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IMPACT OF CRUSHING AND QUARRYING ON VEGETATION IN TUMKUR DISTRICT

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ABSTRACT

The present study was conducted in and around crushing and quarrying areas of Tumkur district for monitoring the level of pollution on leaf surface and its subsequent response for chlorophyll content. Respirable particulate matter has become potential pollutants during quarrying and crushing operation such as crushing, screening and in loading and transportation. The dust and other Respirable particulate matter (RPM) cover the leaf surface and clog the stomata. This completely covers not only the photosynthetic surface but also interferes with the exchange of gases and reduces the transpiration rate. The study indicates that the chlorophyll concentration differed significantly with the control in most cases. Species of *Oryza sativa*, *Capsicum frutescens*, *Cyamopsis tetragonolba*, and *Citrus sinensis* showed marked reduction in chlorophyll concentration. In almost all the cases there occurred more reduction in Chl "b" than Chl "a". Species of C*asuarina* and *Cassia* accounted for having least amount of chlorophyll. However some species showed no difference in pigment concentration over control, as observed in species of M*angifera indica*, *Lycopersicon esculentum* growing around manual type of quarries without crushers.

INTRODUCTION

Plants in any ecosystem remain in constant interaction with their physical, chemical and biological environment. The physical environment of the plants regulates their growth and in turn affects the chemical composition (Trivedy

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and Goel, 1987). The determination of pollutant from industrial, residential, heavy traffic and commercial areas in particular are gaining importance on the account of their adverse effects on soil characteristics, human and plant life (Hester, 1983; Harrison and Perry 1986; Arpacioglu *et al*. 1993). Plants sensitive to a particular pollutant show visible symptoms like chlorosis, necrosis and growth retardation (Jacobson and Hill, 1970; Pandey and Shrivastava, 1980). Again photosynthetic efficiency depends upon leaf area and chlorophyll content in a particular intensity and duration of light. The variations in the total chlorophyll content in different experimental sites may be attributed possibly due to edaphic factors and as well as due to different concentration of the effluents (Wright and Smith, 1983; Singha and Patil, 1986; Ashraf and Khan, 1990; Estill *et al.* 1991). The leaf tissue is in layers with a skin of epidermis layer on top and bottom and photosynthetic cells in between. The stomata are the entrances in the leaf bottom (and in some leaves in the top) through which CO_2 enters to play its role in photosynthesis. These openings are protected by a pair of specialized guard cells which open and close to allow gases to enter or to leave the leaf. The primary factor which controls gas absorption by the leaves is the degree of opening of stomata. When the stomata are wide open, absorption is maximum and vice versa. Consequently, the same conditions that enhance the absorption of the gas predispose the plant to injury. The conditions that cause the stomata to open are high light intensity, high relative humidity and adequate moisture supply to the roots of the plant and moderate temperatures. The response of leaves against dust pollution is very useful for monitoring of levels of air pollution. Keeping this in view, the present study has been undertaken to monitor air pollution levels in the Cushing and quarrying areas of Tumkur District.

The district covers an area of 10535 km^2. It is situated between 12° 45′ and 14° 20′ North latitude and between 76° 20′ and 77° 31′East longitude. It is bounded on the north by the Anantapur district of Andhra Pradesh, on the east by Kolar and Bangalore districts, on the south by Mandya district and on the west by districts of Chitradurga, Chickamagalur and Hassan

METHODOLOGY

The plant samples around quarries and crushers within the radius of 50 to 500m of polluted and non-polluted environment have been collected. Chlorophyll is the site of production of organic matter. The chlorophyll content is an ecological index as well as growth parameter (Billore and Mall, 1975). There exists a close correlation between the total amount of leaf chlorophyll and rate of photosynthesis. The correlation between growth transition of green plants, which grow out-doors and are continuously exposed to pollutants have helped to decipher many pollution zones (Rao and and Le Blanc, 1966). So fresh and matured leaf samples were collected thoroughly washed and analyzed for chlorophyll "a", chlorophyll "b" and total chlorophyll spectrophotmetricaly. The leaf area was measured using manual planimeter. A survey of agricultural activities around quarrying and crushing sites has been carried out using a well scheduled questionnaire.

RESULTS AND DISCUSSION

Plants sensitive to a particular pollutant show visible symptoms like chlorosis, necrosis and growth retardation (Jacobson and Hill, 1970; Pandey and Shrivastava, 1980). In the study area noticeable ones are rice blast disease, leaf spot of ground nut, necrosis and chlorotic symptoms. This might be due to dust pollution as a result of quarrying. The agricultural crops shows stunted growth, minimum leaf area, less number of leaves and this is attributed to accumulation of dust and other particulate matter which in turn lowers the metabolic activity like photosynthesis, transpiration, respiration etc. Fine dust particles block the stomata opening. When dust falls on the surface, the conditions that cause the stomata to open is reduced because of reduction of high light intensity and high relative humidity. Farmers in Somadevanahalli and Yelladadlur reported that there is a drastic decrease in the yield of the crops. This can be attributed to high intensity of dust fall due to crushing activity and disposal of waste water from the quarry in to the surrounding agricultural fields. In general the present study revealed drop in agricultural production due to degradation of environment. The variation in the total chlorophyll content and yield of the crop in the different experimental sites may be attributed possibly due to edaphic factors, as well as due to different concentration of dust fall on the vegetation and leachates from the dump site. The non-polluted plants show maximum leaf area and grain yield in comparison to those of polluted plants. The results based on the observations are compared between affected and control samples to discern significant variations if any. The chlorophyll concentration differed significantly with the control in most cases. Species of *Oryza sativa*, *Capsicum frutescens*, *Cyamopsis tetragonolba*, *Citrus sinensis* showed marked reduction in chlorophyll concentration. In almost all the cases there occurred more reduction in Chl "b" than Chl "a". Species of C*asuarina* and *Cassia* accounted for having least amount of chlorophyll. However some species showed no difference in pigment concentration over control, as observed in species of M*angifera indica*, *Lycopersicon esculentum* growing around manual type of quarries without crushers. The data on leaf area index also showed significant variations with control samples. A decrease in pigment concentration was noticed in the plants growing near the crushers. Chlorophyll content in leaves (polluted) is relatively less than the control indicating that the quarrying activity has put the plants under stress and has affected the physiology of plants. The results have revealed that rice plants with higher leaf area contribute to higher number of grains. This is supported by the results of Rosenow *et al*. (1983), Ludlow and Muchow (1990) and Ashraf *et al*. (1992).

CONCLUSION

Thick deposits of quarry dust on the agricultural crops and trees are noticed in the surrounding areas of quarries and crushing sites. Several diseases noticed in plants may be attributed to the deposition of dust. Lowering of crop yield is noticed in the agricultural lands present adjacent to quarries and crushing sites. Deposition of quarry dust has resulted in the reduction in the leaf area and chlorophyll content and also in the stunted growth.

Table 1

Chlorophyll concentration (µg/gm) in some plants at various sites in Tumkur district

Sl.No.	Sample	Control			Pemmanahalli, Maidala, Oblapur								
					PEM			MIA			OBL		
		Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total
2.	*Cyamopsis tetragonolba*	1.4	0.3	1.7	0.9	0.2	1.1	0.8	0.2	1.0	0.7	0.2	0.9
3.	*Oryza sativa*	1.1	0.8	1.9	0.6	0.3	0.9	0.8	0.6	1.4	0.6	0.9	1.5
4.	*Citrus sinensis*	0.989	0.743	1.331	0.5	0.61	1.11	0.4	0.61	1.1	0.5	0.7	1.2
5.	*Puccinia calcitrapae varcentaureae*	0.66	0.561	0.50	0.21	0.13	.034	0.21	0.11	.032	0.36	0.1	0.4
6.	*Mangifera indica*	2.0073	2.0073	3.0195	1.2	1.1	2.3	1.2	1.0	2.2	1.6	1.9	3.5
7.	*Lycopersicon esculentum*	1.809	1.226	3.035	1.2	0.9	2.1	1.0	0.9	1.9	0.9	1.2	2.1
8.	*Sun Flower*	0.93	1.87	30.3	0.54	1.2	1.74	0.24	1.2	1.6	0.6	1.2	1.8
9.	*Casuarina*	0.115	0.165	0.280	0.1	0.16	0.28	0.1	0.11	0.21	0.1	0.2	0.3
10.	*Grievellia*	0.887	0.912	1.799	0.7	0.79	1.49	0.7	0.75	1.45	0.8	0.7	1.5
11.	*Lantana camara*	0.857	0.280	1.137	0.64	0.21	0.85	0.64	0.21	0.85	0.65	0.2	0.82
12.	*Calotropis gigantis*	1.439	0.433	1.873	0.9	0.33	1.23	0.9	0.13	1.3	1.3	0.3	1.6
13.	*Psidium*	0.248	0.058	0.306	0.1	0.02	0.12	0.1	0.03	0.13	0.1	0.2	0.3
14.	*Pongamia pinnata*	0.422	0.350	0.772	0.32	0.15	0.47	0.3	0.1	0.4	0.39	0.2	0.59
15.	*Hyptis*	0.576	0.348	0.924	0.321	0.21	0.531	0.3	0.2	0.5	0.4	0.26	0.66
16.	*Cassia*	0.148	0.210	0.438	0.01	0.110	0.120	0.01	0.110	0.120	0.1	0.2	0.3
17.	*Recinus communis*	1.62	0.78	2.4	1.23	0.54	1.77	1.23	0.54	1.77	1.2	0.5	1.7

Sl.No.	Sample	Control			Hosahalli, Chikkagundanahalli, Pandithanahall								
					HOS			CHIK			PAN		
		Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total
2.	*Cyamopsis tetragonolba*	1.4	0.3	1.7	1.1	0.2	1.3	0.9	0.1	1.0	1.2	0.3	1.5
3.	*Oryza sativa*	1.1	0.8	1.9	0.6	0.8	1.4	0.4	0.6	1.0	0.9	1.12	1.92
4.	*Citrus sinensis*	0.989	0.743	1.331	0.85	0.65	1.50	0.8	0.6	1.4	0.8	0.69	1.49
5.	*Puccinia calcitrapae varcentaureae*	0.66	0.561	0.50	0.5	0.4	0.9	0.45	0.4	0.85	0.6	0.45	1.15
6.	*Mangifera indica*	2.0073	2.0073	3.0195	1.8	1.6	3.4	1.9	1.0	2.9	0.5	0.9	1.4
7.	*Lycopersicon esculentum*	1.809	1.226	3.035	1.4	1.1	2.5	1.0	0.8	1.8	0.9	0.8	1.7
8.	*Sun Flower*	0.93	1.87	30.3	0.8	1.2	2.0	0.6	1.3	1.9	0.6	0.9	1.5
9.	*Casuarina*	0.115	0.165	0.280	0.1	0.12	0.22	0.1	0.16	0.26	0.1	0.01	0.11
10.	*Grievellia*	0.887	0.912	1.799	0.7	0.69	1.39	0.8	0.89	1.69	0.4	0.2	0.6
11.	*Lantana camara*	0.857	0.280	1.137	0.7	0.1	0.8	0.54	0.42	1.16	0.56	0.49	1.05
12.	*Calotropis gigantis*	1.439	0.433	1.873	1.2	0.3	1.5	1.1	0.2	1.3	1.2	0.33	1.56
13.	*Psidium*	0.248	0.058	0.306	0.1	0.05	0.15	0.2	0.4	0.6	0.1	0.06	0.16
14.	*Pongamia pinnata*	0.422	0.350	0.772	0.4	0.2	0.6	0.1	0.32	0.42	0.32	0.31	0.63
15.	*Hyptis*	0.576	0.348	0.924	0.42	0.2	0.62	0.5	0.1	0.6	0.4	0.25	0.65
16.	*Cassia*	0.148	0.210	0.438	0.1	0.11	0.21	0.12	0.2	0.32	0.1	0.1	0.2
17.	*Recinus communis*	1.62	0.78	2.4	1.2	0.7	1.8	1.4	0.7	2.1	1.2	0.66	1.86

Sl.No.	Sample	Control			Egihalli,Gutta, Kanthivadarahalli								
					EGI			GUT			KAN		
		Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total	Chl"a"	Chl"b"	Total
2.	*Cyamopsis tetragonolba*	1.4	0.3	1.7	1.1	0.2	1.3	1.0	0.2	1.2	1.2	0.3	1.5
3.	*Oryza sativa*	1.1	0.8	1.9	0.8	0.6	1.4	1.2	0.3	1.5	1.1	0.3	1.4
4.	*Citrus sinensis*	0.989	0.743	1.331	0.9	0.6	1.5	0.8	0.6	1.4	0.8	0.6	1.4
5.	*Puccinia calcitrapae varcentaureae*	0.66	0.561	0.50	0.4	0.56	0.96	0.45	0.5	0.95	0.35	0.42	0.77
6.	*Mangifera indica*	2.0073	2.0073	3.0195	2.1	1.3	3.4	1.9	1.6	3.5	1.8	1.6	3.4
7.	*Lycopersicon esculentum*	1.809	1.226	3.035	1.2	1.1	2.3	1.8	1.2	3.0	1.2	1.0	2.2
8.	*Sun Flower*	0.93	1.87	3.3	0.6	1.4	2.0	0.9	1.5	2.4	0.5	1.2	1.7
9.	*Casuarina*	0.115	0.165	0.280	0.1	0.16	0.26	0.1	0.1	0.2	0.1	0.2	0.3
10.	*Grievellia*	0.887	0.912	1.799	0.4	0.4	0.8	0.4	0.5	0.9	0.1	0.	0.4
11.	*Lantana camara*	0.857	0.280	1.137	0.8	0.1	0.9	0.6	0.5	1.1	0.8	0.1	0.9
12.	*Calotropis gigantis*	1.439	0.433	1.873	1.2	0.3	1.5	1.2	0.3	1.5	0.1	0.6	0.7
13.	*Psidium*	0.248	0.058	0.306	0.2	0.05	0.25	0.1	0.04	0.14	0.2	0.05	0.25
14.	*Pongamia pinnata*	0.422	0.350	0.772	0.4	0.2	0.6	0.3	0.1	0.4	0.23	0.4	0.63
15.	*Hyptis*	0.576	0.348	0.924	0.4	0.3	0.7	0.5	0.1	0.6	0.5	0.3	0.8
16.	*Cassia*	0.148	0.210	0.438	0.1	0.2	0.3	0.1	0.12	0.22	0.12	0.18	0.3
17.	*Recinus communis*	1.62	0.78	2.4	1.5	0.6	2.1	1.2	1.3	2.5	0.9	0.2	1.1

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