**International Journal of Advance and Applied Research**

www.ijaar.co.in

**ISSN – 2347-7075** **Impact Factor – 7.328**

**Peer Reviewed** **Bi-Monthly**

**Vol.10 No.5** **May– June 2023**

# Assessment of Biophysiological Response of Plants Grown In Urban Area

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**DOI- 10.5281/zenodo.8119907**

**Abstract:**

In the urban cities the green belt with both trees and shrubs plays an important role in absorbing the carbon dioxide from the atmosphere, hence contributing toward mitigating climate change. Some plants are highly tolerant to air pollution, while other are less tolerant. Sensitive plant species are useful as indicators, warning the mankind about the rising level of pollution. Plants are known to remove air pollutants by absorption, deposition of particulates and aerosols over leaf surface and fallout of particulate on the leeward side of the vegetation. Plantation of tolerant species are therefore recommended as suitable plants to be grown in urban cities green belt. From our studies, *Mangifera indica, Syzygium cumini* and *Hibiscus rosa-sinensis* are most suitable for the plantation in the urban cities. APTI of trees and shrubs increased to an extent between 4.95% to 54%. Similarly, the amount of injury on the leaf is higher among the plants at the industrial site and the injury varied to the extent approximately between10.9% to 94%. Proline content in in the plant leaves from the experimental site was higher up to 3-4 times than the control. Identifying the best plants that are commonly grown in the cities to improve the aesthetics appearance and also add up to the ecological sustenance of the environment.

## Introduction:

In the past the air we breathe used to be pure and fresh, but in due course of time and with the increasing industrialization and urbanization with subsequent growth and development, there has been a sudden increase in poisonous gases in the environment. The air is getting more and more toxic day by day. Air pollution ensues when dangerous particles, gases, and chemicals are released into air. Similarly, ozone layer that is beneficial for life on earth, is also damaged by pollution and it affects the organisms. Further uncontrolled use of fossil fuels in industries and transport of sectors has led to the increase in concentration of gaseous pollutants such as $SO_2$, $NO_x$ etc (Rai, *et al.,* 2011). Forests are affected because of increasing industrialization, contamination of air, water body and soil by growth inhibiting factors such as gases, acids. Air pollution can directly affect the plants through leaves or indirectly through soil acidification. Today Global warming is most serious problem of environment land by the mankind and plant play role an important as indicator. (C.S Kapoor, 2016). Emissions contain noticeable amount of gaseous and heavy metals including Fe, Pb, Cr, Cd. and atmospheric deposition is also the main source of air-borne heavy metals (S. Gupta *et al.*,2011.)

Leaf has various stages of development because of this leaf act as a good indicator to pollution and leaf compared to other plant parts such as stem and roots is the most sensitive part of plant (Leghari and Zaidi 2013). Plants are directly exposed to pollution that cause serious issue to the overall physiology of trees. The trees have shown maximum variation under stress situation, and certain metabolites are found to function as antioxidant (Nayak *et al.,* 2018). APTI & API of trees are helpful for selection of trees for removing to air pollution. The response of plants to air pollution is to provide a method of monitoring air pollutants. The plant species which are more sensitive act as biological indicators of air pollution (Singh and Rao,1983). Trees have the ability to absorb the environmental dust. They absorb gaseous pollutants through the leaves pores & remove them, four parameter of APTI (ascorbic acid, pH, total chlorophyll and RWC) significant role in determining the tolerance of plant to pollutants. APTI is a good basis to select plants for developed of green belts to mitigate air pollution (Sharma *et, al.*, 2017) Anticipated performance index (API) is an Innovative ecological approach and it help in for selecting plant species for minimize the air pollution. Plants have potential in accumulation of pollutants on the leaf. Pollution may also inhibit the plant growth and productivity (Sharma *et, al.*, 2020). In water deficit, Proline an osmolyte in higher plants, can be accumulated as a common metabolic response to osmotic adjustment (Zou *et, al.,*2013). Moreover, plants growing in the air polluted environment showed changes in their morphology, physiology and biochemistry (Gharge *et. al.,* 2012). In the present investigation plants (trees and shrubs) growing in the study area (Asangaon industrial zone) were selected and assessed for biophysiological response to air pollution.

**Material and methods:**

**Study Area**: Asangaon is an industrial area located in Thane district, Maharashtra state and lies between 19°26'24.4608" N and 73°18' 30.1268 "E. The average temperature highest is 37.6°C and the lowest is 26.3°C, with average rainfall of about 1253 mm. The industrial area has many small-scale Industries like, electrical hardware, mills etc., hence selected as the study site. The area has proximity to the National Highway that further contributes to vehicular air pollution.

**Sampling:** Plants commonly growing in the study area those exposed to industrial emission and or to the vehicular pollution were selected. Total ten plants were selected, five trees *Mangifera indica, Zizyphus jujuba, Syzygium cumini, Pithecellobium dulce,* and *Polyalthia longifolia* and five shrubs viz.*Hibiscus rosa-sinensis, Calotropis proccera, Tabernaemontana divaricata, Vitex negundo* and *Nerium oleander*. Fresh leaves from each plant were collected from both the sites (control site and polluted site) in morning, and were immediately taken to the laboratory in polythene bags. All collected leaf samples were washed with the running tap water, and then used for the analysis. The study period was between 1st July 2022 to 31st March 2023.The study was conducted in triplicate.

**Methods:** All the selected plants leaves were analysed for the following parameters according to the methods by:

**A) Effect of air pollution on the Physical parameters**

1. Leaf Area Index (LAI) (Datta and Chakroboarty 2018)
2. Injured Leaf area ILA (Breda 2003)
3. Dust load (Kaur *et.al.*,2021)

**B) Effect of air pollution on the Biochemical parameters**

1. Air Pollution Tolerance Index- a) Relative water content (RWC) (S.Shrestha 2021); b) Total chlorophyll (Tchl) ( Arnon , 1949); c) pH (S. Shrestha 2021); d) Estimation of Ascorbic acid (Sadashivan *et,al.,* 1987)
2. Anticipated performance index (API) (Prajapati and Tripathi, 2008)
3. Proline estimation- (Bates *et al.,*1973)

**Result and Discussion-** Plants are known to tolerate air pollutants and adapt to changing environment. Green plants are considered as the potential subject to mitigate climate change. They act as responsible agents in controlling the changes in the environment around them and help to sustain the surroundings. The study data obtained for effect of air pollution on the Physical parameters are presented in Table no.1

**Leaf Area Index LAI** - The leaf area of every plant growing in the study area has shown lower value than the corresponding control plant. (Fig 1). The complete data can be assumed to project the negative effect of air pollutants on the leaf area of the plants in both shrubs and trees from the study area. When compared among the trees, higher impact is observed in the *Pithecellobium dulce* plant and least in *Polyalthia longifolia* indicating the tolerance level. Similarly, among the shrubs *Tabernaemontana divaricata* has shown higher negative effect on the leaf area and the least effect observed in leaves of *Vitex negundo*. Leaf area play a major role in plant growth analysis and yield predict. (Datta and Chakroborty 2018). Canopy structure of plant have important role in leaf area. Leaf area index help in understanding good growth rate of plant also. Each plant species has different ability in producing shade (Ghafar *et al.* 2020).

**Injured Leaf Area (ILA)** - This parameter helps to study the impact of pollutants in the air that actually causes injury on the photosynthetic leaf area. The effect of injury was visible, and the data is presented in

Table no.1. Many aerial pollutants are known to cause injury on the green photosynthetic tissue such injury can be correlated to the effect of pollutants on the plants. Injured Leaf Area was not very evident on trees and shrubs from the garden, through ILA was evident on trees and shrubs from study area. It clearly indicates the impact of air pollutants on the leaves which indirectly are responsible are reduction in photosynthetic leaf surface area that may be responsible further reduce productivity and growth. The thickness of the foliar lamina slightly decreases under the influence of the air pollutants. Visual symptoms such as necrosis area was observed on plants when leaves exposed to air pollution. Sometime pollution stress altered the structure of the leaves (Irina , 2009**)**.

**Dust load on leaf (DLL)**: Plants from study area showed heavy deposition of dust on the leaf surface except Ziz*yphus jujuba* and *Nerium oleander* . The chemical test performed for analysing the elemental load in the dust was negative for Chlorides, Carbonate ion, Mercury and Zinc indicating absence of these ions in the dust load composition of the study area which is especially close to the highway and being contributed by vehicular pollution. Chemical composition of dust, particulate size and deposition rate decide its influence or toxicity on plants and because the dust particles are absorbed through the outer surface of the plants, they shows some common effects such as chlorophyll degradation, necrosis, reduction in photosynthesis and affect in growth **(**Chaturvedi *et al.*, (2013).

The study data obtained for the effect of air pollution on the biochemical parameters are presented in Table no.2. Various biochemical parameters were analysed to understand the air pollution tolerance index (APTI). The data obtained for parameters like pH, Relative water content (RWC), Ascorbic acid (AA) and Total Chlorophyll content (Tchl ) are presented in Table No.2. Air pollution tolerance index (APTI) being an inherent quality of plants is presently of prime concern particularly in industrial and non-industrial areas. The plants that were constantly exposed to the environment stress, absorb, accumulate and integrate pollutants impinging on their foliar sprays leading to variation in the leaf parameters like RWC,Tchl, AA and leaf extract pH content and therefore are used to study the degree of tolerance of air pollution by the trees. Plants have been categorized into groups according to their degree of sensitivity toward and tolerance of various air pollutants on the basis of experiment and available data (Khan and Abbasi, 2002).

RWC is the water present in leaves relative to the full turgidity and it help to maintain the physiological balance under stress condition caused by pollution especially when the prevailing transpiration rate are high. In the present study RWC varied from 62.5 % to 91.8 % in the experimental leaves sample collected from industrial zone. Among these samples, highest relative water content was observed in *Syzygium cumini* (91.8 %) and lowest in *Pithecellobium dulce (*62.5 %). Studies conducted by various researchers have shown an increase in the relative water content with the rise in pollution. RWC has been found to vary with varying air pollution level. In various studies, it has been observed that RWC was higher at the polluted sites as compared to a control site (Amulya and Jagannath 2015).

AA(Ascorbic acid ) concentration is a strong reductant that activates many physiological and defence mechanism **(**Levin, 1976**).** The leaf samples of *Mangifera indica* had highest ascorbic acid content (4.65:mg g-1) whereas *Polyalthia longifolia* has least amount of ascorbic acid (0.852 mg g-1). There was increase in the ascorbic acid content in every experimental sample compared to the respective control sample. This response of the plants could indirectly confirm the exposure to air pollutant stress. Several studies earlier have stated that higher concentration of ascorbic acid in plants is an indicator of exposure to high concentration of $SO_2$, and higher tolerance of the plant. It also helps to protect the thylakoids' structure (and chlorophyll) from reactive oxygen species (ROS) formed in plants during water stress conditions (Deepika *et al*, 2016). In the present study among the ten plants studied, higher ascorbic acid content in the leaves of few plant species may indicate the tolerant nature of the plants, while the lower ascorbic acid contents may correlate to the sensitive nature of these plants towards pollutants particularly automobile exhausts. Ascorbic acid as an anti-oxidant was found in large amount in all growing plants that are influenced greatly to adverse environmental condition like air pollution. The increased level of ascorbic acid reported in the trees under study may be in response as a defence mechanism by the respective plants to its polluted environment as suggested by Cheng *et, al.*,2007**.**

Tchl (Chlorophyll) content of plant signifies its photosynthetic activity resulting into the growth and development of biomass of plant, as an index of productivity (Raza and Murthy, 1988). Pigment reduction has widely considered as indication of air pollution.Chlorophyll content of plants varies from species to species, age of leaf and also with the pollution level as well as with other biotic and abiotic conditions. The total chlorophyll content in the leaves of industrial study samples was found highest in *Hibiscus rosa-sinensis* (0.3159 mg g-1), least in *Zizyphus jujuba* (0.0722 mg g-1) and all the control plant samples exhibited higher chlorophyll content with respect to the experimental samples (Table no 2). It has been found that there is an inverse relation between the levels of pollutants and the chlorophyll content. Reports show that certain pollutants adversely affect the biochemical processes and in totality reduce the total chlorophyll content (Allen *et al.,* 1987). Chlorophyll content of plants varies from the pollution status of the area i.e. higher the pollution level in the form of vehicular exhausts lower the chlorophyll content and as well varies with the tolerance as well as sensitivity of the plant species i.e., higher the sensitive nature of the plant species lowers the chlorophyll content (Jyothi *et al,* 2010).

All the leaves samples collected from polluted site exhibited pH towards acidic range, which may be due to the presence of $SO_2$ and $NO_X$ in the ambient air causing a change in pH of the leaf sap towards acidic side (Swami *et al* 2004) .That plants with lower pH is more susceptible while those with pH around 7 are tolerant. The change in leaf extract pH might influence the stomata sensitivity due to air pollution. In the study samples *Syzygium cumini* with pH 4.8 was found to be most acidic followed by *Mangifera indica* with pH 5.4. (Table no.2). The air pollution tolerance index (APTI) plays a significant role to determine resistivity and susceptibility of plant species against pollution levels. The significance of APTI in determining the tolerance along with the sensitivity of plant species were investigated by several authors (Pathak *et al.,* 2011**)**. Variation in four physiological and biochemical aspects (pH, RWC, AA and T chl content) of plant species results in variation in APTI values. All the control samples also exhibit a specific level of inherent tolerance (Fig. 3). In the present study *Mangifera indica* with highest APTI (11.53) can be predicted to be highly tolerant to automobile pollutants whereas *Nerium oleander* (6.99) was found to be least tolerant though not sensitive. Thus, it is evident from the study that plants like *Mangifera indica* and *Syzygium cumini* with high APTI may act as important bio accumulators of air pollutants. The tolerance nature of the plants can be arranged in the order of higher to lowest as *Mangifera indica > Hibiscus rosa-sinensis>Syzygium cumini>Calotropis procera>Tabernaemontama divaricata> Zizyphus jujuba>Polyalthia longifolia>Vitex negundo>Pithecellobium dulce>Nerium oleander***.** According to Prasanna *et al*, (2005), plants with higher APTI being tolerant species accumulate the pollutants, whereas plants that show APTI < 9 are classified as sensitive to air pollution. However, the trees with low APTI being sensitive may produce certain visual symptoms and act as bio indicators of air pollution (Rai *et al*, 2013). APTI determination is significant because with the increase in hazard to the existing flora. Hence bio monitoring plants is an important tool to evaluate the impact of pollution on plants (Menon and Gharge ,2021).

**Anticipated Performance Index (API)**

Analysis of API was necessary to investigate the potential or suitability of different plants for Green Belt development. Based on certain important characters, different grades (+ or -) were allotted to the plants (Mondal *et al.,* 2011).The evaluation of API (Table no.3) and assessment of different plants are based on their APTI values. The API values *Mangifera indica* was the highest (+++++) with score above 90% and therefore categorised as "Best", and *Syzygium cumini* 75% as" very good" while *Zizyphus jujuba, Polyalthia longifolia* and *Calotropis procera* are judged as" Moderate" category. These trees are good performer having spreading dense canopy of evergreen foliage, providing protection from pollution stress. *Pithecolobium dulce* and *Hibiscus rosa-sinensis* showed API below 50, therefore categorized as "Poor". *Tabernaemontama divaricata, Vitex negundo* and *Nerium* *oleander* score below 40 and therefore categorized as "Very poor". Thus, API might be useful in the selection of appropriate species. While studying the biochemical parameters, estimation of proline, as stress indicator molecule was also studied (Table no.4). The proline content in the sample of polluted area was more than garden site. In trees, *Pithecelobium dulce* has showed highest proline content (0.148 mg/g) whereas least in *Syzygium cumi*ni (0.005 mg/g) and in shrubs *Tabernaemontana divaricata* showed highest proline content (0.163 mg/g) and least in *Nerium oleander* (0.044 mg/g). It was interesting to correlate that APTI values reduced in experimental plants *Pithecolobium dulce* and *Nerium oleander* than control, where the proline content which indicate the stress level was highest than all other plant sample. Proline content in plant is excellent stress detector, and quantity of proline depends upon type and intensity of stress. **(**Gahlot and Khanna, 2019**).** Proline accumulation could play important role in preventing lipid peroxidation stimulated by air pollution and could help in reducing the damage of membrane and protein (Sanaeirad, 2017***)***. The air pollutants induced proline accumulation was found to be dependent upon the duration of exposure by the plants. Proline may act by protecting the key enzymes from being inactivated by toxic pollutants ions. Toxic metal ions present in the environment through anthropogenic activity can affect the quality of the plant crops and they represent one of the main abiotic stress factor adversely influencing the plant primarily and the health of man as a secondary effect (Menon *et. al.,* 2018).

**Conclusion**: In the present scenario, air pollution in urban cities is at the peak with severe adverse effect observed which are harmful for the human life and to the other living organisms. In addition, the $CO_2$ emissions from various sources are directly contributing to the global warming, thereby resulting to climate change. Knowledge about the best suitable plants (trees, shrubs and herbs) that can adapt to the high exposure of a pollutants and these grow, absorbing the $CO_2$ in the air thus reducing the global warming process in the cities. Such plants can improve the overall environmental conditions and contribute to improve the air quality, water quality and the land resource. Identifying the best plants that are commonly grown in the cities to improve the aesthetics appearance and also add up to ecological sustenance was the main aim of the research. *Mangifera indica, Hibiscus rosa sinensis* and *Syzygium cumini* are good choice for urban green.

**Acknowledgement-**The authors express thanks to the Management, the Principal and the PG department of Botany of R. K. Talreja college of Arts,Sci.& Commerce college for providing support for the present investigation.

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**Table No.1**– Estimation of Ecological parameters LAI, ILA and Dust load in the selected plant species from the study area

| Sr.NO | Name of plant | Experimental site | LAI | ILA (%) | Dust load (%) |
|---|---|---|---|---|---|
| 1 | Mangifera indica | C | 0.00013 | 19.04 | 105.72934 |
| | | SS | 0.00008 | 23.82 | 108.769 |
| 2 | Zizyphus jujuba | C | 0.00004 | 26.66 | 156.43836 |
| | | SS | 0.00003 | 22.85 | 129.517 |
| 3 | Syzygium cumini | C | 0.00013 | 3.5 | 109.49017 |
| | | SS | 0.00009 | 10.3 | 109.587 |
| 4 | Pithecellobium dulce | C | 0.000011 | 35.55 | 110.84746 |
| | | SS | 0.000004 | 28.07 | 142.424 |
| 5 | Polyalthia longifolia | C | 0.00047 | 12.6 | 103.05277 |
| | | SS | 0.00039 | 13.98 | 111.782 |
| 6 | Hibiscusrosa sinensis | C | 0.0014 | 2.38 | 108.63636 |
| | | SS | 0.0012 | 8.13 | 112.965 |
| 7 | Calotropis procera | C | 0.0014 | 1.11 | 105.63423 |
| | | SS | 0.0012 | 11.57 | 114.901 |
| 8 | Tabernaemontana divaricata | C | 0.00036 | 15.38 | 109.31721 |
| | | SS | 0.00024 | 4.85 | 114.66 |
| 9 | Vitex negundo | C | 0.00020 | 12.71 | 128.9987 |
| | | SS | 0.00020 | 26.43 | 133.402 |
| 10 | Nerium oleander | C | 0.00026 | 9.25 | 107.89474 |
| | | SS | 0.00025 | 35.09 | 106.413 |

**Table no 2:** Estimation of Air Pollution Tolerance Index of plants from the study area

| Sr. No | Name of plant | Study site | RWC (%) | pH | Chlorophyll (mg/g) | Ascorbic acid (mg/g) | APTI |
|---|---|---|---|---|---|---|---|
| 1 | Mangifera indica | C | 86.2745098 | 5.55 | 0.240576 | 1.395 | 9.4347 |
| | | SS | 89.04428904 | 5.46 | 0.1825973 | 4.651 | 11.533 |
| 2 | Zizyphus jujuba | C | 48.13186813 | 5.5 | 0.1242553 | 2.093 | 5.9901 |
| | | SS | 76.71517672 | 6.486 | 0.072243 | 2.441 | 9.2703 |
| 3 | Syzygium cumini | C | 73.07692308 | 4.07604 | 0.17996 | 1.279 | 7.8505 |
| | | SS | 91.84514003 | 4.84 | 0.161681 | 1.86 | 10.1143 |
| 4 | Pithecellobium dulce | C | 82.69230769 | 6.343 | 0.190318 | 1.162 | 9.0499 |
| | | SS | 62.5 | 6.07 | 0.13339006 | 2.441 | 7.7970 |
| 5 | Polyalthia longifolia | C | 83.93162393 | 6.146 | 0.21375733 | 0.4651 | 8.6885 |
| | | SS | 85.98130841 | 5.913 | 0.1528273 | 0.8527 | 9.1149 |
| 6 | Hibiscus rosa sinensis | C | 73.1884058 | 6.486 | 0.2574713 | 1.395 | 8.2937 |
| | | SS | 87.64204545 | 6.88 | 0.3159633 | 2.48 | 10.5486 |
| 7 | Calotropis procera | C | 76.8887788 | 6.603 | 0.136060667 | 0.852 | 8.2739 |
| | | SS | 87.61976803 | 6.436 | 0.25623133 | 1.317 | 9.6415 |
| 8 | Tabernaemontana divaricata | C | 80 | 6.476 | 0.16824733 | 0.620 | 8.4220 |
| | | SS | 84.99210111 | 6.696 | 0.20992933 | 1.317 | 9.4077 |
| 9 | Vitex negundo | C | 47.65625 | 5.43 | 0.286728 | 1.317 | 5.5178 |
| | | SS | 68.20652174 | 5.576 | 0.127784 | 2.015 | 7.9680 |
| 10 | Nerium oleander | C | 76.32432432 | 5.513 | 0.130949333 | 1.24 | 8.3314 |

| Sr.no | Name of plant | E. S | APTI | P. H | C.S | T. P | S | T | H | E. V | Total | % Scoring | API Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Mangifera indica | C | ++ | ++ | ++ | + | + | + | + | ++ | 12 | 75 | V.G |
| | | SS | +++++ | ++ | ++ | + | + | + | + | ++ | 15 | 93.75 | B |
| 2 | Zizyphus jujuba | C | - | + | + | + | - | + | + | ++ | 7 | 43.75 | P |
| | | SS | ++ | + | + | + | - | + | + | ++ | 9 | 56.25 | M |
| 3 | Syzygium cumini | C | - | ++ | + | + | + | - | + | ++ | 8 | 50 | P |
| | | SS | +++ | ++ | + | + | + | - | + | ++ | 12 | 75 | V.G |
| 4 | Pithecellob ium dulce | C | ++ | + | + | + | - | + | + | + | 8 | 50 | P |
| | | SS | - | + | + | + | - | + | + | + | 6 | 37.5 | V.P |
| 5 | Polyalthia longifolia | C | + | + | + | + | + | + | + | + | 8 | 50 | P |
| | | SS | ++ | + | + | + | + | + | + | + | 9 | 56.25 | M |
| 6 | Hibiscus rosa sinensis | C | - | - | - | + | + | - | - | + | 3 | 18.75 | N. R |
| | | SS | ++++ | - | - | + | + | - | - | + | 7 | 43.75 | P |
| 7 | Calotropis procera | C | - | - | - | + | ++ | + | + | + | 6 | 37.5 | V.P |
| | | SS | +++ | - | - | + | ++ | + | + | + | 9 | 56.25 | M |
| 8 | Tabernaem ontana divaricata | C | - | - | - | + | + | - | - | + | 3 | 18.75 | N. R |
| | | SS | ++ | - | - | + | + | - | - | + | 5 | 31.25 | V.P |
| 9 | Vitex negundo | C | - | - | - | + | + | + | - | ++ | 5 | 31.25 | V.P |
| | | SS | - | - | - | + | + | + | - | ++ | 5 | 31.25 | V.P_ |
| 10 | Nerium oleander | C | - | - | - | + | + | + | + | + | 5 | 31.25 | V. P |

Table no.3: Anticipated Performance Index of plants (Trees and Shrubs) from the study area

Table no.4: Estimation of Proline content in plants from study area

| Sr. No | Name of plant | Proline (mg/g) | |
|---|---|---|---|
| | | Control | Study Site |
| 1 | *Mangifera indica* | 0.042±0.02 | 0.050±0.03 |
| 2 | *Zizyphus jujuba* | 0.015±0.001 | 0.037±0.02 |
| 3 | *Syzygium cumini* | ND | 0.005±0.01 |
| 4 | Pithecollobium dulce | 0.145±0.021 | 0.148±0.03 |
| 5 | *Polyalthia longifolia* | 0.066±0.02 | 0.084±0.025 |
| 6 | *Hibiscus rosa -sinensis* | 0.026±0.03 | 0.089±0.02 |
| 7 | *Calotropis procera* | 0.023±0.014 | 0.063±0.3 |
| 8 | *Tabernaemontana divaricata* | 0.147±0.02 | 0.163±0.035 |
| 9 | *Vitex negundo* | 0.042±0.022 | 0.055±0.02 |
| 10 | *Nerium oleander* | 0.034±0.03 | 0.044±0.01 |

(**E S**: Experimental site, **P H:** Plant habit, **C S:** Canopy structure, **TP**: Type of plant, **S**: Size, **T:** Texture, **H:** Hardness, **E V**; Economic value, **V G**: Very good, **B**: Best**, P**: Poor, **M**: Moderate, **V P**: Very poor, **N R**: Not recommended).

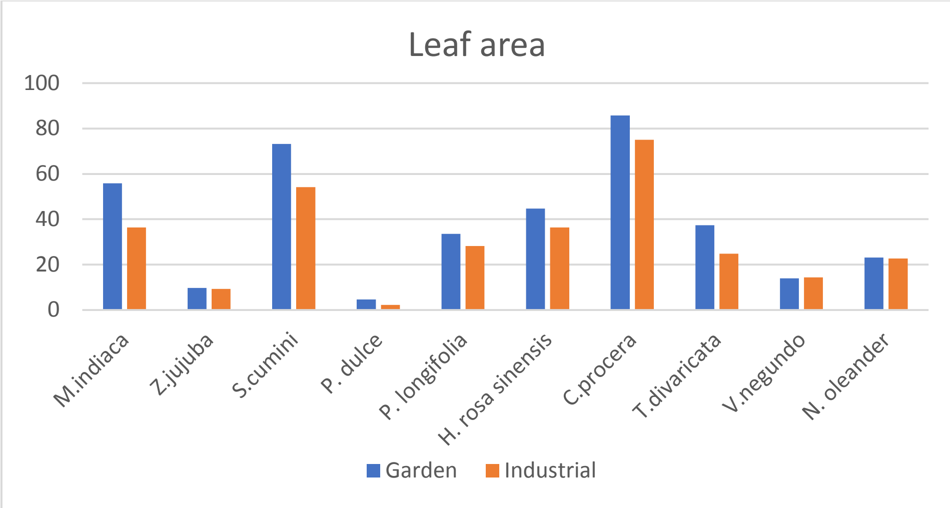


**Fig 1: Comparison of Leaf area index of selected trees and shrubs**

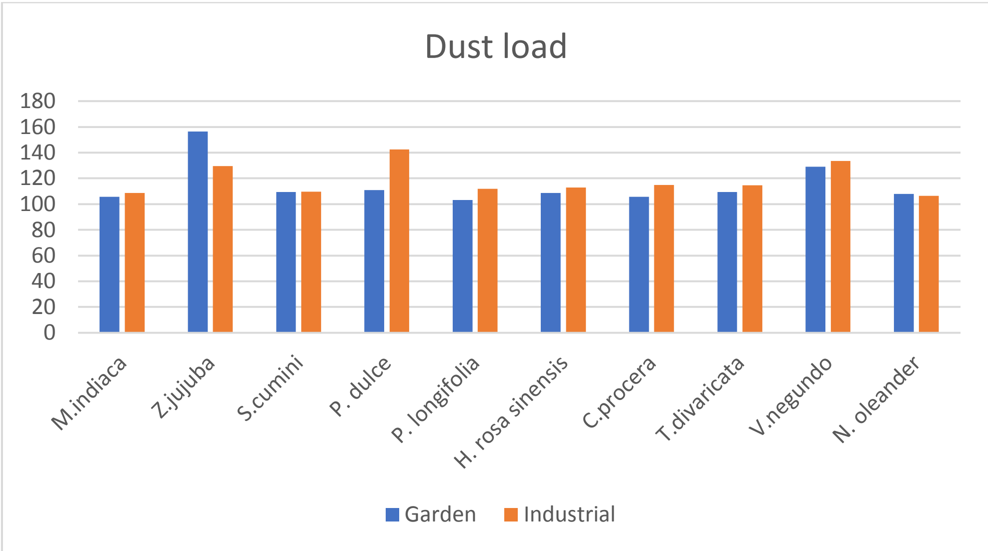


Fig 2: Comparison of dust load on selected trees and shrubs.

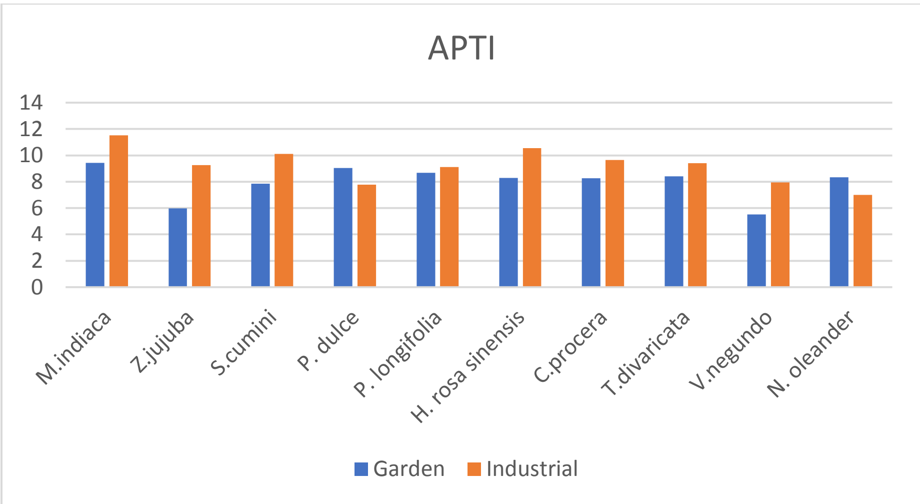


**Fig 3: Comparison of APTI of selected trees and shrubs**