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Fire Retardantes Different Efficiency In Eucalyptus Plantations In The South Of Espírito Santo, Brazil

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ABSTRACT

Forest fire occurrences cause destruction of biodiversity on the planet, and large losses in planted forests. The forest sector seeks prevention and pre-suppression with highest possible efficiency. Wet firebreaks emerge as a viable and widespread use in forests option. The use of fire retardants accompanied by water increases the efficiency of wet firebreaks. The biggest advantage of flame retardants is increasing water use efficiency with a relatively low cost, since one of the major difficulties in fire fighting is the availability of water at the site of the accident. There are several options retardants in the market, each of which indicates a different level of concentration. Thus arises the need to select best retardant and ideal concentration to be used in wet clearings.The objective of this study was to evaluate the effect of different concentrations retardants and on the intensity of burning eucalyptus plantation in fighting forest fires in Espirito Santo. Data collection was performed in the field on a farm in the south Espírito Santo. Three retarders of different brands were tested at four concentrations (1.0%, 1.5%, 2.0% and 2.5%) plus treatment with water. The tail dosage of the mixture of water with retardants used in the study was 0.5 liter per square meter of area. During the firing of each plot the following variables were evaluated: relative humidity, wind speed, time spent on the fire burn the portion with and without the product and the distance that the fire advanced the plot. For the analysis was calculated intensity burning portion of product concentration. There was no significant interaction between retardants and concentrations, as analysis of variance at 5% probability. The retarding HMIS 1-0-0 DPnb and WD 881 showed the best results and F-500 was lower, however, when compared with water to the difference between the results is remarkable. The concentration of 2.5% showed the lowest burning intensity values. The lower intensity of burning was 40.76 kcal $m^{-1}s^{-1}$ observed in 1-0-0 HMIS DPnb concentration of 2.5%, with a value of approximately 2.5 times less than the control presented.TheHMIS 1-0-0 DPnB and WD 881were retardants that showed the best results in fighting fires in planted forests in southern Espirito Santo.

INTRODUCTION

Planted forests cover an area of 7.74 million hectares, which corresponds to 0.9% of the country, the Brazilian sector of planted trees is responsible for 91% of all timber produced for industrial purposes in the country - the others 9% come from legally managed native forests. The eucalyptus plantations occupy 5.56 million hectares of trees planted area in the country, representing 71.9% of the total (IBA, 2015). These areas have a wide availability of fuel material such as wood and organic material that is on the ground, composed of leaves and branches, as well as vegetation present understory (Borges *et al.*, 2011; Soares, 1992).

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Fire is the main cause of damage to forests in Brazil and in the world, generating environmental, economic losses, and even human (Santos *et al*., 2006). According to Soares (1985), fire is the physical phenomenon resulting from the rapid combination of three elements: oxygen, heat and fuel (fire triangle).

Any occurrence of fire in forest areas is considered a forest fire, whose causes may be natural or not, can also be associated with accidental and therefore unforeseen by those responsible for areas not being taken into account the size (Fonseca and Ribeiro, 2003). The forest fire is defined as an uncontrolled burning that goes on consuming their natural forest fuels, responding only to environmental changes and influences derived from plant-based fuels, climate and relief (Batista and Soares, 2003).

Forest fire occurrences cause countless damage to forest ecosystems and have important ecological importance because of its influence on air pollution and climate change, which have direct and indirect impacts on habitats, ecosystems and planted forests (Batista, 2009).

Due to the high susceptibility of these areas how many forest fires, it is necessary to estimate the techniques of combat and prevention, with a view to the prevention of a fire is possible, however, can not extinguish the possibility of the same.To fight a forest fire should be aimed at eliminating at least one of the components of the fire triangle, the combustible material, oxygen or heat (Fiedler *et al*., 2000).

Fighting forest fires is a costly process due to the difficulty in obtaining water near the fire outbreaks. In addition to the damage caused by wildfire, the costs for the transport of water are by tanker trucks or even helicopters, further increase spending on fighting fires outbreaks.

Wet firebreaks emerge as a viable and widespread use in forests option. The use of fire retardants accompanied by water increases the efficiency of wet firebreaks. The biggest advantage of flame retardants is increasing water use efficiency with a relatively low cost, since one of the major difficulties in fire fighting is the availability of water at the site of the accident.

According to Ribeiro *et al*. (2006), retardants are chemical compounds basically a mixture of ammonium phosphate and ammonium sulfate, which are diluted in water for application. The product changes the flammability of combustible material, changing the direction of the combustion reaction when exposed to fire. It provides a means of releasing water direct transformation of combustible materials in coal, preventing the release of flammable gases that contribute to preheating the combustion flame and hence the spread of fire. Pardo (2007), states that the action of the product remains even with maximum rainfall of 4 mm of rain. Under these conditions, the product will remain with all retarding characteristics indefinitely.

Machado Filho *et al*. (2012) reported that the product can be applied easily with the help of fire-costal pumps in small areas. And in larger areas with the help of agricultural machinery or by air, with planes or helicopters.

There are several types on the market of retardant to fight forest fires, they indicate the concentrations to be used in combat. These concentrations do not present the consumer reliability therefore not characterize the combustible material that fight, type of material, moisture content, density, etc. To White *et al*. (2014), control forest fires is necessary to know the basic characteristics of combustible materials.

Since the importance of using retardants in fighting forest fires, coupled with the lack of reliability in the variety and concentration levels of the same, there is the need for scientific studies in order to answer what kind and the most efficient concentration in fire fighting in forest plantations. This research aimed to evaluate the effect of different concentrations retardants and under the intensity of burning eucalyptus plantation in southern Espírito Santo.

Material Methods:

The study was conducted on a farm in the municipality of São José do Calçado, Espírito Santo, (20 ° 55 '55.4 "S and 41 ° 37' 34.0" W). The property is in a rainy natural area, characterized by having mild temperatures and rugged terrain with slopes greater than 8% (INCAPER, 2010). The area is occupied by eucalyptus plantations, coffee and pasture. The unpaved roads cut eucalyptus plantations, providing dry combustible material buildup.

In order to standardize the experiment, all plots were mounted with the characteristic of combustible material eucalyptus, ie dry litter deposited in the soil consisting of dried leaves and twigs of up to 5 cm in diameter. The amount of syrup used in this study was 0.5 L per square meter, at different concentrations (1.0%, 1.5%, 2.0% and 2.5%) of fire retardant HMIS 1-0-0 DPnb, F-500 e WD 881, post-check, in addition to water, as a witness. The test was carried out on a road of a eucalyptus plantation seven years (Figure 1), without slope, with plots of 1.0 x 3.0 m in size.

Fig. 1: Positioning of the plots.

For assembly of the plots, the road three meters wide was divided into three equal parts of a meter wide. The central part of the material received from two other parties to form a single windrow to 1 meter wide. Dosages were applied in the third part of the plots (1.0 x 1.0 m), being sprayed 500 ml of syrup evenly, with different concentrations.

The design of plots was carried out entirely at random, 36 mounted plots three retardants were tested with four concentrations in three repetitions, and a control with water.

Before being given the ignition on one side of the plot, it was applied homogeneously mixing fire retardant with water in the space provided (1.0 x 1.0 m). The line of fire was ignited at one end portion (without the product), so that the fire percorresse towards the location with the applied product. Burnt distance referred, only to the extent that the fire ran in the plot with retardants. The part of the product portion without served only to the line of fire to establish.

During the firing of each parcel the following measurements were performed: relative humidity, wind speed, time spent for the fire to burn part of the plot without the product, time spent for the fire to burn part of the plot with the product.

The intensity of burning was determined by the equation Byram (1959). The intensity of burning allowed an assessment of the fire effects on shoot vegetation at higher levels in order to heat release to the atmosphere (Equation 1).

$$I = H.w.r \qquad (01)$$

Note:
E = intensity burning, (kcal.m-1 s-1.);
H = calorific value of the dominant fuel material (kcal);
w = available combustible material load (kg m^{-2});
r = fire propagation velocity ($m.s^{-1}$)

To determine the moisture was used a template of 2.5 kg of combustible material per square meter. The sample material was taken to the greenhouse (65 °C) to constant weight to determine the amount of dry matter, moisture and determination of the calorific value.

After calculating intensity of each firing treatment, statistical analysis was done using the software Sisvar 5.4. To verify the interaction between the concentrations and the analysis of variance retarding the 5% level of significance was performed. The mean retardants were subjected to Tukey's t-test at 5% significance when necessary. The effect of concentrations were evaluated by regression analysis at 5% significance.

Results:

The total combustible material used in this study was 2.5 kg m^{-2}, which corresponded to 25 t ha^{-1}. The characterization of the material in Table 1.

Table 1: Average values of the mass of combustible material, humidity, height and density.

	Average	Maximum value	Minimum value	Standard deviation
Total MC* humid (kg.m^{-2})	2,5	2,63	2,39	0,1235
Total MC* dry (kg.m^{-2})	2,18	2,37	1,99	0,1862
Humidity (%)	12,80	16,39	10,04	3,2471
Total MC* (ton.ha^{-1})	25,00	26,31	23,86	1,2326
Height MC* (cm)	20,00	20,00	20,00	-
Density (kg.m^{-3})	12,50	13,15	12,35	0,6176

* MC = Fuel Material

The fuel material does not present great variation between the average parameters, maximum value, minimum value and standard deviation. The humidity ranged from 10.04 to 16.39%, the average 12,80. Height did not change in any parameter. The density varied from 12.35 to 13.15 kg.m^{-3}, average 12.50. The small variation entres the parameters shows that the fuel material used in the treatments was homogeneous.

For a qualitative evaluation of different between treatments was performed retardant test medium and the quantitative effects (concentration) was conducted regression analysis. The variance analysis of the interaction between retardants and concentrations was not significant at the 5% probability (Table 2).

Table 2: Analysis of variance for flame retardants in different concentrations.

Vf	DF	SS	SM	Fc	Pr>Fc
Retardants	2	512,1271	256,0635	15,36	0.0001
Concentrations	3	772,0299	257,3433	15,43	0.0001
Retardants* Concentrations	6	242,4476	40,4079	2,42	0.0565
Residue	24	400,0835	16,6702		
Total	35	1926,6881			
CV (%)	7,52				
Overall average	54,3223				

Note: Vf = variation factor; DF = degrees of freedom; SS = Sum of Square; SM: square medio; Fc = F calculated; Pr = probability; CV = coefficient of variation (%).

Table 3 shows the means of the types of retarding evaluated in three treatments by t test Tukey at 5% probability. It is noted that retarding HMIS 1-0-0 DPnb and the WD 881 showed lower values and intensities burning did not differ statistically, since the F-500 showed higher burn intensity between treatments.

Table 3: Comparison of the average intensity of burning types retardants evaluated in the research, t test of Tukey at 5% probability.

Treatments	Medium Kcal*m^{-1}*s^{-1}	Test results
Silv-ex	50,726	A
Pós-check	52,708	A
F-500	59,532	B

Note: Means followed by the same letter do not differ from each other by t test of Tukey at 5% probability.

The results obtained using the concentration values of the regression analysis indicate that with increasing concentration of the retardant decreases the intensity burning (Figure 2).

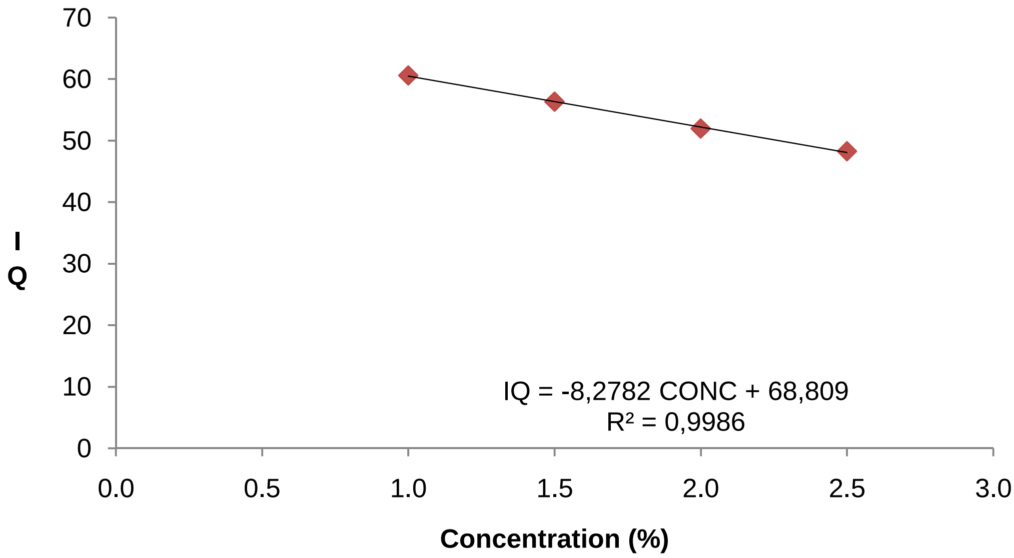

Fig. 2: Burning intensity of behavior in different concentrations tested.

Note: IQ = intensity of burning ($Kcal.s^{-1}.m^{-1}$).

By means of regression analysis it was observed that with an increase of 1% of the retardant concentration is decreasing burning intensity at 8,278 $Kcal.m^{-1}.s^{-1}$.

Discussion:

The total combustible material used was 25 t ha^{-1} (Table 1), this value was within the expected because Rego and Botelho (1990), state that the amount of combustible material in forests may range from 20 to 100 t. ha^{-1}.

According to classification the Brown (1974), studied the combustible material fits in the smallest thickness and diameter classes ranging from 0-5 cm. The density of the combustible material used was 1.31 compared to Batista *et al*. (2008). This condition of high density, associated with the diameter of less than 5 cm combustible material, was essential for propagation of the fire (Botelho and Fernandes, 1999), causing burning of high intensity and making it possible to thus evaluate the efficiency of retarders and their concentrations.

According Fiedler *et al*. (2015), the retardants WD 881and HMIS 1-0-0 DPnb have lower burning intensity values, 48.613 $Kcal.m^{-1}.s^{-1}$ and 54,296 $Kcal.m^{-1}.s^{-1}$, respectively, while burning intensity of F-500 was 57.320 $Kcal.m^{-1}.s^{-1}$. These values are similar to those 50.726, 52.708 and 59.532 found in the search for retarding HMIS 1-0-0 DPnb, WD 881 and F-500, respectively (Table 3).

The results obtained with the application of retarding show a reduction on burning intensity when comparing these intensity values using only water, which was 100.821 $Kcal.m^{-1}.s^{-1}$.

The Retardants HMIS 1-0-0 DPnb and WD 881 under conditions in which the work was performed, showed better results, since the lower the intensity of burning a fire, the easier it tends to be their control.

Conclusion:

The HMIS 1-0-0 DPnB and WD 881 were retardants that showed the best results for combustible material conditions defined in the study, in fighting fires in forests planted in southern Espirito Santo. The concentration of 2.5% is the most suitable for fighting fires in planted forests, among the analyzed concentrations.

REFERENCES

Brazilian industry trees (IBA). Iba Report 2015. Available at: <http://www.iba.org/images/shared/iba_2015.pdf>.

Batista, A.C., A. Martini, J. F. Pereira and J. Ferreira, 2008. Evaluation of the efficiency of a long term retarder, based on diammonium polyphosphate in firings controlled laboratory conditions. Scientia Forestalis, 36: 223-229.

Batista, A.C. and R.V. Soares., 2003. Manual of preventing and fighting forest fires. Curitiba: Forest Research Foundation of Paraná.

Batista, A.C., 2009. The use of retardants in aerial combat forest fires. Journal Forest, Curitiba, 39: 5-10.

Borges, T.S., N.C. Fiedler, A.R. Santos, E.B. Loureiro and R.G. Mafia, 2011. Performance of some fire risk indices in eucalyptus plantations in the north of the Espírito Santo. Forest and Environment, Seropédica, 18(2): 153-159.

Botelho, H. And P. Fernandes, 1999.Manual use fire use scrubland management. Real Village. University of Tras-os-Montes and Alto Douro, p: 59.

Brown, J.K., 1974. Handbook for inventorying downed woody material. Ogden: Intermountain Forest and Range Experiment Station,1-24.

Byram, G.M., 1959. Combustion of forest fuels. In: DAVIS, K.P. Forest fire - control and use. New York: McGraw Hill, pp: 77-84.

Capixaba Institute of Research, Technical Assistance and Rural Extension (INCAPER). Technical Assistance and Rural Extension Program 2010. Available at: <http://www.incaper.es.gov.br/proater/municipios/Caparao/Sao_Jose.pdf. .Acessado On Sep 25. 2015.

Fiedler, N.C., J.C. Silva, J. Santiago and M.B. Medeiros, 2000. Fighting forest fires. In: Journal Communications Forestry Techniques, 1(2): 36.

Fiedler, N.C., W.P. Canzian, R.G. Máfia, G.A. Ribeiro and J. Krause Jr, 2015. Intensity different burning flame retardants. Tree Magazine, Viçosa-MG, 39(4): 691-696.

Fonseca, E.M. B and G.A. Ribeiro., 2003. Manual prevention and control of forest fires. Belo Horizonte, CEMIG.

Machado Filho, C., M.C. Martins, G.A. Ribeiro, G.S. Lima, M.T. Cardoso, C.M.M.E. Torres and F.B. Pinto., 2012. Efficiency of a long term retardant used in forest fire. Forest Science, Santa Maria, 22(2) 365-371.

Pardo, J.M., 2007. Land Retardants a navidad en La lucha de forestales fires. IV Symposium South American on preventing and fighting forest fires and 8th joint technical meeting SIF / FUPEF / IPEF on control of forest fires. Belo Horizonte.

Rego, F.C. and H.S. Botelho., 1990. The technique of controlled fire. Alto Douro: University of Tras-os-Montes and Alto Douro, pp: 77-83.

Ribeiro, G.A., G.S. Lima, A.L.S. Oliveira, V.L. Camargo and M.U. Magalhaes, 2006. Efficiency of a long-term retardant in reducing the spread of fire. Tree Magazine, 30: 1025-1031.

Santos, J.F., R.V. Soares and A.C. Batista. 2006. Profile forest fires in Brazil in protected areas from 1998 to 2002. Journal Forest, Curitiba, 36(1): 93-100.

Soares, R.V., 1985. Forest Fire - Control and Use of Fire. Curitiba: FUPEF.

Soares, R.V., 1992. Occurrence of fire in forest stands Forest, Forest Magazine. Curitiba, 22(1): 39-53.

White, B.L.A., A.S. Ribeiro, L.A.S. White and G.T. Ribeiro2014. Characterization of the surface fuel on the Sierra National Park Itabaiana - Sergipe, Brazil. Forest Science, Santa Maria, 24(3): 699-706.