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Effects of industrial effluents on growth and development of maize (*Zea mays* L.)

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ABSTRACT

A study was carried out in green house of Abia State University, Uturu-Nigeria to evaluate the effects of Beverage and Pharmaceutical sewage effluents (Jawamox, Minta and Plant oxidation pond effluent) on the growth characteristics of maize. The physico-chemical properties of the studied effluents showed pH of 8.38, 8.09 and 7.52 in Jawamox, Minta and Plant oxidation pond effluents respectively, an indication that there was no salinity problem. Plant height, root length increased with increase in the concentration of the studied effluents. Studied effluents improved stem diameter in relation to control but not among the treatments. The results indicated that the various effluent treatments positively influenced maize plant fresh and dry weights. It is suggested that application of the studied effluents at the concentrations of 25% - 75% can improve the growth and development of maize plant and as such could be used by farmers as source of fertilizer.

KEYWORDS

Jawamox;
Minta;
Plant oxidation pond effluents;
Maize;
Growth parameters.

INTRODUCTION

Nigeria is undergoing rapid transformation and industrialization thus resulting into large scale usage of chemicals in various human activities. Majority of these industries are water based and considerable volume of waste water is discharged into the environment without treatment or inadequately channelled leading to surface and ground water pollution. This contaminated water is used for diverse human activities especially in agriculture. Sewage effluent is defined as water used for domestic or industrial purposes and considered useless from the point of further use and as such disposed off[8]. Sewage effluents have been variously utilised in many countries[5,12]. reported the use of sewage waters in crop irrigation and agriculture respectively. Studies have revealed that the application of rubber factory effluent impacted positively on the growth and yield characteristics of cucumber[4]. The choice of sewage effluent in the cultivation of maize is in keeping with the modern day conservation of limited resources which includes water. In most urban and rural localities scarcity of water is a serious problem especially in dry seasons. Different types of effluents have influenced the growth of several crops[10]. Effluents contain heavy metals and nutrients[3] which affect soils in many ways[1]. conducted a study to determine the effects of marble industry effluents on seed germination, post germination growth and productivity of *Zea mays* and concluded that marble industry effluents can be used as a fertilizer in low concentration especially for highly acidic soils. There was an improvement in soil fertility on application of palm oil mill effluent and no adverse effect on the environment was recorded[13]. The germination and growth of seed are fundamental for the furtherance of the existence of seeds, and seedlings are particularly susceptible to environmental pressure owing to incidence of pollutants in the environment. There are few studies on effects of effluents on growth and development of crops in Nigeria. Thus the objective of this study was to determine the effects of various concentrations of effluents on the growth and development of maize.

MATERIALS AND METHODS

The experiment was carried out at the Green House of Abia State University; Uturu located at latitude 7°6 and longitude 6°E. Maize seeds var Oba super 2 used in the experiment were obtained from the National Seed Centre, South East field Office, Umudike-Nigeria. Effluents were collected from Jawa Pharmaceutical Industry, Minta Beverage industry and sewage treatment Plant oxidation pond located in the Southeastern-Nigeria. Treatment details are as shown below.

Top soil was collected and sieved to remove large objects, deadwood and fragments. 9.8kg of the dry soil were placed in 10 litre plastic pots perforated at their bases in order to allow excess water to drain out. The pots were arranged in a completely randomized block design with 10 treatments and replicated three times. The treatment details are as outlined in TABLE 1. Four maize seeds were planted at 2.0 cm depth in each pot. Two weeks after germination and establishment, the seedlings were thinned to 2 seedlings per pot. The plants were irrigated according to the treatment concentrations in TABLE 1 above. The effects of the effluents were investigated on maize plant height, root length, stem diameter, fresh weight and dry weights. After harvesting, plants in each replicate were separated into shoots and roots. They were placed in separate envelops and oven dried at 70°C for 48 hours to determine dry weights.

TABLE 1 : Various concentrations of studied effluents

Concentrations (%) in triplicate	CODE
Control (Tap water)	T1
25% Jawamox + 75% Tap water	T2
50% Jawamox + 50% Tap water	T3
75% Jawamox + 25% Tap water	T4
25% POPE + 75% Tap water	T5
50% POPE + 50% Tap water	T6
75% POPE + 25% Tap water	T7
25% Minta + 75% Tap water	T8
50% Minta + 50% Tap water	T9
75% Minta + 25% Tap water	T10

POPE = Sewage treatment Plant Oxidation Pond Effluent

Data obtained were analyzed using analysis of variance with SPSS statistical package. Means were separated using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The physico-chemical properties of the soil used for the experiment showed that the soil was sandy loam. The pH (5.7) revealed that the soil is acidic. Soil organic carbon was less than 1% implying that sustainable crop yields will be difficult to achieve. Organic matter content of soil was 1.52%. Typically soils range from 1% to 10% of organic matter[7]. The organic matter content of the experimental soil suggests that the soil is vulnerable to soil fertility decline (TABLE 2).

PHYSICO-CHEMICAL PROPERTIES OF THE EFFLUENTS

The physico-chemical properties of the studied effluents showed pH of 8.38, 8.09 and 7.52 in respect of Jawamox, Minta and Plant oxidation pond effluents. This is an indication that there is no salinity problem (TABLE 3).

Plant height (cm)

The maximum plant height of 22.05± 0.04 was obtained from 75% Plant oxidation pond effluent, followed by 75% Minta effluent (21.17± 0.01), while the control had the minimum plant height increased 12.44±0.05 (TABLE 4). Plant height increased with increase in the concentration of the studied effluents. There was significant difference ($p<0.05$) among the treatments. However, there was no significant difference between 25% concentrations of Jawamox and Minta effluents. In the study carried out by[2] increase in sewage water concentration resulted in plant height increase[9]. reported that sewage concentration gave rise

TABLE 2 : Physico-chemical properties of the soil prior to planting

Parameter	Value
Sand	73.4%
Silt	7.6%
Clay	19.3%
Texture	Sandy loam
Ph	5.7
Organic carbon	0.87%
Organic matter	1.52%
Nitrogen	0.11%

TABLE 3 : Chemical properties of the effluents

Parameters	EFFLUENTS		
	Jawamox	Minta	Plant oxidation pond effluent
N%	11.25	10.93	13.63
P (ppm)	1.85	1.43	12.35
pH	8.38	8.09	7.52
Organic carbon (%)	3.65	3.43	6.12
Organic matter (%)	7.39	7.52	4.35

to taller plants.

Root length (cm)

The effects of various levels of effluents on maize plant growth are shown in TABLE 4. There was significant difference ($p<0.05$) among the treatments. Increased effluent concentration gave rise to increased root length. The highest root length (19.07± 0.01) was observed in 75% Plant oxidation pond effluents (T7), while the least was found in the control (T1). Studies carried out by[6] revealed that root development of maize was improved positively by treatment with sewage water[9]. also posited that increasing concentration of sewage gives rise to gradual increase in the root length of maize. The result of this study agrees with their assertion.

Stem diameter (mm)

Data on stem diameter as affected by different concentrations of the studied effluents are presented in TABLE 4. Maximum stem diameter was found in 75% Plant oxidation pond effluents (T7), and the minimum in the control (T1). Analysis of variance showed a significance difference ($p<0.05$) between the concentrations. However no significant difference existed between 25% Jawamox (T2), 50% Jawamox (T3), 25% Minta (T8) and 50% Minta (T9). Also significant differences were not observed between 25% (T5) and 50% (T6) Plant oxidation pond effluents as well as in 75% Jawamox (T4) and 75% Minta effluents (T10). Thus it can be deduced from this study that the studied effluents improved stem diameter in relation to control but among the treatments.

Plant fresh weight (g)

The maximum maize plant fresh weight was recorded in 75% Plant oxidation pond effluents (T7), while the minimum was found in the control (T1). The results of the various levels of effluents were significantly higher than the control. However, there was no significant difference among 75% Jawamox (T3) and 25% Plant oxidation pond effluent (T7) treatments (TABLE 5). The results indicated that the various effluent treatments positively influenced maize plant fresh weight.

TABLE 4: Plant height, root length and stem base diameter as affected by various levels of effluents

Treatment	Mean		
Concentrations (%)	Plant height (cm)	Root length (cm)	Stem diameter (cm)
Control (T1)	12.44 ± 0.05^a	12.07 ± 0.04^a	4.50 ± 0.11^a
25% Jawamox (T2)	16.44 ± 0.03^b	15.66 ± 0.01^b	6.20 ± 0.01^b
50% Jawamox (T3)	17.68 ± 0.02^c	16.85 ± 0.02^c	6.20 ± 0.02^b
75% Jawamox (T4)	20.53 ± 0.06^d	16.19 ± 0.01^d	6.80 ± 0.01^d
25% POPE (T5)	16.88 ± 0.02^e	16.41 ± 0.01^e	6.50 ± 0.01^c
50% POPE (T6)	19.53 ± 0.01^f	17.42 ± 0.01^f	6.50 ± 0.01^c
75% POPE (T7)	22.05 ± 0.03^g	19.07 ± 0.01^g	7.00 ± 0.01^e
25% Minta (T8)	16.45 ± 0.02^h	15.91 ± 0.01^h	6.20 ± 0.01^b
50% Minta (T9)	18.48 ± 0.01^i	16.99 ± 0.01^i	6.30 ± 0.01^b
75% Minta (T10)	21.17 ± 0.01^j	18.14 ± 0.01^j	6.70 ± 0.01^d

Values followed by the same letter are not significantly different at $P<0.05$; POPE = Sewage treatment Plant Oxidation Pond Effluent

TABLE 5 : Plant fresh and dry weights as affected by various levels of effluents

Treatments/Concentrations	Plant fresh weights	Plant dry weights
Control (T1)	10.96 ± 0.01a	9.04±0.04a
25% Jawamox (T2)	14.65± 0.02b	11.52±0.01b
50% Jawamox (T3)	15.84± 0.01c	13.00± 0.01c
75% Jawamox (T4)	15.25±0.03d	13.53± 0.01d
25% POPE (T5)	15.92±0.02c	12.80±0.01c
50% POPE (T6)	16.90± 0.01e	13.66±0.01e
75% POPE (T7)	18.23± 0.02f	15.33±0.01f
25% Minta (T8)	14.41± 0.01g	12.86±0.02g
50% Minta (T9)	16.54± 0.07h	13.61± 0.01h
75% Minta (T10)	14.95± 0.03i	12.57± 0.01j

Values followed by the same letter are not significantly different at $P<0.05$; POPE = Sewage treatment Plant Oxidation Pond Effluent

Plant dry weight (g)

Maize plant dry weight was maximum in 50% Plant oxidation pond effluent concentration followed by 50% Minta effluent concentration and the minimum plant dry weight of 9.04± 0-01 was recorded in the control treatments (TABLE 5). There was significant difference in maize plant dry weight among the treatments ($p<0.05$). It can be concluded that the introduction of various concentrations of the effluents positively affected maize plant dry weight[11]. reported that undiluted Minta effluent has low agro potentiality and suggested its improvement through dilutions. Based on this study, it is suggested that application of the studied effluents at the concentrations of 25% - 75% can improve the growth and development of maize plant and as such could be used by farmers as source of fertilizer.

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