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Influence of nitrogen fertilization on the chemical composition of Paspalum plicatulum at differents phenological stages in the central plateau of Fouta-Djallon

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Abstract

The direct and residual effect of different levels of nitrogen fertilization on the chemical composition of *Paspalum plicatulum* at different phenological stages was conducted at the Bareng Agronomic Research Center in the Central Plateau of Fouta-Djallon between May 2014 and December 2015. A factorial design comparing six nitrogen doses (0 ; 50 ; 100 ; 150 ; 200 and 250 kg N/ha) combined with three phenological stages (bolting, flowering and after seedling) on plots of 8 m² (4 m x 2 m) in four replicates, for a total of 72 experimental plots was used. In the second year, no fertilization was done. A representative sample of 500 g of *P. plicatulum* whole plants was collected on each plot, separated into stems and leaves, and then dried at 60 °C for the chemical composition evaluation. The results of this study showed that nitrogen fertilization influenced variably the chemical composition of *P. plicatulum* regardless of the phenological stage and the cutting year. In fact, crude protein, Ash, digestible organic matter, digestible nitrogenous matter and metabolizable energy increased significantly ($p<0.05$) with the direct and residual effect of nitrogen fertilization up to the optimum dose of 200 kg N/ha. However, dry matter and crude fiber contents of the plant were not significantly influenced by nitrogen fertilization irrespective of the phenological stage during the two years of cutting.

Keywords: chemical composition, nitrogen fertilization, *Paspalum plicatulum*, phenological stages

1. Introduction

The nutritional deficit remains one of the main factors leading to the low level of productivity of ruminants in the humid tropical zone of the African continent (Tendonkeng et al., 2011, Musco et al., 2016). In this area, grassland dominated by C4 grasses is the main source of animal nutrition (Musco et al., 2016, Kambale et al., 2018). These grasses are of good nutritional value only at the beginning of the rainy season, and this value deteriorates as they age with the season (Tendonkeng et al., 2011, Klein et al., 2014).

Moreover, in these areas, the demographic pressure on arable lands formerly exploited as rangeland makes it difficult or even impossible to use the traditional mode of animal management characterized by rambling (Musco et al., 2016). As a result, livestock are virtually devoid of overgrazed marginal rangelands or crop residues for food (Obulbiga and Kaboré Zoungrana 2007, Tendonkeng et al., 2011). The permanent conflict between farmers and herders pushes them to look for alternative solutions to overcome both qualitative and quantitative deficiencies in fodder (Zogang-Fogang et al., 2013, Musco et al., 2016, Kambale et al., 2018). An improvement in animal productivity requires a better control of production systems through the intensification of forage crops (Tendonkeng et al., 2011).

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However, without fertilization, any form of fodder crop exploitation leads to a decrease in the stock of soil nutrients in general and nitrogen in particular (Obulbiga and Kaboré Zoungrana 2007). Thus, good management of forage crops requires not only the mastery of agronomic techniques, knowledge of the needs of the plant in order to ensure a better nutritional value but also a better knowledge of the evolution of it with respect to different phenological stages (Tendonkeng et al., 2011, Kambale et al., 2018).

Various studies have shown that nitrogen fertilization contributes to the improvement of the nitrogen and macro-mineral content of forage grasses (Obulbiga and Koboré-Zoungrana 2007, Meschy 2010 and Tendonkeng et al 2011). While some work has been done elsewhere on the effect of nitrogen fertilization on the chemical composition of some grass species (*Brachiaria ruziziensis* in Cameroon and *Adropogon gayanus* in Burkina Faso), no studies have yet been conducted on the effect of mineral nitrogen fertilization in the form of NPK (17-17-17) on the chemical composition of *Paspalum plicatulum* in the Central Plateau of Fouta-Djallon in Guinea.

The present study proposes to contribute to the improvement of the nutritive value of fodder through the nitrogen fertilization in the form of NPK (17-17-17) reasoned on the chemical composition of *Paspalum plicatulum* in the Central Plateau of Fouta-Djallon in Guinea.

2. Material and Methods

2.1. Study area

The study was carried out at the agronomic research station of Bareng in the Central Plateau of Fouta Djallon, located between 12° 70'and 12° 04' West longitude and between 10° 55' and 11° 68' North latitude with an average altitude of 925m. This work was conducted from May 2014 to January 2015. The original vegetation of this region is that of a grassy savannah and wooded in places. The rainfall varies between 1600 and 2000 mm per year. The climate of this region is characterized by a rainy season extending from May to November, followed by a cold dry season from December to February and a hot dry season from March to April. March is hottest and records a maximum temperature of 30° C. The months of December and January are very cold with a minimum of 7° C. The soil of the study zone is of ferralitic type under anthropic pressure through food crops and vegetables in all seasons (Cruz et al., 2011).

2.2. Experimental Design

A factorial design comparing six doses of nitrogen fertilizer (0; 50; 100; 150; 200 and 250 kg N/ha) in the form of NPK (17-17-17) and three phenological stages (bolting, flowering and after seed set) on plots of 8 m² (4 x 2 m, spaced 0.5 m apart) in four replicates, for a total of 72 experimental plots was used. Soil samples (n = 5) were collected from the experimental site in the 0-20 cm horizon before soil preparation and plantation of stump fragments. The soil analysis was carried out at the Laboratory of the Training and Research Unit for Soil Analysis and Environmental Chemistry (UFRASCE) of the University of Dschang following the method describe by Pauwel et al. (1992). This analysis shows that this soil is very acidic sandy-loam (pH<5) with medium porosity. It is poor in major nutrients assimilable (0.13% for nitrogen, 0.53 meq / 100g for potassium and 8.3% for phosphorus) and organic matter (2.53%). This soil requires a fertilizer supplement for intensive forage production. The average organic carbon content (2.53%). The value of the C/N ratio > 20 indicates that the mineralization is blocked or momentarily blocked (Sys et al., 1991). The exchangeable base content was moderate (7.30 meq / 100g). According to Beernart and Bitondo (1992), the Cation Exchange Capacity of 11.5 would be described as low (<20 meq / 100 g). These observations show that this soil cannot retain the ions for the nutrition of the plants, proper characteristics of the oxisols. An improvement of the CEC so that any widespread fertilizer is retained to be made available to the plants is therefore necessary (Tendonkeng et al., 2011).

2.3. Soil Preparation, Plantation of Plants and Fertilization

The experimental site was plowed with a tractor and plantation of the plots was done manually. The previous cultural site prior to the implementation of the trial was a fallow of 5 years after two successive years of fonio (*Digitaria exilis* Stapf). The same amount (80g) of phosphate fertilizer in the form of single superphosphate was applied per plot (including controls) as a bottom fertilizer. Young plant of *P. plicatulum* wsere removed from the fodder base of the Bareng Agricultural Research Station (Fouta Djallon Central Plateau). One month after planting, a control cut was made at 20 cm above the soil and the plots fertilized once at different fertilizer doses.

The maintenance of the plots consisted of the manual removal of the weeds and the cleaning of the alleys between the different blocks and parcels.

2.4. Data Collection

For each level of fertilization, a representative sample of 500 g of whole plants was taken from the plots. These plants were separated into leaves and stems and then dried in a Gallenkamp ventilated oven at 60 °C to constant weight. Then, they were crushed using a hammer mill with 1 mm mesh and stored at room temperature in plastic bags before chemical analysis.

2.5. Evaluation of the chemical composition

The dry matter (DM), crude fiber (CF), Ash and crude protein (CP) contents were determined according to the methods described by AOAC (1990). The organic matter (OM) was determined by difference of Ash to 100 g of dry matter (DM).The contents of digestible nitrogenous matter (DNM) and metabolizable energy (ME) were obtained by the following equations:

- DNM (en g/kg OM) = 0.917CP (en g/kg OM) – 0.0055CF (en g/kg OM) – 17.6 with R=0.998) (Jarrige, 1980).
- ME (kcal/kg OM) = DOM (%) x 0.15 (Guérin et al., 1989 cités par Zirmi-Zembri et Kadi, 2016).

2.6. Statistical analysis

The chemical composition data were subjected to one-way analysis of variance (fertilization levels) using the General Linear Model (MLG) using SPSS software version 23.0. When differences existed between different treatments, the means were separated by Duncan test at 5% significance level (Steel and Torrie, 1980). The year-by-year comparison of data was done using Student's « t » test.

3. Results

3.1. Influence of fertilization on the chemical composition of *Paspalum plicatulum* at bolting

In the first year of cutting, the organic matter (OM) content in plants cut on unfertilized plots and that of plots fertilized at 100, 150, 200 and 250 kg N/ha were comparable ($p > 0, 05$), but above that of plots fertilized at 50 kg N/ha (Table 1). The highest ($p < 0.05$) Ash content was obtained on plots fertilized at doses of 50, 100 and 250 kg N/ha, which were otherwise comparable ($p > 0.05$). The levels of DM and CF were not influenced ($p > 0.05$) by the direct effect of fertilization. Nutrient levels (digestible organic matter, digestible nitrogenous matter, metabolizable energy) increased ($p < 0.05$) with the level of nitrogen fertilization up to the 200 kg N/ha level before decreasing to 250 kg N/ha.

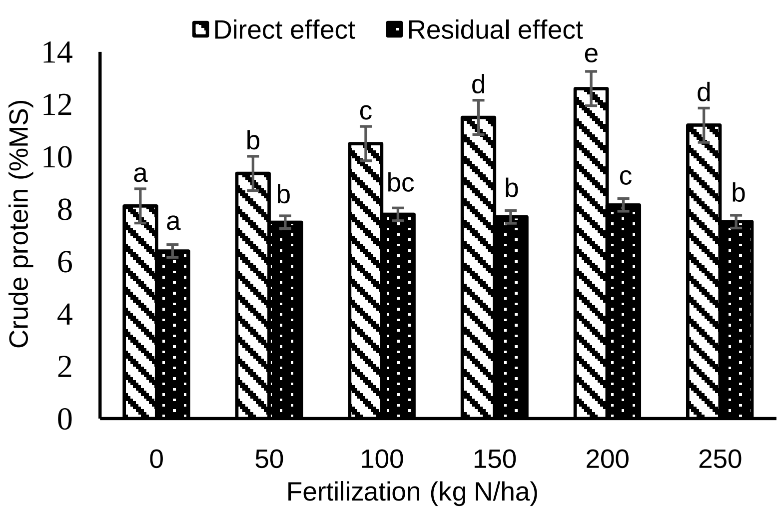
In the second year of cutting, the Ash, OM and CF contents varied in a saw tooth pattern. The highest Ash and crude fiber (CF) values ($p < 0.05$) were obtained in the cut plants on the plots with the residual effects of nitrogen fertilization at a dose of 250 kg N/ha. That of OM was obtained in the plots produced having been fertilized at a dose of 50 kg N/ha. The Ash content of the mowed plants on the 200 and 250 kg N/ha plots were comparable ($p > 0.05$) and higher ($p < 0.05$) than those obtained from the other fertilizer levels. The CF content of *P. plicatulum* plants increased with the level of fertilization. Thus, mowed plants at the 200 and 250 kg N/ha fertilizer rates had the highest levels ($p < 0.05$) in CB compared to other N fertilizer levels (Table 1).

Table 1. Direct and residual effect of nitrogen fertilization in form of NPK (17-17-17) on the chemical composition of *Paspalum plicatulum* at bolting

Fertilization (kg N/ha)		Chemical composition						
		DM (%)	Ash (%MS)	OM (%MS)	CF (%MS)	DOM (%MS)	DNM (g/kgMS)	ME (kcal/kgMS)
2014	0	89,20[a]	11,36[a]	88,63[b]	27,60[a]	55,46[a]	68,00[a]	1786[a]
	50	89,07[a]	12,23[b]	87,76[a]	27,96[a]	58,06[b]	77,45[b]	1872[b]
	100	89,19[a]	11,16[ba]	88,83[b]	28,53[a]	60,81[c]	88,43[c]	1963[c]
	150	88,88[a]	10,68[a]	89,32[b]	28,60[a]	62,74[d]	95,45[d]	2026[d]
	200	89,31[a]	11,35[a]	88.65[b]	28.66[a]	67.53[f]	109.20[f]	2185[f]
	250	89.82[a]	11.37[ab]	88.56[ab]	28.66[a]	64.84[e]	101.10[e]	2096[e]
	SEM	0.25	0.27	0.27	0.37	0.47	1.63	15.66
	P	0.22	0.04	0.04	0.26	0.00	0.00	0.00
2015	0	87.91[a]	11.16[b]	88.83[a]	27.50[a]	52.50[a]	54.71[a]	1688[a]
	50	87.08[a]	10.23[a]	89.80[b]	28.60[b]	52.46[a]	55.30[a]	1687[a]
	100	86.65[a]	10.73[ab]	89.27[ab]	27.83[a]	52.80[a]	56.40[ab]	1697[a]
	150	87.31[a]	10.25[a]	89.75[b]	27.93[a]	53.18[ab]	58.81[b]	1711[a]
	200	87.43[a]	11.20[ab]	88.80[a]	29.66[c]	54.08[b]	62.10[c]	1741[b]
	250	88.10[a]	11.28[ab]	88.72[a]	29.73[c]	52.92[a]	56.60[ab]	1702[a]
	SEM	0.310	0.190	0.193	0.229	0.220	1.063	7.40
	Prob	0.05	0.005	0.005	0.00	0.003	0.004	0.00

a. b. c. d. e. f: averages with the same letters in the same column and for the same year are comparable to the 5%. DM: Dry Matter. DOM: Digestibility of Organic Matter. ME: Metabolizable Energy, OM : Organic Matter, CF : Crude Fiber. DNM : Digestible Nitrogenous Matter. SEM: Standard Error of the Mean. Prob: Probability Specifically,

Figure 1 illustrates the direct and residual effects of N mineral fertilization on the crude protein content of *P. plicatulum* at bolting. It shows that fertilization increased ($p < 0.05$) the crude protein content of the entire *P. plicatulum* plant in the first and second year of mowing to a maximum of 200 kg N/ha beyond which it has dropped from 250 kg N/ha regardless of the year of mowing.



a, b, c, e : the histograms bearing the same letters for the same effect (direct or residual) correspond to averages comparable to the threshold of 5%.
Figure 1. Direct and residual effects of nitrogen fertilization on crude protein content of *Paspalum plicatulum* at bolting.

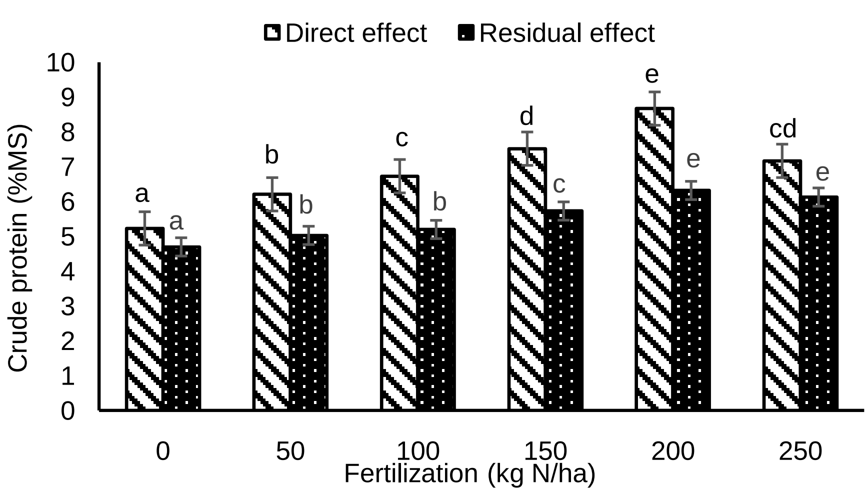
3.2. Influence of Nitrogen Mineral Fertilization on the Chemical Composition of *Paspalum plicatulum* at flowering

At flowering, nitrogen fertilization did not affect ($p > 0.05$) DM and CF levels of *P. plicatulum* in the two years of mowing (Table 2). On the other hand, the Ash content of the grass was positively influenced ($p < 0.05$) by nitrogen fertilization. For this purpose, the highest Ash content ($p < 0.05$) was obtained in the plants mown on the plots fertilized at a dose of 250 kg N/ha. On the other hand, the OM content of the plant was not influenced ($p > 0.05$) by fertilization during the two years of mowing. However, DOM, DNM, and ME levels increased ($p < 0.05$) with increasing nitrogen fertilization in the first and second year of mowing to the optimum of 200 kg N/ha. Specifically, Figure 2 illustrates the direct and residual effects of nitrogen fertilization on the crude protein content of the whole plant of *P. plicatulum* at flowering. It shows that the crude protein content of *P. plicatulum* increased ($p < 0.05$) with the level of nitrogen fertilization in the first and second year of mowing up to the optimum rate of 200 kg N/ha, before decreasing at the rate 250 kg N/ha.

Table 2. Direct and residual effects of nitrogen fertilization in form of NPK (17-17-17) on the chemical composition of *Paspalum plicatulum* at flowering

Fertilization (kg N/ha)		**Chemical composition**						
		DM (%)	**Ash (%MS)**	**OM (%MS)**	**CF (%MS)**	**DOM (%MS)**	**DNM (g/kgMS)**	**ME (kcal/kg MS)**
2014	0	91,30^{a}	10,33^{a}	89,66^{c}	31,53^{a}	52,50^{a}	55,16^{a}	1688^{a}
	50	91,71^{a}	11,20^{bc}	88,80^{b}	31,67^{a}	55,10^{b}	66,50^{b}	1774^{b}
	100	92,00^{a}	10,83^{b}	89,16^{d}	31,16^{a}	57,50^{c}	76,66^{c}	1854^{c}
	150	92,00^{a}	11,43^{c}	88,56^{b}	31,00^{a}	60,23^{d}	86,00^{d}	1944^{d}
	200	92,20^{a}	11,51^{c}	88,42^{b}	31,17^{a}	63,35^{e}	96,23^{e}	2047^{e}
	250	92,00^{a}	12,20^{d}	87,80^{a}	31,80^{a}	59,75^{d}	83,35^{d}	1928^{d}
	SEM	0,472	0,218	0,218	0,367	0,389	1,412	12,83
	Prob	0,301	0,00	0,00	0,25	0,00	0,00	0,00
2015	0	92,58^{a}	8,73^{a}	91,30^{c}	31,80^{a}	49,50^{a}	39,03^{a}	1589^{a}
	50	93,00^{a}	9,33^{b}	90,66^{a}	31,20^{a}	51,25^{b}	49,40^{b}	1648^{b}
	100	93,30^{a}	9,15^{b}	90,85^{a}	31,23^{a}	51,71^{bc}	52,05^{bc}	1662^{bc}
	150	93,27^{a}	9,10^{ab}	91,00^{b}	31,23^{a}	51,53^{b}	51,14^{b}	1657^{b}
	200	93,00^{a}	9,23^{b}	90,76^{ab}	31,67^{a}	52,40^{c}	55,55^{c}	1685^{c}
	250	93,20^{a}	9,30^{b}	90,71^{ab}	31,73^{a}	51,50^{b}	50,65^{b}	1655^{b}
	SEM	0,312	0,086	0,086	0,355	0,332	1,916	7,751
	Prob	0,160	0,00	0,00	0,37	0,00	0,00	0,00

a. b. c. d. e. f: averages with the same letters in the same column and for the same year are comparable to the 5%. DM: Dry Matter. DOM: Digestibility of Organic Matter. ME: Metabolizable Energy, OM : Organic Matter, CF : Crude Fiber. DNM : Digestible Nitrogenous Matter. SEM: Standard Error of the Mean. Prob: Probability.



a, b, c, e : the histograms bearing the same letters for the same effect (direct or residual) correspond to averages comparable to the threshold of 5%.

Figure 2. Direct and residual effects of nitrogen fertilization on crude protein content of *Paspalum plicatulum* at flowering.

3.3. Influence of fertilization on the chemical composition of *Paspalum plicatulum* after seedling

In the first year of cutting, Ash, DM and OM contents of the plant were not influenced ($p > 0.05$) by nitrogen fertilization (Table 3). The CF levels observed in the plucked *P. plicatulum* plants in the 50, 200 and 250 kg N/ha plots were higher ($p < 0.05$) than those observed in the 0, 100 and 150 kg N/ha which, moreover, were comparable ($p > 0.05$). The amount of DNM, DOM and ME in *P. plicatulum* plants increased ($p < 0.05$) with the level of nitrogen fertilization up to the optimum dose of 200 kg N/ha.

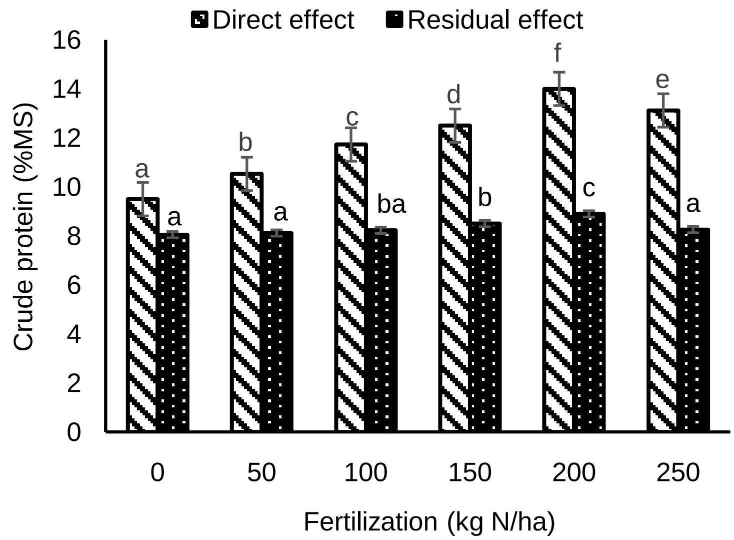
At the second year of mowing, the dry matter (DM) content of the *P. plicatulum* plant varied variably. The highest value (96.70 ± 0.30% DM) was obtained in mowed plants on the 150 and 200 kg N/ha plots, which were comparable ($p > 0.05$). No significant difference ($p > 0.05$) was observed between the Ash and OM concentrations obtained in the plants regardless of the residual level of nitrogen fertilization. The CF content of the plant was not influenced ($p > 0.05$) by residual nitrogen fertilization. On the other hand, the levels of DOM, DNM and ME of the plant were positively influenced ($p < 0.05$) by the residual effect of fertilization. They were higher ($p < 0.05$) in the mowed plants on the fertilized plots at doses of 200 and 250 kg N/ha than those obtained from the other fertilization levels (Table 3).

Table 3. Direct and residual effects of nitrogen fertilization in form of NPK (17-17-17) on the chemical composition of *Paspalum plicatulum* after seedling

Fertilization (kg N/ha)		Chemical composition						
		DM (%)	Ash (%MS)	OM (%MS)	CF (%MS)	DOM (%MS)	DNM (g/kg MS)	ME (kcal/kgMS)
2014	0	95,46^{a}	7,83^{a}	92,17^{b}	34,86^{a}	48,01^{a}	28,47^{a}	1540^{a}
	50	95,12^{a}	7,93^{a}	92,10^{b}	35,80^{b}	49,20^{b}	37,44^{b}	1580^{b}
	100	96,00^{a}	8,43^{ab}	91,60^{a}	34,90^{a}	50,00^{c}	42,22^{c}	1606^{c}
	150	95,68^{a}	8,80^{b}	91,20^{a}	35,07^{a}	51,22^{d}	49,40^{d}	1646^{d}
	200	96,05^{a}	8,25^{a}	92,00^{b}	35,50^{b}	53,13^{e}	60,00^{e}	1709^{e}
	250	95,65^{a}	8,32^{ab}	92,00^{ab}	35,63^{b}	50,60^{cd}	46,16^{cd}	1626^{cd}
	SEM	0,350	0,227	0,227	0,223	0,341	2,09	11,25
	Prob	0,24	0,012	0,012	0,00	0,00	0,00	0,00
2015	0	96,14^{ab}	8,40^{a}	91,63^{a}	35,63^{b}	47,50^{a}	23,57^{a}	1523^{a}
	50	95,92^{a}	8,46^{a}	91,53^{a}	34,80^{a}	47,82^{ab}	26,64^{b}	1534^{ab}
	100	96,10^{ab}	8,35^{a}	91,65^{a}	36,00^{b}	48,00^{b}	28,10^{b}	1540^{b}
	150	96,46^{bc}	8,72^{a}	91,28^{a}	35,00^{a}	48,64^{c}	33,00^{c}	1561^{c}
	200	96,70^{c}	8,80^{a}	91,21^{a}	36,10^{b}	49,42^{d}	38,34^{d}	1587^{d}
	250	96,50^{b}	8,66^{a}	91,33^{a}	35,60^{b}	49,16^{d}	36,65^{d}	1578^{d}
	SEM	0,210	0,196	0,196	0,323	0,165	1,354	5,460
	Prob	0,02	0,18	0,18	0,00	0,00	0,00	0,00

a. b. c. d. e. f: averages with the same letters in the same column and for the same year are comparable to the 5%. DM: Dry Matter. DOM: Digestibility of Organic Matter. ME: Metabolizable Energy, OM : Organic Matter, CF : Crude Fiber. DNM : Digestible Nitrogenous Matter. SEM: Standard Error of the Mean. Prob: Probability.

Specifically, Figure 3 illustrates the direct and residual effects of nitrogen fertilization on the crude protein (CP) content of the whole plant of *P. plicatulum* after seedling. It shows that *P. plicatulum* CP content increased ($p < 0.05$) during the first year of mowing with the increasing level of nitrogen fertilization up to the optimum of 200 kg N/ha before to decrease for the dose 250 kg N/ha. However, in the second year of mowing, the CP content was little changed by the residual effect of increasing nitrogen doses. The highest levels ($p < 0.05$) were obtained in mowed plants from plots fertilized a year earlier at doses 200 and 250 compared to those induced by the other fertilizer levels. However, MAD levels obtained in plants fertilized at 200 and 250 kg N/ha were comparable ($p > 0.05$).



a, b, c, e, f: the histograms bearing the same letters for the same effect (direct or residual) correspond to averages comparable to the threshold of 5%.

Figure 3. Direct and residual effects of nitrogen fertilization on crude protein content of *Paspalum plicatulum* after seedling.

4. Discussion

In this study, the dry matter content of *Paspalum plicatulum* was not significantly influenced by nitrogen fertilization in the first and second year of atbolting and flowering stage. However, although not significant, an increase in the plant content was observed in fertilized plants at doses of 150, 200 and 250 kg N/ha. This result is in agreement with the observation made by Tendonkeng et al. (2011) who reported an increase in the content of *Brachiaria ruziziensis* with the increasing level of nitrogen fertilization. However, it is contrary to the observation made by Delaby (2000), who reported that the use of increasing amounts of mineral nitrogen on pure grass prairie generally results in a decrease of the dry matter content of plants. This contradiction could be explained by the forage species and/or soil type during this test.

The Ash content of the plants of *Paspalum plicatulum* increased with the increasing level of nitrogen fertilization. This result is consistent with that of many authors (Obulbiga and Kaboré-Zoungrana 2007, Tendonkeng et al., 2011) who observed that the ash content of forage grasses increases with nitrogen fertilization. Indeed, the absorption of minerals must adjust to the speed of development of new plant tissues, that is to say, the absorption dynamics and metabolism of nitrogen and carbon (Salette and Huché , 1991).

At bolting and flowering stage, fertilization did not significantly affect the crude fiber content of P. plicatulum. After seedling, a sawtooth evolution of the content of this parietal component with increasing levels of nitrogen fertilization was observed. The results obtained at the time of bolting and flowering stage are in agreement with those of other authors (Delaby, 2000, Nordheim-Viken and Volden, 2009) who reported that the cell wall content is not affected by the nitrogen fertilization.. The increase in crude fiber content after planting in plants fertilized at 200 and 250 kg/ha is inconsistent with the observations of Bélanger and McQueen (1999), who noted that lack of nitrogen increases cell walls of plants. Thus, the increase in the crude fiber content of the plant after seedling is attributable to a decrease in the use of carbon chains for protein synthesis and for the production of energy necessary for the reduction of absorbed nitrates (Peyraud 2000).

During the two years of study, the digestibility of organic matter (DOM) and the metabolizable energy (ME) of *P. plicatulum* were influenced to a large extent by fertilization. These observations are consistent with those of Tendonkeng et al. (2011), who reported that changes in the chemical composition of the grass, induced by nitrogen fertilization, have minor consequences on the digestibility of organic matter and metabolizable energy. In addition, an increase in these two parameters was observed from the 200 kg N/ha dose.

This is contrary to the observations of Gonzalez-Ronquillo et al. (1998) on *Cenchrus ciliaris*, which have reported that a reduction in nitrogen fertilization leads to a decrease in the digestibility of organic matter. However, it is close to that of Delaby (2000) and Peyraud (2000) who reported that changes in the chemical composition of the grass induced by nitrogen fertilization have minor consequences on the digestibility of organic matter. The latter varies much more depending on the season or month, than with the level of nitrogen fertilization. With regard to crude protein (CP) and nitrogenous digestible matter (NDM), the levels increased significantly with nitrogen fertilization up to the optimum dose of 200 kg N/ha, after which it was observed a decrease on the protein content of fertilized plants at 250 kg N/ha. These observations are consistent with those of many authors (Obulbiga and Kobore-Zoungrana, 2007, Nordheim-Viken and Volden, 2009, Tendonkeng et al., 2011, Samuil et al., 2012). In fact, in the absence of nitrogen fertilization, the crude protein content of grass depends first and foremost on the availability of soil nitrogen (Delaby 2000). The increase in the crude protein content of the grass as a result of nitrogen fertilization is accompanied by a decrease in the protein nitrogen component in favor of the non protein nitrogen (Delaby, 2000). In fact, the entry of nitrogen into the plant, which takes place essentially in the form of nitrate, increases rapidly with fertilization, which leads in a first step to the accumulation of nonprotein nitrogen, then nitrate (N-NO3) for excessive levels of nitrogen fertilization (Nordheim-Viken and Volden, 2009).

In the second year of mowing, the crude protein content of the *P. plicatulum* plant at different phenological stages increased slightly with the residual effects of different levels of fertilization. These results are consistent with those obtained in other studies by Tendonkeng et al. (2011), who found that in the absence of fertilization, the crude protein content of the plant depends mainly on the nitrogen in the soil.

5. Conclusion

This study shows that nitrogen mineral fertilization positively influenced the first and second year of mowing the crude protein (CP), digestible nitrogenous matter (DNM), DOM and metabolizable energy (ME) levels of the plant. *P. plicatulum* whatever the phenological stage up to the optimum dose of 200 kg N/ha. Dry matter and crude fiber contents of the plant were not significantly influenced by nitrogen fertilization regardless of the phenological stage during the two years of mowing. Fertilization at the rate of 200 kg N/ha over a period of two years can therefore in practice be recommended for the cultivation of *Paspalum plicatulum* in the Central Plateau of Fouta-Djallon.

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