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STUDY ON GROWTH PARAMETERS OF *BRACHIARIADEFLEXIA* (SCHUMMACH.) C.E. HUBB. EX ROBYNS AND *PASPALUM SCROBICULATUM* (L.) GROWN ON WASTE ENGINE OIL CONTAMINATED SOIL

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ABSTRACT: *In this study, the growth response of the two indigenous Nigerian plants; B. deflexa and P. scrobiculatum grown on waste engine oil contaminated soil were investigated. The experiment was laid out as a completely randomized design (CRD). 4 kg of air-dried soil was measured into 4 kg perforated plastic buckets. Waste engine oil was added to obtain different concentrations on weight basis: 0 % (control), 2 %, 4 %, 7 % and 10 % v/w oil- in-soil. The mixing was gradually done to ensure thorough and even mixing. After the mixing, the soil was left for a period of seven days without planting. At the end of the seventh day, the plant materials collected from the wild were transplanted into the buckets. The growth parameters measured at 2, 4, 6, 8 weeks after planting were plant height, leaf number, leaf area and shoot girth. It was observed that as the concentration of waste engine oil in the soil increased there was reduced growth of the two-grass species studied as was evident in the growth parameters studied. In conclusion, the two-grass species studied showed evidence of sensitivity to waste engine oil contaminated soil and their sensitivity were determined by the five different concentrations of waste engine oil used.*

KEYWORDS: Contaminated, Growth, Grown, Parameters, Soil, Waste Engine Oil.

INTRODUCTION

Environmental pollution has become a serious concern and various contaminants have accumulated in water, air and soil. A major concern for soils is their acute and diffuse contamination by potentially toxic heavy metals. Metals cannot be degraded and remain in the soil for decades or centuries, since they partly strongly adhered to the soil particles. Certain metal fraction in the solution of the soil does constitute pathway to plant roots, microorganisms and soil animals (Renberg *et al*., 2010). Phytoremediation plants remove harmful chemicals from the ground when their rootstake in water and nutrients from the polluted soil, stream and ground water and how deep that their roots can grow can only determine the extent of the clean-up of chemicals. Trees are used to reach pollution deeper in the ground because their roots grow deeper than those of smaller plants (USEPA, 2001). According to USEPA (2001), phytoremediation occurs even if the pollutants are not taken into the roots of the plant. Like, contaminants can stick to the roots of the plants or microorganisms living plant roots zone can change them into less toxic pollutants. The plants are allowed to grow and take in pollutants afterwards they are either harvested and destroyed or recycled if pollutants stored in the plants can be reused. Usually, trees are left to grow and are not harvested (USEPA, 2001). Utilizing plants to detoxify, accumulate and absorb substrates for growth pollutants by chemical, biological and physical processes is a widespread practice (Jilani and Khan, 2006; White *et al*., 2006).

Currently, most of research in this field is concentrated on determining the best candidate plant species to deploy for phytoremediation trials, and also, quantifying the mechanisms by which the plants interact with the pollutants to bring about degradation or remediation. Therefore, as more plants species are subjected to site studies, phytoremediation is being established as a promising technology for a variety of contaminants (Oyibo, 2013). The potential for the technology is high in the tropics due to the prevailing climatic conditions which favour growth of plants and stimulate microbial activities. Low cost component of the technology is advantageous to tropical environments where requisite funds for alternative clean-up measures may be lacking. Investigations of the tropical plants' potential for phytoremediation however, are scarce (Oyibo, 2013). Although, in many studies, in areas polluted with petroleum hydrocarbons, grasses have been choosing for their potentials to facilitate the phytoremediation (Reilly *et al*., 1996; Qui *et al*., 1997), there is however, paucity of information on the restoration of oil-impacted soils using tropical plants species solely (not in synergy with other microorganisms/chemicals-. bacteria/fungi) (Oyibo, 2013). The objective of the study was to determine the response of *B. deflexa and P. scrobiculatum* grown on waste engine oil contaminated soil.

MATERIAL AND METHODS

The experiment was conducted within the experimental farm of Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture, Umudike, Abia State in 2015. Umudike is located within Longitude $07^{0}34''$ E, Latitude $05^{0}29''$ N and at an elevation of 122 m above sea level. The experiment was laid out as a Completely Randomized Design (CRD).

Experimental soil sampling and preparation: Soil samples were taken from within the experimental farm of the Department of Plant Science and Biotechnology, Michael Okpara University, of Agriculture, Umudike, Abia State. The collected soil samples were air dried, sieved using 2 mm mesh gauze to remove debris and homogenized. Soil samples from uncontaminated soil were obtained and analyzed for physiochemical properties. Thereafter, 4 kg of soil was introduced into the 4 litres perforated plastic buckets. The different percentages of the waste engine oil were calculated. The 2 % gave 80 ml, 4 % gave 160 ml, 7% gave 280 ml while 10 % gave 400 ml of waste engine oil. The different ml of waste engine oil was added to different 4 litres perforated plastic buckets containing 4 kg of soil to obtain different concentrations on weight basis: 2 %, 4 %, 7 % and 10% v/w oil- in-soil and were denoted as T_1, T_2, T_3, and T_4. The mixing was gradually done to ensure thorough and even mixing. The untreated soil that is 0% oil served as the control (T_c) (Adenipekun *et al.*, 2009). Treatments were replicated 3 times. After the mixing, the soil was left under shade for a period of seven days without planting. This was done for uniformity of oil, moisture content, air content, temperature, and effective activities of soil micro-organisms (Oyibo, 2013). Soil samples were also obtained seven days after waste engine oil simulation, air dried and stored for laboratory analysis for initial heavy metal contents of the soil. The soil was taken to the experimental farm, artificially irrigated with water before the transplanting of the grass species being studied and then were left for natural irrigation. The experiment spanned for a period of 8 Weeks. The heavy metal content of the contaminated soil in the various plant buckets at the end of 8^{th} week were collected and was determined (mg/kg) so as to establish the true concentrations of the contaminants in the soil.

Sources of propagation materials: The plant materials *Brachiaria deflexa and Paspalum scrobiculatum* were collected from the wild (from road sides and bush fallows) within Umuahia Capital Territory, Abia State. The plants were identified by an experienced Plant Taxonomist (Prof. H. O. Edeoga) in the Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture, Umudike. The two-grass species were denoted as *B. deflexa* - plant 1(P_1) *and P. scrobiculatum* - plant 2(P_2).

Waste engine oil: The waste engine oil used were obtained as pooled waste engine oil from two different motor mechanic workshops, located in the mechanic village, Umuahia.

Propagation of plant species: The plant species being investigated were propagated by tillers. At first, the tillers of the grasses were separated differently. After selecting tillers that were of the same height (shoot: 15 cm), the tillers were stored in water for 2 days to improve their rooting ability (Brandt, 2003). Then each of the 2-grass species being investigated were transplanted in each perforated plastic buckets with soil contamination of different percentages of waste engine oil: 2%, 4%, and 7%, and 10% and 0% as the control were denoted as T_1, T_2, T_3, T_4 and T_c. The 0 % grasses used as control for the twospecies under investigation was transplanted into buckets without soil contamination and each had 3 tillers per perforated plastic bucket.

Assessment of experimental plants for growth performance: Records were taken every two weeks starting from 2 weeks after transplanting till the eighth week on the following growth parameters; pant height (cm), leaf area (cm), leaf number taken and shoot girth (cm). The plant heights were assessed for attained height using metric measurement (tape) for above ground portions (shoots). The plant height (cm) was measured with a measuring tape from the top soil level to the terminal bud. Leaf area was determined by measuring the length and width (at the widest point) of each leaf using a meter rule. The product was multiplied by a correction factor of 0.75 to take care of the leaf shape (Agbogidi and Eshegbeyi, 2006). The number of leaves were determined by visual counting of the number of leaves per grass stand per bucket per treatment. Shoot girth diameter at 3 cm from the soil level was measured using Vernier Caliper.

RESULTS

The results of the effect of various percentages of waste engine oil pollution on the plant height of *B. deflexia* showed that the increasing concentrations of waste engine oil had significant ($P<0.05$) adverse effect on the height of the grass. It was observed that at 10 % and 7 % waste engine oil concentrations there was increased reduction in the height when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 1). The results of the effect of various percentages of waste engine oil pollution on the plant height of *P. scrobiculatum* revealed that the increasing concentrations of waste engine oil had significant ($P<0.05$) adverse effect on the height of the grass. It was observed that at 10 % and 7 % waste engine oil concentrations there was increased reduction in the height when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 2).

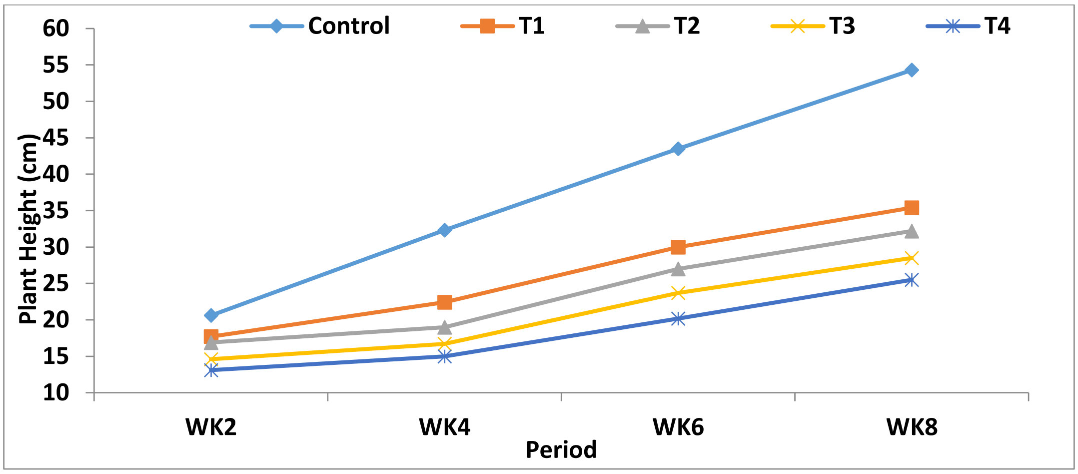

Fig. 1: Effects of various percentages of waste engine oil pollution on the plant height of *B. deflexia.*

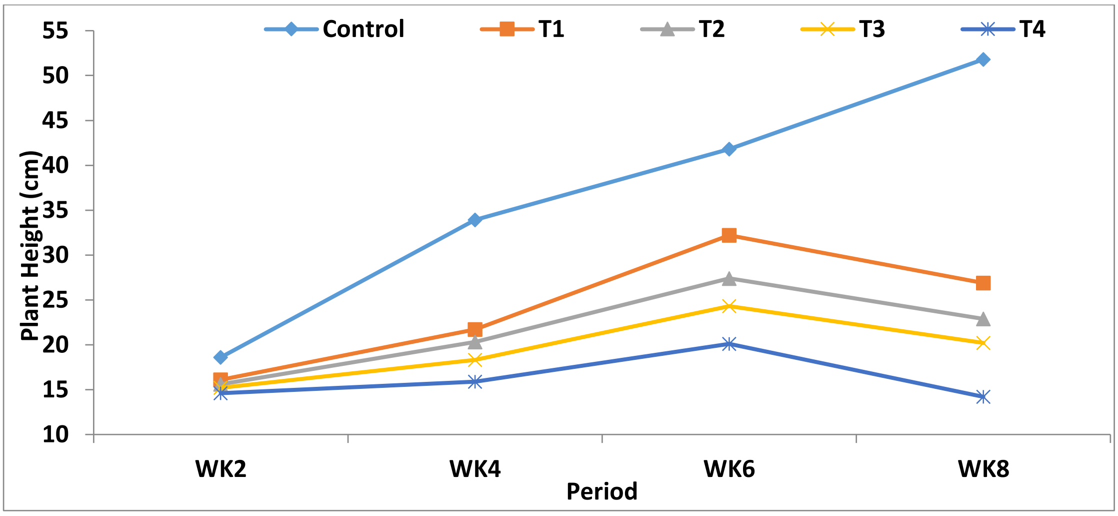

Fig. 2: Effects of various percentages of waste engine oil pollution on the plant height of *P. scrobiculatum.*

The results of the effect of various percentages of waste engine oil pollution on the leaf area of *B. deflexia* showed that the leaf area was highly significantly ($P<0.001$) affected by waste engine oil applications. It was observed that at 10 %, 7 % waste engine oil concentrations there was increased reduction in the leaf area when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 3). The results of the effect of various percentages of waste engine oil pollution on the leaf area of *P. scrobiculatum* revealed that the leaf area was highly significantly ($P<0.001$) affected by waste engine oil applications. It was observed that at 10 %, 7 % waste engine oil concentrations there was increased reduction in the leaf area when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 4).

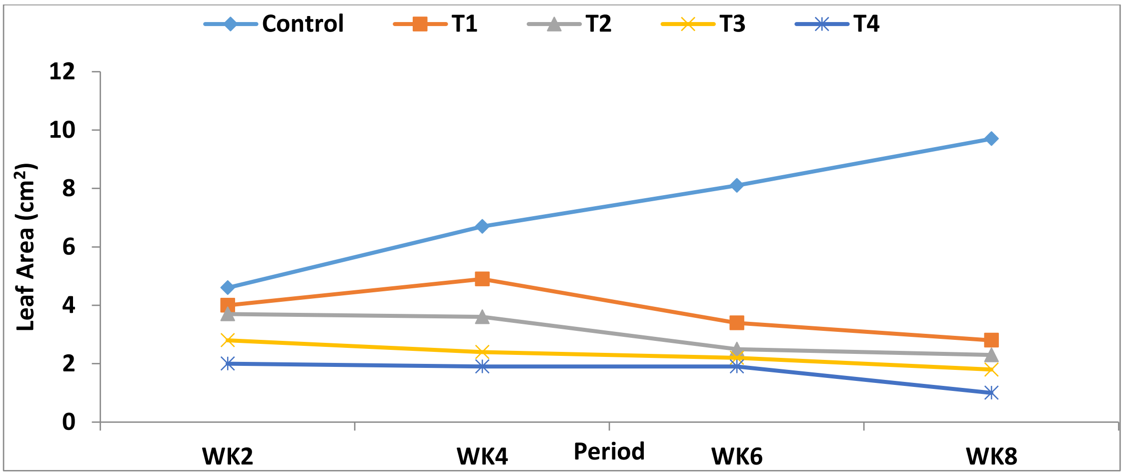

Fig. 3: Effects of various percentages of waste engine oil pollution on the leaf area of *B. deflexia.*

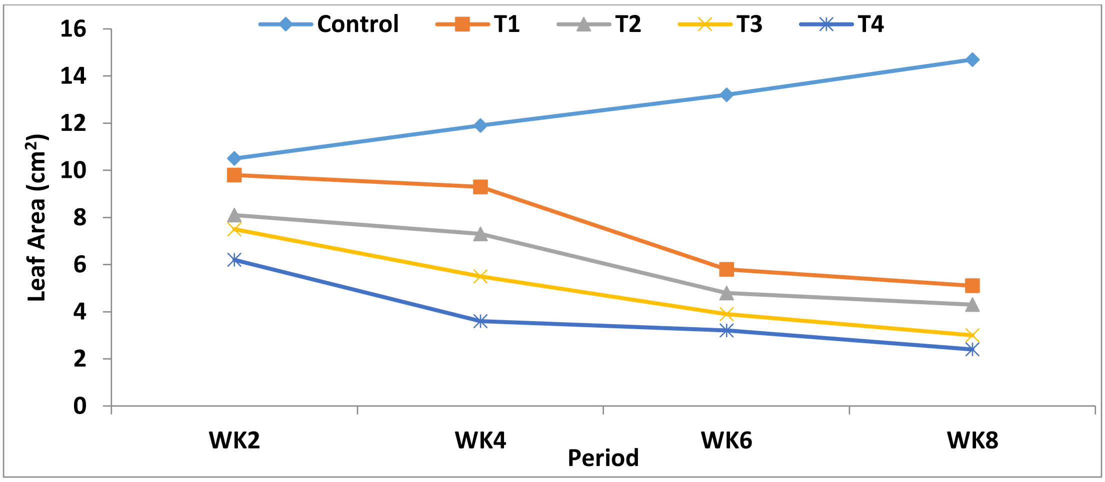

Fig. 4: Effects of various percentages of waste engine oil pollution on the leaf area of *P. scrobiculatum.*

The result of the effect of various percentages of waste engine oil pollution on the leaf number of *B. deflexia* showed that the waste engine oil pollution exerted significant (P<0.05) influence on the leaf number. It was observed that at 10 %, 7 % waste engine oil concentrations there was increased reduction in the leaf number when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 5).The results of the effect of various percentages of waste engine oil pollution on the leaf number of *P. scrobiculatum* showed that the waste engine oil pollution exerted significant (P<0.05) influence on the leaf number. It was observed that at 10 %, 7 % waste engine oil concentrations there was increased reduction in the leaf number when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 6).

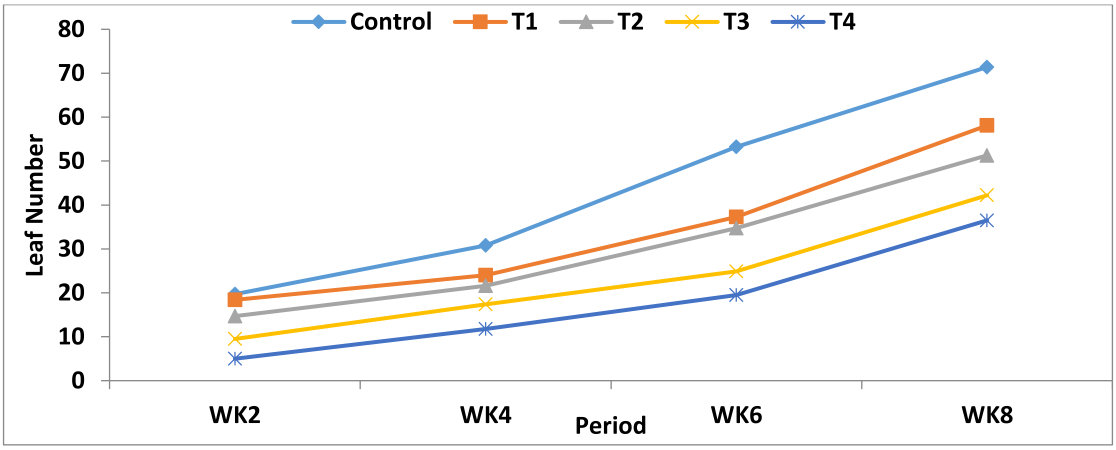

Fig. 5: Effects of various percentages of waste engine oil pollution on the leaf number of *B. deflexia.*

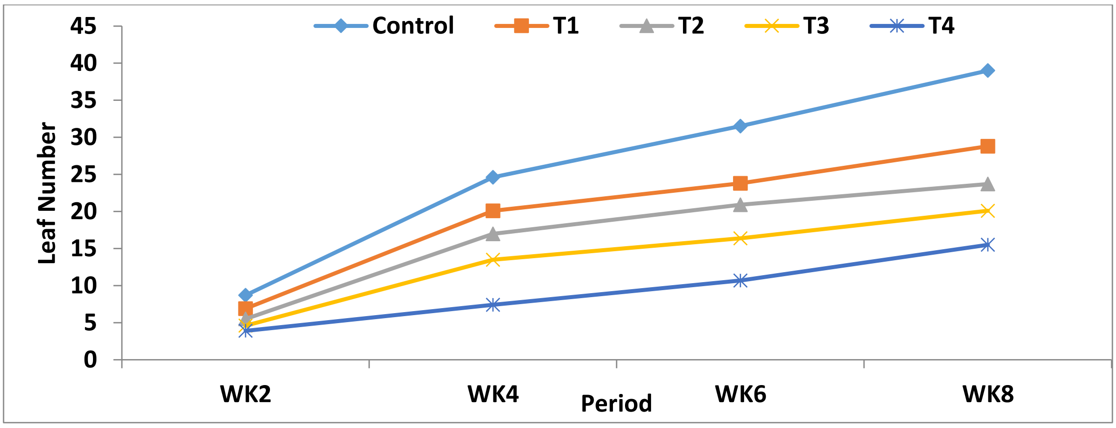

Fig. 6: Effects of various percentages of waste engine oil pollution on the leaf number of *P. scrobiculatum.*

The result of the effect of various percentages of waste engine oil pollution on the shoot girth of *B. deflexia* showed that the waste engine oil pollution exerted significant ($P<0.05$) effect on the shoot girth development by affecting its thickness. It was observed that at 10 %, 7 % waste engine oil concentrations there was increased reduction in the shoot girth when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 7).The results of the effect of various percentages of waste engine oil pollution on the shoot girth of *P. scrobiculatum* revealed that the waste engine oil pollution exerted significant ($P<0.05$) effect on the shoot girth development by affecting its thickness. It was observed that at 10 %, 7 % waste engine oil concentrations there was increased reduction in the shoot girth when compared to 4 %, 2 % waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 8).

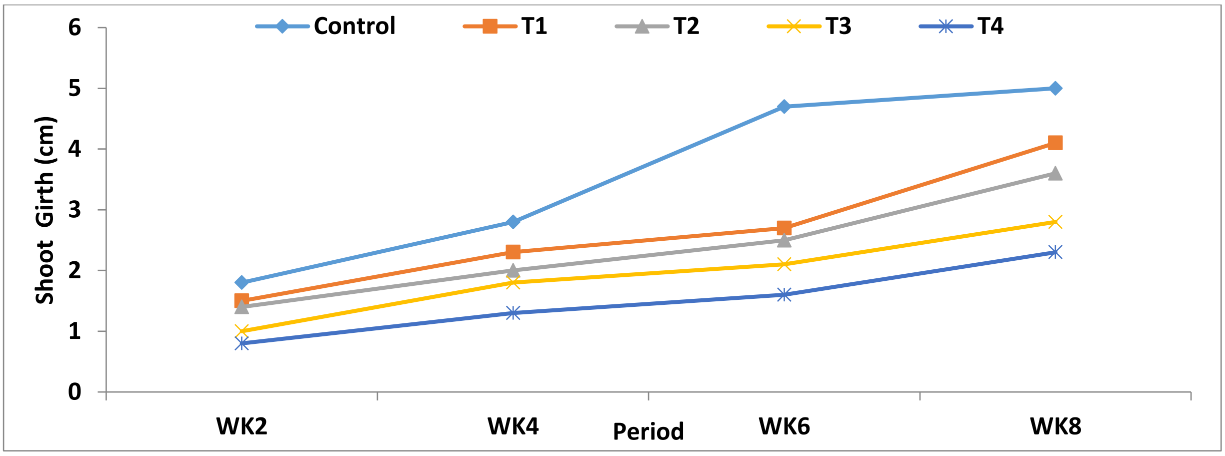

Fig. 7: Effects of various percentages of waste engine oil pollution on the shoot girth of *B. deflexia.*

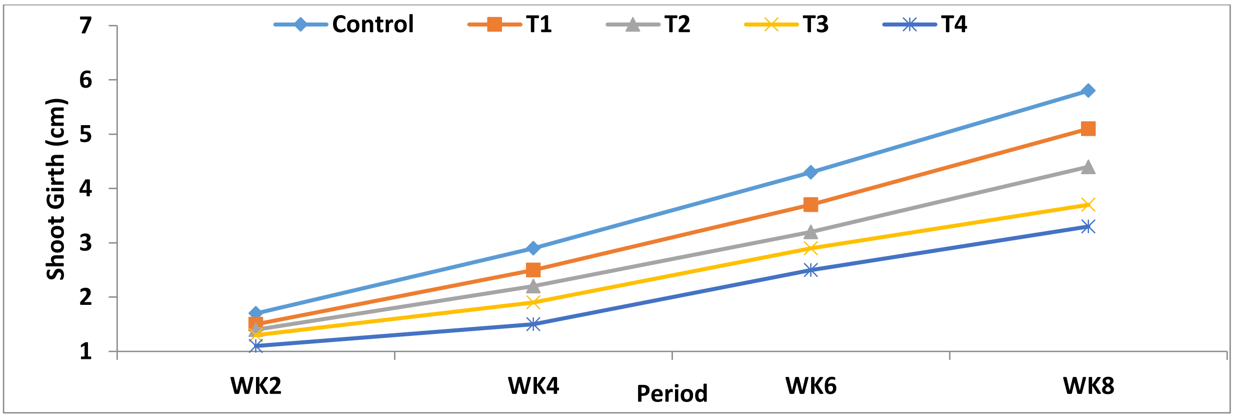

Fig 8: Effects of various percentages of waste engine oil pollution on the shoot girth of *P. scrobiculatum.*

DISCUSSION

Effects of waste engine oil on the growth of the two-grass species studied were found in line with other studies carried out on these growth parameters - plant height, leaf area, leaf number and shoot girth. Decrease in vegetative growth of plants grown in waste engine oil-polluted soil was observed by Anoliefo *et al* (2010) and Ikhajiagbe and Anoliefo (2012). Apart from hydrocrabon constituents which inhibit plant growth by a variety of ways, the viscose nature of waste engine oil limits the penetration of water, which ionizes nutrients, thus the plant is starved of nutrients; and oxygen, which is required for respiration (Atlas, 1977). As the concentrations of waste engine oil increased there was observed significant reduction in leaf area in the leaves of the grass species studied. Udo and Fayemi (1975) confirmed the work by stating that the leaves of plants affected by oil tended to dehydrate and show a general sign of chlorosis; indicating water deficiency which lead to reduction of leaf area. This study agreed with Boyd and Murray (1982) that observed that reduction in photosynthetic rate resulted in the decreased rate of growth and reduction of leaf sizes. The increased loss in leaf number observed in the leaves of the two grasses as the concentrations of waste engine oil increased was also observed by Osuagwu *et al* (2013). Leaf number was significantly reduced in the air potato plants grown in crude oil polluted soil when compared with the control treatment and the reduction followed increase in crude oil intensity. The reduction in leaf number reduces the rate of photosynthesis which results in the reduction of plant growth (Osuagwu *et al*., 2013). More so, as the concentrations of waste engine oil increased, there was an observed reduction in the diameter of the shoot girth of the two-grass species. Agbogidi and Ilondu (2013) reported that the plant height, number of leaves, leaf area, stem diameter and dry weight production of seedlings of *M. oleifera* in the control plots differed significantly ($P \leq 0.05$) from those planted in the spent oil contaminated soils respectively. The negative interaction observed in the growth parameters (plant height, number of leaves, leaf area, stem diameter and biomass production measured) could be attributed to the presence of the numerous hydrocarbons and related compounds which are harmful to biological organisms (Agbogidi and Ilondu, (2013). The phytotoxic and herbicidal properties of spent engine oil to organisms have been confirmed by Vwioko and Fashemi (2005), Agbogidi (2011) and Agbogidi and Edema (2011).

CONCLUSION

The growth parameters of *B. deflexia* and *P. Scrobiculatum* were affected as the waste engine oil concentrations in the soil increased when compared to control. This shows that the two-grass species studied were sensitive to waste engine oil pollution, despite the fact that the plants were also able to withstand the pollution to varying degrees. However, *B. deflexia* and *P. Scrobiculatum* could be potential candidates for phytoremediation of waste engine oil polluted sites. This study has improved the data on the phytoremediation of waste engine oil polluted sites using the two-grass species studied.

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