**ORIGINAL ARTICLE**

# GROWTH, YIELD AND LEAF NUTRIENT COMPOSITION OF LETTUCE GROWN IN A SILTY LOAM SOIL AMENDED WITH COMPOST AT DIFFERENT RATES

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**Abstract**

Application of compost has been reported to influence several soil physical, chemical and biological properties positively to increase food production and reduce or prevent the negative environmental impacts associated with conventional agriculture. Poultry manure and *Leucena leucocephala* leaf compost were incorporated to supply 0, 50, 100 and 200 kg N $ha^{-1}$ respectively, based on the initial N content (% N) of the compost in three pot trials consecutively conducted between February and December, 2012. The fresh weight, dry weight and nutrient compositions of lettuce grown as a test crop were determined in each trial 6 weeks after transplanting. Fresh and dry matter contents were higher ($P<0.05$) in the compost amended soils than the control. All the compost treatments showed significantly higher ($P<0.05$) soil N (0.10 - 0.23%) than the control (0.03 % N). Similarly, leaf N, K, Ca, Na and Mg concentrations were significantly greater ($P<0.05$) in the samples from the compost treatments compared to those from the control. Only compost applied at 200 kg N $ha^{-1}$ maintained high levels of N concentration in the lettuce leaves consistently in the 3 trials. The study confirmed earlier report that compost is a viable option for soil fertility management in organic vegetable production systems.

**Keywords:** Compost, dry weight, Nitrogen use efficiency, nutrient composition

## Introduction

Decline in crop production driven by low inherent soil fertility levels has been identified as a major cause of food insecurity, low incomes and poor livelihoods of smallholder farmers in sub-Saharan Africa (SSA) (Palm *et al*., 2001; Smalling and Dixon, 2006). Loss of soil fertility is a major barrier to achieving food security in sub-Saharan Africa because most farmers in SSA use cropping systems, which deplete the soil without paying much attention to soil fertility replenishment (Palm *et al*., 2001; Shisanyai *et al*., 2009). The low soil fertility status and the increasing need to meet the food requirements of their burgeoning population pressure often forces many farmers in SSA to resort to the use of agrochemical including fertilizers for crop production. However, over use and prolonged use of these chemical often result in human and soil health hazards as well as environmental pollution (Yadav *et al*., 2013).

Furthermore, conventional soil fertility management strategies involving the use of synthetic fertilizers are problematic not only because of the unreliable supply of fertilizers and the lack of capital to purchase these inputs, but most importantly, many of these fertilizer inputs tend to cause pollution of surface and ground water (Yadav *et al*., 2013). The increasing global concerns for food security and environmental safety, therefore, necessitate the search for soil fertility management alternatives that are sustainable and are devoid of any adverse health and environmental consequences (Topliantz *et al.*, 2005). According to Yadav *et al.* (2013), the major driving factor behind the increasing global demand for organic food is the health consciousness and the willingness of consumers to pay premium prices for organic produce.

Composting is the biological decomposition and stabilization of organic matter derived from plants or animals through the action of diverse microorganisms under aerobic conditions (Amlinger *et al.*, 2007). Application of compost offers the potential to restore soil nutrients, soil organic matter (SOM) contents ( Hu *et al.*, 2009) and improve crop production through enhanced nutrient use efficiency due to increased nutrient availability, which is promoted by improved soil structure and soil water retention capacity often associated with compost additions (Leon *et al.*, 2012).

Compost can be considered as an organic multi-nutrient fertilizer because it contains significant amounts of valuable plant nutrients including N, P, K, Ca, Mg and S as well as a variety of essential trace elements (Amlinger *et al.*, 2007). Leaching in compost amended soils is lower compared to those treated with soluble mineral fertilizers (Amlinger *et al.*, 2007) and so nutrients in compost remains in the soil for periods far longer than inorganic fertilizer. This is indicative that compost addition is a sustainable strategy for soil fertility replenishment to ensure synchrony between nutrient release and crop uptake for improved crop productivity, food security and enhanced livelihoods. This study therefore examines the effect of compost addition on growth and yield, and nutrient composition in lettuce.

## Materials and Methods

### Soil sampling

Highly weathered tropical soil (*Haplic acrisol*) sampled from the University of Cape Coast Teaching and Research Farm in the coastal savanna agroecological zone of Ghana were used for the study. Surface (0 -20 cm) soils were sampled from 20 different spots at the site and were thoroughly mixed and sub-sampled to form a composite sample after all plant debris had been removed. The samples were air-dried and sieved through a 2 -mm mesh sieve. The fine earth (< 2 mm) fraction was used for laboratory analysis as well as the pot experiment. The experimental design was a split plot in a randomized complete block involving four treatments with four replicates each.

### Soil analysis

Initial and post-harvest soil samples were analyzed for physicochemical properties using standard laboratory procedures. Soil pH was measured in a 1:2 soil: solution ratio in distilled water using a microprocessor glass electrode pH meter (Rowell, 1994). Soil texture analysis was done using the method of Bouyoucos (1962). The wet combustion method of Walkley and Black (1934) was used for soil organic carbon determination. Total N was determined using the microKjedahl method described by Bremner (1965). Available phosphorus was determined using the method of Bray and Kurtz (1945). Exchangeable bases were extracted with 1.0 M

NH4OAc (pH 7.0); Na and K in the extract determined by flame photometry (Chapman and Pratt, 1961) whiles Mg, Ca concentrations were determined by EDTA titration method (Rowell, 1994). Exchange acidity was determined following the procedure described by Thomas (1982) and Effective Cation Exchange Capacity (ECEC) was estimated as the sum of the exchangeable cations and exchangeable acidity. Table 1 shows some physicochemical properties of the soil used in the study.

**Compost**

The compost used in the study was prepared with poultry manure (PM) and *Leucena leucocephala* leaves (L) in a ratio of 4:1 (PM:L), at the Technology Village of the University of Cape Coast using the pit method as described by Inckel *et al.* (2005). The pit was 50 cm deep, 2 m wide and 10 m long. The compost materials were arranged in layers and maize stuble was included to ensure that the C: N ratio was about 30:1. To maintain an aerobic decomposition the pile was turned every three weeks until decomposition was finished in about 60 days. During decomposition the temperature of the pile was about 25°C and increased steadily to about 45ºC after 30 days. The temperature declined again to about 24°C at the end of the decomposition. At the end of the decomposition the compost had developed an earthy smell. The plastic mulch was removed and the compost exposed to sunlight and air for 5 days to reduce the moisture content as recommended by Seed (2004).

**Pot experiment**

In the study, lettuce seedlings were sown in the pots for three consecutive times (10$^{th}$ February – 29$^{th}$ March; 9$^{th}$ April – 23$^{rd}$ May and 20$^{th}$ October- 3$^{rd}$ December, 2012). The experimental design was completely randomized design and each treatment was replicated four times. Compost was mixed thoroughly with the soil at rates of 18 tons ha$^{-1}$, 9 tons ha$^{-1}$ and 4.5 tons ha$^{-1}$ to supply 200 kg N ha$^{-1}$, 100 kg N ha$^{-1}$, and 50 kg N ha$^{-1}$, respectively based on the nitrogen content (%) in the compost. The treatment included an unamended (no compost) soil.

In the study, plastic pots of volume 0.64 l were filled with 800 g soil repacked to a bulk density of 1.2 g cm$^{-3}$. The soils were kept at 60% water filled pore space (WFPS) and maintained constant throughout the period of the study by mass balance. A fast growing and N-efficient *Marietto* lettuce variety *was* used as the test crop. Two lettuce seedlings were transplanted at two seed leaf stage per pot and thinned to one a week after planting. Plant height and plant width were measured weekly for 6 weeks. At the end of the sixth week, the lettuce was harvested. The aboveground biomass was separated from the below ground biomass. The fresh weights of the above and below ground biomass from each pot were recorded. The samples were then oven-dried at 60°C until a constant weight was attained and recorded as leaf dry weight. The aboveground biomass was ground and analyzed for total N, P and K, Ca. Mg and Na concentrations using standard laboratory procedure of Page *et al.* (1982).

**Nitrogen Use Efficiency**

The Nitrogen Use Efficiency (NUE) in each treatment was determined as follows:

NUE (%) = (Lettuce $N_{treatment}$ - Lettuce $N_{control}$ / $N_{applied}$) *100

Where $N_{treatment}$ is lettuce N uptake in the compost-amended treatment; Lettuce $N_{control}$ is the lettuce uptake in the control treatment and $N_{applied}$ is the amount of N applied in kg $ha^{-1}$.

**Statistical analysis**

The results obtained were analysed by ANOVA using the MINITAB 15 statistical software (2015 MINITAB, Inc.) and considering the treatment as the independent variable. The means were separated by the Tukey's test, considering a significance level of $P<0.05$ throughout the study.

**Results**

The physicochemical properties of the soil used in the study are summarized in Table 1. The soil N, P and K concentrations of 0.09%, 6.21 mg $kg^{-1}$ and 0.37 c mol $kg^{-1}$ were all low. The ECEC (sum of exchangeable cations and exchangeable) measured in the soil was also very low (7.43 cmol $kg^{-1}$). Soil pH in the compost amended treatments were higher ($P<0.05$) than in the control. The soil pH of the control was 5.21 while those in the compost treatments varied from 5.62 to 5.90 (Table 3). Organic carbon concentration increased slightly in the compost amended soils compared to the control, with the 200 kg N $ha^{-1}$ compost treatments showing the highest ($P<0.05$) organic C concentration of 1.41%.

The ECEC acidity in all the soils were low, ranging from 7.43 in the control to 9.22 cmol$kg^{-1}$ in the 200 kg N $ha^{-1}$ treatment. Available P values recorded in all the soils were low, but the available P in the soils followed the decreasing order 200 kg N $ha^{-1}$> 100 kg N$ha^{-1}$> 50 kg N $ha^{-1}$> control. Percentage N concentrations in the compost amended soils were comparatively higher ( $P < 0.05$) in the compost amended soils than in the control, ranging from 0.10 in the 50 kg treatment to 0.23 kg N $ha^{-1}$ in the 200 kg N $ha^{-1}$ treatment, as compared to 0.03 % in the control.

The chemical compositions of the compost used in the study and the soils after the third lettuce growing cycle are presented in Tables 2 and 3 Figures 1 and 2 show the leaf lengths and widths, respectively, measured at 6 weeks after planting (6 WAP).

Leaf heights and widths in the compost treatments were higher ($P < 0.05$) than in the control during all the three growing cycles. The highest plant height (13.2 cm) and plant width (8.3 cm) were obtained in the 200 kg N $ha^{-1}$ compost treatment, but no significant difference occurred between the plant heights and plant widths recorded in the 50 and 100 kg N $ha^{-1}$ treatments.

The fresh and dry weights of the lettuce estimated from each treatment during the three growing cycles are presented in Figures 3 and 4. Fresh weights measured in all the treatments ranged from 4.1 to 15.2 g pot $^{-1}$, with the 200 kg N $ha^{-1}$ treatments showing the highest ($P<0.05$) fresh and dry weights in all the 3 growing periods. In all the three cycles, fresh weights of the lettuce in the control were significantly lower ($P<0.05$) than in all the compost amended treatments. The leaf dry weights recorded in the study followed a similar trend as was found in the fresh weight following the order 200 kg N $ha^{-1}$> 100 g N $ha^{-1}$ = 50 g N $ha^{-1}$> control. Thus, the highest (4.1 g $plot^{-1}$, $P<0.05$) and the least (1.2 g plot $^{-1}$, $P<0.05$) dry weights were recorded in the 200 g N $ha^{-1}$ and control treatments, respectively.

**Table 1: Physicochemical characteristics of the soil used in the study**

| Property | Unit | Value |
|---|---|---|
| Bulk density | $gcm^{-3}$ | 1.2 |
| Parent material | | Granite |
| Sand | % | 31.0 |
| Silt | % | 52.4 |
| Clay | % | 16.7 |
| Textural class | | Silt loam |
| pH (1: 1 soil :$H_2O$) | | 5.53 |
| Organic | % | 1.02 |
| N | % | 0.21 |
| Available P | $mgkg^{-1}$ | 6.21 |
| Ca | $cmolkg^{-1}$ | 4.27 |
| Mg | $cmolkg^{-1}$ | 1.09 |
| Na | $cmolkg^{-1}$ | 0.21 |
| K | $cmolkg^{-1}$ | 0.26 |
| ECEC | $cmolkg^{-1}$ | 7.43 |
| Exchange acidity | $cmolkg^{-1}$ | 0.10 |
| Classification (FAO, 1998) | | *Haplic acrisol* |

**Table 2: Chemical properties of the compost used in the study**

| Compost parameter (%) | Value |
|---|---|
| Total N | 1.12 |
| Organic C | 31 |
| C:N ratio | 27.7 |
| Available P | 0.9 |
| Available Ca | 21 |
| Available Mg | 0.9 |
| Available Na | 0.25 |
| Available K | 1.7 |
| pH (1: 1 soil :$H_2O$) | 7.6 |

**Table 3: Chemical properties of the soil after three cycles of okra production**

| Soil parameter | Unit | Control (Soil only) | Rate of compost applied (ton $ha^{-1}$) | | |
|---|---|---|---|---|---|
| | | | 4.5 | 9 | 18 |
| pH | | 5.21a | 5.62b | 5.69b | 5.90c |
| Organic C | % | 1.00a | 1.17b | 1.24b | 1.44b |
| Total N | % | 0.03a | 0.10b | 0.11b | 0.25c |
| Available P | $mgkg^{-1}$ | 5.18a | 16.16b | 17.02b | 17.99b |
| Ex. Ca | $cmolkg^{-1}$ | 3.04a | 4.40b | 4.59b | 5.23b |
| Ex. Mg | $cmolkg^{-1}$ | 0.58a | 0.73b | 0.75b | 0.98b |
| Ex. Na | $cmolkg^{-1}$ | 0.20a | 0.27b | 0.29b | 0.34b |
| Ex. K | $cmolkg^{-1}$ | 0.33a | 0.43b | 0.45b | 0.56b |
| Ex. acidity | $cmolkg^{-1}$ | 2.95a | 2.82b | 2.80b | 2.11c |
| ECEC | $cmolkg^{-1}$ | 5.10a | 8.65b | 9.14c | 9.22c |

Values followed by the same alphabet in the same row are not significantly different at $P < 0.05$

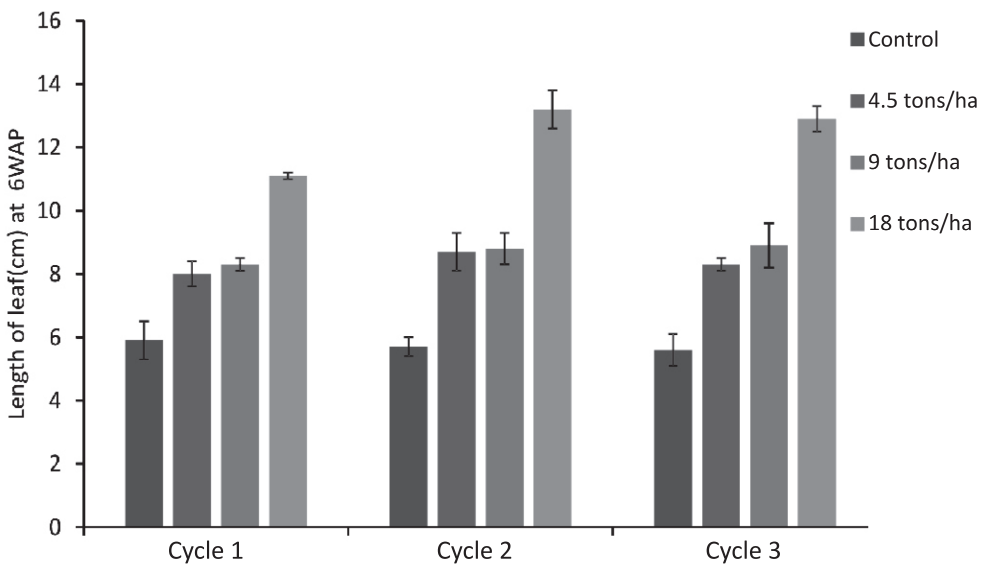


**Figure 1: Length of lettuce leaf (cm) at 6 WAP. Error bars represents ± 1 standard deviation**

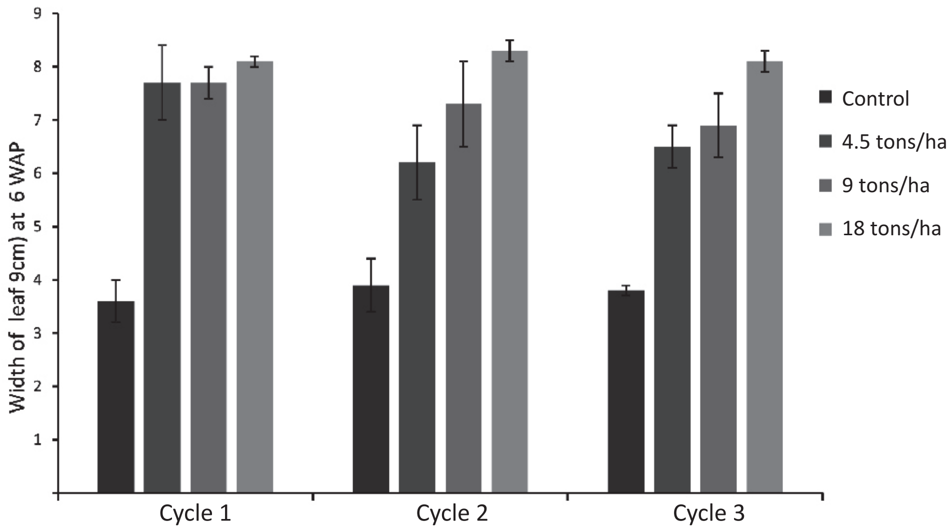


**Figure 2: Width of lettuce leaf (cm) at 6 WAP. Error bars represents ± 1 standard deviation**

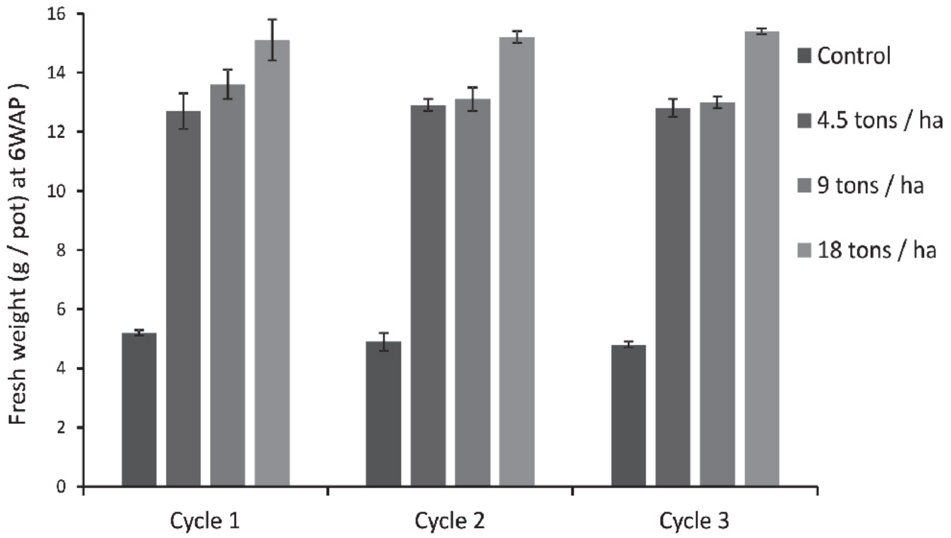


**Figure 3: Fresh weight of lettuce at maturity (g/ pot). Error bars represents ± 1 standard deviation**

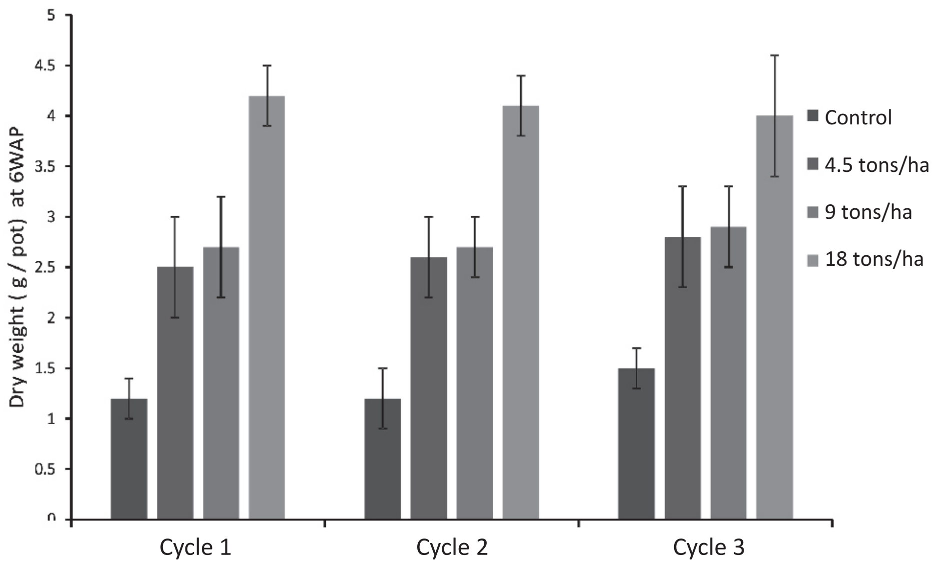


**Figure 4: Dry weight of lettuce at maturity (g / pot). Error bars represents ± 1 standard deviation**

## Lettuce leaf nutrient composition and Nitrogen Use Efficiency (NUE)

**Table 4: Nutrient composition of lettuce leaves at maturity**

| Compost treatment (tons ha⁻¹) | N | P | K | Ca | Mg |
|---|---|---|---|---|---|
| | ← | | gkg⁻¹ | | → |
| **Cycle 1** | | | | | |
| Control | 4.0 ± 0.8a | 4.5±1.3a | 33.1±3.6a | 4.1±1.0a | 3.4±0.2a |
| 4.5 | 6.2± 1.2b | 5.3±1.1b | 39.2±3.5b | 5.1±1.2b | 3.4±0.9a |
| 9 | 6.1±1.6b | 5.6±1.5b | 39.6±4.8b | 5.6±0.9b | 3.6±0.2a |
| 18 | 10.0±0.9c | 7.5±1.2b | 44.0±5.8b | 6.5±0.8b | 3.5±0.5a |
| **Cycle 2** | | | | | |
| Control | 4.1 ±0.5a | 4.5±1.2a | 33.2±1.5a | 4.0±1.2a | 3.4±0.2a |
| 4.5 | 6.0± 1.2b | 5.1±0.9b | 38.6±1.7b | 5.6±0.7b | 3.2±0.5a |
| 9 | 6.2±1.2b | 5.5±0.3b | 39.2±0.7b | 5.5±0.5b | 3.4±0.2a |
| 18 | 10.9±0.7c | 7.2±0.4b | 41.2±2.2b | 6.3±1.1b | 3.7±0.2a |
| **Cycle 3** | | | | | |
| Control | 4.0 ±0.7a | 4.1±0.2a | 32.0±1.0a | 4.0±0.8a | 3.2±0.3a |
| 4.5 | 6.1± 1.2b | 4.9±1.1b | 39.3±2.1b | 5.4±1.4b | 3.1±1.0a |
| 9 | 6.2±1.5b | 5.7±1.5b | 39.1±1.3b | 5.5±1.1b | 3.6±0.2a |
| 18 | 11.7±0.3c | 7.3±0.9b | 43.7±1.2b | 6.4±0.9b | 3.3±1.1a |

Values followed by the same alphabet in the same row are not significantly different at P<0.05

The N, P, K, and Ca concentrations in all the compost treatments were higher (P<0.05) compared to the control (Table 4). However, Mg concentrations measured in all the treatments were similar. The least N concentration of 4.0 g $kg^{-1}$ was found in leaves from the control during the first growing cycle and the highest of 11.7 mg $kg^{-1}$ was measured in samples from the 200 kg N $ha^{-1}$treatment during the third growing cycle. The P concentrations measured in the lettuce samples 200 kg N $ha^{-1}$ treatments were about 67% higher than in the control, but no significant difference occurred among the P concentrations in the various compost amended treatments. Of all the nutrient elements determined in the leaves during the three growing cycles only the 200 g N $ha^{-1}$ treatment showed a consistently increasing N concentration from growing cycle one to three.

The Nitrogen Use Efficiency (NUE) of lettuce following incorporation of compost at different rates is shown in Figure 5. During the three growing cycles, NUEs estimated in all the treatments were less than 25 %. During the second growing cycle NUE values estimated in the 200 kg N $ha^{-1}$ treatments was significantly greater (P<0.05) than in all the other compost treatments, but no statistical difference was found between NUE values found in the 50 and 100 kg N $ha^{-1}$ treatments throughout the study.

## Discussion

### Effect of compost application on soil fertility

The chemical composition of the soils used show that the soil had low inherent fertility status, in that the initial N, P and K concentrations of

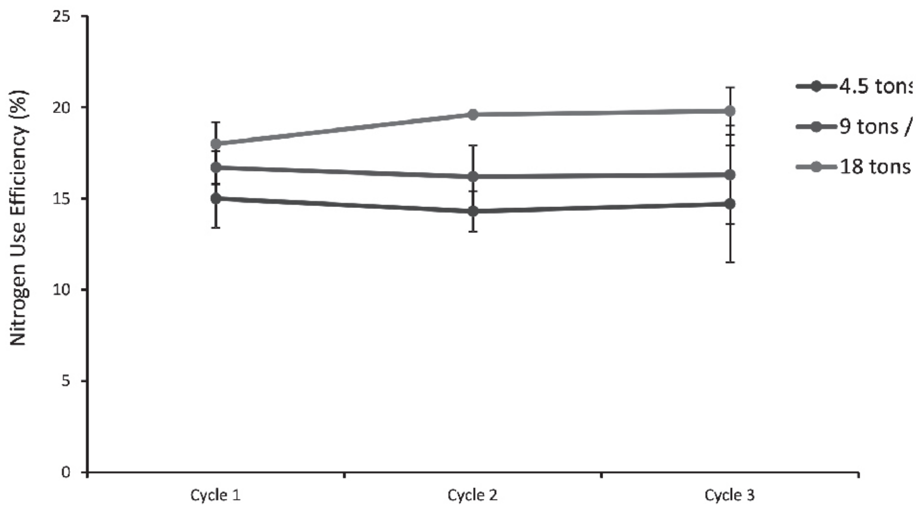


**Figure 5: Nutrient Use Efficiency (%) of lettuce grown in compost-amended soils**

0.09%, 6.21 mg $kg^{-1}$ and 0.37 c mol $kg^{-1}$ were all lower than the critical limits of 0.13%, 20 mg $kg^{-1}$, 0.47 c mol $kg^{-1}$ recommended by the Council for Scientific and Industrial Research (CSIR) (Yeboah *et al*., 2012). The ECEC measured in the soil was also less than 10 c mol $kg^{-1}$. Soils in Africa are typically low in fertility and in how they respond to inputs (AGRA, 2007). Low N, P and K concentration in the soil can be attributed to the inherently low nutrient composition of the parent material and continuous cropping, which results in nutrient mining and depletes soil organic matter (Shisanyai *et al*., 2009). Therefore, recycling organic residues through compost can effectively improve the soil's fertility level (Senesi *et al*., 2007).

The compost used in the study, as others of different origin, contained relatively lower concentrations of nutrients (1.12 % N and less than 1% P) compared to inorganic fertilizers. This observation is in accordance with the findings of Sikora and Enkiri (1999), who reported that low mineralization rates of compost require high application rates to satisfy the optimum N and P requirements of crops. In accordance with Bullock *et al*. (2002), addition of compost to the soil slightly improved soil pH and soil organic carbon content, particularly in the 200 kg N $ha^{-1}$ treatment. In this study approximately 9 tons $ha^{-1}$ of the compost was applied so as to meet the 100 kg N $ha^{-1}$ recommended application rate.

Initial C:N ratio of the compost was less than 30: 1 and so a net N mineralization was expected. However, the trend of marginal increases that were found in N, P, K, Ca and Mg concentrations, following addition of compost at 200 mg N $ha^{-1}$ indicates that compost addition offers the potential to increase soil fertility but that its effect appears to be long term. In general, ECEC in all the soils were low (ranging from 7.43 in the control to 9.22 $cmolkg^{-1}$ in the 200 kg N $ha^{-1}$ treatment), but the relatively higher ECEC in the compost amended soils were in accordance with findings of Amlinger *et al*. (2007) who reported that compost application significantly increased SOM and hence soil CEC compared to the control. Amlinger *et al*. (2007) explained that SOM contributes about 20 – 70% to the CEC of many soils.

The yield and leaf N concentration of lettuce found in the control were significantly lower than in the all the compost treatment. This is attributable to the low initial total nitrogen concentration in the soil used for the experiment. This indicates that the inherent soil fertility status is an important consideration for soil amelioration with organic inputs (Sanchez, 1991). The low lettuce growth rate, as shown by the low leaf length and width in the control could also be due to the low soil fertility status, which is exacerbated by the acidic nature of the soil. This is in accordance with the report by Palm *et al*. (2001) that, efficiency of applied compost is relatively poor in acid soils. In this study the highest yield obtained from the 200 kg N $ha^{-1}$ treatment translates to less than 20 t $ha^{-1,}$ indicative that, overall, the yield of lettuce attained after the additions of compost at different rates was lower than its potential. This conclusion is supported by the findings of Drews *et al*. (1996) who recorded lettuce yield up to 30 tons $ha^{-1}$ in compost amended soils. This observation therefore, suggests that it is imperative to investigate how amelioration of soil acidity, through liming for instance, together with compost application will influence lettuce yield.

**Effect of compost on lettuce growth and yield**

In accordance with Lee and Park (2004) who studied growth of lettuce in soils amended with different compost concentrations, compost addition significantly increased leaf length and leaf width, leaf fresh weight and leaf dry weight, particularly, when it was applied at 200 kg N $ha^{-1}$. Compost application has also been reported to increase the yield of tomato (Montemoro *et al*., 2005) and fresh weight of parsley. During the $2^{nd}$ growing cycle, addition of compost at a rate of 200 kg N $ha^{-1}$ more than doubled leaf fresh weight and increased leaf dry weight by 3- fold. This indicates that the addition of compost enhanced lettuce growth and yield. Compared to the control, fresh and dry weights in the 50 and 100 kg N $ha^{-1}$ treatments were up to 60 % higher, confirming the earlier conclusion that the quantity of compost incorporated was an important factor affecting the growth of lettuce in this study. These observations were consistent with those made by Mrabet *et al*. (2012) who found significant increases in yield, length and width of lettuce in soils amended with compost. Similarly, Strancheva and Mitova (2002) reported a significant increase in total dry weight of lettuce in response to vermicompost application. Jat and Ahlavat (2006) also showed that application of 3 tons of vermicompost $ha^{-1}$ to chickpea improved dry matter accumulation, grain yield, soil N and P contents and bacteria count.

Although nutrient release following decomposition of compost is slow, net N mineralization may occur if the C:N ratio of the input is narrow. In this study, the C:N ratio of the compost added was less than 30 therefore , the greater plant height, width, fresh and dry weights observed in the 200 kg N $ha^{-1}$ treatments compared with the other treatments were not unexpected. Organic C contained in the compost is likely to serve as a source of energy supply for the heterotrophic soil microorganisms, which drive the soil nutrient release processes, enhancing plant nutrient availability to support plant growth and yield.

**Effect of compost application on lettuce leaf nutrient composition and nitrogen use efficiency**

Apart from N and P in the 200 kg N $ha^{-1}$ treatment, concentrations of nutrients determined in leaves sampled from all the treatments were lower than the sufficiency levels reported by Ludwick (2002). Leaf nutrient concentrations found in the 50 and 100 kg N $ha^{-1}$ treatments were not above the yield-limiting nutrient deficiency concentrations. The data further indicated that incorporating compost at a rate of 200 kg N $ha^{-1}$significantly improved NUE in lettuce, during the second growing cycle, compared to when compost was added at 50 or 100 kg N $ha^{-1}$ (Figure 5). This observation is in good agreement with similar findings made by Drews *et al*. (1996). It must, however, be emphasized that in all the treatments NUE was less than 25%, indicative that N mineralization from compost amended soils can be slow and hence N availability to growing plants may be low, especially at the initial years of crop production. This is in good agreement with the Drews *et al*. (1996) and Amlinger et al. (2007)'s view that N in organic nutrient inputs including compost is released to soils through low rates mineralization process. Mylvarapu and Zinati (2009) also found increased crop nutrient uptake associated with increased soil nutrient concentration in compost amended soils. Hornick *et al*. (1984) recommended that compost applications rates needed to satisfy the complete N requirements of crops ranging from 40 to 100 tons $ha^{-1}$.It is instructive to indicate that, in this study, the lower limit of Hornick *et al*. (1984)'s recommended application rate is higher than the highest rate (200 kg N $ha^{-1}$), which corresponds to 18 tons $ha^{-1}$, applied in this study.

## Conclusion

The study revealed that that the effect of compost on lettuce growth and yield was dependent on the quantity of compost. Fresh and dry matter contents were higher in the compost amended soils than the control. All the compost treatments showed significantly higher soil N than the control. Similarly, leaf N, K, Ca, Na and Mg concentrations were significantly greater in the samples from the compost treatments compared to those from the control. The study also revealed that Nitrogen Use Efficiency in lettuce can be improved more in soils amended with 18 tons $ha^{-1}$ (200 kg N $ha^{-1}$) equivalence of poultry manure and *Leucena* leaf compost. In conclusion, the study demonstrated that application of composts has the potential to improve soil fertility and N availability for crop uptake, and enhance lettuce growth and yield.

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