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Air Pollution tolerance indices (apti) of some plants around Otorogun Gas Plant in Delta State, Nigeria.

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ABSTRACT: The study examined the air pollution tolerance indices (APTI) of six plant species around Otorogun gas plant in Ughelli-South Local Government Area of Delta State. Four physiological and biochemical parameters, which are leaf relative water content (RWC), Ascorbic acid content (AA), total leaf chlorophyll (TCh) and leaf extract pH were used to compute the APTI values. The result showed order of tolerance as Emilia Samtifolia (1.49%)> Manihot esculenta (2.19%)> Elaesis guineensis (2.41%)> Impereta cylindrical (25.56%)> Eupatorium Odoratum (35.17%)> Psidium guayava (45.11%). @ JASEM

All combustion releases gases and particles into the air. These can include sulphur and nitrogen oxides, carbon monoxide and soot particles, as well as smaller quantities of toxic metals, organic molecules and radioactive isotopes. Air pollution can be defined as the human introduction into the atmosphere of chemicals, particulate matter or biological materials that cause harm or discomfort to humans, or other living organism or damage the environment (Anonymous 2008) Air pollution is a major problem arising mainly from industrialization (Odilora, et al 2006). Air pollutions can directly affect plants via leaves or indirectly via soil acidification (Steubing, et al 1989). It has also been reported that when exposed to air pollutants, most plant experience physiological changes before exhibiting visible damage to leaves (Dohmen, et al 1990). Studies has also shown the impacts of air pollution on Ascorbic acid content (Hoque, et al 2007) chlorophyll content (Flowers et al 2007), leaf extract pH (Klumpp et al 2000) and relative water content (Rao 1979). These separate parameters gave conflicting results for same species (Han, et al 1995). However, the air pollution tolerance index (APTI) based on all four parameters has been used for identifying tolerance levels of plant species (Singh and Rao, 1993; Yan-Ju and Ding, 2007; Singh et al 1991); Several contributors agrees that air pollutants effect plant growth adversely (Rao, 2006; Bhatia, 2006; Sodhi, 2007; Horsefall, 1998). Air pollution tolerance index is used by landscapers to select plant species tolerant to air pollution (Yan-Ju, 2007). Air pollution tolerance index has also been used to rank plant species in their order of tolerance to air pollution (Raza and Murthy, 1988; Singh and Rao, 1983). The aim of this study is therefore to determine the APTI values of six plants species within the Otorugun gas plant in Ughelli South Local Government Area of Delta State. The study will also identify the plant species which are tolerant to the prevailing atmospheric conditions.

MATERIALS AND METHODS

Area of Study: The area for study is Otorogun gas plant, Otorogun in Ughelli South Local Government Area of Delta State.

Sampling: Plants were randomly selected from the immediate vicinity of the station. This is designated as experimental site (ES). Leaf samples of the various plants were then collected. Three replicates of fully matured leaves were taken and immediately taken to the laboratory for analysis. A composite sample of each plant specie was obtained before analysis. A site nearby with similar ecological conditions was selected as the control site (CS). The plant selected for the study were those available at the experimental site. The leaf fresh weight was taken immediately upon getting to the laboratory. Samples were preserved in refrigerator for other analyses.

RELATIVE LEAF WATER CONTENT (RWC): With the method as described by Singh 1997, leaf relative water content was determined and calculated with the formular.

$$RWC = \frac{FW - DW}{TW - DW} \times 100$$

FW = Fresh weight
DW = Dry weight
TW = Turgid weight

Fresh weight was obtained by weighing the fresh leaves. The leaves were then immensed in water over night, blotted dry and then weighed to get the turgid weight. The leaves were than dried overnight in an oven at 70^{o}C and reweighed to obtained the dry weight.

TOTAL CHLOROPHYLL CONTENT (TCh)
This was carried out according to the method described by Arnon, (1949). 3g of fresh leaves were blended and then extracted with 10ml of 80% acetone and left for 15 minutes for thorough extraction. The

liquid portion was decanted into another test-tube and centrifuged at 2,500rpm for 3 minutes. The supernatant was then collected and the absorbance taken at 645nm and 663nm using a spectophotometer. Calculations were done using the formula below.

Chlorophyll a = $12\text{-}7_{DX\ 643} - 2.69_{DX645}$ X vmg mg/g

1000w

Chlorophyll b = $22\text{-}9_{DX\ 645} - 24.68_{DX665}$ X vmg mg/g

1000w

TCh = Chlorophyll a + b mg/g

D_x = Absorbance of the extract at the wavelength xnm.

V = Total volume of the chlorophyll solution (ml)

W = Weight of the tissue extracted (g)

LEAF EXTRACT pH

5g of the fresh leaves was homogenized in 10ml deionised water. This was filtered and the pH of the leaf extract determined after calibrating pH meter with buffer solution of pH 4 and 9.

ASCORBIC ACID (AA) CONTENT ANALYSIS

Ascorbic acid content (expressed in mg/g) was measured using spectrophotemetric method (Bajaj and Kaur, 1981). 1g of the fresh foliage was put in a test-tube, 4ml oxalic acid – EDTA extracting solution was added; then 1ml of orthophosphoric acid and then 1ml 5% tetraoxosulphate (vi) acid added to this mixture, 2ml of ammonium molybdate was added and then 3ml of water. The solution was then allowed to stand for 15 minutes. After which the absorbance at 760nm was measured with a spectrophotometer. The concentration of ascorbic acid in the sample were then extrapolated from a standard ascorbic acid curve.

AIR POLLUTION TOLERANCE INDEX (APTI) DETERMINATION

This was done following the method of Singh and Rao 1983. The formular of APTI is given as

$$APTI = \frac{A(T+P) + R}{10}$$

A – Ascorbic acid content (mg/g)

T = Total chlorophyll mg/g

P = pH of leaf extract

R = Relative water content of leaf %

RESULT AND DISCUSSION

TABLE 1: Air Pollution Tolerance Index (APTI) of some plant species around Otorogun Gas Plant. Result of composite sample (mean)

Species	Sites	TCh	AA	RWC	pH	APTI	% increase in APTI
Manihot	ES	6.48	0.15	82.14	5.89	8.41	
Esculenta	CS	3.90	0.14	81.07	4.69	8.23	2.19
Psidium	ES	9.54	0.14	67.74	5.22	6.98	
guayava	CS	2.07	0.11	47.37	4.51	4.81	45.11
Eupatorium	ES	6.30	0.09	77.38	5.37	7.84	
Odoratum	CS	3.01	0.09	57.26	4.93	5.80	35.17
Emilia	ES	7.45	0.14	80.62	5.38	8.24	
Santifolia	CS	4.09	0.10	80.26	4.44	8.12	1.49
Impereta	ES	6.75	0.10	76.19	5.40	8.35	
cylindrical	CS	2.03	0.80	65.91	4.61	6.65	25.56
Elaesis	ES	9.16	0.15	69.92	5.30	7.21	
guineensis	CS	2.07	0.11	69.74	4.58	7.04	2.41

The results are as shown on table 1. Sharma and Butler in 1973 reported that plants that are constantly exposed to environmental pollutants absorb, accumulate and integrate these pollutants into their systems. They further reported that depending on their sensitivity level, plants show visible changes which would include alteration in the biochemical processes or accumulation of certain metabolites. In this study, changes in parameters such as ascorbic acid, total chlorophyll, relative water content, pH of leaf extract were used in evaluating the degree of tolerance to air pollution by the plant species. Under experimental conditions, the ascorbic acid concentration is higher than those of the control site. Ascorbic acid is a strong reductant and it activates many physiological and defence mechanism. It's reducing power is directly proportional to its concentration (Raza and Murthy, 1988). However it's reducing activity is pH dependent, being more at higher pH levels. Chlorophyll is an index of productivity of plant (Raza and Murthy, 1988). Whereas certain pollutants increase the total chlorophyll content (Allen et al, 1987), other decrease it. In the present study, it has been observed that plants from experimental site contain more chlorophyll compared with those from the control site. The relative water content in a plant body helps in maintaining it's physiological balance under stress conditions of air pollution (Dedio, 1975). This is responsible for the higher level of relative water

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content in the plants in the experimental site than the control site.

An overview of the entire result obtained from this study reveals that different plants respond differently to air pollution, hence the different indices it is observed that plants growing in apparently polluted environment have higher APTI than less from less polluted environment. From the result obtained, it has been observed that *Emilia Santifolia, Manihot esculenta* and *Elaesis guineensis* were the more tolerant species since they had the least percentage increase in APTI values.

In conclusion therefore, APTI determination are of importance because with increase industrialization, there is increasing danger of deforestation due to air pollution. The results of such studies are therefore handing for landscaping.

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