RESULTS AND DISCUSSION

5.1 Introduction

Rapid development in urban areas creates air pollution. Air quality is negatively affected by emissions from mobile and point sources. These sources are directly linked with energy consumption, environmental policy, city density, number of industries and transport by motor vehicles. Pollutants in the air travel a considerable distance away from their originating source. The main environmental problems associated with air pollutants are harm to human health and damage to water, soils and plants. Emissions from sources in urban areas have significant impacts on human and plant health (WHO/UNEP, 1992).

Results of air pollution studies carried out by Chavan and Sonwane (2011) reveal that present condition of air is good in Aurangabad city but the areas with high traffic and more number of industries are harmful to the plant and human health. The tolerance capacity of trees reduced in high vehicular and industrial areas. People living in these areas are prone to some respiratory diseases. Air pollutant levels in residential areas in city are within the standards. However, values of suspended particulate matter exceeded at few places in traffic area. This is mainly due to traffic pollution. For the increase in air pollution in the city, chemical factories and increasing number of automobiles, impurity of petrol and diesel, irregular check up of vehicles and improper maintenance, improper traffic control, increasing traffic are responsible.

5.2 Trees and their pollution tolerance ability

Air pollution affects plants in various ways. It creates different diseases in plant (Katiyar and Dubey, 2000) which includes killing or collapse of leaf tissues called as Necrosis while Chlorosis is a loss or reduction of green plant pigments, chlorophyll usually results in pale green or yellow pattern. Chlorosis indicates deficiency of nutrients required for plants. Chlorosis is a condition in which leaves produce insufficient chlorophyll, turning them yellow. Chlorosis can be caused by a nutrient deficiency of iron called iron chlorosis or by a shortage of magnesium or
nitrogen. Chlorosis can also be caused by pathogens including viruses, bacteria and fungal infections, or sap-sucking insects. Abscission is a disease of dropping of leaves. Epinasty is a downward curvature of leaf due to higher rate of growth on the upper surface. Some kinds of injury to plant tissue can also found due to natural and manmade causes which includes the injuries like acute injury and chronic injury. The acute injury leads to necrotic patterns like area of dead tissue. Chronic injury causes chlorosis or leaf abscission. The overall effect is reduction in plant growth and yield. It is due to growth suspension. The injury is in the form of without invisible marking.

Every tree has its own capacity to fight against the various pollutants, diseases and injuries. Trees in polluting atmosphere have less tolerance potential while trees from unpolluted atmosphere have high level of tolerance potential (Sing and Rao, 1983). This tolerance potential changes according to season to season. This seasonal tolerance capacity of trees can be studied in the form of air pollution tolerance index of trees in which some biochemical parameters like chlorophyll content, ascorbic acid, leaf extracts pH and relative water content are required to analyze. In the present investigation all these parameters are measured, studied and the results are interpreted scientifically.

5.3 Studies on chlorophyll content of leaf extract

5.3.1 Effect of tree canopy shade on chlorophyll pigment

The chlorophyll content of plant signifies its photosynthetic activity in plant and the growth and the development of plant which varied in the plant grown in the shade and in un-shaded plant as an impact of incident solar radiation has one of the abiotic factors. Duration of photosynthetic pigment is generally used as an indication of air pollution. The impact of solar radiation is a major limiting factor with common surrounding condition for both plants studied. The present study revealed that the chlorophyll content varied with the availability of solar intensity in same locality.

The plants growing in shade contain more chlorophyll content (10.21 mg/gm) in comparison with open light grown plants (5.25 mg/gm) on fresh weight
basis. The chlorophyll content observed in present study is illustrated graphically in table and figure no- 5.1.

Table-5.1: Chlorophyll content in Mangifera indica grown under shade and in open light.

<table>
<thead>
<tr>
<th>Pigment</th>
<th>Light exposure</th>
<th>Dark situation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mg/gm fresh weight</td>
<td></td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>2.07</td>
<td>4.06</td>
</tr>
<tr>
<td>Chlorophyll b</td>
<td>3.18</td>
<td>6.15</td>
</tr>
<tr>
<td>Total chlorophyll</td>
<td>5.25</td>
<td>10.21</td>
</tr>
</tbody>
</table>

Fig-5.1: Effect of light and Dark on Chlorophyll content in Mangifera indica.

High chlorophyll contents and larger leaf size in shade grown plant suggest that it is well adapted to low light intensities and the plants exposed to open light shows decrease in chlorophyll a, b and total chlorophyll content as compared to plants grown in dark. The increase in chlorophyll content in the leaves of shade grown plant may be attributed to an increase in the number and size of chloroplast (Boardman et al., 1974).
The chlorophyll contents studied exhibited variation between the plant grown in the shade of Neem tree (*Azadirachta indica*) and in unshaded area. The present study shows increase in number of leaves and larger leaf area in shade grown (dark) plants than of open light exposed plants, as noticed by Nakamura (1965) in *Pisum sativum*. The chlorophyll content was found increased in the plant reason in shade which is attributed to the less stress on plant exhibited by solar radiation (Agrawal, 1988). Different conditions with considerable variation imbalance the plant growth therefore they need to be studied separated (Sing and Rao, 1983). To know the exact impact of the particular parameter under controlled condition with same environment the efforts have been made. In the present study the change in chlorophyll content was attributed to the sensitivity of *Mangifera indica* to the exposure of solar radiation.

The chlorophyll content of the plants signifies the photosynthetic activity of the plant and greatly influences the plant growth and biomass development (Jyothi and Jaya, 2010). The chlorophyll content varies from species to species and plant to plant but gets drastically affected by the pollution levels and the surrounding biotic and abiotic factors (Katiyar and Dubey, 2000). The photosynthetic pigments work mainly in presence of solar radiation which is a major abiotic component and gets affected by shades. The levels of automobile exhaust also decrease the chlorophyll pigments (Mir et al., 2008; Tripathi and Gautam, 2007) and the cumulative impact of shade and pollutants may enhance this process. Low sunlight intensity and short photoperiods lower the rate of photosynthesis irrespective of other parameters (Beg et al., 1990).

### 5.3.2 Impact of air pollution on chlorophyll pigment

In the present study reduced chlorophyll content was observed in the selected tree species. Trees show variation in chlorophyll content according to their sensitivity and concentration of pollutants in surrounding air. Such trees can be used as bio-indicators of air pollution by automobile exhaust in cities. In the present study four species of trees were tested for total chlorophyll which reflected different responses from species to species to the air pollution.
In *Azadirachta indica* the concentration of total chlorophyll content was 10.25 mg/g, in leaves sample collected from university area which is considered as a reference area for comparisons while the concentration of total chlorophyll was 7.57 mg/g in leaves sample collected from site Kranti chowk. In case of *Mangifera indica* the concentration of total chlorophyll content was 8.26 mg/g, in leaves sample collected from reference site (University area) while the concentration of total chlorophyll was 4.14 mg/g in leaves sample collected from site Kranti chowk.

The same pattern of variation in chlorophyll content was observed in *Polyalthia longifolia* and *Dalbergia sissoo*. The concentration of total chlorophyll content in *Polyalthia longifolia* was 9.13 mg/g, in leaves sample collected from reference site (University area) while the concentration of total chlorophyll was 5.92 mg/g in leaves sample collected from site Kranti chowk. In case of *Dalbergia sissoo* the concentration of total chlorophyll content was 7.21 mg/g, in leaves sample collected from reference site (University area) while the concentration of total chlorophyll was 4.35 mg/g in leaves sample collected from site Kranti chowk. Vehicular emissions adversely affect and reduce the chlorophyll contents of the plant. Trees grown at polluted sites show less chlorophyll content than trees at unpolluted site.

Mishra and Gupta (1993) also reported that encrusted leaf surface is responsible for reduced photosynthesis and thereby causing reduction in chlorophyll content. Agarwal et al., (1988) found that industrial pollutant and vehicular emission adversely affect and reduce the chlorophyll content of the plant. Mandre and Tulmets (1977) found that pollutant reduces the chlorophyll a and b.
Table-5.2: Effect of air pollution on chlorophyll a and b pigments in different Plants.

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Chlorophyll ‘a’ (Mg/gm)</th>
<th>Chlorophyll ‘b’ (Mg/gm)</th>
<th>Total Chlorophyll (Mg/gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>University area</td>
<td>Kranti chowk</td>
<td>University area</td>
</tr>
<tr>
<td>Azadirachta indica</td>
<td>3.10</td>
<td>2.07</td>
<td>7.15</td>
</tr>
<tr>
<td>Mangifera indica</td>
<td>2.14</td>
<td>2.10</td>
<td>6.12</td>
</tr>
<tr>
<td>Polyalthia longifolia</td>
<td>3.02</td>
<td>1.71</td>
<td>6.11</td>
</tr>
<tr>
<td>Dalbergia sisoo</td>
<td>2.06</td>
<td>1.18</td>
<td>5.15</td>
</tr>
</tbody>
</table>

### 5.3.3 Trees as bioindicators of air pollution

In the study of trees as bioindicators of air pollution, it was observed that the total chlorophyll content in *Azadirachta indica* was more (7.26 mg/gm) at reference site (University area) as compared to polluted (Kranti chowk) site (5.81 mg/gm). *Mangifera indica* was also showed more chlorophyll content (6.20 mg/gm) as compared to polluted site (5.44 mg/gm) and the same results were observed in case of *Polyalthia longifolia* and *Dalbergia sisoo*. In *Polyalthia sisoo* total chlorophyll observed at reference site was (6.12 mg/gm) which was more compared to polluted site (4.98 mg/gm) while *Dalbergia sisoo* also showed decrease in chlorophyll content at polluted site it was (5.64 mg/gm) as compared to reference site (6.90 mg/gm). Many researchers agree that vehicular exhaust adversely affect plant growth which can be used as bioindicators in monitoring of general air quality. Joshi and Chauvan (2008) also reported that primary air pollutants such as suspended particulate matter (SPM), SO₂, and NO₂ from automobile exhaust reduce or affect Chlorophyll content of the plants.
Table-5.3: Total chlorophyll content at reference and polluted sites.

<table>
<thead>
<tr>
<th>Tree species</th>
<th>Total Chlorophyll (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botanical name</td>
<td>Common name</td>
</tr>
<tr>
<td>Azadirachta indica</td>
<td>Neem</td>
</tr>
<tr>
<td>Mangifera indica</td>
<td>Mango</td>
</tr>
<tr>
<td>Polyalthia longifolia</td>
<td>Ashoka</td>
</tr>
<tr>
<td>Dalbergia sissoo</td>
<td>Sheesham</td>
</tr>
</tbody>
</table>

C* - Reference site (University area)  P** - Polluted site (Kranti Chowk)

Fig-5.2: Total chlorophyll content at reference (University area) and Polluted (Kranti chowk) sites.
5.3.4 Chlorophyll and Ascorbic acid negative correlation

Table-5.4: Chlorophyll and Ascorbic acid content in plant species in different seasons.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Tree species/ Seasons</th>
<th>Azadirachta indica</th>
<th>Mangifera indica</th>
<th>Polyalthia longifolia</th>
<th>Dalbergia sissoo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyll (Mg/g)</td>
<td>Rainy</td>
<td>10.25</td>
<td>10.20</td>
<td>7.21</td>
<td>8.21</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>8.80</td>
<td>8.32</td>
<td>6.82</td>
<td>7.20</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>7.26</td>
<td>6.22</td>
<td>6.12</td>
<td>6.92</td>
</tr>
<tr>
<td>Ascorbic acid (Mg/g)</td>
<td>Rainy</td>
<td>7.90</td>
<td>6.34</td>
<td>7.30</td>
<td>5.80</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>8.10</td>
<td>6.88</td>
<td>7.52</td>
<td>5.86</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>8.32</td>
<td>6.91</td>
<td>7.63</td>
<td>5.88</td>
</tr>
</tbody>
</table>

Fig-5.3: Negative correlation of Chlorophyll and Ascorbic acid content in different seasons.
In *Azadirachta indica* highest chlorophyll content recorded was in rainy season (10.25 mg/g) which was followed by summer (8.80 mg/g) and winter (7.26 mg/g), while the highest ascorbic acid content recorded was in winter season (8.32 mg/g), which was followed by summer (8.10 mg/g) and then rainy (7.90 mg/g) seasons. In case of *Mangifera indica* highest chlorophyll content recorded was in rainy season (10.20 mg/g) which was followed by summer (8.32 mg/g) and winter (6.22 mg/g) while the highest ascorbic acid content recorded was in winter season (6.91 mg/g), which was followed by summer (6.88 mg/g) and then rainy (6.34 mg/g) seasons.

The same negative correlation was observed in case of *Polyalthia longifolia* in which highest chlorophyll content recorded was in rainy season (7.21 mg/g) which was followed by summer (6.82 mg/g) and winter (6.12 mg/g), while the highest ascorbic acid content recorded was in winter season (7.63 mg/g) which was followed by summer (7.52 mg/g) and then rainy (7.30 mg/g) seasons while in *Dalbergia sissoo* highest chlorophyll content recorded was in rainy season (8.21 mg/g) which was followed by summer (7.20 mg/g) and winter (6.92 mg/g) while the highest ascorbic acid content recorded was in winter season (5.88 mg/g) which was followed by summer (5.86 mg/g) and then rainy (5.80 mg/g) seasons.

It was observed that when chlorophyll content decreases that time ascorbic acid content increases in all selected four plant species. Chlorophyll is most important photosynthetic pigment and plays an important role in photosynthesis. It is found in the chloroplast of plants, it absorbs sunlight which is essential for plants to carry out photosynthesis. Chlorophyll traps energy from sun which is used by plants to combine carbon dioxide and water to make carbohydrates. The seasonal variation in the leaf pigment of selected plant species is shown in the table-5.4. It is evident from the table that chlorophyll content in all the plant species was maximum in rainy season followed by summer and winter. The study also shows that there is an increase in ascorbic acid content in leaves with decrease in chlorophyll content. Decrease in chlorophyll content in the leaves may be due to the alkaline conditions created by dissolution of chemicals.
The study show changes in pigment content of plants exposed to pollution. It is clear from table-5.4 total chlorophyll content in all the selected tree species is maximum in rainy season while ascorbic acid content is maximum in winter season than other seasons. The fig.-5.3 clearly shows negative correlation between chlorophyll and ascorbic acid content. Chlorophyll content decreased and ascorbic acid content increased in all seasons.

Total chlorophyll content of polluted leaves is lower than that of unpolluted leaves and is reported by several researchers (Somshekhar et al., 1999; Mandal and Mukherji, 2000; Samal and Santra, 2002) Decrease in chlorophyll content causes decrease in productivity of plant. Therefore, plants maintaining their chlorophyll even under polluted environment are said to be tolerant one. (Singh and Verma, 2007). Decrease in total chlorophyll content in the leaves may be due to alkaline condition created by dissolution of chemicals present in dust particles in cell sap which is responsible for chlorophyll degradation. The ascorbic acid content of leaves increases to cope with these stresses since it retards leaf senescence (Garg and Kapoor, 1972).

Ascorbic acid plays a role in cell wall synthesis, defense and cell division, plays an important role in carbon fixation, with reducing power directly proportional to its concentration. It is also called as vitamin ‘c’. It plays a significant role in light reaction of photosynthesis and under stress condition it can reduce water from water reaction II. Ascorbic acid is a natural antioxidant in plant which shows an importance in pollution tolerance (Joshi and Swami, 2007). The Ascorbic acid content is known to improve tolerance of the plants to air pollutants.

There is considerable increase in ascorbic acid content of leaves of the plant species in polluted environment .The ascorbic acid is known to improve the tolerance of the plants to air pollutants. The concentration of ascorbic acid in plant species were maximum in winter followed by summer and rainy season. Ascorbic acid is found in large amounts of all growing plants and influence resistance to adverse environmental conditions including air pollution. Increased levels of ascorbic acid in leaves will increase air pollution tolerance in plants. (Chaudhary
and Rao, 1977). Pollution load dependent increase ascorbic acid content of all the plant species may be due to increased rate of production of relative oxygen species (ROS), during photo oxidation of SO$_2$ and SO$_3$, where sulfites are generated from SO$_2$ absorption. Chaudhary and Rao (1977) are of the opinion that higher ascorbic acid content of plant is a sign of its tolerance against pollution.

Ascorbic acid is a strong reluctant and it activates many physiological and defense mechanism. Its reducing power is directly proportional to its concentration. However its reducing activity is pH dependent, when pH is high at that time concentration of ascorbic acid is low. Hence the leaf extract pH on the higher side gives tolerance to plants against pollution. (Agrawal, 1988). Leaf pH showed maximum during monsoon with decrease in winter and then in summer. Lower ascorbic acid contents in the leaves of plant species studied supports the sensitive nature of these plants towards pollutants particularly automobile exhaust. Tripathi and Gautam (2007) also reported that increase in the concentration of ascorbic acid in the leaves of plants near roadside due to enhanced pollution loads of automobiles. Ascorbic acid concentration is higher than those of control sites.

Present study clearly shows that plants responses differently according to the seasons. Climatic conditions affect the biochemical process in plants. Chlorophyll content decreases in plants because of some natural and anthropogenic factors. Alkaline conditions caused by dissolution of dust particles in cell sap lead to pigment degradation while shading effect of dust create due to increased number of vehicles. There is an increase in ascorbic acid content in leaves with a decrease in chlorophyll content. The concentration of ascorbic acid in plant species were maximum in winter followed by summer and rainy season.

5.4 Stomatal studies

5.4.1 Leaf cuticular features as indicator of air pollution

Air pollution inhibits plant growth. Stomatal density and stomatal index decreases in polluted areas. These features can be used as indicators of air pollution in city area. It is suggested that such patterns in the plants of polluted areas can be significant in determining the degree of pollution and preventive measures can be
taken to reduce the level of air pollution in the polluted area. Stomatal density calculated in *Azadirachta indica* was 16.11 at reference site while at polluted site it was 13.33. In *Mangifera indica* it was 6.11 at reference site, while at polluted site it was 5.00. In *Polyalthia longifolia* it was 6.94 at reference site, while at polluted site it was 5.55, and in *Dalbergia sissoo* it was 5.00 at reference site and 4.16 at polluted site.

Stomatal index calculated in *Azadirachta indica* at reference site was 14.28, while at polluted site it was 14.11. In *Mangifera indica* it was 20.00 at reference site, while at polluted site it was 16.07, and in *Polyalthia longifolia* and *Dalbergia sissoo* it was 16.16, 20.00 at reference site and 20.00 and 18.75 at polluted sites respectively.

Polluted environmental conditions had adverse effect on the growth of plant, reduction in biomass and the rate of photosynthesis in plant. In some leaves of plant species stomatal conductance was significantly reduced at the polluted site confirming to some reports (Field et al., 1995, Kull et al., 1996) and can cause low photosynthetic rate (Farage et al., 1991). Chlorophyll ‘b’ was more severely affected than chlorophyll ‘a’ as noticed earlier in various woody and non-woody plants (Joshi et al., 1993) SO₂ (Esmat, 1993; Ali, 1998) and O₃ (Khan and Khan, 1994) inhibit chlorophyll biosynthesis. Stomatal index of both epidermal layers increased with plant age at the unpolluted site. Length and width of stomata on both epidermis of leaf were significantly reduced in polluted environment.

The dust loading on leaves may reduce plant growth (Bender et al., 2002). Through its effect on leaf gas exchange (Earnst, 1982) occlude stomata (Hirano et al., 1995), reduce photosynthetically active radiations and increase the leaf temperature (Naidoo and Chirkooot, 2004). The particles enter the leaf through stomatal openings and their toxicity may disturb the physiological activity of plants (Farmer, 1993). The inhibition implant growth, rate of photosynthesis, late flowering and the total hormonal imbalance may be due to the efficiency of nutrients in the polluted plants (Farooqui et al., 1995). It has been reported earlier that under stress conditions plants produce more wax than control (Hollenbach et al., 1997).
The structure and morphology of epicuticular waxes is a reliable indicator of plant health Neinhunis and Barthlott (1988) and to a great extent regulate the resistance to pollution stress. Sauter and Pambor (1989) observed increased degradation of epicuticular wax in spruce and fir due to deposition of road dust. In the dust treated plants characteristic wrinkles appeared and sinuous nature of epidermal cells and distinct cell boundaries were completely lost on the cuticle.

5.4.2 Stomatal responses to air pollution

Plant shows different responses in polluted and unpolluted atmosphere. Stomatal density, stomatal index decreased in polluted area while leaf length and width also decreased in polluted area compared with the less polluted area.

Fig-5.4: Photographs showing stomatal status.

A- Stomata slide of *Azadirachta indica* from university area.

B- Stomata slide of *Azadirachta indica* from Kranti chowk.

C- Stomata slide of *Polyalthia longifolia* from University area.

D- Stomata slide of *Polyalthia longifolia* from Kranti chowk.
Table-5.5: Leaf length and width of tree species from reference site (University Area) and polluted (Kranti Chowk).

<table>
<thead>
<tr>
<th>Tree species</th>
<th>Leaf length (cm)</th>
<th>Leaf width (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>University area</td>
<td>Kranti Chowk</td>
</tr>
<tr>
<td><em>Azadirachta indica</em></td>
<td>06</td>
<td>5.0</td>
</tr>
<tr>
<td><em>Mangifera indica</em></td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td><em>Polyalthia longifolia</em></td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td><em>Dalbergia sissoo</em></td>
<td>07</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Leaf length calculated in *Azadirachta indica* was 6.0 cm. at reference site, while at polluted site it was 5.0 cm. In *Mangifera indica* it was 20 cm. at reference site while at polluted site it was 18 cm. In *Polyalthia longifolia* and *Dalbergia sissoo* it was 18 cm, 7.0 cm at reference site and 16 cm. and 6.5 cm. at polluted sites respectively. Leaf width calculated in *Azadirachta indica* was 2.5 cm. at reference site while, at polluted site it was 2.0 cm. In *Mangifera indica* it was 5.5 cm. at reference site while at polluted site it was 4.8 cm. In *Polyalthia longifolia* and *Dalbergia sissoo* it was 5.4 cm, 6.0 cm. at reference site and 4.0 cm. and 4.2 cm. at polluted sites respectively.

As the roadside plants covered with dust suffer from water deficiency, a well epicuticular wax layer may be crucial in protecting them from water loss and any change in the original morphological structure make these plants more sensitive to water loss (Saneoka and Ogata, 1987). Local annuals subjected to urban dust spray showed reduced growth and altered leaf surface. These changes show the stress conditions of plants and can serve as an indicator of dust pollution. Leaves sample collected from relatively less polluted area had longer leaves compared to the leaf length of leaves from polluted region.
The comparison made in the relatively unpolluted and polluted plants indicate that the plant exhibits certain morphological and cuticular adaptations which have ecological significance and may be useful in the ecological understanding of these important plants. Study of the effect of air pollution on some plants has shown that length of stomatal pore, stomatal density, photosynthetic rate and chlorophyll content were reduced in polluted plants. Overall number of leaves was comparatively smaller at polluted site the difference being statically significant in the flowering stage. Total leaf area per plant was lower at the polluted areas than at unpolluted one and so was the dry mass of the foliage.

The stomata of lower epidermis increased in length and width with the age of plant at unpolluted site. Under pollution stress stomata width and length were significantly smaller on lower surfaces in each stages of the plant growth. Stomatal density increased with plant age on both epidermises in plants grown at reference site. It showed a marginal decline under the pollution stress. Both the light and temperature also influence stomatal response to polluted atmosphere (Burrows and Milthorpe, 1976). The stomatal response may be complete in respect of changed atmosphere due to the interaction between the environmental factors and soil moisture status.

Pollution is an important environmental variable that may adversely affect plant growth. The differential effect it has on specific plants has been used as a measure of environmental quality. In most of the industry and commercial establishment level of air pollution is more. Repeated exposure produces serious and irreversible damages. There are only a few of investigations were to a determination of the importance of leaf cuticular features as indicator of air pollution. The effect of environmental pollution on plant is well documented by (Solberg et al., 1956). Sensitivity of plants to air pollutants is directly proportional to the stomatal index values in polluted conditions (Salisbury, 1927). Adverse effects due to pollution on the micromorphology of plants have been seen on the area of stomata, except stomatal index and frequency of lower epidermis. The epidermis begins the over most protective layer in all organisms, exhibits
modification of abnormalities in form, function and structure with the changes in surrounding environment and such modifications are likely to serve as indicators of environmental pollution (Salisbury, 1927).

The stomatal density has been known to show direct reaction to pollution as studied by Ghouse et al., (1984). However the size of the stomata and stomatal aperture pore are less in polluted areas, as compared to the plants growing in control areas. Decreases in stomatal density, stomatal index and aperture size in polluted plants have been reported by many workers (Gupta and Ghouse, 1986). These changes are favorable adaptations since increased stomatal density could aid in increasing gaseous exchange uptake while decreased stomatal aperture size could obstruct the entry of dust particles which are harmful for the survival of plants. Thus, increased stomatal density compensate for the small stomatal pore size in polluted plants. Similar results were shown by Agrawal and Kalsat (1982) in plants subjected to industrial pollution.

5.4.3 Effect of Automobile exhaust on leaf stomata

The stomatal frequency, stomatal index, length and breadth of stomata and epidermal cells increase in unpolluted area while decrease in polluted area where there is more number of vehicles. It has been observed that the responses of leaves to air pollution vary significantly. There are qualitative changes in micro- morphological characters of leaf surface. Stomata slightly raised from rest of the cells were often filled with dust particles and at some places were also clogged. Patches of injured cells were also observed. It was noticed that particles larger than the stomata openings generally pile up on the pore, while fine particles clog the stomata, affecting gaseous exchange process and in turn affecting photosynthesis, water retention, respiration and overall growth of the plants.
Table-5.6: Table showing values of stomatal density at reference and polluted sites

<table>
<thead>
<tr>
<th>Tree species</th>
<th>Stomatal density (mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>University area (Reference Site)</td>
</tr>
<tr>
<td>Azadirachta indica</td>
<td>16.11</td>
</tr>
<tr>
<td>Mangifera indica</td>
<td>6.11</td>
</tr>
<tr>
<td>Polyalthia longifolia</td>
<td>6.94</td>
</tr>
<tr>
<td>Dalbergia sissoo</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Fig-5.5: Graph showing values of stomatal density at reference (University area) and polluted (Kranti chowk) sites.

Stomatal density calculated in *Azadirachta indica* was 16.11 mm$^2$ at reference site while at polluted site it was 10.27 mm$^2$. In *Mangifera indica* it was 6.11 mm$^2$ at reference site while at polluted site it was 4.16 mm$^2$. 
The stomatal density in *Polyalthia longifolia* was 6.94 mm\(^2\) at reference site while at polluted site it was 5.00 mm\(^2\) while in *Dalbergia sissoo* it was 5.00 mm\(^2\) at reference site while at polluted site it was 3.80 mm\(^2\). The results are represented in table-5.6 and graphically expressed in fig-5.5. The significant reduction in epidermal cell size and stomata resulted due to inhibited cell elongation. Kulshreshtha et al., (1980) reported significant decrease in the size of epidermal cells, stomata and trichomes per unit area in hydrogen fluoride carbon particulate-polluted population of *Jasminum sambae* collected from a factory area. In this study the deposition of dust on upper leaf surface was not uniform and more than 50% stomata were found clogged in some plants.

The vehicular pollution induced longer and numerous trichomes on leaves, which appeared to be defense mechanism against excessive entry of particulate and gaseous matter, platform to trap particulate matter and insulators for leaf surface. Pollution induced lower stomatal frequency. It means that the amount of gaseous pollutants entering the leaves through stomata is reduced and the plant becomes tolerant to the pollution.

**5.5 Anticipated performance index (API) of plant species**

Combining the results of APTI values with some relevant biological and socio-economic characters (Plant habitat, canopy structure, type of plant, laminar structure and economic value) the API was calculated for different species. Based on these characters, different grades (+ or -) are allotted to the selected plant species. Different plants scored different grades according to their socio-economic values.
Table-5.7 (a): Assessment parameters of selective tree species for API.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Local Name</th>
<th>Scientific Name</th>
<th>APTI</th>
<th>Tree Habitat</th>
<th>Canopy Structure</th>
<th>Tree type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neem</td>
<td><em>Azadirachta Indica</em></td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Mango</td>
<td><em>Mangifera Indica</em></td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Ashoka</td>
<td><em>Polyalthia Longifolia</em></td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Sheesham</td>
<td><em>Dalbergia Sissoo</em></td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Table-5.7 (b): Assessment parameters of selective tree species for API.

<table>
<thead>
<tr>
<th>Size</th>
<th>Texture</th>
<th>Hardness</th>
<th>Economic Value</th>
<th>Total Plus</th>
<th>% Scoring</th>
<th>API Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>11</td>
<td>69</td>
<td>4</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>11</td>
<td>69</td>
<td>4</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>09</td>
<td>56</td>
<td>3</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>07</td>
<td>44</td>
<td>2</td>
</tr>
</tbody>
</table>
Table-5.8: API Assessment of selective tree species

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Local Name</th>
<th>Scientific Name</th>
<th>Total plus (+)</th>
<th>% Scored</th>
<th>API</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neem</td>
<td><em>Azadirachta Indica</em></td>
<td>11</td>
<td>69</td>
<td>4</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>Mango</td>
<td><em>Mangifera Indica</em></td>
<td>11</td>
<td>69</td>
<td>4</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>Ashoka</td>
<td><em>Polyalthia Longifolia</em></td>
<td>09</td>
<td>56</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>4</td>
<td>Sheesham</td>
<td><em>Dalbergia Sissoo</em></td>
<td>07</td>
<td>44</td>
<td>2</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Plant species were evaluated for various biological and socio-economic as well as some biochemical characters. These parameters were subjected to a grading scale to determine the anticipated performance of plant species as described by (Sing and Rao, 1983). API was calculated using the assessment parameters with respect to grading characters using a summation of the anticipated performance of the plant species. *Azadirachta indica* and *Mangifera indica* was the tree species having good API value with respect to the biological and socio-economic uses while *Polyalthia longifolia* and *Dalbergia Sissoo* were judged to be moderate and poor tree species respectively.

*Azadirachta indica* found to be most tolerant tree species among all other species. It has dense canopy. The economic and aesthetic value of this tree species is also well known. *Mangifera indica* is also another tree species having good API and tolerant to air pollution. It is an evergreen tree having dense canopy, rough leaves and valuable for aesthetic and economic uses. *Polyalthia longifolia* is also evergreen tree but its economic uses are less so the API value calculated is moderate. *Polyalthia longifolia* is an evergreen tree but its economic uses are less so the API value calculated is moderate. *Dalbergia Sissoo* is a deciduous tree and the size is medium texture is smooth so the API value calculated is poor and not recommended for the planting nearby roads.
5.6 Seasonal variation in biochemical parameters of selective tree species

Air pollution tolerance indices showed changes in parameters like ascorbic acid, total chlorophyll, relative water content, and pH of leaf extract when evaluated for the degree of tolerance to air pollution by the tree species. It was found that the trees *Azadirachta indica* and *Mangifera indica* are the tolerant to air pollution while *Polyalthia longifolia* and *Dalbergia sissoo* are moderate to tolerate the air pollution. Trees that are constantly exposed to environmental pollutants absorb, accumulate and integrate these pollutants into their systems. Depending on their sensitivity level, plants show visible changes which include alteration in the biochemical processes or accumulation of certain metabolites. Higher chlorophyll content in plants might favor tolerance to pollutants (Joshi et al., 1993). Higher pH is known improve tolerance to the air pollution (Agrawal, 1986) and it has observed that majority of plants showed pH of leaf extract in the range of 5 to 7. According to (Keller and Schwager, 1977), Ascorbic acid is an antioxidant that is found in growing parts of the plants and influences resistance to adverse environmental conditions, including air pollution. Soil contamination and air pollution have been found to result in a decrease of leaf ascorbic acid content in exposed saplings (Klumpp et al., 2000), increased level of ascorbic acid in leaves will increase air pollution tolerance in plants (Chaudhary and Rao, 1977). High level of relative water content is advantageous for drought resistance (Dedio, 1975) and it increase the tolerance capacity of trees against the pollution.

According to Katiyar and Dubey (2000), overall growth and development of plants are functions of various environmental factors like air, water, and soil. The variation in leaf pigment content in plants is because of these factors. Dust particles might be the cause of inhibition of chlorophyll synthesis since it has various metals and polycyclic hydrocarbons, thus inhibiting the enzyme necessary for synthesizing chlorophyll particles. Dust deposition affects the light available for photosynthesis and blocks the stomatal pore for diffusion of air and thus put stress on plant metabolism (Eller et al., 1977). Decrease in total chlorophyll content in the leaves may be due to the alkaline condition created by dissolution of chemicals present in the dust particulates in cell sap which is responsible for chlorophyll degradation.
The ascorbic acid content of leaves increases to cope with these stresses since it retards leaf senescence (Garg and Kapoor, 1972). Total chlorophyll content of polluted leaves is lower than that of control leaves and is reported by several researchers (Somashekar et al., 1999; Mandal and Mukherji, 2000; Samal and Santra, 2002). While the influence of leaf characteristics on dust accumulation have studied by (Vora and Bhatnagar, 1986; Somashekar et al., 1999; Garg et al., 2000). The high dust accumulation in the winter season may be due to wet surfaces of leaves which help in capturing dust, with a gentle breeze and foggy condition preventing particulate dispersion. In the rainy season the least dust accumulation is reported because of washing of leaves and settling of particulates because of rain while a high concentration of dust in summer season may be because of high wind speed.

5.6.1 Seasonal variations in chlorophyll content (mg/gm) of selective tree species.

Table-5.9: Seasonal variations of chlorophyll content (mg/gm) in Azadirachta indica at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>8.8</td>
<td>8.62</td>
<td>5.81</td>
<td>5.66</td>
</tr>
<tr>
<td>Rainy</td>
<td>10.25</td>
<td>9.18</td>
<td>6.10</td>
<td>5.76</td>
</tr>
<tr>
<td>Winter</td>
<td>7.26</td>
<td>7.1</td>
<td>5.72</td>
<td>5.02</td>
</tr>
</tbody>
</table>

Chlorophyll content was calculated in three different seasons and at four different locations. In case of Azadirachta indica in summer season at reference site in University area the total chlorophyll content was 8.80 mg/gm, 8.62 mg/gm at Cannought place, 5.81mg/gm at Kranti chowk and 5.66 mg/gm at Chikalthana MIDC. In rainy season at reference site in University area the total chlorophyll content was 10.25 mg/gm, 9.18 mg/gm at Cannought place, 6.10 mg/gm at Kranti chowk and 5.76 mg/gm at Chikalthana MIDC. In winter season at reference site in University area the total chlorophyll content was 7.26 mg/gm, 7.10 mg/gm at Cannought place, 5.72 mg/gm at Kranti chowk and 5.02 mg/gm at Chikalthana MIDC.
Fig-5.6: Seasonal variations of chlorophyll content in *Azadirachta indica* at different locations.

In rainy season at all four sites there was more chlorophyll content compared with summer and winter. In rainy season at site-I (University area) calculated total chlorophyll content was 10.25 mg/gm while it was 8.80 mg/gm and 7.26 mg/gm in summer and winter seasons respectively. At site-II (Cannaught place) in rainy season, calculated total chlorophyll content was 9.18 mg/gm while it was 8.62 mg/gm and 7.10 mg/gm in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated total chlorophyll content was 6.10 mg/gm while it was 5.81 mg/gm and 5.72 mg/gm in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated total chlorophyll content was 5.76 mg/gm while it was 5.66 mg/gm and 5.02 mg/gm in summer and winter seasons respectively.

Table-5.10: Seasonal variation of chlorophyll content (mg/gm) in *Mangifera indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk (mg/gm)</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>8.32</td>
<td>7.65</td>
<td>6.21</td>
<td>5.32</td>
</tr>
<tr>
<td>Rainy</td>
<td>10.2</td>
<td>8.72</td>
<td>6.28</td>
<td>5.36</td>
</tr>
<tr>
<td>Winter</td>
<td>6.2</td>
<td>6.22</td>
<td>5.44</td>
<td>4.8</td>
</tr>
</tbody>
</table>
In case of *Mangifera indica* in summer season at reference in University area the total chlorophyll content was 8.32 mg/gm, 7.65 mg/gm at Cannought place, 6.21 mg/gm at Kranti chowk and 5.32 mg/gm at Chikalthana MIDC. In rainy season at control site in University area the total chlorophyll content was 10.20 mg/gm, 8.72 mg/gm at Cannought place, 6.28 mg/gm at Kranti chowk and 5.36 mg/gm at Chikalthana MIDC. In winter season at control site in University area the total chlorophyll content was 6.20 mg/gm, 6.22 mg/gm at Cannought place, 5.44 mg/gm at Kranti chowk and 4.80 mg/gm at Chikalthana MIDC.

![Seasonal variation of chlorophyll content in *Mangifera indica*](image)

Fig-5.7: Seasonal variation of chlorophyll content (mg/gm) in *Mangifera indica* at different locations.

In rainy season at all four sites there was more chlorophyll content compared with summer and winter. In rainy season at Site-I (University area) calculated total chlorophyll content was 10.20 mg/gm while it was 8.32 mg/gm and 6.20 mg/gm in summer and winter seasons respectively. At site-II (Cannaught place) in rainy season, calculated total chlorophyll content was 8.72 mg/gm while it was 7.65 mg/gm and 6.22 mg/gm in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated total chlorophyll content was 6.28 mg/gm while it was 6.21 mg/gm and 5.44 mg/gm in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated total chlorophyll content was 5.36 mg/gm while it was 5.32 mg/gm and 4.80 mg/gm in summer and winter seasons respectively.
Table-5.11: Seasonal variations of chlorophyll content (mg/gm) in *Polyalthia longifolia* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>6.82</td>
<td>6.02</td>
<td>5.82</td>
<td>5.1</td>
</tr>
<tr>
<td>Rainy</td>
<td>7.21</td>
<td>7.1</td>
<td>6.32</td>
<td>5.12</td>
</tr>
<tr>
<td>Winter</td>
<td>6.12</td>
<td>6</td>
<td>4.98</td>
<td>4.66</td>
</tr>
</tbody>
</table>

In case of *Polyalthia longifolia* in summer season at reference site in University area the total chlorophyll content was 6.82 mg/gm, 6.02 mg/gm at Cannought place, 5.82 mg/gm at Kranti chowk and 5.10 mg/gm at Chikalthana MIDC. In rainy season at control site in University area the total chlorophyll content was 7.21 mg/gm, 7.10 mg/gm at Cannought place, 6.32 mg/gm at Kranti chowk and 5.12 mg/gm at Chikalthana MIDC. In winter season at reference site in University area the total chlorophyll content was 6.12 mg/gm, 6.00 mg/gm at Cannought place, 4.98 mg/gm at Kranti chowk and 4.66 mg/gm at Chikalthana MIDC.

![Seasonal variations of chlorophyll content in *Polyalthia longifolia*](image)

Fig-5.8: Seasonal variations of chlorophyll content (mg/gm) in *Polyalthia longifolia* at different locations.
In rainy season at all four sites there was more chlorophyll content compared with summer and winter. In rainy season at site-I (University area as reference site) calculated total chlorophyll content was 7.21 mg/gm while it was 6.82 mg/gm and 6.12 mg/gm in summer and winter seasons respectively. At site-II (Cannaught place) in rainy season, calculated total chlorophyll content was 7.10 mg/gm while it was 6.02 mg/gm and 6.00 mg/gm in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated total chlorophyll content was 6.32 mg/gm while it was 5.82 mg/gm and 4.98 mg/gm in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated total chlorophyll content was 5.12 mg/gm while it was 5.10 mg/gm and 4.66 mg/gm in summer and winter seasons respectively.

Table-5.12: Seasonal variations of chlorophyll content (mg/gm) in *Dabergia sissoo* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>7.2</td>
<td>7</td>
<td>5.84</td>
<td>4.59</td>
</tr>
<tr>
<td>Rainy</td>
<td>8.21</td>
<td>8.1</td>
<td>5.96</td>
<td>4.82</td>
</tr>
<tr>
<td>Winter</td>
<td>6.92</td>
<td>5.96</td>
<td>5.64</td>
<td>4.00</td>
</tr>
</tbody>
</table>

In case of *Dabergia sissoo* in summer season at reference site in University area the total chlorophyll content was 7.20 mg/gm, 7.00 mg/gm at Cannought place, 5.84 mg/gm at Kranti chowk and 4.59 mg/gm at Chikalthana MIDC. In rainy season at reference site in University area the total chlorophyll content was 8.21 mg/gm, 8.10 mg/gm at Cannought place, 5.96 mg/gm at Kranti chowk and 4.82 mg/gm at Chikalthana MIDC. In winter season at reference site in University area the total chlorophyll content was 6.92 mg/gm, 5.96 mg/gm at Cannought place, 5.64 mg/gm at Kranti chowk and 4.00 mg/gm at Chikalthana MIDC.
Fig-5.9: Seasonal variations of chlorophyll content (mg/gm) in *Dabergia sissoo* at different locations.

In rainy season at all four sites there was more chlorophyll content compared with summer and winter. In rainy season at site-I (University area) calculated total chlorophyll content was 8.21 mg/gm while it was 7.20 mg/gm and 6.92 mg/gm in summer and winter seasons respectively. At site-II (Cannaught place) in rainy season, calculated total chlorophyll content was 8.10 mg/gm while it was 7.00 mg/gm and 5.96 mg/gm in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated total chlorophyll content was 5.96 mg/gm while it was 5.84 mg/gm and 5.64 mg/gm in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated total chlorophyll content was 4.82 mg/gm while it was 4.59 mg/gm and 4.00 mg/gm in summer and winter seasons respectively.

It is clear from the above tables and figures that the amount of chlorophyll content is decreasing in each season at all sites as compared to the reference site. It suggest that the commercial area (Cannaught place) is more polluted than reference site (University area) while, the Kranti Chowk and then Chikalthana MIDC areas are more polluted than site-I (University area) and site-II (Cannaught Place). Chlorophyll content in plant increases in healthy environment while it decreases in polluted environment Agarwal et al., (1988).
5.6.2 Seasonal variations of Ascorbic acid content (mg/gm) in selective tree species.

Table-5.13: Seasonal variations of Ascorbic acid content (mg/gm) in *Azadirachta indica* at different locations

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>8.1</td>
<td>8.22</td>
<td>8.25</td>
<td>8.41</td>
</tr>
<tr>
<td>Rainy</td>
<td>7.9</td>
<td>7.92</td>
<td>7.97</td>
<td>8</td>
</tr>
<tr>
<td>Winter</td>
<td>8.32</td>
<td>8.38</td>
<td>8.39</td>
<td>8.81</td>
</tr>
</tbody>
</table>

Ascorbic acid was calculated in three different seasons and at four different locations. In case of *Azadirachta indica* in summer season at reference site in University area the total Ascorbic acid content was 8.10 mg/gm, 8.22 mg/gm at Cannought place, 8.25 mg/gm at Kranti chowk and 8.41 mg/gm at Chikalthana MIDC. In rainy season at reference site in University area the total Ascorbic acid content was 7.90 mg/gm, 7.92 mg/gm at Cannought place, 7.97 mg/gm at Kranti chowk and 8.00 mg/gm at Chikalthana MIDC. In winter season at reference site in University area the total Ascorbic acid content was 8.32 mg/gm, 8.38 mg/gm at Cannought place, 8.39 mg/gm at Kranti chowk and 8.81 mg/gm at Chikalthana MIDC.

Fig-5.10: Seasonal variations of Ascorbic acid content (mg/gm) in *Azadirachta indica* at different locations.
In winter season at all four sites there was more Ascorbic acid content compared with summer and winter. In winter season at site-I (University area) calculated Ascorbic acid content was 8.32 mg/gm while it was 8.10 mg/gm and 7.90 mg/gm in summer and rainy seasons respectively. At site-II (Cannaught place) in winter season, calculated Ascorbic acid content was 8.38 mg/gm while it was 8.22 mg/gm and 7.92 mg/gm in summer and rainy seasons respectively. At site-III (Kranti Chowk) in winter season, calculated Ascorbic acid content was 8.39 mg/gm while it was 8.25 mg/gm and 7.97 mg/gm in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in winter season, calculated Ascorbic acid content was 8.81 mg/gm while it was 8.41 mg/gm and 8.00 mg/gm in summer and rainy seasons respectively.

Table-5.14: Seasonal variations of Ascorbic acid content (mg/gm) in *Mangifera indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>6.88</td>
<td>6.93</td>
<td>7.16</td>
<td>7.24</td>
</tr>
<tr>
<td>Rainy</td>
<td>6.34</td>
<td>6.86</td>
<td>7.12</td>
<td>7.18</td>
</tr>
<tr>
<td>Winter</td>
<td>6.91</td>
<td>7.1</td>
<td>7.24</td>
<td>7.3</td>
</tr>
</tbody>
</table>

In case of *Mangifera indica* in summer season at reference site in University area the Ascorbic acid content was 6.88 mg/gm, 6.93 mg/gm at Cannought place, 7.16 mg/gm at Kranti chowk and 7.24 mg/gm at Chikalthana MIDC. In rainy season at reference site in University area the Ascorbic acid content was 6.34 mg/gm, 6.86 mg/gm at Cannought place, 7.12 mg/gm at Kranti chowk and 7.18 mg/gm at Chikalthana MIDC. In winter season at reference site in University area the Ascorbic acid content was 6.91 mg/gm, 7.10 mg/gm at Cannought place, 7.24 mg/gm at Kranti chowk and 7.30 mg/gm at Chikalthana MIDC.
Fig-5.11: Seasonal variations of Ascorbic acid content (mg/gm) in *Mangifera indica* at different locations.

In winter season at all four sites there was more chlorophyll content compared with summer and winter. In winter season at site-I (University area) calculated Ascorbic acid content was 6.91 mg/gm while it was 6.88 mg/gm and 6.34 mg/gm in summer and rainy seasons respectively. At site-II (Cannought place) in winter season, calculated Ascorbic acid content was 7.10 mg/gm while it was 6.93 mg/gm and 6.86 mg/gm in summer and rainy seasons respectively. At site-III (Kranti Chowk) in winter season, calculated total chlorophyll content was 7.24 mg/gm while it was 7.16 mg/gm and 7.12 mg/gm in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in winter season, calculated Ascorbic acid content was 7.30 mg/gm while it was 7.24 mg/gm and 7.18 mg/gm in summer and rainy seasons respectively.
Table-5.15: Seasonal variations of Ascorbic acid content (mg/gm) in *Polyalthia longifolia* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>7.52</td>
<td>7.71</td>
<td>8</td>
<td>8.52</td>
</tr>
<tr>
<td>Rainy</td>
<td>7.3</td>
<td>7.58</td>
<td>7.86</td>
<td>8</td>
</tr>
<tr>
<td>Winter</td>
<td>7.63</td>
<td>7.9</td>
<td>8.01</td>
<td>8.55</td>
</tr>
</tbody>
</table>

In case of *Polyalthia longifolia* in summer season at reference site in University area the Ascorbic acid content was 7.52 mg/gm, 7.71 mg/gm at Cannought place, 8.00 mg/gm at Kranti chowk while 8.52 mg/gm at Chikalthana MIDC. In rainy season at reference site in University area the Ascorbic acid content was 7.30 mg/gm, 7.58 mg/gm at Cannought place, 7.86 mg/gm at Kranti chowk and 8.00 mg/gm at Chikalthana MIDC. In winter season at reference site in University area the Ascorbic acid content was 7.63 mg/gm, 7.90 mg/gm at Cannought place, 8.01 mg/gm at Kranti chowk and 8.55 mg/gm at Chikalthana MIDC.

Fig-5.12: Seasonal variations of Ascorbic acid content (mg/gm) in *Polyalthia longifolia* at different locations.
In winter season at all four sites there was more Ascorbic acid content compared with summer and rainy seasons. In winter season at site-I (University area) calculated Ascorbic acid content was 7.63 mg/gm while it was 7.52 mg/gm and 7.30 mg/gm in summer and rainy seasons respectively. At site-II (Cannought place) in winter season, calculated Ascorbic acid content was 7.90 mg/gm while it was 7.71 mg/gm and 7.58 mg/gm in summer and rainy seasons respectively. At site-III (Kranti Chowk) in winter season, calculated Ascorbic acid content was 8.01 mg/gm while it was 8.00 mg/gm and 7.86 mg/gm in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in winter season, calculated Ascorbic acid content was 8.55 mg/gm while it was 8.52 mg/gm and 8.55 mg/gm in summer and rainy seasons respectively.

Table-5.16: Seasonal variations of Ascorbic acid content (mg/gm) in *Dalbergia sissoo* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>5.86</td>
<td>5.88</td>
<td>6.1</td>
<td>6.25</td>
</tr>
<tr>
<td>Rainy</td>
<td>5.8</td>
<td>5.87</td>
<td>6.02</td>
<td>6.12</td>
</tr>
<tr>
<td>Winter</td>
<td>5.88</td>
<td>5.9</td>
<td>6.1</td>
<td>6.28</td>
</tr>
</tbody>
</table>

In case of *Dalbergia sissoo* in summer season at reference site in University area the Ascorbic acid content was 5.86 mg/gm, 5.88 mg/gm at Cannought place, 6.10 mg/gm at Kranti chowk while 6.25 mg/gm at Chikalthana MIDC. In rainy season at reference in University area the Ascorbic acid content was 5.80 mg/gm, 5.87 mg/gm at Cannought place, 6.02 mg/gm at Kranti chowk and 6.12 mg/gm at Chikalthana MIDC. In winter season at reference site in University area the Ascorbic acid content was 5.88 mg/gm, 5.90 mg/gm at Cannought place, 6.10 mg/gm at Kranti chowk and 6.28 mg/gm at Chikalthana MIDC.
Fig-5.13: Seasonal variations of Ascorbic acid content (mg/gm) in *Dalbergia sissoo* at different locations.

In winter season at all four sites there was more Ascorbic acid content compared with summer and rainy. In winter season at site-I (University area) calculated Ascorbic acid content was 5.88 mg/gm while it was 5.86 mg/gm and 5.80 mg/gm in summer and rainy seasons respectively. At site-II (Cannought place) in winter season, calculated Ascorbic acid content was 5.90 mg/gm while it was 5.88 mg/gm and 5.87 mg/gm in summer and rainy seasons respectively. At site-III (Kranti Chowk) in winter season, calculated Ascorbic acid content was 6.10 mg/gm while it was 6.10 mg/gm and 6.02 mg/gm in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in winter season, calculated Ascorbic acid content was 6.28 mg/gm while it was 6.25 mg/gm and 6.12 mg/gm in summer and rainy seasons respectively.

It is clear from the above tables and figures that the amount of ascorbic acid content is increasing after control site in each season. It suggest that the commercial area (Cannought place) is more polluted than reference area (University area) while, the Kranti Chowk and then Chikalthana MIDC areas are more polluted than site-I (University area) and Site-II (Cannought Place). Ascorbic acid increases the air pollution tolerance capacity of trees (Singh and Verma, 2007). Tripathi and Gautam (2007) also reported the increase in the concentration of ascorbic acid in the leaves of plants near roadside due to enhanced pollution loads of automobiles.. Chlorophyll and ascorbic acid has negative relationship, when chlorophyll content increases that time ascorbic acid in plant decreases (Prjapati et al., 2006).
**5. 6. 3: Seasonal variations of Relative water content (%) of selective tree species.**

Table-5.17: Seasonal variations of Relative water content (%) in *Azadirachta indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>77</td>
<td>68</td>
<td>56</td>
<td>50</td>
</tr>
<tr>
<td>Rainy</td>
<td>82</td>
<td>80</td>
<td>66</td>
<td>55</td>
</tr>
<tr>
<td>Winter</td>
<td>80</td>
<td>78</td>
<td>57</td>
<td>51</td>
</tr>
</tbody>
</table>

Relative water content was calculated in three different seasons and at four different locations. In case of *Azadirachta indica* in summer season at reference site in University area the relative water content was 77%, 68% at Cannought place, 56% at Kranti chowk and 50% at Chikalthana MIDC. In rainy season at reference site in University area the relative water content was 82%, 80% at Cannought place, 66% at Kranti chowk and 55% at Chikalthana MIDC. In winter season at reference site in University area the relative water content was 80%, 78% at Cannought place, 57% at Kranti chowk and 51% at Chikalthana MIDC.

![Seasonal variations of Water content in *Azadirachta indica*](image)

Fig-5.14: Seasonal variations of Relative water content (%) in *Azadirachta indica* at different locations.
In rainy season at all four sites there was more water content compared with summer and winter. In rainy season at site-I (University area) calculated relative water content was 82% while it was 80% and 77% in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, calculated relative water content was 80% while it was 78% and 68% in winter and summer seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated relative water content was 66% while it was 57% and 56% in winter and summer seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated relative water content was 55% while it was 51% and 50% in winter and summer seasons respectively.

Table 5.18: Seasonal variations of Relative water content (%) in *Mangifera indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>71</td>
<td>59</td>
<td>58</td>
<td>55</td>
</tr>
<tr>
<td>Rainy</td>
<td>88</td>
<td>78</td>
<td>68</td>
<td>61</td>
</tr>
<tr>
<td>Winter</td>
<td>78</td>
<td>63</td>
<td>60</td>
<td>57</td>
</tr>
</tbody>
</table>

In case of *Mangifera indica* in summer season the relative water content was 71% at reference site in University area, 59% at Cannought place, 58% at Kranti chowk and 55% at Chikalthana MIDC. In rainy season at reference site in University area the relative water content was 88%, 78% at Cannought place, 68% at Kranti chowk and 61% at Chikalthana MIDC. In winter season at reference site in University area the relative water content was 78%, 63% at Cannought place, 60% at Kranti chowk and 57% at Chikalthana MIDC.
Fig-5.15: Seasonal variations of Relative water content (%) in *Mangifera indica* at different locations.

In rainy season at all four sites there was more water content compared with summer and winter. In rainy season at site-I (University area) calculated relative water content was 88% while it was 78% and 71% in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, calculated relative water content was 78% while it was 63% and 59% in winter and summer seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated relative water content was 68% while it was 60% and 58% in winter and summer seasons respectively. At Site-IV (Chikalthana MIDC) in rainy season, calculated relative water content was 61% while it was 57% and 55% in winter and summer seasons respectively.
Table-5.19: Seasonal variations of Relative water content (%) in *Polyalthia longifolia* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>74</td>
<td>69</td>
<td>58</td>
<td>55</td>
</tr>
<tr>
<td>Rainy</td>
<td>80</td>
<td>77</td>
<td>61</td>
<td>60</td>
</tr>
<tr>
<td>Winter</td>
<td>79</td>
<td>70</td>
<td>60</td>
<td>56</td>
</tr>
</tbody>
</table>

In case of *Polyalthia longifolia* in summer season at reference in University area the relative water content was 74%, 69% at Cannought place, 58% at Kranti chowk and 55% at Chikalthana MIDC. In rainy season at reference site in University area the relative water content was 80%, 77% at Cannought place, 61% at Kranti chowk and 60% at Chikalthana MIDC. In winter season at reference site in University area the relative water content was 79%, 70% at Cannought place, 60% at Kranti chowk and 56% at Chikalthana MIDC.

![Seasonal variations of Water content in *Polyalthia longifolia*](image)

In rainy season at all four sites there was more water content compared with summer and winter. In rainy season at site-I (University area) calculated relative water content was 80 % while it was 79% and 74% in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, calculated relative water content was 77% while it was 70% and 69% in winter and summer seasons.
respectively. At site-III (Kranti Chowk) in rainy season, calculated relative water content was 61% while it was 60% and 58% in winter and summer seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated relative water content was 60% while it was 56% and 55% in winter and summer seasons respectively.

Table-5.20: Seasonal variations of Relative water content (%) in *Dalbergia sissoo* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>77</td>
<td>70</td>
<td>60</td>
<td>48</td>
</tr>
<tr>
<td>Rainy</td>
<td>78</td>
<td>76</td>
<td>63</td>
<td>59</td>
</tr>
<tr>
<td>Winter</td>
<td>72</td>
<td>70</td>
<td>62</td>
<td>50</td>
</tr>
</tbody>
</table>

In case of *Dalbergia sissoo* in summer season at reference site in University area the relative water content was 77%, 70% at Cannought place, 60% at Kranti chowk and 48% at Chikalthana MIDC. In rainy season at reference site in University area the relative water content was 78%, 76% at Cannought place, 63% at Kranti chowk and 59% at Chikalthana MIDC. In winter season at reference site in University area the relative water content was 72%, 70% at Cannought place, 62% at Kranti chowk and 50% at Chikalthana MIDC.

![Seasonal variations of Water content in Dalbergia sissoo](image)

Fig-5.17: Seasonal variations of Relative water content (%) in *Dalbergia sissoo* at different locations.
In rainy season at all four sites there was more water content compared with summer and winter. In rainy season at site-I (University area) calculated relative water content was 78% while it was 72% and 77% in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, calculated relative water content was 76% while it was 70% and 70% in winter and summer seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated relative water content was 63% while it was 62% and 60% in winter and summer seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated relative water content was 59% while it was 50% and 48% in winter and summer seasons respectively.

It is clear from the above tables and figures that the percentage of relative water content decreases after reference site (University area). There is less water content at site-II (Cannaught place) comparing with University area while at site-III (Kranti Chowk) and site-IV (Chikalthana MIDC) the relative water content is less than site-I (University area) and site-II (Cannaught place). It suggests that the relative water content decreases in polluted sites as compared to reference site. The amount of relative water content is more in rainy season while it decreases in winter and then in summer season.

### 5.6.4 Seasonal variations of Leaf extract pH of selective tree species

Table-5.21: Seasonal variations of Leaf extract pH in *Azadirachta indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti Chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>5.21</td>
<td>5.18</td>
<td>5.11</td>
<td>5.01</td>
</tr>
<tr>
<td>Rainy</td>
<td>6.25</td>
<td>6.1</td>
<td>5.9</td>
<td>5.1</td>
</tr>
<tr>
<td>Winter</td>
<td>5.8</td>
<td>5.72</td>
<td>5.6</td>
<td>5.08</td>
</tr>
</tbody>
</table>

Leaf extract pH was calculated in three different seasons and at four different locations. In case of *Azadirachta indica* in summer season at reference site in University area the leaf extract pH was 5.21, 5.18 at Cannought place, 5.11 at
Kranti chowk and 5.01 at Chikalthana MIDC. In rainy season at reference site in University area the leaf extract pH was 6.25, 6.10 at Cannought place, 5.90 at Kranti chowk and 5.10 at Chikalthana MIDC. In winter season at reference site in University area the leaf extract pH was 5.80, 5.72 at Cannought place, 5.60 at Kranti chowk and 5.08 at Chikalthana MIDC.

Fig-5.18: Seasonal variations of Leaf extract pH in *Azadirachta indica* at different locations.

In rainy season at all four sites there was more leaf extract pH compared with summer and winter. In rainy season at site-I (University area) calculated leaf extract pH content was 6.25 while it was 5.80 and 5.21 in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, calculated leaf extract pH was 6.10 while it was 5.72 and 5.18 in winter and summer seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated leaf extract pH was 5.90 while it was 5.60 and 5.11 mg/gm in winter and summer seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated leaf extract pH was 5.10 while it was 5.08 and 5.01 in winter and summer seasons respectively.
Table-5.22: Seasonal variations of Leaf extract pH in *Mangifera indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>5.32</td>
<td>5.12</td>
<td>5.07</td>
<td>5.00</td>
</tr>
<tr>
<td>Rainy</td>
<td>6.2</td>
<td>6.1</td>
<td>5.12</td>
<td>5.01</td>
</tr>
<tr>
<td>Winter</td>
<td>5.7</td>
<td>5.62</td>
<td>5.1</td>
<td>5.00</td>
</tr>
</tbody>
</table>

In case of *Mangifera indica* in summer season at reference site in University area the leaf extract pH was 5.32, 5.12 at Cannought place, 5.07 at Kranti chowk and 5.00 at Chikalthana MIDC. In rainy season at reference site in University area the leaf extract pH was 6.25, 6.1 at Cannought place, 5.12 at Kranti chowk and 5.01 at Chikalthana MIDC. In winter season at reference site in University area the leaf extract pH was 5.7, 5.62 at Cannought place, 5.10 at Kranti chowk and 5.00 at Chikalthana MIDC.

![Seasonal variations of Leaf extract pH in *Mangifera indica*](image)

Fig-5.19: Seasonal variations of Leaf extract pH in *Mangifera indica* at different locations.

In rainy season at all four sites there was more leaf extract pH compared with summer and winter. In rainy season at site-I (University area) leaf extract pH was 6.2 while it was 5.7 and 5.32 in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, leaf extract pH was 6.1 while it was 5.62
and 5.12 in winter and summer seasons respectively. At site-III (Kranti Chowk) in rainy season, the leaf extract pH was 5.12 while it was 5.10 and 5.07 in winter and summer seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, leaf extract pH recorded was 5.01 while it was 5.00 in winter and summer seasons respectively.

Table-5.23: Seasonal variations of Leaf extract pH in *Polyalthia longifolia* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>5.92</td>
<td>5.82</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Rainy</td>
<td>6.3</td>
<td>6.26</td>
<td>5.1</td>
<td>5.02</td>
</tr>
<tr>
<td>Winter</td>
<td>6.1</td>
<td>6</td>
<td>5.02</td>
<td>5</td>
</tr>
</tbody>
</table>

In case of *Polyalthia longifolia* in summer season at reference site in University area the leaf extract pH was 5.92, 5.82 at Cannought place and 5.00 at Kranti chowk and Chikalthana MIDC. In Rainy season at reference site in University area the leaf extract pH was 6.3, 6.26 at Cannought place, 5.1 at Kranti chowk and 5.02 at Chikalthana MIDC. In winter season at reference site in University area the leaf extract pH was 6.1, 6.00 at Cannought place, 5.02 at Kranti chowk and 5.00 at Chikalthana MIDC.

![Seasonal variations of Leaf extract pH in Polyalthia longifolia](image)

Fig-5.20: Seasonal variations of Leaf extract pH in *Polyalthia longifolia* at different locations.
In rainy season at all four sites there was more leaf extract pH compared with winter and summer. In rainy season at site-I (University area) leaf extract pH was 6.3 while it was 6.1 and 5.92 in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, leaf extract pH was 6.26 while it was 6.00 and 5.82 in winter and summer seasons respectively. At site-III (Kranti Chowk) in rainy season, the leaf extract pH was 5.10 while it was 5.02 and 5.00 in winter and summer seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, leaf extract pH recorded was 5.02 while it was 5.00 in winter and summer seasons respectively.

Table-5.24: Seasonal variations of Leaf extract pH in *Dalbergia sissoo* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>5.26</td>
<td>5.12</td>
<td>5.1</td>
<td>5.03</td>
</tr>
<tr>
<td>Rainy</td>
<td>6.21</td>
<td>6.2</td>
<td>5.32</td>
<td>5.2</td>
</tr>
<tr>
<td>Winter</td>
<td>5.76</td>
<td>5.3</td>
<td>5.12</td>
<td>5.1</td>
</tr>
</tbody>
</table>

In case of *Dalbergia sissoo* in summer season at reference site in University area the leaf extract pH was 5.26, 5.12 at Cannought place, 5.10 at Kranti Chowk and 5.03 at Chikalthana MIDC. In rainy season at reference site in University area the leaf extract pH was 6.21, 6.20 at Cannought place, 5.32 at Kranti Chowk and 5.20 at Chikalthana MIDC. In winter season at reference site in University area the leaf extract pH was 5.76, 5.30 at Cannought place, 5.12 at Kranti Chowk and 5.10 at Chikalthana MIDC.
Fig-5.23: Seasonal variations of Leaf extract pH in *Dalbergia sissoo* at different locations.

In rainy season at all four sites there was more leaf extract pH compared with summer and winter. In rainy season at site-I (University area) leaf extract pH was 6.21 while it was 5.76 and 5.26 in winter and summer seasons respectively. At site-II (Cannought place) in rainy season, leaf extract pH was 6.20 while it was 5.30 and 5.12 in winter and summer seasons respectively. At site-III (Kranti Chowk) in rainy season, the leaf extract pH was 5.32 while it was 5.12 and 5.10 in winter and summer seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, leaf extract pH recorded was 5.20 while it was 5.10 and 5.03 in winter and summer seasons respectively. Higher pH is known improve tolerance to the air pollution (Agrawal, 1986). In present investigation higher levels of pH were calculated at polluted sites compared with less polluted sites.

5.6.5 *Seasonal variations of Air pollution tolerance index of selective tree species.*

Table-5.25: Seasonal variations of Air pollution tolerance index (APTI) in *Azadirachta indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti Chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>19.04</td>
<td>18.14</td>
<td>14.6</td>
<td>13.97</td>
</tr>
<tr>
<td>Rainy</td>
<td>21.23</td>
<td>20.1</td>
<td>16.16</td>
<td>14.18</td>
</tr>
<tr>
<td>Winter</td>
<td>18.86</td>
<td>18.54</td>
<td>15.19</td>
<td>13.99</td>
</tr>
</tbody>
</table>
APTI of tree species was calculated in three different seasons and at four different locations. In case of *Azadirachta indica* in summer season at reference site in University area the APTI was 19.04, 18.14 at Cannought place, 14.60 at Kranti chowk and 13.97 at Chikalthana MIDC. In rainy season at reference site in University area the APTI was 21.23, 20.10 at Cannought place, 16.16 at Kranti chowk and 14.18 at Chikalthana MIDC. In winter season at reference site in University area the APTI was 18.86, 18.54 at Cannought place, 15.19 at Kranti chowk and 13.99 at Chikalthana MIDC.

![Seasonal variations of Air pollution tolerance index in *Azadirachta indica*](image)

In rainy season at all four sites there was more APTI recorded compared with summer and winter. In rainy season at site-I (University area) calculated APTI was 21.23 while it was 19.04 and 18.86 in summer and winter seasons respectively. At site-II (Cannought place) in rainy season, calculated APTI was 20.10 while it was 18.14 and 18.54 in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated APTI was 16.16 while it was 14.60 and 15.19 in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated APTI was 14.18 while it was 13.97 and 13.99 in summer and winter seasons respectively.

Fig-5.22: Seasonal variations of Air pollution tolerance index in *Azadirachta indica* at different locations.
Table-5.26: Seasonal variations of Air pollution tolerance index in *Mangifera indica* at different locations

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>16.48</td>
<td>14.74</td>
<td>13.87</td>
<td>12.97</td>
</tr>
<tr>
<td>Rainy</td>
<td>19.19</td>
<td>17.96</td>
<td>14.91</td>
<td>13.54</td>
</tr>
<tr>
<td>Winter</td>
<td>16.02</td>
<td>14.7</td>
<td>13.63</td>
<td>12.85</td>
</tr>
</tbody>
</table>

In case of *Mangifera indica* in summer season at reference site in University area the APTI was 16.48, 14.74 at Cannought place, 13.87 at Kranti chowk and 12.97 at Chikalthana MIDC. In rainy season at reference site in University area the APTI was 19.19, 17.96 at Cannought place, 14.91 at Kranti chowk and 13.54 at Chikalthana MIDC. In winter season at reference site in University area the APTI was 16.02, 14.70 at Cannought place, 13.63 at Kranti chowk and 12.85 at Chikalthana MIDC.

Fig-5.23: Seasonal variations of Air pollution tolerance index in *Azadirachta indica* at different locations.

In rainy season at all four sites there was more APTI recorded compared with summer and winter. In rainy season at site-I (University area) calculated APTI was 19.19 while it was 16.48 and 16.02 in summer and winter seasons respectively.
At site-II (Cannought place) in rainy season, calculated APTI was 17.96 while it was 14.74 and 14.70 in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated APTI was 14.91 while it was 13.87 and 13.63 in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated APTI was 13.54 while it was 12.97 and 12.85 in summer and winter seasons respectively.

Table-5.27: Seasonal variations of Air pollution tolerance index in *Polyalthia longifolia* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>16.98</td>
<td>16.02</td>
<td>14.45</td>
<td>14.1</td>
</tr>
<tr>
<td>Rainy</td>
<td>17.86</td>
<td>17.82</td>
<td>15.07</td>
<td>14.11</td>
</tr>
<tr>
<td>Winter</td>
<td>17.22</td>
<td>16.48</td>
<td>14.01</td>
<td>13.85</td>
</tr>
</tbody>
</table>

In case of *Polyalthia longifolia* in summer season at reference site in University area the APTI was 16.98, 16.02 at Cannought place, 14.45 at Kranti chowk and 14.10 at Chikalthana MIDC. In rainy season at reference site in University area the APTI was 17.86, 17.82 at Cannought place, 15.07 at Kranti chowk and 14.11 at Chikalthana MIDC. In winter season at reference site in University area the APTI was 17.22, 16.48 at Cannought place, 14.01 at Kranti chowk and 13.85 at Chikalthana MIDC.

![Seasonal variations of Air pollution tolerance index in *Polyalthia longifolia*](image)

Fig-5.24: Seasonal variations of Air pollution tolerance index in *Polyalthia longifolia* at different locations.
In rainy season at all four sites there was more APTI recorded compared with summer and winter. In rainy season at site-I (University area) calculated APTI was 17.86 while it was 16.98 and 17.22 in summer and winter seasons respectively. At site-II (Cannought place) in rainy season, calculated APTI was 17.82 while it was 16.02 and 16.48 in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated APTI was 15.07 while it was 14.45 and 14.01 in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated APTI was 14.11 while it was 14.10 and 13.85 in summer and winter seasons respectively.

Table-5.28: Seasonal variations of Air pollution tolerance index in *Dalbergia sissoo* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>15</td>
<td>14.12</td>
<td>12.67</td>
<td>10.81</td>
</tr>
<tr>
<td>Rainy</td>
<td>16.16</td>
<td>15.99</td>
<td>13.09</td>
<td>12.03</td>
</tr>
<tr>
<td>Winter</td>
<td>14.09</td>
<td>13.64</td>
<td>12.76</td>
<td>10.71</td>
</tr>
</tbody>
</table>

In case of *Dalbergia sissoo* in summer season at reference site in University area the APTI was 15.00, 14.12 at Cannought place, 12.67 at Kranti chowk and 10.81 at Chikalthana MIDC. In rainy season at reference site in University area the APTI was 16.16, 15.99 at Cannought place, 13.09 at Kranti chowk and 12.03 at Chikalthana MIDC. In winter season at reference site in University area the APTI was 14.09, 13.64 at Cannought place, 12.76 at Kranti chowk and 10.71 at Chikalthana MIDC.
In rainy season at all four sites there was more APTI recorded compared with summer and winter. In rainy season at site-I (University area) calculated APTI was 16.16 while it was 15.00 and 14.09 in summer and winter seasons respectively. At site-II (Cannought place) in rainy season, calculated APTI was 15.99 while it was 14.12 and 13.64 in summer and winter seasons respectively. At site-III (Kranti Chowk) in rainy season, calculated APTI was 13.09 while it was 12.67 and 12.76 in summer and winter seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated APTI was 12.03 while it was 10.81 and 10.71 in summer and winter seasons respectively.

5.7 Washable Dust deposition

Significant variation in washable dust deposition on leaves is observed in different seasons. Various factors are responsible for dust interception and its accumulation in different plant species. Leaf shape and size, texture of leaf, presence and absence of hairs etc., Climatic factors like weather, wind speed and direction and other anthropogenic factors are included in those factors.

Higher dust deposition in Mangifera indica ($7 \text{ mg/cm}^2$) in winter season may be due to the rough surface of the leaf, while less dust accumulation in Azadirachta indica ($1 \text{ mg/cm}^2$) in winter season may be due to the less surface area and smooth leaf surface and vertical position of the leaf. The harmful effects of dust deposition are evidenced by the reduced leaf area and low chlorophyll content. Dust forms a
uniform coating over the leaf surfaces, plugging the leaf stomatal aperture and impairing gas exchange (Stern, 1977; Khoshoo and Ahmad, 1981; Krishnamurthy and Rajachidambaram, 1986). The effluence of leaf characteristics on dust accumulation have also been studied by (Vora and Bhatnagar, 1986; Somshekhar, et al., 1999; Garg, et al., 2000).

Highest dust accumulation in winter season may be due to wet surface of leaves which helps in capturing dust with slow wind speed preventing particulate dispersal, while in rainy season the least dust accumulation is reported because of washing of leaves. In summer season though the concentration of dust is more high wind speed takes it away from the leaf surface.

Fig-5.26: Dusted leaves from reference (University area) and polluted (Kranti chowk) sites.

A- Neem (R)  B- Mango(R)  C-Ashoka(R)  D-Sheesham (R)

A- Neem (P)  B- Mango(P)  C-Ashoka(P)  D-Sheesham (P)

R-Reference Site  P- Polluted Site.
5.7.1 Seasonal variations of washable Dust deposition (mg/cm²) in *Azadirachta indica*.

Table-5.29: Seasonal variations of washable dust deposition (mg/cm²) in *Azadirachta indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Rainy</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Winter</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Dust deposition was calculated in three different seasons and at four different sites. In case of *Azadirachta indica* in summer season at reference site in University area the dust deposition calculated was 1 mg/cm². It was 1 mg/cm² at Cannought place, 2mg/cm² at Kranti chowk and 1 mg/cm² at Chikalthana MIDC. In rainy season at reference site in University area the dust deposition was 0 mg/cm² and 1mg/cm² at Cannought place, Kranti chowk and Chikalthana MIDC respectively. In winter season at University area and Cannought place the dust deposition was 1 mg/cm², 4 mg/cm² at Kranti chowk and 3mg/cm² at Chikalthana MIDC.

![Seasonal variations of Dust deposition in *Azadirachta indica*](image)

Fig-5.27: Seasonal variations of washable Dust deposition (mg/cm²) in *Azadirachta indica* at different locations.
In winter season at all four sites there was more dust deposition compared with summer and rainy. In winter season at site-I (University area) calculated total dust deposition was 1 mg/cm² while it was 1 mg/cm² and 0 mg/cm² in summer and rainy seasons respectively. At site-II (Cannought place) in all the seasons, calculated dust deposition was 1 mg/cm². At Site-III (Kranti Chowk) in winter season, calculated dust deposition was 4 mg/cm² while it was 2 mg/cm² and 1 mg/cm² in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated dust deposition was 3 mg/cm² while it was 1 mg/cm² in summer and rainy seasons respectively.

5.7.2 Seasonal variations of washable Dust deposition (mg/cm²) in *Mangifera indica*.

Table-5.30: Seasonal variations of washable Dust deposition (mg/cm²) in *Mangifera indica* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area (mg/cm²)</th>
<th>Cannought place (mg/cm²)</th>
<th>Kranti chowk (mg/cm²)</th>
<th>Chikalthana MIDC (mg/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Rainy</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Winter</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

In case of *Mangifera indica* in summer season at reference site in University area the dust deposition calculated was 1 mg/cm², 3 mg/cm² at Cannought place, 5mg/cm² at Kranti chowk and 4 mg/cm² at Chikalthana MIDC. In rainy season at reference site in University area the dust deposition was 1 mg/cm², 2mg/cm² at Cannought place, 4 mg/cm² at Kranti chowk and at 2 mg/cm² at Chikalthana MIDC. In winter season at reference site in University area the dust deposition was 2 mg/cm², 4mg/cm² at Cannought place, 7 mg/cm² at Kranti chowk and 5mg/cm² at Chikalthana MIDC.
Fig-5.28: Seasonal variations of washable Dust deposition (mg/cm$^2$) in *Mangifera indica* at different locations.

In winter season at all four sites there was more dust deposition compared with summer and rainy. In winter season at site-I (University area) calculated total dust deposition was 2 mg/cm$^2$ while it was 1 mg/cm$^2$ in summer and rainy seasons respectively. At site-II (Cannaught place) in winter season the dust deposition recorded was 4 mg/cm$^2$, 3 mg/cm$^2$ in summer season and 2 mg/cm$^2$ in rainy season. At site-III (Kranti Chowk) in winter season, calculated dust deposition was 7 mg/cm$^2$ while it was 5 mg/cm$^2$ and 4 mg/cm$^2$ in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated dust deposition was 5 mg/cm$^2$ while it was 4 mg/cm$^2$ in summer and 2 mg/cm$^2$ rainy season.
5.7.3 Seasonal variations of washable Dust deposition (mg/cm\(^2\)) in *Polyalthia longifolia*.

Table-5.31: Seasonal variations of washable Dust deposition (mg/cm\(^2\)) in *Polyalthia longifolia* at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area (mg/cm(^2))</th>
<th>Cannought place (mg/cm(^2))</th>
<th>Kranti chowk (mg/cm(^2))</th>
<th>Chikalthana MIDC (mg/cm(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Rainy</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Winter</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

In case of *Polyalthia longifolia* in summer season the dust deposition at reference site in University area calculated was 1 mg/cm\(^2\), 1 mg/cm\(^2\) at Cannought place, 2 mg/cm\(^2\) at Kranti chowk and 1 mg/cm\(^2\) at Chikalthana MIDC. In rainy season at reference site in University area the dust deposition was 0 mg/cm\(^2\) and 1 mg/cm\(^2\) at Cannought place, Kranti chowk and Chikalthana MIDC respectively. In winter season at reference site in University area the dust deposition was 2 mg/cm\(^2\), 2 mg/cm\(^2\) at Cannought place, 4 mg/cm\(^2\) at Kranti chowk and 2 mg/cm\(^2\) at Chikalthana MIDC.

Fig-5.29: Seasonal variations of washable dust deposition (mg/cm\(^2\)) in *Polyalthia longifolia* at different locations.
In winter season at all four sites there was more dust deposition compared with summer and rainy. In winter season at site-I (University area) calculated total dust deposition was 2 mg/cm² while it was 1 mg/cm² and 0 mg/cm² in summer and rainy seasons respectively. At site-II (Cannought place) in winter season calculated dust deposition was 2 mg/cm² while it was 1 mg/cm² in summer and rainy seasons. At site-III (Kranti Chowk) in winter season, calculated dust deposition was 4 mg/cm² while it was 2 mg/cm² and 1 mg/cm² in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in rainy season, calculated dust deposition was 2 mg/cm² while it was 1 mg/cm² in summer and rainy seasons respectively.

5.7.4 Seasonal variations of washable Dust deposition (mg/cm²) in Dalbergia sissoo.

Table-5.32: Seasonal variations of washable Dust deposition (mg/cm²) in Dalbergia sissoo at different locations.

<table>
<thead>
<tr>
<th>Season/Site</th>
<th>University area</th>
<th>Cannought place</th>
<th>Kranti chowk</th>
<th>Chikalthana MIDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Rainy</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Winter</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

In case of Dalbergia sissoo in summer season at reference site in University area the dust deposition calculated was 1 mg/cm², 1 mg/cm² at Cannought place, 3mg/cm² at Kranti chowk and 2 mg/cm² at Chikalthana MIDC. In rainy season at reference site in University area the dust deposition was 0 mg/cm² while it was 1 mg/cm² at Cannought place, Kranti chowk and Chikalthana MIDC respectively. In winter season at reference site in University area and Cannought place the dust deposition was 2mg/cm², 4 mg/cm² at Kranti chowk and 3mg/cm² at Chikalthana MIDC.
Fig-5.30: Seasonal variations of washable Dust deposition (mg/cm²) in *Dalbergia sissoo* at different locations.

In winter season at all four sites there was more dust deposition compared with summer and rainy. In winter season at site-I (University area) calculated total dust deposition was 2mg/cm² while it was 1 mg/cm² and 0 mg/cm² in summer and rainy seasons respectively. At site-II (Cannought place) in winter season the dust deposition was 2 mg/cm² while in summer and rainy seasons it was 1 mg/cm². At site-III (Kranti Chowk) in winter season, calculated dust deposition was 4 mg/cm² while it was 3 mg/cm² and 1 mg/cm² in summer and rainy seasons respectively. At site-IV (Chikalthana MIDC) in winter season, calculated dust deposition was 3 mg/cm² while it was 2 mg/cm² in summer and 1 mg/cm² in rainy season.

5.8 Social Survey on tree importance (Observations based on questionnaire)

Environmental awareness is one of the effective way through which we can save our environment. Today an adverse environmental condition does not harm only animals and human being but the vegetation also. Environmental awareness is a need of time so the field surveys was organized and in all 300 citizens including students and employers were interviewed and the data was recorded. The questions asked were related to role of trees, important value of trees and aim of planting trees preferred type of tree species for planting and most beneficial tree species etc. The study results show that peoples are aware about the adverse impacts of
pollution and importance of trees to avoid the pollution. Presently the environmental quality in Aurangabad city is good. Citizens are of the opinion that some special efforts should be taken to stop the further degradation of city environment. The field survey reflects citizen’s care towards their environment. Neem and Mango are the tree species which are suggested in more number by the people.

5.8.1 Condition of air in Aurangabad city.

The questionnaires were prepared with a view to get information regarding present status of air pollution and awareness about trees in Aurangabad city. The opinion poll on the condition of air is represented in fig.5.31.

![Condition of air in Aurangabad city](image)

Fig. 5.31: Condition of air in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph. The data collected from total 100 students studying in junior college which shows clear picture about their view towards the condition of air in Aurangabad city. According to the data collected by survey 28% girls and 42% boys were of the view that condition of air is good in Aurangabad
city where as 38% girls and 28% boys were of the view that condition of air is better in Aurangabad city. About 34% girls and 18% boys said that condition of air is best in Aurangabad city while 0% girls and 12% boys were of the opinion that air is worst in Aurangabad city.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the condition of air in Aurangabad city. According to the data collected by survey 48% girls and 50% boys were of the view that condition of air is good in Aurangabad city where as 36% girls and 30% boys were of the view that condition of air is better in Aurangabad city. About 2% girls and 14% boys said that condition of air is best in Aurangabad city while 14% girls and 6% boys were of the opinion that air is worst in Aurangabad city.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the condition of air in Aurangabad city. According to the data collected by survey 62% females and 58% males were of the view that condition of air is good in Aurangabad city where as 18% females and 18% males were of the view that condition of air is better in Aurangabad city. About 14% females and 12% males said that condition of air is best in Aurangabad city while 6% females and 12% males were of the opinion that air is worst in Aurangabad city.
5.8.2 Major Source of air pollution in Aurangabad city.

The opinion poll for major source of air pollution in city is represented in fig 5.32

![Major source of air pollution in Aurangabad city](image)

Fig-5.32: Major source of air in Aurangabad city.

The questionnaires were prepared with a view to get information regarding major source of air pollution and awareness about trees in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the major source of air pollution of air pollution in Aurangabad city. According to the data collected by survey 36% girls and 84% boys were of the view that industries are the major source of air pollution in Aurangabad city where as 28% girls and 10% boys were of the view that waste burning is the major source of air pollution in Aurangabad city. About 18% girls and 0% boys said that automobiles are the major source of air pollution in Aurangabad city while 18% girls and 6% boys were of the opinion that dust is the major source of air pollution in Aurangabad city.
Senior college students

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the major source of air pollution of air pollution in Aurangabad city. According to the data collected by survey 34% girls and 54% boys were of the view that industries are the major source of air pollution in Aurangabad city where as 14% girls and 12% boys were of the view that waste burning is the major source of air pollution in Aurangabad city. About 38% girls and 26% boys said that automobiles are the major source of air pollution in Aurangabad city while 14% girls and 8% boys were of the opinion that dust is the major source of air pollution in Aurangabad city.

Employers

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the major source of air pollution of air pollution in Aurangabad city. According to the data collected by survey 42% females and 60% males were of the view that industries are the major source of air pollution in Aurangabad city where as 2% females and 2% males were of the view that waste burning is the major source of air pollution in Aurangabad city. About 34% females and 26% males said that automobiles are the major source of air pollution in Aurangabad city while 22% females and 12% males were of the opinion that dust is the major source of air pollution in Aurangabad city.
5.8.3 Diseases due to air pollution

The opinion poll of diseases due to air pollution in city is represented in fig.5.33

![Diseases due to Air pollution](image)

Fig-5.33: Diseases due to air pollution in Aurangabad city.

The questionnaires were prepared with a view to get information regarding the diseases due to air pollution in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the diseases caused due to air pollution in Aurangabad city. According to the data collected by survey 64% girls and 30% boys were of the view that they are not having any disease due to air pollution where as 18% girls and 26% boys were of the view that air pollution in city is responsible for their skin diseases. About 10% girls and 10% boys said that respiratory diseases are caused to them due to air pollution in Aurangabad city while 8% girls and 34% boys were of the opinion that air pollution is responsible for other types of diseases caused to them.
**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the diseases caused due to air pollution in Aurangabad city. According to the data collected by survey 44% girls and 60% boys were of the view that they are not having any disease due to air pollution where as 12% girls and 12% boys were of the view that air pollution in city is responsible for their skin diseases. About 30% girls and 8% boys said that respiratory diseases are caused to them due to air pollution in Aurangabad city while 14% girls and 20% boys were of the opinion that air pollution is responsible for other types of diseases caused to them.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the diseases caused due to air pollution in Aurangabad city. According to the data collected by survey 42% females and 52% males were of the view that they are not having any disease due to air pollution where as 12% females and 16% males were of the view that air pollution in city is responsible for their skin diseases. About 36% females and 22% males said that respiratory diseases are caused to them due to air pollution in Aurangabad city while 10% females and 10% males were of the opinion that air pollution is responsible for other types of diseases caused to them.
5.8.4 Factor that will be most effective to control air pollution.

The questionnaires were prepared with a view to get information regarding the factor that will be effective in controlling air pollution in Aurangabad city. The opinion poll for factor that will be most effective to control air pollution is represented in fig-5. 34.

![Factor that will be effective to control air pollution](image)

Fig-5.34: Factor that will be effective to control air pollution.

**Junior college students**

The questionnaires sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph. The data collected from total 100 students studying in junior college shows clear picture about their view towards the various factors which will be effective to control air pollution. According to the data collected by survey 34% girls and 44% boys were of the view that individual factor will be most effective to control air pollution in Aurangabad city where as 38% girls and 22% boys were of the view that state and central government will play the important role. About 22% girls and 16% boys said that private sector will be more effective to control the air pollution in Aurangabad city while 6% girls and 18%
boys were of the opinion that NGO’s will prove to be more effective to control the cities air pollution.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the various factors which will be effective to control air pollution. According to the data collected by survey 38% girls and 48% boys were of the view that individual factor will be most effective to control air pollution in Aurangabad city where as 34% girls and 24% boys were of the view that state and central government will play the important role. About 8% girls and 12% boys said that private sector will be more effective to control the air pollution in Aurangabad city while 20% girls and 16% boys were of the opinion that NGO’s will prove to be more effective to control the cities air pollution.

**Employed**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the various factors which will be effective to control air pollution. According to the data collected by survey 34% females and 44% males were of the view that individual factor will be most effective to control air pollution in Aurangabad city where as 30% females and 30% males were of the view that state and central government will play the important role. About 24% females and 18% males said that private sector will be more effective to control the air pollution in Aurangabad city while 12% females and 16% males were of the opinion that NGO’s will prove to be more effective to control the cities air pollution.
5.8.5 Role of trees in controlling air pollution.

The questionnaires were prepared with a view to get information regarding the role of trees in controlling air pollution in Aurangabad city. The opinion poll for role of trees in controlling air pollution is represented in fig.5.35

![Role of trees in controlling air pollution](image)

Fig-5.35: Role of trees in controlling air pollution.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the role of trees to control air pollution. According to the data collected by survey 100% girls and 96% boys were of the view that trees play an important role in controlling air pollution where as 0% girls and 4% boys were of the view that there is no any role of trees in controlling air pollution.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the
role of trees to control air pollution. According to the data collected by survey 98% girls and 94% boys were of the view that trees play an important role in controlling air pollution where as 2% girls and 6% boys were of the view that there is no any role of trees in controlling air pollution.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the role of trees to control air pollution. According to the data collected by survey 100% females and 98% males were of the view that trees play an important role in controlling air pollution where as 0% females and 2% males were of the view that there is no any role of trees in controlling air pollution.

**5.8.6 Most important role of trees in our surrounding.**

The opinion poll for most important role of trees in surrounding is represented in fig.5.36

![Most important role of trees in our surrounding](image-url)

Fig-5.36: Most important role of trees in our surrounding.
The questionnaires were prepared with a view to get information regarding most important role of trees in our surrounding in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the most important role in our surrounding. According to the data collected by survey 36% girls and 50% boys were of the view that greenhouse gas reduction is the most important role of trees in our surrounding where as 24% girls and 18% boys were of the view that the most important role of trees is to provide timber. About 8% girls and 14% boys said that the important role of trees in our surrounding is to provide fuel wood while 32% girls and 18% boys were of the opinion that other role of trees is most important in our surrounding.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the most important role in our surrounding. According to the data collected by survey 80% girls and 54% boys were of the view that greenhouse gas reduction is the most important role of trees in our surrounding where as 8% girls and 12% boys were of the view that the most important role of trees is to provide timber. About 4% girls and 14% boys said that the important role of trees in our surrounding is to provide fuel wood while 8% girls and 20% boys were of the opinion that other role of trees is most important in our surrounding.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100
employers show clear picture about their view towards the most important role in
our surrounding. According to the data collected by survey 80% females and 76%
males were of the view that greenhouse gas reduction is the most important role of
trees in our surrounding where as 4% females and 14% males were of the view that
the most important role of trees is to provide timber. About 4% females and 2%
males said that the important role of trees in our surrounding is to provide fuel
wood while 12% females and 8% males were of the opinion that other role of trees
is most important in our surrounding.

5.8.7 Aim of planting trees in our surrounding.

The opinion poll for aim of planting trees in our surrounding is represented in
fig.5.37

![Aim of planting trees in surrounding](image)

Fig-5.37: Aim of planting trees in our surrounding.

The questionnaires were prepared with a view to get information regarding
the aim of planting trees in our surrounding and awareness about trees in
Aurangabad city.

Junior college students

The questionnaire sheets with suitable questions were circulated among the
50 girls and 50 boys student and data was collected. The data collected is
represented in the form of graph given above. The data collected from total 100
students studying in junior college shows clear picture about their view towards the
aim of planting trees in our surrounding. According to the data collected by survey 62% girls and 80% boys were of the view that avoiding pollution is the main aim of planting trees in our surrounding where as 30% girls and 8% boys were of the view that the most important role of trees is for ornamental use. About 8% girls and 4% boys said that the main aim of trees in our surrounding is for commercial use while 0% girls and 8% boys were of the opinion that the main aim of planting trees in our surrounding is for shade.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the aim of planting trees in our surrounding. According to the data collected by survey 90% girls and 72% boys were of the view that avoiding pollution is the main aim of planting trees in our surrounding where as 4% girls and 10% boys were of the view that the most important role of trees is for ornamental use. About 6% girls and 4% boys said that the main aim of trees in our surrounding is for commercial use while 0% girls and 14% boys were of the opinion that the main aim of planting trees in our surrounding is for shade.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the aim of planting trees in our surrounding. According to the data collected by survey 90% females and 78% males were of the view that avoiding pollution is the main aim of planting trees in our surrounding where as 2% females and 0% males were of the view that the most important role of trees is for ornamental use. About 4% females and 14% males said that the main aim of trees in our surrounding is for commercial use while 4% females and 8% males were of the opinion that the main aim of planting trees in our surrounding is for shade.
5.8.8 Most important value of trees.

The opinion poll for most important value of trees is represented in fig. 5.38

![Most important value of trees](image)

Fig-5.38: Most important value of trees.

The questionnaires were prepared with a view to get information regarding most important value of trees.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the most important value of trees. According to the data collected by survey 40% girls and 38% boys were of the view that commercial value of trees is the most important value of trees where as 40% girls and 28% boys were of the view that the aesthetic value of trees is the most important value. About 12% girls and 28% boys said that the religious value of trees is most important than other while 8% girls and 6% boys were of the opinion that the recreational value of tree is most important value of the trees.
Senior college students

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the most important value of tree. According to the data collected by survey 12% girls and 30% boys were of the view that commercial value of trees is the most important value of trees where as 48% girls and 34% boys were of the view that the aesthetic value of trees is the most important value. About 24% girls and 16% boys said that the religious value of trees is most important than other while 16% girls and 20% boys were of the opinion that the recreational value of tree is most important value of the trees.

Employers

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the most important value of tree. According to the data collected by survey 46% females and 20% males were of the view that commercial value of trees is the most important value of trees where as 32% females and 22% males were of the view that the aesthetic value of trees is the most important value. About 4% females and 8% males said that the religious value of trees is most important than other while 18% females and 50% males were of the opinion that the recreational value of tree is most important value of the trees.
5.8.9 Type of tree suggested for planting.

The opinion poll for type of tree suggested for planting is represented in fig-5.39

![Type of tree suggested for planting](image)

Fig-5.39: Type of trees suggested for planting.

The questionnaires were prepared with a view to get information regarding type of tree suggested for planting in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the type of tree suggested for planting. According to the data collected by survey 58% girls and 76% boys were of the view that pollution tolerating plants should be planted where as 16% girls and 20% boys were of the view that the fruit bearing plants should be planted in our surrounding. About 10% girls and 2% boys said that the shade giving plants should be planted while 16% girls and 2% boys were of the opinion that commercially important plants should be planted.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100
Students studying in senior college shows clear picture about their view towards the type of tree suggested for planting. According to the data collected by survey 74% girls and 52% boys were of the view that pollution tolerating plants should be planted where as 8% girls and 8% boys were of the view that the fruit bearing plants should be planted in our surrounding. About 12% girls and 36% boys said that the shade giving plants should be planted while 6% girls and 4% boys were of the opinion that commercially important plants should be planted.

Employers

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the type of tree suggested for planting. According to the data collected by survey 78% girls and 64% boys were of the view that pollution tolerating plants should be planted where as 14% girls and 10% boys were of the view that the fruit bearing plants should be planted in our surrounding. About 0% girls and 24% boys said that the shade giving plants should be planted while 8% girls and 2% boys were of the opinion that commercially important plants should be planted.

5.8.10 Most beneficial tree species.

The opinion poll for most beneficial tree species is represented in fig.5.40

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Fig-5.40: Most beneficial tree species.
The questionnaires were prepared with a view to get information regarding most beneficial tree species for Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the most beneficial tree species. According to the data collected by survey 72% girls and 62% boys were of the view that Neem is the most beneficial tree species where as 20% girls and 26% boys were of the view that Mango is the most beneficial tree species than other. About 4% girls and 4% boys said that Ashoka is more beneficial while 2% girls and 0% boys were of the opinion that Sheesham is the most beneficial tree and 2% girls and 8% boys were of the opinion that other type trees are more beneficial.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the most beneficial tree species. According to the data collected by survey 92% girls and 56% boys were of the view that Neem is the most beneficial tree species where as 2% girls and 20% boys were of the view that Mango is the most beneficial tree species than other. About 4% girls and 6% boys said that Ashoka is more beneficial while 0% girls and 10% boys were of the opinion that Sheesham is the most beneficial tree and 2% girls and 8% boys were of the opinion that other type trees are more beneficial.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100
employers show clear picture about their view towards the most beneficial tree species. According to the data collected by survey 56% females and 84% males were of the view that Neem is the most beneficial tree species where as 20% females and 6% males were of the view that Mango is the most beneficial tree species than other. About 6% females and 6% males said that Ashoka is more beneficial while 10% females and 0% males were of the opinion that Sheesham is the most beneficial tree and 8% females and 4% males were of the opinion that other type trees are more beneficial.

5.8.11 Plants planted by an individual.

The opinion poll for plants planted by an individual is represented in fig.5.41

![Plants planted by an individual](image)

Fig-5.41: Plants planted by an individual.

The questionnaires were prepared with a view to get information regarding the number of plants planted by an individual in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100
students studying in junior college shows how many plants they have planted. According to the data collected by survey 42% girls and 34% boys have planted only one plant where as 24% girls and 26% boys have planted up to ten plants. About 30% girls and 36% boys have planted ten and more plants while 4% girls and boys had not planted any plant.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows how many plants they have planted. According to the data collected by survey 30% girls and 16% boys have planted only one plant where as 34% girls and 34% boys have planted up to ten plants. About 22% girls and 44% boys have planted ten and more plants while 14% girls and 10% boys had not planted any plant.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show how many plants they have planted. According to the data collected by survey 30% females and 28% males have planted only one plant where as 26% females and 28% males have planted up to ten plants. About 40% females and 28% males have planted ten and more plants while 4% females and 16% males had not planted any plant.
5.8.12 Plants those are still alive.

The opinion poll on plants those are still alive is represented in fig.5.42

![Plants those are still alive](image)

Fig-5.42: Plants those are still alive.

The questionnaires were prepared with a view to get information regarding the number of plants that are still alive in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows the number of plants those are still alive. According to the data collected by survey 22% girls and 24% boys told that about 80 % of the plants are still alive which they had planted where as 46% girls and 46% boys told that about 50 % of the plants are still alive which they had planted. About 30% girls and 26% boys told that all of the plants are still alive which they had planted while 2% girls and 4% boys told that no any plant is still alive which they had planted.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100
students studying in senior college shows the number of plants those are still alive. According to the data collected by survey 10% girls and 41% boys told that about 80% of the plants are still alive which they had planted where as 46% girls and 25% boys told that about 50% of the plants are still alive which they had planted. About 28% girls and 22% boys told that all of the plants are still alive which they had planted while 16% girls and 12% boys told that no any plant is still alive which they had planted.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show the number of plants those are still alive. According to the data collected by survey 20% females and 26% males told that about 80% of the plants are still alive which they had planted where as 40% females and 30% males told that about 50% of the plants are still alive which they had planted. About 34% females and 30% males told that all of the plants are still alive which they had planted while 6% females and 14% males told that no any plant is still alive which they had planted.

**5.8.13 Citizens aware of importance of trees.**

The opinion poll for awareness of citizens for trees is represented in fig.5.43

![Citizens aware of importance of trees](image)

Fig-5.43: Citizens aware of importance of trees.
The questionnaires were prepared with a view to get information regarding the awareness of citizens for the importance of trees in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys students and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the awareness of citizens for the importance of trees. According to the data collected by survey 78% girls and 72% boys were of the view that citizens are aware of importance of trees where as 22% girls and 28% boys were of the view that citizens are not aware of importance of trees.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys students and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the awareness of citizens for the importance of trees. According to the data collected by survey 64% girls and 54% boys were of the view that citizens are aware of importance of trees where as 36% girls and 46% boys were of the view that citizens are not aware of importance of trees.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the awareness of citizens for the importance of trees. According to the data collected by survey 74% females and 74% males were of the view that citizens are aware of importance of trees where as 26% females and 26% males were of the view that citizens are not aware of importance of trees.
5.8.14 Need for more education about the importance of trees.

The opinion poll for need for more education about the importance of trees is represented in fig. 5.44

The questionnaires were prepared with a view to get information regarding need for more education about the importance of trees in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys students and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the need of more education about the importance of trees. According to the data collected by survey 98% girls and 98% boys were of the view that there is need of more education about the importance of trees where as 2% girls and 2% boys told that there is no need of more education about the importance of trees.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys students and data was collected. The data collected is
represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the need of more education about the importance of trees. According to the data collected by survey 98% girls and 92% boys were of the view that there is need of more education about the importance of trees where as 2% girls and 8% boys told that there is no need of more education about the importance of trees.

Employers

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the need of more education about the importance of trees. According to the data collected by survey 100% females and 96% males were of the view that there is need of more education about the importance of trees where as 0% females and 4% males told that there is no need of more education about the importance of trees.

5.8.15 Need for special rules and regulations to protect trees.

The opinion poll for need of special rules and regulations to protect trees is represented in fig.5.45

![Need for special rules to protect trees](image)

Fig-5.45: Need for special rules and regulations to protect trees.
The questionnaires were prepared with a view to get information regarding need for special rules and regulations to protect trees in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the need of special rules and regulations to protect the trees. According to the data collected by survey 98% girls and 96% boys were of the view that there is need of special rules and regulations to protect the trees where as 2% girls and 4% boys told that there is no need of special rules and regulations to protect the trees.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the need of special rules and regulations to protect the trees. According to the data collected by survey 100% girls and 92% boys were of the view that there is need of special rules and regulations to protect the trees where as 0% girls and 8% boys told that there is no need of special rules and regulations to protect the trees.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the need of special rules and regulations to protect the trees. According to the data collected by survey 96% females and 92% male employers were of the view that there is need of special rules and regulations to protect the trees where as 4% females and 8% male employers told that there is no need of special rules and regulations to protect the trees.
5.8.16 Trees that should be protect preferably.

The opinion poll for trees that should be protected preferably is represented in fig.5.46

![Bar chart showing trees that should be protected preferably]

Fig-5.46: Trees that should be protect preferably.

The questionnaires were prepared with a view to get information regarding the types of trees that should be protected preferably in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the trees that should be protect preferably. According to the data collected by survey 34% girls and 38% boys were of the view that commercially important trees should be protect preferably where as 34% girls and 22% boys were of the view that the historic trees should be protect preferably. About 20% girls and 22% boys said that the rare trees should be protect preferably while 12% girls and 18% boys were of the opinion that any other type of trees should be protect preferably.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100
students studying in senior college shows clear picture about their view towards the trees that should be protect preferably. According to the data collected by survey 28% girls and 22% boys were of the view that commercially important trees should be protect preferably where as 22% girls and 18% boys were of the view that the historic trees should be protect preferably. About 40% girls and 44% boys said that the rare trees should be protect preferably while 10% girls and 16% boys were of the opinion that any other type of trees should be protect preferably.

**Employed**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the trees that should protect preferably. According to the data collected by survey 26% females and 30% males were of the view that commercially important trees should be protect preferably where as 22% females and 32% males were of the view that the historic trees should be protect preferably. About 42% females and 30% males said that the rare trees should be protect preferably while 10% females and 8% males were of the opinion that any other type of trees should be protect preferably.

**5.8.17 Preferred locations for tree plantation.**

The opinion poll for preferred locations for trees is represented in fig.5.47

Fig-5.47: Preferred locations for trees.
The questionnaires were prepared with a view to get information regarding the preferred locations for tree plantation in Aurangabad city.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the preferred locations for trees. According to the data collected by survey 20% girls and 44% boys were of the view that plants should be planted preferably nearby the industries where as 24% girls and 20% boys were of the view that plants should be planted preferably at roadsides. About 28% girls and 16% boys said that plants should be planted preferably near hospitals and schools while 16% girls and 10% boys were of the opinion that plants should be planted preferably in home surrounding and 12% girls and 10% boys were of the opinion that plants should be planted anywhere else other than above places.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the preferred locations for trees. According to the data collected by survey 48% girls and 34% boys were of the view that plants should be planted preferably nearby the industries where as 16% girls and 24% boys were of the view that plants should be planted preferably at roadsides. About 16% girls and 22% boys said that plants should be planted preferably near hospitals and schools while 18% girls and 10% boys were of the opinion that plants should be planted preferably in home surrounding and 2% girls and 22% boys were of the opinion that plants should be planted anywhere else other than above places.
**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the preferred locations for trees. According to the data collected by survey 30% females and 32% males were of the view that plants should be planted preferably nearby the industries where as 28% females and 32% males were of the view that plants should be planted preferably at roadsides. About 14% females and 10% males said that plants should be planted preferably near hospitals and schools while 24% females and 14% males were of the opinion that plants should be planted preferably in home surroundings and 4% females and 12% males were of the opinion that plants should be planted anywhere else other than above places.

**5.8.18 Most important ecological role of trees.**

The opinion poll for most important ecological role of trees is represented in fig.5.48

![Most important ecological role of trees](image-url)

**Fig-5.48: Most important ecological role of trees.**
The questionnaires were prepared with a view to get information regarding most important ecological role of trees.

Junior college students

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys students and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the most important ecological role of trees. According to the data collected by survey 50% girls and 54% boys were of the view that pollution abatement is the most important ecological role of trees where as 20% girls and 32% boys were of the view that regulation of food chain is the important ecological role of trees. About 20% girls and 8% boys said that food production is more important than other ecological roles while 10% girls and 6% boys were of the opinion that any other role is more important than the above mentioned ecological roles.

Senior college students

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys students and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the most important ecological role of trees. According to the data collected by survey 58% girls and 56% boys were of the view that pollution abatement is the most important ecological role of trees where as 36% girls and 32% boys were of the view that regulation of food chain is the important ecological role of trees. About 2% girls and 8% boys said that food production is more important than other ecological roles while 4% girls and 4% boys were of the opinion that any other role is more important than the above mentioned ecological roles.

Employers

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100
employers show clear picture about their view towards the most important ecological role of trees. According to the data collected by survey 76% females and 52% males were of the view that pollution abatement is the most important ecological role of trees where as 12% females and 20% males were of the view that regulation of food chain is the important ecological role of trees. About 6% females and 20% males said that food production is more important than other ecological roles while 6% females and 4% males were of the opinion that any other role is more important than the above mentioned ecological roles.

5.8.19 Trees importance for the existence of human life.

The opinion poll for importance of trees for the existence of human life is represented in fig.5.49

![Importance of trees for human existence](image)

Fig-5.49: Importance of trees for the existence of human life.

The questionnaires were prepared with a view to get information regarding importance of trees for the existence of human life.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards the
importance of trees for the existence of human life. According to the data collected by survey 96% girls and 94% boys were of the view that there will be no existence of human life without trees where as 4% girls and 6% boys were of the view that existence of human life is possible without the existence of trees.

**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards the importance of trees for the existence of human life. According to the data collected by survey 98% girls and 86% boys were of the view that there will be no existence of human life without trees where as 2% girls and 14% boys were of the view that existence of human life is possible without the existence of trees.

**Employers**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards the importance of trees for the existence of human life. According to the data collected by survey 94% females and 96% males were of the view that there will be no existence of human life without trees where as 6% females and 4% males were of the view that existence of human life is possible without the existence of trees.
5.8.20 Importance of trees for habitat.

The opinion poll for importance of trees for habitat is represented in fig.5.50

Fig-5.50: Importance of trees for habitat.

The questionnaires were prepared with a view to get information regarding the importance of trees for habitat.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys students and data was collected. The data collected is represented in the form of a graph given above. The data collected from total 100 students studying in junior college shows a clear picture about their view towards importance of trees for habitat. According to the data collected by survey, 84% girls and 58% boys were of the view that trees are important for the habitat whereas 10% girls and 26% boys were of the view that trees are slightly important for the habitat. About 2% girls and 4% boys said that trees are not very important for the habitat while 2% girls and 10% boys were of the opinion that trees are not important at all as a habitat for living beings and 2% girls and 2% boys were of the opinion that they don’t know the importance of trees for habitat.
**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards importance of trees for habitat. According to the data collected by survey 84% girls and 74% boys were of the view that trees are important for the habitat where as 12% girls and 12% boys were of the view that trees are slightly important for the habitat. About 2% girls and 8% boys said that trees are not very important for the habitat while 0% girls and 2% boys were of the opinion that trees are not important at all as a habitat for living beings and 2% girls and 4% boys were of the opinion that they don’t know the importance of trees for habitat.

**Employed**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards importance of trees for habitat. According to the data collected by survey 84% females and 88% males were of the view that trees are important for the habitat where as 8% females and 6% males were of the view that trees are slightly important for the habitat. About 0% females and 2% males said that trees are not very important for the habitat while 2% females and 0% males were of the opinion that trees are not important at all as a habitat for living beings and 6% females and 4% males were of the opinion that they don’t know the importance of trees for habitat.
5.8.21 Importance of trees for aesthetic value.

The opinion poll for importance of trees for aesthetic value is represented in fig.5.51

![Importance of trees for aesthetic value](image)

Fig-5.51: Importance of trees for aesthetic value.

The questionnaires were prepared with a view to get information regarding the importance of trees for aesthetic value.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards importance of trees for aesthetic value. According to the data collected by survey 42% girls and 36% boys were of the view that trees are important for the aesthetic value where as 30% girls and 32% boys were of the view that trees are slightly important for the aesthetic value. About 22% girls and 14% boys said that trees are not very important for the aesthetic value while 2% girls and 4% boys were of the opinion that trees are not important at all for a aesthetic value and 4% girls and 14% boys were of the opinion that they don’t know the importance of trees for aesthetic value.
**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards importance of trees for aesthetic value. According to the data collected by survey 60% girls and 48% boys were of the view that trees are important for the aesthetic value where as 34% girls and 32% boys were of the view that trees are slightly important for the aesthetic value. About 0% girls and 6% boys said that trees are not very important for the aesthetic value while 0% girls and 2% boys were of the opinion that trees are not important at all for aesthetic value and 6% girls and 12% boys were of the opinion that they don’t know the importance of trees for aesthetic value.

**Employed**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total employers show clear picture about their view towards importance of trees for aesthetic value. According to the data collected by survey 60% females and 66% males were of the view that trees are important for the aesthetic value where as 24% females and 22% males were of the view that trees are slightly important for the aesthetic value. About 6% females and 10% males said that trees are not very important for the aesthetic value while 0% females and males were of the opinion that trees are not important at all for the aesthetic value and 10% females and 2% males were of the opinion that they don’t know the importance of trees for aesthetic value.
5.8.22 Importance of trees for clean air.

The opinion poll for importance of trees for clean air is represented in fig.5.52

![Importance of trees for clean air](image)

Fig-5.52: Importance of trees for clean air.

The questionnaires were prepared with a view to get information regarding the importance of trees for clean air.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards importance of trees for clean air. According to the data collected by survey 78% girls and 70% boys were of the view that trees are important for the clean air whereas 8% girls and 10% boys were of the view that trees are slightly important for the clean air. About 10% girls and 6% boys said that trees are not very important for the clean air while 4% girls and 6% boys were of the opinion that trees are not important at all for a clean air and 0% girls and 8% boys were of the opinion that they don’t know the importance of trees for clean air.
Senior college students

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards importance of trees for clean air. According to the data collected by survey 98% girls and 92% boys were of the view that trees are important for the clean air whereas 0% girls and 6% boys were of the view that trees are slightly important for the clean air. About 2% girls and 2% boys said that trees are not very important for the clean air while 0% girls and boys were of the opinion that trees are not important at all for a clean air and they don’t know the importance of trees for clean air.

Employed

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards importance of trees for clean air. According to the data collected by survey 100% females and 92% males were of the view that trees are important for the clean air whereas 0% females and 8% males were of the view that trees are slightly important for the clean air. And 0% females and males said that trees are not very important, not important at all for the clean air and they don’t know the importance of trees for clean air.
5.8.23 Importance of trees for water quality.

The opinion poll for importance of trees for water quality is represented in fig. 5.53

![Importance of trees for water quality](image)

Fig-5.53: Importance of trees for water quality.

The questionnaires were prepared with a view to get information regarding the importance of trees for water quality.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards importance of trees for water quality. According to the data collected by survey 62% girls and 56% boys were of the view that trees are important for the water quality where as 20% girls and 18% boys were of the view that trees are slightly important for the water quality. About 6% girls and 12% boys said that trees are not very important for the water quality while 6% girls and 4% boys were of the opinion that trees are not important at all for the water quality and 6% girls and 10% boys were of the opinion that they don’t know the importance of trees for the water quality.
Senior college students

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards importance of trees for water quality. According to the data collected by survey 84% girls and 84% boys were of the view that trees are important for the water quality where as 12% girls and 10% boys were of the view that trees are slightly important for the water quality. About 2% girls and 2% boys said that trees are not very important for the water quality while 0% girls and 0% boys were of the opinion that trees are not important at all for the water quality and 2% girls and 4% boys were of the opinion that they don’t know the importance of trees for the water quality.

Employed

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 male employers and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards importance of trees for water quality. According to the data collected by survey 90% females and 76% males were of the view that trees are important for the water quality where as 8% females and 22% males were of the view that trees are slightly important for the water quality. About 2% females and 2% males said that trees are not very important for the water quality while 0% females and males were of the opinion that trees are not important at all for the water quality and they don’t know the importance of trees for the water quality.
5.8.24 Importance of trees for property value.

The opinion poll for importance of trees for property value is represented in fig. 5.54

![Importance of trees for property value](image)

Fig-5.54: Importance of trees for property value.

The questionnaires were prepared with a view to get information regarding the importance of trees for property value.

**Junior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in junior college shows clear picture about their view towards importance of trees for water quality. According to the data collected by survey 54% girls and 48% boys were of the view that trees are important for the property value where as 24% girls and 22% boys were of the view that trees are slightly important for the property value. About 8% girls and 10% boys said that trees are not very important for the property value while 4% girls and 12% boys were of the opinion that trees are not important at all for the property value and 10% girls and 8% boys were of the opinion that they don’t know the importance of trees for the property value.
**Senior college students**

The questionnaire sheets with suitable questions were circulated among the 50 girls and 50 boys student and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 students studying in senior college shows clear picture about their view towards importance of trees for water quality. According to the data collected by survey 62% girls and 54% boys were of the view that trees are important for the property value where as 30% girls and 26% boys were of the view that trees are slightly important for the property value. About 6% girls and 14% boys said that trees are not very important for the property value while 0% girls and 6% boys were of the opinion that trees are not important at all for the property value and 2% girls and 0% boys were of the opinion that they don’t know the importance of trees for the property value.

**Employed**

The questionnaire sheets with suitable questions were circulated among the 50 females and 50 males employed and data was collected. The data collected is represented in the form of graph given above. The data collected from total 100 employers show clear picture about their view towards importance of trees for water quality. According to the data collected by survey 68% females and 42% males were of the view that trees are important for the property value where as 14% females and 46% males were of the view that trees are slightly important for the property value. About 6% females and 8% males said that trees are not very important for the property value while 4% females and 4% males were of the opinion that trees are not important at all for the property value and 8% females and 0% males were of the opinion that they don’t know the importance of trees for the property value.