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RESEARCH PAPER

Factors determining the productivity of *Panicum maximum* C1 in Burkina Faso

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Abstract

The study was conducted for three months in 2011, in the agricultural research station of Niangoloko, located in the Western zone of Burkina follow the behaviour during all the year of Faso, to the fodder of Panicum maximum C1.The compared treatments correspond to the three periods (cold, hot and rainy).One put an experimental device, arranged well with possibilities of irrigation of Panicum maximum C1 following: Three (3) vats of 4m2 containing three argillaceous soil types (Clayey, Clay loam, Clay sandy); 2) 3 vats of 4 m2 containing three sandy soil undefined (Sandy, Sandy loam , Sandy clay); 3) 3 vats of 20 m2 panicum arranged for the tests of the NPK is 200 g, 300 g, 400 g; 4) 3 vats of 20 m2 Panicum maximum C1 arranged for the tests of hydrous gradient, 100 liters, 200 liters and 150 liters every three days. The climatic variations had an effect on the growth of the Panicum maximum C1. The evolution of tiller according to the periods shows a growth imports tiller for the periods heat and rainy. The growth of the Panicum maximum C1 is better on the grounds mixed Sandy clay 2,6 tillers/d or Sandy loam 2,4 tillers/d respectively. The test on the gradients of hydrous did not show significant difference between tiller from one period to another. On the other hand the gradient of manure shows significant differences with the threshold of 5%.The cuts of biomass operated between the periods show a difference with a superiority of the sandy grounds. Panicum maximum C1 is much more productive during the rainy season. The modification morphology is found in the course of time on the level of the species. At the stage tillering the proportion of sheet is important. The report breaks into leaf on stem is high and higher than on the sandy grounds. On the level as of soil types in fact especially the clay soils, Clay sandy and Sandy clay give much more grains is respectively 700 kg/ha of DM, 600 kgDM/ha and 500 kg/ha of Dry Matter (DM).

Keywords: Panicum maximum C1, growth of the plants, biomass, climatic effect, ground, pluviometry

Introduction

In many African countries such as Kenya, Senegal, Niger and Burkina Faso, millions of people live off livestock in cities and their outskirts (Lee-Smith et al., 1987; Ali et al., 2003; Samandoulgou, 2011). In these countries, feeding cattle is the major concern of pastoralists. Food is provided almost exclusively by natural pasture. However, in Burkina Faso, livestock is an important source of foreign exchange for Burkina Faso (MRAH, 2015). The share of animal products is 21% of the value of exports, the second largest item after cotton (MRAH, 2015). On the basis of the national survey on livestock numbers, carried out in 1989, the livestock population was estimated in 2015 at 8,982,153 cattle's, 9,209,641 sheep's, 13,691,422 goats, 2,328,551 pigs, 1,103,693 donkeys, 39,531 horses, 17,792 camels and 41,820,486 poultry (hens and guinea fowl). The annual growth rate is 2% for cattle, pigs, donkeys and camels, 3% for small ruminants and poultry, and 1% for horses (MRA, 2011).

Livestock farming is an activity practiced by almost all families in Burkina Faso. Certain ethnic groups such as the Fulani are more specialized in this activity and specifically on certain animal species (ruminants) than others.

Livestock activities are omnipresent in the production systems of Burkina Faso. However, the relative weight of animal production varies from one region to another depending on the diversity of agro-ecological and socio-economic conditions. In the different ecological zones of the country, livestock exerts increased pressure on natural resources causing degradation of the ecosystem and conflict situations between the different actors.

However, it should be noted that in Burkina Faso, the quantitative and qualitative insufficiency of food resources is probably one of the most important if not the most important bottleneck in the development of ruminant farming, especially over the long term.. One of the strategies is mastering the forage culture based on local and exotic species. This is why, improved forage crops have been introduced including the species *Andropogon gayanus, Cenchrus ciliaris, Mucuna* (*Mucuna* sp.), Cowpea (Lablab Niger), local cowpea and the dual-purpose cowpea (food and fodder) siratro, Stylosanthes, and *Panicum maximum* C1. Work on tropical forages has largely focused on determining the most productive species (Samandoulgou, 2010).

Panicum maximum C1 is originally a forest plant, the C1 variety of which is characterized by high productivity and good palatability (Picard, 1979, Adjolohoun et al,, 2012, 2013a). Burkina Faso has four major climatic zones with variable temperatures and precipitation: - a Sahelian zone with a semi-desert climate located north of the 14th parallel (400 to 600 mm of rain per year). - a sub-Sahelian zone with a dry tropical climate located north of the Mossi plateau between the 13th and the 14th parallel (an annual rainfall of 600 to 750 mm), - a North Sudanian zone covers the central region of the country between 11 ° 30 'and 134 ° North (750 and 1,000 mm) - a South Sudanese zone located south of 11 ° 30' north receives rainfall between 1,000 and 1,300 mm.

The experimentation which takes place in a station in Niangoloko helps to explain the factors influencing the productivity of the species under the conditions of Burkina Faso. It makes it possible to acquire knowledge on the factors of variations in the productivity of *Panicum maximum* C1.

Material and Method

Study site

The study was conducted at the Niangoloko experimental station. The town of Niangoloko is located in the western part of Burkina Faso, in the province of Comoé, Cascades region. It is 500 km from Ouagadougou the political capital, 132 km from Bobo-Dioulasso the economic capital and 47 km from Banfora, its capital of the provinces and the region. The main activity practiced by 59% of household heads is agriculture associated with livestock. The vegetation is typical of the Sudano-Guinean zone. It is a savannah populated by trees and shrubs. Due to its location, the town is influenced by the tropical climate of the South Sudanese type marked by the alternation of 2 seasons: a rainy season (May - November) and a dry season (December - April). The average rainfall is 1100 mm / year. The average temperature varies little during the year: The maximum of the monthly average is 31 ° C in March and April and the minimum is 25 ° C in August and 26 ° C in December-January.

Experimental apparatus

This study concerns the evaluation of the production of *Panicum maximum* C1 as a function of soil types, the dose of NPK fertilizer and the water gradient. The study was conducted for three (03) periods of the year. These are the cold dry season (October-January), hot dry season (February-May) and rainy season (June-September). The experiments were carried out in experimental devices protected from pests and livestock with irrigation possibilities. Three types of effects on the production of *Panicum maximum* C1 were studied: type of soil, Nitrogen, Phosphorus and Potassium (NPK) fertilization and amount of water.

Effects of soil type

The production of P. *maximum* C1 according to the types of soil was studied in 12 tanks built 4m² each (2m X 2m). In each tank, six (6) feet were planted with 2 strands of P. maximum C1 at a spacing of 30 cm by 30 cm between the plants and the lines respectively. The tanks received a single dose of 100 kg / ha of Nitrogen14%, Phosphorus 15% and Potassium 14 % (NPK) two (2) weeks after transplanting.

Three types of predominantly clay and sandy soils each were used for the study in tubs of 4 m² each (2 m × 2 m):

- The predominantly clayey soils are: 100% clay soil, clay-loam soil (75% and 25%), clay-sandy soil (75% and 25%);
- The predominantly sandy soils are: 100% sandy soil, sandy loam soil (75% and 25%), sandy clay soil (75% and 25%)

Effects of NPK fertilization

The production of P. maximum C1 as a function of the dose of NPK was tested in 3 rectangular tanks of 20 m² each (10 m × 2 m). Each tank is filled with clay-sandy soil, comprising 20 feet of 2 strands of P. maximum C1 at a spacing of 30 cm by 30 cm lines and feet. The applied NPK rates are as follows: 100 kg / ha (tank I), 150 kg / ha (tank II) and 300 kg / ha (tank III). The fertilizer was applied 2 weeks after transplanting.

Effects of the amount of water

The production of P. maximum C1 as a function of the water gradient was tested in 3 tanks of 20 m² each (10 m × 2 m). Each tank is filled with clay-sandy soil, comprising 20 feet of 2 strands. The plants received a single dose of 100 kg / ha of NPK two (2) weeks after transplanting. The different tanks received different quantities of water at a frequency of three days: 100 liters for tank I, 150 liters for tank II and 200 liters for tank III.

Parameters evaluated

- Phenology

  Phenology monitoring was carried out on 5 feet of Panicum maximum C1 chosen randomly from each tank (clay soil and sandy soil). Each individual chosen is marked by a numbered stake. Observations are made every 7 days during each period of cold dry season (October-January), hot dry season (February-May) and rainy season (June-September). They relate to the appearance of the different stages (emergence, tillering, climbing, heading, and flowering).The observations of phenology were coupled with measurements of the height and the counting of the tillers.

- Biomass

  The full cut method was applied for the evaluation of the biomass of Panicum maximum C1. It is a reliable method thanks to its simplicity and precision (Fournier and Lamotte, 1983). The cuts were made 10 centimeters from the ground in three periods of the year, the cold dry season (October-January), the hot dry season (February-May) and the rainy season (June-September). The height of cut practiced is recommended to allow good development of tufts after cutting. A teach cut a biomass sample of Panicum maximum C1 is taken for the determination of dry matter After oven dried at 80 ° C for 48 hours. To follow the height and the counting of the tillers 5 tufts are chosen at randomly. Each individual is marked with a numbered stake and observations are made every 7 days.

- Seed production assessment

  Seed production was assessed at the level of the test for the influence of soil types on the production of Panicum maximum C1. The seeds from each bin were collected. The maturation and the fall of the seeds are out varied inside the same panicle, so that it is impossible to determine a harvest date. To recover as much seeds as possible, the inflorescences should be wrapped before ripening in inverted nylon bags (rice or fertilizer bags). The seeds are collected in the bags at the end of the dissemination period. This technique achieves germination of around 90% for var. C1.

Data processing and statistical analysis

The data collected were entered in the Excel version 2010 spread sheet. The analysis of this data was carried out using R software (R-Development-core-team, 2013). Analysis of Varians (ANOVA) was applied. Bartlett's test or that of Student Newman and Keuls at the 5% threshold was used for the separation of variances when the analysis revealed a difference between the means. Furthermore, when necessary, the Bonferronni method was used for the correction of probabilities as recommended in the event of repeated tests (Rice, 1989). The graphs and tables have been plotted using the Excel version 2010 spread sheet.

Results

Influence of soil types on phenology

In general, Panicum maximum C1 is planted at tillering stage with an average height of 40 cm. During the cold dry season, hot dry season and rainy season there is a longer tillering time on sandy soils compared to clay soils.
The rise stage is long on clay soils, this phenomenon can be observed in all seasons (cold, hot and rainy). By cons in rainy period this stage is well developed especially on clay soils. Comprehensive phenology monitoring was continued on sandy and clay soils during the rainy season.

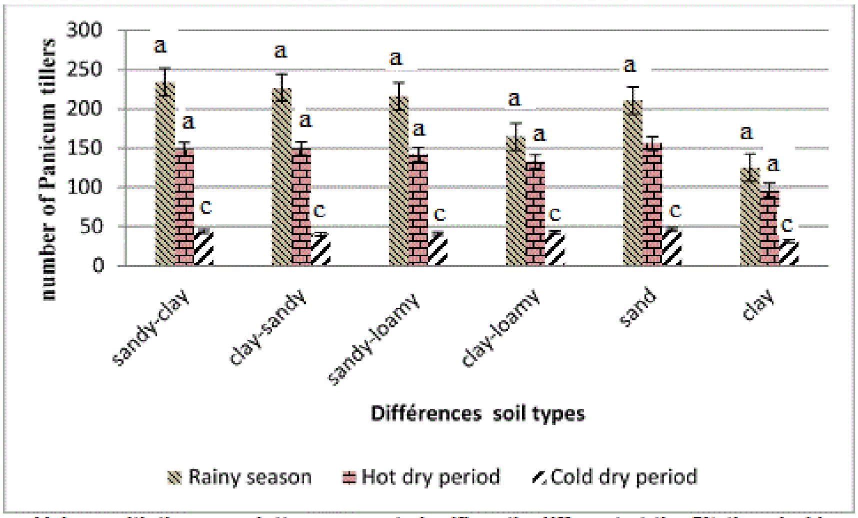
Influence of production factors on tillering of P. maximum C1.

Effect of season and soil

On all soil types, there were no significant differences in the production of number of tillers between the rainy season and the hot dry season (Figure 1). The rainy season (June-September) and hot dry season (February-May) were more productive in tiller numbers than the cold dry season (October-January). There was no significant difference observed at the 5% threshold between the rainy season and hot dry season periods for the number of tillers irrespective of the soil types.

Considering the type of substrate, sandy soil seems to be more favourable check the spelling for tillering of Panicum maximum C1 than clay soil. In fact, during the hot dry season the number of tillers on clay soil is 1.65 times lower than that on sandy soil.

Similarly in the rainy season, the difference in the number of tillers on clay soil and on sandy soil is 85 tillers per tuft. In general, tillering of Panicum maximum C1 is higher on mixed sandy-clay, sandy-loamy soils. The species tends best in rainy periods and in hot dry seasons. The cold period does not seem conducive to the production of Panicum maximum C1.



Values with the same letter were not significantly different at the 5% threshold

Figure 1: Average number of tillers per clump of Panicum maximum C1 depending on the period and type of soil

Effect of season and amount of water

The results on the production of Panicum maximum C1 as a function of the amount of water is given in Figure 2. The production of tiller was highest during the rainy season followed by the hot dry season. Cold- dry. Season recorded the lowest value. During the rainy and cold periods, the number of tillers was not significantly influenced by the amount of water supplied by watering. On the other hand, in hot dry periods, the supply of water at the rate of 150 liters / week seems to induce better production of tillers compared to the 100 liters / week and 200 liters / week.

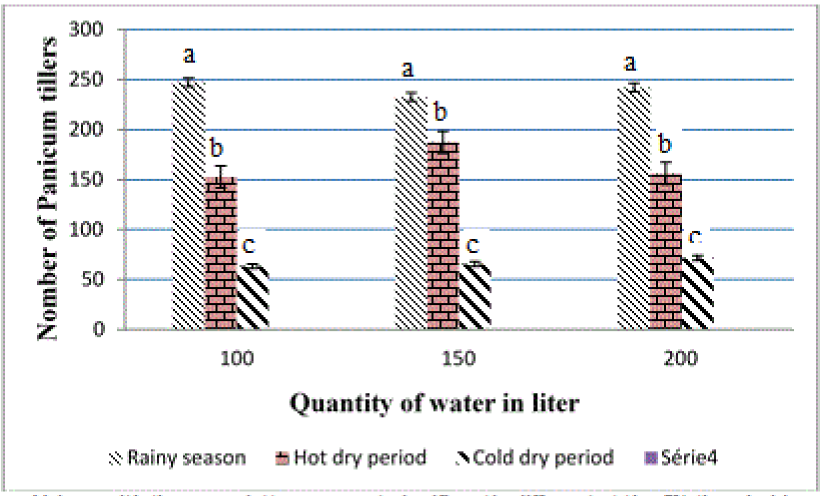


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Figure 2: Average number of tillers according to the periods and the amount of water (in liters) supplied per week

Effect of mineral fertilization

The application of 150 kg / ha of NPK induced a significantly higher number of tillers ($P < 0.05$) than to that of 100 kg / ha and 300 kg / ha of NPK during the rainy and hot periods. No significant difference was observed in the number of tillers beyond the 150 kg / ha level. A dose of 300 kg / ha of NPK has been led to a depressive effect on the tillering capacity of Panicum maximum C1. The dose of 150 kg / ha of NPK then seems to be the optimal dose for the production of Panicum maximum C1. The effect of the quantity of NPK per hectare on the number of tillers is different for the periods (hot rainy). Irrespective of the amount of fertilizer dose, the number of tillers is not significant in the cold period. However, whatever the quantity of NPK, the number of tillers is higher in the rainy period followed by the hot dry period and lowest finally in the cold dry period (Figure 3).

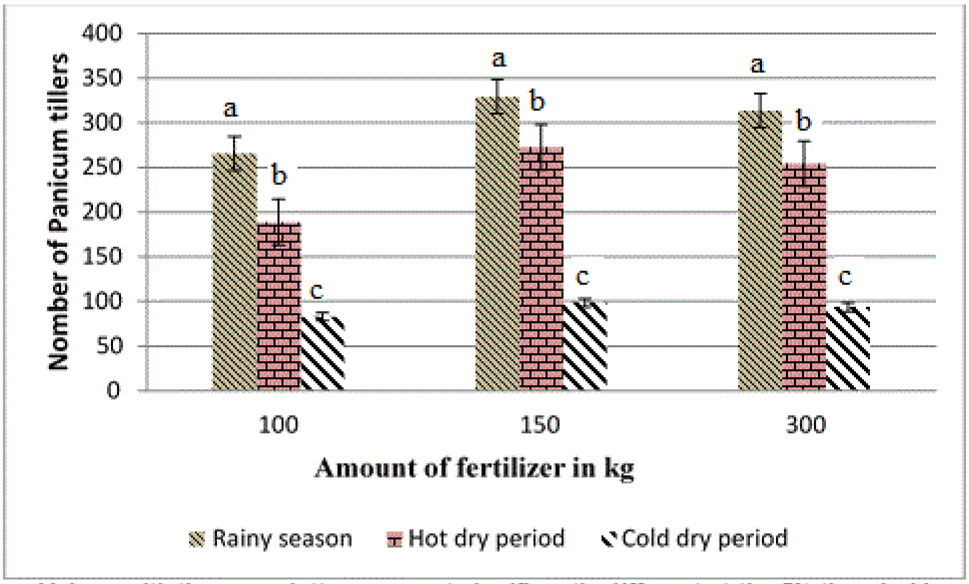

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Figure 3: Number of tillers according to the periods and the quantity of NPK

Influence of production factors on height growth of P. maximum C1

Effect of soil types

Observations reveals that height increase is important during rainy periods than during the in two periods of the dry season i.e. (cold and hot). There is no significant difference at the 5% threshold between the hot and cold periods regardless to the type of soil. However, the heights are higher in mixed soils compared to simple soils (clay and sandy). In general, the growth of Panicum maximum C1 is better in mixed sandy-clay or sandy-loamy soils. Height increase is significantly higher at the threshold of 5% in the rainy season than in the cold and hot periods of the dry season (Figure 4).

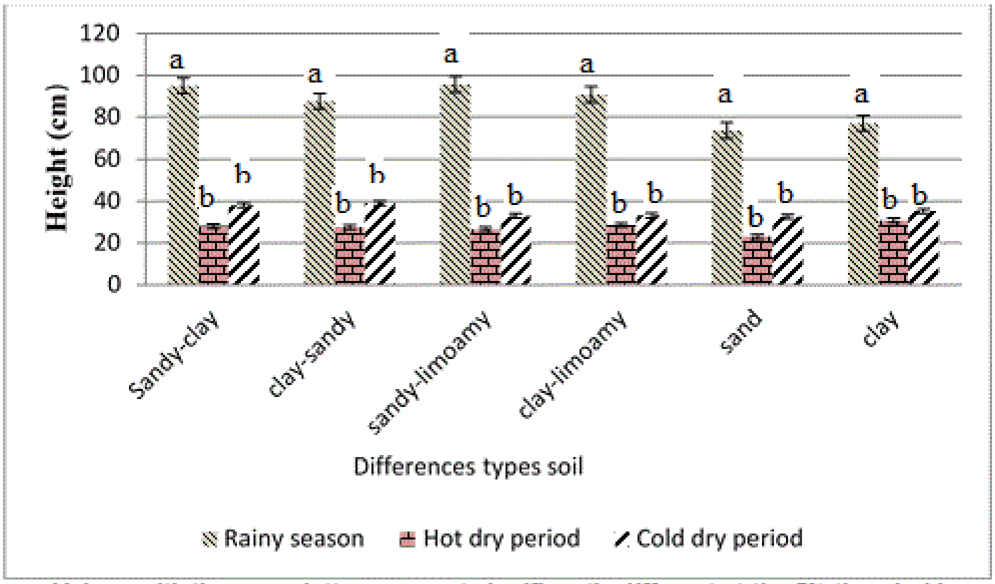

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Figure 4: Maximum P. height as a function of seasons and soil types

Effect of the amount of water on height increase

The increase in height of Panicum maximum C1 was inversely proportional to the amount of water supplied per week. The minimum water intake (100 liters / week) induces the best height increase in any season. The cold dry season had the lowest height increase regardless of water supply. Whatever the amount of water there is no significant difference at the 5% threshold between the rainy and hot period. A significant difference at the 5% threshold was observed between the cold period and the two periods (rainy and hot). The best growth was recorded in the rainy season and in the hot- dry season (Figure 5).

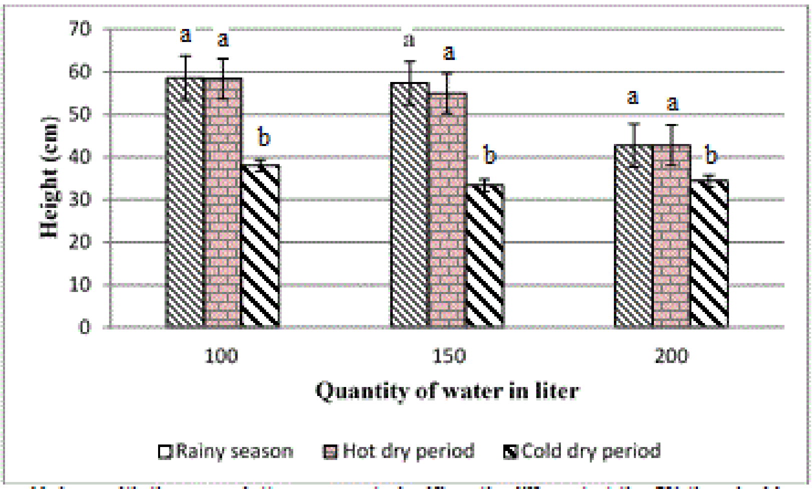

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Figure 5: Increase in height of Panicum maximum C1 depending on the periods and the amount of water (in liters) supplied per week

Effect of fertilizer doses on height increase of Panicum maximum C1

The cold dry season had the lowest Panicum maximum C1 height increase regardless of the fertilizer dose. In the rainy season, the maximum NPK rate (300 kg / ha) induced the best height increase. During the same period, the two NPK fertilization levels (100 kg / ha and 150 kg / ha) did not significantly influence height growth (Figure 6).

In the hot dry season, the minimum NPK application (100 kg / ha) induced the best height growth compared to the other two doses (150 kg / ha and 300 kg / ha).

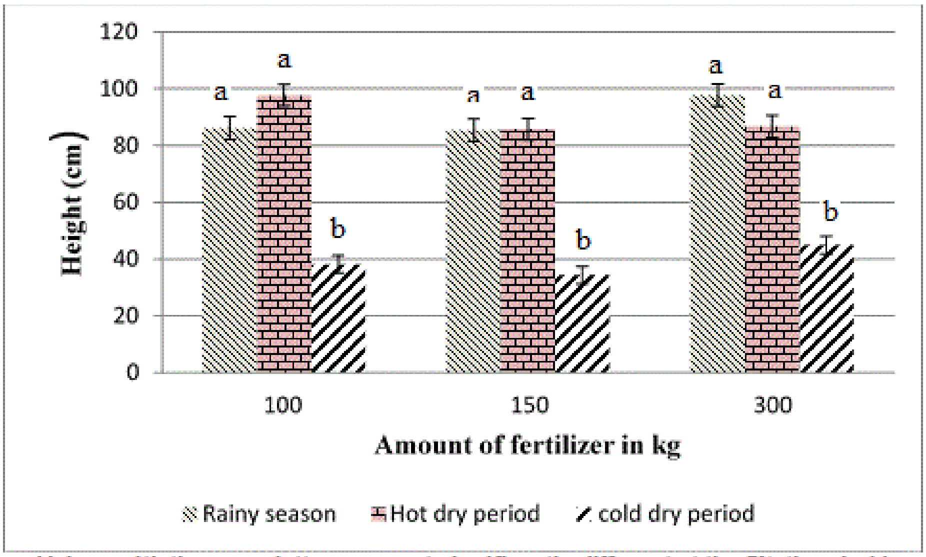

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Figure 6: Influence of the fertilizer dose on the height growth of P. maximum C1 according to the seasons

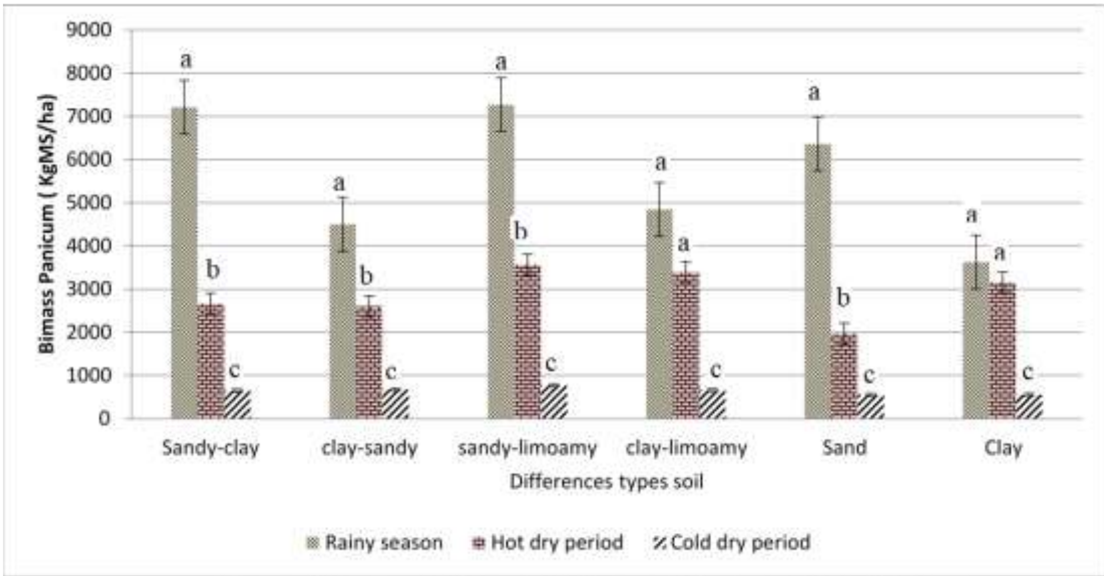
Influence of production factors on the biomass of P. maximum C1

Effect of soil types

The cold- dry season is the least productive period with biomass between 556 kg DM / ha and 700 kg DM/ ha depending on soil types. Biomass production is higher in the rainy season than in the hot and cold- dry season regardless of the soil type (Figure 7).

Sandy, sandy-silty and sandy-clay soils are the soils on which the production of biomass is the highest with values which vary between 6327 and 7227 kg / ha of DM in the rainy season. For the other soil types, at the same time of the year, the biomass produced varies between 3627 and 4847 kg / ha DM.

Depending on the period, significant differences at the 5% threshold are observed between the biomass of the different types of sandy soil. In clay and clay-loam soils, this difference is not significant between the rainy and hot period.

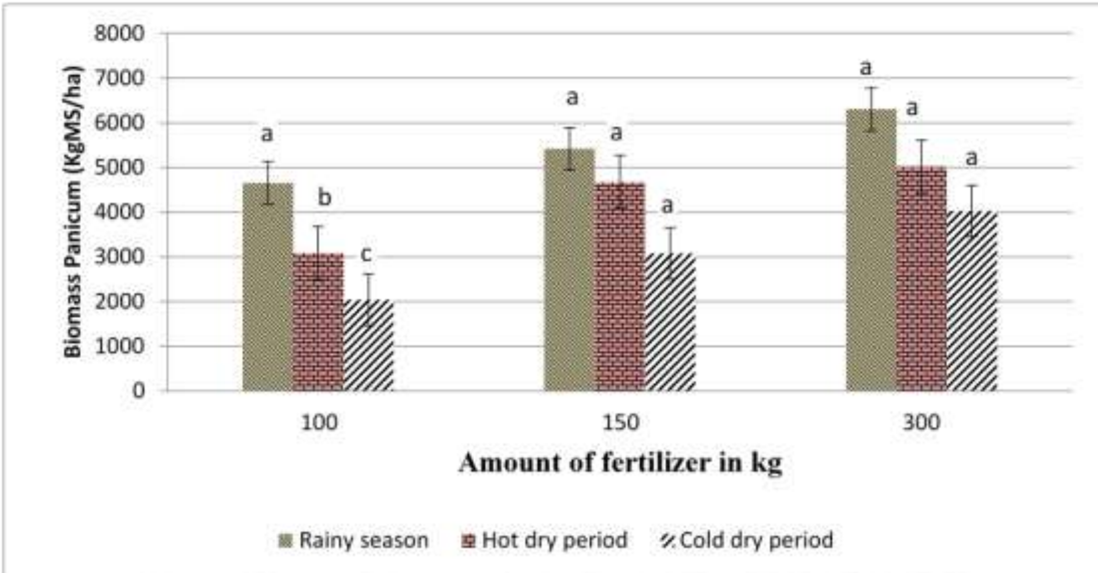


Values with the same letter were not significantly different at the 5% threshold

Figure 7: Biomass production of Panicum maximum C1 as a function of time of year and type of soil

Effect of fertilizer supply on biomass production

The fertilizer treatments did not significantly to influence at the 5% Panicum maximum C1 of biomass threshold during the rainy season. The 150 kg / ha and 300 kg / ha doses of NPK induced greater biomass than the 100 kg / ha dose during all three study periods. The doubling of the NPK dose from 150 kg to 300 kg had no significant effect on the biomass of Panicum maximum C1 irrespective to the season (Figure 8)



Values with the same letter were not significantly different at the 5% threshold

Figure 8: Biomass production as a function of the quantity of NPK supplied according to the time of year

Effect of different types of soil on the biomass of different organs of P. maximum C1

Whatever the type of soil, the biomass production of Panicum leaves is greater than that of stems and inflorescences (Table 1). The leaf biomass on sandy soil reaches around 3 tonnes DM / ha and is significantly higher than that of other types of soil at the 5% threshold. There is no significant difference (at the 5% threshold) between the production of biomass from clayey, clayey-sandy, clayey-silty and sandy-silty soils. However, the production in leaf biomass of these latter types of soils is statistically higher than that of sandy-clay soil.

For stem biomass, the production of clay soil is significantly higher than that of other types of soils (at the 5% threshold). And the lowest production is observed on sandy soils with 512 kgMS / ha. As for the biomass of the inflorescences, the sandy, sandy-clayey and sandy-silty soil types have a statistically lower production (at the threshold of 5%) than soils with a clayey tendency. For the production of this organ, clay-sandy and clay-loam soils do not show any significant difference at the 5% threshold.

The leaf to stem ratio (F / T) is high and greater than 1. The F / T ratio is greater on sandy soils (5.72) than on clay soils (3.14), a reduction of more than 55%.

Table 1: Organ biomass according to soil type (kgMS / ha)

	organ biomass			
Type of soil	Leaves	Rods	inflorescence	Stem / leaf ratio
Sandy	2928^{a}	512^{c}	100^{c}	5,72^{a}
sandy-clay	2204^{c}	674^{b}	120^{c}	3,27^{c}
sandy-silty	2500^{b}	520^{c}	110^{c}	4,81^{a}
Clay	2546^{b}	810^{a}	150^{b}	3,15^{c}
Sandy clay	2520^{b}	584^{bc}	170^{a}	4,39^{b}
clay loam	2658^{b}	606^{bc}	180^{a}	4,32^{b}

Values with the same letter are not significantly different at the 5% threshold

Panicum seed production

The quantity of seeds varies according to the types of soil (Figure 9). The clay soil with 751 kg / ha gives grain yields significantly higher than other types of soils. It is followed by clay, sandy and sandy clay, soils with a production of 640 kg / ha of DM and 596 kg / ha of DM respectively.

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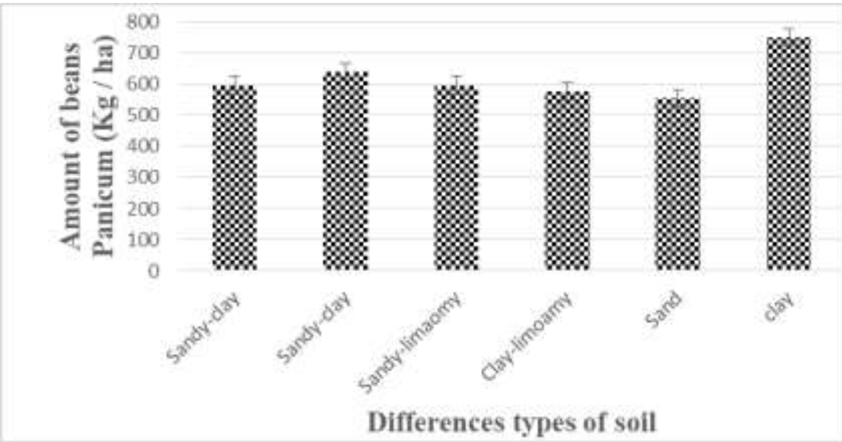

Figure 9: Amount of grain produced according to soil type

Discussion

The results obtained show that the average number of tillers is lower in the cold- dry season compared to the rainy seasons and hot- dry season. The number of tillers is higher on sandy soil than on clay soil. Our results corroborate with those obtained by and Sana et al (2012) on Panicum maximum C1 and that of Sawadogo (1990) on Panicum anabaptistum at the experimental research station of Gampéla. The results of this last author show a weak tillering on clay soil 47.65 tillers and 23 tillers in rainy period respectively. The number of tillers seems to be largely related to the amount of water for the year. In fact, according to the water gradient (100 l / week, 150 l / week and 200 l / week) and the periods of the year (cold-- dry season, hot-- dry season and rainy season) we observed a variation in the number tillers. Sana (2015) observed a decrease in the number of tillers due to the low rainfall. The biomass production capacity of *Panicum maximum* C1 varies according to periods and soils. The best biomass productivity was obtained on sandy-loamy and sandy-clay soils, the maximum values were 7 t / ha DM and 10 t / ha DM, especially during the rainy season.

Similarly, Pernes et al. (1975) and Mandret et al., 1990, found, in the rainiest zone, a yield of 15 tonnes of DM / ha / year in rain fed and unfertilized crops and in Côte d'Ivoire. The maximum level of nitrogen fertilization experimented for the cultivation of *Andropogon gayanus* by certain authors (Kone and Groot, 1996; Traore et al., 1996; Buldgen1997, Adjolohoun et al., 2008) was 300 nitrogen units of nitrogen / ha. We used doses (100 units of nitrogen / ha, 150 units of nitrogen / ha and 300 units of nitrogen / ha depending on the periods (cold, hot and rainy). The biomass production of *Panicum maximum* C1 increases depending on the quantity of Vlavonou fertilizer, 2008. However, for the fertilizer dose it is useless to apply a dose higher than 150 kg / ha. The maximum biomasses were obtained in the rainy season at the level of the different rates 100 kg / ha, 150 kg / ha and 300 kg / ha are 4.02 t / ha DM, 5.09 t / ha DM and 6.03 t / ha DM respectively, These data are lower than those obtained (Buldgen and Dieng, 1997, Adjolohoun et al., 2008, Adjolohoun et al., 2013) for a cut at the end of the cycle and with a nitrogen fertilization level of 80 units of nitrogen / ha. Our results are also lower than the 8.57 tMS / ha obtained by the same authors for a 30-day cut and with an even higher nitrogen fertilizer dose of 100 nitrogen units / ha. Other authors ((Buldgen, 1997; Traore, 1998, Michiels, 2000, Buldgen et al., 2001) obtained with *Andropogon gayanus* additional production gains of 77 and 62 kg DM / kg of nitrogen used by applying a very high level of manure of 300 kg of nitrogen / ha. They all show that an addition of nitrogen manure to the forage crop of *Andropogon gayanus* very appreciably increases its yield in DM. All the results concerning the production dry matter content of *Brachiaria mutica* for the three seasons studied shows that the productivity of *Brachiaria mutica* is considerably slowed down in the cold dry season.

Conversely, it is maximum in the rainy season. Thus, for the nitrogen level, it will take 80 days to obtain 900 kg / ha of DM in the cold- dry season, against 55 days in the hot- dry season and 14 days in the Rainy season (Mandet et al, 1990). The same results were found at the level of Panicum maximum C1. The authors (Obulbiga et al., 2007; Pamo et al., 2008; Tendonkeng et al., 2011) emphasized that the effectiveness of this positive response of the species to manure is closely linked all rain fed and their climatic conditions , the spatio-temporal distribution of rains. Indeed our results confirm a significant production of the rainy period compared to the other two periods (cold and hot). Since nitrogen is the main for limiting plant growth and production (Morot-Gaudry, 1997) above 200 kg N / ha, becomes toxic to the plant. A study conducted by Kiema et al., 2012 on the management of forage stocks in the Sahel shows that the cold and hot seasons are those during which the stored fodder is used most. It shows that 83.7% of grasses are used in the hot- dry season against 42.9% for stocks of woody fodder. The haulms are mainly used in cold and hot periods at more than 8.8% and 61.8% respectively.

We observe a formation of organs (leaves, stems) with the evolution of plants of *Panicum maximum* C1. Indeed, the observation of the evolution of the biomass (leaves, stems) as a function of soil types shows a significant production of the biomass sandy in soils compared to clayey soils, i.e. 2,910 kg / ha DM and 2,500 kg / ha of MS. Minson (2012) reports that the proportion of leaves in the whole plant varies enormously, ranging from 72% for a 28-day regrowth of *Chloris gayana*, to 9% of leaf blade in *Panicum maximum* C1 of 105 days. During the evolution of the plant, there is a modification of the morphological composition at the level of Panicum maximum C1 in particular of the leaf / stem ratio obtained on two tropical grasses (*Panicum maximum* C1 and *Chloris gayana*). The work of Laredo and Minson (1973), Sana, (1991) also highlights a difference in the composition of the organs.

Boyer and Roberge (1985), Sana, (1991) observed that lleaf / stem ratio varying from 2.40 to 4.4 for 4 week regrowth and from 2 to 3 for 8 week regrowth. Similar results were observed on sandy and sandy- loam soils of 5.72 and 4.81 respectively.

The production of P. *maximum* C1 seeds varies depending on the soil and the time of year. Indeed it is especially during the rainy season that Panicum maximum C1 produces more seeds. The grain yield is important on clay soils, ie 700 kg / ha. The low seed production on sandy soils is due to a strong tendency to produce new tillers and especially sterile tillers. The work carried out in Côte d'Ivoire by Noirot et al. (1986), Noirot, 1992, Noirot and Ollitrault, 1996, Mandret and Noirot, 1999, give a quantity of 300 kg / ha.

Conclusion

The growth of tillers was greater during the rainy and hot-dry periods than during the cold -dry periods. The water gradient of 100 liters / week has induced significant growth of tillers during hot and rainy periods.

The greatest biomass of P. *maximum* C1 was obtained on mixed soil with a sandy component and in the rainy period. Thus, the biomass during the same period was 1.8 times higher on these types of soil than on clay soil. On clay soil, the species' biomass was significantly higher in the rainy period than in the hot dry period. The lowest biomass was collected during the cold- dry period. The effect of soils and times of the year on tiller growth is comparable to that of the species' biomass production. From the point of view of dry matter production, nitrogen fertilization and the period of exploitation greatly influenced the dry matter production of Panicum maximum C1.

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