EFFECT OF ORGANIC FERTILIZATION BASED ON CATTLE DUNG IN VILLAGE CULTIVATION OF SUGAR CANE (*Saccharum officinarum* L.) IN IMMATURE PHASE IN NORTHERN IVORY COAST

ABSTRACT

This study aimed to determine the dose of organic fertilizer adapted to the agroecological conditions of the Ferkéssédougou zone during the immature or vegetative phase with a view to improving agricultural productivity in rainfed sugar cane cultivation. The trial was conducted using a Fisher block experimental design with three (3) repetitions and six (6) treatments including the control treatment. The observations mainly focused on growth parameters. Health monitoring was also carried out to detect the presence of diseases. Regarding growth parameters, no statically significant effect of fertilizers was observed between treatments. However, the fertilizers used had a positive impact in terms of gain compared to the control. Thus, three (3) groups of fertilizers stood out. Group 1 was composed of mineral manure at the normal dose (350 kg/ha of NPK), organic manure at the normal dose (20t/ha), double dose of compost (40t/ha) and the organo-mineral mixture, namely the normal dose of compost (20t/ha) + half dose of mineral fertilizer (175 kg/ha of NPK). These treatments promoted good emergence, good elongation of the plants with large diameters and a large number of internodes. Group 2, composed only of half a dose of compost (10t/ha), allowed us to have a large number of stems. For group 3, corresponding to the control treatment, no growth parameter was correlated. No symptoms of major illnesses were observed during the observations. The M1400/86 variety used is resistant to termite attack.

Keywords : *Saccharum officinarum* L., rainfed cultivation, cattle dung, variety M 1400/86, Ferkessédougou

1. INTRODUCTION

Sugar cane (*Saccharum officinarum* L., Poaceae), cultivated for its stems (source of crystallizable sugar), is native to Papua New Guinea [1]. Its global production was estimated at 1.859 billion tonnes in 2021, or 180 million tonnes of sugar [2]. It represents approximately 86% of sugar crops and sugar beet, the rest [3], hence its capital importance for the sugar industries. In Côte d'Ivoire, where sugar complexes are located, average production is around 200,000 t of sugar per year for the consumption needs of the population by 2025, estimated at 320,000 t per year [4] . Indeed, the Ivorian sugar sector has a low yield, 40 t/ha for village cultivation and 80 t/ha for industrial cultivation [5]. However, in Malawi, which has natural conditions comparable to those of Côte d'Ivoire, the yields in rainfed and industrial crops are respectively 70 t/ha and 160 t/ha. Faced with this observation, various works have been carried out to increase the productivity of plantations. This involved the selection of varieties adapted and productive in rainfed conditions and under irrigation [6] and crop [7]. However, average yields in rainfed conditions remain low [8] (Péné *and al*., 2012). This could then be explained by other factors such as grass cover on plots and soil fertility. And, this last case, was confirmed by Péné *and al*., [9], in the context of Ferkéssédougou, the main sugar cane growing area in Côte d'Ivoire. Thus, according to Bakayoko *and al*.,[10], one of the possibilities recommended in such a situation is soil fertilization. However, mineral fertilization, in addition to these ecological and environmental impacts [11] and its high cost [12] has shown its limits [13]. Hence, the use of organic amendments to meet this major need [10], [14]. It is in this context that this study was initiated by the National Agronomic Research Center (CNRA) with the aim of contributing to the improvement of agricultural productivity in rainfed sugar cane cultivation through organic fertilization for sustainable management. of soil fertility in the north of Côte d'Ivoire. The present work, which is limited to the vegetative stage of sugar cane development, has the general objective of determining the dose of organic fertilizer adapted to the agroecological conditions of the Ferkessédougou zone during the immature or vegetative phase with a view to improving the agricultural productivity in rainfed sugarcane cultivation. Specifically, this involves: (i) determining the physicochemical composition of the soil and chemical composition of the compost and (ii) evaluating the effect of organic manure on sugarcane growth parameters.

2. MATERIAL AND METHODS

2.1. Study area and site

The research work was carried out at the Research Station of the National Agronomic Research Center (09° 35' north latitude, 05° 12' west longitude and at 323 m altitude), located in Ferkessédougou, 52 km from Korhogo and 585 km from Abidjan. The town of Ferkessédougou is one of the main sugar cane production areas in the country. The region's climate is dry tropical with a uni-modal rainfall regime centered on the months of August and September. The wet season is from April to October and the dry season is from November to March. The annual cumulative rainfall is around 2300 mm, almost half of which is recorded between July and September. The maximum and minimum temperatures are 35.1 °C and 16°C, but maximum temperatures can reach 37°C during dry season days. The average annual duration of insolation is around 2216 h/year. The dry season is marked by a very favorable period for the maturation of sugar cane [4]. The soils are shallow, made from granite or gneiss, hydromorphic in the lowlands and sandy in the alluvial terraces of the Bandama River. However, ferralitic soils are predominant, with a shallow topsoil limited by hardpans at 40-60 cm [15]. The soils of Ferkessédougou are also characterized by a poverty in organic matter (1.5%) with an acidic pH (6.0) and a low cation exchange capacity (8 mEq/100g) [8].

2.2. Material

Plant material

The plant material used in the experiment consisted of the commercial variety M1400/86 of sugar cane taken from the cane collection plot of the research station of the National Agronomic Research Center (CNRA) located in Ferkessédougou. It is one of the varieties best adapted to the pedoclimatic conditions of Côte d'Ivoire. It is characterized by satisfactory agro-morphological, technological and yield parameters, good resistance to several diseases present in the sugar areas of Côte d'Ivoire such as charcoal, scald, rust and dashed mosaic [16].

Fertilizing equipment

The fertilizing material consisted of compost made from cow dung and NPK mineral fertilizer (23-10-05).

2.3. Methods

2.3.1.Experimental device and conduct of the test

The trial was conducted using a Fisher block experimental design with three (3) repetitions and six (6) treatments including the control treatment. Each treatment consisted of 5 lines (furrows) of cane (2 border lines and 3 useful lines). The lines, 4 m long and spaced 1.5 m apart, contained 12 cuttings with 3 eyes. The surface area of the useful plot was 30 m². In order to minimize border effects, the distances between blocks or repetitions and those between treatments or elementary plots were 2 m. The different treatments were as follows: Control treatment without fertilizer (T1); Normal dose of mineral fertilizer (350 kg/ha; T2); Half dose of compost (10 t/ha; T3); Normal dose of compost (20 t/ha; T4); Double dose of compost (40 t/ha; T5) and Normal dose of compost (20 t/ha) + Half dose of mineral fertilizer (175kg/ha) (T6).

The addition of organic manure (cattle dung compost) takes place before planting the cuttings. As for the mineral fertilizer, the application took place two weeks after planting the cuttings.

2.3.2. Parameters evaluated

Physico-chemical analysis of the soil

The soil analysis consisted of taking 3 soil samples at a depth of 30 cm before setting up the tests. These samples were labeled then sent to a laboratory for physicochemical analysis. Thus, the percentage of organic matter was determined by the Walkley and Black method (1934), those of total nitrogen and assimilable potassium ion (K^+), respectively by the NF ISO 11261 (June 1995) and NF methods. X 31-108 (2002). Concerning the compost, once its preparation was completed, a sample was taken and sent to the laboratory to carry out a chemical analysis of its composition in total nitrogen, phosphorus and potassium (by the NF EN 13650 : 2002 method).

Resumption (emergence) rate of cuttings

To determine the rate of recovery (emergence) of the cuttings, a useful plot was demarcated. It was made up of 3 central lines of each elementary subplot, i.e. an area of 18 m². In each of the useful plots, the number of so-called primary stems, resulting from buds that had germinated, was counted respectively 10, 14, 21, 28 and 42 days after planting. The lifting rate was determined from the following formula :

Lift rate (%) = (n/N) x 100

n: number of buds (eyes) raised; N: total number of buds (eyes) planted.

Tillering

The tillering assessment was carried out on each elementary plot every two weeks from the 2nd month after planting (MAP). It consisted of counting the stems of each line of the useful plot. The number of stems per hectare was determined according to the following formula :

Tillering = (total number of stems x 6667) / (number of useful lines x length of 1 useful line)

Stem elongation

Elongation was assessed through plant height, taken every two weeks from the 2nd to 11.5 months after planting. It consisted of measuring, using a tape measure, the height of the stems from the ground to the base of the last leaf (ochrea), of 10 plants (selected and labeled) or 3 to 4 plants per useful line. level of each treatment.

Growth velocity (Vc) and growth rate (GR)

The growth rate (Vc expressed in cm/d) was determined from the following formula :

$$Vc = \Delta L / \Delta t$$

Vc : Growth speed ; ΔL : variation in plant size and Δt: variation over time.

Rate of increase

The rate of growth or evolution of the sugar canes in the treatment compared to the control treatment was determined from the following formula :

RG (%) = (Hn-H1/H1) x 100

RG : Rate of growth or Rate of evolution ; H1 : Height of the control treatment and Hn : Height of the nth treatment.

Number of visible internodes of sugarcane plants

Determining the number of internodes consisted of counting the visible internodes on 10 plants (identified and marked with plastic bags) in the useful plot (3 central lines) of each micro-plot. These are the same plants used for height measurement.

Diameter of sugar cane stalks

The diameter of the stems was determined at the collar using a caliper every two weeks from the 8th month after planting (MAP) of the sugarcane cuttings until 11.5 months. These measurements were determined on the 10 plants identified and labeled in the useful plot of each micro-plot

Health monitoring of sugar cane

Health control or monitoring was carried out on all sugar cane plants in order to look for possible attacks by sugar cane pests such as insects and diseases (smut, mosaic, etc.). It consisted of making a visual observation of all the sugar cane plants and identifying the damage as well as the causal agents thereof.

2.3.3. Statistical analyses

The data of the different parameters were recorded using Excel software to construct matrices. Then, a normality test of the values obtained was carried out to check the distribution of the variables. Subsequently, an analysis of variance using STATISTICA 7.1 software made it possible to determine the average values of the different parameters evaluated. In the event of a significant difference between the means, the Duncan test at the 5% threshold was used for the comparison. In order to determine and visualize the correlations between the parameters evaluated on the one hand and the correlations between the parameters and the different treatments on the other hand, the XLSTAT software version 2019.2.2.59614 was used to perform a principal component analysis (PCA).

3. RESULTS

3.1. Determination of the physicochemical composition of the soil and chemical composition of the compost

Physical composition of the soil

The results of the physical analysis of the soil samples are recorded in Table 1. The average content of silt was 44.87%, that of sand (39.77%) and that of clay (13.93%). %). The soil therefore had a loamy-sandy texture.

Table 1 : Results of physical analysis of soil samples

Sample.	CE%	FS%	H2O%	Clay%	Silt%	Sand%	GT
Average	37.77	62.27	0.60	13.93	44.87	39.77	Sandy loam

CE : Coarse Element; FS: Fine Sieve; H2O: Water ;% : Percentage ; T: Texture ; GT : Ground Texture

Soil chemical composition

The results of the chemical analysis of the soil samples showed a C/N ratio of 12, as well as a hydrogen potential of water (pH-water) and KCl (pH-KCl) less than 7. The contents average soil carbon (C), organic matter (OM), nitrogen (N), potassium (K), sodium (Na) and calcium (Ca) were respectively 1.1% ; 1.8% ; 0.1% ; 0.2 mEq/100g ; 0.1 mEq/100g and 1.5 mEq/100g. Concerning the Cation Exchange Capacity (CEC), its average composition was 10.1 mEq/100g (tables 2).

Chemical composition of compost

The results of the chemical analysis of the compost based on cow dung are recorded in Table 3. They showed a C/N ratio equal to 12. The average organic matter contents ; in nitrogen and potassium were respectively 23.70% ; 1.12% and 0.28 mEq/100g. The average phosphorus composition was 0.3% while that of carbon was 13.75%.

Table 2 : Results of chemical analysis of soil samples

Chemical analysis results											
Sam.	**water pH**	**pH KCl**	**C %**	**MO %**	**NT %**	**C/N**	**SiO2 (ppm)**	**K (mEq/ 100g)**	**N / A (mEq /100g)**	**Ca (mEq /100g)**	**CEC (mEq /100g)**
Avg.	5.8	4.9	1.1	1.8	0.1	12.0	47.1	0.2	0.1	1.5	10.1

Sam : Sample; C: carbon; MO: Organic matter; N.T: total nitrogen; P: phosphorus; K: potassium; % : percentage ; C/N: carbon-nitrogen ratio; mg/kg: milligram per kilogram; KCl: potassium chloride; Na: Sodium; Ca: Calcium; SiO2: silica; ppm: parts per million

Table 3 : Results of chemical analysis of cow dung compost samples

Chemical analysis results						
Sam.	**C%**	**MO%**	**NT%**	**C/N**	**P%**	**K (mEq/100g)**
Cow dung compost	13.75	23.70	1.12	12	0.3	0.28

Sam. : sample ; C : carbon; MO: organic matter; N.T: total nitrogen; P: phosphorus; K: potassium; % : percentage ; C/N: carbon to nitrogen ratio

3.2. Evaluation of the effect of organic manure on sugarcane growth parameters

Resumption (emergence) rate of sugarcane cuttings

Table 4, presents the recovery rates of sugarcane cuttings observed at 10, 14, 21, 28 and 42 days after planting (DAP). It appears that no statistically significant difference was observed in the different treatments ($p > 0.05$). The average cutting recovery rate increased from 10.9 ± 1.4% (10 DAP) to 51.6 ± 8.6% (42 DAP) for all treatments. However, lifting gains compared to the control were noted. Thus, at 42 DAP, the cuttings from the treatments having received mineral and/or organic fertilizer showed gains compared to the control with a greater value (+34%) in the plants treated with the organo-mineral mixture.

Table 4 : Average rate of recovery (emergence) of sugar cane cuttings depending on the treatments

Treatments	% 10 DAP	% 14 DAP	% 21 DAP	% 28 DAP	% 42 DAP	LG (% T1)
T1	7.8a	27.8a	35.6a	42.2a	45.6a	-
T2	10.0a	30.0a	41.1a	46.7a	52.2a	+14.47
T3	12.2a	28.9a	40.0a	44.4a	51.1a	+12.06
T4	8.9a	14.4a	25.6a	32.2a	37.8a	-17.10
T5	12.2a	33.3a	41.1a	44.4a	55.6a	+21.92
T6	11.1a	25.6a	40.0a	46.7a	61.1a	+34
Average	10.9	26.4	37.6	42.9	51.6	
Standard deviation	1.4	7.3	6.7	6.1	8.6	
Variance	2.1	52.7	45.3	36.8	74.4	
CV (%)	13.3	27.5	17.9	14.1	16.7	
P	0.99	0.83	0.88	0.88	0.72	
Treatment effect	ns	ns	ns	ns	ns	

Lif: lifting; DAP: days after planting; LG (% T1): lifting gain compared to the control treatment T1; CV: coefficient of variation; P: probability; ns: not significant

Tallage (number of stems per hectare)

Table 5 highlights the average number of sugarcane stems per hectare from 2 to 11.5 months after planting (MAP) in rainfed conditions. Results showed no statistically significant difference ($p>0.05$) between 11.5 MAP treatments. On average, the number of stems increased from123,346 to 177,614 stems.However, gains in tillering compared to the control were noted in the different treatments: T2 (+ 19.50%); T3 (+28.53%); T4 (+3.98%); T5 (+6.58%) and T6 (+14.20%).

Stem height

Table 6 shows the average heights of sugarcane stems at 2 and 11.5 MAP under rainfed conditions. No significant effect of the treatments applied was observed ($p>0.05$). However, respective growth rates of (+18.97%) ; (+11.54%) ; (+21.40%) ; (+16.76%) and (+16.21%) compared to the control, were generated respectively by treatments T2, T3, T4, T5 and T6.

Table 5 : Average number of sugar cane stems per hectare at 2 and 11.5 months after planting (MAP) in rainfed conditions

TREATMENTS	Stem/ha 2 MAP	Stem/ha 11.5 MAP	TG (%T1)
T1	122 965 a	154 914 a	-
T2	124 803 a	185 129 a	+ 19.50
T3	104 569 a	199 113 a	+28.53
T4	130 513 a	161 088 a	+3.98
T5	134 116 a	165 822 a	+6.58
T6	122 731 a	176 920 a	+ 14.20
Average	123 346	177 614	
Standard deviation	11,428	15,259	
CV (%)	9	9	
P	0.92	0.41	
Treatment effect	ns	ns	

MAP : month after planting ; TG : tillering gain compared to the control treatment

Table 6 : Average heights of sugarcane stems at 2 and 11.5 months after planting (MAP) in rainfed conditions

TREATMENTS	H.2 MAP	H. 11.5 MAP	HG (%T1)
T1	42.50a	109.80 a	-
T2	45.63a	130.63a	+19.97
T3	44.00 a	122.47a	+11.54
T4	33.15a	133.30 a	+21.40
T5	61.30 a	128.20 a	+16.76
T6	47.67a	127.60 a	+16.21
Average	46.35	128.44	
Standard deviation	10.07	16.22	
CV (%)	21.72	16.22	
P	0.91	0.67	
Treatment effect	ns	ns	

H : height ; HG: height gain compared to the control treatment ; MAP : month after planting

Sugarcane growth rate

The results concerning the average growth speed of sugar cane stems are presented in Table 7. It was 0.30 ± 0.10 cm/d between 2-5 MAP, 0.07 cm/d between 5 -9.5 MAP and 0.66 ± 0.12 cm/d between 9.5-11.5 MAP.

Table 7 : Evolution of the growth speed of sugar cane stems from 2 to 11.5 months after planting in rainfed conditions

TREATMENTS	Vc (2-5 MAP)	Vc (5-9.5 MAP)	Vc (9.5-11.5 MAP)

	cm/d	cm/d	cm/d
T1	0.26	0.06	0.58
T2	0.27	0.07	0.84
T3	0.30	0.08	0.67
T4	0.50	0.09	0.72
T5	0.21	0.05	0.68
T6	0.32	0.08	0.66
Average	0.30	0.07	0.66
Standard deviation	0.10	0.01	0.12

Vc : average growth speed ; cm/d : centimeter per day

Number of internodes of sugar cane stems

Table 8, shows the average number of visible internodes observed at 9.5; 10 ; 11 and 11.5 months after planting (MAP) of sugar cane in rainfed conditions. This average number increased from 14 ± 0.9 at 9.5 MAP to 18 ± 1.2 at 11.5 MAP. Statistical analysis revealed no significant difference (p>0.05) between treatments during the observation periods. However, all treatments presented an increase rate greater than or equal to that of the control (T1) at 11.5 MAP, these are : T4 (+ 11.11%), T6 (+ 11.11%), T5 (+5.5%), T2 (+5.5%) and T3 (0%).

Table 8 : Evolution of the average number of internodes of sugar cane stems from 2 to 11.5 months after planting in rainfed conditions

Treatments	NI 9.5 MAP	NI 10 MAP	NI 11 MAP	NI 11.5 MAP	GNI (% T1)
T1	13 a	16 a	17 a	18 a	-
T2	14 a	16 a	17 a	19 a	+5.5
T3	14 a	16 a	17 a	18 a	-
T4	15 a	18 a	18 a	20 a	+ 11.11
T5	14 a	17 a	18 a	19 a	+5.5
T6	14 a	17 a	18 a	20 a	+ 11.11
Average	14	16	18	19	
Standard deviation	0.7	0.8	0.7	0.8	
CV (%)	4.7	4.1	3.7	4.1	
P	0.5	0.2	0.2	0.3	
Treatment effect	ns	ns	ns	Ns	

MAP : month after planting ; NI : average number of internodes , GNI : gain of number internodes compared to control treatement

Diameter of sugar cane stems

Table 9 showsthe values of the average diameter at the collar of sugar cane stems, measured at 9 ; 9.5;10 ; 11 and 11.5 months after planting (MAP) in rainfed conditions. Analysis of variance revealed no significant difference (p>0.05) between the different treatments during the observation periods. This average diameter increased from 21.24 ± 0.77 mm at 9 MAP to 22.60 ± 0.87 mm at 11.5 MAP. However, in terms of gain or increase in diameter, all treatments presented a positive rate (TA) compared to the control T1 at 11.5 MAP with respectively T2 (+ 7%) ; T3 (+5%) ; T4 (+9%) ; T5 (+11%) and T6 (+7%).

Table 9 : Evolution of the average diameter of sugar cane stems from 9 to 11.5 months after planting in rainfed conditions

TREATMENTS	D. (mm) 9 MAP	D. (mm) 9.5 MAP	D. (mm) 10 MAP	D. (mm) 11 MAP	D. (mm) 11.5 MAP	DG (%T1)
T1	19.93a	20.73a	21.00 a	21.13 a	21.37a	-
T2	21.30 a	21.80 a	22.27 a	22.30 a	22.93 a	+7.30
T3	20.87a	21.30 a	21.93a	22.23a	22.37a	+4.68
T4	21.80 a	22.35a	22.45a	22.90 a	23.30 a	+9.03
T5	22.30 a	22.90 a	23.55a	23.60 a	23.80 a	+ 11.37
T6	21.60 a	22.20 a	22.37a	22.67 a	22.77 a	+6.55
Average	21.24	21.78	22.12	22.33	22.60	
Standard deviation	0.77	0.76	0.84	0.83	0.87	
Variance	0.59	0.58	0.70	0.70	0.76	
CV (%)	3.61	3.49	3.78	3.74	3.87	
P	0.06	0.12	0.20	0.17	0.10	
Treatment effect	ns	ns	ns	ns	ns	

D : diameter of sugar canne stem ; DG : diameter gain compared to the control treatement

Determining an optimal fertilizer dose

Relationships between growth parameters and the treatments studied

Our principal component analysis results made it possible to highlight existing correlations both between the parameters and the axes F1 and F2 on which they are projected (Table 10), between the parameters studied (Table 11), and between parameters and treatments (Figure 1).

The parameters stem diameter, elongation, number of internodes and lift were positively correlated with the F1 axis. As for the stem number parameter, it was positively correlated with the F2 axis (Table 10). The results in Table 11 (Pearson correlation matrix) showed that the emergence of cuttings is positively correlated with the diameter, elongation and number of internodes. Which implies correlations between the diameter of the stems, the elongation and the number of internodes and between the elongation and the number of internodes. Thus, the biplot projection plan (Figure 1) expressed the total variance expressed at 88.15% with a contribution of 64.74% for the F1 axis and 23.42% for the F2 axis.

All of this information made it possible to identify three groups of treatments. Group 1, composed of treatments T2, T4, T5 and T6, favored better emergence of the cuttings, good elongation of the stems with a good diameter and a high number of internodes. Group 2, consisting only of the T3 treatment, provided a greater number of stems. Finally, group 3, consisting of the control, was not favorable to any parameter.

Table 10 : Correlation between variables and factors

Variables	F1	F2
Stem/ha	-0.040	**0.978**
Diam	**0.913**	0.144
Elg	**0.910**	0.318
EN	**0.913**	-0.238
Lifting	**0.862**	-0.191

Table 11 : Correlation matrix between the parameters studied (Pearson correlation matrix)

Variables	Stem/ha	Diam	Elg	IN	Lifting
Stem/ha	**1**	0.046	0.236	-0.245	-0.142
Diam		**1**	0.880	0.689	0.713
Elg			**1**	0.791	0.602
EN				**1**	0.793
Lifting					**1**

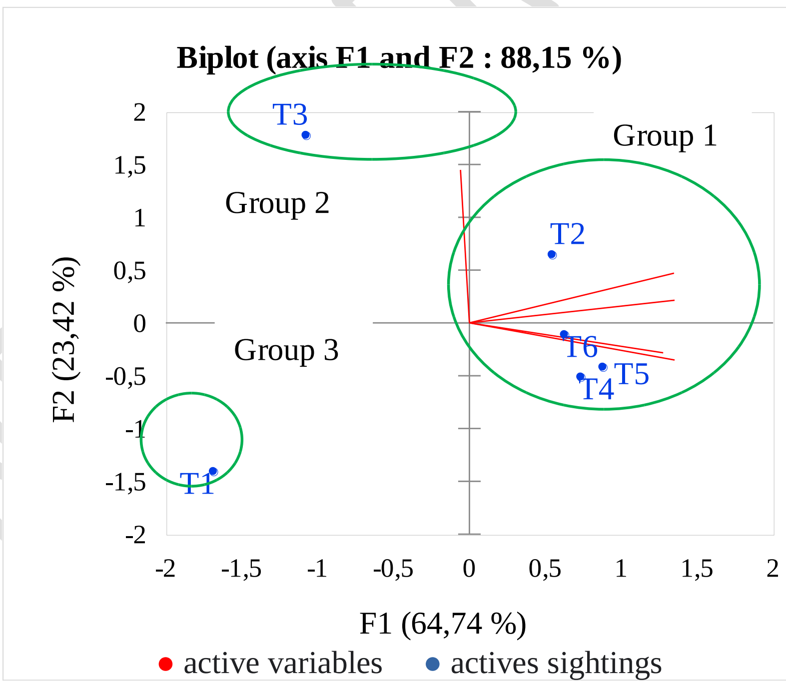

Figure 1 : Representation of relation ships between treatments and variables in the biplot plan along axis F1 and F2

Health monitoring of sugar cane

During the various observations of sugarcane plants at the different treatments, no symptoms of major sugarcane diseases were observed. However, a few so-called minor diseases that have not had a significant influence to date on the growth of sugar cane have been detected. These are red snot and pokkah boeng. These symptoms eventually went away on their own. In addition, a significant attack of termites was noted, especially during the period of absence of rain.

4. DISCUSSION

The results of the physicochemical analyzes of the three soil samples from the study site revealed that the soil had a loamy texture with a potential for hydrogen (pH) in water and acidic Kcl. This acidity of the pH of the said site could be linked to the accumulation of acidic compounds (Aluminium and Manganese) over the years on this soil. For Sradnick *and al.*, [17], the pH of the soil is determined, to know the mobility and solubility of plant nutrients. According to the same author, nutrients could be more mobile, and therefore, easily available to plants in sandy-clay soil than in sandy-loamy soil. Thus, the analysis of the three soil samples showed an average richness in organic matter and an acceptable rate of decomposition of organic matter. Through these results, a poverty in nitrogen was noted, compared to the threshold value estimated at 2% according to Ruiz [18]. These results could therefore explain a low level of soil fertility [19].

As for the results of the analysis of the compost based on cattle dung, they revealed average nitrogen and potassium contents, which could be available to the plants during their growth phase. These analysis results also highlighted the richness of the compost made from cattle dung in phosphorus and organic matter. As well as a satisfactory decomposition trend of the latter thanks to the C/N ratio equal to 12.

All of these results made it possible to propose doses of manure to be tested on village canes during their immature phase and in rainfed conditions in the Ferkessédougou area in the north of Côte d'Ivoire.

Our results concerning the emergence of cuttings showed an increase in this rate 42 DAP. However, no statistically significant effect of manure was observed. But, a gain in emergence compared to the control was indicated in cuttings having received mineral and/or organic fertilizer with a greater value in plants treated with an organo-mineral mixture. These results could be explained by the fact that the combined addition of two types of fertilizer (organic and mineral) increases the stock of nutrients, corrects soil deficiencies and improves yield. Indeed, it seems that this association makes mineral elements more easily available to the plant, thus promoting its growth and the good development of its vegetative organs. These results are similar to those of Akanza and Yao (2011) [20], who showed the effectiveness of the combination between organic manure (poultry droppings) and mineral fertilizers (NPK + urea + dolomite) on cassava yields.

Concerning tillering, number of internodes and stem height, an increase 11.5 MAP was also shown. But, no statistically significant effect of the treatments applied was observed. However, gains in stems and growth compared to the control were reported for plants on fertilized soils. These results obtained could be attributed to the fact that the mineral fertilizer would have mineral elements, directly assimilated by the plants and to the mineralization of the organic fertilizer, which would have favored the rapid growth of the plants. As noted by Ilunga *and al*. (2018) [21]and Kouassi *and al*. (2019) [22], the richness of this mineral fertilizer (NPK) in nutrients, especially nitrogen which is an essential element for growth, certainly contributes to the good growth of plants. Furthermore, given the low C/N ratio (C/N=12) of cow dung compost, rapid mineralization of this manure would have been carried out to make nitrogen available to the plants. Indeed, in practice, during a manure analysis, the C/N ratio provides information on the decomposition speed [23]. According to Culot (2005) [24] organic matter with a low C/N ratio (4 to 12) decomposes faster than that with a high ratio (C/N> 12). All of this information thus makes it possible to better translate the growth rates, which were higher in the plants in the fertilized plots compared to the control.

In terms of collar diameter, despite an increase in mean values, 11.5 MAP, no statistically significant effect of the treatments was revealed. However, in terms of gain compared to the control, the plants in the elementary plots having received mineral and/or organic fertilization displayed positive diameter growth rates. These results are corroborated by the work of Siéné *and al*. [25] who showed that organic and mineral fertilizers promote strong growth vigor in the collar diameter of millet. According to Muyayabantu *and al*. [26], this observation highlights the availability of mineral elements in organic fertilizers for the growth and development of crops in the open field.

Furthermore, our results on growth parameters made it possible to establish relationships between them. Thus, It was observed that the emergence of cuttings is positively correlated with the diameter, elongation and number of internodes. Which implies correlations between the diameter of the stems, the elongation and the number of internodes and between the elongation and the number of internodes.

5. CONCLUSION AND PERSPECTIVES

This study aimed to contribute to improving the productivity of sugar cane in rainfed conditions in Ferkessédougou by determining an optimal dose of organic fertilizer. However, our first stage work in this study was focused on the immature phase of sugar cane. It consisted of determining the effect of organic fertilization using compost based on cow dung in village sugarcane cultivation on growth parameters. The analysis of soil samples taken from the experimental site indicated that the soil of the site is moderately acidic, of loamy texture with a C/N ratio of 12. As for the analysis of the cattle dung compost, it also presented a C/N ratio of 12.

Our results showed that the different applications of mineral and/or organic fertilizer, although not having had statistically significant effects on the growth parameters, nevertheless made it possible to obtain gains or growth rates per compared to the control in terms of emergence, tillering, height, growth speed, number of internodes and diameter. Thus, three groups of treatments or fertilizers were distinguished according to their tendency to favor these parameters.

Group 1, composed of T2 (normal dose of mineral manure :350 kg/ha NPK), T4 (normal dose of organic manure :20t/ha), T5 (double dose of organic manure; 40t/ha) and the organo-mineral mixture, T6 (normal dose of organic manure + half manure mineral : 20t/ha of compost + 175kg/ha of NPK). These treatments would promote good emergence, good elongation with a good proportion of diameter and a good number of internodes.

Group 2, consisting mainly of treatment T3 (Half dose of organic manure : 10kg/ha) would provide a large number of stems and group 3, represented by control T1, to which no parameter was attached.

These results are preliminary, only the results of the production phase will be able to confirm them. If this is the case, it will be necessary to repeat it and consider an economic study and take into account the ecological impact of these doses of manure to propose one to village cane producers.

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