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Research Article

DUST DEPOSITION DUE TO ANTHROPOGENIC ACTIVITIES INDUCES EPIDERMAL CHANGES IN LEAVES OF *CASSIA FISTULA* GROWING NEAR THE ROAD SIDE OF REWA CITY.

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ABSTRACT

This study was conducted to evaluate the effects of air pollution on epidermal structure of leaves of Cassia Fistula growing near the road side of the city. There was marked alternations in the epidermal attributes of plant leaves exposed to urban air pollution. The leaf samples showed increased number of stomata and epidermal cells, stomatal frequency, stomatal index on both side of leaves surfaces at polluted and non-polluted sites of the sampling area. Samples of leaf were collected from polluted sites exhibited decreased length and width of epidermal cell and guard cell as compared to control ones. The results indicate that this plant species have developed some adaptations to survive under stressed conditions of air pollution.

INTRODUCTION

The hazard of urban air pollution is driven mainly by emissions from vehicular traffic, industrial gasemissions and activities around urban areas like coal mining, quarrying, stone crushing, thermal power plants, cement industries etc.such activities induce high levels of dust in the environment which is dispersed, transported and leads to atmospheric chemical reaction in the form of deposition as gaseous ions,solid and liquid particles.. Around 60-70% pollution in the urban environment is caused by motor vehicles which leads to40% air born particulate matter known as Respirable Suspended Particulate Matters (RSPM).RSPM comprises 40% of the total air pollution problems in India. Through anthropogenic activity when very fine dust particles arereleased react with other pollutants pollutants like nitrogen oxides, sulphur dioxide, ammonia and volatile organic compounds (Shrivastava *et al*., 2013).

Epidermal surface is the direct phase of contact between the plant and the atmosphere. Stomata are present on upper and lower surface of leaves and they are the major sites of gaseous exchange, so the effect of pollutants is first noticed here in plants. There are variety of plants growing along the road sides and are exposed to auto exhaust pollution. Various researchers have found that plants sensitive to air pollutants exhibit differences in their morphology, biochemistry and anatomy (Aggarwal, 2000; Rai and Singh, 2015; Pawar, 2016; Reig-Armiñana *et al*., 2004; Silva *et al*., 2005; Salgare and Acharekar, 1991; Giri et.al, 2013; Pawar, 2015; Gupta *et al*., 2009;Karthiyayini*et al*., 2005;Pratibha and Sharma, 2000; Ramakrishnaiah and Somashekar, 2003; Various researchers have noticed adverse impacts of different gaseous pollutant on leaf structure of plants (Carreras *et al*., 1996; Kulshreshtha *et al*., 1994a, 1994b; Rai and Kulshreshtha, 2006;Sharma and Roy, 1995; Pal *et al*,, 2000; Amulya *et al*., 2015; Sher and Hussain, 2006;).Automobile exhausts pollution play an important role in the ambient atmosphere of the city. The assessment of air pollution in epidermal qualities of roadside plant species; *Cassia fistula* is very important.

MATERIALS AND METHODS

Selection of Site-Site selected to conduct this work in Rewa (M.P.) is located 24.53 latitude and 81.30 longitudes.

Selection of plant-For epidermal study, road side tree species, *Cassia fistula* growing atcampus of the University, as control site and polluted sites of Rewa city, M.P.(India) were selected.

Microscopic studies-Light microscope were used for the examination of Characteristics of Leaf surface ondorsal and ventral side .*Cassia fistula*leaf were collected from polluted and control locations for light microscopic study.Leaves are properlyrinsed with tap and deionized water to clean dust particles which is deposited on the surface of the leaves. Lasting impressions methods used for preparation of leaf

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epidermal peel slides. By transparent nail polish one square centimeter leafsurface area painted and then completely allowed to dry. Dried nail polish area is taped by transparent tape. Smoothly, take out the covered patch by pulling a corner of the tape. Then leaf imprint was fixed on slides as adaxial and abaxial surface. Leaf imprint was observed under light microscope ("MagVision" software of Olympus optical microscope) and with the help of the software guard cells size and epidermal cells size were observed. Stomatal number and epidermal cell number were counted per square millimetre area and for the calculation of the stomatal frequency and stomatal index formula used given by (Salisbury, 1927):

Stomatal index is calculated by formula

$$SI = S / (E+S) \times 100$$

Stomatal frequency is calculated by formula

$$SF = (S/E) \times 100$$

Where, E= Average number of epidermal cells and S= Average number of stomata

RESULTS

The tree species *Cassia fistula* growing at polluted sites of Rewa city were observed for number of stomata, epidermal cells and length and width of guard cells. Similar observations were also made for the respective tree species growing in the campus of A.P.S. University Rewa (M.P.), a control site.

Average number, length and width of epidermal cells of *Cassia fistula* growing at non polluted and polluted locations of the study area are shown in Table 1. Datarevealed noticeable changes in characteristics of epidermal cell with increased number per unit area on dorsal and ventral sides of leaves of *Cassia fistula* at polluted sites as compared to non-polluted sites (Table 1).Increased number of epidermal cells at polluted sites was statistically insignificant on dorsal surfaces but significant on ventral side of the leaves of *Cassia fistula* (Table 2). Polluted sites Samples showed insignificant reduction on ventral side in epidermal cells length and significantly reduction in epidermal cells width on the surfaces of *Cassia fistula*than those of non-polluted sites. (Table2).

Table- 3 Observation on width and length of guard cells of both side of leaves and average number of Stomata of *Cassia fistula* growing in the polluted and non-polluted sites of Rewa city. The leaves of *Cassia fistula* have shown stomata on both dorsal and ventral surface collected from polluted and controlled site. Results (Table-3) clearly indicated stomata number increased and decreasedin length and width of stomatal guard cells of leaves of *Cassia fistula* on both surface ventral and dorsal at polluted sites in comparison to non-polluted site. This decrease in width and length of guard cells and increase in no of stomata at polluted site was significant (Table-4) except insignificant width of stomatal guard cell on dorsal surface. Similarly, stomatal index value and frequency of stomata were also seen to be higher for the leaves sample of *Cassia fistula* from polluted site, as compared to control ones.

Table 1 Average number (per mm^2), width (µm) and length (µm) of epidermal cells of *Cassia fistula* growing at controlled and polluted sites

Leaf Surfaces	Epidermal Characters	Polluted site	Control site
Dorsal	LEC	43.200 ± 4.940	62.100 ± 12.252
	WEC	32.70 ± 4.111	38.400 ± 10.178
	NEC	47.200 ± 7.843	40.400 ± 6.041
Ventral	LEC	41.400 ± 9.778	45.900 ± 5.666
	WEC	16.500 ± 2.54	21.900 ± 4.909
	NEC	87.900 ± 8.25	77.300 ± 7.917

Table 2 Size of epidermal cells and values of't' test between number of epidermal cells of leaves of *Cassia fistula* polluted and controlled sites

Leaf Surfaces	Epidermal Characters	t-test	P value
Dorsal	LEC	4.524 *	P=0.0003
	WEC	1.642 *	P=0.1179
	NEC	0.05602	P=0.1179
Ventral	LEC	1.260	P=0.2239
	WEC	3.090 *	P=0.0063
	NEC	2.105 *	P=0.0496

Table 3 Length (µm) and width of guard cells (µm), average number of stomata cells (mm^2), stomata index (%) and frequency of stomata (%) of *Cassia fistula* leaves growing at polluted and control sites

Leaf Surfaces	Stomatal Characters	Polluted site	Control site
Dorsal	LGC	24.00 ± 4.00	30.60 ± 3.94
	WGC	15.600 ± 4.648	17.70 ± 3.59
	NOS	24.500 ± 4.552	20.40 ± 3.27
	SF	28.95	25.50
	SI	22.45	20.31
Ventral	LGC	23.400 ± 3.688	30.00 ± 4.899
	WGC	13.500 ± 2.121	18.900 ± 6.935
	NOS	34.800 ± 4.51	21.900 ± 4.818
	SF	40.98	28.33
	SI	29.07	22.07

Table 4 Values of 't' test between size of guard cells and number of stomatal cells of *Cassia fistula* leaves growing at polluted and control sites

Leaf Surfaces	Stomatal Characters	t-test	P value
Dorsal	LGC	3.717 *	P=0.0016
	WGC	1.131	P=0.2730
	NOS	2.313 *	P=0.0327
Ventral	LGC	3.404 *	P=0.0032
	WGC	2.355 *	P=0.0301
	NOS	6.181 *	P<0.0001

NOS= Stomata cells No.
LGC= Guard cell Length
WGC= Guard cell width
SF= Stomatal Frequency
SI= Stomatal Index
LEC= Epidermal cellLength
WEC= Epidermal cell Width
NEC= Epidermal cells Number
* Significant
't' value at 18 d.f. on 0.05% level is 1.734

DISCUSSION

This study demonstrates that epidermal characters of *Cassia fistula* growing at polluted sites are altered due to the pressure of vehicular emission with increased traffic load and construction works going on in the city. The adverse effect of traffic emissions on plants was greater in the area receiving higher pollution load due to higher vehicle density and vice versa. The pollutants released from vehicles interact with plants growing along roadsides and these air pollutants alter the normal functioning of the plants.

Anatomy and morphology of a leaf is useful to assess the impact of pollutants released from vehicular exhaust (Pal *et al.* 2002). Keeping above view in mind, the present work is undertaken to assess the influence of air pollution on the epidermal structure of leaves of *Cassia fistula* growing along the road side of Rewa city. The findings on anatomical traits of these species growing at polluted sites have been compared with the findings of respective plant species growing at University campus, considered as control site in this study. Both the species of selected study sites registered significant increase in epidermal cells number and stomata number on their leaf surfaces, as compared to control areas.

On the other hand, the plant species of polluted sites have shown reduction in the size of epidermal and guard cells in comparison to respective control plants. Similar results were observed by various workers (Kulshreshtha *et al*., 1980, 1994;Sharma and Roy, 1995; Ramanathan and Kanabiran, 1989; Aggarwal, 2000; Kaur, 2004; Dineva, 2006; Rai and Kulshreshtha, 2006; Raina and Chand Bala, 2011; Rai and Mishra, 2013; Shrivastava and Mishra, 2018).Stomata size is less in number reflected as response of the plant to avoid entry of harmful gases which can cause adverse effects (Satyanarayana *et al*., 1990; Salgare and Thorat, 1990; Shrivastava and Prakash,2017;andZarinkamar *et al*., 2013).

Different changes in epidermal structures could be an indicator of environmental stress caused due to vehicular air pollution. The marked alternations in the size and number of foliar epidermal and guard cells, stomatal frequency and stomatal index in both dorsal and ventral surfaces of plant species under this study are not unexpected. It is evident from the above discussion that the pollutants such as RSPM, SPM, SO2 and NO2 from automobile exhaust not only cause bad air quality condition around nearby areas but also cause significant reduction in number of stomata and epidermal cells of trees growing near the road sides of Rewa city.

CONCLUSION

It may be concluded that leaf epidermal surface are sensitive to the air pollution. Different types of Pollutants present in the ambient air were found to have changed the structure of leaves of *Cassia fistula*. *Cassia fistula* has been found to be resistant to air pollutants and despite modification it continues on its growth path to attain maturity. This work was undertaken to assess the impact of gaseous and dust pollution on the epidermal structure of leaves of a tree species growing along the road side of Rewa city.

References

1. Aggarwal, P. (2000). The effect of auto-exhaust pollution on leaf surface of Cassia siamea(L.), a road side tree. ActaEcologica, 22: 101-106.
2. Amulya,L.; Kumar, N.K.H and Jagannath,S.(2015).Air pollution impact on micromorphological and biochemical response of Tabernaemontanadivaricata L. (Gentianales: Apocynaceae) and Hamelia patens Jacq. (Gentianales: Rubiaceae). *Brazilian Journal of Biological Sciences*. p. 287-294.
3. Carreras, H.A.; Canas, M.S. and Pagnate, M.L. (1996). Differences in responses to urban air pollutants by Ligustrumlucidum Ait. F. tricolor (Rehd.). Environmental Pollution. 2: 211-218.
4. Dineva, S. (2006). Development of leaf blades of Acerplatanoides in industrially contaminated environment. Dendrobiology, 55: 25-32.
5. Giri, S.; Shrivastava, D., Deshmukh, K. and Dubey, P. (2013). Effect of Air Pollution on Chlorophyll Content of Leaves. *Current Agriculture Research Journal*, Vol.1 (2), 93-98.
6. Gupta, S.; Bhattacharjee, D.; Datta, J.K.; Nayek, S. and Satpati, S. 2009. Effect of vehicular lead emissions on biochemical constituents of leaves. Poll. Res..28 (2): 157-160.
7. Karthiyayini, R.; Ponnammal, N.R. and Joseph, R. 2005. Air pollution tolerance index of certain plants of Coimbatore- Ooty highways, near ITI area, Coimbatore, Tamilnadu. Poll Res. 24(4) :801-803.
8. Kulshreshtha, K., Farooqui, A., Srivastava, K., Singh, S.N., Ahmad, K.J. and Behl, H.M. (1994a). Effect of diesel pollution on cuticular and epidermal features of Lantana camara Linn. And Syzygiumcumini Linn. (Skeels). *Journal of Environmental Science and Health*. 29 (2): 301-308.
9. Kulshreshtha, K.; Srivastava, K. and Ahmad, K.J. 1994b. Effect of automobile exhaust pollution on leaf surface structure of Calotropisprocera L. and Neriumindicum L. FeddesRepertorium, 105: 185-189.
10. Kulshreshtha, K., Yunus, M., Dwivedi, A.K. and Ahmad, K.J. (1980). Effect of air pollution on the epidermal traits of Jasminumsambac. New Botanist, 7: 193-197.
11. Pal, A., Kulshreshtha, K., Ahmad, K.J. and Yunus, M. (2000).Changes in leaf surface structures of two avenue tree species caused by auto exhaust pollution. *Journal of Environmental Biology*, 21 (1): 15-21.
12. Pawar, A. (2015). A survey of road side flora growing under stress of auto exhaust pollution in city Ghaziabad. Journal of Pure & Applied Sciences & Technology, Vol. 5(2), pp.27-32.
13. Pawar, A. (2016). Impact of urban air pollution on epidermal traits of Amaranthusviridis growing along the road Side. *Journal of Pure and Applied Science & Technology*. pp. 7-10.
14. Pratibha and Sharma, M. (2000). Changes in chlorophyll and total free amino acids of gram in response to sulphur dioxide exposure under field conditions. Poll. Res..19 (1): 95-97.
15. Rai, A. and Kulshreshtha, K. (2006). Effect of particulates generated from automobile emission on

some common 50151 *International Journal of Current Research*, Vol. 9, Issue, 05, pp. 50147-50152.
16. Rai, P. and Mishra, R.M. (2013). Effect of urban air pollution on epidermal traits of road side tree species, Pongamiapinnata(L.) Merr. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, pp.04-07.
17. Rai, P.K. and Singh, M.M. (2015). Lantana camara invasion in urban forests of an Indoe Burma hotspot region and its ecosustainable management implication through biomonitoring of particulate matter. *Journal of Asia-Pacific Biodiversity*, 375-381.
18. Rai, A. and Kulshreshtha, K. (2006). Effect of particulates generated from automobile emission on some common plants. *Journal of food, Agriculture and Environment* .4(1): 253-259.
19. Raina, A.K and Bala, C. (2011). Effect of vehicular pollution on Durantarepens L. in Jammu city. Journal of Applied andNatural Science, Vol. 3(2), pp. 211-218.
20. Ramakrishnaiah, H. and Somashekar, R.K. (2003). Higher plants as biomonitors of automobiles pollution. Eco.Env. and Cons. 9 (3): 337-343.
21. Reig-Armiñana, J., V. Calatayud, J. Cerveró, F. J. García- Breijo, A. Ibars and M.J. Sanz. (2004). Effects of ozone on the foliar histology of the mastic plant (Pistacialentiscus L.). Environ. Pollu., 132: 321-331.
22. Salgare, S.A. and Acharekar, C. (1991).Effect of ambient air on the leaf anatomy of some wild plants-1.Environ. Biol., 12 (4): 347-352.
23. 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(4): 267-272.
24. Salisbury, E.J. (1927). On the causes and ecological significance of stomatal frequency, with special reference to the woodland fora. Philos. Trans. R. Soc. London B 216, 1-65.
25. Satyanarayana, G., Pushpalatha, K. and Charya, U.H.A. 1990. Dust loading and leaf morphological trait changes of plants growing in automobile polluted area. Advances in Plant Sciences. 3(1): 125-130.
26. Sharma, M. and Roy, A.N. (1995). Effect of automobile exhauston the leaf epidermal features of Azadirachtaindica nd Dalbergiasissoo *Int. Journal of Mendel*, 12 (1-4): 18-19.
27. Sher, Z. and Hussain, F. (2006). Effect of automobile traffic on some cultivated trees along road side in Peshawar. *Pakistan Journal of Plant Science.* 12(1): 47-54.
28. Shrivastava, R. K.; Saxena, N. and Gautam, G.(2013). Air pollution due to road transportation in India: a review on assessment and reduction strategies. *Journal of Environmental Research And Development*. Vol. 8, 69-77.
29. Shrivastava, R. and Mishra, A. (2018). Air pollution induced changes in foliar miro-morphology of road side shrub species ThevetiaperuvianaandP lumeriaalbain Rewa City, MP, India. *International Research Journal* Vol. 7(3), 1-7.
30. Shrivastava, R. and Prakash, J. (2017). Effect of Vehicular Pollution on Micro-Morphological Structure of Hibiscus RosaSinensis. *International Journal of Engineering Technology Science and Research Volume* 4(12), 521-527.
31. Silva, H. G. de O. ; Pires, A. J. V. ; Silva, F. F. da ; Veloso, C. M. ; Carvalho, G. G. P. de ; Cezario, A. S. ; Santos, C. C., (2005). Effects of feeding cocoa meal (Theobroma cacao L.) and palm kernel cake (Elaeisguineensis, Jacq) on milk intake and yield for lactating goats. Rev. Bras. Zootec., 34 (5): 1786-1794.
32. Zarinkamar, F.; Saderi, Z. and Soleimanpour, S. 2013. Excluder strategies in response to Pb toxicity in Matricariachamomilla. Environment and Ecology Research. v. 1, n. 1, p. 1-11.

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