Bio- monitoring of air pollution using *Nerium oleander* L and *Calotropis gigantea* Linn in Three different pollution zones of Chennai.

[1]M. Jeevitha, [2]S. Meera, [3]Anjan Edakunni, [4]Dr. A. Subhashini

[1,2,3]Research Scholar, [4]Assistant Professor
Department of Plant Biology and Plant Biotechnology
Quaid-E-Millath Government College for Women
Annasalai, Chennai-2

***Abstract*- Every living thing in the planet needs air which plays an important role in the development, growth and to survive. Any changes in their concentration and composition worsening the air quality as well as causes human health concern and ecological problem. Gaseous substances such as SO_2, NOx and O_3 emitting out from road transport while vehicular traffic and from the industries effluents are responsible for the air pollution. These can also injure the plant parts which exhibit the morphology and anatomical changes. In recent days, plants play an important tool for the determination for monitoring air pollution by their injuries level. Hence in our study, we put forth our research on monitoring of air pollution by using of two plants *Nerium oleander* L *and Calotropis gigantea* Linn as bio- indicators. AIR POLLUTION INDEX studies (API) were carried out to determine the pollution levels. Estimation of chlorophyll, relative water content, pH levels, ascorbic acid content were determined by Air Pollution Tolerance Index study. By these methods, we found that both the plants have revealed the intermediate APTI values. From the results we concluded that *Nerium oleander* L *and Calotropis gigantea* Linn can been used as bio-indicating tools for monitoring of air pollutants.**

***Keywords:* Air pollution, Bio-Indicator, *Nerium oleander, Calotropis gigantea,* Air Pollution Index.**

INTRODUCTION

Air is more essential to survive not only for human beings but also for animals, plants.

The atmosphere is a complex gaseous system which is essential to support life on the earth planet. But nowadays, Air is heavily polluted by our activities. Main factors of the Air pollution is rapid industrialization and urbanization[1]. Air pollution affects our health and it impacts the environment by reducing visibility and blocking sunlight, causing acid rain, harming forests, wildlife and crops. The polluted air contains Particulate Matter(PM) pollutants, Small Particulate Matter (SPM), and gaseous pollutants. Among these pollutants, gaseous pollutants is mainly released by vehicular movement, such as oxide of nitrogen ,Sulphur ,carbon ,heavy metals etc.

Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in last few decades. Children living near polluted areas are affected to pneumonia and asthma. The recent survey reveals that most of the people are dead due to the direct as well as indirect effects of air pollution.

So now we are forced to figure out how to clean the air with cheap and easiest methods. Some plants act as a sink to absorb pollutants in the air and purify the polluted air which is known as Bio monitoring plants. This is the only way to clean the atmosphere[2]. Some indoor plants is used purify the air in the room such as snake palm, money plant, spider plants ferns etc. Nowadays many research works have revealed that most of the plant act as sink for the pollutants from the vehicular pollution.

Air pollution tolerance index (APTI) describes the inherent quality of plants to tolerate air pollution. It is one of the important parameters that could be considered for the selection of traffic barrier plant species

Air pollution tolerance index or APTI is the evaluation of tolerance and sensitivity of the tree species to air pollution. The plant biochemical parameters such as ascorbic acid content, chlorophyll content, leaf extract pH, and relative water content are impacted by air pollution. It is used to identified the tolerance level of the plants[3,4].

MATERIALS AND METHODS:

2.1 Study site:

With a population of 12,395,000, Chennai is the state's largest city in Tamil Nadu, India. It is located on the coromandel coast of the Bay of Bengal. The sites selected for our study includes a low polluted control site[Adyar(SI 1)-Residential site],a moderately polluted commercial site[Kilpauk(SII)] and a highly polluted Industrial site [Manali(S III)] having an approximate traffic density.

2.2 Collection of plant sample;

Fresh leaves from two plants *Nerium oleander* L and *Calotropis gigantea* Linn were collected before sunrise from the sites(control and polluted). This study is used to predict the asses of pollutants on the plants. The further analysis was carried out in the laboratory. Collected leaf samples were washed with tap water, rinsed with distilled water and then used for further studies.

2.3 Estimation of Total Chlorophyll (Arnon's Method -1949):

1gm of fresh leaves of *Nerium oleander* L and *Calotropis gigantea* Linn were washed with water and air dried at room temperature, then macerated with 80% acetone in mortar and pestle. A pinch of calcium carbonate was added to the material to prevent deterioration of chlorophyll. The leaf extract was centrifuged at 2000rpm for 15 min, and filtered. The Optical density (OD) of

the filtrate was measured using spectrophotometer at 645nm and 663nm.The total chlorophyll content was calculated by Arnon[8] formula,
Total chlorophyll=20.2(OD645) ±8.02(OD663)
2.4 Ascorbic acid analysis (Bajaj and Kaur -1981):
1gm fresh leaves of *Nerium oleander* L and *Calotropis gigantea* Linn homogenized in 4ml oxalic acid -EDTA extracting solution for 30sec. 0.5ml of metaphosphoric acid – acetic acid and 1ml of 5% v/v sulphuric acid followed by 2ml of ammonium molybdate and diluted with distilled water. The solution was kept undisturbed for 15min, the absorbance was measured by digital spectrophotometer at 760 nm. The concentration of Ascorbic acid was determined from standard curve by Bajaj and Kaur[9] method.

2.5 Measuring pH of leaf extract (A.Singh – 1977):
5g of *Nerium oleander* L and *Calotropis gigantea* Linn leaves were homogenized in 10ml of distilled water. Leaf extract was filtered by Wattman filter paper and the pH was determined after calibrating pH meter with the buffer solution 4,7 and9[10].

2.6 Relative Water Content (Barr and Weatherly-1962):
Fresh weight was measured by weighing the fresh leaves [10].The leaves were then immersed overnight in the water bottled ,dry and then weighed to get turgid weight. The leaves were kept to dry overnight in an oven and reweighed to obtain the dry weight. RWC were calculated by following formula of Barr and Weatherly.
RWC(%)=[(FW-DW)]/[(TW-DW)]x100
Where,
FW=Fresh weight
DW=Dry weight
TW=Turgid weight.
2.7 Air Pollution Tolerance Index determination (Singh and Rao - 1983):
The air pollution index was determined by the following method by Singh and Rao [13]
APTI=[Ax(T±P)±R/[10]
Where,
A=Ascorbic acid
T=Total chlorophyll
Result And Discussion

3.1 Total Chlorophyll
The concentration of total chlorophyll was decreased in both the plants were collected at high polluted sites when compare to the control. Maximum total chlorophyl reduction was seen in *Nerium oleander* L [Table.1]. Decreased in chlorophyll content has been suggested as an indicator of SO_2 Since chlorophylls are the chief photosynthetic pigments, their content signifies growth and development of biomass and overall health status of plants. Decrease in chlorophyll content has been suggested as an indicator of SO2 pollution. High amount of gaseous SO2 causes destruction of chlorophyll and that might be due to the replacement of Mg++ by two hydrogen atoms and degradation of chlorophyll molecules to phaeophytin [11].This is accordance with F. LeBlanc, and D.N. Rao (1966). A considerable loss of total chlorophyll in the plants exposed to pollutants supports the argument that the chloroplast is the primary site of attack by air pollutants such as SPM, SO_2 and NOx .This is stated by A.K. Tripathi, and M. Gautam(2007) [5]. Pollutants such as SO_2, NO_2 and O_3 cause damage to membranes and associated molecules including chlorophyll pigments [12].

Table:1 Mean Concentration of Total Chlorophyll

S.NO	NAME OF THE PLANT	LOCATION		
		SI Adyar	SII Kilpauk	SIII Manali
1	*Nerium oleander*	12.471±0.047	1.754±0.0241	7.88±0.0849
2	*Calotropis gigantea*	13.652±0.764	12.917±0.0810	6.388±0.0161

3.2 Ascorbic Acid
Ascorbic content was increased in both plant samples *Nerium oleander* L and *Calotropis gigantea* Linn collected at high polluted site when compare to control site. *Calotropis gigantea* Linn had high amount of Ascorbic Acid collected from high polluted zone. The low amount of ascorbic acid content has been noted in both plants collected at control sites[Table.2] Ascorbic acid is an antisorbic vitamin, strong reducing agent reported to play an important role in SO_2 reduction and it activates many physiological and defense mechanism, also maintains the stability of plant cell membranes during pollution stress. Its reducing power is directly proportional to its concentration .This is accordance with S.H. Raza, and M.S.R. Murthy(1988) [17].

Table:2 Mean Concentration of Ascorbic Acid

S.NO	NAME OF THE PLANT	LOCATION		
		SI Adyar	SII Kilpauk	SIII Manali
1	*Nerium oleander*	0.036±0.0005	00.0373±0.0015	0.04±0.001
2	*Calotropis gigantea*	0.037±0.0026	0.0387±0.0015	0.042±0.0034

3.3 pH

The *Nerium oleander* L and *Calotropis gigantea* Linn sample collected from pollution side exhibited different pH due to pollution. The presence of SO and NOx in the air causes a change in pH of leaf sap towards acidic range upon diffusion of SO_2 through stomata, gaseous dissolve in water to form sulphite,

bi sulphate and their ionic species with the generation of protons influencing the cellular pH[(14)]. This is accordance with W. Dedio (1975) [Table.3].

Table:3 Mean Concentration of pH of leaf extract

S.NO	NAME OF THE PLANT	LOCATION		
		SI Adyar	SII Kilpauk	SIII Manali
1	*Nerium oleander*	6.08±.058	6.337±0.574	5.64±0.231
2	*Calotropis gigantea*	8.01±0.0058	8.006±0.0057	7.44±0.0115

3.4 Relative water content

Plants grown in polluted site showed reduced relative water content, with maximum reduction in *Nerium oleander* L. The relative water content in plant body helps in maintaining its physiological balance under stress condition including air pollution stress [12,14]. The relative water content is associated with protoplasmic permeability in cells. Loss of water and dissolved nutrients results in early senescence of leaves. This is stated by H. Rama Krishnaiah, and R.K. Somashekar (2003).The reduced relative water content indicate disturbed physiological status in the plants due to pollution[13].

Table:4 Mean Concentration of Relative water content

S.NO	NAME OF THE PLANT	LOCATION		
		SI Adyar	SII Kilpauk	SIII Manali
1	*Nerium oleander*	85.401±0.003	61.768±0.019	50.165±0.001
2	*Calotropis gigantea*	81.987±0.017	70.803±0.0032	49.276±0.0030

3.5 Air pollution tolerance Index

The calculated APTI decreased progressively from control to high polluted site . Many reports have also indicated that the specious with low index value are sensitive to air pollution.

Due to higher reduction in air pollution, tolerance index *Nerium oleander* L and *Calotropis gigantea* Linn can be considered as intermediate species. The level of APTI exclusively depends on the intrinsic nature of each species since the level of total chlorophylls, ascorbic acid, pH and relative water contents varies greatly from species to species.

Table:5 Mean Concentration of Air Pollution Tolerance Index

S.NO	NAME OF THE PLANT	LOCATION			RESPONCE
		SI Adyar	SII Kilpauk	SIII Manali	
1	*Nerium oleander*	8.923±0.001	6.805±0.098	5.881±0.003	Intermediate
2	*Calotropis gigantea*	9.385±.0005	7.848±0.050	5.848±0.001	Intermediate

CONCLUSION:

The present investigation shows that the stress levels created by the vehicular emissions were higher in the heavy polluted site when compared to control which is in concordance to the study done by S.K. Singh, and D.N. Rao (1991)at IIT campus Delhi. This study also reveals that most suitable species for traffic barriers based on the air tolerance pollution is *Calotropis gigantea* Linn, also stated by Khanoranga Achakzai(2017) *et al* in Rawalpindi, Pakistan[18].

It is evident that the plants growing alongside busy roadways have exhibited significant reduction in total chlorophyll, ascorbic acid, relative water content and pH of leaf extracts and has resulted in the substantial reduction of air pollution tolerance in plants. This is because of the pollutants released by automobiles.

Furthermore, APTI determination provides a reliable method for screening large number of plants with respect to their response to air pollution.

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