ISSN No:-2456-2165

Dust Deposition (DD) and Air Pollution Tolerance Index (APTI) Analysis of Common Plant Species: A Comparative Study of Seven Plant Species in Industrial and Residential Areas

Muhammad Waqar Talib[1]
Chen Xiaoguang[1, 2,*]
[1]Shanghai Frontier Science Research Center for Modern Textiles, College of Environmental Science and Engineering, Donghua University, Shanghai, 201620, China
[2]State Environmental Protection Engineering Center for Pollution Treatment and Control in Textile Industry, Donghua University, Shanghai, 201620, China

Abstract:- To study and reduce the effects of air pollution on human health, selection of sensitive and tolerant plant species as bio-indicators is necessary for green belt development. The Air Pollution Tolerance Index (APTI) is a crucial instrument for separating out plants depending on how sensitive or tolerant they are to various air pollutants. In this study a set of seven most common plant species (Mangifera Indica, Saraca Asoca, Cassia Fistula, Syzygium Cumini, Amarnthus Viridus, Malva Neglecta, and Datura Inoxia) were examined at each of two different locations: residential site and industrial site. Plants were selected with increasing distance of 50-100m, 250-300m, 500-600m at each location from the pollution source making it a broader study with a set of 21 test points at each location: 42 test points in total for both locations. The present study suggested that the Cassia. Fistula (Average APTI = 16.32) and Mangifera Indica (Average APTI = 15.75) are the most tolerant species and as remedial measures and for green belt designing, these plants could be cultivated near pollution sources due to their high level of tolerance towards environmental pollutants. The Datura Inoxia and Amarnthus Viridus were found the most sensitive species with Average APTI of 10.87 and 10.63 respectively and can be used as bio indicators for the pollution indicator at these sites. In addition, the study found that the average dust deposition was higher in the industrial site (4.25mg/cm^2) than in the residential site (1.92mg/cm^2), indicating the adverse consequence on the health of workers in boiler industry locations. The dust deposition was also recorded increasing with the decreasing distance from the source of pollution at industrial site (50-100m = 4.25mg/cm^2) > (500-600m = 3.65mg/cm^2) which highlights the urgent need for effective planetary management to mitigate the impact of air pollution on human health.

Keywords:- *Component; Air Pollution Tolerance Index (APTI), Bio-Indicator, Dust Deposition (DD), Relative Water Content (RWC), Total Chlorophyll Concentration (Chl), Ascorbic Acid Content (ACC), Ph of Leaf Extract (pH)*

I. INTRODUCTION

The rapid growth of urbanization and industrialization has led to widespread environmental degradation and a sharp increase in air pollution levels around the world [1][2]. Air is a crucial element for human survival, and the development of green belts is an effective approach to mitigate the negative effects of air pollution [3]. By using plants to absorb pollutants and improve air quality, green belts can make a significant impact on the health and well-being of local communities. However, not all plant species can thrive in polluted environments, making it crucial to identify species that can tolerate air pollution and contribute to the development of effective green belts.

The aim of our study is to compare the DD and APTI of selected plant species in the residential and industrial areas of Faisalabad. The findings of our research will help identify suitable plant species for green belt development in polluted areas and contribute to improving Faisalabad's air quality. Previous studies have shown that plant species' tolerance to air pollution varies depending on the species, location, and type of pollutant. [4], [5]–[8]. Therefore, we used DD to measure the level of air pollution and APTI to evaluate the tolerance, considering various physiological and biochemical parameters, such as chlorophyll content, leaf site, and antioxidant enzyme activities. [9]

In conclusion, the results of our study will be significant to urban planners, landscape architects, and environmentalists in the development of green belts in polluted areas. Our findings will provide insight into the selection of plant species for green belt development, contributing to improving Faisalabad's air quality and overall environmental conditions. Urgent action is needed to address the problem of air pollution, and the widespread planting of species such as Cassia fistula and Mangifera Indica is crucial to improving worker safety and health, especially in industrial areas. With careful planning and thoughtful implementation, green belts can make a significant positive impact on the environment and human health.

Our findings will be valuable to urban planners, landscape architects, and environmentalists, and we hope that our research can contribute to the improvement of air quality and overall environmental conditions in the region.

II. MATERIALS AND METHODS

- *Study Site Selection*

Keeping the theme of research, two distinctive sites were selected for the study in the Faisalabad city of Pakistan and named as the residential site and industrial site. The city is the 3rd most populous city of the country and second-largest city of province Punjab. Selection of industrial site (Khurrianwala) was easy for us because this city has the highest number of textile industries in the world, that is why it is also called Manchester city of Pakistan. Selection of residential site was difficult, and Canal Road was selected for the study as it is attached to the busiest and crowded Road and a continuous traffic stream. The goal of this research was twofold. The first was to understand the pollution effect of both sites, providing authorities with critical information on how industrial pollution impacts the health of boiler sector employees at the industrial site. The second goal was to understand how continuous traffic pollution is affecting the residence of nearby sites at residential site, enabling authorities to take the required measures to preserve the public's health.

- *Pollution Source*

Deciding the pollution source and studying its effects on air and plants is necessary with respect to emissions. Karar et al., [10] assessed the levels of gaseous pollutants (SO_2, NO_2, and NH_3) in the populous urban site of Faisalabad at three monitoring sites. For our study, continuous discharge of smoke from steam boilers and oil heaters is taken as pollution source at industrial site as an average industry in Faisalabad has minimum two to maximum four boilers operational at a time. For residential site, the continuous smoke from the vehicles exhaust is taken as pollution source. Vehicular emission and particulate pollution are affecting the residence's health, which is important to look after.

- *Plant Sampling and Methodology*

After studying hundreds of plants, seven different plant species were found common at both sites. One set of seven plants was found and selected within each location at increasing distances of 50-100m, 250-300m, and 500-600m from the pollution source making it total three set at each site. Seven selected common plant species were Mangifera Indica, Saraca Asoca, Cassia Fistula, Syzygium Cumini, Amarnthus Viridus, Malva Neglecta, and Datura Inoxia. We had a total of twenty-one plants (21-test points) at each location, making it a total of forty-two Plants (42-test points) for this research. Sampling was carried out for five consecutive days at both locations.

- *Test Sampling*

Each plant was sampled by collecting ten leaves, which were subsequently stored in a dry ice container and transported back to the laboratory for analysis. First, the fresh weights of the leaves were measured with calibrated analytical balance. To study the dust deposition (DD) and to take dried leave weights, leaves were washed with distilled water, dried with cotton, and kept at rest for one minute to complete the drying procedure. Five leaves for each plant and tree with the best shape and size were selected for further studies of biochemical analysis including total chlorophyll content (TChl), ascorbic acid (ACC), relative water content (RWC), and pH. Selected leaves were kept refrigerated in the lab.

The amount of dust deposition (DD) was calculated by the listed formula (Eq.1) method used by [11]

$$\mathbf{W} = \frac{\boldsymbol{W_1} - \boldsymbol{W_2}}{\mathbf{A}} \qquad \textbf{(Eq.1)}$$

- *Whereas*

- ✓ *W_1 = Fresh Leaf Weight (mg)*
- ✓ *W_2 = Dried Leaf Weight (mg)*
- ✓ *A = Leaf sample Site (cm^2)*
- ✓ *W= DD = Dust Deposition (mg/cm^2)*

pH sample was measured by crushing 0.5g of leave and then homogenized in 50mL of distilled water. The mixture was centrifuged at 2000rpm for two-minutes and the pH of the supernatant was measured using the pH meter.

Relative water content (RWC) was measured using (Eq.2) by the method listed in [12]. By leaving the leaf immersed in water overnight, then weighted to get the turgid weight. The leaf is then put in the oven at 70°C for two hours, then weighted to get the dry weight.

$$\text{RWC} = \frac{(W_f - \text{W}_d)}{(W_t - \text{W}_d)} \text{ X } 100 \qquad \textbf{(Eq.2)}$$

- *Whereas*

- ✓ W_f = Fresh leaf Weight after sampling (mg)
- ✓ W_t = Turgid leaf Weight after immersed in water (mg)
- ✓ W_d = Oven Dried leaf weight sampled at 70°C (mg)

Total chlorophyll content of leaf samples was calculated by the method described by Arnon [13] and Ascorbic acid content of leaf samples was determined by spectrophotometric method by Bajaj and Kaur [14].

Finally, Air Pollution tolerance index (APTI) of leaf sample was calculated by using above four parameters with the formula (Eq.3) given by Singh and Rao [15]

$$\text{APTI} = \frac{\text{ACC (TChl + pH) + RWC}}{10} \qquad \textbf{(Eq.3)}$$

- *Whereas*

- ✓ ACC = Ascorbic acid content (mg/g)
- ✓ TChl = Total chlorophyll (mg/g)

- ✓ pH = pH of leaf extract
- ✓ RWC = Relative water content of leaf (%)

Species having APTI value of ≤11 considered as sensitive and can be used as bioindicator. APTI values between 12 and 16 are considered intermediate. While APTI values ≥17 are considered to be tolerant and can be used in green belt designing [16].

III. RESULTS AND DISCUSSIONS

➢ *Relative Water Content (RWC)*

According to Kuddus [17], plants with tall water content are better able to fend off the negative effects of air pollutants as well as maintain ecological balance, so although plants with lower lenience may result in reduced transpiration rates and harm to the leaf engine that draws aquatic up by the roots [18]. RWC of the plant species is the water available in it, and it is a direct measure of deficit in the plant leaves [19]. Under stressed and polluted conditions, plants can maintain their water balance due to their high-water content.

Fig.1 and Fig.2 show the RWC of all seven plants with different distance at residential site and industrial site respectively in one frame. Fig. 3 summarizes the relation of TChl with respect to both sites' results, keeping the distance constant.

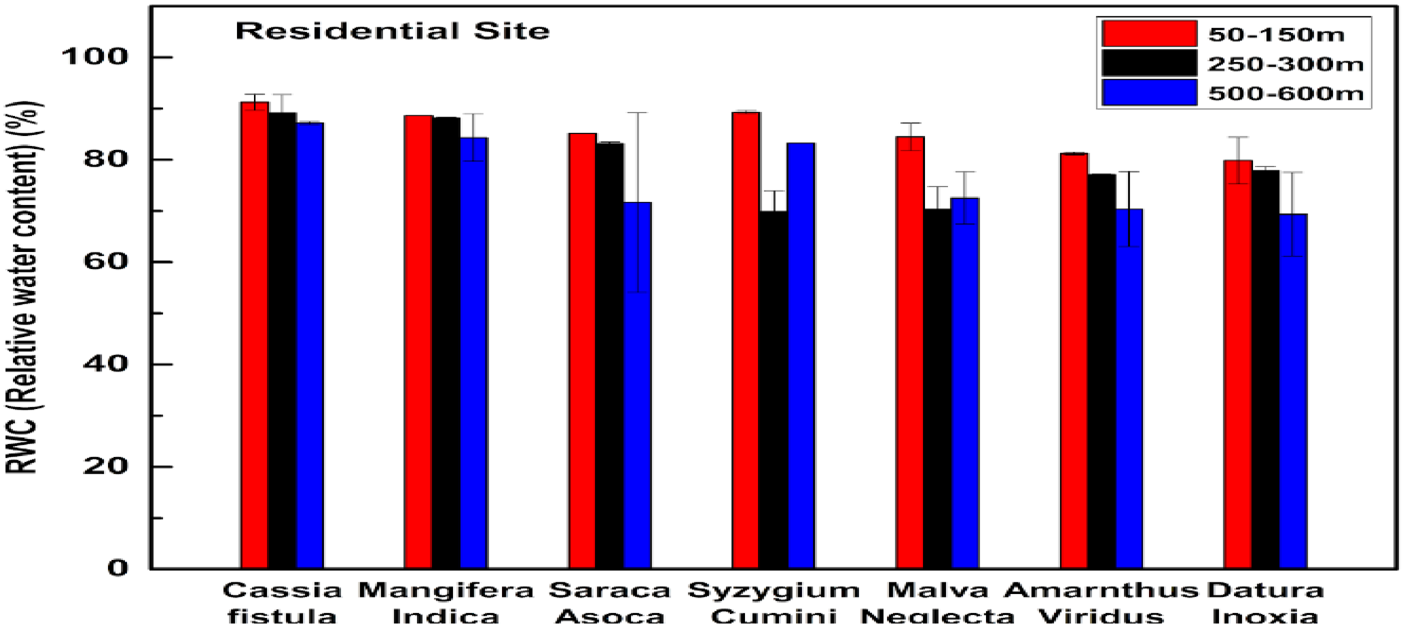


Fig 1 Variations in RWC (%) of studied plants with increasing distance from source at residential Site.

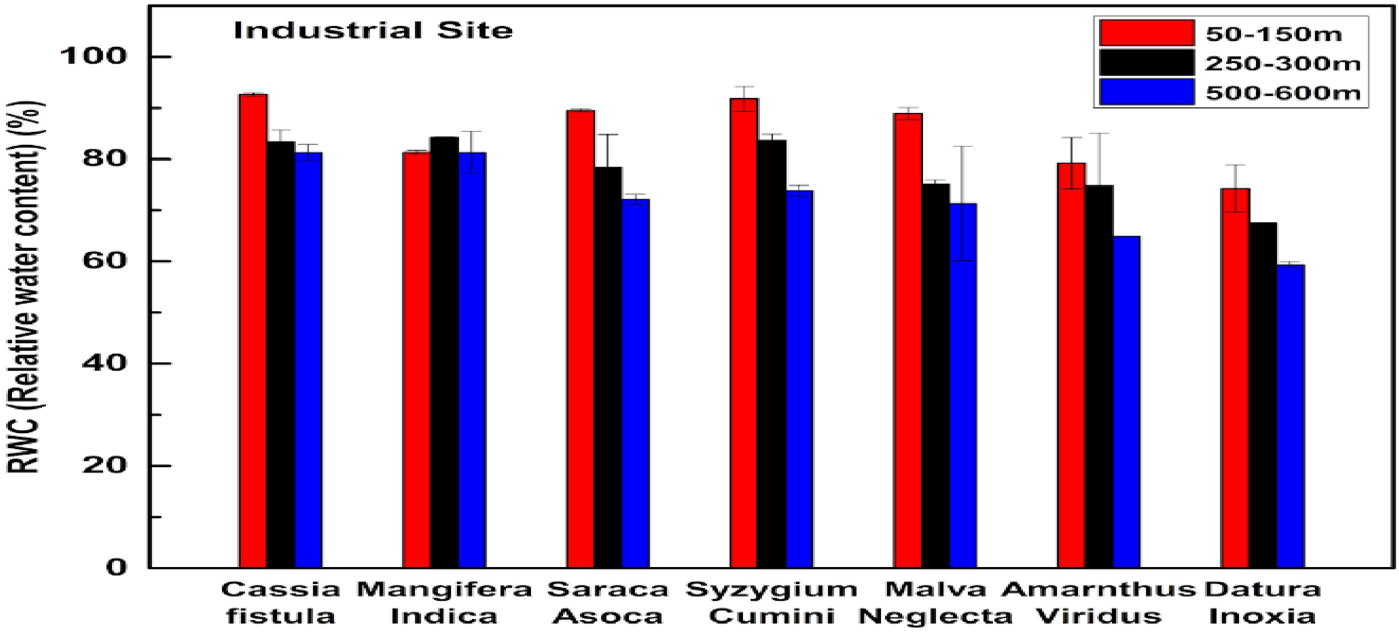


Fig 2 Variations in RWC (%) of studied plants with increasing distance from source at industrial Site.

The RWC of the had been originating to vary in both experimental sites with varying air pollution levels. Among the class, the highest mean RWC of 92.67 ± 0.34% was noticed in Cassia fistula in industrial site, whereas the lowest mean comparative water content of 74.27 ± 4.62% was obtained in Datura Inoxia in industrial site. In residential site, the highest mean RWC was recorded in Cassia fistula of 91.24 ± 1.59%. The lowest mean RWC was noted by Datura Inoxia of 74.27 ± 4.62%, and 79.87 ± 4.55% respectively in all experimental sites.

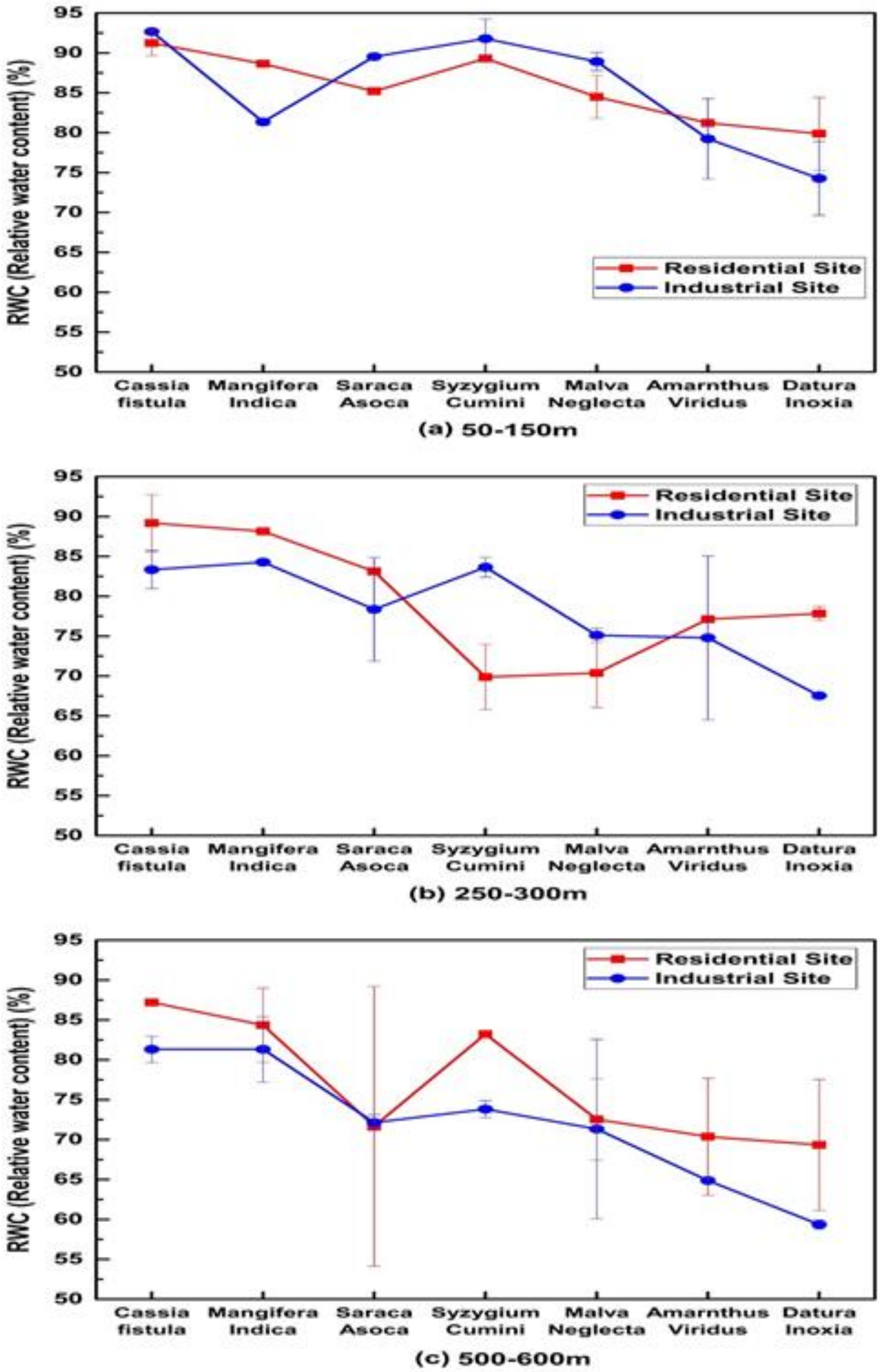


Fig 3 Correlation of RWC (%) with Respect to Distance at both Sites

- *Total Chlorophyll Content (TChl)*

Leaf chlorophyll is a key indicator of leaf greenness, and it is often used to investigate leaf nutrient deficiencies and changes in chlorophyll TChl (mg/cm) is the average of Chl-a (Chlorophyll a) and Chl-b (Chlorophyll b). The photosynthetic activity, growth, and development of biomass of plants can be determined by measuring the chlorophyll content. [5], [6], [20].

Fig. 4 and Fig. 5 show the TChl (mg/g) of all seven plants with different distance at residential site and industrial site respectively in one frame. Fig. 6 summarizes the relation of TChl with respect to both sites' results, keeping the distance constant. The variation in chlorophyll content among plant species can be attributed to both the conditions and pollution levels of the surrounding environment, as well as the plants' sensitivity to these factors. Additionally, the process of photosynthesis, which is crucial for plant growth, may be hindered by the accumulation of dust on the plants.

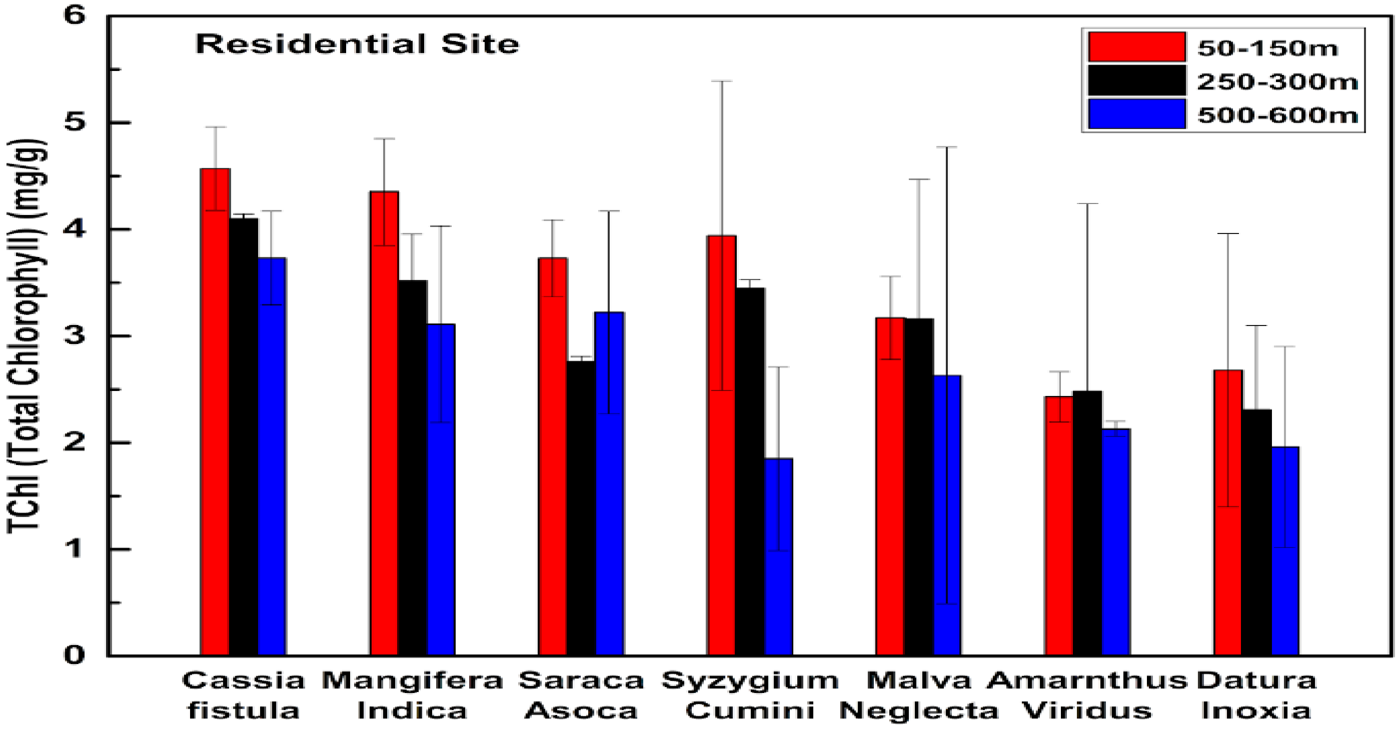


Fig 4 Variations in TChl (mg/g) of studied plants with increasing distance from source at residential site.

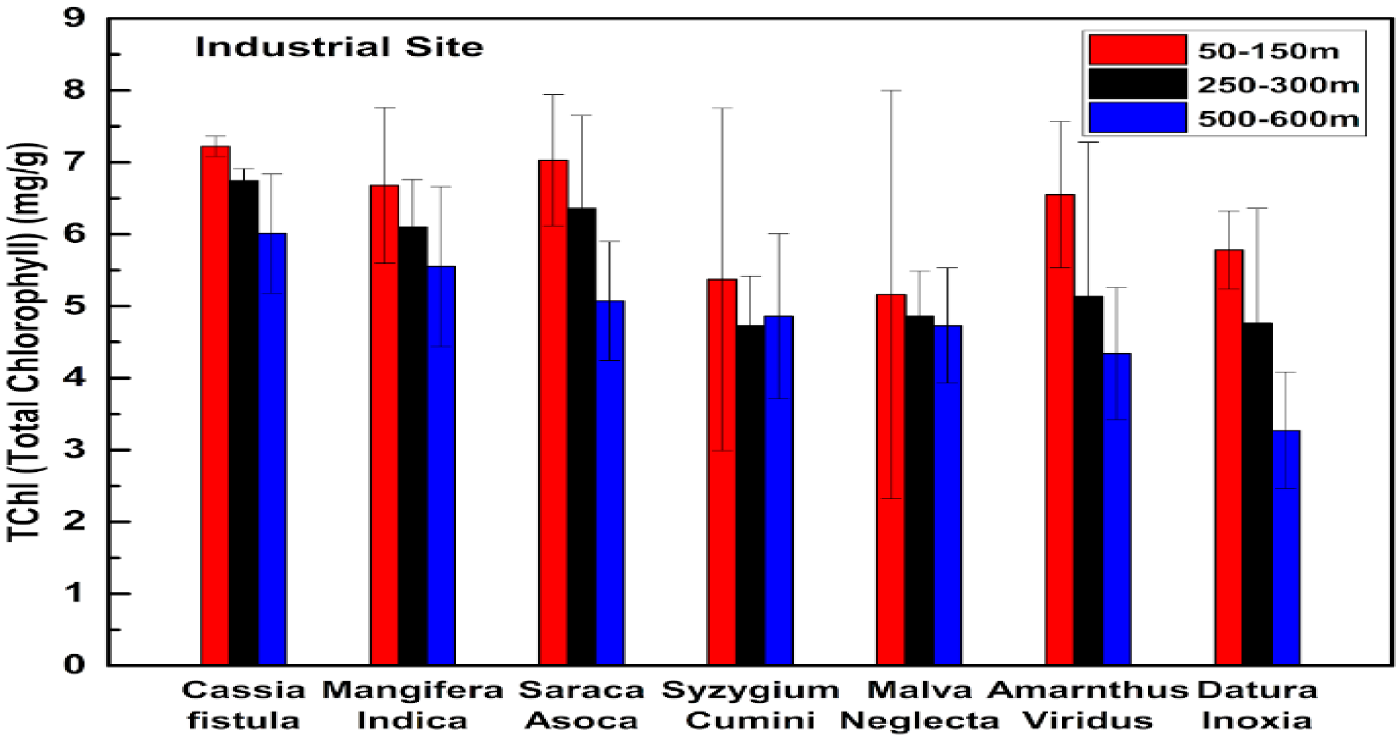


Fig 5 Variations in TChl (mg/g) of studied plants with increasing distance from source at industrial site.

The TChl ranged from 2.68 ± 1.28 (mg/g) to 7.22 ± 0.14 (mg/g). In residential and industrial site, the highest mean worth of chlorophyll content was showed in Cassia Fistula of 7.22 ± 0.14 (mg/g) and Saraca Asoca of 7.03 ± 0.914 (mg/g) respectively. The lowest mean value of TChl was revealed in Datura Inoxia of 2.68 ± 1.28 (mg/g), 2.08±0.48 (mg/g), and 2.43 ± 0.236 (mg/g) individually in residential site.

ISSN No:-2456-2165

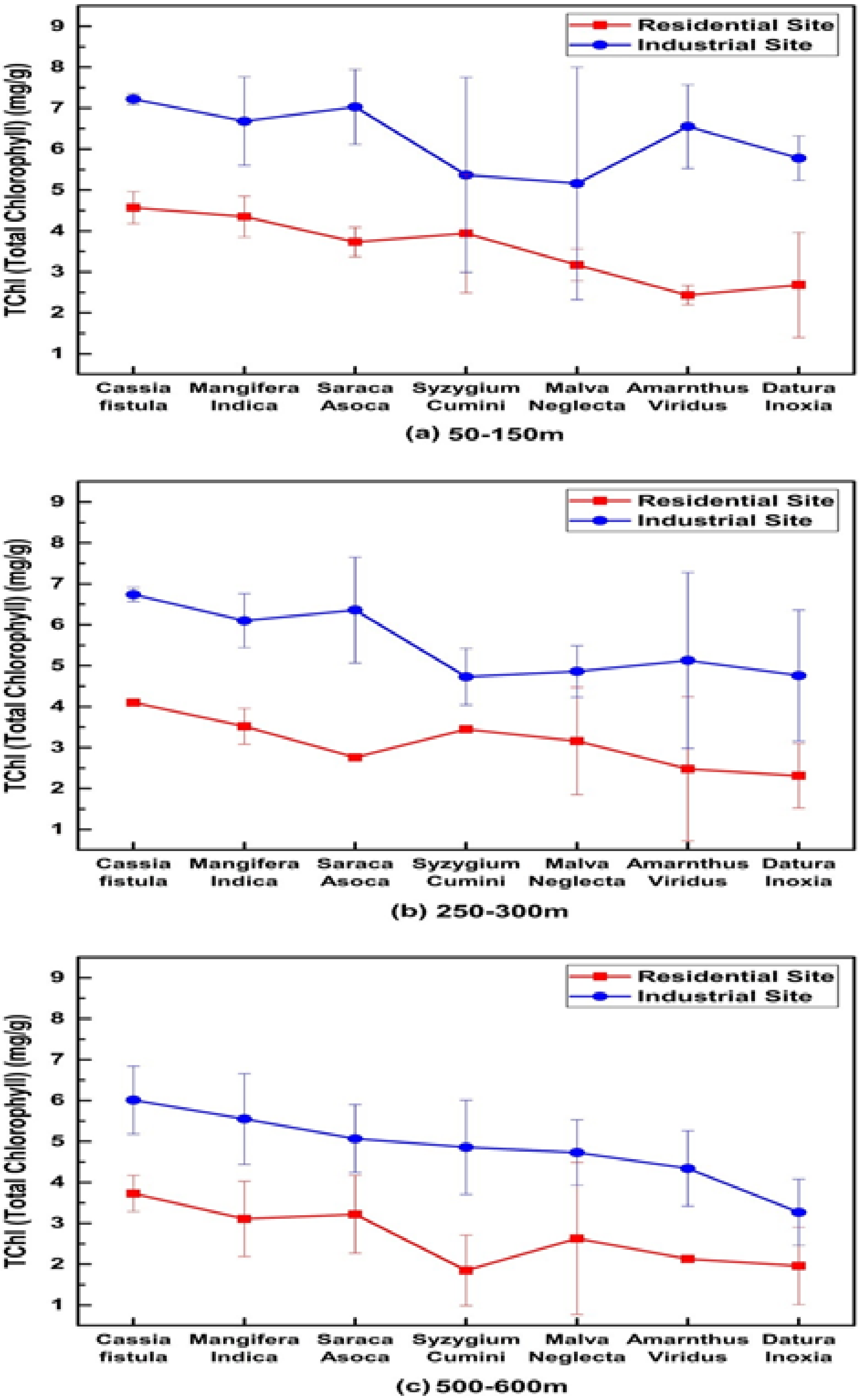


Fig 6 Correlation of TChl (mg/g) with respect to distance at both sites

➢ *Ascorbic Acid Content (ACC)*

Rai et al. [21] stated that maintaining a high level of ascorbic acid contented under polluted conditions is a symbol of tolerance to air pollution stress in plants. Joshi et al. [22] reported that higher levels of ACC in plants growing in polluted sites may be owing to their resistance mechanism to cope with stressful circumstances.

Ascorbic acid plays an important role in stress tolerance. It is antioxidant and in all the growing plants it found in large amounts, and it influences the resistance during the air pollution and worst environmental situations [23]. Ascorbic acid plays an essential role in cell wall synthesis defense, and cell division [24]. The reducing power of ascorbic acid is said to be proportional to its concentration, and it is dependent on pH [25].

Fig. 7 and Fig. 8 show the ACC of all seven plants with different distances at residential site and industrial site respectively in one frame. Fig. 9 summarizes the relation of ACC with respect to both sites' results, keeping the distance constant.

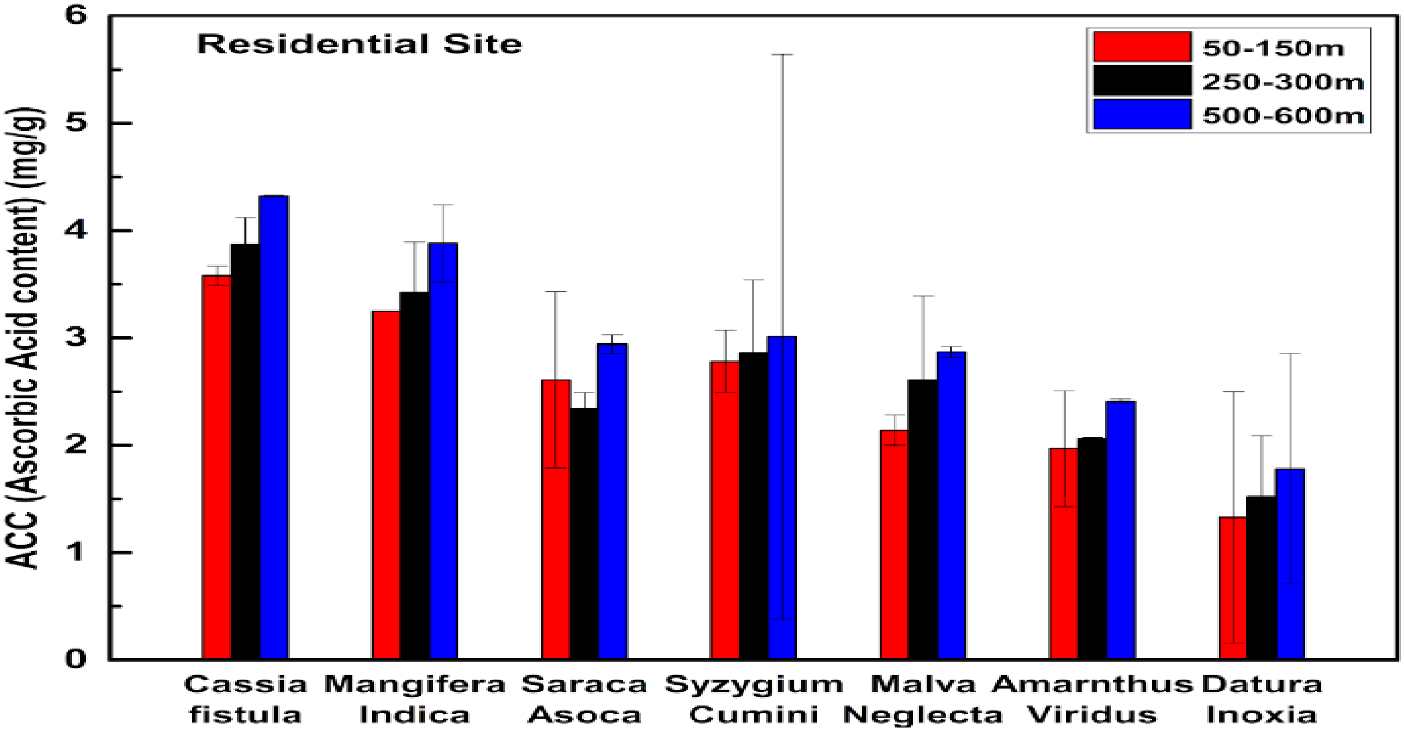


Fig 7 Variations in ACC (mg/g) of studied plants with increasing distance from source at residential site

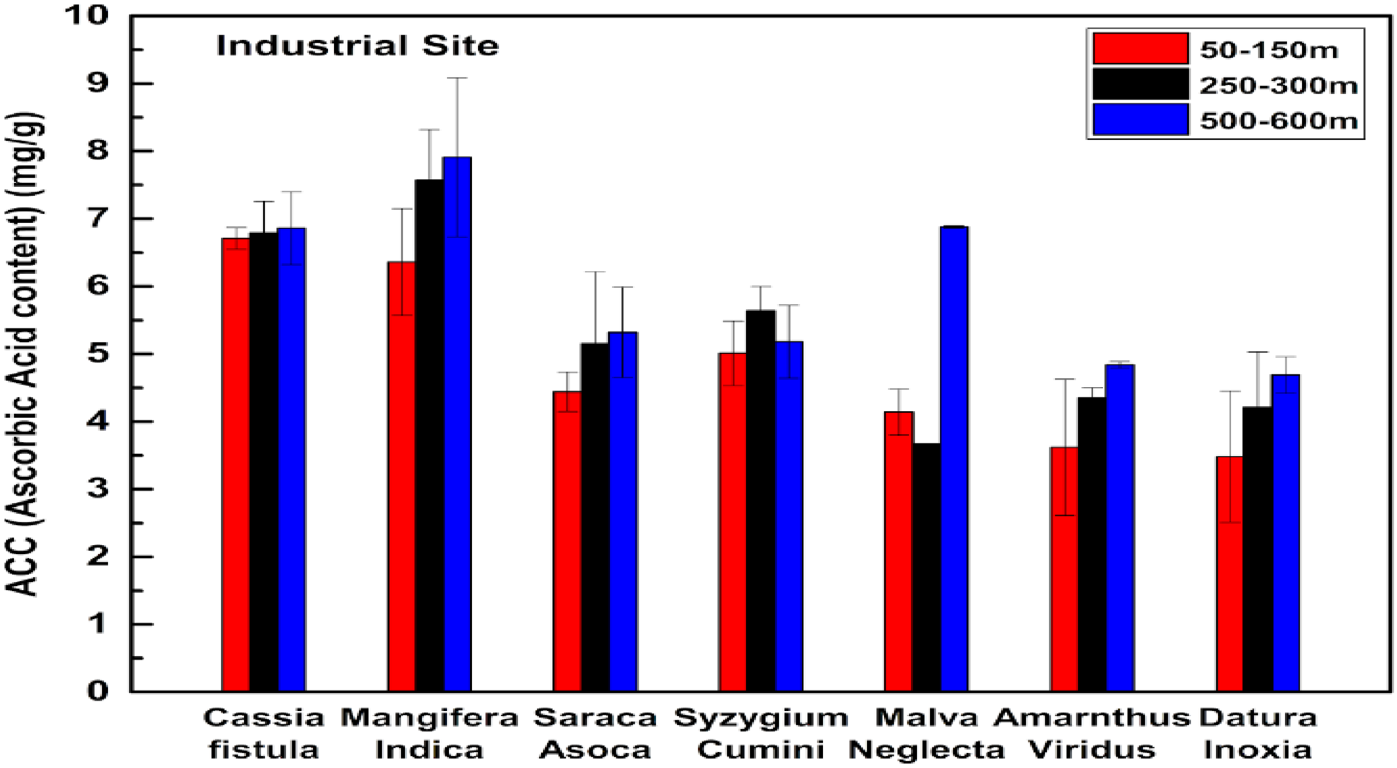


Fig 8 Variations in ACC (mg/g) of studied plants with increasing distance from source at industrial site.

ACC in different experimental sites ranged from 1.33 ± 1.17 (mg/g) to 6.71 ± 0.16 (mg/g). When ACC of the leaf samples from residential site and industrial site were compared, significant increase in ascorbic acid was recorded in most of the sample of industrial site, except in Datura Inoxia and Amarnthus Viridus. In residential site, the maximum mean ascorbic acid was verified in Cassia fistula of 3.58 ± 0.09 (mg/g) while its minimum mean was in Datura Inoxia of 1.33 ± 1.17 (mg/g). In industrial site, the highest mean ACC was showed in Cassia fistula of 6.71 ± 0.16 (mg/g) whereas, the lowest mean value in Datura Inoxia of 3.48 ± 0.97 (mg/g).

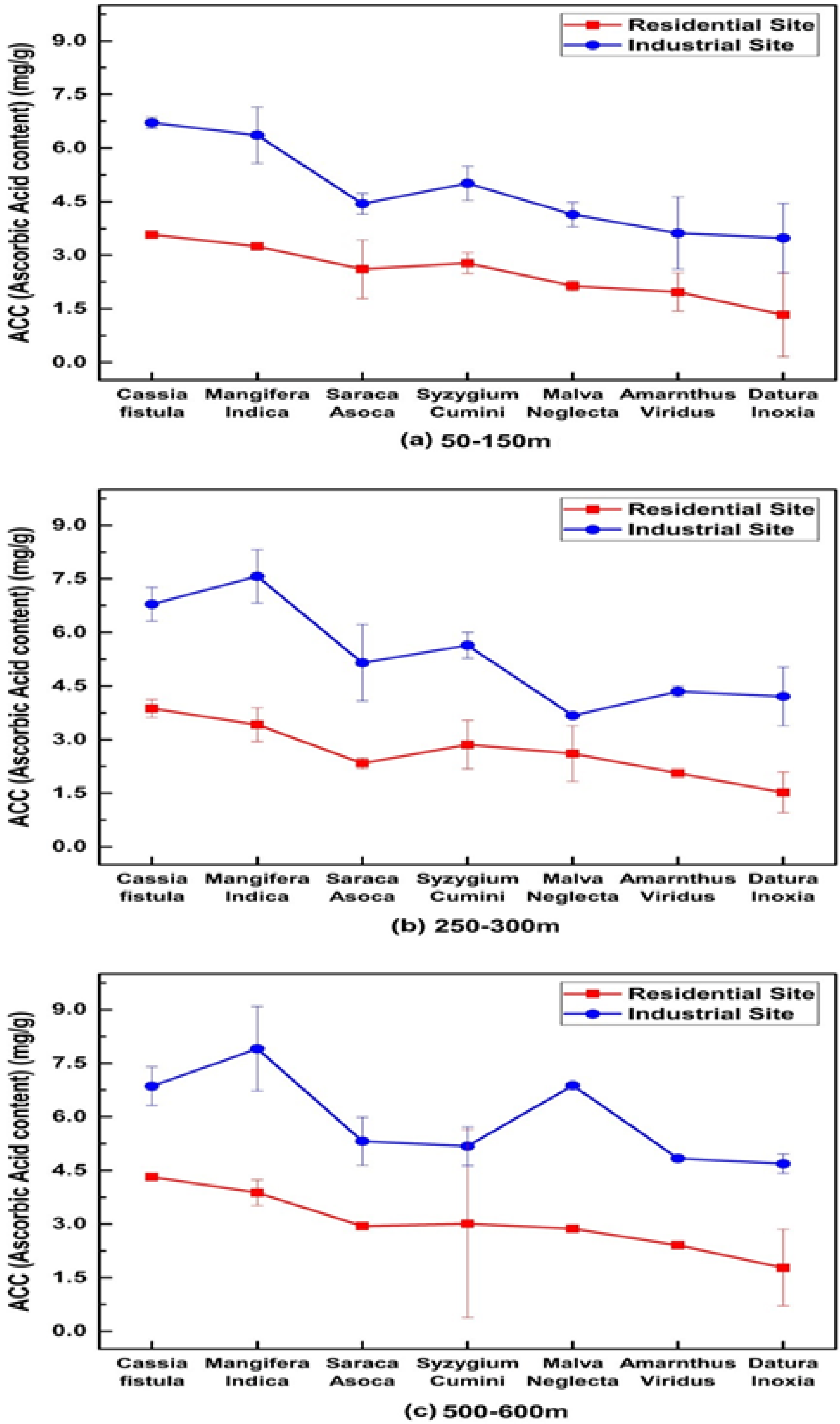


Fig 9 Correlation of ACC (mg/g) with respect to distance at both sites

➢ *Potential Hydrogen (pH)*

Acidic pollutants are identified to affect the pH of plant leaves, with a more pronounced decline in pH observed in sensitive species. Joshi and Chauhan [26] found that leaf pH was consistently in the acidic range in plants growing in sites with high stages of gaseous pollutants. This is in line with the observations made by Escobedo et al., [16]–[18], who reported that low leaf pH can negatively impact photosynthetic efficiency in plant species.

Fig. 10 and Fig. 11 show the pH of all seven plants with different distances at residential site and industrial site respectively in one frame. Fig. 12 summarizes the relation of pH with respect to both sites' results, keeping the distance constant. The pH of a plant species' leaf extract serves as a biochemical parameter indicating its sensitivity to air pollution and tolerance capacity. A higher pH indicates that the plant species can tolerate polluted conditions.

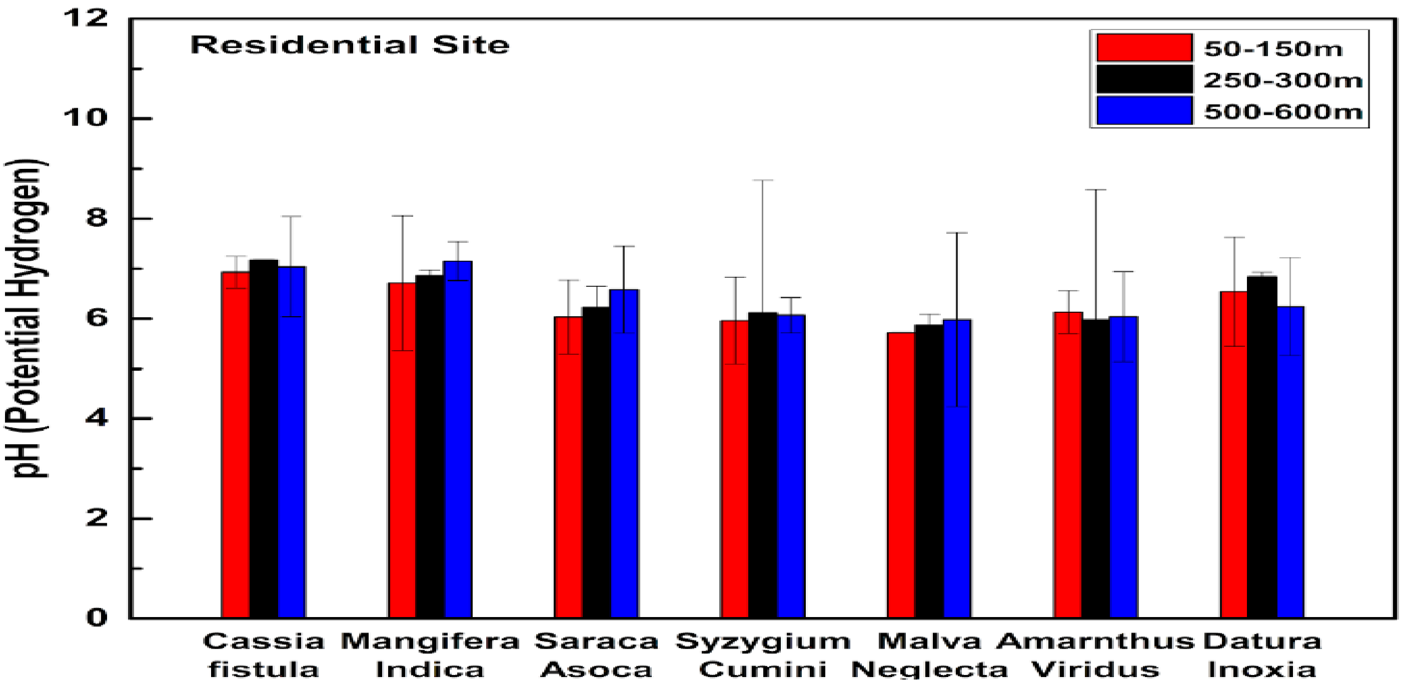


Fig 10 Variations in pH of studied plants with increasing distance from source at residential site.

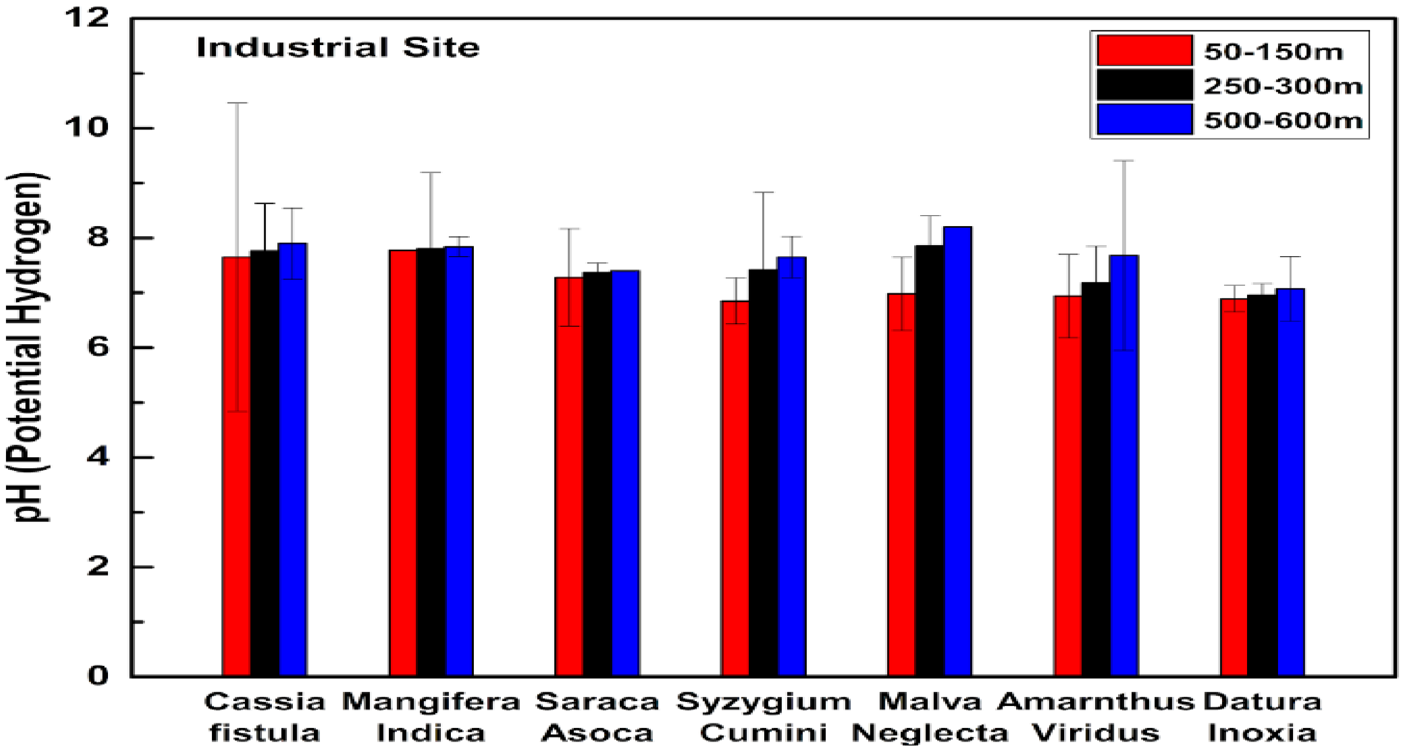


Fig 11 Variations in pH of studied plants with increasing distance from source at industrial site.

The designated plant species of different experimental sites noticed an important variation in leaf extract pH. The mean value of leaf excerpt pH of plant type was found to be decreased in residential site than industrial site. The lowest pH value of 5.72 ± 0.007 was noted in Malva Neglecta whereas the highest mean value of 7.77 ± 0.0012 was recorded in Mangifera Indica in. In residential site, maximum value of pH 6.93 ± 0.32 was noticed in Cassia fistula whereas the minimum value of pH, 5.72 ± 0.007 was observed on Malva Neglecta. In the industrial site maximum value of pH, 7.77 ± 0.0012 was obtained by Mangifera Indica and the minimum value of pH, 6.85 ± 0.42 by Syzygium Cumini.

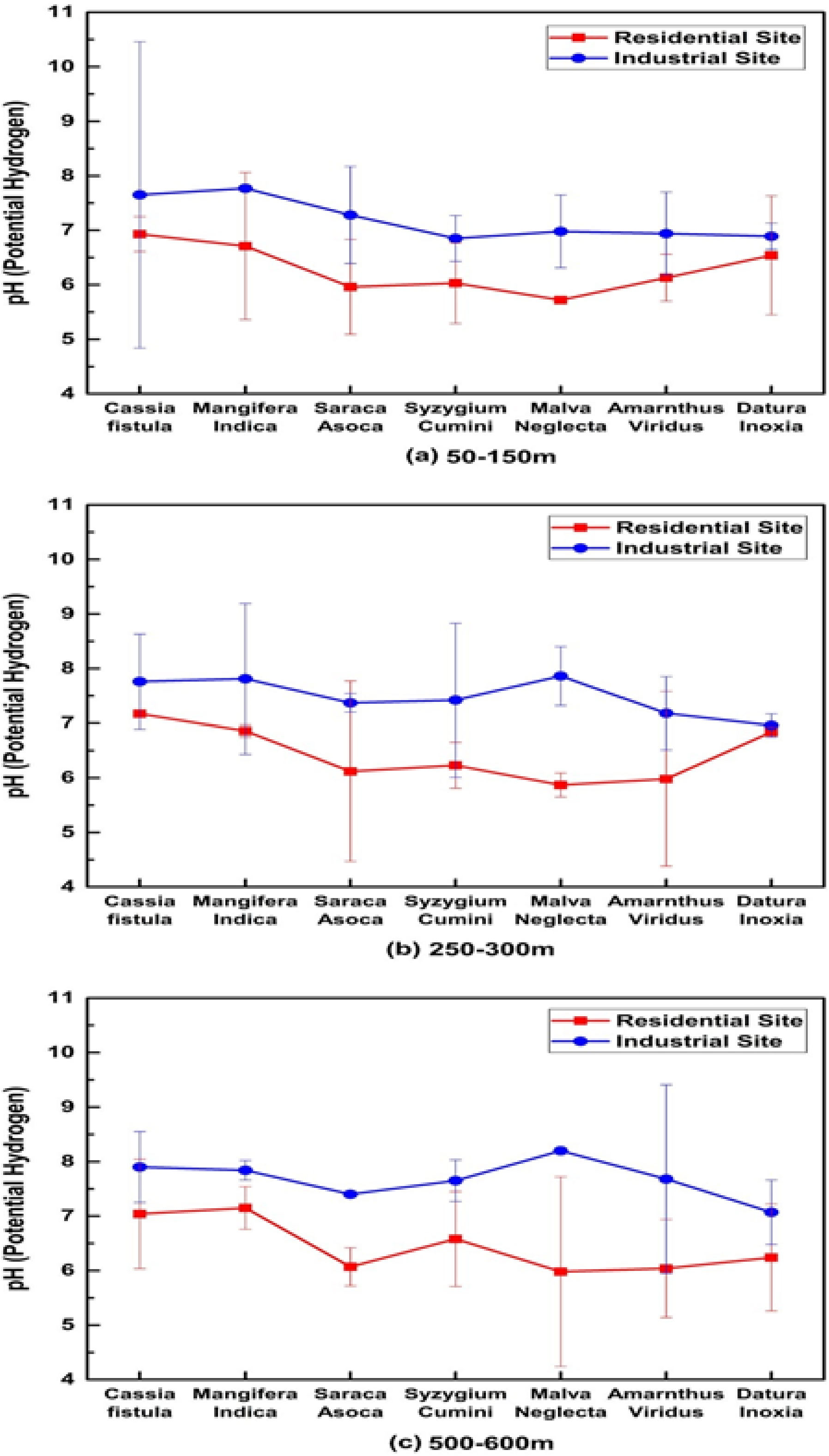


Fig 12 Correlation of pH with respect to distance at both sites

- *Air Pollution Tolerance Index (APTI)*

The susceptibility of plants to pollution is indicated by the Air Pollution Tolerance Index (APTI). A high APTI value indicates that the plant is tolerant to pollution. The present investigation revealed marked variations in susceptibility to air pollutants among all studied plant species.

Fig. 13 and Fig. 14 show the variation in APTI of all seven plants with different distances at residential site and industrial site respectively in one frame. Fig. 15 summarizes the relation of APTI with respect to both sites' results, keeping the distance constant.

The mean APTI values among the selected species ranged from (9.39 ± 1.29) to (19.27 ± 1.51). The highest mean APTI value of (13.24 ± 0.34) and (19.27 ± 1.51) were recorded by Cassia fistula in residential site and industrial site respectively. The lowest mean values of APTI were presented by Datura Inoxia with respective values of (9.39 ± 1.29) and (11.88 ± 1.32) in residential site and industrial site.

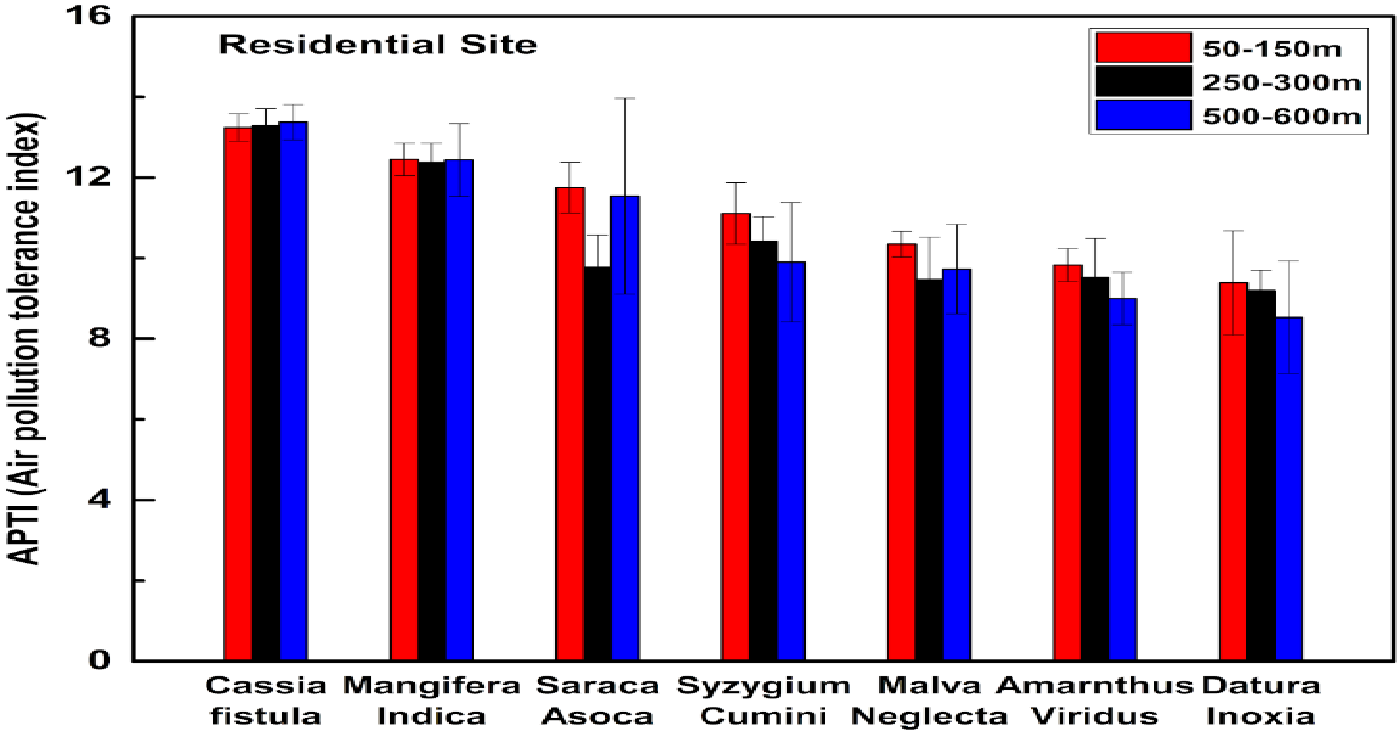


Fig 13 Variations in APTI of studied plants with increasing distance from source at residential site.

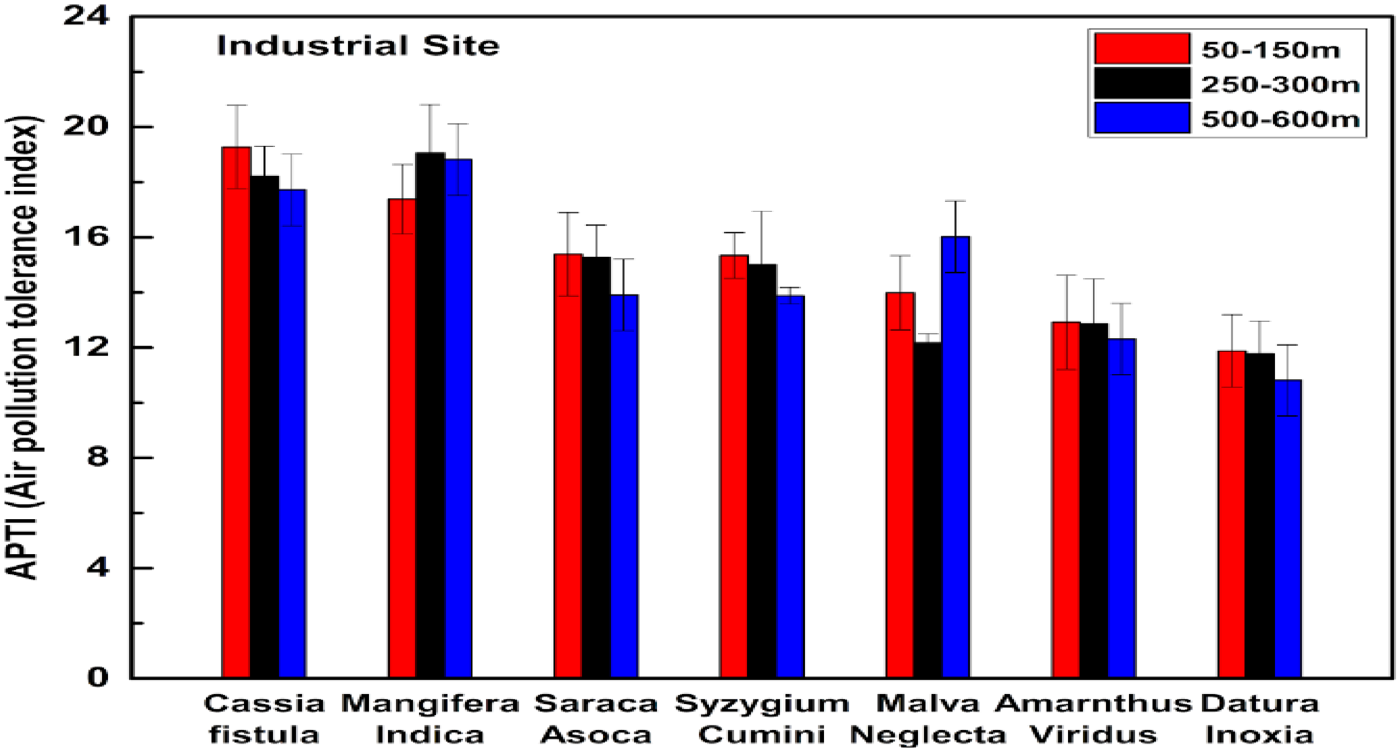


Fig 14 Variations in APTI of studied plants with increasing distance from source at industrial site.

This variation in the air pollution index of plants can be linked to the variation in any of the four biochemical parameters used to compute the total pollution index. According to Agrawal et al. [27], plants were divided into three categories based on Air pollution tolerance indices. Species with APTI values less than 16 were considered sensitive, whereas those with values greater than 16 were considered tolerant and could withstand high pollution loads. [11]

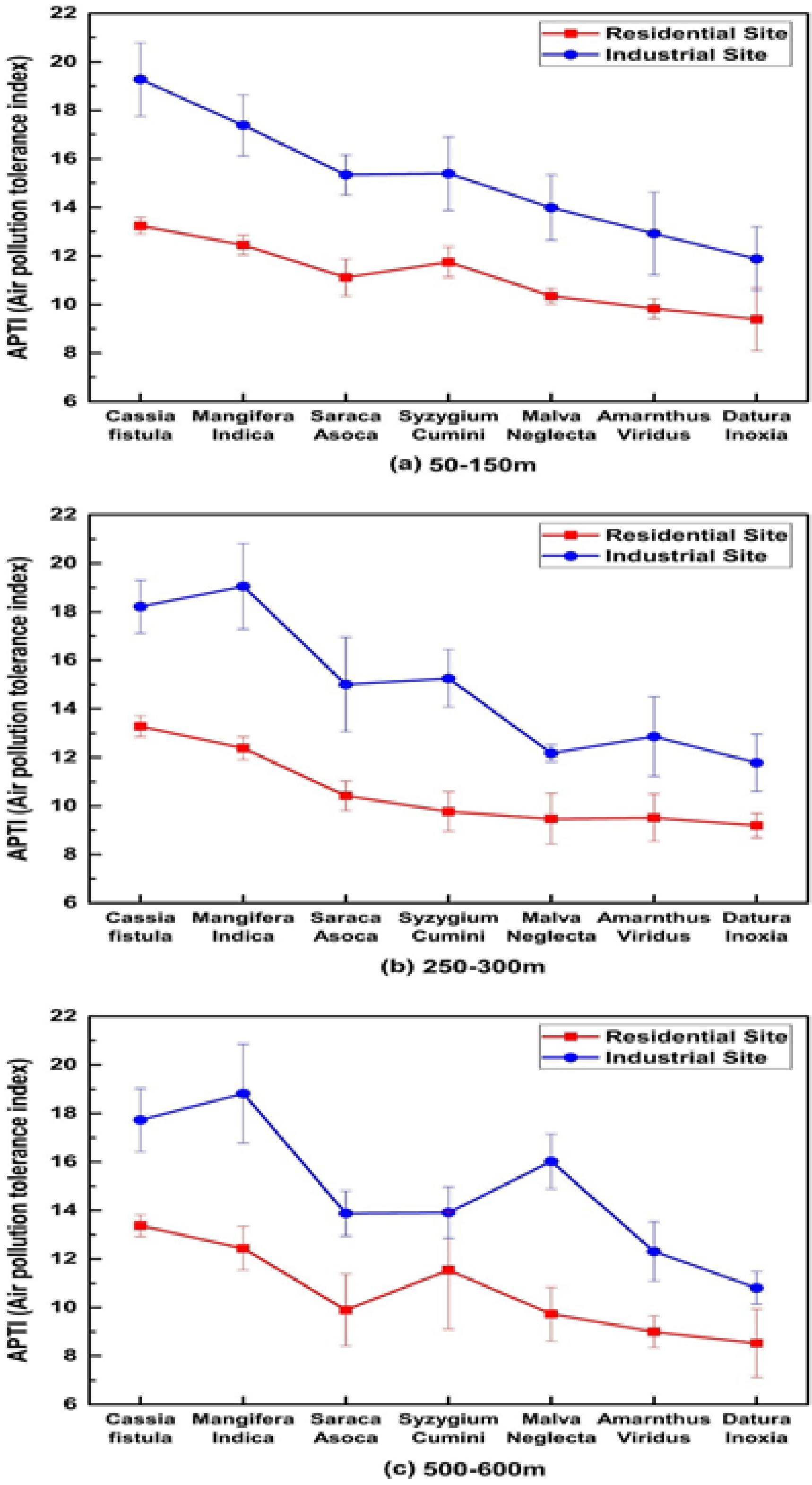


Fig 15 Correlation of APTI with respect to distance at both sites

➢ *Dust Deposition (DD)*

Dust capturing capacity of leaves depends upon many factors such as morphological characteristics, climatic condition. Seasonal variation also influences the dust deposition. DD not only prevents sunlight reaching up to leaves, but it also blocks stomata, which ultimately reduces gaseous exchanges. Dust also affected the biochemical characteristics.

Fig. 16 and Fig. 17 show the variation in DD (mg/cm^2) of all seven plants with different distances at residential site and industrial site respectively in one frame. Fig. 18 summarizes the relation of DD (mg/cm^2) with respect to both sites' results, keeping the distance constant.

ISSN No:-2456-2165

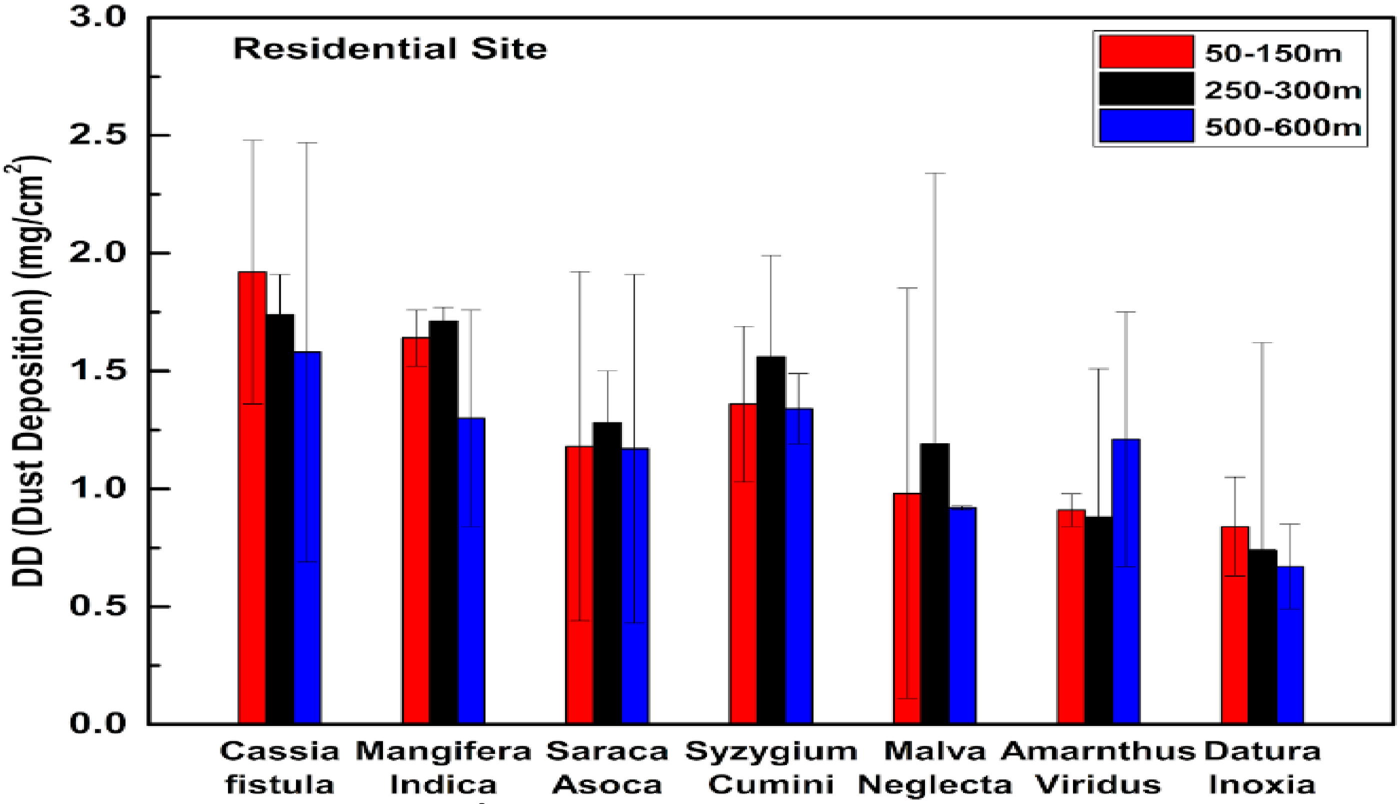


Fig 16 Variations in DD (mg/cm^2) of studied plants with increasing distance from source at residential site

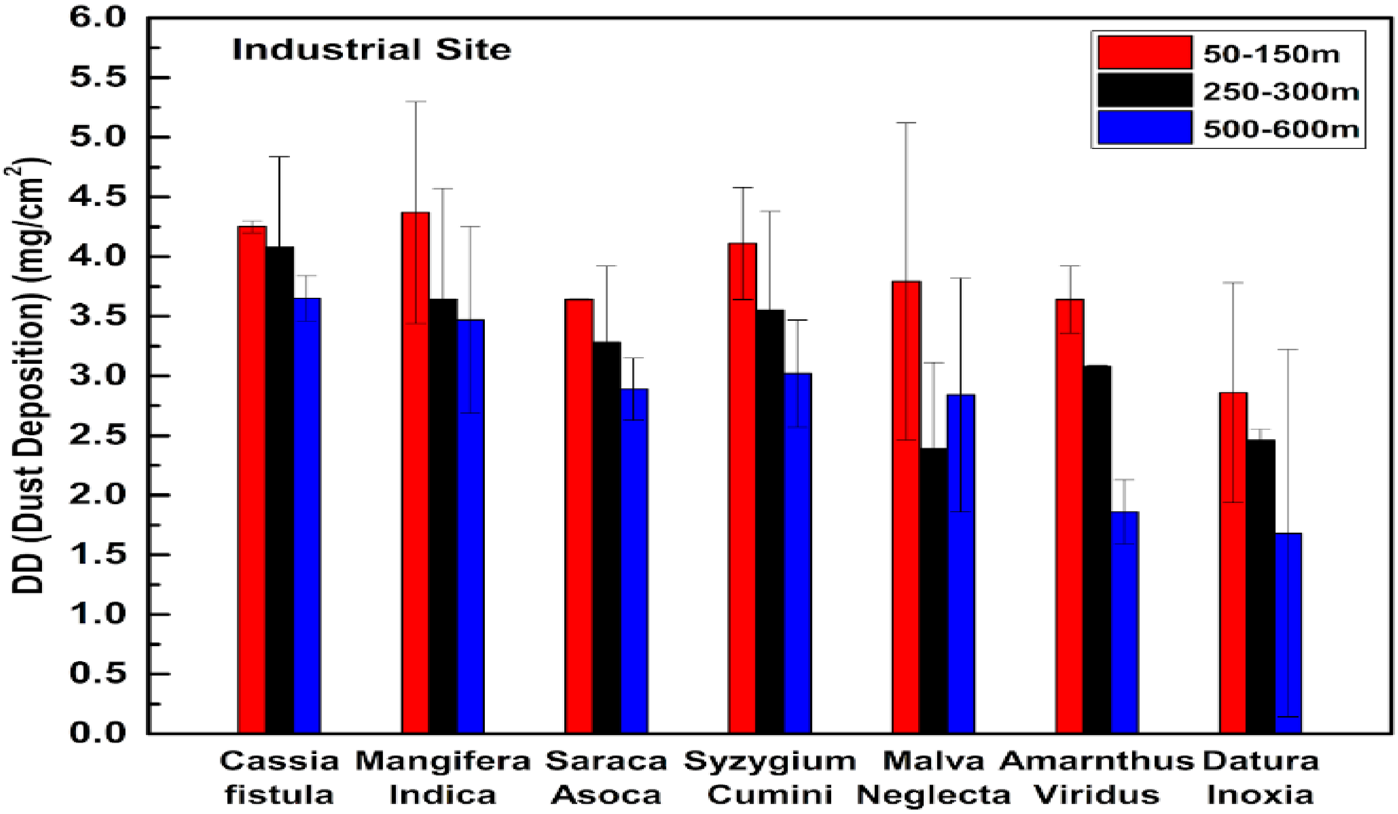


Fig 17 Variations in DD (mg/cm^2) of studied plants with increasing distance from source at industrial site.

The DD was found to be increased in industrial site than residential site. The mean DD ranged from 0.84 ± 0.21 mg/cm2 to 4.37 ± 0.93 (mg/cm^2). In residential site, the highest mean total DD of 1.92 ± 0.56 (mg/cm^2) was noticed by B Cassia fistula. In the industrial site, the highest mean total DD was noticed in Mangifera Indica of 4.37 ± 0.93 (mg/cm^2). The lowest mean DD of 0.84 ± 0.21 (mg/cm^2), and 2.86 ± 0.92 (mg/cm^2) were noticed in Datura Inoxia respectively in all experimental sites.

ISSN No:-2456-2165

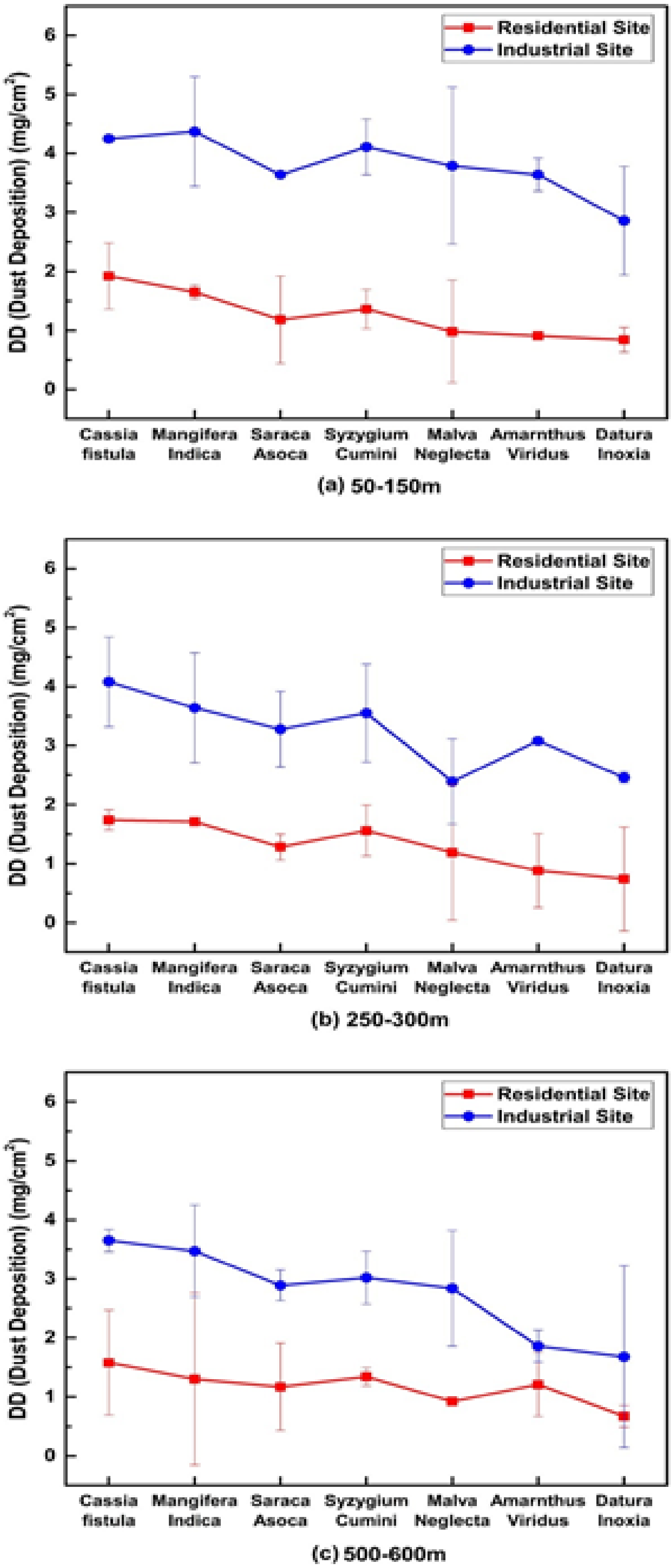


Fig 18 Correlation of DD (mg/cm^2) with respect to distance at both sites

ISSN No:-2456-2165

IV. CONCLUSIONS AND SUMMARY

➢ *APTI Order and Plant Suggestion*

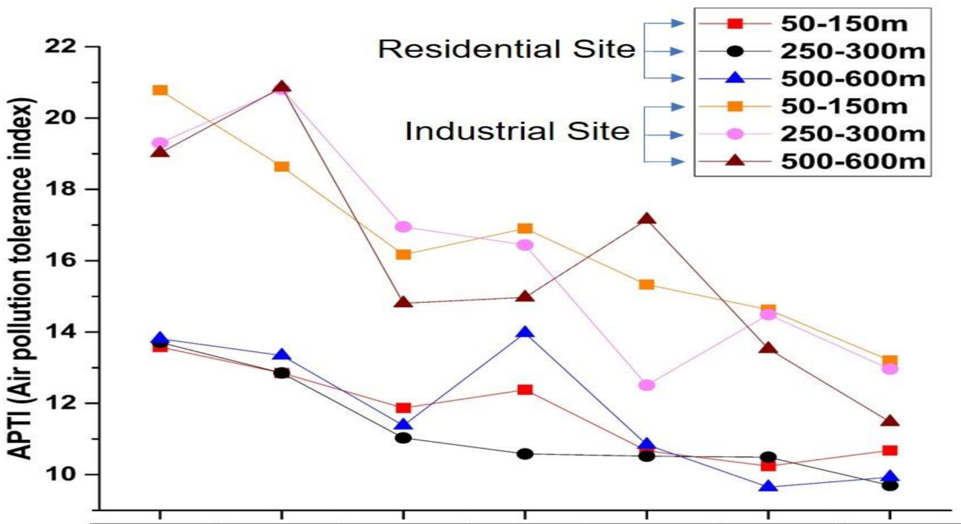
At residential site, the highest APTI order for all three distances of selected plant species was found Cassia fistula (13.37) > Mangifera Indica (12.45) > Syzygium Cumini (11.75) > Saraca Asoca (11.11) > Malva Neglecta (10.35) > Amarnthus Viridus (9.83) > Datura Inoxia (9.39).

At industrial site, the highest APTI for all three distances showed higher values and the order was Cassia Fistula (19.27) > Mangifera Indica (19.05) > Syzygium Cumini (15.39) > Malva Neglecta (15.34) > Saraca Asoca (16.02) > Amarnthus Viridus (12.92) > Datura Inoxia (11.88).

The present study suggested that the Cassia Fistula and Mangifera Indica showed the highest values of APTI at both sites. Cassia Fistula (Average APTI= 16.32) and M. Indica (Average APTI= 15.75) are the most tolerant species and as remedial measures and for green belt designing, these plants could be cultivated near pollution sources due to their high level of tolerance towards environmental pollutants.

The study showed that Datura Inoxia and Amaranthus Viridus exhibited the lowest values and were identified as the most sensitive species, with an average APTI of 10.87 and 10.63, respectively, making them suitable bioindicators for pollution at these locations.

Fig. 19. Shows all the average APTI values incorporating the standard deviation at each distance for both the locations. A total of 42 test points results.



Cassia fistula	Mangifera Indica	Saraca Asoca	Syzygium Cumini	Malva Neglecta	Amarnthus Viridus	Datura Inoxia
13.58	12.85	11.87	12.38	10.67	10.24	10.68
13.71	12.85	11.03	10.58	10.52	10.49	9.70
22.96	13.34	11.38	13.97	10.84	9.65	9.93
20.78	18.64	16.17	16.90	15.33	14.63	13.20
19.30	20.81	16.95	16.44	12.51	14.49	12.96
19.02	20.86	14.81	14.97	17.15	13.53	11.48

Fig 19 All Average APTI total 42 test point results for Both sites (Residential and Industrial) at each of distance (50-150m, 250-300m, and 500-600m)

➢ *Dust Deposition Order and Air Pollution Effect*

At residential site, the DD (mg/cm^2) order of selected plant species was found Cassia fistula (1.92) > Mangifera Indica (1.71) > Syzygium Cumini (1.56) > Saraca Asoca (1.28) > Malva Neglecta (1.19) > Amarnthus Viridus (0.91) > Datura Inoxia (0.84).

At industrial site, the results of Dust deposition (mg/cm^2) were found higher due to increased pollution created by operational boilers throwing numerous harmful gases into air. The DD order of selected plant species was found Mangifera Indica (4.37) > Cassia fistula (4.25) > Syzygium Cumini (4.11) > Malva Neglecta (3.79) > Saraca Asoca (3.64) ≥ Amarnthus Viridus (3.64) > Datura Inoxia (2.86).

The present study suggested that actions must be taken on an immediate basis to control the dust and air pollution control at both sites, especially industrial site for the worker's health safeties. On the same step planetary action must be taken with serious concerns and for that Cassia fistula and Mangifera Indica is the best choice to be increased in numbers at both sites.

In addition, the study found that the average DD was higher in the industrial site (4.25mg/cm^2) than in the residential site (1.92mg/cm^2), indicating the adverse consequence on the health of workers in boiler industry locations. The DD was also recorded increasing with the decreasing distance from the source of pollution at industrial site (50-100m = 4.25mg/cm^2) > (500-600m = 3.65mg/cm^2) which highlights the urgent need for effective planetary management to mitigate the impact of air pollution on human health.

Tables. 1, 2, and 3 are presented to have all the 5 biochemical parameters at one place (Dust Deposition, Ascorbic acid content, Relative water content, Total Chlorophyll content, pH and Air pollution tolerance index. Assessment of all parameters for seven selected and studied plant species Cassia fistula, Mangifera Indica, Syzygium Cumini, Saraca Asoca, Malva Neglecta, Amarnthus Viridus, and Datura Inoxia with increasing distance from source at residential site. Table. 1, 2 and 3 will correlate the data of 50-100m, 250-300m and 500-600m respectively for both the sites.

The means of five replicates of each plant specimen ± ½ STDEV represent the values. (DD-mg/cm^2), (TChl-mg/g), (RWC-%), (ACC-mg/g), (pH) and (APTI).

ACKNOWLEDGEMENTS

The project was funded by College of Environmental Science and Engineering, Donghua University, Shanghai, 201620, China (Shanghai Frontier Science Research Center for Modern Textiles).

Table 1 Chart for residential and industrial sites comparison of all parameters at 50-150m Distance from Source

Name of Plants	Dust Deposition (DD) (mg/cm^2)		Total Chlorophyll (TChl) (mg/g)		Relative water content (RWC) (%)		Ascorbic Acid content (ACC) (mg/g)		pH of leaf extract (pH)		Air pollution tolerance index (APTI)	
	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial
Cassia fistula	1.92 ± 0.56	4.25 ± 0.05	4.57 ± 0.39	7.22 ± 0.14	91.24 ± 1.59	92.67 ± 0.34	3.58 ± 0.09	6.71 ± 0.16	6.93 ± 0.32	7.65 ± 2.81	13.24 ± 0.34	19.27 ± 1.51
Mangifera Indica	1.64 ± 0.12	4.37 ± 0.93	4.35 ± 0.50	6.68 ± 1.08	88.65 ± 0.002	81.35 ± 0.39	3.25 ± 0.001	6.36 ± 0.79	6.71 ± 1.35	7.77 ± 0.0012	12.45 ± 0.40	17.38 ± 1.26
Syzygium Cumini	1.36 ± 0.33	4.11 ± 0.47	3.94 ± 1.45	5.37 ± 2.38	89.31 ± 0.31	91.79 ± 2.44	2.78 ± 0.29	5.01 ± 0.48	6.03 ± 0.74	6.85 ± 0.42	11.75 ± 0.63	15.39 ± 1.51
Saraca Asoca	1.18 ± 0.74	3.64 ± 0.005	3.73 ± 0.36	7.03 ± 0.914	85.19 ± 0.02	89.54 ± 0.26	2.61 ± 0.82	4.44 ± 0.29	5.96 ± 0.87	7.28 ± 0.89	11.11 ± 0.76	15.34 ± 0.83
Malva Neglecta	0.98 ± 0.87	3.79 ± 1.33	3.17 ± 0.39	5.16 ± 2.84	84.50 ± 2.70	88.91 ± 1.14	2.14 ± 0.14	4.14 ± 0.34	5.72 ± 0.007	6.98 ± 0.668	10.35 ± 0.32	13.99 ± 1.34
Amarnthus Viridus	0.91 ± 0.07	3.64 ± 0.28	2.43 ± 0.236	6.55 ± 1.02	81.22 ± 0.24	79.23 ± 5.04	1.97 ± 0.54	3.62 ± 1.01	6.13 ± 0.43	6.94 ± 0.76	9.83 ± 0.41	12.92 ± 1.71
Datura Inoxia	0.84 ± 0.21	2.86 ± 0.92	2.68 ± 1.28	5.78 ± 0.542	79.87 ± 4.55	74.27 ± 4.62	1.33 ± 1.17	3.48 ± 0.97	6.54 ± 1.09	6.89 ± 0.24	9.39 ± 1.29	11.88 ± 1.32

Table 2 Chart for residential and industrial sites comparison of all parameters at 250-300m Distance from Source

Name of Tree/Plants	Dust Deposition (DD) (mg/cm^2)		Total Chlorophyll (TChl) (mg/g)		Relative water content (RWC) (%)		Ascorbic Acid content (ACC) (mg/g)		pH of leaf extract (pH)		Air pollution tolerance index (APTI)	
	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial
Cassia fistula	1.74 ± 0.17	4.08 ± 0.76	4.10 ± 0.046	6.74 ± 0.17	89.18 ± 3.54	83.34 ± 2.38	3.87 ± 0.25	6.79 ± 0.47	7.17 ± 0.01	7.76 ± 0.87	13.28 ± 0.43	18.21 ± 1.09
Mangifera Indica	1.71 ± 0.06	3.64 ± 0.93	3.52 ± 0.437	6.10 ± 0.66	88.14 ± 0.22	84.28 ± 0.13	3.42 ± 0.47	7.57 ± 0.75	6.86 ± 0.11	7.81 ± 1.38	12.38 ± 0.47	19.05 ± 1.76
Syzygium Cumini	1.56 ± 0.43	3.55 ± 0.83	3.45 ± 0.08	4.73 ± 0.69	69.88 ± 4.09	83.64 ± 1.25	2.86 ± 0.68	5.64 ± 0.36	6.23 ± 0.42	7.42 ± 1.41	9.77 ± 0.81	15.26 ± 1.18
Saraca Asoca	1.28 ± 0.22	3.28 ± 0.64	2.76 ± 0.49	6.36 ± 1.29	83.12 ± 0.34	78.36 ± 6.50	2.34 ± 0.15	5.15 ± 1.07	6.12 ± 2.65	7.37 ± 0.17	10.42 ± 0.61	15.01 ± 1.94
Malva Neglecta	1.19 ± 1.15	2.39 ± 0.72	3.16 ± 1.31	4.86 ± 0.63	70.38 ± 4.34	75.11 ± 0.87	2.61 ± 0.78	3.67 ± 0.001	5.87 ± 0.22	7.86 ± 0.54	9.47 ± 1.05	12.17 ± 0.34
Amarnthus Viridus	0.88 ± 0.63	3.08 ± 0.01	2.48 ± 1.76	5.13 ± 2.15	77.12 ± 0.11	74.79 ± 10.27	2.06 ± 0.01	4.35 ± 0.15	5.98 ± 4.6	7.18 ± 0.67	9.52 ± 0.97	12.86 ± 1.63
Datura Inoxia	0.74 ± 0.88	2.46 ± 0.09	2.31 ± 0.79	4.76 ± 1.6	77.84 ± 0.88	67.54 ± 0.003	1.52 ± 0.57	4.21 ± 0.82	6.84 ± 0.09	6.96 ± 0.21	9.20 ± 0.50	11.78 ± 1.18

Table 3 Chart for residential and industrial sites comparison of all parameters at 500-600m Distance from Source

Name of Tree/Plants	Dust Deposition (DD) (mg/cm^2)		Total Chlorophyll (TChl) (mg/g)		Relative water content (RWC) (%)		Ascorbic Acid content (ACC) (mg/g)		pH of leaf extract (pH)		Air pollution tolerance index (APTI)	
	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial		
Cassia fistula	1.58 ± 0.89	3.65 ± 0.19	4.10 ± 0.046	6.01 ± 0.83	87.21 ± 0.32	81.32 ± 1.65	4.32 ± 0.01	6.86 ± 0.54	7.04 ± 1.004	7.9 ± 0.65	13.37 ± 0.44	17.72 ± 1.3
Mangifera Indica	1.30 ± 1.46	3.47 ± 0.78	3.52 ± 0.437	5.55 ± 1.11	84.35 ± 4.65	81.32 ± 4.11	3.88 ± 0.36	7.91 ± 1.18	7.15 ± 0.39	7.84 ± 0.18	12.44 ± 0.90	18.82 ± 2.04
Syzygium Cumini	1.34 ± 0.15	3.02 ± 0.45	3.45 ± 0.08	4.86 ± 1.15	83.24 ± 0.066	73.83 ± 1.07	3.01 ± 2.63	5.18 ± 0.54	6.58 ± 0.87	7.65 ± 0.38	11.54 ± 2.43	13.91 ± 1.06
Saraca Asoca	1.17 ± 0.74	2.89 ± 0.26	2.76 ± 0.49	5.07 ± 0.83	71.68 ± 17.54	72.14 ± 0.99	2.94 ± 0.09	5.32 ± 0.67	6.07 ± 0.35	7.4 ± 0.01	9.90 ± 1.48	13.88 ± 0.93
Malva Neglecta	0.92 ± 0.008	2.84 ± 0.98	3.16 ± 1.31	4.73 ± 0.80	72.54 ± 5.11	71.33 ± 11.24	2.87 ± 0.05	6.88 ± 0.02	5.98 ± 1.74	8.2 ± 0.006	9.73 ± 1.11	16.02 ± 1.13
Amarnthus Viridus	1.21 ± 0.54	1686 ± 0.27	2.48 ± 1.76	4.34 ± 0.92	70.37 ± 7.34	64.87 ± 0.006	2.41 ± 0.02	4.84 ± 0.05	6.04 ± 0.9	7.68 ± 2.73	9.00 ± 0.65	12.31 ± 1.22
Datura Inoxia	0.67 ± 0.18	1.68 ± 1.54	2.31 ± 0.79	3.27 ± 0.81	69.34 ± 8.22	59.36 ± 0.57	1.78 ± 1.07	4.69 ± 0.27	6.24 ± 0.98	7.07 ± 0.59	8.53 ± 1.40	10.81 ± 0.67

ISSN No:-2456-2165

REFERENCES

[1]. B. E. E. and H. I. of A. P. A. R. F. P. H. 2020 F. 20;8:14. doi: 10. 3389/fpubh. 2020. 00014. P. 32154200; P. P. Manisalidis I, Stavropoulou E, Stavropoulos A,

[2]. from https://oxfordre. com/environmentalscience /view/10. 1093/acrefore/9780199389414. 001. 0001/acrefor.-9780199389414-e-5. Molina, L., Zhu, T., Wan, W., & Gurjar, B. Impacts of Megacities on Air Quality: Challenges and Opportunities. Oxford Research Encyclopedia of Environmental Science. Retrieved 15 Apr. 2023, "No Title."

[3]. P. Kumar *et al.*, "The nexus between air pollution, green infrastructure and human health," *Environ. Int.*, vol. 133, no. October, p. 105181, 2019.

[4]. W. Zhang *et al.*, "Comparison of the suitability of plant species for greenbelt construction based on particulate matter capture capacity, air pollution tolerance index, and antioxidant system," *Environ. Pollut.*, vol. 263, 2020.

[5]. M. S. Anjum *et al.*, "An Emerged Challenge of Air Pollution and Ever-Increasing Particulate Matter in Pakistan; A Critical Review," *J. Hazard. Mater.*, vol. 402, no. June 2020, p. 123943, 2021.

[6]. K. Achakzai *et al.*, "Air pollution tolerance index of plants around brick kilns in Rawalpindi, Pakistan," *J. Environ. Manage.*, vol. 190, pp. 252–258, 2017.

[7]. E. Science, "Estimation of APU of tree species for air pollution mitigation in Pakistan," vol. 59, no. June, pp. 50–59, 2020.

[8]. E. Guanabara, K. Ltda, E. Guanabara, and K. Ltda, "No 主観的健康感を中心とした在宅高齢者における 健康関連指標に関する共分散構造分析Title."

[9]. I. T. Enitan, O. S. Durowoju, J. N. Edokpayi, and J. O. Odiyo, "A Review of Air Pollution Mitigation Approach Using Air Pollution Tolerance Index (APTI) and Anticipated Performance Index (API)," *Atmosphere (Basel).*, vol. 13, no. 3, 2022.

[10]. CPCB, "Air quality monitoring, emission inventory and source apportionment study for Indian cities," *Cent. Pollut. Control Board (CPCB), 2010*, vol. 39, no. 8, pp. 483–490, 2010.

[11]. A. Roy, T. Bhattacharya, and M. Kumari, "Air pollution tolerance, metal accumulation and dust capturing capacity of common tropical trees in commercial and industrial sites," *Sci. Total Environ.*, vol. 722, 2020.

[12]. W. Feng *et al.*, "Spatial distribution, pollution characterization, and risk assessment of environmentally persistent free radicals in urban road dust from central China," *Environ. Pollut.*, vol. 298, no. January, p. 118861, 2022.

[13]. N. E. I. 2014. 3(11): p. 14-19. Rai, P.K. and L.L.J.I.R.J.o.E.S. Panda, Leaf dust deposition and its impact on biochemical aspect of some roadside plants of Aizawl, Mizoram,

[14]. P. Agbaire and E. Esiefarienrhe, "Air Pollution tolerance indices (apti) of some plants around Otorogun Gas Plant in Delta State, Nigeria.," *J. Appl. Sci. Environ. Manag.*, vol. 13, no. 1, 2010.

[15]. R. N. Lohe, B. Tyagi, V. Singh, P. Kumar Tyagi, D. R. Khanna, and R. Bhutiani, "A comparative study for air pollution tolerance index of some terrestrial plant species," *Glob. J. Environ. Sci. Manag.*, vol. 1, no. 4, pp. 315–324, 2015.

[16]. 83-92. Lerman, J. C. (1972). Chloroph yll measurements as indicators of air pollution stress in plants. Environmental Health Perspectives,

[17]. 189-194. Kuddus, M. R., Ahmed, R., & Hossain, M. A. (2011). Impact of air pollution on relative water content and chlorophyll content of some roadside trees in Dhaka city. Bangladesh Journal of Botany, 40(2),

[18]. 791-798. Seyyednejad, S. M., Ebadi, A., Piri, I., & Ghanati, F. (2011). Air pollution-induced changes in the physiological parameters of three plant species in an urban area. Environmental Science and Pollution Research, 18(5),

[19]. 111926. Sarangi, S., Chakraborty, R., & Pradhan, D. (2021). Air pollution tolerance index (APTI) of tree species in a mining area of Odisha, India. Ecotoxicology and Environmental Safety, 211,

[20]. A. Mohammadi *et al.*, "Health effects of airborne particulate matter related to traffic in Urmia, north-west Iran," *J. Air Pollut. Heal.*, vol. 4, no. 2, pp. 99–108, 2019.

[21]. P. K. Rai, "Biodiversity of roadside plants and their response to air pollution in an Indo-Burma hotspot region: Implications for urban ecosystem restoration," *J. Asia-Pacific Biodivers.*, vol. 9, no. 1, pp. 47–55, 2016.

[22]. P. S. Singh, S. V. Joshi, J. J. Trivedi, C. V. Devmurari, A. P. Rao, and P. K. Ghosh, "Probing the structural variations of thin film composite RO membranes obtained by coating polyamide over polysulfone membranes of different pore dimensions," *J. Memb. Sci.*, vol. 278, no. 1–2, pp. 19–25, 2006.

[23]. B. Rich, G. Goldstein, B. Rich, and G. R. Goldstein, "New paradigms in prosthodontic treatment," *J. Prosthet. Dent.*, vol. 88, no. March, pp. 208–14, 2002.

[24]. 24914-24925. Liu, Y., Chen, X., Wang, S., Xu, X., Xu, C., & Hu, J. (2019). Effects of simulated acid rain on the growth and nutrient uptake of tea plants (Camellia sinensis). Environmental Science and Pollution Research, 26(24),

[25]. S. Kumar, A., Singh, S. K., & Singh, M. K. (2019). Acid rain and its ecological consequences. In Environmental Pollution and Control (pp. 99-116). Springer,

[26]. 127-132. Tripathi, B. D., & Gautam, M. (2007). Biochemical parameters of plants as indicators of air pollution. Journal of Environmental Biology, 28(1),

[27]. W. A. R. T. W. Bandara and C. T. M. Dissanayake, "Most tolerant roadside tree species for urban settings in humid tropics based on Air Pollution Tolerance Index," *Urban Clim.*, vol. 37, no. April, p. 100848, 2021.

[28]. J. P. Hamal and M. K. Chettri, "Air Pollution Tolerance Index of Some Selected Gymnosperm Species Along the Road Side of Kathmandu Valley, Nepal," *Ecoprint An Int. J. Ecol.*, vol. 24, pp. 13–19, 2017.