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EFFECT OF AIR POLLUTION ON METABOLIC CONTENTS OF SOME TREES IN AMRAVATI CITY (MS)

Khedkar, D.D*. and Gadge, V.D.
Department of Botany, Shri. Shivaji Science College, Shivaji Nagar, Amravati (MS), India.
**Email:* sonudin@gmail.com

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Abstract: Increasing level of pollution load in environmental conditions severely alters metabolism in any organism. One of such significantly contributor pollution is air pollution. Industrial and automobile revolution is the main cause behind the rise in pollution load in the environment. Amongst the respondents to this pollution plant are more threatened due to their static nature. They suffer from the number of problems leading to metabolic disorders and consequent changes in the growth performance. The aim of this investigation is to determine the effects of air pollution on the morphology and metabolism of the plant in terms of the levels of total soluble sugar, ascorbic acid, protein, prolein, chlorophyll in four tree species and assess the role of these parameters as a marker for plant damage. It was determination of the current health status of tree species surviving in the polluted area and its comparison to the plants from the area where environment was more clean and healthy. To achieve this aim the objectives focused were: Assessment of biochemical characteristics of tree species under consideration, Percent variation in trees from polluted and healthy sites and Impact assessment. Two individuals each of the four tree species *Azardirachta indica, Ficus religiosa, Terminalia catappa, Polyalthia logifolia* were selected from heavily polluted and healthy and cleaner area of the city. Important metabolic contents like chlorophyll, total soluble sugar, ascorbic acid protein and prolein amino acid were estimated from both the individuals from polluted and healthy sites. The results were compared for the percent change in the metabolite contents of the plants from the heavily polluted site. The biochemical analyses of selected all plants have shown decreased metabolic contents due to pollution except Proline, which has shown an increase in the plants at polluted site. The observed reductions in almost all the metabolic parameter are exposing the impact of the air pollution on the physiological condition of the plant under exposure. Such adverse effects of air pollution on biota and ecosystem have been demonstrated worldwide.

Key words: Metabolic contents, Chlorophyll, Total soluble sugar, Ascorbic acid protein, Prolein

INTRODUCTION

Pollution is not a new phenomenon. In fact, pollution has been a problem since the appearance of our earliest ancestors (Markham, 1994). Amongst the different types of pollution air pollution is most severely affecting life. Air pollutants can harm plants by causing leaf injury, stomatal damage, premature senescence, decrease photosynthetic activity (Tiwari *et al*., 2006). In case of human, asthma attacks, irritation of eyes, throat and nose, cancer, cardiovascular problem are the results of exposure to air pollution. There are five primary pollutants that together contribute about 90 percent of the global air pollution. These are carbon oxides (CO and CO_2), nitrogen oxides, sulfur oxides, volatile organic compounds (mostly hydrocarbons) and suspended particulate matter. Further pollution can arise if primary pollutants in the atmosphere undergo chemical reactions. The resulting compounds are called secondary pollutants e.g. sulfuric acid, nitric acid, carbonic acid, etc. The effects of these pollutants may be immediate or delayed. Primary effects of pollution occur immediately after contamination occurs, such as the death of marine plants and wildlife after an oil spill at sea which has took place recently in Mexican city. Secondary effects may be delayed or may persist in the environment into the future, perhaps going unnoticed for many years climate change that we are facing now may be an example of secondary pollution effect. Pollution effects are indeed many and wide-ranging. There is no doubt that excessive levels of pollution are causing lot of damage not only

to humans, animals and plants but also to the entire ecosystem and our biosphere.

The aim of this investigation is to determine the effects of air pollution on the metabolism of the plant in terms of the levels of total soluble sugar, ascorbic acid, protein, prolein, chlorophyll in four tree species and assess the role of these parameters as a marker for plant damage.

MATERIALS AND METHODS

The present investigation was focused on the heavily polluted area of Amravati city where vehicular emission and dust flow was at peak. To study the effects of air pollution on plants, four tree plants species i.e. *Azadirachta indica, Ficus religiosa, Terminalia catappa* and *Polyalthia longifolia* were selected. The samples for the biochemical investigation were collected from healthy (unpolluted) and polluted areas of Amravati region. The selected plants were studied for biochemical parameters and were therefore collected according to the analysis of the parameters. So, in order to complete one parameter in all plant, samples collected of all the four plants from both the sites in a single day and performed analysis. Leaf samples of the selected plants were analyzed for different parameters using different prescribed methods. Total chlorophyll was analyzed following the method of Arnon (1949), proline amino acid by Moore and Stein (1948), protein by Lowry et al. (1951), total soluble sugars by phenol sulphuric acid method of Dubois *et al*. (1951) and ascorbic acid by Sadasivam and Balasubraminan (1987).

Impact of the pollution was assessed by considering samples from healthy sites as a control and percent variation estimated, tested statistically to draw conclusions.

RESULTS AND DISCUSSION

Leaf samples of the plant species were analyzed for chlorophyll, proline, protein, soluble sugar, and ascorbic acid. All the biochemical parameters shown significant variation ($p<0.001$) (Table 1).

The biochemical analyses of selected 4 plants have shown decreased metabolic contents due to pollution except Proline, which has shown an increase in the polluted site.

In *Azadirachta indica*, the chl. a content was observed to be 8.36 mg/gm in the healthy site, while the chl. a content was reduced to 4.83 i.e. nearly half of the healthy site. Similar condition was seen in all the parameters in this particular plant species with the exception of Proline which

Table 1. Biochemical analysis of trees under polluted and healthy environment

Parameters	*Azadirachta indica*		*Ficus religiosa*		*Terminalia catappa*		*Polyalthia longifolia*	
	Control	Polluted	Control	Polluted	Control	Polluted	Control	Polluted
Chl. A (mg/gm)	8.369	4.838	8.508	7.403	10.083	7.303	10.794	7.137
Chl. B (mg/gm)	14.838	8.06	15.159	12.48	19.44	14.861	14.724	12.306
Total chl. (mg/gm)	13.091	7.11	13.37	11.009	17.15	13.11	19.271	12.989
Ascorbic acid (mg/gm)	0.05	0.046	0.029	0.022	0.022	0.017	0.046	0.019
Protein (mg/g)	20.8	18.7	22	19.5	18.87	16.5	23.5	18.5
Proline (µmole/g)	4.502	24.242	4.15	20.779	2.77	15.23	3.463	17.31
Total Soluble Sugar (mg/g)	70.1	47.43	75.93	63.82	58.37	39.2	60.5	51.38

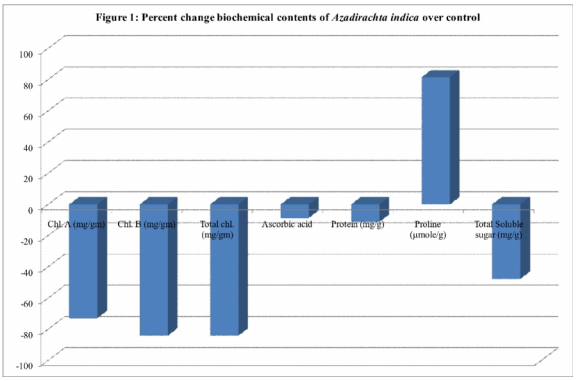
has shown an increase in the polluted site. This increase is 6 times of the *Azadirachta indica* plant from healthy site.

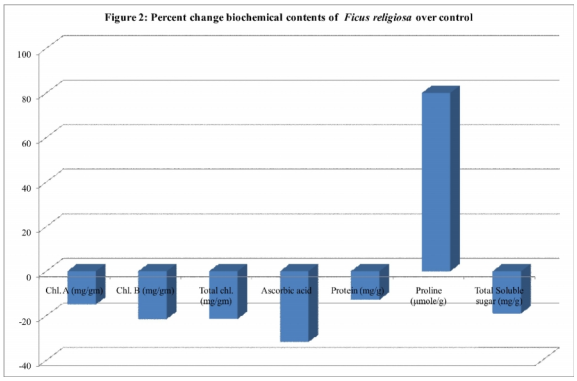
As far as, *Ficus religiosa* is concerned, it has shown slight reduction in all parameters, except Proline which has increased upto four times than that of the plant from healthy site.

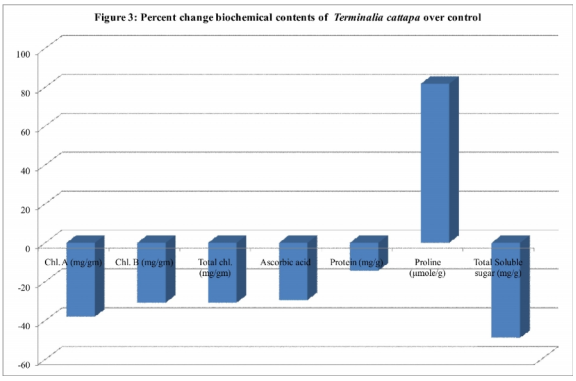
While in *Terminalia cattapa* and *Polyalthia longifolia* all the parameters have shown near about similar parameter changes. The metabolic contents i.e. Chl. a, b, total chl., Ascorbic acid, Protein and Total soluble sugar have recorded a decrease while Proline resulted in an increase of nearly seven times in both the plant species in polluted sites.

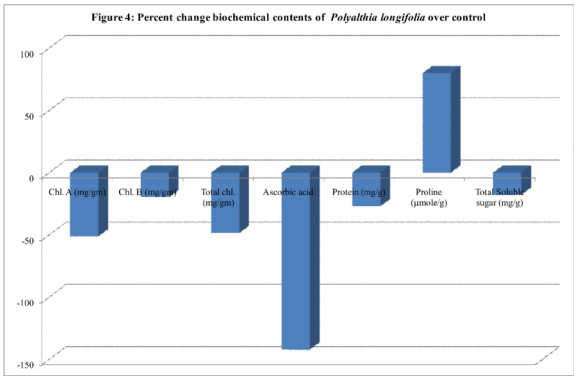
The graphical presentation (Fig. 1 to 4) clearly shows the percent change in the biochemical contents due to pollution. It can be observed that the Chl. a content in all the plants, has decreased in polluted site but this percent change is recorded comparatively more in *Azadirachta indica*. Similar condition is observed in Chl. b and Total Chl. content in all the plants. While in case of Ascorbic acid, maximum reduction is noticed in *Polyalthia longifolia* and minimum in *Azadirachta indica*. Protein has also shown a reduction which in near about same in *Azadirachta indica, Ficus religiosa* and *Terminalia cattapa* species in polluted site but this percent change is slightly more in *Polyalthia longifolia* As far as Total soluble sugar is concerned, it has also reduced in polluted site. The amount of decrease in total soluble sugar is nearly same in *Azadirachta indica* and *Terminalia cattapa* while *Ficus religiosa* and *Polyalthia longifolia* shows similar percent change.

The observed reductions in almost all the metabolic parameter are exposing the impact of the air pollution on the physiological condition of the plant under exposure. Such adverse effects of air pollution on biota and ecosystem have been demonstrated worldwide. Much experimental work has been conducted on the analysis of air pollution effects on crop and vegetation at various levels ranging from biochemical to ecosystem level. Similar biochemical alterations in the *Terminalia arjuna, Mangifera indica* are reported by









Tiwari *et al.* (2006) while studying these plants as an indicators for the air pollution.

These results are also in concurrence to Agbaire and Esiefarienrhe (2009). Their study revealed that plants which are constantly exposed to environmental pollutants absorb, accumulate and integrate these pollutants into their systems. It has also reported that depending on their sensitivity level, plant shows visible changes which would include alteration in the biochemical process and accumulation of certain metabolites.

The remarkable increase in the amount of the proline in all the plants facing pollution load is also noteworthy observation of this study. Proline is considered as the stress amino acid. In many plants, free proline accumulates in response to the imposition of a wide range of biotic and abiotic stresses. This accumulation of the proline has significant implications on the other physiological attributes of the plants (Hare and Cress, 1997). The defensive attribute of the *Ficus religiosa* is claimed towards the presence of the proline in it by Jain and Tiwari (2012). Autrup and coworkers (1999) evaluated the burden with environmental toxicants present in ambient air using various biomarkers and compared the predictive values of these biomarkers. Proline was considered as a biomarker and the present study revealed an increase in the amount of the proline in the plants under exposure of the pollutants from air.

In pollution exclusion experiments conducted by Bolsinger and Fluckiger (1989) on the verge of a widely-used motorway, it has been shown that roadway emissions increase the abundance of the proline due to loss of ambient air quality.

Ascorbic acid is also considered to be the most important compound to estimate the stress level. In present context the reduction in the quantity of the ascorbic acid was reported. This reduction may be due to the stressful conditions in the polluted environment. This observation is in line with Kelly (2003) who studied role of air pollution and its adverse health effects. This study brought to light that ambient air contains a range of pollutants, the exact combination of which varies from one microenvironment to the next. Many of the individual pollutants that make up this ambient mix are free radicals (for example, nitrogen dioxide) or have the ability to drive free radical reactions (for example, ozone and particulates). As a consequence, exposure to a wide range of air pollutants gives rise to oxidative stress resulting in to lowering of the ascorbic acid in living system.

Protein is the important parameter under influence of the air pollutants. Ninave et al. (2001) studied plants namely *Bougainvillaea spectabilis, Azadirachta indica, Pongamia pinnata* and *Polyalthia longifolia* from Vidarbha region for impact assessment of air pollution. They explored the biochemical contents of the leaves of the above plants from the city of Nagpur. Results of this investigation are in coordination with the present study. *Azadirachta indica* and *Polyalthia longifolia* during this study shown reduction in the protein contents of the plant leaves facing air pollution.

Chlorophyll degradation was evident in present assessment. These observations are also in harmony with the studies by Kardish *et al.* (1987) during analysis of Lichen for influence of air pollution on the concentration of ATP and chlorophyll degradation.

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