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Field Productivity of Carrot (*Daucuscarota*L.*)* in Adamawa Cameroonand Chemical Properties of Roots According ToChicken Manure Pretreatments and Vivianite Powder

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Abstract: *Field trial was carried out in the Sudano-Guinean zone of Cameroon to investigate the effect of pretreatment of chicken manures and vivianitepowder (applied as mineral supply)on agronomic parameters of carrot plants (Daucuscarota L.) and some chemical propertiesof carrot roots. Randomized complete block design with 11 treatments and three replications was used.Treatments were applied per plant: T0 = control; P5 = 5g vivianite powder, P10 = 10g vivianite powder, FS1 = 0.25g dried manure, FS2 = 0.5kg dried manure; FC1=0.25 Kg composted manure; FC2=0.5 Kg composted manure; X1=0.25 Kg dried manure+0.25 Kg composted manure; X2=0.5 Kg dried manure + 0.5 Kg composted manure; X3=0.5 Kg composted manure + 0.25 Kg dried manure; X4=0.25 Kg composted manure + 0.5 Kg dried manure. Growth parameters (plant height and number of leaves) and production parameters (length of root, fresh weight of root and root yield) are evaluated. Results show that plants from X2 presented significantly (p <0.05) highest plants height: 26.18 ± 4.62 cm; length of root: 17.53 ± 2.4 cm; weight of fresh root: 68.48 ± 1.79 g; root yield: 7.28 ± 1.12 t/ha. B-Carotene content of carrot root ranged from 0.85 for T0 to 10.86 mg/100 gMF for X2. In conclusion, X2 treatment should be recommended to carrot growers of Adamawa –Cameroon. But several studies on chemical properties of carrot root need to be investigated.*

Key Word:*Daucuscarota*L.*, chicken manure, vivianite, agronomic parameters, chemical properties, Adamawa Cameroon*

I. Introduction

Carrot (*Daucuscarota*L.) is one of the most popular root vegetables grown throughout the world. It is the most important crop of Apiaceae family. Members of this family have small, mostly white, 5-parted flowers arranged in umbrella-like inflorescence called umbel [1]. This Apiaceae is a dicotyledonous herbaceous crop grown for the enlarged tap roots. Color of the flesh may be orange, yellow, white, red, purple or even black. However, the color and size depends on the cultivar grown [2]. Carrots were first used for medical purposes and gradually as food [3]. This vegetable is an important source of bioactive compounds with beneficial effect for the consumer health. They are consumed in different ways; they can be eaten raw or cooked. It is recognized as an important source of natural antioxidants besides, anticancer activity of β-carotene being a precursor of vitamin A [4].Moisture content of carrot varies from 86 to 89%. Carrots are a good source of carbohydrates and minerals like Ca, P, Fe, Na, Cu, Zn and Mg [5]. They are also a good source of *B*-carotenes, thiamine, riboflavin, vitamin C [5;6].

China, USA, Uzbekistan, and Poland are major producing countries [7].The area under carrot in India is 22,538 ha with an annual production of 4.14 lakh tons [8]. In Bangladesh, carrot is cultivated on about 846 ha and production is 6350 t with an average yield of 7.51 t/ha [9]. Comparatively, the yield of carrot in our country is very low. Carrot cultivation is widespread in Algeria, Niger, Senegal, Cameroon and several other African countries. Despite the very low yield produced, Cameroon exports carrots to Gabon and Equatorial Guinea [10].Current studies on carrot aimed to improve the growth potential of the plant and the selection of variety with good quality of roots. In this respect, [11] study the influence of chicken manure and NPK (17-17-17) fertilizer on growth and yield of carrot in Rwanda and reported that combination of chicken manure and NPK had shown significant influence on the growth and yield of carrot.Studies of [12] on response of farmyard manure and inorganic fertilizers for sustainable growth of carrot in Northern Nigeria show that the application of nitrogen, phosphorous and farmyard manure significantly increased agronomic parameters. [13]evaluate the effect of four levels of applied nitrogen on the growth and yield of carrot in Debigonj, Panchagorh and found that maximum agronomic parameters were found in 100 kg N/ha.

Farmers in Adamawa Cameroonregion mostly use chemical fertilizers for carrots cultivation. However, the high cost and unavailability of these chemical fertilizers make them almost inaccessible to small farmers [14]. Moreover, chemical fertilizers usuallyincreasesoilacidity, degrade soil physicalphysical status and decrease soil organic matter [15]. In this context, the introduction of low-cost agricultural practices aimed at increasing agricultural production whilerespecting environment [16],to the limit of our knowledge, no studies have been carried out on the combined effect of pretreated chicken manures and vivianite powderon the agronomic parameters of carrot plant in Adamawa - Cameroon region. Growing carrot plants with these natural fertilizers would improve productivity of plants while ensuring sustainable agriculture. In fact chicken manures are rich in P [17] and cheaper to famers in Cameroonian market. In addition, it is known as an efficient source for soil maintenancefertility, providing varied macro and micro-elements [18]. Vivianite is an oxide of iron and phosphate; its formula is $Fe_2^{3+}(PO_4)_28H_2O$[19]. In Cameroon, it outcrops in the small lake basins of Hangloa in Adamawa more specifically in the North West of Ngaoundere. The high concentration of phosphorus in the vivianite suggests that this mineral can be used for soil improvement fertility[20].Phosphorus is one of the macronutrients essential for plant growth and development [21]. It is the second most important microelement after nitrogen. This work aimed to improve durably carrot production in Adamawa Cameroon region. Specifically, these include to: (1) Investigate the effect of pretreated chicken manures and vivianite powder on growth and development of carrot plants; (2) Determine the level of chicken manures and vivianite powderthat would ensure optimal productivity of carrot plants; and (3) Investigate the influence of chicken manures and vivianite powder on some chemical compounds of carrot roots.

II. MaterialAnd Methods

Description of the study area

This investigation was carried out from July toOctober 2016 in the experimental farm of the University of Ngaoundere(7°25'119 "North latitude, 13°33'415.83" East longitude and 1106 m altitude). Physical and chemical characteristics of soil in the experimental site were as follows: soil is brown reddish, an argillaceous texture, pH 5.6, N and P contents were 0.15 ± 0.03 and 0.04 ± 0.01 mg/100 g dry soil, respectively. The climate belongs to the Soudano-Guinean type with an average annual rain of 1.479 mm. The average temperature was 22 ± 4 °C and the relative humidity (80%) was maximum in July-August.

Material

Carrot seeds

The carrots seeds(average length of 2.5 mm)variety (Madona) was bought on the local market of Ngaoundéré. 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 present great adaptability to rainy season and has short reproduction cycle (90 days). Usingvariety presented short reproduction cycle is advantageous for farmers in that they may have several harvests per year if he has off-season crops.

Figure 1: Carrot seeds variety (Madona).

Fertilizers: chicken manure and vivianite powder

Manures of subspecies *Gallus domesticus* from a laying hen farm located in Manwi district (Ngaoudéré Cameroon) have undergone two pretreatments (composting and drying) before using.Mature compost was black, odorless and friable (Figure 2a);manure drying was carried out at free air under the sun during 20 days. It was weighed every 5 days until constant weight[22]. Vivianite was collected in Hangloa located at the Center North Cameroon at 25km North-West of Ngaoundere chief town of the Adamawa region. 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, and then this powder is sieved before using in the field (Figure2b). It is composed of Fe_2O_3 (68.72%), P_2O_5 (9.17%), Al_2O_3 (7.72%) and SiO_2 (9.67%) [23].


a) Mature Compostb) Vivianite powder

Figure2: Fertilizers

Methods

Land preparation and experimental design

Experimental field was plowed at 40 cm depth in order to remove weeds roots and to allow well development ofour carrot roots. The experimental field measures 16 m × 9.5 m (152 m^2). The experimental design was randomized complete block design with three replicates and 11 treatments: T0 = control; P5 = 5g vivianite powder, P10 = 10g Vivianite powder, FS1 = 0.25g dried manure, FS2 = 0.5kg dried manure; FC1=0.25 Kg composted manure; FC2=0.5 Kg composted manure; X1=0.25 Kg dried manure+0.25 Kg composted manure; X2=0.5 Kg dried manure + 0.5 composted manure; X3=0.5 Kg composted manure + 0.25 Kg dried manure; X4=0.25 Kg composted manure + 0.5 Kg dried manure. Two consecutive blocks are spaced at 1 m and space between two consecutive elementary parcels in the same block is 0.5 m. The experimental unit measures 2.5m x 1m (2.5m^2) (Figure 3). Space between two plants within each experimental unit was 10 cm. The treatment were made up of two levels of phosphorus (5 and 10 g/plant); two levels of dried manure (0.25 and 0.5 kg/plant); two levels of composted manure (0.25 and 0.5 Kg/plant) and four levels of combination dried manure-composted manure (0.25 Kg composted manure + 0.25 Kg dried manure, 0.5 Kg composted manure + 0.5 Kg dried manure, 0.25 Kg composted manure+0.5Kg dried manure and 0.5 Kg composted manure + 0.25 Kg dried manure/plant).

Collection of data and statistical analysis

10 days after sowing, seedling emergence rate was evaluated on all samples.During the vegetative phase, data on plant height and number of leaves per plant wererecorded on 30 targeted plants at regular intervals of 7 days. At maturity, data on length of root, diameter of root, weight of fresh roots and roots yield expressed in t/ha were recorded from 30 selected randomized plants. Concerning chemical properties of carrots harvested, moisture content was evaluated according to [24] method; vitamin C content was carried out by titration method described by [25];evaluation of β carotene content is determined according to [26]method.Means and confidence intervals were determined from triplicate measurements. Data were subjected to variance analysis following by the Duncan multiple range tests when any significant effect was observed. The statistical software "Statgraphics plus" was used for this propose.

III. Results And Discussion

Seedling emergence rate at 10 days after sowing

Different levels of fertilizers used increase the emergence rate of plants relative to the control. Seedling emergence rate of plants from T0, P5, P10, FS1, FS2, FC1, FC2, X1, X2, X3 and X4 are respectively 36.5; 48.52; 49.14; 65.98; 66.14; 64.85; 66.57; 68.78; 65.73; 67.22 and 65.12%. In general, the emergence rate of plants from plots treated with chicken manure was highest (66.30%). Plants treated with vivianitepowder presented an intermediate value (48.83%) on seedling emergence rate. The lowestvalue of this parameter (36.5%) was observed on control plots. In this study, seedling emergence rate of carrot plants was observed at 10 days after sowing. According to [27], germination of carrot seeds typically ends between 8 and 15 days after sowing. Beneficial effect of organic manure on plants emergence has been demonstrated. Indeed, [28] carried out the cultivation of *Phaseolus vulgaris* in Adamawa Cameroonregion using compost and reported that this fertilizer improved plants emergence compared to control. In addition [29]study the effects of organic manure on growing and development of *Ricinuscommunis*L. in Sudano-Guinean savannas of Adamawa Cameroon region and reveals that this fertilizer improves plants emergence rate. On the other hand, studies of [30] shown that phosphorus affects root development by activating rhizogenesis. This would explain the beneficial effect of vivianite powderon seedlingemergence rate of carrot used in this study.

Effects of fertilizers on growth parameters of *D.carota*

X2 treatment improved significantly ($p < 0.05$) the growth parameters (plants height and number of leaves) of carrot plants compared to other treatments at 70 days after sowing. There was no significant

difference between control, P5 and P10 treatments on the growth parameters studied (Figure 3 and 4). Carrot plants from X2 treatment presented the highest height (26.18 ± 4.62 cm) and the maximum number of leaves per plant (14.7 ± 2.89). Plants height obtained in this study is less than that found in the literature. Indeed, [11] study on influence of chicken manure and NPK (17-17-17) fertilizer on growth and yield of carrot in Rwanda and found that plantsheight vary from 34.12 cm for control to 45.59 cm for 5 t/ha of chicken manure. In addition, studies of [13] in Debigonj, Panchagorh on effect of Nitrogen on the growth and yield of carrot shown that plants height rangedfrom 47.36 to 44.76 cm. Significant and positive correlation was observed between both parameters (plant height and number of leaves per plant(0.71; $p < 0.5$)).

The beneficial effect of mixture dried manure and composted manurewould be linked to the combined action of improving soil properties and mineralization of nutrients elements. Indeed, studies conducted under other experimental conditions have shown that local resources such as organic wastes applied to poor and acidic tropical soils can provide nutrients elements necessary for plant growing [15]. In addition, [31] reports that crops can draw enough nutrients from organic manure and develop well without the need for commercial fertilizers.Organic manure provides nutrient and increases or stabilizes soil pH. It increases organic matter content of soil and improves soil structure. This allows yields increasing. This would explain the well growing of carrot plants observed on plots treated with organic fertilizer. The levels of phosphorus used did not improve significantly the growth of our carrot plants compared to control. This suggest thatlevels of phosphorus applied are not sufficiently to ensure the best growing and development of our carrot plants, but this need to be investigated.

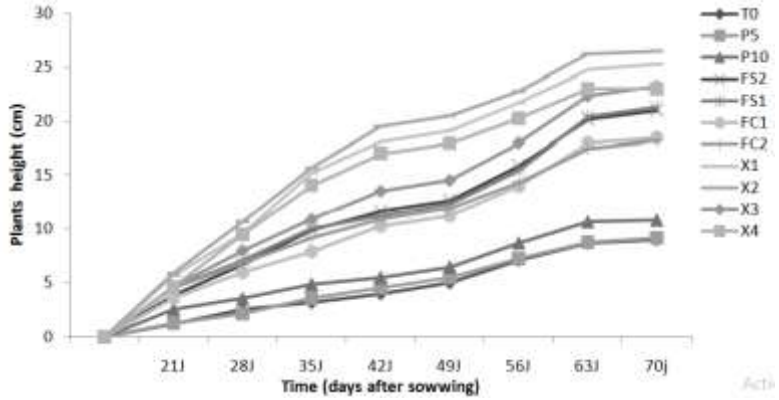

Figure3: Variation in the height of carrot plants after sowing depending tofertilizers

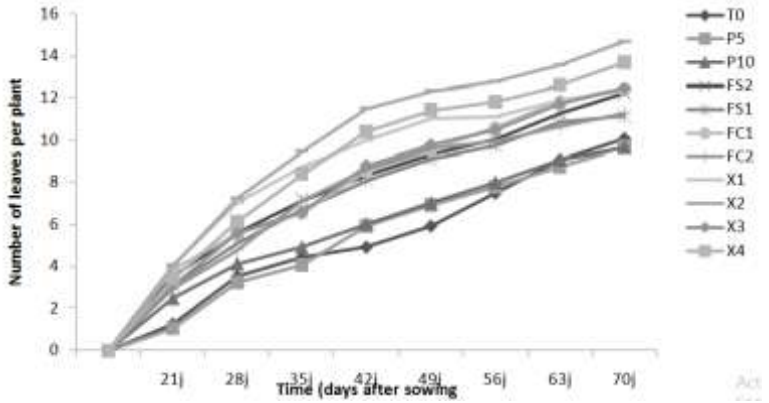

Figure4: Variation in the number of leaves of carrot plants after sowing depending tofertilizers
T0=control; P5=5g phosphorus; P10=10g phosphorus; FS1=0.25 g dried manure; FS2=0.5 Kg dried manure; FC1=0.25 Kg composted manure; FC2=0.5 Kg composted manure; X1=0.25 Kg dried manure+0.25 Kg composted manure; X2=0.5 Kg dried manure + 0.5 composted manure; X3=0.5 Kg composted manure + 0.25 Kg dried manure; X4=0.25 Kg composted manure + 0.5 Kg dried manure.

Effects of fertilizers on carrot production

Table 1 shows the length, the weight and the yield of carrot rootdepending tofertilizers used in this study. Results show that the different treatments influence significantly ($p < 0.05$) the production parameters of carrots. In general, carrot plants from plot treated with X2 are more productive than those from other plots. Carrot plants treated with vivianite powder have intermediate values on production parameters and control

plants are significantly ($p < 0.05$) less productive than others plants. The length of carrot roots used in this study varies from 12.26 ± 2.37 cm for control treatment to 19.97 ± 2.11 cm for X2 treatment. These results are in conformity with those of [11]. In fact, these authors had observed that the length of carrot root varies from 15.77 to 19.50 cm. In addition, studies of [13] reported that the length of carrot roots varies from 15.39 to 17.19 cm. There was a positive and significant correlation ($r = 0.64$; $p < 0.05$) between the length and diameter of carrot roots obtained in this study. The weight of carrot roots ranged from 18.60 ± 1.61 g for control treatment to 76.58 ± 0.11 g for X2 treatment. These results are different to those obtained in the literature. Indeed, [13]evaluated the effect of nitrogen on the growth and yield of carrot in Debigonj, Panchagorh and found that the weight of fresh roots vary from 38.33 g for control to 68.33 g in 100 Kg N/ha. This would be explained by different climaticand edaphic conditions in the studies areas. Present study was carried out underSudano-Guinean climate, on argillaceous soil, while trial of [13] took place under sub-tropical climate on sandy soil. This corroborates the studies of [32] and [33].In fact, these authors reported that plants productivity varies according to genotype and agroecological zone. The maximum root yield (13.46 ± 0.64 t/ha) was obtained from X2 while the minimum (1.17 ± 0.23 t/ha) was obtained from control. Our results obtained on root yield are in conformity with data found in literature: [34]; [13] and [11] also reported similar results in carrot. In this study, root yield (1.17 ± 0.23 t/ha) of carrot from control is lower than those found in literature. The low yields of our carrot plants resulted mostly from the poor growing conditions characterized by low phosphorus (0.04 ± 0.01 mg / 100 g) and nitrogen (0.15 ± 0.03 mg/100g) contents in the soil. In fact, nitrogen and phosphorus are the first macronutrients essential for plants growth and their development.The high nutrient concentration of manures, especially N and P in X2 treatment, would be responsible for improving carrot plants production. In addition, [35] reported that chicken manures favor root development and accelerate plant maturity. This suggests the beneficial effect of dried manure and composted manure of carrot used in this study. In addition, [36] shown that chicken manures improve availability of nitrogen, potassium and phosphorus in the soil. This is in conformity with studies of [29] who reported that organic manure increased castor bean production in Adamawa Cameroon region; studies reported by [37]in the forest zone of Cameroon, also show that chicken manures increases the fruit yield compared to control. Moreover, the phosphorus element contained in the manures, would influenced our carrot production. Indeed, the studies of[38] reveal that carrot plants treated with phosphorus presented high production compared to control; the studies of [30], which shown that phosphorus element stimulates roots development of carrot seedlings at germination, which contributes to increase productivity. These are in conformity with results obtained in this study. In fact, chicken manure and vivianite are rich in phosphorus. This suggests the beneficial effect of fertilizers in the present work on carrots production.

Table 1: Agronomic parameters of *D. carota* depending fertilizers

Treatments	**T0**	**P5**	**P10**	**FS1**	**FS2**	**FC1**
Length of roots (cm)	12,26±2.37^{a}	13,31±1.94^{a}	13,64±2.96^{a}	17±2.18^{b}	17,86±2.96^{b}	17±2.18^{b}
Fresh weight of root (g)	18.60 ± 1.61^{a}	22.12 ± 3.58^{b}	23.18±4.98^{b}	20.09±0.97^{ab}	35.07±3.23^{c}	21.80±1.97^{ab}
Rootyield (t/ha)	1,17±0,23^{a}	2,42±0,89^{b}	2,18±0,66^{b}	4,05±1,03^{c}	6,85±1.84^{d}	9.14±2,67^{e}
Treatments	**FC2**	**X1**	**X2**	**X3**	**X4**	
Length of roots (cm)	14,68±2.78^{b}	15.45±1.93^{b}	17.95±2.89^{b}	17.53±2.40^{b}	17.03±1.97^{b}	
Dry biomass of roots (g)	69.97±3.92^{d}	60.07±3.01^{d}	76.58±0.11^{e}	68.48±1.79^{d}	52.45±1.83^{f}	
Rootsyield (t/ha)	4.72±0.97^{c}	6.69±0.33^{d}	13.46±0.64^{e}	7.68±0.84^{de}	7.28±1.12^{de}	

T0=control; P5=5g phosphorus; P10=10g phosphorus; FS1=0.25 g dried manure; FS2=0.5 Kg dried manure; FC1=0.25 Kg composted manure; FC2=0.5 Kg composted manure; X1=0.25 Kg dried manure+0.25 Kg composted manure; X2=0.5 Kg dried manure + 0.5 composted manure; X3=0.5 Kg composted manure + 0.25 Kg dried manure; X4=0.25 Kg composted manure + 0.5 Kg dried manure.
Values of a line followed by the same letter are not significantly different

Effects of fertilizers on chemical compound of carrot root

Table 2 shows moisture, β-carotene and vitamin C contents of carrot root depending treatments. There was a significant difference ($p < 0.05$) between chemical properties of carrot root obtained in this study. Globally, moisture, β-carotene and vitamin C contents of carrot root from X2 presented the highest values. Moisture content of carrot root ranged from 70,80±0,34 for control to 85.76 ± 0.42% for X2. This corroborates works found in literature. Indeed, studies of several authors reveals that moisture content of carrot roots vary from 86 to 89%[(39; 41].One of the most important physiological factors in successful food storage is the moisture content of crop. High moisture content in a cropencourages bacterial and fungal problems.Pathogens such as *Pythium* spp., *Sclerotiniasclerotiorum*, *Phytophthoramegasperma* fungus caused carrot roots diseases during conservation[42; 43].In this study, moisture content of carrot roots derived from control plants was a lowest(70.80 ± 0.34%). This suggests that the conservation of carrot roots from control plants against pathogens attacks would be easier, but it need to be investigated. B-Carotene is a naturally occurring orange-colored

carbon-hydrogen carotenoid, abundant in yellow-orange fruit and vegetables and in dark green, leafy vegetables[44]. It is also widely distributed carotenoid in foods [45]. It exerts a number of beneficial functions in mammals, including humans, owing to its ability to generate vitamin A [46; 47]. In this study, β-carotene content of carrot roots ranged from 0.85 mg / 100 gMF for control plants to 10.86 mg / 100 gMF for X2 treatment plants. These results corroborate the work of [48] which reported that β-carotene content of carrot roots ranged from 3 to 13 mg / 100gMF. Carrot roots from X2 treatment are richer in β-carotene than those from other treatments. This suggests that carrot root from X2 treatment can be recommended to pregnant woman of Adamawa Cameroon region in order to solve vitamin A deficiency problem. In human health, vitamin C has been associated with reduction of incidence of cancer, blood pressure, immunity, and drug metabolism and urinary hydroxyproline excretion, tissue regeneration [49]. Vitamin C content of carrot root obtained in this work ranged from 3.97 ± 0.18 mg / 100gMF for control to 9.60 ± 1.17 mg / 100gMF for X2. Carrot roots obtained from X2 treatment are richer in vitamin C than those harvested on other treatments. This suggests that, carrot roots from plots treated with X2 treatment would be more beneficial to human health, but it need to be investigated.

Table 2: Moisture, β-carotene and vitamin C contents of carrot root depending on fertilizers

Treatments	oisture content (%)	β-carotene content (mg/100gMF)	Vitamin C content(mg/100gMF)
T0	70,80±0,34^{a}	0,85±0,16^{a}	3,97±0,18^{a}
P5	78,38±0,39^{b}	2,21±0,73^{abc}	8,72±0,62^{f}
P10	84,10±0,85^{c}	1,71±0,45 ^{ab}	7,04±0,40^{e}
FS1	82,87±0,29^{d}	3,12±0,69^{bcd}	4,86±0,29^{b}
FS2	84,02±0,20^{c}	3,95±0,32^{cd}	8,17±0,37^{f}
FC1	84,12±0,44^{c}	6,49±1,84^{ef}	6,59±0,33d^{e}
FC2	71,25±0,52^{a}	5,09±0,92^{de}	6,18±0,16cd^{e}
X1	74,68±0,41^{e}	6,63±0,29^{ef}	6,11±0,44^{cd}
X2	85,76±0,42^{f}	10,86±2,41^{g}	9,60±1,17^{g}
X3	81,36±0,64^{d}	4,75±0,58d^{e}	5,30±0,21^{bc}
X4	73,28±0,12^{c}	7,17±1,29^{f}	6,00±0,28^{cd}

T0=control; P5=5g phosphorus; P10=10g phosphorus; FS1=0.25 g dried manure; FS2=0.5 Kg dried manure; FC1=0.25 Kg composted manure; FC2=0.5 Kg composted manure; X1=0.25 Kg dried manure+0.25 Kg composted manure; X2=0.5 Kg dried manure + 0.5 composted manure; X3=0.5 Kg composted manure + 0.25 Kg dried manure; X4=0.25 Kg composted manure + 0.5 Kg dried manure.
Values of a column followed by the same letter are not significantly different

IV. Conclusion

The purpose of this study was to evaluate the effect of pretreatedchicken manures and vivianite powder on field productivity of carrot plants in Adamawa Cameroon region and on roots chemical properties. Results obtained show that carrot plants treated with fertilizers in this study growth well compared to control. In addition, carrot plants from X2 treatment (0.5 Kg dried manure + 0.5 Kg composted manure)present the highest values of agronomic parameters studied like plants height: 26.18 ± 4.62 cm; number of leaves per plant: 14.7 ± 2.89; length of root: 17.53 ± 2.4 cm; weight of fresh root: 68.48 ± 1.79 g and root yield 7.28 ± 1.12 t/ha. Indeed, β-carotene and vitamin C contents of carrot roots of plants from X2 treatment are higher than those harvested on other treatments. These results suggest that X2 treatment can be recommended to carrot growers of Adamawa Cameroon region, but several studies on chemical properties of carrot roots need to be investigated.

Reference

[1]. Essing F.B. 2013. What's in a Family? The Apiaceae. Florida Gardening, 18: 36-37
[2]. Yamaguchi M., 1983. World vegetables, principles, production and nutritional values, Ellis Horward Ltd. Chichester, England, 240 – 246
[3]. Carlos J. and Dias S. 2014. Nutritional and Health Benefits of Carrots and Their Seed Extracts. Food and Nutrition Sciences, 5: 2147-2156, doi: 0.4236/fns.2014.522227.
[4]. Speizer FE, Colditz GA, Hunter DJ, Rosner B. andHennekens C. 1999.prospective study of smoking, antioxidant intake and lung cancer in middle aged women, cancer causes control vol 10, pg 475-482.
[5]. Arscot S.A. and Tanumihardio S.A. 2010. Carrots of many colors provide basic nutrition and bio-available phytochemicals acting as a functional food.Comprehensive Reviews in Food Sci-ence and Food Safety, 9(2): 223-239. DOI: 10.1111/j.1541-4337.2009.00103.x
[6]. Sharma K.D., Karki S., Thakur N.S. and Attri S. 2012.Chemical composition, functional properties and processing of carrot – a review.J. Food Sci. Technol., 49(1): 22-32. DOI: 10.1007/s13197-011-0310-7
[7]. FAOSTAT, 2007. Production de carotte au niveau mondial : tonnages et surfaces cultivées. 3p.
[8]. Thamburaj S. and Singh N. 2005. Textbook of vegetables, tuber crops and spices, New Delhi: Indian council of Agriculture Research, 3:21-30
[9]. BBS. 2007.Yearbook of Agricultural Statistics of Bangladesh.Bangladesh Bureau of Statistics.Ministry of Planning.Govt. of the People's Republic of Bangladesh.
[10]. AGRI-STAT. 2012. Annuaire des statistiques du secteur Agricole Campagne 2009 et 2010. N° 017. Direction des Enquêtes et Statistiques Agricoles du Ministère de l'Agriculture et du Développement Rural-Cameroun, 123p.

[11]. Habimana S., Uwamahoro C. and Uwizerwa J. B. 2014. Influence of chicken manure and NPK (17-17-17) fertilizer on growth and yield of carrot. Net Journal of Agricultural Science, Vol. 2(4), pp. 117-123

[12]. Ahmed, A., Sambo, B. E.,Arunah, U. L. and Odion, E. C. 2014.Response of Farmyard Manure and Inorganic Fertilizers for Sustainable Growth of Carrot (*Daucuscarota* L.) in Northern Nigeria.Journal of Agriculture and Veterinary Science. Volume 7, Issue 2, PP 18-25.

[13]. Moniruzzaman M., Akand M. H., Hossain M. I., and Sarkar M. D. 2013. Effect of Nitrogen on the Growth and Yield of Carrot (Daucuscarota L.).Scientific Journal of Krishi Foundation. 11(1): 76-81 (2013).

[14]. Useni S.Y., Chukiyabo K.M., Tshomba K.J., Muyambo M.E., Kapalanga K.P., Ntumba N.F., Kasangij A-K.P., Kyungu K.A., Baboy L.L., Nyembo K.L. and Mpundu M.M. 2013.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 66:5070 – 5081

[15]. 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, Gembloux Agro bio tech, 220p.

[16]. Megueni C., Awono E. T. and Ndouenkeu 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 vignaunguiculata (L.) Walp.Journal of Applied Biosciences, 40: 2668-2676.

[17]. Kimuni L., Marlene M., Mulenbo T., Jonas L. W., Antoine L., Becker K., Mubemba M. and Babay L. 2014.Effets des doses croissantes des composts de fumiers de poule sur le rendement de chou de chine installé sur un sol acide de Lubumbashi. Journal of Applied Biosciences, 77: 6509-6522.

[18]. Pulgar G., Villora G., Moreno D. A. and Romero L. 2000. Improving the Mineral Nutrition in Grafted Watermelon Plants: NirogenMetabolism.BiologiaPlantarum. Vol. 43 (4): 607-609.

[19]. Bariand P., Cesbron F. and Geffroy J. 1978.Les Minéraux2, Minéraux de concentration d'élémentscommunsetd'élémentsrares, Minéraux et fossiles. UTF-8 / MARC-8.

[20]. Chien S.H. and Hammond L.L. 1978.A comparison of various laboratory methods for predicting the agronomic potential of phosphate rock for direct application, Soil Sci. Soc. Am. J., 42, 1758-1760 (1978).

[21]. Vassilev P. and Vassileva M. 2003.Biotechnological solubilization of roch phosphate on media contening agro-industrial wastes.AppliedMicobiologyBiotechnology. (61): 435-440.

[22]. STAV. 2001. Sciences et Techniques Avicoles HORS SÉRIE - SEPTEMBRE 2001, 12p.

[23]. Fodoué Y., Nguetnkam J.P., Tchameni R., Basga S.D. and Penaye J. 2015. Assessment of the Fertilizing effect of Vivianite on the Growth and yield of the Bean ''phaseolusvulgaris''onOxisoils from Ngaoundere (Central North Cameroon).International Research Journal of Earth Sciences. Vol. 3(4), 18-26.

[24]. AFNOR (Association Française de Normalisation). 1981. Recueil de normes françaises. Corps gras, graines oléagineuses, produits dérivés

[25]. Harris L. J. and Ray S. N. 1935. Diagnostic of Vitamine C Subnutrition by urinanalysis: with a note on the antiscorbibutic Value of human milk. Archinte.jamanetwork.com. 57 (2): 241-274.

[26]. Wolff J. P., 1968. Manuel d'analyse des corps gras. Azoulay éd., Paris, 519 p.

[27]. Peron J. Y. 2006.Références productions légumières : 2ème édition. Synthèse Agricole, 696 p.

[28]. Ngakou A., Megueni C., Noubissie E. and Tchuentcheu T.L. 2008. Evaluation of the physico-chemicalproperties of cattle and kitchen manures derived compost and their effects on field grown Phaseolus vulgaris L. International Journal of Sustainable Crop Production 3(5): 13-32.

[29]. Tchuenteu T. L. 2014.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., Département des Sciences Biologiques, Faculté des Sciences, Université de Ngaoundéré Cameroun. 135 p.

[30]. Bennai M. et Benabbas B. 2007. L'amélioration des rendements des céréales par une fertilisation adaptée aux conditions pédoclimatique algériennes. Constantine. Ed, Profert, 33p.

[31]. Sequi P. 1990.The role of agriculture in nutrient cycling. Alma mater studiorum, 3 (2): 155-190.

[32]. Koutroubas S. D., Papakosta D. K. and Doitsinis A. 1999.Adaptation and yielding ability of castor plant (*Ricinuscommunis* L.) genotypes in a Meditarranean climate European Journal of Agronomy 11, 227-237 Krinsky and Johnson, 2005).

[33]. Tchuenteu T. L., Megueni C. and 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) : p. 251-263

[34]. Abdel Razik, A. K. and El-Haris. 1997. Effect of nitrogen fertilizer levels and gebberelic acid concentration on carrot yield in sandy soils. Alexandria J. Agril. Res. 41 (2): 379-388.

[35]. Onana L. G., 2006. Pratiques de fertilisation et caractéristiques des sols en zone maraichère périurbaine de Yaoundé : cas des basfonds de Nkolondom. Mémoire de fin d'étude, Université de Dschang, 73 p.

[36]. Zamil S. S., Quadir F. Q., Chowdhury M. A. H. and Al Wahid A. 2004.Effets of different manures on yield quality and nutrient uptake by mustard cv. Agrani BRAC Univ. J., 1,2.

[37]. Segnou J., Akoua A., Youmbi E. and Njoya J. 2012.Effet de la fertilisation minérale et organique sur le rendement en fruits du piment (Camsicumannuum L., Solanaceae) en zone forestière de Base Altitude du Cameroun. AgronomieAfricaine 24 (3): 231-240.

[38]. Rioux J-A., Trépanier M., Lamy M. P. and Simard F. 2013.Stimulation par les champignons endomycorhiziens de la synthèse de composés nutraceutiques et aromatiques dans les fruits et légumes. Cultivons l'avenir, une initiative fédérale-provinciale-territoriale. Centre de recherche en horticulture, Université Laval, Québec, 2 p.

[39]. Howard F. D., MacGillivary J. H. andYamaguchi M. 1962.Nutrientcomposition of fresh California grown vegetables. Bull Nr 788,CalifAgricExptStn, University of California, Berkeley

[40]. Gill H. S. and Kataria A. S. 1974. Some biochemical studies in European and Asiatic varieties of carrot (*Daucuscarota*) Curr Sci. 43:184–185.

[41]. Gopalan C., Ramasastry B. V. andBalasubramanian S. C., 1991.Nutritive value of Indian foods.Hyderabad: National Institute of Nutrition; p. 47.

[42]. Berry D. 2012. Culture biologique de la carotte. Agriculture biologique, Fiche Technico Economiqe, outil d'accompagnement des projets d'installation et de conversion d'Agriculture de Rhône Référent technique régional légume bio, 12 p.

[43]. David, J.C. 1988.Alternariadauci.CMI Descriptions of Pathogenic Fungi and Bacteria, No. 952.Commonw. Mycol. Inst., Kew, Surrey, England. 2 p.

[44]. Krinsky, N.I. and Johnson E.J., 2005.Carotenoid actions and their relation to health and disease. Mol. Aspects Med. 2005, 26, 459-516.

[45]. Rodriguez-Amaya, D.B.; Kimura, M.; Godoy, H.T. and Amaya-Farfan, J. 2008.Updated Brazilian database on food carotenoids: Factors affecting carotenoid composition. J. Food Compos.
[46]. Dubost M. 2006. La nutrition 3ᵉédition. Montréal Chenelière Education, 366 p.
[47]. Blomhoff, R. and Blomhoff, H.K., 2006.Overviewof retinoid metabolism and function.J.Neurobiol, 66, 606–630.
[48]. Clotault J. 2009. Impact de la sélection sur l'expression et la variété de séquences de gènes de la voie de biosynthèse des caroténoïdes chez la carotte cultivée. Thèse de doctorat. Université d'Angers, Angers, 183 p.
[49]. Walingo, 2005.Role of vitamin c (ascorbic acid) on human health- a review. African Journal of Food Agriculture and Nutritional Development (AJFAND): (5)1.