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EFFECT OF THE USE OF SAWDUST AS A GROWTH MEDIUM ON THE GROWTH AND YIELD OF TOMATO

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ABSTRACT
Tomato is one of the most important vegetable crops grown in Nigeria and other part of Africa. Most hydroponic tomato growers in Africa are using sawdust as a growing medium due to its availability and affordability. However, there is little or no information on how sawdust influences growth parameters of tomato and its yield. The aim of the study was to determine the effect of the use of sawdust as a growth medium on growth and yield of tomato as against the use of soil medium. Seeds of tomato raised in nursery condition were transplanted into sawdust (10 pots) and soil (control) and watered daily for period of 8 weeks. The results showed that weeks after transplanting had significant effect on all the growth parameters and different growth media used showed differences on the growth and yield of tomato. The result of this study showed that sawdust can be used as an alternative growth medium in planting tomato although all the growth parameters (plant height, number of leaves, leaf length and leaf width, number of fruits) were delayed as compared to those planted on the soil. Therefore, saw dust can be used for commercial production of tomato hydroponically and further studies should be conducted on the use of mixture of sawdust and soil media for growing tomato hydroponically and also to check whether the yield and quality of hydroponically grown tomatoes are being affected in terms of yield and nutrient content.
KEY WORDS: *Sawdust, growth, yield, tomato.*

INTRODUCTION

Tomato is an herbaceous plant commonly grown as an annual, though perennial tomato culture is an established practice in many parts of South America. As an important source of minerals, vitamins and health acids, tomato is one of the most important vegetable crops of solanaceae grown universally with the production of 124.75 million tonnes (FAO, 2007).

In Nigeria, tomato is regarded as the most important vegetable after onions and pepper (Fawusi, 1978). It is an important condiment in most diets and a very cheap source of vitamins. It also contains a large quantity of water (%), calcium (%) and Niacin all of which are of great importance in the metabolic activities of man. Tomato is a good source of vitamins A, C and E and minerals that are very good for body and protect the body against diseases (Taylor, 1987, Adelusi and Oseni, 2015). Tomatoes are planted by an estimated 85% of the gardens each year. If well managed, tomato is highly productive (Denton & Swarup, 1983). Cropping of tomatoes

during the wet and dry seasons contributes immensely to the national requirement but the bulk of production is from the dry season cropping particularly in southern states (Anon, 1989).

Adegbola *et al*. (2012) stated that Nigeria is undeniably the 14th largest producer of tomatoes, second to Egypt in Africa at 1.51 million metric tonnes valued at 87.0 bilion naira with a cultivated area of 254,430 ha being the biggest producer in Sub-Sahara Africa and with this potential, it is unbelievable that Nigeria could still be importing tomatoes products of different kind.

Purseglove (1992) reported that tomato is a short lived perennial, grown as an annual, branching herb with hairy weak trailing stems, hairy leaves and variable in shape. Lycopersicon is a relatively small genus within the extremely large and diverse family Solanaceae. The family Solanaceae is an important source of vegetable and desert crops including the potato, egg-plant, various pepper, the tree tomato and the tomato, *Lycopersicon esculentum* among others. The African tomatoes on the other hand were introduced by European merchants and colonizers. Therefore, the African tomatoes were probably descended from varieties bought from Europe (Villareal, 1980).

Maboko *et al*. (2009) reported that in Africa, the majority of tomato producers are still practicing open field production while soilless cultivation in a protected environment has gained popularity due to improvement in yield and quality. In addition, almost all open field vegetable production is seasonal. In Africa, with its diverse climatic conditions and soil types, growing plants in soil is unpredictable, with a range of challenges, such as changing temperatures, moisture holding capacity, available nutrient supply, poor root aeration as well as diseases and pest control (Maboko & du Plooy, 2014). Soilless production using growing media alleviates some of these problems, while giving the farmer better control over plant growth and development.

In Africa, sawdust is popular and readily available, especially in forested areas such as Nigeria and other tropics. Sawdust is affordable compared to imported growing media, and it is suitable for use as a growing medium. Researchers have reported the favourable effect that organic growing media have on plant growth (Tzortzakis & Economakis, 2008; Maboko *et al*., 2013), as it increased the porosity and water retention of the growing medium (Hardgrave & Harrisman, 1995; Marinou *et al*., 2013). Maboko *et al*., (2013) reported that organic growing media (sawdust and coir) did not have a significant effect on tomato yield.

Positive physical properties such as biogradability at an acceptable rate, low superficial specific gravity, high porosity, high water retention, moderate drainage and high bacterial tolerance elevated the usage of sawdust as a plant growth medium in manufacturing industries (Maharani *et al*., 2010). Despite the fact that sawdust has been commercially used for many years, data is lacking that describes whether sawdust is suitable for tomato production as a growth substrate.

This research therefore fills the gap where little has been done on sawdust. Sawdust has specifically been chosen as test material because it is the most commonly used and readily available in Africa (Niederwieser, 2001). It is also widely used throughout the world (Niederwieser, 2001; Miller & Jones, 1995) and it is therefore an important growth medium for commercially grown tomatoes in hydroponics.

The aim of the study was to identify if sawdust is suitable for tomato production in a hydroponic system. The main objective of this study was to contribute scientific knowledge on

the utilisation of sawdust as a growing medium in tomato production. It also outlines the effect of use of sawdust on the growth, yield and quality of hydroponically grown tomatoes. The specific objectives are to evaluate the performance of tomato plants grown in sawdust and to determine the effect on growth, yield and quality of tomato grown in sawdust hydroponically.

MATERIALS AND METHODS

Experimental Set-up. The experiment started in 5th of July 2016 by planting seeds of tomato in a rotkwool (Plate 1) at the rate of 3 seeds/ rotkwool for 5 rotkwool (15 seeds) which serve as a nursery stage. After 48 hours, 100% germination was recorded for the seeds and were ready for transplanting.

Plate 1: Tomato seed planted in a rock wool

Preparation phase. 10 buckets (21 L) each of dimension 30.5 cm x 34 cm x 30.5 cm (L x B x H) with the base of the bucket perforated to ensure proper drainage of water and aeration were filled with sawdust. The sawdust was first moistened with water before filling up into the buckets and before planting in order to improve moisture condition and reduce transplant shock. Staking was done at the time of fruiting.

Plate 2: Tomatoes planted on a sterilized saw dust in a plastic pot

Transplanting phase. 8 days old tomato seedlings were brought from the nursery and were transplanted (3 seedlings/bucket) into 21 L plastic bucket filled with sawdust as growing medium for the test experiment and 4 seedlings were planted on the soil to serve as control.

Plate 3: Tomato Seedling Transplanted on sawdust

Fertigation. The plants were irrigated two times per day at 12 hourly intervals and the irrigation volume was gradually increased as plants enlarged, to ensure that at least 5-10% of the applied water leached out of the pots to reduce salt build-up in the growing medium. Water soluble fertilizers that were used were Hydroponic® A & B. The composition and chemical concentration of fertilizers used for tomato production were: Hygroponic® (A: Monoamonic phosphate, Calcium nitrate, Potassium nitrate. B: $MgSO_4$, $CuSO_4$, $ZnSO_4$, $MnSO_4$, Boric acid, Ammonic Molybolate, $MgNO_3$, Iron chelate). Hydroponic solution A was prepared by diluting 2.5ml to 1 litre of water while solution B was prepared by diluting 1 ml of the solution with 1 litre of water. 25 ml of the prepared solution was used to water the plant twice a day.

Plant height and stem diameter. The plant height plants per pot & soil and replicate were measured and recorded from the one week after transplanting and thereafter on a fortnightly basis until 8 weeks after transplanting (WAT). A metre measuring tape was used to measure the plant height. The number of leaves was also counted on plants on a fortnightly basis.

Leaf length and width. The leaf length and leaf width of plants per pot & soil were measured and recorded from the one week after transplanting and thereafter on a fortnightly basis until 8 WAT.

Number of fruits and time of fruiting. The number of fruit per plant was counted and the time of fruiting was observed under the two different media.

Data and Statistical Analysis. The mean and standard error of all the growth parameters measured were determined using Microsoft Excel, 2007 and all the data were plotted as a line graph using Microsoft Excel, 2007. One-way ANOVA was done to compare the mean of the growth parameters under the sawdust medium and soil medium

RESULTS AND DISCUSSIONS

Plant height. Weeks after transplanting (WAT) with a p-value of <0.05 were found to have a significant effect on plant height (Fig.1) under the two different medium (sawdust and soil). The mean plant height increased with an increase in number of weeks after transplanting (Fig. 1). Planting on different growth medium showed that the height of tomatoes planted on soil medium was significantly ($p<0.05$) higher than the tomatoes planted on saw dust. The growing pattern of the plant height was in a linear form (Fig. 3). Tomato plants have shown a rapid growth rate at the developmental stage and tend to show slow growth rate at the reproductive stage as the photoassimilates are distributed for the production of flowers and fruits development instead of plant growth (Grudnicki & Ianovici, 2014; Hurd *et al*., 1979; Okunlola *et al.,* 2015).

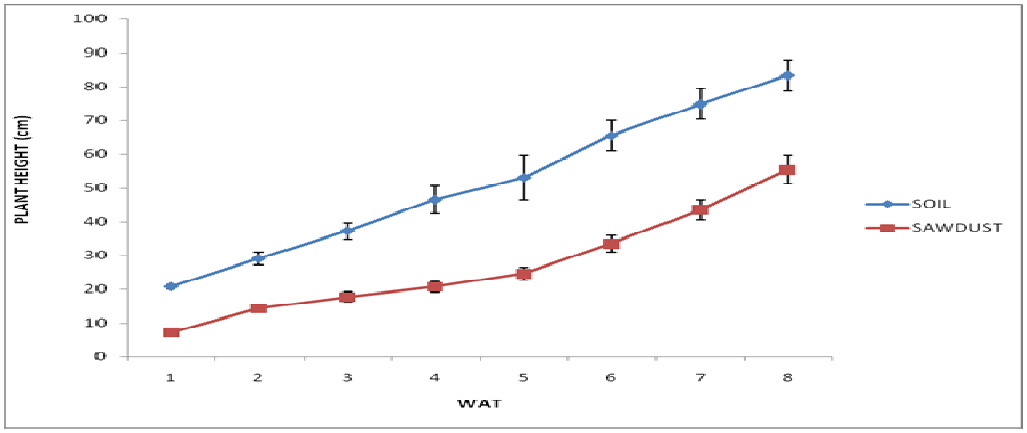

FIG. 1. Plant Height of tomatoes planted on soil and saw dust

Number of leaves. The result (Figure 2) indicated that there was a significant difference from WAT from 1 to 8 WAT. The number of leaves of tomatoes planted on soil showed a linear pattern and significantly ($P<0.05$) higher than the number of leaves planted on saw dust from 1WAT to 5WAT while in 6 WAT, the number of leaves in tomatoes planted on saw dust was significantly higher than those planted on the soil. In 7 WAT, the number of leaves planted on both soil and saw dust was the same and 8 WAT, the number of leaves in tomatoes planted on saw dust was lower than the number of leaves planted on soil although not significant. A study conducted by Logendra *et al*. (2001) reported that an increase in the number of leaves elevated the photosynthetic reaction and increased carbohydrates. There was significant increase in number of leaves with an increase in number of WAT which underscore the likely increase in the photosynthates and hence productivity.

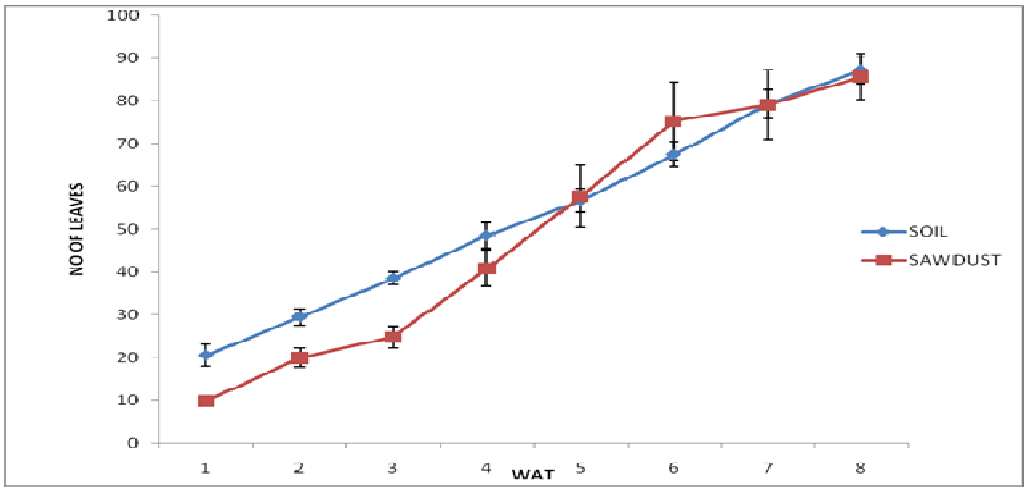

FIG. 2. Number of leaves of tomatoes planted on soil and sawdust

Leaf length. There was significant increase in leaf length from 1 to 6 WAT with no further significant increase in leaf length after 6 WAT (Figure 3). However, there was a significant difference amongst the two growth medium (soil and saw dust) on the leaf length of tomato. The leaf length of tomato planted on soil medium show a liner increase as they increase from 1WAT to 8 WAT while there was a drop in the leaf length of tomatoes planted on sawdust from 2WAT to 8 WAT and within 5 WAT to 8 WAT, there was an increase.

Leaf width. Figure 4 shows that leaf width was significantly high from 5 WAT to 8 WAT under the two different growth media. From 1 WAT to 2 WAT, the leaf width of tomatoes planted on sawdust was longer than the leaf width of tomatoes planted on the soil while from 3 WAT to 8 WAT, the leaf width of tomatoes planted on the soil was significantly higher than the leaf width of tomatoes planted on the saw dust.

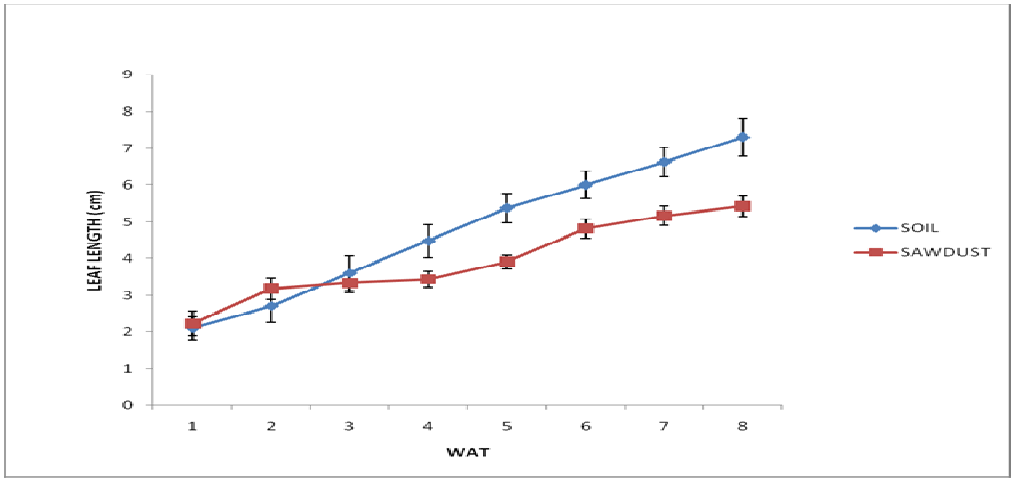

FIG. 3. Leaf length of tomatoes planted on sawdust and soil

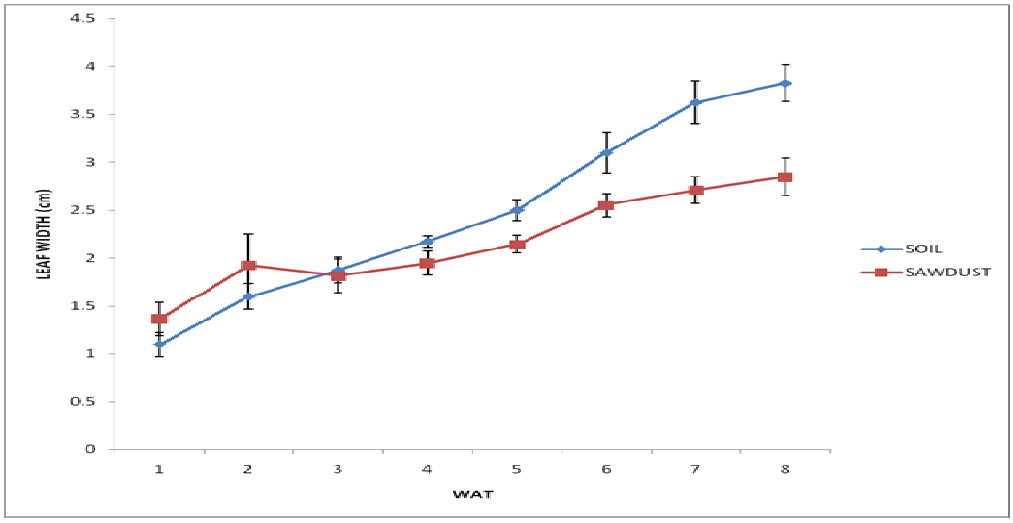

FIG. 4. Leaf Width of tomatoes planted on saw dust and soil

Number of Fruits and Time of fruiting. The tomatoes planted on the saw dust has not started fruiting as at 8 WAT but the process of fruiting has started with the evidence of buds seen on the plants while the tomatoes planted on soil started fruiting as at 6 WAT and as the number of WAT increases, the number of fruit increases.

CONCLUSION

The result of this study has shown that sawdust can be used as an alternative growth medium in planting tomato although all the growth parameters (plant height, number of leaves, leaf length and leaf width, number of fruits) were delayed which may be due to the

inavailability of soil microorganism that can make the medium nutrient rich through decomposition process as compared to soil medium. The tomatoes planted on soil medium grew faster and produce fruit earlier than those planted on saw dust due to the above reason. In general, the growth parameters measured in this study increases as the weeks after planting increase.

REFERENCES

- Adegbola, A., Adewoye, A., Abosede, O. (2012). On Investigating Pollution Of Groundwater from Atenda Abattoir Wastes, Ogbomoso, Nigeria. International Journal of Engineering and Technology, 2(9) 2029- 3444.
- Adelusi, A.A. and Oseni, O.M. (2015). Effects of nitrogen nutrient on the photosynthetic pigments accumulation and yield of *Solanum lycopersicum*. *Annals of West University of Timisoara ser. Biology*, 18(2): 131-138.
- Anon. (1989). Linear Regeneration Sampling Report 1984-1988. Technical Paper No. 21.
- Denton, O.A., Swarup, V. (1983). Tomato cultivation and its potential in Nigeria. Acta Horticulturae 123: 257-271.
- FAO. (1998). In The global plan of action on plant genetic resources for food and agriculture. Rome, Italy. Pp.104.
- Fawusi, M.O.A. (1978). Emergence and seedling growth of Pepper as influenced by soil compaction nutrient status and moisture regime. Soc. Hortic., 9: 329-335
- Grudnicki M., Ianovici N. 2014. *Noţiuni teoretice şi practice de Fiziologie vegetală*, Ed. Mirton, Timişoara, 289 p.,
- Hardgrave, M., Harriman, M., (1995). Development of organic substrates for hydroponic cucumber production. Acta Horticulturae, 401: 219–224.
- Hurd,. R.G. Hurd, A.P. Gay, A.C. MountfieldThe effect of partial flower removal on the relation between root, shoot and fruit growth in the indeterminate tomato. Ann. Appl. Biol., 93 (1979), pp. 77-89.
- Logendra, L. S., Thomas, J., Gianfagna, T. J., David, R., Specca, D. R., Harry, W. and Janes H.W. (2001). Greenhouse tomato limited cluster production systems: crop management practices affect yield. *HortiScience*, 36 (5): 893–896.
- Maboko M.M., Du-Plooy, CP, Bertling, I., (2009). Comparative Performance of Tomato Cultivars in Soilless vs. In-Soil Production Systems Acta Horticulturae, At 843, 319-326, Volume: 843
- Maboko, M.M; Du-Plooy, CP. (2013). Highdensity planting of tomato cultivar's with early decapitation of growing point increased yield in a closed hydroponic system. Acta Agriculturae Scandinavica 63: 676-682
- Maboko, M.M; Du-Plooy, CP. (2014). Yield of hydroponically grown tomato cultivars as affected by transplanting stage or direct seeding. HortScience 49: 438-440.
- Maharani, R., Tamai, Y., Takashi, Y. and Terazawa, M., (2010), Scrutiny of Physical Properties of Sawdust from Tropical Countries Wood Species: Effect of Different Mills and Sawdust Particle Size. Journal of Forestry Research, Vol. 7, No. 1, 20-32
- Miller, J.H. and Jones, N. (1995). Organic and compost -based growing media for tree seedling nurseries. World Bank Technical Paper No. 264, Forestry Series
- Niederwieser, J.G. (2001). Guide to hydroponic vegetable production. 2nd ed. Agricultural Research Council, Roodeplaat, Vegetable and Ornamental Plant Institute. Pretoria, South Africa
- Okunlola, G.D., Adelusi, A.A., Olowolaju, E.D., Oseni, O.M**.** and Akingboye, G.L. (2015). Effects of water stress on the growth and some yield of *Solanum lycopersicum* L. *International Journal of Biological and Chemical Sciences*, 9(4): 1755-1761
- Purseglove, S.W. (1992). Tropical Crops, Monocotyledons. Vol. 2, Longman Group Ltd., London, 20-140.
- Taylor, J.H. (1987). Text of lectures delivered at the national workshop on fruit and vegetable seedlings production held at NIHORT 9-13
- Tzortzakis, N.G., Economakis, C.D.(2008). Impacts of the substrate medium on tomato yield and fruit quality in soil less cultivation. *Hort. Sci.* (Prague), 35(2): 83–89.
- Villareal, R.L., Boulder, Colorado: Westview Press (**1980**), pp. 174,