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EFFECTS OF DUMPSITE SOILS ON MAIZE YIELD IN PORT HARCOURT, RIVERS STATE

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ABSTRACT

This study examined the effect of dumpsite soils on maize yeild in Port Harcourt, Rivers State. Dump site soil samples were collected from three locations (Njemanze, Mileone flyover and Chinda) and the control soil from Rivers State University. The soil samples were analysed for N, P, K, Mg and Zn. Results of the soil analysis showed high nutrient concentrations in the dumpsite soils than the control except for poatassium. The results also showed that there were slight differences in the nutrient profile of the dumpsite soils with nutrient analysis of total nitrogen(1.17±0.003, 0.92±0.006, 0.54±0.003 and 0.08±0.001),phosphorus (10,11±0.08, 9.31±0.06, 9.58±0.03 and 1.32±0.005), magnesium (60.541±1.67, 67.384±3, 89,113.307±5.09 and 22.311±0.23), potassium (3702.236±6.03, 3345.778±3.90, 5770.125±9.34 and 7501.789±11.56) and zinc (142.303±3.04, 2837.142±12.45, 163.141±2.06 and 38.903±1.11) for Njemanze, Mileone flyover, Chinda and control respectively. Yield assessment revealed highest and lowest weight and length of cob for Chindah and Njemanze respectively. Mileone flyover recorded highest width of cob (4.0) while lowest width (3.6) was observed for Njemanze. Generally, the nutrient levels in the dumpsite soils were high and resulted to higher yield of maize. The use of dumpsite soils portends a greater agricultural yield for maize growth and should be encouraged but care should be taken to avoid soils that are heavy metal impacted as this is detrimental to health.

KEYWORDS:

Dumpsites; Soil; Nutrient profile; Maize and Yield.

INTRODUCTION

Soil is a key resource for sustaining human need for an enabling environment for quality food supply (Fatoki, 2000; Opaluwa *et al.*, 2012). Agriculturalists are faced with one primary interest of using soil as a medium for plant production (Benjamin *et al*., 2003).

Wastes found in the dumpsites come from municipal, domestic and industrial sources. The management of these wastes generated has become an issue of concern as little or no efforts have been made in order to improve on the wastes collection and disposal facilities which ultimately results in the deterioration of soil quality (Obute *et al*., 2010; Ideriah *et al*., 2010).

In Nigeria, there is a strong believe that soil fertility can be enhanced by the presence of decayed and composted waste. Hence, the frequent use of abandoned land or dumpsites that is in use as farm land has become common practice in urban areas (Shao *et al.*, 2022). Dumpsites and landfills are the main vessels for domestic and industrial wastes.

The use of dumpsite wastes for agro-related practices play an important role in protecting soil environment from undesirable occurrences, sustaining the security of the soil and recycling of nutrients that are essential to plants. These wastes impacts on the physical, chemical, and biological properties of the soil positively as well as increasing the yield of crops by stimulating plant growth (Hossain *et al*., 2017).

Several crop management decisions aimed at improving the soil for maximizing food production have been created. Farmers recognize that the physical condition of the soil will affect crop production and they are interested in maintaining the productive capability of the soil (Benjamin *et al*., 2003). Soil amendment is carried out on the dumpsite soil and used for several purposes because of the belief of their richness in mineral and organic content (Akanchise *et al.*, 2020), dumpsite wastes has been seen to majorly contain nitrogen and other organic matter which are good sources for the improvement of soil fertility (Hossain *et al*., 2017). Hence, the study was carried out to determine the effect of dumpsite soils on maize yield.

Materials and Method

Study Area

The study was carried out in Rivers State University Botanical Garden, Port Harcourt, Rivers State, Nigeria.

Soil Sample Collection

In this study, the soil samples were collected from three solid waste dump sites located at; Njemanze, Mileone flyover and Chinda in Port Harcourt, Rivers State. The control soil was collected from the Botanical Garden of Rivers State University. The names of the locations of the dump sites were adopted to represent the different dump sites. Soil samples were collected at 0 – 15cm with a soil auger for analysis.

Analysis of Soil Samples

The soil samples were analyzed for 5 nutrients; nitrogen, phosphorus, magnessium, potassium and zinc. The macro Kjeldahl method was used for the determination of total nitrogen in the soil samples. The ascobic acid method was used for the determination of phosphorus in the soil samples. The American Public Health Association (APHA 3111C) method was used to determine magnessium, potassium and zinc.

Yield Measurement

The number of cobs per plant was determined by counting the matured cobs. Cob length was measured using meter rule from the base of cob to the pointy part at one end of the cob. Cob width was measured from one end to another using Vernier caliper (Columbus, Model-VCC) and cob weight of each of the cobs was measured using a digital electronic compact scale (SF-400C3).

RESULT AND DISCUSSION

Soil Nutrient Analysis

The nutrients (N, P, Mg, K, Zn) present in soil samples from three different dump sites as well as the control are shown in Table.1. The nutrients (N, P, Mg, K, Zn) were present in the different soil samples with Chinda having high nutrient content for P, Mg and K (N; 0.54, P; 9.58, Mg; 113.307, K; 57700.125, Zn; 163.141). In Mileone Flyover, P, K and Zn were high (N; 0.92, P; 9.31, Mg; 67.384, K; 3345.778, Zn; 2837.142). P and K were also high for Njemanze (N; 1.17, P; 10.11, Mg; 60.541, K; 3702.236, Zn; 142.303). Rivers State University (Control) had low concentrations except K that was high (N; 0.08, P; 1.32, Mg; 22.311, K; 7501.789, Zn; 38.9

Table 1: Analysis of Nutrients Present in Soil Samples Collected from Three Different Dumpsites in Port Harcourt

S/n	Parameters	RSU (Control)	Njemanze	Mile one flyover	Chinda by Iwofe
1	Total Nitrogen (%)	0.08 ± 0.001^{a}	1.17 ± 0.003^{d}	0.92 ± 0.006^{b}	0.54 ± 0.003^{c}
2	Phosphorus (mg/kg)	1.32 ± 0.005^{a}	10.11 ± 0.08^{c}	9.31 ± 0.06^{b}	9.58 ± 0.03^{b}
3	Magnessium (mg/kg)	22.311 ± 0.23^{a}	60.541 ± 1.67^{b}	67.384 ± 3.89^{c}	$113.307^{c}\pm5.09$
4	Potassium (mg/kg)	7501.789 ± 11.56^{c}	3702.236 ± 6.03^{a}	3345.778 ± 3.90^{a}	5770.125 ± 9.34^{b}
5	Zinc (mg/kg)	38.903 ± 1.11^{a}	142.303 ± 3.04^{b}	2837.142 ± 12.45^{d}	163.141 ± 2.06^{c}

Values are Expressed as Mean S.E.M (n=5). Means with Different Superscripts (a-c) are Significantly Different (Tukey, HSD, p<0.05)

This study has shown that soils collected from Mileone flyover, Chinda, Njemanze dumpsite and Rivers State University (control soil) contain nutrients such as; nitrogen, phosphorus, magnesium, potassium and zinc in varying concentrations. This study has also shown that the dumpsite soils contained high concentrations of the nutrients analysed than the control soil, except for potassium that was high in the control soil. This is in agreement with the findings of Obianefo *et al*. (2017) and Ideriah *et al*. (2006) which examined the nutrient status of soils from solid waste dumpsites in Port Harcourt. The result of the study recorded high nutrient concentrations in the dumpsite soils for total nitrogen, phosphorus and potassium than the control soil. The study concluded that the waste dump contributed to the high levels of nutrients in the dumpsite soils.

Number of Cobs

The average number of cobs of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig. 1. There were no significant differences in the number of cobs of the plants. However, the plants in the soil from Chinda by Iwofe Dumpsite had more cobs (1.1) than the maize plants in the soils from Rivers State University (Control) (1.0), Mileone Flyover Dumpsite (1.0), and the Njemanze Dumpsite (1.0).

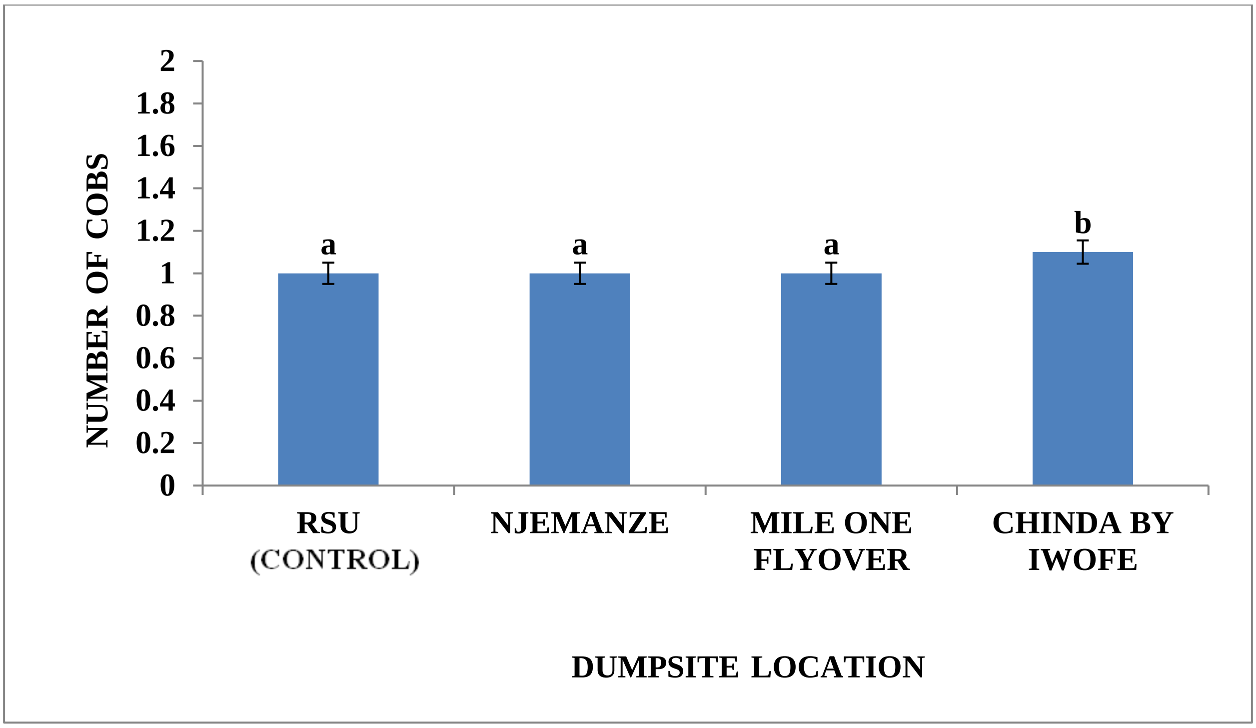

Figure 1: Number of Cobs per Plant of Maize Grown in Soils Collected from Three Different Dumpsites in Port Harcourt. Values are Expressed as Mean ± S.E.M (n=5). Means with Different Superscripts a-b Significantly Different (Tukey, HSD, p<0.05)

This study has shown that the average number of cobs per plant was not significant. Chinda dumpsite having more cobs than the maize plants in the soils from Rivers State University, Mile one flyover dumpsite and the Njemanze dumpsite. This is not in harmony with the study of Ngoune and Mutengwa (2019) as they estimated maize (*Zea mays* L.) yield per harvest area and observed that an increase in maize density was significant in the number of cobs harvested.

Cob Length

The average cob length of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig. 2. There were no significant differences in the cob length of the plants. However, the plants in the soil from Chinda Dumpsite had the longest cobs (16.0 cm) than the maize plants in the soils from Rivers State University (Control) (15.8 cm), Mileone Flyover Dumpsite (12.9 cm), and the Njemanze Dumpsite (10.9 cm).

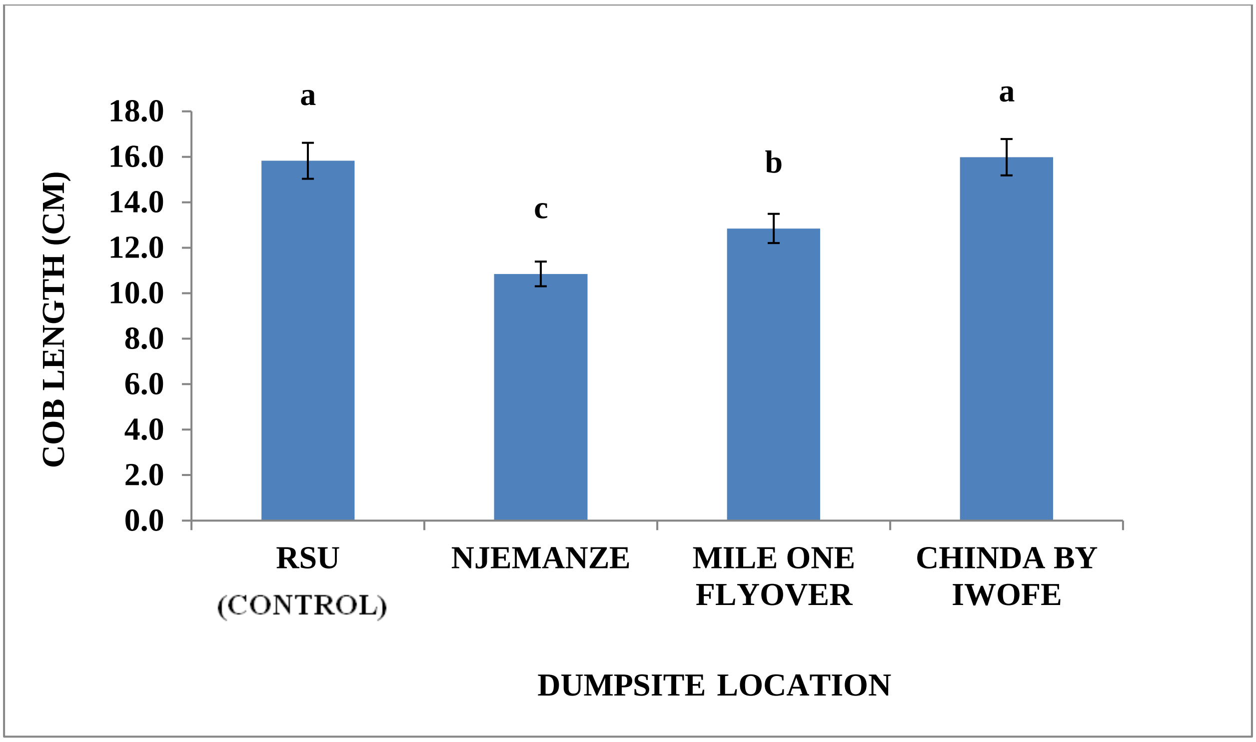

Figure 2: Cob Length of Maize Grown in Soils Collected from Three Different Dumpsites in Port Harcourt. Values are Expressed as mean ±S.E.M (n=5). Means with Different Superscripts (a-c) Significantly Different (Tukey, HSD, p<0.05)

The average cob length of the maize plants established in soils from the different dumpsite locations as well as the control in this study showed that there were no significant differences in the cob length of the plants with the plants in the soil from Chinda dumpsite taller (16.0 g) than the maize plants in the soils from Rivers State University (Control) (15.8g), Mileone flyover dumpsite (12.9 g), and the Njemanze dumpsite (10.9 g). This study is not in line with the research of Ekundayo *et al*. (2001) which studied the effect of crude oil on growth and yield of maize and recorded significant reduction at 95% level of probability in yield (maize cobs) when compared with the control at 98.6%, 96.5% and 58.3% for pre-plant, five weeks after planting (5 WAP) and seven weeks after planting (7 WAP) treatments, respectively.

Cob Width

The average cob width of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig. 3. There were no significant differences in the cob width of the plants. However, the cobs from the plants in the soil from Mileone Flyover Dumpsite had the highest width (4.0 cm), when compared to the Chinda Dumpsite width (3.9 cm), Rivers State University (Control) had width (3.7 cm), while Njemanze Dumpsite had the least width (3.6 cm).

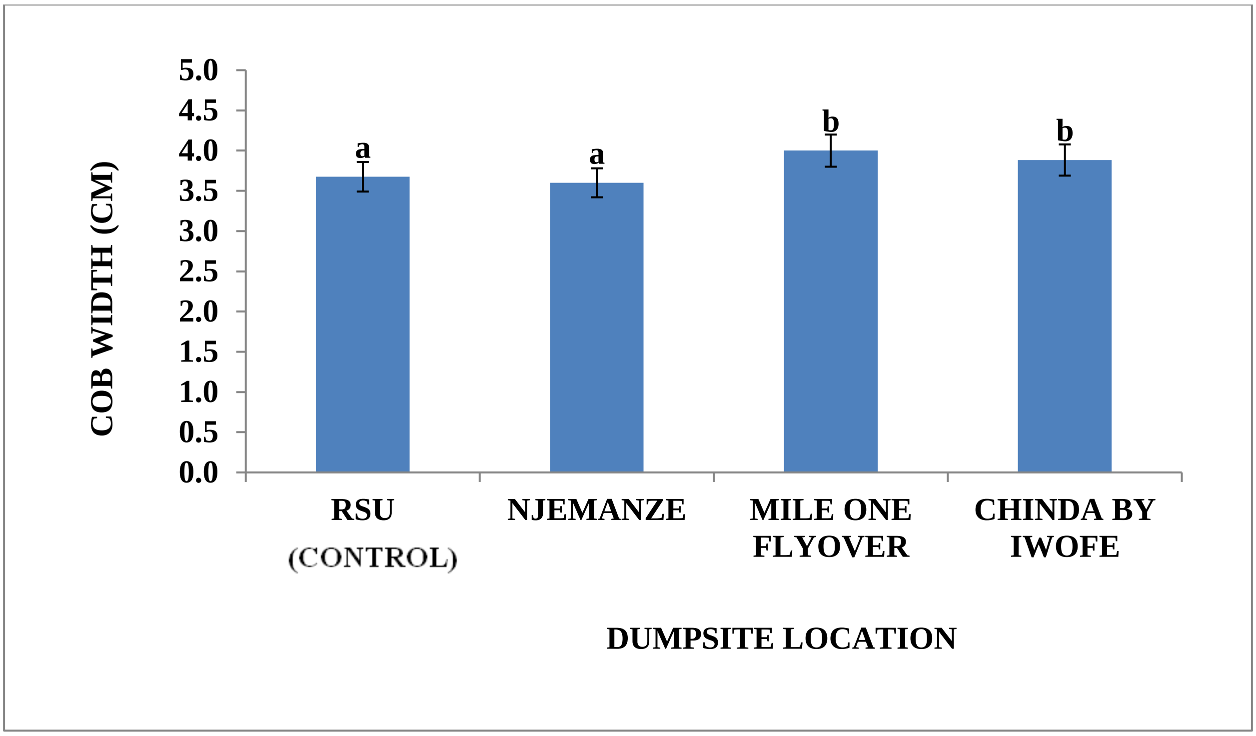

Figure 3: Cob Width of Maize Grown in Soils Collected from Three Different Dumpsites in Port Harcourt. Values are Expressed as Mean ± S.E.M (n=5). Means with Different Superscripts (a-b) Significantly Different (Tukey, HSD, $p<0.05$)

The average cob width of the maize plants showed no significant differences in the cob width of the plants with the plants in the soil from the Mileone flyover dumpsite with the highest width (4.0 cm), Chinda dumpsite with width (3.9 cm), the maize plants in the soils from Rivers State University (Control) width (3.7 cm), while Njemanze dumpsite had the least width (3.6 cm). Ayotamuno and Kogbara (2007) on the other hand, investigated the tolerance level of *Zea mays* (maize) on contaminated soil and found that maize can survive in soil contamination of about 21% (similar to 177 000 mg/kg) and still produce fresh cob yield of about 60% than on normal soil. This implied that there was a stimulated increase in fresh cob yield in the maize grown on contaminated soil, than that obtained on normal soil.

Cob Weight

The average cob weight of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig. 4. There were significant differences in the weight of the plants with the plants in the soil from Chinda Dumpsite heavier (115.7 g) than the maize plants in the soils from Rivers State University (Control) (98.1 g), Mileone Flyover Dumpsite (77.6 g), and the Njemanze Dumpsite (55.4 g).

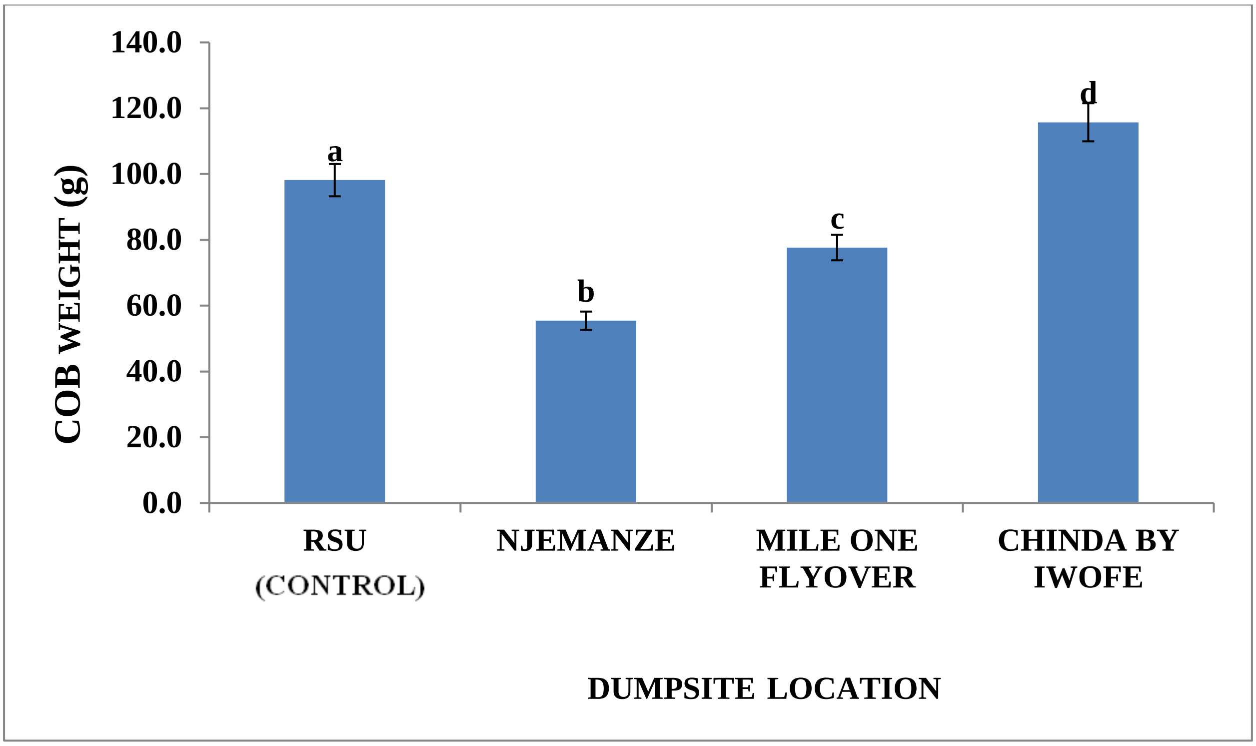

Figure 4: Cob Weight of Maize Grown in Soils Collected from Three Different Dumpsites in Port Harcourt. Values are Expressed as Mean ± S.E.M (n=5). Means with Different Superscripts (a-d) Significantly Different (Tukey, HSD, $p<0.05$)

In this study, cob weight of the maize plants established in soils from various dumpsites showed that there were significant differences in the weight of the plants with the plants in the soil from Chinda dumpsite heavier (115.7 g) than the maize plants in the soils from Rivers State University (Control) (98.1g), Mileone flyover dumpsite (77.6 g), and the Njemanze dumpsite (55.4 g). This study is not in line with the research of Qian et al. (2010) which recorded decrease in the weight of cob. This is because of the competition among plants for nutrient uptake from the soil.

CONCLUSION

From this study, waste dumpsite has been seen to contain soil nutrients necessary for the growth of maize. The study showed positive growth rate of the maize plant grown on dumpsite soils, this could be as a result of the high organic matter contained in dumpsite soils. The study concludes that though dumpsite soil enhances plant growth, it is important that soils are tested for toxins before being used as planting sites, as this is key when accessing the components of risk at dumpsites and most especially to avoid risk to animals and man.

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