Effects of Magnetic Treated Domestic Wastewater on the Growth of African Eggplant (*Solanum Macrocarpon*)

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***Abstract*—Disposal of wastewaters from different sources has always been a major issue of environmental concern. Domestic wastewater may be applied into a more beneficial use through irrigation rather than being allowed to constitute nuisance to the receiving environment. This study determined the variations in the growth parameters of the African eggplant under different treatments of irrigation with freshwater, magnetized and non-magnetized domestic wastewater replicated thrice in a derived savannah region of Oyo State. The study was carried out in a screen house situated at Agricultural and Bio-Environmental Engineering Department of The Oke-Ogun Polytechnic, Saki (TOPS), Oyo State in South Western Nigeria. Surface soil samples from 0-15cm depth randomly collected for planting were taken to the laboratory for analysis to know the preliminary status of the soil before planting. Plant height, number of leaves and stem girth were measured as indicators for plant growth. The deviations between the average values of the growth parameters for the three treatments were considered while least square difference (LSD) was used to test for significant differences in the growth parameters for the treatments.**

Generally, magnetization of the domestic wastewater before application as irrigation water was found to improve the growths of the vegetable in terms of the plant heights, stem girths and number of leaves. The statistical analysis of the results also revealed significant differences between the mean values of the magnetized wastewater treatment and control experiment at various growth stages.

Keywords—Magnetization, domestic wastewater, growth, African eggplant.

Introduction

African Eggplant (*Solanum Macrocarpon*) is a vegetable crop belonging to the family *solanacae***.** The genus solanum includes both the edible and non-edible species, the family is one of the largest and most important families of vegetables grown for their edible fruits. African Eggplant originated from West Africa, but is now widely distributed in Central and East Africa. Through an introduction from West Africa, the plant also grows in the Caribbean, South America, and some parts of Southeast Asia. It is widely cultivated for its use as a food, its medicinal purposes, and as an ornamental plant (12). The African Eggplant which is popularly called Efo gbagba or Efo igbo is one of the most glamorous vegetables in Lagos area markets, the vegetables does not come to the market in comparatively large quantities like the others; it is cherished amongst the Yoruba people.

The plant is usually cultivated for its leaves, which is a bit bitter, the fruits are eaten occasionally but are mainly preserve for the purpose of propagation. The roots, leaves, and fruit of African Eggplant contain medicinal qualities. In Nigeria, the fruit is used as a laxative, and as a means to treat cardiac diseases. The flowers are chewed on to clean teeth. In Sierra Leone, the leaves are heated and then are chewed to ease throat pain. In Kenya the roots are boiled and the juice is then consumed to kill any hookworms in the stomach. The root is also used for bronchitis, body aches, asthma, and speed up the process of healing wounds. The seeds of *S. macrocarpon* are crushed to treat toothaches (7). Promising molluscicidal and schistosomicidal activities were displayed for the S. macrocarpon extracts and fractions which are attributed to the glycol-alkaloid content (2).

Aside from the fruit, every other part of African Eggplant has been reported to cause heart failure, digestive problems, and lethargy in dogs (7). Because African Eggplant is part of the Solanaceae family, it contains alkaloids, giving the plant and fruit its bitter taste. Consuming the plant in large frequencies may potentially be poisonous. African Eggplant contains glyco-alkaloids and the levels found in the fruit were 5-10 times higher than what is considered safe, and may not be safe for humans to eat *(*8).

Disposal of wastewaters from different sources has always been a major issue of environmental concern (9). When untreated, wastewater can have serious impacts on the quality of an environment and on the health of the people. Pathogens can cause a variety of illness. Some chemicals pose risks even at very low concentrations and can remain a threat for long period of time because of bioaccumulation in animal and human tissues. Rather than allowing domestic wastewater to constitute nuisance to the receiving environment, they may be applied into a more beneficial use through irrigation.

At a global level, around 80% of wastewater produced is discharged into the environment untreated, causing widespread water pollution *(*13).

Sewage may drain directly into major watersheds with minimal or no treatment but this usually has serious impacts on the quality of an environment and on the health of people. Pathogens can cause a variety of illnesses. Some chemicals pose risks even at very low concentrations and can remain a threat for long periods of time because of bioaccumulation in animal or human tissue. Some water demanding activities do not require high grade water. In this case, wastewater can be reused with little or no treatment. Irrigation with recycled wastewater can also serve to fertilize plants if it contains nutrients, such as nitrogen, phosphorus and potassium. In developing countries, agriculture is using untreated wastewater for irrigation - often in an unsafe manner. There can be significant health hazards related to using untreated wastewater in agriculture (11).

Magnetized water is obtained by passing of water through the permanent or through electromagnet installed in/on a feed pipeline. This technology was used mainly in countries which have very little chemical industry like Russia, China, Poland, Bulgaria, Australia, Turkey, Portugal, England, united State, and Japan (3), decree of soil alkalinity, increase in mobile forms of fertilizers, increase in crop growth and yields and earlier vegetation periods can achieved by magnetized water treatment.

It was reported that there are some changes occurred in the physical and chemical properties of water according to magnetic treatment, mainly hydrogen bonding polarity, surface tension, conductivity, pH and solubility of salts, and these changes in water properties may be capable of affecting the growth plants (6). They deduced that the reduction in water pH and increase in EC in magnetic treated water may be due to changes in hydrogen bonding and increased mobility of ions. Magnetic treated water undergoes several changes in its physical properties. It also exerts several effects on the soil-water-plant system. Leaching the soil with MW significantly increases available soil phosphorous content compared with the leaching with normal water at all soil depths. Behaviour of nutrients under MF is a function of their magnetic susceptibility (10). (4) also revealed that the MW increases the contents of various minerals compounds of soil as nitrogen, phosphorous and improved the fertilizer dissolve in the soil irrigated with MW.

Several studies have shown that MW treatments enhance the flowers and total fruit yield of strawberry and tomatoes. (5) observed that magnetic treatment increases the nutrients absorption in tomato. Some of the main effects of magnetic treatment of seed or irrigation with MW in plant include plant growth rate, transplant dry weight, transplant leaf area, and seed germination. (1) also showed that irrigation with MW enhances the leaf area in the grown seedlings of tomato. Similarly, several other studies have reported improvements of the leaf size of different seedling grown by magnetically seed. In this regard, it was found that magnetically water irrigation is an ecological and harmless technology.

This study determined the variations in the growth parameters of the African eggplant under different treatments of irrigation with magnetized and non-magnetized domestic wastewater.

Materials and Methods

Study site description

The study is carried out in the screen house situated along Agricultural and Bio-Environmental Engineering Department of The Oke-Ogun polytechnic, Saki, Oyo State in South Western Nigeria. The soil samples were taken from the Teaching and Research Farm of the department in Saki, Oyo State. The vegetation is a derived savanna with a mean annual rainfall of about 1289.2mm. Surface soil samples from 0-15cm depth were randomly collected for analysis and planting.

Planting Operations and Experimental Procedures

The study was conducted and carried out using experimental pots. Loamy sand soil randomly collected from the study site was used for the experimentation. Soil samples randomly taken were bulked together and taken to the laboratory at Institute of Agricultural Research and Training, Ibadan, Nigeria (I.A.R.&T.) for analysis to ascertain its fertility status before planting. There were three treatments of irrigation with magnetized wastewater, non-magnetized wastewater and freshwater (serving as control experiment). Each treatment was replicated thrice thus giving a total of nine experimental pots. The irrigation schedule was at 2 days interval for the three treatments.

Broadcast method of planting was used for the propagation of the vegetable seeds which was later pruned to enhance ventilation and better growth rate two weeks after planting. Magnetization of the wastewater was done by the passage of wastewater from a plastic gallon (serving as a reservoir) through a metallic pipe which was already laced with magnets thrice along its length to enable full magnetization of the wastewater. The metallic pipe was attached to a tap at the bottom of the gallon to enable a controlled flow of the wastewater through the pipe.

Indicators for Assessment

Plant Heights:- Three plants randomly selected from each experimental pots were always used to represent the population Plant height was measured from ground level to the tip of the terminal bud using measuring tape and the average value was determined.

Number of Leaves:- Three plants randomly selected from each experimental pots were used to represent the population as with the plant heights and number of leaves were counted for each experimental pots. The average value was also determined for each treatment. This was also done at two weeks interval after planting.

Stem Girth/Width:- The selection criteria for this measurement for each experimental pot follow suit that of plant heights and number of leaves. The stem girth was measured using digital vernier caliper and the average value for was calculated.

Analysis of Results

The deviations between the average values of the growth parameters for the three treatments were considered. Least Square Difference (LSD) was also used to test for significant differences in the mean values of the parameters using IBM SPSS Statistics, version 23.

Results and Discussions

Effects of Magnetized wastewater on growth parameters

The results of the effects of the three treatments (magnetized wastewater, non magnetized wastewater and freshwater) on the plant heights, stem girths and number of leaves at two weeks after planting (2 WAP), four weeks after planting (4 WAP), six weeks after planting (6 WAP) and eight weeks after planting (8 WAP) are as presented in Figures 1, 2, 3 and 4 respectively. At 2 WAP, the plant heights had a peak value of 6.00 cm for magnetized wastewater and least value of 2.00 cm for freshwater (control), stem girths had a peak value of 0.135cm for control and a least value of 0.007cm for non-magnetized wastewater while the number of leaves are the same for all the treatments. The mean differences were not significant for the growth parameters at the 0.05 significance level for this growth stage.

The trend for 4WAP follows the same pattern with 2 WAP. The plant heights had a peak value of 10.40 cm for magnetized wastewater and least value of 8.03cm for freshwater (control), stem girths had a peak value of 0.143cm for control and a least value of 0.106cm for non-magnetized wastewater while the number of leaves are also the same for the three treatments. The mean differences were significant for the plant heights between the magnetized wastewater treatment and the control experiment at the 0.05 significance level for the growth stage. At 6 WAP, the trend remains the same for plant heights but there were slight variations for both the stem girths and number of leaves. The trend for 8 WAP followed suit that of 6 WAP. The mean differences were significant for both the plant heights and stem girths between the magnetized wastewater treatment and the control experiment at the 0.05 significance level for 6WAP while the mean differences were significant for both the plant heights and stem girths between the magnetized wastewater treatment and the control experiment and also between the non magnetized wastewater treatment and control at the 0.05 significance level for 8WAP.

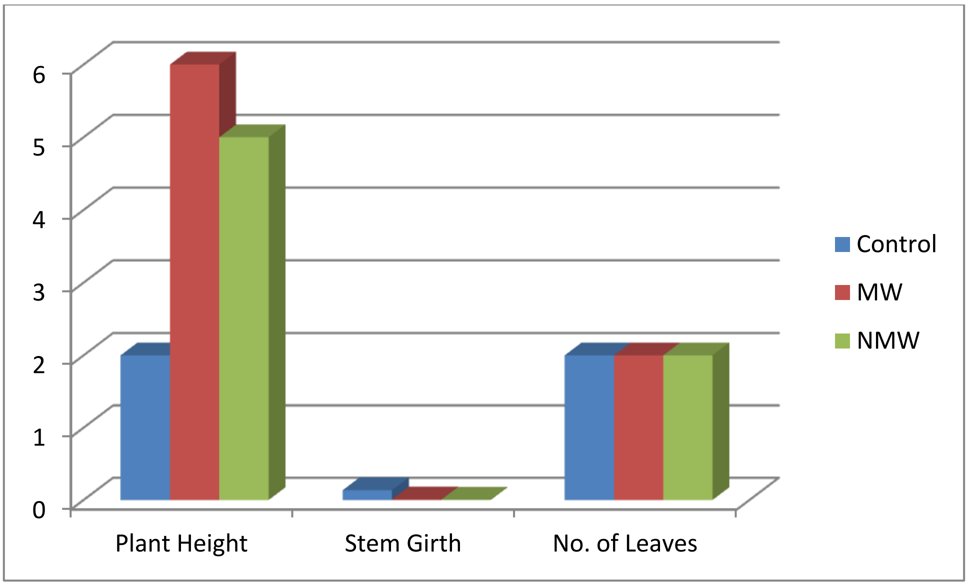

Figure 1. Effects of magnetization of wastewater on Plant growth at 2 WAP

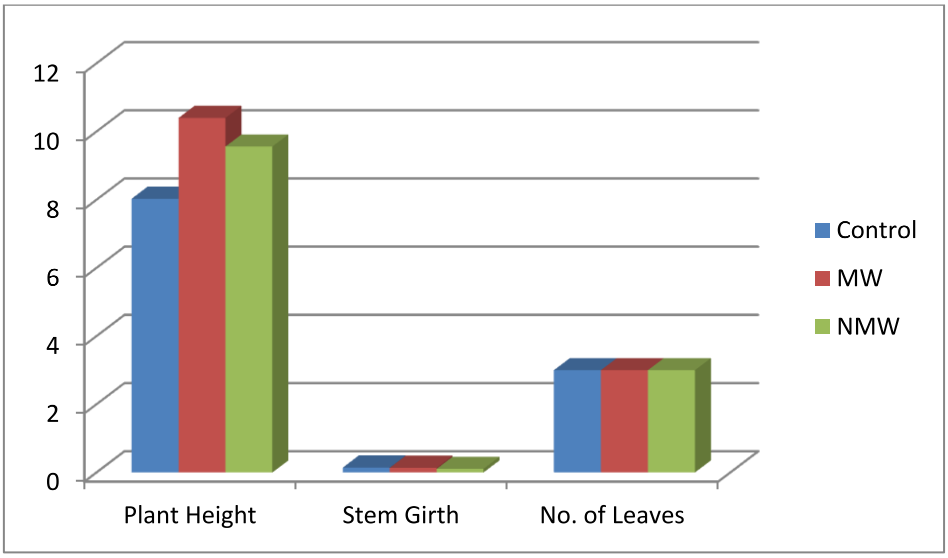

Figure 2. Effects of magnetization of wastewater on Plant growth at 4 WAP

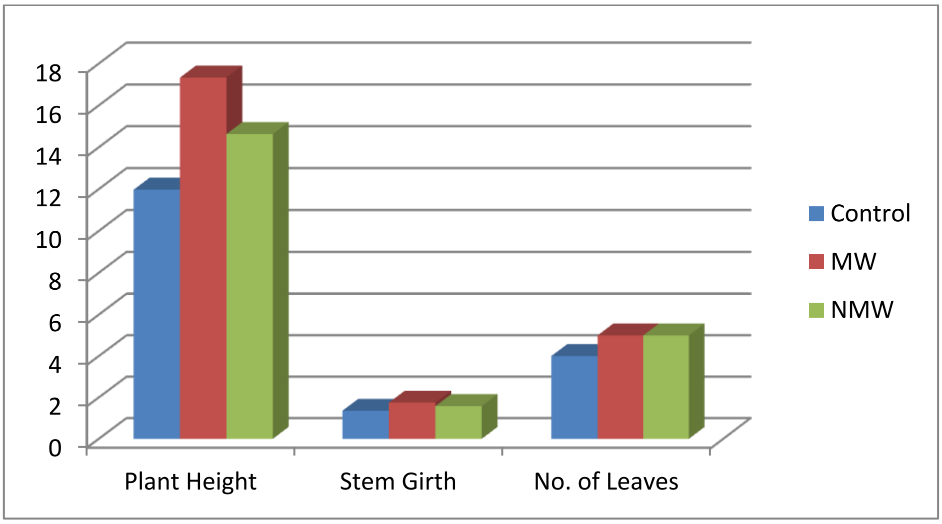

Figure 3. Effects of magnetization of wastewater on Plant growth at 6 WAP

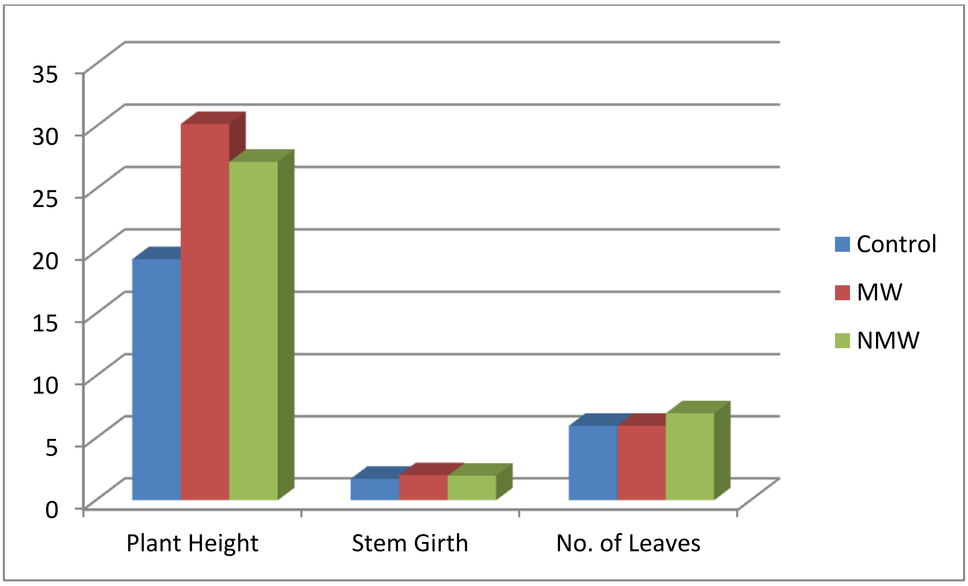

Figure 4. Effects of magnetization of wastewater on Plant growth at 8 WAP

Conclusions

This study assesses the effects of magnetization of domestic wastewater on the growth of African eggplant (*Solanum macrocapon*), a leafy vegetable. Magnetization of the domestic wastewater before application as irrigation water was found to improve the growths of the vegetable in terms of the plant heights, stem girths and number of leaves. The statistical analysis of the results also revealed significant differences between the mean values of the magnetized wastewater treatment and control experiment at various growth stages. From the revelation of this work on the effects of magnetization of wastewater on the growth of African eggplant, it is then suggested that further studies be carried out on other leafy vegetables and even beyond.

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