Jr. of Industrial Pollution Control 22 (2)(2006) pp 291-296

ROLE OF TREES IN MITIGATING THE PROBLEM OF DUST POLLUTION IN STONE QUARRIES- A CASE STUDY BANGALORE AND KOLAR DISTRICTS

PARAMESHA NAIK, USHAMALINI AND R.K. SOMASHEKAR

Department of Environmental Sciences, Bangalore University
Bangalore 560 056, India

Key words : Stone quarry, Dust pollution and dust abatement by trees.

ABSTRACT

It is known that vegetation can filter out dust, shoot, smoke and much other fine particulate matter present in air by process of absorption, detoxification, accumulation or metabolization. The tree species possessing higher dust escaping capacity has higher chances of survival in the polluted areas. The study indicated that evergreen plants with simple, rough, hairy and fast growing trees are good dust arrestors. The study suggested a systematic way of selecting plant species on the basis of their efficiency in dust control.

INTRODUCTION

The role of trees in controlling ambient temperature and rainfall has long been understood. The variation of dust deposition in different plants is due to the fact that different plants have acquired different morphological features apart from those factors like phyllotaxy, leaf shape, plant height, leaf texture, presence or absence of hairs, stomatal frequency are also related to the efficiency of dust collecting capacity of plants (Das *et al.* 1978) have shown that not only the upper surface but the lower surface of the leaf also collect significant amount of dust particle. The study suggested a systematic way of selecting plant species on the basis of their efficiency in dust control.

Earlier studies have revealed that extent of dust deposition on plants depends on the morphology structure and arrangement of leaves (Pattanayak *et al.* 1994,). It is known that vegetation can filter out dust, shoot, smoke and many other fine particulate matter present in air by process of absorption,

detoxification, accumulation or metabolisation (Maiti, 1992). Dust particulates remain in air for varying lengths of time and get settled out on various parts of plant, especially on leaf surface, which affects the vegetation of the area. The extent of impact depends on the amount of dust deposition. Hence the present study is an attempt to select the appropriate tree species that could be recommended for plantation in stone quarry area. The approach has been that the tree species possessing higher dust escaping capacity has higher chances of survival in these polluted areas. The objectives of the present study is

- To estimate the amount of deposition of particulate on the surface of leaves of various species.
- To study the dust filtering capacity of different species of plants having different leaf shape, physiology etc.
- To suggest suitable plant species foe plantation in stone quarry area.

MATERIALS AND METHODS

The leaves of 12 different plant species were collected from the same place, height and age in the stone crushing area. Following plant species were selected for the present investigation.

For the present study plant species chosen were of both evergreen and deciduous types with simple and compound leaves. The leaves were collected in a polythene bags and washed with distilled water (Patel *et al*. 1991). The sampled bags were taken to laboratory and leaves were washed with 300 ml distilled water and polythene bags were also washed with 50ml of distilled water to wash out the dust remaining inside the polythene bags. The dust was filtered with GF/C filter paper and dried at 70 to 80° C for 3 hours and dried dust was weighed. Individual leaf area in cm^2 was calculated by tracing out the leaves on graph paper and results were expressed in g/m^2.

RESULTS

The detailed morphological characteristics of the sampled plant species in the study area are shown in the Table 1. The dust trapping efficiency of different plant species listed in ascending order is shown in the Table 2. The investigation revealed many interesting and vital information on the dust escaping efficiency of the trees which can be considered highly favorable for promoting their growth in stone quarry area. The maximum dust depositions recorded were in *Tectona grandis, Ficus bengalensis, Psidium gaujava, Butea monosperma, Mangifera indica, Muntingia calabura, Artocarpus heterophyllus etc*., which may be attributed to hairy surface of leaves, horizontal elevation, stiff petiole and branches etc., which results in less movement of leaves thus exhibiting lesser chances of falling of accumulated dust.

Earlier studies have revealed that extent of dust deposition on plant depends on the morphological structure and arrangement of leaves (Pattanayak *et al*. 1994) Smooth and flexible leaves like Millingtonia hortensis, *Azadiracta indica, Melia rubia* do not hold dust to the same degree compared to horizontally arranged leaves of *Grevillea robusta, Delonix regia, Anacardium occidentale,*

Table 1
List of plant species and their taxonomical characters selected for the study

Plant Species	Leaf Type	Leaf shape	Family	Leaf nature & Surface	Leaf & Branch
Dalbergia Species	Deciduous, simple	Lanceolate	Myrteceae	Thin, smooth	Small & flexible branches,
Eucalyptus globulus	Evergreen, simple			Thick, smooth	Borne on small drooping branches freely swingling leaves
Acacia auriculiformis	Evergreen, simple	Ovate	Fabaceae	Thick smooth	Borne on small branchlets, highly drooping freely movable.
Azadiracta indica	Decidious	Ovate	Meliaceae	Small, smooth	Borne on small branches elevated in all direction freely movable
grandis	Decidious	Ovate	Verbenaceae	Big broad hairy	Stiff branches, elevated mostly horizontally, freely immovable
Ficus religiosa	Evergreen, simple	Chordate	Moraceae	Thin, smooth	Borne on stiff branches with flexible petiole
Bauhinia Varigata	Decidious, simple	Obchordate	Caesalpinaceae	Broad, glabrous	Stiff branches, mostly horizontal
Cassia fistula	Decidious, compound,pinnate	Ovate	Caesalpinaceae	Small pinnae, smooth	Stiff branches, leaf axis Flexible, elevated horizontally.
Millingtonia hortensis	Deciduous compound,	Awl shaped pinnate	Bignonaceae	Smooth, pinnate	Borne on small drooping branch lets, movable.
Pongamia pinnata	Decidious, simple	Ovate	Fabaceae	Brood, smooth	Stiff branches, elevated in all directions Ficus bengal-
ensis	Evergreen, simple	Ovate	Moraceae	Thick, smooth	Borne on stiff branches, elevated mostly horizontal.
Ficus bengalensis	Evergreen, simple	Ovate	Moraceae	Thick, smooth	Borne on stiff branches, elevated mostly horizontal.
Grevillea robusta	Evergreen, palmetly lobed	Serrate	Proteaceae	Leaf margin, highly incision	Stiff branches
Tabubia argentea	Semi evergreen palmate	Oblong	Bignonaceae	Thick, smooth	Leaf axis flexible, elevated all direction, freely movable.
Pithacolobium dulse	Decidious pinnate	Palmate	Mimosaceae	Small, smooth spinous type	Thin & flexible leaf axis elevated in all directions, freely movable.
Polyalthia longifolia	Evergreen, simple	Lanceolate	Annonaceae lanceolate	Smooth, highly drooping,	Borne on stiff & drooping branch lets, leaf freely immovable.
Terminalia arjuna	Evergreen, simple	Lanceolate	Combretaceae	Smooth, thick	Stiff branches
Mangifera indica	Evergreen simple	lanceolate	Anacardiaceae	Thick, smooth	Stiff branches, elevated in all direction

Tectona

Table 2
Plants arranged according to the weight of pollutants deposited in descending order

Plant species	Average area of the leaves (Sq.m)	Ave. weight of the pollutants (per sq. m)	Standard error
Terminalia arjuna	*0.002885*	*2.657*	*10.064*
Tabubia argentina	0.006645	2.650	10.052
Eucalyptus globulus	0.0062382	2.546	10.046
Mangifera indica	0.0062224	2.468	10.038
Ficus bengalensis	0.0061165	1.842	10.032
Ficcus religiosa	0.0061254	1.012	10.024
Acacia auriculiformis	0.005917	0.946	10.020
Cassia fistula	*0.005832*	*0.843*	*10.020*
Tectona grandis	0.01708	0.769	10.018
Psidium guajava	0.0057262	0.752	10.016
Dalbergia species	0.0054262	0.654	10.012
Grieviella robusta	0.0053148	0.532	10.010
Azadirachta indica	0.0052469	0.419	10.010
Millingtonia sps	0.0052112	0.326	10.08
Polyalthia longifolia	0.0052018	0.228	10.007
Pithacolobium dulse	0.011214	0.210	10.003

Tamarindus indica species bearing stiff, horizontal and elevated leaves with rough and hairy surface which hold large amount of dust particles.

Similarly drooping leaves and branches have higher chances of dropping down dust during disturbance by agents like wind, animal etc. Free hanging leaves as well as swirling leaves are the main morphological characteristics of dust escaping efficiency as in *Dalbergia sisso, Eucalyptus globulus*, *Acacia auriculiformis* etc. Certain species acquire a peculiar type of leaves which are devoid of leaf damage and hurt. Such modification of leaf surface is highly favorable in dusty environment like stone quarry.

DISCUSSION

The variation in the deposition of pollutants in different plant species sampled is due to to the fact that the different plants have acquired different dust collecting capacity. Among the species investigated *Psidium gaujava, Muntigia calabura, Mangifera indica, Terminalia arjuna* etc., showed highest dust collecting capacity. There are also other factors responsible for the collection of pollutants on the leaf surface. The phyllotaxy of leaf of also played important role in this regard. It has been found of alternatly arranged leaves have acquired highest dust collecting capacity. this is because in alternate phyllotaxy there is only one leaf in each node. As a result these leaves are more exposed to free silica content than the leaves of cyclic phyllotaxy where two or more leaves present at each side.

Similarly the shape of the leaf is also important. Lanceolate type of the leaf shows highest dust collecting capacity (*Terminalia arjuna*). The lowest dust collecting capacity pf *Pithacolobium dulse* species can be attributable to its arrangement of leaves. In whorled phyllotaxy there are more than two leaves present at each node. There fore each leaf at each node receives lesser amount of pollutants than one leaf at each internodes.

CONCLUSION

The study indicated that, plants can be used as potential device of dust remover in stone quarry area. For dust abatement purpose the leaves showing evergreen, simpled, rough and hairy and fast growing trees are suggested. The above findings suggest that species like *Terminalia arjuna, Tabebuia argentia, Eucalyptus globulus, Muntingia calabura, Ficus bengalensis, mangifera indica, psidium guajava* ect., can be grown in dust polluted areas to reduce the pollution.

REFERENCES

Das, T.M. and Pattanayak, P. 1977. The nature and pattern of deposition of air borne particle on leaf surface of plants, Proc.seminor on Afforestation, *Inst. J.of P.H.E.* pp. 56-62.

Jackson, M.L. 1973. *The Text book of Soil Chemical Analysis.* Prentice-Hall Inc., Engle Wood Cliffs, Jersy.

Maiti, S.K. 1992. Dust collection capacity of plants growing in coal mining areas. IJEP. 13 (4) : 276-280.

Tiwari, T.N. and Patel, M.K. 1993. Effect of cement dust on some plants : Correlations among foliar dust deposition, chlorophyll content and calcium content. *Ind. J. Envt. Prot.* 13 (2) : 93 - 95.

Patel, M.K. and Tiwari, T.N. 1991. A study of dust pollution in the Rourkela industrial complex. *Part -I . Ind. J. Proc.* 11 : 29 - 31.