Impact of Domestic Treated Sewage Water on Crop

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***Abstract*- Rise in population and urbanization increased the fresh water demand and waste water generation. and large gap exist between natural water demand and supply of fresh water. Due to water scarcity and in order to ensure food safety it became important for farmers to search alternate source for irrigation. Efficient use of waste water generated can reduce the stress of water scarcity face by farmers. In this study a pilot field experiment was conducted in which an impact on alteration of micronutrients and heavy metals intake by crops was studied by irrigating Spinach (Spinacia oleracea) and Fenugreek (Trigonella foenum-graecum) with freshwater and treated waste water. The concentrations of micronutrients :- Zinc (Zn),Iron(Fe),Copper(Cu), and Manganese (Mn) and heavy metals :- Cobalt(Co), Cadmium (Cd),Chromium (Cr),Lead (Pb) in spinach & Fenugreek irrigated with domestic treated sewage water was observed below the critical limits. Waste water application showed increased in the yield of crops compared to irrigation with fresh water. If treated properly waste water can encounter the problem of water scarcity and fertilizers. Findings indicate that waste water treated by giving tertiary treatment using phytorid treatment plant can be used for irrigation.**

Index Terms- Treated Sewage effluent, Crops, Micronutrients, Heavy metals

I. INTRODUCTION

India is basically an agrarian country and ranks second in farm output. Major part of the country directly or indirectly depends upon it for their economy growth. Agriculture shares major part of fresh water for irrigation. Urbanization and Industrialization has reduced fresh water availability and increased waste water generation. Water required for agriculture should be met in order to ensure food safety and livelihood of dependent. Therefore it is important to take some substantial action for providing sufficient water for agriculture. According to the UNESCO (United Nations Educational, Scientific and Cultural Organization) report India may face intensified water crisis by 2050. That is why we should stress on the need of more efficient water practices in agriculture. In order to deal with the situations of water scarcity in agriculture it is important to find some alternative sources of water in agriculture.

Currently, reuse and recycling of waste water is not practiced on a large scale in India. There is considerable scope and incentive to use this alternative in irrigation [1]. In India and other countries, domestic sewage water generated from cities and towns are being used by the farmers having their land adjoining to the sewage water flowing drains. In Nagpur waste water flowing through Nag River is used mainly by farmers living in nearby it. This waste water is used by farmers in either treated and untreated form without having proper knowledge of pollutant load. Crops cultivated by using this waste water can have both positive as well as negative impacts on human health. Wastewater irrigation practiced with effluent having high pollutant load may lead to chemical degradation of lands and possible entry of pollutants / toxicants in the food chain and water table.

The pollutant level in the soil irrigated by sewage water and the crop can be more than phytotoxicity limit which can cause soil degradation, affect crop quality, may affect environment, can also impact the health of farmer and people consuming that food in the city. Thus an attempt is made to study the

"Impact of Domestic Treated Sewage Water on Crop and Agricultural Soil"

2. MATERIAL AND METHODS

In this study a pilot field experiment was conducted in Horticulture Experimental Learning unit & PG research farm, Nagpur for one year. Waste water from Nag river was treated using Phytorid based sewage treatment plant and this treated sewage was used for irrigating two crops namely Spinach (Spinacia oleracea) and Fenugreek (Trigonella foenum-graecum).

Fig 1 :- Location of experimental site

2.2 Site Preparation:-

Basins of experimental site were prepared by following RANDOMIZED BLOCK DESIGN. Randomized block design is the Most widely used experimental designs in agricultural research. Site basins were divided into 20 blocks of 1m X 1 m each. Seeds of crops were sowed in 5 rows spaced @ 20 cm. Out of 20 blocks spinach is cultivated in 10 blocks and Fenugreek in another 10.Out of this 10 blocks of each crop 5 blocks is applied with fresh water (supplied from NMC)and 5 with treated water(Sewage effluent from Nag River Nagpur treated by using Nag Nalla Sewage Treatment Crop using Phytorid technology).

2.3 Sampling of Water and Analysis:- Treated water by using Nag Nalla Sewage Treatment Crop using Phytorid technology and Water supplied from NMC was collected and analyzed for different parameters.

2.4 Crop sample collection and Analysis:-Field experiment was carried out at PG research farm, near Maharajbagh, Nagpur to investigate waste water irrigation impact on crops. Different standard methods of analysis were used for the analysis of the crop samples to assess the pollutant taken by the crop due to irrigation of the sewage water and are given below.

Table 1. Standard methods of analysis of crops

Sr. No.	Parameter	Name of method	Reference
1	Micronutrients and heavy metals.	Fe, Mn, Zn, Cu, Pb, Cr, Cd, Ni were determined using Atomic Absorption Spectrophotometer from the above digested solution	(Page, 1982).

2.4.1 Digestion of samples :- Root samples of each crops were placed in plastic sieve and washed with low pressure tap water to remove all soil particles content in it. Followed by washing of remaining parts of crops(leaf, sprout samples) by using demonized water. Cleaning of crops was done by using dilute solution of 0.005% HCL.After cleaning was done, alconox 0.1 % + water was used to wash crops for four times. Water was drained of by using filter paper and crops were dried in a oven 700 C. For chemical analysis dried crops were grounded by using hammer mill. Mineralization of crop was done by washing 1.0 g in a muffle furnace at 5000C for 10-12 hrs and the ash was dissolved in 50:50 (v/v) H2O: HCL solution (Page et al., 1982). Atomic Absorption Spectrophotometer was used for chemical analysis of crops.

3. RESULTS AND DISCUSSION:

I. Analysis of Water Sample

Sewage effluent from Nag River Nagpur is treated by using Nag Nalla Sewage Treatment Plant using Phytorid technology. This Treated water and Water supplied from NMC was collected and analyzed for different parameters.

Sr No.	Parameters	Domestic treated effluent	Fresh water	Permissible Limits (As per FAO)
1	PH	7.1±0.12	7.5±0.76	6.5-8.4
2	EC(	0.644±0.18	0.441±0.0	0 - 3

	dS/m)		17	
3	SAR	0.702±0.098	0.658±0.056	<3
4	Carbonates (mg/l)	0.619±0.068	0.321±0.013	0-3
5	Bicarbonates (mg/l)	4.076± 0.23	3.403±0.036	610
6	Chlorides (mg/l)	3.938±0.98	1.584±0.84	1050
7	Calcium (mg/l)	4.408±0.096	2.868±0.09	400
8	Magnesium (mg/l)	1.519±0.32	0.770±0.09	60
9	Sodium (mg/l)	1.166±0.022	0.856±0.014	920
10	BOD (mg/l)	4.429±0.32	1.733±0.084	100
11	COD (mg/l)	16.05±0.54	6.185±0.074	250
12	TDS (mg/l)	426.93±0.67	297.46±0.85	2000
13	Nitrogen (mg/l)	3.959±0.24	1.177±0.098	5
14	Phosphate(mg/l)	1.381±0.81	0.267±0.087	2
15	Potassium (mg/l)	0.327±0.07	0.226±0.016	2

II. Analysis of crop
Variety :All Green
Plot size 1m x 1m
Replication :10

Date of Sowing :
Statistical Design :Randomized Block design
Plot to plot distance : 1 m
Spacing:20 cm row spacing with isolation of 1m on each side

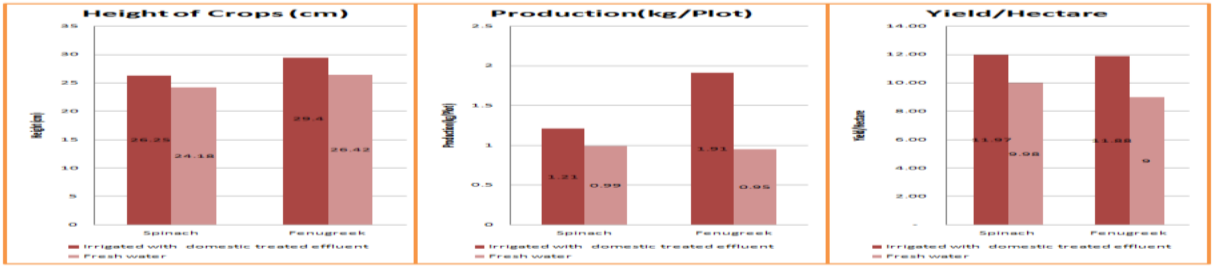
i) Fertilizer Dose: University, recommended doses of fertilizers and standard irrigation scheduling was followed.
ii) Irrigation: Measured quantity of irrigation was provided through water meter in both the treatment plot. In all total 8 irrigations of 8 cm depth were provided from
iii) Growth Parameters: The crop height of the spinach and fenugreek crop was recorded at the time of harvest i.e after 39 DAS similarly yield in kg per plot and yield in ton per ha was recorded on weight basis from the treatment plot.
iv) Incidence of pest and disease: Occurrence of pest and disease were nil.
v) Visual Observations:

SPINACH

Sr. No.	Parameters	Irrigated with domestic treated effluent	Fresh water
1	Height	26.25 cm	24.18 cm
2	Production	1.21 kg/plot	0.99 kg/plot
3	Yield/ hectare	11.97 tonne	9.98 tonne

FENUGREEK

Sr. No.	Parameters	Irrigated with domestic treated effluent	Fresh water
1	Height	29.40 cm	26.42 cm
2	Production	1.91 kg/plot	0.95 kg/plot
3	Yield/ hectare	11.88 tonne	9.00 tonne

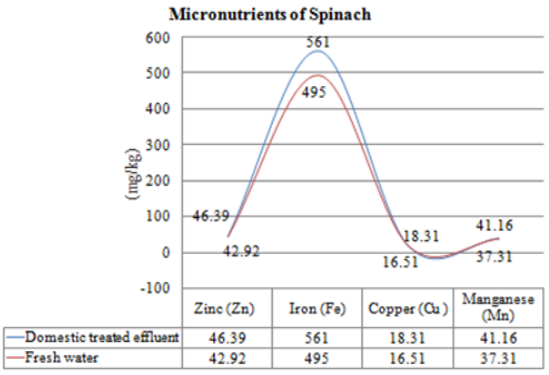


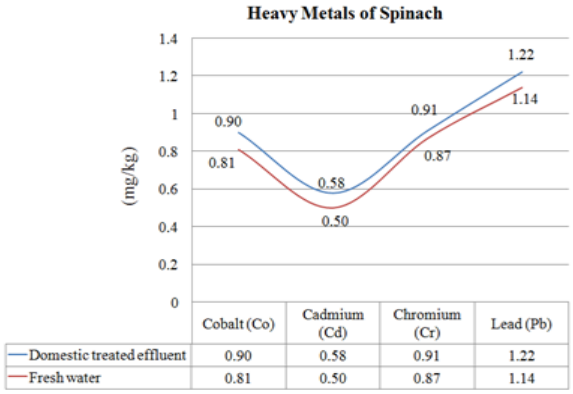
vi) Concentration of micronutrients in Spinach

Treatments	Micronutrients (mg/kg)			
	Zinc (Zn)	Iron (Fe)	Copper (Cu)	Manganese (Mn)
T1- Treated Water	46.39	561	18.31	41.16
T2 - Fresh Water	42.92	495	16.51	37.31
Safe Limit	1-400	500	20-1000	5-20

vii) Concentration of Heavy Metals in Spinach

Treatments	Heavy Metals (mg/kg)			
	Cobalt (Co)	Cadmium (Cd)	Chromium (Cr)	Lead (Pb)
T1- Treated Water	0.90	0.58	0.91	1.22
T2 - Fresh Water	0.81	0.50	0.87	1.14
Safe Limit	0.02-1	0.1-2.4	0.03-1.4	0.2-20



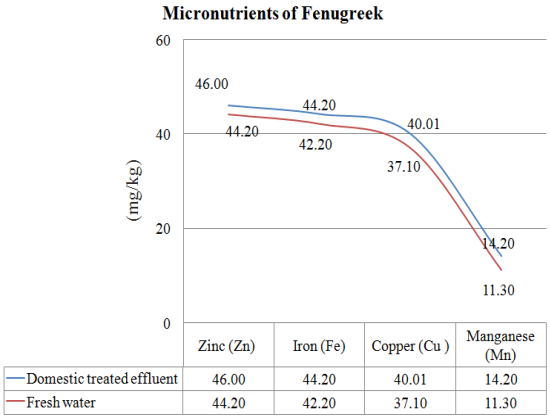


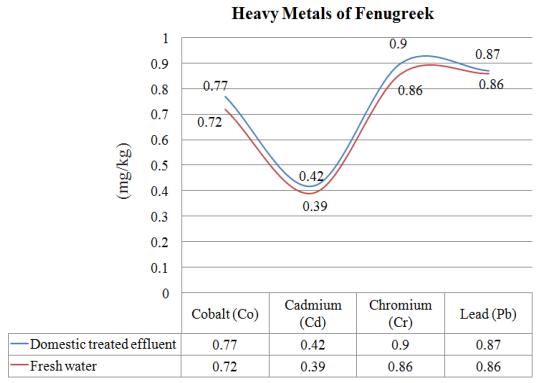
viii) Concentration of micronutrients in Fenugreek

Treatments	Micronutrients (mg/kg)			
	Zinc (Zn)	Iron (Fe)	Copper (Cu)	Manganese (Mn)
T1-Treated Water	46	44.2	40.01	14.2
T2 - Fresh Water	44.2	42.2	37.1	11.3
Safe Limit	1-400	500	20-1000	5-20

ix) Concentration of Heavy Metals in Fenugreek

Treatments	Heavy Metals (mg/kg)			
	Cobalt (Co)	Cadmium (Cd)	Chromium (Cr)	Lead (Pb)
T1-Treated Water	0.77	0.42	0.90	0.87
T2 - Fresh Water	0.72	0.39	0.86	0.86
Safe Limit	0.02-1	0.1-2.4	0.03-1.4	0.2-20





4. DISCUSSION & CONCLUSION

Domestic treated sewage water proved to be good nutrient source for crops. It was observed that percentage of organic matter, micronutrients was within safe limits. The concentrations of micronutrients (Zn, Fe, Cu, and Mn) and heavy metals like Co, Cd, Cr and Pb in spinach , Fenugreek and soil irrigated with treated waste water was below the critical limits prescribed for the phytotoxicity of these metals. Use of treated waste water for irrigation increased the yield of crops compared to irrigation with fresh water. If managed properly it can encounter the problem of water scarcity and fertilizers. Findings indicate that waste water treated

by giving tertiary treatment using phytorid treatment plant can be used for irrigation.

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