Poll Res. 43 (1–2) : 100-104 (2024)

ISSN 0257–8050
DOI No.: http://doi.org/10.53550/PR.2024.v43i01-02.019

EFFECT OF CEMENT DUST POLLUTION ON FOLIAR MICRO MORPHOLOGY AND BIO CHEMISTRY OF *BOUGAINVILLEA SPECTABILIS* WILLD

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(Received 2 November, 2023; Accepted 28 December, 2023)

ABSTRACT

As the construction around India is increasing so is the demand for cement but in this demand of cement the cement pollution in those area is on rise. To assess the effect of cement dust on the plants of such an area this study was conducted. The present investigation focusses on the morphological and biochemical parameters of *Bougainvillea spectabilis* willd. belonging to the family Nyctaginaceae. In the morphological study a significant decrease in the stomatal index and frequency was observed. Trichomes were observed more on upper epidermis than on the lower epidermis and trichome density of the experimental leaves was higher than the control. Biochemical study showed increase in pH, chlorophyll-a and proline of experimental leaf also a significant increase in contents of calcium, iron and magnesium was observed. A decrease in the amount of chlorophyll-b and total chlorophyll was observed.Soil and dust pH at experimental site increased showing alkaline nature of the site. The results proved that cement-dust has a significant effect on *Bougainvillea spectabilis* willd. both micromorphologically and biochemically. The plant is tolerant to cement dust because despite the pollution the plant was still flowering.

KEY WORDS: Cement-dust, *Bougainvillea spectabilis* willd, Micromorphological, Biochemical.

INTRODUCTION

Air pollutants comprises particulate matter, automobile exhaust, and industrial emissions causing adverse health effects in humans, disturb plant ecosystem, growth, and impact globally by altering the atmosphere. The pollutants get deposited on the surface of the leaf, flower, and stem. *Bougainvillea* has many hair on its leaf surface, and it is considered as a good plant as an adaptor of air pollution. Air pollution causes deposition of dust on the surface of the leaf. The polluted area we have selected is near a cement factory, so the amount of pollution the plant is going through is very great (Manjunath *et al*., 2019). Plants which grow under stress conditions tend to produce stress proteins and the active constituent concentration in the plant reduces or become absent altogether. The physical appearance of the plant also changes because of the pollution, or it can be said that the plant adapts to that environmental stress by altering the physical appearance of the plant. *Bougainvillea spectabilis* is commonly referred to as the "paper flower." The bracts of the flower are thin and papery so the common name. *B. spectabilis* has pink coloured bract. Stem is a woody perennial vine, with multiple branching and many stems which spread up to 2-4 m. The colour of the stem is from light to dark green. The old stem is woody and corky. Branching is close and short resulting in a dense plant. The leaves are simple and alternate, dark green on the upper side and light green on the lower side. Leaves have many hair. There are stipules present in the axil of the leaf in the form of thorn. The flower arises in the axils of leaf in cluster of three. The flowers are small, white, slender with hairy tubes. The flower is surrounded

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by pink coloured bracts known as petaloid bract (Anisa Ghogar *et al*., 2017)

MATERIALS AND METHOD

The present investigation was carried out in Maharashtra. Experimental and control field sites were selected at Borivali and Thane. Experimental site was selected at Virar where there was a cement factory and cement dust. Leaves of the plant were collected from predetermined nodes in polythene bags, from both the sites and studied for micro-morphological and biochemical parameters.

The micro-morphological parameters selected for foliar studies were stomatal frequency, trichome density. Micro-morphology was studied by epidermal peeling method. Biochemical parameters selected for foliar studies were leaf pH, chlorophyll a, chlorophyll b, total chlorophyll (Arnon's method, 1949) and proline (Sadasivam and Manickam, 1996). Concentration of calcium and magnesium by EDTA Titration method and Iron content by AAS (Atomic Absorption Spectroscopy). Soil and dust samples were collected in polythene bags from both the field sites and analysed for pH (Reeds and Cummings, 1945).

RESULTS AND DISCUSSION

Observations

It is seen that different ecological areas play an important role in the morphology and biochemistry of the plants, external environment of the plant affects the overall makeup of the plant. Plants possess different pollution tolerance capabilities depending on the species and the environmental factors affecting them (Nwadinigwe, 2014). *Bougainvillea* is a very tolerant plant as it is used as road separator plant. It was observed that the stomatal index of experimented site has reduced as compared to the control site, Trichome density is found more in the experimental site as compared to the control site indicating that the plant tolerates the stress by producing more trichome in polluted area.Sharma and Butler (1973) observed lower stomatal density and high trichome density in selected plant populations. They considered it a modification of plant with ecological significance.

Table 1. Micromorphological Observations - Lower Epidermis of *Bougainvillea spectabilis* willd.

Sr. No.	Parameters	Control	Experimental	% DFC
1	Stomatal Index/ mm^2	13.4152 ± 0.4307	12.1033 ± 0.3369	-9.7792
2	Trichome density/mm^2	13.2 ± 2.7809	15 ± 2.6247	13.6364

Values represents Mean, % DFC = Percent difference from control,
* Significant at p<0.05 Student's t-test.

Table 2. Biochemical Analyses Results of *Bougainvillea spectabilis* willd.

Parameters	Control	Experimental	% DFC
Leaf pH	6.043 ± 0.02058*	6.61 ± 0.07379*	9.3828
Chlorophyll a (mg/g)	1.2170 ± 0.00466*	1.6454 ± 0.00028*	35.2013
Chlorophyll b (mg/g)	3.8870 ± 0.00466	1.3261 ± 0.00028	-65.8837
Total Chlorophyll (mg/g)	5.10 ± 0.014317*	2.96 ± 0.01606*	-41.9608

Values represents Mean, %DFC = Percent difference from control,
*Significant at p<0.05 Student's t-test.

Table 3. Foliar biochemical Analyses Results of *Bougainvillea spectabilis* willd.

Sr. No.	Parameters	Control	Experimental	% DFC
1.	Proline (µ moles/g tissue)	0.2991 ± 0.006992*	0.4348 ± 0.00527*	45.3694
2.	Concentration of calcium mg/g	17.2344 ± 0.048305*	22.044 ± 0.052705*	27.9070
3.	Concentration of magnesium mg/g	20.64 ± 0.05164*	32.16 ± 0.005164*	55.8140
4.	Concentration of Iron mg/g	2.158 ± 0.000675*	3.630 ± 0.000789*	68.2113

Values represents Mean, %DFC = Percent difference from control,
* Significant at p<0.05 Student's t-test.

Table 4. Biochemical Analyses Results ofsoil and dust.

Sr. No.	Parameters	Control	Experimental	% DFC
1.	Dust pH	7.415 ± 0.00527*	7.858 ± 0.02974*	5.9744
2.	Soil pH	7.603 ± 0.012517*	7.981 ± 0.009944*	4.9717

Values represents Mean, %DFC = Percent difference from control,
* Significant at p<0.05 Student's t-test.

Verma *et al.* (2006) also reported a significant decrease in stomatal frequency in Ipomoea pestigridis grown under various degrees of environmental stresses.

Chlorophyll estimation is an important tool to evaluate the effects of air pollutants on plants as it plays an important role in plant metabolism so that any drop in chlorophyll content indicates direct impact on plant growth (Patel and Nirmal Kumar, 2018). It is observed that the control site shows more chlorophyll content as compared to experimental site, hence the shunted growth of the plant. The present findings regarding reduction in pigments were also in conformation with the report of Misra *et al*. (1993) stating that cement dust decreases the amount of photosynthetic pigments in plants. The alkaline cement dust taken up by the plant through soil-root pathway parhaps make the cell sap alkaline. Increase in pH leads to pigment degradation or may inhibit the activity of enzymes required for the activity of pigment biosynthesis.

Proline is a stress indicator more amount of proline indicates that the plant is under stress conditions. Experimental site that shows presence of slightly more amount of proline indicates that the plant is under stress conditions. Experimental site with % DFC of 45.37% indicates that more amount of stress protein is present in experimental site plant.

pH is observed to be more in experimental site it may be due to the alkalinity of the cement dust which enters the plant through root pathway causing the shift in pH (Adamson and *et al*. 1994). The cement dust and soil at cement factory were found to be alkaline in nature. Soil and dust at the experimental site showed higher total soluble salt content than control site. These cement dust and soil particles which were absorbed by the leaf cells brought about biochemical changes in cytoplasm shifting the leaf pH towards the alkaline side.

ACKNOWLEDGEMENT

The author Kajal Somnath Sharma would like to thank her mentor Vaishnavi More for her guidance and her family for their support and encouragement.

REFERENCES

Adamson, E., Adamson, H. and Seppelt, R. 1994. Cement dust contamination of Ceratodonpurpureus at Casey, East Antarctica: damage and capacity for recovery. *Journal of Bryology*. 18(1): 127-137.

Adebayo, J.O., Adesokan, A.A., Olatunji, L.A., Buoro, D.O. and Soladoye, A.O. 2005. Effect of ethanolic extract of Bougainvillea spectabilis leaves on haematological and serum lipid variables in rats. An introduction to Practical Biochemistry - David T Plummer

Arnon, D.I. 1949. Copper enzymes in isolated chloroplasts. Polyphenoloxidase in Beta vulgaris. *Plant Physiology*. 24: 1-15.

Babu, G.B., Parveen, S.N., Kumar, K.N. and Reddy, M.S. 2013. Evaluation of air pollution tolerance indices of plant species growing in the vicinity of cement industry and Yogi VemanaUniversity campus. *Indian Journal of Advances in Chemical Science.* 2(1): 16-20.

Baralabai, V. C. and Vivekanandan, M. 1996. Foliar application of electrostatic precipitator dust on growth, stomata and leaf biochemistry in certain legume crops. *Rev Brasil Fisiol Veg.* 8: 7-14.

Biochemical Methods - S. Sadasivam and A. Manickam, 2nd edition, 1996.

Çelik, Ö. and Atak, C. 2012. The effect of salt stress on antioxidative enzymes and proline content of two Turkish tobacco varieties. *Turkish Journal of Biology.* 36(3): 339-356.

Ceulemans, R., L. Van Praet, and Jiang, X. N. 1995. Effects of CO2 enrichment, leaf position and clone on stomatal index and epidermal cell density in poplar (Populus). *New Phytologist.* 131(1): 99-107.

Chew, S. 2010. Anatomical features of Bougainvillea (Nyctaginaceae). *SURG Journal.* 4(1): 72-78.

Darley, E. F. 1966. Studies on the effect of cement-kiln dust on vegetation. *Journal of the air pollution control association.* 16(3), 145-150.

Das, P.K., Vaghela, J.S. and Badore, N. 2021. Pharmacognostical, Phytochemical and Fluorescence analysis of the plant Bougainvillea spectabilis (Willd.). *Research Journal of Pharmacy and Technology.* 14(7): 3733-3738.

Ferrante, A., Trivellini, A., Borghesi, E. and Vernieri, P. 2012. Chlorophyll a fluorescence as a tool in evaluating the effects of ABA content and ethylene inhibitors on quality of flowering potted Bougainvillea. *The Scientific World Journal*.

Ghogar, A. and Jiraungkoorskul, W. 2017. Antifertility Effect of *Bougainvillea spectabilis* or Paper Flower. *Pharmacognosy Reviews*. 11(21): 19-22.

Hajare, C.N., Inamdar, F.R., Patil, R.V., Shete, C.S., Wadkar, S.S., Patil, K.S. and Ghosh, J.S. 2015. Antibacterial activity of the leaves of Bougainvillea spectabilis against E. coli NCIM 2832 and M. aureus NCIM 5021. Int *J Pharm Sci Rev Res.* 34: 194-6.

IPNI, 2023. International Plant Names Index. Published on the Internet http://www.ipni.org, The Royal Botanic Gardens, Kew, Harvard University Herbaria & Libraries and Australian National Herbarium. [Retrieved 23 February 2023].

Kalaskar Priya and More Vaishnavi, 2023. Impact of Particulate Matter Fromvehicle Exhauston Morphology and Biochemistry of Bougainvillea Glabra. *International Journal of Scientific Research.* 10(9): 1-2.

Khandelwal, K.R. 2006. Practical Pharmacognosy Techniques and Experiments, Nirali Prakashan, Sixteenth edition.

Lerman, S. L. and Darley, E. F. 1975. Particulates, in. responses of plants to air pollution. M.R. Almeida, Flora of Maharashtra, Volume Four (A).

Mandre, M., Kask, R., Pikk, J. and Ots, K. 2008. Assessment of growth and stemwood quality of Scots pine on territory influenced by alkaline industrial dust. *Environmental Monitoring and Assessment.* 138(1): 51-63.

Manjunath, B.T. and Reddy, J. 2019. Comparative evaluation of air pollution tolerance of plants from polluted and non-polluted regions of Bengaluru. *Journal of Applied Biology and Biotechnology.* 7(3): 6-8.

Misra, J., Pandey, V., Singh, S.N., Singh, N., Yunus, M. and Ahmad, K.J. 1993. Growth responses of *Lycopersicon esculentum* to cement dust treatment. *Journal of Environmental Science & Health Part A.* 28(8): 1771-1780.

More, V.V. 2023. Sustainable And Ecological Adaptation of *Peltophorum Pterocarpum* (DC) Backer. In Alkaline Dust Pollution. *International Journal of Research and Analytical Reviews*. 10(2): 74-77.

Narayanan, C.R., Joshi, D.D., Mujumdar, A.M. and Dhekne, V.V. 1987. Pinitol- a new anti-diabetic compound from the leaves of Bougainvillea spectabilis. *Current Science.* 56(3): 139-141.

Nwadinigwe, A.O. 2014. Air pollution tolerance indices of some plants around Ama industrial complex in Enugu State, Nigeria. *African Journal of Biotechnology.* 13(11).

O.P. Sharma, Plant Taxonomy. 1993.

Patel, D. and Nirmal Kumar, J. 2018. An Evaluation of Air Pollution Tolerance Index and Anticipated Performance Index of Some Tree Species Considered for Green Belt Development: A Case Study of Nandesari Industrial Area, Vadodara, Gujarat, India. *Open Journal of Air Pollution*. **7**: 1-13.

Perales, Y.J. and Leysa, M. 2012. Phytochemical screening and antibacterial acitivity of Bougainvillea glabra plant extract as potential sources of antibacterial and resistance-modifying agents. In: *Proceedings of the International Conference on Life Science and Engineering* (pp. 121-125).

Petkovšek, S.A.S., Batiè, F. and Lasnik, C.R. 2008. Norway spruce needles as bioindicator of air pollution in the area of influence of the Šoštanj

POWO, 2023. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Published on the internet. http://www.plantsoftheworldonline.org/ Retrieved 28 February 2023.

Rai, P.K., Panda, L.L., Chutia, B.M. and Singh, M.M. 2013. Comparative assessment of air pollution tolerance index (APTI) in the industrial (Rourkela) and non-industrial area (Aizawl) of India: An ecomanagement approach. *African Journal of Environmental Science and Technology*. 7(10): 944-948.

Reed, J.F. and Cummings, R. W. 1945. Soil reaction–glass electrode and colorimetric methods for determining pH values of soils. *Soil Science*. 59(1): 97-105.

Saleem, H., Usman, A., Mahomoodally, M.F. and Ahemad, N. 2021. Bougainvillea glabra (choisy): A comprehensive review on botany, traditional uses, phytochemistry, pharmacology and toxicity. *Journal of Ethnopharmacology*. 266: 113356.

Sharma, G.K. and Butler, J. 1975. Environmental pollution: leaf cuticular patterns in *Trifolium pratense* L. *Annals of Botany*. 39(5): 1087-1090.

Shelke Mitali, Palathingal Trisa and Bhagat Sachin, 2021. A Comparative Study of APTI of Some Plants Growing Along the Roadside Regions of P South and P North Wards of Mumbai. *International Journal of Creative Research Thoughts (IJCRT).* 9: a359- a363.

Sherwani, S. K., Khan, M. M., Zubair, A., Shah, M.A. and Kazmi, S.U. 2013. Evaluation of in vitro thrombolytic activity of Bougainvillea spectabilis leaf extract. *International Journal of Pharmaceutical Sciences Review and Research*. 21(1): 6-9.

Siti Noor Aisyah Mohd Sabri, Mardiana Idayu Ahmad, Yusri Yusup, 2015. Assessment of Air Pollution Tolerance Index of Selected Plant Species Commonly Found along Roadsides in Pulau Pinang, Malaysia. *International Journal of Science and Research (IJSR).* 4(11): 2319-7064.

Thermal Power Plant, Slovenia. *Environmental Pollution.* 151(2): 287-291.

Verma, R.B., Siddiqi, T.O. and Iqbal, M. 2006. Foliar response of *Ipomea pes-tigridis* L. to coal-smoke pollution. *Turkish Journal of Botany*. 30(5): 413-417.

Xu, Suxia, 2009. Reproductive organography of Bougainvillea spectabilis Willd. Scientia. *Horticulturae.* 120(3): 399-405.