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# Effect of Organic Fertilizer application rate and *Azospirillum brasilense* inoculum level on growth and growth components of sweetpotato (*Ipomoea batatas* L).

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## ABSTRACT

A pot experiment was conducted in the green house facility of the College of Agricultural Studies, Sudan University of Science and Technology Shambat, to study the effect of Organic fertilizer application rate and *Azospirillum brasilense* inoculation on growth and growth components of, sweetpotato (*Ipomoea batatas* L). Three levels of *Azospirillum brasilense* inoculum applied were; (0, $10^4$ and $10^8$Cfu/ml), respectively and the three rates of Al Khaseeb Organic fertilizer were; (0 t/ha, 25 t/ha and 50 t/ha). The experiment was set in factorial arrangement in a completely randomized design. Shoot fresh weight and root length showed significant effect with (26.70 g) and (41.33cm) compared to (3.67g) and (16.67 cm) for uninoculated control. However, the shoot dry weight showed a significant effect with (5.10g) compared to (1.3g) for uninoculated control. The results indicated a great potential of using Organic fertilizers and biofertilizers to improve growth and yield of sweetpotato in addition to production cost reduction and conservation of natural resources.

**Key words:** Organic Fertilizer, biofertilizer, sweetpotato, growth components.

## INTRODUCTION

Sweetpotato is one of the world's most important food crops in terms of human consumption, particularly in Sub-Saharan Africa, parts of Asia, and the Pacific Islands. First domesticated more than 5,000 years ago in Latin America, grown in more developing countries than any other root crop (CIP, 2015). It is a tuberous-rooted perennial mainly grown as annual. It is cultivated for food in more than 100 countries. The area under cultivation was 8.5 million ha. In 2009 and worldwide tuber yield was 12648 kg/ha. (FAO, 2010). Sweetpotato is rich in complex carbohydrates, dietary fiber and beta-carotene (a provitamin A carotenoids). In general sweetpotato varieties with dark orange flesh have more β-carotene than those with light colored flesh (Coghlan, 2012).

In Sudan the main sweetpotato producing areas are New Halfa scheme, Rahad scheme, Damazein and pervious southern states; with an average yield of 8-15t/ha. The sweetpotato stands as one of the most important crops in the rapidly expanding vegetable industry of the Sudan (Ahmed, 2000).

*Azospirillum* is considered to be an important growth promotive rhizobacteria that can improve the growth and yield of several plants including economically important cereals and grasses. *Azospirillum*-plant association leads to the enhanced development and increased yield of different host plants under appropriate growth conditions (Singh, *et al.*, 2010). Azospirillum is known to be a very active nitrogen fixer under laboratory as well as soil conditions providing fast growth, better health of the plant and higher yield (Kannan and Ponmurugan,

2010). Organic fertilizers are fertilizers derived from animal matter human excreta or vegetable matter. (e.g. compost, manure)(Dittmar, *et al.*, 2009).

## MATERIALS AND METHODS

A pot experiment was conducted for 12 weeks in the greenhouse facility of the College of Agricultural studies, Sudan University of Sciences and Technology Shambat, to study the effect of *Azospirillum brasilense* inoculation and Organic Fertilizer application rate on growth and growth component of sweetpotato under greenhouse conditions using 5kg Shambat top soil (0-30cm), heat sterilized with Oven by sterilizing at 180c° for 2 hours using tenderilyzation method, then cooled, weighted and packed in black polyethylene plastic bags size 30 x20 cm. Sweetpotato clean cuttings were obtained from farmer's plots in Al Seliet Agricultural scheme Khartoum state, Propagated in small plots before planting in the pots. *Azospirillum brasilense* inoculum strain was supplied by biofertilization department, Natural Resources and desertification Research Institute, National Research Centre, Khartoum. The inoculum propagated in the lab. and a set of colony forming units (Cfu) counts tests were done. The three levels of *Azospirillum brasilense* inoculum applied were; (0, $10^4$ and $10^8$Cfu/ml) respectively and the three rates of Al Khaseeb Organic fertilizer were (0t/ha, 25t/ha and 50t/ha). The experiment was set in factorial arrangement in a completely randomized design, with three replicates. The organic fertilizer was mixed with the soil before planting and the pots were watered with adequate

amount of tap water. The next day clean sweetpotato apical vine cutting 25 cm in length were planted, one in each pot and immediately watered after planting. *Azospirillum* inoculum was prepared in the laboratory by inoculating the broth with the strain of *Azospirillum brasilense* and kept on rotary shaker at 150 rpm for 96 hrs. for growth. Serial dilutions were done ($10^1$ to $10^8$) for cfu counting. The inoculum was added from $10^4$ and $10^8$ according to the cfu count result. Daily observations were recorded of the plants growth. Insecticide was sprayed when whitefly infection observed on the plants. The plants were watered regularly with tap water as required and after12 weeks the plants were harvested by separating the shoot carefully and the root from the adhered soil, washed with tap water and the shoot and root lengths were measured in cm. The shoot and root fresh weights were determined with electric balance and placed in yellow paper envelops to dry in oven at 70C for 48 hrs, when the dry weights were determined.

Table (1.0) The treatments used in the study:-

| | |
|---|---|
| T1 : | Control. |
| T2: | *Azospirillum*$10^4$. |
| T3: | *Azospirillum*$10^8$. |
| T4: | 25 t/ha of Al Khaseeb organic fertilizer. |
| T5: | *Azospirillum*$10^4$+25 t/ha. Of Al Khaseeb organic fertilizer. |
| T6: | *Azospirillum*$10^8$+25 t/ha. Of Al Khaseeb organic fertilizer. |
| T7: | 50 t/ha of Al Khaseeb organic fertilizer. |
| T8: | *Azospirillum*$10^4$+50 t/ha. Of Al Khaseeb organic fertilizer. |
| T9: | *Azospirillum*$10^8$+50 t/ha. Of Al Khaseeb organic fertilizer. |

## RESULTS AND DISCUSSIONS

The obtained results presented in Figure (1) showed increase in sweetpotato shoot fresh weight with application of(T7) 50 t/ha of Al Khasieb organic fertilizer alone, indicating the great influence of organic fertilizer on shoot growth, followed by application of(T3),*Azospirillum Brasilense*$10^8$ biofertilizer inoculation and these show the potential of *Azospirillum Brasilense* biofertilizer in improving plant growth and reducing the production cost, by replacing the chemical fertilizers with organic and bio- fertilizers and conserving the natural resources. However the application of (T5) Azospirillum biofertilizer $10^4$+ 25 t/ha of Al Khasieb organic fertilizer showed significant effect indicating to the importance of co-inoculation of both the *Azospirillum Brasilense* Biofertilizer and Al Khasieb Organic fertilizer in sweetpotato growth improvements compared to (T1) the control (Figure(1), similar results were obtained by(Singh, *et al.*, 2010)when they reported" that *Azospirillum Brasilense* can improve the growth and yield of several plants including economically important cereals and grasses".

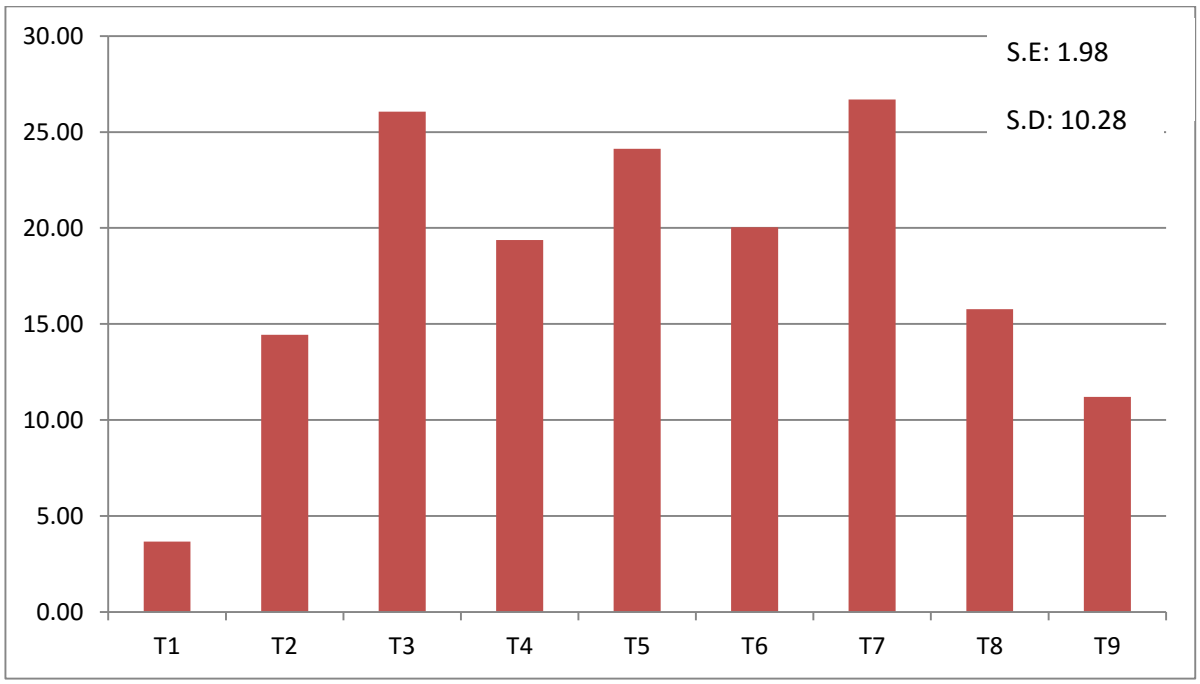


**Figure :(1)** Effect of *Azospirillum brasilense* and organic fertilizer on shoot fresh weight (g/plant).

The obtained results revealed that inoculation of sweetpotato with(T5) *Azospirillum brasilense* $10^4$cfu +25t/ha of Al Khasieb Organic fertilizer, showed almost similar effect to the application of 50t/ha of (*Al Khasieb*) Organic fertilizer alone on root length, indicating that with *Azospirillum* biofertilizer application 50% of the organic fertilizer need could be saved. Meanwhile inoculation with (T6) *Azospirillum brasilense*$10^8$ cfu+25t/ha of Organic fertilizer showed an increase in root length followed by inoculation with(T2) *Azospirillum brasilense* $10^4$cfu+ 0 t/ha of Al Khasieb Organic fertilizer and inoculation with (T3) *Azospirillum brasilense* $10^8$ cfu alone compared to the control (Figure (2).

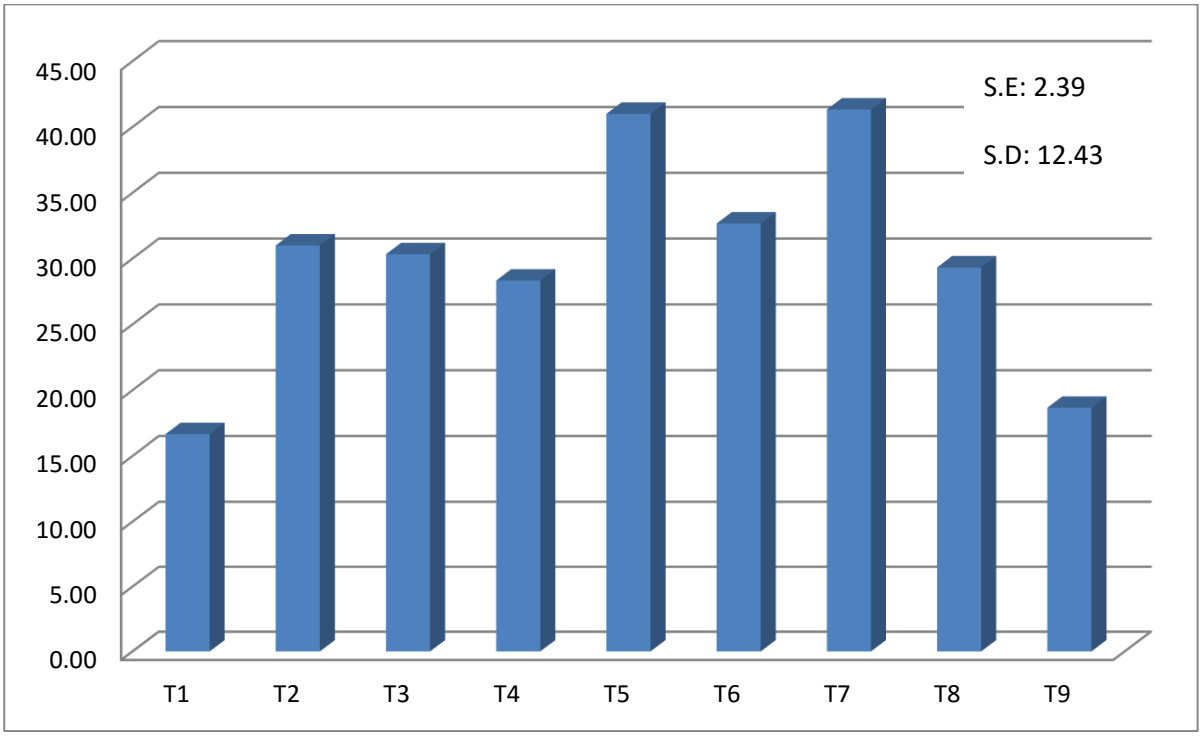


**Figure :( 2)** Effect of *Azospirillum brasilense* and organic fertilizer on root length (cm/plant).

The obtained results showed that inoculation with *Azospirillum brasilense* $10^8$cfu+ 0 t/ha of Al Khasieb Organic fertilizer(T3) effect was very high on sweetpotato shoot dry weight followed by inoculation with(T5)*Azospirillum brasilense* $10^4$ cfu+25 t/ha of Al Khasieb Organic fertilizer and the third most high effect was observed in (T7) application of 50 t/ha of Organic fertilizer alone, Followed by (T6) inoculation with *Azospirillum brasilense* $10^8$cfu+ 25 t/ha of Al Khasieb Organic fertilizer and(T4) application of 25 t/ha of Al Khasieb Organic fertilizer alone compared to uninoculated control Figure(3). These results are in consistence with the findings of the (Bashan, *et.al.*, 1990) who reported that "All *Azospirillum brasilense* strains significantly improved wheat and soybean growth by increasing root and shoot dry weight".

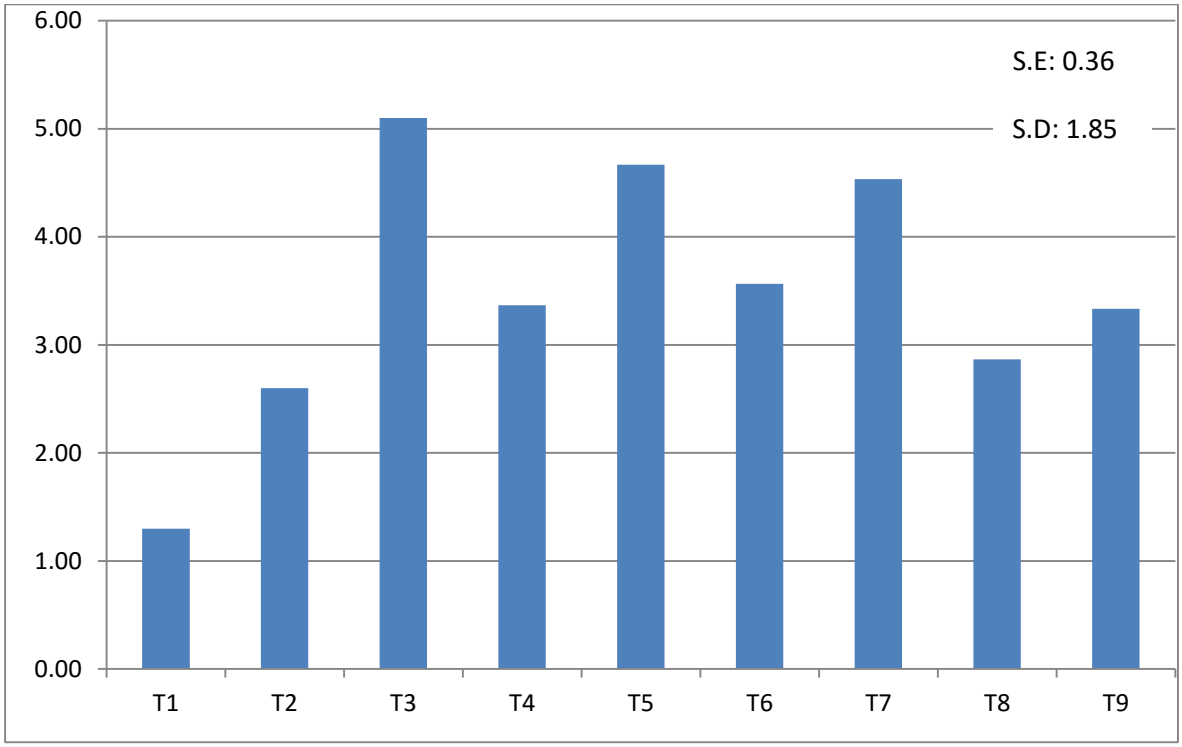


**Figure:(3)** Effect of *Azospirillum brasilense* and organic fertilizer on shoot dry weight(g/plant).

The obtained results of (T7) application of 50 t/ha of Al Khasieb organic fertilizer alone showed the highest effect on sweetpotato root dry weight, followed by (T8) inoculation with *Azospirillum brasilense* $10^4$ +25 t/ha of Al Khasieb organic fertilizer, however (T6) inoculation with *Azospirillum brasilense* $10^8$ +25 t/ha of Al Khasieb organic fertilizer showed less effect than (T8). These can indicate the essential role of the suitable dose of organic fertilizer in activation of *Azospirillum brasilense* biofertilizer. On the other hand (T2 and T9) showed almost similar effect on root dry weight. All treatments showed increase in root dry weight value compared to the control without inoculation and without fertilization (Figure (4).

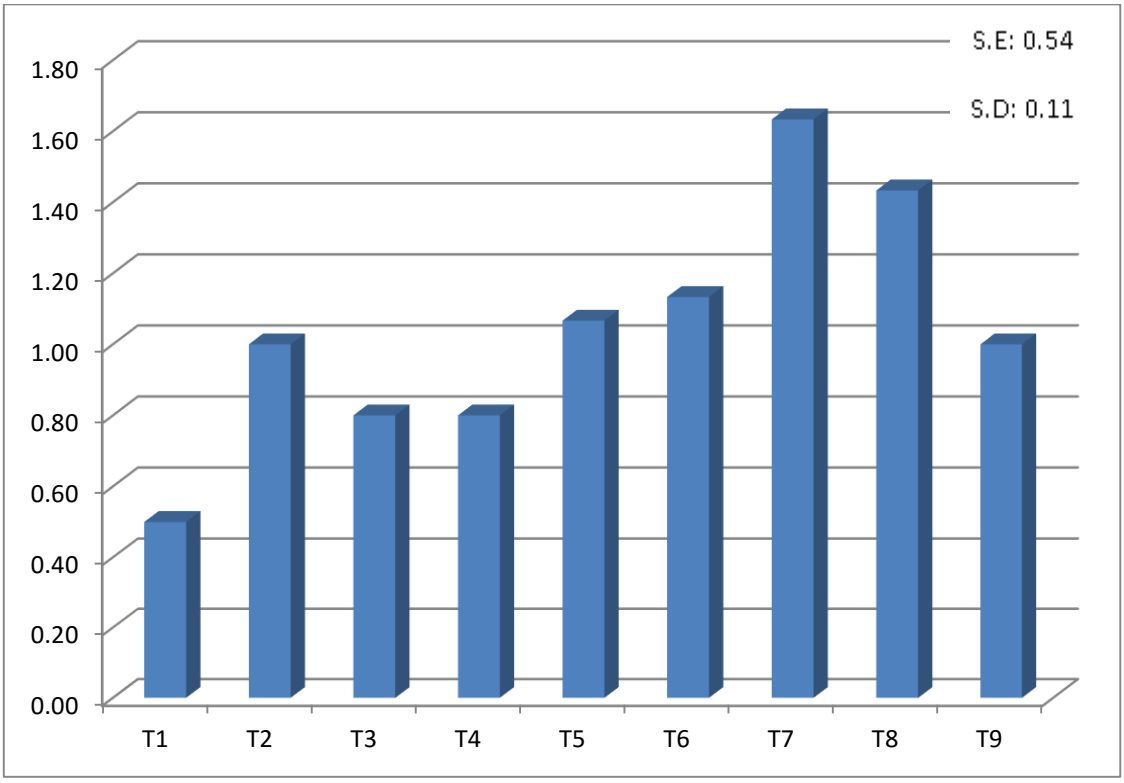


**Figure (4):** Effect of *Azospirillum brasilense* and organic fertilizer on root dry weight (g/plant)**.**

The Color Rating results showed that a combination of inoculation with *Azospirillum brasilense* $10^4$ cfu+ 25 t/ha of Al Khasieb Organic fertilizer (T5)gave the highest effect with more than 3.5 out of 4,indicating the most suitable application rate of Al Khasieb Organic fertilizer and inoculation level of *Azospirillum brasilense*, followed by treatments (T2, T3, T7 and T8) with 3 out of 4 in color rating degrees, Compared to the control without inoculation and without fertilization (Figure (5).

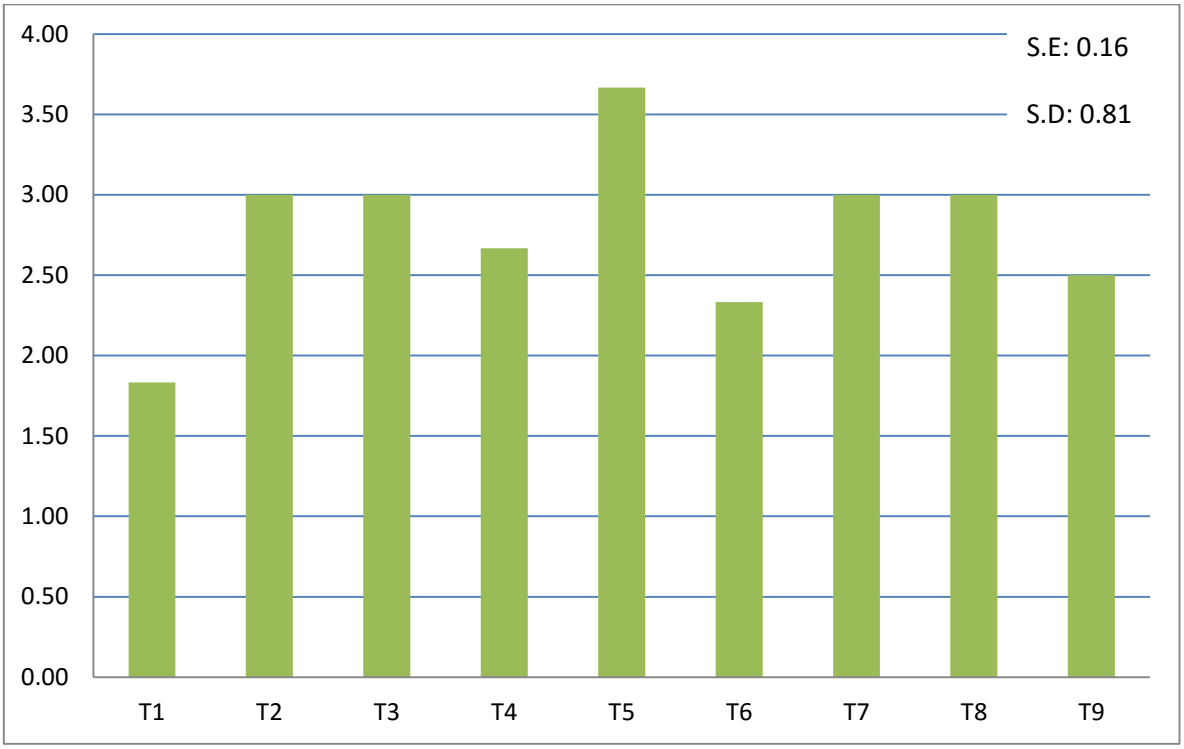


**Figure:( 5)** Effect of *Azospirillum brasilense* and organic fertilizer on colour grading.

## CONCLUSION

Stated results showed significant effect of treatments compared to the control, indicating the great potential of Al Khasieb Organic fertilizer and *Azospirillum brasilense* biofertilizer on sweetpotato growth, and it's expected to improve yield of such strategic crop in addition to natural resources conservation.

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