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Studies on Soil Micronutrient Content and Soil Quality in Jorve Village of Sangamner Tehsil of Ahmednagar District, India

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Abstract

Global population is growing at a faster rate than the increase in the yields of crops which supply most of the plant nutritional needs. The growing population is a huge threat to food security. To fulfill the need of food it is essential to increase the crop yields. Fertilizers increase crop yields but without soil testing farmer may be applying too much food elements to the little needed plant and too little of another element which is actually the principle factor, limiting plant growth. The pH directly affects nutrient availability. Electrical conductivity (EC) level of the soil water is a good indication of the amount of nutrients available for crops to absorb. In present study an attempt has been made to assess the chemical properties, primary, secondary and micro nutrient of soil samples. The results reveal that the some sampling sites were affected by excess irrigation and use of chemical fertilizer. The some sampling sites shows organic carbon, potassium, magnesium, zinc, manganese and copper were very high.

Keywords: Chemical properties, primary nutrient, secondary nutrient and micronutrient content.

Introduction

Soil makes up the “thin” layer of the earth where we live. The soil supports the plants that provide us with food, fiber, and forest products. The soil stores and purifies water. Many waste products and chemical pesticides are destroyed by soil microorganisms. Soil that wanders about as sediment in waters or as dust in the air contributes to the pollution of our environment. Since the production of our food and the quality of our environment are so importantly related to the wide use of the soil[1].

Soil pollution is defined as the build-up in soils of persistent toxic compounds, chemicals, salts, radioactive materials or disease causing agents, which have adverse effects on plant growth and animal health. The physicochemical properties of soil deteriorate to the change in land use especially from agriculture and forest, cropping and leaching of soil nutrient, in turn adversely affects the soil quality parameter[2]. Most micro element/trace metal does not exist in soluble forms for a long time in water. They are present mainly as suspended colloids or are fixed by organic substance[3]. As the population is increases the use of land is also increases therefore the waste material is discharge from houses and from industries causes serious problems of soil. In agriculture areas, the addition of metals into the system is primarily due to commercial fertilizer application[4]. Once the pollutants enter and are incorporated into the soil, the concentration in soil continuously increasing and accumulating, which is toxic to all forms of life like plants, microorganism and human being[5]. So it is very important that all of us know some basic facts and ideas about the soil.

For the plant growth sixteen elements are essential, these elements are grouped into micro and macro nutrient. The deficiency or excess presences of micronutrient like zinc, iron, manganese, copper and boron may produces synthetic and antagonistic effects in the plants[6]. Around the study area sugarcane, wheat, sorghum and onion are cultivated as main crops but the crop yield per acre are decreasing in part of the study area. The present study deals with the chemical properties, primary, secondary and micronutrient of soil samples from the Jorve village of Sangamner tehsil.

Material and Methods

The study area is located in Sangamner tehsil of Ahmednagar district of Maharashtra, India. The 10 soil samples were collected from selected sampling sites. These soil samples were collected in clean polythene bags to laboratory for the analysis of chemical properties, primary nutrient and secondary nutrient. The pH meter, Conductivity Bridge and Flame Photometer was used for the analysis of pH, EC, Na^+ and K^+ respectively. Kjeldhals methods were used for the determination of nitrogen and the micronutrient analyzed by Pravra Agro Biotech, Chikhali, Sangamner using atomic absorption spectrophotometer. The soil was collected as per standard procedure given in the literature. The analysis was carried out using standard methods[7-9].

Results and Discussion

Interpretation of graphical representation for chemical properties of a soil samples: i. pH: It ranges from acidity (below 7.0), neutrality (pH 7.0), and alkalinity (above 7.0). Soil pH is important, because it affects root growth, controls nutrient availability, solubility of toxic ions, and microbial activity. Soil pH from 6.0 to 8.0 is suitable for a wide range of crops. All sampling sites show alkaline pH (figure 1). ii. EC: EC expresses the total soluble salts in the soil. Determination of EC is especially important in heavily-fertilized nursery soils and self affected soils, in which salts may accumulate in quantities which are detrimental to plant growth[10]. The sampling sites S1,S2,S3,S5 and S6 shows moderate, S4,S7,S8,S9 and S10 shows low EC in study area (figure 2). iii. Organic carbon: Determination of OC helps to estimate the nitrogen which will be released by bacterial activity depending on the climatic conditions, pH and type of organic material. S2, S5, S8, S10 shows very high %, S1, S3, S6 shows high. S7, S9 and S4 shows moderate and low % of organic matter respectively (figure 3). iv. Na: Greater than 2.5% may cause adverse physical and chemical conditions to develop in the soil that may prevent plant growth. High levels of sodium affect soil permeability and may be toxic to sensitive plants. The replacement of the Na by ca or mg and the removal of sodium by leaching. All sampling sites show moderate concentration of Na (figure 5).

Table-1
Chemical properties of soil samples

	Sampling Sites									
Parameter	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
pH	9.39	8.78	9.15	8.77	8.57	8.85	8.78	9.38	8.81	9.12
EC	0.67	0.98	0.84	0.47	0.75	0.88	0.39	0.27	0.16	0.44
OC	0.96	1.05	0.82	0.47	1.12	0.97	0.45	1.27	0.74	1.02
$CaCO_3$	11.87	10.62	12.75	10.00	13.12	9.37	8.75	7.50	10.00	10.62
Sodium	1.89	2.10	2.13	1.98	2.18	2.15	1.76	1.82	1.95	2.01

Table-2
Compared with standard value of chemical properties

	Range of standard value							
Parameter	**V.high**	**S.sites**	**High**	**S.sites**	**Mod.**	**S.sites**	**Low**	**S.sites**
EC(dS/m)	-	-	1.01-2.00	-	0.61-1.00	S1,S2,S3,S5,S6	0.00-0.61	S4,S7, S8,S9,S10
OC(%)	1.01-2.00	S2,S5, S8,S10	0.81-1.00	S1,S3,S6	0.41-0.80	S7,S9	0.00-0.40	S4
$CaCO_3$ (%)	-	-	10.01-15.00	S1,S2,S3,S5,S10	5.01-10.00	S4,S6,S7,S8,S9	0.00-5.00	-
Na (m.e%)	-	-	2.51-4.00	-	1.01-2.50	All sampling sites	0.00-1.00	-

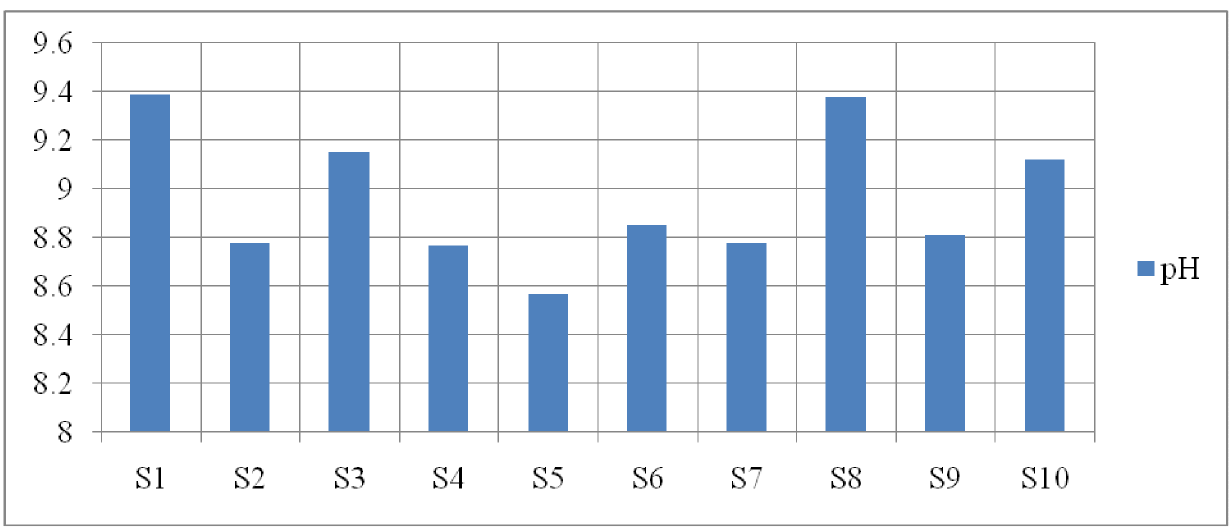

Figure-1
Graphical representation for chemical properties of soil: Ph

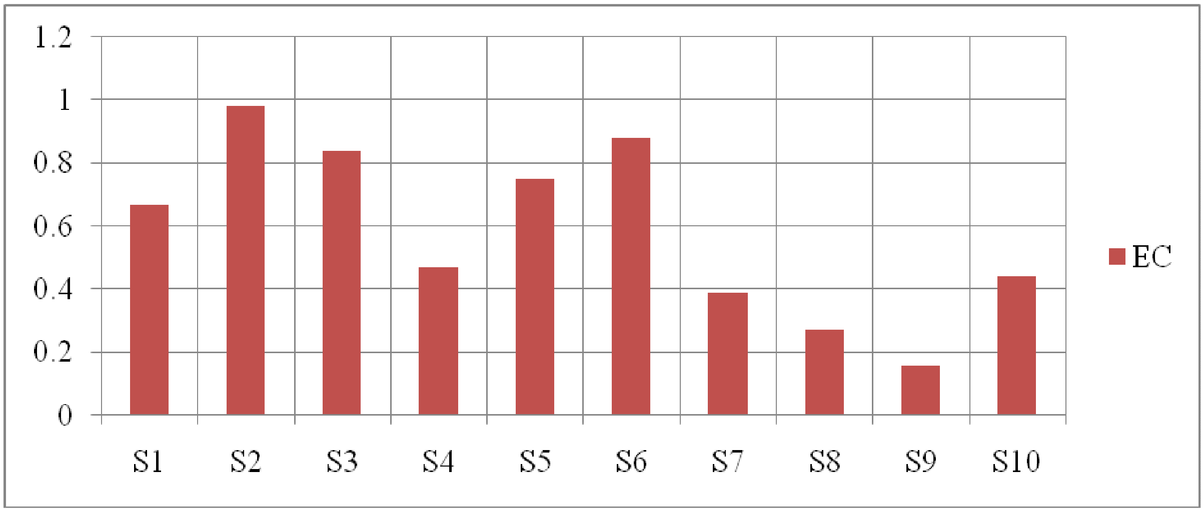

Figure-2
Graphical representation for chemical properties of soil: EC

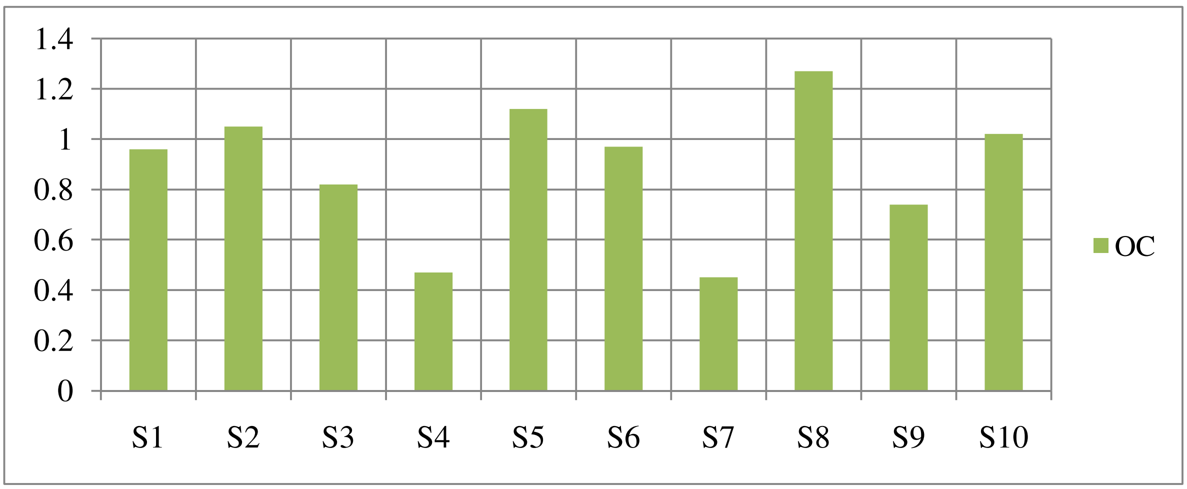

Figure-3
Graphical representation for chemical properties of soil: Organic Carbon

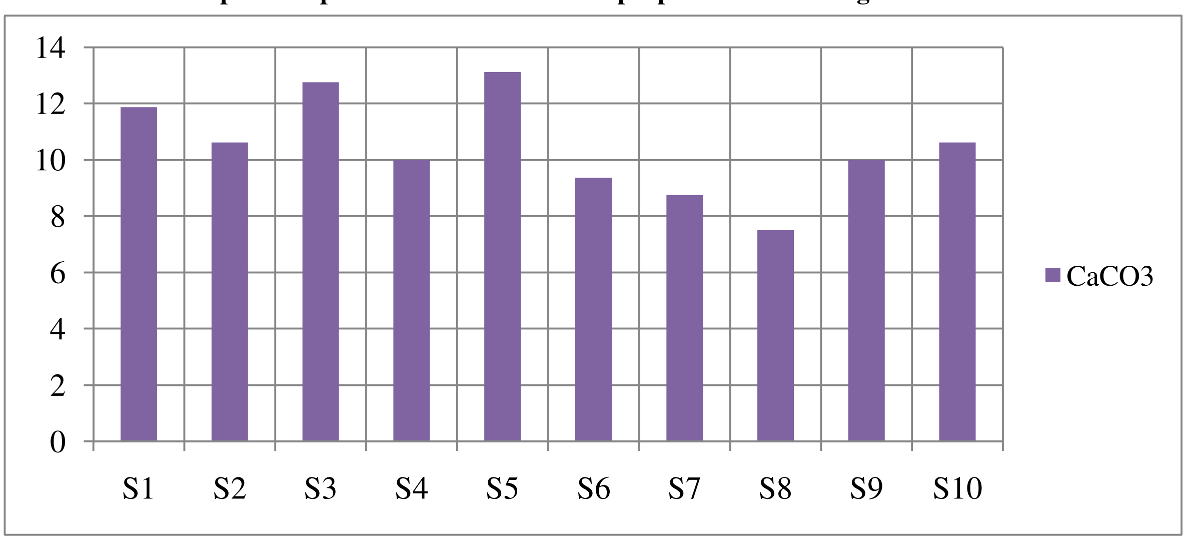

Figure-4
Graphical representation for chemical properties of soil: CaCO3

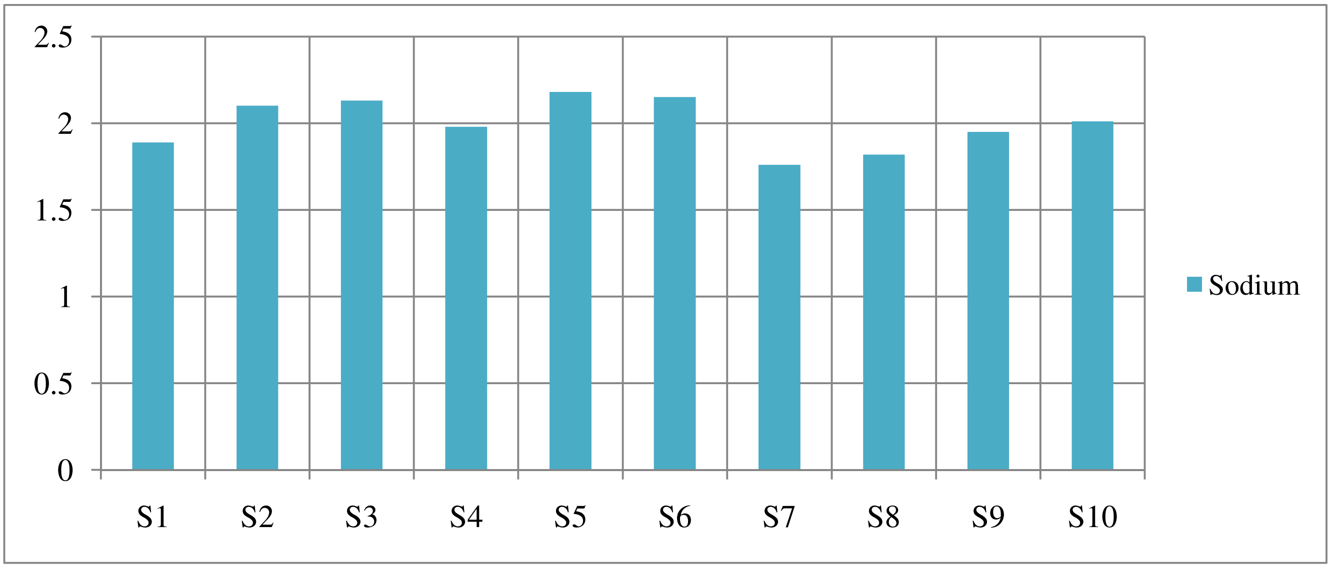

Figure-5
Graphical representation for chemical properties of soil: Sodium

Table-3
Primary nutrients of soil samples

Parameter	Sampling Sites									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
N (Kg/h)	356.12	386.96	263.52	391.68	378.12	265.90	265.90	405.00	360.00	398.50
P (Kg/h)	59.44	20.62	13.95	48.82	32.75	17.28	40.94	46.48	40.00	33.36
K (Kg/h)	206.23	203.12	193.65	241.00	216.50	211.00	246.35	237.12	220.00	222.00

Table-4
Compared with standard value of primary nutrient

Parameter	Range of standard value							
	V. high	S. sites	High	S. sites	Mod.	S. sites	Low	S. sites
N (Kg/h)	701.0-900.0	-	461.0-700.0	-	281.0-460.00	S1,S2,S3,S4,S5,S6, S8,S9, S10	0.00-280.0	S7
P (Kg/h)	35.10-42.00	S1,S4,S5, S8,S9,S7	0.81-1.00	S10	0.41-0.80	S2,S6	0.00-0.40	S3
K (Kg/h)	361.0-420.0	-	301.0-360.00	S1,S2,S3,S5,S10	181.0-300.00	All sampling sites	0.00-180.0	-

Interpretation of graphical interpretation for primary nutrient of a soil samples: i. N: Nitrate-N and ammonia-N are the most available forms of nitrogen to plants since most of the nitrogen is tied up in organic matter. Nitrogen requirements are different for each crop. S1, S2, S3, S4, S5, S6, S8, S9 and S10 shows moderate nitrogen concentration and S7 shows low nitrogen (figure 6). ii. P: Soil phosphorus is available in very low amounts to plants since most of the total soil phosphorus is tied up in insoluble compounds, and its availability depends on the soil pH. Calcium phosphate is formed in neutral and alkaline soils. Iron and aluminum phosphates are formed in acidic soils. Phosphorus is most available from pH 6 to 7 and is absorbed by plants primarily as orthophosphates. S1, S4, S5, S8, S9 and S7 sampling sites shows very high concentration of phosphorous, S10 shows high, S2 and S6 shows moderate and S3 shows low concentration of phosphorous in study area (figure 7). iii. K: Potassium is the third most important plant nutrient along with nitrogen and phosphorus. Soil K exists in three forms like as unavailable, slowly available and available. The exchangeable form becomes available when the potassium in solution is removed by the crops. All sampling sites moderate concentration potassium in the study area (figure 8).

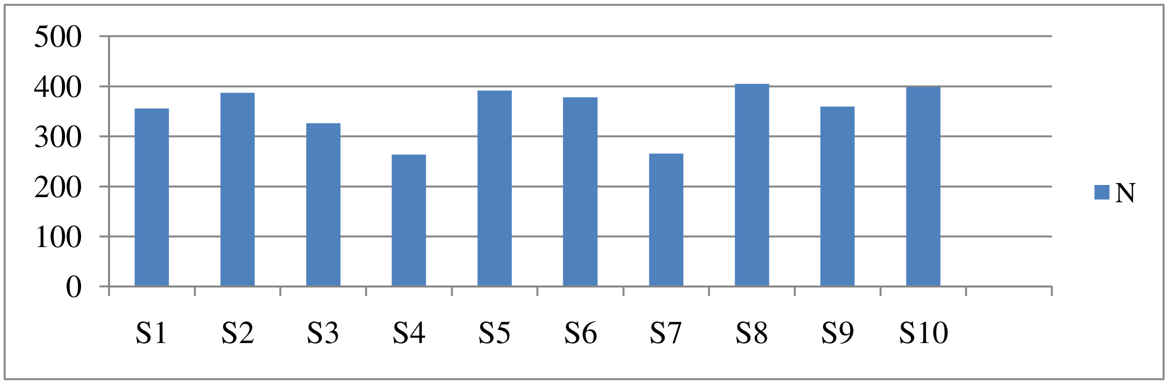

Figure-6
Graphical representation for primary nutrient of soil: Nitrogen

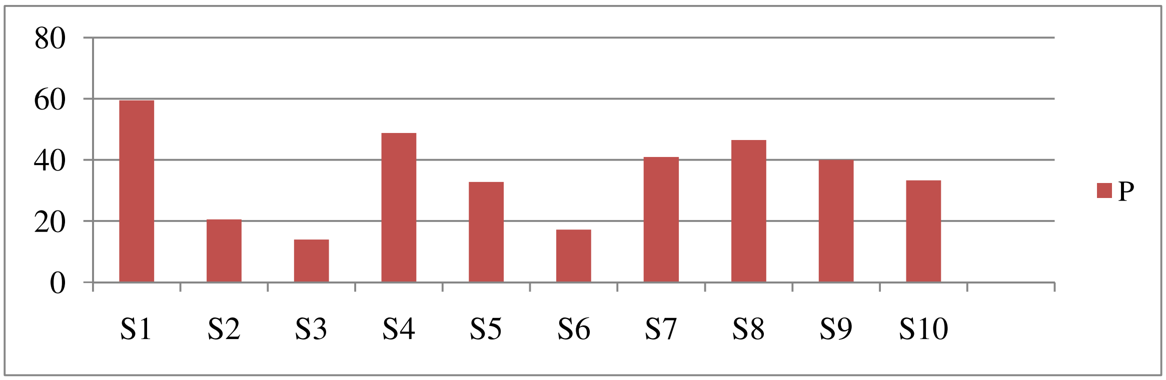

Figure-7
Graphical representation for primary nutrient of soil: Phosphorous

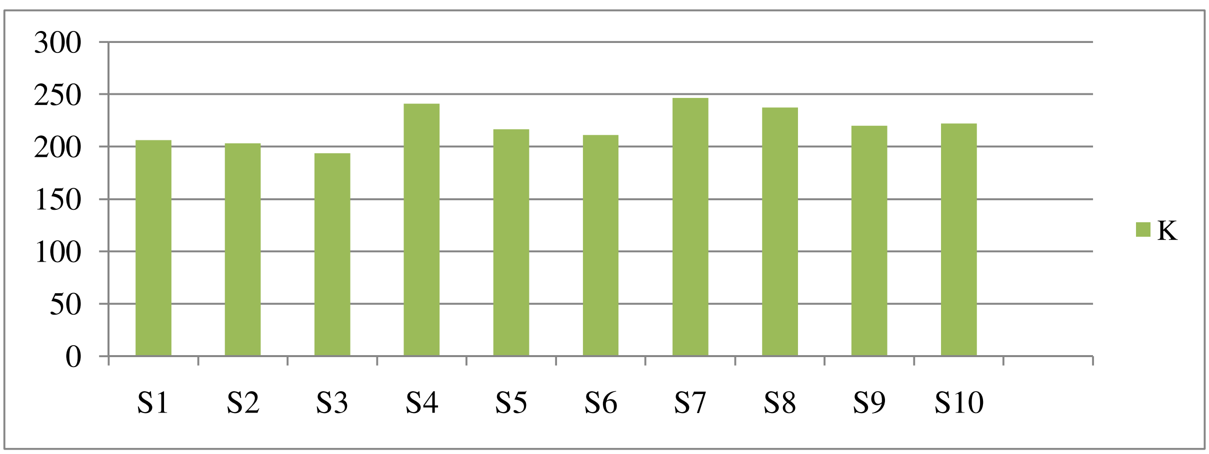

Figure-8
Graphical representation for primary nutrient of soil: Potassium

Table-5
Secondary nutrients of soil samples

Parameter	Sampling Sites									
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
Ca (m. e. %)	0.29	0.47	0.41	0.45	0.41	0.29	0.35	0.53	0.50	0.01
Mg (m. e. %)	0.84	0.72	0.87	0.90	0.85	0.81	0.78	0.93	0.60	0.90
S (ppm)	28.56	31.20	23.26	28.71	32.56	27.89	28.96	32.65	24.52	34.15

Table-6
Compared with standard value of Secondary nutrients of soil samples

Parameter	Range of standard value							
	V. high	**S. sites**	**High**	**S. sites**	**Mod.**	**S. sites**	**Low**	**S. sites**
Ca (m. e. %)	-	-	0.51-1.00	S8,S10	0.21 0.50	S1,S2,S3,S4,S5,S6, S7,S9	0.00-0.20	-
Mg (m. e. %)	> 0.50	All sampling sites	0.21-0.50	-	0.11-0.20	-	0.00-0.10	-
S (ppm)		-	51.0-100.00	-	11.0-50.00	All sampling sites	0.00-10.0	-

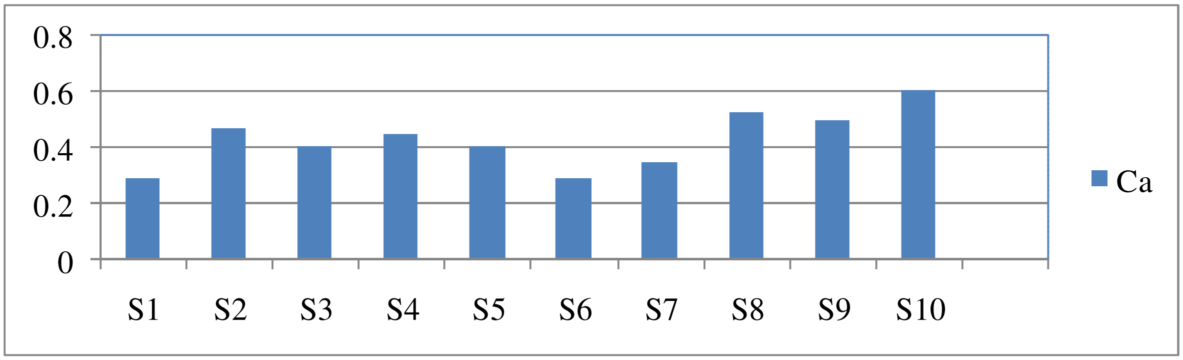

Figure-9
Graphical representation for secondary nutrient of soil: Calcium

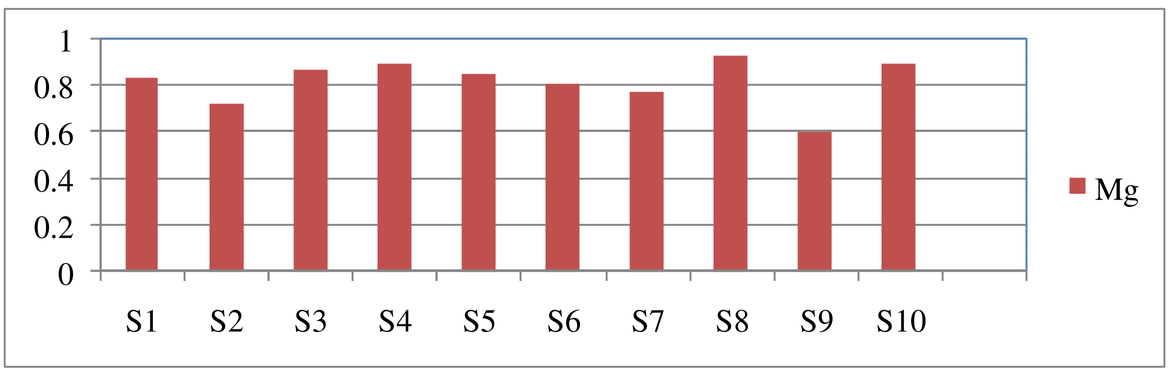

Figure-10
Graphical representation for secondary nutrient of soil: Magnesium

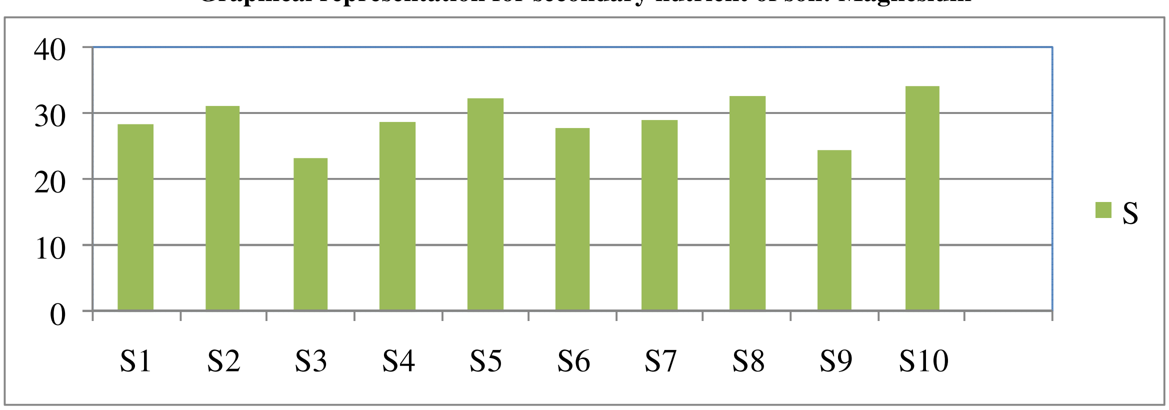

Figure-11
Graphical representation for secondary nutrient of soil: Sulphur

Interpretation of graphical representation for secondary nutrient of a soil samples: i. Ca: Calcium deficiencies are rare when the soil pH is adequate. Values 10% above or below can indicate a problem with the water percolation and poor soil aeration on sensitive crops. A Ca: Mg ratio of 4:1 or 3:1 is appropriate for a good soil structure. The sampling sites S8 and S10 shows high concentration. The S1, S2, S3, S4, S5, S6, S7 and S9 sites shows moderate concentration of calcium (figure 8). ii. Mg: Optimum magnesium levels normally range from 100 to 250 ppm (200 - 500 lb/Acre). Soils having a magnesium base saturation in excess of 30 - 35 % may exhibit serious problems, such as crusting and restricted root development. All sampling sites show the very high concentration of magnesium (figure 10). iii. S: Sulfur is part of every plant cell and is an important constituent of proteins. It is absorbed primarily as sulfate (SO_4^{-2}) anion. Values below 7 - 15 ppm are considered low for tomatoes, legume, and sugar beets. All sampling sites show the moderate concentration of sulphur (figure 11).

Table-7
Micro nutrients of soil samples

Parameter	Sampling Sites									
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
Zn(ppm)	3.00	2.09	9.54	2.01	2.36	2.87	7.92	3.10	2.36	1.55
Fe(ppm)	7.45	4.75	4.26	7.17	6.02	6.59	3.75	6.54	6.15	4.76
Mn(ppm)	14.32	25.27	37.70	27.70	36.74	23.55	13.89	16.89	14.91	11.01
Cu(ppm)	1.69	2.06	2.31	1.87	2.28	2.19	2.13	1.69	2.18	1.87
B(ppm)	0.46	0.53	0.51	0.48	0.57	0.54	0.53	0.56	0.56	0.52

Table-8
Compared with standard value of micronutrients of soil samples

Parameter	Range of standard value							
	V. high	**S. sites**	**High**	**S. sites**	**Mod.**	**S. sites**	**Low**	**S. sites**
Zn(ppm)	> 2.00	S1,S2,S3,S4,S5, S6,S7,S8,S9	0.51-1.00	S10	0.21 0.50	-	0.00-0.20	-
Fe(ppm)	>15.00	-	10.01-15.00	-	4.51-10.0	S1,S2,S4,S5, S6,S8,S9,S10	0.00-4.50	S3,S7
Mn(ppm)	>8.00	All sampling sites	5.01-8.00	-	2.01-5.00	-	0.00-2.00	-
Cu(ppm)	>0.90	All sampling sites	0.41-0.90	-	0.21-0.40	-	0.00-0.20	-
B(ppm)	>1.50	-	1.01-1.50	-	0.51-1.00	S2,S3,S4,S5, S6,S7,S8,S9,S10	0.00-0.50	S1

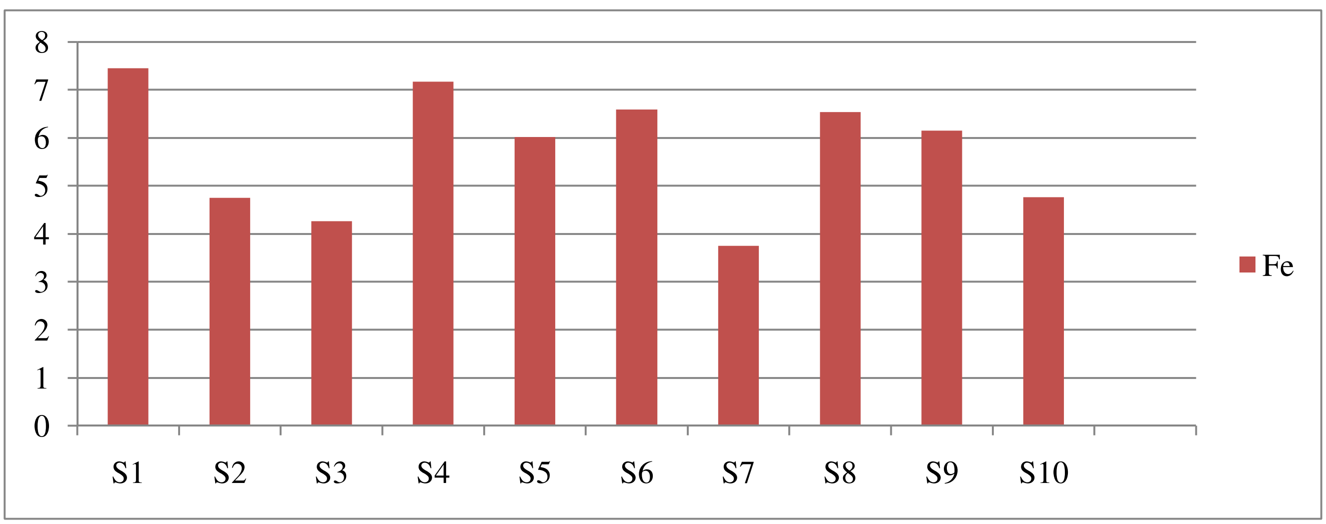

Figure-12
Graphical representation for micronutrient of soil: Iron

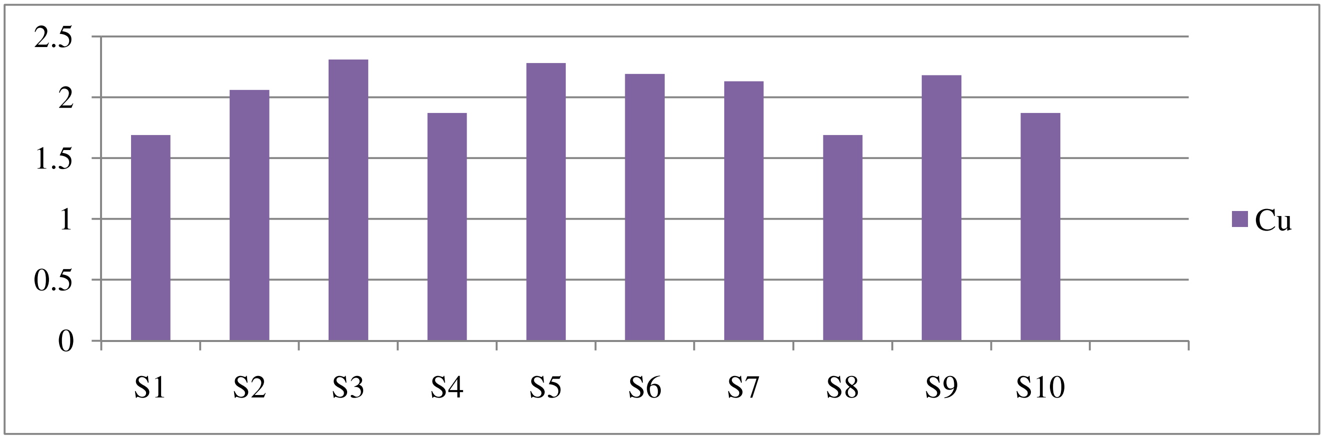

Figure-13
Graphical representation for micronutrient of soil: Copper

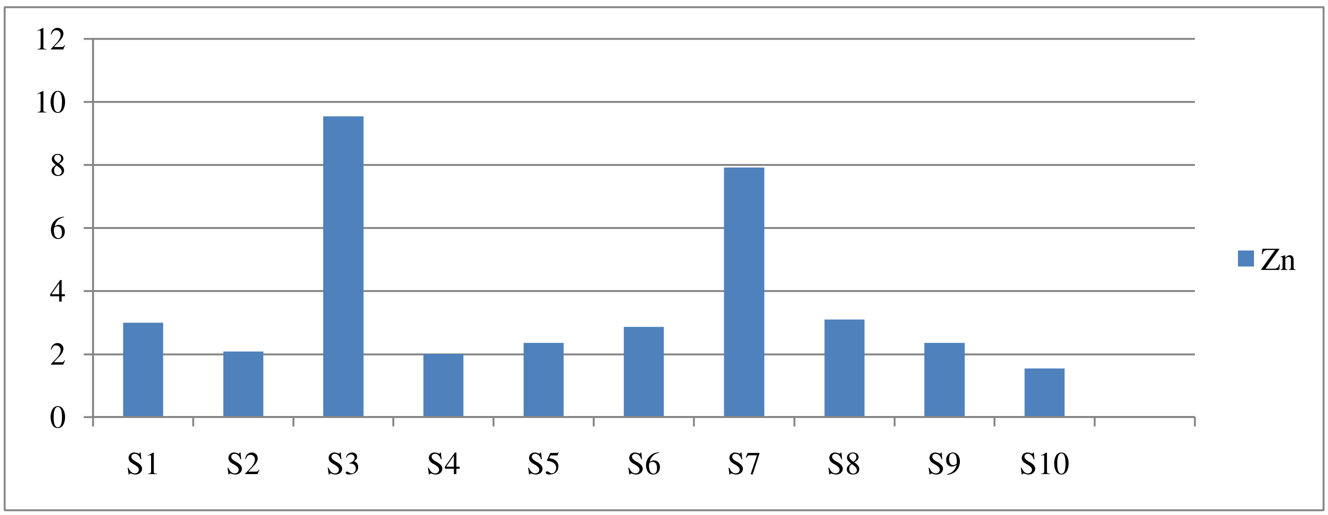

Figure-14
Graphical representation for micronutrient of soil: Zinc

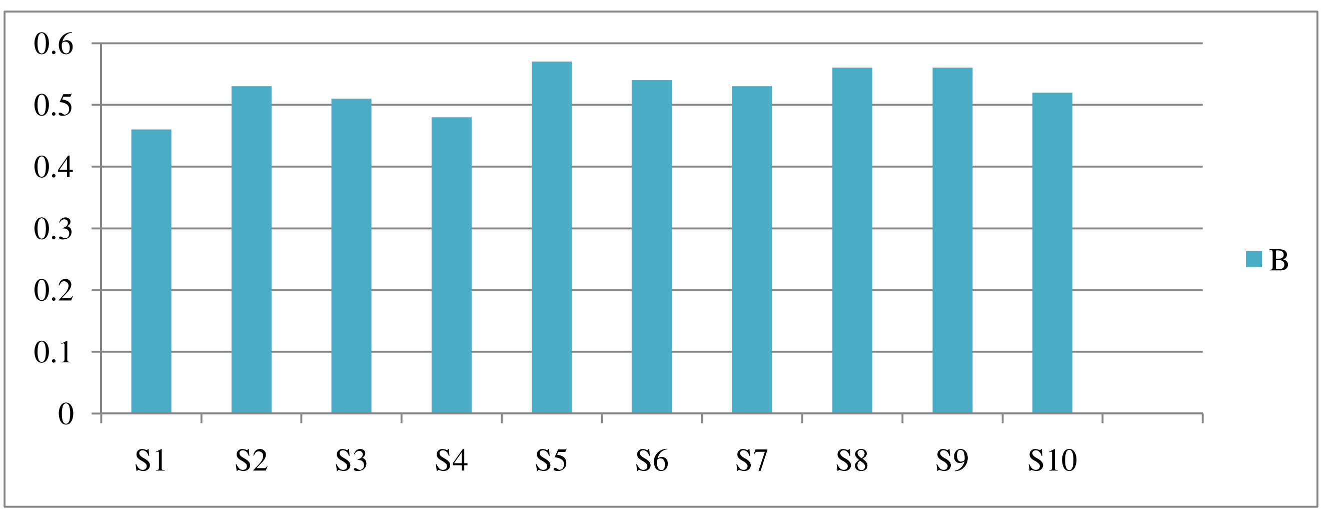

Figure-15
Graphical representation for micronutrient of soil: Boron

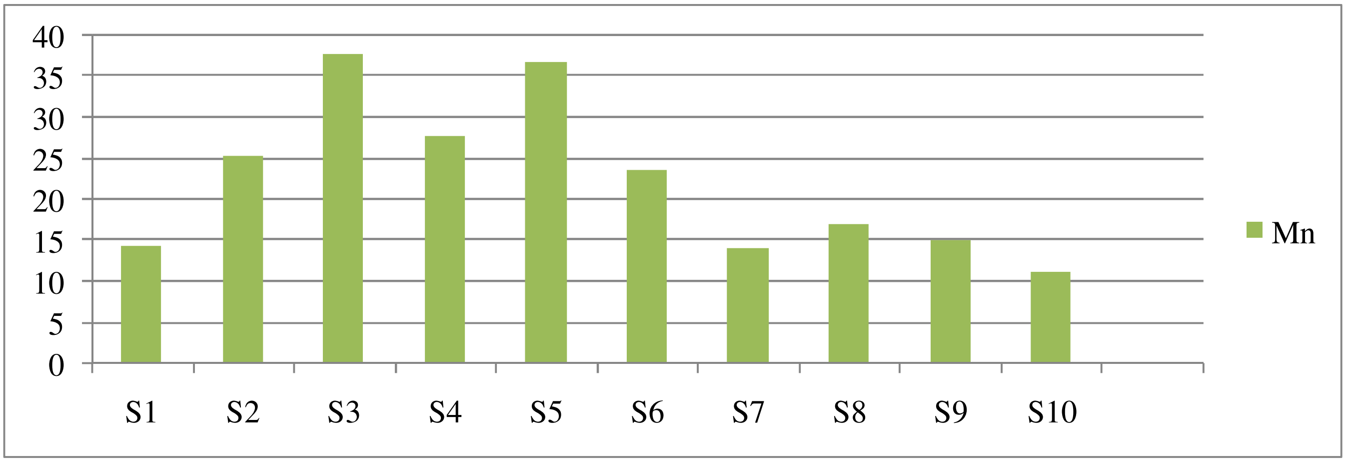

Figure-16
Graphical representation for micronutrient of soil: Manganese

Interpretation of graphical representation for micronutrient of a Soil Samples: i. Fe: Iron deficiency likely occurs in soils with high pH, poor aeration, excessive phosphorus or low organic matter. It may be produced also by an imbalance of Mo, Cu, and Mn. In plants, the deficiency shows up as a pale green leaf color (chlorosis) with sharp distinction between green veins and yellow intervenial tissues. S1, S2, S4, S5, S6, S8, S9 and S10 show moderate concentration. Sampling sites S3 and S7 shows low (figure 12). ii. Cu: Copper deficiency is most likely in organic soils. Cu is not always available even though the soil has plenty of Cu. Sandy soils with low organic matter also are deficient because of leaching losses. In plants Cu deficiency shows up as leaves losing turgor and developing a bluish-green shade before becoming chlorotic and curling. All sampling sites show higher concentration of copper (figure 13). iii. Zn: Zn deficiency most often is present in sandy soils with neutral or alkaline pH, or with low organic matter. Total zinc may be high but the availability depends on other factors. S1, S2, S3, S4, S5, S6, S7, S8 and S9 show very high concentration of zinc. S10 sampling sites show high concentration (figure 14). iv. B: There is a very narrow range between deficiency and toxicity in boron. Deficiencies are more often when the organic matter is low and the dry weather slows the decomposition. Uptake of boron is reduced at pH levels higher than 7.0. Plant toxicity symptoms manifest as leaf tip and marginal chlorosis. Boron toxicity occurs in dry areas and is generally associated with the irrigation water. All sampling sites shows deficient amount of boron (figure 15). v. Mn: Plants need small amount of Mn to grow and mature properly; otherwise they fail completely as if they lacked the major element. The deficiencies of manganese generally associated with naturally neutral or alkaline soils[11]. All sampling sites show high concentration of Mn (figure 16).

Conclusion

The soil sample quality is disturbed due to the excess use of chemical fertilizer and the excess water for irrigation. There is a need for proper management to achieve sustainable agriculture progress. By all means, the natural quality of soil was contaminated in this area.

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