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PHYTOTOXIC INFLUENCE OF WASTE ENGINE OIL ON THE GROWTH OF *Chloris pilosa (*Schumach) and *Anthephora ampullacea* (Stapf and C.E. Hubb) GROWN IN EAST – SOUTHERN PART OF NIGERIA

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ABSTRACT

The present study explored the use of growth characters of Chloris pilosa and Anthephora ampullacea as phytoindicators of waste engine oil contamination. Four (4) kg of air-dried soil was measured in to perforated plastic buckets and treated with waste engine oil to obtain different concentrations [0% (control), 3%, 6%, and 9%] on a volume to weight basis. The experiment was set up in 3 replicates. The soil samples were allowed to stand for seven days in the experimental field before seedlings were planted. The plants were harvested 8 weeks after transplanting. The growth parameters investigations of the plant height, shoot girth, leaf area, and leaf number were carried out. The growth parameters reduction with increase in the levels of pollution was significant (P<0.05). The highest plant height values were 63.17cm (C. pilosa) and 40.47cm (A. ampullacea) in 6% and 3% contamination while lowest values of 44.73cm (C. pilosa) and 30.03cm (A. ampullacea) were both recorded in 9% contamination at week 8. The shoot girth, C. pilosa and A. ampullacea gave the highest values of 1.6cm and 2.23cm at 6% and control while C. pilosa and A. ampullacea gave the lowest values of 0.63cm and 1.13cm at control and 9% pollution at week 8. The highest leaf area values were 8.51cm (C. pilosa) and 25.94cm (A. ampullacea) in 6% contamination and control while the lowest values of 4.14 cm (C. pilosa) and 14.66 cm (A. ampullacea) were both recorded in 9% contamination at week 8. In the leaf number, C. pilosa and A. ampullacea gave the highest values of 4.33 and 18 at control and 9% pollution while C. pilosa and A. ampullacea gave the lowest values of 3 and 12 at control respectively at week 8. The result showed that the two grass species studied had different degrees of tolerance to varying -levels of waste engine oil toxicity, so they both possess the potentials as phytoindicators of toxic environment.

KEYWORDS: *Anthephora ampullacea, Chloris pilosa, Contamination, Indicators, Transplanting*

INTRODUCTION

Waste engine oil refers to oil that has been collected from oil changed from workshops, garages and industry sources as hydraulic and turbine oils (Olugboji and Ogunwole, 2008). Waste engine oil is a mixture of several different chemicals, heavy metal contaminants such as aluminium, chromium, tin, lead, manganese, nickel, and silicon that come from engine parts as they wear down (Wang *et al*., 2000). The use of automobiles, generators and industrial activities has made the risk of oil spill in the environment very high and these comes with negative effects on the ecosystems, devastating biodiversity and stripping soils of nutrients (Onuoha *et al*., 2003). Heavy metals such as Cu and Zn are essential for normal plant growth, although elevated concentration of both essential and non-essential metals can result in growth inhibition and toxicity symptoms (Hall *et al*., 2002). Unlike organic wastes, heavy metals present in waste engine oil are non-biodegradable and needed to be removed from the environment (Alluri *et al*., 2007). Heavy metals may be retained in the polluted soil from season to season but at higher concentrations in the dry seasons than in the wet seasons (Nwadinigwe *et al*., 2014). Plants and the associated microbes have been found to be effective in remediation of heavy metal polluted site (Ghose and Singh, 2005). However, the ability to accumulate heavy metals varies significantly between species and among cultivars within species, as different mechanisms of ion uptake are operative in each species, based on their genetic, morphological, physiological and anatomical characteristics (Mohammad *et al*., 2008). A major disadvantage of phytoremediation is its relatively slow pace, because it requires several years or even decades to halve metal contamination in soil (McGrath and Zhao, 2003). The challenge for plant scientists is therefore to improve the plants' performance in removing toxicants from the soil, which will require more basic research and knowledge on the natural detoxification mechanisms of plants (Clemens *et al*., 2002; Hall *et al*., 2002; Rea and Odusola, 2004). The aim of this study is to determine the phytotoxic influence of waste engine oil on the growth parameters of *C. pilosa* and *A. ampullacea.*

MATERIALS AND METHODS

Soil Samples

Soil samples used for this study were collected from the experimental farm of the Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture, Umudike, Nigeria. The waste engine oil used was obtained as pooled engine oil from two different major Mechanic Workshops located in the Mechanic Village, Umuahia, Abia State. The plant materials *C. pilosa* and *A. ampullaceal* used were collected from bush fallow located at Umuahia metropolis. Top soil (0-10cm depth) was collected from a marked area, air dried and sieved through a 2mm mesh gauge (Ogedegbe *et al*., 2013). Four (4) kg each of the soil sample was introduced into 4 L perforated plastic buckets after which different concentrations (3%, 6% and 9%) of waste engine oil were added to each of the 4kg soil samples. The mixing was done gradually to ensure thorough and even mixing and the treatments were replicated three times. The untreated soil with 0% waste engine oil served as the control (Adenikpekun *et al.,* 2009). After thorough mixing, the soil samples were left under the shade for a period of seven days without planting to ensure uniformity of oil, moisture content, air content, constant temperature and effective activities of soil micro-organisms (Oyibo, 2013), after which they were irrigated with water in the experimental field before transplanting the plant species and left for natural irrigation.

Plant Materials

The plant species *C. pilosa* and *A. ampullacea* belong to the family Poaceae (grass). Grass families because of their multiple ramified root systems, were considered for phytoremediation because they allow increased rhizospheral zone. The plant species were propagated by tiller. At first, tillers of the same height (shoots of about 15cm) of the plants were selected and separated. The tillers were soaked in water for 2 days to improve their rooting ability (Brandt, 2003) before transplanting three tillers in each treated soil samples. After eight weeks, the plant samples were harvested and soil was washed off with water after which they were separated from the shoot and placed in well labeled envelopes for heavy metals analysis. Post-harvest soil samples were also collected for analysis. Records were taken every two weeks starting from 2 weeks after transplanting till the eighth week on the following growth parameters; plant height (cm), shoot girth (cm), leaf area (cm) and leaf number taken. 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. Shoot girth diameter at 3 cm from the soil level was measured using Vernier Caliper. 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.

Data Analysis

The results were summarized using Descriptive Statistic Package of Microsoft Excel while one-way ANOVA was used to test for statistical differences among the treatments. Tukey's pairwise comparisons test was performed to determine the location of significant difference ($P<0.05$).

RESULTS

The plant height of *C. pilosa* reduced significantly ($P<0.05$) with waste engine oil contamination increase in levels. It was observed that at 9% waste engine oil concentrations there were increased reduction in the height when compared to 6% and 3% waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 1). The plant height of *A. ampullacea* reduced significantly ($P<0.05$) with waste engine oil contamination increase in levels. It was observed that at 6% and 9% waste engine oil concentrations there were increased reduction in the height when compared to 3% waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 2).

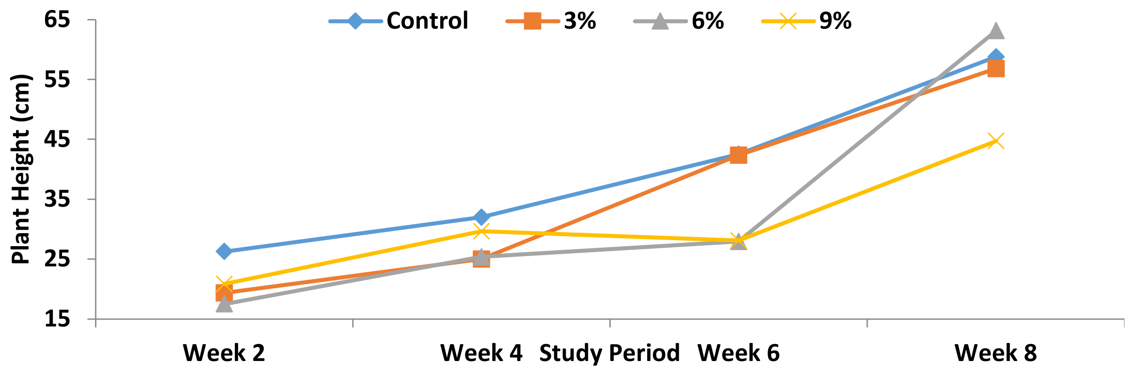

Fig. 1: Effects of various percentages of waste engine oil pollution on the plant height of *C. pilosa* 8 weeks after planting

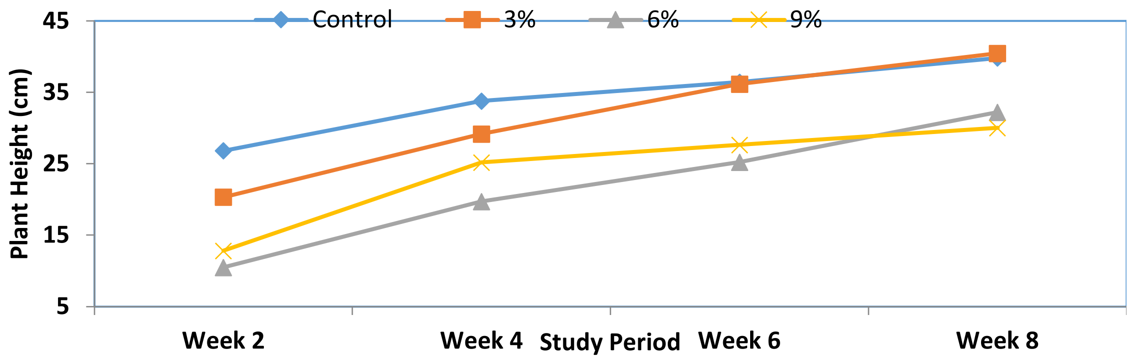

Fig. 2: Effects of various percentages of waste engine oil pollution on the plant height of *A. ampullacea* 8 weeks after planting

The different levels of waste engine oil pollution result effect on the shoot girth of *C. pilosa* showed that the waste engine oil pollution exerted significant ($P<0.05$) effect on the thickness of the shoot girth development. It was observed that at 3%, 6% and 9% waste engine oil concentrations, there were increase in the shoot girth when compared to control at WK2, WK4, WK6 and WK8 (Fig 3). The different levels of waste engine oil pollution result effect on the shoot girth of *A. ampullacea* showed that the waste engine oil pollution exerted significant ($P<0.05$) effect on the thickness of the shoot girth development. It was observed that at 3%, 6% and 9% waste engine oil concentrations, there were increased reduction in the shoot girth when compared to control at WK2, WK4, WK6 and WK8 (Fig 4).

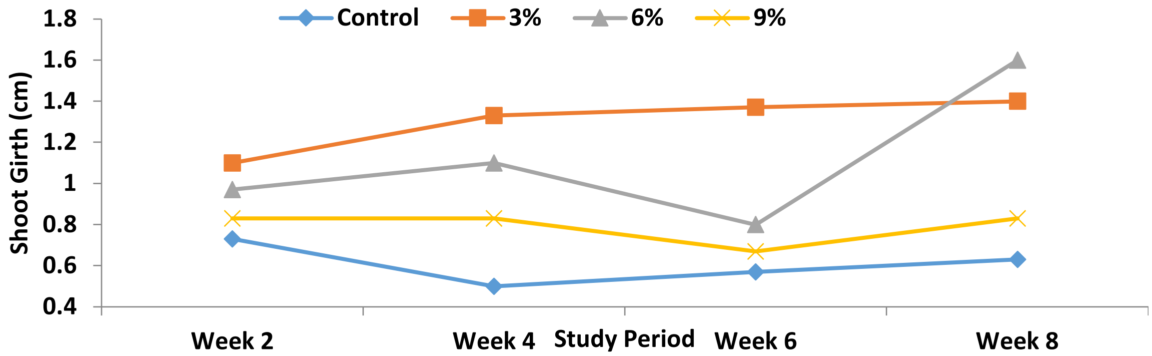

Fig. 3: Effects of various percentages of waste engine oil pollution on the shoot girth of *C. pilosa* 8 weeks after planting

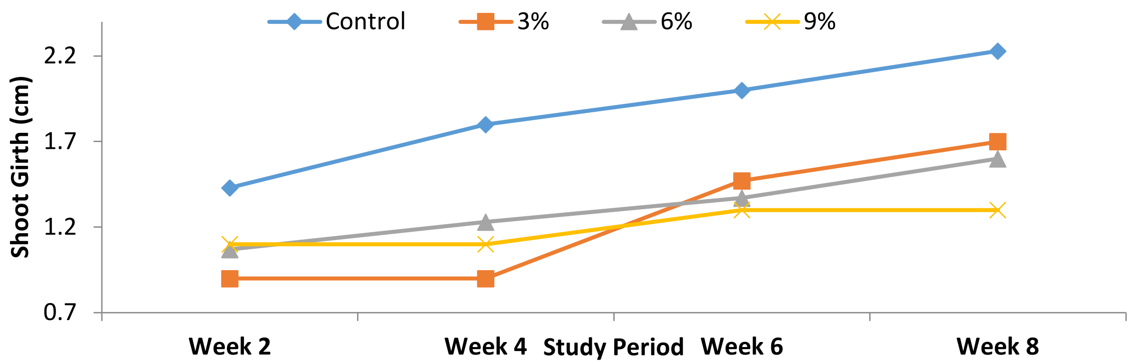

Fig. 4: Effects of various percentages of waste engine oil pollution on the shoot girth of *A. ampullacea* 8 weeks after planting

The leaf area of *C. pilosa* reduced with waste engine oil contamination increase in levels. It was observed that at 9% waste engine oil concentrations there were increased reduction in the leaf area when compared to control, 3% and 6% waste engine oil concentrations at WK2, WK4, WK6 and WK8 (Fig 5). The leaf area of *A. ampullacea* significantly (P<0.05) increased with waste engine oil contamination levels. It was observed that at 9% and 3% waste engine oil concentrations there were increased reduction in the leaf area when compared to 6% waste engine oil concentrations and control at WK2, WK4, WK6 and WK8 (Fig 6).

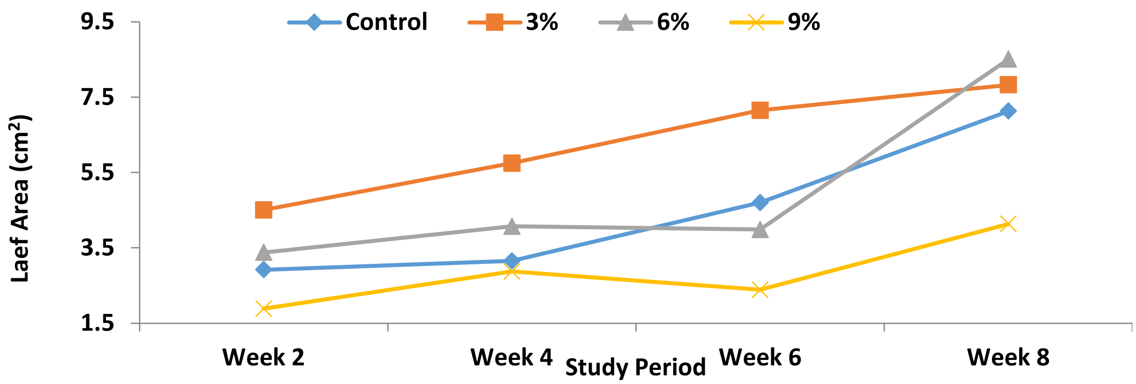

Fig. 5: Effects of various percentages of waste engine oil pollution on the leaf area of *C. pilosa* 8 weeks after planting

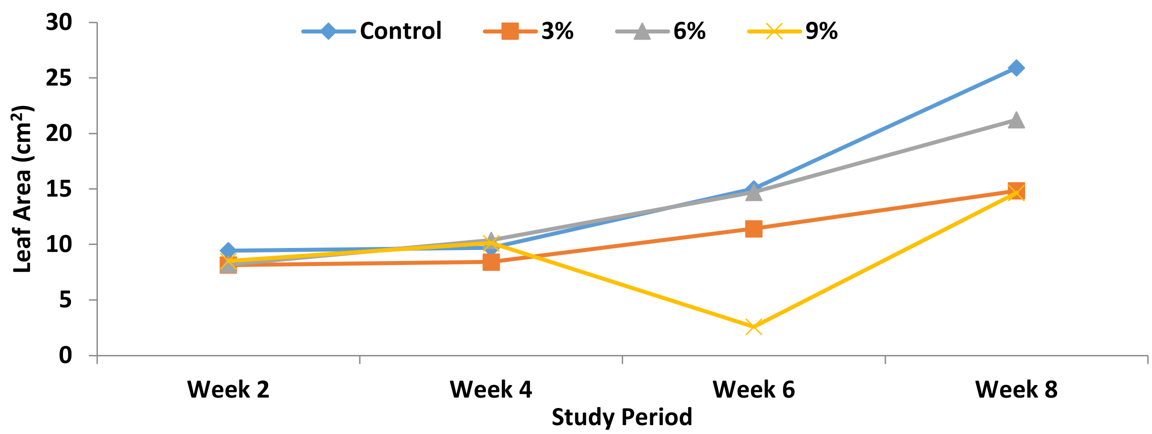

Fig. 6: Effects of various percentages of waste engine oil pollution on the leaf area of *A. ampullacea* 8 weeks after planting

The number of leaves of *C. pilosa* reduced significantly ($P<0.05$) with waste engine oil contamination increase in levels. It was observed that at 9%, 6% and 3% waste engine oil concentrations there were increased reduction in the leaf number when compared to control at WK2, WK4, WK6 and WK8 (Fig 7).

The leaf number of *A. ampullacea* increased significantly ($P<0.05$) with waste engine oil contamination increase in levels. It was observed that at 9%, 6% and 3% waste engine oil concentrations there were increment in the leaf number when compared to control at WK2, WK4, WK6 and WK8 (Fig 8).

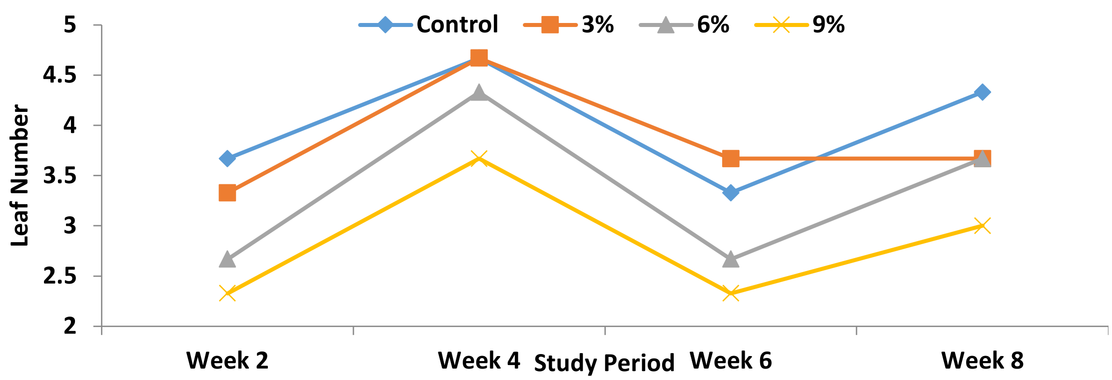

Fig. 7: Effects of various percentages of waste engine oil pollution on the leaf number of *C. pilosa* 8 weeks after planting

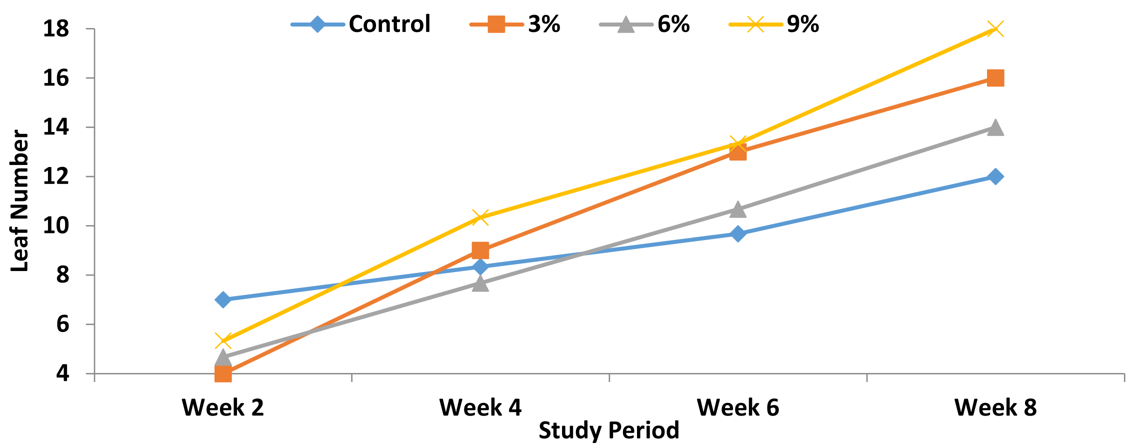

Fig. 8: Effects of various percentages of waste engine oil pollution on the leaf number of *A. ampullacea* 8 weeks after planting

DISCUSSION

In this research work, it was revealed that the waste engine oil had a significant (0.05%) effect on the growth of the two grass species studied by assessing these growth characters' plant height, shoot girth, leaf area and leaf number. Reduction in plant heights were observed among the two grass species studied as the concentrations of waste engine oil increased. This could be as a result of physiological adaptations to the phytotoxic soil in which they were grown. Olayinka and Arinde (2012), opined that the mean plant height used for the study decreased significantly with an increase in the concentrations of waste engine oil. Al-Qahtani (2011) agreed by stating that significant reduction in plant height and dry matter contents of *Vinca rosea* in soil contaminated with oil refinery sludge were observed compared with control treatment. The physiological adaptations inhibited seed germination, decreased plant biomass production and increased plant mortality have been observed after oil contamination (Merkl *et al*., 2005; Yang *et al*., 2009). More so, as the concentrations of waste engine oil increased, there were observed changes in the diameter of the shoot girths of the two-grass species which could be as a result of morphology adaptations to the pollution indicators. Bona *et al.* (2011) indicated that waste engine oil negatively affected stem girth of *Schinus terebinthifolius* Raddi which decreased over time. The control had greater stem girth length when compared to the plants grown in waste engine oil treated soil. In terrestrial areas, the physical, chemical and biological characteristics of soils are affected by waste engine oil pollution and these compounds penetrate macro- and micro pores in soil and, thus, limit water and air transport that are necessary for organic matter conversion in plants (Erdogan and Karaca, 2011). Moreover, as the concentrations of waste engine oil increased, there were also observed significant reduction in leaf area in the leaves of the two grass species studied which could be as a result of adaptation changes in mechanism of water conservation which led to negative effects on photosynthesis. Morphological changes in plant leaves can reduce photosynthesis and temperature regulation, while coating of roots can disrupt root architecture and water and nutrient uptake (Khan *et al*., 2013; Pezeshki *et al*., 2000). Also, the phytotoxicity of heavy metals is commonly revealed in significant growth reductions and foliar anomalies. In addition, the reduction in leaf number reduced the rate of photosynthesis also, these effects together resulted in the reduction of plant growth. This was also in agreement with reports of Olayinka and Arinde (2012), which showed that the highest mean number of leaves of *A. hypogaea* obtained from the control treatment was significantly different from that obtained in soil, polluted with different concentrations of waste engine oil. The inhibitory effects of Cd on plant morphology, including fresh and dry mass accumulation, height, root parameters, leaf number and size have been reported (Moya *et al*., 1993; Vassilev and Yordanov, 1997; Foy *et al*., 2005).

CONCLUSION

From the result, it could be concluded that *C. pilosa* and *A. ampullacea* resisted the phytotoxic environmental stressful conditions in which they were grown but in different ways. They could withstand waste engine oil-polluted soil of 9% w/w oil-in-soil treatment for two months making them possible candidates for environmental phytoindicators. The mechanisms of tolerance of *C. pilosa* and *A. ampullacea* to waste engine oil-polluted soil are still to be ascertained as further studies would be required to determine these.

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