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Seasonal Variations of Micronutrients in Saline Tracts Soil of Bikaner Division, Rajasthan, India

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Abstract

Micronutrients are bio-accumulated and bio-transferred both by natural and anthropogenic sources. Soil samples were collected in each season from selected sites (Rawatsar, Badopal and Loonkaransar) for four major seasons viz. spring, summer, rainy and winter from the saline tracks of division Bikaner. Samples were analysed for Copper (Cu), Iron (Fe), Manganese (Mn) and Zinc (Zn) by Atomic Absorption Spectrophotometer. Results showed that concentration of Copper was very high in all seasons, Manganese and Iron concentration was normal while Zinc concentration was low. It was noticed that the concentration of micronutrients were varied in the seasons.

Keywords: Micronutrients, Soil, Saline Tract, Bikaner Division

Introduction

Micronutrients are important for soil, crop and plants. The probability of food contamination is increase by accumulation of heavy metals such as Ni, Cd and Pb in plants growth. Ultimately, increasing the heavy metal content in soil also increases the uptake of heavy metals by plants depending upon the soil type, plant growth stages and plant species (Ullah *et al*.,2011).

The most significant source of heavy metals in the environment is the human activities such as use of pesticides in agriculture, mining, smelting, paper and pulp industry, steel and iron industry, chemical industry, transportation as well as domestic activities (Suciu *et al.,* 2008, Stihi *et al*., 2006). The vital source of heavy metals in soil are Chemical and metallurgical industries (Pantelica *et al.,*2008, Jantschi *et al*.,2008, Schutze *et al*., 2007). The occurrence of heavy metals in soil can affect the wildlife, plant growth etc (Cojaru *et al*., 2006, Popescu *et al.,* 2009, Ene *et al*., 2009). These heavy metals may harmful to soil ecology, agricultural production or product quality, groundwater quality and eventually harmful to health of living organism by food chain (Ene *et al.,* 2009). Similar study was carried out by (Nazier *et al.,*2015) who reported the impacts of heavy metals on soil, water and plants in Tanda Dam Area Kohat.

Review of Literature

The heavy metals have bad effects on the human body (Gitimoni *et al*., 2009). The quality of soil and groundwater are effected by heavy metals and organic compounds (Bhattacharjee *et al.,* 2003). The toxic effect of heavy metals such as Cd, Hg and Pb causes environmental pollution and their continuous exposure to human beings causes serious health problem (Yusuf and Sonibare,2004). Metals are naturally present in our environment especially in the Earth's crusts. The toxic metals are spread in the environment by various human activities and contaminated the soil and increase plant metal levels through root uptake (Mihaly *et al.,* 2005). By this problem lands under peri-urban agriculture are badly affected (Kaur and Rani, 2006). Heavy metals such as Zn, Mn, Fe and Cu were also analyzed. This soil contains higher amount of heavy metals and exceed permissible limits. The effluent from the textile industry was the major source of pollution which will affect the flora and fauna existing in such environment. The research concluded that the soil quality deteriorates after continuous discharge of industrial effluent. Thus, there is need for treatment of textile effluent before they are discharged into the environment (Bansal *et al.,* 2016). Some micronutrients such as Cu, Fe, Mn and Zn are essential for plants growth and development. Soil samples were analyzed by Atomic Absorption Spectrophotometer for heavy metals like Cu, Fe, Mn and Zn.

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Study Area

Saline tracts of Bikaner division viz. Rawatsar (Hanumangarh), Badopal (Ganganagar) and Loonkaransar (Bikaner) were studied for micronutrients in soils. Rawatsar lies between $29^0$15'53.68"N latitudes and $74^0$24'10.20"E longitudes elevation 180.137m, Badopal $29^0$21'51.76"N latitudes and $74^0$02'32.99"E longitudes elevation 169.164m and Loonkaransar $28^0$29'36.61"N latitudes and $73^0$44'17.52"E longitudes elevation 189.89m from mean sea level (fig.1). The annual rainfall of study area is 325.4 mm. of during study year. 80% of annual rainfall is received during Mansoon season. The temperature ranges between freezing point (in winter) to about 50^oC (in summer).The diurnal temperature fluctuation is also high. The climate of the study area is arid. The humidity is very low. The soil of the study area is very poor in nutrient load. The colour of the soil is pale yellow with very low humus content. The **Texture Of The Soil Is Loamy Clay.**

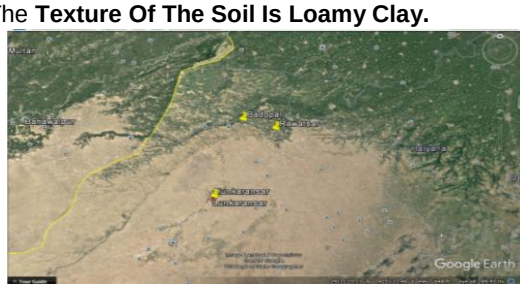

Fig.1 Map of the Study Area

Material and Methods

The soil samples were collected from three different sites of waterlogged areas in saline tracts of Bikaner division. The collected samples have been analyzed for the micronutrients. The soil samples were collected in morning time during various seasons viz. spring, summer, rainy and winter (2015-2016). Soil samples collected from surface as well as from the depth of 10 inches and 20 inches. The selection of sites for soil samples collection were done in such a way that it represents the diversity of samples as well the impacts of saline tracts on soil. Therefore, the samples taken from bank of water bodies, from distance of 100meter from water bodies and from agricultural fields, which were considered as control site. Samples were collected in plastic bags and labeled beg with a marker.

The soil samples analyzed for micronutrients viz. Cu, Mn, Fe and Zn by Atomic Absorption Spectrophotometer. Micronutrients in soil were determined by using standard methods (APHA, 1998).

Table-1 Concentration of Micronutrients in Rainy Season (August 2015)

S.No.	Site	Location	Copper(ppm)	Iron(ppm)	Manganese(ppm)	Zinc(ppm)
1	Rawatsar	Non-waterlogged area	1.58	3.66	1.6	1.1
2			0.44	1.34	0.7	0.66
3			0.34	2.92	1.54	0.8
4		100meter away from water body bank	0.26	2.75	1.58	0.68
5			0.37	2.9	1.51	0.77
6			0.39	2.31	1.08	0.74
7		In the vicinity	0.25	2.73	2.27	0.8
8			0.21	2.47	1.58	0.76
9			0.15	1.79	1.07	0.75
10	Badopal	Non-waterlogged area	0.42	2.18	0.94	0.66
11			0.64	1.84	0.62	0.42
12			0.92	3.06	1.94	3.06
13		100meter away from water body bank	1.48	6.34	1.18	0.35
14			0.96	1.72	1.61	0.35
15			1.03	1.43	1.4	0.31
16		In the vicinity	1.07	12.97	1.05	0.42
17			0.8	7.82	1.68	0.42
18			1.63	2.58	2.01	0.33
19	Loonkaransar	Non-waterlogged area	0.36	1.44	1.22	0.46
20			0.44	1.04	1.18	0.46
21			0.34	1.04	0.44	0.44
22		100meter away from water body bank	0.31	2.9	1.17	0.4
23			0.34	2.1	0.82	0.32
24			0.33	1.74	0.77	0.38
25		In the vicinity	0.23	3.94	0.55	0.6
26			0.21	2.42	0.92	0.33
27			0.46	2.66	1.03	0.37

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Table-2 Concentration of Micronutrients in Winter Season (December 2015)

S.No.	Site	Location	Copper(ppm)	Iron(ppm)	Manganese(ppm)	Zinc(ppm)
1	Rawatsar	Non-waterlogged area	0.5	1.3	2.02	0.36
2			0.32	1.18	0.84	0.52
3			0.26	0.5	0.7	0.06
4		100meter away from water body bank	0.32	7.9	0.88	0.15
5			0.31	0.75	0.5	0.05
6			0.29	1.24	0.76	0.1
7		In the vicinity	0.29	10.6	10.51	0.13
8			0.31	1.49	0.83	0.04
9			0.4	2.04	0.77	0.06
10	Badopal	Non-waterlogged area	0.44	1.86	4.16	1.36
11			0.32	1.18	1.32	0.76
12			0.34	1.04	1.08	0.26
13		100meter away from water body bank	0.44	11.5	1.29	0.25
14			0.26	11.92	4.35	0.16
15			0.74	13.12	7.98	0.98
16		In the vicinity	0.33	9.28	8.1	0.28
17			0.56	16.17	8.82	0.21
18			0.76	11.46	4.24	0.15
19	Lonkaran sar	Non-waterlogged area	0.32	1.08	7.1	1.4
20			0.26	1.3	1.14	0.34
21			0.34	0.82	1.2	0.22
22		100meter away from water body bank	1.05	7.52	3.21	0.8
23			0.47	10.19	1.03	0.13
24			1.0	10.37	1.32	0.3
25		In the vicinity	0.55	7.15	4.78	0.27
26			0.18	1.19	1	0.06
27			0.18	0.61	0.82	0.22

Table-3 Concentration of Micronutrients in Spring Season (March 2016)

S.No.	Site	Location	Copper(ppm)	Iron(ppm)	Manganese(ppm)	Zinc(ppm)
1	Rawatsar	Non-waterlogged area	0.48	2.14	1.66	0.18
2			0.3	1.56	1.08	0.08
3			0.28	1.46	1.02	0.06
4		100meter away from water body bank	0.29	2.33	1.87	0.07
5			0.26	1.29	1.09	0.03
6			0.26	0.89	0.97	0.04
7		In the vicinity	0.3	1.56	3.39	0.11
8			0.29	1.74	1.07	0.07
9			0.27	2.41	1.07	0.06
10	Badopal	Non-waterlogged area	0.34	1.82	7.24	0.7
11			0.32	1.72	1.18	0.08
12			0.3	0.98	1.08	0.02
13		100meter away from water body bank	0.64	18.44	6.96	0.48
14			0.69	9.99	2.26	0.2
15			0.68	13.31	1.42	0.3
16		In the vicinity	0.49	10	8.13	0.28
17			0.65	13.01	2.99	0.24
18			0.5	11.99	2.41	0.2
19	Loonkaransar	Non-waterlogged area	0.28	1.34	4.64	0.24
20			0.32	1.46	1.42	0.18
21			0.32	1.18	1.66	0.4
22		100meter away from water body bank	0.54	2.51	1.85	0.26
23			0.26	2.15	1.3	0.06
24			0.25	1.48	1.21	0.04
25		In the vicinity	0.45	5.04	1.74	0.39
26			0.27	1.02	1.08	0.03
27			0.29	2.14	2.31	0.05

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Table-4 Concentration of Micronutrients in Summer Season (June 2016)

S.No.	Site	Location	Copper(ppm)	Iron(ppm)	Manganese(ppm)	Zinc(ppm)
1	Rawatsar	Non-waterlogged area	0.68	2.66	6.5	0.8
2			0.12	0.86	0.9	0.8
3			0.06	1.38	0.96	0.6
4		100meter away from water body bank	0.27	2.34	1.76	0.34
5			0.1	1.33	0.87	0.34
6			0.07	0.98	0.87	0.26
7		In the vicinity	0.12	6.5	2.16	0.41
8			0.18	1.85	0.91	0.33
9			0.13	1.62	1.02	0.28
10	Badopal	Non-waterlogged area	0.18	2.26	5.74	0.32
11			0.06	0.44	0.84	0.32
12			0.08	1.1	1.52	0.28
13		100meter away from water body bank	0.39	19.3	1.87	0.71
14			0.15	12.34	11.89	0.32
15			0.21	11	10.83	0.3
16		In the vicinity	0.35	12.7	3.61	0.37
17			0.35	10.12	1.47	0.31
18			0.29	9.02	1.06	0.33
19	Loonkaransar	Non-waterlogged area	0.3	1.68	9.36	0.82
20			0.3	2.84	1.56	0.56
21			0.3	3.06	1.1	0.6
22		100meter away from water body bank	0.55	2.91	1.55	0.33
23			0.18	2.12	0.87	0.19
24			0.22	1.32	0.71	0.23
25		In the vicinity	0.51	2.41	1.18	0.32
26			0.24	2.26	1.04	0.22
27			0.13	2.57	0.99	0.24

Fig.1 Average Concentration of different Micronutrients in Rawatsar Site

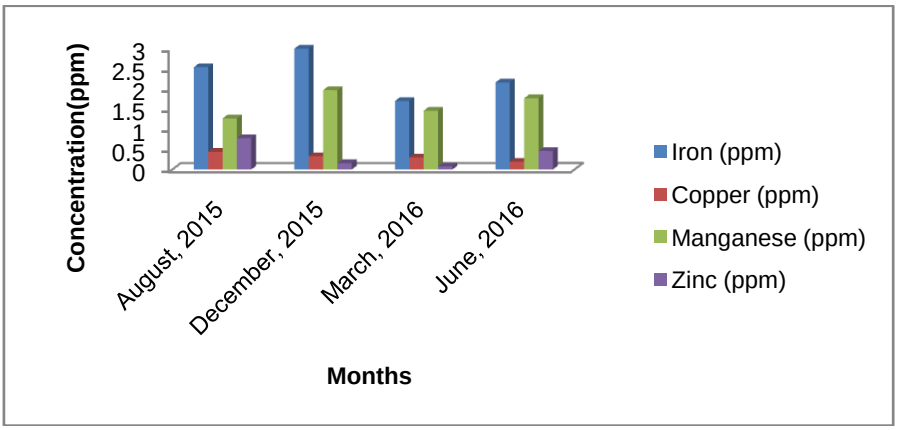


Fig.2 Average Concentration of different micronutrients in Badopal Site

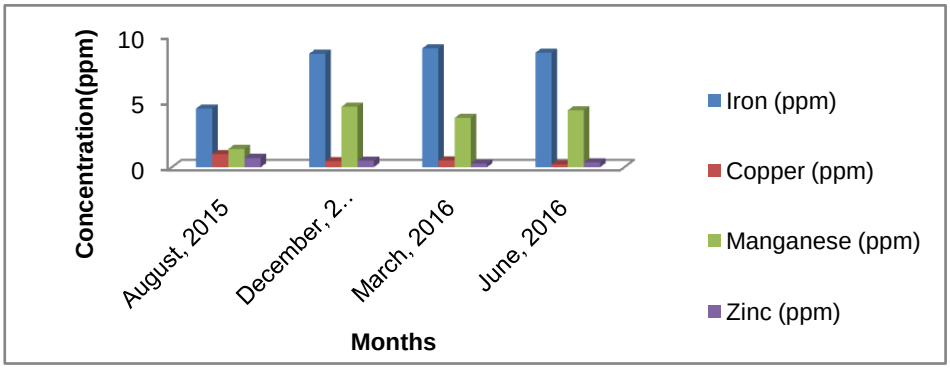


Fig. 3 Average Concentration of different Micronutrients in Loonkaransar Site

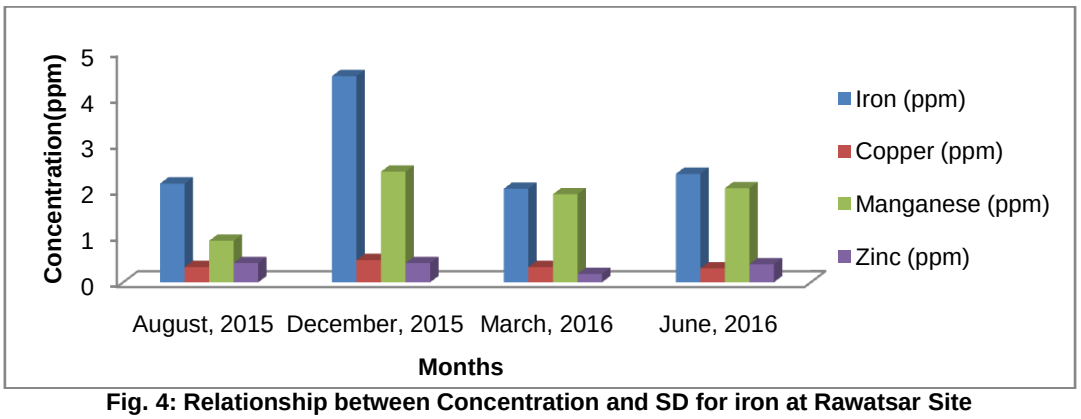


Fig. 4: Relationship between Concentration and SD for iron at Rawatsar Site

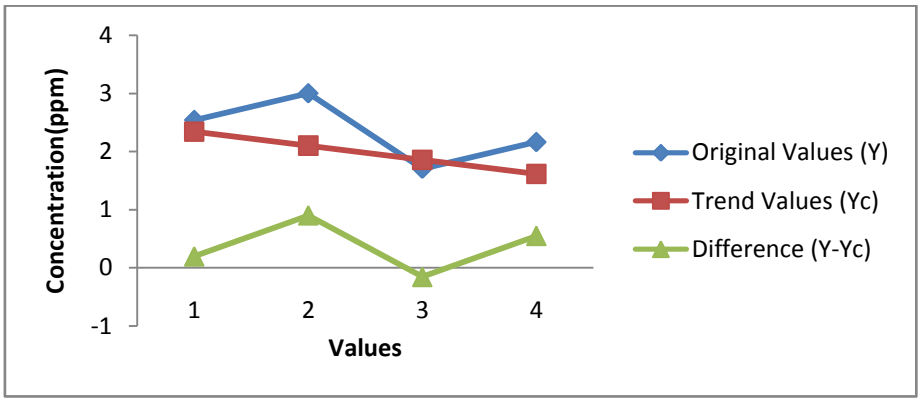


Fig. 5 Relationship between Concentration and SD for Copper at Rawatser Site

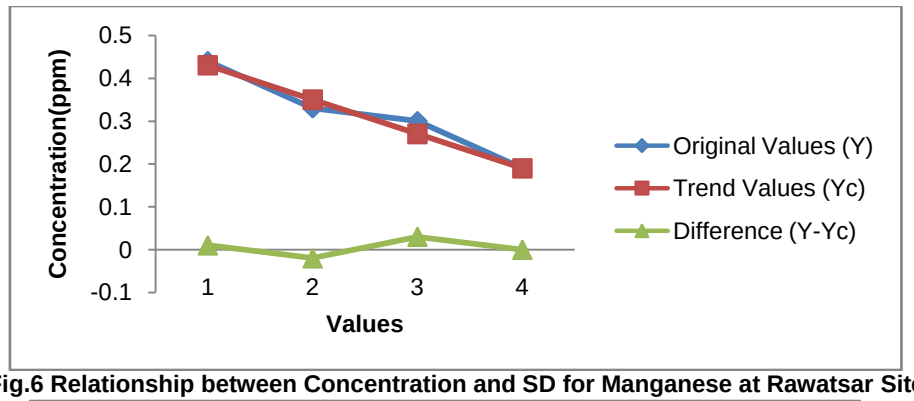


Fig.6 Relationship between Concentration and SD for Manganese at Rawatsar Site

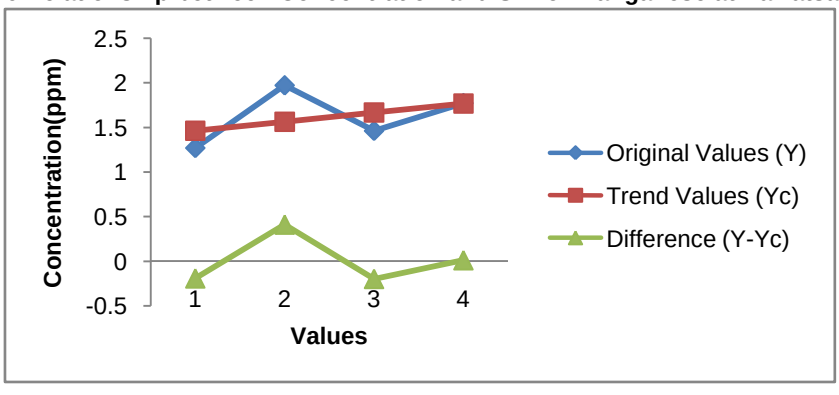


Fig. 7 Relationship between Concentration and SD for zinc at Rawatsar Site

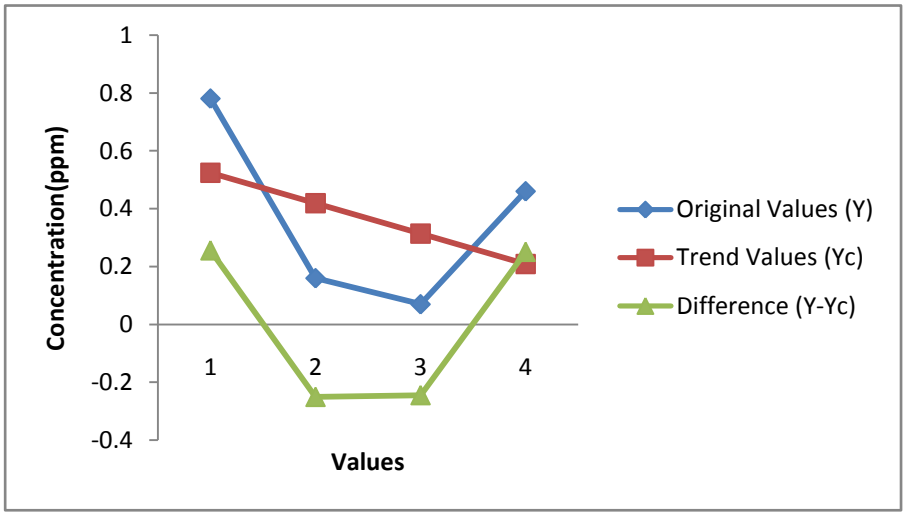


Fig.8 Relationship between Concentration and SD for Iron at Badopal Site

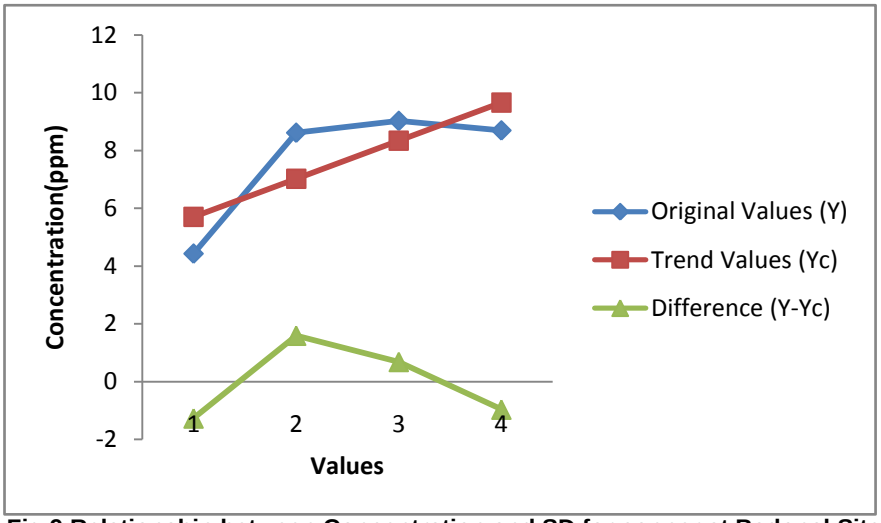


Fig.9 Relationship between Concentration and SD for copper at Badopal Site

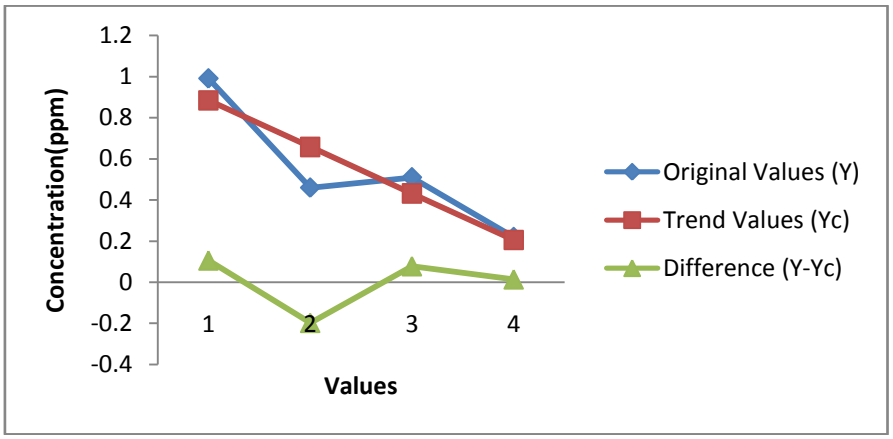


Fig. 10 Relationship between Concentration and SD Manganese at Badopal Site

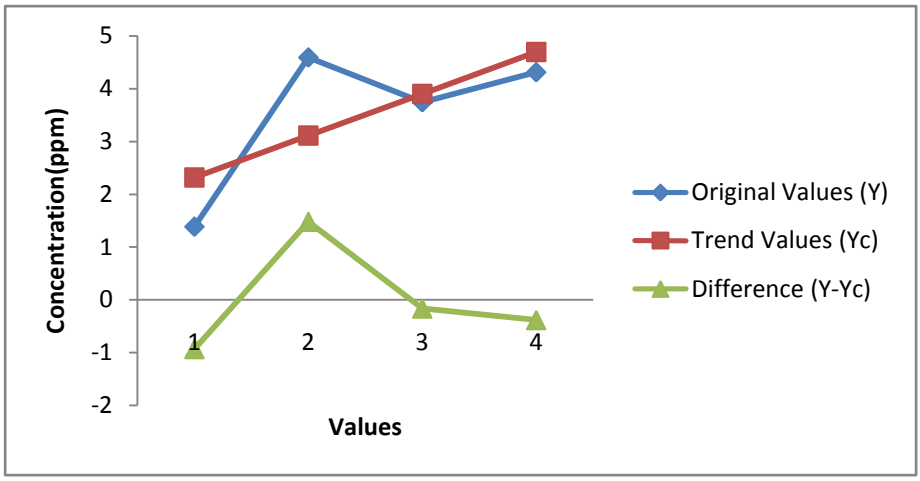


Fig.11 Relationship between Concentration and SD for zinc at Badopal Site

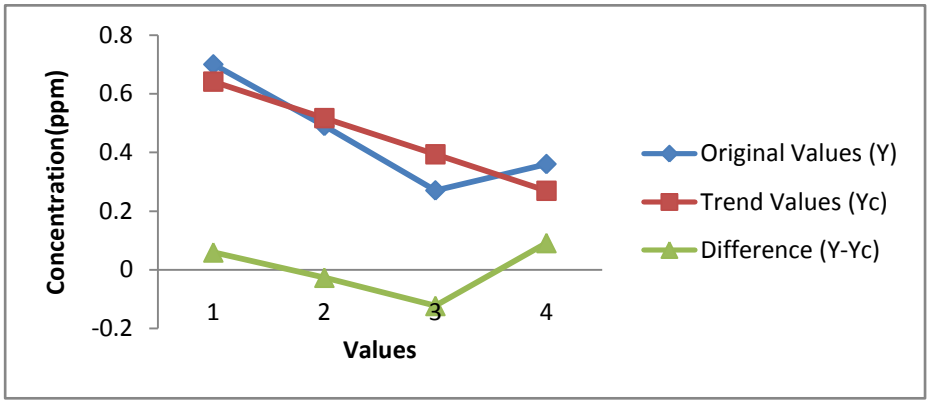


Fig. 12 Relationship between concentration and SD for Iron at Loonkaransar site

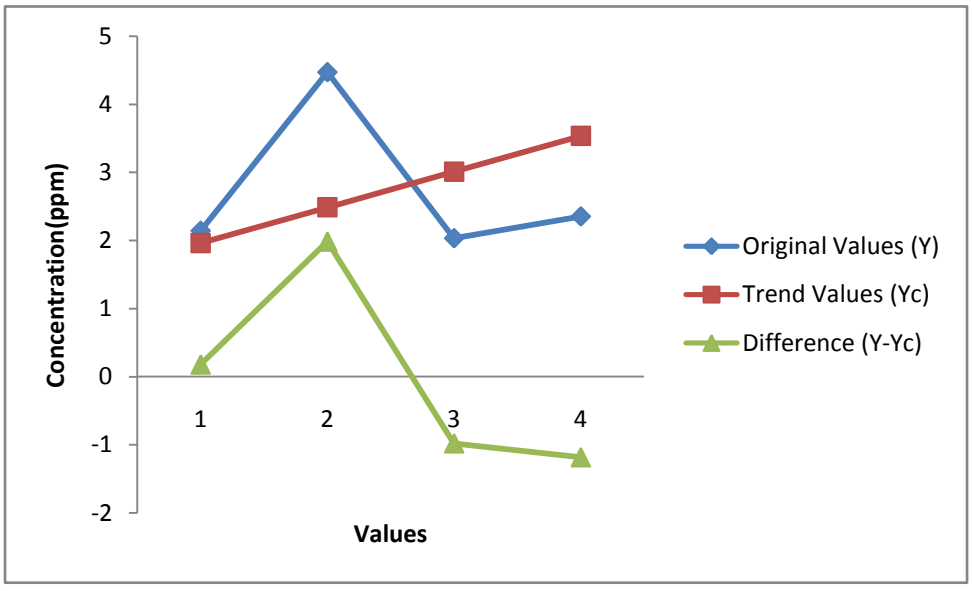


Fig. 13 Relationship between Concentration and SD for Copper at Loonkaransar Site

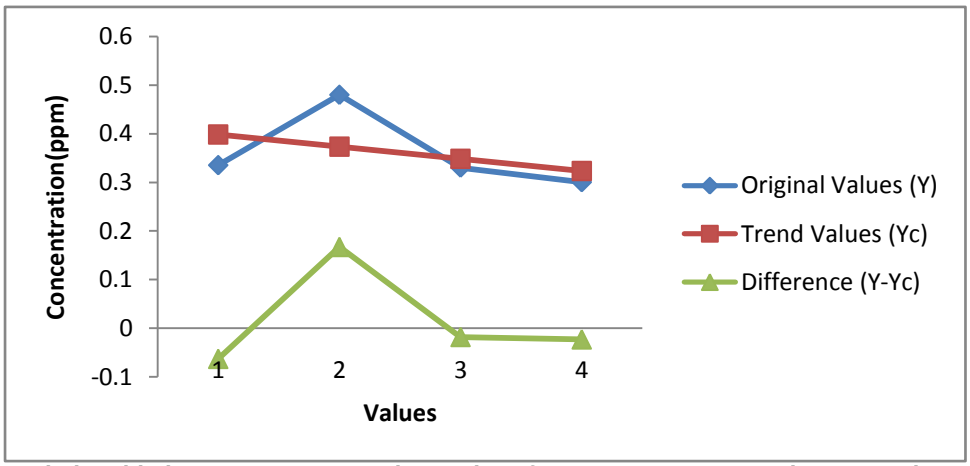


Fig. 14 Relationship between Concentration and SD for Manganese at Loonkaransar Site

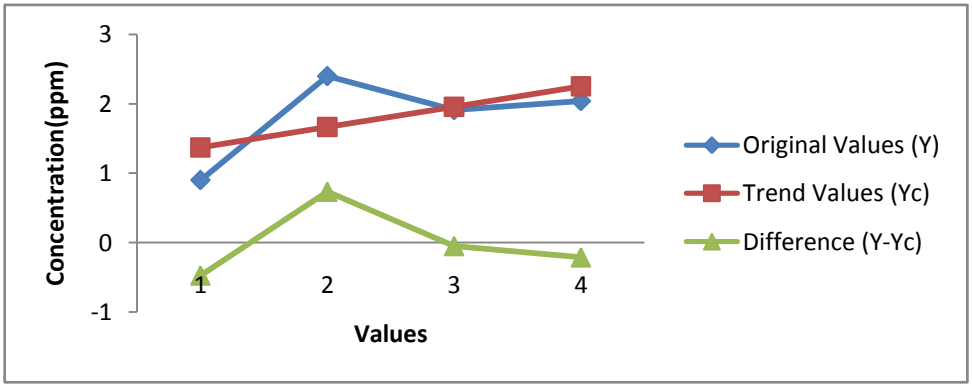
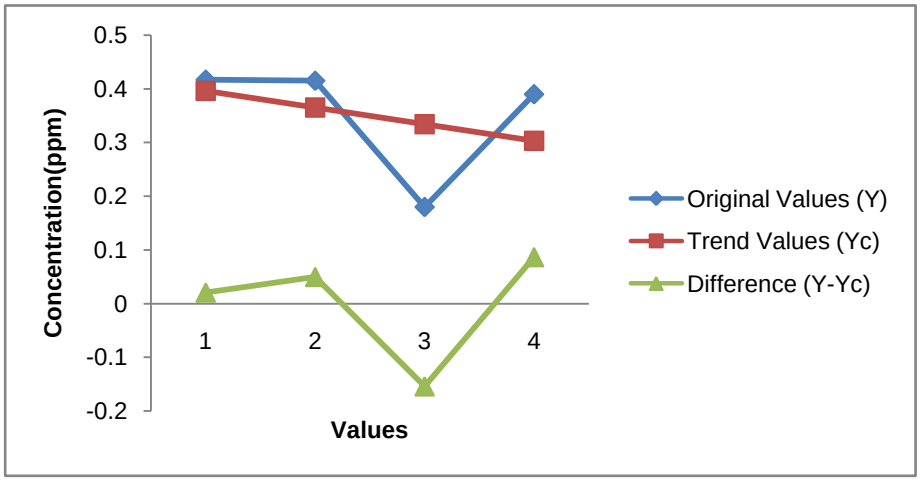


Fig. 15 Relationship between Concentration and SD for Zinc at Loonkaransar Site



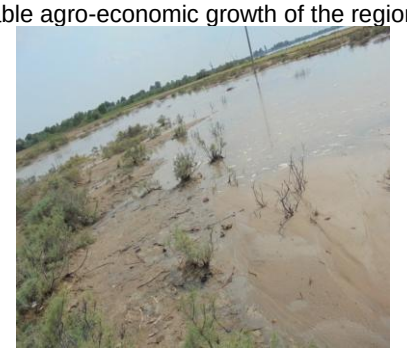
Results and Discussion

The soil samples collected from waterlogged and non- waterlogged areas showed wide variation in micronutrients. The results revealed that micronutrients value of Zn ranged from 0.03 to 0.9ppm and in rainy season Rawatsar and Badopal soil samples (away from waterlogged areas) concentration were very high, in winter season Badopal and Loonkaransar soil samples (away from waterlogged areas) concentration were very high and in summer and spring seasons Zn concentration were normal in range. The permissible limit of zinc in water according to WHO standards is 5mg/l. In all the collected water samples concentration of zinc was recorded below the permissible limit. WHO's recommended limit of zinc in plants is 50mg/kg [Shah *et al.,* 2011].The value of Fe ranged from 0.98 to 18.44ppm and in rainy season Badopal soil samples concentration very high (12.97ppm), in winter season Badopal and Loonkaransar soil samples

concentration high (7.52 to 16.17ppm), in spring season Badopal soil samples concentration high (9.99 to 18.44ppm) and in summer season Badopal soil samples concentration high and Loonkaransar soil samples concentration were low. The maximum allowed concentration of iron in drinking water is 1.0mg/l according to WHO report [Patel et al 2011]. In all the collected water samples concentration of iron was recorded above the permissible limit according to WHO. Concentration of iron in water samples ranged between 1.745 to 2.433mg/l. The WHO recommended level of iron in plants is 20mg/kg [Shah *et al*., 2011]. In the levels of *Xanthium strumarium* concentration of iron was recorded above the permissible limit while in all the other collected plants its concentration was recorded below the permissible limit. The value of Cu ranged from 0.1 to 1.63ppm and all seasons and all sites concentration were high only in summer season Rawatsar waterlogged and Badopal non waterlogged areas soil concentration was low. The permissible limit of copper for plants is 10mg/kg recommended by WHO [Hassan *et al*., 2012]. Contamination of drinking water with high level of copper may lead to chronic anemia [Iqbal *et al.,* 2011]. Copper accumulates in liver and brain. Copper toxicity is fundamental cause of Wilson's disease [Zerabruk *et al*., 2011]. The value of Mn ranged from 0.44 to 11.89ppm and in all seasons Rawatsar soil samples concentration was low, in winter, spring and summer seasons Badopal soil samples concentration were high (2.0 to 11.89ppm) only in rainy season soil concentration was very low 2.0ppm and in all seasons Loonkaransar soil samples concentration was low but some samples concentration high.

Conclusion

The present study was undertaken to assess the concentration of different micronutrients in the saline tracts of waterlogged areas of division Bikaner, Rajasthan. Since the inadequate concentration of such micronutrients may leads to improper growth of vegetation, thus the regular assessments of such micronutrients may play an important role to combat with the situation. The results of the study may help the policy makers and local administration to mitigation the effects of such problems, raised by water logging which is the results of improper irrigation, techniques, public unawareness, failure of irrigation department etc. Therefore the present study may help to improve the soil quality and enhance the sustainable agro-economic growth of the region.



RAWATSAR-HANUMANGARH

BADOPAL-GANGANAGAR

LOONKARANSAR-BIKANER

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