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A Study on Air Pollution effects on *Eucalyptus camaldulensis*

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Abstract. The present experiment was done to determine the impact of ambient air pollution on some biological factors in *Eucalyptus camaldulensis* plants using two sites; control (unpolluted) and polluted (around one of the oil fields in south west of Iran). Two biochemical characteristics of the plants were studied in both of sites and compared with each other. Plants subjected to pollution showed higher soluble carbohydrate and proline contents as compared to plants growing in control site. Proline levels in polluted leaves significantly increased ($p < 0.01$), suggesting the activation of protective mechanism in these plants under air pollution stress, and also the plant make physiological adjustments to compensate for that environmental stress.

Key words: air pollution, *Eucalyptus camaldulensis*, proline, soluble sugar.

1. Introduction

Air pollution is one of the severe problems world facing today. It deteriorates ecological condition and can be defined as the fluctuation in any atmospheric constituent from the value that would have existed without human activity (Tripathi and Gautam, 2007). In recent past, air pollutants, responsible for vegetation injury and crop yield losses, are causing increased concern (Joshi and Swami, 2007).

Over the years there has been a continuous increase in human population, road transportation, vehicular traffic and industries which has resulted in further increase in the concentration of gaseous and particulate pollutants (Joshi et al., 2009). Environmental stress, such as air pollution, is among the factors most limiting plan productivity and survivorship (Woo et al., 2007).

The River Red Gum (*Eucalyptus camaldulensis*) is a tree of the genus *Eucalyptus* (Myrtaceae family). It is one of around 800 in the genus. It is a plantation species in many parts of the world but is native to Australia and plays an important role in stabilizing river banks, holding the soil and reducing flooding. *E. camaldulensis* is the most widely planted eucalypt worldwide. Great variation is shown within this species and provenance is very important as the tolerances and characteristics vary widely.

In order to determination of effects and alterations due to air pollutants in plants, present study examines the impact of air pollution on *E.* camaldulensis around one of the oil factory in Iran.

2. Materials and Methods

2.1. Area of study

This study was conducted between Oct 2009 to Des 2009. The area of study is situated in industrial region (around one of the oil fields in south west of Iran). This is designated as polluted site. A site with similar ecological conditions was selected as the control (unpolluted) site. Three replicates of the plant sample leaves in two regions were taken and immediately taken to the laboratory for analysis. The plants studied in two regions were 10 to 15 years old. The climate in this land is warm and humid.

2.2. Biochemical measurements

Analyze of soluble sugar were done after making hydro alcoholic extract of leaf powder. Total soluble carbohydrate concentration was determined by phenol sulphuric acid method of Helle bust and Graigie (1978).

To determine proline, fresh leaves, ninhydrin and acetic acid were used according to the Bates et al., procedure (Bates et al., 1975).

The results were analyzed statistically by using the statistical software MSTATC in order to determine the significant differences between polluted and control stands. Analysis of variance was done by Completely Randomized Design.

3. Results and Discussions

An increase 4.24% in soluble carbohydrate concentration was observed in leaves collected from polluted site (Fig 1). In current study the changes in sugar contents were not significant while proline in leaves exposed to pollution significantly ($p < 0.01$) increased (355.62%) from 0.872 in control to 3.973 in polluted site (Fig 2).

Adverse effects of air pollution on biota and ecosystems have been demonstrated worldwide. Much experimental work has been conducted on the analysis of air pollutant effects on crops and vegetation at various levels ranging from biochemical to ecosystem levels. (Tiwari et al., 2006). Urban air pollution is a serious problem in both developing and developed countries (Li, 2003). Air pollution can directly affect plants via leaves or indirectly via soil acidification. When exposed to airborne pollutants, most plants experienced physiological changes before exhibiting visible damage to leaves (Liu and Ding, 2008).

Plants that are constantly exposed to environmental pollutants absorb, accumulate and integrate these pollutants into their systems. It reported that depending on their sensitivity level, plants show visible changes which would include alteration in the biochemical processes or accumulation of certain metabolites (Agbaire and Esiefarienrhe, 2009). Vegetation is an effective indicator of the overall impact of air pollution (Rai et al., 2009). Pollutants can cause leaf injury, stomatal damage, premature senescence, decrease photosynthetic activity, disturb membrane permeability and reduce growth and yield in sensitive plant species (Tiwari et al., 2006).

Soluble sugar is an important constituent and source of energy for all living organisms. Plants manufacture this organic substance during photosynthesis and breakdown during respiration (Tripathi and Gautam, 2007). In this study soluble carbohydrates in polluted leaves were reduced under pollution conditions.

The deleterious effects of the pollutants are caused by the production of reactive oxygen species (ROS) in plants, which cause peroxidative destruction of cellular constituents (Tiwari et al., 2006). It has been reported that proline act as a free radical scavenger to protect plants away from damage by oxidative stress (Wang et al., 2009). The effects of pollutants on plants include pigment destruction, depletion of cellular lipids and peroxidation of polyunsaturated fatty acid (Tiwari et al., 2006). There appears to be a relationship between lipid peroxidation and proline accumulation in plants subjected to diverse kinds of stress (Wang et al., 2009). If such a relationship exists, proline accumulation might play an important role in inhibiting air pollution-induced lipid peroxidation. proline accumulation often occurs in a variety of plants in the present of different stresses. For example, proline accumulation in leaves of plants exposed to SO_2 fumigation (Tankha and Gupta, 1992), heavy metals (Wang et al., 2009) and salt (Woodward and Bennett, 2005) stress has been reported (Tankha and Gupta, 1992; Wang et al., 2009; Woodward and Bennett, 2005). The present work also demonstrated that under air pollution conditions, proline level of polluted leaves significantly increased ($p < 0.01$).

Several factors can alter the results of such studies. For example, determination being tolerance or sensitive for one tested plant species could be changed during different seasons (Liu and Ding, 2008). It is suggested, for some species, the biggest effects of pollution treatment are associated with the early stages of the life cycle (Honour et al., 2009). The long term, low-concentration exposures of air pollution produces harmful impacts on plant leaves without visible injury (Joshi et al., 2009). In summary, plant adaptation to changing environmental factors involves both short-term physiological responses and long-term physiological, structural and morphological modifications. These changes help plants minimize stress and maximize use of internal and external resources (Dineva, 2004).

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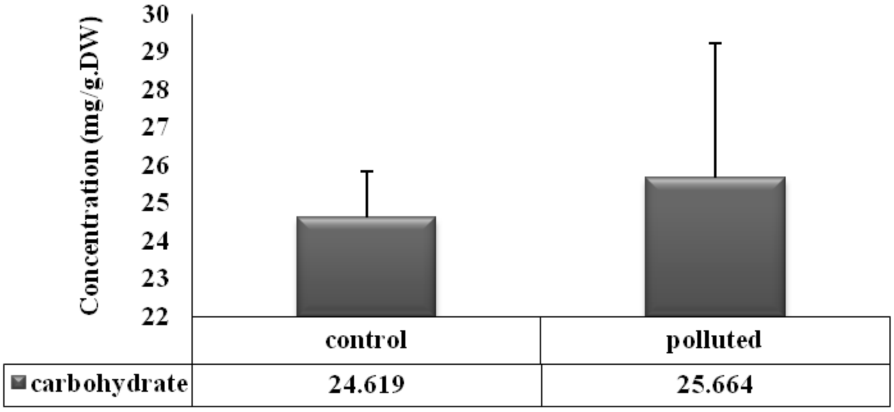

Figure 1 Soluble carbohydrate content of *E. camaldulensis* grown in control and polluted sites. Bars represent standard deviation. * = $p < 0.05$; ** = $p < 0.01$.

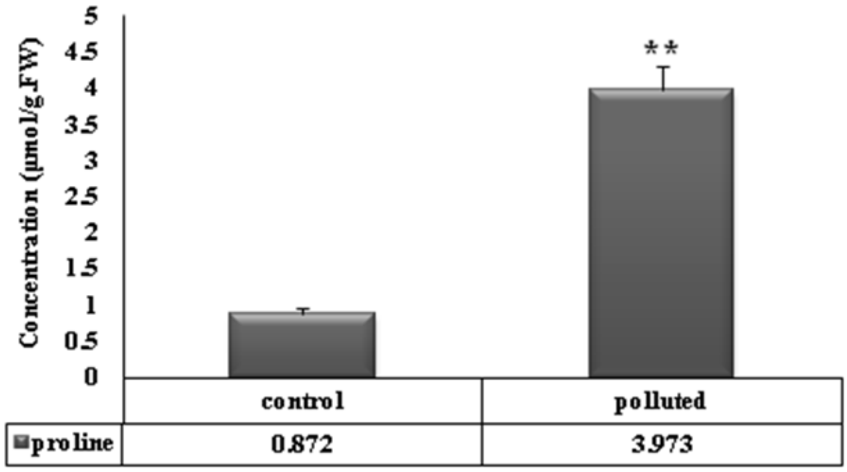

Figure 2 Proline content of *E. camaldulensis* grown in control and polluted sites. Bars represent standard deviation. * = $p < 0.05$; ** = $p < 0.01$.