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Short Communication

Air pollution tolerance indices (APTI) of some plants around Erhoike-Kokori oil exploration site of Delta State, Nigeria

P. O. Agbaire*

Chemistry Department, Delta State University, P. M. B. 1, Abraka. Delta State, Nigeria. E-mail: patagbaire@gmail.com.

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The study examined air pollution tolerance indices (APTI) of ten plant species around the Erhoike-Kokori oil exploration station of Delta state. Four physiological and biochemical parameters; 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 that combining variety of these parameters gave a more reliable result than those of individual parameter. The order of tolerance is as follows: *Psidium guajava* < *Elaesis guineensis* < *Musa paradisiaca* < *Bambosa bambosa* < *Anacadium occidentale* < *Terminalia catappa* < *Manihot exculenta* < *Impereta cylindrical* < *Chromolaena odorata* < *Manifera indica.*

Key words: Air pollution tolerance indices (APTI), ascorbic acid (AA), total leaf chlorophyll (TCh), Abraka, Nigeria

INTRODUCTION

Air pollution is 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). The atmosphere is a complex, dynamic natural gaseous system that is essential to all living things. There are some substances in the atmosphere which may impair the health of plants and animals. Air pollution is a major problem arising mainly from industrialization. Pollutants could be classified as either primary or secondary. Pollutants that are pumped into the atmosphere and directly pollute the air are called primary pollutants while those that are formed in the air when primary pollutants react or interact are known as secondary pollutants (Anonymous, 2008). Air pollutants 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). Previous studies also showed the impact 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 plants species (Singh and Rao, 1993; Singh et al., 1991).

Several contributors agree that air pollutants effect plant growth adversely (Rao, 2006; Bhatia 2006; Sodhi, 2005; Henry and Heinke, 2005; Horsfall, 1998). Air pollution tolerance index is used by landscapers to select plant species tolerance to air pollution (Yan-Ju, 2007). The aim of this study is to determine the APTI values of ten plant species within Erhoike-Kokori oil exploitation site of Delta State, Nigeria.

MATERIALS AND METHODS

Area of study

The area of study is the Erhoike-Kokori Oil Exploration Station in Ethiope-East, Delta State. 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 site nearby with similar ecological conditions was selected as the control site (CS). The plants used for the study were those available in the experiment

Table 1. Air pollution tolerance index (APTI) of some plant species around Erhoike-Kokori oil exploration station.

S/N	Species	Site	TCh	AA	RWC	pH	APTI	Increase in APTI (%)
1	*Anacadium occidentale*	Experimental	72.50	1.350	76.5	5.60	18.19	10.69
		Control	65.84	1.241	76.0	5.36	16.43	
2	*Terminalia catappa*	Experimental	71.01	1.161	88.3	5.39	17.70	14.02
		Control	55.10	1.243	79.9	5.50	15.52	
3	*Impereta cylindrical*	Experimental	71.08	1.224	84.8	6.83	18.02	21.52
		Control	72.54	0.928	75.7	5.64	14.83	
4	*Mangifera indica*	Experimental	71.93	1.151	90.9	5.77	18.03	43.79
		Control	56.66	1.257	46.9	5.80	12.54	
5	*Elaesis guineensis*	Experimental	71.97	1.257	84.5	5.53	18.19	2.83
		Control	72.61	1.261	78.2	5.78	17.70	
6	*Musa paradisiaca*	Experimental	70.81	1.173	86.1	7.53	17.80	6.59
		Control	67.60	1.192	79.8	5.55	16.70	
7	*Manihot esculenta*	Experimental	72.11	1.098	95.8	7.12	18.30	21.89
		Control	61.30	1.257	65.8	5.66	15.00	
8	*Bambosa bambosa*	Experimental	72.35	1.240	46.6	7.66	14.58	9.50
		Control	72.43	1.122	45.7	5.52	13.32	
9	*Psidium guajava*	Experimental	72.54	1.181	80.4	5.66	17.27	0.54
		Control	72.51	1.272	72.4	5.65	17.18	
10	*Chromolaena odorata*	Experimental	64.87	1.131	74.7	6.27	15.52	39.37
		Control	58.99	1.131	37.9	5.93	11.13	

RWC = Relative water content, AA = ascorbic acid content, and TCh = total leaf chlorophyll.

site. The leaf fresh weight was taken immediately upon getting to the laboratory. Samples were preserved in a refrigerator for other analyses.

Relative leaf water content (RWC)

Following the method described by Singh (1977), leaf RWC was determined and calculated with the formula:

$$RWC = [(FW - DW)/(TW - DW)] \times 100$$

FW = Fresh weight, DW = dry weight, and TW = turgid weight.

Fresh weight was obtained by weighing the fresh leaves. The leaves were then immersed in water over night, blotted dry and then weighed to get the turgid weight. Next, the leaves were dried overnight in an oven at 70°C and reweighed to obtain the dry weight.

Total chlorophyll content (TCH)

This was done according to the method described by Arnon (1949). 3 g of fresh leaves were blended and then extracted with 10 ml of 80% acetone and left for 15 min. The liquid portion was decanted into another text-tube and centrifuged at 2,500 rpm for 3 min. The supernatant was then collected and the absorbance was then taken at 645 nm and 663 nm using a spectrophotometer. Calculations were made using the formula below:

$$\text{Chlorophyll a} = 12.7_{DX663} - 2.69_{DX645} \times V/1000W \text{ mg/g}$$

$$\text{Chlorophyll b} = 22.9_{DX645} - 4.68_{DX663} \times V/1000W \text{ mg/g}$$

TCh = chlorophyll a + b mg/Dx = Absorbance of the extract at the wavelength Xnm, V = total volume of the chlorophyll solution (ml), and W = weight of the tissue extract (g).

Leaf extract pH

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

Ascorbic acid (AA) content analysis

Ascorbic acid content (expressed as mg/g) was measured using spectrophotometric method (Bajaj and Kaur, 1981). 1 g of the sample was measured into a test-tube, 4ml oxalic acid – EDTA extracting solution was added. Then 1 ml of orthophosphoric acid followed by 1 ml 5% tetraoxosulphate (vi) acid. To this 2 ml ammonium molybdate was added and then 3 ml of water. The solution was then allowed to stand for 15 min, after which the absorbance at 760 nm was measured with a spectrophotometer. The concentration of ascorbic acid in the samples was then extrapolated from a standard ascorbic acid curve.

APTI determination

The air pollution tolerance indices of ten common plants were determined following the method of Singh and Rao, 1983. The formula of APTI is given as

$$APTI = [A(T+P) + R]/10$$

Where A = Ascorbic acid content (mg/g), T = total chlorophyll (mg/g), P = pH of leaf extract, and R = relative water content of leaf (%).

RESULTS AND DISCUSSION

An overview of the result obtained from this study reveals that different plants responded differently to air pollutants (Table 1). The variation of the APTI can be attributed to the variation in any of the four physiological factors which governs the computation of the index. The four physiological factors gave conflicting result just as reported by Han et al. (1995). A more conclusion deduction can however be drawn from the APTI values. The result also revealed that of the ten species studied, *Psidium guajava* is most tolerance, followed by *Elaise guineensis* and *Musa paradisiaca*. The order is as follows: *Psidium guajava < Elaise guineensis < Musa Paradisiaca < Bambosa bambosa < Anacadium ocidentale < Terminalia catappa <Manihot esculenta < Impereta cylindrical < Chromolaena odorata < Manifera indica.* The result obtained from *Elaise guineensis* and *Musa paradisiaca* are comparable to result obtained previously (Agbaire, 1996).

In conclusion, APTI determinations are of importance because with increase industrialization, there is increasing danger of deforestation due to air pollution. The results of such studies are therefore handy for future planning. It is worth noting that combining a variety of parameters gave a more reliable result than when based on a single biochemical parameter.

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