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Seasonal Variation in Proline Content of the Leaves of *Azadirachta Indica*, Under the Influence of Marble Slurry Dust

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Abstract: ***Azadirachta indica A. juss. is the most preferred tree species for plantation in green belt and on road sides. Even in the Marble Slurry Dump yard at Kishangarh, Ajmer, it is the most dominant tree species in the green belt developed on the embankment. The plants in the region are subjected to air, water as well as soil polluted by the prevailing Marble Slurry Dust. Proline is an important secondary amino acid and its measurement is an excellent stress detector. In the present course of study, higher level of proline has been reported during winter months as well as during the rainy season. The former may be attributed to the greater accumulation of suspended slurry dust on the aerial plant parts while higher level of proline during monsoons indicates the stress induced by the soil and ground water pollution.***

Keywords: *Azadirachta indica A. juss.*, Marble Slurry, Proline, Stress, Pollution

1. Introduction

Accumulation of free proline, in various plant parts, is one of the most widespread stress induced response. So, its measurement is an excellent stress detector. It is perhaps one of the most frequently reported metabolic modifications induced by different stresses in plants. The amount of free proline accumulated, depends on the type and intensity of stress. Free proline concentration increase can be dramatic under severe stress when the initial proline content is low; however, it is possible that such an increase is not evident under mild stress (Pedrol N., (2000)). The accumulation of proline in the cytoplasm is accompanied by a reduction in the concentration of less compatible solutes and an increase in cytosolic water volume (Cayley S., 1992). The accumulation of proline in a wide variety of plant species under different type of stresses and its possible role in adaptive mechanism have been reviewed by (Verbruggen, 2008). Several reasons have been proposed to such an accumulation of proline by various scientists. Plants develop several mechanisms to induce stress-tolerance, including accumulation of antioxidants. Proline is one of the most important amino acids produced and accumulated in the plant in response to stress (Marin, Andreu, Carrasco, & A., 2010). Since the first report on proline accumulation in wilting perennial rye grass (Kemble A.R., 1954), various research studies have shown that different environmental stresses, like drought, induce the accumulation of proline in higher plants, (Slabbert M.M., 2014), (Tabot P.T., 2014)and salinity stress (Abdelhamid M.T., 2013), (Semida W.M., 2014).

2. Study Area

The Marble slurry dump yard is situated in the industrial area of Kishangarh Tehsil, of Ajmer district in Rajasthan. The area of the Tehsil falls between 26^0 15' to 27^0 0' North latitudes and 74^0 30' to 75^0 15' East longitudes. It is about 30 km from Ajmer.

3. Material and Method

Leaves of *Azadirachta indica* A. juss. were collected from the trees growing on the embankment of the marble slurry dump yard and the control samples of leaves were collected from the Botanic Garden of Samrat Prithviraj Chouhan Government College Ajmer. Young leaves were collected for the present study during the first week of each month, during the morning hours, in order to maintain uniformity in collection of study samples. Duration of the study was from April, 2014 to March 2015.

Free proline concentrations (µmoles per gram tissue) were determined using the rapid colorimetric method of (Bates L., 1973). The free proline content in each sample was determined from a standard curve prepared using analytical grade proline.

4. Observations

It was found that all species have maximum slurry dust deposition in the winter season followed by summer and rainy seasons. However, during rainy season the slurry dust deposited on the phylloplane is washed down and pollutes the soil and in turn the soil water in the rhizosphere. Thus, the tree species in the region are under continuous environmental stress, whether it be in the form of suspended particulate matter or that available in the soil and soil water. High levels of free proline have been recorded during the present course of study not only during the winter months but also during the rainy season. As is very obvious from the graph provided, the proline content is many fold during the monsoon months. This reiterates the fact that proline is an indicator of water stress and soil salinity stress, in particular.

Table 1: Metrological Data of the Study Period:

Month	Mean Max. temp (°C)	Mean Min. temp. (°C)	Monthly rainfall(mm)
Apr -14	36.9	23.3	014.5
May-14	39.2	26.5	031.8
June-14	40.4	29.7	010.3
July-14	35.5	26.9	149.6
August-14	32.1	25.1	219.4
September-14	31.9	23.9	196.9
October-14	34.2	21.3	001.3
November-14	31.2	16.0	000.0
December-14	24.6	10.1	000.0
January-15	22.4	10.0	015.7
February-15	28.3	14.7	000.2
March-15	30.5	17.9	049.6

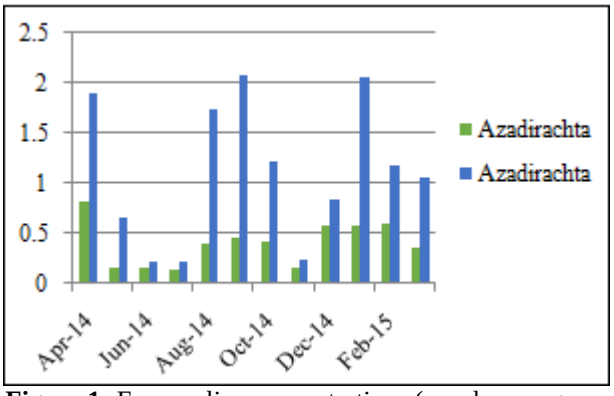

Figure 1: Free proline concentrations (µmoles per gram tissue)

5. Discussion

Trees act as a sink for air pollutants and thus reduce their concentration in the air. Removal of pollutants by plants from air is by three means, namely absorption by the leaves, deposition of particulate matter and aerosols over leaf surfaces, and the fallout of suspended particulates on the leeward side of the vegetation because of the slowing of the air movement(Tewari, 1994); (Rawat, 1996.). Air pollutants, particularly the suspended particulate matter, damage plants leaves, impair plant growth, and limit primary productivity according to the sensitiveness of the plants to pollutants (Ulrich, 1984). The most noticeable damage occurs in the leaves. Limestone and cement dusts, with pH values of 9 or higher, may cause direct injury to leaf tissues (Vardaka, 1995) or indirect injury through alteration of soil pH (Hope, 1991); (Auerbach, 1997). During the present course of study similar observations were recorded for the *Azadirachta* trees growing in the pollution infested study area.

Although proline has long been considered as a compatible osmolyte, recent results highlight its multiple functions in stress adaptation. Stabilization of proteins and protein complexes in the chloroplast and cytosol, protection of the photosynthetic apparatus and enzymes involved in detoxification of ROS are an important, but not the only function of proline accumulation during stress. (Szabados L., 2009). High level of proline during winter months are because of greater deposition of marble slurry dust on the leaf-surface, enhancing the shade effect on the phylloplane. In the months of July-September higher value of free proline in the leaves of the trees growing in polluted area are due to the increased concentration of marble slurry in the soil and ground water, which has been washed down by the prevalent rains in the region.

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