International Journal of Agricultural and Applied Sciences, June 2022, 3(1):133-136
https://www.agetds.com/ijaas
ISSN: 2582-8053
https://doi.org/10.52804/ijaas2022.3122

Research Article

OPEN ACCESS

Effect of Vehicular Pollution on Avenue Trees of NH-31 from Naugachhia to Begusarai

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(**Received:** 07/10/2021; **Revised:** 25/03/2022; **Accepted:** 21/05/2022)

ABSTRACT
The major pollutant emitted from vehicles are Carbon monoxide, Nitrogen oxide, Hydrocarbons, Sulphur dioxide and Sulphur trioxides, tetraethyl lead and tetramethyl lead, etc. These pollutants directly affect the Avenue trees by reducing their Chlorophyll content, increasing Ascorbic acid and closing Stomata.
To evaluate the effect of vehicular pollution on avenue trees of NH-31 from Naugachhia to Begusarai (Distance 113 Km) APTI of 10 plants were calculated. APTI ranged in between 7.067 to 13.755. The minimum was of *Aegle marmelos* and maximum of *Acacia arabica* followed by *Ficus benghalensis, Ficus religiosa, Azadirachta indica and Saraca indica.*
Keywords: Ascorbic acid, APTI, RWC, Vehicular pollution.

INTRODUCTION

Air pollution is the accumulation of undesirable substances in the atmosphere. Air pollution can result from both human and natural actions. Major sources of pollutions are power and heat generation, burning of solid wastes, industrial processes, and, transportation.
The major sources of air pollution are Hydrocarbons, Sulphur, burning of fossil fuel, oxides of carbon, Sulphur dioxide, Sulphur trioxide, etc. Vehicles are the major source of air pollution.
The major pollutants from these sources are carbon monoxide – 77.2%, Nitrogen oxide- 7.7% and Hydro carbons- 13.7%. Combustion of petroleum use in auto mobiles containing lead product. Such as tetraethyl lead and tetra methyl lead emit various particulate lead compounds. Many of the products of incomplete combustion of Petrol and Diesel undergo photo chemical reactions with oxides of Nitrogen to generate photo chemical smog.
Several countries have targeted vehicles and associated sectors (such as, fuel) to overcome the problem of air pollution. Notable successful initiatives are: conversion of public transport from diesel to CNG in Delhi, switching Vikrams (tuk-tuks) from diesel to electricity in Kathmandu valley, shifting from leaded to unleaded gasoline in many countries etc. Still the pollution problem in urban cities may continue to loom large due to ever-burgeoning vehicular population, which is outpacing any such measure and road network development.

MATERIALS AND METHODS

The study area was selected on NH-31 from Naugachhia to Begusarai which is about 113 Km. Avenue trees on road sides were observed and specimens were collected in summer season. Survey was conducted in the month of May-June 2018. Specimens were collected both from road side and 3 kms away from the road side. Collected specimens were brought to the laboratory and identified with standard monograph (Botany of Bihar & Orissa-Hens, H.H).
Study was conducted for measurement of pH, Relative Water Content and Ascorbic Acid, Chlorophyll content of fresh leaves. APTI was calculated for each plant.

Measurement of pH of Leaf Extract

5 g of fresh leaves of all selected trees were homogenized in double distilled water and finally the volume was made 25 ml and the pH was measured directly by Digital pH Meter.

Estimation of Relative Water Content (RWC)

It was determined by Sivakumaran and Hall (1978) method. Individual leaves of different selected plant species were excised and weighed immediately. They were dipped into distilled water in petri dishes lined with filter paper. After 8 Hours the leaves were blotted and reweighed. Leaves were than dried at 80^0C for 24 Hours and reweighed. Calculation was carried out using following formula-

$$\text{RWC} = \frac{Initial\ Wt. - Dry\ Wt.}{Saturated\ Wt. - Dry\ Wt.} x100$$

Estimation of Chlorophyll

250 mg of fresh leaves were cut into small pieces and put into 25 ml of 80% Acetone and kept for 24 Hours in dark. The absorbance was taken with 645 nm and 663 nm in

spectrophotometer. Total Chlorophyll was estimated by the formula as described by Arnon (1949)-

$$\text{Total Chlorophyll } (\frac{\text{mg}}{\text{g}}\text{FW}) = \frac{20.2\,(A645)+8.02\,(A663)}{1000X\,FW} X\,V$$

Where,

A_{645} = Absorbance at 645 nm
A_{663} = Absorbance at 663 nm
FW = Fresh weight of Leaves
V = Volume of Chlorophyll Extract

Estimation of Ascorbic Acid

Ascorbic Acid was estimated by following method

Reagents:

Extractant- 2% Oxalic acid

Dye-2,6 Dicholorophenol Indophenol

100 mg of pure dye was dissolved in warm water in a beaker and slowly filtered to 250 ml volumetric flask taking care to dissolve as much dye as possible. Volume was made up to 250 ml and stored in cool place.

Ascorbic Acid: 25 mg of ascorbic acid powder was weighed out and dissolved to 250ml of 2% Oxalic acid solution in a 250ml conical flask.

Preparation of Sample

10 g fresh green leaves were weighed out and to it 100 ml of 2% oxalic acid was added and it was grinded in mortar. The pulp was taken and transferred to 250 ml volumetric flask and volume was made up to 250 ml. the aliquot was filtered through muslin cloth and this was preserved for final analysis.

Standardization

The dye was filled in a clean burette. 10 ml of standard ascorbic acid (AA) was pipette out and diluted with 500 ml DDW in a conical flask. It was titrated until a pink colour appeared which persists for few minutes. The first appearance of pink colour was taken as an end point. The ml of dye consumed for 10 ml of AA solution is equivalent to 1 mg of AA.

Analysis of Sample

10ml of aliquot was taken and titrated against the dye and the volume of the dye consumed was noted.

Calculation:

It was calculated by following method

X ml of dye = 1 mg of AA

1ml of dye = 1/x me of AA

y ml of dye = y/x mg of AA

Estimation of Air Pollution Tolerance Index (APTI)

APTI was calculated by following formula:

$$\text{APTI} = \frac{[A(T+P)]+R}{10}$$

Where,

A = Ascorbic acid content in mg/gm
T = Total chlorophyll content mg/gm
R = Relative water content in %
P = pH of leaf extract

RESULTS AND DISCUSSION

Relative water content, pH, Chlorophyll content and Ascorbic acid content of selected road side trees of NH-31 from Naughachhia to Begusarai was estimated in laboratory and APTI was calculated. It was then compared with control trees which were about 3kms away from road side where vehicular pollution was nil. The maximum value of APTI was recorded for *Acacia arabica* (13.755) and minimum for *Aegle marmelos* (7.067). The result is tabulated in Table no. 01 to 3.

The measurement of ability of the plant to resist the stress condition arising under the effect of automobile pollution is depicted by its air pollution tolerance index`1 (APTI). Plants with low APTI value could be categorized as sensitive and with high APTI value tolerant because the former can serve as indicator and later as sink for abatement of air pollution. Air pollution tolerance index (APTI) was calculated by working out four attributes i.e relative water content (RWC) leaf extract pH, total chlorophyll content and ascorbic acid content.

Reduction in the amount of chlorophyll content and leaf extract pH and increment in ascorbic acid content and relative water content of the leaves results in inability of the plants to cope up with stress conditions. The differential susceptibility of plant species is mainly due to the difference in plants ability to avoid the entry of pollutant and the physiological as well as biochemical differences between species.

Table 01. Estimation of pH and Chlorophyll of leaf extract of road side and 3kms away from road side of Avenue trees.

Botanical Name	Common Name	Family	pH (road side)	pH (3kms away from road side	Chl. mg/g (road side)	Chl. mg/g (3kms away from road side
Aegle marmelos	Bel	*Rutaceae*	5.64	6.41	0.0056	0.0890
Azadirachta indica	Neem	*Meliaceae*	5.94	6.55	0.0226	0.0258
Dalbergia sisso	Sisam	*Papilionaceae*	6.07	7.01	0.0053	0.0079
Cassia fistula	Amaltas	*Caesalpinaceae*	6.45	6.89	0.0204	0.0219
Delonix regia	Gulmohar	*Caesalpinaceae*	6.62	6.97	0.0250	0.0275
Saraca indica	Ashoka	*Caesalpinaceae*	6.47	6.78	0.0223	0.0246
Acacia arabica	Babool	*Mimosaceae*	6.15	6.95	0.0658	0.0746
Thevetia officinalis	Kanel	*Apocynaceae*	6.92	7.45	0.0088	0.0124
Ficus benghalensis	Bargad	*Moraceae*	6.22	6.97	0.0230	0.0490
Ficus religiosa	Peepal	*Moraceae*	7.16	7.55	0.0117	0.0193

Table 02. Estimation of Ascorbic acid and RWC of leaf extract of Avenue trees at road side and 3kms away from road side

Botanical Name	Common Name	Family	Ascorbic Acid mg/ml (road side)	Ascorbic Acid mg/ml (3kms away from road side	RWC (road side)	RWC (3kms away from road side
Aegle marmelos	Bel	*Rutaceae*	1.34	1.25	63.10	40.14
Azadirachta indica	Neem	*Meliaceae*	2.13	1.06	84.74	50.43
Dalbergia sisso	Sisam	*Papilionaceae*	2.42	1.83	75.11	70.23
Cassia fistula	Amaltas	*Caesalpinaceae*	1.12	1.06	78.23	48.15
Delonix regia	Gulmohar	*Caesalpinaceae*	1.48	1.12	71.91	45.30
Saraca indica	Ashoka	*Caesalpinaceae*	2.98	1.63	72.63	46.14
Acacia arabica	Babool	*Mimosaceae*	9.56	7.45	78.13	61.31
Thevetia officinalis	Kanel	*Apocynaceae*	3.92	3.65	87.52	68.58
Ficus benghalensis	Bargad	*Moraceae*	3.13	2.07	95.46	84.12
Ficus religiosa	Peepal	*Moraceae*	3.16	2.09	97.15	82.72

Table 03. Estimation of APTI of Avenue trees at road side and 3kms away from road side

Botanical Name	Common Name	Family	APTI (road side)	APTI (3kms away from road side
Aegle marmelos	Bel	*Rutaceae*	7.067	4.826
Azadirachta indica	Neem	*Meliaceae*	9.745	5.740
Dalbergia sisso	Sisam	*Papilionaceae*	8.989	8.307
Cassia fistula	Amaltas	*Caesalpinaceae*	8.548	5.548
Delonix regia	Gulmohar	*Caesalpinaceae*	8.174	5.314
Saraca indica	Ashoka	*Caesalpinaceae*	9.198	5.723
Acacia arabica	Babool	*Mimosaceae*	13.755	11.364
Thevetia officinalis	Kanel	*Apocynaceae*	7.468	5.988
Ficus benghalensis	Bargad	*Moraceae*	11.500	9.864
Ficus religiosa	Peepal	*Moraceae*	11.983	9.854

Decreasing air quality due to increase in vehicular density, damage to avenue trees at road side in heavy traffic area is one of the important factors on National Highway. To examine the fact NH-31 from Naugachhia to Begusarai (Bihar) which is about 113 Km was selected. A large number of Vehicles passes from NH-31 as it joins Uttar Pradesh, Bihar, Assam and West Bengal. The avenue trees near the Road side are severely affected by the pollutants emitted from the Vehicles. The Petrol and Diesel which burn in Vehicle engine produces a large number of pollutants such as SO_2, NO_x, CO, Pb and unburnt Hydrocarbons. The response of plants to polluting gasses cans also the affected by other ambient conditions, such as light, humidity, temperature and supply of water and minerals. Dust pollution is of localize impotence near Road side. Dust blocks the stomata of leaves and lower their conductance to CO2, simultaneously interfering with photo-system II. Polluting gasses enter into leaves through stomata and damage the plant. Pollution tolerant species are less effected as sensitive species are damaged more. To assess the effect of these pollutants on avenue trees of this area this study was conducted.

Altogether 10 trees species were recorded. It is observed that all the plant species collected from road side exhibited a pH towards acidic side whereas for 3 km away from road side, plant species collected showed neutral to slightly alkaline pH range.

RWC of all the plant species collected from road side were higher as compared to 3 km away from road side.

Ascorbic acid is regarded as an antioxidant found in large amount in all growing plant parts and influence resistance to adverse environmental condition including air pollution. The ascorbic acid content increased in the leaves of plants at road side than those of the 3 km away from road side.

Chlorophyll content of plant signifies its photosynthetic activity as well as the growth and development of biomass. Chlorophyll content of plant varies from species to species depending upon the age of leaf, pollution level as well as other biotic and abiotic condition. The chlorophyll content was found to be low in the leaf samples collected from road side plants as compared to the plants of 3 km away from road side for all the investigated plant species. The present study revealed that chlorophyll content in all the plants varied with the pollution status of the area. The APTI values calculated for each plant species at two sites are presented in Table no. 03 which clearly showed an

increase in the APTI value of road side plants as compared to the plants of 3 km away from road side.
This study showed that the maximum vehicular pollution resistant avenue trees are *Acacia Arabica, Ficus benghalensis, Ficus religiosa, Azadirachta indica and Saraca indica.*

CONCLUSION

A large number of Buses, Trucks, Cars, Auto and several other heavy vehicles passes through NH-31 and release high number of pollutants. Plants with high APTI are resistant so they can minimize air pollution. It is clear from present study that *Acacia Arabica, Ficus benghalensis, Ficus religiosa, Azadirachta indica and Saraca indica* are plants with high APTI and hence more resistant to air pollution. These plants should be grown at road side to minimize air pollution.

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Citation: Kumari Sujata 2022. Effect of Vehicular Pollution on Avenue Trees of NH-31 from Naugachhia to Begusarai. *International Journal of Agricultural and Applied Sciences*, 3(1):133-136. https://doi.org/10.52804/ijaas2022.3122