Agriculture and Food Sciences Research
Vol. 6, No. 1, 85-88, 2019
ISSN(E) 2411-6653/ ISSN(P) 2518-0193
DOI: 10.20448/journal.512.2019.61.85.88

Ethylene Biosynthesis Inhibitors on the Quality of the Coffee Beverage and Efficiency of the Mechanical Harvest

Alisson Augusto Santos[1]
Thayane Leonel Alves[2]✉
Evandro Freire Lemos[3]
José De Arruda Barbosa[4]
Ian Lucas de Oliveira Rocha[5]
Gabriela Mourão De Almeida[6]


(✉ Corresponding Author)

[1,5]*Agronomist, Universidade do Estado De Minas Gerais (UEMG), Passos, Minas Gerais, Brazil.*
[1]*Email: santosaalisson@outlook.com Tel: +5537998680032*
[4]*Email: ian.rocha1997@outlook.com Tel: +5535997293320*
[2,4,6]*Master Student, Post graduated Graduation in Agronomy (Science of the Soil), Universidade Estadual Paulista (UNESP), Jaboticabal, São Paulo, Brazil.*
[2]*Email: thayaneleonel@hotmail.com Tel:+5537999696029*
[4]*Email: josearruda777@gmail.com Tel: +5581998072060*
[6]*Email: gabrielamouraodealmeida@gmail.com Tel: +5591982353699*
[3]*Agronomist, Prof. Dr., Universidade do Estado De Minas Gerais (UEMG), Passos, Minas Gerais, Brazil.*
[3]*Email: evandro.lemos@uemg.br Tel: +5535992052422*

Abstract

The aim of the project is to evaluate the efficiency of the product based in Ethephonin® the standartization of the maturation of the fruits, in an answer of the mechanical harvest and the quality of the coffee beverage. The study was conducted at Aruã Farm, in Piumhi, Southwest of Brazil. The plants used in the research are from *Coffea arábica* L, planted in 2005, in the space of 3.2m x 0.60m. The experimental design adopted had randomized blocks with four treatments: T1 – Ethephon® (130ml/100ml water), T2 – controlling treatment, T3 – Ethephon® plus pH reductor (130ml plus 40ml/100 L water), T4 – Ethephon® plus bioprotector (130 ml plus 285.71 gr/100 L water) and 4 repetitions, totalizing, 16 parcels. To determine the percentual of the leaves fall of the coffee trees, four scores of the leaves: before applying the product, 15 days after applying, before and after the mechanical harvest. The harvest started when, the maturation of the beans got the following levels: T1 – 89.79% of cherry fruits, T2 – 72.98% of fruits, T – 86.02% of cherry fruits, T4 86.63% of cherry fruits. After the harvest the beans were taken to testes, of the region. The product Ethephon influenced in the maturation of the coffee fruits, increasing the efficiency of the mechanical harvest, reducing the volume (percentual) of the pass through. The product didn't influence the defoliation of the plants. There was no interference among the treatments to taste the beverages and the samples ranking.

Keywords: Coffee tree, Flowering, Weather, Physiological maturation, Coffea arábica, Fall of the leaves, Beverage tasting.

Citation | Alisson Augusto Santos; Thayane Leonel Alves; Evandro Freire Lemos; José De Arruda Barbosa; Ian Lucas de Oliveira Rocha; Gabriela Mourão De Almeida (2019). Ethylene Biosynthesis Inhibitors on the Quality of the Coffee Beverage and Efficiency of the Mechanical Harvest. Agriculture and Food Sciences Research, 6(1): 85-88.
History:
Received: 15 February 2019
Revised: 20 March 2019
Accepted: 24 April 2019
Published: 4 July 2019

Publisher: Asian Online Journal Publishing Group

Contribution/Acknowledgement: All authors contributed to the conception and design of the study.
Funding: This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. The Aruã farm, for the support in the development of the work.
Competing Interests: The authors declare that they have no conflict of interests.
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study was reported; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained.
Ethical: This study follows all ethical practices during writing.

Contents

Contribution of this paper to the literature

This study contributes to the existing literature by evaluating the efficiency of the product based in Ethephonin® the standartization of the maturation of the fruits, in an answer of the mechanical harvest and the quality of the coffee beverage.

1. Introduction

The coffee trees belong to the Rubiaceas Family, and the most produced species in Brazil are *Coffea arabica* and *Coffea canefora*. The *C. arabica* is an autogamy plant, with only 10% of cross-polination and the *C. canefora* is alogama, presenting incompability of the gametes of the same plant [1]. The flowering depends on the genotype and the phenotype of the plant, in the *C. arabica*, it occurs in diferent times, from August to November, it can go until January, due to the weather changes [2]

The granulation of the coffee beans is the hardening of the endosperm, after the sleepy stage of the fruits, having the direct influence of the weather conditions as well. After the granulation, the ripening of the green to red and yellow fruits, depending on the variety starts. The senescence of the fruits and the gradative dry of the mucilage are easy phases of infection by microorganism, occuring in the fermentation of the beans and affecting their quality [3].

The manual harvest encopasses the withdraw of the beans on cloths, after this, it is made the shaking to remove the leaves. The mechanical harvest is made by autistic harvester or the pulled one, making all the derive and the fruits gathering process. Due to the uneven flowering of the flowers, the maturation is uneven too, it is possible to find green, green-cane, cherry fruits in the same plant. The ideal time of the harvest occurs when the cherry fruits reach the red or yellow coloring, in the most pasrt of the species [4].

To determine the time of the harvest is necessary to have an evaluation of the maturation of the fruits, choosing four plants to represent the field, the fruits are picked and the quantity harvested is measured, after that, the sample, one liter of coffee is taken, and the green fruits, green-cane, cherry, raising and dry are separated, they are weighted and related to each percentage. The ideal measure to start the harvest is from 5% to 20% of green fruits in the samples [3].

The processing step of the coffee is very important, in the after harvest, it is fundamental the separation of the green fruits and not maturated cherry fruits to obtain a quality drink, and, for this to happen, many processing technics are used: keep the fruit intact, being this fruit processed in its integral shape, denominated natural coffee, remove only the shell, part of the mucilage, denominated peeled cherry; remove the shell and the mucilage mechanicaly; or remove the shell mechanicaly and the mucilage by the fermentation way (depleted) [5].

According to the instruction of the normative number 8, from June, 11th 2003, Ministerio de Agricultura, Pecuaria e Abastecimen to Normative [6] it is defined that the benefited coffee, row bean, be classified in: cathegory (*Coffea arabica* and *Coffea canefora*), subcategory (flat, moca and spout); group (Arabica and Robusta); subgroup (Arabica: extremely soft, only soft, hard, river, robust: excellet, good, regular, anormal); class: (green/blue, green cane, green, yellow. Brown, gray, White and discrepant; and type.

The application of the growing regulatories, based on ethylene, has an advantage with the uniform maturation and the anticipation of the fruits harvest. Though, the coffee growing is made in a exquisite way, there are not many studies in this case. The product based on the active principle [7]: ETHEPHON, registered at Ministerio da Agricultura, Pecuaria e Abastecimento – MAPA n 03292, the application must be done when the fruits of the plants get 90% of physiological maturation, since they are not affected by prages and diseases.

According to the standart of breathing of each fruit, they are classified as climateric and non climateric, being the breathing the main and principal process after harvest of the fruits. In the case of the climateric plants, the respiratory peak is due to the increasement of the production of ethylene (gas), occuring the ripening of the fruits after the harvest [8]. During many years, the addition of technics of the production of ethylene were added, without knowing its effects, for economical reasons, the research progresses to the final production of fruits that don´t have the interference in its quality [9].

So, the verification of the efficience of the product based on ethephon in the standardization of the coffee fruits maturation were intended, the percentage of the leaves fall and its benefits to the mechanical harvest, and its influence in the final quality of the coffee relating to the classification of the beverage.

2. Material and Methods

The study was conducted at Aruã Farm, in Piumhi, west region of Minas Gerais, Brazil. The area has an average high of 840m, the average temperature is 19ºC and the precipitation is 1562 mm annually. The weather is classified as Cwa (temperate climate wet in dry winter and hot summer) and the vegetation is native, typical of cerrado, according to Koppen classification.

The plants used at the research are of the New World variety (*Coffea arabica* L.), planted in 2005, in the space of 3.2m x 0.60m and the average population of 5208.33 plants ha^{-1}. The experimental adopted design was outlined in blocks used in 4 treatments, such as: T1 – Ethephon® (130ml/100ml water), T2 – controlling treatment, T3 – Ethephon® plus pH reductor (130ml plus 40ml/100 L water), T4 – Ethephon® plus bioprotector (130 ml plus 285,71 gr/100 L water) and 4 repetitions, totalizing, 16 parcels. Each parcel had 30 plants, being useful 22 central plants and 4 plants of each border. The blocks were distributed in all the coffee line. All the applications were made using the volume of 700L ha^{-1}, in April 13th 2017, the moment that the plants presented 90% of the fruits physiologicaly mature, through the manual costal sprays, with the capacity of 20 liters and conical jet nozzle, with low output.

To determine the percentual of the coffee tree leaves fall, four countings of plants leaves were made: before applying the product, 15 days after applying the product, before the mechanical harvest and after the mechanical harvest. Each parcel was marked with a ribbon, four branches of three plants randon inside the work area, being two branches in each side of the coffee street. The process that takes to the leave fall is connected to the breaking of the layer abscission existing in the region of the petiole, near the brach. It occurs due to the alteration of the levels of auxine and, mainly ethylene.

The harvest started when, aproximately, the percentual of maturation was reached: T1- cherry fruit: 89.79% and green fruits: 10.21%; T2 – cherry fruits: 72.98% and green fruits: 27.01%; T3- cherry fruits 86.02% and green fruits13.97%; T4 – cherry fruits: 86.63% and green fruits: 13.37%. An automotive harvester from CASE was used, model 200, on May, 14th 2017, 31 days after the application of the product, with operational velocity of 900 meters and the vibration of the bars of 850 rotations per minute (rpm). Following, the sweeping was made, to take the advantage of the fruits that fell on the floor before and during the mechanical harvest snd right after, the manual repass was made, picking the remaining fruits of the mechanical harvest.

After harvested in each operation, the coffee beans were measured and passed in a sieve with air curtain, to remove the dirty parts (leaves, stone and wood). Following, they were taken in a box containing water and separated by the different steps of maturation: green beans, cherry beans and dry beans. Due to the weather conditions, in the first day after the harvest, the beans were dried in the shadow in the shed of the property and soon, when there was no rain forecast, the lots of beans were taken to the yard coated with concrete, until the final dry (humidity 11.5%). The solving of the layers was made, the minimum 10 times per day, to uniform the drying. After dried, the beans were submitted for a period of rest and right after they were benefited.

The obtained results were put in an eletronic table, to make the statistics analyses. It was made using Genes [10] to identify the treatments that were superior agonomically.

3. Result and Discussion

By the middle of the medium squares, was realized that the effect of the treatment was significant to 5% to the percentual of the picked volume by the mechanical harvest and non significant to the percentuals of the fallen leaves, before and after the mechanical harvest Table 1.

Table 1. Analyses of the variance of the percentual riped in the mechanical harvest (VCM) and the percentual of the fallen leaves during the action of the product before the mechanical harvest (QFAC), and the percentage of fallen leaves after the mechanical harvest (QFDC). Passos, 2017.

FV	GL	QM		
		VCM	QFAC	QFDC
Blocks	3	3.0696	0.1176	4.2026
Treatments	3	75.6471 *	0.3736 ns	187.6138 ns
Waste	9	15.0070	0.1716	85.4367
TOTAL	15			
Average		73.91	1.71	82.51
CV (%)		5.24	24.23	11.20

Note: ns;*;**: non significative, significative a 5% e 1%, respectively, by Test F.

It is possible to verify that the use of the product Ethephon®, propitiated a superior percentage riped in the mechanical harvest, related to the controlling treatment, having na increase of the volume from 67.6% to 75.03%. There was no difference between the treatments Ethephon®, Ethephon® with pH reductor and Ethephon with bioprotector, although, all of them were superior to the controlling treatment. Similar results were obtained in studies made by Silva, et al. [11] those, that the efficience of the harvest increased ifrom 65% to 77% of the pending load, for the treatment with Ethephon®.

Related to the defoliation before and after the mechanical harvest, the average of the treatments, didn't differ between them, the same was verified in the work of Dias, et al. [12] Table 2.

Table-2. Average of the percentual got in the mechanical harvest (VCM); and the percentage of the fallen leaves before the harvest(QFAC), and after the harvest(QFDC). Passos, 2017.

Treatment	Average		
	VCM	QFAC	QFDC
Ethephon®	75.03 a	1.73 a	79.82 a
Witness	67.60 b	1.30 a	91.00 a
Ethephon® + reductor	77.57 a	2.04 a	74.89 a
Ethephon® + bioprotector	75.44 a	1.76 a	84.32 a

Note: Average followed by the same letter of the column doesnt differ between them, by the test of Scott & Knott of 5% of probability.

It is necessary to observe that during the period that the experiment was installed, the preciptation was 104.5 mm (collected in the place of the experimente). It is possible to verify in the literature that the coffee treee needs an annual precipitation between 1500 mm and 1800 mm, according to each region.

It was observed, by the middle of the mediun squares, that the effect of the treatment was not significative to determine the quality of the beverage and all the samples (sweeping, cherry, dry and green), not even to the percentual of PVA black, green and blazing); from the samples of dry and green, being significative to 5% to PVA and the sweeping and cherry PVA Table 3.

Table-3. Analyses of the variance of the beverage tasting of the samples of the sweeping (BVA), cherry(BCD), dry (BBO), green (BVE); and the percentage of PVA of the sweeping sample (PVAVA), dry (PVABO), and green (PVAVE) Passos, 2017.

FV	GL	QM							
		BVA	BCD	BBO	BVE	PVAVA	PVACD	PVABO	PVAVE
Blocks	3	1.57	14.746	0.43	0.22	0.70	0.45	1.96	0,08
Treatments	3	3.01 ns	42.480 ns	1.31 ns	0.14 ns	7.72 *	3.26 *	1.88 ns	2,41 ns
Waste	9	1.67	19.555	1.80	0.15	1.46	0.63	1.34	28,4
TOTAL	15								
Average		27.2	30.70	27.2	27.0	6.33	4.52	6.75	44.6
CV (%)		4.75	14.40	4.93	1.46	19.1	17.6	17,1	11.9

Note: ns;*;**: non significative, significative to 5% and 1%, respectivaly, by Test F.

It was verified that the drinking taste and the classification of the beans, didn't suffer influence of the treatments Table 4. It can be justified in function of the non occurrence of rain, during the period of the harvest. The same was observed by Silva, et al. [11] in the taste of the cup, when there was no influence in the application of the mature in the beverage, soon, related to the defect of this Project, was observed s discreet incensement for the treatment with Ethephon®.

Table-4. Average of the tasting beverageof the sweeping samples (BVA), cherry (BCD), dry (BBO) and green (BVE); and the percentage of PVA of the sample of the sweeping (PVAVA), cherry (PVACD), dry (PVABO) and green (PVAVE). Passos, 2017.

Treatment	Average							
	BVA	**BCD**	**BBO**	**BVE**	**PVAVA**	**PVACD**	**PVABO**	**PVAVE**
Ethephon®	27.9 a	33.0 a	27.2 a	27.0 a	4.66 a	4.25 a	6.00 a	45.0 a
Witness	28.0 a	27.9 a	27.3 a	26.8 a	6.66 a	4.66 a	6.33 a	43.5 a
Ethephon® + reductor	26.4 a	27.9 a	26.6 a	27.2 a	6.00 a	3.50 a	7.33 a	45.25 a
Ethephon® + bioprotector	26.5 a	34.0 a	28.0 a	27.2 a	8.00 a	5.66 a	7.33 a	44.75 a

Note: Average followed by the same letter of the column doesnt differ between them, by the testo f Scott & Knott of 5% of probability.

4. Conclusion

The product Ethephon® influenced in the maturation of the fruits of the coffee trees, increasing the efficiency in the mechanical harvest, reducing the volume (percentage) of repass.

The product didn't influence the index of defoliation, however, the coffee trees that received Ethephon® associated with a bioprotector presented the tendency to remain with more leaves.

There was no interference between the treatments for the beverage tasting and the classification of the samples, it was observed, though, a tendency of a better quality in the beverage in the treatmens Ethephon and Ethephon plus bioprotector, in the samples of cherry fruits.

References

[1] C. H. S. D. Carvalho, *Coffee cultivars: Origin, characteristics and recomendation*. Brasilia, DF: Embrapa Coffee, 2008.

[2] A. P. Camargo, "Flowering and fruiting of arabica coffee in the different coffee regions of Brazil," *Brazilian Agricultural Research, Brasília*, vol. 20, pp. 831-839, 1985.

[3] C. M. D. Mequita, J. E. Rezende, J. S. Carvalho, J. M. A. Fabri, N. C. Moraes, P. T. Dias, R. M. D. Carvalho, and W. G. Araújo, *Manual de café: Harvest and prepare (Coffea arabica L.)*. Belo Horizonte: EMATER-MG, 2016.

[4] J. C. Carvalho, F. M. Borém, R. G. F. A. Pereira, and F. Silva, "Influence of different harvesting systems on coffee quality (/ Coffea arabica / L.)," *Science and Agrotechnology (Brazil)*, vol. 27, pp. 1089-1096, 2003. Available at: https://doi.org/10.1590/s1413-70542003000500017.

[5] C. H. R. Reinato, F. M. Borem, M. A. Cirillo, and E. C. Oliveira, "Quality of the coffee dried in terreiros with different pavings and thicknesses of layers," *Coffee Science, Lavras*, vol. 7, pp. 223-237, 2012.

[6] Normative, "Normative instruction No. 8, June, 11 2003 of the ministry of agriculture, livestock and supply, Brazil. Law number 9,972, dated May 25, 2000, Decree number 3,664, from November, 2000, and Process number 21000.006212 / 2002-41," 2003.

[7] E. Purgatto, *Ethylene and ripening*. Napan: Support Center for Research in Food and Nutrition, 2017.

[8] G. M. Felipe, *Ethylene. In: plant physiology 2* vol. 2. São Paulo: EPU, 1986.

[9] A. B. Rena and M. Maestri, "Physiology of coffee," *Agricultural Report, Belo Horizonte*, vol. 11, pp. 26-40, 1985.

[10] C. C. D. Genes, "A software package for analysis in experimental statistics and quantitative genetics," *Acta Scientiarum*, vol. 35, pp. 271-276, 2013.

[11] F. M. D. Silva, T. J. Arre, E. D. S. Tourino, T. S. Gomes, and M. D. C. Alves, "Use of ethrel in the mechanized and selective harvesting of arabica coffee (Coffea Arabica L.)," *Coffee Science, Lavras*, vol. 4, pp. 178-182, 2009.

[12] R. E. A. A. Dias, F. M. D. Silva, J. P. B. Cunha, R. C. Avelar, and F. C. Fernandes, "Efficiency of mechanized harvesting of coffee with the use of ethylene biosynthesis inhibitor," *Coffee Science, Lavras*, vol. 9, pp. 527-536, 2014.