



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 9, September 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569



Effect of Vehicular Emissions on Anatomy of Some Angiosperm Plants at Nh-58 in Western Uttar Pradesh

Harjinder Singh¹, Mohd. Ajaz²

Department of Botany, Meerut College, Meerut (U. P.), India¹

Department of Botany, Meerut College, Meerut (U. P.), India²

ABSTRACT: The present paper deals with the study of vehicular emission on anatomical features of two angiosperms viz. *Syzygium cumini* and *Dalbergia sissoo* growing alongside NH 58 in western Uttar Pradesh. Anatomical evaluation of leaves of selected plant species growing at Meerut cantonment, Khatauli bypass and Muzaffarnagar bypass was done and compared with the same plants species growing at control sites. Observations revealed minor alteration in three anatomical attributes studied namely, thickness of midrib, palisade tissue and spongy parenchyma. All these parameters showed minor reduction in thickness in comparison to the control site plants. Some black spots of pollutants were also observed in these tissues. Observations were recorded in three different seasons and it was noticed that impact was maximum during winter season and at Meerut cantonment site. The alteration in anatomical attributes may be an adaptation to resist against vehicular pollution. The vehicular emission also effects the metabolic processes and enzymatic activities of the plants. These plants species may be consider as biomonitoring species to observe the effect of vehicular emission.

KEYWORDS: Anatomy, vehicular emission, *Syzygium Cumini*, *Dalbergia Sissoo*, reduction

I. INTRODUCTION

Plants are important and integral part of the ecosystem. They as we know, absorb CO₂ (also called as carbon sink) and give out O₂ which is the mainstay of humans and animals life. Plants play an important role in balancing the cycles of natural gases in the atmosphere. Atmosphere is a complex and dynamic natural system of gases that is essential to support life on Earth planet. Now this system has been disturbed by human activities through unsustainable exploitation of natural resources. Urbanization, industrialization along with burning of fossil fuel through automobiles posing many negative impacts on the well being of the flora and fauna, as well as the environment as a whole. The ever increasing road vehicles are one of the major sources of regional and global atmosphere pollution.

Vehicular emissions cause air polluting and this can damage plants both in the short and long term. In the urban areas, the vehicular pollutions is predominant and significantly deteriorating the quality of air. Automobiles discharge volatile organic compound (VOC), carbon mono-oxide (CO), suspended particulate matter (SPM), oxides of sulphur (SO_x) and oxides of nitrogen (NO_x), which have adverse effect on plants and surrounding ecosystem as well.

Tree alongside roads or national highways are under continuous stressful environment due to vehicular pollution. The effect of different pollutants on the various aspects of different plants has been investigated by many workers. It results in environmental degradation which suppresses performance and shortens life span (Gilbertson and Bradshaw, 1985; Jim, 1996, 1998; Web, 1998) Air pollution can reduce growth and yield, with or without leaf injury (Brandt and Heck, 1967). Rapid increase in automobile vehicles in last 20-25 years has posed a serious threat to the environment and the problem is increasing day by day. Motor vehicle account for 60-70% of the total pollution found in an urban environment (N. Singh, M. Yunus, 1995; A. K. Tripathi, 2007; A. K. Dwivedi, 2008).

Geographically our study area i.e. NH 58 in western Uttar Pradesh lies between 28°57' to 29°02' north latitude and 77°40' to 77°45' East longitude in the Indo-Gangetic Plains of India. Being located in doab regions, the soil is composed of Pleistocene and recent alluvial sediments transported and deposited by river action from the Himalayan regions.

This highway connects National Capital to various tourists destinations located in western parts of India such as Himachal Pradesh, Uttarakhand, Jammu and Kashmir. Thus the traffic load throughout the year remains very high, resulting in the roadside plants are under continuous environmental stress due to vehicular pollutions.



The present investigation has been undertaken two commonly grown plants along side NH 58, viz. *Dalbergia sissoo*, *Syzygium cumini* have been selected. Increase in population, urbanization and expansion of the cities has drastically increased the vehicular traffic. Depending upon the type of fuel, the main emissions are NO_x, SO_x, carbon particles, heavy metals, water vapors and hydrocarbons.

Several studies have been carried out to highlight the impact of air pollution, vehicular pollution on the morphological, anatomical, physiological and biochemical aspects of different plants (Sharma and Tyree, 1973; Ayer and Bedi, 1990; Chattopadhyay, 1996; Mandal and Mukherji, 2000). Leaves remain direct contact to the atmosphere, thus they directly or indirectly effected by vehicular exhaust in various ways. Several researchers have reported upon the impact of air pollution on anatomy of plants, Ninova *et. al.*, 1983; Christodoulaki and Fasseas, 1990). Gupta and Ghose, 1986; reported reduction in thickness of vascular regions number of parenchyma cells in the cortex and pith and thickness of epidermis in *Cloredendron inermis*, *Durenta plumeri*, *Hibiscus rosa sinensis*, *Lawsonia alba* and *Nyctanthes arbor tristis* growing under polluted conditions of automobile emission.

MATERIAL AND METHODS: The following two angiosperm trees and two shrubs which are commonly grown along roadsides NH-58, Meerut to Muzaffarnagar have been selected for the present study:

1. *Syzygium cumini* (L.) (Myrtaceae)
2. *Dalbergia sissoo* Roxb. ex. DC. (Fabaceae)

NH-58 is about 538 km. long National Highway which connects New Delhi to Badrinath and Mana Pass in Uttarakhand, near Indo-Tibbet border. On this highway three polluted sites were selected in western Uttar Pradesh : Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass.

Due to high vehicular pollution, these sites are taken as experimental sites and about 200 meters internal area from the road side were taken as control sites and the investigations are carried out in all three seasons namely –summer season, rainy season and winter season continuously.

To assess the effect of vehicular pollution on angiosperms the following parameters were studied.

1. Selection of Site
2. Selection of Plants
3. Histo - anatomical attributes (characteristics)
 - Midrib thickness
 - palisade tissue thickness
 - Spongy Parenchyma thickness

(1) Survey of Study sites:

The survey of the study sites along NH-58 in western Uttar Pradesh was conducted and three sites: Meerut Cantonment (P₁), Khatauli bypass (P₂) and Muzaffarnagar bypass (P₃) were selected for experiment. These areas are under continuous vehicular emission of automobiles.

(2) Selection of Plants:

More than 30 major angiosperm plants are found along NH-58, but we selected the two angiosperm trees and two shrubs that grow extensively along the National Highway in western Uttar Pradesh. These plants are following:

1. *Syzygium cumini* (L.) (Myrtaceae)
2. *Dalbergia sissoo* Roxb. ex. DC. (Fabaceae)
- 3.

(3) Collection/Selection of Sample:

To study leaf morphology fresh, mature leaves (ten leaves from each selected species from polluted sites) and 10 leaves from controlled sites were collected randomly to measure the length, width and area of the leaves. Tree foliage is an essential tool for monitoring the health state of the tree, *Duquesnay et.al.* (2000). In addition, the foliage is a convenient portion of the tree as a whole. The foliage region is affected more comparison to other plant parts in vehicular pollution.

(4) Histo anatomical Attributes (Characteristics):

Through section cutting and microscopy the following histo anatomical attributes of affected plants were examined and compared with control sites.

- Variations in midrib thickness of selected plants.
- Variations in palisade tissue thickness of selected plants.
- Variation in spongy parenchyma of selected plants.

The observations made through investigation show that vehicular emission has a deleterious effects on all the four plants. The results were co-related and discussed on the basis of the collected data. The higher the concentration of



air pollutant more severe the plants were affected at all experimental sites. The effects were observed in the form of decrease in growth and changes in anatomical characteristics etc.

II. ANATOMICAL STUDIES

For anatomical studies midrib thickness, palisade tissue thickness and spongy parenchyma thickness of selected plants growing along sides NH 58 and control sites were compared and observations have been presentation tables (1-3) and figures (1-6).

During summer season the percent decrease of midrib thickness at polluted sites in comparison to control sites was found to be 2.6, 1.8 and 2.4 for *Syzygium cumini*, 3.2, 2.6 and 3.0 for *Dalbergia sissoo* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively.

During rainy season percent decrease in midrib thickness was found to be 1.8, 1.4 and 1.7 for *Syzygium cumini*; 2.6, 2.1 and 2.4 for *Dalbergia sissoo* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar respectively. Whereas reduction in midrib was maximum during winter season. It was percent reduced by 4.6, 3.8 and 4.2 for *Syzygium cumini*; 4.2, 3.6 and 4.1 for *Dalbergia sissoo* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively. Percent reduction in midrib thickness observed maximum for *Abutilon indicum* (6.2) in winter season and minimum for *Calotropis procera* (1.2) during rainy season at Meerut Cantonment and Khatauli bypass respectively.

During summer season the percent decrease of palisade tissue thickness at polluted sites in comparison to control sites was found to be 16.32, 15.16 and 16.18 for *Syzygium cumini*; 17.41, 17.01 and 17.32 for *Dalbergia sissoo*; 20.12, 19.36 and 20.06 for *Abutilon indicum* and 9.71, 9.62 and 9.70 for *Calotropis procera* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively.

During rainy season the percent decrease in thickness of palisade tissue was found to be minimum. It was observed 9.41, 9.23 and 9.35 for *Syzygium cumini*; 14.21, 13.92 and 14.18 for *Dalbergia sissoo* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively.

During winter season the reduction in palisade tissue thickness was maximum. Percent decrease in thickness of palisade tissue was found to be 18.64, 17.23 and 18.23 for *Syzygium cumini*; 20.64, 20.12 and 20.52 for *Dalbergia sissoo* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively.

Along with thickness of midrib and palisade tissue, thickness of spongy parenchyma of pollution affected plants was also found to be decreased significantly. During summer season the percent decrease in thickness of spongy parenchyma was found to be 10.25, 10.18 and 10.22 for *Syzygium cumini*; 12.03, 11.86 and 11.96 for *Dalbergia sissoo*; 15.29, 14.18 and 15.06 for *Abutilon indicum* and 6.42, 6.23 and 6.34 for *Calotropis procera* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively.

During rainy season the reduction in thickness of spongy parenchyma was minimum. Percent decreased in spongy parenchyma thickness during rainy season was found to be 7.82, 7.32 and 7.69 for *Dalbergia sissoo* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively.

Thickness of spongy parenchyma found to be reduced maximum during winter season in all selected plants at all experimental (polluted) sites.

Percent decrease in thickness of spongy parenchyma was found to be 13.52, 13.24 and 13.48 for *Syzygium cumini*; 14.73, 13.79 and 14.26 for *Dalbergia sissoo* at Meerut Cantonment, Khatauli bypass and Muzaffarnagar bypass respectively.

Table-1: Variation in thickness of midrib region (μm) of experimental plants at polluted sites along National Highway 58 during different seasons.

S.No.	Site	Season	<i>Syzygium cumini</i>	<i>Dalbergia sissoo</i>
1.	Control	Summer Rainy Winter	1125.65 $\pm$ 6.47 1133.37 $\pm$ 4.39 1118.93 $\pm$ 4.81	960.32 $\pm$ 6.42 974.48 $\pm$ 4.65 954.64 $\pm$ 3.96
2.	Meerut Cantonment	Summer Rainy Winter	1106.49 $\pm$ 3.42 1118.36 $\pm$ 6.34 1072.47 $\pm$ 4.66*	935.86 $\pm$ 3.96 950.39 $\pm$ 4.85 921.83 $\pm$ 5.39*

3.	Khatauli Bypass	Summer Rainy Winter	1112.86 ± 2.93 1124.46 ± 4.86 1084.39 ± 3.94	940.32 ± 4.61 956.29 ± 4.03 914+ 52 ± 3.96
4.	Muzaffarnagar Bypass	Summer Rainy Winter	1110.56 ± 4.46 1120.49 ± 3.96 1061.96 ± 4.82	933.92 ± 2.46 946.64 ± 3.21 919.41 ± 4.72*

Value are in mean, ± standard error (SE) in the column superscript are significantly different at (*) $P \leq 0.05$.

Table-2: Variation in thickness of palisade tissue (μm) of experimental plants at polluted sites along National Highway 58 during different seasons.

S.No.	Site	Season	<i>Syzygium cumini</i>	<i>Dalbergia sissoo</i>
1.	Control	Summer Rainy Winter	90.65 ± 3.46 102.23 ± 4.08 84.36 ± 3.64	69.36 ± 3.69 78.46 ± 4.84 64.57 ± 2.93
2.	Meerut Cantonment	Summer Rainy Winter	74.46 ± 2.42 92.61 ± 3.91 68.42 ± 2.82	57.46 ± 3.82 66.63 ± 4.67 52.73 ± 3.82
3.	Khatauli Bypass	Summer Rainy Winter	84.53 ± 2.87 95.64 ± 3.08 72.32 ± 4.26	59.31 ± 4.24 67.82 ± 3.62 54.21 ± 3.21
4.	Muzaffarnagar Bypass	Summer Rainy Winter	76.37 ± 3.67 93.46 ± 2.84 69.68 ± 3.46	57.08 ± 2.83 66.21 ± 2.64 53.23 ± 3.43

Value are in mean, ± S.D., differ significantly at $P \leq 0.05$.

Table-3: Variation in thickness of spongy parenchyma (μm) of experimental plants at polluted sites along National Highway 58 during different seasons.

S.No.	Site	Season	<i>Syzygium cumini</i>	<i>Dalbergia sissoo</i>
1.	Control	Summer Rainy Winter	125.25 ± 4.24 138.48 ± 3.46 120.36 ± 3.69	92.36 ± 2.68 102.44 ± 3.73 87.46 ± 4.85
2.	Meerut Cantonment	Summer Rainy Winter	112.46 ± 2.36 127.67 ± 4.16 104.29 ± 1.68	81.42 ± 3.46 95.69 ± 2.46 74.84 ± 1.84
3.	Khatauli Bypass	Summer Rainy Winter	115.64 ± 1.93 128.43 ± 2.08 110.04 ± 4.63	83.94 ± 2.48 97.68 ± 3.46 76.47 ± 4.66

4.	Muzaffarnagar Bypass	Summer Rainy Winter	113.94 $\pm$ 3.48 127.18 $\pm$ 2.69 107.86 $\pm$ 4.64	82.64 $\pm$ 2.84 95.14 $\pm$ 3.65 75.24 $\pm$ 2.98
----	----------------------	---------------------------	---	--

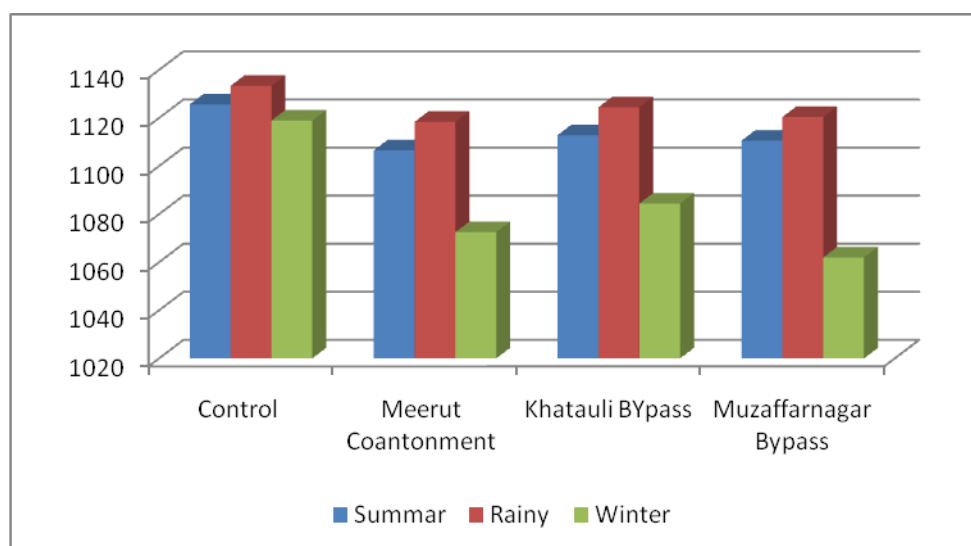


Fig. 1: Variation in thickness of midrib (*Syzygium cumini*)

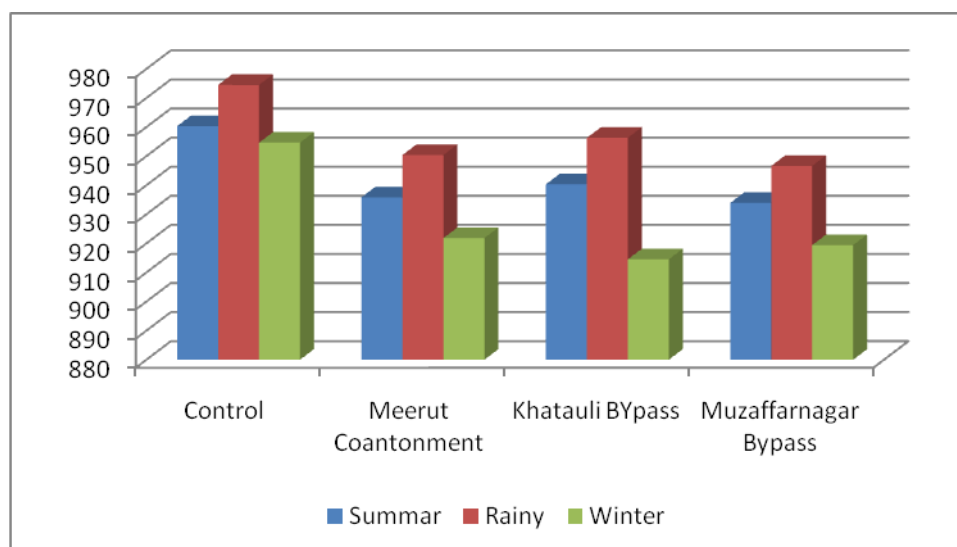


Fig. 2: Variation in thickness of midrib (*Delbergia sissoo*)

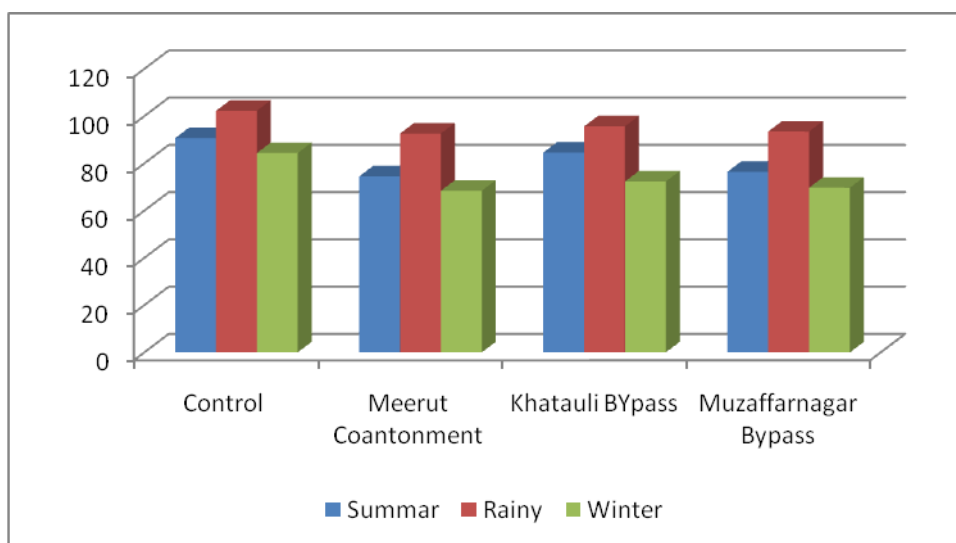


Fig. 3: Variation in thickness of palisade tissue (*Syzygium cumini*)

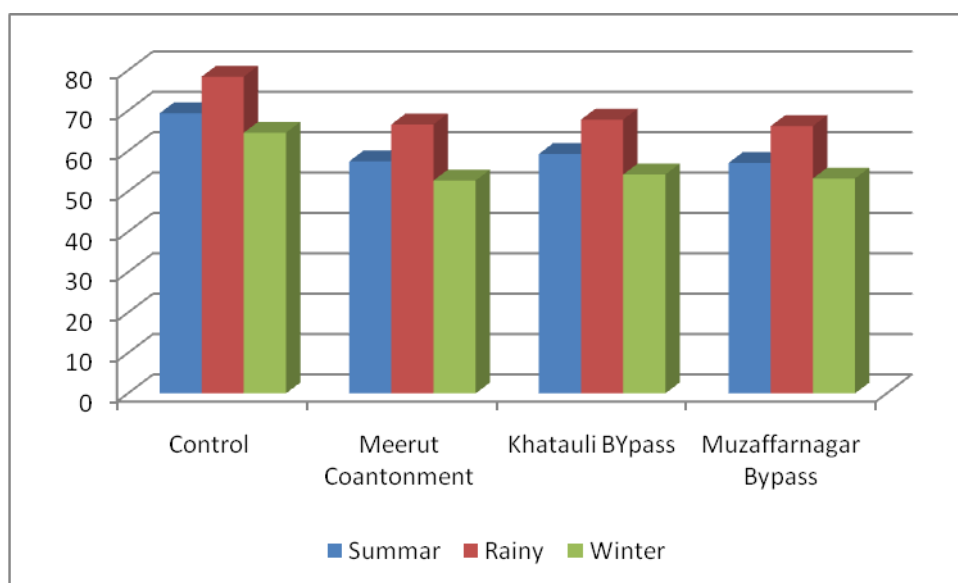
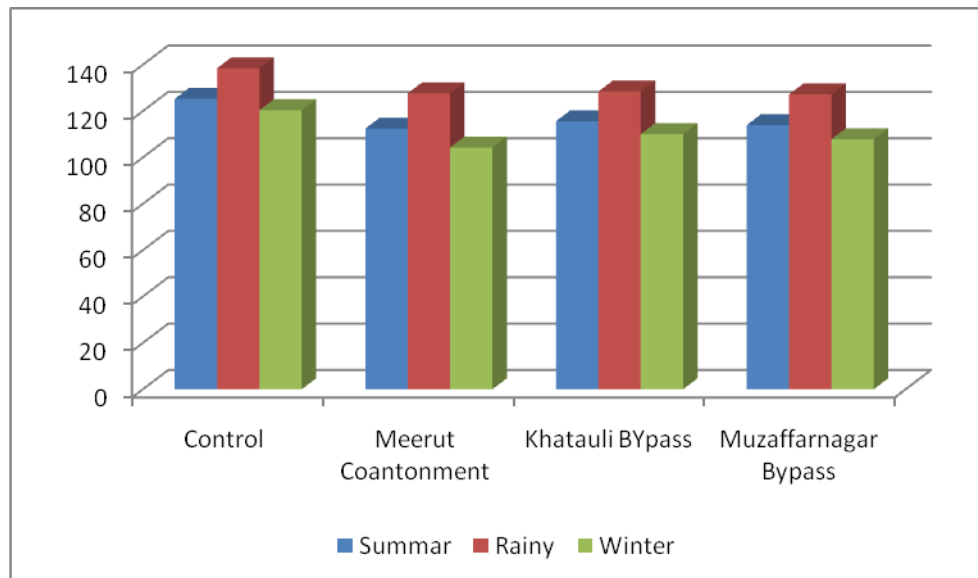
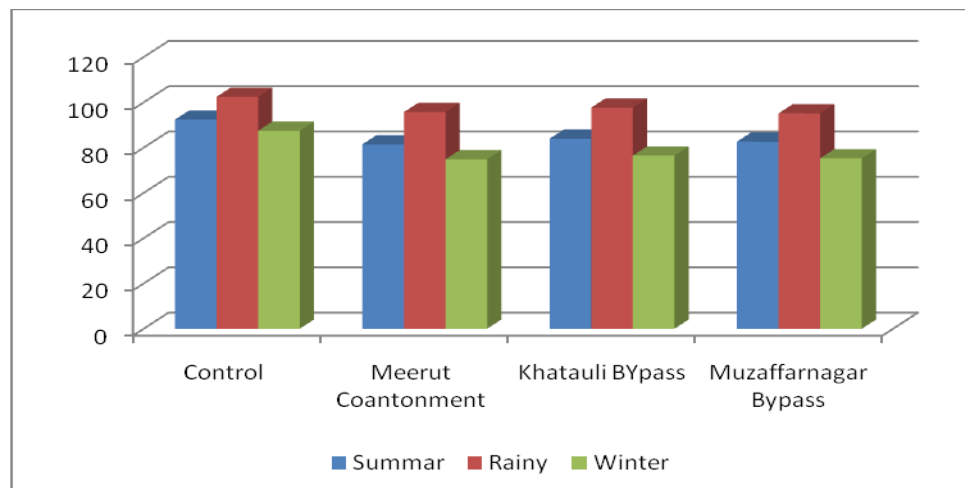


Fig. 4: Variation in thickness of palisade tissue (*Delbergia sissoo*)

Fig. 5: Variation in thickness of spongy parenchyma (*Syzygium cumini*)Fig. 6: Variation in thickness of spongy parenchyma (*Delbergia sissoo*)

III. RESULT AND DISCUSSION

In present study midrib thickness, palisade tissue thickness and spongy parenchyma thickness were examined of the experimental plants and compared these parameters with plants growing under control conditions. Significant reduction in thickness of midrib, palisade tissue and spongy parenchyma was recorded. Higher level of pollutants along national highways causes reduction in these attributes.

Vehicular pollutants such as SO_x , NO_x , CO, CO_2 etc. emitted by automobiles enter directly through stomata of leaves growing along the roadsides and severally affect the anatomical attributes of the leaves which also have been reported by many researchers, D. Ninova, 1983; G. D. Torre et al., 1998; Salgare and Rawal (1990) and Kulshreshtra et al. (1994) etc.

REFERENCES

1. A.K. Dwivedi and B. D. Tripathi, "Effect of ambient air sulphur dioxide on sulphate accumulation in plants," *Journal of Environmental Biology*, vol. 29, no. 3, pp. 377-379. 2008.
2. A.K. Tripathi and M. Gautam, "Biochemical parameters of plants as indicators of air pollution," *Journal of Environmental Biology*, vol. 28, no. 1, pp. 127-132, 2007.



3. Ayer, S.K. and Bedi, S.J. (1990) : Effect of artificial fumigation of sulphur dioxide on growth and yield of *Zea mays* L. var. American sweet corn. *Pollut. Res.* 9 : 33-37.
4. Brandt, C. S. and W. W. Heck (1967) : Air Pollution Academic Press, New York, USA. p. 443.
5. Chattopadhyay, S.P. (1996) : Leaf surface effects of air pollution on certain tree species Calcutta. *Adv. Plant Sci.* 9(1) : 1-4.
6. Christodoulakis, N.S. and Fasseas, C. (1990) : Air pollution effects on the leaf structure of *Laurus nobilis*, an injury resistant species. *Bulletin of Environmental Contamination and Toxicology.* 44(2) : 276-281.
7. Gilbertson, P. and A. D. Bradshaw (1985) : Tree survival in cities. The extent and nature of the problem, *Arborie. J.*, 9 : 131-142.
8. Gupta, M.C. and Ghouse, A.K.M. (1986) : The effects of coal smoke pollution on the leaf epidermal architecture in *Solanum melongena* L. cv. Pusa Purple Long. *Environ. Pollut.* 41 : 315-321
9. Jim, C. Y. (1998) : Pressure on urban trees in Hong Kong : Pervasive problem and possible amelioration, *Arborie. J.*, 22 : 37-60.
10. Kulshreshtha, K., Farooqui, A.L., Srivastava, K., Singh, S.N., Ahmad, K.J. and Behl, H.M. (1994) : Effect of diesel exhaust pollution on cuticular and epidermal features of *Lantana camara* L. and *Syzygium cumini* L. *Journal of Environmental Science and Health Part-A. Environmental Science and Engineering.* 29(2) : 301-308.
11. M. Mandal and S. Mukherji, "Changes in chlorophyll content, chlorophyllase activity, Hill reaction, photosynthetic CO₂ uptake, sugar and starch contents in live dicotyledonous plants exposed to automobile exhaust pollution," *Journal of Environmental Biology*, vol. 21, no. 1, pp. 37-41, 2000.
12. Ninova, D., Dushkova, P.I. and Kovacheva, G.V. (1983) : Anatomical, morphological and physiological studies on *Platanus acerifolia* at various degree of air pollution. *Exologiya Bulgaria.* 12 : 35-47.
13. Salgare, S.A. and Rawal, M. (1990) : Effect of auto exhaust pollution at Andheri (west), Bombay on the anatomy of some cultivated plants (monsoon collection). *Journal of Ecobiology.* 2(4) : 273-280.
14. Salgare, S.A. and Thorat, V.B. (1990) : Effect of auto exhaust pollution at Andheri (west), Bombay on the micromorphology of some trees. *Journal of Ecobiology.* 2(41) : 267-272.
15. Sharma, G.K. and Tyree, J. (1973) : Geographic leaf cuticular and gross morphological variation in *Liquidamber styraciflus* and their probable relation to environmental pollution. *Bot. Gaz.* 134 : 179-184.
16. Singh, N., Yunus, M. Srivastava, K., Singh, S.N., Pandey, V, Misra, J. and Ahmad, K.J. 1995. Monitoring of auto exhaust pollution by road side plants. *Env. Mont Ass.* 34 : 13-25.
17. Torre, G.D., Feranti, F., Lupattelli, M., Pocceschi, N., Figoli, A., Noli, C., Lorenzini, G., Della-Torre, G. and Paoletti, E. (1998) : Effect of ozone on morpho-anatomy and physiology of *Hedera helix*. *Chemosphere.* 36(4-5) : 651-656



**Impact Factor:
7.569**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details