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# Plant responses to vehicular pollution: specific effect on photosynthetic pigments of plants at divider of NH-4 highway Nipani Area, Karnataka State, India

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**ABSTRACT**

*The ornamental plants such as Bougainvillea spectabilis, Caesalpinia pulcherima, Thevetia peruviana, Nerium oleander, Callendria brevipes and Tecoma gaudichaudi etc. planted along the divider of NH-4 highway are selected in the present work and see the effect of vehicle gases on photosynthetic pigments, this effect has been studied by calculating Chlorophyll-a, Chlorophyll-b and, Total Chlorophyll.*

**Keywords:** Vehicle gases, Pigments, Ornamental plants, NH-4 highway.

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## INTRODUCTION

Air pollution is one of the major problems in the world. It is influenced by four major factors, such as industrialization in the cities, increase in traffic, rapid economic development, and higher level of energy consumption. The growth of both an industrial and residential area is unplanned in many developing cities of India, thus, it contributing to the air pollution problems. In urban areas, the mobile or vehicular population is predominant and significantly contributes to air quality problems. In recent past, air pollutants, responsible for vegetation injury and crop yield losses, are causing increased concern [1]. Air pollution is one of the serious problems in the world, its facing today. It deteriorates ecological condition and can be defined as the fluctuation in any atmospheric constituent from the value that would have existed without human activity [2]. It has been observed that plants particularly growing in the urban areas affected greatly due to varieties of pollutants (oxides of nitrogen and sulphur, hydrocarbon, ozone, particulate matters, hydrogen fluoride, peroxyacyl nitrates (PAN) etc.) [3]. Chlorophyll is found in the chloroplasts of green plants and is called a photoreceptor. Chlorophyll itself is actually not a single molecule but a family of related molecules, designated as chlorophyll "a", "b", "c" and "d". Chlorophyll "a" is the molecule found in all plant cells and therefore its concentration is what is reported during chlorophyll analysis [4]. Chlorophyll is an index of productivity of plant. Whereas certain pollutants increase the total chlorophyll content, others decrease it [5]. Ramteke *et.al* have been studied the effect of common fertilizers on plant growth parameters of some vegetable plants [6-8]. The leaf epidermis is the first target of air pollution as the pollutant first passes through the stomata where most of the gas exchange takes place through these small pores on the exposed surfaces. In the present piece of work some ornamental plants such as *Bougainvillea spectabilis, Caesalpinia pulcherrima,*

*Thevetia peruviana, Nerium oleander, Callendria brevipes and Tecoma gaudichaudi* growing along the NH-4 highway are selected and an effect of vehicular with respect to photosynthetic efficiency has been studied.

## MATERIALS AND METHODS

### 2.1. Study area and sample Collection

The Ornamental plants such as *Bougainvillea spectabilis, Caesalpinia pulcherrima, Thevetia peruviana, Nerium oleander, Callendria brevipes and Tecoma gaudichaudi* etc. planted along the divider of NH-4 highway from Nipani to Shankeshwar (The study area is situated in Belgaum district, Karnataka, India.) are selected for the present study.

### 2.2. Determination of Chlorophyll Content

The fresh leaves were collected from these said plants, brought to the laboratory and rinsed with tap water. The veins and veinlets were removed from leaves. Weight 1.0 g of leaves and crushed it in pestle and mortar with addition of small amount (approximately 20 mL) of 80 % acetone. The extract is filtered though double layered muslin cloth and filtrate is centrifuged at 5000 rpm for five minutes and supernent is transferred to the clean volumetric flask. The procedure was repeated for three times and the final volume is adjusted to 100 mL with 80 % acetone. The absorbance of the extract was read on UV-VIS Spectrophotometer (Labtronics, LT29) at 645 nm, 663 nm and 652 nm against the solvent (80 % acetone) blank. Amount of chlorophyll present in the extract in mg chlorophyll per gram of leaf tissue can be calculated by following equation [9].

mg of Chlorophyll-a/ g tissue = $12.7(A_{663}) - 2.69 (A_{645})$ x V / 1000 x W
mg of Chlorophyll-b/ g tissue = $22.9(A_{645}) – 4.68 (A_{663})$ x V / 1000 x W
mg total Chlorophyll / g tissue = $20.2(A_{645}) – 8.02(A_{663})$ x V / 1000 x W

Where,
A= Absorbance at specific wavelengths
V= Final volume of chlorophyll extract in 80 % acetone
W= Fresh weight of tissue extracted

## RESULTS AND DISCUSSION

Several researcher have been recorded, reduction in chlorophyll content under air pollution [10, 11]. Significant reduction in total chlorophyll content at traffic area was recorded in plant species mainly includes neem (*Azardirachta indica*), peepal (*Ficus religiosa*), banyan (*Ficus benghalensis*), almond (*Terminalia catapa*) [12].Increase in content of chlorophyll a, chlorophyll b, total chlorophyll and carotenoid in *Albizia lebbeck* and *Callistemon citrinus*, has been reported by Seyyednejad *et.al* [13] Investigation proved that chlorosis is the first indicator of flour effect on plant [14]. Yun [15] Showed reduction in photosynthesis because of the PS-II function damage, in sensitive species of tobacco. In the present paper reported the similar results like Wagh *et.al*.[14]. The significant reduction in chlorophyll-a, b and total in the plants like

**Table No.1: Photosynthetic efficiency of unexposed (vehicle gases) ornamental plants**

| Name of the plants | Plant material used: Leaves | Chlorophyll-a (mg/100 g) | Chlorophyll-b (mg/100 g) | Total Chlorophyll (mg/100 g) |
|---|---|---|---|---|
| *Bougnvillia spectebilis* | Young | 139.1059 | -16.4262 | 122.6638 |
| | Mature | 219.0872 | -34.308 | 184.778 |
| *Nerium oleander* | Young | 105.2445 | 3.939 | 109.164 |
| | Mature | 118.4564 | 20.76 | 139.187 |
| *Thevatia peruviana* | Young | 103.4756 | 55.2 | 158.633 |
| | Mature | 174.4467 | 121.2826 | 295.644 |
| *Callindria brevipes* | Young | 111.9065 | 67.2102 | 179.067 |
| | Mature | 213.3512 | 193.4856 | 406.712 |
| *Cesalpinea pulcherrima* | Young | 154.3473 | 92.759 | 247.038 |
| | Mature | 177.773 | 105.378 | 283.073 |
| *Tecoma gaudichaudi* | Young | 102.6404 | 55.0696 | 157.667 |
| | Mature | 118.966 | 72.2768 | 191.189 |

**Table No.2: Effect of vehicular pollution on photosynthetic efficiency of some exposed ornamental plants**

| Name of the plants | Plant material used: Leaves | Chlorophyll-a (mg/100 g) | Chlorophyll-b (mg/100 g) | Total Chlorophyll (mg/100 g) |
|---|---|---|---|---|
| *Bougnvillia spectebilis* | Young | 28.5877 | 17.2894 | 45.864 |
| | Mature | 88.1919 | 74.6346 | 162.777 |
| *Nerium oleander* | Young | 34.9972 | 24.7864 | 59.766 |
| | Mature | 45.995 | 35.6313 | 81.6 |
| *Thevatia peruviana* | Young | 43.418 | 23.436 | 66.836 |
| | Mature | 39.4792 | 36.28 | 75.736 |
| *Callindria brevipes* | Young | 78.4245 | 35.731 | 108.351 |
| | Mature | 73.6963 | 67.7074 | 141.36 |
| *Cesalpinea pulcherrima* | Young | 103.2128 | 49.1624 | 152.335 |
| | Mature | 133.063 | 67.082 | 200.092 |
| *Tecoma gaudichaudi* | Young | 155.7774 | 83.6876 | 194.112 |
| | Mature | 133.997 | 60.1652 | 239.11 |

**Table No.3.Camparisons of total chlorophyll content in exposed and unexposed ornamental plants**

| Name of the plants | Plant material used: Leaves | Total Chlorophyll (mg/100 g) Exposed plants | Total Chlorophyll (mg/100 g) Unexposed plants |
|---|---|---|---|
| *Bougnvillia spectabilis* | Young | 45.864 | 122.6638 |
| | Mature | 162.777 | 184.778 |
| *Nerium oleander* | Young | 59.766 | 109.164 |
| | Mature | 81.6 | 139.187 |
| *Thevetia peruviana* | Young | 66.836 | 158.633 |
| | Mature | 75.736 | 295.644 |
| *Callindria brevipes* | Young | 108.351 | 179.067 |
| | Mature | 141.36 | 406.712 |
| *Cesalpinea pulcherrima* | Young | 152.335 | 247.038 |
| | Mature | 200.092 | 283.073 |
| *Tecoma gaudichaudi* | Young | 194.112 | 157.667 |
| | Mature | 239.11 | 191.189 |

*Bougainvillea spectabilis, Caesalpinia pulcherrima, Thevetia peruviana, Nerium oleander, Callendria brevipe;* But *Tecoma gaudichaudi* shows positive response to the air gases which came from the vehicles. The Table no 1, 2 and 3 represent the significantly increased values of exposed plant i.e. *Tecoma gaudichaudi*. These increased values of chlorophyll content indicates that, the gases like oxides of nitrogen and sulphur, hydrocarbon, ozone, particulate matters, hydrogen fluoride, peroxyacyl nitrates (PAN) etc are play the role of growth regulator for *Tecoma gaudichaudi* plant. The air gases which exhausts from vehicles shows the adverse effects on chlorophyll-a, and b represented in Table 1 and 2 and also total chlorophyll content, it is reported in Table no 3. This adverse effect of vehicle gases is prominent on *Bougnvillia spectabilis* and *Nerium oleander* plants than others. On the basis of found values, the vehicle gases are more harmful to the young leaves than mature leaves. The vehicle gases are beneficial to the *Bougnvillia spectabilis* plant, because of the chlorophyll-b values increased when it exposed.

## CONCLUSION

On the basis of reported values in the Table no 1, 2, and 3 of exposed and unexposed leaves of plants like *Bougainvillea spectabilis, Caesalpinia pulcherrima, Thevetia peruviana, Nerium oleander, Callendria brevipes, Cesalpinea pulcherrima* and *Tecoma gaudichaudi* to the vehicle gases, it shows reduction in all plants except *Bougainvillea spectabilis and Tecoma gaudichaudi,* both the plants leaves shows positive responses with the vehicle gases when it exposed, but most of the plants leaves have been adversely affected. Hence, concluded that, the vehicles gases are acted as an air pollutant for the studied plants leaves.

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