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Regrowth in post-fire area in a fragment of semideciduous seasonal forest in Viçosa-MG

Rebrota em área pós-fogo em um fragmento de floresta estacional semidecidual no município de Viçosa-MG

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Abstract

The sprouting is the typical response of pointers to death of trees as a result of fire, courts, diseases or physiological disorders. The present work aimed to study the regrowth ability of species remaining trees in a Seasonal Forest Semidecidual degraded by fire and assess the importance of resprouting ability in the area of recovery. The fire resulted in the destruction of 12 hectares of native vegetation, with differential levels of degradation. The study focused on the section where the effect of the fire was more severe, with total destruction of the vegetation cover. The area a complete survey of all species showing budding was performed. The diameter (cm) at the base of the bud, using a caliper, and the height (m) of the sprout with the aid of a tape was measured. It was observed that the sprouting capacity varies with the tree species and the size/age of the plant. *Mabea fistulifera* and *Dalbergia nigra* showed a higher number of shoots; *Anadenanthera macrocarpa* and *Piptadenia gonoacantha* the greatest height and diameter, the first of which also had the highest number of shoots per array; *Aegiphila sellowiana* showed high potential for regrowth both the stem and the roots. The widespread occurrence of grasses, especially the grass (*Melinis minutiflora*) represents a physical impediment and reduces the brightness to the by sprouting roots.

Additional keywords: budding; forest fire; natural regeneration; secondary succession.

Resumo

A brotação é a resposta típica à morte de ponteiros de árvores como um resultado de incêndios, cortes, doenças ou distúrbios fisiológicos. O presente trabalho teve como objetivo estudar a capacidade de rebrota de espécies de árvores remanescentes em uma Floresta Estacional Semidecidual degradada pelo fogo e avaliar a importância desta rebrota na capacidade de recuperação da área. O incêndio culminou com a destruição de 12 hectares da vegetação nativa, apresentando níveis diferenciais de degradação. O estudo concentrou-se no trecho onde o efeito do fogo foi mais severo, com destruição total da cobertura vegetal. Na área foi realizado um levantamento completo de todas as espécies que apresentaram brotação. Foi medido o diâmetro (cm) na base do broto, utilizando-se um paquímetro, e a altura (m) do broto, com o auxílio de uma trena. Observou-se que a capacidade de rebrota varia com a espécie arbórea e o tamanho/idade da planta. *Mabea fistulifera* e *Dalbergia nigra* apresentaram maior número de brotos; *Anadenanthera macrocarpa* e *Piptadenia gonoacantha* as maiores altura e diâmetro, sendo que a primeira apresentou, também, o maior número de brotos por matriz; *Aegiphila sellowiana* apresentou alto potencial de rebrota tanto pelo caule como pelas raízes. A ocorrência generalizada de gramíneas, principalmente do capim-gordura (*Melinis minutiflora)* representa um impedimento físico e reduz a luminosidade para as brotações por raízes.

Palavras-chave adicionais: brotamento; incêndio florestal; regeneração natural; sucessão secundária.

Introduction

Fire can change the structure, the floristic composition and the growth of plants, limiting the recruitment of new species and, thus, resulting in lower tree density (Woods, 1989; Cochrane & Schulze, 1999). The recovery of vegetation after fire can vary depending on the intensity and duration of the fire (Keeley et al., 2003). In some cases, the fire can inhibit the forest regeneration cycle (Kennard et al., 2002; Laurance, 2003; Otterstrom & Schwartz, 2006). On the other hand, when these disturbances occur in

intermediate intensity, it may be important for maintaining a large number of species (Hubbell et al., 1999) and rapid regrowth after fire (Hoffmann & Solbrig, 2003).

However, the fire promotes a reversal of communities to early successional states, in which species previously excluded by competition settle again, and when very aggressive, they may intensify the competition for resources and, following an inhibition model, delay the regeneration process (Sheil & Burslem, 2003). Some research in Seasonal Semideciduous Forests concluded that the regeneration of this ecosystem hit by the fire is hampered by the occurrence of lianas and that this formation has considerable number of species with regrowth capacity (Silva et al., 2005; Rodrigues et al., 2004; Martins et al., 2002; Penha et al., 2002; Hayashi et al, 2001).

The regrowth process is an alternative to species of several successional groups to reoccupy sites more quickly after a natural or anthropogenic disturbance event, like fire. The sprouting is the typical response to the death of tree pointers as a result of fire, cutting, diseases or physiological disorders (Kramer & Kozlowski, 1972), where occurs the emission of shoots by resistant buds located in the roots, stem or canopies (Coutinho, 1990).

The regrowth is a regeneration strategy and occurred in 50% of the species in areas degraded by fire in Semideciduous Forest in Paraguay (Kammesheidt, 1999). The production of shoots depends on the use of nutrients stored in the stumps, assuming that the number and size of sprouts are related to the amount of stored photoassimilates and that the loss of apical dominance induces formation of sprouting in the buds, stimulated by auxins (Kramer & Kozlowski, 1972).

The growth rate of the shoots, in its early stage of growth, is high in relation to the growth of plants from seedlings. Sharma (1979) noted maximum annual average increment for shoots of *Eucalyptus* hybrid at 5 and 6 years, to two different sites, while in the first rotation that maximum was reached at 8 and 11 years, respectively. The storage of reserves (organic and inorganic) in lignotubers or in the root system is considered the main reason for this rapid initial growth of shoots. It should also be considered the existence of a root system already formed that favors the absorption of water and nutrients, due to the high proportion of root biomass in relation to shoot. Thus, the regrowth from bud roots in tropical forest environments can be considered as a process that would act on the dynamics of regeneration of these formations (Rodrigues et al., 2005; Greig, 1993; Uhl et al., 1981).

This study aimed to study the regrowth capacity of species of remaining trees in a Seasonal Semideciduous Forest degraded by fire and to assess the importance of this regrowth in the resilience of the area.

Material and methods

The study was conducted in an area of secondary Seasonal Semideciduous Forest, located on the Campus of the Federal University of Viçosa, in the municipality of Viçosa-MG, (42°53' W and 20°45' S). The climate in the region, according to Köppen classification, is of the Cwb type, tropical of altitude, with hot and rainy summers and cold, dry winters, average rainfall of 1221 mm, with the coldest month temperature below 18 °C and above 3 °C and temperature of the hottest month exceeding 22 °C (Arruda et al., 1999).

The topography of the area is rugged with narrow, humid valleys. The region has strong undulating and mountainous terrain and coincidence of elevations tops, with dominance of concave-convex profile slopes. The region is presented geologically grounded in gneiss-granite substrate, with three classes of predominant soils: dystrophic Yellow Oxisol in the convex tops and Red-Yellow Oxisol on the slopes of elevations; Red-Yellow Cambic Ultisol in the terraces; and at the back of the valleys, where are found the larger beds, Fluvisols associated with the hydromorphic ones (Rezende et al., 1972).

An accidental fire culminated with the destruction of 12 hectares of native vegetation, showing differential levels of degradation. At 14 months after the fire, it was held a survey of all the species that showed regrowth. The study concentrated on the stretch where the effect of fire was more drastic, with total destruction of the vegetation cover. It was measured the diameter (cm) at the base of the bud, using a caliper, and its height (m), with the aid of a measuring tape. Botanical material was collected for taxonomic identification of species. It were also performed measures of distance between the originating shoots and the mother plant.

The finding and identification of species, which were established based on the regrowth of strains, were conducted examining, in each individual, the inclusion of shoots in the stem base. As for species with regrowth of bud roots, were carried out excavations and exposure of the root system starting from the base of stem of the sprouts issued, in order to confirm their connection to the trunks of adult individuals (Penha et al., 2002) that were hit by fire.

Results and discussions

Individuals who resprouted from stems and roots after the fire contributed to the recovery of species richness, as they showed size for inclusion in the tree layer (Figure 1). It appears that the species *Aegiphila sellowiana*, *Dalbergia nigra* and *Mabea fistulifera* contributed with 59% of all shoots, what shows a high capacity for regrowth of these individuals. The species in the group "other" (totaling 12) accounted for only 11% of the total shoots, each of which contributes with less than 3% of this total and 8 of them represent less than 1%. A similar result was recorded

by Melo & Durigan (2010) in a Semideciduous Forest, especially in relation to *Piptadenia gonoacantra* and *Dalbergia nigra* species belonging to the family of Leguminosae. This may indicate that this family has a greater capacity for regrowth in environments that suffered burnings, since in these two studies, about 25% of the species that more showed sprouting belong to this family, or even because this family would be most abundant in the area before the burning.

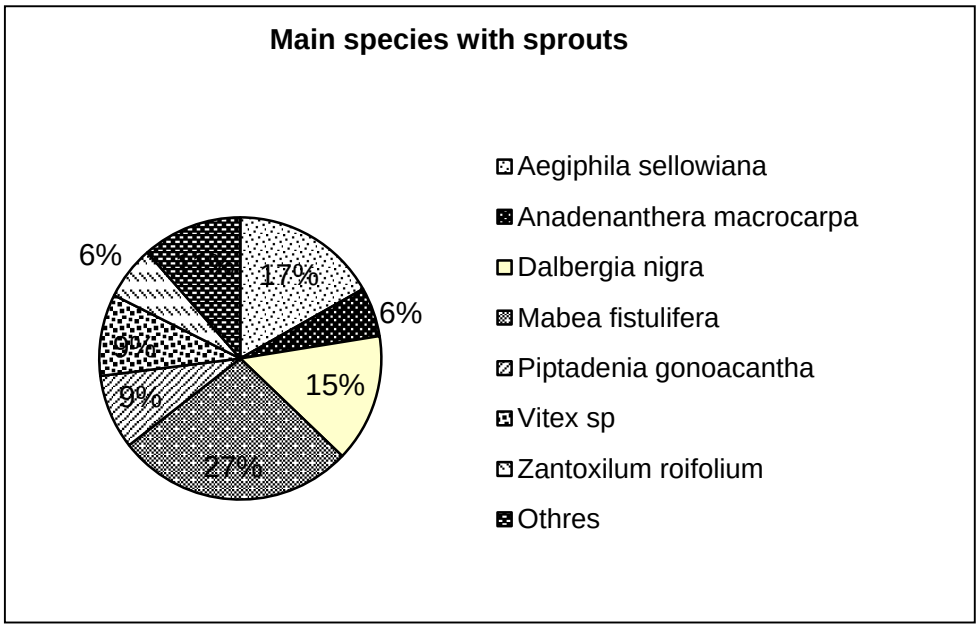

Figure 1 – Percentage distribution of sprouting among species in the study area.

The difference in the regrowth capacity may be due to the number of arrays, low regrowth capacity, the degree of injury caused, the specific potential of each species or even by other factors such as competition and adaptation to the degraded environment (Silva et al., 2005). Regeneration by regrowth of tree species post-fire occurs initially with low density, being more important for pioneer species, giving them an opportunity of quick occupation of the disturbed environment (Uhl et al., 1981).

In some species as *Myrcia fallax* and *Luehea grandiflora* it was found only an array with one bud each, while *Mabea fistulifera*, of the family Euphorbiaceae, and *Dalbergia nigra*, family Fabaceae, had 74 and 22 arrays with regrowth, respectively, what indicates a high potential for regrowth of these species. Highest average of shoots per array were observed in *Anadenanthera macrocarpa* (7.0 shoots), *Aegiphila sellowiana* (6.67 shoots) and *Peltophorum dubium* (6.0 shoots).

About 80% of the species showed shoots with a height superior than 1 m. Notwithstanding, the standard deviation of the height of shoots showed a high value (0.71 m) in relation to the average height (1.45 m), demonstrating the wide variation found for this feature, probably by the difference in the rate of emission of shoots, growth of species and higher fire-resistance capacity of the arrays (Table 1).

Peltophorum dubium (Spreng.) Taub, with only one array, showed shoots with larger diameter, followed by *Anadenanthera macrocarpa* (Benth.) Brenan, with five arrays. On the other hand, *Anadenanthera macrocarpa* and *Piptadenia gonoacantha* present, besides large diameter, the largest heights of shoots, demonstrating therefore high capacity for regrowth and growth rate that impart them a greater importance in the recovery process of these areas.

In only four species it was verified budding by roots (Table 2), and only two of them (*Machaerium triste* and *Zanthoxylum rhoifolium*) scored. As the fire was quickly controlled, it could be assumed that the heat produced may not have reached enough depth to trigger the gems of the roots, explaining the low incidence found for this type of regrowth. It is further believed that the aggressive presence of the molasses grass (*Melinus minutiflora*), recorded by Martins et al. (2002), soon after the occurrence of the fire in this area, and by Silva et al. (2005), in a similar forest, might have represented a physical impediment and light reduction to the initial development of root sprouts.

Normally, with the destruction of the shrub-tree vegetation by fire, the grass species are favored due to the increase in light levels that stimulate tillering (Silva et al., 2005; Castellani & Stubblebine, 1993) and by the increased availability of nutrients (Coutinho, 1990; Martins et al., 1995). The aggressiveness of these species can inhibit the regeneration of later species in plant succession (Zahawi & Augspurger, 1999). For D'Antonio et al. (2000), these invasive communities, when very aggressive, can intensify the competition for resources and, following an inhibition model, delay the regeneration process.

Table 1 – Number of arrays per species (Arrays), average number of shoots per array (Shoots), average height of seedlings (Height) and average diameter at the base of the shoots (Diameter) of the species found in the study area.

Species	Arrays	Shoots	Height (m)	Diameter (cm)
Aegiphila sellowiana Cham.	15	6.67	1.33	1.69
Anadenanthera macrocarpa (Benth.) Brenan	5	7.00	2.28	2.83
Apuleia leiocarpa (Vogel) J.F. Macbr.	1	4.00	2.03	2.43
Casearia sp	1	3.00	1.70	1.23
Dalbergia nigra (Vell.) Alemão ex. Benth.	22	3.82	1.38	1.41
Dictyoloma sp	2	2.50	1.32	1.78
Erythroxylum sp	2	2.50	1.32	1.78
Jacaranda macrantha Cham.	3	3.00	0.80	1.11
Luehea grandiflora Mart.	1	1.00	1.50	1.70
Mabea fistulifera Mart.	74	2.80	0.77	0.80
Machaerium triste Vogel	4	4.00	1.28	1.58
Myrcia fallax (Rich.) DC.	1	1.00	1.40	1.10
Piptadenia gonoacantha (Mart.) J.F. Macbr.	11	4.81	2.33	2.66
Peltophorum dubium	1	6.00	1.77	3.33
Piptocarpha sp	1	4.00	0.83	0.90
Plathypodium elegans Vogel	3	3.67	1.62	1.69
Unknown	2	5.00	0.56	0.62
Vitex sp	15	3.87	1.64	1.65
Zanthoxylum rhoifolium Lam.	11	3.45	1.69	1.68
Mean	9.16	3.72	1.45	1.68
Standard deviation	16.89	1.72	0.71	0.99

Table 2 – Number of shoots arising from roots and average distance of the shoot relative to the mother plant found in the study area.

Species	Total of shoots	Average distance of the shoot (m)
Aegiphila sellowiana	43	2.14
Mabea fistulifera	12	1.31
Machaerium triste	1	0.4
Zanthoxylum rhoifolium	1	0.1
Mean		1.90
Standard deviation		2.48

The distance between the shoot and the plant mother varied greatly, being found mean values in the range of 0.1 to 2.14 m (Table 2). The species with shoots more distant from the array was *Aegiphila sellowiana*, probably by the presence of a shallow root system, developed laterally, which enabled a larger storage of organic and inorganic reserves, or even because the species has distinctive characteristics for this type of sprouting. There was an increase in the number of shoots issued in relation to the increase of the distance from the main trunk to *Aegiphila sellowiana* and *Mabea fistulifera*.

It is highlighted the difference observed between the diameter at the base and the height of the shoots by root and stem. The sproutings by roots showed a diameter and height of 1.40 cm and 1.01 m, respectively, while in the sproutings by stem, the average values of diameter (1.82 cm) and height (1.64 m) were higher.

Figure 2 shows the relationship between root shoots and stem shoots in the species with the two types of shoots. It was found that for *Aegiphila sellowiana*, the relationship stem/root sprouting was low, which may highlight the importance of sprouting by roots in the survival of this species in areas of occurrence of fire and/or for recovering of the same. For the other species, which have shown the two types of sprouting, this relationship has performed high, not being representative, in these, the sprouting by roots (Figure 2). Nonetheless, in these species, the regrowth

from the stem may indicate another restoration standard of the tree community in the fragment, parallel to that of the pioneer species. Castellani & Stubblebine (1993) also observed regrowth from the stem for the *Zanthoxylum rhoifolium* species.

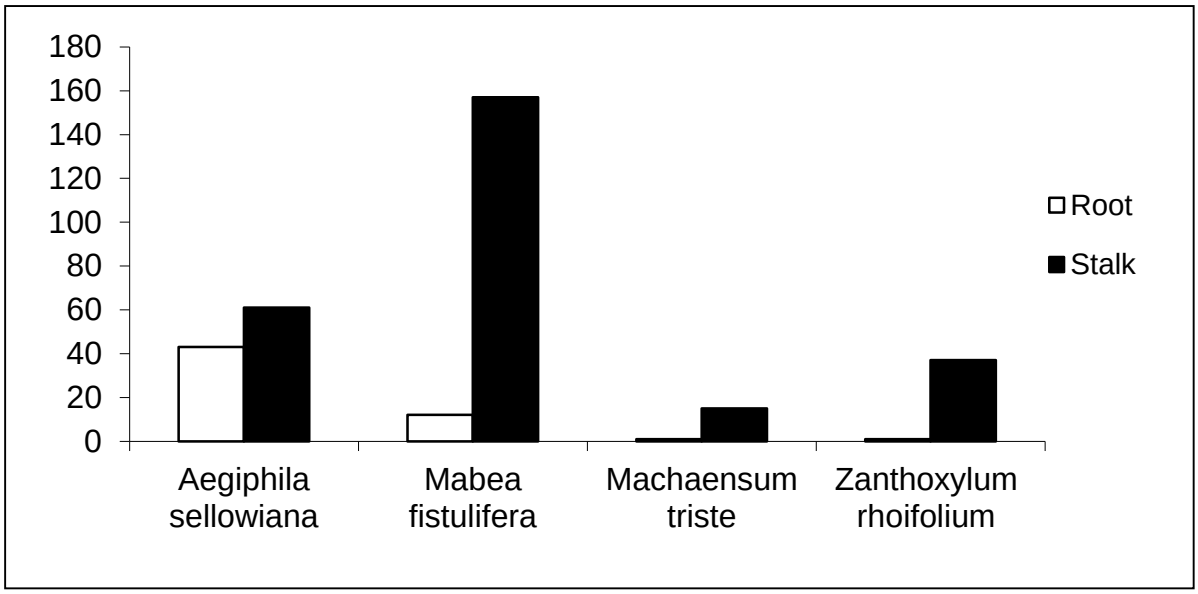

Figure 2 – Number of root shoots and stem shoots in species with the two types of sproutings.

Conclusions

The species *Mabea fistulifera*, *Aegiphila sellowiana* and *Dalbergia nigra* had higher number of individuals with shoots and greater capabilities of regrowth after fire.

The species *Aegiphila sellowiana*, *Mabea fistulifera*, *Manchaerium triste* and *Zanthoxylum rhoifolium* showed regrowth by root and stem.

The molasses grass (*Melinis minutiflora*) represented a physical impediment and light reduction for shoots by roots.

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