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IMPACTS OF DIFFERENT CONCENTRATIONS OF SPENT CARBIDE WASTE ON THE GROWTH AND YIELD OF MAIZE (*Zea mays* Linn.) AND GROUNDNUT (*Arachis hypogea* Linn).

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ABSTRACT

The impacts of different concentrations of spent carbide waste on the growth and yield of *Zea mays* Linn. (maize) and *Arachis hypogea* Linn. (groundnut) were studied at the screen house, Botanic garden, University of Port Harcourt, Nigeria. The crops were planted in carbide waste concentrations of 40g, 80g, 120g, and 160g per 2,8 kg of soil alongside a control in bags of height 20.5cm. Results indicated that carbide waste had significant (p=0.05) adverse affects on plant height, fresh weight and dry weight yield of the two crops (maize and groundnut) especially at 120g and 160g carbide waste concentrations. Results also showed that *Zea mays* experienced highest yield in total fresh weight (3.59±0.11), shoot dry weight (0.99±0.02), and total dry weight (1.33±0.06) at 80g carbide waste; while *Arachis hypogea* showed highest yield in total fresh weight (4.53±1.2), shoot dry weight (1.32±0.1), root dry weight (0.32±0.02), and total dry weight (1.64±0.01) in 40g carbide waste. These values were significantly (p=0.05) higher than their respective controls. Shoot-root ratios of the two crops and the soil pH were found to increase with increasing carbide waste concentrations. It therefore, means that these two crops can tolerate carbide waste pollutant at low concentrations but the phytotoxicity of this waste was high at higher concentrations.

KEY WORDS: Spent Carbide Waste, Growth, Yield, Pollution, Concentration.

INTRODUCTION

Human activities have continued to reduce environmental quality in many parts of the world. Environmental pollution and habitat degradation have attracted considerable attention. An impressive volume of publications exist in the literature on large scale environmental pollution problems such as oil pollution and acid rain but unfortunately, relatively little has been done on the environmental pollution problems generated by small – scale industrial establishment like welding workshops. Welders and panel beaters use calcium carbide (CaC_2) to generate acetylene (C_2H_2), which is the gas used in combination with Oxygen as fuel to produce oxy – acetylene flame. After welding, the waste comes out as white or grayish lump. It is alkaline in nature. This waste generated from these welding activities is normally dumped indiscrimately on farmlands within the premises of the welding workshops and get incorporated into the soil sooner or later. These farmlands are mostly used as homestead gardens for the cultivation of crops.

Maize (*Zea mays* Linn.), a monocotyledon and groundnut (*Arachis hypogea* Linn.), a dicotyledon belong to the family *Poaceae* and *Fabaceae* respectively. They are mostly grown as homestead garden plants and also commercially on large scale. They are eaten by man and also use to feed livestock. Maize provides man with carbohydrate while groundnut provides proteins. The growth and yield of these crops have been mostly affected negatively by environmental pollution in some places.

Kinako and Amadi (1997) reported that carbide waste have significant adverse effects on water infiltration, vegetation regeneration and the accumulation of plant biomass. They went further to explain that the slowing down of water infiltration at a carbide waste polluted site is attributed to the inward movement of fine carbide waste particles into the soil's pore spaces which invariably retarded plant growth. Kathleen (1980) reported that *E. coli, S. cerevisiae* and *B. subtilis* were inhibited within 15 minutes by the addition of 1% solution of carbide waste, due to the increase in the pH of the medium.

This work was carried out to investigate the impacts of carbide waste on the growth and yield of maize and groundnut. It is expected that result obtained from this study will broaden our knowledge of environmental degradation caused by small – scale environmental pollutants. It will help to create the awareness that carbide waste is an environmental pollutant and also give a guide on how to manage and dispose this waste in the environment.

MATERIALS AND METHODS

This research work was carried out in the screen house at the University of Port Harcourt Botanic Garden, Choba-Port Harcourt, Rivers State, Nigeria. The study site is situated along the east-west road, 26 km North-West of the city of Port Harcourt, on latitude 4^o 43N and longitude 7^o 05E in the Niger-Delta part of Nigeria.

The seeds of maize and groundnuts; and the

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planting bags were bought from Agricultural Development Programme (ADP), Rumuodomaya, Port Harcourt, Rivers state, Nigeria. The spent carbide waste was collected from a mechanic workshop in Choba-Port Harcourt. This was grinded into powder form and allowed to dry under room temperature for five days to get rid of water so as to obtain the dry weight. The loamy soil for the planting was collected from the Botanic Garden of University of Port Harcourt.

Planting bags were filled with the collected top loamy soil to a height of 20.5cm leaving a space of 2cm from the top for the addition of treatments and water. Each bag and soil weighed 2.8kg. The bags were perforated at the sides and bases to increase aeration and prevent water-logging. The treatment (carbide waste) was thoroughly mixed with the soil in the bags. The quantity of carbide waste used were 40g, 80g, 120g and 160g, along side a control. Each treatment was replicated 10 times making a total of 50 observations. These were moistened with water and allowed for one week for the carbide waste to be fully incorporated into the soil before planting was done. Germination test was carried out on the seeds of the two crops in Petri – dishes and each showed above 80% germination. Each treatment was separated into two sets of 5 replicates each. Four (4) seeds each of maize and groundnut were planted in each bag per treatment of set one and set two respectively. After one week of germination, the seedlings in each bag were thinned to two seedlings, to avoid overcrowding and interspecies competition. Seventy (70) millitres of water was used to water the plant in each bag. Plants were watered every morning for dry days and once in two days on very wet days.

The following parameters were measured: plant height, fresh weight, dry weight of shoot and root, shoot – root ratio and soil pH. The plant height (shoot length) in centimeters was measured on weekly basis with a metre – tape from the soil surface to the shoot apex. At the end of the experiment the plants were harvested and the roots washed in clean water to get rid of soil particles attached to the roots. This was immediately taken to the laboratory (to avoid water loss) and measured with a weighing balance (METTLER TOLEDO model) to obtain the fresh weight yield. Dry weight was obtained by drying the plant of each treatment in FANEM drying and sterilizing oven model 315SE at 80^{o}C for 48 hours. Root, shoot and total dry weight yields were obtained in grammes. The shoot – root ratio for each plant was obtained by dividing the shoot dry weight yield by the root dry weight yield. Composite soil samples from each treatment bag were collected and tested for pH. pH meter (JENNWAY 3015 model) was used. Soil samples were put into a beaker and mixed with distilled water. The electrode was rinsed with distilled water before putting it into the beaker containing the sample. The pH value was read when the figure on the metre-screen stabilizes.

All data collected were subjected to statistical analysis of variance (ANOVA) and standard error mean (SEM).

RESULTS

The response of the two crops (*Zea mays* Linn and *Arachis hypogea* Linn) to spent carbide waste application depended on the concentration of application. Results indicated that growth and yield of the two crops were adversely affected by the carbide waste pollution especially at the higher concentrations.

Fig. 1 shows the response of plant height of the two plants (maize and groundnut) to the application of carbide waste. Plant height of the two crops were drastically affected by carbide waste pollution. The reduction in growth (plant height) was found to be proportional to the concentration of carbide waste pollution with time; with the control showing the highest growth rate. From 80g to 160g, no significant differences (p=0.05) were recorded in the plant heights of the two crops.

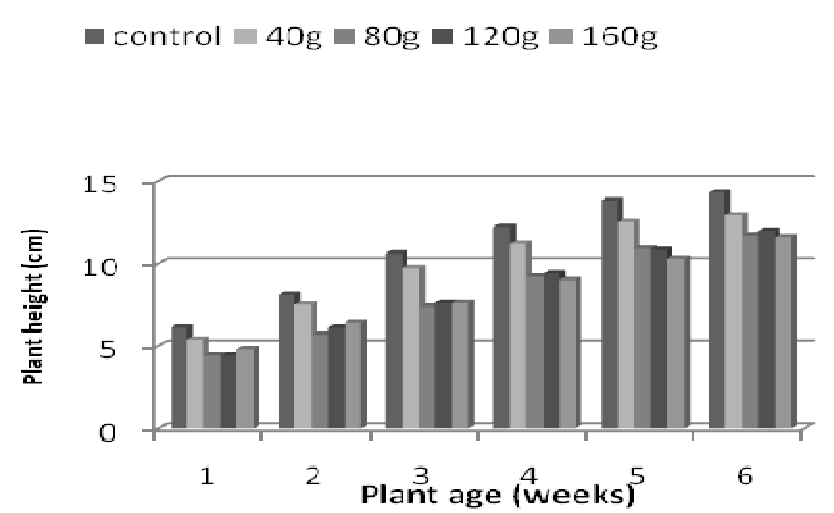

Fig.1a. Impact of carbide waste on plant height of maize

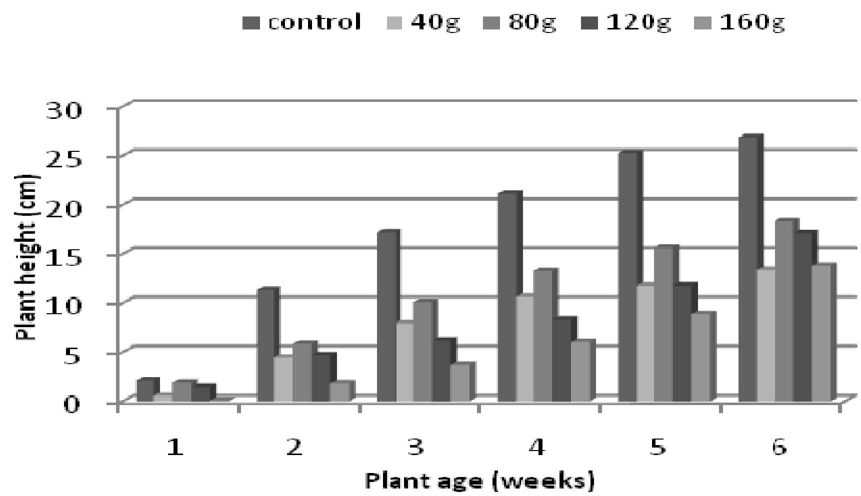

Fig.1b. Impact of carbide waste on plant height of groundnut

Addition of carbide waste promoted total fresh weight yield of maize and groundnut at 80g and 40g concentration respectively (Fig 2). The same pattern were experienced in the shoot dry weight (Fig. 3) and total dry weight (Fig.5) of the two crops. Higher concentration of carbide waste decreased significantly both the shoot dry weight and the total dry weight (p=0.05) of the two crops. At moderate concentration of 40g carbide waste, dry weight of root of maize and groundnut increased significantly (p=0.05) above the control (Fig.4).

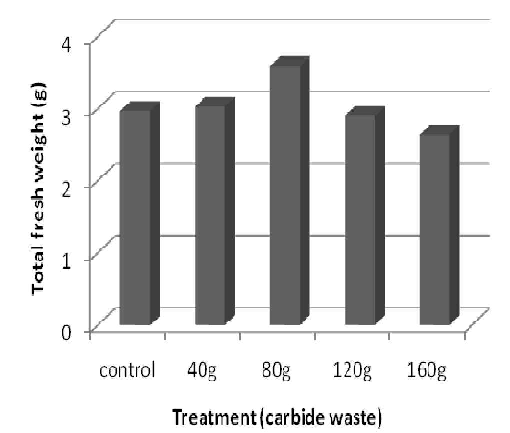

Fig. 2a. Impact of carbide waste total fresh weight of Maize

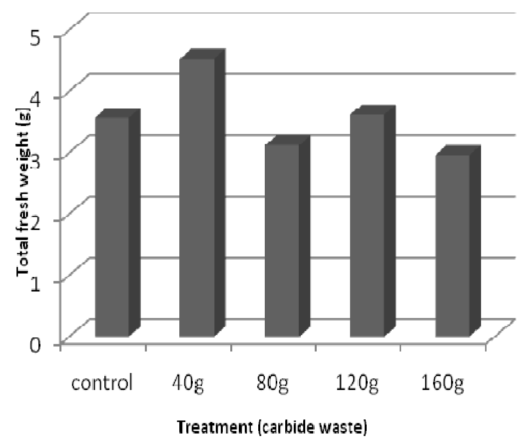

Fig.2b. Impact of carbide waste on total fresh weight of groundnut

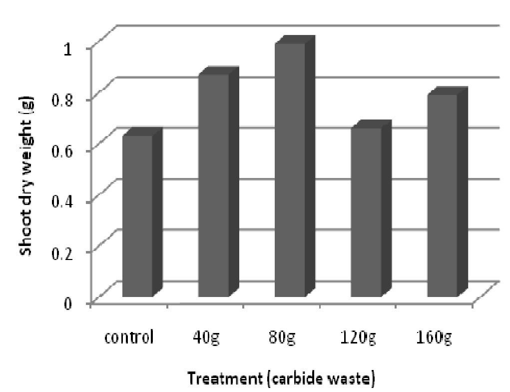

Fig.3a. Impact of carbide waste on Shoot dry weight of maize

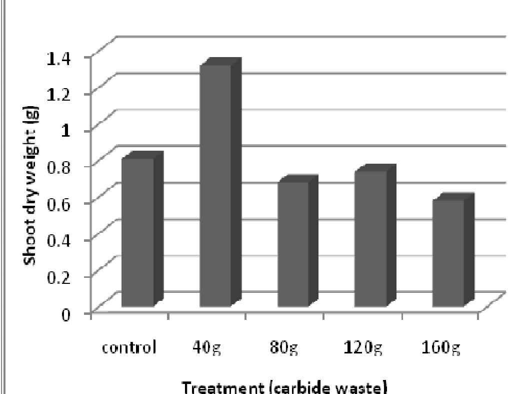

Fig. 3b. Impact of carbide waste on shoot dry weight of groundnut

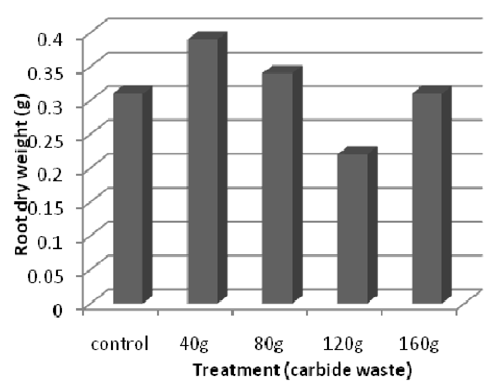

Fig.4a. Impact of carbide waste on root dry weight of maize.

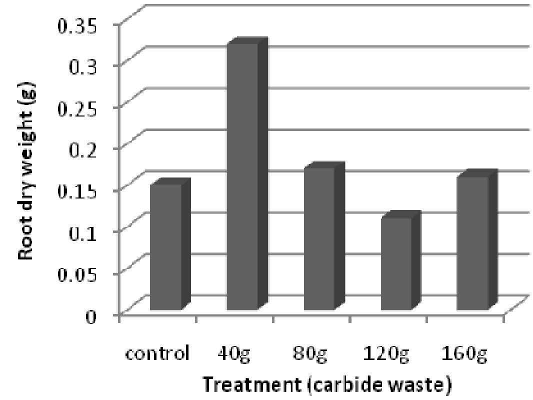

Fig.4b. Impact of carbide waste on root dry weight of groundnut

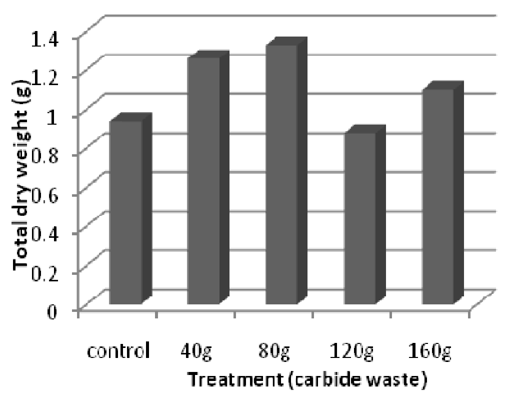

Fig.5a. Impact of carbide waste on Total dry weight of maize

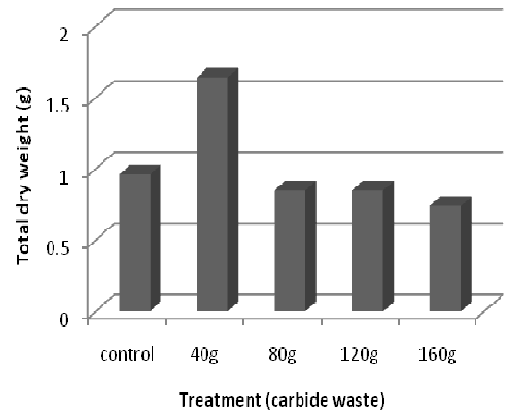

Fig.5b. Impact of carbide waste on total dry weight of groundnut

Shoot – Root ratio was found to increase as the concentration of carbide waste increase especially in maize with a sudden decrease at the highest carbide concentration (160g). In groundnut, there was no significant (p=0.05) difference in the shoot – root ratio from the control to 80g. While the only significant increase in value was observed at 120g carbide waste (Fig. 6).

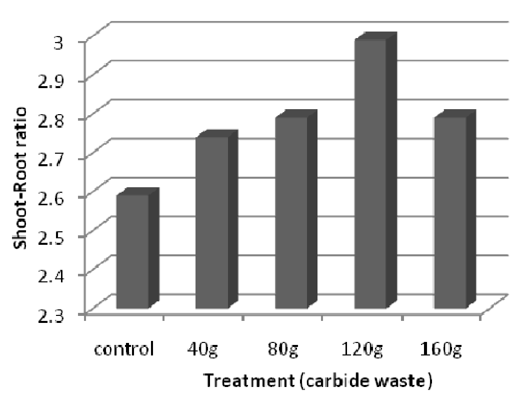

Fig.6a. Impact of carbide waste on shoot-root ratio of maize

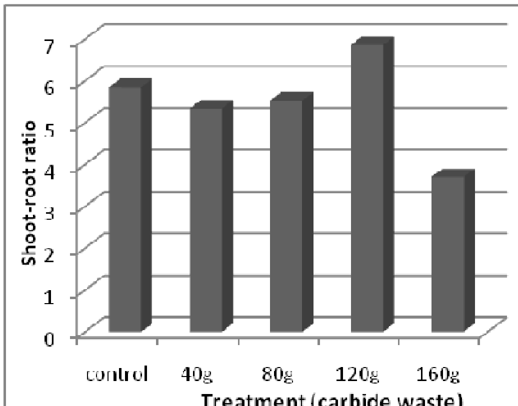

Fig.6b. Impact of carbide waste on shoot-root ratio of groundnut

It is also observed that the addition of carbide waste to the soil increased the soil pH from acidic to alkaline (Fig.7)

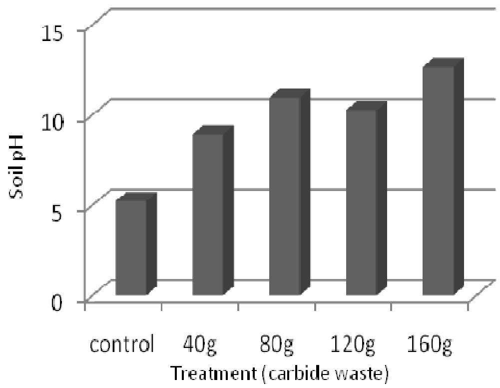

Fig. 7a. Impact of carbide waste on Soil pH of maize.

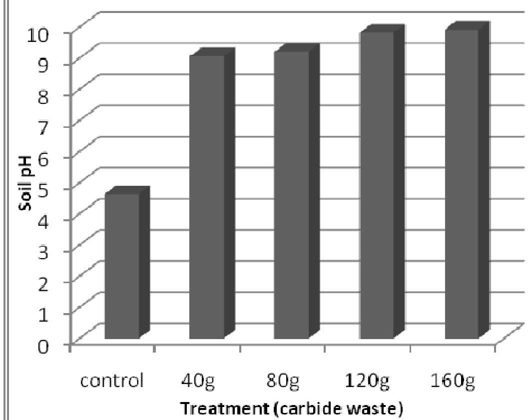

Fig. 7b. Impact of carbide waste on soil pH of groundnut.

DISCUSSION

It is observed that carbide waste significantly affected the growth and yields of Maize (*Zea mays* Linn) and Groundnut (*Arachis hypogea* Linn). The effect was found to be related to the concentration of treatment. The inhibitory effect of the treatment was mostly observed at 120g and 160g of carbide waste, in the two crops. It might be deduced that the adverse effect of this treatment was as a result of the interference with soil-nutrient and water by carbide waste. Nutrient and water are important factors needed for plant growth and development Odjegba and Sadiq (2002) report that any condition that disrupt the normal plant-water relationship of the roots within the soil will negatively affect normal growth of plants. Absence of these factors lead to stunted growth and death. This is in line with Kinako and Amadi (1997) who report that reduction in vegetation regeneration and biomass accumulation in carbide waste polluted sites was due to reduction in water infiltration which invariably interfere with the soil – water – plant relationship as a result of blocking of soil pores. The increase in soil pH to alkalinity (Fig. 7) might also be responsible for the reduction in growth and yield especially in high concentrations of treatment (carbide waste). This is because maize and groundnut grow best at slightly acidic pH of 5.7-7.0 and 5.5 – 6.5 respectively (Purseglove, 1985a and 1985b).

At 40g and 80g of carbide waste, total fresh weight, shoot dry weight and total dry weight yields of groundnut and maize respectively were promoted. This can be attributed to the non-toxicity of carbide waste at low concentrations in the soil indicating the absorption of calcium (a major component of carbide waste) by the plant. Calcium is a major constituent of plant tissue. Its absorption into the plant will invariably increase the fresh and dry weight of the two crops.

Shoot – root ratio was found to increase as the concentration of treatment increase attaining the highest value at 120g treatment, indicating more shoot yield than root yield at each treatment option. This is because root growth require diversion of energy from potential above ground growth (Kinako *et al.,* 2004)

It was observed that maize and groundnut differ in their responses (growth and yield) to the different concentrations of carbide waste treatment. This is logical since plants vary in their ability to accumulate nutrient under stressful conditions which may be attributed to the differences in their physiological, biochemical and genetic nature (Tanee and Anyanwu, 2007)

It can be concluded that spent carbide waste adversely affects the growth and yield of maize (*Zea mays* Linn) and groundnut (*Arachis hypogea* Linn) especially at high concentrations. There is need therefore, to make welders and panel beaters take cognizance of the adverse environmental effects of this waste. Better ways of disposing and managing this waste should be sought rather than dumping them in homestead gardens where these crops can be cultivated. Alternative uses and recycling of this waste should be considered in the management of this waste. One suggestion is that the since the carbide waste is capable of increasing the pH of the soil, it can be used in amending acidic soils.

REFERENCES

Kathleen, R. L., 1980. Toxicity of carbide waste to heterotrophic microorganisms in caves. *Microbial Ecology* **6**(2):173 – 179.

Kinako, P. D. S. and Amadi, I. U., 1997. Short term effects of carbide waste on water infiltration and vegetation regeneration at a barred terrestrial habitat in the Choba area of Rivers State. *Nigerian Journal of crop, Soil and Forestry* 3:174 – 180.

Kinako P. D. S.; Anyanwu, D. I. and Awi – Waadu, G. D. B., 2004. *Dynamics of Ecology:* A Laboratory and field manual for General Ecology Students. Belk Publishers. Port Harcourt.

Odjegba, V. J. and Sadiq A. O., 2002. Effect of spent engine oil on the growth parameters, chlorophyll and protein levels of *Amarauthus hybridus* L. *The Environmentalist*. 22:23 – 28

Purseglove, J. W., 1985a. Tropical Crops: *Monocotyledons*. New York Longman Group Ltd. New York.

Purseglove J. W., 1985b. Tropical Crops: *Dicotyledons*: Longman Group Ltd. New York.

Tanee, F. B. G. and Anyanwu, D. I., 2007. Comparative studies of the growth and yield of two cassava lines (TMS 30572 and TMS 30555) in a crude oil polluted habitat. *Scientia Africana* 6 (1): 81-84.