



Research Paper

## Comparative Performance Study of Second-Cycle Bananas and Plantains Cultivated Under Slash-and-Burn and Non-Burn Conditions at Yayoli

KelekeleKwengene John<sup>1,3</sup>, Swennen Rony<sup>4</sup>, Abdallah Kivaghani Christophe<sup>1,2</sup>,  
IsaboLimba Gaston<sup>1</sup>, BaiyeBolifa Augustin<sup>1</sup>, AluaLitwanga Léon<sup>1</sup>,  
AssumaniAngbonda Dieu Merci<sup>1</sup>, BakumiBafelo Jean Paul<sup>1</sup>, EbandabuaAlingo  
Prosper<sup>1</sup>, LisungilaLitwanga Rodeo<sup>1</sup>, MambokoloMolongo Charles<sup>2</sup>,  
LituchaBakokola Joseph<sup>2\*</sup>

<sup>1</sup> National Institute for Agronomic Study and Research (INERA), Yangambi, P.O. Box 2037, Kinshasa, Democratic Republic of the Congo

<sup>2</sup> Faculty Institute of Agronomic Sciences of Yangambi, P.O. Box 1232, Kisangani, Democratic Republic of the Congo

<sup>3</sup> University of Kisangani, Faculty of Agronomic Sciences, P.O. Box 2012, Kisangani, Democratic Republic of the Congo

<sup>4</sup> Catholic University of Louvain (UCLouvain), B.P. 1348, Louvain-la-Neuve, Belgium

### ABSTRACT

This study compared the performance of second-cycle banana and plantain cultivars under two field conditions: one plot prepared by burning (slash-and-burn) and another without burning. Regarding stool survival, the cultivar Yangambi Km5 maintained the highest number of surviving stools compared with all other cultivars. The average height of banana and plantain plants established in the non-burned plot was greater than that of plants established in the burned plot. However, this difference was not observed for the Yangambi Km5 cultivar.

The average pseudostem diameter of second-cycle plants grown in the non-burned plot was higher than that of plants grown in the burned plot. Among the plantain genomic group, the cultivar Litete recorded values exceeding 35 cm in the non-burned plot and above 30 cm in the burned plot. Among bananas, the cultivar Gros Michel showed an average diameter of 33.3 cm compared with 29.6 cm in the burned plot.

The average number of leaves varied among cultivars. For the cultivar Litete, 11 functional leaves were recorded on plants in the non-burned plot compared with 9 leaves on plants in the burned plot. For Gros Michel banana, the number of leaves remained the same in both plots, averaging 8.5 leaves.

Several differences observed between measured parameters in the two plots were highly significant at the 5% significance level, with superior values consistently observed in the non-burned plot. Within cultivar groups, significant differences were also observed, particularly between the plantain cultivar Litete and the banana cultivar Yangambi Km5. Plant height differences were significant at the 5% level with a *p*-value of 0.00016.

The statistically significant superiority of plants grown in the non-burned plot confirms the hypothesis that slash-and-burn practices negatively affect banana and plantain production in the long term in Yayoli and, more generally, in the Yangambi region.

Based on these findings, further studies should be conducted on other crop species and in different environments. Agroforestry trials involving bananas should also be initiated as a medium- and long-term alternative to slash-and-burn practices, which continue to be criticized for their environmental impacts.

**Keywords:** Banana, Plantain, Slash-and-burn agriculture, Second cycle, Growth performance, Yayoli, Yangambi.

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## I. INTRODUCTION

Bananas constitute an agricultural commodity of high commercial value and currently rank fourth among the world's most important food crops after rice, wheat, and maize. Global production is estimated at approximately 74 million tonnes annually (Swennen and Vuylsteke, 2001).

Banana is a multipurpose crop with high agronomic potential. However, its cultivation faces several biological constraints, particularly pests and diseases, which discourage producers (Lassoudière, 2007). Consequently, the Honduran Foundation for Agricultural Research (FHIA) developed a breeding program aimed at obtaining banana cultivars resistant to major diseases and pests (Anonymous, 1993).

In Africa, low production levels are mainly explained by attacks from pests and diseases that not only affect crop growth but also reduce yield and fruit quality, sometimes rendering fruits unsuitable for consumption. These constraints can even lead to the disappearance of a cultivar or plant species from a given region (Lassoudière, 2007).

The low fertility of tropical soils and their overexploitation through shifting cultivation and slash-and-burn agriculture, often without adequate fallow periods, also contribute significantly to reduced banana productivity. This situation worsens over successive cropping cycles unless soils are rapidly replenished through fertilizers or sustainably enriched through organic matter inputs such as agroforestry systems (Yenga, 2014).

The use of fire as a means of land preparation not only reduces the productivity of crops such as banana and plantain but also contributes to the disappearance of numerous plant species, especially legumes (Yenga, 2014).

The hypotheses of this study were based on the temporary fertilization effect of ash and the perennial nature of banana and plantain stools:

- The first hypothesis suggested that the decline in banana and plantain performance under slash-and-burn management would become evident during the second cropping cycle, particularly through reduced stool survival.
- Vegetative growth parameters of plants established on burned plots would be significantly lower than those of plants grown on non-burned plots.
- Yield performance of second-cycle bananas and plantains grown on burned plots would be lower than that of plants grown on non-burned plots.

## II. OBJECTIVES

### General Objective

To determine the long-term negative effects of slash-and-burn practices on banana and plantain cultivation in Yayoli and the wider Yangambi region.

### Specific Objectives

- To inventory second-cycle banana and plantain stools in the experimental field at Yayoli.
- To measure plant height, pseudostem diameter, and count functional leaves.
- To determine the number of suckers and bunches produced by the measured plants.

## III. MATERIALS AND METHODS

### Study Area

The study was conducted around the Yayoli Forest Reserve, located approximately 20 km from Yangambi. The availability of land and the diversity of banana and plantain cultivars motivated the selection of this site. Yayoli is located at 0°56'N and 25°13'E, with an average altitude of 437.7 m.

The climate corresponds to the Yangambi region, classified as humid evergreen equatorial rainforest (A according to Köppen's classification). Soils are derived from sandy-clayey alluvial deposits associated with the Yangambi soil series.

### Plant Material

Four cultivars commonly grown in Yayoli were selected:

Cultivar	Type	Genome	Use
Litete	False Horn Plantain	AAB	Cooking
Libanga Likale	French Plantain	AAB	Cooking
Gros Michel	Banana	AAA	Dessert
Yangambi Km5	Banana	AAA	Dessert

Where:

- A = *Musa acuminata*
- B = *Musa balbisiana*

### Experimental Design

The experiment consisted of two 0.25-hectare blocks:

- Burned plot (slash-and-burn)
- Non-burned plot

Cultivars were planted in alternating rows at a spacing of 5 m × 3 m.

Observations were made on 240 plants (120 per block) selected from a central area of 900 m<sup>2</sup>. Three replications per cultivar were considered.

Measured parameters included:

- Stool survival inventory.
- Plant height.
- Pseudostem diameter.
- Number of functional leaves.
- Number of suckers.
- Number and weight of bunches harvested.

Data were analyzed using Analysis of Variance (ANOVA).

## IV. RESULTS AND DISCUSSION

### Survival of Second-Cycle Banana and Plantain Stools

Cultivar	Burned Plot	Non-Burned Plot
Yangambi Km5	24	26
Gros Michel	21	20
Libanga	18	20
Litete	12	12
Mean	18.75	19.50

Yangambi Km5 maintained the highest number of surviving stools in both treatments. Overall stool survival was slightly higher in the non-burned plot, suggesting that slash-and-burn practices accelerate stool decline over successive cropping cycles.

Among plantains, Litete showed the greatest reduction in stool survival, with only 12 surviving stools from the original 30 established during the first cycle.

### Plant Height

Plant height varied mainly according to cultivar. Within cultivars, plants grown in the non-burned plot generally reached greater heights than those in the burned plot, except for Yangambi Km5.

The differences observed indicate an early manifestation of reduced performance under burned conditions. Significant differences were observed between cultivars, especially between Litete and Yangambi Km5 ( $p = 0.00016$ ).

### Pseudostem Diameter

Plants established in the non-burned plot consistently exhibited larger pseudostem diameters.

For plantains, Litete exceeded 35 cm in diameter under non-burned conditions. Among bananas, Gros Michel exhibited larger diameters than Yangambi Km5.

### Functional Leaves

Leaf production differed among cultivars. Litete produced an average of 11 functional leaves in the non-burned plot compared with 9 leaves in the burned plot.

Gros Michel maintained the same average number of leaves (8.5) under both treatments.

### Sucker Production

Yangambi Km5 produced similar numbers of suckers under both treatments.

Other cultivars produced more suckers in the non-burned plot. Previous studies reported between one and five suckers per plant, with Yangambi Km5 generally producing more suckers than Litete.

### Bunch Production

Cultivar	Burned Plot	Non-Burned Plot
Yangambi Km5	9	10
Gros Michel	6	8
Libanga	5	6
Litete	4	4
Mean	6	7

Plants grown in the non-burned plot produced more bunches overall. Gros Michel showed the largest difference between treatments.

#### **Bunch Weight**

Average bunch weight reached 12.9 kg in the non-burned plot compared with only 8.4 kg in the burned plot, confirming the negative long-term effect of slash-and-burn practices on productivity.

### **V. CONCLUSION AND RECOMMENDATIONS**

This study compared the performance of second-cycle banana and plantain cultivars under burned and non-burned field conditions.

Yangambi Km5 maintained the highest stools survival. Plant height, pseudostem diameter, leaf production, bunch number, and bunch weight were generally higher in the non-burned plot.

Several differences were statistically significant at the 5% level, consistently favoring the non-burned treatment. These findings support the hypothesis that slash-and-burn agriculture negatively affects banana and plantain production over time in Yayoli and the Yangambi region.

Future studies should extend this research to other crop species and environments. Agroforestry systems integrating banana cultivation should be promoted as a sustainable alternative to slash-and-burn agriculture.

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