Micronutrient and heavy metal status of sewage irrigated cabbage

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***Abstract*: In present study micronutrient and heavy metal status of cabbage grown on sewage water is evaluated. The study was carried out during year 2008-2010. The study revealed that micronutrients as well as heavy metals are in high concentration in sewage irrigated cabbage than sewage un-irrigated one.**

***Keywords*: Sewage water, micronutrients, trace elements cabbage**

I. Introduction

Use of sewage water for irrigation especially for vegetable crops is increasing worldwide. Sewage water varies from well water in its contents. The micronutrients and heavy metals are beneficial for vegetable crops. But prolonged use of sewage water can lead to accumulation of toxic chemicals in soils and crops. This can cause long term toxic effect on human health through food chain, Ahmednagar, a growing city of Maharashatra (India) produces large domestic waste water. From past few decades this sewage water is used for irrigation of vegetable crops in areas adjoining to Sina river. In present investigation, a comparative study of micronutrient and heavy metal status of sewage irrigated and non-irrigated cabbage is carried out.

II. Material Method

Collection of plant samples

The samples of cabbage (five) were collected at each site selected at Nalegaon and Burudgaon road. The cabbage samples (two) were also collected from area where cabbage is grown on the soil where sewage water is not used for irrigation. Thus in all 7 plant samples were collected (Table 3)

Table 1. Details of plant sampling

Sr No	Name of site/village	Sample No
A	**Sewage water**	
1	Nalegaon	Nalegaon Plant 1
2	Nalegaon	Nalegaon Plant 2
3	Nalegaon	Nalegaon Plant 3
4	Burudgoan	Burudgaon Plant 1
5	Burudgoan	Burudgaon Plant 2
B	**Sewage Unirrigated**	
1	Nepti	Nepti Plant 1
2	Nepti	Vilad Plant 1

Collection and preparation of plant samples

Representative composite cabbage samples were collected and oven dried at 55o C. The samples were processed by using Willey grinding Mill and preserved for analysis.

Plant analysis

Nitrogen-Nitrogen from plant sample was estimated by Microkjeldahl method as described by Parkinson and Allen (1975).
Phosphorous -It was estimated by Vanadomolybdate phosphoric acid yellow colour method as described by Jackson (1973).
Potassium-It was estimated by Flame photometric method as described by Jackson (1973).
Calcium-It was estimated by Versanated titration method as by Chapman and Pratt (1961).
Micronutrients Fe, Mn, Zn, Cu-The micronutrients in plant were estimated on Atomic absorption spectrophotometer as described by Zoroski and Burau (1977).
Heavy metals Cd, Cr, Ni, As-The heavy metals were estimated on Atomic absorption spectrophotometer As described by Page et al. (1982)
Ascorbic acid-It is estimated by Titrimetric 2, 6 dichlorophenol indophenol dye (reduction) method as described by Ranganna (1977).
Total Soluble Solids (T.S.S.)- It was estimated by Refractometer as described by A.O.A.C. (1975).
Reducing Sugar-It was estimated by colorimetric (Nelson and Somogyi) method as described by Nelson (1944).

Statistical analysis
The correlation between soil properties and the total and available concentration of trace elements was carried out as suggested by Panse and Sukhatme (1985).

Table 2 Nutrient and trace element concentration in cabbage

Parameter	Sewage irrigated cabbage					Sewage unirrigated cabbage	
	Nalegaon	Nalegaon	Nalegaon	Burudgaon	Burudgaon	Nepti	Vilad
Nitrogen %	4.20	4.56	3.64	4.62	4.90	1.82	1.12
Phosphorus %	0.330	0.240	0.274	0.470	0.347	0.224	0.123
Potassium %	2.10	1.90	1.40	2.55	2.00	1.625	1.27
Calcium %	2.10	2.30	2.00	2.40	2.30	2.10	2.00
Fe,mg kg^{-1}	524.00	749.25	617.25	1361.00	857.25	771.00	702.00
Mn, mg kg^{-1}	250.50	186.25	204.25	197.50	263.00	30.50	28.25
Zn, mg kg^{-1}	101.25	117.75	113.50	132,50	159.75	74.75	70.25
Cu, mg kg^{-1}	118.75	120.00	125.50	134.25	138.00	17.50	15.75
B, mg kg^{-1}	7.183	7.567	6.800	7.662	6.896	6.700	6.995
Cd, mg kg^{-1}	3.00	2.75	2.25	2.50	3.25	0.50	0.75
Cr, mg kg^{-1}	2.20	2.45	2.475	1.625	1.75	1.75	0.55
Ni, mg kg^{-1}	123.75	135.25	135.00	130.20	140.00	78.00	70.00
As, mg kg^{-1}	7.50	6.00	9.00	8.00	7.00	0.50	0.50

Table 3 Nutrient and trace element concentration in Cabbage

Parameter	Sewage irrigated Cabbage					Sewage unirrigated cabbage	
	Nalegaon	Nalegaon	Nalegaon	Burudgaon	Burudgaon	Nepti	Vilad
Ascorbic acid mg 100 g^{-1}	32.5	31.5	17.3	36.1	23.3	36.8	40.5
T.S.S. %	13.20	8.3	8.0	6.0	7.2	7.9	8.1
Reducing sugar %	16.75	20.00	21.00	16.50	14.00	22.25	23.50

Nutrient and trace elements concentration in cabbage as influenced by sewage irrigation
The concentration of nutrients as well as trace in elements in the cabbage grown on sewage irrigation was studied in order to know the accumulation of heavy metals in plant. Similarly the concentration of these elements was also estimated in the cabbage grown on the soils of sewage free areas.
Nitrogen-The nitrogen concentration in cabbage grown on sewage irrigated soils ranged from 3.64 to 4.90 percent (Table 2). The nitrogen concentration in cabbage grown on sewage free soils ranged from 1.12 to 1.82 percent. The higher concentration of nitrogen was observed in the cabbage grown on sewage fed soils.
Phosphorus- The phosphorus content in cabbage grown on sewage irrigated soils ranged from 0.24 to 0.47 percent. The phosphorus concentration in cabbage grown on sewage free soils ranged from 0.123 to 0.224 percent.
Pottassium- The potassium content of cabbage grown on sewage irrigated soils ranged from 1.4 to 2.55 percent (Table 2). The potassium content of cabbage of grown on sewage free soils ranged from 1.27 to 2.55 percent (Table 2).
Calcium- The concentration of calcium in cabbage grown on sewage irrigated soils ranged from 2.0 to 2.4 percent while in cabbage grown on sewage from 2.0 to 2.4 percent while in cabbage grown on sewage free soils it varied from 2.0 to 2.1 percent indicating a slight increase in the calcium concentration.
Trace elements-The concentration of Fe, Mn, Zn, Cu, B in cabbage grown on sewage fed soils ranged fom 524 to 1361 mg kg^{-1} **,** 186.25 to 263 mg kg^{-1} **,** 101.25 to 159.75 mg kg^{-1} **,** 118.25 to 138 mg kg^{-1} **,** 6.80 to 7.662 mg kg^{-1} respectively. According to Tandon (1993) a concentration of Fe at more than 200 mg kg^{-1} in Zn at more than 250 mg kg^{-1} and Cu at more than 15 mg kg^{-1} in cabbage is considered as high. Thus, it is observed that the concentration of Fe, Mn and Cu in accumulation of these elements in excess which may cause nutrient imbalance in plant resulting into decline in growth and yield.
The concentration of Cd, Cr, Ni, As ranged from 2.25 to 3.25 mg kg^{-1} , 1.625 to 2.475 mg kg^{-1} , 123.75 to 142.75 mg kg^{-1} , 7.5 to 8.0 respectively. Heavy metals concentration were also high in sewage irrigated cabbage as compared to that in sewage unirrigated cabbage.
Quality of vegetable as influenced by sewage irrigation
Ascorbic acid- The ascorbic acid content in cabbage grown on sewage irrigated soils ranged from 17.3 to 36.1 mg 100 g^{-1} sewage unirrigated cabbage ranged from 36.8 to 40.5 (Table 3)
Total soluble solids

The total soluble solids of sewage irrigated cabbage ranged from 6.0 to 13.20 percent. The total soluble solids of sewage unirrigated cabbage ranged from 7.9 to 8.1 percent (Table 3)

Reducing sugars-The reducing sugars in the cabbage grown in sewage water ranged from 14.5 to 20.25 percent. The reducing sugars of sewage unirrigated**.** Cabbage ranged from 22.25 to 23.50 percent (Table 3)

Thus, it was observed that the ascorbic acid and reducing sugar was lowered in the cabbage, grown on sewage irrigate soils as compared cab with cabbage grown on sewage free areas.

The use of sewage water as irrigation although observed to increase the essential plant nutrient status in respect of N, P, K and Ca the higher concentration of trace elements added through sewage may cause potential toxicity problems.

Thus, it was observed that the concentration of Fe, Mn and Cu was considerably higher in cabbage grown on sewage irrigated soils which being excessive as compared to standard nutrient norms may cause imbalance of nutrients in plant. Further, the concentration of trace elements like Cu, higher than the phytotoxicity limits of 50 mg Kg^{-1} and Chromium more than 2 mg Kg^{-1} in grown cabbage on sewage irrigated soils may be phytotoxic and become potentially harmful affecting optimal growth and development of plant. Similarly, the Cadmium concentration above the suggested permissible limit may enter the food chain resulting into human health hazard.

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