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A Comparative Study of APTI of Some Plants Growing Along the Roadside Regions of P South & P North Wards of Mumbai

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Abstract

Air pollution has now become a major problem in the cities. As the plants are constantly exposed to pollution, they show small changes depending on their sensitivity level. It has been reported that when exposed to air pollutants most plants experience physiological changes before exhibiting visible damage. Planting of trees and shrubs is one of the best way to curb pollution level in cities. Selection of plants for planting in these areas is very important, and for this, knowledge of the tolerance level of the selected plants is necessary. The objective of the present study was to identify tolerant and sensitive plants that can be used to develop green belts around the road side areas. This was done by calculating the Air Pollution Tolerance Index (APTI). For the present study five most commonly found plant species growing along the roadside areas of Mumbai from Malad to Goregaon along S.V Road were selected for experimental study and the same species were selected from Borivali – Sanjay Gandhi National Park for the control study. It was observed that *Polyalthia longifolia* and *Crinum asiaticum* have maximum APTI values hence these plants can be selected for growing along the roadside and on median strips while *Bougainvillea spectabilis (*Willd) is a sensitive plant (with comparatively lower APTI values and should be avoided.

Key Words: Air pollution, APTI, Green belt, tolerant plants, Bio indicators

INTRODUCTION

The constant increase in the number of vehicles and industries have resulted in increased pollution level as well as reduction in green cover. Dust deposited on leaves can affect the normal functioning and productivity of the plants. Plants are important components of our ecosystem and are affected by air pollution. Air pollutants can enter the plants directly through the leaves or indirectly through the soil. Trees are known to act as biological filters hence they improve the quality of air in polluted environments. Planting of trees and shrubs is one of the best way to curb pollution level in cities and the selection of plants for planting in these areas is very important. The tolerant species of plants are able to reduce pollution better and the sensitive species may not be able to survive longer in the polluted environment. The tolerant species can be identified by calculating the Air Pollution Tolerance Index (APTI). Ascorbic acid, Total chlorophyll content, Leaf extract, pH, and relative water content are used to calculate this index. In the present work five most commonly found plant species growing along the roadside areas from Malad to Goregaon along S.V Road were selected for experimental study and the same species were selected from Borivali – Sanjay Gandhi National Park for the control study and their APTI values were calculated to find out the tolerant and sensitive species.

Material and Methods

The following five plants species from both the experimental and control sites were selected for the study

1.*Polyalthia longifolia* (Sonn.)

2. ***Azadirachta indica*** A.Juss

3. ***Catharanthus roseus*** **(**L)G.Don

4. ***Bougainvillea spectabilis (***Willd)

5. Crinum asiaticum L.

Sites Selected

1) **Experimental site**

The area between Malad to Goregaon along S.V road was selected as the experimental site. This road is packed with vehicular traffic

2) Control site

Sanjay Gandhi National park was selected as control site which is comparatively a cleaner area

Parameters Studied

1 .Relative water content was determined and calculated by Singh 1997 method

2.Determination of Leaf Extract pH by using pH meter **Agbair (2009) Method**.

3.Total Chlorophyll Content is determined according to Arnon (1949) method

4.Ascorbic Acid Content was measured by titrimetric method, Using 2,6, Dichlorophenol indo phenol dye.

5.The APTI for selected plants were determined by method of Singh & Rao – 1983

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

Where, A = Ascorbic acid content (mg/gm),

T = Total chlorophyll (mg/gm),

P = pH of leaf extract,

R = Relative water content of leaf.

Table no 1. Relative water content in the leaves

Sr. no	Name of plant species	RWC in %	
		Experimental area	Control area
1.	*Polyalthia longifolia*	86.66±3.05	83.48±0.03
2.	*Azadirachta indica*	69.39±0.04	79.38±0.02
3.	*Catharanthus roseus*	68.87±0.03	76.48±0.04
4.	*Bougainvillea spectabilis*	51.17±0.03	54.62±0.05
5.	*Crinum asiaticum*	89.23±0.03	84.62±0.05

values given are mean ± SD

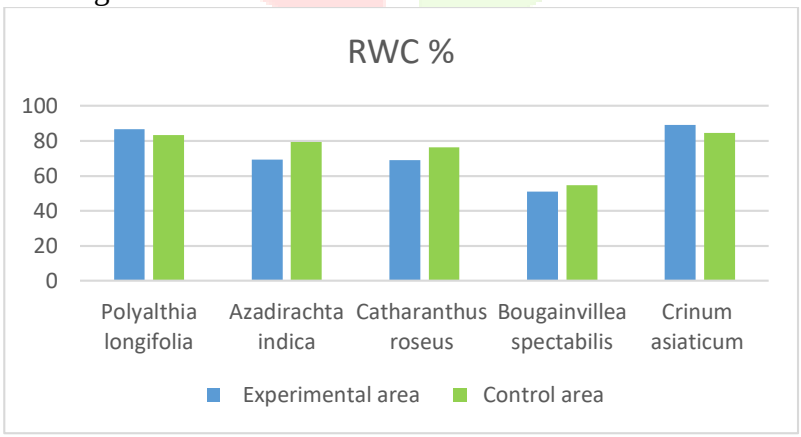


Table no 2. pH in the leaf extract

Sr. no	Name of plant species	pH	
		Experimental area	Control area
1.	*Polyalthia longifolia*	5.74±0.03	5.64±0.01
2.	*Azadirachta indica*	6.01±0.04	5.82±0.02
3.	*Catharanthus roseus*	5.93±0.01	6.01±0.06
4.	*Bougainvillea spectabilis*	6.02±0.03	5.92±0.01
5.	*Crinum asiaticum*	6.16±0.02	6.07±0.02

values given are mean ± SD

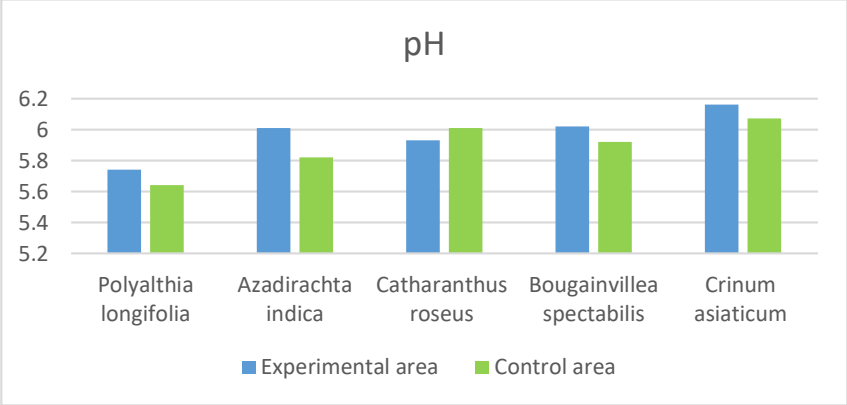


Table 3. Total chlorophyll content (mg/g) in the leaves

Sr. no	Name of plant species	TCH	
		Experimental area	Control area
1.	*Polyalthia longifolia*	0.463±0.003	0.611±0.002
2.	*Azadirachta indica*	0.623±0.020	0.684±0.003
3.	*Catharanthus roseus*	0.695±0.003	0.674±0.003
4.	*Bougainvillea spectabilis*	0.670±0.003	0.713±0.002
5.	*Crinum asiaticum*	0.488±0.003	0.540±0.003

values given are mean ± SD

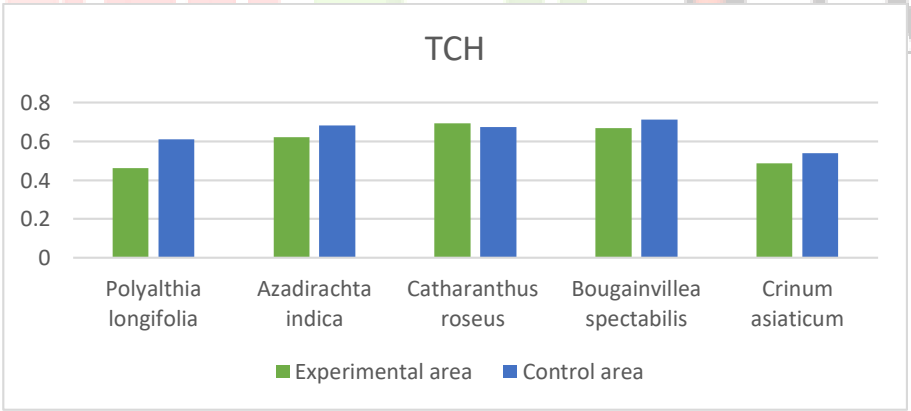


Table no 4. Ascorbic acid content (mg/g) in the leaves

Sr. no	Name of plant species	Ascorbic acid	
		Experimental area	Control area
1.	*Polyalthia longifolia*	4.62±0.32	3.75±0.21
2.	*Azadirachta indica*	3.53±0.17	3.02±0.33
3.	*Catharanthus roseus*	3.01±0.27	2.56±0.25
4.	*Bougainvillea spectabilis*	3.87±0.21	3.17±0.27
5.	*Crinum asiaticum*	3.43±0.17	2.86±0.20

Values given are mean ± SD

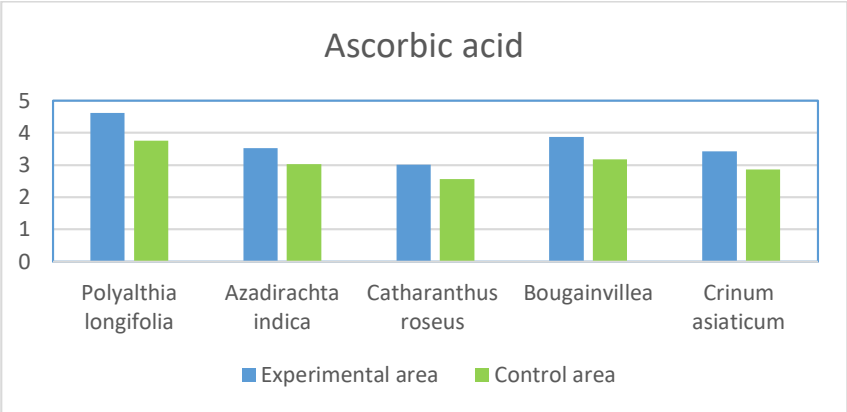
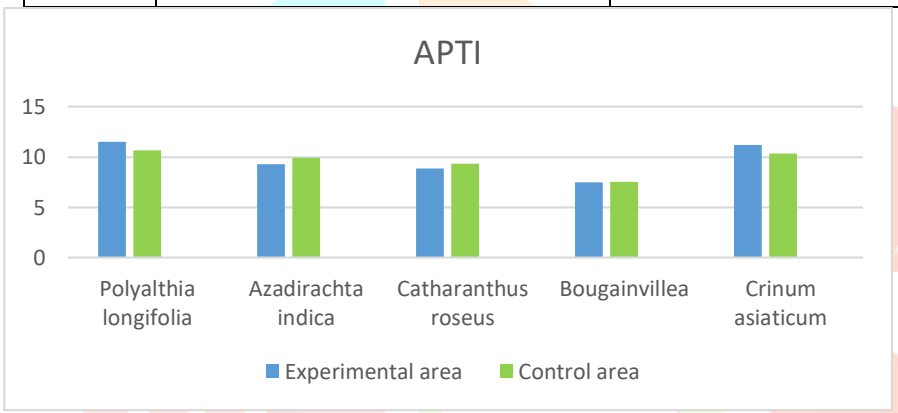


Table no 5. Air Pollution Tolerance Index

Sr. no	Name of plant species	APTI	
		Experimental area	Control area
1.	*Polyalthia longifolia*	11.53± 0.04	10.69 ±1.09
2.	*Azadirachta indica*	9.28±1.02	9.90±0.09
3.	*Catharanthus roseus*	8.88±0.06	9.35±0.07
4.	*Bougainvilleaspectabilis*	7.51±1.09	7.56±0.08
5.	*Crinum asiaticum*	11.20±1.08	10.35±0.4



RESULTS AND DISCUSSION

In the present study the highest value of relative water content was found in *Crinum asiaticum* i.e 89.23% (Table no 1). However, in the control site the RWC was found to be a little lower i.e 84.62%. The minimum RWC was observed in *Bougainvillea spectabilis* plant collected from the polluted site. In the present work the RWC in *Bougainvillea spectabilis* was found to be 51.17% in the plants collected from the experimental site. G. Buchchi Babu et al.(2013) have recorded high relative water content values for *Azadirachta indica* (85%) followed by *Cassia auriculata* (83%) in polluted site while in the control site, the lowest was recorded for *Ziziphus* in both the sites with 58 and 55%respectively. Similar observation was also made by Prabhat Kumar Rai et al., 2013. They observed a lower RWC value in *Bougainvillea spectabilis* plant collected from Aizawal area which is comparatively a cleaner area compared to Rourkela which is an Industrial area. Reduction in relative water content in plant species could be due to impact of pollutants on transpiration rate in leaves.

In the present study it has been observed that the plants from control area contain more chlorophyll as compared to those of the experimental area (table no 3).

Gour Deepika Parag (2016) reported that a high amount of chlorophyll in plants increase air pollution tolerance. Agrawal, A.L., (1988) reported that the chlorophyll contents of plants varied with the pollution status of the area, as well as the tolerance and sensitivity of the plant species.

Buchchi Babu G., **(**2013) have stated that plants with lower pH are more susceptible while those with pH around 7 are tolerant. Agarwal et al 1988 has reported that with higher concentration of acidic air pollutants, the pH of the cell sap shows a decrease. In the present study the pH values in leaves ranged from 5.74 to 6.16 in the Experimental area and 5.64 to 6.07 in the control area (Table no 2). It was observed that the pH was found to be maximum in *Crinum asiaticum* 6.16 in experimental area, However in the control area the pH was found to be 6.07. Minimum Ph was observed in *Polyalthia longifolia* (5.74) in experimental area and 5.64 in control area.

In the present study Ascorbic acid content was found to increase in all plant species in experimental area as compared to control area (Table no 4). in which maximum range of values was observed in *Polyalthia longifolia* i.e 4.62 mg g^{-1} and minimum in *Catharanthus roseus* i.e 3.01 mg g^{-1} in experimental area whereas Ascorbic acid content was found to decrease in control area showing values ranging from *Polyalthia longifolia* i.e 3.75mg g^{-1} and minimum in *Catharanthus roseus* i.e 2.56 mg g^{-1}

Deepika et al.,2016. Have stated that higher concentration of ascorbic acid in plants is an indicator of exposure to high concentration of SO2, and higher tolerance of the plant

In the present work The APTI values were in the range of 7.51 to 11.53 in the experimental area and 7.56 to 10.69 in the control area (Table 5). Highest APTI value was recorded in Polyalthia *longifolia* (i.e 11.53 in experimental site and 10.69 in control site) .Lowest APTI value was observed in *Bougainvillea spectabilis* (7.51 in experimental site and 7.56 in control site). Relatively good levels of ascorbic acid may be the reason for higher APTI values and tolerant behaviour of most of the species. Joshi et al ,2016 has reported a higher APTI values in winter.

In the present work it was observed that trees show higher APTI values in both the areas as compared to shrubs. In control area *Azadirachta indica , Catharanthus roseus* and *Bougainvillea spectabilis* have shown higher APTI values than *Polyalthia longifolia* and *Crinum asiaticum* whereas, in experimental area *Polyalthia longifolia* and *Crinum asiaticum* have registered higher values as compared to other plants. Thus, this shows that *Polyalthia longifolia* and *Crinum asiaticum* are more tolerant towards air pollution.

CONCLUSION

It was observed that most of the trees along S.V road in this region , have high tolerance level to air pollution .Out of five plant species studied highest APTI value was observed in *Polyalthia longifolia* collected from the experimental site. Concentration of Ascorbic acid content was also found to be maximum in *Polyalthia longifolia* collected from experimental area .*Crinum asiaticum* was found to be moderately tolerant with high APTI. Based on the results it is recommended that *Crinum asiaticum* which is moderately tolerant may be preferred for green belt development in the median strips and *Polyalthia longifolia* can be grown along the road side pathways.

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