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DENDROMETRY AND PRODUCTION OF JATROPHA SEEDS IN SOUTHERN SUDANIAN ZONE OF BURKINA FASO

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ABSTRACT

In a context of desertification and climate change, a good number of development actors in Burkina Faso have been interested in Jatropha curcas L. as a source of sustainability of production. In order to evaluate the dendrometric parameters and Jatropha seed production, tests were carried out for 12 months in Torokoro and Tin sites in the Southern Sudanian zone with a rainfall of about 1200 mm. Jatropha plants. 6 years old, are planted at 5m intervals between rows and 2m between plants. On each site, two (02) producers were selected for the conduct of works.a total of four (04) producers and four (04) parcels of Jatropha curcas. In each plot, three (03) 400 m2 repetitions (20m x 20m) with 5 Jatropha hedges were delineated for data collection. The results indicate that the observed dendrometric values are higher in Torokoro plantations than in Tin. Yields of Jatropha curcas from plantations are highly variable depending on the site, and range from 295.6 to 796.3 kg / ha. The productivity and the filling rate of the seeds are low, and show a great variability between the sites.

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INTRODUCTION

The south-Sudanese zone of Burkina Faso is one of the pioneering sites that have benefited from the promotion of Jatropha curcas culture in Burkina Faso, thanks to project activities such as the AU Jatropha project "African Union Jatropha curcas". This zone has agro-climatic conditions that are relatively favorable to crop production. Producers in this area have know-how in planting fruit trees (mango. citrus). As a result, the culture of Jatropha curcas was quickly adopted with the accompaniment of promoters. The current area of Jatropha curcas plantations in the western zone is estimated at more than 10.000 hectares, planted by nearly 200 village groups (Traoré 2009. Bazongo 2011). The information on yields is isolated and highly variable and does not relate to the situation in Burkina Faso, which may leave doubts about the contribution of the plant to the improvement of producers' incomes. Doumergue and Pirot (2008) indicate yields of 250 kg / ha / year at 5 t / ha / year, while Vinay and Vermeulen (2013) report values of 300 g to 6 kg / plant depending on growing conditions. These authors indicate that yields are lower in hedge production conditions. This variability in Jatropha curcas yields was not possible according to Janin and Ouedraogo (2009) and Ogunwole *et al*. (2007), to perfectly calibrate the yields of Jatropha curcas in the Sahelo-Sudanian environment because of the diversity of the cultivation modes and the potentialities of the soils. Thus, questions remain about the real or supposed productivity of Jatropha curcas culture, hence the need to carry out this study. The objective of this study is to evaluate the dendrometric parameters and seed production of Jatropha curcas.

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MATERIAL AND METHODS

Presentation of the study sites: The work was carried out in a rural environment in the South-Sudanese zone of Burkina Faso.in the localities of Torokoro with coordinates 4 ° 20 'west longitude. 9 ° 59' north latitude and 297 m altitude and Tin located between 11 ° 08 'north latitude. 04 ° 97' west longitude and 459 m altitude (Bazongo, 2011). The annual rainfall in these areas can reach 1200 mm. with a rainy season that lasts from 4 to 5 months. These sites were chosen because of previous extension actions of the Jatropha curcas culture by some promoters. The soils of the Torokoro and Tin sites are of the leached tropical ferruginous type (lixisol) on the slopes as well as some pseudogley hydromorphic soils(Youl, 2009).

Plant material: Plant material. Consisting of Jatropha plants aged 2 years and 6 years.

MATERIALS AND METHODS

Data collection device: On each of the two sites (Tin and Torokoro), two (02) producers were selected for the conduct of the works, in total four (04) producers and four (04) fields of JatrophaCurcas. In each plot, three (03) 400 m2 repetitions (20m x 20m) with 5 Jatropha hedges were delineated for data collection.

Measured parameters

The height of the shrubs: the height was measured from the collar to the top of the highest branch, so that the ribbon is perpendicular to the ground.

The height of the trunk: this is the measurement of the height of the foot of the shrub using a tape measure, from the ground to the first branch that emerges from the trunk;

The number of branches: the number of branches located between the ground and a height of 0.50 m was counted in order to estimate the production per foot because the number of branches is very often positively correlated to the production.

The collar diameter and the diameter of the crown: Since the crown does not generally have a regular shape, we proceeded as Rondeux (1999), deducing the average diameter (D) of the crown according to the formula.

$$D=\sqrt{[\sum_{i=1}^{n}(Di)^2\ \frac{1}{n}]}$$

Where D is the average diameter of the crown (cm). I. the North-South and East-West diameters and N. the number of diameter measurements made.

Evaluation of seed yields and filling rate of Jatropha curcas seeds: seed production was evaluated over twenty (20) linear meters. The fruits were harvested per plot, dried and decapsulated. The seeds obtained were weighed, and an average was determined for the three (03) measurements (repetitions) and reported per hectare. The filling rate of the seeds was obtained by making the ratio of the weight of the seeds to that of the fruits. Similarly, the ratio of seed weight to capsule weight has been calculated. The evaluation of these two parameters focused on 100 fruits.

Data analysis

The collected data were entered with the Excel spreadsheet and analyzed using the XLSTAT version 2007 software. The averages of the treatments were separated by the Newman-Keuls test at the 5% significance level to check for significant differences between the averages.

RESULTS

Dendrometric parameters

The characteristics of Jatropha curcas as a function of the site and the age of the plants are given in Table I. The diameter of the trunks of the Torokoro plants is significantly greater than that of the Tin plants both in the six-year plantations and in the two (02) years old. The difference between the average trunk diameter of plants at Torokoro and Tin plants is 4.2 cm for 6-year-old plantations and 3.4 cm for 2-year-old plantations. For the average diameter of the crown, the results also show that the plants of the Torokoro site have diameters significantly greater than those of Tin plants. The differences are 75.9 cm and 7.5 cm between the average crown diameter of the plants at the Torokoro site and that of the Tin plants respectively for the 6 and 2 year old plantations. However, there is no significant difference in the height of the trunks regardless of the age of the plantations and the site. The results reveal significant differences between the plant heights of the Torokoro site and those of Tin. The plants at the Torokoro site are significantly larger. It can be seen that the number of branches on the Torokoro site is higher than that of the Tin plants, with an average of 12 to 14 branches for the plants of the Torokoro site, as against 5 to 6 branches for the Tin plants. Values followed by the same letter in the same column are not significantly different at the 5% probability level.

Seed yields: The results are shown in Figure 1. Regardless of the site, two (02) years after planting, Jatropha curcas goes into production with low yields. For yields, significant differences are observed between the Jatropha curcas plantations of the Tin site and those of Torokoro, both at 6 years and at 2 years. In 6-year-old plantations, an increase in seed yields of 68.7 kg.ha-1 is obtained at the Torokoro site compared with Tin.

Table 1. Dendrometric parameters of Jatropha *curcas plants*

Age of plants	Site / plot	Trunk diameter (cm)	Average crown diameter (cm)	Trunk height (cm)	Total height (cm)	Number of branches
2 ans	Torokoro	8.58*b*±0.46	149.55*b*±43.42	8.78*a*±2.83	188.67*b*±15.45	6*a*±0.38
	Tin	5.18*a*±0.6	142.5*a*±45.4	9.18*a*±2.71	177.56*a*±8.88	5.56*a*±0.58
Probability		0.021	0.012	0.232	0.017	0.432
6 ans	Torokoro	17.24*b*±1.13	328.69*b*±51.38	17.22*a*±7.12	220.89*b*±7.34	15.44*b*±0.69
	Tin	13.01*a*±0.95	252.71*a*±42.71	16.18*a*±7.12	204.56*a*±7.34	12.11*a*±1.64
Probability		0.014	0.002	0.237	0.009	0.035

The same trend is observed in 2-year-old plantations with an increase in seed yields of 58.3 kg.ha-1 in the plantations of the Torokoro site compared to those of Tin. In 2-year-old plantations. The highest yields are 295.6 kg.ha-1 at Torokoro. Compared to 237.2 kg.ha-1 at Tin. The same trend is observed in plantations aged 6 years with yields of 796.3 kg.ha-1 in Torokoro, against 727.5 kg.ha-1 in Tin. The best yields are obtained at the Torokoro site for both 6-year-old and 2-year-old plantations. Per site when the histogram pair is surmounted by different letters.the difference is significant at the 5% probability threshold (Newman-Keuls test).

Filling rate of the seeds: The results obtained are shown in Table II. These results show a slight variability between the sites, and also indicate that the age of the plantation does not affect the filling rate of Jatropha curcas seeds. However, the weight of the fruit and the seed are significantly higher in the Torokoro plantations. Weights of 100 fruits and 100 seeds are 7% higher in the Torokoro plantations, compared to those obtained at the Tin site in the 2-year-old plantations.

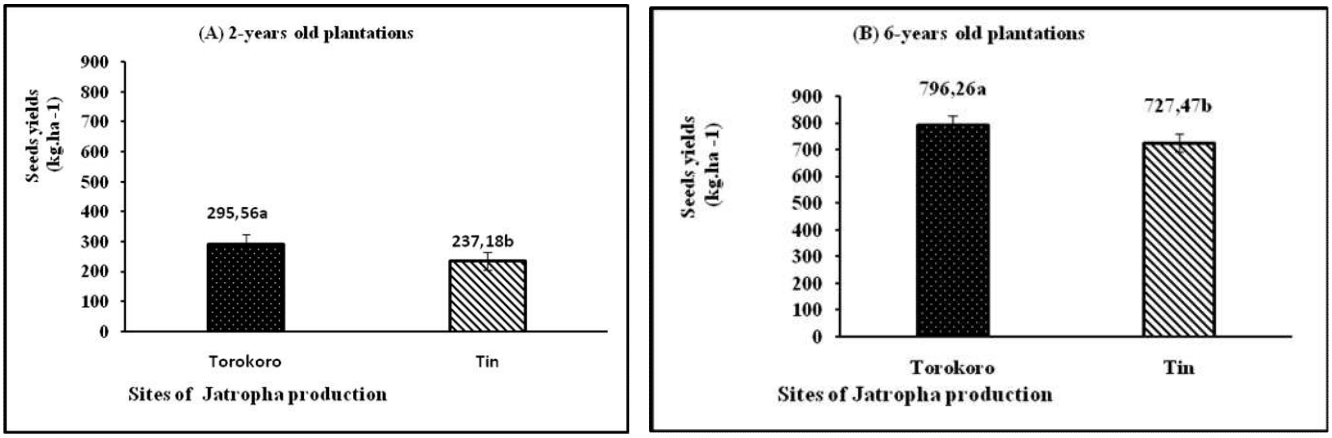

Figure 1. Average seed yield in 2-year (A) and 6-year (B) plantations

Table 2. Weight of 100 fruits, 100 seeds and seed filling rate

Sites / Age plantation	Weight 100 fruits (g)	Weight 100 seeds (g)	Filling rate (%)
Torokoro-2 years old	158	120	65
Tin-2 years old	137	90	62
Torokoro-6 years old	239	169	67
Tin-6 years old	204	132	64

The same trend is observed in 6-year-old plantations with an increase of 8% in the weight of 100 fruits and 100 seeds for Torokoro plants, compared to those of Tin plants.

DISCUSSION

Dendrometric parameters: The highest values observed for trunk and crown diameter, heights and number of branches in the Torokoro site compared to Tin plantations may be related to rainfall and soil type. Even if the plant is not demanding in nutrients, it ensures its growth thanks to the nutrients present in the soil. These results are in agreement with those of Yélémou *et al*. (2009), from Yelemou *et al*. (2013), and Ouédraogo (2015), who showed that the dendrometric parameters evolve with the nature of the soil. Older plants are mainly confronted with competition for space, in search of nutrients, but also for light which could justify their weak growth and development. The results obtained by Domergue and Pirot (2008), showed that Jatropha curcas is a shrub, reaching 5 to 8 m high. This competition for light and nutrients explains the interest of using Jatropha curcas as a hedge but also for its impact against erosion and the restoration of soil fertility (Brittaine *et al*., 2010; Reubens *et al*., 2010).

Seed production: Yields and seed fill rates vary from site to site. The study revealed that the yields obtained are located according to the sites and the age of the plantations, between 237.1 and 796.2 kg.ha-1. The disparity of yields is linked to rainfall and soil conditions, but also to the age of planting. These values are similar to those obtained in Senegal in the 5th year of production with 500 kg.ha-1 (Terren *et al*., 2013) and in Tanzania after the 6th year of production with 875 kg.ha-1 (Wahl *et al*. al., 2009). The yields of Jatropha pure culture do not exceed 500 kg.ha-1 in Senegal in the river valley (Terren *et al*., 2012), 300 kg.ha-1 in Burkina Faso, but up to 1250 kg.ha-1 in a situation of cultivation on fertile soils (Derra, 2014). In addition, this disparity in yields was highlighted by Ghinwal *et al*. (2005). While admitting the influence of the water factor on Jatropha plants, it seems logical to consider as Üllenberg (2008), Trabucco *et al*. (2010). Rajaona *et al*. (2011), that soils, a source of nutrients for plants, have a great influence on Jatropha productivity. According to Mergeai (2016), even when cultivated under favorable conditions with the application of large quantities of fertilizer, Jatropha produces less than what was announced by the promoters. J. curcas seed yield on marginal lands is very low in some parts of Africa (Achten *et al*., 2008 and Minengu. 2014).

Conclusion

In order to evaluate the dendrometric parameters and the seed production of Jatropha curcas, trials were set up on farms in the south-Sudanese zone of Burkina Faso. The study showed that the improvement of the dendrometric parameters is a function of the rainfall and the nature of the soil. In addition, the yields obtained are according to the sites and the age of the plantations. The productivity and the filling rate of the seeds are low, and show a great variability between the sites. Jatropha ensures its growth thanks to the nutrients present in the soil, even though it is not demanding in nutrients. This study deserves to be conducted under other pedoclimatic zones by associating other parameters such as litter,bedding production would help to understand the impact of Jatropha curcas in chemical soil fertility.

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