Journal of Pharmaceutical and Scientific Innovation

www.jpsionline.com (ISSN : 2277 -4572)

Research Article

COMPARATIVE SOIL PROFILE STUDY IN IRRIGATED AND NON-IRRIGATED AREA

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DOI: 10.7897/2277-4572.101199

Received on: 28/01/21 Revised on: 06/02/21 Accepted on: 26/02/21

ABSTRACT

Soil analysis is useful for cropping pattern so as to increase crop yield and to maintain long term productivity. The farmer's main objective is to maintain the productivity of his soil. An excessive use of fertilizer which is not utilized for crop production can pollute the environment. For this purpose, it is very important to consider as to what the crop requirement for various nutrients is and what their actual use is. In this study, components of soil such as pH, Salinity (EC), Nitrogen, Phosphorous and Potassium Fe, Cu, Mn, Zn were analyzed by different instruments like pH-meter, spectrophotometer, flame photometer and conductivity meter. The soil analysis was done for both Irrigated and Non-Irrigated area. The values of pH, Salinity (EC), Nitrogen, Phosphorous and Potassium, Fe, Cu, Mn, Zn were observed in moderate to slight increased or decreased range. The values for Irrigated areas were observed different than Non-Irrigated areas.

Keywords: pH, salinity, Nitrogen, Phosphorus, Potassium, Fe, Cu, Mn, Zn

INTRODUCTION

Now the Indian agricultural economy is being changed structurally. In 1970, the share of agriculture was 43% of the GDP and now it contributes about 16%. This reduction is due to the rapid growth in the sectors such as services, industrial output and non-agricultural sectors. In India, most of the cultivated land is rain fed. So irrigation is very important from the economical point of view[1]. India has 159.7 million hectors of land under cultivation. Out of that, nearly 82.6 million hectors of land are irrigated[2]. Agriculture has been the main occupation of Maharashtra even it being an industrialized state of India. Irrigation facilities are provided to make agriculture less dependent upon rainwater. The rain fall in Sahyadri cress is 400 cm, while in north, it is only 70 cm. Solapur and Ahmednagar districts are in the heart of the dry zone. Pathardi is the Tehsil located in Ahmednagar.

Rainfall, soil structure, irrigation, cropping patterns, weather etc. are very important factors in the field of agricultural. In the same way, fertilizers also play very important role in the productivity. But the specialty of this factor is that it is controllable unlike other factors. So, we will highlight it. It is very important in enhancing crop production. The need of food of India can be satisfied with it. It is not possible for any country to increase agricultural productivity without expanding the use of chemical industry. So, application of N, P and K through correct method and time of application in right proportion can be called balanced fertilization. So, soil analysis is very important in the field of agriculture.

To maintain the soil health and to sustain the crop productivity, the use of N, P and K fertilizer should be encouraged. If we use these fertilizers without balance, then the coefficient use will go down considerably, and it will affect the average yields of economic crops.

PHYSICO CHEMICAL PARAMETERS

Soil pH

Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and is measured in pH units. Some plants need more acidic soil than others; so, it is a good idea to test it before planting certain plants. Soils in non-irrigated area have a tendency to be more acidic and will often have values of 7.0 or less, while soils in irrigated area have more alkalinity and will often have a pH of 7.0 or more. For many plants the desired range of pH is between 5.5 and 8.5[3].

Conductance

The amount of soluble salts present within the soil is represented by salinity. Soils containing a high salt content have a high electrical conductivity level. As with high hydrogen ion amounts, high salinity levels may indicate certain nutrient deficiencies within a soil environment. EC of 2 mmho/cm or lower, no plants should have problems. Symptoms may appear in very sensitive plants at levels of 2 to 4 mmho /cm, and will appear more universally at levels ranging from 4 to 8 mmho /cm. At EC levels above 8, even plants with moderate levels of salt tolerance will begin to show symptoms[4].

Organic carbon

The decomposition of plant and animal tissue produce Soil organic carbon on the soil surface and in the subsurface. It consists of amino acids, organic acids, plants fibers and the biomass of micro-organisms. The soil microbial community is benefited, and all other organisms are influenced by soil organic matter. Though it occurs in small amounts in soil, organic matter has a major influence on soil aggregation, nutrient reserve and its availability, moisture retention and biological activity[5].

N.P.K. in soil

Nitrogen, Phosphorus and Potassium are known as macronutrients because they are required in large quantity for plants. These nutrients increase growth of crops. They also increase ability of crops to survive in unfavorable condition. The crops easily absorb these nutrients from the soil.

Nitrogen: Nitrogen is part of both the plant's structure and its life processes. We find it in the leaves, seeds, stems, flowers, roots and tissues of plants. It is needed for growth and for seed and fruit production. Nitrogen is an essential part of the molecular structure of chlorophyll. It plays vital role in photosynthesis. Light green plant and yellow older leaves are the symptoms of Nitrogen deficiency

Phosphorus: Phosphorus also is important for photosynthesis and plant growth. It increases the growth of healthy roots and encourages flowering plants to blossom. Stunted growth, dull or dying leaves, dark green plants with purple cast, small leaves and plants and the formation of a red pigment at the leaf base are the consequences of the phosphorus deficiency.

Potassium: Potassium plays very important role in photosynthesis, building protein, producing fruit and fighting diseases. Potassium is also called as potash. Plants use it to build stronger stalks and stems.

Micronutrients: There are about seven nutrients: manganese, boron, copper, iron, chlorine, molybdenum and zinc. They are essential for growth and health of the plant and needed in very small quantities. Out of that, Fe, Cu, Mn and Zn are measured in this study[6].

Copper: Due to copper deficiency, browning of leaf tips occurs in crops and chlorosis. Young leaves uniformly become pale yellow.

Iron: It is essential for chlorophyll synthesis. So, an iron deficiency result in chlorosis i.e. leaves become yellow to almost white.

Manganese: It activates some important enzymes involved in chlorophyll formation. In Manganese deficient leaves becomes yellowish-gray or reddish, gray with green veins

Zinc: It plays very important role in chlorophyll formation and also activates many enzymes. Symptoms of zinc deficiency are pronounced interveinal chlorosis, bronzing of leaves and stunted growth.

MATERIALS AND METHODS

Ten places from irrigated area and ten places from non-irrigated areas (S. S) were selected for the study. Soil samples of fields of the two selected farmers (S. F - S_A & S_B) of each selected station or place were collected for the analysis. Further the analysis was carried out by standard methods.

pH of soil: One pint of the mixed soil is removed and allowed to dry at room temperature. Distilled water is added to the soil sample. Closed the container tightly and shaken it vigorously. Standardized pH-meter by using potassium Hydrogen phthalate (pH 4) buffer solutions. Measured the pH of the soil sample finally[7].

Electrical conductivity of soil (Soluble Salts): 30 grams of soil and 30 milliliters of deionized water are measured into large test tubes and shaken for 30 minutes. The electrical conductivity of this slurry is determined with a dipping cell and reported as millimhos per centimeter (mmohs/cm).

Percentage organic carbon: One g of soil was taken in a 500 ml conical flask. 10 ml of 1N $K_2Cr_2O_7$ solution was added and shaken to mix it. Then 20 ml Con. H_2SO_4 was added and swirled the flask 2 or 3 times. Allowed the flask to stand for 30 minutes on an asbestos sheet for the reaction to be completed. 200 ml of water was poured to the flask to dilute the suspension. That solution was filtered. It is expected that the end point of the titration is to be clear. 10 ml of 85% H_3PO_4 and 1 ml of Diphenylamine indicator was added and titrated the solution with 0.5 N Ferrous Ammonium Sulphate, till the colour flashes from violet through blue to bright green. This is back titration. H_3PO_4 gives sharper end point by making the colour change, distinct through a flocculating effect. The volume of Ferrous Ammonium Sulphate is noted. Blank titration (without soil) is carried out in a similar manner[5].

Calculation

$$\% \text{ of organic carbon in soil} = 10 (V_1 - V_2) \times 0.003 / V_1 \times 100/W$$

Where, W - Weight of Sample, V_1 - Blank Titer value, V_2 - Titer value of the Sample, Milliequivalent weight of carbon-0.003

The soil Nitrogen: 1g sample of soil Weighed and placed in Kjeldahl flask.0.7 g copper sulphate, 1.5 g K_2SO_4 and 30 ml H_2SO_4 is added in it. This flask heated gently until frothing ceases; glass beads added to reduce frothing. Boiled briskly until solution is clear and then digestion continued for 30 minutes. Removed the flask from the heater and cooled, 50 ml water added and transfer to distilling flask. Accurately 25 ml standard acid (0.1M HCl) is taken in the receiving conical flask so that there is an excess of 5 ml of the acid. Drops of methyl red indicator added in it. Enough water added to cover the end of the condenser outlet tubes. 30 ml of 35% NaOH is added in the distilling flask in such a way that the contents did not mixed. The contents heated to distil the ammonia for about 40 minutes. Receiving flask removed and rinsed outlet tube with a small amount of distilled water. Excess acid in the distillate is titrated with 0.1M NaOH.

Calculation

$$\text{Percent N} = 1.401 (V_1M_1 - V_2M_2) - (V_3M_1 - V_4M_2) / W \times \text{df}$$

Where, V_1 - ml of standard acid taken in receiving flask for samples, V_2 - ml of standard NaOH used in titration, V_3 - ml of standard acid taken to receiving flask for blank, V_4 - ml of standard NaOH used in titrating blank, M_1 - Molarity of standard acid, M_2 - Molarity of standard NaOH, W - Weight of sample taken (1 g)

df - Dilution factor of sample (if 1 g taken for estimation, the dilution factor will be 100).

Note: 1000 ml of 0.1 M HCl or 0.1 M H_2SO_4 = 1.401 g Nitrogen.

The soil phosphorus

The soil phosphorus measured is that which is extracted by a solution consisting of 0.025 N HCl and 0.03 N NH_4F, referred to as Bray-1 extractant. 1 gram scoop of soil and 10 milliliters of extractant are shaken for 5 minutes. The amount of phosphorus extracted is determined by measuring the intensity of the blue color developed in the filtrate when treated with ammonium molybdate hydrochloric acid solution and then aminonaphthol-sulfonic acid solution. The color is measured by a spectrophotometer at 640 nm. The result is reported in parts per million (ppm) phosphorus (P) in the soil[8].

The soil potassium: Potassium is extracted from the soil by mixing 10 ml of 1N neutral ammonium acetate with a 1-gram scoop of soil and shaken for 5 minutes. The exchangeable potassium is measured by analyzing the filtered extract on an atomic absorption spectrophotometer set on emission mode at 776 nm. The results are reported as parts per million (ppm) of potassium (K) in the soil[8].

Micronutrients (Zinc, Copper, Iron, and Manganese): Zinc, copper, iron, and manganese (Zn, Cu, Fe, and Mn) are determined by treating a 10-gram scoop of soil with 20 milliliters of DTPA extracting solution (0.005 molar DTPA, 0.1 molar TEA, and 0.01 molar $CaCl_2$, adjusted to pH 7.3). After shaking for two hours, the soil was filtered, and the extract analyzed for metals with an inductively coupled plasma atomic emission spectrophotometer (ICP-AES).

RESULT AND DISCUSSION

Table 1: Soil Parameters in Irrigated Area

Sr. No.	S.S.	S.F.	pH	E.C.	OC%	N	P	K	Fe	Cu	Mn	Zn
1	S_1	S_{1A}	7.84	0.25	0.44	385.5	15.42	223.2	3.94	0.44	3.40	0.53
2		S_{1B}	7.78	0.27	0.35	409.0	16.85	310.4	3.97	0.38	3.37	0.54
3	S_2	S_{2A}	8.01	0.16	0.35	408.0	19.29	252.1	3.93	0.35	3.63	0.45
4		S_{2B}	7.70	0.16	0.38	469.2	11.17	247.4	3.98	0.57	2.54	0.87
5	S_3	S_{3A}	7.64	0.30	0.27	507.4	11.33	318.3	4.21	0.56	3.00	0.56
6		S_{3B}	7.89	0.27	0.27	501.5	10.51	303.2	4.30	0.39	2.51	0.56
7	S_4	S_{4A}	7.99	0.18	0.37	469.6	14.11	299.7	3.95	0.55	2.97	0.60
8		S_{4B}	7.99	0.17	0.28	411.7	15.66	275.4	3.96	0.57	2.90	0.30
9	S_5	S_{5A}	7.99	0.11	0.38	399.4	16.52	233.9	3.87	0.44	3.20	0.92
10		S_{5B}	7.95	0.16	0.25	421.5	13.52	259.5	3.81	0.54	3.45	0.77
11	S_6	S_{6A}	7.93	0.14	0.25	483.6	18.79	258.2	4.01	0.46	3.56	0.46
12		S_{6B}	7.91	0.15	0.34	481.2	10.68	253.8	4.18	0.49	2.52	0.60
13	S_7	S_{7A}	7.89	0.15	0.34	437.3	14.43	250.8	4.13	0.42	4.00	0.45
14		S_{7B}	7.92	0.16	0.36	488.4	12.35	242.8	3.91	0.35	2.50	0.43
15	S_8	S_{8A}	7.96	0.16	0.37	465.4	19.84	234.4	3.97	0.35	3.11	0.49
16		S_{8B}	7.97	0.23	0.23	439.7	10.92	224.5	3.99	0.33	2.83	0.59
17	S_9	S_{9A}	7.88	0.14	0.24	471.6	11.54	277.4	3.99	0.31	2.81	0.48
18		S_{9B}	8.01	0.15	0.25	362.9	17.80	266.6	4.09	0.34	3.45	0.72
19	S_{10}	S_{10A}	7.95	0.14	0.34	385.5	15.34	249.4	4.11	0.38	3.67	0.70
20		S_{10B}	7.89	0.14	0.37	399.9	10.30	225.6	4.76	0.33	3.28	0.83

S.S.-Selected Station, S.F.-Selected Farmer, E.C.-Electrical conductivity, OC- Organic Carbon

Table 2: Soil Parameters in Non- Irrigated Area

	S.S.	S.F.	pH	E.C.	OC%	N	P	K	Fe	Cu	Mn	Zn
1	S_{11}	S_{11A}	8.49	0.16	0.40	375.27	11.12	216.82	4.02	0.31	2.67	0.89
2		S_{11B}	7.93	0.45	0.45	383.60	10.25	238.38	4.40	0.38	2.58	0.46
3	S_{12}	S_{12A}	8.43	0.18	0.36	396.40	12.37	233.60	3.84	0.27	2.96	0.54
4		S_{12B}	8.38	0.36	0.39	408.22	16.56	257.60	3.59	0.24	3.14	0.53
5	S_{13}	S_{13A}	8.33	0.26	0.41	392.54	12.78	249.60	4.01	0.27	2.19	0.58
6		S_{13B}	8.24	0.16	0.41	475.61	12.11	294.44	4.67	0.27	3.10	0.39
7	S_{14}	S_{14A}	8.43	0.61	0.41	351.23	17.24	283.24	4.51	0.28	2.55	0.67
8		S_{14B}	8.26	0.18	0.46	467.41	15.83	202.32	4.50	0.28	3.58	0.70
9	S_{15}	S_{15A}	8.39	0.42	0.47	375.72	13.82	268.80	4.08	0.38	2.24	0.54
10		S_{15B}	8.07	0.23	0.35	377.17	12.23	228.27	3.67	0.38	2.48	0.63
11	S_{16}	S_{16A}	8.10	0.32	0.41	432.31	12.60	224.00	3.41	0.43	2.31	0.61
12		S_{16B}	8.30	0.62	0.40	378.41	15.76	205.10	3.78	0.44	2.63	0.66
13	$S1_7$	S_{17A}	8.17	0.19	0.41	392.60	13.54	200.41	4.25	0.45	2.56	0.65
14		S_{17B}	8.19	0.26	0.46	458.41	27.22	306.79	4.38	0.33	2.19	0.68
15	S_{18}	S_{18A}	8.34	0.34	0.45	362.20	17.39	215.50	4.60	0.35	3.55	0.58
16		S_{18B}	8.13	0.29	0.42	382.85	18.19	212.50	3.89	0.32	2.41	0.59
17	S_{19}	S_{19A}	8.28	0.26	0.43	453.75	15.30	355.20	3.71	0.42	2.29	0.54
18		S_{19B}	8.08	0.23	0.42	381.18	14.10	242.20	3.88	0.32	2.49	0.45
19	S_{20}	S_{20A}	8.33	0.32	0.47	345.21	15.24	214.60	4.10	0.42	3.62	0.77
20		S_{20B}	8.11	0.31	0.42	359.52	15.53	210.83	3.78	0.42	3.04	0.58

S.S.-Selected Station, S.F.-Selected Farmer, E.C.-Electrical conductivity, OC- Organic Carbon

Table 3: Average and Standard values of soil parameters

Soil parameters	pH	E.C.	OC%	N	P	K	Fe	Cu	Mn	Zn
Average values from Irrigated area	7.9	0.179	0.32	439.7	14.32	260.26	4.07	0.43	3.12	0.603
Average values from Non Irrigated area	8.25	0.31	0.42	397.98	14.41	243	4.06	0.35	2.72	0.61
Good values for crop	5.5 - 8.5	0.0 - 2.0	0.41-0.60	281 - 420	14 - 21	151-250	4.0-8.0	0.21-0.40	2.1-4.0	0.60-1.20

All the values of E.C. are expressed in mmhos/cm, that of N, P and K are expressed in Kg/ha and the values of Fe, Cu, Mn and Zn are expressed in ppm.[8]

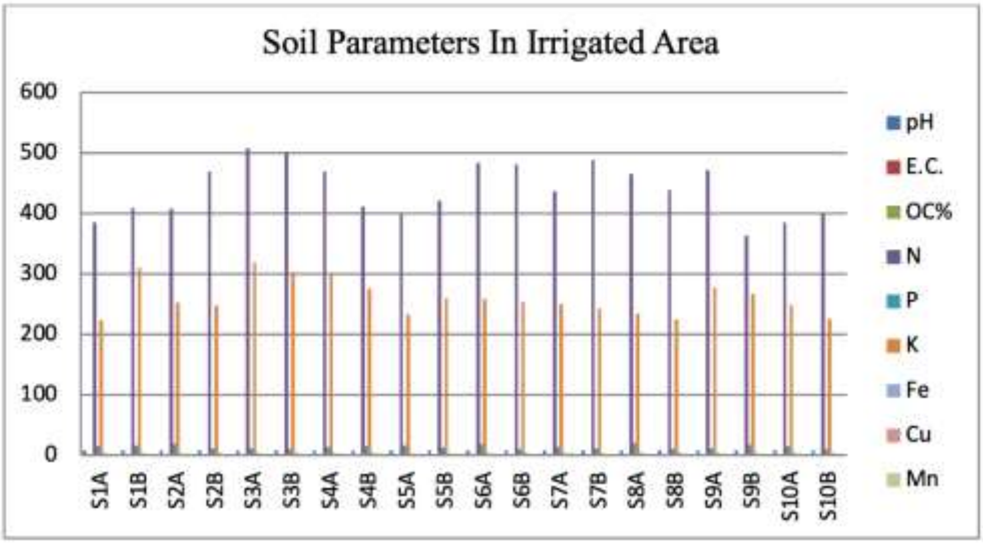

Fig: 1 Soil Parameters in Irrigated Area

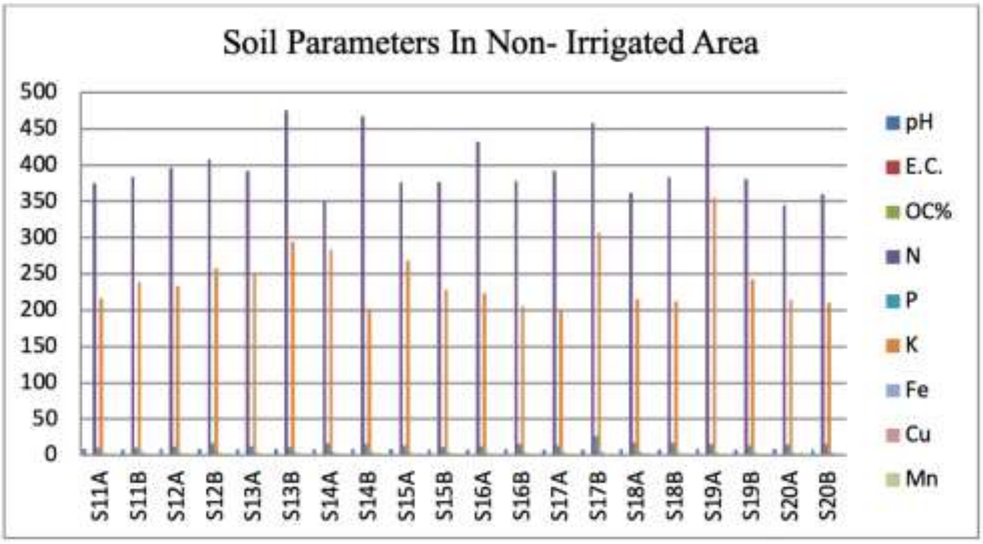

Fig: 2 Soil Parameters in Non- Irrigated Area

Observed soil parameters

pH: The observed average pH value of soil in irrigated area is 7.9. The average pH value of soil in non-irrigated area is 8.25. In the picture in investigations, overall picture showed that soil in non-irrigated area is slightly more alkaline than irrigated area. The higher values of pH might be due to the increase in concentration of neutral salts like NaCl $CaSo_4$ content and soluble salt accumulation (rich in carbonates). The lower value of pH in irrigated area is due to the dilution effect and dilution of neutral salts[3].

EC.: The observed average value of EC of soil in irrigated area is 0.18 mmho /cm. The observed average value of EC of soil in non-irrigated area is 0.31 mmho/cm. From the observation, it is observed that high salinity levels are typical of dry and arid environments. EC of non-irrigated soil is slightly higher than that of irrigated soil. Land reclamations decrease salinity levels in irrigated lands. This decrement perhaps was caused by the land reclamation[9]. The observed EC range is in between 0-1 mmho /cm which is good for the growth of the plant.

Organic carbon: The observed average carbon% value for irrigated area is 0.32. The observed average carbon values for non-irrigated area are 0.42%. The observed values in irrigated area are slightly less than the moderate values which range between 0.41% and 0.60%. Cultivation and continuous cropping lead to the exhaustion of soil fertility and thus decreases organic carbon content of soil in irrigated area[4].

Nitrogen (N): The observed average value of nitrogen for irrigated area is 439.7kg/ha. The observed average value of nitrogen for non-irrigated area is 397.98 kg/ha. The soil test shows that the irrigated soils are high in primary nutrient elements. The moderate value of N for plants is 281 kg/ha to 420 kg/ha and observed values are in between that limit[4].

Phosphorus (P): The observed average P value of soil in irrigated area is 14.32kg/ha. The average value of P in soil of non-irrigated area is 14.41kg/ha. The requirement of p is 14 to 21 kg/ha[10]. less value of P might be due to removal of P from soil solution by adsorption to colloidal surfaces or precipitation as Ca, Fe, Al phosphates or immobilized to organic P[11].Rock phosphate is a cheap source of P. Application of organic matter along with rock phosphate increases the P in soil[12].

Potassium (K): The average K values of soil in irrigated area is 260.26kg/ha. The observed average value of K in non-irrigated area is 243.0 kg/ha. The requirement of K is 151-250 Kg/ha. The observed values are slightly greater. Straws of cereals generally contain large amount of K which is water soluble[13] and their recycling can markedly increase K availability in soil[14]. Potassium is not bound in any organic compound in the plant material and thus its release does not involve microorganism with the addition of organic residues. There is an increase in exchangeable and available K[15].

Micronutrients

Fe: The average value observed for Fe in irrigated soil is 4.07 ppm. The average value observed for Fe in non-irrigated area is 4.06 ppm. The observed values of Fe in irrigated and non-irrigated area are nearly moderate i.e. greater than 2 ppm[16]. The organic matter addition increases the water soluble content of Fe^{2+} and Mn^{2+}

Cu: The average value of Cu in irrigated area is 0.43 ppm. The average value is 0.35 ppm. The required range of Cu for crop is 0.21- 0.40 ppm[4]. From the above observation, it is observed that the copper content is more in irrigated area than non-irrigated area. It might be due to in situ incorporation of sun hemp residue significantly. Improved the availability of copper in irrigated area[15].

Mn: The average value observed for Mn in irrigated area is 3.12 ppm. The average value observed for Mn in non-irrigated area is 2.72 ppm. The observed values of Mn in irrigated and non-irrigated area are adequate in level for plant i.e.2.0-4.0 ppm[4]. Application of rice straw increases Fe^{2+} and Mn^{2+}i.e. increases up take of Mn and Fe[17].

Zn: The average value of Zn observed in irrigated area is 0.603 ppm. The Average value of Zn observed in non-irrigated area is 0.61ppm. The observed values of Zn in irrigated and non-irrigated area are adequate in level for plant i.e.0.60-1.20 ppm[4]. Application of wheat and rice straw decreases the Zn concentration in flooded and upland soils[18]. About 50 to 80 % of Zn. Cu and Mn taken up by rice and wheat crops can be recycled through residue incorporation[19].

CONCLUSION

The soil analysis was done for both Irrigated and Non-Irrigated areas. The values of pH, Salinity (EC), Nitrogen, Phosphorous and Potassium, Fe, Cu, Mn, Zn were observed in moderate range in non-irrigated areas. But the average values of %OC in Irrigated areas were observed slight less than moderate values. The values of N, K and Cu for Irrigated areas were observed greater than moderate values.

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How to cite this article:
Nirmala Kakade and Rituja Satpute. Comparative soil profile study in irrigated and non-irrigated area. J Pharm Sci Innov. 2021;10(1):23-28.
http://dx.doi.org/10.7897/2277-4572.101199

Source of support: Nil, Conflict of interest: None Declared