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Study of manganese in the irrigation water of Chopra Bari area of Bikaner city (Rajasthan)

SURUCHI GUPTA and AJAY SINGH SOLANKI*

P.G. Department of Chemistry, Goverment. Dungar College, Bikaner - 334 003 (India)

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ABSTRACT

Chopra Bari area of Bikaner city uses industrial effluent of dyeing and printing units for irrigation purpose. This water is highly contaminated with heavy metals. Heavy metals ditorts the quality of water and makes it unfit for drinking and irrigation purpose, and brings various physiological disorders in plants/crops. Various samples of these units are taken for analyze of heavy metal (Mn) and it was observed that all the samples show very low range of Manganese ranging from (0.01 to 0.14 PPM)

Key words: Manganese, deficiency, plants/crops.

INTRODUCTION

Water pollution can be defined as the presence in water, of some foreign substances or impurities (organic, inorganic, radiological or biological) in such quantity so as to constitute a health hazard by lowering the water quality and making it unfit for use.[1]

Various agents such as domestic, industrial, thermal, Radioactive. Oils are responsible for detoring quality of water, but growing industrialization is a key stone in this respect. The industrial effluent contains various toxic heavy metals, which are the source of many diseases in plants/crops when being used for irrigation purpose.

The area under present investigation (Chopra bari) is a vast irrigation field, which uses only industrial effluent of dyeing and printing units for irrigation; this area is one of the big producer of vegetables in Bikaner city and it transports one tone vegetables per day in the city; various disorders like leaf curling, burning of leaves, immature fruit, or early falling of fruits, diesel like appearance of leaves, stunted growth, blackening of roots, chlorosis are present in the plants/crops growing here; on the behalf of all these problems, heavy metal analysis (Mn) is carried out of area in irrigation water (waste water) of this area.

Manganese is a mineral element that is both nutritionally essential and potentially toxic. The derivation of its name from the Greek word for magic remains appropriate because scientists are still working to understand the diverse effect of manganese deficiency and manganese toxicity in living organisms. [1]

Plant absorbs Mn only when it occurs in solution as a divalent cation (Mn^{2+}). Mn also occurs in oxidized forms (Mn^{3+} and Mn^{4+}), both of which are unavailable for plant uptake. Soil microorganisms oxidize plant available Mn^{2+} to Mn^{+3}, which makes it unavailable to plants; biological reaction occurs slowly when soil pH is between 5 and 6.5. However, it proceeds more pH increases up to 7.5 (Russell, 1988). Thus the form of Mn in a soil system depends largely on functioning of soil micro–organism, and their activity depends on soil pH.

Plants have a vascular system for moving water, metabolites and solutes from one part to another. The plant vascular system consists of two components, xylem and phloem. Xylem transports water dissolved nutrients from root upward to shoots, with virtually no downward movement. Phloem transports water, metabolites and solutes in all direction throughout the plant.

Mn is absorbed by roots and moved upward to the leaves through the xylem; however, Mn cannot transport through the phloem. Therefore, Mn accumulated in leaves cannot be remobilized in any significant quantity (Graham, 1988).

Mn provides plant ability to light energy for use in photosynthesis. In nitrogen metabolism, it plays a role in production of ammonium. Probably through interaction with an enzyme known as nitrate reductase. It acts as a precursor of auxin harmone and vital role in carbohydrate production.[2]

Crops with high manganese requirement include beans (lima, snap), lettuce, oat, onion, raddish, raspberry, soyabean, spinach, sorghum and wheat. These with medium relative manganese needs are barley, beet cabbage, carrot, cauliflower, celery, corn Cucumber, pea, potato, tobacco and tomato.[3]

EXPERIMENTAL

For the analysis of Manganese in industrial effluent, various samples from the area are collected in wide mouth plastic bottles. The samples were than filtered using whatman no. 42 filter paper and were analyzed on Atomic Absorption spectrophotometer (AAS).[4, 5]

RESULTS AND DISCUSSION

The concentration of manganese metal shown in table–1 shows that the Mn–level in industrial effluent is very low, and irrigation with this effluent produces Mn deficient conditions in plants/ crops growing in the field, such deficient symptoms are chlorosis is most severe at the top of the plant, yellowing of the leaves appears first near leaf margins and develops in a V–shaped pattern. Leaves then develop a tan or gray spots that can easily be mistaken for air pollution damage. These spots are the major difference between manganese and iron deficiency.

Table - 1: Concentration of Manganese in various samples of Chopra Bari area :

Sample No.	Concentration of Manganese in PPm
1.	0.05
2.	0.01
3.	0.04
4.	0.17
5.	0.04
6.	0.03
7.	0.03
8.	0.04
9.	0.04
10.	0.04

Manganese deficiency in oat is known as gray speck. This is not pathogenic disease but a break down of leaf tissue. Gray speck usually starts as a gray oval–shaped spot on the edge of a new leaf when the oat plant is in the three to four leaf stage. The speck appears away from the tip and may gradually spread across the entire leaf or many such spots may appear. In wheat and barley, manganese deficient plant develops yellow parallel streaks on upper leaves that run the length of the leaf. the tip does not remain green as in oat, and the yellowing does not start at the tip of wheat or barley plants as it does with nitrogen or potassium deficiencies. In beans and most non–grain crops, manganese deficiency appears as Interveinal chlorosis. The top leaves of deficient plant turn yellow in the area between the veins, while the veins remain green.[6]

Seed deformities are seen in grain legumes. Lupins Suffers from split seed which is caused by the embryo breaking through a very weak seed coat. ‘Split–seed’ will reduce yields and also viability of the harvested grain. A similar conditions in peas is known as ‘Marsh–spot’ due to a diffuse dark grey area with in the seed.

In water melon the interveinal area of 4–8 leaves turn yellow before the plants to flower. Interveinal chlorosis and white spots appear after the plants begin bearing fruits. Deficiency symptoms spread from lower leaves to upper ones overtime. In grapes leaves show interveinal chlorosis, while the veins remain green to citrus and tomato the colour of leaves becomes yellow.[7]

Potatoes shows reduced leaf size while Mn–deficient corn plants grown on organic soils shows light–yellow–green pin striping of the leaves. Mn–deficiency in soyabeans, dry edible beans, snap beans, sugarbets, celery, cucumbers and cabbage often causes marked yellowing between the leaf veins, the veins themselves remain dark green. Mn–deficient onions are olive–green and the leaves may appear wilted.

In order to correct the deficiency of manganese, manganese fertilizer should be applied to soil, spraying it on the foliage or making the soil more acidic. Generally, when Mn is deficient, $MnSO_4$ or manganese Oxide is mixed with the fertilizer and applied in a band near the seed. Acidifying the soil with materials such as sulfur and aluminum sulphate can correct manganese deficiency. These treatments cost more than manganese fertilizer. Growers must manage soil pH in order to improve Mn availability for plants. Thus, it is concluded that by the apply of above suggestions, growers of chopra bari area can get rid off Mn deficiency from their plants/crops. (Endnotes)

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