Investigation of Plant Habits Near Copper Mines of Khetri Located in Jhunjhunu, Rajasthan

Dr. Anita

Assistant Professor, Department of Botany, Ravindra Academy Girls PG College, Chirawa, Jhunjhunu, Rajasthan.

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 solubilization and availability of metal from soil to plants. The aim of the study was to investigate and the plants habits grown near copper mining sites at Khetri located in Jhunjhunu, Rajasthan, India. A field survey was conducted and plant samples were collected from some vicinity of a copper mine. The metal concentrations were analyzed by standard methods in soil samples collected from the different areas near mine. Soil samples have a copper concentration detected. The metal tolerant plants has significant scientific value for phytoremediation and development of metal tolerant crops through genetic engineering.

DOI of the Article: https://doi.org/10.46501/IJMTST0706056

Available online at: http://www.ijmtst.com/vol7issue06.html

As per UGC guidelines an electronic bar code is provided to seure your paper

To Cite this Article: Dr. Anita. Investigation of Plant Habits Near Copper Mines of Khetri Located in Jhunjhunu, Rajasthan. *International Journal for Modern Trends in Science and Technology* 2021, *7*, 0706219, pp. 341-343. https://doi.org/10.46501/IJMTST0706056

Article Info. Received: 19 May 2021; Accepted: 18 June 2021; Published: 24 June 2021

INTRODUCTION

Environmental pollution, including contamination of sediments, soil, surface and groundwater, vegetation, meiofaunal assemblages, algae and of small animals, resulting from copper works have also been reported by various researchers [1]. Contamination of the environment with elevated levels of toxic elements persisting near as well as several kilometers distant from the copper processing site or the tailings dump site has been indicated in almost all these studies. Khetri, the region considered for this study, situated in the north eastern part of the state of Rajasthan, India, has been the centre of copper mining activity in the historic past, even long before the first geologist Hackett (1877), examined the region towards the end of the nineteenth century. Extensive activity of the ancient miners in the region is evidenced from the old workings spread all over the belt, slag heaps and dumps of mine wastes near the portals of all the old slopes [2]. Development of the more recent Khetri Copper Complex was started by National Mineral Development Corporation (NMDC) and the project was handed over to Hindustan Copper Ltd. (HCL) in 1967 when HCL was formed. Subsequently, smelting and refining facilities were added. This Khetri Copper Complex is some 8 km away from the older Khetri, connected by road and an aerial ropeway. The complex occupies a lower ground and is partially encircled by mineralized hills, the valley of which also serves as the dump or pond for the tailings generated from copper ore processing [3] .

Geobotanical prospecting refers to prospecting based on indicator plants like metallophytes and the analysis of vegetation.People in the region noticed a connection between vegetation and the minerals located underground. There were particular plants that throve on and indicated areas rich in copper. Copper is an essential metal for normal plant growth and development, although it is also potentially toxic. Copper participates in numerous physiological processes and is an essential cofactor for many metalloproteins, however, problems arise when excess copper is present in cells. Excess copper inhibits plant growth and impairs important cellular processes (i.e., photosynthetic electron transport).[4] Since copper is both an essential cofactor and a toxic element, involving a complex network of metal trafficking pathways, different strategies have evolved in plants to appropriately regulate its homeostasis as a function of the environmental copper level. Such strategies must prevent accumulation of the metal in the freely reactive form (metal detoxification pathways) and ensure proper delivery of this element to target metalloproteins. [5] The mechanisms involved in the acquisition of this essential micronutrient have not been clearly defined although a number of genes have recently been identified which encode potential copper transporters. More important features concerning copper toxicity and tolerance in plants, and brings information of recent findings on copper trafficking including copper detoxification factors, copper transporters and copper chaperones.[6]

DISCUSSION

Acacia and *Eucalyptus* were mainly growing in an abandoned copper mine located in Khetri, Rajasthan. As per the total metal analysis of leaf and corresponding soil samples, *Acacia* accumulated 93.6 mg kg^{-1} of Cu in leaf while the corresponding soil concentration was 1632 mg kg^{-1}. The *Eucalyptus* accumulated 5341 mg kg^{-1} of Cu in leaf while the concentration of this heavy metal in soil was 65 mg kg^{-1} in soil.[7]

The effect of heavy metal toxicity on biota is severe and there is an urgency to control the level of toxicity and impact on public health, particularly from abandoned mine lands like Khetri, Rajasthan. Identification of suitable remediating species of plants could reduce the ecological risks of heavy metals such as copper to contaminate water bodies and damage gills causing premature death of fishes . It is thought to be an important component for identifying the species positively responsible for bioaccumulation of pollutants being transferred from plants into the food chain . [8] The accumulation of metals in the foliar region could be severe due to the reoccurring of soil pollution by metal accumulation in litter of mine site plants. Therefore, it has been established that species of plants having high metal concentration ratio (≥1) of roots to soil is called bioconcentration factor (BCF), a low shoots to roots metal concentration ratio (≤1) known as the translocation factor (TF) and ≤1 ratio of metal content in above ground plant parts over metal content in soil known as enrichment factor (EF) is considered to be ideal HM stabilizers. [9] The leguminous *Acacia* and non-leguminous *Eucalyptus* were included with an aim

to find answers to the issues of bioavailability, bioaccumulation and biotransformation of copper. *Acacia* has attributes of root nodule formation and an active microbial activity. Screening at the mine site also indicated more copper accumulation in the root zone for this species.[10]

RESULTS

The bioavailability of heavy metals like copper is based on the influence of soil physical factors. The soil being tested in this study is from the copper contaminated dry mine spoil. The *Acacia* rhizosphere soil was a sandy loam comprising 8% clay whereas the *Eucalyptus* rhizosphere soil had 72% clay as per the hydrometer readings. The lack of water stagnation and low water holding capacity of soil result into low electrical conductivity and acidic nature of soil. The extent of root and the physico-chemical properties of soil influence the uptake or accumulation values analysed currently using the top soil Copper concentrations. A highest soil copper yielded less foliar concentration. This result could be also attributed to the copper enrichment in *Eucalyptus* leaves through root uptake which is called systemic uptake, and through bark called dermal sorption, or by a combination of both. The accumulation level of Copper in *Acacia* and *Eucalyptus* is different in root, stem and leaf suggesting the independent behaviour of each species against copper. According to studies there is a physiological effect on cellular processes of higher plants. One such effect is due to Cu^{2+} where enzymatic and leaf senescence is brought about with Ca^{2+} moving into xylem through apoplast pathway. Moreover, the study also points out about the photosynthetic apparatus where Cu^{2+} and Ca^{2+} are involved in the process of escaping metal toxicity. Generally, the *Acacia* species have been widely preferred to *Eucalyptus* for afforestation and greening programs because it can grow in poor soils faster, can fix nitrogen, and revegetate even in nutrient deficient soil .[11]

CONCLUSION

The present study of copper mine site at Khetri, Rajasthan a semi-arid climate provides insight into the ability of native trees to interact with metals present in soil. The studies suggest that *Eucalyptus* is a hyperaccumulator . We suggest that the use of a native species like leguminous *Acacia* has a better edge over *Eucalyptus* to stabilise pollutants such as Copper in a long run. Overall, this study recommends to avoid *Eucalyptus* growth in copper polluted mine sites like Khetri, Rajasthan. [12]

REFERENCES

1. Bahuguna, P. P. (1995), Subsidence studies in Indian coalfields by a semi empirical Approach, Land Subsidence (Proceedings of the Fifth International Symposium on Land Subsidence, The Hague, October 1995). IAHS Pubi. no. 234, Pp 127-133
2. Bahuguna, P. P. (1993), Development of mine subsidence prediction model for Indian Coalmines, PhD Thesis, Deptt. of Civil Engg, University of Roorkee, India.
3. Bahuguna, P. P. (1994), Subsidence Monitoring, Proceedings of 2nd Indian Conference on Coal Mine Surveying, ICCMS-94.
4. Bahuguna, P.P. and Srivastava, A.M.C., Saxena, N.C.(1991), A Critical Review of Mine Subsidence prediction Methods. Mining Science Technology. Pp.369-382. Vol. 13. No.3. Dec. 1991.
5. Duk-Won Park (2004), Paper on Subsidence Simulation using Laser Optical Triangulation Distance Measurement Devices, Presented in 6th North America Rock Mechanics Symposium.
6. Fulton A (2005-2006), Study on Land subsidence: What is it and why is it an important aspect of groundwater Management, Article No. 3, in the discussion on the topic of ground water and wells in Northern Sacramento Valley.
7. Mine Subsidence. Singh, Madan M. ed. Society of Mining Engineers, Littleton, CO, 1986.
8. AIME. Pp.73-143. Mining Environmental Handbook. Marcus, Jerrold J. Imperial College Press, London. 1997.
9. Prokopovich, N. P. Environmental Geology. Betz, Fredrick Jr. ed. (1 9 7 2), Land Subsidence and Population Growth. Reprint from 24th Intern. Geol. Congr. Proc., 13, 44-54.
10. SME Mining Engineering Handbook (1992). Hartman, Howard L. Society of Mining, Metallurgy and Exploration, Inc. Port City Press, Baltimore Soliman,
11. Mostafa M. et al. (1998), Environmental Hydrogeology. CRC Press LLC, 1998. Pp81-101.
12. Whittaker, B. N., and Reddish, D.J. (1989), Subsidence—Occurrence, Prediction and Control: Elsevier, 528.

