OPEN ACCESS
Haya: The Saudi Journal of Life Sciences
Abbreviated Key Title: Haya Saudi J Life Sci
ISSN 2415-623X (Print) |ISSN 2415-6221 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: http://scholarsmepub.com/haya/

**Original Research Article**

# Growth, Fruits Yield and Fruits Physicochemical Properties of *Capsicum annum* L. as Affected by Compost and Vivianite Powder at Dang Locality in Adamawa Cameroon

Tchuenteu Tatchum Lucien*, Maimouna Abba, Simeu Ngalle Yolande Christelle, Megueni Clautilde

Department of Biological Sciences, Faculty of Sciences, University of Ngaoundere, Unnamed Rd, Yaounde, Cameroon

**DOI:** 10.36348/SJLS.2019.v04i09.005 | **Received:** 02.10.2019 | **Accepted:** 09.10.2019 | **Published:** 27.10.2019

***Corresponding author:** Tchuenteu Tatchum Lucien

## Abstract

*Capsicum annum* L. (sweet pepper) is a vegetable which belongs to Solanaceae family. In order to increase sustainable sweet pepper production, study was conducted on effect of natural fertilizers on its productivity under Sudano-Guinean climate of Adamawa Cameroon. Randomized complete block design with 07 treatments and 03 replications was used. Treatments that applied per plant were: compost (CBV); 20 g of vivianite (V20); 30 g of vivianite (V30); CBV and V20 mixture (CBV + V20); CBV and V30 mixture (CBV + V30); chemical fertilizer (T+) and unfertilized plants (T-). Stage of plants development; growth and yield as well as fruits physicochemical characteristics were evaluated. Results showed that flowering and fruiting of treated plants by natural fertilizers (compost and vivianite) were early compared to T- and T+ plants. Fruits yield from mixture of 1 kg of compost + 20 g of vivianite was significantly ($p<0.05$) higher than that from the other treatments and is 1.46 fold higher than that from T+ plants. Overall, fruits from treated plants by natural fertilizers are richer in vitamin C and mineral elements than those from T- and T+ plants. Fruits vitamin C content from amended compost plants is 1.60 fold higher than that from T+ plants. These results suggest that the quality of natural fertilizer is important not only for improving sweet pepper growth and fruits yield, but also for improving nutritional value of fruits. 1 kg of compost + 20 g of vivianite mixture is recommended to sweet pepper grower of Adamawa Cameroon.

**Keywords:** *Capsicum annum* L., compost, vivianite, growth, physicochemical properties, Adamaoua-Cameroon.



## INTRODUCTION

*Capsicum annum* L. (sweet pepper) is an annual plant known as Solanaceae family. It is native to Mexico and Central America. It is used as a vegetable-fruit in most dishes [1]. This Solanaceae is becoming more and more one of the most consumed spices in the world. Dietary and nutritional qualities of sweet pepper are excellent [2]. Sweet pepper fruits are rich in mineral elements such as calcium (13 ‰) and magnesium (10 ‰). It is particularly rich in vitamin C (150 ‰) and its content in vitamin C is greater than that of lemon [3]. Also, sweet pepper fruits are a good antioxidant [4]. Sweet pepper is the third most popular market gardening crop in the world after tomatoes and peppers. Worldwide sweet pepper production is estimated at 24.5 million tons per year [5]. China, Mexico, Turkey, Spain and the United States are the major producers and account for 72% of this production. China is the largest producing country with an average annual production, about 10 million tons (44.5% of total world production) [5]. Cameroon exports sweet pepper to Gabon and Equatorial Guinea [6].

Adamawa Cameroon peasants most often use chemical inputs for sweet pepper cultivation [7]. However, the use of chemical fertilizers, presents immediate beneficial effect on crop productivity, provides an immediate solution to declining fertility problem, but their high cost and unavailability make them almost inaccessible to small farmers. In addition, its exclusive use leads to a decrease of soil fertility [8]. In this context, the introduction of low-cost agricultural practices aimed at increasing agricultural production and based on the respect of ecological functionalities is necessary [9]. Our recent studies on sweet pepper in Cameroon aim to improve the plants growth. In this respect [7], study the Physicochemical properties of various composts and their effects on growth, yield and fruits quality of *C. annum* at Dang locality (Ngaoundéré Cameroon) and revealed that compost derived from

cattle manure improve fruits yield and fruits vitamin C content compared to chemical fertilizer.

However, no work has been carried out on sweet pepper fertilization based on rock powder in Cameroon. In this respect, mixture of compost and rock powder for sweet pepper cultivation would contribute not only to improve plants growth, to environmental sanitation and to reduce the utilisation of chemical fertilizers that pollute the environment and induce soil poverty, but also to enhance mineral elements and vitamine C contents of fruits that can contribute to solve the lack of vitamine C that suffer a lot of pregant women in Adamawa Cameroon region. Compost and rock powder play a major role in maintaining soil fertility and consequently, in sustainability agricultural production. These natural fertilizers are rich in mineral elements needed for plant growth. They improve soil physical characteristics [10, 11] as well as soil biological composition.

The purpose of this study was to improve durablely the productivity of *C. annum* in Cameroon. Specifically, it consists: (1) to determine the effect of mixture compost and vivianite powder on stages of sweet pepper development in Adamawa Cameroon); (2) to study the effect of compost and vivianite powder on plants growth; (3) to determine the effect of natural fertilizers on fruits physicochemical properties of sweet pepper.

## MATERIALS AND METHODS

### Study Site

Study was conducted within campus of the University of Ngaoundere Cameroon in the season cropping year 2018. Ngaoundere Cameroon belongs to agro-ecological zone II known as sudano-guinean savannahs with six months dry season (November to March) and six months raining season (April to October) [12]. Mean annual temperature and total annual precipitation is respectively 25.75 °C and 1898.6 mm [13]. Study site was located at latitude 03°38'805", at longitude 08°20'806" and at 1106 m elevation.

## MATERIALS

### *Capsicum Annum* Seeds, Compost and Vivianite Powder

*Capsicum annum* L. seeds (average 4 mm length and 3 mm width) variety (Yolo Wonder) was bought on 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). Using variety presented short reproduction cycle is advantageous for farmers. So that, they may have several harvests per year if the have off-season crops [7].

Composts used in this study are produced at experimental composting unit of Laboratory of Biodiversity and Sustainable Development located behind the deanship of the University of Ngaoundere. This compost derived from cattle manure.

Vivianite was collected in Hangloa located at Center North Cameroon at 25 km North-West of Ngaoundere chief town of Adamawa. Hangloa locality is located between 7°20 and 7°30 North latitude and between 13°20 and 13°25 East longitude. Vivianite is powdered using hammer before using in field (Figure-2). It is composed of $Fe_2O_3$ (68.72%), $P_2O_5$ (9.17%), $Al_2O_3$ (7.72%) and $SiO_2$ (9.67 %) [14].

**Fig-1: Sweet pepper seeds**

**Fig-2: Vivianite powder**

## METHODS

### Composting

Cattle manure originated from a sheep-pen located nearly the campus were sequentially collected from 8-9 am daily according to its availability and it was stored in 50 kg bag and then, transported in the composting area. Composting experiment was conducted in 4 $m^2$ area. Composting process took place from December 2017 to April 2018 (05 months). Composting in pile [15] was used in the process. Herbs and shrubs are removed from the composting site. Then for 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 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 pile was covered with a 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 cattle manure degradation [7, 16].



**A)** Composting on the 1st day | **B)** Pile of compost | **C)** mature compost

**Fig-3: Compost appearance at different stages of composting**

**Evaluation of Compost and Vivianite Powder on Sweet Pepper Growth and Yield**

**Land Preparation and Experimental Design**

Experimental site mesured 384 $m^2$ area. Experimental field was plowed at 50 cm depth and elementary plot of 15 $m^2$ area (5 m × 3 m) was formed. Experimental site meseared 21 experimental units was formed. The experimental device used is a complete block with 7 treatments (compost produced with 100% cow dung (CBV), 20g of vivianite powder ($V_{20}$), 30g of vivianite powder ($V_{30}$), CBV and $V_{20}$ mixture (CBV + $V_{20}$). ), CBV and $V_{30}$ mixture (CBV + $V_{30}$), chemical fertilizer NPK (20-10-10) (T +) and unfertilized plants (T-)) repeated 3 times. There were 30 plants per experimental unit (about 1000 plants/ha). Two consecutive plants in an experimental unit spaced 30 cm × 65 cm.

**Determination of fruit yield and yield related traits**

During the vegetative phase, plant height and number of leaves per plant were measured on 30 targeted plants at regular intervals of 14 days from the 14th day after transplantation ; the dry biomass and stem diameter of sweet pepper plants were evaluated at flowering on 10 targeted plants at the center of 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 (figure 4) [17, 18]. 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.


**A:** leaf length | **B:** leaf width

**Fig-4: Measuring of lenght and width of sweet pepper leaf**

**Evaluation of Physicochemical Characteristics of Fruits and Statistical Analyses**

Physical characteristics studied included: length, diameter and fresh weight. Fruits diameter and fruits length were evaluated using digital caliper (Transitek, model LCD 5 digit) with precision 0.01 mm. Fruits weight was evaluated using electric scale with precision 0.001 g and 30 fruits was sampled. Chemical properties include fruits vitamine C content as well as calcium and magnesium contents. Vitamine C content was assessed based on titrimetric method according to [19]. Calcium and magnesium assays were carried out by titration with Ethylenediaminetetraacetic acid [20]. All data were statistically analyzed using the Stagraphic plus Program version 5.0. The significance of differences was determined using Duncan test.

# RESULTS AND DISCUSSION

## RESULTS

**Stage of Plants Development**

Dates of 50 % flowering and fruiting depending on treatment were determined (Table-1). *Capsicuim annum* seeds were germinated at 6th day after sowing for each treatment. Flowering and fruiting of unfertilized plants were late compared to those of plants treated with natural fertilizers (compost and vivianite powder). Indeed, flowering and fruiting of treated plants by compost or vivianite powder were observed at 45th and 52th day after transplantation respectively. Sweet pepper treated with natural fertilizers flourished 8 days and 3 days early than unfertilized plants and plants treated with chemical fertilizer respectively. Also, treated plants by natural fertilizer fructify respectively 8 days and 3 days earlier than unfertilized plants and plants treated using chemical fertilizer.

**Table-1: Dates of germination, 50 % flowering and fruiting depending on fertilizer**

| Stage of plants developement | Traitments | | | | | | |
|---|---|---|---|---|---|---|---|
| | **T-** | **T+** | **CBV** | **$V_{20}$** | **$V_{30}$** | **CBV+$V_{20}$** | **CBV+$V_{30}$** |
| Germination (DAS) | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Flowering (DAT) | 53 | 48 | 45 | 45 | 45 | 45 | 45 |
| Fruiting (DAT) | 60 | 55 | 52 | 52 | 52 | 52 | 52 |

T-: unfertilizer plants (negative control) ; $T^+$ : chemical fertilizer (NPK 20-10-10 : 50g/hole) (positive control); CBV : Compost (1 kg/hole); $V_{20}$ : 20g of vivianite/hole ; $V_{30}$ : 30g of vivianite/hole ; CBV+$V_{20}$ : Mixture CBV with $V_{20}$ ; CBV+$V_{30}$ : Mixture CBV with $V_{30}$ ; DAS : Days after sowing ; DAT : Days after transplantation.

**Effect of mixture compost and vivianite powder on *Capsicum annum* growth**

**Plants height and number of leaves per plant depending to time and fertilizer**

The Analysis of variance showed a significant difference ($p<0.01$) between treatments on plants height and foliar production at maturity. At 70 days after transplantation, unfertilized plants (T-) exhibited the lowest plants height (19 ± 0.95 cm) and the lowest number of leaves per plant (17 ± 0.54) while the tallest plants (31.33 ± 0.95 cm) and the greatest number of leaves per plant (26.33 ± 0.54) were observed on amended plants by compost. Heights of treated plants by chemical fertilizer (T +), fertilized plants by 20 g of vivianite (V20), mixture compost + 20 g of vivianite (CBV+V20) and mixture compost + 30 g of vivianite (CBV+V30) are 19 ± 0.95; 29 ± 0.95; 26.66 ± 0.95; 28 ± 0.95 and 24.66 ± 0.95 cm respectively (figure 5). Plants height from plots treated with compost is 1.64 fold greater than that from unfertilized plants, while plants height from T +, V20, CBV + V20 and CBV + V30 are respectively 1.08; 1.17; 1.11 and 1.27 fold higher than that from T- plants.

The number of leaves per plant from T-; V20; V30; CBV+V20 and CBV+V30 treatments are respectively 26 ± 0.54, 23.66 ± 0.54, 17.33 ± 0.54, 25.66 ± 0.54 and 22 ± 0.54 (figure 6). The number of leaves per plant from CBV treatment is 1.54 fold higher than that from T- plants, whereas foliar production from T +; V20; V30; CBV + V20 and CBV + V30 treatments are respectively 1.01. ; 1.11; 1.51; 1.02 and 1.09 fold higher than that of T- plants.

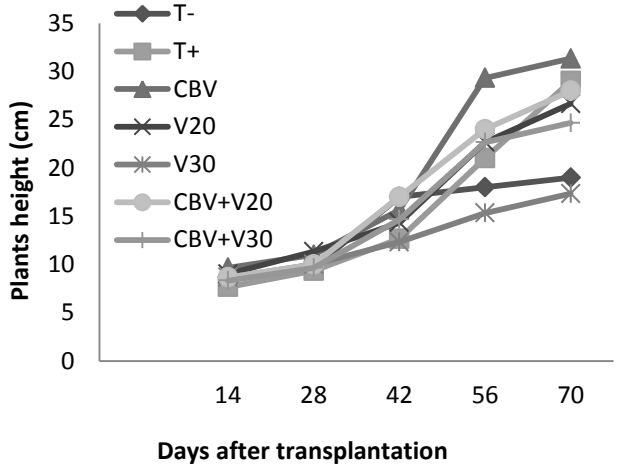


**Fig-5: Variation on plants height**

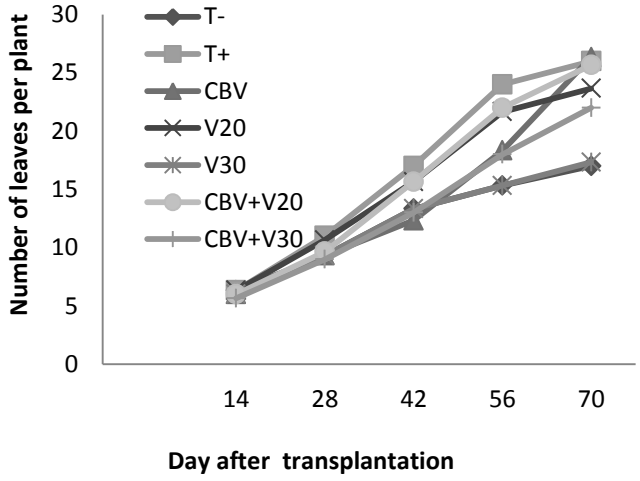


**Fig-6: Variation on foliar production**

T-: unfertilizer plants (negative control) ; $T^+$ : chemical fertilizer (NPK 20-10-10 : 50g/hole) (positive control); CBV : Compost (1 kg/hole); V20 : 20g of vivianite/hole ; V30 : 30 g of vivianite/hole ; CBV+V20 : Mixture CBV with V20 ; CBV+V30 : Mixture CBV with V30

**Diameter of Stem, Leaf Area, Branching and Dry Biomass of Plants at Maturity**

The analysis of variance generally revealed a significant difference ($p <0.01$) between diameter of stem at collar, leaf area, number of branches per plant and dry biomass of plants at 70 days after transplantation (table 1). In this study, the diameter of stem ranged from 2.33 ± 0.66 cm for unfertilized plants (T-) to 6.66 ± 0.66 cm for amended plants by compost (CBV). In this study diameter of stem of CBV plants was 2.21 fold higher than that of T- plants, while the values of this parameter on treated plants by chemical fertilizer (T +); 20 g of vivianite (V20); 30 g of vivianite (V30); mixture compost + 20 g of vivianite and mixture compost + 30 g of vivianite are respectively 1.40; 1.40; 1.82; 1.55 and 1.47 fold higher than that of T- plants.

The number of branches per plants ranged from 4.66 ± 0.84 for T- plants to 10.33 ± 0.84 for CBV

plants. Branching numbers of CBV plants are 2.21 fold greater than that of T- plants, while the number of ramification per plant from T +, V20, V30, CBV + V20 and CBV + V30 treatments are respectively 1,40; 1.40; 1.82; 1.55 and 1.47 fold higher than those from T- treatment.

In this study, Foliar surface of CBV + V30 plants is 1.57 fold higher than that of V30 plants, whereas plants treated with T-, T +, CBV, V20 and CBV + V20 are 1.42; 1.13; 1.50; 1,69 and 1,18 fold greater than that of V30 plants.

Plants dry biomass ranged from 1.19 ± 0.85 g for V30 treatment to 5.75 ± 0.85 g for CBV treatment. Dry biomass of CBV plants is 4.83 fold higher than that of treated plants by V30, while dry biomass of plants from T-, T +, V20, CBV + V20 and CBV + V30 plots are respectively 3.40; 1.20; 1.37; 1.11 and 1.34 fold higher than that of plants from V30 plot.

**Table-2: Diameter, leaf area, branching and dry biomass of plants depending to fertilizer**

| Traitments | Parameters | | | |
|---|---|---|---|---|
| | DC (cm) | LE ($cm^2$) | NBP | DBP (g) |
| **T-** | $2.33 \pm 0.66^{a}$ | $23.33 \pm 3^{ab}$ | $4.66 \pm 0.84^{a}$ | $1.69 \pm 0.85^{a}$ |
| **T+** | $3.66 \pm 0.66^{a}$ | $25.66 \pm 3^{ab}$ | $7.33 \pm 0.84^{b}$ | $4.79 \pm 0.85^{c}$ |
| **CBV** | $6.66 \pm 0.66^{b}$ | $32.33 \pm 3b^{c}$ | $10.33 \pm 0.84^{c}$ | $5.75 \pm 0.85^{c}$ |
| **$V_{20}$** | $4.33 \pm 0.66^{a}$ | $24.33 \pm 3^{ab}$ | $7.33 \pm 0.84^{b}$ | $4.17 \pm 0.85^{bc}$ |
| **$V_{30}$** | $3.66 \pm 0.66^{a}$ | $21.66 \pm 3^{a}$ | $5.66 \pm 0.84^{b}$ | $1.19 \pm 0.85^{a}$ |
| **CBV+$V_{20}$** | $4.33 \pm 0.66^{a}$ | $31 \pm 3b^{c}$ | $6.66 \pm 0.84^{ab}$ | $5.16 \pm 0.85^{c}$ |
| **CBV+$V_{30}$** | $4.33 \pm 0.66^{a}$ | $36.66 \pm 3^{c}$ | $7.00 \pm 0.84^{ab}$ | $4.29 \pm 0.85^{bc}$ |

T-: unfertilizer plants (negative control) ; $T^{+}$ : chemical fertilizer (NPK 20-10-10 : 50g/hole) (positive control); CBV : Compost (1 kg/hole); V20 : 20g of vivianite/hole ; V30 : 30 g of vivianite/hole ; CBV+V20 : Mixture CBV with V20 ; CBV+V30 : Mixture CBV with V30 ; DC: diameter of stem at collar; LE: leaf area; NBP: number of branches per plant; DBP: dry biomass of plants; Column values affected by the same letter are not significantly different ($p < 0.05$).

**Fruits yield at 105 days after transplantation**

Figure-8 shows fruits yield of sweet pepper expressed in t/ha at 105 days after transplantation. It appears from this result that there is a significant ($p<0.05$) difference between treatments on fruits yield. Treated plants by mixture of 1 kg of compost and 20 g of vivianite powder exhibited the highest fruits yield (59.33 ± 0.05 t/ha) and the lowest value of this production parameter (26.66 ± 0.12 t/ha) is observed on sweet pepper grown on unfertilized plot. Fruit yields of treated plants based on chemical fertilizer, compost, 20 g of vivianite, 30 g of vivianite and mixture compost + 30 g of vivianite powder are respectively 40.66 ± 0.17; 48.66 ± 0.28; 44 ± 0.15; 34 ± 0.08 and 51.33 ± 0.08 t/ha. The mixture of 1 kg of compost and 20 g of vivianite powder increases fruits yield of 122.54 % and 45.91 % relative to unfertilized plants and treated plants using chemical fertilizer respectively.

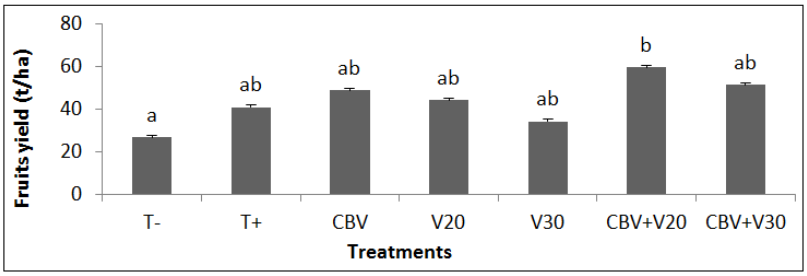


**Fig-8: Fruits yield depending on treatments**

T-: unfertilizer plants ; $T^{+}$ : chemical fertilizer (NPK 20-10-10 : 50g/hole) ; CBV : Compost (1 kg/hole); V20 : 20g of vivianite/hole ; V30 : 30 g of vivianite/hole ; CBV+V20 : Mixture CBV with V20 ; CBV+V30 : Mixture CBV with V30 ; bands values affected by the same letter are not significantly different ($p < 0.05$)

**Fruits Physicochemical Characteristics of Sweet Pepper**

**Fruits Physical Characteristics**

Fruits physical characteristics of sweet pepper obtained in this study are presented in Table-3. Analysis of variance (ANOVA) shows that sweet pepper fruits harvested on plots that received no fertilizer, provided significantly ($p <0.05$) the smallest values of studied physical characteristics (length, width and weight). Overall, there is no significant difference between fertilizers used on fruit physical characteristics. Length, width and weight of fruits varied respectively from 55 ± 3.84 cm, 42.33 cm and 65.66 ± 7.91 g for fruits from unfertilized plants to 74.00 ± 3.84 cm, 53,33 ± 2.87 cm and 108 ± 7.91 g for fruits from treated plants based on mixture 1 kg of compost + 20 g of vivianite powder. Fruits weight from mixture 1 kg of compost + 20 g of vivianite powder is 1.64 fold higher than that of fruits from unfertilized plants.

**Table-3: Physical characteristics of fruits depending to treatment**

| Treatments | Parameters | | |
|---|---|---|---|
| | Lenght (cm) | Diameter (mm) | Weight (g) |
| T- | 55 ±3.84$^{a}$ | 42. 33±2.87$^{a}$ | 65. 66±7.91$^{a}$ |
| T+ | 69.66±3.84$^{bc}$ | 56. 66±2.87$^{cd}$ | 92.33±7.91$^{bc}$ |
| CBV | 69.66±3.84$^{bc}$ | 61. 33±2.87$^{d}$ | 106. 33±7.91$^{c}$ |
| $V_{20}$ | 64±3.84$^{abc}$ | 49. 33±2.87$^{abc}$ | 100. 33±7.91$^{c}$ |
| $V_{30}$ | 61.66±3.84$^{ab}$ | 44. 33±2.87$^{ab}$ | 72. 33±7.91$^{ab}$ |
| CBV+$V_{20}$ | 74±3.84$^{c}$ | 53. 33±2.87$^{cd}$ | 108±7.91$^{c}$ |
| CBV+$V_{30}$ | 75±3.84$^{c}$ | 52±2.87$^{bc}$ | 84. 66±7.91$^{abc}$ |

T-: unfertilizer plants (negative control) ; $T^{+}$ : chemical fertilizer (NPK 20-10-10 : 50g/hole) (positive control); CBV : Compost (1 kg/hole); V20 : 20g of vivianite/hole ; V30 : 30 g of vivianite/hole ; CBV+V20 : Mixture CBV with V20 ; CBV+V30 : Mixture CBV with V30; Column values affected by the same letter are not significantly different ($p < 0.05$)

**Nutritional Values of Fruits**

The analysis of variance (ANOVA) revealed a significant difference ($p<0.05$) between treatments on vitamin C content, calcium content and magnesium content of sweet pepper fruits (Table-4). Overall, fruits harvested on plants treated with natural fertilizer (1 kg of compost per plant (CBV), 20 g of vivianite per plant (V20), 30 g of vivianite per plant (V30), mixture compost + 20 g of vivianite per plant (CBV + V20) and mixture compost + 30 g of vivianite per plant (CBV + V30)) were significantly ($p <0.05$) higher in vitamin C, calcium and Magnesium than fruits from unfertilized plants (T-) and fruits from treated plants using chemical fertilizer (T+). Moreover, there is no significant difference ($p <0.05$) between treatments used in this work on fruits dry matter content.

Fruit Vitamin C content ranged from 208.13 ± 18.38 mg/100 g of dry matter for T- treatment to 403.71 ± 37.61 mg/100 g of dry matter for CBV treatment. In this study, fruits vitamin C content from CBV plants is 1.93 fold higher than that of fruits from T- plants while vitamin C content of fruits harvested on T +, V20, V30, CBV + V20 and CBV + V30 plots are respectively 1.59; 1.05; 1.13; 1.07 and 1.09 fold higher than that of fruits from T- plots. However, sweet pepper fruits from CBV plots are richer in Vitamin C than those from other treatments.

In this study, fruits calcium content ranged from 110.42 ± 22.04 mg/100 g of dry matter for T- treatment to 374.52 ± 157.03 mg/100 g of dry matter for V30 treatment. On the other hand, fruits magnesium content varied from 5.12 ± 1.02 mg/100 g of dry matter for T+ to 17.32 ± 1.83 mg/100 g of dry matter for CBV + V20 treatment.

**Table-4: Chemical properties of sweet pepper fruits depending on treatment**

| Treatments | Parameters | | | | |
|---|---|---|---|---|---|
| | $Ca^{2+}$(‰) | $Mg^{2+}$(‰) | Vit C (‰) | DM (%) | M (%) |
| T- | 110.42±22.04$^{a}$ | 5.23±1.37$^{a}$ | 208. 13±18.38$^{a}$ | 7. 51±0.60$^{a}$ | 92.42±0.60$^{a}$ |
| T+ | 120.69±27.24$^{a}$ | 5.12±1.02$^{a}$ | 253. 29±26.26$^{a}$ | 6. 65±0.45$^{a}$ | 93.34±0.45$^{a}$ |
| CBV | 248.22±30.57$^{ab}$ | 16.73±2.06$^{b}$ | 403. 71±37.61$^{b}$ | 6. 25±0.42$^{a}$ | 93.74±0.42$^{a}$ |
| $V_{20}$ | 315.78±97.14$^{ab}$ | 15.47±4.76$^{b}$ | 382. 61±10.41$^{b}$ | 6. 55±0.98$^{a}$ | 93.44± 0.98$^{a}$ |
| $V_{30}$ | 374.52±157.03$^{b}$ | 10.70±4.49$^{ab}$ | 354. 93±21.15$^{b}$ | 7. 37±0.27$^{a}$ | 92.62±0.27$^{a}$ |
| CBV+$V_{20}$ | 235.61±43.11$^{ab}$ | 17.32±1.83$^{b}$ | 375. 31±13.36$^{b}$ | 6. 29±0.50$^{a}$ | 93.70 ± 0.50$^{a}$ |
| CBV+$V_{30}$ | 236.11±55.71$^{ab}$ | 9.09±2.14$^{ab}$ | 369. 34±41.51$^{b}$ | 6. 76±0.02$^{a}$ | 93±0.02$^{a}$ |

Vit C : vitamin C ; DM : dry matter ; M : moisture ; T-: unfertilizer plants ; $T^{+}$ : chemical fertilizer (NPK 20-10-10 : 50g/hole) ; CBV : Compost (1 kg/hole); V20 : 20g of vivianite/hole ; V30 : 30 g of vivianite/hole ; CBV+V20 : Mixture CBV with V20 ; CBV+V30 : Mixture CBV with V30 ; Column values affected by the same letter are not significantly different ($p<0.05$).

## DISCUSSION

It was observed in this study that, natural fertilizers (compost and vivianite powder) stimulate the flowering and fruiting sweet pepper plants. This benefic effect of natural fertilizers on plants development suggests that the use of these fertilizers for the cultivation of sweet peppers would allow of Adamawa Cameroon peasants to have several harvests per year if they have crop possibilities in the off-season, but this need to be investigated.

Plants height values of sweet pepper obtained in this the present work are smaller than those reported by [21] who revealed that sweet pepper plants can reach 50 cm height. The beneficial effect of compost and vivianite powder on plants height and foliar production of sweet pepper has been demonstrated: [7] study the physico-chemical properties of three types of compost and their influence on growth, fruits yield and fruits quality and reported that these natural fertilizers improve growing parameters of sweet pepper compared to unfertilized plants. Foliar production is an indicator of fruits yield. Indeed, leaves are organs responsible for photosynthesis; the increase of foliar production of sweet pepper suggests an increase of photosynthetic activity and consequently an increase of fruits yield. In fact, the work of several authors [7, 16, 22] revealed a positive and significant correlation between plants

growth parameters: plants height and leaf production; plants height and diameter of stem; plants height and dry bioimass of plants and between plant height and fruits yield. In this regard, we expected higher fruits yield on plants from amended compost plots.

*C. annum* is grown for its fruits rich in Vitamin C and mineral elements like calcium and magnesium. Results obtained on fruits yield of sweet pepper in this work partially corroborate the work of [3]. Indeed, the studies of these authors reported that fruits yield of sweet pepper under greenhouse cultivation ranged from 40 to 80 t/ha. In addition, [7] revealed that fruits yield of sweet pepper varied from 12.86 ± 1.21 t/ha for unfertilized plants to 28.00 ± 2.14 t / ha for amended plants using compost under Sudano-Guinean climate of Adamawa Cameroon.

The beneficial effect of compost on growth and fruits yield of sweet pepper observed in this work does not surprise us. The positive effect of compost in plant productivity has been demonstrated [7, 9, 23-26]. Indeed, compost and rock powder play a major role in maintaining soil fertility and consequently, in the sustainability of agricultural production. These natural fertilizers are rich in mineral elements needed for plant growth. The beneficial effect of compost on sweet pepper growth and fruits yield would be related to the combined effect of improved soil properties and nutrients mineralization. In addition, studies shown that local resources such as organic waste, applied to poor tropical and acidic soils can provide nutrients needed for plant growth [8]. Compost plays a major role in maintaining soil fertility and consequently, in the sustainability of agricultural production. This natural fertilizer is rich in mineral elements needed for plant growth. It improves soil physical characteristics [10, 11] as well as its biological composition. Natural phosphate used in this work is represented by vivianite powder collected at Hangloa locality Vina Division of Adamawa Cameroon region. Composition of this rock powder includes: Fe2O3 (68.72%); P2O5 (9.17%); Al2O3 (7.72%) and SiO2 (9.67%) [14], thus justify the beneficial effect of vivianite powder on sweet pepper growth and fruits yield observed in the present study. In general, treated sweet pepper using mixture compost + 20 g of vivianite is more productive than those from unfertilized plants and treated plants using chemical fertilizer. Moreover, the beneficial effect of plants treated with chemical fertilizer on sweet pepper fruits yield compared to 20 g of vivianite/hole and 30 g of vivianite/hole would be justify by the fact that these levels of vivianite powder applied per plant are not sufficient to ensure a optimal production of sweet pepper. Therefore, the study vivianite powder level that ensures optimal sweet pepper productivity in our study area is needed. Soil fertilization influence no only plant growth, but also plants physico-chemical properties. For this reason, the study of influence of mixture compost + rock powder on fruits quality is interesting.

Data obtained on vitamin C content in this study are greater than that found by [27] who reported that vitamin C content of sweet pepper fruits was average 150 mg/100 g of dry matter. The higher value of fruits vitamin C content observed on amended compost plots is explained by fact that this compost would be a precursor of ascorbic acid biosynthesis, but this remains to be studied. High mineral elements content of sweet pepper fruits harvested on plants treated with mixture compost + vivianite powder would explained by the fact that this mixture present a physical structure in powder form and present various mineral elements compared to chemical fertilizer used in the present work. Moreover, chemical fertilizer present a granular structure and tend to be dissolved by water and thus to leach itself also causing in its course the minerals it contains, which would explain the low mineral elements content on fruits from T+ plants compared to sweet pepper fruits harvested on treated plots using natural fertilizer.

## CONCLUSION

Flowering and fruiting of treated sweet pepper plants using natural fertilizer (compost and vivianite powder) are early compared to unfertilized plants and treated plants using chemical fertilizer. Sweet pepper plants from treated plots by compost and rock powder provide significantly ($p<0.05$) the highest fruits yield. Fruits yield from mixture 1 kg of compost + 20 g of vivianite powder is 1.46 fold higher than fruits yield from treated plants using chemical fertilizer. The mixture 1 kg of compost and 20 g of vivianite powder increases fruits yield of 122.54 % and 45.91 % relative to unfertilized plants and treated plants using chemical fertilizer respectively. Overall, vitamin C content and mineral elements contents of fruits from treated plants using natural fertilizers are higher than those from unfertilized plants and treated plants using chemical fertilizer. Mixture of 1 kg of compost + 20 g of vivianite powder is recommended to sweet pepper grower of Adamawa Cameroon.

## REFERENCES

1. Segnou, J., Amougou, A., & Youmbi, E. (2012). Viabilité et développement végétatif des plantules de piment (*Capsicum annuum* L.) suivant différents matériels de conditionnement des semences. *Tropicultura*, 30(1): 15-23.
2. Salifou, K. (2005). Etude d'impact de la production et de la commercialisation du poivron dans la région de Diffa au Niger – Rapport final, 59.
3. Elattir, H., Skiredj, M., & Elfadl, A. (2003). 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*, 100: 24-67.
4. Willcox, G. (2004). Measuring grain size and identifying Near Eastern cereal domestication:

evidence from the Euphrates valley. *Journal of Archaelogical Science*, 33(2): 145-150.
5. FAO. (2005). Notions de nutrition des plantes et de fertilisation des sols. Manuel de formation, Projet Intrants, Niger, 24.
6. AGRI-STAT. (2009). 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, 111.
7. Tchuenteu, T., L., Megueni, C., Noubissie E., & Wamkoua, M. M. (2018). Study on physico-chemical properties of composts and the effects on growth, yield and fruits quality of *Capsicum annum* L. at Dang locality (Ngaoundéré Cameroon). *Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 11(11): 26-35.
8. Mulaji, K. C. (2011). Utilisation des composts de biodéchets ménagers pour l'amélioration de la fertilité des sols acides de la province de Kinshasa (République Démocratique du Congo). *Thèse de doctorat*, 220.
9. Megueni, C., Awono E. T., & Ndjouenkeu, R. (2011). 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 *Vigna unguiculata* (L) Walp. *Journal of Applied Biosciences*, 40: 2668-2676
10. Evanylo, G. & Sherony, C. (2002). Economic and environmental effects of compost use for sustainable vegetable production. *International compost Science and Utilisation Conférence*, Columbus, 730-740.
11. Landes, E., Timmermann, F., & Ziegler W. (2002). Verbund-Forschungsprojekt Kompostverwertung in der Landwirtschaft-Zwischenbericht.
12. Antiaobong, E. E., & Bassey, E. E. (2009). 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 South eastern Nigeria. *Journal of Agricultural Reserach*, 4(1):17-21.
13. Derogoh, N. A. N., Megueni, C., & Tchuenteu, T. L. (2018). Study of intercropping system castor bean and legumes on seeds yield and yield related traits in two agroecological zones of Cameroon. *Scholars Journal of Agriculture and Veterinary Sciences*, 5(6): 352-368.
14. Fodoué, Y., Nguetnkam, J. P., Tchameni, R., Basga, S. D., & Penaye J. (2015). Assessment of the Fertilizing effect of Vivianite on the Growth and yield of the Bean '*Phaseolus vulgaris'* onOxisoils from Ngaoundere (Central North Cameroon). *International Research Journal of Earth Sciences*, 3(4), 18-26.
15. Rieux, C. (2006). What is the fertilizer value of composts? Les Publications agricoles franco-ontariennes. info.gricom@lavoieagricole.
16. [16]. Ngakou, A., Megueni, C., Noubissié, E., & Tchuenteu, T. L. (2008). Evalution of the physic-chemical properties of cattle and kitchen manure derived compost and their effect on field grown *Phaseolus vulgaris. International journal of sustainable crop-production*, 3(5): 13-32.
17. Ngatchou, N. J. (1987). Enjeu de la conservation des ressources génétiques. IRA Yaoundé. *Biosciences* 1990: 241-242.
18. Noubissié, T. J. B., Youmbi, E., Njintang, Y. N., Alidoum N. A., Nguimbou R. M., & Bell J. M. (2011). Genetic arrchitechture of some leaf yield and quality attributes in dual-purpose cowpea (*Vigna unguiculata* L.W.). *American Journal of experimental Agriculture*, 1(4) : 400-413.
19. [19]. Harris, L. J., & Ray, S. N. (1935). Determination of ascorbic acid in urine. Method using titration with 2, 6 dichlorophenol indophenol. *Lancet*, 1(176): 462.
20. AFNOR. (1986). Recueil des normes françaises. Eaux–Méthodes d'essai. AFNOR, Paris (France).
21. Messiaen, C. M. (1997). *Le potager tropical : piments et poivrons. Collection techniques vivantes*. Presses Universitaires. Paris-France, 257-268.
22. Tchuenteu, T. L., Megueni, C., & Njintang, Y. N. (2013). A study of the variability for grain and oil yield and yield related traits of castor beans accessions in two savannah agro-ecological zones of Cameroon. *International Journal of Biosciences*, 3(8): 251-263;
23. Nwaga, D. (2008). Biofertilisant Myco. 4èédition, février 2008, Université de Yaoundé I. 6.
24. Mihoub, A. (2012). *Dynamique du phosphore dans les systèmes sol-plante en condition pédoclimatiques Sahariennes*. Thèse. Mag. Université Ouargla, 101.
25. Ngakou, A., Ngo, N. L., Ngo, B. M., Fankem, H., Adamou, S., Kamguia, K., Nwaga, D. & Etoa, F. X. (2014). Inoculation and screening of indigenous Bambara Groundnut (*Vigna subterranea*) nodulating bacteria for their tolerance to some environmental stresses. *American Journal of Microbiological Research*, 3(2): 65-75.
26. Megueni, C., Tchuenteu, T. L., Noubissie, E., Maimouna, A., & Bachirou, H. (2017). Field Productivity of Carrot (*Daucus carota* L.) in Adamawa Cameroon and chemical properties of roots according to chicken manure pretreatments and vivianite powder. *Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 10(5): 16-23.
27. Mougeot, L. J. A. (2000). Urban agriculture: definition, presence, potential and risks. In: *Growing cities, growing food. Feldafing*, 67-96.