Research Paper Botany

Withania- The Bio-Indicator of Auto-Exhaust Pollution

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ABSTRACT

The present paper deals with the evaluation of Air Pollution Tolerance Index (APTI) of ***Withania somnifera*** growing along the roads in Industrial town Ghaziabad. Three sites were selected for study purpose- HPA (Highly Polluted Area), MPA (Medium Polluted Area) and Fresh Area (FA). Four parameter i.e leaf extract pH, Relative Water Content %, Total chlorophyll content and Ascorbic acid content were determined and they are computed together to calculate APTI values. Reductions were noted in all the parameter , which resulted in reduced value of APTI . Reductions are more drastic at HPA site than at MPA site. Decline in value of APTI proves ***Withania somnifera*** as sensitive species to auto exhaust pollution and hence could be considered as bio-indicator of exhaust pollution.

KEYWORDS pH, Chlorophyll, Ascorbic acid, APTI.

INTRODUCTION

India is a developing country and facing problem of population and pollution. Main sources of air pollution are- Industrial, Domestic sources and Transportation . According to the data collected from of Central Pollution Control Board, in year 1970 contribution of Industrial sources was 56%, Domestic sources was 21% and that of Transportation was 23%. But in the year 2000, contribution of Industrial, Domestic sources and Transportation were- 25%, 5% and 70% respectively. World's third biggest carbon dioxide emitter is now India (Khergamker, 2011). Pollution has become a serious problem in India country due to poorly maintained vehicles as well as roads. Most of the Indian cities are in grip of pollution, according to Agrawal (2005), in several large cities of India is amongst the highest in the world. There is large variety of plants growing along the road sides. Different plants react differently to the stressed condition of auto-exhaust pollution (Pawar, 2015). Bio-monitoring of flora is effective tool to evaluate the effect of air pollution. Response of plants can be assessed by determining the Air Pollution Tolerance Index (APTI). On the bases of APTI values plant can be categorized as tolerant or sensitive to air pollution. For present study ***Withania somnifera*** (Ashwagandha) is selected and area of study is Ghaziabad.

MATERIALS & METHODS

Proposed study was carried out in city Ghaziabad-One of the important industrial city of western Uttar Pradesh. For study purpose three sites were selected depending upon the traffic load & pollution. Sites are designated as Highly Polluted Area (HPA) and Medium Polluted Area (MPA). Area away from roads is treated as control i.e. Fresh Area (FA). Leaf samples of ***Withania*** were collected from study sites and analyzed for the following parameters:-

Leaf Extract pH

A 5.0 gm of fresh leaves were homogenized with 25 ml of double distilled water and its pH is recorded with help of digital pH meter.

Relative Water Content % (RWC)

Relative Water Content of leaf was measured by the method of Sivakumaran & Hall (1978).

RWC % =Initial Wt.-Dry Wt./Saturated Wt. – Dry Wt. x 100.

Chlorophyll a, Chlorophyll b and ***Total Chlorophyll*** content was measured according to the method of Arnon (1949). ***Ascorbic acid*** content was estimated according to the method of Keller and Schwager (1977).

RESULTS & DISCUSSION

Results are shown in Table 1 and graphically compared in figure 1. Relative Water Content in ***Withania somnifera*** leaves showed a decline by 14.88% at MPA site and 19.30% at HPA site. Such decrease in RWC % was also reported by Chauhan (2010). According to Dedio (1975), high Relative Water Content favors resistance in plants. The values of leaf extract pH recorded at FA, MPA & HPA sites were 5.32, 5.15 & 4.91 respectively, which indicate increasing acidic nature of cell sap pH in the samples collected from polluted sites in comparison to the control area. Change in pH indicates that the pollutants have entered the leaf directly through the stomata, as these are the main portals meant for the exchange of gaseous and they also provide passage for the entry of foreign particles. Swami et al. (2004) reported the presence of SO2 and NOx in ambient air causes a change in pH of the cell sap towards acidic range. Many workers reported change in pH of cell sap in the plants growing along the road side[Chauhan, 2010 and Deepalakshmi et al, 2013] A decline was recorded in chlorophyll **a** i.e. 6.08% at MPA and 9.29% at HPA site. Chlorophyll **b** also reduced in samples polluted sites i.e. 4.32% & 6.92% at MPA and HPA sites respectively. As there was reduction in content of Chlorophyll **a** and Chlorophyll **b,** total chlorophyll content also declined in polluted leaf samples to the tune of 5.34% and 8.28% at MPA and HPA sites, respectively. Such decrease was reported in various plants by many workers (Kumari et al.,2005; Bafna et al. 2008 and Raina & Bala, 2011).Chlorophyll is basically index of productivity, reduced photosynthetic activity of chlorophyll is associated with the formation of toxic ions on dissolution of SO2 in water and displacing Mg^{+2} from the chlorophyll molecule and converting it into photosynthetically inactive brown pigment phaeophytin (Rao & Le Blanc, 1966; Malhotra & Hocking, 1976 and Saxe,1983). Like other attributes reduction was also noted in ascorbic acid content in the polluted leaf samples i.e. 3.63% and 9.09% at MPA and HPA sites, respectively. Ascorbic acid is an natural antioxidant in plants which play important role in pollution tolerance (Killer & Schwager, 1977). Chaudhary and Rao (1977) related air pollution tolerance of the plants with their ascorbic acid level and concluded that higher is the level of ascorbic acid content greater will be the tolerance. Decreased level of A.acid in the leaf samples of ***Withania*** collected from polluted sites indicates its sensitivity to auto-exhaust pollution. APTI values calculated for ***Withania somnifera*** were 11.48, 9.94 and 9.33 for FA, MPA and HPA sites, respectively. Air Pollution Tolerance Index (APTI) reflect tolerance power of plant towards air pollution. Higher the val-

ue of APTI more will be the capacity of the plant to combat air pollution , lower the value of APTI less tolerant will be the plant. Earlier work on ***Withania*** also proves its sensitivity to auto-exhaust pollution in terms of phenology (Pawar, 2013), its reducing number along the road sides (Pawar, 2015) and micromophology (Pawar, 2016). Present study also proves sensitivity of ***Withania*** because all the parameter on the bases of which APTI values are calculated suffer decline in road side samples which resulted in reduced value of APTI, hence this plant can be considered as bio-indicator of auto-exhaust pollution.

TABLE-1: leaf pH, Relative water content, Chlorophyll a, Chlorophyll b & Total Chlorophyll content, Ascorbic acid content and APTI value of *Withania* leaf samples collected from FA, MPA & HPA sites. [*Values are in mean (n= 10) with S.E.]*

SITES→ ATTRIBUTES↓	FA	MPA	HPA
Relative Water Content (%)	91.16 ±2.68	77.59 ±2.21	73.56 ±2.10
Leaf Extract pH	5.32 ±0.03	5.15 ±0.02	4.91 ±0.03
Chlorophyll **a** (mg g-1 f.wt.)	3.12 ±0.03	2.93 ±0.03	2.83 ±0.02
Chlorophyll **b** (mg g-1 f.wt.)	2.31 ±0.03	2.21 ±0.02	2.15 ±0.02
Total chlorophyll (mg g-1 f.wt.)	5.43 ±0.04	5.14 ±0.03	4.98 ±0.04
Ascorbic acid (mg g-1 f.wt.)	2.20 ±0.03	2.12 ±0.02	2.00 ±0.02
Air Pollution Tolerance Index (APTI)	11.48	09.94	09.33

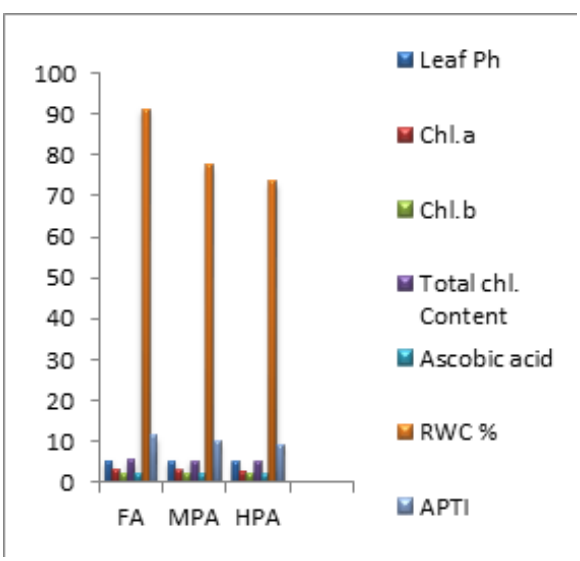

Figure 1: Chart Showing comparative values of all the parameters studied.

REFERENCE

[1] Agrawal, M. (2005). "Effect of air pollution on agriculture: An issue of national concern." Natl. Acad. Sci. Lett., 28(3&4): 93-105.

[2] Arnon, D.J. (1949). "Copper enzyme in isolated chloroplast," Pl. Physiol., 24: 1-15.

[3] Bafina, A., Pawar, K. and Dube, B. (2008). "Physio-chemical effect of auto-exhaust on ***Cassia fistula*** leaves growing along Agra-Bombay road (India)." Journal of Environmental Research & Developmennt., 2(3): 432-435.

[4] Chaudhary, C.S. and Rao, D.N.(1977). "Study of some factors in plants controlling their susceptibility to sulphur dioxide pollution." Proc. Indian National Sci. Acad. , 46: 236-241.

[5] Chauhan, A. (2010). "Photosynthetic pigment changes in some selected trees induced by automobile exhaust in Dehradun, Uttrakhand." New York Science Journal, 3(2): 45-51.

[6] Deepalakshmi, A.P., Ramakrishnaiah, H., Ramachandra, Y.L and Radhika, R.N. (2013). "Roadside plants as bio-indicators of urban air pollution." IOSR Journal of Environmental Science, Toxicology and Food Technology. 3(3): 10-14.

[7] Deodi,W.(1975). "Water relation in wheat leaves as screening test for drought resistance." Canadian Journal of Plant Science. 55: 369-378.

[8] Keller, T and Schwager, H. (1977). "Air pollution and ascorbic acid." European Journal of Pathology, 7: 338-350.

[9] Khergamker, G. (2011). "Manage traffic to reduce pollution." In:Times of India, New Delhi- Chandigarh Edition, 23th June, 62 (147): 9.

[10] Kumari, S.I, Rani, P.U. and Suresh, C.H. (2005). "Absorption of automobile pollutants by leaf surfaces of various road side plants and their effect on plant constituents." Poll. Res., 24(3): 509-512.

[11] Malhotra, S.S. and Hocking, D. (1976). "Biochemistry and cytological effect of sulphur dioxide on plant metabolism." New Phytol. 76: 227-237.

[12] Pawar; A. (2013). "Impact on the phenological events of plants under stress conditions of auto-exhaust pollution." Journal of Pure & Applied Sciences & Technology. 3(2): 1-4.

[13] Pawar; A. (2015). "A survey of road side flora growing under stress of auto exhaust pollution in city Ghaziabad." Journal of Pure & Applied Sciences & Technology. 5(2): 27-32.

[14] Pawar, A. (2016). "Auto-exhaust pollution induced changes in micromorphology of ***Withania somnifera.***" Global Journal for Research Analysis. 5(3): 52-53.

[15] Raina, A.K. and Bala, C. (2011). "Effect of vehicular pollution on ***Duranta repens*** L. in Jammu city." Journal of Applied & Natural Science. 3(2): 211-218.

[16] Rao, D.N. and Le Blanc, F. (1966). "Effect of sulphur dioxide on the lichens algae with special reference to chlorophyll." Bryologist. 69: 69-75.

[17] Saxe, H. (1983). "Long term effect of low levels of SO2 on bean plants *(**Phaseoulus vulgaris***). II Emmission response effects on biomass production : quantity and quality. Plant Physiol. 57: 108-113.

[18] Sivakumaran, S. (1978). "Effect of age and water stress in endogenous levels of plant growth regulators in Euphorbia lathyrus." Journal of Experimental Botany. 29: 195-205.

[19] Swami, A., Bhatt, D. and Joshi, P.C. (2004). "Effect of automobile pollution on Sal (***Shorearobusta***) and rohini (***Mallotusphillipinensi***s) at Asarori, Dehradun. Himalayan Journal of Environment and Zoology." 18(1): 57-61.