

USE OF METAMITRON AS AN APPLE THINNER¹

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ABSTRACT - The aim of this study was to evaluate the efficacy of metamitron or metamitron plus benzyladenine as a post-bloom thinner on ‘Baronesa’ and ‘Fuji’ apples. Three experiments (rate, timing and BA combination) were conducted during two crop seasons, 2013/14 and 2014/15 at the experimental station located in Caçador, SC. Fruit set, fruit drop, yield per tree, fruit size and flowering return were assessed. The efficacy of metamitron was affected by time of application, and when applied at petal fall, promoted the proper adjustment of the production load of plants. Yield per plant reduces, whereas the allocation of fruits in categories of greater size increases proportionally to the increase in the metamitron concentration applied. However, there is excessive fruit drop with the use of high concentrations. The addition of BA to metamitron also promoted fruit drop; however, no difference was observed between single application of metamitron and BA addition. Metamitron shows great potential to be used as thinner for apples, since it reduces the number of fruits per tree.

Index terms: *Malus domestica*, post-bloom thinning, fruit drop, return bloom, fruit quality.

METAMITRON NO RALEIO QUÍMICO DA MACIEIRA

RESUMO - O objetivo deste estudo foi avaliar o efeito de diferentes épocas e concentrações de metamitron e a mistura com benziladenina, no raleio químico em pós-floração das macieiras ‘Baronesa’ e ‘Fuji’. Foram conduzidos três experimentos durante as safras agrícolas de 2013/2014 e 2014/2015, no município de Caçador-SC. Foram avaliados: a frutificação efetiva, a queda de frutos, a produção por planta, a distribuição dos frutos em classes de calibre e o retorno de floração. A época de aplicação de metamitron influenciou a eficiência do produto, sendo que, quando aplicado na queda de pétalas, este promoveu o adequado ajuste da carga produtiva das plantas. A produção por planta reduz, enquanto a alocação dos frutos em categorias de maior calibre aumenta, proporcionalmente ao aumento da concentração de metamitron aplicada. No entanto, há queda excessiva de frutos com a utilização de concentrações elevadas. A mistura de metamitron com benziladenina, promove a queda de frutos, porém não há efeito aditivo entre a mistura e a aplicação individual de metamitron. O princípio ativo metamitron tem potencial para uso num programa de raleio químico em macieira, visto que reduz a frutificação.

Termos para indexação: *Malus domestica*, raleio em pós-floração, queda de frutos, retorno de floração, qualidade de frutos.

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INTRODUCTION

In apple crop, thinning aims to reduce fruit set, particularly in years where climatic conditions favor excessive floral induction, adjusting the number of fruits per plant to increase the proportion of fruits in higher size categories and commercial acceptance, also avoiding production alternation (STOVER et al., 2004; REIGHARD et al., 2006). Chemical thinning is promising because it is a quick operation and allows thinning flowers and fruits at the right moment, guaranteeing better quality of fruits and significantly reducing labor costs when compared to hand thinning (COSTA et al., 2006).

Due to the great climatic variability observed in the southern region of Brazil, fruit set from year to year is very variable, so that the evaluation of the need and intensity of thinning can only be performed after fertilization, making chemical thinning at flowering a practice of great risk for producers (PETRI et al., 2013). Post-bloom chemical thinning is the most indicated when abundant flowering and high fruit set are observed (PETRI et al., 2006). However, COSTA et al (2004) highlight the low availability of thinning products, especially in areas under strict regulatory controls for the registration of new molecules, requiring the development of new environmentally safe and highly efficient products, such as benzyladenine.

Herbicide metamitron is an inhibitor of photosystem II, belonging to triazinone chemical group, which has recently been reported as efficient product in the thinning of apple crops (LAFER, 2010; BASAK, 2011; STERN, 2014), as it affects the photosynthetic apparatus for 7 to 10 days after application, reducing electron transport rates by up to 60% (MCARTNEY; OBERMILLER, 2012). The 'metamitron' active principle is effective in the chemical thinning of apple trees when applied at the stage of petal fall until fruit reaches a diameter of up to 18 mm (BASAK, 2011), which effect may be enhanced when associated with other thinners (MCARTNEY; OBERMILLER, 2012; GREENE, 2014). The decrease in plant fructification as well as the increase in mean fresh fruit weight is proportional to the increase in the metamitron concentration applied (BRUNNER, 2014; GREENE, 2014; STERN, 2014). However, McCartney and Obermiller (2014) point out the possibility of excessive fruit drop depending on the concentration and application stage of this plant growth regulator. In addition, the effect of chemical thinners is dependent on the interaction between genotype and climatic conditions, and should therefore be tested in each

producing region (PETRI et al., 2013). In view of the limited availability of thinners for apple trees, studies with metamitron are needed for the improvement of the chemical thinning and subsequent use by the productive sector in Brazil.

The aim of this study was to evaluate the effect of different times of application and metamitron concentrations applied either alone or in combination with benzyladenine on post-bloom chemical thinning of 'Baronesa' and 'Fuji' apple cultivars.

MATERIAL AND METHODS

The work consisted of three experiments in 2013/2014 and 2014/2015 crop seasons conducted at an experimental orchard located in the municipality of Caçador, SC (26°46'S, 51°00'W and 960 m a.s.l.).

In experiment 1, 12-year-old apple trees Baronesa / M-26 cultivar were used at planting density of 2,500 plants ha⁻¹. Baronesa apple cultivar is of high fruit set and little responsive to chemical thinners, similarly to 'Fuji' cultivar (CAMILO; DENARDI, 2006). Four times of metamitron application at 350 mg L⁻¹ (petal fall - QP, fruits from 5 to 10 mm in diameter, fruits from 15 to 20 mm in diameter, and fruits greater than 20 mm in diameter) were evaluated and hand thinning treatment and control treatment (plants without thinning) were compared.

In experiment 2, 12-year-old Baronesa / M-26 apple trees were used at planting density of 2,500 plants ha⁻¹, and six metamitron concentrations (0 mg L⁻¹, 350 mg L⁻¹, 700 mg L⁻¹, 1050 mg L⁻¹, 1400 mg L⁻¹ and 1750 mg L⁻¹) in a single application performed when fruits were 20 to 25 mm in diameter (11/11/2013).

In experiment 3, two metamitron concentrations (350 mg L⁻¹ and 700 mg L⁻¹), applied alone or in combination with benzyladenine (BA) at 0.8 mg L⁻¹ were tested in a single application period (fruits from 5 to 10 mm in diameter), comparing with hand thinning and plants without thinning (control). Twenty-four-year-old Fuji / M-7 apple trees at planting density of 1000 ha⁻¹ plants in the 2013/2014 and 2014/2015 crop seasons were used. In the 2013/2014 crop season, treatments were applied on 10/22/2013, when most fruits were 5 to 10 mm in diameter and hand thinning was performed on 11/01/2013. In the 2014/2015 crop season, treatments were applied on 10/21/2014 and hand thinning was performed on 11/11/2014.

The experimental design was randomized

blocks with six replicates and the experimental unit was composed of one plant. Commercial product Goltix® 700SC WG (70% i.a.) was used as source of metamitron, and commercial product MaxCel® (2% i.a.) was used as source of benzyladenia (BA). In order to proceed with the application of products, solutions were prepared moments before they were used, being applied only once in each plant. Products were applied with a motorized costal sprayer (20 L) containing three fan-type D-S nozzles, with syrup volume equivalent to 1000 L ha⁻¹. The diameter (mm) of the equatorial section of fruits was measured with a pachymeter, randomly in the plants, and when fruits were in the desired phase, thinners were applied. Hand thinning adopted the criterion of maintaining one (01) and two (02) fruits in the fruiting structures of twig and spur type, respectively, and in the chemical thinning, no hand thinning supplement was performed.

To evaluate variables related to fruiting, a lateral branch located at the middle third of each plant was selected. Fruit set (%), number of fruits per inflorescence, fruit drop (%) and flowering return (%) were estimated. Fruit set, expressed as a percentage, was obtained by the relationship between total number of fruits counted before and 30 days after the application of treatments and the number of inflorescences counted during full bloom ($[\text{initial number of fruits} / \text{number of inflorescences}] \times 100$). The number of fruits per inflorescence was estimated by counting the number of fruits in each inflorescence before and 30 days after the application of treatments. Fruit drop, expressed as a percentage, was given by the relationship between final number of fruits and initial number of fruits ($[\text{final number of fruits} / \text{initial number of fruits}] \times 100$); flowering return was estimated in the production cycle after the application of thinning treatments, and was obtained from counting the total number of buds and number of flowering buds on the marked branch ($[\text{number of flowering buds} / \text{total number of buds}] \times 100$), expressed as a percentage.

Harvest was individually performed for each plant in a single pass-through and afterwards the fresh weight of fruits of each plant was measured with a digital scale with accuracy of ± 0.01 kg, and data were expressed in kg plant⁻¹. Then, fruits were counted (fruits plant⁻¹) and the relationship between total fresh weight and the total number of fruits harvested was used to obtain the average fresh weight of fruits (g). Fruits were classified into three categories, according to the size: <135 (> 141 g); 136-165 (105 to 141 g); and ≥ 180 (≤ 104 g) and then the percentage of fruits per size category was calculated.

In a sample of twenty fruits per treatment, physicochemical characteristics pulp firmness (Lib in⁻²), iodine-starch index, total soluble solids content (°Brix) and titratable acidity (% malic acid) were evaluated according to methodology described by Scolaro et al. (2015).

Data expressed as a percentage were transformed using the equation $\text{sine arc} (x / 100)^{1/2}$. Data obtained were submitted to analysis of variance (ANOVA), and the significant variables by the F test ($P \leq 0.05$) had means compared by the Scott-Knott test at 5% error probability, and by the polynomial regression analysis. Statistical analyses used the Sisvar software, version 5.3 (FERREIRA, 2010).

RESULTS AND DISCUSSION

In 'Baronesa' apple trees, no change in the mean number of fruits per inflorescence among times of metamitron application at 350 mg L⁻¹ was observed (Table 1). Such a response may be associated with high floral density and high fruit set observed before thinning and, consequently, the occurrence of intense natural fruit drop.

Significant difference with reduction in the number of fruits per plant was verified with the use of metamitron at 350 mg L⁻¹ in the stage of petal fall and in fruits with 5 to 10 mm in diameter, as well as in plants submitted to hand thinning, compared to the other treatments. There was no difference among treatments for fruit weight per plant. The mean fresh fruit weight increased with the application of 350 mg L⁻¹ metamitron in the petal fall phase compared to the other treatments, since benefits are higher at this stage due to intense cell division. Similar results were reported by Lafer (2010), in which applications of 350 mg L⁻¹ metamitron in early fruit development stages (6 to 8 mm in diameter) significantly reduced the number of fruits per plant in 'Elstar' apple trees, while later applications (12 to 14 mm) did not differ from untreated plants. The abscission of smaller fruits can be enhanced when associated to climatic conditions that favor the reduction of carbohydrate levels in plants, especially low light levels and high temperature after application (FALLAHI and GREENE, 2010).

The flowering return in the year after the application of chemical thinners should also be considered in the selection of new substances for use. In the study of times of metamitron application, the highest flowering return was observed in plants manually thinned (34.9%), followed by metamitron applications at 350 mg L⁻¹, during the period of petal fall and in fruits with diameter greater than

20 mm. For plants in which 350 mg L⁻¹ metamitron was applied at with fruits from 5 to 10 mm or 11 to 15 mm in diameter, no difference was observed in comparison to control plants regarding the flowering return. Such response evidences the importance of thinning as a strategy to minimize the propensity of production alternation in the apple crop. Basak (2011) observed that 350 mg L⁻¹ metamitron applied only once in fruits from 6 to 8 mm in diameter, or in two times, one in fruits from 6 to 8 mm and another in fruits from 10 to 16 mm in diameter, did not interfere with the flowering of the subsequent year in 'Gala Must' apple trees. Similarly, Stern (2014) reported that plants treated with metamitron did not undergo any change in flowering return, although the concentration used was lower. On the other hand, Lafer (2010) reported that the flowering return was extremely related to the harvest load of the previous year, since plants with smaller yields had higher flowering return.

There was a significant difference in fruit distribution per size class when 350 mg L⁻¹ metamitron was applied in the period of petal fall and hand thinning of fruits in relation to the other treatments, and in both treatments, there was an increase in the percentage of fruits in the highest size class (135) and reduction of the proportion of fruits in the lowest size class (180) (Table 2). These data are similar to those obtained by Stern (2014), who evaluated metamitron at 130 mg L⁻¹ in two applications, one in the period of full bloom followed by another, seven days after, or one in full bloom and another 14 days after and also observed reduction in the number of fruits in the category considered small fruits and increase in the number of fruits in the medium and large fruit size categories.

The physicochemical fruit characteristics pulp firmness and starch index did not differ among times of metamitron application, but the soluble solids content was higher when thinner was applied at 350 mg L⁻¹ in the period of petal fall. Greene (2014) observed that applications of metamitron in combination with benzyladenine determined slight changes in variables related to fruit maturation, pulp firmness and soluble solids.

Evaluating the use of metamitron at different concentrations in 'Baronesa' apple trees, a direct proportional relationship was observed between concentration of this phyto regulator and fruit drop (Figure 1a). This increase in fruit drop associated with increased metamitron concentration has also been reported for 'Golden Delicious' (BRUNNER, 2014) and 'CandyCrisp' apple trees (GREENE, 2014). It is noteworthy that there was a 31.6%

reduction in the number of fruits per inflorescence in plants treated with 1750 mg L⁻¹ metamitron compared to untreated plants. According to McArtney and Obermiller (2014), high concentrations of this thinner can promote excessive fruit drop, requiring some care during application.

With the increase in the thinner concentration applied, there was a significant reduction in the number of fruits per inflorescence (Figure 1b) and in the total number of fruits per plant (Figure 1c). Brunner (2014) evaluated the use of metamitron at concentrations ranging from 0 to 990 mg L⁻¹ applied in the thinning of "Golden Delicious" fruits with 8 mm in diameter and observed that the decrease in the production per plant was proportional to the increase in concentration, and the application of 990 mg L⁻¹ determined the reduction of 8.5% in production per plant and 35.8% in the number of fruits compared to untreated plants.

The maximum increase in mean fresh fruit weight was obtained at concentration of 1050 mg L⁻¹ when compared to control plants (Figure 1g). On the other hand, the highest fruit weight per plant was obtained in the control treatment (Figure 1h). The increase in the mean fresh fruit weight provided by the use of metamitron at higher concentrations resulted in an increase in the proportion of fruits in the highest size classes (Figures 1d, 1e and 1f). The higher allocation of fruits in greater size categories observed in this work corroborates results obtained by Stern (2014) in 'Gala' apple trees and Brunner (2014) in 'Golden Delicious' apple trees, in which larger fruits generally have better commercial acceptance, evidencing the importance of thinning as a strategy to improve the quality of fruits produced.

It is noteworthy that the use of different metamitron concentrations for the thinning of 'Baronesa' apple trees did not change the flowering return in the cycle after application when compared to untreated plants (Figure 1i). Likewise, this result was observed when using metamitron in combination with benzyladenine in 'Fuji' apple trees (Table 3). Similar results have been reported by Stern (2014), who observed no change in flowering return on metamitron-treated 'Gala' apple trees, but Brunner (2014) reported great variability in flowering density in response to metamitron use according to cultivar and times of application. The experiment related to the study of times of metamitron application in 'Baronesa' apple trees also evidenced differences among treatments.

In the 2013/2014 crop season, the use of the combination of 350 mg L⁻¹ metamitron and 0.8 mg L⁻¹ benzyladenine and the use of 700 mg L⁻¹ metamitron

significantly reduced fruit set after application in relation to the other treatments. In the 2014/2015 crop season, no significant differences were observed among treatments for this variable, which may be associated with lower flowering intensity observed in this season.

In the 2013/2014 crop season, all treatments with metmitron, regardless of concentration adopted, alone or combined with benzyladenine, promoted fruit drop rates higher than 50.9%, exceeding hand thinning treatment. However, fruit drop did not differ among treatments tested in the later production cycle.

The mean number of fruits per inflorescence was not influenced by the use of metmitron, alone or in mixture with benzyladenine, in both crop seasons evaluated. For the average number of fruits per plant, there was a decrease in the 2013/2014 crop season compared to control plants, plants treated with 350 mg L⁻¹ metmitron, 350 mg L⁻¹ metmitron

in combination with 0.8 mg L⁻¹ benzyladenine and 700 mg L⁻¹ metmitron, respectively, but without alteration in the total fresh weight of fruits produced per plant. In the subsequent production cycle, there was a reduction in the number and total fresh weight of fruits produced in plants treated with 350 mg L⁻¹ metmitron in combination with 0.8 mg L⁻¹ benzyladenine and 700 mg L⁻¹ metmitron, alone and in combination with 0.8 mg L⁻¹ benzyladenine.

A significant difference was observed in the distribution of fruits in greater size classes for treatments 350 mg L⁻¹ metmitron + 0.8 mg L⁻¹ benziladenine, 700 mg L⁻¹ metmitron and 700 mg L⁻¹ metmitron + 0.8 Mg L⁻¹ benziladenine in the 2013/2014 crop season in relation to the other treatments (Table 4). This higher allocation of fruits in higher size categories was also reported by Stern (2014), who worked with applications of different metmitron dosages in 'Gala' apple trees.

TABLE 1-Average number of fruits per inflorescence after thinning, average number and fresh weight of fruits per plant, average fresh weight of fruits and flowering return of 'Baronesa' apple trees submitted to different treatments for fruit thinning in the 2013 / 2014 crop season. Caçador, SC, 2015.

Treatments	Average number of fruits per inflorescence	Average number of fruits per plant	Weight of fruits per plant kg	Average fresh weight of fruits g	Flowering return %
Control (no thinning)	1.9 ^{ns}	602.2 a	47.5 ^{ns}	81.0 b	13.3 c
Hand thinning	1.5	340.2 b	35.6	112.5 b	34.9 a
350 mg L ⁻¹ MM (petal fall)	1.7	246.8 b	32.6	143.6 a	23.0 b
350 mg L ⁻¹ MM (Ø from 5 to 10 mm)	1.9	369.8 b	35.7	99.1 b	8.9 c
350 mg L ⁻¹ MM (Ø from 10 to 15 mm)	2.0	460.5 a	42.0	94.3 b	9.0 c
350 mg L ⁻¹ MM (Ø > 20 mm)	1.8	476.8 a	39.5	92.1 b	16.1 b
CV (%)	17.0	19.9	29.5	18.0	13.3

^{ns} not significant (P > 0.05). Averages followed by the same letter in the column do not differ from each other by the Scott-Knott test at 5% error probability. MM: metmitron; CV: Coefficient of variation; Ø: diameter of fruits.

TABLE 2- Distribution of fruits by size, pulp firmness, total soluble solids content and iodine-starch index of ‘Baronesa’ apple fruits submitted to different fruit thinning treatments in the 2013/2014 crop season.

Treatments	Fruit distribution by size			Pulp firmness lib cm ⁻²	TSS (%)	Iodine Starch Scale (0-9)
	>135 ¹	136-165 ²	≥180 ³			
	(%)					
Control (no thinning)	4.2 b	29.6 ^{ns}	66.2 a	16.0 ^{ns}	11.6 b	4.4 ^{ns}
Hand thinning	25.7 a	45.5	28.8 b	16.1	11.7 b	2.7
350 mg L ⁻¹ MM (petal fall)	37.8 a	49.2	13.0 b	15.9	13.3 a	3.5
350 mg L ⁻¹ MM (Ø from 5 to 10 mm)	12.0 b	45.5	42.5 a	16.0	12.5 b	3.5
350 mg L ⁻¹ MM (Ø from 10 to 15 mm)	7.7 b	39.2	53.2 a	16.3	11.9 b	3.3
350 mg L ⁻¹ MM (Ø > 20 mm)	10.0 b	40.2	49.8 a	16.4	12.1 b	2.5
CV (%)	53.3	15.8	30.1	3.9	4.7	36.9

^{ns} not significant (P > 0.05). Means followed by the same letter in the column do not differ from each another by the Scott-knott test at 5% error probability. MM: metatimron; Ø: fruit diameter; Size > 135 (fruit weighing more than 141 g); size from 136 to 165 (fruit with weight ranging from 105 to 141g); size ≥180 (fruit with weight equal to or less than 104 g); CV - Coefficient of variation.

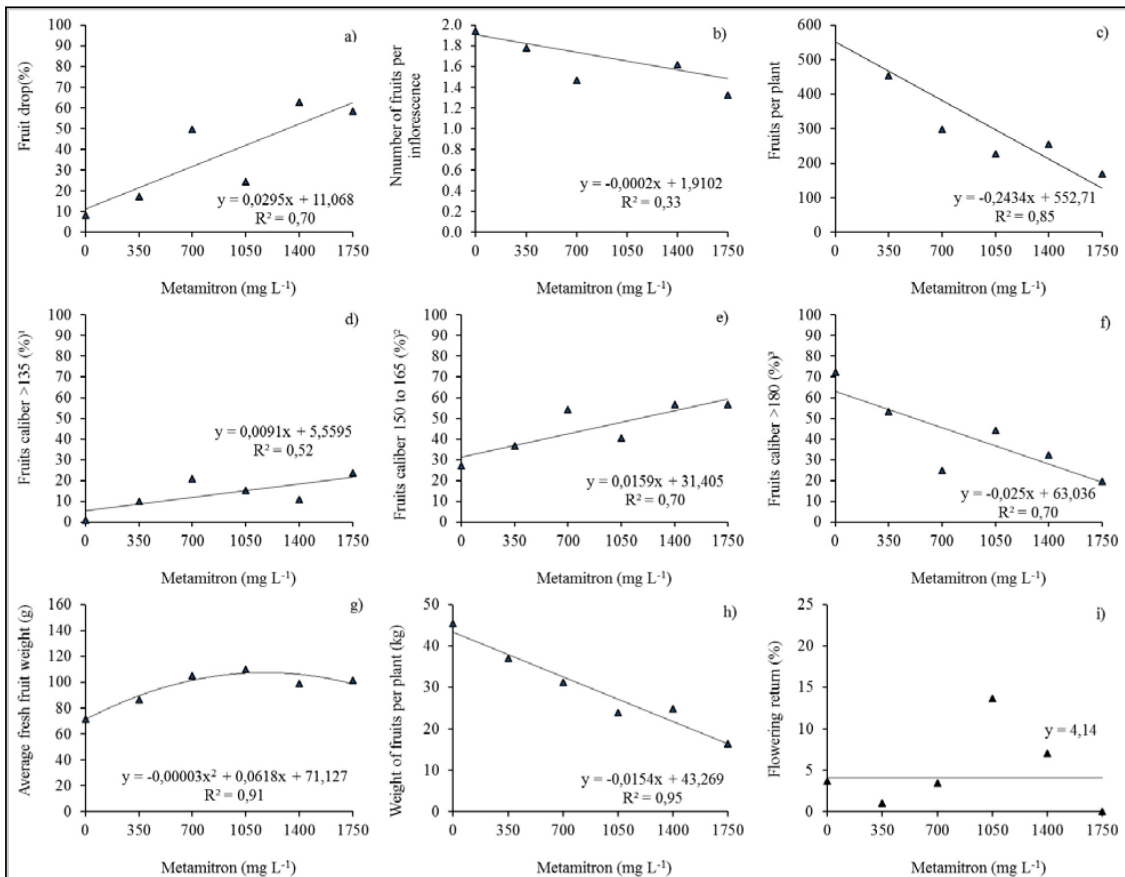


FIGURE 1 - Fruit drop (a), average number of fruits per inflorescence (b), fruits per plant (c); distribution of fruit by size class (d, e, f): (1) > 135 (fruit weighing more than 141 g); (2) 150 to 165 (fruits with weight ranging from 105 to 141g); (3) ≥180 (fruit weighing 104 g or less); average fresh fruit weight (g); weight of fruits per plant (h) and flowering return of ‘Baronesa’ apple plants treated with different MM concentrations (mg L⁻¹) (i), in the 2013/2014 crop season. Caçador-SC, 2015.

TABLE 3 - Fruit set, fruit drop, number of fruits per inflorescence, fruit weight per plant, average number of fruits per plant and average fresh weight of fruits under effect of post-bloom thinning of 'Fuji' apple trees in 2013/2014 and 2014/2015 crop seasons.

Treatments	Fruit set	Fruit drop	Average number of fruits per inflorescence	Fresh weight of fruits per plant	Average number of fruits per plant	Average fresh weight of fruits	Flowering return
	%	%	-	kg	-	g	%
-----2013/2014-----							
Control (No thinning)	82.1 a	24.6 b	1.69 ^{ns}	65.4 ^{ns}	654.8 a	107.4 c	36.8 ^{ns}
Hand thinning	101.4 a	24.5 b	1.73	75.7	666.0 a	114.5 c	57.6
350 mg L ⁻¹ MM	67.7 a	50.9 a	1.74	43.5	342.0 b	127.4 b	38.6
350 mg L ⁻¹ MM + 0.8 mg L ⁻¹ BA	32.8 b	54.4 a	1.41	46.4	313.8 b	143.8 a	55.5
700 mg L ⁻¹ MM	37.0 b	52.7 a	1.17	28.7	192.2 b	148.3 a	41.1
700 mg L ⁻¹ MM + 0.8 mg L ⁻¹ BA	63.0 a	69.4 a	1.78	62.5	471.0 a	133.7 b	55.5
CV (%)	51.5	40.5	31.0	48.2	28.2	9.3	40.4
-----2014/2015-----							
Control (No thinning)	78.1 ^{ns}	21.9 ^{ns}	1.8 ^{ns}	43.7 a	417.5 a	105.4 ^{ns}	-
Hand thinning	67.4	49.7	1.4	44.4 a	397.5 a	111.9	-
350 mg L ⁻¹ MM	95.8	35.6	1.9	49.3 a	444.0 a	111.8	-
350 mg L ⁻¹ MM + 0.8 mg L ⁻¹ BA	52.2	31.4	1.7	32.1 b	267.2 b	124.9	-
700 mg L ⁻¹ MM	51.3	32.2	1.6	17.2 b	137.7 b	125.1	-
700 mg L ⁻¹ MM + 0.8 mg L ⁻¹ BA	81.2	32.3	1.6	30.2 b	256.8 b	118.3	-
CV (%)	30.9	31.9	20.0	38.4	21.5	11.3	-

MM: metatitron; BA: benzyladenine; VC (%): variation coefficient. Averages followed by the same letter in the column do not differ by the Scott-Knott's test at 5% probability. ns: not significant (P> 0.05).

TABLE 4- Fruit distribution by size in 'Fuji' apple trees submitted to different thinning treatments, in the 2013/2014 and 2014/2015 crop seasons. Caçador, SC, 2015.

Treatments	Distribution of fruits per size (%)					
	-----2013/2014-----			-----2014/2015-----		
	< 135	150-165	>180	< 135	150-165	>180
Control (No thinning)	17.1 b	47.9 ^{ns}	35.0 a	14.2 b	35.5 ^{ns}	50.3 a
Hand thinning	19.3 b	49.9	30.8 a	12.5 b	45.7	41.8 a
350mg L ⁻¹ MM	24.2 b	52.4	23.5 b	11.8 b	38.0	50.2 a
350mg L ⁻¹ MM + 0.8mg L ⁻¹ BA	33.9 a	45.2	20.9 b	21.5 a	44.2	34.3 b
700mg L ⁻¹ MM	38.3 a	48.8	12.9 b	27.2 a	38.3	34.5 b
700mg L ⁻¹ MM + 0.8mg L ⁻¹ BA	35.0 a	48.2	16.8 b	20.7 a	46.3	33.0 b
CV (%)	12.3	6.0	18.1	22.9	12.9	12.4

MM: metatitron; BA: benzyladenine; VC (%): variation coefficient. size> 135 (fruit weighing more than 141 g); size from 150 to 165 (fruit with weight ranging from 105 to 141g); size ≥180 (fruit with weight equal to or less than 104 g). Averages followed by the same letter in the column do not differ by the Scott-Knott's test at 5% probability. ns: not significant (P> 0.05).

CONCLUSIONS

There is an effect of the time of metamitron application on the chemical thinning of 'Baronesa' apple tree, and when applied at petal fall, it promotes adequate adjustment of the productive capacity of plants.

The metamitron concentration is inversely proportional to the production per plant and directly proportional to the increase of the allocation of fruits in the higher size categories. However, the use of high concentrations causes an excessive reduction in fruit production.

The mixture of metamitron and benzyladenine promotes a reduction in the number of fruits per plant. However, there is no additive effect on fruit drop between mixture with benzyladenine and single application of metamitron.

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