Influence of Bio-organic Fertilizers on Tomato Plants Growth under Deep Tillage Preparation in Western Omdurman Soil

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Abstract

The study was conducted in season (2014/2015) at small Farm in Western Omdurman, Khartoum State, Sudan. The main objective of this study was to study the effect of bio-organic fertilizers on growth component of tomato plants. The experiment was arranged in randomised complete block design (RCBD) with four replication and 7 treatments. The experimental treatments were as follows: Compost application 15t ha^{-1}, inoculation of *Azotobacter spp.* and *Mycorrhizal* fungi and their combinations with compost. Statistical analysis (spss) was used to test the effects of treatments on different parameters. The results revealed that compost application alone in this season had affect on the shoot fresh and dry weight of tomato plants rather than root fresh and dry weight. Inoculation of *Azotobater spp* in combination with compost showed increase on tomatoes growth components compared to the control and *Azotobacter spp* alone. *Mycorrhiza* treatment to tomato plants alone showed an increase in plant growth components compared to the control and that in combination with compost. Application of biofertilizers both Azotobacter and Mycorrhiza in combination with compost 15 t ha^{-1} showed a positive effect on tomato growth components including plant height, shoot fresh and dry weight, and root fresh and dry weight.

Keywords: Omdurman, Azotobacter spp, Mycorrhizal fungi, compost, Tomatoes.

INTRODUCTION

Tomato *(Lycopersicon esculentum)* is one of the most popular and widely grown vegetables around the world. Tomato is grown as an annual plant. It is a branching, herbaceous plant with hairy, weak, trailing stems. The leaves are hairy and vary in size. It bears yellow flowers in clusters. The fruits are round to lobed and they vary in size and colour ranging from red, pink or yellow when ripe. An average daily mean of 20 ° to 24 °C is optimum for growth, yield and fruit quality (daff.gov.). Low soil fertility is one of the main factors responsible for low productivity of vegetable crops in western Omdurman Farms, Khartoum State- Sudan. Soil fertility can be presumably enhanced by organic and inorganic fertilizers application. However, the use of any type of fertilizer depends on several factors such as soil type, nature of crop and socio-economic conditions of the area (Babiker, 2005). Bio-fertilizers are preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilising or cellulolytic micro-organisms used for application to seed, soil or composting areas with the objective of accelerating microbial processes which augment the availability of nutrients that can be easily absorbed by plants (Prajakta *et al*, 2013). All the isolates were positive for more than one plant growth promoting traits (Rao, 2011). Deepak 2014 reported that, Azotobacter plays an important role in the nitrogen cycle in nature, besides playing role in nitrogen fixation. Jayathilake *et al* 2006 concluded that, integrated nutrient supply system with nitrogen fixing biofertilizers (Azotobacter) in combination with organic manure (vermicompost and farmyard manure) and chemical fertilizers can be integrated to obtain optimum economical yield of onion. The main objective of this study was: to study the effect of bioorganic fertilizers on growth component of tomato plant.

MATERIALS AND METHOD

The study was conducted in a small Farm in Western Omdurman Farm, Khartoum State- Sudan. Latitudes 15 º.68 N and longitudes 32 º.35 E and altitudes 402 m above sea level. The climate of the area is within the semi-desert zone according to the climatic zones (Personal communication. 2014). The soil of the study area are generally reddish brown, sandy clay loam, non calcareous, non saline and non sodic soil, with slight limitation such as low organic matter and organic nitrogen content. The most active process is the water erosion as deflation and deposition (Personal communication. 2014).

Farm yard manure and *Moringa oleifera* leaves were composted. Inorganic nitrogen fertilizers were added as urea to enhance growth and activity of microorganisms. The mixture was wetted by 384 litter of water and mixed monthly for duration of 4 months.

The mycorrhiza (VAM) vascular arbuscular mycorrhizal spores were isolated by wet sieving and decanting method (Gerdemann, and Nicholson 1963), using one size of sieves 45 μm arranged in decending order of their mesh size. Sudan grass was planted and inoculated by VAM spores for propagation for three month before transfer once to the soil as a biofertilizer.

Azotobacter spp was isolated from a rhizosphere soil under sorghum plant from Shambat soil by using nitrogen free medium selective for Azotobacter growth.

The land was prepared using chisel plough tillage. The ploughing depth was (40 – 60) cm, followed by leveling.

The plots were arranged in randomizal complete block design (RCBD) with four replication and 7 treatments. The experimental treatments were as follows; compost treatments 15 t ha^{-1}, inoculation of *Azotobacter spp* and Mycorrhizal fungi and their combinations.

Application of compost was done in November 2014 before the sowing inside the ridges. Bio-fertilizers were inoculated five weeks after sowing date.

Tomato plants *(Lycopersicon esculentum)* were transplanted in the field on 17th January 2015 from the nursery. Replanting was done two times using seedling two weeks after sowing date and seed application one month after sowing. The growth was measured three month after sowing.

The following Parameters were measured; Plant height after the plants were harvested from the ground surface. A maturity stage was chosen to measure the average shoot fresh and dry weight. Root fresh and dry weight.

RESULTS

Data given in (Figure 1) revealed that increased in tomato plants height without a significant different. However, combinations of *Azotobacter spp*, Mycorrhiza and compost 15t ha^{-1} treatment affect the plant height by obtained the highest value, follow by the combination of *Azotobacter spp* and compost 15t ha^{-1}, and compost 15t ha^{-1} treatments compared to the control and other treatments, while the treatments Azotobacter and the combination of Mycrrohiza and compost 15t/ha gave the lowest plant height compared to the control.

Figure (2) showed that shoots fresh weight of tomatoes plant affected by application of bio-organic fertilizers without significant difference at ($P \leq 0.05$). However, application of

Azotobacter, Mycorrhiza and compost 15t ha^{-1} gave the height shoots fresh weight of plant follow by the application of compost 15t ha^{-1} in combination with Azotobacter and compost 15t/ha compared to control and other treatments.

Figure (3) revealed that the combination of *Azotobacter spp*, Mycorrhiza and compost 15t ha^{-1} rise the highest shoot dry weight of tomato plants without a significant different at ($P \leq 0.05$), follow by the application of compost 15t ha^{-1}, while the *Azotobacter spp* and the combination of Mycorrhiza and compost 15t ha^{-1}, appear the lowest value compared to the control.

Data given in (Figure 4) showed that the combination of *Azotobacter spp*, Mycorrhiza and compost 15t ha^{-1} application rise the highest roots fresh weight of tomato plant followed by the Mycorrhiza and the combination of *Azotobacter spp* and compost 15t ha^{-1} treatments compared to the control and other treatments.

In figure (5) the results presented the combination of *Azotobacter spp*, Mycorrhiza and compost 15t ha^{-1} treated obtained the highest root dry weight followed by Mycorrhiza and the combination of *Azotobacter spp* and compost 15t ha^{-1} application compared to the control and other treatments.

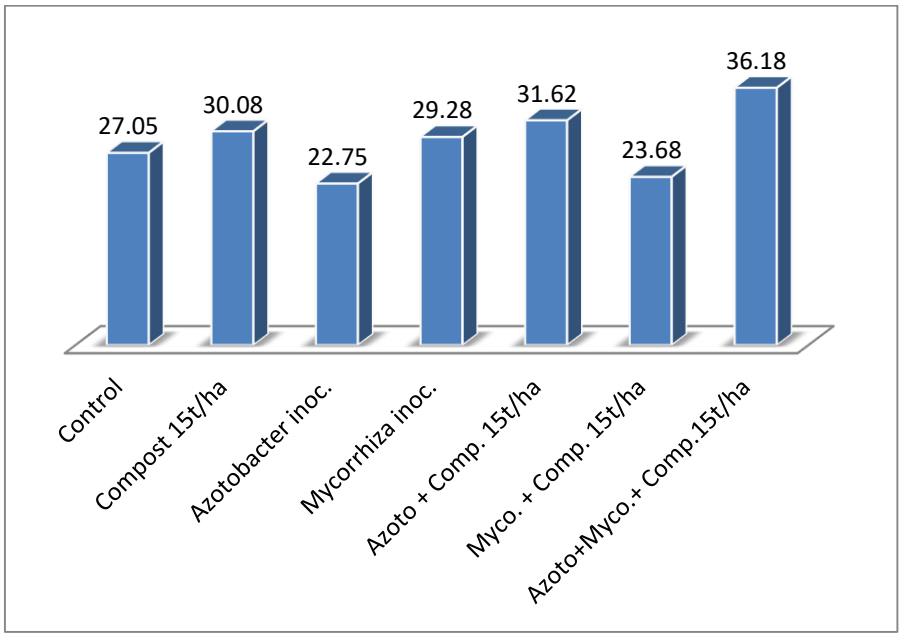

Figure (1): Effect of inorganic and bio-organic fertilizers on plant height.

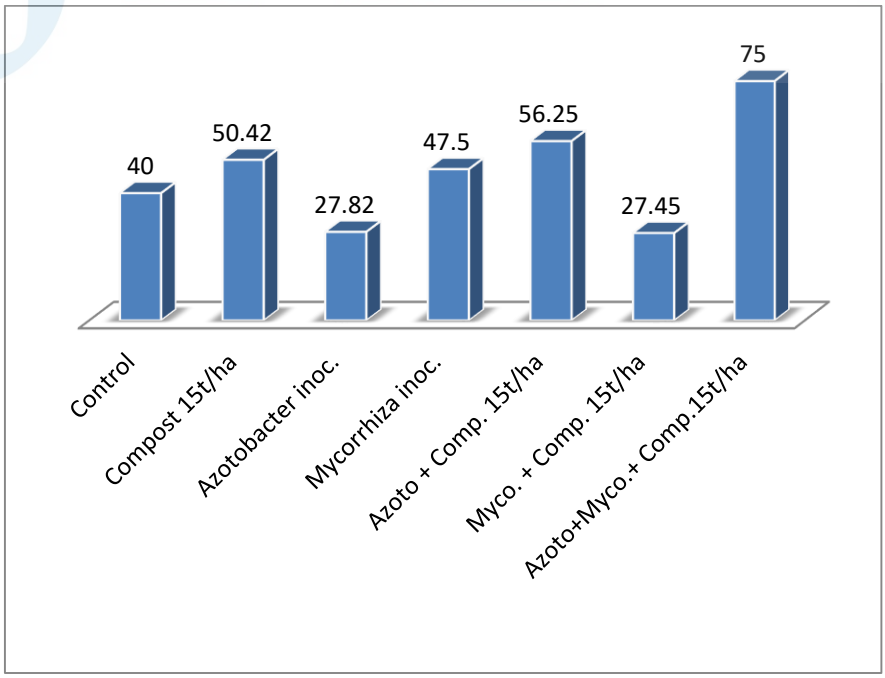

Figure (2): Effect of inorganic and bio-organic fertilizers on shoot fresh weight.

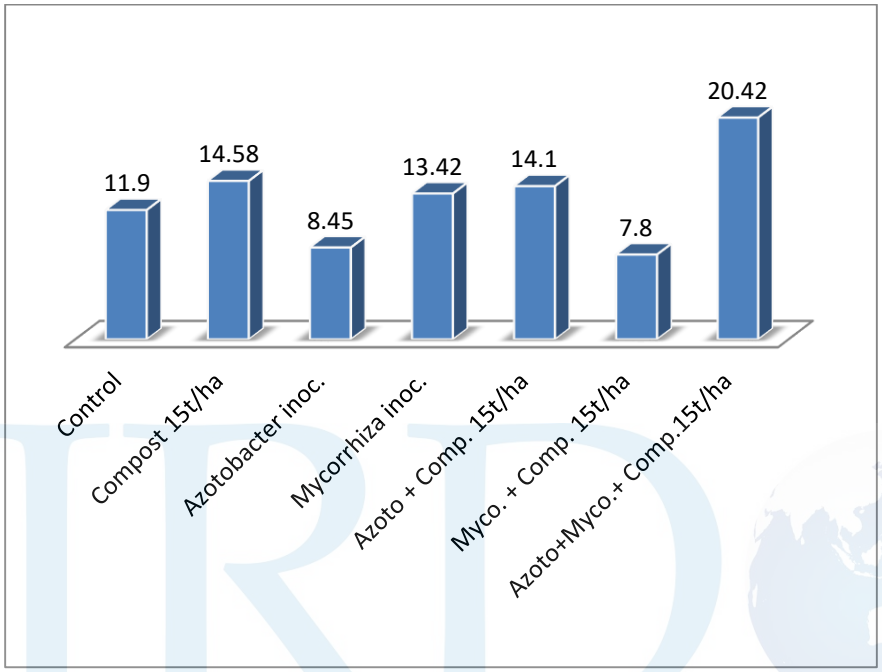

Figure (3): Effect of inorganic and bio-organic fertilizers on shoot dry weight.

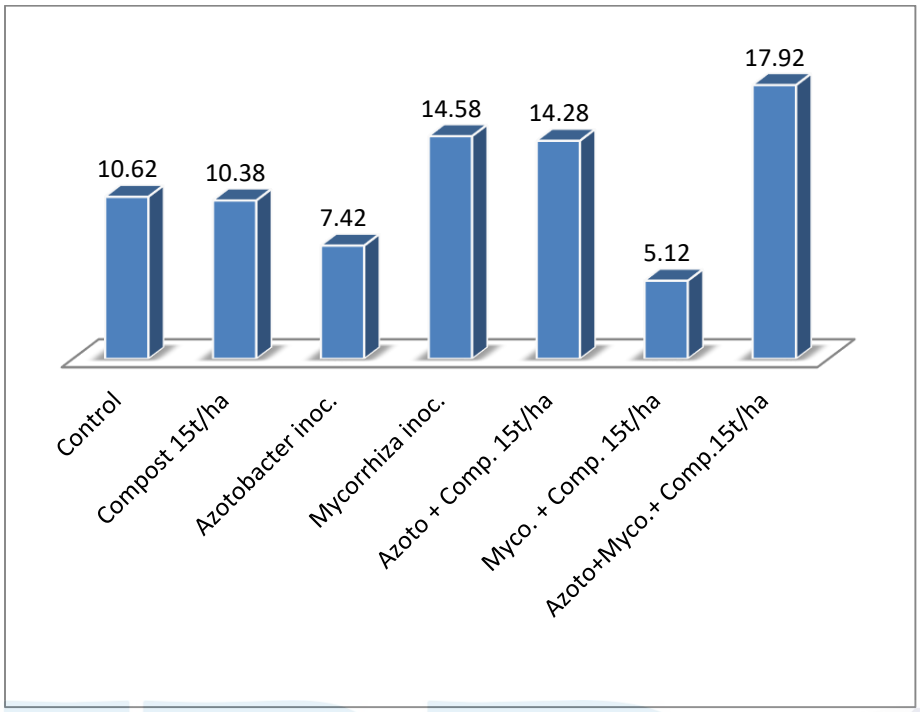

Figure (3): Effect of inorganic and bio-organic fertilizers on roots fresh weight.

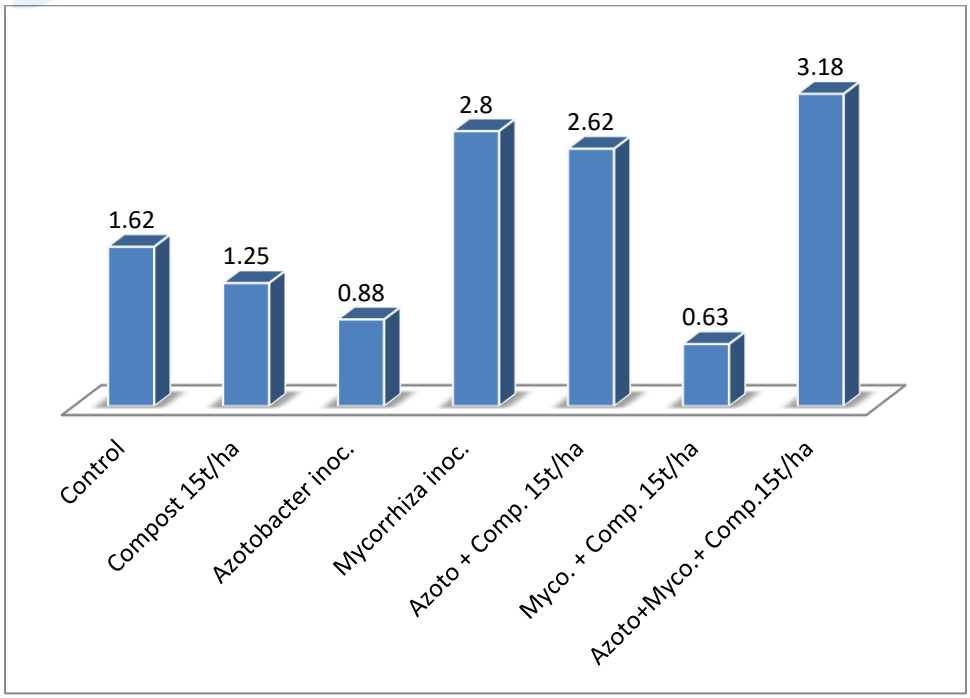

Figure (3): Effect of inorganic and bio-organic fertilizers on roots dry weight.

DISCUSSIONS

Organic manure application as compost affected some growth components of tomato plants including plant height, shoot dry and fresh weight when compared to control, *Azotobacter spp* and Mycorrhiza treatments alone. These results were in conformity with that of Ibrahim and Fadni, 2013. Tomatoes Agronomic parameters were significantly ($P \leq 0.05$), affected by the addition of different sources of organic fertilizers. Yifan, 2009 concluded that, maturity of compost was an important factor in assessing the effects of composts on tomato growth. But the compost 15 t ha^{-1} applications can not affect the root growth of tomato plants compared to control and Mycorrhiza treatments figure (5).

Application of *Azotobacter spp* as biofertilizers alone cannot affect the tomato plants growth components compared to the control and other treatments. These results disagreed with that obtained by Ramakrishnan, and Selvakumar, 2012, who observed that Aztotobacter affect significantly high performance in whole plant dry weight (g $plant^{-1}$), plant height (cm), number of leaves per plant, number of fruits per plant, yield per plant (g). Peng *et al* 2013. Who showed that organic fertilizers in the form of N-fixing Azotobacter enhanced biofertilizer increased yield with positive effects on measured plant height, weight and leaf index.

Mycorrhiza fungi (AM) inoculation alone affects the tomato plants growth components by increasing plant height, compared to that of the control and some other treatments, shoots fresh and dry weight, roots fresh and dry weight affected increasingly compared to that of the control, Azotobacter, and the combination of Mycorrhiza and each compost treatments. These results are

in conformity with that of Salvioli *et al.* 2008. Who reported that; Arbuscular Mycorrhizal fungi (AMF) represent a key-component of the rhizosphere, since they form a mutualistic association with the roots of plants. They are improvement of plant establishment and growth.

Application of *Azotobacter spp* as biofertilizers in combination with compost 15 t ha^{-1} to tomato plants showed increased in plant height, shoots, and roots fresh and dry weight compared to the control and Azotobacter treatment alone. These result compatible with that of Peng *et al* 2013 who, concluded that, integrated nutrient supply system with nitrogen fixing biofertilizers (Azotobacter) in combination with organic manure can be integrated to obtain optimum economical yield of onion.

Application of Mycorrhiza in combination with compost 15 t ha^{-1} can not affect the growth component of tomatoes compared to control and each other treatments These results compatible with that results obtained by Yildiz *et al* 2008. Who showed that, AM inoculation in both open and closed soilless systems did not increasingly influence the vegetative plant growing and nutrient uptake of tomato cultivar M19. Increasing the rate of OM and inoculation with AMF species increased shoot nutrient concentrations.

Application of *Azotobacter spp*, Mycorrhiza in combination with compost 15t ha^{-1} reveal that a non significant at ($P \leq 0.05$) increased plant growth components, included plant height plant shoot fresh and dry weight and root fresh and dry weight compared to control and each that of other treatments. These results compatible with that obtained by Zhen *et al* 2014. Who indicate that the application of manure compost plus bacterial fertilizers can immediately improve the microbial community structure and diversity of soil. Abdullah *et al* 2012 who showed that, the highest plant height; number of branches; plant fresh and dry weights, were

given by adding compost at 8 ton / fed + Azotobacter +Bacillus spp. compared to other combination treatments.

CONCLUSION

Compost 15 t ha^{-1} application alone affects the growth of tomato plants.

Inoculation of Azotobacter in combination with compost 15t ha^{-1} showed an increase in tomato plants growth components compared to the control and Azotobacter alone.

Mycorrhiza treated to tomato plants alone increased plant growth components compared to control and that in combination with compost 15 t ha^{-1}.

Applications of biofertilizers both Azotobacter and Mycorrhiza in combination with compost 15 t ha^{-1} showed positive effect on tomatoes growth components and gave the highest rate compared to control and treatments.

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