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IMPACT OF PARTICULATE MATTER FROM VEHICLE EXHAUST ON MORPHOLOGY AND BIOCHEMISTRY OF BOUGAINVILLEA GLABRA

Botany

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ABSTRACT

Automobile exhaust has become a serious problem for the modern industrialized world.Fossil fuel consumption has accelerated due to increased in human population,industrial revolution & technological advancement.Exhaust gas is a result of the combustion of fuels such as diesel,natural gas,gasoline,etc.It shows drastic effect on plants.For the present investigation Bougainvillea glabra were studied.The experimental site selected was Sant Namdev Road at Dahisar where there is heavy vehicular traffic causing auto exhaust pollution.The control site selected was Sanjay Gandhi National Park.The plants were studied from both the sites using micro- morphological and biochemical parameters..Biochemical parameters selected were Dust load,Chlorophyll content,Phosphorous content, iron content & proline content. Biochemical study showed a significant decrease in chlorophyll,iron and phosphorous content.The leaves from experimental site showed more dust load. Proline content at experimental site increased showing plant under stress condition. Micromorphological parameter selected were stomatal size and index.Leaves from control site showed maximum stomatal size and index.The results proved that automobile exhaust has significantly affected Bougainvillea glabra.

KEYWORDS

Bougainvillea ,automobile exhaust, morphology, Biochemical analysis

INTRODUCTION

The prime concern for today's world is changes in the gaseous compositions of the earth's atmosphere. Various ornamental plants are planted along the road to increase the beauty of streets. One of such plant is *Bougainvillea glabra*, belongs to the family, Nyctaginaceae. It is a family of flowering plants of around 33 genera and 290 species. Bougainvillea, a popular ornamental plant growing in most areas with warm climates. They are evergreen plants scrambling over other plants with their thorns. The flower are bright coloured such as pink, purple, white or yellow. It also called as 'paper flower'. Bougainvillea can be used as a houseplant or hanging baskets. Bougainvillea may be deciduous if there is a dry season. The leaves are simple and alternate.

Ornamental plants can be used as a supplementary approach for improvement of air quality and this is necessary in urban environment (Manish kapoor,2017).Leaf chlorophyll concentration is an important parameter that is regularly measured as an indicator of chloroplast content, photosynthetic mechanism and of plant metabolism. Chlorophyll is an compound which are present and stored in the chloroplast of green leaf plants and mainly it is present in the green area of leaves,stem and flowers. Dust particles impacts on plants with alteration of morphological, biochemical, epidermal, stomata functions, soil nutritions and also species communities (Kameswaram, et al 2019). Cuticle, stomata,guard cells and epidermal cells get affected due to stress induced by the air pollution.It further affects the gaseous exchange and respiration in plants.This is an indicator of environmental stress.Stomata are dumbell or crescent in shape.They are made up of guard cells and subsidiary cells.Stomatal opening helps in exchange of water and gases. Stomatal density and size of stomata may affect the rate of physiological processes such as photosynthesis and transpiration(Vijay Paul,et al 2017).

Proline is one of the amino acids & plays a vital role in transitions of globular protein(Walid Saibi,2020). Proline are able to reduce the damage of oxidative stress induced by heavy metals,high salinity, drought and UV radiation.Hence it is considered as scavenger of reactive oxygen species.In higher plants,glutamate and ornithine synthesize proline but the levels of free proline also controlled catabolically. Under normal conditions,high level of proline found in flowers and low level of proline found in roots of plant.

Plant cells accumulates proline under stress condition.Iron plays a significant role in various biochemical and physiological pathways.Iron activates many metabolic pathways and it is a prosthetic group constituent of many enzymes. In plants,iron is involved in chlorophyll synthesis and it is essential for chloroplast structure and function maintenance. Phosphorus is an important constituent of energy rich compounds like ATP and nucleic acids,hence it supplies energy to regulate various cellular processes.

MATERIAL & METHODS

Study Sites : For the present study, two sites were selected. Experimental site selected were at Vaishali nagar, Sant Namdev Maharaj Road, Dahisar. This region has a heavy vehicular traffic especially during morning and evenings. Sanjay Gandhi National Park, Borivali was taken as the control site. The park is a home to a number of endangered species of flora and fauna.

The fresh leaves of the plant taken for the present study were collected, cleaned and studied for micromorphological and Biochemical parameters. The micro morphological parameter selected were stomatal size and index by epidermal peeling method. The biochemical parameters selected for foliar studies was total chlorophyll content by Arnon's method,1949, proline content (Sadasivam and Manickam,1996).Phosphorus content and iron content was performed by standard method.

Observations

In the present study it was observed that the size of stomata in leaves of experimental site significantly decreased. The leaves collected from the control site showed higher chlorophyll content in comparison to leaves collected from polluted site.The Dust load in the plants collected from the polluted site found to be much higher than the plants collected from the control site. The proline content was found higher in plants of polluted site in comparison to the plants of control site. The iron and phosphorous content found less in leaves from experimental site.

Table 1:Micromorphological observations- Lower epidermis of Bougainvillea glabra

Sr.No	Parameters	Experimental	Control	%DFC
1.	Stomatal index	17.24 ± 0.094	18.94 ± 0.188	-1.70
2.	Stomatal length (mm)	0.018± 0.001	0.024± 0.001	-0.006
3.	Stomatal breadth (mm)	0.006 ± 0.001	0.012 ± 0.001	-0.006

Value represents Mean ± SD, DFC = Percent difference from control, *significant at $p<0.05$ student's t-test

Table 2:Biochemical analysis results of Bougainvillea glabra

Sr. No.	Parameters	Experimental	Control	%DFC
1.	Total chlorophyll (mg/gm)	0.576 ± 0.012	0.986 ± 0.011	-0.41
2.	Proline (µ moles/g tissue)	0.242 ± 0.30	0.159 ± 0.10	0.083
3.	Phosphorous (mg/gm)	8.23 ± 0.13	24.6 ± 0.33	-16.37
4.	Iron content (mg/gm)	2.72 ± 0.12	4.42 ± 0.01	-1.70
5.	Dust load (g/leaf)	0.09 ± 0.006	0.02 ± 0.004	0.07

Value represents Mean ± SD, DFC = Percent difference from control, *significant at $p<0.05$ student's t-test

RESULT AND DISCUSSION

Chlorophyll content in plants is different in different species depending upon the leaf age,pollution level,biotic and abiotic condition (Katiyar and Dubey ,2001).The chlorophyll production is mainly depend on penetration of sunlight and it is the main source of energy for plant. It was observed that reduction in pigment was found at sites receiving high pollution load (Dutta S.,2017).In the present investigation, maximum amount of chlorophyll content was observed in leaves from control site compared to leaves from experimental site. The reduction in total chlorophyll as compared to control leaves taken as indicator of moderate air pollution.Dust is a collection of the solid particles of natural or industrial origin.It is considered as one of most widespread pollutants and their sources include cement factories, power plant,road transport (Chaturvedi,R. et al,2012).Dust particles are absorbed through the outer surface of the plants.Dust affects photosynthesis, relative water content,transpiration,pH and allows penetration of gaseous pollutants (Prabhat Kumar Rai,2014).The plant response to dust accumultion vary with species of the plant depending on their leaf surface,phyllotaxy,epidermal and cuticular features, height and canopy of roadside plants (Chaturvedi R.,2013). reported that rough and hairy texture of leaf enables it to accumulate greater dust. In the present study,dust load on leaves found higher in experimental site as compared to control site. Phosphorus is an essential element & plays a vital role in genetic transfer,seed germination, flower and seed formation, increased in root and shoot strength (Malhotra,H. et al,2018).Phosphorous deficiency reduces plant growth,decrease in photosynthesis.Phosphorous plays a vital role in cellular processes such as membrane structure maintenance, synthesis of biomolecules and high energy molecules formation. Phosphorous released when roots or secretion of phosphate undergo mineralization and decomposition. Concentration of inorganic phosphate is less as compared to other macronutrients due to diffusion in soil (Ishan Ajmera, 2019) .Proline accumulates in root tip,shoot apex, lateral buds and germinating seeds. Under stress condition, accumulation of proline is at peak,especially in the shoot tissues signals that imposition of stress without necessarily being involved in cell protection (Sofia Spormann,2023).Proline content is significantly more in experimental site and indicates that *Bougainvillea glabra* grows under stressed conditions.Many plant species synthesize proline in cytosol and accumulates in chloroplast (Walid Saibi,2020). Iron is an essential mineral nutrient for all living organisms and it is required for various cellular functions,to maintain balance between iron uptake,transport, storage and utilization is required for iron homeostasis. In the present study, iron content found less in leaves from experimental site as compared to control site.Iron deficiency can affect photosynthesis, nitrogen metabolism and reactive oxygen metabolism. It can cause various metabolic disorders such as reduced chlorophyll contents and photosynthetic rate, abnormalities of chloroplast morphology and structures. (Yanping Wang et al,2022).When the plant does not receive sufficient water,it closes the stomata to prevent loss of water(Fatima ismail,2019).In the present study, Stomatal length and breadth decreased significantly in experimental plant leaves.The decrease in stomatal size may be an avoidance mechanism against the effect of pollutant on physiological activities like photosynthesis(Verma,R.B. et al,2006). The present research work reveals that automobile exhaust has significant effect on *Bougainvillea glabra*.Nevertheless it can survive with reduced flowering and it is tolerant to some extent.

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