MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2086-2098

Evaluate the Effect of Sewage Water on Soil Properties, Heavy Metal Contamination in Plant and Livestock Blood Serum

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Abstract:
Present investigation was carried out on "to evaluate the effect of sewage water on soil properties, heavy metal contamination in plant and livestock blood serum**"** For conducting the experiment representative soil, fodder, blood serum and water samples were collected from sewage drainage near Cattle Cross Breeding Project located in Parbhani district of Marathwada region during the year 2019-2020 to determine the heavy metal content and its contamination on soil nutrient status and plants. Forty representative GPS based soil samples were collected from the selected field from 0-30 cm depth depending upon the area in *Kharif* and *Rabi* season for estimation of nutrients in order to know the heavy metals and soil nutrient contents. The soil and fodder samples were collected from the field in vicinity of sewage drainage. The physicochemical properties of survey area were found to be slightly alkaline in reaction, safe in soluble salt concentration, low too high in organic carbon content, slightly calcareous in nature. The pH, EC and organic carbon of soil samples were observed more in *Rabi* season than in *Kharif* season. DTPA extractable heavy metals of survey area *viz.* lead (Pb), nickel(Ni) and cobalt(Co) had shown significance of sewage water in *Rabi* season as compared to *Kharif* season, the levels of heavy metals in studied soil was found below the various maximum permissible limit and safe except cadmium (Cd) shows more concentration than critical limit. Total heavy metal content in soil samples were also found below than critical limit and safe except cobalt, Cadmium and Mercury. The total heavy metals in fodder samples in *Kharif* and *Rabi* season grown in vicinity of sewage water shows maximum. Total heavy metal content of fodder samples were also found below critical limit and safe. Heavy metal content in blood serum of cattle, such as cobalt, nickel, cadmium, lead, aesenic, mercury and selenium were recorded more in *Rabi* season as compared to *Kharif* season. Blood serum sample of cattle found sufficient in copper, zinc and manganese deficient in iron. In sewage water pH was near about neutral.

Keywords: Blood Serum, Organic Carbon, Cobalt, Cadmium and Mercury, pH, EC.

INTRODUCTION

Scarcity of good quality fresh water and increasing population forced people to use poor quality water for agricultural activities. Effect of global climate change results in poor and uneven rainfall over the world which has also imposed the use of sewage water for crop production. Sewage water contains very low concentration of heavy metals but the long term use of this water may build-up notable amount of these metals, if used for irrigation (Dotaniya *et al*., 2018).

Concentrations of heavy metals can be occurred in water, soil, fodder, livestock tissues and organs and in livestock products also. The root through which heavy metal enter to agricultural soils are atmospheric deposition, sewage sludge, animal manures, agrochemicals and inorganic fertilizers. Dust fall, bulk precipitation and gas or aerosol adsorption process are responsible for transfer of heavy metal from atmosphere to the soil and vegetation from distant sources increases level of toxic metal and these will be absorbed by the plant and transferred up to the food chain. The transfer of heavy metal from the soil to plant is depend upon soil properties, plant species and metal bioavailability. Generally hazardous effects of these metals depend upon dietary concentration of the element, elements taken by the system, homeostatic control of the body and obviously on species of animal involved (Makridis *et al*., 2012). Distribution of this heavy metal in soil is governed by reactions of heavy metals like mineral precipitation and dissolution, ion exchange, adsorption and desorption, aqueous complexation, biological immobilization and mobilization and plant uptake (Lone *et al*., 2003). Soils are occasionally treated with Cu as an addition to soil if the land is Cu deficient. Similarly, Mn is supplied to cereal and root crops. In intensive farming large quantities of fertilizers are added to supply significant amount of N, P and K for crop growth. This compound contains trace amount of heavy metals (e.g. Cd and P) as impurities. Continue application of this compound may significantly increase their amount in the soil. Zinc is an essential metal having important enzymatic and regulatory roles in biological systems. Heavy metals caused reduction in richness of bacterial species and relative increase in actinomycetes species or can decrease in biomass and diversity of the bacterial communities found in contaminated soil. High concentration of Zn may cause rot, chlorosis and suppress the development of plants, while gastrointestinal misery, loose bowels, pancreatic harm, and sickliness in both people and animals. (Cocoros *et al*., 1973). Excess concentration of trace metals in soil affects the seed germination, growth, yield and quality of agricultural crops (Dotaniya *et al*., 2018). Precipitate of heavy metals present onto topsoil increases human health risk and magnification of element accumulated heavy metals into plants grown on topsoil. Thus vegetables and fruits contain high amount of heavy metals (Orisakwe *et al*., 2012). Toxic level of Cu can stimulate alterations in photosynthesis, respiration, enzyme activity, DNA and membrane integrity which lead to stunted growth and make plant survival endangered. So that it's concentration within cellular component should be maintained (Rehman *et al*., 2019). In animal body, animals' feeds, green fodder, drinking water and pharmaceutical medicines, etc. are the sources of heavy metals entry. Accidental access to limed field, mineral supplements with high content of trace metal

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2086-2098

and licking of painted surfaced containing metallic pigments are also responsible for heavy metals entry (Mukesh *et al*., 2008). Environmental factors show close relationship with mineral status of forages of various type. Mineral status of forage plants is affected by soil factors like pH, drainage, fertilization and plant factors like variability of forage species and maturity of forage plant. It has long been reported that deficiency of plant nutrients like copper (Cu), Cobalt (Co), and Iron (Fe) in feed and fodder cause nutritional anemia or 'salt sick' disease in cattle. Ruminant animals survive on such feed and fodder suffers from mineral deficiency (Fine *et al*., 1941). Lead is water soluble and transported through atmosphere. It acts like calcium for body and deposit in bone, liver, kidney and other tissues. In animal, sometimes chelation treatment leads to fatal outcome due to urgent surge of lead from the accumulated site to blood which leads to severe damages to kidney and brain (Swarup *et al*., 2005). Lead produces acute and chronic poisoning. In case of acute poisoning fatality may go up to highest level i.e. 100%. In cattle, due to acute lead toxicity there is sudden onset of signs and the animal may succumb within one day i.e. 24 hours at pasture (Mukesh *et al*., 2008). Arsenic shows chronic and acute toxicity. Chronic poisoning shows disorders like weight loss, capricious appetite, conjunctively and mucosal erythematic lesion with mouth ulcer and reduce milk yield. While acute toxicity cause abdominal cramping, hyperesthesia in extremities, abdominal patellar reflexes and abdominal electrocardiogram. Major sources of mercury pollution are sewage water from the chloroakali industry and industrial waste. In most of the animals shows toxicosis symptoms like coordination of movement, visual aberration and decline in awareness. Few years before Japan was suffered from Minamata disease caused due to mercury toxicity including symptoms as fatigue, loss of memory and concentration constriction of visual field, cortical blindness etc. (Jarup *et al*., 2003). Nausea, vomiting, jaundice and liver necrosis, damage to the proximal tubules of the kidney and hemolytic anaemia are the signs of copper toxicity. In man Wilson's disease is a form of chronic copper toxicity with signs like mental alterations, motor abnormalities, dysphagia, ataxia hemolytic anaemia, renal dysfunction, renal stones and hepatic failure (Orisakwe *et al*., 2017).

MATERIALS AND METHODS

The present investigation was carried out on **"**To determine heavy metal contamination in soil, from sewage water disseminated**"** For conducting the experiment representative soil and water samples were collected from sewage drainage near Cattle Cross Breeding Project located in Parbhani district of Marathwada region during the year 2019-2020. Parbhani district situated at a height of about 423.46 meters above the mean sea level within the Godavari drainage basin in the central part of India between 76^0, 46' East longitude and 19^0, 16' North longitude. The surface (0-30 cm) GPS based soil samples was collected randomly by avoiding any metallic contamination with the help of screw auger and scoop. The soil and fodder samples were collected from the field in vicinity of sewage drainage which is located near Cattle Cross Breeding Project. The water samples were collected from well, bore well and sewage drainage. For sampling, whole fodder was taken from representative field in *Kharif* and *Rabi* season. Plant samples were collected at random, from working field, covering whole field (Bansal *et al*., 2004). Blood samples (20) will collect using fresh needle in sterilized test tubes from cattle from Jugular vein punctures under guidance of veterinary doctors. After collection of blood in test tubes, they kept in slanting position, serum comes out from blood was collected in separate sterilized vials and stored in deep freeze (4^0C) for analysis. The correlation coefficient of all data will be worked out by standard statistical procedure. (Panse and Sukhatme, 1985).

Table 1. GPS location of survey area

Sr. No	Sample site	GPS
1	NECS1	N19^{0}13'56.3" E76^0 47'07.0"
2	NECS$_2$	N19^{0}13'57.1" E76^{0}47' 08.0"
3	NECS$_3$	N19^{0}13' 57.6" E76^{0}47' 09.7"
4	NECS$_4$	N19^{0}13' 54.3" E76^0 47' 03.7"
5	NECS$_5$	N19^{0}13' 53.6" E76^0 47' 07.7"
6	NWCS$_1$	N19^{0}14' 00.5" E76^0 47' 04.3"
7	NWCS$_2$	N19^{0}14' 00.2" E76^0 47' 03.9"
8	NWCS$_3$	N19^{0}14' 00.2" E76^0 47' 02.9"
9	NWCS$_4$	N19^{0}14' 01.2" E76^0 47' 03.5"
10	NWCS$_5$	N19^{0}14' 01.8" E76^0 47' 03.3"
11	NNES$_1$	N19^{0}14' 03.6" E76^0 47' 08.5"
12	NNES$_2$	N19^{0}14' 04.7" E76^0 47' 09.6"
13	NNES$_3$	N19^{0}14' 03.9" E76^0 47' 12.1"
14	NNES$_4$	N19^{0}14' 03.2" E76^0 47' 13.3"
15	NNES$_5$	N19^{0}14' 01.3" E76^0 47' 12.8"
16	NNWS$_1$	N19^{0}14' 06.2" E76^0 47' 06.7"
17	NNWS$_2$	N19^{0}14' 06.4" E76^0 47' 06.0"
18	NNWS$_3$	N19^{0}14' 08.2" E76^0 47' 06.4"
19	NNWS$_4$	N19^{0}14' 07.7" E76^0 47' 07.3"
20	NNWS$_5$	N19^{0}14' 06.7" E76^0 47' 07.6"

RESULTS

Chemical properties of soil under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Soil pH

From present investigation the data on pH of soil samples collected from CCBP farm VNMKV, Parbhani are reported in Table 2. The soil samples collected in *Kharif* season have pH value ranged from 7.23 to 8.14 and 7.47 to 8.26 in *Rabi* season with mean 7.86 and 7.95 in *Kharif* and *Rabi* season respectively. More values were found in *Rabi* season as compared to *Kharif*. The result revealed that maximum pH was observed in *Rabi* than *Kharif* season. It can be occurred due to leaching of basic cations (eg. Ca^{+2}, Mg^{+2}, K^{+}) from soil profile, left behind more stable materials rich in Al^{+3} and Fe^{+2} oxides and generally devoid of nutrients Uchida and Hue, (2000).

Electrical conductivity (EC)

EC of soil samples collected from CCBP farm VNMKV, Parbhani are reported in Table 2. It was showed the range of EC varied from 0.25 dSm^{-1} to 1.91 dSm^{-1} in *Kharif* season and 0.28 to 1.98 dSm^{-1} with an average 0.65 dSm^{-1} and 0.72 dSm^{-1}respectively. Higher value of EC was observed in *Rabi* season as compared to *Kharif* season. The results revealed that the soils were normal to electrical conductivity.

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ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2086-2098

Table 2. Physico-Chemical properties of soil under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	Sample site	PH		E. C. (dSm^{-1})		Organic Carbon (gKg^{-1})	
		Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
1	NECS1	7.23	7.50	1.31	1.45	5.80	6.30
2	$NECS_2$	7.59	7.69	1.91	1.98	3.20	4.60
3	$NECS_3$	7.29	7.47	0.48	0.49	5.10	5.90
4	$NECS_4$	7.60	7.67	0.46	0.49	5.50	5.80
5	$NECS_5$	7.76	7.79	1.25	1.52	4.30	4.80
6	$NWCS_1$	7.79	7.82	1.43	1.49	3.90	4.90
7	$NWCS_2$	8.00	8.02	0.52	0.58	4.20	5.60
8	$NWCS_3$	8.00	8.18	0.59	0.66	6.40	6.50
9	$NWCS_4$	8.12	8.17	0.92	0.95	4.30	4.80
10	$NWCS_5$	8.02	8.09	0.72	0.78	5.50	5.80
11	$NNES_1$	8.00	8.02	0.56	0.60	3.80	3.90
12	$NNES_2$	8.08	8.14	0.28	0.30	4.40	4.46
13	$NNES_3$	8.09	8.12	0.29	0.30	3.00	3.30
14	$NNES_4$	8.08	8.26	0.50	0.50	4.50	4.60
15	$NNES_5$	8.14	8.26	0.25	0.28	1.50	1.30
16	$NNWS_1$	8.00	8.06	0.30	0.31	3.70	3.90
17	$NNWS_2$	7.89	7.96	0.46	0.58	8.40	8.70
18	$NNWS_3$	7.83	7.84	0.28	0.36	3.20	3.80
19	$NNWS_4$	8.10	8.19	0.32	0.47	2.80	2.70
20	$NNWS_5$	7.74	7.80	0.33	0.38	1.20	1.60
	Mean	7.86	7.95	0.65	0.72	4.23	4.46

Organic carbon

Values of organic carbon content of soil samples collected from CCBP farm VNMKV, Parbhani are reported in Table 2. Data were varied from 1.20 g Kg^{-1} – 8.40 g Kg^{-1} with an average 4.23 g Kg^{-1} in *Kharif* while, in *Rabi* it was ranged from 1.30 – 8.70 g Kg^{-1}with mean 4.46 g Kg^{-1}. The results revealed that the soil organic carbon content were low to high. Organic carbon increase in cultivated soil due to natural occurrence organic matter in soil resulting from decomposition by microbes. These conditions also occur in forest soil. Values were found to be increased in *Rabi* season as compared to *Kharif* season may be because organic carbon content decreases with increase in temperature. Kirschbaum (1995), Albercht, (1995), and decomposition rates (microbial respiration) doubles with every 10^0C increase in the temperature Schlesinger, (1997), Hartel, (2005).

Total heavy metal and micro nutrients content in Marvel grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Table 3. Total heavy metal content in Marvel grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	Name of Fodder	Total Cobalt (mg Kg^{-1})	Total Nickel (mg Kg^{-1})	Total Cadmium (mg Kg^{-1})	Total Lead (mg Kg^{-1})	Total Mercury (mg Kg^{-1})	Total Arsenic (mg Kg^{-1})	Total Selenium (mg Kg^{-1})
1	MGS1	0.72	26.48	0.28	326.96	0.08	0.028	1.16
2	MGS2	0.82	24.16	0.23	372.78	0.04	0.048	1.88
3	MGS3	0.70	27.24	0.26	342.78	0.03	0.078	2.56
4	MGS4	0.64	28.68	0.34	387.86	0.07	0.042	6.74
5	MGS5	0.65	26.34	0.16	339.47	0.09	0.064	6.51
6	MGS6	0.60	22.76	0.22	375.82	0.07	0.062	3.16
7	MGS7	0.94	27.48	0.23	401.83	0.11	0.064	2.98
8	MGS8	0.73	28.74	0.15	417.68	0.09	0.052	1.44
9	MGS9	0.77	26.40	0.22	399.46	0.03	0.056	7.62
10	MGS10	0.92	29.71	0.30	423.78	0.04	0.036	5.43
11	MGS11	0.81	20.14	0.29	406.71	0.06	0.029	7.28
12	MGS12	0.48	22.42	0.35	374.62	0.09	0.028	4.18
13	MGS13	0.58	23.68	0.27	370.84	0.01	0.042	2.92
14	MGS14	0.78	19.43	0.36	356.76	0.10	0.046	5.61
15	MGS15	0.28	24.36	0.34	423.95	0.02	0.039	7.70
16	MGS16	0.78	27.52	0.24	391.32	0.11	0.048	3.26
17	MGS17	0.46	18.47	0.20	436.72	0.06	0.028	4.14
18	MGS18	0.84	20.26	0.33	414.08	0.06	0.027	1.86
19	MGS19	0.66	21.82	0.28	349.76	0.07	0.043	1.42
20	MGS20	0.98	18.12	0.37	375.08	0.04	0.026	1.22
Mean		0.70	24.21	0.27	384.41	0.06	0.044	3.95

Total Cobalt (Co)

The samples of marvel grass collected from CCBP farm VNMKV, Parbhani in *Kharif* season for total cobalt showed in Table 3, that cobalt ranges from 0.28 mg kg^{-1} to .98 mg kg^{-1} with mean value 0.70 mg kg^{-1}.

Total Nickel (Ni)

The samples of marvel grass collected in *Kharif* season from CCBP farm VNMKV, Parbhani for total nickel content and the data of nickel showed in Table 3, that nickel ranges from 18.12 mg kg^{-1} to 29.71 mg kg^{-1} with an average value 24.21 mg kg^{-1}. The results found below permissible limit given by WHO i.e. 0.67 (1989). Similar results were shown by Barman *et al*., (2000).

Total Cadmium (Cd)

The marvel grass samples collected in *Kharif* season from CCBP farm VNMKV, Parbhani for total cadmium content and the data of cadmium showed in Table 3 that copper ranges from 0.15 mg kg^{-1} to 0.37 mg kg^{-1} with an average of 0.27 mg kg^{-1}. The results found below permissible limit given by WHO i.e. 0.67 (1989). Similar results were shown by Barman *et al*., (2000).

Total Lead (Pb)

The samples of marvel grass collected from CCBP farm VNMKV, Parbhani in *Kharif* season for total lead showed in Table 3 that lead ranges from 326.96 mg kg^{-1} to 436.72 mg kg^{-1} with mean value 384.41 mg kg^{-1}. Lead concentration found with in Indian standard (Arora *et al*.,

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2086-2098

2017).

Total Mercury (Hg)

The samples of marvel grass collected in *Kharif* season from CCBP farm VNMKV, Parbhani for total mercury content and the data of manganese showed in Table 3 that mercury ranges from 0.01 mg kg^{-1} to 0.11 mg kg^{-1} with average 0.06 mg kg^{-1}.

Total Arsenic (As)

The marvel grass samples collected in *Kharif* season from CCBP farm VNMKV, Parbhani for total arsenic content and the data of arsenic showed in Table 3 that arsenic ranges from 0.026 mg kg^{-1} to 0.04 mg kg^{-1} with mean 0.44 mg kg^{-1}.

Total Selenium (Se)

The samples of marvel grass collected from CCBP farm VNMKV, Parbhani in *Kharif* season for total selenium showed in Table 3 that selenium ranges from 1.16 mg kg^{-1} to 7.70 mg kg^{-1} with an average 3.95 mg kg^{-1}.

Total Iron (Fe)

Iron is important for formation of chlorophyll and protein synthesis in plants. During respiration iron acts as oxygen carrier (leghaemoglobin). Deficiency of iron causes interveinal complete chlorosis and scorching of leaf margin. The marvel grass samples collected in *Kharif* season from CCBP farm VNMKV, Parbhani for total iron content and the data of iron showed in Table 4, that iron ranges from 264.34 mg kg^{-1} to 482.10 mg kg^{-1} with an average of 377.70 mg kg^{-1}.

Table 4. Micro nutrient content in Marvel grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	Name of Fodder	Total Iron (mg Kg^{-1})	Total Zinc (mg Kg^{-1})	Total Manganese (mg Kg^{-1})	Total Copper (mg Kg^{-1})
1	MGS1	395.67	53.83	47.33	16.33
2	MGS2	379.50	55.00	30.16	14.33
3	MGS3	400.68	36.50	38.66	14.00
4	MGS4	303.17	46.16	53.16	14.33
5	MGS5	383.13	42.83	68.35	12.00
6	MGS6	390.50	33.00	60.16	13.83
7	MGS7	336.68	52.83	52.00	16.16
8	MGS8	264.34	30.66	65.33	14.66
9	MGS9	311.67	44.16	42.66	13.66
10	MGS10	383.34	36.66	45.33	15.00
11	MGS11	466.17	47.33	42.66	15.83
12	MGS12	293.67	32.33	52.16	13.83
13	MGS13	334.51	49.00	47.89	15.33
14	MGS14	352.67	40.66	42.83	13.16
15	MGS15	346.53	51.74	39.85	14.36
16	MGS16	382.34	53.00	49.00	15.83
17	MGS17	433.43	44.00	44.50	16.00
18	MGS18	482.10	34.63	41.00	14.47
19	MGS19	464.84	38.83	62.66	14.83
20	MGS20	449.17	43.00	52.67	13.66
	Mean	377.70	43.30	48.91	14.58

Total Zinc (Zn)

Zinc plays important role in biosynthesis of hormones and photosynthesis. Zinc also plays important role in synthesis of chlorophyll, carbohydrate, and starch formation. The samples of marvel grass collected from CCBP farm VNMKV, Parbhani in *Kharif* season for total zinc showed in Table 4, that zinc ranges from 30.66 mg kg^{-1} to 55.00 mg kg^{-1} with an average 43.30 mg kg^{-1}. Similar results were shown by Khan *et al*., (2015).

Total Manganese (Mn)

Manganese plays important role in photosynthesis and respiration and formation of chlorophyll. It also acts as a co-factor coenzyme and catalylist in redox reaction. The samples of marvel grass collected in *Kharif* season from CCBP farm VNMKV, Parbhani for Table 4, manganese content and the data of manganese showed in Table that iron ranges from 30.16 mg kg^{-1} to 68.35 mg kg^{-1} with an average 48.918 mg kg^{-1}.

Total Copper (Cu)

Copper is important constituent of plastocyanin and required in low amount. The marvel grass samples collected in *Kharif* season from CCBP farm VNMKV, Parbhani for copper content and the data of copper showed in Table 4, that copper ranges from 12.00 mg kg^{-1} to 16.00 mg kg^{-1} with an average 14.58 mg kg^{-1}. The results found below permissible limit given by WHO (1989). Similar results were shown by Khan *et al*., (2015).

Total heavy metal and micro nutrients content in Lucerne grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Cobalt (Co)

The data reported in Table 5, shows the value of Lucerne grass samples collected from CCBP farm VNMKV, Parbhani which concluded the ranges of cobalt in lucerne from 0.16 mg kg^{-1} to 0.53 mg kg^{-1} with average value 0.37 mg kg^{-1}.

Nickel (Ni)

Lucerne grass samples were collected from CCBP farm, VNMKV, Parbhani for analysis of nickel (Ni) and the presented in Table 5. It showed that ranges of nickel varied from 21.64 mg kg^{-1} to 39.80 mg kg^{-1} with mean value 30.42 mg kg^{-1}. The results found below permissible limit given by WHO i.e. 0.67 (1989). Similar results were shown by Barman *et al*., (2000).

Cadmium (Cd)

Lucerne grass samples were collected for analysis of cadmium (Cd) from CCBP farm VNMKV, Parbhani and the data presented in Table 5. It reported the ranges of cadmium in lucerne from 0.37 mg kg^{-1} to 0.65 mg kg^{-1} with mean value 0.50 mg kg^{-1}. The results found below permissible limit given by WHO (1989). Similar results were shown by Barman *et al*., (2000).

Lead (Pb)

The data of lead (Pb) of lucerne grass samples collected from CCBP farm VNMKV, Parbhani is reported in Table 5. It revealed that lead ranges from 314.70 mg kg^{-1} to 389.10 mg kg^{-1} with an average of 360.07 mg kg^{-1}.

Mercury (Hg)

Table 5, showed the data of mercury (Hg) of Lucerne grass samples collected from CCBP farm VNMKV, Parbhani. It showed the ranges of mercury varied from 0.03 mg kg^{-1} to 0.10 mg kg^{-1} with mean value 0.05 mg kg^{-1} in Lucerne.

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ISSN: 1053-7899
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Arsenic (As)

The samples of lucerne grass collected from CCBP farm VNMKV, Parbhani for arsenic (As) showed in Table 5, that arsenic ranges from 0.031 mg kg^{-1} to 0.058 mg kg^{-1} with mean 0.04 mg kg^{-1}.

Selenium (Se)

The samples of lucerne grass collected from CCBP farm VNMKV, Parbhani for selenium content and the data of selenium showed in Table 5, reported the minimum value of lucerne 1.50 mg kg^{-1} and maximum value 6.37 mg kg^{-1} with average 3.78 mg kg^{-1}.

Table 6. Total micro nutrient content in Lucerne grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	Name of Fodder	Total Iron (mg Kg-1)	Total Zinc(mgKg-1)	Total Manganese (mg Kg-1)	Total Copper (mg Kg-1)
1	LGS1	254.36	40.23	60.23	18.26
2	LGS2	203.89	31.52	62.49	19.05
3	LGS3	312.78	30.19	62.99	17.54
4	LGS4	289.69	29.18	61.48	19.63
5	LGS5	345.72	31.99	59.48	18.99
6	LGS6	248.66	30.75	58.55	19.08
7	LGS7	296.41	41.96	60.15	17.53
8	LGS8	274.85	43.39	61.97	18.99
9	LGS9	359.42	41.25	59.22	18.71
10	LGS10	229.64	40.57	60.41	19.56
MEAN		281.54	36.10	60.69	18.78

Total Iron (Fe)

Table 6, showed the data of total iron (Fe) of Lucerne grass samples collected from CCBP farm VNMKV, Parbhani. It showed the ranges of iron varied from 203.89 mg kg^{-1} to 359.42 mg kg^{-1} with average 281.54 mg kg^{-1} in lecerne.

Total Zinc (Zn)

The samples of lucerne grass collected from CCBP farm VNMKV, Parbhani for total zinc (Zn) showed in Table 6, that zinc ranges from 29.18 mg kg^{-1} to 43.39 mg kg^{-1} with the mean 36.10 mg kg^{-1}. Similar results were shown by Khan *et al*., (2015).

Total Manganese (Mn)

The samples of lucerne grass collected from CCBP farm VNMKV, Parbhani for total manganese content and the data of manganese showed in Table 6, reported the minimum value of lucerne 58.55 mg kg^{-1} and its maximum limit was 62.99 mg kg^{-1} with mean 60.69 mg kg^{-1}.

Total Copper (Cu)

The data of total cobalt (Co) of lucerne grass samples collected from CCBP farm VNMKV, Parbhani is reported in Table 6. It revealed that in lucerne the copper ranges from 17.53 mg kg^{-1} to 19.63 mg kg^{-1} with mean 18.7 mg kg^{-1}. The results found below permissible limit given by WHO (1989). Similar results were shown by Khan *et al*., (2015).

Total heavy metal and micro nutrients contain in Berseem grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Cobalt (Co)

The data reported in Table 7, showed the value of berseem grass samples collected from CCBP farm VNMKV, Parbhani which concluded the ranges of cobalt in berseem from 0.14 mg kg^{-1} to 0.75 mg kg^{-1} with average value 0.41 mg kg^{-1}.

Nickel (Ni)

Berseem grass samples were collected from CCBP farm, VNMKV, Parbhani for analysis of nickel (Ni) and the presented in Table 7. It showed that ranges of nickel varied from 22.54 mg kg^{-1} to 38.20 mg kg^{-1} with mean value 30.56 mg kg^{-1}. The results found below permissible limit given by WHO i.e. 0.67 (1989). Similar results were shown by Barman *et al*., (2000).

Table 7. Total heavy metal content in Berseem grass under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	Name of Fodder	Total Cobalt (mg Kg^{-1})	Total Nickel (mg Kg^{-1})	Total Cadmium (mg Kg^{-1})	Total Lead (mg Kg^{-1})	Total Mercury (mg Kg^{-1})	Total Arsenic (mg Kg^{-1})	Total Selenium (mg Kg^{-1})
1	BGS1	0.14	23.81	0.49	342.69	0.04	0.040	2.56
2	BGS2	0.25	28.25	0.18	360.61	0.06	0.061	7.61
3	BGS3	0.75	24.35	0.61	362.39	0.06	0.035	3.81
4	BGS4	0.26	31.62	0.59	344.56	0.09	0.033	3.81
5	BGS5	0.58	38.20	0.55	382.19	0.11	0.059	7.23
6	BGS6	0.51	22.54	0.16	348.62	0.09	0.047	4.46
7	BGS7	0.41	31.80	0.59	370.91	0.09	0.040	3.11
8	BGS8	0.46	37.07	0.51	360.21	0.10	0.043	5.76
9	BGS9	0.60	35.80	0.68	370.74	0.05	0.046	8.21
10	BGS10	0.19	32.21	0.43	390.64	0.07	0.043	4.91
MEAN		0.41	30.56	0.47	363.35	0.07	0.0447	5.14

Cadmium (Cd)

Berseem grass samples were collected for analysis of cadmium (Cd) from CCBP farm VNMKV, Parbhani and the data presented in Table 7. It reported the ranges of cadmium in berseem from 0.18 mg kg^{-1} to 0.68 mg kg^{-1} with mean value 0.47 mg kg^{-1}. Similar results were shown by Barman *et al*., (2000).

Lead (Pb)

The data of lead (Pb) of berseem grass samples collected from CCBP farm VNMKV, Parbhani is reported in Table 7. It revealed that lead ranges from 342.69 mg kg^{-1} to 390.64 mg kg^{-1} with an average of 363.35mg kg^{-1}.

Mercury (Hg)

Table 7, showed the data of mercury (Hg) of berseem grass samples collected from CCBP farm VNMKV, Parbhani. It showed the ranges of mercury varied from 0.04 mg kg^{-1} to 0.11 mg kg^{-1} with mean value 0.07 mg kg^{-1} in berseem.

Arsenic (As)

The samples of berseem grass collected from CCBP farm VNMKV, Parbhani for arsenic (As) showed in Table 7, that arsenic ranges from 0.033 mg $kg^{1}$to 0.061 mg kg^{-1} with mean 0.044 mg kg^{-1}.

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Selenium (Se)

The samples of berseem grass collected from CCBP farm VNMKV, Parbhani for selenium content and the data of selenium showed in Table 7, reported the minimum value of berseem 2.56 mg kg^{-1} and maximum value 8.21 mg kg^{-1} with average 5.14 mg kg^{-1}.

Table 8. Total micro nutrient content in Berseem grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani

Sr. No.	Name of Fodder	Total Iron (mg Kg^{-1})	Total Zinc (mgKg^{-1})	Total Manganese (mg Kg^{-1})	Total Copper (mgKg^{-1})
1	BGS1	412.23	50.16	40.89	19.45
2	BGS2	396.00	58.29	46.75	21.69
3	BGS3	478.12	60.13	53.82	29.80
4	BGS4	496.37	49.22	55.39	26.49
5	BGS5	356.18	70.56	39.92	31.09
6	BGS6	370.80	69.46	47.80	28.96
7	BGS7	384.10	52.94	51.06	36.52
8	BGS8	423.09	70.89	43.71	33.71
9	BGS9	461.33	67.45	48.12	34.10
10	BGS10	494.55	79.23	59.63	30.25
MEAN		427.27	62.83	48.70	29.20

Total Iron (Fe)

Table 8, showed the data of total iron (Fe) of berseem grass samples collected from CCBP farm VNMKV, Parbhani. It showed the ranges of iron varied from 356.18 mg kg^{-1} to 496.37 mg kg^{-1} with average 427.27 mg kg^{-1} in berseem.

Total Zinc (Zn)

The samples of berseem grass collected from CCBP farm VNMKV, Parbhani for total zinc (Zn) showed in Table 8, that zinc ranges from 50.16 mg kg^{-1} to 79.23 mg kg^{-1} with the mean 62.83 mg kg^{-1}. The results found below permissible limit given by WHO (1989). Similar results were shown by Khan *et al*., (2015).

Total Manganese (Mn)

The samples of berseem grass collected from CCBP farm VNMKV, Parbhani for total manganese content and the data of manganese showed in Table 8, reported the minimum value of berseem 39.92 mg kg^{-1} and its maximum limit was 59.63 mg kg^{-1} with mean 48.70 mg kg^{-1}.

Total Copper (Cu)

The data of total cobalt (Cu) of berseem grass samples collected from CCBP farm VNMKV, Parbhani is reported in Table 8. It revealed that in berseem the copper ranges from 19.45 mg kg^{-1} to 36.52 mg kg^{-1} with mean 29.20 mg kg^{-1}. The results found below permissible limit given by WHO (1989). Similar results were shown by Khan *et al*., (2015).

Heavy metal and micronutrient content in blood serum of cattle under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Cobalt (Co)

The data of total cobalt in blood serum of cattle living near sewage drainage area, CCBP farm VNMKV, Parbhani presented in Table 9. Co in serum samples ranges from 0.10 µg $ml^{-1}$to 0.32 µg $ml^{-1}$with mean values 0.23 µg $ml^{-1}$of samples collected in *Kharif* season. Co ranges from 0.28 µg ml^{-1} to 0.51 µg ml^{-1} with mean value 0.35 µg ml^{-1} of samples collected in *Rabi* season. Singare (2018) © also reported the same results

Nickel (Ni)

Table 9, that indicate the blood samples of cattle near sewage drainage CCBP farm, VNMKV, Parbhani have Ni ranges from 0.095 µg ml^{-1} to 0.184 µg ml^{-1} with mean value 0.144 µg ml^{-1} of samples collected in *Kharif* season. Nickel ranges from 0.130 µg ml^{-1} to 0.201 µg ml^{-1} with mean 0.167 µg ml^{-1} of samples collected in *Rabi* season.

Cadmium (Cd)

The data of total cadmium (Cd) in blood serum of cattle living near sewage drainage area, CCBP farm VNMKV, Parbhani presented in Table 9. Cd in serum samples ranges from 0.02 µg ml^{-1} to 0.096 µg ml^{-1} with mean value 0.044 µg ml^{-1} of samples collected in *Kharif* season. Cd ranges from 0.011 µg ml^{-1} to 0.104 µg ml^{-1} with mean value 0.060 µg ml^{-1} of samples collected in *Rabi* season.

Table 9. Total heavy metal (Cobalt, Nickel, Cadmium and Lead) content in blood serum of cattle under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	No. of Cattle	Total Cobalt (µg ml^{-1})		Total Nickel (µg ml^{-1})		Total Cadmium (µg ml^{-1})		Total Lead (µg ml^{-1})	
		Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
1	1172	0.24	0.37	0.140	0.153	0.002	0.011	0.018	0.029
2	1161	0.25	0.28	0.095	0. 148	0.044	0.049	0.031	0.040
3	1216	0.24	0.25	0.101	0. 143	0.047	0.051	0.064	0.063
4	1140	0.27	0.51	0.165	0.171	0.096	0.103	0.030	0.038
5	F4	0.24	0.46	0.184	0. 201	0.023	0.042	0.072	0.830
6	1165	0.10	0.18	0.144	0.147	0.041	0.047	0.045	0.906
7	1151	0.26	0.39	0.170	0.190	0.057	0.067	0.096	0.169
8	1158	0.32	0.33	0.191	0. 206	0.069	0.091	0.069	0.190
9	1213	0.27	0.53	0.097	0. 130	0.038	0.104	0.034	0.056
10	F5	0.18	0.29	0.162	0.178	0.031	0.039	0.087	0.089
MEAN		0.23	0.35	0.144	0.167	0.044	0.060	0.054	0.241

Lead (Pb)

The data of total lead (Pb) in blood serum of cattle living near sewage drainage area, CCBP farm VNMKV, Parbhani presented in Table 9. Pb in serum samples ranges from 0.018 µg ml^{-1} to 0.096 µg ml^{-1} with mean value 0.054 µg ml^{-1} of samples collected in *Kharif* season. Pb ranges from 0.029 µg ml^{-1} to 0.906 µg ml^{-1} with mean value 0.241 µg ml^{-1}.

Mercury (Hg)

Blood samples of cattle near sewage drainage CCBP farm, VNMKV, Parbhani, presented in Table 10, Hg rages from 0.004 µg ml^{-1} to 0.015 µg ml^{-1} with mean value 0.011 µg ml^{-1} of samples collected in *Kharif* season. Hg ranges from 0.009 µg ml^{-1} to 0.016 µg ml^{-1} with mean 0.012 µg ml^{-1} of samples collected in *Rabi* season.

Arsenic (As)

Blood samples of cattle near sewage drainage CCBO farm, VNMKV, Parbhani, presented in Table 10. As ranges from 0.0020 µg ml^{-1} to

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0.0112 µg ml^{-1} with mean value 0.0041 µg ml^{-1} of samples collected in *Kharif* season. As ranges from 0.0028 µg ml^{-1} to 0.0422 µg ml^{-1} with mean 0.0130 µg ml^{-1} of samples collected in *Rabi* season.

Selenium (Se)

The data show in Table 10. Blood samples of cattle near sewage drainage CCBP farm, VNMKV, Parbhani have Se ranges from 0.009 µg ml^{-1} to 0.050 µg ml^{-1} with mean value 0.029 µg ml^{-1} of samples collected in *Kharif* season. Se ranges from 0.010 µg ml^{-1} to 0.062 µg ml^{-1} with mean 0.040 µg ml^{-1} of samples collected in *Rabi* season.

Table 10. Total heavy metal (Mercury, Arsenic and Selenium) content in blood serum of cattle under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	NO. of Cattle	Total Mercury (µg ml^{-1})		Total Arsenic (µg ml^{-1})		Total Selenium (µg ml^{-1})	
		Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
1	1172	0.009	0.011	0.0029	0.0032	0.019	0.025
2	1161	0.015	0.016	0.0031	0.0036	0.027	0.033
3	1216	0.004	0.009	0.0024	0.0028	0.046	0.053
4	1140	0.013	0.013	0.0038	0.0245	0.050	0.057
5	F4	0.010	0.012	0.0020	0.0026	0.009	0.010
6	1165	0.011	0.013	0.0040	0.0047	0.016	0.062
7	1151	0.014	0.015	0.0043	0.0195	0.031	0.041
8	1158	0.013	0.014	0.0112	0.0422	0.041	0.053
9	1213	0.008	0.009	0.0037	0.0096	0.038	0.039
10	F5	0.014	0.015	0.0041	0.0179	0.020	0.030
MEAN		0.011	0.012	0.00415	0.0130	0.029	0.040

Total Iron (Fe)

Table 11, showed the data of total iron (Fe) in blood serum of cattle living near sewage drainage area, CCBP farm VNMKV, Parbhani. It showed the ranges of iron varied from 0.203 µg ml^{-1}to 0.323 µg ml^{-11} with an average µg ml^{-1} of blood samples collected in *Kharif* season Iron content in blood serum samples collected in *Rabi* season ranges from 0.097 µg ml^{-1} to 0.418 µg ml^{-1} with an average 0.238 µg ml^{-1}. This study revealed that blood samples contain iron below its critical limit 0.65 µg ml^{-1}.

Total Zinc (Zn)

The data of total zinc (Zn) in blood serum of cattle living near sewage drainage area, CCBP farm VNMKV, Parbhani presented in Table 11. Zinc in serum samples ranges from 0.21 µg ml^{-1} to 1.07 µg ml^{-1} with mean 0.72 µg ml^{-1} of samples collected in *Kharif* season. Zinc ranges from 0.12 µg ml^{-1} to 1.40 µg ml^{-1} with mean 0.76 µg ml^{-1} of samples collected in *Rabi* season. This study concluded that the blood serum zinc concentration of given samples is within normal range.

Total Manganese (Mn)

The data of total Manganese in blood serum of cattle living near sewage drainage area, CCBP farm VNMKV, Parbhani presented in Table 11. Mn in serum samples ranges from 0.04 µg ml^{-1} to 0.59 µg ml^{-1} with mean value 0.24 µg ml^{-1} of samples collected in *Kharif* season. Mn ranges from 0.16 µg ml^{-1} to 0.63 µg ml^{-1} with mean value 0.44 µg ml^{-1} with of samples collected in *Rabi* season. It revealed that the serum Mn content is deficient in most of the samples. This is in agreement with findings of Singare (2018).

Total Copper (Cu)

The data of total copper in blood samples of cattle near sewage drainage CCBP farm, VNMKV, Parbhani, presented in Table 11, Cu ranges from 0.12 µg ml^{-1} to 0.61 µg ml^{-1} with mean value 0.38 µg ml^{-1} of samples collected in *Kharif* season. Copper ranges from 0.14 µg ml^{-1} to 0.64 µg ml^{-1} with mean 0.39 µg ml^{-1} of samples collected in *Rabi* season. It revealed that most of the samples were deficient in Cu concentration. Similar results were also reported by Singare (2018).

Table 11. Micronutrients content in blood serum of cattle under Sewage drainage area, near CCBP, VNMKV, Parbhani.

Sr. No.	No. of Cattle	Serum Iron Content (µg ml^{-1})		Serum Zinc Content (µg ml^{-1})		Serum Manganese Content (µg ml^{-1})		Serum Copper Content (µg ml^{-1})	
		Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
1	1172	0.301	0.311	0.21	0.52	0.04	0.16	0.12	0.14
2	1161	0.203	0.097	0.71	0.12	0.09	0.43	0.61	0.64
3	1216	0.155	0.201	0.82	0.89	0.08	0.18	0.31	0.41
4	1140	0.147	0.152	0.74	0.75	0.07	0.61	0.17	0.20
5	F4	0.114	0.135	1.03	1.06	0.18	0.27	0.47	0.30
6	1165	0.281	0.302	0.89	1.40	0.13	0.51	0.54	0.58
7	1151	0.126	0.299	0.72	0.73	0.58	0.63	0.49	0.59
8	1158	0.323	0.418	0.62	0.67	0.59	0.59	0.44	0.46
9	1213	0.244	0.260	1.07	1.03	0.33	0.47	0.31	0.41
10	F5	0.208	0.209	0.46	0.48	0.39	0.60	0.41	0.21
MEAN		0.21	0.2384	0.72	0.76	0.24	0.44	0.38	0.39

CONCLUSION

The pH, EC and organic carbon of soil samples were observed more in *Rabi* season than in *kharif* season.

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The micro nutrients and total heavy metals in fodder samples in *Kharif* and *Rabi* season grown in vicinity of sewage water shows maximum content

All the total micro nutrients such as total iron, total copper, total manganese and total zinc, also recorded highest influence of sewage water spread on the fodder samples. Total heavy metal content of fodder sample were also found below critical limit and safe.

Micronutrient content and total heavy metal content in blood serum of cattle total iron, total copper, total manganese, total zinc and total heavy metal such as cobalt, nickel, cadmium, lead, arsenic, mercury and selenium were recorded more in Rabi season as compared to Kharif season. Blood serum sample of cattle found sufficient in copper, zinc and manganese deficient in iron.

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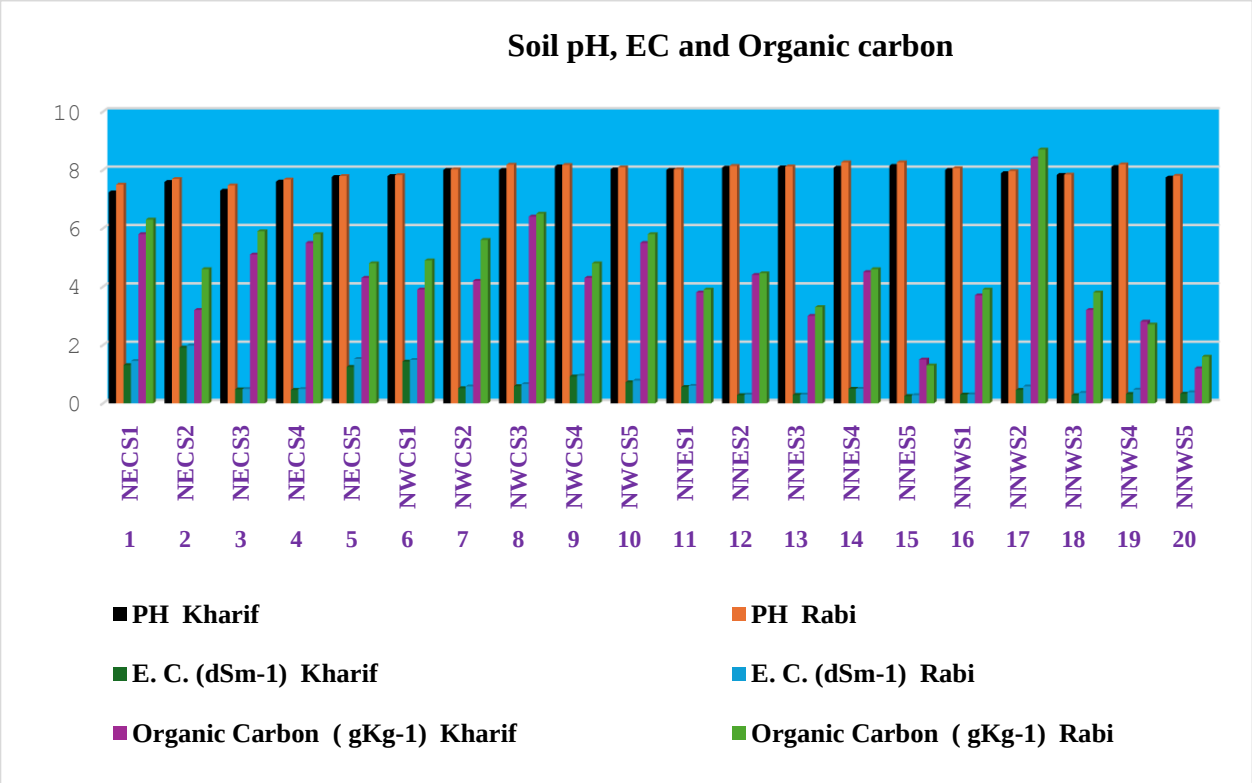

Fig. 1 Physico-Chemical properties of soil under Sewage drainage area, near CCBP, VNMKV, Parbhani.

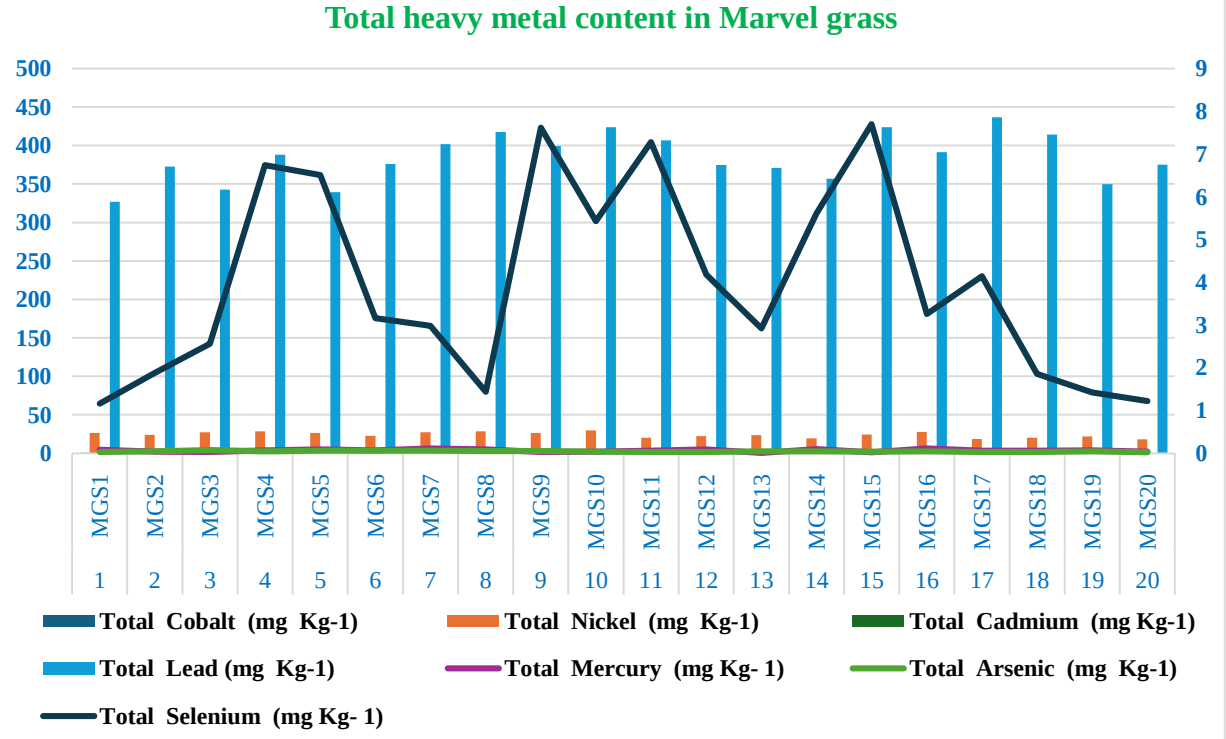

Fig. 2 Total heavy metal content in Marvel grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

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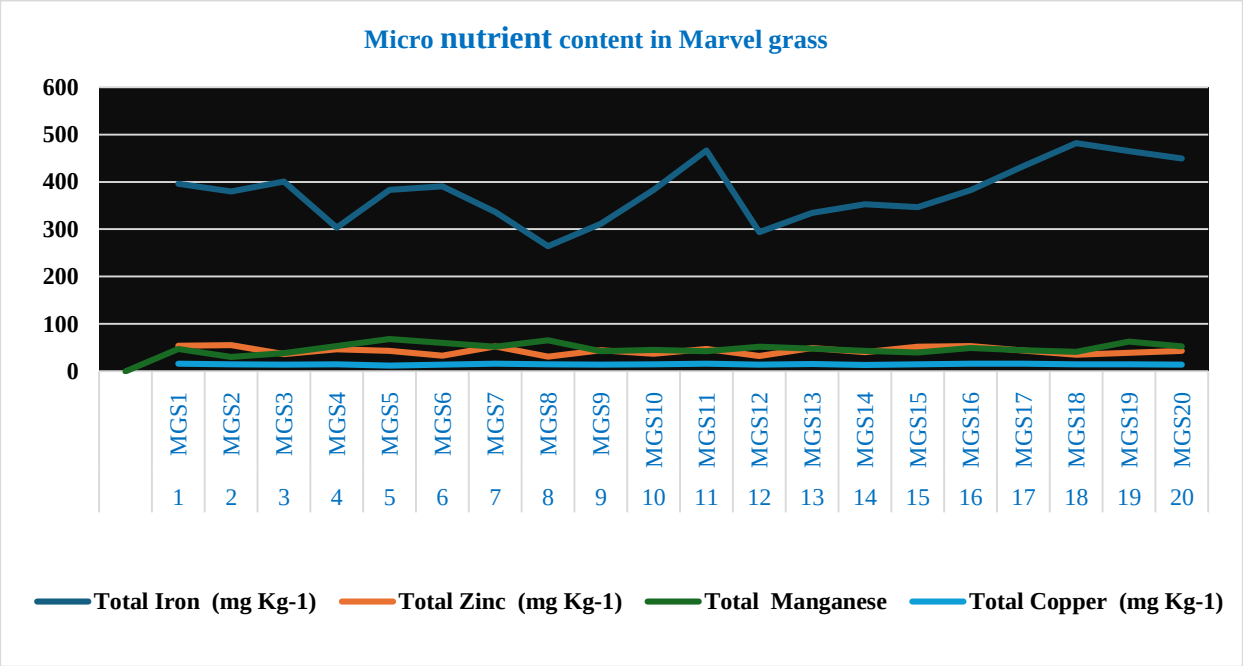

Fig. 3 Micro nutrient content in Marvel grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

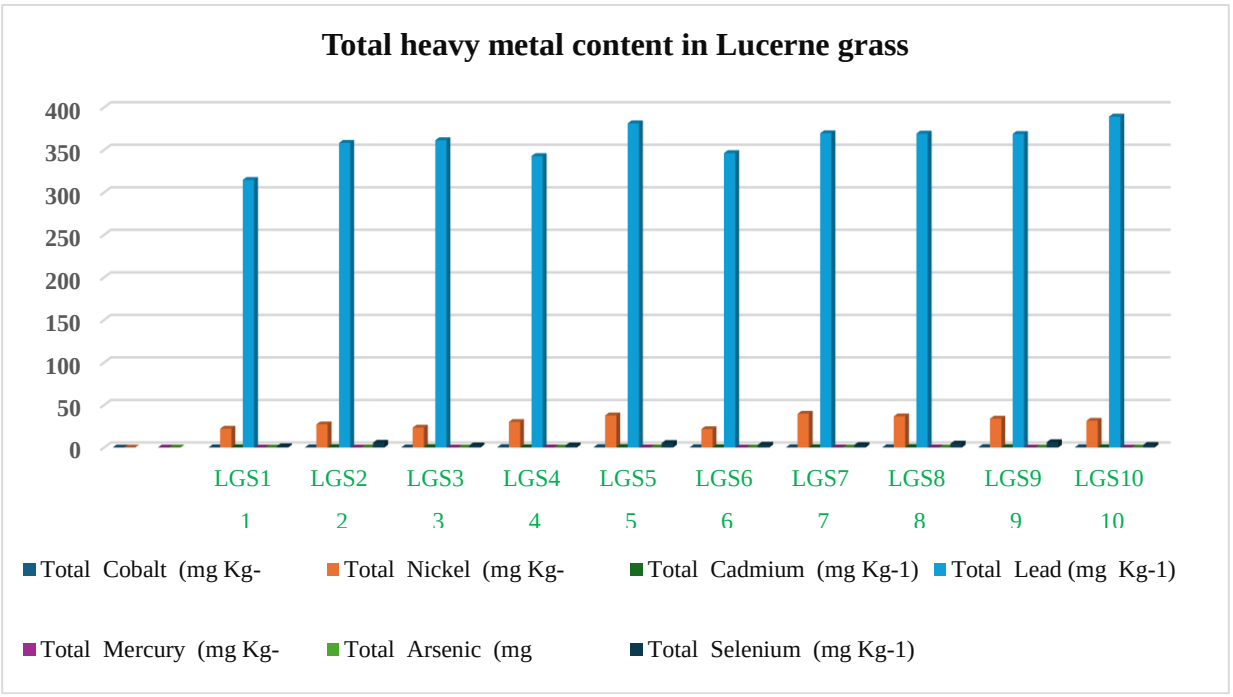

Fig. 4 Total heavy metal content in Lucerne grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

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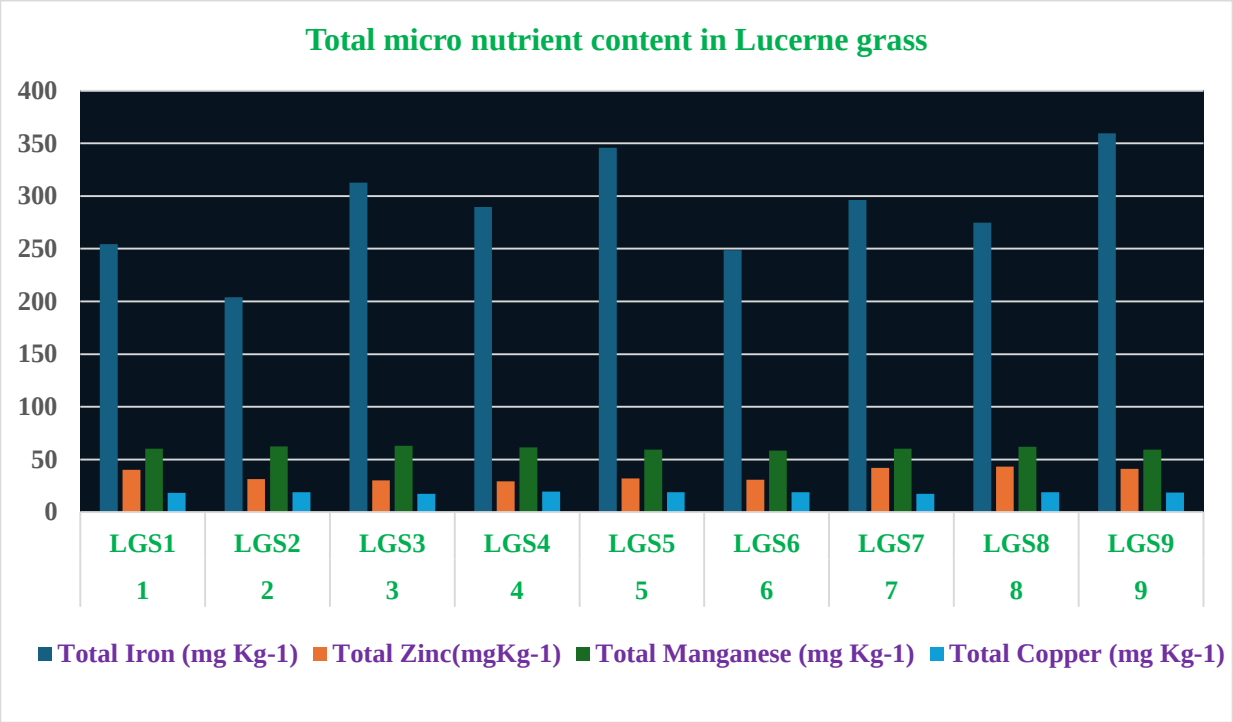

Fig. 5 Total micro nutrient content in Lucerne grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani.

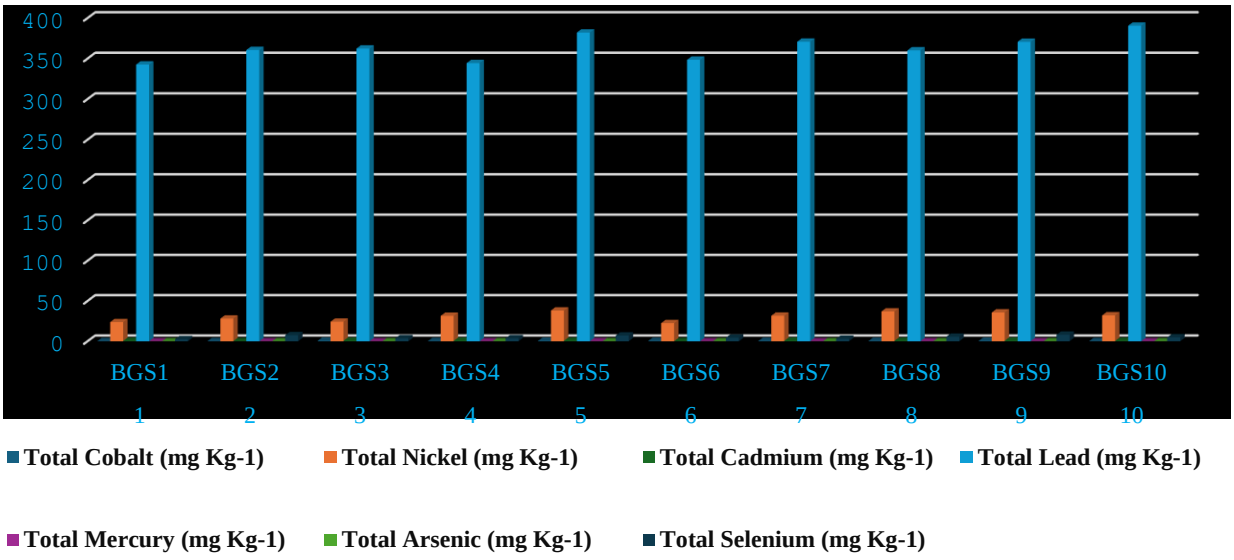

Fig. 6 Total heavy metal content in Berseem grass under Sewage drainage area, near CCBP, VNMKV, Parbhani.

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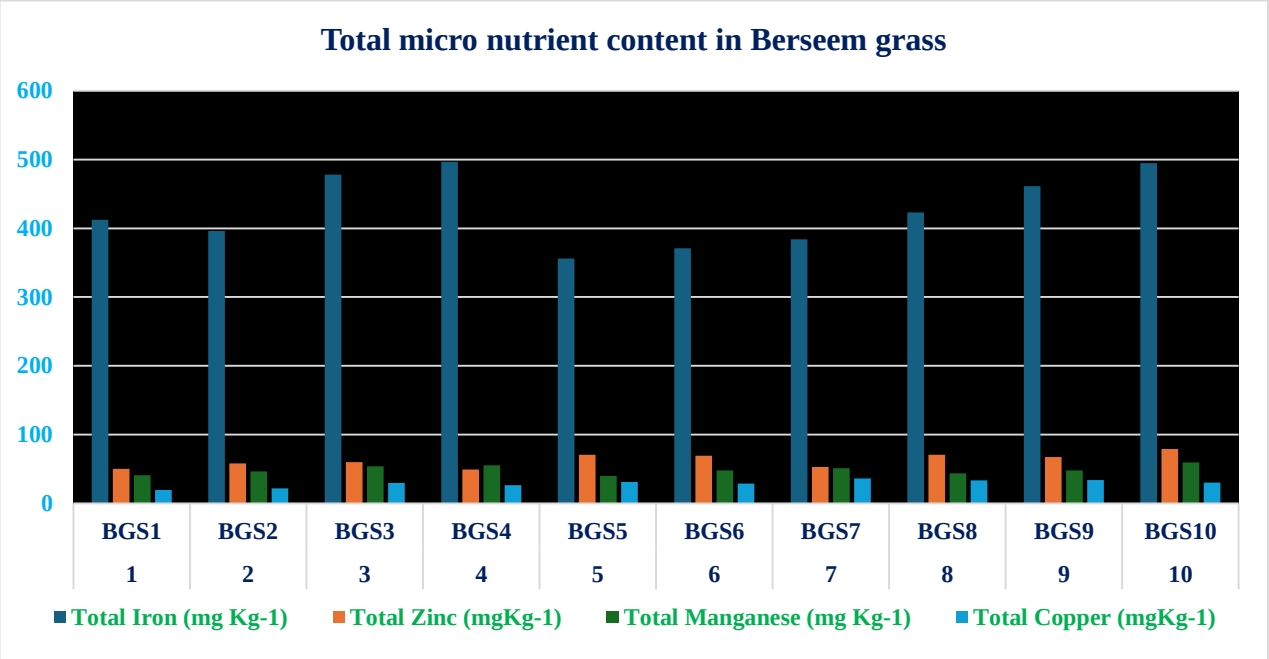

Fig. 7 Total micro nutrient content in Berseem grass, under Sewage drainage area, near CCBP, VNMKV, Parbhani

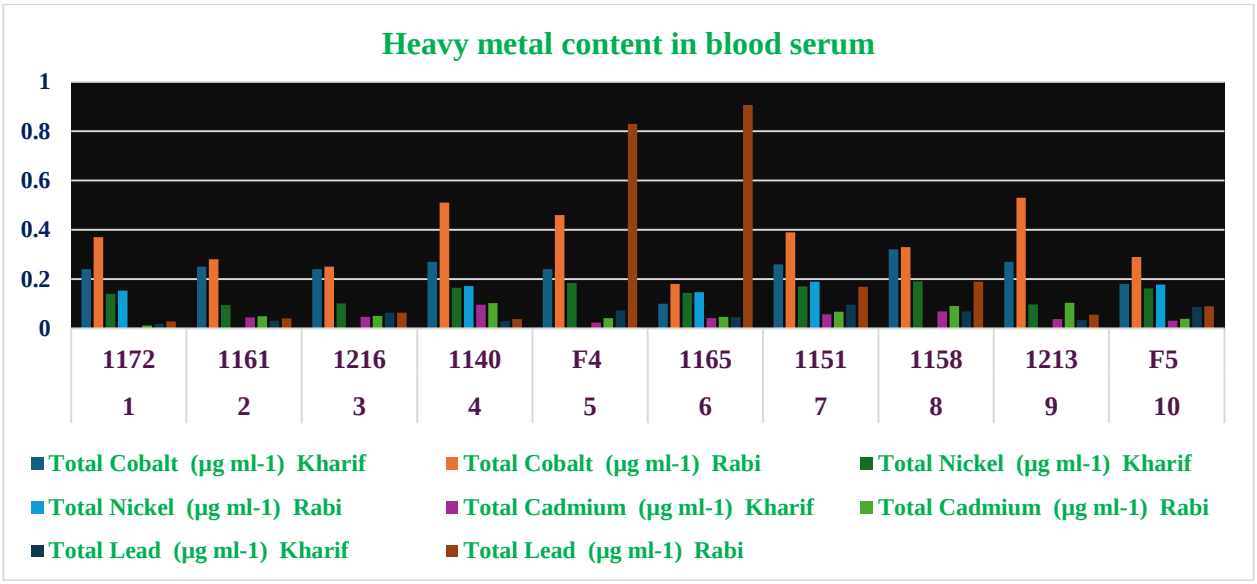

Fig. 8 Total heavy metal (Cobalt, Nickel, Cadmium and Lead) content in blood serum of cattle under Sewage drainage area, near CCBP, VNMKV, Parbhani.

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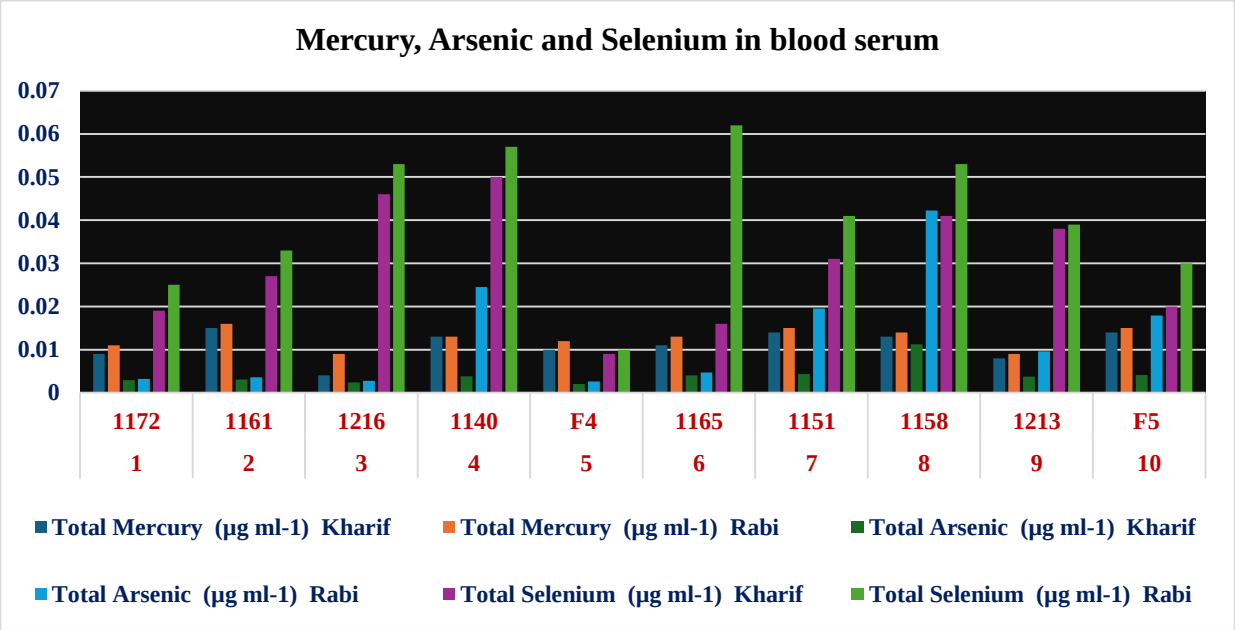

Fig. 9 Total heavy metal (Mercury, Arsenic and Selenium) content in blood serum of cattle under Sewage drainage area, near CCBP, VNMKV, Parbhani.

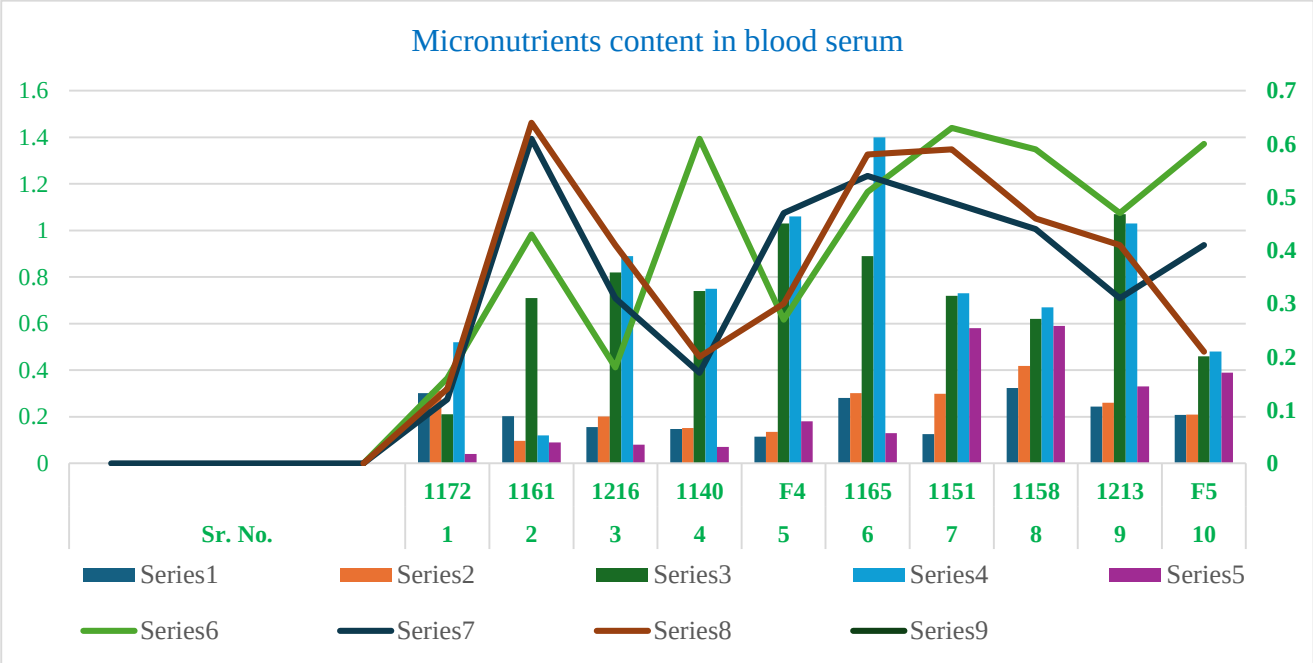

Fig. 10. Micronutrients content in blood serum of cattle under Sewage drainage area, near CCBP, VNMKV, Parbhani.