Ciência Rural, Santa Maria, v.54:07, e20230062, 2024
http://doi.org/10.1590/0103-8478cr20230062
ISSNe 1678-4596
RURAL ENGINEERING

Octave band sound pressure level emitted by agricultural implements in coffee plantations

Carlos Guida Anderson[1] Paulo Henrique de Siqueira Sabino[2] Geraldo Gomes de Oliveira Júnior[1] Gian Otávio Alves da Silva[2*]

[1]Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais (IFSULDEMINAS), Muzambinho, MG, Brasil.
[2]Universidade José do Rosário Vellano (UNIFENAS), 37130-000, Alfenas, MG, Brasil. E-mail: gianotavio@hotmail.com. *Corresponding author.

ABSTRACT: In Brazil, certain studies have been performed on the exposure to global occupational noise levels when mechanized equipment is used in coffee-growing. However, these did not indicate the behavior within a frequency spectrum (Hz) by octave bands. The objective of this study was to assess the sound pressure levels of the brush, mower, and atomizer attached to a tractor under actual operating conditions by using 1/1 octave band filters. Quantitative assessments were performed with the mower, brush, and atomizer attached to the MF 275 tractor under two conditions: operative and static. The noise levels obtained under actual operating conditions were determined using a DOS 1000 noise dosimeter and an octave band filter. The static condition assessments were performed inside and outside the coffee plantation using a Hikari HDB 900 digital sound level meter. The NR 15 and NHO 01 standards were used to analyze the data. Under operative and static conditions, the tractor units showed noise levels above the exposure limit of 85 dB (A) for an 8h working day. The assessment of the frequency spectrum revealed the highest noise levels to be in the 125–1000 Hz range.
Key words: tractor units, frequency, regulatory standard.

Nível de pressão sonora em bandas de oitava emitido por implementos agrícolas no cafeeiro

RESUMO: No Brasil, alguns estudos têm sido realizados sobre exposição a níveis de ruído ocupacional global na utilização de conjuntos mecanizados na cafeicultura, não apontando o comportamento dentro de um espectro de frequência (Hz) por bandas de oitava. O objetivo do presente estudo foi avaliar o nível de pressão sonora dos implementos trincha, roçadora e pulverizador acoplados ao trator em condições reais de operação por filtros de banda de 1/1 oitava. As avaliações quantitativas foram realizadas com os implementos roçadora, trincha e pulverizador acoplados ao trator MF 275 em duas condições: operação e estático. Os níveis de ruído obtidos em condições reais de operação foram determinados com dosímetro de ruído DOS 1000 e filtro de banda de oitava. Já as avaliações em condição estática dentro e fora da lavoura cafeeira ocorreram por meio da utilização de sonômetro digital Hikari HDB 900. Foram utilizadas as normativas NR 15 e NHO 01 para análise dos dados. Em condições de operação e estático, todos os conjuntos tratorizados apresentaram níveis de ruído superiores ao limite de exposição de 85 dB (A) para uma jornada de trabalho de oito horas. A avaliação do espectro de frequência apontou que os maiores níveis de ruído foram encontrados no intervalo de 125 a 1000 Hz.
Palavras-chave: conjuntos tratorizados, frequência, norma regulamentadora.

INTRODUCTION

Coffee growing has undergone significant transformations in terms of the mechanization of cultivation (MATIELLO & PAIVA, 2020). Different tractor units have been used to perform cultivation activities, e.g., brushes and mowers have been used to control spontaneous vegetation, and turbo atomizers have been used for pesticide application.

The use of this equipment is of the utmost importance in reducing costs and increasing the yield of agricultural operations. However, it is noteworthy that this equipment may expose workers to high levels of occupational noise that can cause health problems depending on the intensity and duration of exposure (LOPES et al., 2013).

Several studies have been conducted on the exposure to noise levels in coffee growing (SILVA et al., 2018; OLIVEIRA et al., 2020; SILVA et al., 2021). However, the studies assessed the total occupational noise level rather than the behavior within a frequency spectrum (Hz) by octave bands. Conducting octave band assessments enables more detailed and accurate analyses for recommending control measures including collective, administrative, and/or individual ones. It should be noted that according to NBR 16077:2021, the selection of hearing protectors using the octave band method shows a statistical confidence level of 98% (ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS, 2021).

It is also noteworthy that sound pressure levels (SPLs) obtained under actual operating

Received 02.02.23 Approved 10.10.23 Returned by the author 12.28.23
CR-2023-0062.R1
Editor: Leandro Souza da Silva

conditions (AOCs) may differ from those determined under test conditions (TCs). Therefore, the calibration of regression models for noise estimation that enable a comparison of these two types of conditions (AOCs and TCs) at different speeds of the tractor units is of high importance in defining strategies for preventing and controlling occupational exposure to noise.

Therefore, the objective of this study was to assess the SPL of the brush, mower, and atomizer attached to a tractor under AOCs by using 1/1 octave band filters.

MATERIALS AND METHODS

The data were collected at the Federal Institute of Education, Science and Technology of Southern Minas Gerais (IFSULDEMINAS), Muzambinho Campus, MG. These were collected from coffee trees planted with the cv. Catuaí Vermelho 144. The trees had an average height of 3.30 m and spacing of 4.20 m between rows × 0.80 m between plants. The noise levels were measured using a Massey Ferguson MF-275® single-drive tractor with a power of 75 hp (Figure 1A) coupled to the following three coffee implements: a Kamak KD 160® brush (Figure 1B), LUMA TL 160H® mower (Figure 1C), and Jacto 400® turbo atomizer (Figure 1D).

The noise levels of the tractor units were assessed under the following conditions: operative and static. These were observed in two locations: inside and outside the coffee plantation. For the assessments under AOCs, an operator drove the tractor units at a constant speed of 1950 rpm to obtain 540 rpm at the power take-off.

Actual operating condition

During the assessment of the tractor units in operation, the noise was classified as continuous and intermittent. The noise levels were collected using an integrator meter acquired for personal use, a digital DOS-1000 noise dosimeter with INSTRUTHERM 1/1 octave band filters **(**Figure 2A**)** and electronically calibrated by the Brazilian Calibration Network (BCN) (certificate no. 114476R/20), and field calibration (before and after measurements) using the CAL - 4000 INSTRUTHERM IEC 942/CLASS 2 calibrator (Figure 2B).

Prior to the assessments, the dosimeter was configured with the following parameters: an "A" weighting circuit; a slow response circuit; reference criterion: 85 dB(A), which corresponds to a 100% dose for an 8 h exposure; integration threshold level: 80 dB(A); minimum measurement range: 80–115 dB(A); and dose doubling increments (q-5) and (q-

Figure 1 - Tractor and implements used in the study. Caption: Massey Ferguson MF 275 tractor (A); Kamak KD 160 mower (B); LUMA TL 160H brush (C); Jacto 400 turbo atomizer (D).

Figure 2 - DOS-1000 Noise Dosimeter (A); CAL - 4000 Calibrator (B).

3) to satisfy the requirements of NR 15 and NHO 01, respectively, in conjunction with an indication of the occurrence of levels above 115 dB(A) (BRASIL, 2020b; FUNDACENTRO, 2001).

During the assessments, a wind shield was added to the noise dosimeter's microphone to prevent environmental interference, as recommended by NHO 01. To obtain data representative of the daily occupational exposure to noise that the operators is actually subjected to in the performance of his/her duties, the measurements were obtained with the microphone positioned in the worker's hearing zone at a distance of ±15 cm from the entrance to the ear canal (FUNDACENTRO, 2001).

For each tractor unit, four 2 h dosimetry tests were performed. After collection, the data was downloaded and processed in the DOS-1000 software. The normalized exposure levels (NEN) were obtained. The NEN according to NR 15 and NHO 01 were calculated using Eqs. 1 and 2, respectively:

$$NEN = NE + 16{,}61 \log\left(\frac{T_E}{480}\right) \quad (1)$$

where

NE = mean level representative of daily occupational exposure;

T_E = daily working time (min).

$$NEN = NE + 10 \log\left(\frac{T_E}{480}\right) \quad (2)$$

where

NE = mean level representative of daily occupational exposure;

T_E = daily working time (min).

The NEN results from the actual operating conditions were compared with the exposure limits and action levels of both NR 15 and NHO 01. Then, the noise levels within the 1/1 octave frequency spectrum (63–8000 Hz) were compared. The level of attenuation required for hearing protectors was determined using the long method with NBR 16077:2021 (ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS, 2021) as a calculation criterion.

The total SPL and attenuation considering the values obtained within each frequency were calculated using Eq. 3 (NBR 16.077:2021):

$$NPS\ total = 10 \log\left[10^{\left(\frac{NPSn}{10}\right)} + 10^{\left(\frac{NPSn}{10}\right)} + \ldots . 10^{\left(\frac{NPSn}{10}\right)}\right] \quad (3)$$

where

SPL = total sound pressure level;

NPSn = sound pressure level for each frequency (63–8000 Hz).

Environmental noise level: static condition

The environmental noise level was assessed under static conditions through a controlled field test. Each tractor unit was subjected to four speeds: 1400, 1600, 1800, and 2000 rpm. The units were positioned inside the plantation (IP) approximately 10 m from the edge of the track and outside the plantation (OP) in a free area with a radius of approximately 20 m. The noise levels were determined for each condition using a Hikari HDB-900 digital sound pressure meter configured in a slow response circuit and an "A" equalization curve. The measurements were extracted with the sound level meter using a wind shield. The data were collected at the height of the worker's hearing zone when seated at the operating bench. The results obtained were expressed in dB (A).

The noise levels obtained were subjected toa Shapiro–Wilk test for normality analysis (R CORE TEAM, 2016). The residuals showed a normal distribution ($P > 0.05$). These were subjected to an analysis of variance. In cases where the F-test value was significant, Tukey's tests were performed at a 5% significance level. The statistical software "SISVAR" (FERREIRA, 2011) was used to perform this. The noise levels obtained under static conditions for different speeds were subjected to a regression analysis. The models were adjusted by assessing the adjusted coefficient of determination (R^2) (CORNELL & BERGER, 1987).

RESULTS AND DISCUSSION

The occupational noise levels emitted by tractor units used in coffee growing under actual operating conditions are shown in table 1. There was no significant difference in the interaction between the tractor units and the NR 15 and NHO 01 standards

Table 1 - Occupational noise level (± standard error) emitted by tractor units used on coffee plantations under actual operating conditions.

Tractor	Implement	NR 15	NHO 01
		dB (A)	
MF 275®	Mower - Kamak KD 160®	96.1^{ns} ± 0.27	96.3^{ns} ± 0.30
MF 275®	Brush - LUMA TL 160H®	94.5^{ns} ± 1.04	94.7^{ns} ± 0.99
MF 275®	Atomizer - Jacto 400®	94.2^{ns} ± 1.00	94.4^{ns} ± 0.89

*^{ns}= Not significant. MF = Massey Ferguson.

(F = 0.99; P > 0.05). It was also observed that the noise levels quantified during the operation of each tractor unit did not differ between standards (Table 1).

The results showed that the noise levels observed for the different tractor units were higher than the exposure limit (85 dB) recommended by NR 15 and NHO 01 for an 8 h working day. In this context, the maximum working time permitted with tractor units without effective protection is approximately 120 min (NR 15) and 47 min (NHO 01) so that the exposure limit is not exceeded (BRASIL, 2020b; FUNDACENTRO, 2001).

Another recommended protection strategy is the use of hearing protectors with adequate attenuation levels (ALs) to reduce the impact of noise on the operator's ear. This would enable an operator to work for 8 h. In this study, the long method was used to recommend hearing protectors. This was because it shows a confidence level of 98%, whereas the simplified method shows a confidence level of 84% (SALIBA, 2018; ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS, 2021).

The effect of the interaction between tractor units and noise levels in the 1/1 octave frequency spectra was significant (P = 1.00; P < 0.05) (Table 2). The lowest noise levels emitted by the tractor units were at 4000 and 8000 Hz. The highest noise levels were observed between 125 and 1000 Hz. There was no difference in noise emission between tractor units within each frequency assessed (Table 3).

An octave band noise assessment enables the selection of protective measures with a statistical confidence level of 98%. The conventional (direct) method shows a confidence level of 84%. Therefore, considering the noise values obtained at 500 Hz (Table 2), it is necessary to select a hearing protector with an AL of 11 dB for this frequency and an overall attenuation of 16 dB so that the action level (80 dB (A)) is not exceeded. It should be noted that the AL indicated for hearing protectors should discount the standard deviation for the tests performed in laboratories according to NBR 16076 - B (ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS, 2021).

For this study, the action level of 80 dB (A) was considered as the criterion for selecting hearing protection. This was because it provides higher safety to tractor unit operators than the 85 dB (A) exposure limit in NR 15. It should be noted that according to NR 07, workers exposed to noise levels above the action level should undergo audiometric tests regardless of the use of hearing protectors (BRASIL, 2020a).

It should also be noted that the exposure limit is used to determine the level of unhealthy

Table 2 - Comparison between the noise level observed in actual operating conditions and that estimated by the adjusted model in test conditions inside and outside the coffee plantation for tractor units (± standard error).

Condition	Treatment. Mower	Treatment. Brush	Treatment. Atomizer
	Noise Level dB(A)		
AOC - NHO - 01*	96.3 ± 0.30 a	94.7 ± 0.99 a	94.4 ± 0.89 a
AOC - NR -15*	96.1 ± 0.27 a	94.5 ± 1.04 a	94.2 ± 1.00 a
Est. Adjusted Model (IP)[1]	92.8 ± 0.00 b	92.8 ± 0.00 a	94.7 ± 0.00 a
Est. Adjusted Model (FL)[2]	91.4 ± 0.00 b	93.1 ± 0.00 a	94.3 ± 0.00 a

*Assessments performed in actual operating conditions (AOCs) with equipment configured to comply with Regulatory Standard NR 15 and Occupational Hygiene Standard - NHO 01; [(1)] Noise estimated from the adjusted model in test conditions outside the plantation (OP); [(2)] Noise estimated from the adjusted model in test conditions inside the plantation (IP); The means followed by identical lowercase letters in the column are equivalent according to Tukey's test at a 5% significance level.

Table 3 - Occupational noise level emitted by tractor units - dB (A) within the 1/1 octave frequency spectrum (± standard error).

	----------Tractor unit----------			
Frequency	----------Mower----------	----------Brush----------	----------Atomizer----------	-------Attenuation [1]------
Hz	----------Noise dB(A)----------		----------dB----------	
63	86.5 ± 0.50 b	85.0 ± 0.89 b	85.6 ± 0.40 a	7
125	87.7 ± 0.75 a	87.2 ± 1.23 a	86.8 ± 0.97 a	8
250	88.7 ± 0.48 a	87.2 ± 1.35 a	87.2 ± 0.86 a	9
500	90.2 ± 0.25 a	88.4 ± 1.20 a	88.8 ± 0.58 a	11
1000	88.7 ± 0.48 a	87.8 ± 1.15 a	87.4 ± 0.74 a	9
2000	85.5 ± 0.29 b	83.8 ± 0.96 b	83.6 ± 0.93 b	6
4000	81.2 ± 0.25 c	80.4 ± 1.16 c	80.4 ± 0.81 c	2
8000	79.7 ± 0.25 c	79.6 ± 1.02 c	79.4 ± 1.16 c	-
Total [2]	96 a	94 a	94	16

Approximate attenuation level of the hearing protector for each frequency considering the action level of 80 dB (A) as a criterion; [2] Total sound pressure level calculated in accordance with NBR 16.077:2021. The means followed by identical lowercase letters in the column are equivalent according to Tukey's test at a 5% significance level.

working conditions. Thus, the exposure limit should not be considered as a guarantor of health or a definitive threshold between safe and unsafe levels. This is because this occupational parameter refers to the value at which it is considered that the majority of workers can be exposed repeatedly without adverse effects on their hearing health.

The linear models fitted as a function of noise levels and rotation inside (IP) and outside (OP) the coffee plantation show that the noise level for the three tractor units increased as the rotation increased. The highest values were obtained at 2000 rpm: 93.22 and 95.44 dB(A) for the tractor and atomizer units, IP and OP, respectively (Figure 3). ALVES et al. (2011) and MAGALHÃES et al. (2012) also observed that the noise level increased as the speed did. The models were accurate with adjusted R^2 values above 0.91 for all the tractor combinations, both IP and OP (Figure 3).

A significant effect occurred when the noise of operative and static tractor units were assessed ($P < 0.05$) (Table 3). The noise level observed in actual operating and static conditions (IP and OP) differed only in the tractor/mower combination (Table 4). This difference may be related to the construction features of

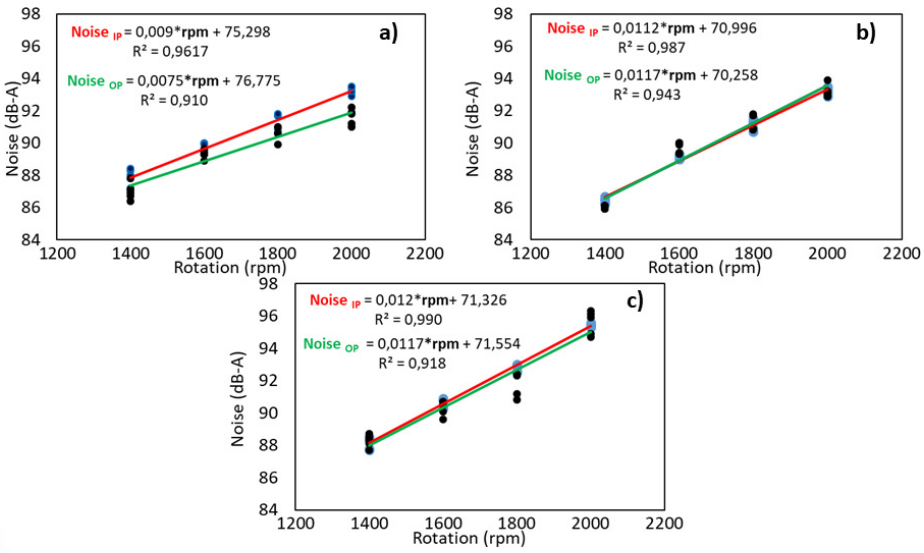

Figure 3 - Linear models fitted to estimate noise as a function of tractor rotation. Tractor/mower inside (IP) and outside (OP) the coffee plantation (a); Tractor/brush inside (IP) and outside (OP) the coffee plantation (b); Tractor/atomizer inside (IP) and outside (OP) the coffee plantation (c).

Table 4 - Configuration between the noise level in real operation condition with the estimated level by the adjusted pattern in experiment condition inside and outside the coffee growing area for the agricultural tractor sets (+- standard mistake).

Condition	----------Harvester----------	---------Crusher tractor---------	---------Tractor sprayer---------
	----------Noise level dB (A)----------		
CRO - NHO - 01*	96,3 ± 0,30 a	94,7 ± 0,99 a	94,4 ± 0,89 a
CRO - NR -15*	96,1 ± 0,27 a	94,5 ± 1,04 a	94,2 ± 1,00 a
Adjusted pattern study (IG)[1]	92,8 ± 0,00 b	92,8 ± 0,00 a	94,7 ± 0,00 a
Adjusted pattern study (OG)[2]	91,4 ± 0,00 b	93,1 ± 0,00 a	94,3 ± 0,00 a

*Evaluations made in real operation conditions (ROC) with equipment adjusted in order to respect the NR15 Regulating Rule and the Rule of occupational hygiene – NHO 01; (1) Noise estimated from the adjusted pattern in experiment condition outside of growing area (OG); (2) Noise estimated from the adjusted pattern in experiment condition inside of growing area (IG); Averages followed by the same lower case letters don´t vary among themselves according to the Tukey test in 5% level of significance.

the mower. The mower has specific opening and closing mechanisms and mechanical components that contribute to producing and dispersing different levels of sound pressure. In this context, the specific assessment of noise in static conditions of the mower does not reproduce the values observed in actual operating conditions.

However, it is noteworthy that the noise assessments performed under test conditions for the brush and atomizer did not show significant differences from those performed under AOCs. This revealed that the fitted linear models (Figure 3) may be used to estimate the occupational noise levels in AOCs as a function of rotation.

CONCLUSION

The noise levels were higher than the exposure limit recommended by NR 15 and NHO 01. This indicated the need to adopt preventive measures at the source control, administrative, or individual levels. The frequency spectrum showed higher noise levels in the 125–1000 Hz range. The increase in rotation increased the noise level for the three tractor units. The linear models fitted under test conditions for the brush and atomizer may be used to estimate the occupational noise levels during operation.

ACKNOWLEDGMENTS

We wish to thank the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for granting scholarships to a few of the authors, which enabled us to conduct this work.

DECLARATION OF CONFLICT OF INTEREST

We, the authors, declare that we have provided our consent to submit the manuscript to the Ciência Rural journal. We also declare that the work is original, has not been submitted for publication in any other journal, and has no conflict of interest.

AUTHORS' CONTRIBUTIONS

All the authors have contributed equally to the conception and writing of the manuscript. They have critically reviewed the manuscript and approved the final version.

REFERENCES

ALVES, A. D. S. et al. Níveis de potência sonora emitidos por trator agrícola em condições estáticas e dinâmicas. **Pesquisa Agropecuária Tropical**, v.41, n.1, p.110-119, 2011. Available from: <https://doi.org/10.5216/pat.v41i1.9741>. Accessed: Apr. 07, 2021. doi: 10.5216/pat.v 41i1.9741.

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **NBR ISO 16077:** Equipamento de proteção individual - Protetores auditivos - Método de cálculo do nível de pressão sonora na orelha protegida. Rio de Janeiro, 2021. 6p.

BRASIL. Ministério da Economia. Inspeção do Trabalho. Portaria 3.214, de jun. 1978. **Normas regulamentadoras de segurança e saúde no trabalho – NR 07: exames médicos**. Brasília, 2020a. Available from: <https://www.gov.br/trabalho-e-previdencia/pt-br/composicao/orgaos-especificos/secretaria-de-trabalho/inspecao/seguranca-e-saude-no-trabalho/ctpp-nrs/norma-regulamentadora-no-7-nr-7>. Accessed: Apr. 07, 2021.

BRASIL. Ministério da Economia. Inspeção do Trabalho. Portaria 3.214, de jun. 1978. **Normas regulamentadoras de segurança e saúde no trabalho – NR 15: atividades e operações insalubres**. Brasília, 2020b. Available from: <https://www.gov.br/trabalho-e-previdencia/pt-br/composicao/orgaos-especificos/secretaria-de-trabalho/inspecao/seguranca-e-saude-no-trabalho/ctpp-nrs/norma-regulamentadora-no-15-nr-15>. Accessed: Apr. 07, 2021.

CORNELL, J. A.; BERGER, R. D. Factors that influence the coefficient of determination in single linear and nonlinear models. **Phytopathology**, v.77, n.1, p.63-70, 1987. Available from: <https://www.apsnet.org/publications/phytopathology/backissues/Documents/1987Articles/Phyto77n01_63.pdf>. Accessed: Apr. 08, 2021.

FERREIRA, D. F. Sisvar: a computer statistical analysis system. **Ciência e Agrotecnologia**, v.35, n.6, p.1039-1042, 2011. Available from: <https://doi.org/10.1590/S1413-70542011000600001>. Accessed: Apr. 07, 2021. doi: 10.1590/S1413-70542011000600001.

FUNDACENTRO. Norma de Higiene Ocupacional. **Procedimento Técnico. Avaliação da Exposição Ocupacional ao Ruído. NHO 01.** São Paulo: Fundacentro, 2001. 37 p.

LOPES, J. E. L. et al. Excesso de barulho**. Revista Cultivar Máquinas**, Pelotas, v.12, n.135, p.30-32, 2013.

MAGALHÃES, A. T. et al. Nível de ruído de um trator agrícola em função da rotação, da distância, da velocidade e da condição do solo obtido por meio de decibelímetro com e sem proteção de vento. **Energia na Agricultura**, v.27, n.4, p.27-44, 2012. Available from: <https://doi.org/10.17224/EnergAgric.2012v27n4p27-44>. Accessed: Apr. 08, 2021. doi: 10.17224/EnergAgric.2012v27n4p27-44.

MATIELLO, J. B.; PAIVA, J. E. P. **Avanços na cafeicultura brasileira**. Varginha: PROCAFÉ, 2020. 100 p.

OLIVEIRA, G. S. A. et al. Variabilidade espacial do nível de ruído em um conjunto trator-pulverizador sob diferentes rotações no cafeeiro. **Brazilian Journal of Development**, v.6, n.11, p.86094-86101, 2020. Available from: <https://doi.org/10.34117/bjdv6n11-143>. Accessed: Apr. 06, 2021. doi: 10.34117/bjdv6n11-143.

R DEVELOPMENT CORE TEAM. **R Foundation for Statistical Computing**. Vienna, Áustria, 2016.

SALIBA, T. M. **Manual prático de higiene ocupacional e PPRA**: avaliação e controle dos riscos ambientais. 9 ed. São Paulo: LTr, 2018. Available from: <https://books.google.com.br/books?hl=pt-BR&lr=&id=2oATEAAAQBAJ&oi=fnd&pg=PA151&dq=SALIBA,+TM.+Manual+pr%C3%A1tico+de+higiene+ocupacional+e+PPRA:+avalia%C3%A7%C3%A3o+e+controle+dos+riscos+ambientais.+9+ed.+S%C3%A3o+Paulo:+LTr,+2018.&ots=VGmswWdZK7&sig=R3Hp7Ck5Zy0NPboR3zUYtMkaibM>. Accessed: Apr. 06, 2021.

SILVA, J. A. R. et al. Occupational noise level in mechanized and semi mecanized haverst of coffee fruits. **Coffee Science**, v.13, n.4, p.448-454, 2018. Available from: <http://www.sbicafe.ufv.br/handle/123456789/11115>. Accessed: Apr. 07, 2021.

SILVA, M. A. et al. Dispersão do Ruído Gerado por um Conjunto Tratorizado Cafeeiro em Condição Estática: Estudo de caso entre diferentes posições e distâncias. **Brazilian Journal of Development**, v.7, n.4, p.37500-37511, 2021. Available from: <https://doi.org/10.34117/bjdv7n4-289>. Accessed: Apr. 07, 2021. doi: 10.34117/bjdv7n4-289.