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SURVEY OF VEGITTION GROWN NEAR COPPER MINE

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Abstract

Mining is an essential evil. Water and soil near mines are rich in metal contamination and hazardous to plants and animals. The acidic nature of contaminated water facilitates solubelization and availability of metal from soil to plants. The aim of the study was to investigate and list the plants grown near copper mining sites at Khetri located in Jhunjhunu, Rajasthan, India. A field survey was conducted and plant samples were collected from 200 meter vicinity of copper mine. The metal concentrations were analyzed by standard methods in soil sample collected from different area near mine.

Soil samples have copper concentration between 88.8 mg/kg to 249 mg/kg range. Similarly Zn and Cd contamination was also observed in soil. Major finding shows that 126 plant species are successfully survive near mine region.

The listing of metal tolerant plants has significant scientific value for phytoremidiation and development of metal tolerant crops through genetic engineering.

INTRODUCTION:

Metal contamination in ground water is a major concern around the world. The natural means of metal pollution are volcano, weathering of metal rocks whereas man mediated sources are household waste, Industrial effluent, mining activities, and agricultural practices. It has been suggested by various researchers that flora and Fauna of area near mine shows maximum effect of metal pollution. A vast literature is available which focuses on effect of metal contamination on animals and plants (Sharma 2012 a,b). Similarly, copper mining also leads to contamination of water,

soil and vegetation in nearby area of mine (Kundu *et al*., 2014, Khichar 2014). Copper is an essential element and act as cofactor for enzymes and activator of many biochemical reactions (Harper et al., 1997b). WHO sets maximum permissible limit for Cu is 0.05 mg/L. It is considered as an essential element for plant but higher concentration of metal causes disorders in physiology of plant (Villiers et al. 2011). A cumulative effect of disorders is appearing as morphological changes in vegetation exposed to high concentration of metal. Generally a narrow range of plants are able to grow near mines which are considered as tolerant plants. It has been reported that metal tolerant plants have a well equipped defense system to counteract metal stress.

Various studies shows effect of metal contamination in hydroponic culture and laboratory systems (Zeid I.M. 2001, Sharma and Dubey, 2007) but a field experiment is required to develop a detailed understanding about metal plant interaction. Present study is conducted to evaluate concentration of metals in soil samples in 200 meter vicinity of Khetri copper mining area. A morphological survey is also done to screen metal tolerant and metal sensitive vegetation from test area.

MATERIALS AND METHODS

The plant samples were collected from Banwas, 200 meter vicinity of khetri copper mine located in Rajasthan. It is situated between latitude $28^0 03' 35''$ to $28^0 04' 45''$ and longitude $75^0 47' 40''$ to $75^0 46' 45''$ in Aravali ranges. The identification of plants was done on the basis of local information and available web literature.

Soil samples were collected from dense vegetation zone divided in 10 centers, on the basis of distance from vicinity of mine. Center A is in outer most periphery whereas center J is located in nearest range of mine. The soil samples were collected and subjected to test pH, EC, total hardness and concentration of Cu, Zn and Cd by standard methods.

RESULT AND DISCUSSION

Vegetation was listed to find out most tolerant plant against abiotic stress near copper mine. Results indicate that only a limited number of plant species are able to survive in I and J centers which were in highest vicinity of mine. Table 1 shows the list of various plants grown near copper mine. According to survey only 12.69% of total plant species were able to grow in high metal condition whereas the 92.23% of total plant species were survives in outer shell of test area. Table 2 illustrates the effect of changes in soil physicochemical properties on distribution of plant species.

Table 1. The list of plants grown near Copper mine

S.No.	Name of the Plant Species/ Vegetation Group	**A**	**B**								
1.	*Abutilon fruticosa*	✓	✓								
2.	*Abutilon indicum*	✓	×								
3.	*Acacia nilotica*	✓	✓								
4.	*Acacia senegal*	✓	×								
5.	*Achyranthus aspera*	✓	×	✓	✓	✓	✓	✓			
6.	*Adhatoda vasica*	✓	✓								
7.	*Adiantum venustum*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
8.	*Aerva persica*	✓	✓								
9.	*Ageratum conyzoides*	✓	×								
10.	*Albezia lebbeck*	×	×								
11.	*Aloe vera*	✓	✓								
12.	*Alysicarpus vaginalis*	✓	✓								
13.	*Amaranthus spinosus*	✓	✓	✓	✓	✓					
14.	*Anogeissus pendula*	✓	✓								
15.	*Argemone mexicana*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
16.	*Aristida adsansionis*	✓	✓	✓	✓	✓					
17.	*Aristolochia bracteolota*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
18.	*Asparagus racemosus*	✓	×								
19.	*Asphodelus tenuifolius*	✓	✓	✓	✓	✓					

20.	*Azadirachta indica*	✓	×								
21.	*Balanites aegyptica*	✓	✓								
22.	*Barleria prionitis*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
23.	*Blepharis sindica*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
24.	*Blumea obliqua*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
25.	*Boerhavia diffusa*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
26.	*Boswellia serrata*	✓	✓								
27.	*Butea monosperma*	✓	✓								
28.	*Caesalpinia pulchirrima*	✓	✓								
29.	*Calligonum polygonoides*	✓	✓								
30.	*Calotropis procera*	✓	✓								
31.	*Capparis decidua*	✓	✓								
32.	*Cassia acutifolia*	✓	✓								
33.	*Cassia angustifolia*	✓	✓								
34.	*Cassia fistula*	✓	✓								
35.	*Cenchrus biflorus*	✓	✓	✓	✓	✓					
36.	*Chenopolium album*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
37.	*Citrullus colocynthis*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
38.	*Cleome gynandra*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39.	*Clerodendrum indicum*	✓	✓								
40.	*Coccinia indica*	✓	✓		✓	✓	✓	✓			
41.	*Cocculus pendulus*	✓	✓	✓	✓	✓					

42.	*Commiphora mukul*	✓	✓								
43.	*Convolvulus arvensis*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
44.	*Convolvulus microphyllus*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
45.	*Corchorus depressus*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
46.	*Cordia gharaf*	✓	×								
47.	*Corollocarpus epigous*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
48.	*Cressa cretica*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
49.	*Crotolaria burhia*	✓	✓								
50.	*Crotolaria medicaginea*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
51.	*Cuscuta chinensis*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
52.	*Cuscuta hyalina*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
53.	*Cymbopogon flexuasus*	✓	✓	✓	✓	✓					
54.	*Cyndon dactylon*	✓	✓	✓	✓	✓					
55.	*Cyperus rotundus*	✓	✓	✓	✓	✓					
56.	*Dalbergia sissoo*	✓	✓								
57.	*Datura metel*	✓	✓								
58.	*Dectylotenium aegypticum*	✓	✓	✓	✓	✓					
59.	*Dicomo tomentosa*	✓	✓	✓	✓	✓					
60.	*Digera muricata*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
61.	*Echinops echinatus*	✓	×								
62.	*Eclipta prostrata*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
63.	*Euphorbia caducifolia*	✓	✓								

64.	*Fagonia cretica*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
65.	*Ficus bengalensis*	✓	×								
66.	*Ficus religiosa*	✓	✓								
67.	*Fimbristylis quinqularis*	✓	✓	✓	✓	✓					
68.	*Ganoderma lucidum*	×	×								
69.	*Glinus lotoides*	✓	✓	✓	✓	✓					
70.	*Glossnema varians*	✓	✓	✓	✓	✓					
71.	*Grewia villosa*	✓	✓	✓	✓	✓	✓	✓			
72.	*Imperata cylindrica*	✓	✓	✓	✓	✓					
73.	*Indigofera oblongifolia*	✓	✓	✓	✓	✓					
74.	*Ipomoea hederaceae*	✓	✓	✓	✓	✓					
75.	*Kapok bush*	✓	×								
76.	*Launaea residifolia*	✓	✓	✓	✓	✓					
77.	*Leucas aspera*	✓	✓	✓	✓	✓					
78.	*Leucas urticaefolia*	✓	✓								
79.	*Lindenbergia indica*	✓	✓	✓	✓	✓					
80.	*Lycium barbatum*	✓	✓								
81.	*Malva rotundifolia*	✓	✓	✓	✓	✓	✓	✓	✓		
82.	*Malva rotundifolia*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
83.	*Mangifera indica*	✓	✓								
84.	*Maytenus emerginat*	✓	✓								
85.	*Mimosa hamata*	✓	✓								

86.	*Mollugo cerviana*	✓	✓	✓	✓	✓					
87.	*Momordica balsaminia*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
88.	*Momordica dioica*	✓	✓	✓	✓	✓					
89.	*Moringa oleifera*	×	×								
90.	*Ocimum americanum*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
91.	*Opuntia elator*	×	×								
92.	*Panicum antidotale*	✓	✓	✓	✓	✓					
93.	*Parthenium hysterophorus*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
94.	*Pentatropis spiralus*	✓	✓	✓	✓	×					
95.	*Peristrophe bivalvis*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
96.	*Phoenix acaulis*	✓	✓								
97.	*Phoralea corylifolia*	✓	✓	✓	✓	✓					
98.	*Polycarpaea corymbosa*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
99.	*Polygala chinensis*	✓	✓	✓	✓	✓					
100.	*Polygonum plebium*	✓	✓	✓	✓	✓					
101.	*Portulaca oleraceae*	✓	✓	✓	✓	✓					
102.	*Prosopis cineraria*	✓	✓								
103.	*Psoralea odorata*	✓	✓	✓	✓	✓					
104.	*Pulicaria crispa*	✓	✓	✓	✓	✓	✓	✓			
105.	*Rhus coriara*	✓	✓								
106.	*Rhus mysorensies*	✓	✓								
107.	*Rivea ornata*	✓	✓	✓	✓	✓					

108.	*Salvadora oleoides*	✓	×								
109.	*Saraca asoca*	✓	✓								
110.	*Sehima nervasum*	✓	✓	✓	✓	✓					
111.	*Sida acuta*	×	✓	✓	✓	✓	✓	✓			
112.	*Sida alba*	✓	✓	✓	×	×	×	×			
113.	*Solanum albicule*	✓	✓	✓	✓	✓					
114.	*Solanum nigrum*	✓	✓	✓	✓	✓					
115.	*Solanum surrattense*	✓	✓	✓	✓	✓					
116.	*Surcostemma acidum*	✓	✓								
117.	*Tamarindus indica*	✓	×								
118.	*Tecomella undulata*	✓	✓								
119.	*Tephrosia villosa*	×	×								
120.	*Tinospora cordifolia Gilo,*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
121.	*Tribulus alatus*	✓	✓	✓	✓	×					
122.	*Vernonia anthelmintica*	✓	✓	✓	✓	✓					
123.	*Vernonia cinerea*	✓	✓	✓	✓	×					
124.	*Viola cinerea*	✓	✓	✓	✓	✓					
125.	*Withana somnifera*	✓	✓								
126.	*Zizyphus nummularia*	✓	✓								

Results shows that acidic soil imposes negative effect on plant diversity in sample J whereas value pH 7.7 was optimum for many plant species. A prominent vegetation pattern was noticed in center A

,B,C and D where most of plant species survive effectively but increasing hardness, metal contamination and variation in pH limits the diversity of plant species.

Table 2: Analysis of Soil samples collected from mine area

Soil Sample No.	pH	EC µmho/ cm	TH mg/L	Copper mg/kg	Zinc mg/kg	Cadmium mg/kg	Total Plants
Max. limit	6.5-8.5	250-4000 µmho/ cm	600 Mg/L	10 mg/kg	50 mg/kg	0.02 mg/kg	%
A	7.4±0.001	2212±0.001	350±0.001	225.5±0.01	31.0±0.002	22.4±0.001	92.23
B	7.6±0.002	1304±0.002	338±0.001	229.8±0.002	33.0±0.004	21.9±0.009	86.50
C	7.7±0.001	4221±0.005	357±0.011	99.8±0.003	18.0±0.011	12.8±0.004	93.65
D	7.6±0.002	3122±0.001	388±0.022	88.8±0.002	11.0±0.002	11.4±0.002	84.92
E	8.5±0.001	1456±0.002	405±0.012	249.9±0.001	19.5±0.003	13.0±0.017	84.12
F	8.7±0.002	3367±0.003	365±0.013	129.6±0.002	10.4±0.002	12.7±0.004	53.96
G	8.0±0.003	4562±0.001	677±0.001	122.7±0.001	12.6±0.001	13.5±0.003	46.82
H	7.9±0.002	3208±0.021	780±0.001	152.2±0.001	12.3±0.002	12.7±0.006	53.96
I	7.1±0.001	1232±0.011	789±0.002	155.1±0.001	15.0±0.011	23.2±0.002	38.88
J	6.8±0.002	1200±0.020	432±0.001	229.2±0.001	27.8±0.010	28.5±0.005	12.69

Data Shows mean ±SD where n=3 for all samples. Data Shows mean ±SD where n=3 for all samples. pH: Hydrogen ion concentration, EC: Electrical conductance, TH: Total Hardness

The plant species present near mine area have distinct morphological traits in order to maintain adaptation to cope with abiotic stress condition.

CONCLUSION

The Vegetation grown near mines is always a matter of interest for researchers. A survey has been conducted to prepare a list of plant species found in mine area. It was observed that 6 plant species were tolerant to highest level of metal concentration. Three plant species viz. *Polycarpaea corymbosa, Parthenium hysterophorus,* and *Adhatoda vasica* were maintained constant appearance with changing soil properties. The collected information will developed a solid background for biochemical and molecular analysis of tolerant plants.

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