to information from Emater RS, the cost of winter pruning and green pruning can represent 15 – 20 % of the total labor cost. This percentage may change when the cultivar expresses high vegetative vigor, removing more branches from the plant. However, if performed incorrectly, it can limit the availability of carbohydrates due to the decrease in the photosynthetic rate as a result of leaf removal, which affects fruit growth, sugar levels in the fruits, and the productivity of the plant as a whole (Conesa *et al*., 2019).

With this, it becomes necessary to carry out studies on the application of tools to control the vegetative growth of plants, such as growth regulators. In this case, products based on calcium prohexadione (PCA) can be used, whose active ingredient is intended to reduce the vegetative growth of the plant, acting by inhibiting the biosynthesis of gibberellins. Gibberellins are a class of phytohormones responsible for the development of plant branches (Petri, 2016). PCA is part of the acylcyclohexaneedione (ACC) group. It blocks the action of dioxygenase enzymes (GA20ox and GA3ox), which act in the conversion of GA20 to GA1, with a reduction in levels of GA1, one of the most active gibberellins in the plant. Thus, the accumulation of precursor GA20 occurs, mobile gibberellin, but causing small alteration in the plant (Wundra *et al*., 2019; Rademacher, 2016).

In fruitful species such as the peach, pear, and apple trees, with the reduction in the levels of active gibberellins, the elongation of the branches becomes smaller, and the incidence of light inside the canopy is greater. This reduces the need for interventions through pruning (Greene, 2007; Magrin, 2017; Carra *et al*., 2021; Dalzochio; Silvestre; Pauletti, 2021). However, this product has a temporary inhibitory action, and the plants return to vegetation sometime after PCA application. Thus, for this growth regulator to reduce the excessive vegetative growth of the peach tree and/or increase the allocation of photoassimilates for fruit growth, it is necessary to establish which plant phenophases are most suitable for applying this plant regulator.

In this context, the objective of this study was to evaluate the efficiency and feasibility of applying calcium prohexadione at different development stages in controlling the vegetative growth and qualitative aspects of the peach tree cultivar Eragil.

## Material and Methods

The experiment was carried out in the 2021/22 season in a rural property in the municipality of Ipê, in the ecoclimatic Northeast mountain region of Rio Grande do Sul, Brazil (geographical coordinates: 28º46' S, 51º 21'W), with an altitude of 676 m above sea level. The region's climate is temperate, with mild summers, cold winters, and uniform rainfall, according to the Cfb Köppen classification. The average annual rainfall is 2000 mm, and the average temperature is 16.6 °C (Emater, 2022).

The peach cultivar evaluated was Eragil, on a 12-year-old Okinawa rootstock. The orchard production is intended for in *natura* consumption and is conducted in the shape of a cup, with a planting density of 1,000 $plants \cdot ha^{-1}$ with a spacing of 5.0 m between rows and 2.0 m between plants. The plants received mineral nutrition as recommended by the Fertilization and Liming Manual for Rio Grande do Sul and Santa Catarina states (CQFS, 2016). Thinning was performed 40 days after flowering, before the endocarp hardened, varying the number of fruits left on each branch from two to four fruits/branch.

Treatments consisted of applications of calcium prohexadione (PCA) at a fixed dose of 20 $mL \cdot 100\ L^{-1}$ at different stages of development. This dose was chosen following the recommendations of the product manufacturer. The treatments tested were: T1 – Control (no application); T2 – application in petal fall; T3 – application at petal fall + application 30 DAA (days after the first application); T4 – application after green pruning; T5 – application after green pruning + application 30 DAA; T6 – application at petal fall + application 30 DAA + application 60 DAA. The commercial product Viviful® was used as a source of PCA, with a concentration of 500 g·L$^{-1}$ (50 % w/v) of calcium prohexadione.

The experimental design used was randomized blocks, with six treatments and four replications. Each plot consisted of four plants, and the two plants were considered useful plants. Applications were carried out with a 20 L knapsack sprayer at the vegetative stages described above, using a spray volume of 1,000 L·ha$^{-1}$.

Evaluations were carried out from sprouting to the post-harvest period. In each useful plant, four branches were previously marked in the upper half, one in each leg, where the number of flowers was counted. The counts were performed in the first application in petal fall and fifteen days after. Effective fruiting was recorded by manually counting flower buds before and after applying PCA in full bloom on branches located in the middle portion of the plant and demarcated with a numbered label.

At harvest time, the number of fruits per plant was determined by manually counting the fruits on the plant before harvesting. Total production was estimated by counting all the fruits on the plant at harvest time multiplied by the average fruit weight, and the result was expressed in kilograms per plant (kg·plant$^{-1}$). The average mass of the fruits was obtained by weighing 50 fruits per repetition, picked randomly. The fruits were weighed on a precision electronic scale, and the results were expressed in grams per fruit (g·fruit$^{-1}$).

Samples of ten fruits per repetition were taken to evaluate the physical-chemical, biometric, and quality parameters. Fruit diameter and length were measured with a measuring tape, placed vertically for length measurement and horizontally for diameter. The results were expressed in millimeters (mm). Pulp firmness was determined using a digital penetrometer with an 11 mm tip. Two readings were taken on diametrically opposite sides, in the equatorial portion of the fruit, after removing the epidermis with a superficial cut of two disks about 1.0 cm in diameter. The results were expressed in pound-force per square centimeter (lbf·cm$^{-2}$).

Afterward, the juice of the ten fruits was extracted with an electric processor. The parameters of titratable acidity (TA), soluble solids (SS), and SS/TA ratio were determined using the extracted juice. The soluble solids content was determined according to method 315/IV of the Manual of Physical-chemical Methods for Food Analysis (IAL, 2008), and the results were expressed in degrees Brix (°Brix). The titratable acidity was determined following the 311/IV method (IAL, 2008), and the results were expressed in percentage weight by volume (% w/v) of malic acid equivalents. The SS/TA ratio was calculated through the ratio between the soluble solids content and the titratable acidity.

Three months after harvesting, pruning was performed, and the average number of branches pruned on each plant was determined by counting the branches removed from each plant and separated according to the treatment. The average length of the pruned branches was obtained with a millimeter measuring tape, and all pruned branches were measured on each plant. The results were expressed in centimeters (cm). The mass of pruned plant material was obtained by weighing all pruned branches on each plant of each treatment on a precision scale, and the results were expressed in kilograms per plant (kg·plant$^{-1}$).

The number of buds per pruned branch was also counted, which was obtained by manually counting the buds in each pruned branch, and the results were expressed in buds per branch (buds·branch$^{-1}$). The internode length was obtained by the quotient between the length of the branch and the number of buds, expressed in centimeters per bud (cm·bud$^{-1}$). The time to carry out winter pruning in each treatment was obtained by recording the time spent pruning each useful plant and multiplying it by the number of plants per hectare. The results are presented in hours per hectare (h·ha$^{-1}$).

The cost of applying the treatments was accounted for by the cost of the product and the application for each treatment, quoted at the time the study was carried out, and the results were expressed in United States dollars per hectare (US$·ha$^{-1}$). The time and cost of green pruning were accounted for by the performance of pruning by a qualified worker in each treatment, multiplied by the hourly rate of the worker, quoted at the time of the study, and the results were expressed in United States dollars per hectare (US$·ha$^{-1}$). The same procedure was performed for winter pruning, with the time required to prune the plants of each treatment being counted and multiplied by the hourly rate of the worker, quoted at the time the study was carried out, and the results were expressed in United States dollars per hectare (US$·ha$^{-1}$). The total cost resulted from the sum of the cost of treatments plus the cost of green pruning plus the cost of winter pruning.

To evaluate the effects of the different treatments, the data obtained were submitted to analysis of variance (ANOVA), and the averages were compared by Tukey's test at a 5 % probability of error, using the statistical program System for Analysis of Variance (SISVAR) version 5.6.

## Results and Discussion

Effective fruiting was influenced by the application of PCA, and the use of PCA at PF + 30 DAA promoted greater fruiting compared to the control (Table 1). In addition, it is important to highlight that T2, T3, and T6 did not differ from the control. This indicates that the most effective epoch of PCA application is in full bloom, regardless of reapplication.

Other studies with peach trees applying PCA had contradictory results. Byers and Yoder (1999) reported that the use of PCA had no inhibitory effect on peach tree growth, while it effectively reduced the vigor of apple trees. On the contrary, Çetinbaş, Sarisu, and Butar (2021) reported that PCA reduced the vigor of peach trees, controlling branch sprouting and enhancing fruit quality. Relative to other temperate fruit species, studies indicate a similar growth inhibition pattern of PCA on apples, pears, and grapes (Greene, 2008; Villar et al., 2011; Lordan *et al*., 2019).

According to Petri et al. (2016), using PCA in full bloom can increase the fruit set rate, as there is a decrease in the synthesis of ethylene, the hormone responsible for fruit abscission after the fertilization period, increasing effective fruit set and yield. In addition, fruiting can be maximized by using substances that reduce vegetative growth at the beginning of sprouting after the winter period by reducing nutritional competition between fruits and vegetative structures to favor the directing of assimilates to increase effective fruiting (Lal *et al*., 2022).

The average fruit mass, number of fruits per plant, and average production per plant did not differ between treatments, with general averages of 133 g, 261 fruits·plant$^{-1}$, and 34.4 kg·plant$^{-1}$, respectively (Table 1). For Anzanello and Tedesco (2020), the average fruit mass is an essential qualitative aspect, as it is associated with the value received per kilogram of fruit, which is paid by size. The larger the size of the fruit, the greater the production and value received by the producer. The number of fruits per plant is determined by thinning the fruits, which takes place within 50 days after plant flowering. The age of the orchard and phytosanitary management can also influence the amount of fruit the plant supports, which determines the total production at the time of harvest.

**Table 1 – Effective fruiting, average fruit mass, number of fruits per plant, and average production of peach trees cv. Eragil submitted to the application of calcium prohexadione (PCA) at different application times in the 2021/2022 harvest. Ipê, RS.**

| Treatment | Effective fructification (%) | Number of fruits (fruit·plant$^{-1}$) | Average mass (g·fruit$^{-1}$) | Average production (kg·plant$^{-1}$) |
|---|---|---|---|---|
| T1 - Control | 90.65 b | 256 $^{NS}$ | 135 $^{NS}$ | 34.0 $^{NS}$ |
| T2 - PCA in PF | 94.85 ab | 267 | 133 | 35.2 |
| T3 - PCA PF + 30 DAA | 96.55 a | 268 | 130 | 35.3 |
| T4 - PCA after green pruning | 90.65 b | 255 | 138 | 33.9 |
| T5 - PCA after green pruning + 30 DAA | 90.65 b | 254 | 130 | 32.6 |
| T6 - PCA PF + 30 DAA + 30 DAA | 94.41 ab | 264 | 135 | 35.4 |
| Mean | 94.11 | 261 | 133 | 34.4 |
| Coefficient of variation (%) | 2.56 | 3.97 | 3.31 | 4.42 |

PF – full bloom. DAA – days after the first application. Means followed by the same letter do not differ from each other by Tukey's Test at a 5 % error probability. $^{NS}$ – not significant.

Regarding the biometric parameters of fruit length and diameter, there was no statistical difference when submitted to the PCA application (Table 2). Dini *et al*. (2021) emphasized that the size of the fruit is a crucial factor for the commercialization of peach, and fruits with larger sizes are better accepted in the market, generating greater profitability for the producer, who is reimbursed according to the fruit size.

The results obtained for pulp firmness, titratable acidity, soluble solids, and SS/TA ratio did not differ statistically between the treatments, presenting values very close to those of the control (Table 2).

**Table 2 – Length, diameter, firmness, soluble solids (SS), titratable acidity (TA), and SS/TA ratio of peach fruits cv. Eragil submitted to the application of calcium prohexadione (PCA) at different application times in the 2021/2022 harvest. Ipe, RS.**

| Treatment | Firmness (lbf·cm-2) | SS (°Brix) | TA (% w/v)* | SS/TA ratio | Length (mm) | Diameter (mm) |
|---|---|---|---|---|---|---|
| T1 – Control | 14.24 NS | 15.05 NS | 0.44 NS | 33.94 NS | 72.25 NS | 59.50 NS |
| T2 - PCA in PF | 11.73 | 15.35 | 0.41 | 37.58 | 71.25 | 59.00 |
| T3 - PCA PF + 30 DAA | 12.79 | 15.53 | 0.43 | 36.88 | 71.50 | 60.00 |
| T4 - PCA after green pruning | 13.53 | 15.30 | 0.41 | 37.84 | 71.50 | 59.75 |
| T5 - PCA after green pruning + 30 DAA | 11.71 | 15.20 | 0.42 | 34.33 | 70.75 | 58.50 |
| T6 - PCA PF + 30 DAA + 30 DAA | 11.75 | 14.70 | 0.43 | 34.33 | 73.25 | 61.25 |
| Mean | 12.39 | 15.17 | 0.42 | 36.17 | 71.83 | 59.66 |
| Coefficient of variation (%) | 20.30 | 7.10 | 3.97 | 7.33 | 4.29 | 4.32 |

PF – full bloom. DAA – days after the first application. Means followed by the same letter do not differ from each other by Tukey's Test at a 5 % error probability. NS – not significant. * – as gram equivalent of malic acid.

According to Simões (2021), the hardness of the fruit can determine the point of harvest, a vital factor for storage and post-harvest, which reduces the physical damage that causes injuries, which favor the development of diseases. The titratable acidity is an important parameter, as it is associated with the fruit flavor. The SS/TA ratio indicates the degree of balance between sugar content and acidity. Fruits with specific SS/TA ratio values are more appreciated by consumers, considering that fruits can have different sugar contents, which are related to soluble solids values (BARRETO *et al*., 2019).

There was a difference in the number of pruned branches and the length and mass of branches compared to the control (Table 3). For the number of pruned branches, there was a decrease of approx. 40 % in treatments where PCA was used. The length of plant branches also differed between treatments, resulting in a reduction of about 50 % in size when compared to the control. Regarding the mass of pruned branches, a decrease of around 49 % was observed (Table 3).

As noted by Kashirskaya, Kuzin, and Kochkina (2021), the use of PCA causes a reduction in the number of pruned branches and, consequently, decreases the length of the branches. With the decrease in pruning mass, the plant is more exposed to light, favoring the differentiation of flower buds suitable for fruiting, reducing the incidence of diseases, and improving the efficiency of phytosanitary applications. It is also possible to control the plant's vegetative growth at specific times, as PCA has a little persistent effect, requiring re-application when a more lasting effect of suppressing branch growth is desired (Carra *et al*., 2017).

**Table 3 – Number of pruned branches, length, weight of branches, number of buds, internode length, and pruning time of peach cv. Eragil submitted to the application of calcium prohexadione (PCA) at different application times in the 2021/2022 harvest. Ipê, RS.**

| Treatment | Number of branches (branches·plant$^{-1}$) | Length of branches (cm) | Mass of branches (kg·plant$^{-1}$) | Number of buds (buds·branch$^{-1}$) | Internode length (cm) | Pruning time (h·ha$^{-1}$) |
|---|---|---|---|---|---|---|
| T1 – Control | 35.00 a | 125.00 a | 8.70 a | 319 a | 0.39 a | 57:10 a |
| T2 - PCA in PF | 22.00 b | 63.00 c | 4.40 d | 178 c | 0.35 c | 25:26 c |
| T3 - PCA PF + 30 DAA | 25.00 b | 79.00 b | 5.50 bc | 236 b | 0.33 c | 35:10 b |
| T4 - PCA after green pruning | 21.00 b | 70.00 bc | 4.50 dc | 106 d | 0.66 b | 20:10 d |
| T5 - PCA after green pruning + 30 DAA | 27.00 b | 64.00 c | 5.40 c | 91 e | 0.70 b | 25:00 c |
| T6 - PCA PF + 30 DAA + 30 DAA | 22.00 b | 78.00 b | 6.10 c | 81 f | 0.96 a | 23:33 c |
| Mean | 25.33 | 80.00 | 5.77 | 169 | 0.57 | 31:33 |
| Coefficient of variation (%) | 13.22 | 7.54 | 5.02 | 1.85 | 10.72 | 4.37 |

PF – full bloom. DAA – days after the first application. Means followed by the same letter do not differ from each other by Tukey's Test at a 5 % error probability. $^{NS}$ – not significant.

For the parameters of number of buds per branch, pruning time, and internode length, there was a significant difference, with the number of buds per branch presenting results 75 % lower than the control in the treatments where PCA was used (Table 3). On the other hand, the internode length had little difference in size compared to the control (T1). In the treatments applied after the green pruning (T4 and T5) and the fractional application in three moments (T6), an increase in the size of the internode was observed.

Pruning time also decreased with PCA, with a 65 % reduction compared to the control. For Dalzochio, Silvestre, and Pauletti (2021), there is a decrease in the number of buds on the branches submitted to the PCA application. The smaller number of buds reduces the formation of biologically active gibberellins, which are responsible for the elongation of the branches, and the internode length may also decrease due to the shortening of the branch. Thus, with a smaller branch size, there is also a minor need for pruning in the plants, reducing the time needed to carry out the practice (Petri; Pasa, 2018).

Treatment costs were calculated based on the price of the Viviful® product (Table 4), which, according to quotations at resellers in the region, in May 2022, was US$ 495.00·L$^{-1}$, plus the cost of application from the machinery and operator, corresponding to US$ 16.50·ha$^{-1}$, resulting in a cost of US$ 115.50·ha$^{-1}$ for each application carried out. The cost of green pruning was calculated by the time needed to prune a plant, which was approx. one minute, multiplied by the worker's hourly rate, corresponds to US$ 2.50·h$^{-1}$ (value practiced in the region), resulting in US$ 41.23·ha$^{-1}$. The cost of winter pruning was calculated by the time needed to carry out the experiment, as shown in Table 3, multiplied by the worker's hourly rate (US$ 2.50). Based on these data, the total application cost was obtained, which corresponded to the sum of the cost of treatments plus the cost of green pruning and the cost of winter pruning, with a gradual increase being observed with the reapplication of the product, which makes the use of Viviful® more expensive in relation to the cost of control (T1), in which only winter pruning was carried out.

**Table 4 – Cost of treatments, cost of green pruning, cost of winter pruning, and total cost of applications in peach trees cv. Eragil that underwent the application of calcium prohexadione (PCA) at different application times in the 2021/2022 harvest. Ipê, RS.**

| Treatment | Cost of treatment (US$·ha$^{-1}$) | Green pruning cost (US$·ha$^{-1}$) | Winter pruning cost (US$·ha$^{-1}$) | Total cost (US$·ha$^{-1}$) |
|---|---|---|---|---|
| T1 - Control | - | - | 140.20 | 140.20 |
| T2 - PCA in PF | 115.50 | - | 62.26 | 177.76 |
| T3 - PCA PF + 30 DAA | 230.90 | - | 85.77 | 316.67 |
| T4 - PCA after green pruning | 115.50 | 41.23 | 48.65 | 205.38 |
| T5 - PCA after green pruning + 30 DAA | 230.90 | 41.23 | 61.86 | 333.99 |
| T6 - PCA PF + 30 DAA + 30 DAA | 346.40 | - | 57.73 | 404.13 |

Skilled labor in the peach tree culture has been decreasing over the years. Socioeconomic factors, such as the rural exodus, make it difficult to hire qualified people to carry out the practice of pruning, and agriculture is undergoing a moment of modernization. In this scenario, using calcium prohexadione (PCA) can be an interesting alternative and an excellent tool to meet the demand for skilled labor. The PCA can be directed to areas of greater peach tree cultivation, with a greater need for labor. In these places, the product can become economically viable in the partial or total replacement of the practice of pruning.

## Conclusion

The application of calcium prohexadione (PCA) reduced the pruning parameters of the tested plants and did not influence biometric characteristics and fruit quality, indicating no late deleterious effects in relation to applications aimed at controlling the vegetative growth of peach trees. This plant growth regulator can be used in full bloom and after green pruning, and in both applications, the results were similar and satisfactory for reducing branch growth, indicating the potential use of PCA as a tool for replacing or reducing the demand of manual pruning in regions with high demand.

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