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EFFECT OF STONE CRUSHER DUST ON LEAVES OF *MELIA AZEDARACH* LINN. AND *DALBERGIA SISSOO* ROXB. IN JAMMU (J&K)

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ABSTRACT

The effect of stone crusher dust, which settles on the leaves and becomes a hard mass when comes in contact with water, on the morphology, micromorphology and anatomical details of leaflets of *Melia azedarach* Linn. and *Dalbergia sissoo* Roxb. growing in the vicinity of a stone crusher in Kaluchak area of Jammu has been studied. The observations on various parameters like colour and area of leaflets, stomatal length, breadth, frequency and index, thickness of leaflet, lower and upper epidermis and mesophyll tissues have been recorded and compared with the plants growing at the reference site. Results indicate that the total thickness of the leaflets and the thickness of upper epidermis decrease at the polluted site in both the genera. The length and breadth of the stomata decreases while the frequency and index of the stomata increases at polluted site in *M. azedarach.* However, reverse of this has been recorded for the *D. sissoo* which seems to be sensitive to dust generated by crushers in its morphological and micromorphological parameters as compared to *M. azedarach.*

INTRODUCTION

Dust emission occurs from many operations in the stone quarrying and processing viz., drilling or blasting from deposit beds, loading and transportation of rocks at crushers, open conveyors, primary, secondary and tertiary crushing of stones, screening, transporting rock by belt conveyors, storage and loading of the crushed materials, etc. Particulate matter produced during the stone quarrying and processing is usually of relatively large particulate size. The chemical composition of the dust tends to be homogenous mixture of oxides of calcium, potassium, aluminium, silica and sodium, which settles into a hard mass when it comes in contact with water.

Stone crusher dust is extremely harmful to human health as well as surrounding vegetation. The dust impairs visibility and increases risk of accidents if crushers are located near the highways. The particulate dust falling on leaves may cause foliar injuries, reduction in yield, change in photosynthesis and transpiration, etc. Several studies conducted under field condition have revealed that when these particulate matters are deposited on vegetation, the plant growth is adversely effected (Singh & Rao 1980, Lal & Ambasht 1980, Oblisami et al. 1978, Inamdar & Chowdhary 1984, Bhirvamurthy & Kumar 1983, Pandey & Simbla 1990, Chatter 1991, Gunamani & Arjunan 1991, Rao 1991, Sharma & Sharma 1991, Aslam et al. 1992, Mishra et al. 1993, Tiwari & Patel 1993, Pandey & Nand 1995, Chowdhary & Rao 1996, Somashekar et al. 1999, Kumar et al. 2000).

There are several stone crushers which are operating in and around Jammu city (Lat. 32°44’ N, Long. 70° 55’ E and altitude 300 msl.) but so far no study has been taken up to know the impact of the dust produced by these crushers on the plants growing around them. Moreover, it is important to generate the base line data on air pollution stress among various components of surrounding environment of stone crushers. In order to avoid dust pollution, identification and plantation of dust resistant plants must be done around the establishment for screening of dust. Keeping the above fact into consideration, attempt has been made in the present study to investigate the effects of stone crusher dust on the qualitative and quantitative micromorphological and anatomical features of leaflets of *Melia azedarach* Linn. and *Dalbergia sissoo* Roxb.

MATERIALS AND METHODS

After thorough survey of Jammu, a stone crusher situated about 900 m away from the National Highway in Balole Nallah, Kaluchak has been selected as polluted site. The trees of *Melia azedarach* and *Dalbergia sissoo* growing there have been selected for recording data from the polluted site. Trees of these species growing under approximately similar ecological and edaphic conditions in the new university campus have been selected as the reference material.

For studying the effects on various parameters, the leaves of approximately same age have been collected from different cross-sections and area of the plants, and mixed to represent the composite sample, which has been analysed for different parameters to represent the averages. Micromeasurements were taken with the help of standardized ocular micrometer. Stomatal index was calculated by the relationship given by Salisbury (1927). Leaf area was calculated by multiplying the length, breadth with a constant that has been worked out using paper graph method.

Thin and fresh vertical sections of the leaflets of the plants have been prepared for recording the measurements for various anatomical parameters with the help of standardized ocular micrometer.

RESULTS AND DISCUSSION

Data recorded for the effect of stone crusher dust on the leaf micromorphology and anatomy of *Melia azedarach* and *Dalbergia sissoo* have been presented in Table 1. In the present study stomata have not been observed on the adaxial surface of the leaves of *M. azedarach.*

Pigment concentration has been reported to decrease in the plants growing near the stone crushers (Somashekar 1999, Kour 2000, Singh 2000) and cement factory (Gunamani & Arjunan 1991, Pandey & Simbla 1990). In the present study also leaflets from both the plants have been observed to be pale green after the removal of dust in the polluted site as compared to dark green colour of the leaflets collected from the reference site.

All the morphological and micromorphological parameters recorded in the present study, i.e., size of the leaf, stomatal frequency, stomatal index, length and breadth of the stomata decrease at polluted site in *D.sisso* except for the length and breadth of the stomata on the abaxial surface, which registered increase in their value as compared to the reference site.

Dust has been reported to affect the micromorphological parameters that can result in increasing or decreasing in their value. Bhirwamurthy & Kumar (1983) and Rao (1991) have reported decrease in stomatal frequency due to the dust. In some of the plants Kour (2000) and Singh (2000) have recorded increase in the stomatal frequency. Increase in the value of stomatal index (S.I.) has been reported by Shanmughavel (1995) in the cement dusted plants where it ranges from 18.3 to 39.3 as compared to normal leaves having S.I. value of 10-20.1. Kour (2000) and Singh (2000) also recorded higher value of S.I. in some other plants polluted with stone crusher dust.

The anatomical studies on the leaflets revealed that the crusher dust has affected the total thickness of the leaflets, thickness of upper and lower epidermis and thickness of mesophyll tissue in both the species. Invariably, all these parameters registered decrease in their value at polluted site as compared to reference site except for the thickness of lower epidermis in *M. azedarach* and thickness of mesophyll tissue in *D. sissoo,* which have higher values at reference site as compared to polluted site.

The decrease in size and loss of pigments in the leaves may affect the process of photosynthesis and also interfere with the exchange of gases and reduces the transpiration rate (Singh & Rao 1981,

Table 1: Quantitative micromorphological and anatomical parameters of *M. azedarach* and *D. sissoo* from polluted and reference sites.

S.No	Parameter		Polluted site		Reference site	
Micromorphological						
	Leaflets		*M. azedarach*	*D. sisso*	*M. azedarach*	*D. sisso*
1	Colour		Pale yellow	Pale Yellow	Dark green	Dark green
2	Area (mm^2)		343.46 ± 56.98	1004 ± 227.08	435.64 ± 51.66	1853 ± 416.4
			(244-452)	(632-1462)	(328-572)	(1436-3209)
	Stomata					
3	Length(µm)	Ab	29.2 ± 4.99	36.25 ± 2.16	37.0 ± 4.48	34.75 ± 3.34
			(26.64-36.63)	(33.33-39.96)	(33.3-43.29)	(29.97-39.96)
		Ad	-	32.5 ± 5.0	-	43.0 ± 4.4
			(26.64-39.96)		(36.63- 53.28)	
4	Breadth(µm)	Ab	13.5 ± 4.91	24.25 ± 4.26	22.6 ± 7.48	22.5 ± 6.12
			(9.99-16.65)	(19.98-29.97)	(19.98-26.64)	(19.99-26.64)
		Ad	-	20.25 ± 2.40	-	26.0 ± 3.20
			(16.65-26.64)		(19.98-33.3)	
5	L/B ratio	Ab	2.57 ± 0.81	1.46 ± 0.043	1.70 ± 0.36	1.52 ± 0.33
			(1.80-3.0)	(1.33-1.66)	(1.57-2.0é)	(1.25-1.83)
		Ad	-	1.58 ± 0.33	-	1.64 ± 0.22
			(1.0-1.83)		(1.33-1.85)	
6	Frequency	Ab	264	367	246	485
		Ad	-	3	-	22
7	Stomatal Index	Ab	27.75 ± 7.37	41.37 ± 5.10	22.57 ± 4.42	43.25 ± 3.05
			(20.0-34.78)	(30.43-47.82)	(13.04-29.62)	(37.93-48.27)
		Ad	-	8.7 ± 2.7	-	9.56 ± 3.54
				(6.25-14.28)		(6.66-16.66)
Anatomical						
Thickness						
8	Upper pidermis (µm)		19.76 ± 3.26	61.5 ± 6.02	22.5 ± 3.70	76.5 ± 8.52
			(15-20)	(45-70)	(15-30)	(60-90)
9	Lower epidermis (µm)		18.18 ± 3.21	49.0 ± 8.6	16.75 ± 2.38	86.5 ± 17.1
			(15-20)	(35-65)	(15-20)	(50-125)
10	Mesophyll tissue (µm)		291.5 ± 19.04	106.25 ± 5.21	247 ± 14.69	113.5 ± 5.02
			(260-330)	(95-115)	(200-265)	(105-120)
11	Leaflet (µm)		143 ± 6.4	400 ± 18.02	152.75 ± 6.79	404-13.56
			(135-155)	(370-420)	(140-165)	(375-420)

Ab = Abaxial surface of leaf; Ad = Adaxial surface of leaf; - = Stomata absent

Pierce 1990, Prasad 1990). This may further effect the growth and development of the plants.

The decrease in number of the stomata in *D. sisso* further reduces the exchange of gases thereby resulting in reduction in the production of photosynthate. The decrease in above parameters of the stomata might have been compensated by the increase in number of epidermal cells which further resulted in the decrease of stomatal index.

In *M. azedarach*, the value of stomatal frequency and S.I. has been observed to increase in the samples collected from the polluted site as compared to the reference site. This suggests that the stress due to dust might have increased the number of stomata thereby facilitating the gaseous exchange. Increase in the number of stomata also compensates the decrease in the length and breadth of the stomata at the polluted site. The increase in frequency of the stomata might have been compensated by the decrease in number of epidermal cells, which further resulted in the increase of stomatal index.

The results indicate that *D. sisso* is sensitive to dust generated by crushers in its morphological and micromorphological parameters as compared to *M. azedarach* whereas both the plant species have been affected anatomically by the dust. However, further confirmation is required with other physiological parameters to use these plants for screening of dust and also as indicators of dust pollution.

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