Quest Journals
Journal of Research in Environmental and Earth Sciences
Volume 12 ~ Issue 6 (June 2026) pp: 10-13
ISSN(Online) :2348-2532
www.questjournals.org

Research Paper

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

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

[1] *National Institute for AgronomicStudy and Research (INERA), Yangambi, P.O. Box 2037, Kinshasa, Democratic Republic of the Congo*
[2] *Faculty Institute of Agronomic Sciences of Yangambi, P.O. Box 1232, Kisangani, Democratic Republic of the Congo*
[3] *University of Kisangani, Faculty of Agronomic Sciences, P.O. Box 2012, Kisangani, Democratic Republic of the Congo*
[4] *CatholicUniversity of Louvain (UCLouvain), B.P. 1348, Louvain-la-Neuve, Belgium*

Abstract
This studycompared the performance of second-cycle banana and plantain cultivars undertwofieldconditions: one plot prepared by burning (slash-and-burn) and anotherwithoutburning. Regardingstoolsurvival, the cultivar Yangambi Km5 maintained the highestnumber of survivingstoolscomparedwith all other cultivars. The averageheight of banana and plantain plants established in the non-burned plot wasgreaterthanthat of plants established in the burned plot. However, thisdifferencewas not observed for the Yangambi Km5 cultivar.
The averagepseudostemdiameter of second-cycle plants grown in the non-burned plot washigherthanthat of plants grown in the burned plot. Among the plantain genomic group, the cultivar Liteterecorded 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 averagediameter of 33.3 cm comparedwith 29.6 cm in the burned plot.
The averagenumber of leavesvariedamong cultivars. For the cultivar Litete, 11 functionalleaveswererecorded on plants in the non-burned plot comparedwith 9 leaves on plants in the burned plot. For Gros Michel banana, the number of leavesremained the same in both plots, averaging 8.5 leaves.
Severaldifferencesobservedbetweenmeasuredparameters in the two plots werehighlysignificant at the 5% significancelevel, withsuperior values consistentlyobserved in the non-burned plot. Within cultivar groups, significantdifferenceswerealsoobserved, particularlybetween the plantain cultivar Litete and the banana cultivar Yangambi Km5. Plant heightdifferenceswere significant at the 5% levelwith a p-value of 0.00016.
The statisticallysignificantsuperiority of plants grown in the non-burned plot confirms the hypothesisthat slash-and-burn practices negatively affect banana and plantain production in the long term in Yayoli and, more generally, in the Yangambiregion.
Based on thesefindings, furtherstudiesshouldbeconducted on othercropspecies and in differentenvironments. Agroforestry trials involving bananas shouldalsobeinitiated as a medium- and long-term alternative to slash-and-burn practices, which continue to becriticized for theirenvironmental impacts.

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

*Received 06 June., 2026; **R**evised 15 June, 2026; **A**ccepted 17 June., 2026 © The author(s) 2026.*
P**ublished with open access at **www.questjournals.org

I. INTRODUCTION

Bananas constitute an agricultural commodity of high commercial value and currentlyrankfourthamong the world'smost important foodcropsafterrice, wheat, and maize. Global production isestimated at approximately 74 million tonnes annually (Swennen and Vuylsteke, 2001).

Banana is a multipurposecropwith high agronomicpotential. However, its cultivation faces severalbiologicalconstraints, particularlypests and diseases, whichdiscourageproducers (Lassoudière, 2007). Consequently, the HonduranFoundation 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 mainlyexplained by attacksfrompests and diseasesthat not only affect cropgrowth but alsoreduceyield and fruit quality, sometimesrendering fruits unsuitable for consumption. Theseconstraintscaneven lead to the disappearance of a cultivar or plant speciesfrom a givenregion (Lassoudière, 2007).

The lowfertility of tropical soils and theiroverexploitationthroughshifting cultivation and slash-and-burn agriculture, oftenwithoutadequatefallowperiods, alsocontributesignificantly to reduced banana productivity. This situation worsens over successive cropping cycles unlesssoils are rapidlyreplenishedthroughfertilizers or sustainablyenrichedthroughorganicmatter inputs such as agroforestrysystems (Yenga, 2014).

The use of fire as a means of land preparation not onlyreduces the productivity of cropssuch as banana and plantain but alsocontributes to the disappearance of numerous plant species, especiallylegumes (Yenga, 2014).

The hypotheses of thisstudywerebased on the temporaryfertilizationeffect of ash and the perennial nature of banana and plantain stools:

- The first hypothesissuggestedthat the decline in banana and plantain performance under slash-and-burn management wouldbecomeevidentduring the second cropping cycle, particularlythroughreducedstoolsurvival.
- Vegetativegrowthparameters of plants established on burned plots wouldbesignificantlylowerthanthose of plants grown on non-burned plots.
- Yield performance of second-cycle bananas and plantains grown on burned plots wouldbelowerthanthat of plants grown on non-burned plots.

II. OBJECTIVES

General Objective

To determine the long-termnegativeeffects of slash-and-burn practices on banana and plantain cultivation in Yayoli and the widerYangambiregion.

Specific Objectives

- To inventory second-cycle banana and plantain stools in the experimentalfield at Yayoli.
- To measure plant height, pseudostemdiameter, and count functionalleaves.
- To determine the number of suckers and bunchesproduced by the measured plants.

III. MATERIALS AND METHODS

Study Area

The studywasconductedaround the Yayoli Forest Reserve, locatedapproximately 20 km fromYangambi. The availability of land and the diversity of banana and plantain cultivars motivated the selection of this site. Yayoliislocated at 0°56'N and 25°13'E, with an average altitude of 437.7 m.

The climate corresponds to the Yangambiregion, classified as humidevergreenequatorialrainforest (Afaccording to Köppen's classification). Soils are derivedfromsandy-clayey alluvial depositsassociatedwith the Yangambisoilseries.

Plant Material

Four cultivars commonlygrown in Yayoliwereselected:

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

Where:

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

Experimental Design

The experimentconsisted of two 0.25-hectare blocks:

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

Cultivars wereplanted in alternatingrows at a spacing of 5 m × 3 m.
Observations were made on 240 plants (120 per block) selectedfrom a central area of 900 m². Threereplications per cultivar wereconsidered.
Measuredparametersincluded:

- Stoolsurvivalinventory.
- Plant height.
- Pseudostemdiameter.
- Number of functionalleaves.
- Number of suckers.
- Number and weight of bunchesharvested.

Data wereanalyzedusingAnalysis 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 highestnumber of survivingstools in bothtreatments. Overallstoolsurvivalwasslightlyhigher in the non-burned plot, suggestingthat slash-and-burn practices acceleratestooldecline over successive cropping cycles.
Among plantains, Liteteshowed the greatestreduction in stoolsurvival, withonly 12 survivingstoolsfrom the original 30 establishedduring the first cycle.

Plant Height
Plant heightvariedmainlyaccording to cultivar. Within cultivars, plants grown in the non-burned plot generallyreachedgreaterheightsthanthose in the burned plot, except for Yangambi Km5.
The differencesobservedindicate an early manifestation of reduced performance underburned conditions. Significantdifferenceswereobservedbetween cultivars, especiallybetweenLitete and Yangambi Km5 ($p = 0.00016$).

PseudostemDiameter
Plants established in the non-burned plot consistentlyexhibitedlargerpseudostemdiameters.
For plantains, Liteteexceeded 35 cm in diameterunder non-burned conditions. Among bananas, Gros Michel exhibitedlargerdiametersthanYangambi Km5.
FunctionalLeaves
Leaf production differedamong cultivars. Liteteproduced an average of 11 functionalleaves in the non-burned plot comparedwith 9 leaves in the burned plot.
Gros Michel maintained the sameaveragenumber of leaves (8.5) underbothtreatments.
Sucker Production
Yangambi Km5 producedsimilarnumbers of suckers underbothtreatments.
Other cultivars produced more suckers in the non-burned plot. Previousstudiesreportedbetween one and five suckers per plant, withYangambi Km5 generallyproducing more suckers thanLitete.

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 bunchesoverall. Gros Michel showed the largestdifferencebetweentreatments.

BunchWeight

Averagebunchweightreached 12.9 kg in the non-burned plot comparedwithonly 8.4 kg in the burned plot, confirming the negative long-termeffect of slash-and-burn practices on productivity.

V. CONCLUSION AND RECOMMENDATIONS

This studycompared the performance of second-cycle banana and plantain cultivars underburned and non-burnedfield conditions.

Yangambi Km5 maintained the higheststoolsurvival. Plant height, pseudostemdiameter, leaf production, bunchnumber, and bunchweightweregenerallyhigher in the non-burned plot.

Severaldifferenceswerestatisticallysignificant at the 5% level, consistentlyfavoring the non-burnedtreatment. Thesefindings support the hypothesisthat slash-and-burn agriculture negatively affects banana and plantain production over time in Yayoli and the Yangambiregion.

Future studiesshouldextendthisresearch to othercropspecies and environments. Agroforestrysystemsintegrating banana cultivation shouldbepromoted as a sustainable alternative to slash-and-burn agriculture.

References

[1]. BangataBithaNyiMbunzu, J. C., BithaGende, S., NgwibabaAnsuele, F., NgbeneloNgbengbu, P., &MobamboKitumeNgongo, P. (2023). Literaturereview on banana plants (*Musa*spp.) and differentcroppingsystems. *Revue Congolaise des Sciences et Technologies, 2*(1), 233–279. https://doi.org/10.59228/rcst.023.v2.i1.29

[2]. BangataBithaNyiMbunzu, J. C., &MobamboKitumeNgongo, P. (2022). Evaluation of the productivity of five banana cultivars associatedwithtreelegumes in Kinshasa, Democratic Republic of the Congo. *Revue Marocaine des Sciences Agronomiques et Vétérinaires, 10*(4), 461–468.

[3]. BangataBithaNyiMbunzu, J. C., NgwibabaAnsuele, F., BithaGende, S., NgbeneloNgbengbu, P., &MobamboKitumeNgongo, P. (2023). Evaluation of banana productivityduring the second cropping cycle established in alley-croppingsystemswithtreelegumes on the Batéké Plateau (Kinshasa, Democratic Republic of the Congo). *Revue Congolaise des Sciences et Technologies, 2*(2). https://doi.org/10.59228/rcst.v2i2.308

[4]. Blomme, G., Ocimati, W., Sivirihauma, C., Vutseme, L., & Turner, D. W. (2020). The performance of a wide range of plantain cultivars at threecontrasting altitude sites in North Kivu, Eastern Democratic Republic of the Congo. *Fruits, 75*(1), 21–35. https://doi.org/10.17660/th2020/75.1.3

[5]. Chalise, B., Shrestha, A. K., Srivastava, A., &Tripathi, K. M. (2023). Effect of plant nutrients on fruit yield and quality of Cavendish banana (*Musa*sp.) cv. "Grand Naine". *Nepalese Horticulture, 17*(1), 86–95. https://doi.org/10.3126/nh.v17i1.60639

[6]. CIRAD. (2024). *Biodiversified system (BANABIO):Agronomic performance and yields of banana plants*. CIRAD Experimental Report.

[7]. KimandaAsha, M., BisimwaByamungu, D., &Ntoto M'Vubu, A. R. (2025). Evaluation of the profitability of plantain banana production in Mansende Village, Kongo Central Province, Democratic Republic of the Congo. *European Scientific Journal, 21*(19), 198–212. https://doi.org/10.19044/esj.2025.v21n19p198

[8]. Mustaki, S. (2021). *Effect of plantingmaterials and sources of nutrients on growth, yield and quality of banana* (Master'sthesis). Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

[9]. Panigrahi, N., Thompson, A. J., Zubelzu, S., & Knox, J. W. (2021). Identifyingopportunities to improve management of water stress in banana production. *ScientiaHorticulturae, 276*, 109735. https://doi.org/10.1016/j.scienta.2020.109735

[10]. Rapetti, M., Ramassamy, R., Truc, C., &Dorel, M. (2025). Effect of suboptimalgrowing conditions induced by agroecological practices on the yield of 12 Cavendish banana cultivars. *Experimental Agriculture, 61*, e2, 1–16. https://doi.org/10.1017/S0014479724000231

[11]. VawaOtro Serge Théodore, Gnonhouri, G. P., & Seri, S. P. (2021). Study of the economic performance of annualreplanting of plantain bananas: A nematode management strategy in southern Côte d'Ivoire. *European Scientific Journal, 17*(34), 55–70.