World Association for Sustainable Development

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Effects of application of different fertilizers on Okra growth and soil quality

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Abstract

Purpose The aim of the experiment was to study the effects of application of different fertilizers on the growth of Okra (Abelmoschus esculentus Moench) and soil quality.

Methodolgy In a nursery trial different rates of composted bagasse (C), neem seed powder (N), diammonium phosphate (D) and urea (U) were applied to a loamy clay soil samples. Okra (Abelmoschus esculentus Moench) was planted as test crop. Water was applied till field capacity to avoid leaching of salts. Plant and soil samples were collected and analyzed for quality assessment druing the growing period of 5 weeks.

Findings The results revealed that application of medium dose of (N) gave better plant growth while higher dose led to a complete plant mortality. With (C) application, plant height was below the control level. Complete plant failure resulted from addition of (D) and (U) which reveals the hazard of chemical fertilizers application rates and date of application. A significant increase in soil pH and EC was evident with (U) and (D). An increase in soil organic carbon was observed with (C). Organic fertilizers play a major role in improving soil organic matter content and availabilty of plant nutrients in the long run. In addition, higher concentrations of Na and Mg were shown in soil samples after application of (U) and (D). Such penomenon is related to the role of chemical fertilizers on leaching of soil minerals with irrigation water during the growing season.

Value Therefore; application of fertilizers should follow regulations and monitoring so as to reserve the soil quality and minimize their hazards.

Keywords Organic fertilizer a chemical fertilizer, soil quality, plant growth

Introduction

Soil organic matter is a major source of plant nutrients (Sanchez, 1989) and (Kodithuwakku & Kirthinghe, 2009); and improves its physical properties, e.g. soil porosity, structure and water capacity (Lavelle, 1988), Soil organic management is very important for the development of sustainable agricultural systems. Although the use of synthetic chemical fertilizers was a revolution in agriculture, their use in semiarid regions may not be effective and even negative (Van Herwaarden et.al., 1998), (Anga´s et.al., 2006) and (Moret et.al., 2007) In agricultural practices, farmers are being increasingly viewed as contributors to environmental degradation (Environmental Databases, Pesticides, US EPA, 2006); (Bhat & Ramaswamy, 1993) and (Caraco & Cole, 1999). Many biochemical and physical changes occur to soil when fertilizers are applied e.g. application of urea for a long period of time adversely affects soil quality and pollute ground water with nitrate via leaching downwards and reduction of microbial biomass and diversity (Zhang et.al., 2008).

Sudanese soils are known to be poor in nitrogen and phosphorus (El Tom, 1972; El Sharif, 1992 & SMSS-USDA/ SSA, 1982). Hence the application of chemical fertilizers is extensively practised in these soils. In addition, soil salinity is a common feature in these soils (Mustafa, 1986). According to (Hoffman, 2002), high salinity levels negatively affect crop yield and survival.

Okra (Abelmoschus esculentus Moench), is a flowering plant in the mallow family. It is valued for its edible green seed pods. The plant is cultivated in tropical, subtropical and warm temperate regions around the world (National Research Council, 2006); (Gullan and Cranston, 2010). Okra is the most popular vegetable in Sudan. In combination with sorghum bread (ksra), it is the staple food of the Sudanese people. It is used in both the fresh and dry form. The wild type (sara) is usually used as a dry powder while the cultivated type is mainly used fresh (Ahmed &Mohammed, 1992).

Materials and methods

3 weights of neem seed powder (N1 2 = gm, N3 = 2 gm, N5 =3 gm), 3 weights of compost bagasse (C=1 2gm , C3= 2 gm, C6 = 3 gm), 11 gm of urea (U) and 3 gm of Diamonium phosphate (D), were added to 400 gm of soil prior to planting Okra plant which was used as the experimental crop. Each fertilizer was added alone in a separate pot with a diameter 10 inches and a control treatment without addition of any fertilizer was tested. Three seeds of Okra were planted per pot. For each treatment, three replicates were carried out and the mixtures were then incubated in the nursery at the National Center for Research, Khartoum for growth monitoring for 5 weeks. 40 ml of distilled water was added to the pots every two days. The following growth parameters: leaves number/plant and plant height were recorded for Okra in all treatments. The physical and chemical characteristics of the soil measured are pH, EC, sand, silt, clay, OC and N.

Results and discussion

Results of soil samples analysis prior to addition of fertilizers (Table 1) gave very low nitrogen content , other soil characteristics i.e. clay loam texture, neutral alkalinity and salinity lie within acceptable range.

Table 1. *Results of soil samples analysis, 30-0 cm depth*

Parameter	pH	EC dS/m	Sand %	Silt %	Clay %	OC %	N %
Sample	7.70	0.71	20.46	50.0	29.54	0.36	0.163

Application of urea (Fig. 1), significantly increased the soil pH compared with that of the control (O). DAP application resulted in a pronounced increase EC of the soil followed by urea (Fig. 2). pH increase is in confromity with Abdel-Rahman (2009) findings.

Figure 1. *pH of ammended soil 5 weeks after planting*

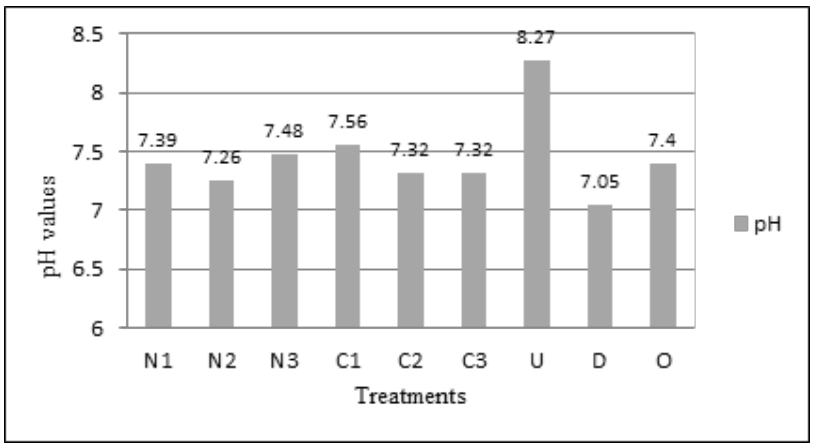
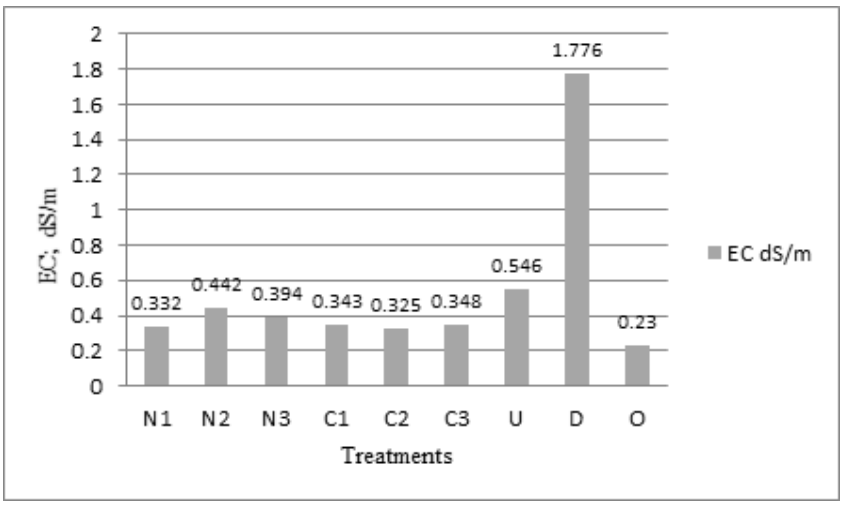
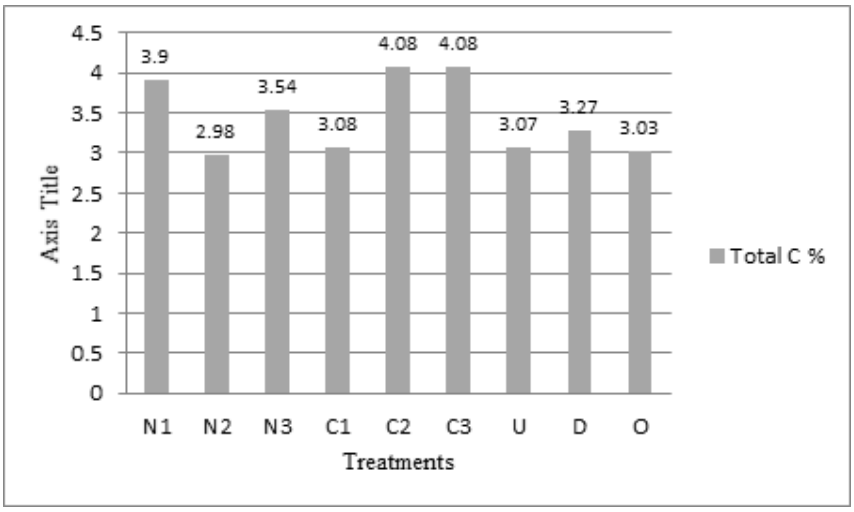


Figure 2. *EC of ammended soil 5 weeks after planting*



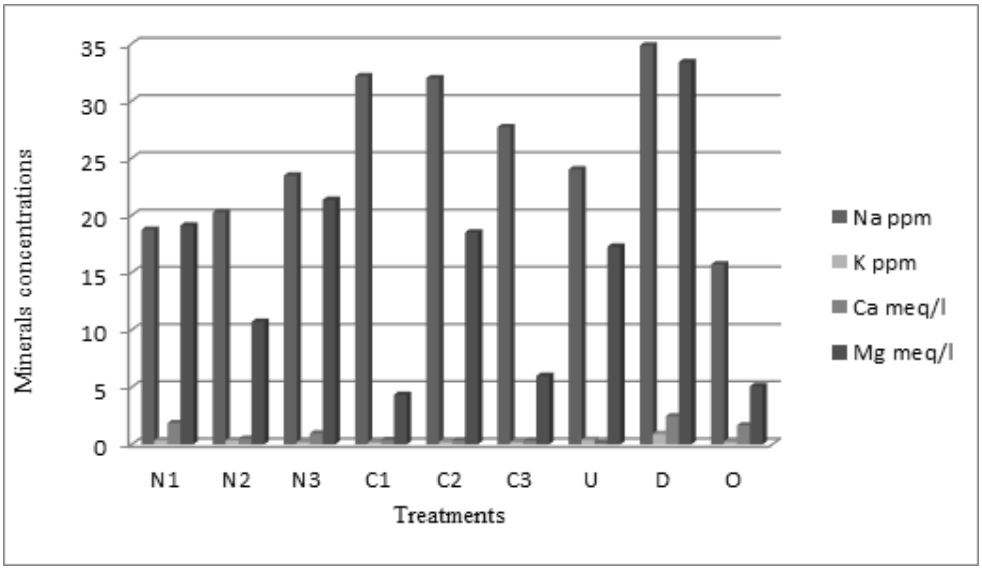
The total carbon content in the soil was obtained with higher doses of compost treatment. This confirms the important role of organic fertilization application to soil in imroving the organic matter content and therefore soil quality.

Figure 3. *Total carbon of ammended soil 5 weeks after planting*



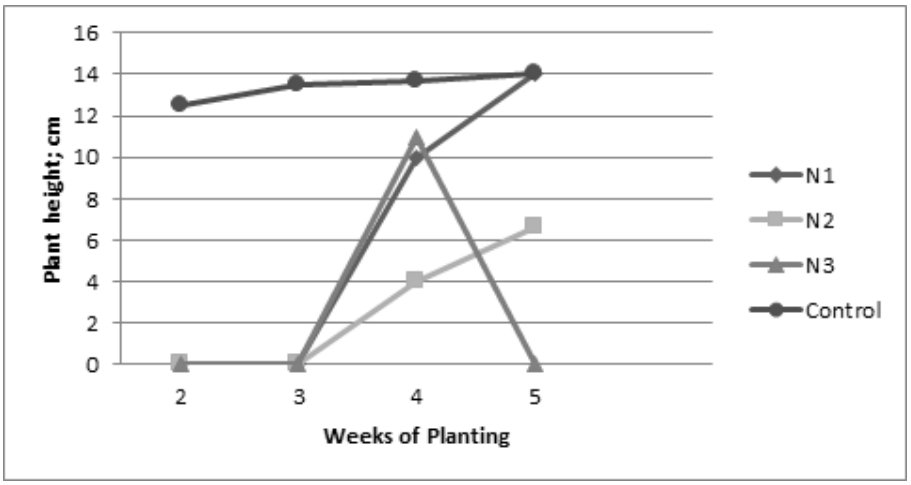
Higher minerals concentrations in the soil Figure (4) were encountered with chemical fertilizers treatments (U and D) above that of the control mainly for Na and Mg contents. This will also result in the loss of these important minerals with irrigation water by leaching downward due to their high solubility.

Figure 4. *Minerals concentration of ammended soil 5 weeks after planting*



These results revealed that plant growth was normal with N2 treatment but below the control level (Figure 5). Complete growth failure was observed with higher level of N application. Therefore, N2 level could be recommended as a suitable dose for further appplication.

Figure 5. *Effect of N applied from Neem seed powder on plant height*



All fetilizer applications were below the control (Figure 6) and growth failure was observed after 4 weeks from planting. C1 and C2 doses were very harmful to the crop which failed also to grow. These results contradict with the findings of (RYM Exports- The Indian Neem Tree Company, 2013) who stated that neem cake is a soil improver active in increasing the growth, leafage, results in rich blossoming, strengthening the roots and improving the general appearance of fruits and vegetables and has a remarkable result in the improvement of the plant immunity. According to (Doran et.al., 2005) farmyard manure, farmyard manure + mineral fertilizers 45 kg plant(1-) of compost was determined more suitable in terms of economical production and organic farming than the other fertilizer types.

Figure7 ilustrates that there was no plant growth with urea treatment. . A significant drop in growth was observed with (D) application especially after 4 weeks. This revealed the risk of application chemical fertilizers on plant growth especially during the first weeks of planting.

Figure 6. *Effect of N applied from compost plant height*

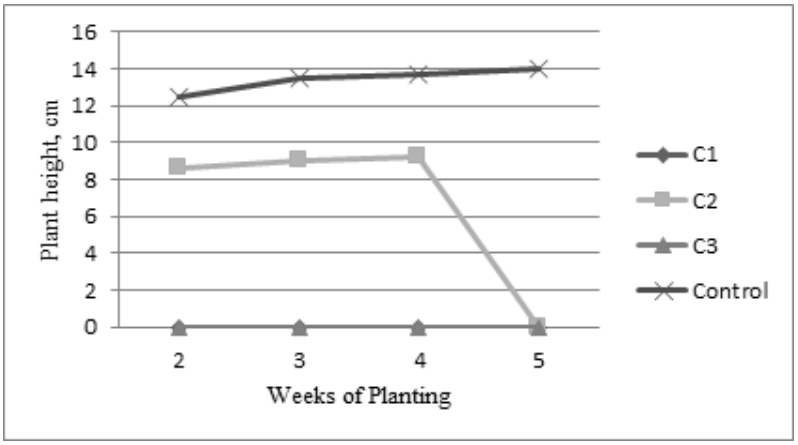
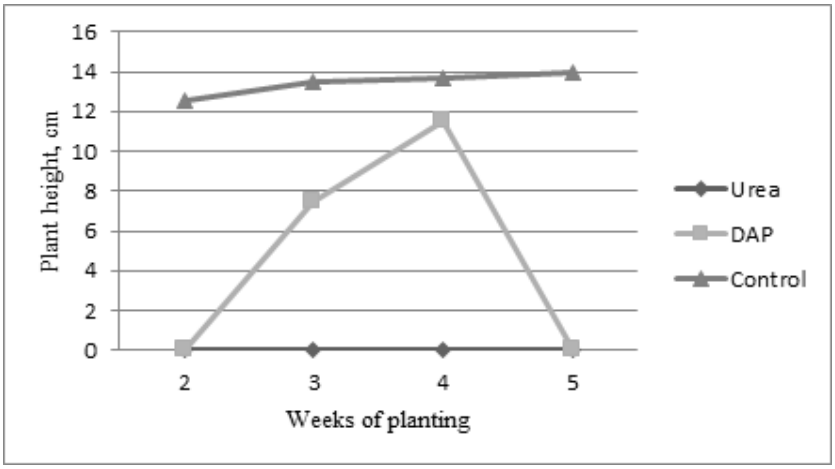


Figure 7. *Effect of N applied from chemical fertilizers on plant height*



A significant increase in leaves number of the control treatment was evident compared with N2 (Figure 8).

Figure (9) confrimed the hazards of compost application to the soil especially during the first weeks of planting and C1 and C2 resulted in comlpete failure crop of growth. (Awad & Sayed, 2007) and (Abdel-Rahman, 2009) reached an opposite result when adding compost to soils cultivated with potatoes and Sorghum bicolor Moench, respectively. In addition, (Mangan et.al., 2005) concluded that the application of organic manures and soil additives is necessary to maintain soil in good condition. Reducing the losses of nitrogen fertilizers can also be achieved through different ways among which was the use of natural products which can retard nitrification regulatory, such as neem cake Both (U) and (D) negatively affected okra growth and no leaves were formed when the former was applied to the soil Figure (10). With D application, growth was retarded after 4th week from planting.

Figure 8. *Effect of N applied from Neem seed powder on leaves number*

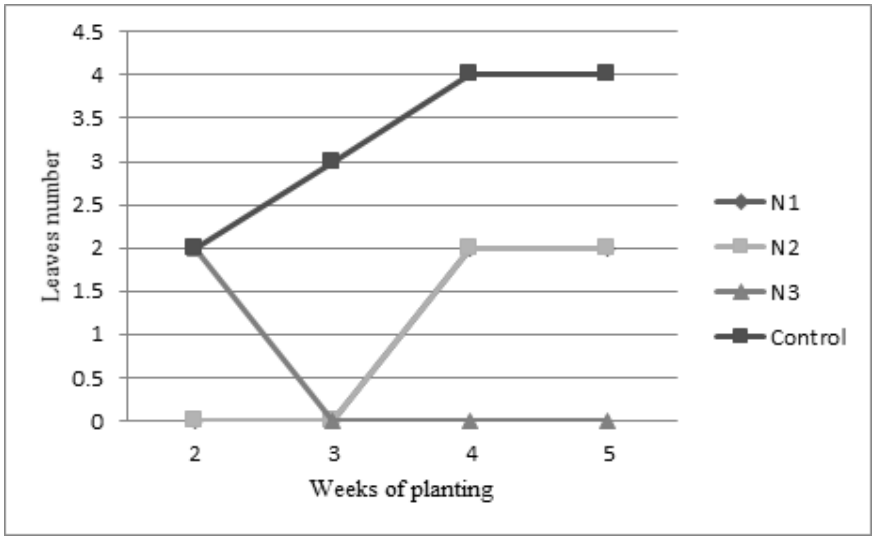


Figure 9. *Effect of N applied from compost on leaves number*

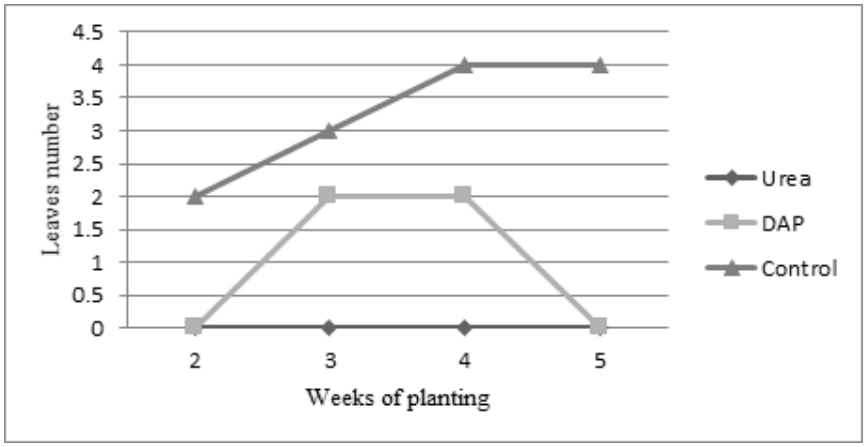
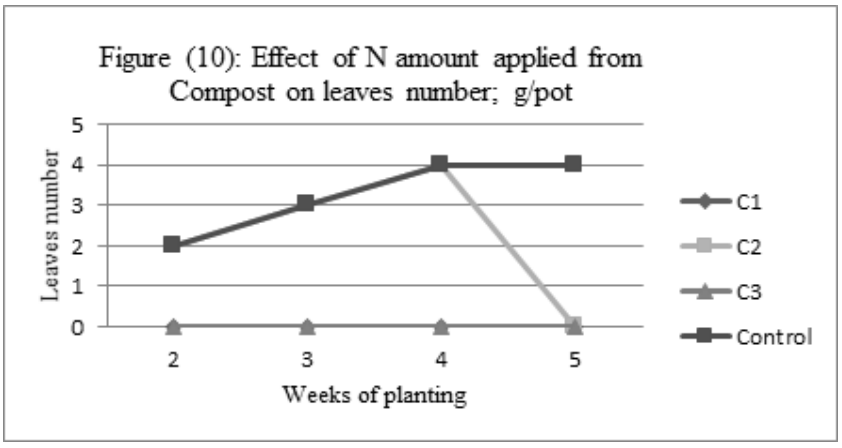


Figure 10. *Effect of N applied from chemical fertilizerson leaves number*



In general, addition of organic and chemical fertilizers gave unexpected results in the different treatments i.e. retardation of plant growth and stunted performance of the tested crop. These results contradicts with many authors e.g. (Doran, 2005), (Abdel Rahman, 2009)and (Schmutterer, 2002) In addition to its compatibilty with soil microbes which enrich the rhizosphere microflora, (Vietmeyer, 1992)concluded that neem seed cake reduces alkalinity in soil, as it produces organic acids on decomposition (Stockdale et.. al., 2000). Hence, it improves the organic matter content of the soil, helping improve soil texture, water holding capacity, and soil aeration for better root development. However, the present results could be explained as related to the following: time and dose of organic and chemical fertilizers, method of application, irrigation problems and sensitivity of tested crop (Ali, 1994).

Recommendations:

1) Application of fertilizers should follow the exact recommended doses.

2) Fertilizers application rate should be considered to avoid crop mortality especially during the first stages of planting.

3) Selection of fertilizer type must be done with relevant to fertilizers characteristics and mode of action on soil.

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