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Studies on Soil Quality Parameters in Relations to Cropping Patterns, Micronutrients and pH from Goagalgaon area in Ahmednagar District of Maharashtra, India

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Abstract: *The Earth's surface is covered by soil and water; the soil is a complex of biological and physical schemes forms by the weathering process of rocks which gives essential support to the plants. Soil contains organic matter, minerals, water, and air supplies micronutrient for optimal growth and reproduction of plants and animals. By considering the fact soil sample were collected from 10 sampling sites of the Gogalgaon area near Loni in Ahmednagar district of Maharashtra. The objective of the study was to analyze the location-specific relationship between Physico-chemical parameters, soil micronutrients, cropping patterns, and pH. The samples were collected from near root zones of the plant and few feet away from root zones of the plant in triplicate at 0-15 cm depth and sieved at 2 mm mesh size used for analysis. The pH was found basic, EC ranges from 0.235 to 0.506 µs/cm, Moisture content ranges from 2.3 to 5.24 %, Chlorides ranges from 184.6 to 440.2 mg/l, Alkalinity ranges from 80 to 385 mg/l, N (total- Nitrogen) ranging from 180.9 to 249.3 kg/ha, P (Phosphate) ranging from 13.2 to 35.43 kg/ha, K (Potassium) ranging from 8 to 81 kg/ha, Ca (Calcium) ranges from 80.1 to 120.2 mg/l, Mg (Magnesium) 24.3 to 82.8 mg/l and micronutrient like Iron (Fe) ranging from 108 to 2.55 ppm, Manganese (Mn) ranging from 3.18 to 16.5 ppm., Zinc (Zn) 1.25 to 4.1 ppm; and Copper (Cu) ranging from 0.63 to 18.7 ppm. The available pH of the soil was slightly basic in nature and N, P and K were insufficient to the amount. In the case of micronutrient Fe and Mn was deficient while Zn and Cu were present in a sufficient amount. The present research data is helpful in increasing agricultural production.*

Key Words: *Soil, quality parameters, Cropping pattern, micronutrient, pH.*

1. INTRODUCTION:

Soil is an important component of planet earth that supports life either directly or indirectly composed by organic matter (humus), mineral matter soil water, and soil air. There are sixteen nutrients present in the soil that are essential for the growth of plants. Soil dissolve nutrients and make them available to the plants along with water content and served as a safeguard medium for perturbations to biogeochemical processes of importance to climate change and acts as a storing reservoir for various natural resources (Rhodes, 1993; Khan et al., 2000; Achazi, 2002; Rashid and Ryan 2004; Kibblewhite et al., 2008; Muhammad Imtiaz et al., 2010; Constable et al., 2015). Soil is a source or a sink for greenhouse gases, and thus underpins the socio-economic and environmental well-being of human beings around the globe (Karlen et al., 2003; Tur et al., 2005; Garg, 2007; Karlen et al., 2008; John Ryan & Rolf Sommer 2012; Moharana et al., 2016, 2018; Pogrzeba et al., 2017; Ingle et al., 2018). Physico-chemical properties of soil include natural minerals, parent material, amount of organic matter; depth to bedrock, sand, or gravel, permeability water holding capacity, and drainage of soil are impacted on the availability of nutrients (Kapkiyai, et al., 1999; Korthals et al., 2005; Singh et al, 2011; Marta Pogrzeba1 et al., 2018). The soil materials often vary in thickness from a few inches to 20 or 30 feet and attain depths of 100 or even 200 feet because of the influence of different agencies that produce and thus, beds of sand and gravel and many surface deposits of clay and silt were formed (Thomas, 1996). There are two general types of soil material are recognized called sedentary materials and the latter transported ones. Soil contains a large number and varieties of elements, trace elements (like cobalt, boron, iodine, cadmium, arsenic, zinc, and barium), inorganic compounds (like chlorides, sulphates, and oxides), and organic compounds. (Trivedi and Goel 1984; Luios and Fedrick 1985; Tamboli et al., 1996; Reddy and Shikhamany 1988; Gundersen et al., 2000; Gupta, 2001; Hartikainen, 2005; Sharma, 2012; Owsianiak et al; 2012; Kamble et al, 2013; Raut and Kurhe, 2016; Udushirinwa et. al., 2018). The available soil micronutrients are largely influenced by the soil properties, such as pH, calcium carbonate ($CaCO_3$), organic matter and cation exchange capacity (CEC), and soil microenvironment as well (Wei et al., 2006). A healthy soil maintains the quality of water and air which supports the diversity of organisms and resists stresses of human impact, climatic change, and environmental degradation; it also enhances the distribution of nutrients, crop productivity, and altimetry human health (Sharma, 2005; Deka et al; 2008; Khoshgoftarmanesh et al., 2010; Dz.U, 2016; Moharana et al., 2017). The microbial fauna and fertility of soil inhabit crop production. But due to rapid growth in various destructive activities by human-like deforestation, animal grazing, harvesting of non-timber forest components, use of chemicals in agriculture leads to a decrease in various soil essential nutrients and loose soil fertility (Gaikwad et al, 1994; Nsiah-Gyabaah, 1996; FAO, 2006; ISRYC, 2007; Udushirinwa et. al., 2018). Supplement of micronutrients cannot be overlooked because of depletions in available nutrients status of continuous cropping patterns which indicate that the nutrients are utilized from soil to meet the requirements of crops. Crop patterns are helpful in the nutrient distribution in the soil profile which results in the full exploitation of the root zone with crops of different rooting depths (Tripathi et al., 2014; Sichone and Mweetwa, 2018). There are several studies that have shown that better yields crop under CF, while limited reports are on the arid desertic ecosystem, cropping patterns, and micronutrients. Therefore, the present study was undertaken to understand the soil quality parameters in relations to cropping patterns, micronutrients, and pH of soils of the Goagalgaon area in Ahmednagar District of Maharashtra, India

2. MATERIALS AND METHODS:

In the present study, the area was served manually and decides to select some sites which will fulfil the required data. For this purpose grid method was practiced accordingly ten sampling sites were selected.

Collection of soil sample: The collection of a good representative soil sample is the first criteria for a reliable soil test. The basic principle behind soil analysis is that a field can be sampled in such a way that chemical analysis of soil sample will accurately reflect the field in respect of true chemical composition. At the time of sampling, the surface litter was removed and a dig of 'V' shape hole was taken up to the depth of 20 cm. From this dig, a layer of 2 cm thickness was removed from top to bottom of the exposed soil surface (about 1 kg). The same sample was taken from at least three places from the same field to represent the whole field. Thus collected samples were mixed together and a representative sample (about 1 kg) was obtained for the chemical analysis. This sample was packed in the plastic bag and labelled for further procedure. The precaution was taken that the sample should not be from the areas which are recently fertilized, old bunds, marshy spots, near trees, compost heaps, etc. This procedure was carried out for all 5 samples and samples thus collected were brought to the laboratory for further analysis.

Analysis of Soil Samples: The collected soil samples were kept in the tray and air-dried for a period of approximately 1-6 days depending on the moisture content in the sample. Then the sample was crushed into a fine powder using mortar and pestle. The care was taken that only aggregate particles were crushed. This crushed soil was then passed through a 0.5 mm size sieve. Thus the soil sample preparation and used to analyze the parameter like pH, Electrical Conductivity (EC), Water Soluble Salts (Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na), and Chloride (Cl)); available nutrients (Sulphate (SO4), Phosphate (PO4) and Nitrate (NO3), etc. For analysis, 1:5 (1gm soil + 5ml water) suspension was prepared with distilled water (Chun-Ming Chin and Zhi-Chun Wang, 2010). The solution was continuously stirred for one hour and filtered with Whitman filter paper. This filtrate was used for physicochemical analysis. A physical parameter-such as, pH Moisture Content, and chemical parameters like Organic Carbon, Macronutrients like Ca, Mg, Cl, Na, K, N, and P by the standard methods given in (Trivedi and Goel et al; 1984, USDA, 1954).

2.1. Physical parameters
i) **pH**: pH is measured with the help of a digital pH meter.
ii) **Electrical conductance:** Electrical conductance is measured with a digital electric conductivity meter.

2.2. Chemical parameters Organic Matter: (Walkely and black method) Organic matter present in the soil is digested with an excess of potassium dichromate and sulphuric acid, and the residual unutilized dichromate is then titrated with ferrous ammonium sulphuric acid, and the residual unutilized dichromate is then titrated with ferrous ammonium sulphate. The elementary carbon present as graphite, charcoal, etc. is not attached in this method only organic carbon is determined as per the reference of Deka et al., (2008) who has been found a high percentage of organic matter in the soil.

2.3. Macronutrients

i) **Calcium (Ca)**: Calcium is determined by volumetrically with the EDTA method. EDTA combines first with calcium and when pH is made sufficiently high Mg is precipitated as hydroxide. The monoxide indicator combines with calcium to give pink colour to the solution. The calcium concentration was determined by using the following formula.

ii) **Chloride** (Cl^-): Chloride was determined by the Tri-geometric method. AgNO3 reacts with the chloride ions to form a slightly soluble white precipitate of silver chloride in presence of Potassium chromate as an indicator. After all, chloride is removed; the indicator changes its colour to reddish-brown of silver chromate. The concentration of chloride was determined.

iii) **Sulphate** (SO_4^{2-}): The Sulphate is determined by the Turbidometric method. The sulphate ions are precipitated in the form of barium chloride in Hydrochloric acid medium. The concentration of sulphate was determined from the absorbance of light by barium sulphate and then by comparing it with a standard curve, using a spectrophotometer at 420mm wavelengths.

iv) **Phosphate** (PO_4^{3-}): The determination of orthophosphate stannous chloride method and ascorbic method. The intensity of the blue colour was measured by Spectrophotometer at 690nm wavelengths. The results were calculated by preparing a calibration curve for standard solutions and concentrations of unknown samples were found out from the graph.

v) **Nitrate** (NO_3^-): The Nitrate is determined by the phenol sulphuric acid method. In this method, nitrate reacts with phenol sulphuric acid to form nitro derivatives, which is an alkaline medium to develop a yellow colour. The absorbance is measured by a spectrophotometer at 410nm wavelengths. The results were calculated by preparing a calibration curve for standard solutions and concentrations of unknown samples were found out from the graph.

vi) **Sodium** (Na^+) and **Potassium** (K^+): The estimation of $Na^+$and K^+ was carried out on Flame Photometer. The instrument is calibrated by using the set of standards of NaCl and KCl. Then reading of unknown soil samples is taken. The results were calculated by preparing a calibration curve for standard solutions and the concentration of unknown samples was found out from the graph.

3. RESULT AND DISCUSSION:

Soil sample collected from Gogalgaon area. The different soil sample shows different physical and chemical properties. The result obtained from study area is presented in Table1.

3.1. Physical parameters of Soil: Physical tests for monitoring soil quality (Arshad et al., 1997).

i). pH: The Tomato crop field required 6.5 to 8.5 pH. The pH from study area varied from the station to station. Soil pH values may differ for station to station sometimes it may be slightly acidic and neutral as studied and suggested by (Benton, 2002; Dauda and Odoh, 2012). The minimum pH was 6.46 in sampling station no 10 whereas maximum pH was 6.46 in sampling station no 10 whereas maximum pH was 8.98 observed at sampling station no 9 and 13. The overall pH recorded in all sampling station is alkaline. But at selected sampling station no.1, 3, 9 13, 14 is higher than the required pH. The alkaline soil pH may be due to the presence of relatively high proportion of soluble sodium (Gransee, and Fuhrs, 2013). It is also showed in graph 1 that site 10 shows low pH than the other site.

ii). **Electrical Conductivity (EC):** The Tomato field required 0 to 1 mmhos / cm EC. The measurement of EC of the soil solution is recognized as giving indication of total salinity in reaction to plant growth, is present investigation study EC of soil sample was observed minimum at station number 10 (0.151 mmoh / cm). The EC recorded in was station no.1 is 0.506 mmhos / cm. In all selected sampling stations EC is in between o to 1mmhos/cm. As compared to the EC value 0.5 dsm-1 for a good soil by (Singaravel et al., 2000); according to them if these EC values of soil exceed the recommended value, it can affect the germination of almost all crops which is serious issue resulting in the reduction of total crop yield produced by farmers. It is also seen that Graph 2 that site 3 and 6 shows less EC values than the other site.

iii). **Soil Moisture:** The soil moisture content of soil gets moisture from the infiltration of precipitated water and irrigation. However, it drains through percolation and evaporation and uptake plant. The soil moisture in the soil can be serves the following purposes. It acts as a solvent, transporting agent also maintain the texture and compactness of the soil (Valentijn Pauwels et al; 2001). The study area shows moisture content varies with station to station. The minimum moisture was 2% at station 12 and maximum was 5.24% at station no. 2. It is also seen that Graph 3 that site 12 shows less moisture content than the other site.

3.2. Chemical Parameters of Soil: i). Chloride: In study area sample collected from different ten stations show the chloride content raging between 184.6 ppm-440.2 ppm. Maximum chloride is observed in station no.6 (440.2 ppm). Minimum chloride is observed station no.7 (184.6 ppm). **ii). Alkalinity:** In study area alkalinity of soil sample showed minimum at site no. 10 (80 ppm). Compared with other horizontal crop Tomato agree are relatively tolerant of salinity and alkalinity but excessive lime is harmful to area and other crop. **iii). Potassium:** The relatively high level of potassium is utilized by growing plant. Potassium activities with same enzyme play role in the water balance in plant. It is also essential for some carbohydrate transformation (Stanley et al, 1997). The value of potassium ranged between 08 kg/hec to 81 kg/hec. The maximum value available in station number 5 is 81 kg/hec and the minimum value available in sampling station number 7 is 08 kg/hec.

iv). Phosphorous: The phosphorus ranged between 13.2 kg/hec to 35.43 kg/hec. The maximum value observed at station number 3 (35.43 kg/hec) while the minimum value observed at station number 6 (13.2 kg/hec.)

v). Nitrogen: Nitrogen is essential for plant growth as it is a constituent of all proteins and nucleic acid and hence of all protoplasm. It is generally taken up by plant either as ammonium or as nitrate ions. But the absorbed nitrate is rapidly reduced, probably the ammonium, through a molybdenum-containing enzyme. The effect of nitrogen was increased leaf growth. The higher nitrogen supply the more rapidly synthesized carbohydrate is converted to the nitrogen present in soil sample ranged from 180.9 to 237.5 kg/hec. The maximum organic carbon present in sampling station number 6 is 4.93% and the minimum organic carbon present in sampling station number 1 is 0.39%. In some sampling station no. 1, 8, 9 shows deficient organic carbon.

vi). Magnesium and Calcium: In addition soil may still contain and appreciable level of calcium because of compensation by hydrogen ion is not available to plants. In alkaline soil the presence of high level of sodium magnesium, potassium sometimes produces calcium deficiency because their ions complete with calcium for availability to plants.

vii). Magnesium: It is important constituent of chlorophyll, which acts as an activated for many enzymes in phosphate transfer reaction particularly, carbohydrate metabolism and nucleic acid synthesis. Deficiency of Magnesium may leads to harmful effects on crops (Romheld and Kirkby, 2007; Gransee and Fuhrs, 2013).

viii). Calcium: Range between 48.0 mg/lit to 160.3 mg/lit. Maximum calcium available in station no. 3 is 160.3 mg/lit and minimum calcium available in station no.8 is 80.1 mg/lit. The magnesium ranged between 24.3 mg/lit to 126.0 mg/lit. The maximum magnesium is available in station no. 9 is 82.8 mg/lit and minimum magnesium available in station no. 4 is 24.3 mg/lit.

3.3. Water Soluble Micronutrients: i). Copper: It is constituent of several oxidizing enzymes. It is higher concentration is toxic to plant. Copper deficiency causes necrosis of the tip of the young leaves. It also causes dieback of citrus and other fruit trees and reclamation diseases of cereals and leguminous plant. Value of copper showed range between 7.75 ppm to 18.7 ppm. The maximum value was observed at station number 5 is 18.7 ppm and the minimum value observed in station number 3 is 7.75 ppm.

ii). Maganese: It is an activator of many respiratory enzymes. It is also activator of the enzymes nitrate re-educates and hydroxylamine re-educates. It is necessary for the evaluation of oxygen during photosynthesis. Manganese deficiency causes chlorotic and necrotic spots on the inter-veinal area of the leaf. Value of manganese showed range between 2.50 ppm to 16.5 ppm. The maximum value was observed at station number 10 is 16.5 ppm and the minimum value observed in station number 1 is 2.50 ppm.

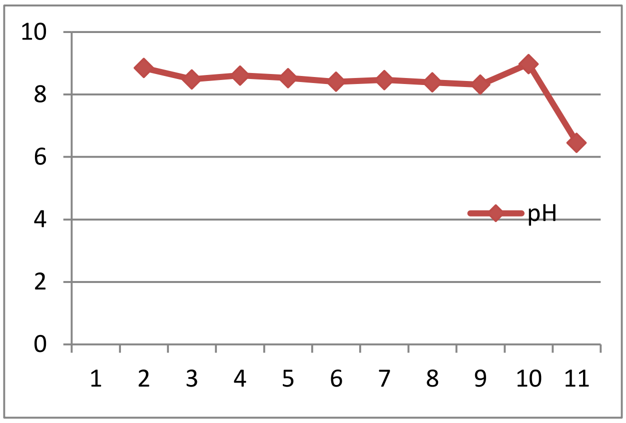
iii). Zinc: It is involved in the biosynthesis of the growth hormones, auxin, indole-3, acetic acid (IAA). Zinc deficiency cause chlorosis of the older which starts from tips and the margins. It causes mottles leaf disease in apple, citrus, walnut and other fruit tree. Value of zinc showed range between 1.25 ppm to 4.10 ppm. The maximum values were observed at station number 7 to 10 is 4.10 ppm and the minimum value observed in station number 1 is 1.25 ppm.

Table 1: The physical and chemical properties and their result obtained from study area.

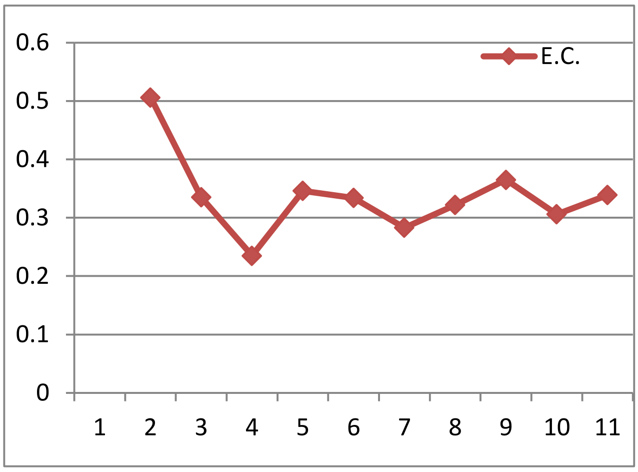
Sr. No.	pH	E.C.	Soil Moisture %	Chloride mg/1	Alkalinity mg/1	Available			Ca mg/1	Mg mg/1	Cu ppm	Mn ppm	Fe ppm	Zn ppm
						N kg/h	P kg/h	K kg/h						
1.	8.85	0.506	4.57	312.4	145	210.7	18.75	56	112.2	58.4	00.63	03.18	1.97	1.26
2.	8.49	0.335	5.24	411.8	125	212.8	24.09	35	112.2	58.4	8.25	4.10	1.80	2.05
3.	8.61	0.235	3.59	355.0	145	219.7	35.43	23	80.1	68.2	7.75	5.25	2.05	1.25
4.	8.53	0.346	5.08	255.6	155	237.5	17.2	15	104	24.3	11.2	4.35	1.97	2.40
5.	8.41	0.334	3.99	293.2	300	249.3	18.2	81	120.2	68.2	18.7	3.18	2.55	2.90
6.	8.47	0.283	3.39	440.2	325	205.4	13.2	29	88.1	53.5	8.70	5.5	2.05	2.40
7.	8.39	0.322	4.40	184.6	355	180.9	29.4	08	112.4	68.2	9.25	6.36	1.80	4.10
8.	8.32	0.365	3.20	255.6	375	235.4	32.3	31	80.4	77.9	00.63	7.80	2.10	3.50
9.	8.98	0.306	3.10	241.4	385	208.5	21.9	38	104.2	82.8	9.35	6.75	2.35	1.26
10.	6.46	0.339	2.30	255.6	80	190.8	19.5	43	96.1	53.6	10.2	16.5	2.40	4.10
Average values	**8.351**	**0.3371**	**3.886**	**300.54**	**239**	**215.1**	**22.997**	**35.9**	**100.99**	**61.35**	**8.466**	**6.297**	**2.104**	**2.522**

(EC: Electrical conductivity; Ca: calcium; Mg: Magnesium; Cu: Copper; Mn: Maganese; Zn: Zinc)

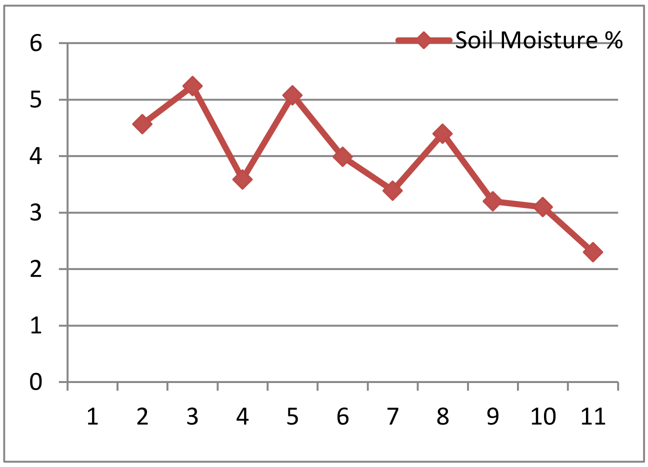
Graph No.1: Showing variations in pH of soils from different Agree Tomato Area



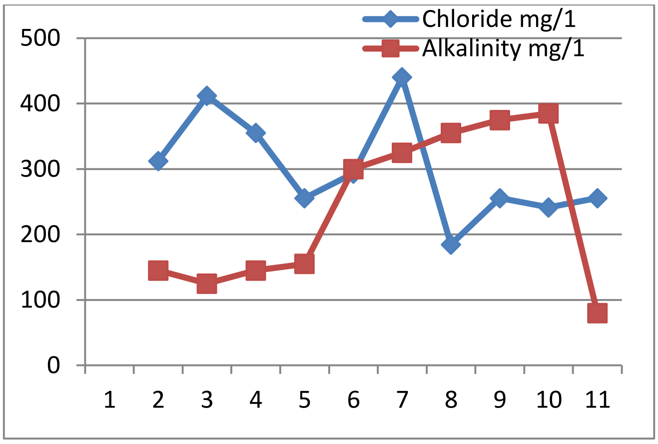
Graph No. 2: Showing variations in EC of soils from different Agree Tomato Area



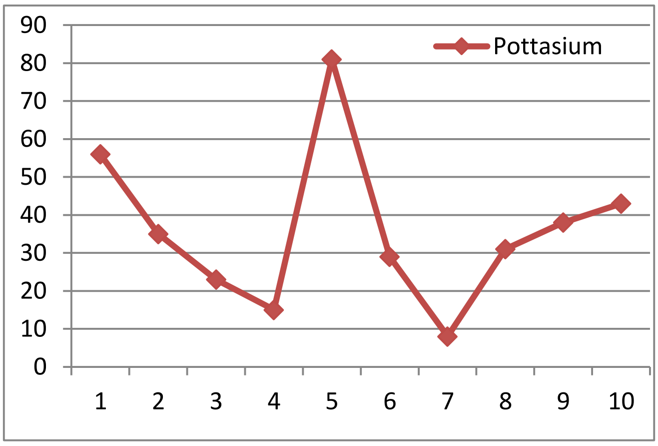
Graph No. 3: Showing variations in Moisture of soils from different Agree Tomato Area



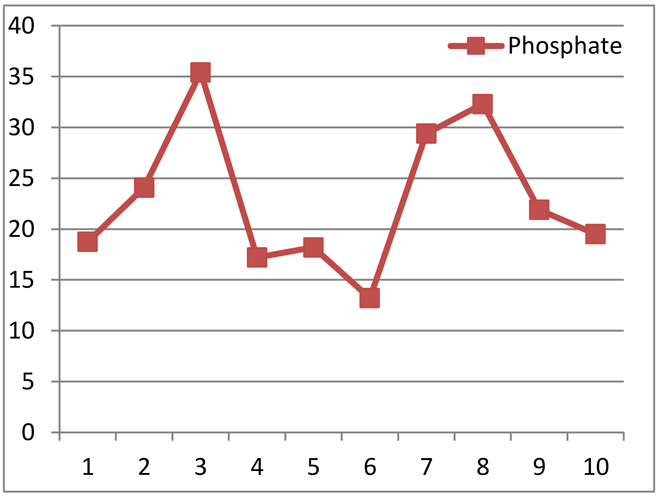
Graph No. 4: Showing variations in Chloride and Alkalinity of soils from different Agree Tomato garden in study area.



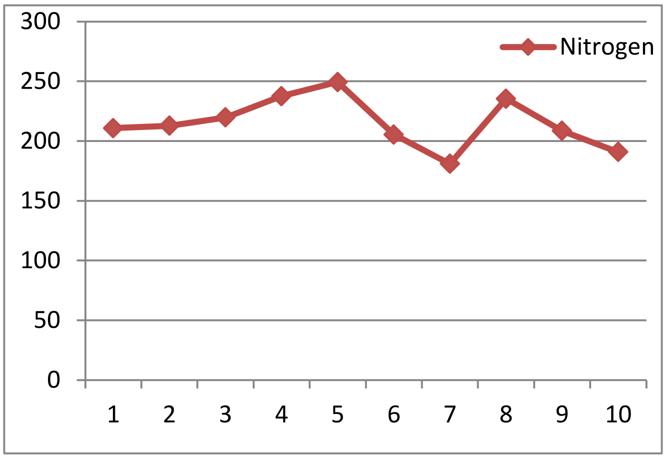
Graph No. 5: Showing variations in Potassium of soils from different Agree Tomato garden in study area.



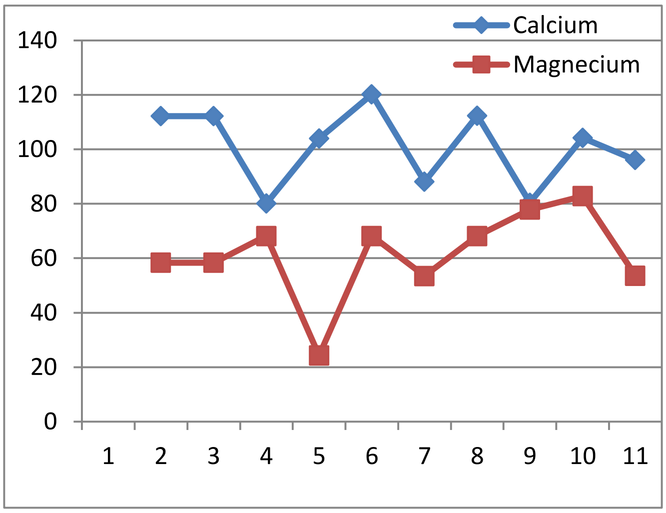
Graph No. 6: Showi1ng variations in Phosphate of soils from different Agree Tomato garden in study area.



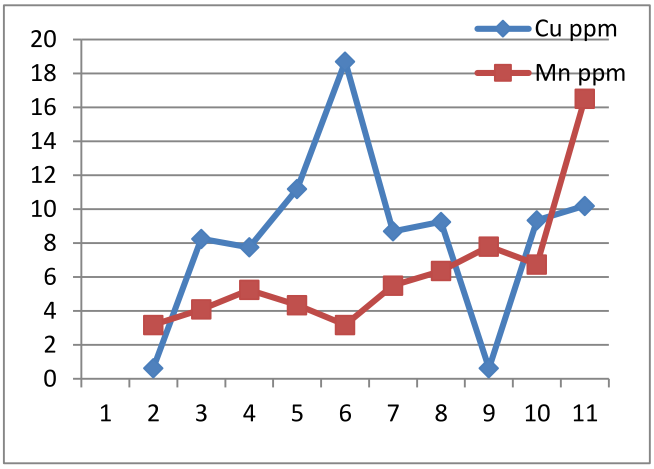
Graph No.7: Showing variations in Nitrogen of soils from different Agree Tomato garden in study area.



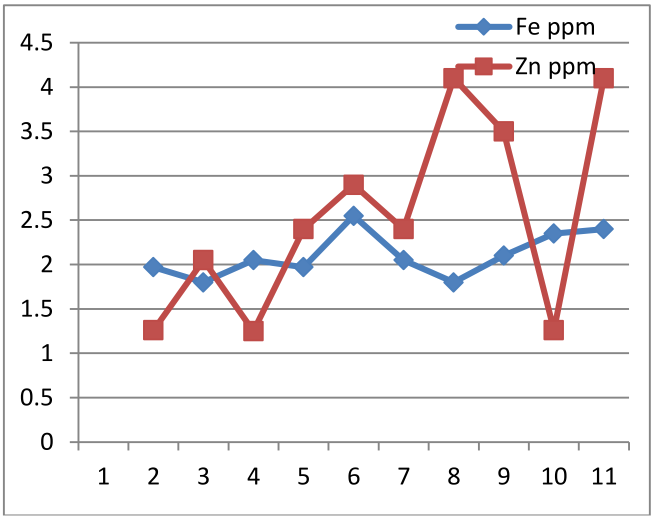
Graph No. 8: Showing variations in ca++ & mg++ of soils from different Agree Tomato garden in study area.



Graph No. 9: Showing variations in Manganese and Copper of soils from different Agree Tomato garden in study area.



Graph No. 10: Showing variations in Iron and Zinc of soils from different Agree Tomato garden in study area.



4. SUMMARY AND CONCLUSION

The study area includes the Gogalgaon village from Rahata Taluka of Ahmednagar District. In the study area, the main source of water supply is dammed water and rainfall coupled with wells and bore wells. The study area experiences drought conditions for water in the summer season, hence the cultivation of cash crops like sugarcane is very difficult. Therefore, some farmers from this are changing their mindset towards the high yielding cash crops in fewer water supplies. Some farmers found that Tomato crop cultivation is suitable in the study area because of the climatic conditions that are suitable for Tomato crop cultivation. The main purpose of this attitude is to increase the yield capacity as well as to enhance the economic conditions of the farmers. The life cycle of the Tomato crop is complete within eight months. The micronutrients are essential for the growth of any crops. The soil analysis, water analysis, plant analysis is essential before starting the cultivation. In the present study pH and electric conductivity found moderate and at some station it was found slightly acidic in nature. N.P.K. is essential for the growth of plants. The artificially provided N.P.K. can affect the soil quality directly or indirectly. The micronutrient is essential for the growth of the plant. In some sampling station of the site the Tomato field that is facing the problem of chlorosis, foliage symptoms, and fruit set due to the lack of micronutrients.

In the present study, we obtained results indicating that the pH of soil increases towards the basic scale of pH. The area under the observation of the study is experiencing mostly the dry climatic conditions salinity and alkalinity of soil increasing day by day. Both the saline and alkaline soil often accumulates earth conspicuous white coating of salt on the surface it can be described as saline and sodic soil (Chun-Ming Chi and Zhi-Chun Wang, 2010). The pH that is a physical characteristic of soil influences on both the physical as well as chemical properties of soil, which plays an important role in the growth and nutrition of crops also the microbial activities in the soil, will be affected. In the present study overall pH ware ranging from 7.7 to 8.5 indicates that the soil is basic in nature. This can cause a negative impact on the growth of various essential microorganisms which can be proven as a serious threat to farmers and crop cultivators. pH also reflects the exchange of H^+ ions, exchangeable base, the availability of K, Ca, Mg, greatly affected by pH conditions soil. The nature and content of the exchangeable base have large influences on the property of soil. High Calcium base saturation in soil results most satisfactory physical condition. In the present study, the sample shows the high content of calcium. The small concentration of calcium is beneficial for reducing the corrosion rate. Calcium deficiency in soil is due to the high pH and EC. The sulphate is found to be high due to the accumulation of soluble salts in the soil and shallow aquifers sulphate has got some indirect importance by producing H2S, which helps in corrosion rate (USDA, 1954). So in conclusion we write the characters of the study area, that continuous irrigation of soil with canal water, excess use of fertilizers, adverse climatic condition, and geographic status of the region reflecting the accumulation of salt and affecting properties. So in the present study, a little effort has been taken to understand alkalization and salinization of soil in the Gogalgaon vicinity where these problems day by day increase and moving towards seriousness.

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