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Study On Physico-Chemical Properties Of Composts And Their Effects On Growth, Yield And Fruits Quality Of Capsicum Annum L. At Dang Locality (Ngaoundéré Cameroon)

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Abstract: *In order to increase sustainably Capsicum annum L. production, study was conducted on effects of compost quality on productivity of this vegetable in Ngaoundéré-Cameroon. Composting was conducted from February to May 2017 and the field trial was carried out during the June-September cropping season of the same year. Determination of pH, conductivity, organic matter, nitrogen, phosphorus, iron, magnesium and calcium, as well as growth of C. annum plants and physico-chemical properties of fruits were assessed. Randomized complete block design with 5 treatments and three replications was used. Treatments were applied per plant: composts derived from holdhouse waste (COM), cattle manure (CBV), mixture holdhouse waste-cattle manures (CM) ; NPK 20-10-10 chemical fertilizer (T+) (positive control) and negative control (T-). Compost improved the overall soil fertility by significantly (p < 0.05) increasing the organic matter and nutrients elements like phosphorus, calcium, magnesium and iron. COM, T+, CBV and CM treatments increased fruit yield respectively at 222 %, 202 %, 157 % and 140 % compared to T- treatment. In addition, vitamine C, calcium and magnesium contents of fruit from T+ plants are significantly lower (p<0.05) than that from others treatments. Vitamin C content of fruits from amended compost plants is higher at 02 times than that from T+ fruits.These results suggest that the quality and the origin of composting substrate were important not only for improving the growth and fruit yield of C. annum, but also for improving chemical properties of fruits.*
Key words: *Capsicum annum L., productivity, composts, Ngaoundéré-Cameroon*

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I. Introduction

The world population is increasing fastly[1]. It will reach nine billion people by the year 2050. Population growth was rapid in the world in recent decades[2,3]. The Cameroonian population has grown at an annual rate of 2.6% on average from 2005 to 2010. At this rythm, Cameroonian population will double it number in about 27 years, ie around 2037[4]. Most changes in farming practices aim to increase yields in order to find a solution to people's food needs.This leads to overexploitation and severe degradation of agricultural land with consequence the decline of agricultural productivity and the abandonment of a large number of soil conservation practices[5]. In addition, the loss of soil fertility is a fundamental problem that limits plants productivity in Adamawa Cameroon region where soils are subject to leaching by rainwater and floods[6]. International organizations (Food Agricultural Organisation and World Bank) recommend to double the agricultural production in order to meet the high demand for food products and reduce the risk of malnutrition[7].

Vegetables are important sources of carbohydrates, vitamins and minerals. Capsicum annum L. (Sweet pepper) which belongs to Solananceae family, is known as a vegetable, and consumed both as fresh anddehydrated spices[8]. The fruits of sweet pepper are rich in mineral elements such as calcium (13‰) and magnesium (10‰). It is particularly rich in vitamin C (150‰) and its content in this vitamin is higher than that of lemon[9]. It is a good antioxidant[10]. C. annum is the third most selling vegetable in the world after tomatoes and chilli pepper. This plant has been extensively grown in China, Mexico, France and Nigeria. Cameroon exports sweet pepper to Gabon and Equatorial Guinea[11].

Adamawa Cameroon's farmers mostly use chemical fertilizers for sweet pepper crop. However, the using of chemical fertilizers exhibites an immediate beneficial effect on crop productivity and provides an immediate solution to declining soil fertility problem, their high cost make them almost inaccessible to small farmers[12]. Furthermore, its exclusive use causes an increase in acidity, a degradation of the physical status and a decrease in soil organic matter[13]. In this context, the introduction of low-cost agricultural practices aiming at increasing agricultural production and based on the respect of ecological functionalities is necessary[14]. In this respect, several authors[15, 16, 17, 18,19] studied the effect of natural fertilizers on plant productivity and reported that these fertilizers improve soil fertility durablely and increase plants yield. To the limit of our knowledge, no studies have been carried out on effect of organic fertilizer such as composts on the yield of C. annum and quality of fruits in Adamawa Cameroon region. Therefore, culture of C. annum by using composts would not only help to improve plants productivity and fruits quality, but also to ensure sustainable agriculture.

Worldwide, there is an increasing interest to use compost as a trail to compensate the decrease in soil fertility. Compost has the advantage of improving the soil quality and crop yields through increased oligoelements[20], rendering plants resistant to diseases[21], and thus is appropriate for a sustainable agriculture for poor resource farmers[22]. This organic amendment is rich in mineral elements needed for plant growth. It improves soil physical characteristics[23, 24] as well as its biological composition. Compost also contributes to sanitation of the environment or considerable reduction of intoxication and diseases risks[25]. This investigation was designed to produce compost derived from cattle an holdhouse wastes and to study their potentials on field growth of C. annum and fruits quality in Adamawa Cameroon region.

II. Material and methods

Study Site

The study was carried out within the campus of the University of Ngaoundere (Dang) in the year 2017. The Adamawa region (Cameroon) covers about 62000 km^2 and belongs to the agro-ecological zone II known as the Guinean savannahs with six months dry (November to March) an draining season each (April to October) [26, 27, 28]. The annual rainfall is 1479 mm, with a coefficient of variation of 9.8 % [29]. The temperature ranges from 5°C to 7°C for the minima, and 30°C to 35°C for the maxima, while the average hygrometry varies from 37.7 % to 81 %[30]. The study site waslocated at latitude 03°38'805", at longitude 08°20'806" and at 1106 m elevation.

Materials

Capsicum annum seeds

The sweet peppers seeds (average 4 mm length and 3 mm width) variety (Yolo Wonder) was bought on the local market of Ngaoundere Cameroon. They are produced by Technisem and then imported and distributed in Cameroon by SEMAGRI (Figure 1). This variety was chosen for its early germination, its presents great adaptability to rainy season and has short reproduction cycle (three months).

Figure 1 : Capsicum annum seeds variety (Yolo Wonder)

Fertilizers: composts and chemical fertilizers

The different composts used in this study are produced at the experimental composting unit of the Laboratory of Biodiversity and Sustainable Development located behind the deanship of the University of Ngaoundere. Three types of compost are used. It is compost derived from cattle manure, kitchen manures and the mixture of cattle-kitchen manures. Chemical fertilizers was bought on the local market of Ngaoundere Cameroon (figure 2). It is NPK (20-10-10) chemical fertilizer. It is compound of 20% N, 10% P_2O_5 and 10% K_2O).

Figure 2 : NPK (20-10-10) chemical fertilizer

Methods

Composting and assessment of physico-chemical properties of composts

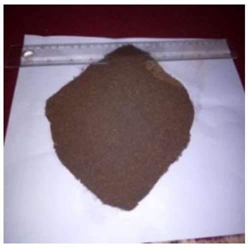
Composting

Cattle manure originated from a sheep-pen located nearby the campus were sequentially collected from 8-9 am daily according to its availability. Holdhouse wastes were collected from Ngaoundere University hostels and restaurant waste bins from 17-18 pm everyday. All the particles resistant to biodegradation were manually discarded, leaving potatoes, stems of legumes, banana peelings, residues of fruits, stems of legumes and other food wastes. Both kitchen and cattle manures were stored in 50 kg bags and then, transported in the composting area using a rickshaw.

The composting experiment was conducted in 825 m^2 area.Composting process took place from December 2016 to April 2017 (05 months). Composting in pile[31] was used in the process. Herbs and shrubs are removed from the composting site. Then for each compost pile the site is moistened and watered with 1.5 L of bin juice (inoculum). This bin juice is rich in various microorganisms involved in the process of organic matter degradation. Then for each pile of compost, 2 Kg of Tithonia diversifolia leaves are spread on the ground. 1.5 L of inoculum is sprayed on these leaves and a layer of raw material (50 Kg) is spread on the moist soil. Finally, 1.5 L of bin juice is sprayed on this layer. After this first arrangement, the pile is watered using water. The same process was repeated three times in order to obtain a pile with 150 Kg weight of biodegradable material weight and 1 m height. Finally each pile was covered with a black plastic in order to increase internal temperature of background and to allow the thermophilic microorganisms to enter in activity. Watering and turning took place at regular interval of 10 days to maintain moisture and to ensure good degradation of raw material.100 g of mature compost from each pile and soil from study site was sampled for physico-chemical analysis that was performed in the Chemistry laboratory of Institute University of Technology, University of Ngaoundéré-Cameroon.

a) Composting on the 1st day

b) Pile of compost



c) Mature compost

Figure 3 : Compost appearance at different stages of composting

Assessment of the physico-chemical properties of composts

The studied physical characteristics include conductivity, color and moisture content. Conductivity was measured using conductimeter (Model ORION 105 – Range 0 – 199.99 dS m-1 ± 0.01, USA). Moisture content throughout this study was measured by dryingat 105^{o}C for approximately 24 h or until obtaining a constant weight using oven-drying according to [32].

In regards to chamical properties of composts and growing soil, pH was measured using pH meter (Model ORION 230A – Range -2 – 19.99 ± 0.01, USA. Total organic matter was determined by calcining samples in the oven at 550 °C according to [33] and the ash residual was used for some mineral determination. Total nitrogen is determined after mineralization of samples according to the Kjeldahl method[34] and the dosage is carried out according to calorimetric technique of [35]. The phosphorus and iron were assessed based on the methods described [36]. Asseessment of calcium and magnesium were carried out by titration with Ethylene Diamine TetraAcetic [37].

Evaluation of composts on Capsicum annum growth and yield

Land preparation and experimental design

Experimental field was plowed at 50 cm depth and elementary plot of 15 m^2 area (5 m × 3 m) was formed. The experimental field measures 27 m × 10 m (270 m^2). The experimental design was randomized complete block design with three replicates and 5 treatments: negative controlor growing soil (T-) ; positive control : NPK (20-10-10) chemical fertilizer (T+) ; compost derived from cattle manure (CBV) ; compost derived from holdhouse waste (COM) and compost derived from 50% cattle manure + 50% holdhouse waste (CM)). Two consecutive blocks and two consecutive elementary plots are spaced at 50 cm. Each elementary unit contain 30 plants spaced at 50 cm × 65 cm. Sowing took place on june 2017 and 40 days after sowing, young plants with 20 cm height and 8 leaves was transplanted in the experimental farm. 200 g of compost and 50 g of chemical fertilizer was applied per plant.

Figure 5: Experimental site after plowing and formation of elementary plots

A : Nursery at 30 DAS

B : Nursery at 40 DAS

Figure 6 : Capsicum annum nursery at 30 DAS (A) and at 40 DAS (B)

DAS = days after sowing

Determination of fruit yield and yield related traits

During the vegetative phase, growing parameters (plant height and number of leaves per plant) were measured on 30 targeted plants at regular intervals of 14 days from the 14^{th} day after transplantation ; the dry biomass and stem diameter of plants were evaluated at flowering on 10 targeted plants at the center of the plots. Leaf area was calculated using the classical formula: leaf area = 2/3(B x b) where B = leaf length and b=maximum leaf width (Ngatchou, 1987 ; Noubissié, 2011). Fruit yield was assessed at maturity on a sample of 30 plants using this formula: R (t/ha) = Q × 10000 where R = fruit yield estimated in t/ha; Q = average fruit weight per plant and 10000 = number of plants per hectare.

Evaluation of physicochemical characteristics of fruits and statistical analyses

The physical characteristics studied include: length, diameter and fresh weight. Fruits diameter and fruits length are evaluated using digital caliper (Transitek, model LCD 5 digit) with precision 0,01 mm. Fruit weight is evaluated using electric scale with precision 0.001 g and 30 fruits are sampled. The chemical properties include the content of fruits in vitamine C, calcium and magnesium. Vitamine C content was assessed based on titrimetric method according to [38]. Calcium and magnesium assays were carried out by titration with Ethylenediaminetetraacetic acid [37].

All data were statistically analyzed using the Stagraphic plus Program version 5.0. The significance of differences was determined using Duncan test.

III. Result and discussion

Physico-chemical properties of composts

The physico-chemical properties (conductivity ; moisture content ; pH ; total organic carbon, organic matter, nitrogen, phosphorus, iron, calcium, magnesium and C/N ratio) of composts produced are presented in Table 1. The results obtained generally show that there is a significant difference ($p<0.05$) between various compost obtained in this study : compost derived from cattle manure (CBV), holdhouse waste (COM) and the mixture of cattle-holdhouse wastes (CM).

Globally, moisture content, organic matter content, pH and conductivity of composts are 21.77 ± 0.49%; 30.61 ± 3.12%, 8.06 ± 0.18; 78.26 ± 0.14 µS/cm respectively. This is in conformity to [39] who studied the influence of various composts on protection of plants against fungal diseases and reported that compost pH was 9. Additionally, [40] studied the evolution of physico-chemical characteristics and biological stability of household waste during composting in France and found that the organic matter and moisture content of compost are respectively 49 and 47.9%. The chemical properties studied: nitrogen, carbon, magnesium, calcium, phosphorus and iron content are respectively 2.55 ± 0.33, 17.80; 0.47 ± 0.08; 0.8 ± 0.09; 0.79 ± 0.03% and 11.76 ± 0.53 ‰.

Organic matter content of different composts produced in this work varies from 27.63 ± 4.72 % for CM to 34.66 ± 1.22% for CBV. Organic matter content of COM (29.54 ± 3.41%) and CM (27.63 ± 4.72%) are close to each other compared to CBV (34.66 ± 1.22%). Organic matter presents an important role in managing better soil fertility. It improves plants growth througth mineral elements released in the soil. In addition, it improves soil structure and increases the useful of water reserve. Organic matter increases nutrients storage such as calcium, potassium and phosphorus [41].

Composts pH varied from 6.95 ± 0.03 for CBV to 9.79 ± 0.12 for COM. Among three produced composts, the both CBV and CM presented neutral pH while COM pH was basic. This result is close to data observed by several authors [24, 42] who reported that composts pH is relatively neutral (8). In addition, the works of [39] revealed that compost derived from household garbage presented basic pH (9). The Hydrogen Potential (pH) measures chemical activity of hydrogen ions (H^+) in solution. It has an influence on assimilation of nutrients and trace elements by plant [43]. Soil acidity is a real problem for enhancing plants growth. Indeed, acidification causes the loss of base cations, an increase in aluminium saturation and a decline in crop yields [44]. In this study, compost pH is greater than pH of growing soil suggesting that ours composts could decrease the acidity of growing soil, thus contribute to imporve soil fertility and plants growth.

Table 1 : physico-chemical properties of mature composts derived from cattlle manure and holdhouse waste

Paramètres	**T-**	**CBV**	**COM**	**CM**
Color	reddish brown	black	black	black
T hum (%)	5.83 ±0.15^a	24.65± 0.88^c	13 .11± 0.16^b	27.55± 0.44^d
Mo (%)	12.11±0.10^a	34.66 ± 1.22^b	29.54± 3.41^b	27.63 ± 4.72^b
pH	4.57±0.20^a	6.95 ± 0.03^a	9.79 ± 0.12^c	7.43± 0.40^b
Cond (µS/cm)	39.31±0.19^a	66.97 ± 0.06^b	97.30 ± 0.27^d	70.50 ± 0.10^c
N (%)	4.23±0.59^c	1.29±0.03^a	3.64±0.95^b	2.71±0.01^b
C (%)	7.04±0.10^a	20.15±0.32^c	17.17±0.29^b	16.06±26^b
C/N	1.66	15.62	4.71	5.93
Fe^{2+} (‰)	1.81±0.07^a	2.17 ±0.02^a	13.95±1.07^b	19.15±0.49^c
Mg (%)	0.10±0.02^a	0.22±0.10^b	0.91±0.11^c	0.29±0.04^b
Ca (%)	0.49±0.00^a	1.08±0.08^c	0.76±0.07^b	0.56±0.11^a
P (%)	0.41±0.02^a	0.56±0.01^a	0.95±0.02^c	0.87±0.05^b

COM =Compost derived from holdhouse waste ; CBV = Compost derived from cattle dejection ; T- = control compost or soil from experimental study ; Cond =conductivity ; T hum =moisture content ; Values in the same line followed by the same letter are not significantly different.

Nitrogen content of compost obtained in the present study ranges from 1.29 ± 0.03 % for CBV to 3.64 ± 0.95% for COM. Among three composts produced, nitrogen content value of both COM (3.64 ± 0.95%) and CM (2.71 ± 0.01%) are close to each other compared to CBV (1.29 ± 0.03%). The lowest nitrogen content of CBV can be explained by the fact that nitrogen is essential for biosynthesis of proteins in the living organisms. Proteins have important biological role on growth and development of all organs but also on antibodies, enzymes and hormones production. Thereby, the lowest nitrogen content in CBV would be explained by the fact that cattle would have used most nitrogen contained in the forage for their needs, but this need to be studied. The value of nitrogen content of our compost derived from cattle manure line with the data found by [45] who reported that total nitrogen content of compost derived from cow manure is 2.22%. Nitrogen is part of amino acids constitution. It is an essential element for cell formation and photosynthesis (it is part of chlorophyll constitution). It is a main factor of plant growth [41].

Phosphorus content of ours compost ranges from 0.56 ± 0.01% for CBV to 0.95 ± 0.02% for COM. Phosphorus content of COM and CM are close to each other compared to CBV. These findings are in conformity to data found in literature. Indeed, [45] reported that total phosphorus content of compost derived from cow manure is 0.86%. Phosphorus presents several physiological roles for plant productivity. It promotes plants growing. It is an essential element for tissue rigidity ; flowering ; fruits maturity and magnification ; root development [46]. A suitable supply of phosphorus allows harmonious plant development.

Overall, organic matter, nitrogen and phosphorus contents of compost produced in this work are 30.61 ± 3.12, 2.55 ± 0.33 and 0.79 ± 0.03% respectively. 12.11 ± 0.10, 4.23 ± 0.59 and 0.41 ± 0.02% are respectively for the soil ofexperimental site. Composts obtained in this study are richer in mineral elements than soil of study site suggesting that these composts could be used for improving the soil fertility of our experimental site. However the influence of this organic fertilizer on sweet pepper growth needs to be investigated. Furthermore, [47] reported that sweet pepper growth well on soils rich in nitrogen. In this study, COM is richer in nitrogen than CBV and CM suggesting that sweet pepper traited with COM would be more productive, but this need to be studied.

Capsicum annum growth and development response to compost quality

Stages of development and survival plants rate

Regarding the stages of development of sweet pepper, plants emergence rate, 50% of flowering and fruiting dates are noted according to treatments. Seedling emerged at 8 days after transplantation (DAT). 50% flowering dates of negative control plants (T-) and those of sweet pepper plants from plot treated using chemical fertilizers (NPK : 20-10-10) ; compost derived from cattle manure (CBV) ; compost derived from holdhouse waste (COM) and compost derived from mixture cattle manure and holdhouse waste (CM) are respectively 65, 57, 55, 55 and 56 DAT. 50% fructification dates are respectively 70, 66, 60, 60 and 65 DAT. These results on stages of development of plants suggesting that different fertilizers used in this study stimulate the flowering and fructification of sweet pepper plants compared to T- plants.

The survival plants rate was evaluated at maturity at 65 DAT. The survival rate of sweet pepper plants from T-, T+, COM, CBV and CM plots was respectively 91.11, 90, 95.33, 96.78 and 96.67%. Globally, the mortality rate of sweet pepper plants from composted seedling was 3.67% while it was 10% from plot treated with chemical fertilizer. The survival plants rate from composted plot is significantly ($p<0.5$) higher (96.33%) than those from T- and T+ plots, suggesting that amended compost plants would be more resistant to diseases, but this needs to be investigated.

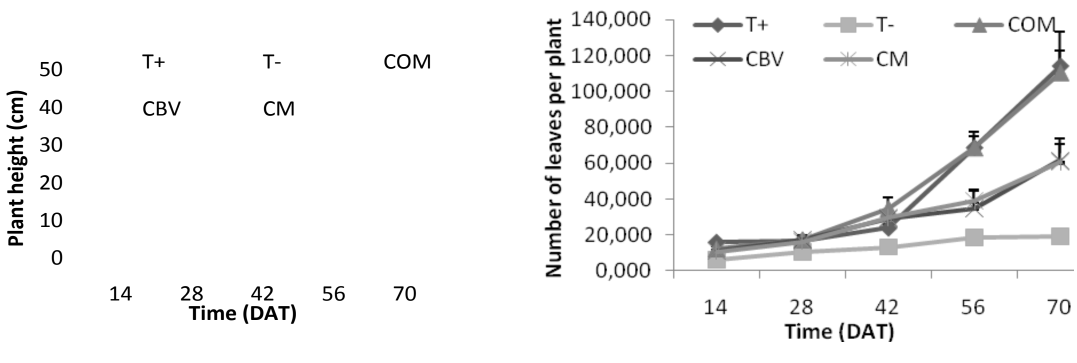
Capsicum annum growth response to compost quality

The analysis of variance revealed that, at maturity there is a significant difference ($p <0.05$) between fertilizers using in this study on morphological characteristics studied (plant height, number of leaves per plant, stem diameter at collar, branches number per plant and dry biomass of plants). Negative control(T-) plants presented significantly ($p<0.5$) the less values of growing parameters studied whereas plants treated with compost derived from holdhouse waste(COM) or NPK (20-10-10) chemical fertilizer (T+) presented the highest value of these growth parameters.C. annum plants amended with compost derived from cattle manure (CBV) and compost derived from mixture cooking-cattle manures (CM) exhibited an intermediate values.

Variation in the plants height and number of leaves per plant

Figure 6 shows sweet pepper plant height depending time and treatments. T- plantsexhibited the smallest plants height (16.733 ± 1.569 cm), while the highest (41.8 ± 3.09 cm) was observed on COMplants. The heights of T+, CBV and CM plantswere 39.43 ± 3.54, 29.57 ± 3.30 and 24.7 ± 1.66 cm respectively. Height ofamended COM was 2.5 folds greater than that of unfertilized plants while the heights of plants grown on T +, CBV and CM plots are respectively 2.4, 1.8 and 1.5 folds greater than that of T- plants. There was a significantly positive correlation between sweetpepper plants height and number of leaves per plant ($r = 0.84$; $p <0.0001$). In this study, amended COM plants had the highest height, suggesting that these plants will exhibit the greatest leaf production and therefore the highest fruit yield, but this remains to be investigated.

At maturity, at 70 DAT, T- plants (19.37 ± 1.74) presented the lowest number of leaves per plant, while the greatest (114.4 ± 25.88) was observed on T+ plants. The number of leaves per plant of sweet pepper grown on plots amended with COM, CBV and CM are respectively 110.43 ± 22.72, 61.67 ± 11.97 and 60.63 ± 9.83. Leaf production is an indicator of fruit yield [48]. Leaves are the organs responsible for photosynthesis, increasing of sweet pepper leaf production suggest an increase of photosynthetic activity, consequently an increase of fruit yield. In this respect, we expected a greater fruit yield on plants grown on plots fertilized with T + and COM. The number of leaves per sweet pepper plants from plots treated with T + was 6 folds greater than T- plants, whereas those of plants amended with COM, CBV and CM are respectively 5.7; 3.2 and 3.1 folds greater than that of T- plants.



A B

Figure 6 : Variation on plant height (A) and number of leaves per plant (B) according to time and fertilizers

COM =Compost derived from holdhouse waste ; CBV = Compost derived from cattle dejection ; T-= control compost or growing soil; T+ : chemical fertilizer NPK (20-10-10) ; DAT=Days after transplantation

Stem diameter, branches numberand leaf area of Capsicum annum

Table 2 summarizesthe stem diameter at collar, branches number per plant and leaf area of Capsicum annum according to fertilizers. Thestem diameter ranged from 4.6 ± 1.07 for T- plants to 7.67 ± 1.57 cm foramended COM plants. The stem diameter of COM, T+, CBV and CM plants arerespectively 1.7, 1.6, 1.3 and 1.3 folds greater than that of unfertilized plants.The number of branches per plants ranged from 3.93 ± 0.83 for T-plants to 26.93 ± 3.70 for T+ plants. The number of branches per plant of T+, COM, CBV and CM plants are respectively 6.9, 5.5, 2.8 and 2.7 folds greater than that of T- plants. Leaf area varied from 17.03 ± 1.00 for unfertilizedplants to 67.89 ± 6.53 cm^2 for T + plants. Leaf areas of T +, COM, CBV and CM plants are respectively 4, 3.4, 2.3and 3.1 folds greater than that of T- plants.Dry biomass of plants ranged from 12,40± 1,97 for T- plants to 19.88 ± 18.86g for CBV plants. The dry biomass of CBV plants is 1.6 folds greater than the dry biomass of unfertilizedplants, while the dry biomass of plants grown on plots fertilized using COM, CM and T+ are respectively 1.22; 1,25 and 1,32folds greater than that of T-plants.

Table 2 : Growth parameters and fruit yield depending treatments

Paramètre	T-	T+	COM	CBV	CM
DSC (cm)	4.61 ± 1.07^a	7.31± 1.93^c	7.67 ± 1.57^c	6.19± 0.94^b	6.02 ± 1.11^b
NB	3.93± 0.83^a	26.93 ± 3.70^d	21.7 ± 3.52^c	10.90 ± 2.52^b	10.5 ± 1.70^b
LA (cm^2)	17.03± 1.00^a	67.89 ± 6.53^d	57.42± 4.60^{cd}	38.42 ± 5.07^b	53.15 ± 1.44^c
DBP(g)	12.40± 1.97^a	16.37 ± 2.87^{ab}	15.17 ± 0.99^b	19.88 ± 2.86^b	15.58 ± 2.97^b
R(t/ha)	12.86±1,21^a	26.09±1.72^b	28.00±2.14^b	20.29±1.54^d	19.09±1.48^d

COM =Compost derived from holdhouse waste ; CBV = Compost derived from cattle dejection ; CM=compost derived from mixture holdhouse waste and kitchen manure ; T-= control compost or growing soil ; T+=NPK (20-10-10) chemical fertilizer ;DSC = diameter of stem at collar; NB = number of branches per plant; LA = leaf area; DBP = dry biomass of plants;R = fruit yield;Values in the same line followed by the same letter are not significantly different.

Fruit yield

Sweet pepper fruit yield (t/ha) depending fertilizers is presented in table 2. The analysis of variance shown that the different treatments applied to pepper in this study influenced significantly ($p < 0.01$) sweet pepper fruit yield. T- plants exhibited significantly ($p < 0.01$) the less fruit yield. In this study, fruit yield ranged from 12.86±1,21for T- plants to 28.00±2.14 t/ha for amended COM plants. The pepper fruit yield values obtained in this study are lower than data found in literature. Indeed, [9] conducted the studies on sweet pepper cultivation under greenhouse and reported that fruit yield ranged from 40 to 80 t/ha. The low value of fruit yield obtained in this work would be justify by the fact that the amount of compost applied per plant would be insufficient to ensure optimal production of our sweet pepper, but this remains to be investigated. In addition, several authors has shown that greenhouse crops are more productive than field crop. In this study, the work was conducted in the field.COM, T+, CBV and CM treatments increased fruit yield respectively at 222, 202, 157 and 140% compared to T- treatment.

In this study, results obtained on C. annum growth and development shown that amended compost plants and sweet pepper plants treated with NPK (20-10-10) chemical fertilizer are significantly ($p < 0.05$) more productive than negative control plants. The beneficial effect of compost on plant productivity has been demonstrated [19, 49, 50]. In addition, [51] studied the effect of compost derived from sugar cane scum on Hibiscus sabdariffa L. growth in Gabon and reported that compost amendment increased the production to 13% compared to control.Compost presents a major role in maintaining soil fertility and improves sustainable agricultural production. This natural fertilizer is rich in mineral elements needed for plant growth.In addition, studies have shown that local resources such as organic waste, applied to poor and acidic tropical soils, can provide nutrients for plant nutrition and productivity [13]. Integrating compost into agricultural system of our region can reduce the risk of soil nutrient deficits and moderate the losses in crop yield and improve the quality of agricultural products. In this respect, it would be interesting to study the effect of composts produced in this study on physico-chemical properties of sweet pepper fruits.

Effects ofcomposts derived from cattle and holdhouse wastes on physicochemical properties of fruits

Table 3 summarizes the physicochemical properties of sweet pepper fruits depending treatments. Physical characteristics ofpepper fruits studied (length, maximal diameter and weight) from negative control (T-) plants was significantly lower ($p < 0.01$) than from fertilized plants whereas fruits harvested on plots treated with compost derived from holdhouse waste (COM) or with NPK (20-10-10) chemical fertilizer (T+) presented significantly the greatest values of physical characteristics and fruits from plants amended using compost derived from cattle manure (CBV) and mixture cooking-cattle manures (CM) presented intermediaite values. Overall, the physical characteristics of fruits harvested on amended compost plants are 02 folds greater than those of fruits T- plants while length, diameter and weight of fruits from T+ plants are respectively 1.2, 1.8 and 2.5 foldsgreaterthan thoseof fruits from T- plants. There was a positive and significant correlation between fruit weight and fruit length ($r = 0.50$; $p<0.0002$), fruit weight and fruit diameter ($r = 0.80$; $p <0.0001$) and between fruit length and fruit diameter ($r = 0.44$; $p <0.0001$).

Treatments apply to sweet pepper plants influenced significantly ($p<0.05$) the studied chemical properties of fruit. Vitamin C content of sweet pepper fruits ranged from 224.86 ± 11.80 for T+ plants to 472.03 ± 17.78 ‰ for COM plants. The vitamin C content of fruits from T- (272.01 ± 18.18 ‰) and T+ treatments (224.86 ± 11.80 ‰) are close to each other and also vitamin C content of fruits from COM (472.03 ± 17, 78 ‰) and CBV treatment (439.42 ± 3.20 ‰) presented the values close to each other. The values of Vitamine C content of fruits obtained in this study are higher than data reported by [52] who reported that Vitamine C content of sweet peppeer fruits was 150 ‰.Vitamine C content of fruits from T+ treatment is less than those from fruit harvested on other treatments. Vitamin C contents of fruits from COM treatment are respectively 2.1, 2, 1.5 and 1.2 folds greater than fruits harvested on T+ plots. All composts used in this study would stimulated the biosynthesis of vitamin C in the fruits ofours sweet peppers and vitamine C content of fruits from COM plants is the highest.

Table3 : Physico-chemical characteristics of the fruits of Capsicum annum depending treatment

Parameters	T-	T+	COM	CBV	CM
LF (mm)	66,08±12,59[a]	78,85±13,96[b]	85,25±9,99[b]	62,11±4,63[a]	80,53±11,86[b]
PF(g)	39,96±16,26[a]	99,66±13,88[c]	99,45±9,20[c]	76,47±4,94[b]	82,37±13,14[b]
DF (mm)	36,89±6,72[a]	65,10±5,11[c]	63,57±5,10[c]	54,11±4,88[b]	52,89±5,60[b]
Vit C (‰)	272,01±18,18[b]	224,86±11,80[a]	472,03±17,8[e]	439,42±3,20[d]	327,99±4,54[c]
Mg (‰)	4,09±1,05[a]	20,22±0,52[bc]	21,61±0,66[c]	16,92±4,89[b]	17,31±2,24[bc]
Ca (‰)	4,00±0,60[a]	12,17±1,63[b]	25,80±3,23[d]	20,38±1,92[c]	23,15±1,33[cd]

COM =Compost derived from holdhouse waste ; CBV = Compost derived from cattle manure ; CM=compost derived from mixture holdhouse waste and cattle manure ; T-= control compost or growing soil ; T+=NPK (20-10-10) chemical fertilizer ;LF =lenght of fruits ; DF = maximal diameter of fruits ; PF =weight of fruits ; values in the same line followed by the same letter are not significantly different.

In this study, Ca and Mg contents of fruits ranged respectively from 4.00 ± 0.60 and 4.09 ± 1.05 ‰ for T- plant to 25.80 ± 3.23 and 21.61 ± 0.66 ‰ for COM plants. These findings on Ca and Mg content of sweet peppers fruit line the studies of [52] who reported that Ca and Mg contents of fruits are respectively 13 and 10 ‰. Fruits obtained on amended compost plant contain more Ca (23,11 ± 1,16 ‰) than Mg (18,61 ± 2,60 ‰) whereas fruits harvested on T+ plants are richer in Mg than in Ca. Fruits from COM plants presented the highest value of Ca (25.80 ± 3.23‰) and Mg (21.61 ± 0.66‰). There is no significant difference on Mg content of fruits between fertilizers used, however Ca content of fruits from T+ plants (12.17 ± 1.63‰) is significantly lower than those of amended compost plants.In general, sweet pepper fruits from amended COM plants are richer in vitamin C and minerals elements (Ca and Mg) than those from other treatments. The higher Ca and Mg contents of fruits from amended compost plants would explained by the fact that composts producing in this study will provide minerals elements in soil of our study area, justifing the higher value of Ca and Mg in sweet pepper fruits from amended compost plants.

IV. Conclusion

The purpose of this study was to improve durablely the productivity of Capsicum annum L. in Adamawa Cameroon region. Physicochemical properties of composts derived from cooking and cattle manures and their effect on C. annum growth as well as quality of fruits have been outlined. Results show that they are significant difference ($p<0.05$) between composts used on studied parameters. Compost derived from holdhouse waste is richer in nutrientselements (N, P, Fe, Mg and Ca) compared to others. Compost derived from holdhouse waste and NPK (20-10-10) chemical fertilizer increase fruit yield respectively at 222 and 202% compared to growing soil. The fruits of sweet pepper from plants treated with chemical fertilizer are less rich in vitamin C, calcium and Magnesium compared to those from amended compost plants and unfertilized plants. The vitamin C content of fruits from compost derived from holdhouse wasteis 2.1 folds greater than those from negative control plants.By producing and using compost for plant growth and development in the Adamawa Cameroon region, we contribute not only to crop growth, to environmental sanitation and to reduce the utilisation of chemical fertilizers that pollute the environment and induce soil poverty, but also to enhance minerals elementsand vitamine C contentsofsweet pepper fruits that can contribute to solve the lack of vitamine C that suffer a lot of pregant women inAdamawa Cameroon region. Further research will be emphasized on the potentials of this natural fertilizer on reduction of C. annum diseases in Adamawa Cameroon region.

References

[1]. FAO (Food and Agriculture Organization). Utilisation des phosphates naturels pour une agriculture durable. Bulletin Fao engrais et nutrition végétale. 2004 ; 176 p.

[2]. Bellefontaine R, Mhirit O, Et-tobi M. Arbres hors foret : Extension et précision du concept. 2001 ; 201 p.

[3]. ICRAF (International Center for Research in Agroforestry). Rapport annuel des populations. Naîrobie : Kenya. 2003 ; 76p.

[4]. Anonyme (MINEPAT). La population du Cameroun en 2010 (3è RGPH). Ministère de la Planification et de l'Administration Territoriale. 2010 ; 67p.

[5]. Koulibaly B. Caractérisation de l'acidité des sols et gestion de la fertilité des agrosystèmes cotonniers au Burkina. Thèse de doctorat, Université de Ouagadougou, Burkina Faso. 2011 ; 183p.

[6]. Mohamed. Seaweeds: A sustainable functional food for complementary and alternative therapy. Trends in food Science and technology. 2012 ; 23 (2): 83-96.

[7]. Pitrat M. et Foury C. Histoires de légumes des origines à l'orée du XXI siècle. INRA Editeur, Piments. 2003 ; pp. 278-289

[8]. Bosland PW, Vostava EJ.) Peppers: vegetable and spice capsicum. CABI publishing, New York, USA. 2000.

[9]. Elattir H, Skiredj M, Elfadl A. Transfert de Technique en Agriculture. Fiches techniques V : la tomate, l'aubergine, le poivron, le gombo. Bulletin Mensuel d'Information et de Liaison du PNTTA. 2003 ; 100: 24-67

[10]. Willcox G. Measuring grain size and identifyingNearEasterncereal domestication : evidencefrom the Euphratesvalley. Journal of Archaelogical Science. 2004 ; 33(2) :145-150.

[11]. AGRI-STAT (Statistiques Agricoles). Statistiques du secteur Agricole Campagne 2006 et 2007.N° 015. Direction des Enquêtes et Statistiques Agricoles du Ministère de l'Agriculture et du Développement Rural-Cameroun. (2009) ; 111p.

[12]. Useni SY, Chukiyabo KM, Tshomba KJ, Muyambo ME, Kapalanga KP, Ntumba NF, Kasangij AKP, Kyungu KA, Baboy LL, Nyembo KL, Mpundu MM. Utilisation des déchets humains recyclés pour l'augmentation de la production du maïs (Zeamays L.) sur un ferralsol du sud-est de la RD Congo. Journal of Applied Biosciences. 2013; 66:5070 – 5081

[13]. Obalum SE, Chibuike GU, Peth S, Ouyang Y. Soil organic matter as sole indicator of soil degradation. Environ Monit Assess. 2017 ; 189:176

[14]. Megueni C, Awono ET, Ndjouenkeu R. Effet simultané de la dilution et de la combinaison du Rhizobium et des mycorhizes sur la production foliaire et les propriétés physico-chimiques des jeunes feuilles de Vignaunguiculata(L) Walp. Journal of Applied Biosciences. 2011 ; 40:2668-2676.

[15]. Nwaga D. Biofertilisant Myco. 4è édition, février 2008, Université de Yaoundé I. 2008 ; 6p.

[16]. Ngakou A, Ngo NL, Ngo BM, Fankem H, Adamou S, Kamguia K, Nwaga D, Etoa FX. Inoculation and screening of indigenous Bambara Groundnut (Vignasubterranea) nodulatingbacteria for theirtolerance to someenvironmental stresses. American journal of MicrobiologicalResearch. 2014 ; 3(2) :65-75.

[17]. Sawant VS, Bansode KG, Bavachkar SN, Bhale UN. Potential of Various Fungi for Biomass Production of Castor.Parkistan Journal of Biological Sciences. 2013; 16: 1378-1382.

[18]. Tchuenteu TL. Caractérisation agronomique des accessions locales de ricin (Ricinuscommunis L.) cultivées en champ dans le Grand Nord Cameroun et évaluation des propriétés physico-chimiques des graines. Thèse de doctorat phD. Faculté des sciences. 2014 ; Université de Ngaoundéré. 135p.

[19]. Yaya F, Nguetnkam JP., Tchameni R, Basga SD, Penaye J. Assessment of the Fertilizing effect of Vivianite on the Growth and yield of the Bean ''phaseolus vulgaris'' on Oxisoils from Ngaoundere (Central North Cameroon). International Research Journal of Earth Sciences. 2015 ; 3(4) : 18-26

[20]. Wiart J. Qualité, maturité et efficacité agronomique des composts de déchets verts : synthèse de références. Session de formation : valeur agronomique des composts. 1997 ; 17 21/3/1997

[21]. Tremier A, De Guardia A, Massiani C, Paul E, Martel Jl. A respirometricmethod for characterising the organic composition and biodegrationkinetics and the temperatureinflunce on the biodegradationkinetics, for a mixture of sludge and bulking agent to bec o-composted. Bioresourcetechnology. 2005 ; 96 :169-180.

[22]. FAO. Republic of Tunisia. Ministry of agriculture and hydric resources. General office of agricultural production. Converting biological agriculture. DGPA/FAO/FIBL. 2006 ; pp 4-33.

[23]. Evanylo G, Sherony C. Economic and environmentaleffects of compost use for sustainablevegetable production. International compost Science and Utilisation Conference, Columbus. 2002 ; pp. 730-740

[24]. Landes E, Timmermann F, Grosskopf W, Ziegler W. Verbund-Forschungsprojekt Kompostverwertung in der Landwirtschaft-Zwischenbericht

[25]. Mariet C (1996) Removing wastes from urban community of Creusot-Montceau. Techn. Sci. Meth. 2002; 12: 24-28

[26]. Antiaobong EE, Bassey EE. Characterization and evaluation of six sweet potato varieties (Ipomoea batatas (L.) Lam.) for quantitative and qualitative characters and tolerance to Cylaspuncticollis (Boh.) in high humid environment of Southeastern Nigeria. J. Agric. Res. Policies. 2009;4(1):17-21

[27]. Rippstein. Etude de la végétation de l'Adamaoua. Evolution, régénération et amélioration d'un écosystème pâturé au Cameroun. IEMVT, 11, Maison Alfort. 1985 ; 367p

[28]. Megueni C, Ngakou A, Makalao MM, Kameni TD. Response of soybean (Glycine max L.) to soil solarization and rhizobial inoculation at Dang Ngaoundéré, Cameroun. Asian Journal of plant Science. 2006; 5(5): 832-837.

[29]. Yonkeu S. Végétation des pâturages de l'Adamawa (Cameroun) : écologie et potentialités pastorale. Thèse doctorat. Université de rennes I, France, 1993 ; pp. 155-190

[30]. Mope Simo, J.A. Annual report on the activities of provincial service of the communal development inAdamawa, Ngaoundéré. 1997 ; 95 p

[31]. Rieux C. What is the fertilizer value of composts? Les Publications agricoles franco-ontariennes. 2006.

[32]. AFNOR (Association Française de Normalisation). Recueil des normes françaises des produits dérivés des fruits et legumes. Jus de fruits. 1ère éd., Paris la défense (France). 1982.

[33]. AFNOR Recueil de normes françaises. Corps gras, graines oléagineuses, produits dérivés. AFNOR, Paris (France), 2ème édition. 1981.

[34]. AFNOR. Recueil de normes françaises. Produits agricoles alimentaires : directives générales pour le dosage de l'azote avec minéralisation selon la méthode de Kjedahl. AFNOR, Paris (France). 1984.

[35]. Devani MB, Shishoo JC, Shal SA, Suhagia BN. Spectrophotometricalmethod for determination of nitrogen in Kjeldahl digest. JAOAC. 1989; 72: 953-956

[36]. Rodier J. L'analyse de l'eau : chimie, physico – chimie, bactériologie, biologie. 6ème éd., Dunod Technique, Paris (France). 1978.

[37]. AFNOR. Recueil des normes françaises. Eaux – Méthodes d'essai.AFNOR, Paris (France). 1986.

[38]. Harris LJ, Ray SN. Determination of ascorbic acid in urine. Method using titration with 2, 6 dichlorophenol indophenol. Lancet1 .1935; (176): 462

[39]. Mohamed L. Influence de la qualité des composts et de leurs extraits sur la protection des plantes contre les maladies fongiques. Thèse présentée à la Faculté des Sciences de l'Université de Neuchâtel, Tunisie. 2006; 80p

[40]. Morel J L, Guckert A, Nicolardot B, Benistant D, Catroux G. Etude de l'évolution des caractéristiques physico-chimiques et de la stabilité biologique des ordures ménagères au cours du compostage. Agronomie, EDP Sciences. 1986 ; 6 (8) : 693-701

[41]. UNIFA (Union des industries de la Fertilisation). Le Diamant A.92909 PARIS CEDEX. 2015

[42]. Kahle P, Belau L. Model experimentstesting the effects of biowaste compost in agriculture. OT : ModellversuchezurPrufung der verwertungsmoglichkeitenvonBiofalkompost in der Landwirtschaft. AgribiologicalResearch. 1998 ; 51 : 193-200

[43]. Genot V, Colinet G, Bock L. La fertilité des sols agricoles et forestiers en Region Wallonne. Laboratoire de géopédologie, Unité sol-écologie-territoire, Faculté des sciences agronomiques de Gembloux. 2006; 73p

[44]. Goulding KWT. Soil acidification and the importance of liming agricultural soils with particular reference to the United Kingdom. Soil Use and Management. 2016 ; 32 : 390–399

[45]. Adande R, Fiogbe ED. Utilisation des fertilisants organiques d'origine animale et végétale pour le développement de la pisciculture dans les étangs. International Journal of Multidisciplinary Research and Development. 2015 ; 12(2).281-287

[46]. FAO 2005. Food security in the context of economic and trade policy reforms: insights from country experiences. CCP 05/11. Rome.

[47]. Tremblay N, Senécal M. La production des plants maraîchers multicellulaires. Bulletin d'information, Quebec. 1991 ; 35p

[48]. Tchuenteu TL, Meguini C, Njintang YN. A study of the variability for grain and oilyield and yieldrelated traits of castor beans accessions in twosavaanh agro-ecological zones of Cameroon. International Journal of Biosciences. 2013 ; 3(8) : 251-263

[49]. Mihoub A. Dynamique du phosphore dans les systèmes sol-plante en condition pédoclimatiques Sahariennes. Thèse. Mag. Université Ouargla. 2012 ; 101 p

[50]. Ngakou A, Megueni C, Noubissié E, Tchuenteu TL. Evalution of the physic-chemical properties of cattle and kitchen manure derived compost and their effect on field grown Phaseolus vulgaris L. International journal of sustainable crop-production. 2008; 3(5):13-32

[51]. Ognalaga M, M'Akoué MD, MedzaMve SD, Ovono PO. Effet de la bouse de vaches, du NPK 15 15 15 et de l'urée à 46% sur la croissance et la production du manioc (ManihotesculentaCrantz var 0018) au Sud-Est du Gabon (Franceville). Journal of Animal &Plant Sciences. 2017; 31(3): 5063-5073

[52]. Mougeot LJA. Urban agriculture: definition, presence, potential and risks. In :Growing cities, growing food. Feldafing, Allemagne. 2000; pp. 67-96.

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