Effect of Fire-Free Land Preparation on the Vegetative Regeneration of Woody Fallow Vegetation in the Eastern Amazon Region

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Abstract

The fallow vegetation of the traditional slash-and-burn land-use cycle in the eastern Amazon region regenerates vegetatively by resprouting. The question has arisen whether its regeneration pattern changes as a consequence of fire-free land preparation by cutting and chopping the woody fallow vegetation, resulting in a change of the species composition. The vegetative regeneration type of 16 common woody species of the fallow vegetation as well as the number and phytomass of their sprouts have been studied after 3 and 16 months of regeneration on plots with and without the use of fire for land clearing. The observed species showed three types of vegetative regeneration: (1) resprouting from the subterranean root-stock, (2) resprouting from epicormic buds of the aboveground part of the stump, and (3) resprouting from horizontal roots and tap-roots. The number of sprouts per stump and their phytomass were, on average, lower in the burnt (1.3 sprouts and 4.6 g per stump, respectively) than in the not burnt plot (5.7 and 26.2 g, respectively) after three months of regeneration. After 16 months, the number of sprouts, on average, increased in the burnt (2.4) and decreased in the not burnt plot (4.2). Eight species have been identified to be favored under the cut-and-chop conditions without burning, so that the species can be divided into two groups: Due to the fact that several species show a favored development under land clearing conditions without the use of fire, a change in the species composition can be expected in the long run.

Keywords

Cut-and-chop technology, Phytomass, Resprouting, Slash-and-burn, Species composition

1 Introduction

The predominant land-use system of small farmers in the northeast of Pará state is a fallow system which includes slash burning for land preparation. As the burn leads to considerable carbon and nutrient losses by volatilization (HÖLSCHER 1995), a cut-and-chop technology has been developed to transfer the fallow vegetation into a manageable mulch to replace the traditional slash-and-burn practice (DENICH et al., this volume). The fallow vegetation, consisting mainly of woody species, was found to be an anthropogenic plant community with a unique species composition, which has developed due to repeated slash-and-burn interventions. After the abandonment of a field subsequent to a 2-year cropping period, the woody fallow vegetation regenerates vegetatively by resprouting (CLAUSING 1994; DENICH 1989; WIESENMÜLLER 1999). The question has arisen whether its regeneration pattern changes as a consequence of the new cut-and-chop technology, resulting in a change of the species composition.

The aim of this study is to compare the resprouting capacity of common woody species after cutting the fallow vegetation, with and without subsequent burning.

2 Materials and Methods

On small farmer land in the municipality of Igarapé Açu (NE Pará, Brazil), the resprouting behavior and capacity of 16 woody tree, shrub and vine species was studied 3 and 16 months after establishing the following experiment: On two abandoned fields, the woody species of 3-4-year-old fallow vegetation had been cut approximately 20 cm above the soil surface. Subsequently, the slashed vegetation of half of the experimental plots had been burned. On all plots, the vegetative regeneration types of the 16 species as well as the number and phytomass (only after 3 months of regeneration) of their sprouts were studied. The studied species are: *Banara guianensis, Casearia grandiflora* (both Flacourtiaceae), *Cecropia palmata* (Cecropiaceae), *Davilla rugosa* (Dilleniaceae), *Lacistema pubescens* (Lacistemataceae), *Lecythis lurida* (Lecythidaceae), *Machaerium quinata* (Leguminosae), *Memora allamandiflora* (Bignoniaceae), *Myrcia bracteata*, *Myrcia cuprea*, *Myrcia deflexa*, *Myrcia sylvatica* (all Myrtaceae), *Rollinia exsucca* (Annonaceae), *Rourea doniana*, *Rourea ligulata* (both Connaraceae), and *Senna chrysocarpa* (Leguminosae).

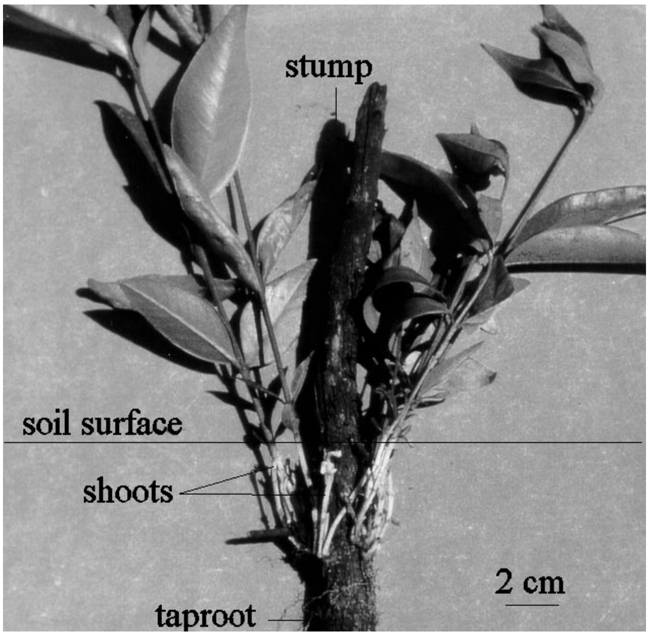

Fig. 1: Resprouting of a burnt *Myrcia deflexa* after 3 months of regeneration

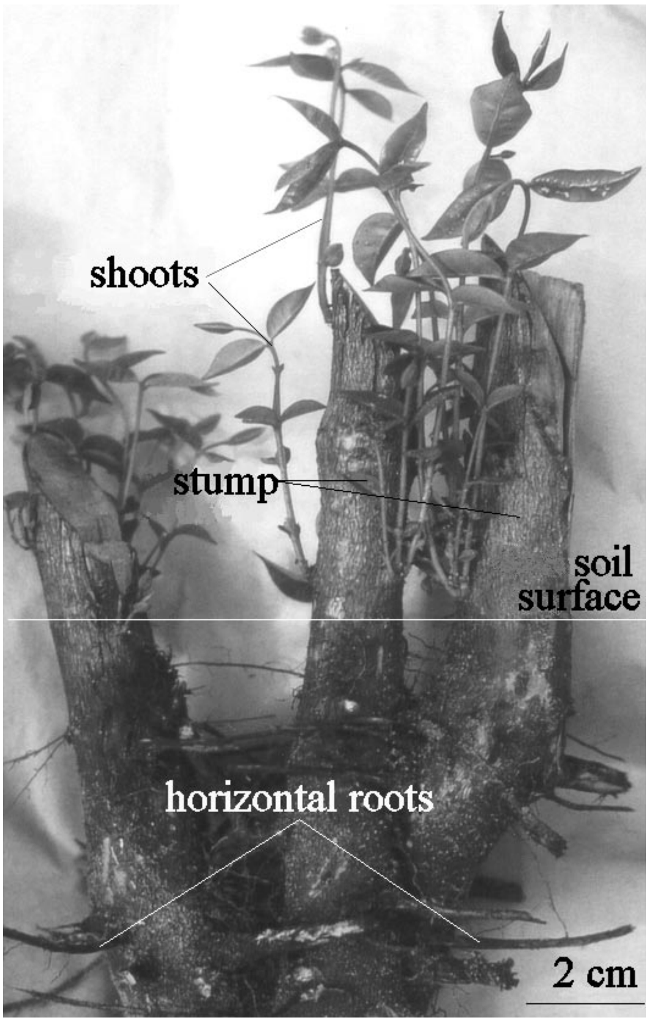

Fig. 2: Resprouting of a not burnt *Myrcia sylvatica* after 3 months of regeneration

Species		**Phytomass [g per stump]**				
		not burnt		**burnt**		
	n	**M**	**± SE**	**M**	**± SE**	**p**
Banara guianensis	15	**30.8**	± 5.2	**0.7**	± 0.6	≤ 0.0001
Casearia grandiflora	15	**41.6**	± 7.8	**0.3**	± 0.3	≤ 0.0001
Cecropia palmata	15	**29.2**	± 9.5	**2.7**	± 1.9	≤ 0.01
Davilla rugosa	15	**10.1**	± 1.7	**5.5**	± 1.4	≤ 0.05
Lacistema pubescens	15	**15.9**	± 3.2	**0.8**	± 0.5	≤ 0.0001
Lecythis lurida	15	**114.2**	± 20.2	**26.5**	± 10.5	≤ 0.001
Machaerium quinata	14	**3.7**	± 8.9	**0.5**	± 0.3	≤ 0.01
Memora allamandiflora	15	**32.1**	± 1.0	**20.7**	± 6.3	ns
Myrcia bracteata	15	7.3	± 1.1	**0.4**	± 0.2	≤ 0.0001
Myrcia cuprea	15	**45.2**	± 10.6	**0.6**	± 0.3	≤ 0.0005
Myrcia deflexa	15	**32.5**	± 4.4	**0.3**	± 0.2	≤ 0.0001
Myrcia sylvatica	15	**14.6**	± 2.3	**0.6**	± 0.3	≤ 0.0001
Rollinia exsucca	15	**11.9**	± 3.7	**1.6**	± 0.8	≤ 0.01
Rourea doniana	15	**16.2**	± 3.3	**4.6**	± 1.8	≤ 0.005
Rourea ligulata	15	**16.4**	± 3.3	7.7	± 2.2	≤ 0.05
Senna chrysocarpa	15	**3.9**	± 1	**0.3**	± 0.2	≤ 0.001
All species	239	**26.2**	± 2.4	**4.6**	± 0.9	≤ 0.0001

Tab. 1: Phytomass of 16 woody species on the burnt and not burnt plots after 3 months of regeneration (M = mean; SE = standard error; p = level of significance; ns = not significant)

3 Results

3.1 Regeneration type

After a period of 3 months, 37% of the observed plant individuals had resprouted on the burnt and 93% on the not burnt plots. They showed 3 types of vegetative regeneration:

1) resprouting from the subterranean root-stock
2) resprouting from epicormic buds of the subterranean and aboveground part of the stump, and
3) resprouting from horizontal roots or tap-roots.

On the burnt plots, 95% of the individuals resprouted from subterranean tissues, compared to 26% on the not burnt plots (Fig. 1 and Fig. 2).

After 16 months of regeneration, however, 99 and 98% of the observed individuals resprouted from subterranean tissues on the burnt plots and the not burnt plots, respectively.

3.2 Phytomass

The phytomass of the sprouts after a period of 3 months was, on average, lower in the burnt (4.6 g per stump) than in the not burnt plots (26.2 g per stump; Tab. 1).

3.3 Number of sprouts

After 3 months, the number of sprouts per stump was, on average, lower on the burnt (1.3 sprouts per stump) than on the not burnt plots (5.7). With the exception of *Davilla rugosa*, *Lecythis lurida*, *Memora allamandiflora*, *Rollinia*

Species	Number of sprouts: after 3 months of regeneration						after 16 months of regeneration							Comparison of the number of sprouts after 3 and 16 months of regeneration	
		not burnt		burnt				not burnt			burnt			not burnt	burnt
	n	M	± SE	M	± SE	p	n	M	± SE	n	M	± SE	p	p	p
Banara guianensis	15	**5,2**	± 0.6	**0,4**	± 0.3	≤ 0.0001	16	**4,2**	± 0.9	13	**1,9**	± 0.8	ns	ns	ns
Casearia grandiflora	15	**5,6**	± 1.3	**1,5**	± 1.3	≤ 0.05	16	**3,7**	± 0.6	13	**2,0**	± 0.3	≤ 0.05	ns	ns
Cecropia palmata	15	**4,0**	± 0.7	**0,6**	± 0.4	≤ 0.0005	16	**2,4**	± 0.4	7	**1,4**	± 0.3	ns	ns	ns
Davilla rugosa	15	**4,9**	± 0.7	**3,7**	± 0.9	ns	16	**3,6**	± 0.5	14	**2,1**	± 0.2	≤ 0.05	ns	ns
Lacistema pubescens	15	**8,2**	± 1.1	**0,9**	± 0.5	≤ 0.0001	16	**4,8**	± 0.8	13	**2,4**	± 0.5	≤ 0.05	≤ 0.01	≤ 0.05
Lecythis lurida	15	**2,4**	± 0.5	**2,3**	± 0.6	ns	16	**4,3**	± 0.8	13	**4,5**	± 0.9	ns	ns	≤ 0.05
Machaerium quinata	14	**1,1**	± 0.2	**0,4**	± 0.2	≤ 0.05	16	**1,4**	± 0.2	13	**1,3**	± 0.1	ns	ns	≤ 0.001
Memora allamandiflora	15	**1,7**	± 0.2	**1,3**	± 0.3	ns	16	**2,4**	± 0.3	13	**1,3**	± 0.2	≤ 0.01	ns	ns
Myrcia bracteata	15	**6,9**	± 0.9	**1,2**	± 0.9	≤ 0.0001	16	**7,2**	± 1.4	13	**3,1**	± 0.6	≤ 0.05	ns	ns
Myrcia cuprea	15	**14,7**	± 1.9	**1,2**	± 0.6	≤ 0.0001	16	**6,4**	± 1.3	13	**3,5**	± 0.8	ns	≤ 0.001	≤ 0.05
Myrcia deflexa	15	**9,0**	± 1.5	**0,6**	± 0.3	≤ 0.0001	16	**3,4**	± 0.5	13	**2,2**	± 0.3	ns	≤ 0.001	≤ 0.005
Myrcia sylvatica	15	**13,8**	± 1.8	**1,1**	± 0.5	≤ 0.0001	16	**9,6**	± 1.9	13	**2,2**	± 0.4	≤ 0.005	ns	ns
Rollinia exsucca	15	**4,5**	± 2.2	**1,6**	± 0.6	ns	16	**2,3**	± 0.3	13	**1,9**	± 0.3	ns	ns	ns
Rourea doniana	15	**2,9**	± 0.6	**1,5**	± 0.6	ns	10	**4,3**	± 1.3	14	**2,0**	± 0.2	≤ 0.05	ns	ns
Rourea ligulata	15	**3,5**	± 0.5	**2,3**	± 0.7	ns	16	**4,6**	± 0.7	13	**2,6**	± 0.4	≤ 0.05	ns	ns
Senna chrysocarpa	15	**1,9**	± 0.4	**0,5**	± 0.4	≤ 0.05	16	**3,2**	± 0.5	13	**3,4**	± 0.5	ns	≤ 0.05	≤ 0.0001
All species	239	**5,7**	± 0.4	**1,3**	± 0.2	≤ 0.0001	250	**4,2**	± 0.3	204	**2,4**	± 0.1	≤ 0.0001	≤ 0.001	≤ 0.0001

Tab. 2: Number of sprouts after 3 and 16 months of regeneration of all species

Group of species	Number of sprouts: after 3 months of regeneration						after 16 months of regeneration						
		not burnt		burnt				not burnt		burnt			
	n	M	± SE	M	± SE	p	n	M	± SE	n	M	± SE	p
Group 1	120	**6.0**	± 0,5	**1.7**	± 0.3	≤ 0.0001	122	**5.0**	± 0.4	106	**2.2**	± 0.1	≤ 0.0001
Group 2	119	**5.4**	± 0.6	**1.0**	± 0.2	≤ 0.0001	128	**3.4**	± 0.3	98	**2.6**	± 0.2	ns
All species	239	**5.7**	± 0.4	**1.3**	± 0.2	≤ 0.0001	250	**4.2**	± 0.1	204	**2.4**	± 0.1	≤ 0.0001

Tab. 3: Number of sprouts after 3 and 16 months of regeneration: (M = mean; SE = standard error; p = level of significance; ns = not significant; Group 1 = species favored on not burnt plots; Group 2 = species not favored on burnt or not burnt plots)

exsucca, Rourea doniana and *R. ligulata* which did not show a significantly different number of sprouts on the burnt and not burnt plot, all other species produced significantly less sprouts on the burnt plot than on the not burnt plot (Tab. 2).

After 16 months, the number of sprouts (average of all species) increased in the burnt (2.4) and decreased in the not burnt plots (4.2), compared to the number of sprouts after 3 months of regeneration. The eight species *Casearia grandiflora, Davilla rugosa, Lacistema pubescens, Memora allamandiflora, Myrcia bracteata, M. sylvatica, Rourea doniana*, and *R. ligulata* produced a significantly lower number of sprouts on the burnt plots than on the not burnt plots. The remaining eight species did not show a significant difference (Tab. 2).

Based on these results, the observed species can be divided into two groups: The first group consists of the eight species mentioned above which had a significant higher number of sprouts on the not burnt plots after a period of 16 months, compared to the burnt plots. The eight species of the second group show a similar behavior on both burnt and not burnt plots (Tab. 3).

4 Conclusion

Several species of the eastern Amazonian fallow vegetation have been identified to be favored under land clearing conditions without the use of fire and, thus, a change in the species composition of the fallow vegetation might take place in the long run.

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