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ORIGINAL RESEARCH

Effect of agro industrial wastes compost on soil health and onion yields improvements: study at field condition

Feyisa Girma Erana[1] · Tesfaye Alemu Tenkegna[2] · Seyoum Leta Asfaw[1]

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Abstract

Purpose Industries are generating numerous amount and types of organic wastes to the environment. The aim of the present study was to investigate the effects of agro industrial wastes compost on soil physicochemical quality, soil microbial population, growth and yield of onion (*Allium cepa* L.) under field condition .

Methods The experiment was conducted in a completely randomized plot design at field condition. *Allium cepa* L. was grown using five different levels of agro industrial wastes compost, three different levels of inorganic fertilizers and three controls.

Results Compost amendment improved the soil pH, TOC, TKN, field capacity (FC), permanent wilting point (PWP), and available water content (AWC), cultivable bacterial count and fungi. But no significant effect was found on electrical conductivity (EC), available phosphorus (P) compared to the control. Exchangeable Na, K, Ca, Mg, Fe, Zn, and Cu increased while Pb, Cr, and Mn value showed no significant change with compost application. Field application of compost improved onion shoot numbers, shoot girth, and shoot length. Further, significant shoot weight and bulb weight were also obtained after compost treatment.

Conclusions After compost amendment significant improvement in soil fertility and onion yield was obtained. This can be recommended for small scale farmer's food security improvement and combined with agro industrial wastes management.

Keywords Compost · Inorganic fertilizer · Soil fertility · Shoot length · Bulb weight

Introduction

Globally during the past three decades, there has been increased awareness of soil degradation and its negative impact on its productivity (Obalum et al. 2012). Similarly, there is high land degradation in Ethiopia due to deforestation, unbalanced crop, and livestock production, inappropriate land-use systems and land-tenure policies (Holden and Yohannes 2002). On top of these, Ethiopia has a high population growth which leads to intensified use of already stressed resources and expansion of production to marginal and fragile lands. Such processes aggravate erosion and productivity declines, resulting in a population–poverty–land degradation cycle. In addition to this, nowadays high agricultural practices are characterized by excessive use of chemical fertilizers, pesticides and herbicides (Nawaz et al. 2015; Sadh et al. 2018). Chemical fertilizers directly enhance crop yield because plants directly or indirectly assimilate the nutrients provided by these inorganic fertilizers. However, on the other hand, the production and use of these chemicals impart various negative effects on the agricultural ecosystem such as degradation of the soil, loss of crop genetic diversity, reduction in soil microbial diversity, contamination of ground-water resources, and pollution of the atmosphere. Generally, land degradation directly affected the type of plant grown in the area (Folberth et al. 2014) Therefore, land degradation is a great threat for the future and it requires great effort and resources to improve.

On the other hand improved economy, rapid population growth in Ethiopia linked to huge consumption of food, booming of industries are resulting in production of numerous amount and types of organic wastes. The most preferred management approach of waste is not to create it in the first

✉ Feyisa Girma Erana
wbatu28@gmail.com

1 Center for Environmental Science, College of Natural and Computational Sciences, Addis Ababa University, Addis Ababa, Ethiopia

2 Department of Microbial, Cellular and Molecular Biology, College of Natural and Computational Sciences, Addis Ababa University, Addis Ababa, Ethiopia

place (Regattieri et al. 2016) while waste that could not be prevented is the best to recycle (Van Ewijk and Stegemann 2016). Composting is a preferred and environmentally sound method whereby organic waste is changed to organic fertilizer through biological processes. It is a way of obtaining a stable product from biological oxidative transformation, similar to that naturally occurs in the soil (Ahmed and Varshney 2011; Deepesh et al. 2016). Organic matter in compost helps to improve the water holding capacity of the soil and also augments its structure, thus increase its nutrients holding capacity (McLaughlin and Kszos 2005; Triberti et al. 2008). Composting also stabilize organic matter, eliminate unpleasant odors and reduce pathogenic microorganisms to an acceptable level. It has better use than inorganic fertilizers for soil and plants (Khalil et al. 2011). Research also found that organic farming improves yield performance of onion. Thus, the objective of this paper was to study the impact of agro industrial wastes compost amendment on soil fertility and onion yield improvements at field condition.

Materials and methods

Study area

Field study was conducted from March to June 2017 in Wonji Shewa, Oromia Regional State found at 35°55′N and 128°47′E. Study area had a dominant sub-tropical climate with mean annual rainfall ranging from 400 to 2000 mm and temperature ranging from 25.1 to 27.5 °C. Adama red onion (*Allium cepa* L.) cultivar which is widely cultivated in the study area was used for the experiment as experimental crop. It is well accepted by both producer and consumer and successfully produced by small farmer and the commercial grower scattered in most regions of the country.

Sources of compost

Compost of agro-industrial waste used in this study was obtained from the Centre for Environmental Science, Addis Ababa University. The compost was prepared by co-composting of wastes from vegetables processing plants and their trimmings, slaughter house wastes, bone meal and saw dust from wood processing factories for 90 days. Chemical composition of this compost has been presented in Table 1.

Experimental design

Randomized complete block design with three replications and different dose treatments were used. Fifty-six days old Adama red onion (*Allium cepa* L.) seedlings were purchased from local seedling producers. Seedlings were transplanted using spacing of farmers' local practice (spacing between irrigation furrows, planting rows and plants within a row was 50, 30, and 20 cm), respectively. A spacing of 1 m was maintained between plots and blocks. One week later transplantation of the onion compost and inorganic fertilizers were applied. Nutrients applied were immediately mixed with soil using hand forks. A total of 27 plots were prepared (15 plots for compost treatment, 9 plots for inorganic treatments and 3 plots for control treatment). The area of each plot was 20 m^2 (2 m by 10 m). Plots without compost and inorganic fertilizers were used as control treatments and fertilizers were applied as described in Table 1. Weed removal was done by hand and watering was done as needed but mostly every week using water pump through farrow irrigation. Harvesting of onion bulbs was done when 75–80% of the onion showed neck fall.

Soil sampling, physicochemical analysis and microbial counting

Soil samples were collected from the experimental plots before and after fertilizer application trials. Soil samples were oven dried, sieved using 2 mm mesh. pH and electrical conductivity (EC) were determined using soil to distilled water in a ratio of 1:5 w/v as filtered extract (Jones et al. 2011). Organic Matter and Organic Carbon (OM and OC) were found titrimetrically by modified Walkley–Black titration (De Vos et al. 2007). Organic matter (OM%) was calculated by multiplying OC with conventional Vanbameller factor. Total nitrogen was determined by Kjeldahl digestion method (Goyal and Hafez 1990) using Kjeldahl apparatus CABCONCO 141102492, SIEMENS Germany. Phosphorus was determined by Olsen method (Olsen and Bakken 1987) and plant available phosphorous was determined by multiplying available phosphorous by 2.29. Textural class or Particle size distribution was estimated by Bouyoucos Hydrometer (Karkanis et al. 1991). Field capacity 33 kPa, Permanent wilting (1500 kPa suction) and water holding capacity were determined according to pressure plate method (Mbah 2012) using moisture equipment SANTA BARBARA CA 0700 series, USA. Total metal analysis for Zn, Cu, Fe, Mn, Ca, Mg, Na K. Cr and Pb were done after extracting through dry ashing then determined by reading on an atomic absorption spectrophotometer AAS, novAA 400, Germany (Hseu 2004).

Total microbial count

The total number of cultivable bacteria, fungi, and actinomycete were counted as colony forming units on nutrient agar, potato dextrose agar (Olsen and Bakken 1987) and Casie-Starch Agar (Vieira and Nahas 2005), respectively, using the dilution plate method. Total cell counts were calculated for 1 g dried soil.

Table 1 Physicochemical characteristic of compost used and treatment design

Compost physicochemical results	
pH	7.3 ± 0.13
EC (μS cm^{-1})	444 ± 37
TP (mg kg^{-1})	22.93 ± 2.5
TOC (%)	25.25 ± 0.28
TKN (%)	2.35 ± 0.03
Na (ppm)	1221.7 ± 12
K (ppm)	1027 ± 32
Ca (ppm)	28690 ± 12
Mg (ppm)	817 ± 168
Pb (ppm)	8.9 ± 1.4
Cr (ppm)	0.15 ± 0.14
Fe (ppm)	30 ± 6.0
Zn (ppm)	0.49 ± 0.01
Cu (ppm)	0.04 ± 0.01
Mn (ppm)	0.4 ± 0.11
Treatment design	
Block no	Application rate
Block 1	10 kgh^{-1} (1A, 1B, 1C replicates)
Block 2	20 kgh^{-1} (2A, 2B, 2C replicates)
Block 3	30 kgh^{-1} (3A,3B, 3C replicates)
Block 4	60 kgh^{-1} (6A, 6B, 6C replicates)
Block 5	90 kgh^{-1} (9A, 9B, 9C replicates)
Block no	Inorganic fertilizers treatments
Block 6	2.5 kgh^{-1}DAP + 5 Urea (2.5 IA, 2.5 IB, 2.5 IC replicates)
Block 7	5 kgh^{-1}DAP + 7.5 kgh^{-1} Urea (IA, IB, IC replicates)
Block 8	7.5 kgh^{-1}DAP + 10 kgh^{-1} Urea (IA, IB, IC replicates)
Block 9	Control 1
Block 10	Control 2
Block 11	Control 3

A, B, C- replications, *DAP* diammonium phosphate, *I* inorganic fertilizers (DAP + Urea), *EC* electrical conductivity, *TP* total phosphorous, *TOC* total organic carbon, *TKN* total Kjeldahl nitrogen

Onion yield improvement

Onion shortest and highest shoot height were recorded in centimeters from the ground to the tip ($n = 51$ plants from each replication). Shoot girth for lowest and shoot girth for highest were recorded in millimeter ($n = 47$ plants from each replication). Sixty plants ($n = 60$ per replication) were considered to count number of shoots per plant. The onion was harvested at the maturity to determine total shoot weight per meter square, bulb weight per meter square and single bulb weight.

Data analysis

Before statistical analysis, distributions of all data sets were checked for normality by running a Shapiro–Wilk goodness of fit test. When the data and residuals were not normally distributed data were transformed, if not further non-parametric Kruskal–Wallis test was used. Data were analyzed using a one-way ANOVA. Mean differences between treatments were determined using Tukey HSD means comparison test. Paired *t* test was used to compare soil physicochemical results between before and after compost amendment. Correlation was done between physicochemical and CFU, between compost treatments and onion shoot height and bulb yields. R-package version 3.0.2. statistical test and Origin version 20 for graph tabulation were used. All significance tests were done at levels of significance $p < 0.05$.

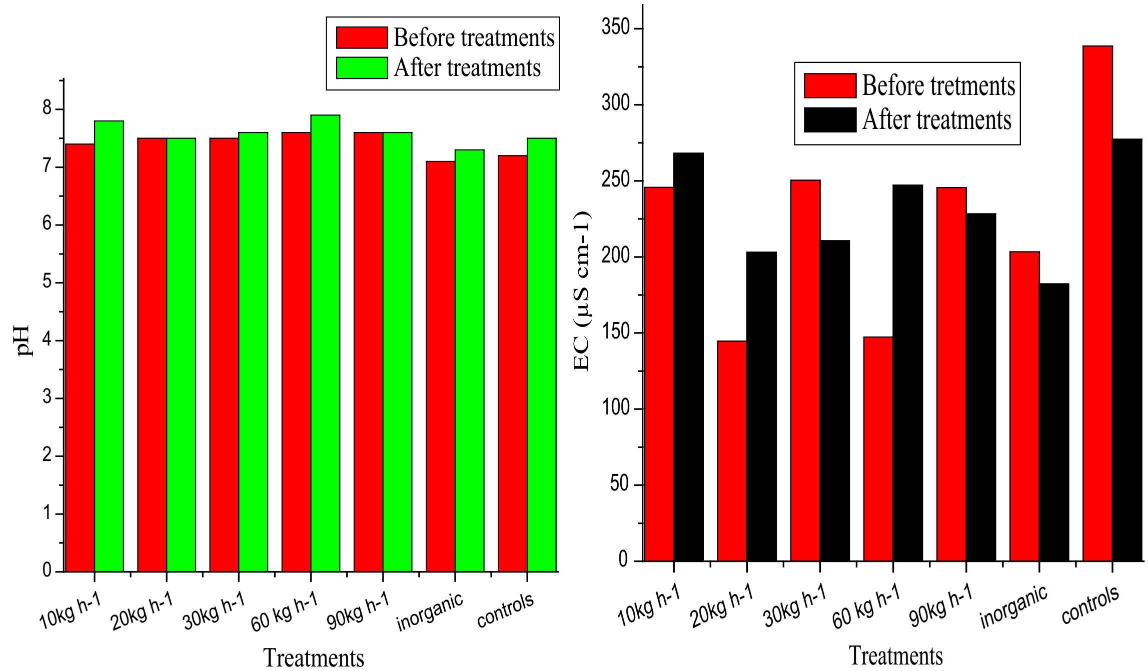


Fig. 1 pH and EC of the field plots used for onion cultivation before and after compost treatment

Results and discussions

Soil physicochemical characteristics

Changes in soil pH and EC have been shown in (Fig. 1). Soil pH before and after compost treatments are significantly different ($p < 0.05$) and significantly higher than control treatment ($p < 0.05$). Most of the treatments showed an increment in pH after compost application. This increment in pH after compost amendment could be explained by decomposition of organic products release of K^+, Ca^{2+} and Mg^{2+} (Das and Dkhar 2012) and OH^- to the soil in resulting slight increase in the soil pH. Soil treated with 10 kg h^{-1}, 20 kg h^{-1} and 60 kg h^{-1} compost showed insignificant increment in electrical conductivity ($p > 0.05$). Decrease in EC values after compost application can be due to removal by onion plant and leaching (Herrera et al. 2008).

Except for control treatment and soil treated with 10 kg h^{-1}, 90 kg h^{-1} compost available phosphorous in soil increased after both organic and inorganic fertilizer treatments. Increment in phosphorus solubility following organic compost application was reported by Giannakis et al. (2014) and Lou et al. (2015). In significant difference in available phosphorous was obtained before and after compost amendment ($p > 0.05$). Nash and Halliwell (1999) reported about twenty percent accumulation of the applied phosphors by the plants. Change in Av. P (available phosphorous), TKN, TOC, FC (field capacity), PWP (permanent wilting point) and AWC (available water content) before, after compost treatments is summarized in Table 2.

Compost application increased TOC contents of soil (Fig. 2) but it statistically insignificant compared to before compost treatments ($p > 0.05$). Similarly, TOC content of compost treated soil was insignificantly different from inorganic treatments ($p > 0.05$) but significantly different from control treatments ($p < 0.05$). An increment in TOC and extractable soil phosphorous was obtained after compost treatment by Giannakis et al. (2014).

Soil TKN after compost treatment significantly increased more than soil TKN before compost treatment ($p < 0.05$). TKN increment after compost treatment was found by Debosz et al. (2002). No significant difference was found between organic and inorganic treated soil in terms of TKN content ($p > 0.05$). Compost treated soil showed a significant increment in TKN value compared to control treatments ($p < 0.05$).

In all treatments, increment in available water content (AWC) was observed after compost treatment except for the 10 kg h^{-1} treated soil. Soil treated with 30 kg h^{-1}, 90 kg h^{-1} and 20 kg h^{-1} compost showed the maximum AWC from highest to lowest, respectively. The same AWC was observed for 60 kg h^{-1} and inorganic treated soil. The lowest AWC was observed with control treatments (Fig. 3).

Table 2 Av. P, TKN, TOC, FC, PWP and AWC before and after fertilizers application

	Av. P (ppm)		TKN (%)		TOC (%)		FC (%)		PWP (%)		AWC (%)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Plot 1 (10 kg h^{-1})	36.08	25.74	0.28	0.29	2.56	2.43	38.8	38.9	26.6	26.7	12.2	12.2
Plot 2 (20 kg h^{-1})	34.18	36.34	0.23	0.24	2.08	2.27	38.1	41.0	26.4	26.6	11.7	14.4
Plot 3 (30 kg h^{-1})	34.60	40.00	0.24	0.26	2.22	2.26	39.2	42.3	28.3	27.1	10.9	15.2
Plot 6 (60 kg h^{-1})	37.40	38.23	0.27	0.30	2.45	2.63	39.1	42.3	28.6	29.3	10.5	13
Plot 9 (90 kg h^{-1})	35.4	34.45	0.29	0.31	2.52	2.97	40.2	44.6	28.9	30.1	11.3	14.5
Plot 10 (Inorganic)	38.22	38.45	0.26	0.25	2.32	2.34	38.7	38.8	28.3	25.9	10.4	12.9
Plot 11 (Control)	37.4	35.56	0.19	0.13	1.94	2.03	37.8	37.9	26.5	26.2	11.3	11.7

Av. P plant available phosphorous, *TKN* total Kjeldahl nitrogen, *TOC* total organic carbon, *PWP* permanent wilting point, *AWC* available water content, *FC* soil field capacity

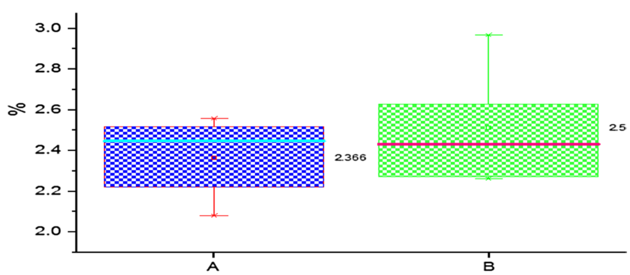


Fig. 2 Mean TOC "A" before treatment and "B" after compost treatment

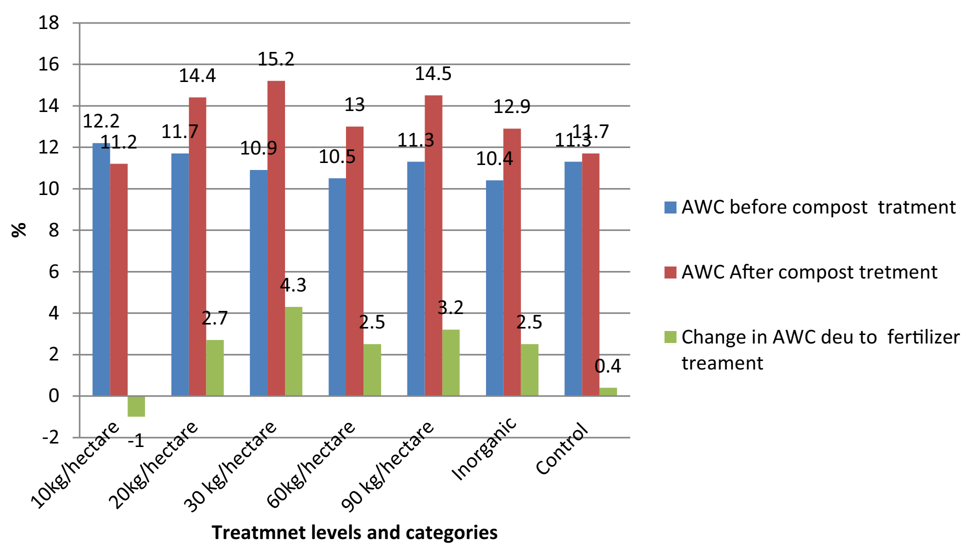
Application

Soil AWC was significantly improved compared to before compost treatment and the counter control group ($p<0.05$) (Fig. 4).

Compost addition increased both soil FC and PWP. Maximum increment in FC and PWP was recorded for 90 kg h^{-1} compost treated soil.

Similarly increment in soil water content, field capacity and permanent wilting point was reported by Suzuki et al. (2007). Strong correlation was observed for TOC and FC ($r=0.774$) TOC and PWP ($r=0.890$) and weak correlation with AWC ($r=0.326$). Strong correlation between organic matter (OM) content, FC and PWP was reported by Huntington (2006). Fertilizer treatments caused less change in the textural class of the soil. Sand and silt were increased more in soil treated with 20 kg h^{-1} and clay in 90 kg h^{-1} (Fig. 5, Tables 3, 4).

Fig. 3 Available water content (AWC) before and after compost treatment and change in AWC due to fertilizer



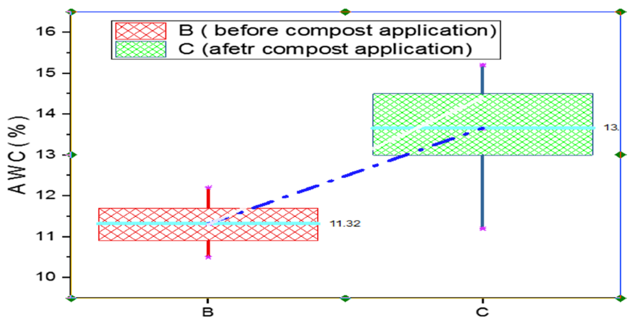


Fig. 4 Box plot for soil AWC before and after compost application

An appreciable increase of macro elements after soil treatment with organic composts was described by Soumare et al. (2003). Since compost has a soluble component, it produces soluble decomposition products which can increase soil metals content (Erhart and Hartl 2010). In other side compost addition to soil known to have immobilizing effects on some metals because humic acids present can bind to metals such as Cd, Pb, Cu, and Cr (Park et al. 2011) and also some metals form precipitation with phosphorous (Bettoni et al. 2016).

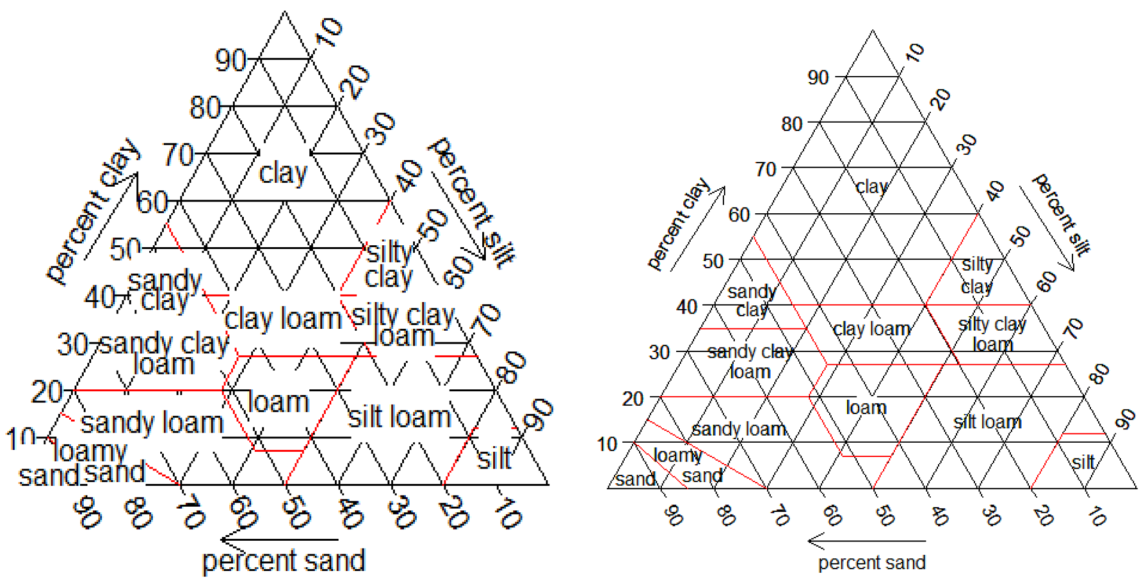


Fig. 5 Left and right soil textural class before and after organic waste treatment

Table 3 Soil metal analysis results from soil treated with different fertilizers and control soil

Treatments	Na (Ppm)		K (Ppm)		Ca (Ppm)		Mg (Ppm)		Pb (Ppm)		Cr (Ppm)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Plot 1 (10 kg/hectare)	1745.2	2384.2	3602.5	4552.5	66790.0	66290.0	1350.6	1604.6	0.01	0.02	0.05	0.05
Plot 2 (20 kg/hectare)	1935.7	2277.2	4057.5	4931.5	66290.0	69290.0	1624.6	1789.1	0.02	0.02	0.05	0.06
Plot 3 (30 kg/hectare)	1841.2	3607.2	4752.0	6230.0	78790.0	67790.0	1390.1	1801.6	0.02	0.02	0.10	0.07
Plot 6 (60 kg/hectare)	1494.2	2079.2	4823.5	5340.0	79290.0	62790.0	1451.6	1627.1	0.02	0.02	0.12	0.1
Plot 9 (90 kg/hectare)	1856.2	2178.5	4465.0	5090.3	56790.0	67790.0	1342.1	1783.1	0.02	0.03	0.08	0.09
Plot 10 (Inorganic)	1767.2	1783.3	3753.0	4539.0	76790.0	75790.0	1174.0	1428.6	0.01	0.01	0.15	0.03
Plot 11 (Control)	1578.7	2411.7	4352.0	4371.5	58790.0	60789.0	1534.6	2246.1	0.01	0.01	0.05	0.09

High level of Na, K, Mg in the soil samples were recorded for all treatments, whereas Ca, Pb, and Cr lower after treatments (Table 3).

Decrease in Fe, Cu, and Mn was recorded after compost soil application, while Zn content showed an increment (Table 4).

Microbial dynamics

Maximum number of bacterial population was counted for 90 kg h^{-1}, 60 kg h^{-1} and 30 kg h^{-1} compost treated soil,

Table 4 Soil metal micro nutrients and textural analysis results from soil treated with different fertilizers and control soil

Treatments	Fe (Ppm)		Zn (Ppm)		Cu (Ppm)		Mn (Ppm)		Sand (%)		Silt (%)		Clay (%)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Plot 1 (10 kg/hectare)	141.3	146.3	0.8	0.96	0.09	0.08	108.2	110	16	16	18	30	66	54
Plot 2 (20 kg/hectare)	145.7	144.1	1.5	1.4	0.08	0.08	108.2	110.6	24	28	52	58	24	24
Plot 3 (30 kg/hectare)	144.7	141.8	0.8	4.3	0.1	0.1	114.4	109.6	24	24	48	48	28	28
Plot 6 (60 kg/hectare)	141.4	140.4	0.8	2.3	0.08	0.09	116.2	112.2	24	24	50	50	26	26
Plot 9 (90 kg/hectare)	140.3	136.8	0.8	0.7	0.09	0.09	112.6	112.0	24	24	52	40	24	34
Plot 10 (Inorganic)	142.3	140.1	0.8	0.7	0.08	0.07	114.4	109.6	30	30	50	45	20	25
Plot 11 (Controls)	141.1	133.3	1.3	1.1	0.08	0.07	114.3	106.4	16	20	52	48	32	32

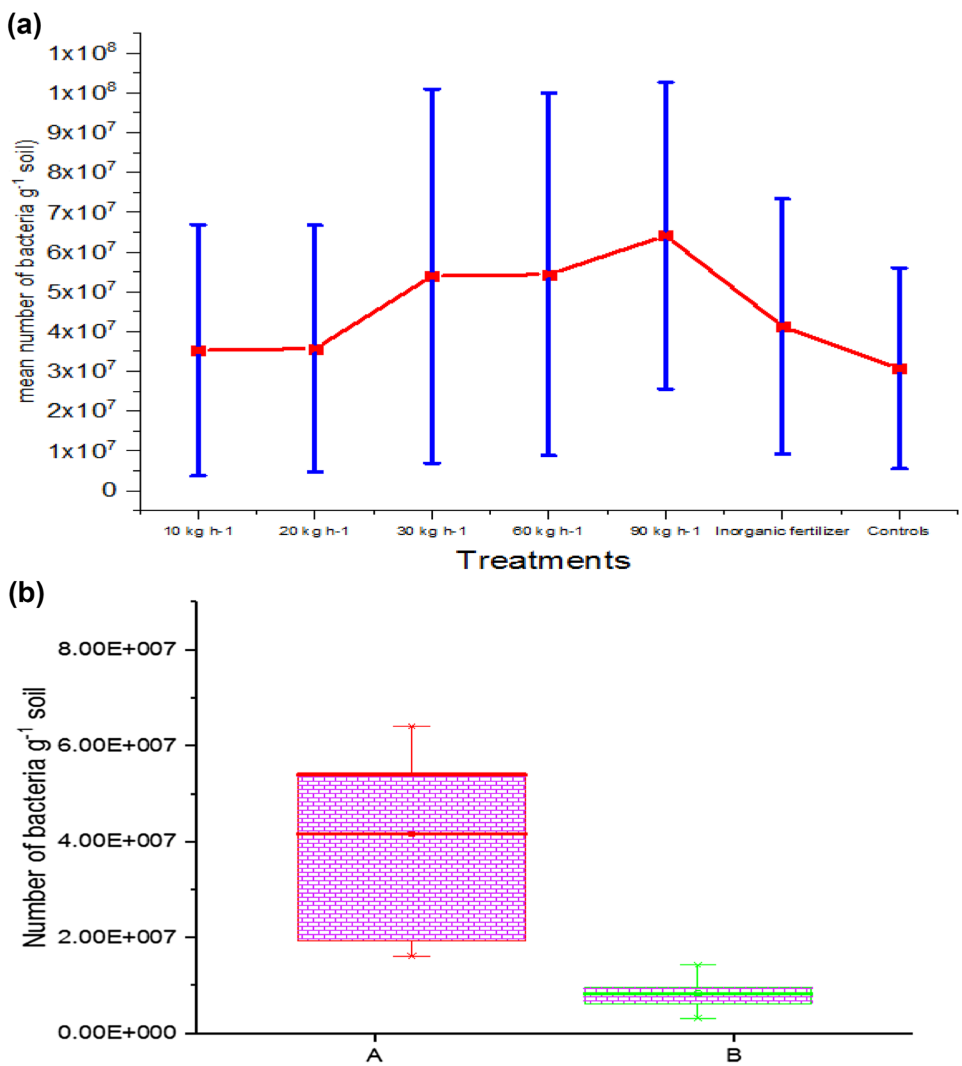


Fig. 6 **a** Total number of bacteria per soil treatments. **b** Number of soil bacteria A (after compost treatment) and B (Before compost treatment)

respectively. Total numbers of bacteria for all treatment have been summarized in (Fig. 6a, b).

Number of soil bacteria significantly increased after compost treatment than before compost treatment ($p < 0.05$). Similarly significant numbers of bacteria were counted in compost treatments than control and inorganic treatments ($p < 0.05$). Significant number of total bacterial was found from soil treated with farmyard compost compared to compost amended soil with chemical fertilizer (Kuninaga 2006). Because, compost application support soil microorganism by providing nutrients and indirectly by changing soil physical and chemical properties (Sutton-Grier et al. 2010). In our

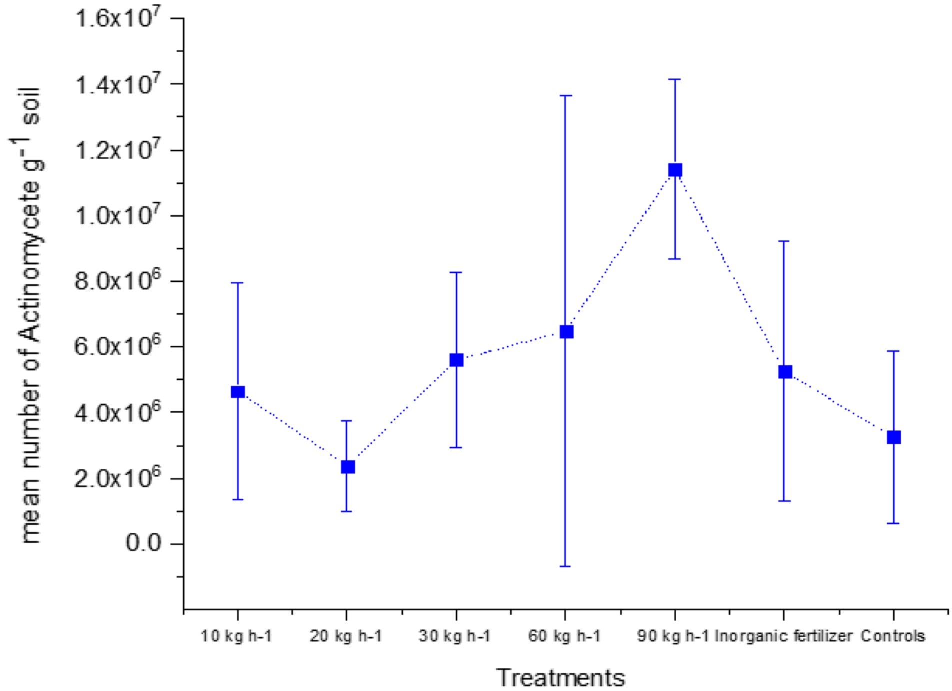


Fig. 7 Total mean number of actinomycete among soil treated with different fertilizers and controls

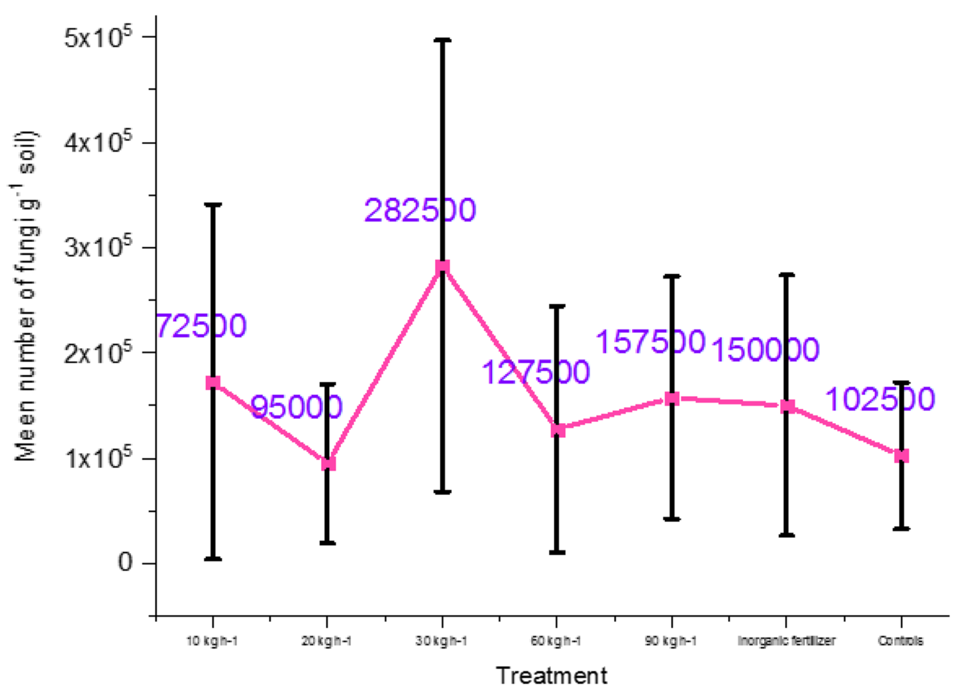


Fig. 8 Number of fungi per different treatments

study, a pH value of both compost and soil was at alkali levels and thus favored the growth of bacteria compared with the controls treatments.

Highest number of Actinomycete was recorded in soil treated with 90 kg h^{-1} compost, whereas the lowest number was for 20 kg h^{-1} treated compost and control treatments (Fig. 7).

No significant difference in numbers of Actinomycete was found between before and after compost treatments ($p > 0.05$) and between inorganic treated soil and control soil ($p > 0.05$).

Significant number of total fungi was counted after soil compost application than before compost treatments ($p < 0.05$). Then total number of fungi in soil treated with

Table 5 Compost and inorganic fertilizer effect on number of onion shoot and its

No	Treatment rate kg/hector	Number of shoots per plant $n=60$ onion for each of three replications	Shortest shoot length (cm) length $n=51$ onion for each of three replication	Highest shoot length (cm) $n=51$ onion for each of three replication
Compost	10	5.12 ± 1.19	26.92 ± 4.83	46.40 ± 6.57
	20	5.50 ± 0.23	24.13 ± 1.05	44.56 ± 4.04
	30	5.56 ± 0.31	32.00 ± 1.19	47.94 ± 7.90
	60	5.94 ± 0.03	32.31 ± 2.50	61.11 ± 0.00
	90	5.88 ± 0.29	29.35 ± 1.00	50.77 ± 1.46
Inorganic fertilizers	2.5DAP + 5 Urea	7.00 ± 0.12	30.76 ± 1.77	49.87 ± 1.70
	5DAP + 7.5Urea	4.72 ± 0.13	26.73 ± 0.19	44.26 ± 2.88
	7.5DAP + 10.0 Urea	4.50 ± 0.36	24.92 ± 1.84	41.52 ± 0.28
Control	Control	4.83 ± 0.40	25.00 ± 1.58	39.30 ± 1.12

DAP diammonium phosphate, *n* number of onion, *n* number of onion and number of shoot counted

organic compost was insignificantly higher than soil treated with inorganic compost and control treatment ($p > 0.05$). Highest number of fungi was recorded in soil treated with 30 kg h^{-1} compost (Fig. 8).

Comparable to our findings, increment in populations of total fungi noticed from soil compost amended compared to control soil (Lee et al. 2004). This was due to the reason that organic amendments may provide a greater diversity of potential substrates for microbial growth; reproduction and also affected soil physical properties (Zhang 2012). In Some treatments decrease in count of microorganisms may be explained with the low content in organic matter (Arslan et al. 2008) and other related soil physical properties such as temperature, pH, moisture, aeration capacity, and microbial association in food web.

Onion data

Significant effect of treatment on onion shoot length, girth length, shoot weight and bulb weight were obtained after soil treatment with compost and inorganic fertilizers (Table 5). Minimum shoot number per plant (4.5 ± 0.36) was obtained from 7.5 DAP + 10.0 kg Urea h^{-1} treated soil. Maximum shoot number per plant (7.0 ± 0.12) was obtained from 2.5 kg DAP + 5 kg Urea h^{-1} treated soil Except 5DAP + 7.5 kg Urea h^{-1} and 7.5 DAP + 10.0 kg Urea h^{-1} all treatment applications produced higher number of shoot per plant compared to control treatments. Shortest shoot length was (24.13 ± 1.05 cm) and highest shoot length was (61.11 ± 0.00 cm). Significant shortest shoot length was obtained only from 60 kg h^{-1} compost treated soil compared to shortest shoot length obtained from control treatments ($p < 0.05$). For soil treated with 10 kg h^{-1}, 20 kg h^{-1}, 30 kg h^{-1}, 60 kg h^{-1} and 90 kg h^{-1} significantly better shoot length was measured compared to the control treatments ($p < 0.05$). Highest leaf length, girth length and total yield of onion followed by compost application were reported by Bettoni et al. (2016) and Bua et al. (2017).

Minimum shoot girth (0.28 ± 0.02 cm) for the shortest shoot was obtained from soil treated with 10 kg h^{-1} compost while maximum shoot girth (0.69 ± 0.03 cm) for the shortest shoot was obtained from soil treated with 5 DAP kg h^{-1} + 7.5 kg h^{-1} Urea b (Table 6).

Minimum girth length from longest shoot was 0.69 ± 0.09 obtained from control treatments. Highest girth length value was 1.44 ± 0.13 from soil treated with 30 kg h^{-1} compost). Similarly higher onion girth for organic treatments was obtained by Lee et al. (2004). Lowest bulb weight per plant was 18.62 ± 7.10 g obtained from control treatments and mean maximum bulb weight was 43.04 ± 13.05 g obtained from 90 kg h^{-1} compost. Except 10 kgh^{-1} treated compost, all other treatments produce significant number of bulb weight per meter square of land ($p < 0.05$). Higher onion bulb yield was harvested after compost treatments by Lee et al. (2004). High onion shoot length, girth length and shoot weight and bulb weight increment after compost and fertilizer treatment probably linked to an increase in photosynthesis rate and assimilation of nutrients in onion tissues from the breakdown of compost and inorganic fertilizers. Compost application also improves soil structure in addition to nutrient contents (Ouédraogo et al. 2001). Compost treatments activate many soil living organisms which release phytohormones that may stimulate the onion growth and that make easy absorption of nutrients (Vidali 2001).

Table 6 Compost and inorganic fertilizers effect on onion shoot girth, shoot weight, bulb weight

Treatment types	Treatment rate kg/hector	Shoot girth for lowest (cm) $n=47$ for each replication plants	Shoot girth for highest (cm) $n=47$ plants for each replication	Average shoot weight per onion (g) $n=10$	Average weight per bulbs (g) $n=10$	Shoot weight (g/m^2) $N=3$ plots	Bulb weight (g/m^2) $n=3$ plot
Compost	10	0.28 ± 0.02	0.69 ± 0.05	16.07 ± 8.80	23.12 ± 8.12	650 ± 50.00	850 ± 43.58
	20	0.35 ± 0.04	0.78 ± 0.27	16.28 ± 2.50	24.61 ± 5.34	1233.33 ± 57.74	2500.00 ± 435.89
	30	0.47 ± 0.03	1.44 ± 0.13	17.07 ± 8.72	28.12 ± 10.70	1266.67 ± 57.74	3133.33 ± 57.73
	60	0.60 ± 0.17	1.11 ± 0.07	13.55 ± 6.62	39.17 ± 17.21	1850.00 ± 259.81	3550.00 ± 50.00
	90	0.57 ± 0.03	1.07 ± 0.12	22.10 ± 7.16	43.04 ± 13.05	2166.67 ± 57.74	3550.00 ± 86.60
Inorganic fertilizers	2.5DAP + 5 Urea	0.68 ± 0.03	1.15 ± 0.00	8.80 ± 5.02	30.04 ± 15.55	133.33 ± 152.72	1933.33 ±
	5DAP + 7.5 Urea	0.69 ± 0.03	1.11 ± 0.01	11.25 ± 5.82	32.02 ± 6.53	1433.33 ± 115.47	1966.67 ± 57.74
	7.5DAP + 10 Urea	0.52 ± 0.03	1.06 ± 0.02	14.11 ± 7.40	33.06 ± 7.00	1366.67 ± 321.46	2333.33 ± 57.74
Controls	Control	0.35 ± 0.02	0.69 ± 0.09	7.02 ± 4.09	18.62 ± 7.10	533.33 ± 57.74	866.67 ± 115.47

N number of shoot for counted shoot, number of onion bulb for bulb counted and weighted

Conclusions

Compost application increased soil physicochemical properties explained by organic carbon, pH, and nitrogen, phosphorous, improved soil moisture content, and some macro nutrients. Significant numbers of total soil bacteria and fungi count were achieved after compost amendment. Better onion shoot weight, shoot girth, and bulb weight were harvested when compost was applied than that of control treatment. Therefore, recycling agro industrial wastes after composting provides soil fertility improvement and highly contribute to management of wastes that can potentially pollute the environment.

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Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest associated with this study.

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