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Effect of organic and organo-mineral amendments on emergence and growth of sugarcane (*Saccharum officinarum* L.) in nursery

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Abstract

The test conducted on the site "Ouéllé 2C" at SUCAF Gabon, aims at determining the type and efficiency of the substrate that should be applied to get an optimal seedling and growth rate in sugarcane nursery. To do this, eighteen (18) treatments were formulated from five (5) amendments (bagasse, boiler ashes, scum, horse manure and sawdust) in various combinations to assess their effect on lifting and sugarcane growth. The control (T0) corresponds to the substrate composed of bagasse and scum. The variables measured were seedling (one month's plantation) and growth through the height (cm), diameter (mm) and tilling on the 49th day after planting (DAP). The results obtained showed that the introduced amendments influenced positively the seedling rate because she was true to the 11th DAP, seven treatments were a strike rate of 100%. For the growth parameter, statistical analyzes revealed a significant effect (p-value <α) at the 5% level. The highest average values of: 68.38 ± 3.92 cm; 22.05 ± 0.27 mm and 34 ± 2.08 respectively tillers for height, diameter and tilling compared to control T0 (32.63 ± 0.75 cm; 13.25 ± 0.85 mm and 20 ± 1.5 tillers) were obtained DAP 49th, with the combinations of treatments based scum associated with horse manure and boiler ashes. It follows a treatment effect from these substrates. However T14 presented a depressive effect on the high setting. In light of the results obtained, we recommend the treatments T9, T16 and T18 for better lift and efficient growth of nursery sugarcane.

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Introduction

Sugarcane (*Saccharum officinarum* L.) is an annual cycle grass. It is primarily grown for its stems which contain a sugar juice from which is extracted sucrose or crystallizable sugar (Hubert, 1968; Arzate, 2005). In the international market, sugar is a strategic commodity in that it is an essential ingredient for the food industry and many other areas (Dangbedji, 2014; Dorin, 2014). It occupies an important place in the global economy. Annual world production of sugar is around 180 million tons between 2010 and 2014 (Dangbedji, 2014; Dorin, 2014), 75% of which come from sugarcane and 25% from sugar beet (*Beta vulgaris*). In addition to the main world producers, the Central African region is not on the sidelines of this dynamic because its annual production amounts to 289,789 tons. These are divided among the biggest sugar producer in the region that is Cameroon (SOSUCAM), with 125 000 tons, while the share of Gabon (Gabon-SUCAF) is 23 850 tons or 8.23% of production in Central Africa (Monaghan, 2007). However, in the specific case of Gabon, population growth is not correlated with the production during the last three years increased from 26 463 tons in 2011 to 23,850 tons in 2014. Indeed, the needs of sugar consumption in the internal market remain to cover since they accumulate between 35 000 and 40 000 tons/year, representing an annual deficit of 10 000 to 18 000 tons/year (Monaghan, 2007). Given this important economic issue, SUCAF Gabon is moving toward development strategies through plant breeding component that enables in situ out of performing varieties, high yield, with interesting agronomic and industrial features including: cane tonnage (TC), sugar tonnage (TS), Hugo performance simplified (RHS) and morphological characteristics (height, diameter and tilling).

This varietal selection, conducted after acquisition of commercial varieties imported from research centers (CIRAD), requires 10 to 13 years of experimental phase before deliberating a variety (Baron et Marie-Sainte, 2000), which seems long. The operation can go below 10 (Kouamé *et al.*, 2010; Kouamé *et al.*, 2012) if the plants perform well in the bucket multiplication phase.

At SUCAF Gabon, bucket multiplication phase lasts 4 months. It is possible to reduce it, which means to have optimal conditions for germination and growth, which go through a quality of irreproachable and controlled substrate (Makita-Ngadi and M'batchi, 1992). In tropical and subtropical areas, the influence of organic amendments on the physical, chemical and biological characteristics of soil for optimal production has been the subject of several studies (Total *et al.*, 2007; Muladji, 2011; Yanick *et al.*, 2014). However, if the benefits of organic matter to improve soil fertility and increase yields are relatively better known today, there remain many questions about their influence regarding the development and growth nursery of sugarcane in the soil and climatic conditions of the area SUCAF Gabon. The assessed literature devotes little space that concern. To this end, the option taken in the context of this work was to develop the various substrates available and easily accessible, such as: machining residues (bagasse, scum and boiler ashes), sawdust, horse manure.

The objective of this study is to determine the potential of these organic fertilizers and organo-mineral amendments raised to ensure optimal emergence and growth of sugar cane in nursery, to allow SUCAF Gabon to succeed his multiplication phase of *Saccharum officinarum* L. in bucket.

Materials and methods

Study site

The study was conducted on the experimental site and multiplication "OUELLE 2C" of SUCAF Gabon. It is geographically located in the department of Mpassa (Province of Haut-Ogooué) between 1°72012 'south latitude and 13°40136' east longitude, at an average altitude of 376 m.

Plant material

The biological material is made of cuttings from the Australian variety Q200. It was introduced in 2012 in the varietal selection SUCAF circuit. His choice based on the fact that the performance of varieties Co 997, 364 and B46 NCo 376, encountered on the site run out of steam and that Q200 is an elitevariety.

Organic and organo-mineral material

Five substrates *viz.,* Scum from sugar cane juice clarification process; they are naturally stabilized; Bagasse or fibrous residue obtained in the cane juice extraction process; Sawdust delivered by the woodwork at SUCAF; Horse Crottins from Moanda equestrian center and Boiler Ashes provided by the factory SUCAF are obtained after combustion of bagasse in boilers were used. Overall organic substrates were used at an advanced level of degradation, while sawdust was a material directly from the mill.

Experimental scheme

The trial was conducted on a complete randomized design comprising eighteen (18) treatments with a control treatment and four (4) replications, 76 experimental units, each having an area of 920 cm^2. Levels or doses correspond to the proportions of the various substrates used (Table 1).

Preparation of samples

The reference substrate used before this test was prepared two weeks before receiving the cuttings. Its constitution contained the following proportions: 2/3 unscreened black earth and 1/3 bagasse and rude scum. This substrate, usually used to SUCAF, corresponds to the control of the current test. Some treatments were made or not made from scum dim to 5 mm. The different substrates were subject to a contribution in the buckets either in isolation mixed with soil or as a combination of 2 or 3 fertilizers.

Growing conditions and maintenance of micro-plots

Fertilized buckets were placed under shade house with a roof made of palm branches. The shade house was 2 m high and an area of 4 m^2. Under shade house temperature was 25 ° C. and the humidity was between 35 and 40%. Rainfall during the period of the experiment was almost low near zero. Thus, the water needs of the plants were fully covered by manual watering, every two or three days at a rate of 100 ml of water by bucket. Weeding and manual weed extirpations were accomplished under various operations.

Planting cuttings

By means of a tool, a slight groove of 4 to 5 cm deep was made in the buckets. Then two one-bud cuttings are placed in buckets center and facing up. Then, a slight decline is performed for better adhesion of the cuttings with soil and thus facilitates root formation.

Measured parameters

Beside emergence, the parameters measured on the plants are: stem height, stem diameter and tillering. The emergence corresponds to the coming out of the first ends of the cuttings from the soil surface and then the transition point (arrow) seedling. It was determined by simply counting the buds and seedlings. The height measured on the strongest stem from a centimeter above the ground to the last stroke ligulaire, with a steel folding rule. The diameter at mid-height on the strongest rod using a caliper. Tillering consisted in counting the number of tillers formed on the plants in each bucket.

Chemical analysis

Soil tests studied were performed at the INSAB laboratory of soil on the particle size fraction smaller than 2 mm according to the methods at our disposal (Aubert, 1978; AFNOR, 1994). They include: the particle size determined at the Robinson pipette-Khön (clays and silts) and sieving (sands), the pH measured in a solid suspension/solution (1/2.5), total nitrogen by the method Kjeldahl, organic carbon by the Anne method, available phosphorus extracted by the Bray method 2. Phosphorus in solution was measured to 712 nm by UV-Visible spectrophotometer (Murphy and Riley, 1962). The pH of compost was measured in the supernatant of a sample suspension of the substrate in distilled water at a solid ratio of 1/5 -solution (Soclo *et al.,* 1999).

Statistical analysis

The data collected during the various observations were analyzed using Xlstat 2007 software to analyze the variance at the threshold of 5% and a Newman-Keuls test was average mean comparison.

Results

Physico-chemical characteristics of the soil

The particle size, pH, available phosphorus, total nitrogen and organic matter are the parameters used for this analysis (Table 2). The results show that the soil silty clay and sandy texture is acidic. It has average content of organic matter, total nitrogen and available phosphorus (Wopereis and Defoer, 1998).

Analysis of fertilizer

In table 3 sawdust and bagasse have acidic pH values (between 5 and 5.5) while the rude scum, boiler ashes and horse manure have alkaline pH values, with respective values of 9, 6; 9.6 and 8.2.

Table 1. The composition of the different treatments.

Treatments	Soil		Fertilizers					
	N_{SS}	S_S	B	N_{SC}	S_C	B_A	H_M	S
T0	2/3	0	1/6	1/6	0	0	0	0
T1	2/3	0	0	1/3	0	0	0	0
T2	2/3	0	0	0	0	1/3	0	0
T3	2/3	0	0	0	0	0	1/3	0
T4	1/2	0	0	0	0	1/4	0	1/4
T5	1/2	0	0	1/4	0	0	0	1/4
T6	1/2	0	1/4	0	0	1/4	0	0
T7	1/2	0	0	1/4	0	1/4	0	0
T8	1/2	0	0	1/4	0	0	1/4	0
T9	2/5	0	0	0	1/5	1/5	1/5	0
T10	0	2/3	0	0	1/5	0	0	0
T11	0	2/3	0	0	0	1/3	0	0
T12	0	2/3	0	0	0	0	1/3	0
T13	0	1/2	0	0	0	1/4	0	1/4
T14	0	1/2	0	0	1/4	0	0	1/4
T15	0	1/2	1/4	0	0	1/4	0	0
T16	0	1/2	0	0	1/4	1/4	0	0
T17	0	1/2	0	0	1/4	0	1/4	0
T18	0	2/5	0	0	1/5	1/5	1/5	0

Legend: N_{SS} = Non sieved soil; S_S= Screened soil; B= Bagasse; N_{Sc}= Non sieved scum; Sc= Screened scum; B_A= Boiler ashes; H_M= Hoarse manure; S= Sawdust.

T0=*Control*=N_{SS} 2/3+B1/6+ N_{SC}; T1= N_{SS} 2/3+N_{SF}1/3; T2= N_{SS} 2/3+B_A1/3; T3= N_{SS} 2/3+H_M1/3; T4= N_{SS} 1/2+B_A1/4+S1/4; T5=N_{SS}1/2+ N_{SC}1/4+S1/4; T6=N_{SS}1/2+B1/4+ B_A1/4; T7=N_{SS}1/2+N_{SC}1/4+B_A1/4; T8= N_{SS}1/2+N_{SC}1/4+H_M1/4; T9= N_{SS}2/5+S_C1/5+B_A1/5+H_M1/5; T10= S_S2/3+S_C1/5; T11= S_S2/3+B_A1/3; T12= S_S2/3+H_M1/3; T13= S_S1/2+B_A1/4+S1/4; T14= S_S1/2+S_C1/4+S1/4; T15= S_S1/2+B1/4+B_A1/4; T16= S_S1/2+ S_C1/4+B_A1/4; T17= S_S1/2+ S_C1/4+ H_M1/4; T18= S_S2/5+S_C1/5+B_A1/5+H_M1/5.

The organic matter content of the (MO) is higher in the rude scums (122 g/kg) compared with sawdust (6 g/kg). This MO rate is intermediate value for the rude scum and horse manure (110 g/kg).

In the boiler ashes organic matter is estimated at 12 g/kg. The total phosphorus content of the substrates varies from 2.1 g/kg (scum) to 0.1 g/kg (sawdust).

The total nitrogen is high in the foam (6.1 g/kg), followed by horse manure with 5.5 g/kg, while this content is average in the bagasse (2.2 g/kg) and very low in sawdust (0.3 g/kg). Influence of treatments on the plants behavior.

Table 2. Physico- chemical characteristics of the soil used.

Physico-	pH		Carbon and mineral elements			Particle size		
	pH_{Water}	pH_{KCl}	Assimilable	Organic	Total	Clay	Silt	Sands
Chemical Characteristics			Phosphorus	carbon	nitrogen			
			(mg/kg)	(g/kg)	(g/kg)	(g/kg)	(g/kg)	(g/kg)
Horizon 0-20cm	4.5	3.8	44	15	1.3	328	515	157

Table 3. Chemical characteristics of the fertilizers used.

	Fertilizers				
Parameters	Bagasse	Rude scums	Boiler Ashes	Hoarse manure	Sawdust
Organic C (g/kg)	26	71	7	64	4
Organic matter (g/kg)	44	122	12	110	6
Nt (g/kg)	2.2	6.1	0.6	5.5	0.3
C/N	11.6	11.7	0.09	11.6	0.09
Total P (g/kg)	0.20	21	0.5	1.8	0.1
pH water	5.5	9.6	9.6	8.2	4.9
pH KCl	5.2	7	8.7	7.2	3.9

Analysis of variance

The effect of organic amendments and organo - minerals was highly significant ($p<0.001$) in stem height, diameter stem and tillering of *Saccharum officinarum* L. (Table 4).

Lifting

The emergence of cuttings was effective from the 11th day after planting (DAP).

All treatments (formulated T1, T3, T5, T7, T13, T15), including control (T0), showed an emergence rate between 87.5% and 100%. Only treatments T14 and T17 feature a number of cuttings (4) and a strike rate (50%) lower compared to the control and other treatments.

Table 5 shows the results of the removal of cuttings in the nursery, in a month of planting in 4 blocks.

Table 4. P-value of the effect of the amendments on the growth parameters.

Parameters	DF*	SS	MS	F	P value
Stem height	18	40931.478	2273.971	20.990	< 0.0001
Stem diameter	18	4998.784	277.710	27.852	< 0.0001
Tillering	18	13123.774	729.099	31.264	< 0.0001

*Degree of Freedom.

Stem height

The height of sugarcane stems increases over time (Table 6) and varies and it varies one treatment to another. The greatest heights were observed, at the 49th DAP, with the T9 treatments (69.28 ± 3.62 cm); T18 (68 ± 4.02 cm) and T16 (67.88 ± 4.13 cm) compared to T0 (32.62 ± 0.75 cm). T9 treatments; T16; T18 which appear most successful, are superior to the control at the 49th DAP, respectively in the order of: 52%; 38% and 33%. However, treatment T14 rather induced an adverse effect on the same parameter of the 7th to the 49th DAP.

Stem diameter

The diametric growth of fertilized plants remains significantly ($p<0.05$) higher than that of plants from control treatments. The average diameter of treatments T9, T16 and T18 increased from 18.23 ± 0.96 mm and 22.05 ± 0.3 mm from the 7th to 49th DAP, a growth rate of 17.32%, while during the same period, that of the control increased by 11.50 ± 0.67 to 13.25 ± 0.58 mm, which represents a growth rate of 23.21%, a difference of 4.11% among the most effective treatments and the witness. Individually 49th DAP, T9, T16 and T18 are higher than To of the order of respectively: 41.40%; 39.40%; 38.90%.

Table 5. Emergence rate (%).

Treatments	Number of Lifted cuttings	Emergence rate after 1 month
To	8	100%
T1	8	100%
T2	6	75%
T3	8	100%
T4	7	87.50%
T5	8	100%
T6	7	87.50%
T7	8	100%
T8	7	87.50%
T9	5	62.50%
T10	5	62.50%
T11	7	87.50%
T12	6	75%
T14	8	100%
T14	4	50%
T15	8	100%
T16	6	75%
T17	4	50%
T18	6	75%

Tillering

The number of tillers (Table 8) increases over time (7th to 49th DAP). The control plants developed fewer tillers compared to the plants grown in fertilized treatments. In the 49th DAP, treatments T9, T8, T16 and T18 induced a greater number of tillers compared with the control and the other treatments, of the order of 44%; 43%; 42% and 39.40%, respectively: 34 ± 1.20; 33.75 ± 4.30; 33 ± 1.40 and 31.75 ± 1.50 tillers.

Discussion

Effect of treatments on emergence

The lifting is consistent with literature data. Indeed, Hainzelin et Hekimian (2009); Fillols and Chabalier (2007) reported that germination of sugarcane cuttings takes place between the 10th and 15th day after planting when soil and weather conditions are good.

Effect of scum on the measured parameters

In this study, the foams appear, the foam appears to be an effective liming. Indeed, when associated in combination treatment (T9, T16 and T18), these scums in horse manure and/or boiler ash, the height parameters, diameter and tillering have known better development. This result is explained by the chemical wealth of amendments which strengthen the pool of ions in the solution of a soil deficient as is the case. Oyewole and Mera (2010) on *H. sabdariffa* L., Choudhary and Kumar (2013) on corn, Ognalaga *et al.* (2015) on *A. cruentus* L. obtained similar results after the contribution of organic manure. Kopp (1929) in his study on sugar cane fertilization showed that the foam can be a fertilizer both nitrogen, phosphorus and calcium medium chemical richness. The fertilizers used (scums, boiler ashes and horse manure) are rich in nitrogen and phosphorus needed

for growth and development of culture (Fillols and Chabalier, 2007; Soobadar, 2009). The beneficial effect of nitrogen on plant growth has been reported in many works (Ayoola and Makinde, 2008; Choudhary and Kumar, 2013; Maman and Mason, 2013). Similarly, Didier (2013) demonstrated that a high level of nitrogen not only increases plant biomass but also the non-sugar components content of the root. Recently Ognalaga *and al.* (2015) suspected that the high elongation of seedlings *A. cruentus* L. observed following the use of Pig manure (30t/ha) could be related to the wealth of this nitrogen fertilizer.

Table 6. Effect of the fertilizers on the stem height (cm).

	Day After Planting (DAP)			
Treatments	7	21	35	49
T0	26.63±1.70^{ab}	28.75±0.96^{ab}	30.25±0.96^{ef}	32.63±0.75^{fg}
T1	32±1.15^{a}	35.75±2.99^{a}	40.25±3.40^{de}	43.48±2.82^{ef}
T2	29,25±4.11^{a}	35.25±3.95^{a}	39.5±4.73^{de}	44.35±4.64d^{ef}
T3	33.5±1.73^{a}	38.75±4.20^{a}	43.25±2.63^{cde}	48.63±4.46^{cdef}
T4	30,88±3.33^{a}	38.63±8.70^{a}	46.5±7.85^{cde}	50.30±7.80^{cdef}
T5	20.50±8.30^{b}	29±7.62^{ab}	32.13±9.20^{ef}	33.85±9.56^{fg}
T6	30.75±3.40^{a}	41.75±8.77^{a}	46.50±8.90^{cde}	49.50±7.40^{cdef}
T7	35.75±4.52^{a}	42.75±4^{a}	52±3.90^{c}	62.55±5,50^{ab}
T8	31.38±2.14a	40.13±3.70^{a}	47±3.74^{cde}	52.55±1.80^{bcde}
T9	41.13±2.32^{a}	49.50±6.24^{a}	64.75±1.30^{a}	69.28±3.60^{a}
T10	31.25±20.90^{a}	36.25±24.2^{a}	46±31^{ab}	48.83±32.70^{ab}
T11	31.75±1.70^{a}	37±2.45^{a}	44±2.71^{cde}	49.75±5,20^{cdef}
T12	28.13±19.25^{a}	30.75±21.09^{a}	36.25±24.34^{cde}	39.98±26.80^{bcde}
T13	31.6±4.50^{a}	43.75±3.80^{a}	49.75±5.12^{cd}	54.60±7.16^{bcde}
T14	13.13+9.31^{b}	15±10.61^{b}	19.75±13.50^{f}	23.50±15.70^{g}
T15	36.88±5^{a}	43±6.2^{a}	49.75±5.80^{cd}	56.50±5.20^{bcd}
T16	32.88±5.70^{a}	47.50±5^{a}	63.25±0.96^{a}	67.88±4.15^{a}
T17	27.38±18.85^{a}	34.25±23.20^{a}	40±27.30^{bc}	43.88±30.15^{abc}
T18	36±5.90^{a}	45.50±8.20^{a}	62.25±1.90^{a}	68±4^{a}

*Means with the same letters in the column are not significantly different.

Effect of combinations of treatments on the measured parameters

The best growth (height, diameter and tillering) *Saccharum officinarum* L. was observed with the T9 treatment consists of: Topsoil (unscreened) Horse manure; scums (dimmed) and boiler ashes. This superior effect of T9, compared to other treatments, could have several origins.

The high concentration of nitrogen due to the combination of scum and horse manure, both rich in this element. Indeed, Lompard *et al.* (2005) have demonstrated that nitrogen is the essential element for the growth, the amount of nitrogen absorbed by the plant determines the level of absorption of other minerals.

Moreover, it is reported in the literature that combinations of treatments that combine organic manure and inorganic or organo-mineral fertilizer induce a good plant growth and good yields (Ayoola and Makinde, 2008).

Good growth *Saccharum officinarum* L., observed in treatments comprising the scum and the boiler ash, may also be related to the pH of these two substrates. Indeed, their alkaline pH had to improve the soil and promote good mineral nutrition of the plant (Soobadar, 2009; Muladji, 2011; Ognalaga and Itsoma, 2014).

The beneficial effect of treatment was more pronounced at the 49th DAP (4 months of plantation) for all parameters studied. This stage is the period of very strong vegetative growth and photosynthetic activity in which sugar cane assimilates nutrients (nitrogen, phosphorus, potassium and trace elements) it needs for its growth in height, training its roots and its tillering (Werker *et al*., 1999).

Table 7. Effect of the fertilizers on the stem diameter (mm).

	Day After Planting (DAP)			
Treatments	7	21	35	49
T0	11.50±0.67^{h}	11.83±0.55^{h}	12.08±0.54^{g}	13.25±0.58^{e}
T1	13.85±0.70^{fgh}	14.05±0.75^{efgh}	14.35±0.87^{defg}	17.38±0.96^{bcde}
T2	15.48±0.43^{defg}	15.85±0.44^{bcd}	16.23±0.41^{bcd}	18.71±0.54^{b}
T3	16.83±0.67^{bcd}	17.25±0.52^{b}	17.68±0.67^{b}	18.40±0.74^{bc}
T4	13.80±0.64^{fgh}	14.30±0.54^{defgh}	14.83±0.55^{defg}	16.65±1.89^{bcde}
T5	13.10±1.02^{h}	13.65±1.11^{fgh}	14.05±1.01^{efg}	15.10±1.60^{de}
T6	13.73±1.16^{fgh}	14.73±1.07^{cdefg}	15.15±1.04^{def}	16.95±1.71^{bcde}
T7	14.78±0.49^{efgh}	15.20±0.52^{cdef}	15.68±0.50^{cde}	17.19±0.80^{bcde}
T8	15.88±0.95^{cdef}	16.63±0.29^{bc}	17.05±0.44^{bc}	18.27±0.97^{bc}
T9	18.88±1.52^{a}	20.58±0.13^{a}	21.13±0.49^{a}	22.60±0.10^{a}
T10	9.48±6.33^{h}	9.68±6.47^{gh}	9.93±6.64^{fg}	11.93±8.05^{bcde}
T11	15.40±0.10^{defg}	15.63±0.10^{bcde}	16±0.22^{bcd}	17.94±1.30^{bc}
T12	10.13±6.80^{gh}	10.40±7^{efgh}	10.63±7.20^{defg}	11.83±7.90^{bcde}
T13	13.35±2.04^{gh}	14.78±2.23^{cdefg}	15.18±2.34^{def}	17.19±2.10^{bcde}
T14	10.29±7^{fgh}	11±7.30^{cdefg}	11.15±7.44^{defg}	11.56±7.70^{cde}
T15	16.40±0.10^{bcde}	16.68±0.05^{bc}	17.20±0.14^{bc}	17.93±1.02^{bc}
T16	17.53±0.05^{abc}	20.18±0.61^{a}	20.90±0.52^{a}	21.85±0.30^{a}
T17	12.39±8.30^{bcde}	12.58±8.40^{bc}	13.08±8.75^{cde}	13.35±8.90^{bcd}
T18	18.28±1.30^{ab}	20.05±0.50^{a}	20.60±0.6^{a}	21.70±0.50^{a}

*Means with the same letters in the column are not significantly different at $p < 0.05$.

Organic matter, which contributes to the structuring of the soil (Gbadamosi, 2006; Choudhary and Kumar, 2013; Ognalaga *et al*., 2015), has reactive sites that set much of the abundant minerals in the middle. In the treatment combinations, the scum and the humified horse manure act as adsorption complex. Thus they would do and put aside the mineral elements both from ashes and organic substrates. *Saccharum officinarum* L. may use those found in solution and as the depletion of ions in pool solution occurs,

there is slow and gradual release of nutrients (Uddin *et al.*, 2009; Adesina and Sanni, 2013; Ognalaga and Itsoma, 2014) retained on the adsorbent complex. This hypothesis is consistent with the findings of Kopp (1929), and the reaction thus contemplated is an asset that can encourage the development of a fertilizer-based organic matter humified and ashes as efficient fertilizer.

The depressive effect of treatment T14 on the longitudinal growth of *Saccharum officinarum* L. could be a combination of factors including the negative impact of sawdust (Belkacem, 1992; Ba *et al.*, 2014).

Table 8. Effect of the fertilizers on the tillering.

	Day After Planting (DAP)			
Treatments	7	21	35	49
T0	9.75±1.70^{ab}	14.25±1^{g}	17.75±1de	19.25±1.50^{e}
T1	18.75±4.45^{a}	23.75±2.10^{cd}	25.75±2.70^{bcd}	27.25±1.70^{bcde}
T2	15±5.70^{ab}	21.25±3.60^{de}	25±3.60^{bcd}	27.25±2.10^{b}
T3	15.25±2.70^{ab}	21.50±1.80^{de}	23.25±1.70^{cd}	24.75±1.50^{bc}
T4	10±1.70^{ab}	16±1,40^{g}	17.50±1.30^{e}	20±1.70^{bcde}
T5	8.50±3.40^{b}	16.25±2.70^{g}	19.50±1.90^{de}	21.75±2.70^{de}
T6	15.50±4.40^{ab}	21.50±1.30^{de}	24.50±2.90^{cd}	26.50±2.10^{bcde}
T7	17.50±4.20^{ab}	24.50±1.30^{bcd}	26.75±0.50^{bc}	28.25±0.50^{bcde}
T8	19.50±1.30^{a}	30±4.10^{a}	32.25±4.70^{a}	33.75±4.30^{a}
T9	17±5.40^{ab}	27.75±1.70^{ab}	31.50±1.90^{a}	34±1.20^{a}
T10	12.50±8.70^{ab}	15.75±10.53^{def}	18.50±12.40^{cd}	19.25±13^{bcde}
T11	15±2.50^{ab}	17.25±1.70^{fg}	21±1.70^{de}	25.75±0.50^{bc}
T12	12±8.30^{ab}	17±11.40^{de}	18.75±12.60^{bcd}	19.75±13.20^{bcde}
T13	12.25±3.30^{ab}	18.50±2.70^{efg}	21.75±2.80^{cde}	23.50±2.10^{bcde}
T14	9.50±6.40^{ab}	11.75±7.90^{g}	13.75±9.20^{de}	15.50±10.50^{cde}
T15	12.25±1.70^{ab}	16.50±1.30^{g}	19±10de	21.25±1.50^{bc}
T16	17.75±6.40^{ab}	27.25±1^{abc}	30±2,60^{ab}	33±1.40^{a}
T17	10.75±7.50^{ab}	13.75±9.30^{efg}	16±10.90^{cde}	17.50±11.80^{bcd}
T18	17.25±3.30^{ab}	25.50±0.6^{bcd}	29.75±1.70^{ab}	31.75±1.50^{a}

*Means with the same letters in the column are not significantly different at $p < 0.05$.

Conclusion

Organic and organo-mineral amendments have had a significant effect ($p < 0.05$) on the improvement of various growth parameters (height, diameter and tillering) of sugarcane (*Saccharum officinarum* L.) in nursery.

However, apart from the adverse effects, these amendments did not affect positively the emergence. It also emerged that the amendments are more effective as a combination of treatments from their isolated application. This pattern of results is encouraging and should help to improve the nursery phase in bucket during the varietal selection process. Thus, at the end of the study, T9 treatment; T16 and T18 may be recommended for an extension on the site SUCAF Gabon.

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