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Effect of Heavy Metal Analysis in Industrial Effluent on Plants Growth being Used for Irrigation in Charkhi Dadri Haryana

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ABSTRACT

Present study is related with Chrakhi Dadridistrictarea of Haryana which uses industrial effluents of various industries and sewage water for irrigation purpose. This water is highly contaminated with heavy metals. Heavy metals distort 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 analyse of heavy metal and it was observed that all the samples show very her anger of ranging Heavy metal analysis [Fe, Cu, Zn, Mn] is done. Study reveals that some of the parameters are higher in range than prescribed, while some are in deficient level.

1. Introduction

Heavy metals are environmentally stable and non-biodegradable, toxic to the living beings and tend to accumulate in plants and animals causing chronic adverse effects on human health. Heavy metals are introduced to the environment through a variety of sources such as combustion, extraction, agricultural runoff, transportation etc[1]. Heavy metals are priority toxic pollutants that severely limit the beneficial use of water for domestic and industrial application[2]. Frequent use of heavy metal contaminated water in the agricultural fields leads to soil pollution and gradually enriched the soil with heavy metals. Different studies have revealed that the presence of toxic heavy metals like Fe, Pb, Hg reduce soil fertility and agricultural output[3]. The lakes have complex and fragile ecosystem, as they do not have self-cleaning ability and therefore readily accumulate pollutants[4]. The aim of this work is to determine the total contents and different fractions of Cd, Ni, Cr, Zn, Mn, Co and Cu by Tessier's sequential extraction scheme in soils irrigated with untreated sewage effluents and to evaluate the relationship between the metal concentrations and their fractional distribution in sewage irrigated soils and their uptake by vegetables (chili and gourd)[5]. The vegetables which were grown by sewage water irrigation are found to contain heavy metals. The use of sewage has significant health implications for both consumers and farmers. It has been well established that bacteria, viruses, protozoa, nematodes and fungi are capable of causing diseases can be found in foods contaminated with sewage water. Therefore, for more satisfactory results, waste water should be treated to remove harmful substances and micro-organisms before it is used for irrigation. When the vegetables / crops irrigated with sewage water, contains poisonous elements and microorganisms in a great amount [6]. Special attention has been paid to those vegetables that are eaten raw. Since the micro-organisms that settle over them are Table-1, to survive for several weeks and when these vegetables are consumed, they produced diarrhoea, Salmonellosis, Shigellosis[7]. The indiscriminate use of sewage causes clogging of soil pores resulting in decreased permeability. Lack of aeration in sewage produces toxic gases which were found to create unhygienic conditions[8].

Perishable vegetables are grown around urban areas, which are more prone to heavy metals contamination due to variety of urban and industrial activities including vehicular pollution. Continuous use of waste water for irrigation leads to accumulation of heavy metals in vegetables[9-10]. A number of serious health problems can develop as a result of excessive uptake of dietary heavy metals. Furthermore, the consumption of heavy metal contaminated food can seriously deplete some essential nutrients in the body causing a decrease in immunological defences, intrauterine growth retardation, impaired psycho-social behaviour, disabilities associated with malnutrition and a high prevalence of upper gastro-intestinal cancer[11].

The present study was planned to assess, the status of metal accumulation in different parts of vegetables grown using the sewage for agriculture. The sewage has health implications for both consumers and farmers, proper health education is indispensable.

2. Material and methods

Sewage sample is collected in a large presterilized containers and transported to the laboratory for physicochemical analysis as per standard methods[12] and Na analysis is made by Atomic Absorption Spectrophotometer. Soil sample is collected with an average depth of 5.20cm where the vegetables were growing. The soil is air dried, sieved to desired particle size for analysis. Different vegetables were dried at 800 in an oven for 24 hours to a constant weight. The dried part of the plant is homogenized with a blender to a powdery form. One 1gm of sample was digested by using AR grade chemicals such as nitric acid (HNO_3^{-}) sulphuric acid (H_2SO_4), hydrogen peroxide (H_2O_2) and perchloric acid (60%) in a 'Gerhardt' digestion unit. The solution was filtered through Whatman filter paper number 44 in a volumetric flask by adding double distilled water and the final volume is made to 100ml and analysed for heavy metals such as Zinc (Zn), Copper (Cu), Manganese (Mn) and Nickel (Ni) with a GBC-932 plus Atomic Absorption Spectrophotometer (Australia) with an air / acetylene flame and metal hollow cathode lamps. Respective wavelengths were used for the estimation of different heavy metals present in sewage soil and vegetables. Standard

solutions for heavy metals were purchased from Sociochemical laboratory Bombay (1000 µg/L). The working standards were prepared by serial dilution of standard stock solutions and were used for the calibration of the instrument[13]

TABLE 1:
HEAVY METAL ANALYSIS IN IRRIGATION WATER OF CHARKHI DADRI DISTRICT HARYANA

S.No.	Chlorine	Zinc	Copper	Manganese	Iron
S_1	605	3.55	3.30	2.65	4.60
S_2	520	3.20	3.10	2.90	4.80
S_3	520	3.20	3.15	3.15	4.90
S_4	510	3.20	4.05	3.20	4.95
S_5	515	3.30	3.90	3.10	4.90

3. Result and Discussion

Study of Heavy Metals (Fe, Cu, Zn, Mn) in irrigation Soil: -

Chloride (Cl) Chloride is essential element for plant growth, plant requirements for chloride are generally assumed to almost as great as for sulphate, Chloride is absorbed by plants through both roots and aerial parts. According to IS, Chloride tolerance limit for irrigation water and soil is 600 mg/l (17 meq/l) chloride ion concentration range in soil is from 510 to 605 ppm. These results show that this soil is deficient for optimal growth of plant.

Effect on plants: - Chlorosis in the younger leaves and on overall wilting of the plant are the two most common symptoms of chloride deficiency.

Iron (Fe)

Iron is very important element for normal metabolism of plant and animals; it is a constituentof cytochrome and non-human iron protein involved in photosynthesis, N_2 Fixation and respiratory linked dehydrogenases. The analysed irrigation water has iron range 4.60 to 4.90ppm, which shows that plant/ crops grown with this water will be iron deficient. A deficiency of iron show up first in the young leaves of plant. It does not appear to be translocated from older tissues to the meristem and a result growth ceases, the young leaves develop an ins**Table1:** Heavy Metal analysis in Irrigation Water of Charkhi Dadri Districtreviewal chlorosis, which progresses rapidly over the entire leaf. In severe conditions over the leaves turn, entirely white.

Effect of Iron on plant: - Affected plant will remain small and will not respond well to normal fertilizers treatment. Iron deficiency show up first in the younger leave of plant. It loses not appear to translocated from tissues to the meristem and as a result growth ceases. The younger leaves develop an interveinal chlorosis and progresses rapidly over the entire leaf. In severe condition over the leaves turn entire white.[14]

Copper [Cu] Copper is essential element in irrigation water. The standard Cu range for irrigation water should be from 0.12 to 3 Mg/L for plant. In the irrigation water sample analysed No. W1 to W5 have Cu range for 3.10 to 4.05 Mg/L. It is toxic and unsuitable for optimal growth of plant.

Effect of Cu on plant: - Copper is essential for plant for synthesizing chlorophyll and for the activity of some enzymes. However, at higher levels (about 0.1 mg/l) Cu can inhibit growth Blue green algae are particularly susceptible to Cu because it inhibits the nitrogen fixing toxic effects of essential carboxylic acid

The most common toxicity symptoms include growth poorly developed or malformed roots system and leaf chlorosis. The basic effect of Cu in related to the root system where it interferes with enzyme functioning. It also interferes with Photosynthesis and fatty acid synthesis. Though copper have been reported in numerous plants although it is more prevalent among crops growing in peat and musk soils, crops most susceptible to copper higher concentration includes alfalfa wheat, barely oats, lettuce, onions carrot, spinach, and table beets.

Zinc (Zn) Zinc is essential elements for plants growth. Plant requires 0.3 ppm zinc in irrigation water for their healthy growth but the analysed samples have zinc in 3.20 to 3.55 ppm range which shows that plants will show toxic effect zinc. At higher concentration, it disturbs photosynthesis process.

Effect on Zn on plant: - The most common toxicity symptoms include reduced growth. (i) Dwarfing in maize plants. (ii) New leaves emerge white in colour which is known as white bud. (iii) Upper leaves are stripped yellowing between veins. (iv) Potato leaves shows greyish-brown to bronze colouration with irregular spots in the middle. (v) In acute condition necrotic or dead area are found on new leave[15]

Manganese (Mn) Manganese is another of the transition metals required as amicronutrient. Manganese is essential elements for plant growth and animals. It isrequired for activity of some dehydrogenises, decarboxylases, Kinases oxidases, peroxidases etc. Manganese tolerance limit for Irrigation is 0.2 to 2.5 ppm, the Mn range in irrigation water sample No. W_1 to W_5 is 2.65 ppm to 3.20 ppm. This shows higher manganese in the area under investigation. Manganese is required for photosynthesis and evolution of oxygen. This metal is not a serious pollutant as in most water its concentration is quite low.The main role of Mn in plant is as an activator of enzyme associated with phosphorous reaction with the plant energy system.Mn is effective in promoting enzyme transformation.Manganese influences auxin levels in plants and it seems that high concentration of this micronutrient favour the breakdown of indoleacetic acid. Plants are injured by excessive amounts of Mn [16]

In the above study it is concluded that irrigation water of Chrakhi Dadri area is unfit for irrigation. If irrigation with this water continuous it will continue to affects plant and animal, and may cause land to become barren. So, this water should be used after proper treatment.

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