

INFLUENCE OF *FAIHERBIA ALBIDA* ON UPLAND RICE PRODUCTIVITY

*CAMARA B^{1,2,3}, NGOM D¹, SANOGO D², GOSME M³ et Christian DUPRAZ³

*Correspondence author: camarabouba2@gmail.com; b.camara3390@zig.univ.sn

(1) Laboratoire d'Agroforesterie et d'Écologie (LAFE) – Département d'Agroforesterie / UFR ST / Université Assane SECK de Ziguinchor / Sénégal BP: 523 (2) Institut Sénégalais de Recherches Agricoles, Centre National de Recherches Forestières, BP:2312, Dakar Hann, Sénégal (3) INRA, UMR SYSTEM (Systèmes de Culture Tropicaux et Méditerranéens) Montpellier

Introduction

In semi-arid regions of West Africa, most farmers consider the trees as an integral part of the cropping system. They have maintained over the centuries the traditional system of land use, that of the "parkland" where trees are scattered in cultivated fields (Boffa, 2000, Dan Guimbo et al., 2010). The farmers of Casamance are no exception to this rule. In lower Casamance, *Faidherbia albida* (Del.) Chev. has always been associated with upland rice. The species is characterized by its inverted phenological rhythm: it loses its leaves during the rainy season and remains leafy during the dry season, reducing light competition with the crop. Furthermore, this tree is able to fix nitrogen, improving soil fertility, and its taproot system reduces water competition with the crops. Therefore *F. albida*'s interest is very large in agroforestry (in combination with both agriculture and livestock) and many traditional systems rely on the beneficial effects of *Faidherbia albida* on microclimate, soil fertility and finally intercrop productivity. The general objective of this study is to contribute to the understanding of the influence of this type of park on the productivity of rainfed rice, testing the hypothesis "*Faidherbia albida* has a positive impact on the productivity of rainfed rice."

Material and methods

To test this hypothesis, rice yields were measured in eight 0.25 x 0.25m squares around each of 5 trees: four in the area under the influence of the tree (below the tree crown, at a distance R/2 from the tree trunk with R the radius of the crown) and four outside (at a distance of 2R), on the East, South, West and North side of the tree. Thus, a total of 40 squares were measured including 20 inside the area of influence of the tree. The following measurements were done in each square: total biomass weight, straw and grain weight, number of tillers with panicles and plant height (from crown to the base of the panicle, measured on 5 randomly chosen tillers). Analysis of variance (1-way ANOVA: effect of sample location inside vs outside of the tree influence) on these variables was performed with the statistical software STATISTICA 7.

Results and discussion

Results

Results of the ANOVA show significant differences between the measurements made inside vs outside of the influence of the tree (**Table 1**).

Variable	Sum of Squares	of d.f.	Mean Squares	F value	p-value
Total biomass	111000.579	38	2921.068	24.759	< 0.0001*
Straw weight	52376.467	38	1378.328	13.709	0.00067*
grain weight	7130.769	38	187.652	38.833	< 0.0001*
stem height	13480.0	38	354.7	12.161	=0.00125*
tillers	471.60	38	12.41	29.008	< 0.0001*

The total weight of the biomass is significantly ($p < 0.0001$) higher in the tree-influenced area: the mean biomass is 183.95 g inside and 98.9 g outside of the tree influence. The weights of the straw and the grain are higher in the tree-influenced area ($p = 0.00067$ and $p < 0.0001$ respectively): the mean straw weight is 102.27 g vs 58.96 g and the mean grain weight is 58.8 g vs 31.97 g in the area inside vs outside of the tree influence (**figure 1**).

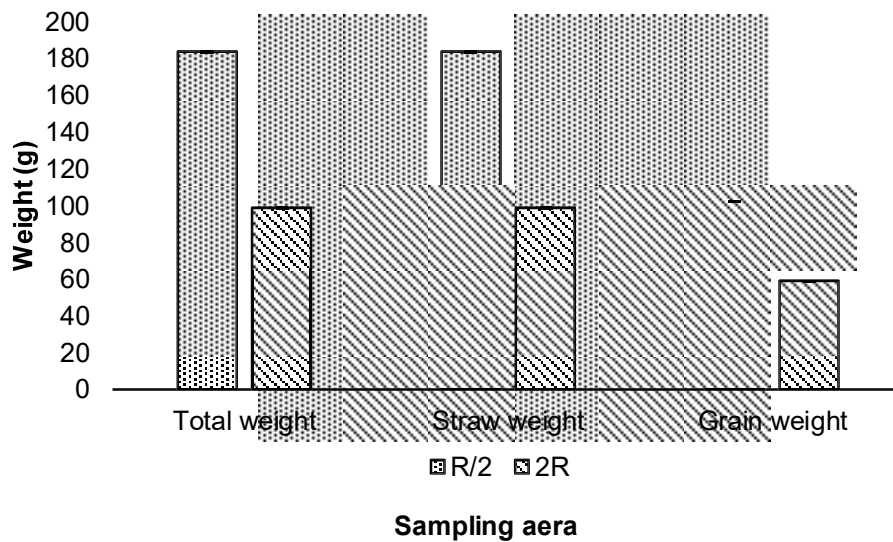


Figure 1: Variation of the total weight, the straw weight and the grain weight according to the sampling area (R/2 = under the crown of the tree, 2R= at a distance equal to twice the radius of the crown).

Stem height is higher in the tree-influenced area than outside ($p = 0.00125$) with an average 105.13 cm against 84.36 cm (**Figure 2**).

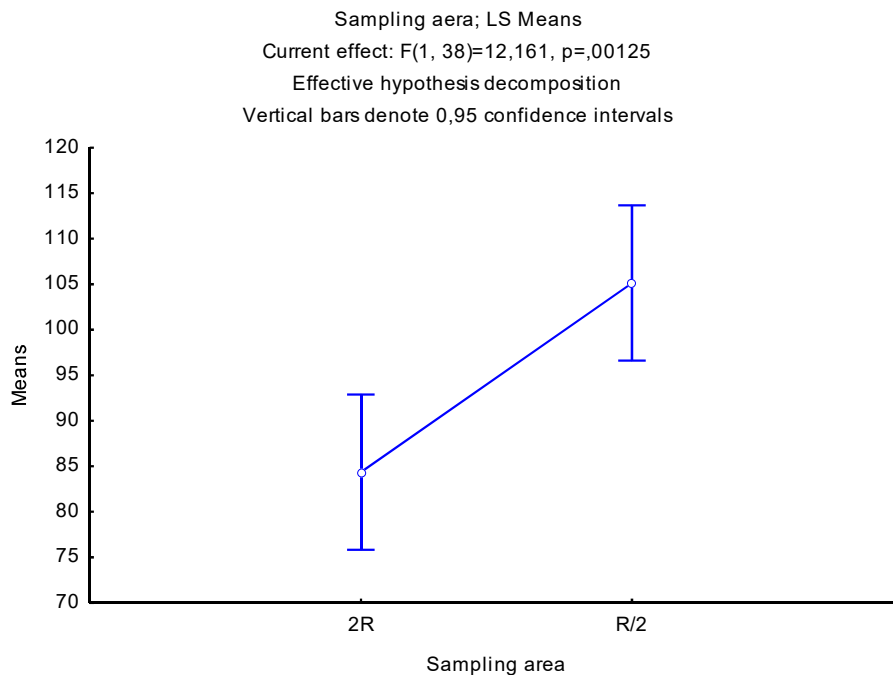


Figure 2: Variation of the height of the stems as a function of the sampling location (R/2 = under the crown of the tree, 2R= at a distance equal to twice the radius of the crown). Vertical bars denote 0,95 confidence intervals

Tillering is significantly ($p < 0.0001$) higher in the tree-influenced area than outside: under the crown, there are 21.1 tillers against 15.1 outside.

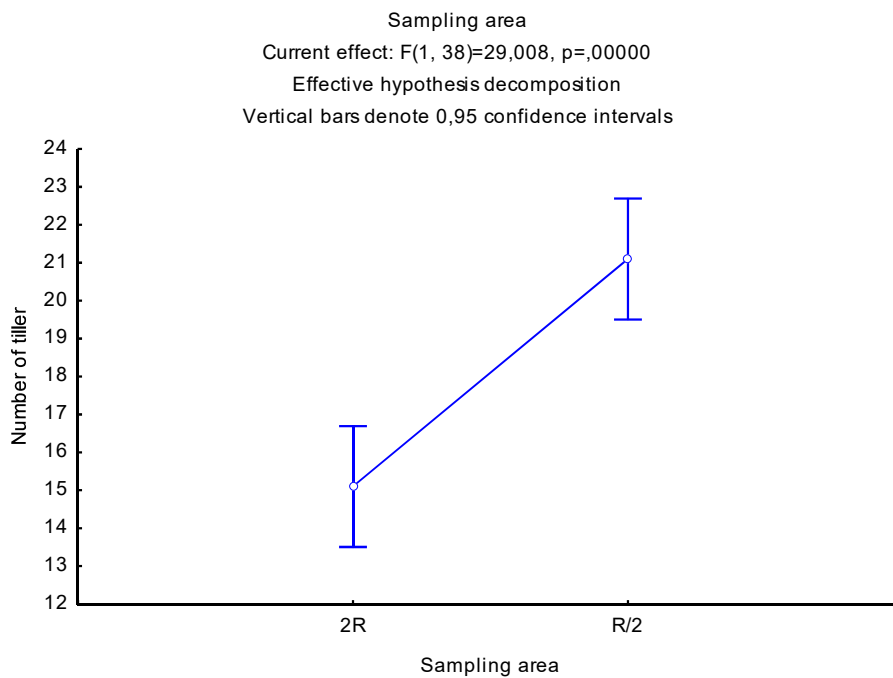


Figure 3: Influence of *Faidherbia albida* on rice tillering. (R/2 = under the crown of the tree, 2R= at a distance equal to twice the radius of the crown). Vertical bars denote 0,95 confidence intervals.

Discussion

The results showed that *Faidherbia albida* has significant positive effects on all measured variables. These results confirm our hypothesis that *Faidherbia albida* has a positive effect on the productivity of rice.

Total biomass and grain weight are more important inside the area influenced by the tree than outside. These results are contradictory to those of Bakhoun et al., (2001). According to these authors, the biomass of peanut pods as well as the biomass of cobs and stalks of millet and sorghum increase with distance from the trunk of *Sterculia setigera*. Gnanglè et al., (2013) found similar results with cotton, which had a higher number of bolls outside the crown of *Vitellaria paradoxa* than under the crown. According to them, the decrease in the number of bolls would be related to the lack of light under the tree. This difference in results can be explained by the loss of leaves of *Faidherbia albida* during the crop growing season in our experiment, which reduce the effect of shading. However, our results are in line with those of Samba et al., (2012). According to them, the total biomass of millet rose 90% on the ground taken from R / 2 compared to 2R (where R is the crown radius) from *Cordyla pinnata*. According to them these results are explained by the fact *Cordyla pinnata* draws nutrients in soil horizons, brings them back to the surface in the form of litter (leaves, branches , bark , fruits) and behaves as an important source of nutritious elements.

The straw weight, stem height and number of tillers with a panicle are more important under *F. albida* than outside of the tree crown. These results contradict those of Gbemavo et al., (2010), in which shea had a negative influence on the height of the cotton and sorghum plants. According to Manssour et al., (2014) the straw weight and height of sorghum stalks also decreased below *Acacia senegal* trees. On the contrary, Clinch et al., (2009) observed an improvement in the recovery and yield of a culture of willows in the (moderate) shade of various species of trees, compared to monoculture. Samba et al., (2012), observed the same effect, with peanut yields increasing 9% close to the trunk of *Cordyla pinnata*.

This study shows that the presence of *Faidherbia albida* in rice fields is of great importance because it creates a favorable environment for the production of upland rice. Under the trees, rice grows better than outside. All measured variables (total biomass, straw and grain weight), stem height and tillering are more important in the area under the influence of the tree, thanks to the intrinsic characteristics of the species, i.e. reverse phenology, pivoting root system and nitrogen-fixing ability. This is the reason why *Faidherbia albida* parklands have been maintained in these secular systems.

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