Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 164 (2022) 56104-56107

ISSN: 2229-712X

Plantain Banana and Tree Association, an Opportunity for the Production of Plantain Banana in Traditional Cropping Systems in Kisangani, DR Congo

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ARTICLE INFO

Article history:
Received: 2 February 2022;
Received in revised form:
27 February 2022;
Accepted: 9 March 2022;

Keywords
Intercroppig,
Tree,
Plantain,
Burns,
Traditional Cropping.

ABSTRACT
Plantain banana are staple crops in DR Congo. These are superficially rooted monocot plants that require a continuous nutrient enrichment mechanism to maintain production, which decreases considerably after a few crop cycles. In burn agriculture, significant nutrient losses are recorded by various mechanisms. This research shows that cropping plantain banana in association with trees makes it possible to increase more not only the production of these on the unburned field in association with the trees, but also and above all to improve the yield of plantains in burned field in association with trees unlike burned cropping without the presence of trees where thirds of low yields are recorded.

Introduction

Bananas and plantains are, in terms of world production, the fourth largest agricultural product after wheat, rice and maize. They occupy the first rank of fruit production. They are among the oldest fruits grown in West and Central Africa and the most important staple food crops in the tropics and subtropics of the world (Chabi et al., 2018); Idumah, (2016) and Techeney, (2007).The consumption of plantains in the East African highlands is about 250 kg of plantains per person per year, showing its importance as a staple food in this region of Africa (Swennen and Vuylsteke, 2001). Bananas and plantains are more of a significant source of income for producing countries (Loeillet, 1995) and an important source of income in rural areas (Ortiz and Vuylsteke, 1996).

In Democratic Republic of Congo (DRC), banana and plantain are grown mainly for self-consumption and play an important role in the food security of the population in the various agro-ecological zones (Ded'ha et al. 2019), with a production of 4.8 million tons in 2019 (INS, 2021). In this country, the vast majority of agricultural production is obtained in the vast majority of cases in itinerant slash-and-burn agriculture. In this cropping system, the fields are opened by clearing undergrowth, felling some trees and incineration. Some trees deemed useful or difficult to cut down by farmers are not kept in the field.

After the opening the field, the farmer plants the plantains banana in association with one or more other crops. Thus, some plantain banana plants then cohabit with trees intentionally kept on in the field by the farmer. Thus, the evaluation of the growth and yield of plantain banana in this cropping system on burns where they cohabit in the same space with the trees kept in the field by the farmer is essential in order to make improvements in the system of peasant production of plantain banana.

The present study is based on the hypothesis that the selective presence of trees in a plantain field on burn in a forest area can not only ensure soil cover, limiting nutrient losses through erosion and leaching, but also promote the enrichment of nutrients from the decomposition of the foliage produced and thus contribute to the improvement of the yield of plantain in burn cultivation.

Material and Method

This research was conducted in Simi Simi, a village located 15 km from downtown Kisangani, DRC.The material used for this research was that of planting consisting of suckers of the false horn plantain banana cultivar called Libanga Lifombo (*Musa* spp. subgroup AAB), obtained after macropropagation.

The experimental design adopted for this research was that of the split plot. To do this, a field with an area of 0.12 ha was opened and divided into 2 parts of 0.06 ha each, one of which was incinerated and another not incinerated. Each half of the field was distributed 8 plots of 10mx15m including 4 plots without trees and 4 others with the trees kept in the field. For plots with trees, all those that could cause significant shade to plantain banana trees were either felled or pruned. The combination of factors (burned or not burned and tree or without tree) led to the following 4 treatments selected for the study: 1, Unburned & tree; 2, Unburned & treeless; 3, Burned & tree; 4, Burned & treeless.

Regarding the planting, the plantains bananas were planted at spacing of 3 m X 2 m. The seedlings that did not recover were refilled a month after planting. Maintenance work consisted of manual weeding, leaf stripping of old leaves and destruction of diseased or attacked seedlings.

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For growth, the diameter at the base and the height of the pseudotronc at 6 months are the vegetative parameters measured. As for the production parameters, the measurements focused on the number of hands and fingers, the length, diameter and median fruit (finger) weight measured on the second hand of the bunch, the bunch weight (kg) and his yield (t/ha).

The diameter of pseudostem was measured at the base while the height of the pseudotronc was measured from the base to the V formed by the insertion of the last two functional or vivid leaves.

The data collected was processed with Statgraphics plus software. The means of results were compared by analysis of variance with the multiple Tukey test.

Results

Diameter at the base (cm) at six month

In the first crop cycle as shown in Figure 1, plantains bananas on unburned in association with trees had a significantly better growth in diameter compared to those on unburned without trees (F-ratio=3.32 and p-Value=0.02) at the significance level of 5%. On the other hand, plantains on burned with or without trees had similar diameters at the base to those on unburned with or without trees.

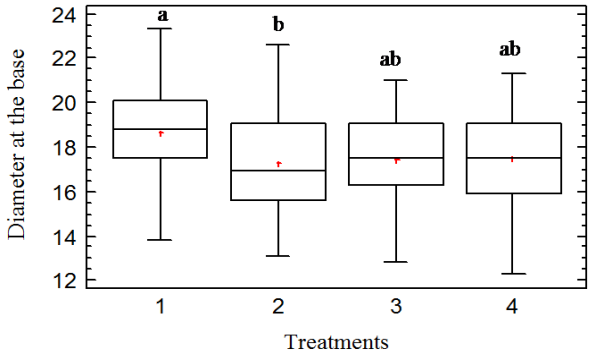

Fig 1. Diameter at the base of plantain banana
Legend: 1, plantains & trees on unburned; 2, plantains & treeless on unburned; 3; plantains & trees on burned; 4, plantains & treeless on burned.

Height of plantain at six month

Regarding the height of plantains at six months of growth (Fig. 2), our results indicate that plantains on unburned with trees are significantly tall than those on burned with or without trees that recorded lower heights (F-ratio=2.46 and p-Value=0.04) at the significance level of 5%. On the other hand, no significant difference was observed between the heights of plantains on unburned with trees and those of plantains without trees. The heights are also similar between plantains on burn with trees and those on burns without trees at the first cropping cycle.

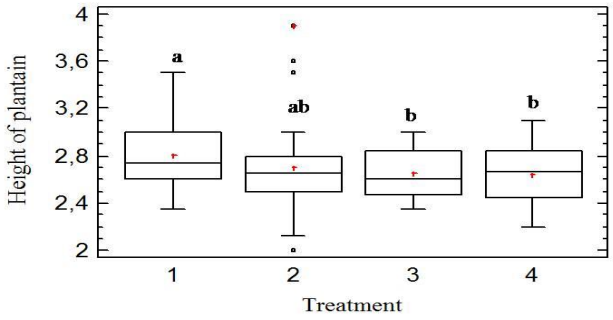

Fig 2. *Height oh plantain at six month*
Legend: 1, plantains & trees on unburned; 2, plantains & treeless on unburned; 3; plantains & trees on burned; 4, plantains & treeless on burned.

Diameter of fingers

At the harvest of the of plantain banana bunch (Fig. 3), the number of hands, the number of fingers and the length of finger did not vary. On the other hand, the diameters of plantain banana fingers associated with trees, similar between unburned and burned, had significantly higher values than those without association with trees on unburned or burned (p-Value=0.02 and F-ratio=3.48) at the significance threshold of 5%,

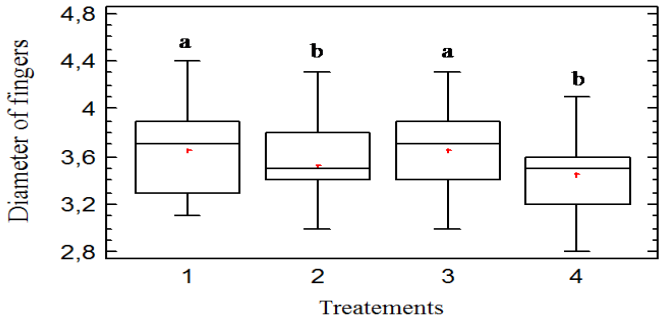

Fig 3. Diameter of fingers of plantain banana at harvest
Legend: 1, plantains & trees on unburned; 2, plantains & treeless on unburned; 3; plantains & trees on burned; 4, plantains & treeless on burned.

Yield of plantain banana at harvest

With regard to plantain banana yields (Fig. 4), the results obtained indicate a similar trend in the finger diameters of plantain banana. Plantain banana yields associated with trees both in burned and in unburned plot are significantly high than those without association with trees in burned plot (F-ratio=7.43 and p-Value=0.000).

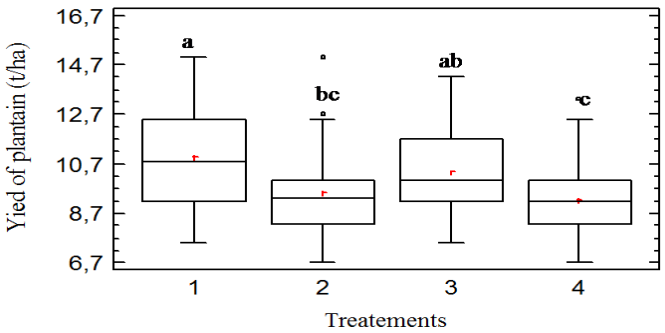

Fig 4. Yield of plantain banana at harvest
Legend: 1, plantains & trees on unburned; 2, plantains & treeless on unburned; 3; plantains & trees on burned; 4, plantains & treeless on burned.

Discussion

Vegetative growth of plantains bananas

Planting plantains near low-density trees in a burn less cultivation system positively affects growth in diameter of pseudotronc at the first 6 months of growth. Plantains installed on unburned plot and in combination with trees would have more nutrients from the decomposition of organic matter. In addition, the low vegetative growth recorded in plantain banana on burns would be due to possible losses of nutrients by erosion or leaching given that the soils are less protected. These results are similar to those of Tutu et al. (2020) found that plantain banana as a monoculture on burned fields gave the lowest vegetative growth.

Production of Plantain Banana

Growing plantains with trees on the unburned leads to a significant improvement in finger diameter and plantain yield in the first crop cycle. Regarding the finger diameter, our results indicate that the latter increases in size when the

plantains bananas are in association with the trees, both in unburned or burned cropping system.

The best results of these two plantain banana production parameters, namely finger diameter and yield, would be related on the one hand to the better vegetative growth recorded during the cycle and on the other hand to the multiple effects of the presence of plant debris and tree foliage on the mineral nutrition of plantain banana. Indeed, plant debris protects the soil by preserving its moisture and reduces the development of weeds. In addition, they limit the loss of nutrients to the soil (through erosion and leaching) and allow it to be enriched with nutrients after decomposition, which is why the growth and yield of plantain banana are better on unburned plot. The positive roles of plant debris or mulch in the plantain banana cropping have been mentioned by several authors. For example, for Obiefuna, (1991), Ruhigwa et al., (1995) and Wilson et al., (1987), plantains grown with mulch produce better than those without soil cover while Salau et al. (1992) note that mulch provides both a physical effect (by covering the soil) as well as a nutritional effect (when it begins to decompose).

Along with the positive effects of plant debris (mulch), trees in combination with plantain banana ensure the protection of the soil by preserving its moisture. They also make it possible to fight against nutrient losses through erosion and contribute to the enrichment of the surface part of the soil through the foliage. According to Nweke et al., (1988), the recycling of nutrients by the deep roots of perennial trees is one of the reasons for the increased yield of plantain banana in the hut garden.

Conclusion

The objectives of this research were to assess the growth and yield of plantains with or without association with trees in a burned or unberned cropping system. In order to achieve the objectives, a essay was made following a split plot experimental design on 0.12 ha involving four treatments namely, Unburned & trees (1); unburned & treeless (2); burned & tree (3) and unburned & treeless (4). The results obtained show that the growth at the height of plantain banana is better on unburned plot with trees than on burned one with or without trees at 6 months of cultivation. In addition, plantain banana trees with large diameters are observed on burn or not but in the presence of trees. Furthermore, the best yields of plantain banana were recorded on unburned and burned in association with trees. On the other hand, plantain banana on burned without trees had low production, which shows the role of the presence of trees in improving the yield of plantains under the conditions of our study.

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