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INFLUENCE OF COMPOST AND COMPOST TEA QUALITY (COMPONENTS AND MICROBIOME) IN BOOSTING ONION YIELD IN THE FIELD

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ABSTRACT

This research was undertaken to study the responses of onions to the field application of Cow Dung compost and compost tea during the 2018/2019 and 2019/2020 cropping seasons. Hence, the fertilizing effects of compost and compost tea were assessed on onion production, in an effort to provide a plausible alternative to synthetic chemical inputs. Field experiments were carried out at Gapring-Lara in the Far North (Cameroon) in a randomized complete block design comprising five treatments, each of which was replicated thrice, including: Cow dung compost (Cp), Cow dung compost tea (CpT), Cow dung compost + Cow dung compost tea (Cp+CpT), Negative control (Ctrl) and NPK 20-10-10 (ChF). Analysis of collected data showed that the experimental soils were enriched in phosphorus, potassium, calcium, iron, magnesium, and nitrogen after experimentation. Four bacterial species (Pseudomonas sp., Bacillus cereus, Bacillus subtilis, and Micrococcus sp.) were identified in compost and compost tea, with Pseudomonas sp. dominating in both compost (69.14%) and compost tea (56.32%). Plots amended with compost had the best average onion bulb weights, with 248 g and 234 g during the first and second cropping year, respectively. Agronomic production was considerably increased by CpT treatment with 65.48 t/ha in 2019 and by the Cp treatment with 28.14 t/ha in 2020 compared to 32.44 t/ha and 8.74 t/ha for the control, respectively. Based on the results of this study, organic fertilizers are recommended for onion cropping systems to promote sustainable soil fertility and sustainability.

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INTRODUCTION

One of the most significant vegetable crops in the world, onions are members of the Amaryllidaceae family and have a high mineral and organic content that is vital for human health in a variety of culinary applications (Abdou, 2014). Due to its high sulfurous content, it is pungent and acts as an aperitif, a stimulant, and a source of energy for the body (Charles, 2013). Onions are the world's second most farmed vegetable, after tomatoes, and occupy an important role in economic development, notably in increasing the income of many rural people (Azud, 2015; Rameez et al., 2014). This vegetable crop has a global production of 82.85 million tonnes per year, with approximately 90.000 tons originating from Central Africa (FAOSTAT, 2013). Furthermore, according to statistics from the Agricultural Sector Development Support Project, 85% of Cameroon's national onion production comes from the North and Far North regions (Kamga et al., 2016). Soil fertility and field yields in market-growing areas are steadily declining, mainly due to a gradual decline in organic matter levels and a deficiency in mineral balances. Farmers use chemical fertilizers and/or pesticides, which increase the risk of poisoning and eco-intoxication (environmental pollution and pesticide residues in products). Therefore, the need for an alternative to this practice, such as the use of natural fertilizers that respect the environment, through the recovery of organic wastes (agro-industrial by-products and slaughterhouse wastes), could be one of the solutions that allow some of their components to be recycled for agricultural purposes (Mondedji et al., 2015). Previous literature endorses the efficacy of compost or its extracts in improving crop growth and yield (Ngakou et al., 2008; 2012; Anguessin et al., 2021). Similarly, according to Haoua et al. (2023), the application of organic and mineral fertilizers promotes the progressive uptake of nutrients and stimulates soil biological functions through resource competition processes. Mbaye et al. (2022) also found that the application of organic fertilizers significantly increased onion output and growth. Despite its economic and culinary importance, to the best of our knowledge, no study has yet been conducted to assess the combined effects of compost and compost tea on onion production. Hence, the present study aimed to assess the effects of compost and its aqueous extract on onion production, with a view to supplementing existing data, and was focused on the characterization of cow dung compost and its derived tea to assess their individual and combined effects on onion yield in field.

METHODOLOGY

Study site

Field work and composting were done in Gapring-Lara in the Mayo Kani Department. The study site is situated at an elevation of 403 meters and is geographically situated at 10°07'45" North latitude, 14°32'54" East longitude. The area has a dry tropical Sudano-Sahelian climate, with a protracted dry season that lasts from November to May. In June, southwesterly breezes show up timidly. June marks the start of the rainy season, which lasts until October. The daily thermal amplitude varies between 6 and 7 °C, whereas the annual temperature varies between 21 and 22 °C (IRAD, 2015).

Composting process and preparation of compost tea

Two cow stalls in the research location yielded 200 kg of cow manure, from which compost tea was extracted to create the compost that was used. The pile composting technique was used to obtain compost (Ngakou et al., 2008). 15 kg of kitchen scraps and 5kg of farm soil were combined to create the inoculum, which was then incubated for seven days to allow the microbes to multiply. To obtain a 1.5m diameter, 1m high pile, the method involved alternating layers of inoculum and 5 kg of cow manure per pile. Then, ventilation holes were pierced in the pile using a stick. The pile was covered with a white plastic sheet and turned and watered every two weeks throughout the three-month composting process. The mature compost was subsequently turned into compost tea at a ratio of a single kilogram of compost and 15L of water (Figure 1).

Figure 1. Steps in the compost tea preparation: A: Compost + water mixture; B: Filtration through a 0.001 mm sieve; C: Compost tea stored in a bottle.

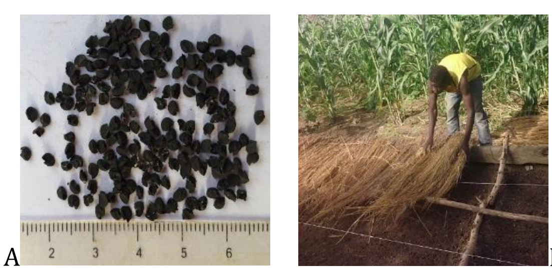
A  B

Figure 2. Onion seeds (A) used for the establishment of the nursery (B).

Transplantation of plantlets in the field and application of treatments

Five (5) treatments, all of which were repeated three times, made up the entirely randomised block experimental design. The experimental field was a 98.58m² plot with 2.25m² per unit, separated by 40 cm. Field trials were conducted from September 2018 to February 2019, and then repeated from September 2019 to February 2020. Treatments consisted of cow dung compost (Cp); cow dung compost tea (CpT); cow dung compost + cow dung compost tea mixture (Cp+CpT); NPK 20-10-10 (ChF) and negative control (Ctrl). After 30 days in the nursery, the seedlings were transferred to the field at a depth of 2 cm. Bobo (2015) states that lines were placed 20 cm apart and 15 cm within one another, resulting in a plant density of 70 plants per experimental unit. Treatments were given every 30 days starting on the fourteenth day after transplantation. Compost was applied at a rate of 22.22 t/ha (5 kg per experimental unit), whereas compost tea was sprayed on plants using a ULV sprayer at a rate of 0.5-1 L per experimental unit. Chemical fertilizer (45 g/m²) was applied to the soil in compliance with the relevant regulations.

Physical and chemical evaluation of organic matter, tea from it and soil

Over the course of fifteen days, the temperature of three compost piles was recorded using a precision thermometer at three different depths (10 cm, 50 cm, and 80 cm) at three distinct sites in each heap at a set time of day (10:00 am). Using a Mettler-Toledo MP 225 pH meter, the pH of the soil was measured in a 1/2.5 (w/v) solution (soil/water).

To ascertain the mineral nutrient levels (nitrogen, phosphorus, iron, calcium, and magnesium), soil samples were air-dried before being ground to fit over a 0.5-2 mm screen. Colorimetry (Anderson and Ingram, 1993) was used to analyse the total nitrogen extracted from humic acid (Buondonno et al., 1995). Using Murphy and Riley's (1962) molybdate blue procedure, available phosphate (P) was extracted and examined. Flame atomic absorption spectrophotometry was used to estimate the amount of iron that was removed using the Mehlich-3 method (Clément et al., 1975). Ammonium acetate was used to extract the exchangeable cations (Ca, Mg, and K), and atomic absorption spectroscopy was used to identify the cations. While K, Ca, and Mg were expressed in mg/100g, total nitrogen, phosphorus, and iron in compost were expressed in mg/kg. After being extracted by dry incineration in a muffle furnace, calcium, potassium, and magnesium were diluted using a solution of diluted HCl/HNO3 acids and subjected to atomic absorption spectrophotometry analysis in parts per million.

Evaluation of compost and compost tea's bacterial microbiome

Bacterial isolation was accomplished using the serial dilution approach. Separately, 5 g of compost or 5 ml of compost tea were added to 50 ml of sterile saline water (0.85% w/v) and rapidly shaken for 20 minutes to create the suspended sample solutions. Five minutes were then spent sedimenting the diluted solution. 9 ml saline solution sterile dilution blanks were labelled 1 through 4 in a consecutive manner. A new, sterile pipette was used to transfer the stock solution (1 mL) to dilution blank 1. One millilitre of dilution 1 was supplied to tube 2 for each subsequent step, then tubes 2 through 3, and lastly tubes 3 through 4. The Nutritive Agar (NA) culture medium was composed of 0.5% peptone, 0.3% yeast extract, 0.5% NaCl, 0.25% glucose, 1.5% agar, and distilled water, all of which were adjusted to a pH of 7 ± 0.2. Each dilution beaker contained 0.5 ml of the dilution, and all of them were then covered for 24 hours at 37°C. Pure bacterial cultures were subcultured in NA media and incubated at 37°C for growth following the successful development of microorganisms (Saha and Santra, 2014). Cultural characterization of colonies on nutrient agar medium by Gram staining was performed to observe colonies and cell morphology, motility. Biochemical assays for catalase, triple iron sugar, and citrate production were performed as described by Collins et al. (1989).

Assessment of the agronomic parameters of *Allium cepa* L.

Sixty-three days after transplanting, the number of leaves on 10 independently selected plants per unit was counted (Challita, 2004). A plastic ruler ranging from 0 to 50 cm was used to measure the tuber diameter and plant size (cm) of ten independently selected plants per plot (Challita, 2004). Kalle (2012) reported that the average bulb weight was determined using an automatic scale type NKS-7115 with a capacity of 5kg/111b 1g/0.1oz, and the bulb diameter was measured using an electronic caliper on 20 independently selected plants per treatment. According to Kalle (2012), the yield of onion bulbs per square meter during harvest was calculated by weighing bulbs from ten independently selected plants per elementary unit: R (g/m^2) = Mt (g)/S, where R: yield; Mt: Total mass and S: Surface area in m^2.

Statistical analysis

Data collected were recorded and statistically analyzed to determine the extent of variation resulting from the experimental treatments. Statgraphic Plus version 5.0 software was used to compare means using analysis of variance (ANOVA) and Duncan's test.

RESULTS

Physico-chemical and microbiological characteristics of soil, compost, and compost tea: Composting temperature

During the composting process, variation of temperature was assessed at different depths (Figure 3). The analysis of variance revealed a significant difference ($p<0.0001$) between temperatures at different depths, with values at 50 cm depth consistently above those of other depths from 15 to 65 days of composting, after which the compost was mature, followed by the decreased temperature at different depths except for the control temperature that continued to increase after compost maturation.

Features of the trial site's earth, both before and after the field experiment

The experimental soils pH ranged from 6.79 to 7.64, and was always within the neutral range after harvest Table 1). The experimental soil was enriched in all the studied mineral nutrients (potassium, calcium, iron, magnesium, and nitrogen) after harvest.

Nutrient composition and pH in compost & compost tea

After three months of composting, the mature compost was sampled and analyzed in the laboratory. The obtained pH was 8.27 in average. This compost was concentrated in elemental nutrients with respective values of 100.64 mg/100g for calcium, 70.72 mg/100g for magnesium, 48.57 mg/Kg for nitrogen, 41.52 mg/Kg for phosphorus, 3.0006 mg/100g for potassium, and 3.006 mg/Kg for iron (Figure 4).

As for compost tea used in both cropping years, the pH was more acidic (6.50), while the concentrations of magnesium and calcium were higher, and that of iron was lower. The different chemical elements analyzed in the compost tea, including nitrogen, phosphorus, iron, potassium, calcium, and magnesium, had concentrations of 18.49 mg/L, 7.56 mg/L, 3.17 mg/L, 7.56 mg/L, 38.08 mg/L, and 91.12 mg/L, respectively, thus lower than that of compost.

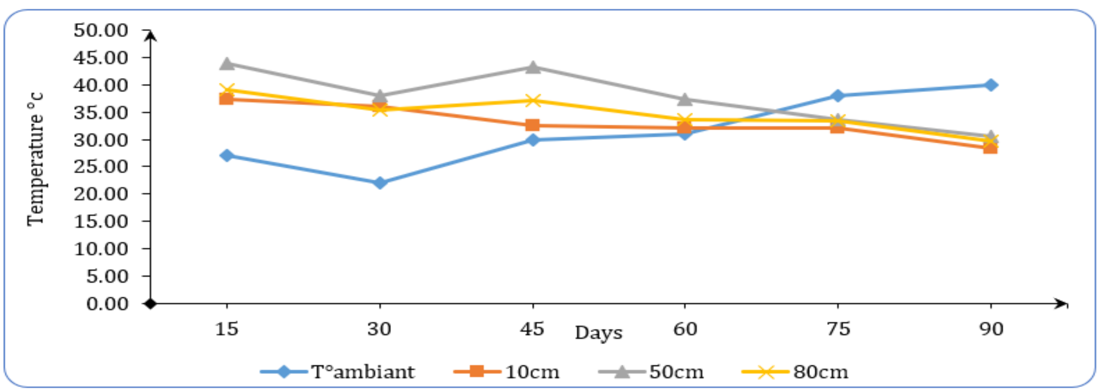


Figure 3. Variation of composting temperature with time as affected by pile depths.

Table 1. Differences in the physico-chemical characteristics of experimental soils before sowing and after harvest during the two cropping years

Soil sampling periods	Soil characteristics						
	pH	N	P	Fe	K	Ca	Mg
		-----------mg/Kg--------			------mg/100g-------		
Before sowing (2019)	6.79	17.23	1.07	0.35	1.01	78.21	59.03
After harvest (2019)	7.64	21.45	1.47	0.47	1.46	85.68	61.2
Before sowing (2020)	7.05	12.45	2.22	0.27	0.28	76.76	62.32
After harvest (2020)	7.12	27.05	2.49	0.85	1.8	89.76	65.28

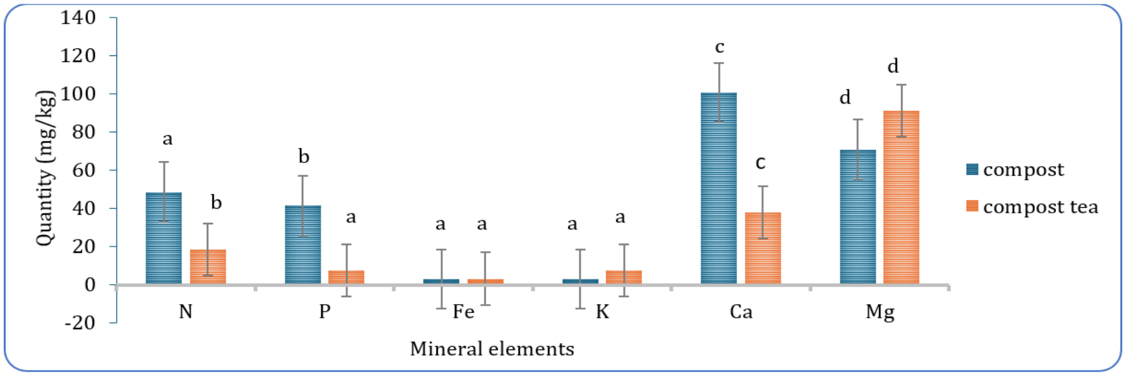


Figure 4. Differences in mineral content of compost and compost tea

N: nitrogen; P: phosphorus; K: potassium; Fe: iron; Ca: calcium; Mg: magnesium for each elemental nutrient, Bars with the same letter at a given year are not significantly different between compost and compost tea at the probability threshold indicated.

Bacterial diversity growing in compost & compost tea

Biochemical tests revealed four species of bacteria in the compost and compost tea (Figure 5). The genus *Pseudomonas* was abundant in compost (69.14%) and compost tea (56.32%), while *Bacillus cereus*, *Bacillus subtilis*, and Micrococcus sp. were 0.71%, 25.07% and 17.87% respectively, in compost tea and 0%, 17.52% and 13.39% in compost. Thus, a total of 859 bacterial colonies were found in compost tea against 799 in compost.

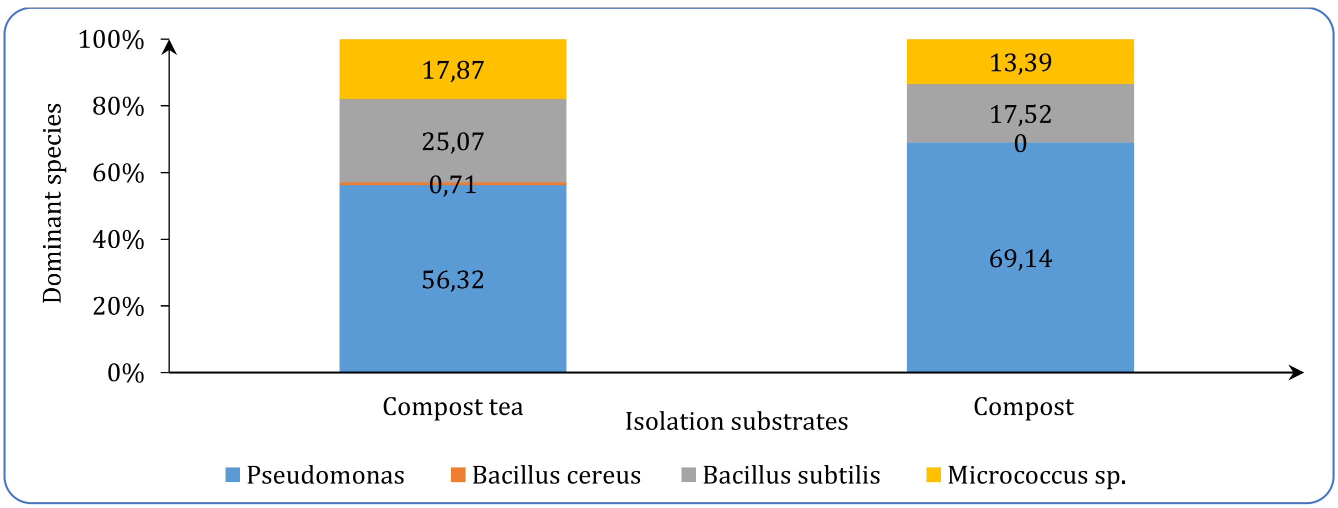


Figure 5. Variation of dominant bacterial species found in compost and compost tea.

Correlation between growth parameters

The results of the correlation analysis between growth parameters are presented in Table 2. During the experiment, the number of leaves and bulb diameter were closely associated with each other (r=0.206; p=0.0003) in the first year, and (r=0.112; p=0.051) in the second year, indicating that a high number of leaves induces a high bulb diameter.

Bulb diameter and plant size positively and significantly correlated during 2019 (r=0.178; p=0.0019) and 2020 (r=0.033; p=0.55), whereas the one between plant size and leaves number was significantly correlated only in 2020 (r=0.402; p<0.001).

Influence of compost and compost tea on onion bulbs' yield attributes at harvest.

The upshot for bulb diameter at harvest during the two years of experimentation is shown in Table 3. Compost and compost tea significantly (p<0.0001) enhanced the diameter of onion bulbs compared to those of the negative control, although the effect of the chemical input was the best. The control plot was the treatment with the smallest onion bulb diameter in each of the experimental years.

Table 2. Correlation between growth parameters of onion plants in field at 63 DAP during the two growing seasons.

Cropping years	Variables	Pearson test	DB	NF	T
2019	DB	p	1		
		r			
	NF	p	0.206	1	
		r	0.0003		
	T	p	0.178	0.033	1
		r	0.0019	0.55	
2020	DB	p	1		
		r			
	NF	p	0.112	1	
		r	0.051		
	T	p	0.171	0.402	1
		r	0.003	0.001	

T: size of plant; NF: number of leaves; DB: bulb diameter.

Table 3. Variation in onion bulb diameter (cm) as impacted by treatments during the two cropping periods.

Treatments	Cropping seasons	
	2019	2020
ChF	7.47±0.97[c]	7.79±1.12[d]
Ctrl	4.71±0.34[b]	5.7±0.75[a]
Cp	6.41±0.61[c]	7.22±1.12[c]
CpT	5.31±0.48[a]	6.01±0.61[b]
Cp-CpT	6.3±0.89[c]	6.99±0.69[cd]
p-value	<0.0001	<0.0001

Ctrl: Negative control; **ChF:** Chemical fertilizer; **Cp:** Cow dung compost; **CpT:** Cow dung compost tea; **Cp+CpT:** Cow dung compost **+** Cow dung compost tea. Values with the same letter for a given year are not significantly different between treatments at the probability threshold indicated.

Bulb weight

The best average weights were obtained for the Compost treatment throughout the earliest and next cropping of cultivation (Figure 6). The untreated treatments recorded the lowest average onion bulb weights in 2019 and 2020 respectively.

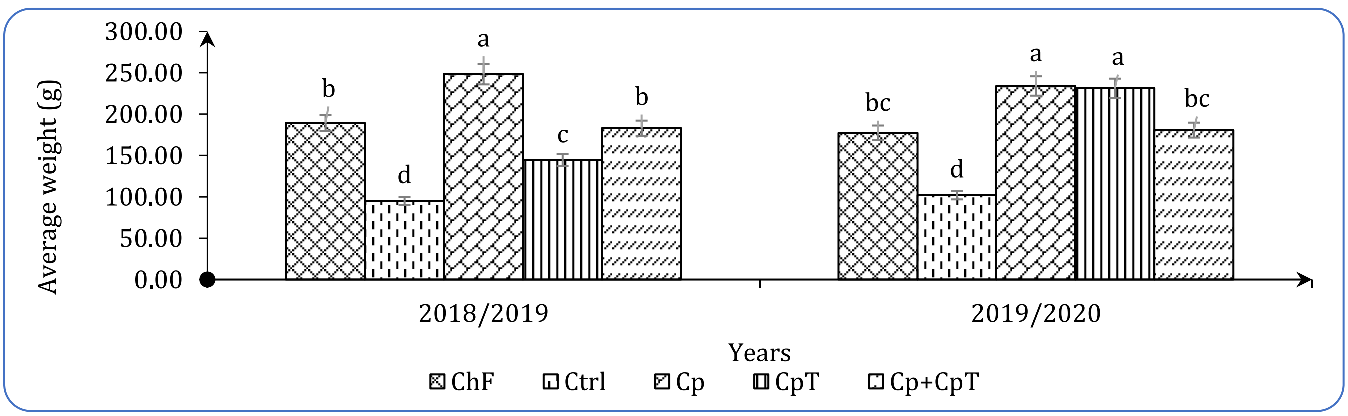


Figure 6. Differences in onion bulb weight as affected by treatments in cropping campaigns.

Ctrl: Negative control; **ChF:** Chemical fertilizer; **Cp:** Cow dung compost; **CpT:** Cow dung compost tea; **Cp+CpT:** Cow dung compost **+** Cow dung compost tea. Bars with the same letter for a given year are not significantly different between treatments at the probability threshold indicated.

Onion yield (t/ha)

Bulb yield was expressed in tons per hectare (t/ha) for the different treatments during the field experimentation years (Table 4). In the first cropping year (2018-2019), the highest yield was obtained from compost tea-treated plots (CpT), compared to that of the control plots (Ctrl), which showed the lowest yield. During the second cropping season (2019-2020), the compost-amended plots yielded the best results compared to the control plots. Ultimately, compost and compost tea proved to be the most effective ecological interventions for enhancing bulb yield.

Table 4. Variation of onion yield (t/ha) between treated plots during the two cropping seasons.

Treatments	Yields (t/ha)	
	2019	2020
ChF	58.07±0.08^{d}	17.11±0.31^{c}
Ctrl	32.44±0.07^{a}	8.74±0.15^{a}
Cp	50.22±0.35^{c}	28.14±0.25^{d}
CpT	65.48±0.70^{e}	15.40±0.76^{bc}
Cp-CpT	34.07±0.26^{b}	15.55±1.41^{bc}
p-value	0.0284	0.0002

Ctrl: Negative control; **ChF:** Chemical fertilizer; **Cp:** Cow dung compost; **CpT:** Cow dung compost tea; **Cp+CpT:** Cow dung compost **+** Cow dung compost tea. Values with the same letter for a given year are not significantly different between treatments at the probability threshold indicated.

DISCUSSION

The average temperature variation, depending on the depth of the pile during the composting process, can be explained by a gradual decrease in degradable organic matter, which lowers the temperature at different depths. The highest recorded temperature at a 50 cm depth could be explained by a high concentration of decomposing microorganisms in the middle of the pile, following the evaporation of water and drying out of the compost at a 10 cm depth, or the lack of oxygen at the bottom of the pile (80 cm depth). These findings are in line with those of M'Sadak et al. (2014), who observed a maximum temperature at 50 cm and 90 cm depths in the center of the pile, with a reduced temperature toward the surface (at a 10 cm depth) during the silvicultural composting of Acacia *cynophylla* chippings.

Soil pH is one of the most important parameters that reflect the overall changes in soil chemical properties (De Lucia et al., 2013). Therefore, the neutral pH range of the experimental soils was similar to recent findings by Haouvang (2019), who also obtained high concentrations of macronutrients, including calcium, magnesium, nitrogen, potassium, sodium, carbon, and phosphorus. The basic pH of compost, on the other hand, fell short of the values provided by Garcia et al. (1992) and Nakasaki et al. (1992), who stated that the pH of compost should typically be between 7 and 8. The decrease in compost pH from a weak alkalinity to a weak acidity in compost tea could be attributed to the development of acidogenic microorganisms during compost tea production, which produce organic acids (Scheuerell, 2004). High nutrient concentrations in compost and compost tea have been reported to be related to the degradation of woody components of waste by bacteria, leading to the release of nutrients trapped in the organic matter and thereby promoting the fertilizing properties of compost and compost tea (Mohammadi et al., 2011).

The presence of a higher number of bacteria in compost tea than in compost could be attributed to significant development of acidifying bacteria during the production of compost tea, as previously revealed by Scheuerell and Mahaffee (2004), who pointed out increased average acid tolerant population of total bacterial cells, with or without the use of additives during the production of compost tea from different composting substrates. The highest population of total bacteria and *Pseudomonas* sp. found in organic matter and tea from it might be related to the nutritional composition of the culture medium, which was rich in amino acids, vitamins, as well as a source of nitrogen and carbon for bacterial proliferation, as reported by the work of Scheuerell and Mahaffee (2004).

The positive correlations obtained between the different growth parameters indicate their interdependences, the larger plant size inducing more leaves and an enhanced bulb diameter. This is why organic matter in the soil favors the growth of microorganisms that induce the activation of soluble nutrients, making them sufficiently available to plants (Serné et al., 2015). The best bulb diameters observed at harvest in batches that received chemical fertilizer and compost might be clarified by the fact that compost is already rich in large quantities of available nutrients for plant development. After application, chemical fertilizer would have immediately provided the nutrients needed for the onion bulbs' growth. These upshots are consistent with those of Singh et al. (1972), who found that the growth of onion bulbs is positively impacted by the chemical fertiliser NPK. Similarly, Seran et al. (2010) observed that onion plots treated with compost had nearly the same effect as those treated with inorganic fertilizers, due to the increased bioavailability of nutrients. According to Geries et al. (2012) and Morsy et al. (2012), improved onion bulb yields were reported as a response to nitrogen fertilization.

The highest average onion weights obtained on plots amended with compost tea and compost suggest that these amendments continuously supply nutrients to the plants throughout the growth and maturity of the bulbs. Thus, mineralization of organic matter and major soil nutrients (N, P, K) would have contributed to improved growth and optimal development of onion bulbs. This finding aligns with the previous answer by Kitabala et al. (2016), who revealed a boost in plant yield after compost application at a reasonable dose. Compost tea may supply nutrients directly through foliar absorption, whereas compost promotes the long-term mineralization of soil nutrients.

According to Charland et al. (2001) and Seran et al. (2010), the use of good compost increases yields compared to unfertilized soils, even when applied at low doses. Furthermore, the drop in yield observed during the second cropping season can be attributed to drastic weather conditions, which negatively impacted yields, in accordance with the adverse effect on onion bulb production due to increased drought (temperature) in a tropical environment, as recently reported by Beucher et al. (2012).

CONCLUSION

According to the study's findings, compost and compost tea are rich in mineral nutrients that plants can take up, as well as various bacterial strains that act to reduce soil acidity. The number of plant leaves, the bulb diameter, and the plant size were positively correlated. Agronomic production of onions was considerably improved by compost tea, yielding 65.48 t/ha in the first year, and by compost, at 28.14 t/ha in the second year of experimentation. These bio-organic fertilizers could be a plausible alternative to chemical fertilizers if sustainable onion production is to be envisioned.

REFERENCES

Abdou, R. 2014. Characterization of the genetic diversity of onion cultivars (Allium cepa L.) from Niger with a view to their in-situ conservation and improvement. Thesis, University of Liège-Gembloux, 151p.

Azud. 2015. *The practice of drip irrigation in onion cultivation.* www.azud.com accessed on 3 April 2018, 25p.

Anderson, J. M. and Ingram, J. S. I. 1993. Tropical soil biology and fertility: a handbook of methods. Second edition. CAB international, the Cambrian News, Aberystwyth, United Kingdom, 22p.

Beucher, O. and Bazin, F. 2012. Agriculture in Africa facing the challenges of climate change, Institute of Energy and the Environment of the Francophonie, Quebec, 79p.

Bobo, D. 2015. Onion technical data sheet, Ministry of Agriculture, Water Resources, Sanitation and Food Security. Burkina Faso, 7p.

Buondonno, A., Rashad, A. A. and Coppola, E. 1995. Comparing tests for soil fertility. The hydrogen peroxide/sulfuric acid treatment as an alternative to the copper/selenium catalyzed digestion process for routine determination of soil nitrogen-Kjeldahl. Communications in Soil Science and Plant Analysis, 26:1607-1619.

Challita, C. 2004. Effect of Salinity on Pepper (*Capsicum annum* L.) Crop Yield. Annals of Scientific Research, 5: 115-127.

Charland, M., Cantin, S., St Pierre, M. A. and Côté L. 2001. Research on the benefits of using compost. CRIQ File 640-PE27158 (R1), Final Report. Recyc-Quebec, 35p.

Charles, J. D. 2013. Onion. In *Antioxidant Properties of Spices, Herbs and Other Sources*. Springer : New York, NY, USA, 610p.

Clément, A. and Nys, C. 1975. Comparison of two spectrometric techniques for analyzing calcium in plants. Demonstration of the interfering effect of phosphorus on the results obtained. Annals of Forest Sciences, INRA/EDP Sciences, 32(3):169-174.

Collins, A. T, Kamo, M. and Sato, Y. 1989. Optical centers related to nitrogen, vacancies and interstitials in polycrystalline diamond films grown by plasma-assisted chemical vapor deposition. Journal of Physics D: Applied Physics, 22: 1402-1410.

De Lucia, B., Cristiano, G., Vecchietti, L., Rea E. and Russo, G. 2013. Nursery growing media: agronomic and environmental quality assessment of sewage sludge-based compost. Applied and Environmental Soil Science, 1:139-142.

Garcia, C., Hernandez, T., Costa, F. and Ayuso, M. 1992. Evaluation of the maturity of municipal waste compost using simple chemical parameters. Communication in soil science and plant analysis, 23:1501-1512.

Geries, L. S. M., Ama A.-D., Karam, S. S. 2012. Response of onion productivity and storability to some sources, rates and time of application of nitrogen fertilizers. Alexandria Journal of Agricultural Research., 57:153-162.

Haoua, B., Hamsatou, B., Adamou, H., Bibata, A. and Toudou A., 2023. Effects of mineral (NPK) and organic (compost) fertilizers on the productivity of onions (*Allium cepa* L.) in Niger: Case of the purple Galmi variety. International Journal of Innovation and Applied Studies, 41(2): 549-557.

Haouvang, L. C. 2019. Influence of organic amendments on the production and physico-chemical and nutritional characteristics of *Moringa oleifera* Lam. (Moringaceae) cultivated in southern Chad. Doctoral thesis, Ph.D., University of Ngaoundere.157p.

IRAD. 2015. National report on the state of plant genetic resources for food and agriculture 88p.

Kalle, D. D. 2012. Effects of mycorrhizal inoculation and NPK on fruit production and chemical properties in peppers (*Capsicum annum* L.) in Dang/Ngaoundéré. Master's degree in Plant Biology, University of Ngaoundere, 76p.

Kamga, R. T, Tchouamo, I. R, Chendjou, R, Bidogeza, J. C. and Afari-Sefa, V. 2016. Gender inequality in smallholder onion (*Allium cepa* L.) production in the far north region of Cameroon. Journal of Gender, Agriculture and Food Security, 1(3): 85-103.

Kitabala, M. A., Tshala, U. J., Kalenda, M. A., Tshijika, I. M. and Mufind, K. M. 2016. Effects of different compost doses on tomato (*Lycopersicon esculentum* Mill) production and rentability in the city of Kolwezi, Lualaba Province (RD Congo). Journal of Applied Biosciences, 102: 9669-9679.

Mbaye, M., Faye, E., Toure, M. A. and BA, A. 2022. Diagnostic analysis of the use of organic matter in onion (*Allium cepa* L.) cropping systems in the Senegal River Valley. Science Africa, 20:136-149.

Mohammadi, K., Heidari, G., Khalesro, S., Sohrabi, Y., 2011. Soil management microorganisms and organic matter interactions: A review. African Journal of Biotechnology, 10(84): 19840-19849.

Mondédji, A. D., Nyamador, W. S., Amevoin, K., Adéoti, R., Abbey, G. A., Ketoh, G. K. and Glitho, I. A. 2015. Analysis of certain aspect of the vegetable production system and producers perceptions of the use of botanical extracts in the management of insect pests in market gardening in southern Togo. International Journal of Biological and Chemical Science, 9(1): 98- 107.

Morsy, M. G., Marey, R. A., Karam, S. S., Abo-Dahab, A. M. 2012. Productivity and storability of onion as influenced by the different levels of NPK fertilization. Journal Agricultural Research Kafer El-Sheikh University, 38:171-187.

M'Sadak, Y. and Saad I. 2014. Diagnosis and thermal analysis of the forestry composting process to prevent the spread of yellow nightshade seeds (*Solanum elaeagnifolium* Cav.). Moroccan Journal of Agricultural and Veterinary Sciences, 2(2): 22-29.

Murphy, J. and Riley, J. P. 1962. A modified single solution method for the determination of phosphate in natural waters. Analytica Chimica Acta, 27:31-35.

Nakasaki, K., Yaguchi, H., Yasushi, S. and Hiroshi, K. 1993. Effects of pH control on composting of garbage. Waste Management and research, 11: 117-125.

Ngakou, A., Megueni, C., Noubissié, E. and Tchuenteu, T. L. 2008. Evaluation of the physico-chemical properties of cattle and kitchen manures derived composts and their effects on field grown *Phaseolus vulgaris* L. *International Journal of Sustainable Crop Production*, 3(5):13-22.

Nkonge, C. and Ballance, G. M., 1982. A sensitive colorimetric procedure for nitrogen determining in micro-Kjeldahl digests. *Journal of Agricultural and Food Chemistry*, 30: 416–420.

Ojetayo, A. E., Olaniyi, J. O., Akanbi, W. B. and Olabiyi, T. I. 2011. Effect of fertilizer types on nutritional quality of two cabbage varieties before and after storage. Journal of Applied Biosciences, 48: 3322-3330.

PRODEX. 2012. Guide to good practices for the production, storage and preservation of onions, 1st Edition, 12p.

Rameez, A. B., Sana, U. B., Shahbaz, K. B., Hafeez, N. B., Shabeer, A. B., Waseem, B., Allah, B. B. and Jehangeer, B. 2014. Economic analysis of onion (*Allium cepa* L.) production and marketing in district Awaran, Balochistan. Journal of Economics and Sustainable Development, 5(24): 2222-2855.

Saha, A., Santra, S. C. 2014. Isolation and characterization of bacteria isolated from municipal solid waste for production of industrial enzymes and waste degradation. Journal of Microbiology & Experimentation, 1(1):12-19.

Scheuerell, S. J. and Mahaffee, W. F. 2004. Compost tea as a container medium drench for suppressing seedling damping-off caused by *Pythium ultimum*. Phytopathology, 94: 1156-1163.

Seran, T. H., Srikrishnah, S. and Ahamed, M. M. Z. 2010. Effect of different levels of inorganic fertilizers and compost as basal application on the growth and yield of onion (*Allium cepa* L.). Department of Crop Science, Faculty of Agriculture, Eastern University, Chenkalady, Sri Lanka. pp. 64-70.

Singh, K. and Batra, B. R., 1972. Effect of nitrogen, phosphorus and sulphur fertilization on growth and quality of onion (*Allium cepa* L.). *International symposium on Sub-tropical and tropical Horticulture,* Bangalore, 144p.

UNDP. 2010. Human Development Report: The Real Wealth of Nations - Pathways to Human Development. New York, 17p. http://hdr.undp.org/en/content/human-development-report-2010