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Ability to Suckering of *Burkea africana* (Hook) in the Guinean Savannah Highlands of Adamawa, Cameroon

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Abstract

Burkea africana is a *Fabaceae* of great socio-economic importance in the Guinean highlands of Cameroon. However, it is subjected to intense animal and human pressure, threatening its survival. It is therefore urgent to contribute to the propagation of this species through root suckering. The main objective of this study is to assess the potential for root suckering of *Burkea africana* in order to promote its in situ conservation and domestication. An inventory is carried out in thirty-one (31) hectares plots, distributed equally between riverbanks, fallow land, and the natural savannah of Ndoctoutou and Berem in the Adamawa region. Root suckering induction trials are then conducted on 270 creeping roots in March 2023. For this, two methods are used: simple wounding and complete severing of the creeping roots. These roots are then subjected to three treatments: exposure to open air, covering with soil, and wrapping with aluminium foil. A total of one hundred and forty-eight (148) individuals of *Burkea africana* are recorded with one hundred and four (104) of which had suckers. Ten months after the induction of suckering, the results show that complete sectioning induced higher suckering rates (72.33 ± 16.72%) than the light wound method (12.22 ± 11.60%). Exposure reveal that the percentage of suckering varies from 26.83 ± 6.02% in roots covered with soil to 58.83 ± 35.38% in those covered with aluminium foil. The induced suckers appear predominantly at the distal pole. *Burkea africana* thus demonstrates a good capacity for artificial suckering. However, at the end of the ten-month observation period, no sucker had developed an independent root system. Nevertheless, characterization permit to identify a natural sucker that have developed its own root system. Although inexpensive, this technique will only truly contribute to the domestication of the species if long-term monitoring is carried out to observe the independence of the suckers through autonomous rooting, successful weaning and sustained growth.

Keywords: *Burkea africana, Guinean highlands, suckering, sucker induction, domestication, rooting.*

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Introduction

Overexploitation of timber resources leads to severe degradation of vegetation cover and significant loss of biodiversity (Fawa, 2014). While important for the immediate satisfaction of population needs, this activity results in the degradation of biodiversity (Tchimbi *et al.,* 2023). This degradation is characterized by a decrease in vegetation cover and the depletion of certain multipurpose tree species (Abdoulaye *et al.,* 2024).

Among agroforestry plants, *Burkea africana* Hook is one of the most widely used. Indeed, in Cameroon, in the Guinean savannah highland of Adamawa region, *Burkea africana* is valued for its numerous nutritional benefits (the young leaves are consumed) and therapeutic properties (its dried roots and seeds relieve candidiasis and related infections) (Nizésété and Bakoet, 2017). In the southwestern region of Burkina Faso, it is among the most widely used plants by the local population. The bark is used to treat stomach aches and malaria, and the leaves are used to strengthen the body (Kaboré, 2015). In West Africa, all parts of *Burkea africana* possess therapeutic properties that can address a variety of ailments (Arbonier, 2009). However, repeated bushfires and overexploitation by local populations have increasingly threatened the species with extinction (Tchimbi *et al*., 2023). This situation underscores the urgency of engaging in participatory domestication and integrating the species into existing peasant production systems (Mapongmetsem *et al*., 2006). Achieving this requires a thorough understanding of all-natural regeneration modes, in order to develop appropriate strategies for in situ conservation and, potentially, for clonal reintroduction into agricultural systems (Meunier *et al*., 2006, 2008). Among these methods, induction by suckering a low-cost vegetative propagation technique requiring only a hoe and minimal training appears particularly suitable for farming communities (Bellefontaine, 2005; Meunier *et al*., 2008). While research on *B. africana* has predominantly emphasized its medicinal properties, little is known about the ecological and physiological factors that influence the growth, survival, and persistence of these trees in their natural habitats (Ethel, 2018).

The main objective of this paper is to characterize the natural regeneration and to evaluate the suckering ability of this species in order to ensure conservation and sustainable management of this valuable resource.

Materials And Methods

Study Area

The study area is situated in the Guinean savannah highlands of Adamawa, specifically in the localities of Ndocktoutou and Berem, within the Vina department of the Adamawa region, Cameroon (Fig. 1). This area was selected due to the presence of the target species. The terrain is rugged, and the soils are primarily red or brownish laterites, resulting from mountain erosion influenced by alternating dry and wet seasons. These soils are characterized by high aluminum and iron contents (Yonkeu, 1993). The Adamawa region experiences a distinctive climate, with moderate monthly temperatures ranging from 20 to 26 °C. The region has a Guinean-type climate with two main seasons: a dry season from November to March, and a rainy season from April to October, during which violent storms frequently occur (Letouzey, 1968; MINEPAT, 2002; PNUD and INS, 2010). Vegetation is dominated by savannas, ranging from grasslands

to wooded savannas, with *Daniellia olivieri* and *Lophira lanceolata* as the principal woody species (Letouzey, 1968; MINEPAT, 2002).

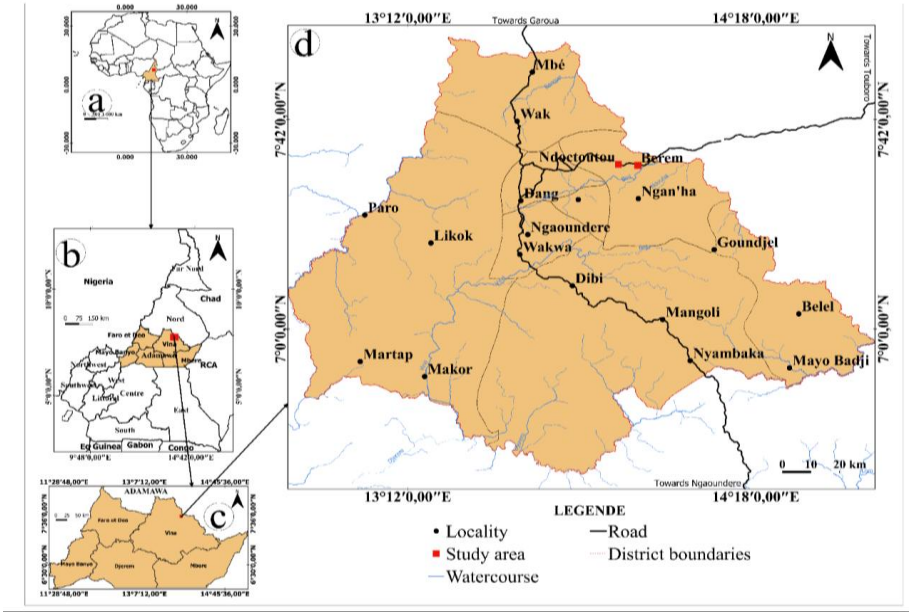


Figure 1. Location Map of the Study Area:
(a) Africa; (b) Adamawa region of the Cameroon;
(c) Vina department and (d) location of study areas in the department of Vina

Characterization of Suckering

The characterization involved randomly delimiting 30 plots of 100 × 100 m² across three different sites: 10 plots in fallow land, 10 on riverbanks, and 10 in savanna, with a spacing of 80 m between plots (Mapongmetsem *et al.*, 2011; *Fawa et al.*, 2017). Within each plot, all regenerations surrounding adult *Burkea africana* individuals were identified within a 5 m radius. A tree, or the most developed stump sprout in a clump, was considered mature when it had a diameter exceeding 3 cm and/or a minimum height of 2 m. Regenerations, including seedlings and suckers, were defined as all plants with a diameter below 3 cm at breast height (1.30 m) and/or height below 2 m. A clump of stump sprouts was classified as a mature tree if at least one sprout had a diameter greater than 3 cm. The superficial root system of regenerations was carefully excavated to determine origin. Natural seedlings displayed a taproot system, whereas suckers remained morphologically connected to the parent root (Fawa *et al.*, 2014). The total number of seedlings and sprouts was recorded. For each sucker, the following parameters were measured: distance from the base of the mother tree, height, ground-level diameter, and presence or absence of a newly formed root system at its base.

Induction of Suckering

The process consisted in the careful excavations of the root systems of 102 trees were carried out at the beginning of the rainy season. One to four shallow roots, 1 to 4 cm in diameter, were excavated at the base of each tree. A total of 270 roots were thus selected, with 90 roots per replicate.

Two induction methods (complete severance and simple wounding) were applied, as well as three exposure methods (exposed to air, covered with soil, and covered with aluminium foil) (Fig. 2). The effects of light and the two induction methods on plant suckering are analyzed (Noubissié *et al.,* 2011; Fawa *et al.,* 2017).



a) b) c)

Figure 2. Different Modes of Section and Exposure:
(a) complete section exposed to open air;
(b) complete section covered with aluminium foil and (c) partial section exposed.

The complete sectioning process involved carefully removing 2-4 cm fragments from 1-3 cm diameter creeping roots, exposed after excavation, using pruning shears. Thus, 45 roots were covered with their original soil, 45 were left exposed on a 5-10 cm fragment, and 45 were covered with aluminium foil.

The minor injury was made by making a 2-4 cm long incision by removing the bark from 8/10ths of the circumference of 135 roots. A total of 45 roots were immediately covered with their original soil, 45 were covered with aluminum foil, and 45 were left exposed to the air as before.

The following parameters of the induced suckers were recorded monthly from May to December (six rainy months and two dry months), the number of suckers, the number of newly formed aerial axes per sucker, the height of the suckers, the number of leaves and the position of appearance of the sucker.

The experimental setup was a three-replicate split-plot. The type of induction (complete severance versus superficial injury) represented the primary treatment. The type of root exposure (roots exposed to air, roots covered with soil, and roots covered with aluminum foil) corresponded to the secondary treatment. The experimental unit was 15 roots. The number of replicates was 3. At the end of the trial, the collected data underwent analysis of variance. The statistical software used was Stagraphics Plus 5.0. The curves were plotted using Microsoft Excel.

Results

Natural regeneration of *Burkea africana*

The number of mother plants varied from 1.8 ± 1.03 individuals in the fallow land to 7.6 ± 1.26 individuals in the savannah (Table 1). Analysis of variance revealed a significant difference between the

different sites (0.0000 < 0.001). The number of mother plants producing suckers ranged from 1 ± 0.75 in the gallery forest to 5.5 ± 1.26 in the savannah (Table 1). Analysis of variance revealed a significant difference between the land cover units (0.0000 < 0.001). Regarding the number of seedlings, it ranged from 1 ± 0.94 in the fallow land to 1.2 ± 0.78 on the riverbank (Table 1). Analysis of variance revealed no significant difference between the land cover units (0.8772 > 0.05). Regarding sprout, its distribution varies from 1.1 ± 0.73 in fallow land to 2.1 ± 0.99 on riverbanks (Table 1). Analysis of variance indicates no significant difference (0.0291 > 0.05) between land cover units (Table 1). The number fluctuates significantly between 1.7 ± 1.47 (riverbank) and 8.1 ± 1.66 (savannah) (0.0000 < 0.001). These regenerations do not survive the dry season due to fires. They are sometimes also affected by herbicides used by farmers for their crops. Naturally, *Burkea africana* regenerates by seeds, suckers and root sprouts.

Table 1. Mother Plants and Natural Regeneration

Stations/ Regeneration	Riverbanks	Fallow	Savannah	Average	P-value
Mother trees	1.8±1.03a	5.4±1.71b	7.6±1.26c	4,93±2,76	0.0000
Mother plants with suckers	1±1.05a	3.9±1.44b	5.5±1.26c	3.46±2.25	0.0000
Seedling	1.2±0.78a	1±0094a	1.1±0.87a	1.1±0.84	0.8772
Sprout	2.1±0.99b	1.1±0.73a	1.9±0.73 b	1.7±1.7	0.0291
Suckers	1.7±1.47a	6.3± 2.05b	8.1±1.66c	5.36± 3.27	0.0000

Note: * The averages of the same row followed by the same letters are statistically identical at the 5% threshold.

Natural Sucker growth Parameters

The percentage of suckers was 70.27%, meaning that 104 out of 148 feet had 1 to 3 suckers at their base. The distance of sucker emergence from the parent plant varied from 42.68 ± 4 cm in the savanna to 48.75 ± 46.06 cm on the riverbanks (Table 2). Analysis of variance revealed no significant difference (0.8842 > 0.05). The height of the suckers varied from 25.7 ± 9.01 cm on the riverbanks to 33.2 ± 16.26 cm in the fallow fields (Table 2). Analysis of variance showed no significant difference (0.6425 > 0.05). The diameter at ground level ranged from 0.50 ± 0.17 cm in savannah to 1.39 ± 0.23 cm in fallow land (Table 2). Analysis of variance showed a significant difference (0.0000 < 0.001). Only one observed natural sucker developed its own root system and could later achieve a certain autonomy.

Table 2. Characteristics of Natural Suckers Observed in the Different Land Cover units

Stations/ Regeneration	Riverbanks	Fallow	Savannah	Average	P-value
Distance between suckers, and mother plants (cm)	48,75±46,06a	45,86±9,81a	42,68±4a	45,76 ± 19,95	0,8842
Ground diameter of the suckers (cm)	0,53± 0,52a	1,39±0,23b	0,50±0,17c	0,80 ± 0,30	0,0000
Sucker heights (cm)	25,7 ± 9,01a	33,2 ± 16,26a	29,75± 11,48a	29,55 ± 16,96	0,6425

Note: * The averages of the same row followed by the same letters are statistically identical at the 5% threshold.

Suckering

In response to the stress experienced by the shallow roots (270) at the base of 102 adult mother plants, the species developed a positive physiological response after 2 months (emission of the first suckers) (Fig. 3).

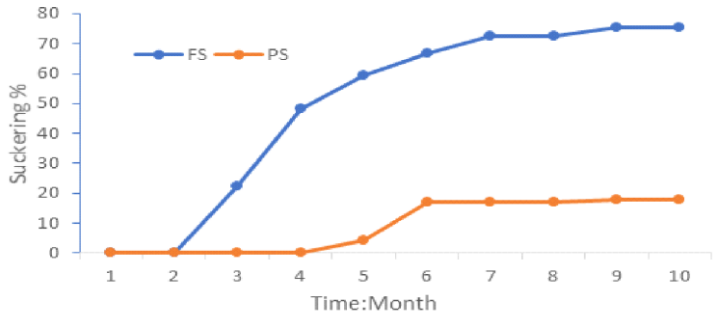


a) **b)** **c)**

Figure 3. Suckers Obtained after Induction;
(a) suckers from the complete section exposed to open air;
(b) suckers from the complete section covered with soil and (c) sucker from the complete section covered with aluminum

Effect of Induction Type on Suckering

After 10 months of observation, the induction method by light injury resulted in a lower rate of suckering (12.22 ± 11.60%) than the method by complete root section (72.33 ± 16.72%) (Fig. 4). The influence of the induction method on the stimulation of suckering is therefore significant (0.0000 < 0.001).

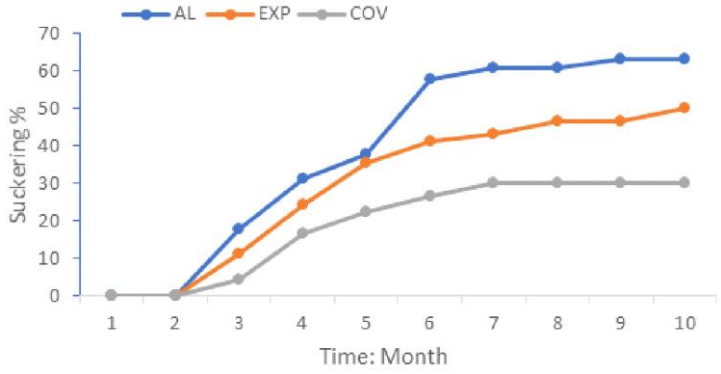


Legend: FS=Roots completely severed and PS = Root partially severed.

Figure 4. Variation in Suckering Rate According to Induction Method

Effect of Exposure on Suckering

Light exposure strongly influenced sucker formation. The lowest percentage of suckers was recorded on roots covered with soil (26.83 ± 6.02%), compared to those exposed to air (39.66 ± 33.07%) and those covered with aluminum foil (58.83 ± 35.58%) (Fig. 5). The exposure method significantly influenced sucker stimulation (0.0000 < 0.001). This result indicates that aluminum foil is a stimulatory factor in sucker formation.

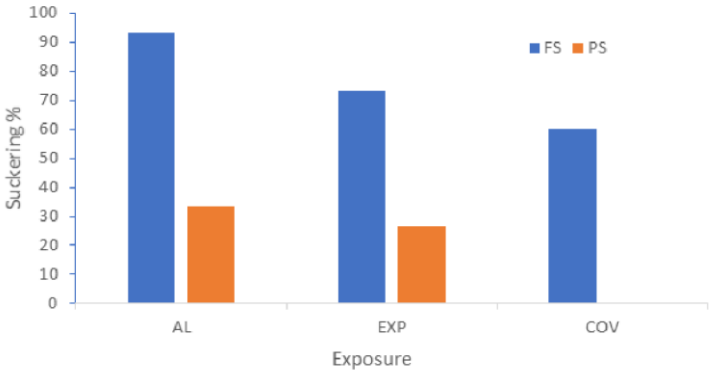


Legend: AL=Root covered with aluminium;
EXP= Roots exposed to the open air and COV= Roots covered in soil.

Figure 5. Variation in the Rate of Suckering According to the Mode of Exposure of the Induced Roots

Effect of the Induction-Exposure Interaction on Suckering

Ten months after the induction of suckering, slightly injured roots covered with soil produced no suckers. Roots that were cut and covered with aluminium foil showed a suckering rate of 91.10 ± 3.85%. Despite this difference, the analysis of variance indicated no significant difference between the interactions (0.3013 > 0.05).

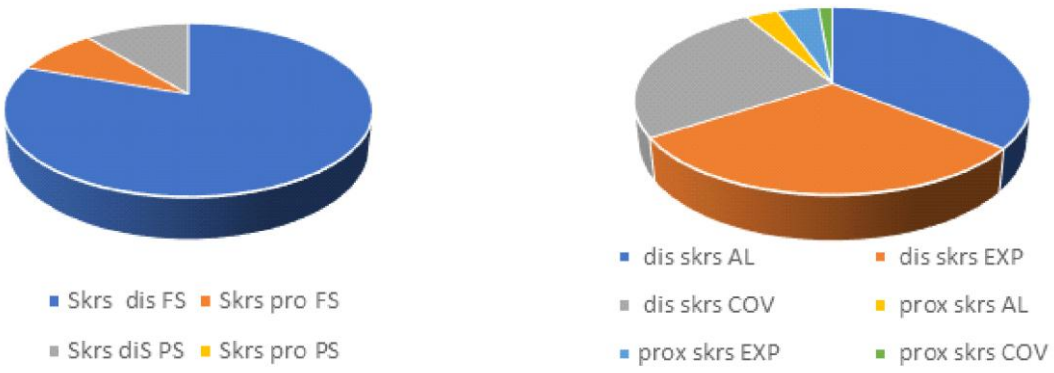


Legend: AL= Root covered with aluminum;
EXP = Roots exposed to the open air and COV= Roots covered in soil.

Figure 6. Rate of Suckering According to the Induction-Exposure Interaction

Polarity of Suckers

Suckers were form both on roots disconnected from the parent tree (distal suckering) and on roots still connected to the parent tree (proximal suckering). The emergence rate varies with the method of root sectioning (Fig. 7a). Analysis of variance (0.000 < 0.001) confirms this percentage difference between the various root sectioning methods. Furthermore, proximal suckers only develop on completely severed roots, while those with only minor injury show no proximal suckers. The rate of distal and proximal suckers also varies with the root exposure method (Fig. 7b). The percentage of distal suckers for this parameter ranges from 1.34% for roots covered with soil to 4.03% for those covered with aluminium foil. The observed variability (0.7822 > 0.05) is not significant. The polarity of the suckers does not depend on the mode of exposure of the root.



a) b)

Figure 7. Distribution of Sucker Polarity:
(a) Variation of sucker polarity according to the sectioning method and
(b) Variation of sucker polarity according to the exposure method.

Growth Parameters of Induced Suckers

Effect of induction type on growth parameters

The number of aerial shoots varied from (3.11 ± 2.89) for injured roots compared to 21.66 ± 3.33 for complete section (Table 3). Analysis of variance showed a significant difference between the induction methods (0.0000 < 0.001). The shoot diameter varied from 1.45 ± 0.62 cm for the partial section to 1.69 ± 0.50 cm for the complete section (Table 3). Analysis of variance indicated a non-significant difference (0.03 < 0.05). Regarding the height of the aerial shoots, it was lower for roots with slight injury (9.72 ± 3.58) compared to 14.01 ± 5.26 for shoots resulting from complete section. The analysis of variance shows a significant difference (0.04 < 0.05). The induction method influences the height (Table 3).

Table 3. Sucker Growth Parameters According to Induction Method

Induction mode / Growth parameters	Complete sectioning	Minor injury	Average	P-value
Number of aerial axes	21.66± 3.33 b	3.11±2.89 a	12.38±0.37	0.0000
Diameter of aerial axes (cm)	1.68±0.50b	1.01±0.62a	1.34±0.68	0.0344
Height of aerial axes (cm)	14.01± 5.26b	9.72±3.58a	11.08±0.78	0.0413

Note: *The averages of the same row followed by the same letters are statistically identical at the 5% threshold.

Effect of exposure on the growth parameters of induced suckers

The formation of aerial shoot also varies with the exposure method. The number of aerial shoots range from 9.83 ± 2.51 cm for roots covered with soil to 15 ± 10.25 cm for roots covered with aluminium foil (Table 4). Analysis of variance shows no significant difference between the exposure methods. The diameter of the aerial shoots also varies, ranging from 0.70 ± 0.03 cm for roots covered with soil to 1.84 ± 0.38 cm for those covered with aluminum foil (Table 4). Analysis of variance shows a significant difference (0.0045 < 0.01) between the exposure methods. Light exposure also influences the height of the shoots. The height fluctuates from 4.95 ± 5.59 cm for roots covered with soil to 14.90 ± 7.96 cm to those exposed to the air (Table 4). Analysis of variance showed a significant difference (0.02< 0.05).

Table 4. Sucker Growth Parameters as a Function of Light Exposure (after 10 months)

Type of recovery / Growth parameters	Roots covered with aluminum foil	Roots exposed	Roots covered with soil	Average	P-value
Number of aerial shoots	15±10.25a	12.33±10.09a	9.83±10.88a	12.38±10.02	0.55 > 0.05
Aerial shoot diameter (cm)	1.84±0.38b	1.49±0.20b	0.70±0.76a	1.34±0.68	0.004 < 0.01
Height of aerial axes (cm)	13.40±3.54b	14.90±7.96b	4.95±5.59a	11.08±7.20	0.0241 < 0.05

Note: *The averages of the same row followed by the same letters are statistically identical at the 5% threshold.

Induction interaction-exposure mode on sucker growth parameters

The number of aerial shoots varies from 0±0 for suckers emitted from partial section and covered with soil to 24 ±4bc for those from the complete section and covered with aluminium foil (Table 5). The analysis of variances presents a non-significant variation (0.80 < 0.05).

Table 5. Number of Axes Following the Interaction Mode of Induction Exposure to Light

Exposure mode / Induction mode	Roots covered with aluminum foil	Roots exposed to the open air	Roots covered with soil	Average	P-value
complete section	24 ±4bc	21.33± 3.05ab	19.66 ± 2.51ab	21.66±3.39	0.80
Partial section	6 ±2ac	3.33 ± 1.52ab	0ab	4.66±2.16	

Note: *The averages of the same row followed by the same letters are statistically identical at the 5% threshold.

The diameter of the aerial axes varied from 2.08 ± 0.41 cm for suckers emitted from roots that were completely severed and covered with aluminum foil to 0 for those that sustained partial injury and were covered with soil (Table 6). Analysis of variance reveals a significant difference (0.001 < 0.01).

Table 6. Diameter of Suckers as a Function of the Induction Mode-Light Exposure Interaction

Exposure mode / Induction mode	Roots covered with aluminum foil	Roots exposed to the open air	Roots covered with soil	Average	P-value
Complete section	2.08±0.41bc	1.56±0.12b	1.40± 0.03ab	1.68±0.37	0.001
Partial insection	1.61±0.20ac	1.41±0.27ab	0a	1.51±0.23	

Note: *The averages of the same row followed by the same letters are statistically identical at the 5% threshold.

The height of the aerial axes varies from 0 for slightly injured and exposed roots to 21.38 ± 1.12 for those completely severed and exposed to the air (Table 7). Analysis of variance reveals a significant difference (0.0036 < 0.01).

Table 7. Height of Suckers as a Function of the Interaction between Induction Mode and Exposure to Light

Exposure mode / Induction mode	Roots covered with aluminium foil	Roots exposed to the open air	Roots covered with soil	Average	P-value
Full section	12.16±2.07b	21.38± 1.12b	9.91± 2.14ab	14.48±5.49	0.0036
Minor injury	14.64±4.74ab	8.43± 5.63ab	0a	11.53±5.76	

Note: *The averages of the same row followed by the same letters are statistically identical at the 5% threshold.

Discussion

Natural Regeneration

The results obtained indicate that *Burkea africana* regenerates effectively through stump sprouts and root suckers across the different land cover units. In the Sahelian zone of Ouaddaï (Chad), Abdoulaye *et al.* (2024) reported that regeneration of *Balanites aegyptiaca* and *Ziziphus mauritiana* occurred mainly via stump sprouts (59.58%), followed by seedlings (33.62%) and, to a lesser extent, root suckers (6.79%). In contrast, *Burkea africana* shows limited establishment along riverbanks, where this land cover unit recorded the lowest tree density. Similar observations were made by Kaboré (2015) in southwestern Burkina Faso, who noted that the species is virtually absent near watercourses. Nevertheless, Ethel (2018), working in southern and northwestern South Africa, classified *Burkea africana* as a regenerating species, highlighting its capacity for vegetative renewal under suitable ecological conditions.

Agriculture is a major driver of the degradation of woody stands (Hall *et al.*, 2002; Gouwakinnou *et al.*, 2009). The clearing of trees for crop production largely accounts for the observed differences in woody density between savannahs and fallow lands. In the Guinean savannah highlands of the Adamawa region of Cameroon, relatively high individual densities have been reported for *Ximenia americana* (31.65 individuals ha^{-1}) and *Lophira lanceolata* (41.20 individuals ha^{-1}) (Fawa, 2015). These results highlight that individual density varies considerably depending on species characteristics and land-use type. Although seedling densities are generally high during the rainy season, most seedlings fail to survive the first dry season, except in relatively humid microhabitats and areas with low grass cover (Agbogan *et al.*, 2015).

In this study, a high percentage of adult *Burkea africana* trees were observed to bear root suckers. This value is higher than that reported by Agbogan *et al.* (2015) in northern Togo, who recorded a suckering rate of 41.1% for *Sclerocarya birrea*. Similarly, in northern Cameroon, the proportion of *S. birrea* individuals producing at least one sucker was 50%, whereas lower frequencies were reported for *Diospyros mespiliformis* (33.3%) and *Balanites aegyptiaca* (9.09%) (Noubissié *et al.*, 2011). The capacity to produce suckers is commonly attributed to genotypic variability (Vaughan *et al.*, 2007; Belem *et al.*, 2008; Eusemann *et al.*, 2013) as well as physiological differences among individuals (Till-Bottraud *et al.*, 2012), including those within the same species.

The average number of suckers per parent tree was higher in the savannah than in other land-use units. Noubissié *et al.* (2011) reported a lower overall mean value (5.15 ± 0.94) in the northern Cameroonian steppe for *Balanites aegyptiaca*, *Diospyros mespiliformis*, and *Sclerocarya birrea*, compared with the values obtained in the present study. Variability in the number of suckers produced per parent tree may be

attributed to differences in edaphic and climatic conditions, as well as to the intensity and nature of disturbances affecting the same woody stand (Bellefontaine, 2005; Vieira *et al.*, 2006; Meunier *et al.*, 2008).

Suckering

The results obtained are consistent with those reported by Rutherford (1983), who demonstrated that *Burkea africana* exhibits a strong suckering response following root damage in the South African savannah. This capacity for natural vegetative regeneration contrasts sharply with the much lower rates recorded for other woody species from the same region, such as *Ximenia americana* (3.47%) and *Lophira lanceolata* (11.89%) (Fawa, 2014). Furthermore, studies conducted on other species of the Guinean savannah highlands, notably *Isoberlinia doka* and *I. tomentosa*, reported suckering rates of 83% and 56% in cultivated fields and fallow lands, respectively, compared with only 39% and 35% in forest environments (Dourma *et al.*, 2006). Collectively, these findings highlight pronounced interspecific variability in vegetative regeneration strategies, likely driven by ecological conditions and land-use practices.

In the case of *Burkea africana*, field observations conducted on 31-ha plots revealed a particularly well-developed and clearly visible shallow root system. This morphological characteristic may account for the high suckering percentages observed across all study sites. This interpretation is supported by the findings of Bellefontaine and Monteuuis (2002), who demonstrated a positive relationship between the extent of the superficial root network and the abundance of root suckers.

The average distance between suckers and parent plants varied among the three land-cover units and was highest in the savannah. By comparison, *Ximenia americana* exhibits an even greater mean distance between suckers and parent plants, reaching 97.7 cm (Fawa *et al.*, 2017). In *Sclerocarya birrea* and *Diospyros mespiliformis*, the reported distances are 1.7 m and 2.5 m, respectively (Noubissié *et al.*, 2011). Abdoulaye *et al.* (2024) further reported substantial interspecific variation, with distances ranging from 56.49 ± 24.57 cm in *Ziziphus mauritiana* to 141.1 ± 81.21 cm in *S. birrea*. In *Bombax costatum*, suckers are generally concentrated beneath the canopy, although they may extend up to 15 m from the parent tree (Belem *et al.*, 2008). In *Litsea glutinosa*, this distance is highly variable, ranging from 0.5 to 25 m, or even more, with suckers sometimes observed at a considerable distance from the parent plant (Jacq *et al.,* 2005). In Togo, in *Isoberlinia doka* and *I. tomentosa*, suckers are distributed around the parent plant between 1 and 2.5 m, and can reach more than 10 m on well-drained and deep soils (Akpagana, 2006). This distance depends mainly on the land use unit considered and the establishment of independent suckers. At this level, *Burkea africana* recorded only one sucker that had developed its own root system. Agbogan *et al.* (2015) state that *Sclerocarya birrea* exhibits very few suckers (17%) producing new roots, and 83% remain connected to the parent plant without necrosis of the parent root. No suckers of *L. lanceolata*, *X. americana*, or *V. doniana* initiated their own root system under the same ecological conditions for rooting. This raises the issue of the independence of these suckers (Fawa *et al.,* 2015). Yet *B. aegyptiaca* and *Z. mauritiana* recorded 11.77 ± 0.95 and 30 ± 2.08 suckers, respectively, that developed their rooting system naturally (Abdoulaye *et al.,* 2024).

Suckering Parameters

Induction type of suckering

This result corroborates those of Fawa *et al.* (2017) on *X. americana*. The authors report that partial sectioning (60%) is less effective than complete sectioning (86.67%). Noubissié *et al.* (2011) observed the same trend on *B. aegyptiaca*, *D. mespiliformis*, and *S. birrea*. This behavior is explained by the intensity of root trauma, which would lead to a modification of the biosynthesis of certain molecules (Fawa, 2014). Trauma such as injury, root severance, or trunk cutting at ground level affects sucker emergence by inhibiting auxin transport and causing the accumulation of cytokinins, nitrogenous substances, in stressed areas. Hormones synthesized in the aerial parts, such as auxins, have an inhibitory effect on sucker production, while nitrogenous inorganic compounds and cytokinins synthesized in the roots stimulate

sucker emergence (Wan *et al.,* 2006; Noubissié *et al.,* 2011). Inducing suckering is a complementary method to sexual regeneration. It is a low-cost tool, important for the future multiplication of the best genotypes of these species (Bellefontaine 2005; Meunier *et al.,* 2006; Dourma *et al.,* 2009 and Noubissié *et al.,* 2011).

Exposure method of suckering

Following root trauma, our experiment indicates that light plays a decisive role in the induction of suckering in *Burkea africana*. Roots covered with aluminium foil produced suckers more readily than those exposed to the air, whereas roots covered with soil exhibited the lowest suckering response. These results are consistent with the findings of Fawa *et al.* (2014), who reported that roots of *Ximenia americana* covered with their original soil suckered less than those left exposed to the air. Similarly, Noubissié *et al.* (2011) showed that roots exposed to light had an average sucker emergence rate of 62.2%, compared with only 33.3% for roots covered with soil. When roots are buried, callus formation may occur without the emergence of an erect axis above the soil surface (Meunier *et al.*, 2006; Harivel *et al.*, 2006). These observations suggest a strong migration or accumulation of growth hormones toward the zone covered with aluminium foil, thereby promoting rapid sucker formation (Fawa, 2015). In addition to light, temperature also plays a critical role in the early development of suckers (Frey *et al.*, 2003).

Polarity of suckers

The rate of induced sucker emergence was higher at the distal pole than at the proximal pole. Complete root sectioning resulted in nearly nine times more suckers at the distal pole compared with the proximal pole, whereas minor injuries did not induce sucker formation at the proximal pole. These findings are consistent with the observations of [Mulaudzi (2022) in South Africa on *Burkea africana*, who recorded 23 distal suckers compared with approximately two proximal suckers. In the same vein, Fawa *et al.* (2015) reported that induced suckers in *Ximenia americana* appeared predominantly at the distal pole of the mother root (54 distal suckers versus 18 proximal suckers). In contrast, in northern Cameroon, Noubissié *et al.* (2011) observed that, on average, *Balanites aegyptiaca*, *Diospyros mespiliformis*, and *Sclerocarya birrea* produced three times more proximal than distal suckers. For *Bombax costatum* in Burkina Faso, 67% of the suckers were located directly at the sites of injury (within the holes), while 33% emerged on root portions clearly upstream or downstream of the injured zones (Belem *et al.*, 2008). Similarly, in Uganda, Meunier *et al.* (2006) reported in *Spathodea campanulata* that complete root severing consistently resulted in the formation of one or more distal suckers, exclusively on the portion of the root disconnected from the parent tree.

Growth parameters

The induction method had a significant positive effect on the number of aerial axes, as well as on their diameter and height. These growth parameters were significantly higher in completely sectioned roots than in partially injured roots. Suckers emerging from completely severed roots were markedly taller than those arising from slightly injured roots. These results corroborate the findings of Fawa (2015), who suggested that complete root severing leads to a higher concentration of phytohormones compared with partial injury. These growth regulators subsequently promote and sustain sucker development.

In South Africa, Mulaudzi (2022) similarly reported increases in the height and diameter of *Burkea africana* suckers in juvenile plants. Furthermore, several studies have demonstrated that sucker growth is strongly correlated with the total pool of non-structural carbohydrates stored in the roots (Schier and Zasada, 1973; Landhäusser and Lieffers, 2002). According to these authors, larger roots generally store greater quantities of carbohydrates. Suckers rely on these root carbohydrate reserves to support the formation of new leaves, shoots, and roots, as well as to maintain respiratory activity in root tissues until the suckers become autonomous and capable of producing sufficient assimilates through photosynthesis.

After ten months (from March to December) of work, observations made in Guinean savannah of Adamawa region indicate that *Burkea africana* suckers do not appear likely to achieve autonomy in just a few months. This result corroborates that of Fawa *et al.* (2023), who observed no root systems in *V. doniana* suckers. Furthermore, in tropical regions, the suckers of *Detarium microcarpum* and *Miconia calvescens* rapidly develop their own root systems (Bellefontaine, 2005). This result suggests that *Burkea africana* suckers cannot become autonomous in a few months and thus become independent of the parent tree under the natural conditions of the Guinean savannas highlands of Cameroon.

Given the results obtained by complete sectioning and root segment propagation, a technique quite similar to suckering should be tested.

Conclusion

The aim of this paper was to characterize the natural regeneration and test the suckering capacity of *Burkea africana* in the localities of Ndoktoutou and Berem in the Guinean highlands of the Adamawa region of Cameroon. This species regenerates through seeding, suckers, and other offshoots. It propagates preferentially in savannah. A total of one hundred and forty-eight (148) individuals of *Burkea africana* were recorded with one hundred and four (104) of which had suckers. The methodological approach consisted in two induction methods notably simple wounding and complete severing of the creeping roots. These roots were then subjected to three treatments: exposure to open air, covering with soil, and wrapping with aluminium foil. As results, the induction method significantly influenced the suckering rate. The complete section method (72.33 ± 16.72%) proved superior to the light injury method (12.22 ± 11.60%). Similarly, covering the injured roots affected suckering stimulation. Covering with aluminium foil resulted in a higher suckering rate of 58.83 ± 35.58. Most of the suckers produced were located on the distal side (91.32%). Induction of suckering allows for the mobilization and rejuvenation of older clones. However, no sucker developed its own root system in our trial. This result may be due to the duration of the trial and the season in which the induction was carried out. For future works, it will be interesting to (i) teste suckering induction at different time of the year; (ii) extend the observation period for these trials and (iii) determine the optimal period for suckering induction which could be crucial for obtaining vigorous and independent suckers.

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Conflict of Interests

No conflict of interest

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