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EVALUATION OF CERTAIN PLANTS FOR THEIR TOLERANCE TO CEMENT KILN – DUST EDMITTED FROM ARIYALUR CEMENT FACTORY

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ABSTRACT
The high resistant and sensitive species have been identified from plant species growing in the vicinity of a cement factory in Ariyalur, influenced by cement kiln dust. Air pollution tolerance index (APTI) was determined using four leaf parameters. Plant species with higher and lower APTI values indicated the high resistance and sensitivity respectively. The resistant species would act as pollutant scavengers to reduce the dust pollution.

KEYWORDS: APTI.

INTRODUCTION
Cement kiln dust (CKD), a by – product of cement factory, is one of the most common industrial air pollutants. It has been considered to be a localized air pollution problem by several researchers (Lerman, 1975; Lal and Ambasht, 1980; Thangarasu, 1985) which causes deleterious effects on crop plants. Among the air pollutants, the particulate material, greyish white dust, falling on leaves cause severe foliar damage, due to incrustation of dust in the presence of moist on leaf surfaces of plants growing in and around the factory areas. To mitigate this dust pollution, it becomes essential to select the resistant plant species growing in the polluted area and increasing their population all around the cultivable lands which are under pollution stress. Hence, the present work is an attempt to identify the tolerant and sensitive plants to CKD.

MATERIALS AND METHODS
The present investigation was carried out in the vicinity of Tamil nadu Cements Corporation Limited, which is located approximately 3 km east, north east of Ariyalur, Tamil nadu. The tolerance level of certain plant species growing in the vicinity of cement factory under long – term exposures was evaluated. For this purpose, fresh leaves from polluted plants of fifteen woody species growing the prevailing wind direction was collected and air pollution tolerance index was determined by using the method of Singh and Rao (1983). The following formula was used to calculate the APTI.

$$APTI = \frac{A\,(T + P) + R}{10}$$

Where A = Ascorbic acid content
T = Total chlorophyll content
P = Leaf extract pH
R = Relative water content

The pH of the leaf extract was measured by a digital pH meter. Leaf ascorbic acid content was estimated by the titrimetric method on the reduction of 2, 6 – dichlorophenol indophenol dye (Roe, 1954). Total chlorophyll content was determined according to the method of Arnon, (1949). The relative water content in the leaves was determined as per the method of Turner (1981).

RESULTS AND DISCUSION
The emission from the smokestacks of a cement factory contains both gaseous and particulate pollutants. The cumulative effect of these pollutants have severely affected the natural plant communities as well as cultivated crop plants in the vicinity of cement factory at about 2 – 5 km distances. For reducing this dust pollution, it requires an urgent measure to select the resistant plants and to introduce them in that polluted area. Thus, the method of evaluation of plants for their tolerance by APTI determination is more reliable and effective (Singh and Rao, 1983; Agarwal, 1986).

The air pollution tolerance index (APTI) oftwelve woody tree speciesand three shrubs is depicted in Table – 1. It is quite evident from Table – 1, that theleaf extract pH indicated the highest values of 7.55, 7.54, 7.52, 7.10 and 6.98 in *E. globulus*, *P. spicigera*, *F. religiosa*, *B. bambos* and *P.longifolia* respectively and the lowest values of 4.70, 5.01, 5.39 and 5.70 in *Morindatinctoria*, *Cnucifera*, *A. indica* and *H. antidysentrica* respectively. The present report agrees with the findings of Singh and Rao (1983) recording similar higher valueof pH (7.96) in Cassia fistula and lower values of pH (6.19) in *Butea monosperma*. Scholz and Reck (1977) were of opinion that acidic pollutants decline the leaf pH more in sensitive species. This shift of pH towards the acidic side in the cell sap could decrease the efficiency of conversion of hexose sugar to ascorbic acid. However the reducing activity of ascorbic acid is pH dependent i. e. the activity is more at high pH and less at lower pH. Therefore, the higher values of pH could render tolerance to plants against pollutants as noticed by Agarwal (1988).

Since the emission from a cement factory contains both gaseous and particulate pollutants, the effect of CKD pollution in respect to leaf chlorophyll content varied in different plant species (Table -1). Speadding and Thomas (1973) noticed that pollution stress generally caused a decrease in the level of chlorophyll content. It is also evidenced that photosynthetic efficiency has not been affected under SO2 which contains highest chlorophyll concentration (Varshney, 1982). This could be attributed to the species of H. *antidysenterica, E. globulus, T. Indica, P. longifolia* and *B. bambos* which could generally be tolerant to cement kiln dust as they maintain a higher concentration of chlorophyll by about 3.14 mg/g, fr. Wt., 2.96 mg/g fr. Wt., 2.93 mg/g fr. Wt., 2.85 mg/g fr. Wt., and 2.54 mg/g fr. wt. respectively.

It is quite evident that ascorbic acid content in the leaves of cement kiln dust affected plant species exhibited maximum level (9.80 mg / g 100 fresh weight to 6.63 mg / g100 fresh weight) in *E.globulus, F. religiosa, C. nucifera* and *A. indica* and minimum level (2.89 mg / g100 fr.wt. to 4.25 mg / g100 fr.wt.) in *A. lebbeck, Morindatinctoria*, I. *carnea*and C. *siamea*. This is in agreement with the findings of Pandey and Agarwal (1994) where they found reduction in ascorbic acid level in *Carrisa* of the urban environment. This is further supported by the findings of Singh and Rao (1983) where they have listed certain plant species around Shree cement limited, Beawar, Rajasthan`. They have reported that the ascorbic acid content of cement dust polluted leaves contained maximum level of 8.18 mg / g100 fr. Wt. in Eucalyptus. Since ascorbic acid activity is related to chloroplast activity including ascorbic acid synthesis, the decreasing ascorbic acid activity in plants exposed to cement kiln dust pollution may be related to chlorophyll content (Aberg, 1958). Ascorbic acid being a strong reductant, activates many physiological and defence mechanisms. Its reducing power is directly proportional to its concentration (Lewin, 1976). Choudary and Rao (1977) have reported that the ascorbic acid, in combination with pH plays a significant role in determining the SO2 sensitivity in plants. This implies that the plants which maintain high ascorbic acid content are tolerant to pollution stress.

It is evident from Table – 1, that relative water content in the leaves, as a result of cement kiln dust pollution, displayed higher values of 68.50%, 65.00%, 62.50% and 60.00% in *B. bambos, E. globulus, F. religiosa* and *P. spicigera* respectively and lower values of 29.41%, 35.29%, 37.65% and 38.34% in *C. nucifera, Morindatinctoria, Z. jujuba* and *C. siamea* respectively. This is in consonance with Dedio (1975) suggesting that higher relative water content favours drought resistance in plants. This is further supported by Singh and Rao (1983) by an investigation made to determine the air pollution tolerance index of certain plants around Shree cement limited, Beawar on the basis of higher values in *Prosopis juliflora* (98.73%) and lower values in *Cassia fistula* (41.58%). This could be attributed that the protoplasmic permeability in cells, mainly depends on the relative water content which causes loss of water and dissolved nutrients resulting in early senescence of leaves (Masuch, et al., 1988). It is likely therefore that plant species with higher relative water content like *B. bambosa, E. globulus, F. religiosa, P. spicigera and P. longifolia* (Table – 1) could be tolerant to particulate pollutants.

With regard to air pollution tolerance index, out of fifteen plant species selected for the determination of APTI, only seven plant species viz. *F. religiosa, E. globulus, B. bambos, P. spicigera, H. antidysenterica, P. longifolia, T. indica* and *A. indica* had higher APTI values (12.788 to 8.962) whereas *Morinda tinctoria, A. lebbeck, I. carnea* had lower APTI values (5.426 to 6.727). Therefore, from the results obtained, it is quite evident that *E. globulus, F. religiosa, B. bambosa, H. antidysenterica and P. longifolia* are highly resistant. *T. indica* and *A. indica* are moderately resistant and *Morinda tinctoria*, A. lebbeck and I. carnea are highly sensitive species and the rest of the plant species are less sensitive based on their air pollution tolerance index. It is quite evident that the plants species with higher and lower APTI values (Table – 1) would act as tolerant and sensitive species respectively. Planting such tolerant species in dust polluted habitats could help us to ameliorate the adverse effects of pollution from the CKD. Such plants are shown to be effective pollutant scavengers (Agarwal and Tiwari, 1977).

Table 1: Air pollution tolerance index of selected plants growing at 2 – 5 km distance in the prevailing wind direction from Ariyalur cement factory.

S. No.	Plant species	Total chlorophyll content (T) mg/g fr. Wt.	Leaf extract pH (P)	Ascorbic acid content (A) mg/g fr. Wt.	Relative water content (R) %	APTI
1.	*Albizzia lebbeck*	1.09 (0.03)	6.30 (0.02)	2.89 (0.07)	41.18 (1.68)	6.253
2.	*Azadirchta indica*	1.80 (0.10)	5.39 (0.07)	6.63 (0.15)	41.93 (2.56)	8.962
3.	*Bambusa bambos*	2.54 (0.05)	7.10 (0.08)	4.50 (0.08)	68.50 (3.41)	11.188
4.	*Cassia siamea*	1.65 (0.08)	6.48 (0.02)	4.25 (0.07)	38.54 (1.70)	7.308
5.	*Cocos nucifera*	1.60 (0.04)	5.01 (0.09)	6.80 (0.08)	28.41 (1.49)	7.431
6.	*Eucalyptus globulus*	2.96 (0.09)	7.99 (0.06)	9.80 (0.10)	65.00 (2.45)	11.545
7.	*Ficus religiosa*	2.01 0.03)	7.52 (0.06)	6.85 (0.04)	62.50 (3.27)	12.778
8.	*Holarrhena antidysenterica*	3.14 (0.13)	5.70 (0.08)	6.46 (0.15)	42.86 (3.45)	9.993
9.	*Ipomaea carnea*	1.59 (0.09)	5.95 (0.07)	3.40 (0.04)	44.83 (2.09)	6.727
10.	*Morinda tinctoria*	1.86 (0.05)	4.70 (0.08)	2.89 (0.04)	35.29 (1.49)	5.426
11.	*Moringa oleifera*	1.96 (0.07)	6.80 (0.08)	4.54 (2.04)	48.75 (0.05)	8.852
12.	*Polyalthia longifolia*	2.85 (0.08)	6.98 (0.11)	2.89 (0.11)	68.60 (3.10)	9.701
13.	*Prosopis spicigera*	2.27 (0.07)	7.54 (0.03)	5.10 (0.12)	60.00 (3.27)	10.493
14.	*Tamarindus indica*	2.93 (0.03)	6.25 (0.04)	5.27 (0.07)	41.67 (1.36)	9.004
15.	*Zizyphus jujuba*	2.53 (0.04)	5.72 (0.05)	5.83 (0.04)	37.65 (1.06)	8.574

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