Partial Replacement of Mineral-N Fertilizer Using Compost and Biochar to Improve Growth and Yield of Peanut (*Arachishypogaea* L.) Grown on a Sandy Loam Soil*

Sarah El-Sayed El-Sayed Fouda[1], Christos Mattas[2] and Pantazis Georgiou[3]

Abstract

In the 2017 and 2018 summer seasons, two field experiments were conducted at Ismailia Governorate, Egypt, to evaluate the effect of adding organic amendments combined with 50% of the recommended 100 kg ha^{-1} of mineral-N fertilization Ammonium nitrate (330 g N kg^{-1}). The five organic sources were three types of biochar and two types of compost at a rate of 24 Mg ha^{-1} on peanuts (Arachis hypogaea L. Giza 6) grown on a sandy soil. Available N, P, K, Fe, Mn, and Zn concentrations in the soil after harvest increased due to the additional treatments, and the highest concentrations were due to Compost B (town refuse residues)+50 kg N ha^{-1}. Electrical Conductivity (EC) and soil pH decreased due to compost addition but slightly increased owing to biochar addition. The highest chlorophyll, protein, and oil contents of 42.8 mg g^{-1}, 226 g kg^{-1}, and 448 g kg^{-1}, respectively, were obtained due to addition of 50 Kg N ha^{-1} AN + Compost B. Generally, the addition of N fertilization 50 kg N ha^{-1} combined with compost had a favorable effect in improving soil properties and increasing peanut, oil, protein content and nutrient uptake as compared to other treatments.

Keywords: *Biochar, compost, peanut, quality, sandy soil.*

Introduction

The oilseed industry is one of the most rapidly growing agricultural enterprises, mainly in semi-tropical and tropical regions. The oilseeds market globally, according to estimations, is expected to garner $255,213 million by 2023, from $215,696 million in 2016, showing a compound annual growth rate of 2.5% between these years (https://www.alliedmarketresearch.com/press-release/oilseeds-market.html accessed 31 January 2021). Several conventional and non-conventional oilseed crops include palm, olive, peanut, cottonseed, rapeseed, sunflower, canola, sesame, copra, safflower, soybean, among others. Oil which is extracted from oilseeds is mostly used for food production for human consumption, animal feed and for biodiesel production. Oilseeds market growth is driven by the increasing consumption of soybean and the high production in developing countries such as Brazil, Argentina, etc. Additionally, the large areas cultivated with genetically modified (GM) oilseeds and their acceptance are expected to contribute to the market growth (https://www.alliedmarketresearch.com/oilseeds-marketaccessed 31 January 2021). As of 2020/2021, the global production of oilseeds by type is presented in Table 1. Peanut crops are wellsprings of vegetable oil in Egypt.

In 2017 the peanuts production quantity in Egypt was equal to 199.000 metric tons (https://www.tilasto.com/en/topic/geography-and-agriculture/crop/peanuts/peanuts-production-quantity/egypt accessed 31 January 2021). Peanut seeds contain up to 50% edible oil. It is used in cooking, making margarine as well as in surfactant-cleansing and cosmetic agents.

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[1]Soil Science Department, Faculty of Agriculture, Zagazig University, Zagazig, Egypt

[2]Laboratory of Engineering Geology and Hydrogeology, School of Geology, Aristotle University of Thessaloniki, Greece

[3]Department of Hydraulics, Soil Science and Agricultural Engineering, School of Agriculture, Aristotle University of Thessaloniki, Greece

Table 1. Global production of oilseeds in metric tons for 2020/2021 (https://www.statista.com/ accessed 31 January 2021).

Type of oilseed	Metric tons ($\times 10^6$)
Sunflowerseed	49.96
Soybeans	362.05
Rapeseed	68.87
Peanuts	47.79
Palm kernel	19.96
Cottonseed	41.8
Copra	5.75

It contains up to 80% unsaturated fatty acids with oleic acid (C18:1), 50% and linoleic acid (C18:2), 30% of total fatty acids (Cecil et al., 2013). Peanut seeds contain about 25% to 30% protein, 45 to 50% oil, 20% carbohydrates, and 5% fiber and ash, making a substantial contribution to human nutrition (Ahmad and Rahim., 2007). About 60% of groundnut produced in the world is mainly utilized for oil production (Birthal et al., 2010).

Nitrogen (N) is an essential element for plant growth and has contributed to the increased agricultural production worldwide over the past decades (Di and Cameron 2002). According to FAO (1997), the use of N fertilizer in the year 1996 was equal to 80×10^6 MgN/y, at a time, that consumption was negligible during the decade of 1940. The intensification of agriculture to meet human needs is recorded since the second half of the twentieth century. It has a significant contribution to the improvement of human wellbeing in many developing countries. Agriculture is a fundamental part of the economy in many countries worldwide, and the income of farmers was increased due to this intensification (Hazell and Wood, 2008).

Over the years, the rapid population growth observed in many parts of the world and the necessity for food security leads to more water-dependent economies having; as a result, the overexploitation and contamination of aquifers. The degradation of water resources is related to the high use of fertilizers (Foster and Chilton, 2003), conducing to an increase in the adverse agriculture impacts on groundwater resources. Therefore, rural population is mainly affected by pollution of groundwater, demonstrated by the increased mineralization rates related to nitrate contamination. Egypt's population increased from 59.6 million in 1996 to 72.6 million in 2006, and then it increased to 94.8 million in 2017 (El-Hamidi and Zaher 2018). Due to the irrational use of fertilizers, the existence of nitrates in groundwater is one of modern societies' major problems. That leads to groundwater quality degradation and hence the loss of significant amounts of reserves. The productivity of cultivated land depends on water quality. Low water and soil quality might lead to economic losses; therefore, water resources sustainable management is essential. This can only be achieved via adequate long-term monitoring using a dense network of groundwater level measuring and sampling points (Sebnem 2017; Capar et al., 2016) to secure for the next generations that quality and quantity will be preserved.

The essential role of Nitrogen (N) may be attributed to one or all of these reasons: 1) N is a constituent of proteins and nucleic acids (Russell, 1973), 2) It enhances the meristematic activities, increasing cell size (Osman et al., 2000) and 3) It increases the uptake of nutrients and photosynthesis (Fathi et al., 2003). Soil organic amendments are essential for soil fertility, crop production, and land protection from contamination, degradation, erosion, and desertification, especially in arid and semi-arid areas. Agricultural soil acts as a conveyer of pollutants towards surface water, groundwater and food that accumulate in surface soils and threaten human health by affecting food quality, drinking water, and air through airborne particles originating from soils (Chen et al., 1997). Potentially toxic contaminants (e.g., metals) in soils are associated with humans' health complications (Kelepertsis et al., 2001).

According to Yasser et al. (2014), the increased use of organic fertilizer instead of chemical is required to increase productivity and reduce the cost of peanuts cultivations in Egypt. Agriculture in Egypt is limited by low soil fertility, shortage of water resources and extended drought periods and according to projections of climate change models things will worsen in the future. The application of alternative and innovative agricultural techniques is demanded to address the challenges that arise. The combined use of organic materials and chemical fertilizers is considered an effective method to enhance and sustain high crop yield and to improve soil characteristics.

Therefore crop residues and animal manures are applied to soils to maintain and increase their fertility (Senesi et al., 2007). Soil organic matter is essential for sustainable agricultural systems (Johnston et al., 2009), especially for sandy soils, which suffer mainly from low fertility and poor plant productivity (Jaiarree et al., 2011). Acceptable contents of N in soils accelerate the decomposition of organic matter and increase crop production (Cleveland and Townsend, 2006). Organic amendments decrease soil bulk density and increase available water content in soil (Ozores-Hampton et al., 2011). In many cases in Egypt, wastewater is being used in agroforestry projects (El-Hamidi and Zaher, 2018).

Biochar is the carbon-rich solid byproduct of heating organic biomass such as wood, manure, stalks, or leaves in the absence or near absence of air at < 700 °C (Lehmann and Joseph, 2012; Verheijen et al.,2010). It improves the air and water management of soil (Batista et al., 2018); both water retention capacity and resistance to evaporation are significantly improved (Smetanová et al., 2013; Maroušek et al., 2019).

The purpose of the current study is to evaluate the effect on soil properties, plant growth, and productivity, and finally, farmers income, of partial substitution of 50 % of the N rate recommended by the Ministry of Agriculture of Egypt as ammonium nitrate using organic sources of Biochar or Compost at 24 Mg ha^{-1} on peanut (Arachis hypogaea L.) grown.

Materials and methods

Two field experiments were carried out on peanut (*Arachis hypogaea* L., cv. Giza 6) grown in a sandy loam soil during two successive summer seasons of 2017 and 2018, in the experimental farm of Ismailia Agricultural Research Station, Ismailia Governorate, Egypt. Groundnut (Arachis hypogaea L.), is popularly known as peanut and is the third most important oilseed crop in the world. It is cultivated in tropical and subtropical regions (El-Hamidi and Zaher 2018). The soil's main properties are presented in Table 2 and were determined according to Klute (1986) and Page *et al.* (1982).

Table 2. Physical and chemical properties of soil

Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Texture	O.M (g kg^{-1})	$CaCO_3$ (g kg^{-1})
20.68	57.25	8.97	13.10	Sandy loam	5.41	12.1

Soluble ions (mmolc L^{-1})

pH	EC	Cations				Anions			
(1:2.5 suspension)	(dSm^{-1})	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}_3	Cl^{-}	SO^{-}_4	CO_3^{-}
7.96	1.58	4.22	2.80	8.00	0.78	1.51	6.40	7.89	0.00

Available nutrients (mgkg^{-1})

N	P	K	Fe	Mn	Zn
32.91	3.77	155	1.22	0.85	0.54

EC in soil paste extract.

The Ministry of Agriculture of Egypt recommends 100 kg N ha^{-1} as ammonium nitrate to peanuts. In this study, chemical fertilizers were partially substituted by the different organic N sources depicted in Table 3.

Table 3. Composition of organic N sources used in the experiment.

Organic N source	Composition
Biochar A (BA)	Maize straw+rice straw+tree leaf straw
Biochar B (BB)	Firewood cotton+tree branches
Biochar C (BC)	Town refuse residues
Compost A (CoA)	Plant residues+farmyard manure
Compost B (CoB)	Town refuse residues

The experimental design was a randomized complete block with three replicates. The plot area was 50 m^2 (5×10 m) and included 20 rows 50 cm apart with two plants per hill and 20 cm between hills. For the experiment's needs, the seeds were sown on 20^{th} and 25^{th} April in 2017 and 2018, respectively. The field trial included six treatments, as shown in Table 4. The biochar, as well as compost sources, were applied at 24 Mg ha^{-1}. Compost and biochar were added 15 days before peanut planting mixed with the 15cm soil surface layer.

Table 4. Composition of treatments used in the experiment.

Field trial treatments
(1) 100 kg N ha^{-1} (control, N_{100})
(2) 50 kg N ha^{-1}(N_{50})+BA
(3) 50 kg N ha^{-1}(N_{50})+BB
(4) 50 kg N ha^{-1}(N_{50})+BC
(5) 50 kg N ha^{-1}(N_{50})+CoA
(6) 50 kg N ha^{-1}(N_{50})+CoB

The main physicochemical properties of biochar and compost are given in Table 5, and their analysis was conducted according to methods proposed by Brunner and Wasmer (1978).

Table 5. Main properties of the biochar and compost sources used in the study.

Parameter		BiocharA (BA)	BiocharB (BB)	BiocharC (BC)	Compost A (CoA)	Compost B (CoB)
pH(1:2.5)		8.30	8.29	8.15	7.65	7.72
EC (1:10)	**(dSm^{-1})**	4.77	3.90	4.55	3.85	4.10
C/N ratio		38.1:1	33.6:1	32.9:1	27.5:1	25.5:1
O.M	**g kg^{-1}**	531	552	582	379	400
Ash		220	270	230	430	470
TotalC		754	723	736	330	301
N		19.8	21.5	22.4	12.0	11.8
P		4.51	5.22	5.51	3.53	4.82
K		48.9	58.8	60.4	38.9	31.4
Na		78.2	83.2	80.4	52.9	42.2
O2		126	138	140	129	157
Fe	**mg kg^{-1}**	95.4	88.5	113	199	215
Pb		1.98	2.44	1.18	1.03	1.08
Mn		145	131	159	110	113
Zn		15.0	17.5	19.9	34.5	50.1

All plots received P before sowing at 15 kg P ha^{-1} as superphosphate (68 g P kg^{-1}). Potassium was added as (K-sulphate, 400g of K kg^{-1}) at a rate of 40 kg K ha^{-1} in two equal splits, 30 and 45 Days After Seeding (DAS). The N fertilizer (ammonium nitrate, 330g of N kg^{-1}) was applied in three equal splits, immediately after thinning (20 DAS), 30 and 45 days later.

Measured parameters

The followings parameters were measured and determined: 1) Plant height. 2) Number of branches $plant^{-1}$. 3) 100-seed weight (g). 4) Straw yield, Mg ha^{-1}. 5) Pod yield, Mg ha^{-1}. 6) Seed yield (Mg ha^{-1}) Mg ha^{-1} 7) Protein content (g kg^{-1})=N content (g kg^{-1}) × 6.25 (Hymowitz, et al., 1972). 8) Protein Yield (kg ha^{-1})=Protein content (g kg^{-1}) × seed yield (Mg ha^{-1}). 9) Nutrient uptake (kg ha^{-1})= nutrient content (g kg^{-1}) × yield (Mg ha^{-1}).

Laboratory analysis

The analyses of plants were carried out in sulfuric/perchloric digests (Ryan *et al*., 1996) using the methods described by Chapman and Pratt (1961). Oil content in seeds was determined using the Soxhlet method (AOAC, 1990).The chlorophyll was determined following the method of Saric *et al.* (1967).

Soil Characteristics

Before experimenting, a representative soil sample of the field was taken at the depth of 0–30 cm. After harvest, soil samples from the same depth were taken from each plot. They were analyzed for EC (in soil past extract), pH (in 1:2.5 soils: water suspension) organic matter, calcium carbonate, and available–N, P, K, Fe, Mn, and Zn as described by Jackson (1973), Klute (1986) and Page *et al*. (1982).

Statistical analysis

Results were statistically analyzed using SPSS software. The ANOVA test was used to determine the significant ($p \leq 0.01$ or $p \leq 0.05$) treatment effect, and Duncan Multiple Range Test was used to provide significance levels for the difference between any pair of means (Duncan, 1955).

Results

Soil properties after harvest

Data in Table 6 show that Mineral fertilizer had the lowest pH in comparison to the application of biochar, similar results found by Glaser et al., (2015). The soil pH tended to slightly decrease from 7.92 to 7.89 due to both Compost+N_{50} addition. During microbial reactions, acidity (H^+) is released, which will ultimately decrease soil pH after repeated use Siam *et al.*(2013) and Rashad et al (2011) pointed out that pH decrease may be connected with the organic acids production due to microbial activity. On the other hand, a slight increase from 7.95 to 8.08 was recorded after the addition of Biochar+N_{50} as compared to the control treatment (N_{100}). Laghari et al. (2016) reported an increase in soil carbon and cation exchange capacity but a decrease in soil pH after application of biochar on soil was reported. The decreases in soil pH might be attributed to the effect of microorganisms on decomposing organic matter releasing organic acids, and producing several phytohormones such as indole acetic acid and cytokinins. These results are similar to those obtained by (Ashmaye et al., 2008 and Abdel-Fattah 2012).

Soil Salinity (ECe)

Concerning the effect of the treatments on soil salinity in the rhizosphere, data in Table 6 reveal that EC decreased in the CoA and CoB treatments compared with AN (control), improving soil conditions for plant growth. The effect is more pronounced in soils treated with CoB+N_{50}, causing the maximum decrease of EC value, equal to 12.3%. Improvement in porosity and aggregation may have occurred due to compost addition enhancing the leaching of salts (Zaka et al**.,** 2005, Shaban and Omar, 2006)**.** A slight increase in soil EC was observed after the application of biochar treatments.

Table 6. Effect of N and organic amendments on soil pH, EC, and available nutrient contents after peanut harvest

Treatment		pH	EC	Available nutrients (mg kg^{-1})					
N addition rate, Kg ha^{-1}	Amendment	(1:2.5)	(dSm^{-1})	N	P	K	Fe	Mn	Zn
100	AN	7.95	1.22 ab	37.9 e	3.89 c	164 d	1.30 c	0.96	0.61
50	BA	8.03	1.31 ab	41.6 d	4.65 b	167 d	1.41 c	1.01	0.64
	BB	8.07	1.39 a	45.2 c	4.87 ab	172 c	1.57 b	1.05	0.68
	BC	8.08	1.23 ab	46.4 c	4.99 ab	177 b	1.70 ab	1.10	0.71
	CoA	7.92	1.09 b	48.4 b	5.09 a	181 b	1.77 a	1.14	0.75
	CoB	7.89	1.07 b	50.1 a	5.17 a	186 a	1.81 a	1.19	0.80
F-Test			*	**	**	**	**	ns	ns

AN, Ammonium nitrate; (BA), biocharA; (BB), biochar B; (BC), biochar C; CoA, compostA, and CoB, compost B. Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of probability and ns, means not significant differ at 0.05 level of probability.

Available macro and micronutrients in the soil after harvest

According to the results illustrated in Table 6, the available N, P, and K significantly increased after the biochar and compost treatments application compared to the control. The soil treated with CoB+50 kg N ha^{-1} showed the highest values. The increase rates were 32.2%, 32.9%, and 13.4%, respectively, compared with AN (N_{100}).Organic and inorganic acids production during the degradation of organic materials (as well as humates) resulting from the microorganisms' activities, must have led to soil pH decrease, increasing chelating ions and the available forms of elements mentioned above. The above findings are corresponding to the results obtained from Ewees and Abdel Hafeez (2010). As for available Fe, Mn, and Zn in the soil after harvest, the compost and biochar treatments showed higher values compared to control. The highest values were recorded after the application of CoB+50 kg N ha^{-1}. Compost+50 kg N ha^{-1} treatments' higher performance could be attributed to the microorganisms that build up the microflora through their biological activity. Application of mineral-N might have improved the activities of microorganisms responsible for N transformation (Shaban *et al***.,** 2012**)**.

Seed Quality

The effect of ammonium nitrate addition and other amendments on total chlorophyll content in fresh leaves, protein, and oil contents in peanut seeds is depicted in Table 7. Data reveal that the plants receiving the aforementioned treatments showed an increase in these parameters. The increase in protein content could be attributed to the combined effect of nitrogen and microbial N_2 fixing bacteria and P-dissolving bacteria that could increase available nutrients (Ewees and Abdel Hafeez, 2010).

Peanut seeds gave oil content in the range of 401 to 448 g kg^{-1}. The oil content is higher than the value of 208 g kg^{-1} reported by Cecil *et al. (*2013).These results are in agreement with those reported by Helmy and Ramadan (2014).

The highest chlorophyll, protein, and oil contents were obtained due to the addition of 50 Kg ha^{-1} AN+(CoB), causing 32.1%, 18.3%, and 11.7% increases over the addition treatment of AN (N_{100}).

Table 7. Effect of N addition rate and organic amendments on some peanut yield quality.

Treatment		Chlorophyll (mg g^{-1}f.w.)	Protein content (g kg^{-1})	Protein Yield (kg ha^{-1})	Oil content (g kg^{-1})	Oil yield (kg ha^{-1})
N addition rate, Kg ha^{-1}	Amendment					
100	AN	32.4 d	191 b	504	401 b	962
50	BA	34.1 cd	205 ab	595	418 ab	1214
	BB	35.2 c	215 a	664	434a	1344
	BC	38.8 b	218 a	718	439a	1442
	CoA	41.8 a	222 a	773	444a	1546
	CoB	42.8 a	226 a	835	448a	1656
F-Test		**	**	ns	**	ns

See footnote of Table 6

Effect of treatments on growth parameters and yield of peanut

Plant height, the number of branches plant^{-1} and 100-seed weight

Plant height, the number of branches plant-1, and 100-seed weight of peanut plants increased by treatments and shown in Table 8. The compost treatments had a more significant positive effect than those of biochar. More specifically, the highest increase that corresponds to 29.5% on plant height, 57.8% on branches per plant, and 29.4% on 100-seed weight compared with the plants that received AN (N_{100}) were recorded after CoB application.

Hay, Pod, and Seed Yields

There was a positive effect of compost and biochar application on hay and pod yields. The effect was weaker regarding the seed yield. The favorable effect of nitrogen fertilizer may be due to N stimulation of plant growth, which increases the amount of light energy intercepted by leaves and increases photosynthetic pigments and photosynthesis, and in turn, increase synthesized metabolites and consequently leaves and seeds (Wortman et al.,2011).

The biochar effect on controlling soils' hydrological, physical, and chemical properties results in improving soil productivity and therefore increasing crop yield (Hill et al.,2007).These results agree with those obtained by Chan et al., (2008); Chan and Xu, (2009); Major et al., (2009); Spokas, and Reicosky, (2009). The maximum hay, pod, and seed yields were achieved due to the application of 50 kg N ha^{-1}+(CoB), and the corresponding increments over the plants received AN solely were 80.8%, 53.2%, and 40.0%, respectively, as compared with addition AN (N_{100}). Von Glisczynski et al.(2016) reported that biochar's addition could affect the colonization of roots by beneficial microorganisms.

Moreover, the results of Biederman and Harpole (2013) showed that biochar addition in soils contributed to increased aboveground production, crop yield, soil microbial biomass and nodulation of rhizobia, as well as higher values of K plant tissue concentration, soil potassium (K), soil phosphorus (P), total soil nitrogen (N) and total soil carbon (C) compared to control conditions. Many other studies (Chan et al., 2007; Alburquerque et al.,2013**;** Abbasi and Anwar, 2015; Van Zwieten et al., 2010; Li and Shangguan, 2018; Asai et al.,2009 and Schulz and Glaser, 2012) found biochar to be the most e*ff*ective in crop yield when applied with mineral fertilizers. Biochar effects on soil properties, plant nutrition and growth are highly complex and differ significantly in combination with mineral or organic fertilizers. More process-based research is needed to understand the biochemical interactions in soil after biochar application in order to optimize complex biochar fertilizers for field application (Glaser et al., 2015).

Macronutrients content and uptake by peanut hay and seeds

Data in Tables 9 and 10 show that N, P, and K contents and uptake significantly increased due to the addition of compost and biochar and their combinations with AN. Treatment consisting of N50 + CoB showed the highest increase in the contents and uptake of N, P, and K of peanut hay and seeds than the other treatments. This could be related to the N effect on microorganisms to fix atmospheric nitrogen as well as the role of these bacteria in improving the availability of soil nutrients through secreting chelating substances (Kandil et al., 2011; Namvar et al., 2012 and Daneshmand et al.,2012**)**. The increased N indicates the efficiency of applied N with compost and biochar (Maral 2012).

Table 8. Effect of N addition and organic amendments combined with fertilizer-N on some yield attributes and yield of peanut.

Treatment		Plant height (cm)	Number of branches (plant^{-1})	100-seed weight (g)	Hay yield (Mg ha^{-1})	Pod yield (Mg ha^{-1})	Seed yield (Mg ha^{-1})
N addition rate, Kg ha^{-1}	Amendment						
100	AN	51.1 f	5.64 e	60.2 e	4.12 b	2.98 a	2.64
50	BA	54.3 e	6.73 d	63.9 d	6.89 a	3.29 ab	2.90
	BB	57.5 d	7.29 cd	69.1 c	7.01 a	3.77 ab	3.10
	BC	61.6 c	7.82 bc	71.0 c	7.13 a	4.08 ab	3.29
	CoA	64.4 b	8.66 ab	75.7 b	7.34 a	4.37 a	3.48
	CoB	66.2 a	8.90 a	77.9 a	7.46 a	4.56 a	3.70
F- Test		**	**	**	**	*	ns

See footnote of Table6.

Table 9. Effect of N addition rate and organic amendments on some macronutrients content (g kg^{-1}) and uptake (kgha^{-1}) by peanut hay.

Treatment		N-content	N-uptake	P-content	P-uptake	K-content	K-uptake
N addition rate, Kg ha^{-1}	Amendment						
100	AN	30.5 d	126 d	1.95 d	8.04 d	31.4 e	130 c
50	BA	31.1 cd	214 c	2.30 cd	15.8 c	31.9 d	220 b
	BB	31.7 c	222 bc	2.70 bc	18.9 bc	32.5 c	228 ab
	BC	32.8 b	97.4 abc	3.15 ab	22.5 ab	33.3 b	237 ab
	CoA	33.3 ab	234 ab	3.35 a	24.6 ab	33.8 a	248 ab
	CoB	33.8 a	252a	3.60 a	26.9 a	34.2 a	255 a
F- Test		**	**	**	**	**	**

See footnote of Table 6

Table 10. Effect of N addition rate and organic amendments on some macronutrients content (gkg^{-1}) and uptake (kgha^{-1}) by peanut seeds

Treatment		N-content	N-uptake	P-content	P-uptake	K-content	K-uptake
N addition rate, Kg ha^{-1}	Amendment						
100	AN	30.5 e	80.6 b	3.05 d	8.06 c	27.9 e	73.7
50	BA	32.9 d	95.5 ab	3.65 c	10.6 bc	28.6 d	83.0
	BB	34.4 c	107 ab	3.95 c	12.2 abc	29.3 c	90.7
	BC	34.9 bc	115 ab	4.61 b	15.2 abc	29.8 bc	97.9
	CoA	35.6 ab	124 ab	5.05 a	17.6 ab	30.2 b	105
	CoB	36.2 a	134 a	5.41 a	20.0 a	31.0 a	114
F-Test		**	**	**	**	**	ns

Micronutrients content and uptake by peanut hay and seeds

Tables 11 and 12 show that compost and biochar's addition in combinations with mineral N_{50} increased Fe, Mn, and Zn contents and uptake by peanut hay and seeds.The above increases may be as a result of the presence of organic sources due to the following: *i*) Nutrients release through the organic matter's microbial decomposition *ii*) Increase of metal ions' chelation by organic legends and other organic function groups; *iii*) Decrease of the redox statues of iron and manganese, leading to reducing higher Fe^{3+} and Mn^{4+} to Fe^{2+} and Mn^{2+} and/or transformingthe insoluble chelated forms intosoluble ions (Nasef et al*.,* 2009). Organic manures can create favorable soil physical conditions (such as structure), that affect the solubility and availability of nutrients and thus uptake of nutrients (Rashad et al.,2011). The addition of CoB +N_{50} resulted in the highest contents and uptake of micronutrients.

Table 11. Effect of N addition rate and organic amendments on some micronutrients content (mg kg^{-1}) and uptake (g ha^{-1}) by peanut hay

Treatment: N addition rate, $Kgha^{-1}$	Treatment: Amendment	Fe-content	Fe-uptake	Mn-content	Mn-uptake	Zn-content	Zn-uptake
100	AN	96.0 e	396 d	61.7 e	254 e	16.9d	69.8 c
50	BA	100.1 d	689 c	65.0 d	449 d	17.6 cd	121 b
	BB	104.0 c	730 bc	70.8 c	497 cd	18.2 bc	127 ab
	BC	108.1 b	770 b	75.4 b	538 bc	18.4 bc	131 ab
	CoA	110.4 b	811 ab	76.8 b	564 ab	18.9 ab	139 a
	CoB	114.9 a	857 a	81.2 a	607 a	19.4a	145 a
F-Test		**	**	**	**	**	**

See footnoteofTable6

Table 12. Effect of N addition rate and organic amendments on some micronutrients content (mg kg^{-1}) and uptake (g ha^{-1}) by peanut seeds

Treatment: N addition rate, $Kgha^{-1}$	Treatment: Amendment	Fe-content	Fe-uptake	Mn-content	Mn-uptake	Zn-content	Zn-uptake
100	AN	70.7 f	187 b	42.0 d	111 b	22.8 d	60.2 b
50	BA	74.3 e	216 ab	42.7 d	124 ab	24.0 d	69.6 ab
	BB	77.7 d	240 ab	45.3 c	140 ab	26.1 c	80.9 ab
	BC	84.0 c	276 ab	48.0 b	158 ab	28.7 b	94.3 ab
	CoA	87.6 b	305 ab	50.2 a	175 ab	31.5 a	110 a
	CoB	89.9 a	332 a	51.7 a	191 a	32.2 a	119 a
F-Test		**	*	**	*	**	*

See footnote of Table 6

Discussion and Conclusions

Compost and biochar's application significantly improves soil physical, chemical, and biological properties, besides enhancing morpho-physiological and biochemical aspects of plant growth. Results based on primary data collected in the present experimental work indicate that amendments at 24 Mg ha^{-1} combined with 50 % of recommended N fertilization managed to achieve improved growth parameters, yield, and quality of peanut plants, compared to the traditional fertilization techniques that are implemented till now. It also has a significant environmental impact since environmental pollution is reduced and soil quality is improved.

According to Maroušek et al. (2019), soil improvement after biochar incorporation in arable land reduces the production cost and long-term economic benefits. Biochar supports the retention of the water in the soil and reducing irrigation costs. It does not need to be added every year to the soil since it is a long-lasting product; hence, chemical, agricultural fertilizers are cost-effective. The use of compost has similar benefits. Syngas and oil are obtained from the process of biomass pyrolysis that is used for biochar production. These products can be used as fuel, providing clean, renewable energy (Aisosa et al., 2019). However, farmers seem to prefer quick profit and tend to sell their biowaste for energy purposes instead of investing in soil improvement methods that will yield profits in thelong run. The main reasons that hinder the development of a biochar market are the persistence of farmers in traditional techniques (Olarieta et al. 2011) and the legal restrictions that many countries impose (Meyer et al. 2017) due to lack of knowledge most of the times. Future work is anticipated on field investigations of biochars and compost usage. Evaluation of impacts on soil and crops can give answers to farmers, authorities, politicians and help them overcome their doubts and hesitations regarding biochar and compost utilization. The obtained knowledge from further studies could be useful for better commercialization of these soil conditioners, resulting in creating a new innovative market.

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