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Assessment of selected macronutrient's form irrigated and non-irrigated soils of ardhapur region, Maharashtra, India

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Abstract

Agricultural soil mechanisms are reliant on the quality and production capacity of crop. Soil nutrient plays a very crucial role to improve soil quality as well as yield. Every element has its own characteristics and these are elaborate in different metabolic crop processes. Some significant soil parameters like pH, Electric Conductivity, Organic Carbon, Phosphorus and Potassium are aptly used to denote the soil quality. Requirement of these elements in soil defines its health and yield capacity. The major focus of proposed work is the estimation of the agricultural soil quality from the 30 selected villages based on its cropping practice in Ardhapur tehsil Nanded district using standard methods. The results revealed the range of pH is in suitable range, EC, and N levels are elevated is high, whereas, P and K levels in soils are low as compared with BIS Standard. It will have varied effects on soil quality and crop yield capacity.

Key word : Soil quality, Yield capacity, Soil nutrients, Agricultural crop.

Soil is the most significant part of planet earth consisting of inorganic particles and organic matter[26]. It provides the structural support to plants and acts as source of water and nutrients. The study of soil quality is important to understand plants growth, soil management and crop yield[8]. Soil quality can be defined as the fitness of a specific kind of soil, to function within its capacity and within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation[21], Arshad and Martin[2]. Soil quality is related to the soil functions, which sustains crop productivity and maintain the quality of surrounding environment, human health and habitation[2,21]. Agriculture is very significant for food security as it provides food for us and it also provide 36 % of total world workforce as primary livelihood source[1]. The range increase in Asia and pacific in the indistinctly populated countries is 40-50% and

[1]Research Scholar, [*2]Research Guide and Assistant Professor

Africa sub- Saharan region is 67%. The population still make their food from agriculture[9].

A nutrient is an element used by an organism to survive, grow, and reproduce[27]. Plants require more varied minerals captivate through roots, plus carbon dioxide and oxygen absorbed through leaves for nutrition. The analysis of these chemical elements and compounds is necessary for better plant growth, increasing plants metabolism and their external supply[25]. Plants are unable to complete a normal life cycle without these nutrients, in the other word nutrients imbalance in soil causes adverse effect on soil health and soil quality. Potential changes in agricultural productivity are associated with changes in crop nutrient use[5]. The essential nutrients for terrestrial crop plants are provided naturally[19]. Macro-nutrients are elements which plants require in relatively large amounts, but the metal pollutants are increasing and has become common in soil environment[16]. Soil organic matter influence with carbon transfer between soils and atmosphere as it indicates current situation of soil environment[3].

Although many elements and mineral indicate soil quality, soil health and capacity of crop production, but generally, pH, Electric Conductivity, Organic Carbon, Phosphorus and Potassium are the basic elements which are responsible for soil health and soil quality. The existing data or knowledge provide a better understanding of current capacity of soil function to predict about its yield capacity and quality. Maintaining soil quality has become an issue nowadays as environment is hastily receiving pollutants due to enhanced pollution from water, air and soil and has become worldwide concern[17].

Nitrogen is most significant macro nutrients for plant, according to its requirement and management in soil[29]. Accessibility of nitrogen is directly related to crop productivity[11,28]. It is used in different form by plant like ammonium and nitrate[20]. The nitrate is very dominate form of mineral which is available for crop[13]. The amount of both forms i.e., nitrate and ammonia generate the pool for plant it is available nitrogen[23]. The nitrate evaluation methods are complex to environmental aspects that affect the soil nitrogen such as temperature and moisture[18]. Nitrogen available in different form for high production uses of nitrogen fertilizers can be done this can be determined after the estimation of soil nitrogen content by potassium permanganate method[7].

Phosphorous is determined as available phosphorus which can be extracted from soil. Its primary role in plant is to store and transfer energy produced by photosynthesis for use in growth and reproductive process. Phosphorus is a chemical element with the symbol P and atomic number 15. It is the second most significant macronutrients in plant nutrition. It also confines plant growth in various soil which is vital for advance and continuous agricultural yield[24,26]. The adsorption of phosphorus in high pH circumstances interpreting it unobtainable. It is taken up and hold by some highly worn and trickled clay minerals henceforward becoming unreachable for uptake. Phosphorus is only available when pH is low in range[10]. Soil phosphorus, and its uptake by plants revels that it is the most chemically reactive because it is insoluble in nature[14].

Potassium It triggers activation of enzymes and is essential for production of ATP (Adenosine triphosphate) and uptake of water through plant roots and AMP (Adenosine monophosphate); its loss through the stomata is affected by potassium knows to improve drought resistance. Proteins and starch synthesis in plant require potassium[4]. Potassium plays an important role in different physiological processes of plants; it is one of the important elements for the plant development. The available Potassium is estimated by Flame photometric method[7].

Study area :

Ardhapur is a town and taluka place in Nanded district of Maharashtra state (Fig. 1). Nanded district is located between 18º.15' and 19º.55' north latitude and 77º.7' to 78º.15' east longitudes. It has 56 villages; the selection process of villages is random manner based on cropping practices in the region. The type of soil is black cotton, typically is denoted as good quality soil for crop which is full of nutrients and minerals. In the selected region, some farmers take cash crop and some takes traditional crops, it's totally depending upon land type as irrigated and non-irrigated. Soil sample method is zig-zag pattern, this pattern provides a good coverage of an area and this is best strategy for collecting samples to analyse soil nutrients and its quality.

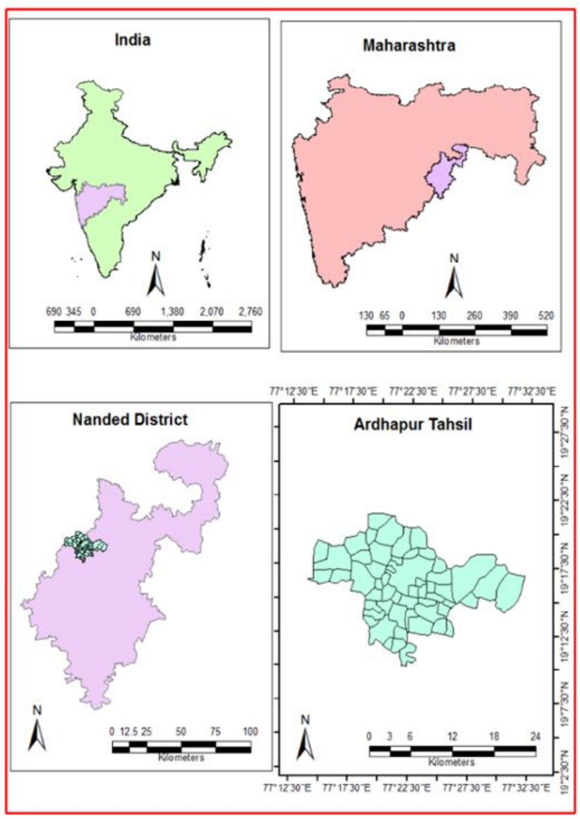

Fig. 1. Showing the Location map of study area *i.e.* Ardhapur Tahsil

For the present investigation the soil samples were collected from different sites of Nanded city by using random sampling methods. Sampling was done three times in the year 2022-2023 at morning. Soil sample were collected during pre-monsoon period from 30 selected villages in Ardhapur tehsil. The experimental analysis is carried out in School of Earth sciences, Swami Ramanand Teerth Marathwada University, Nanded. Samples were collected in sterilized sealed pack polythene bags by using a corer and were brought to the laboratory which is properly labelled. Processed soil samples were analysed for nutrient availability by following standard analytical techniques as per standard methods were composed to standards.

The present research study has been carried out in the Ardhapur tehsil. The observed soil parameters like pH, EC, Nitrogen, Phosphorus and Pottasium *i.e.* (NPK) content was determined (Table-1, Figs. 2-11). The identified results have been shown and discussed respectively.

Table-1. Obtained result of 15 sampling sites from irrigated area

Sample No.	pH	EC	Nitrogen	Phosphorus	Potassium
S1	6.74	816	236.25	4.9	510.12
S2	6.68	779	199.5	5.9	526.44
S3	6.57	857.75	238	5.415	530.03
S4	6.67	814.75	213	6.33	625
S5	6.63	725.25	234.5	4.41	328.27
S6	6.59	709	215.25	6.04	467.3
S7	6.64	853.5	222.25	5.52	415.98
S8	6.69	648.25	250.25	5.55	565.83
S9	6.68	932.5	262.5	4.81	535.31
S10	6.58	869.5	206.5	5.82	547.22
S11	6.83	645.5	266	4.78	523.99
S12	6.73	900.5	203	4.95	399.95
S13	6.63	651.25	259	5.42	485.01
S14	6.63	814.75	220.5	5.05	547.22
S15	6.88	865.75	248.5	4.92	472.43
Minimum	6.57	645.5	199.5	4.41	328.27
Maximum	6.88	932.5	266	6.33	625
Average	6.68	792.22	231.67	5.32	498.67

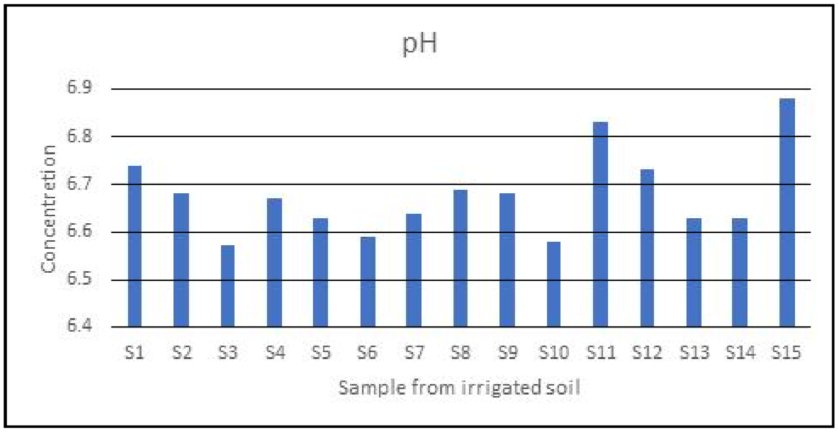

Fig. 2. Showing the Average pH values in the irrigated soil samples in the study area

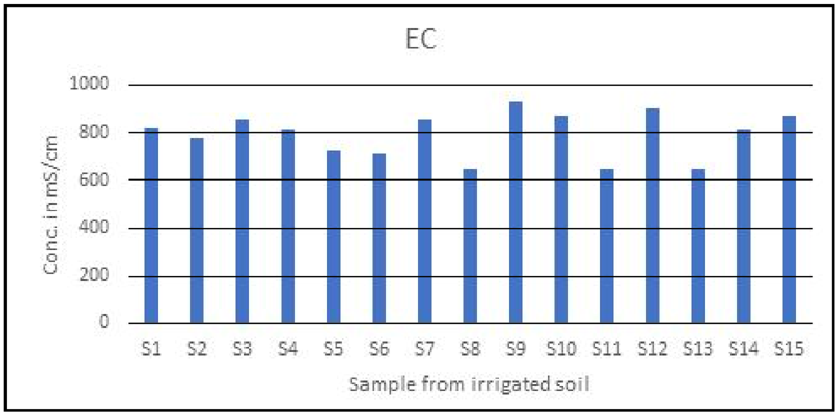

Fig. 3 Proving the EC values in the irrigated soil samples in investigation

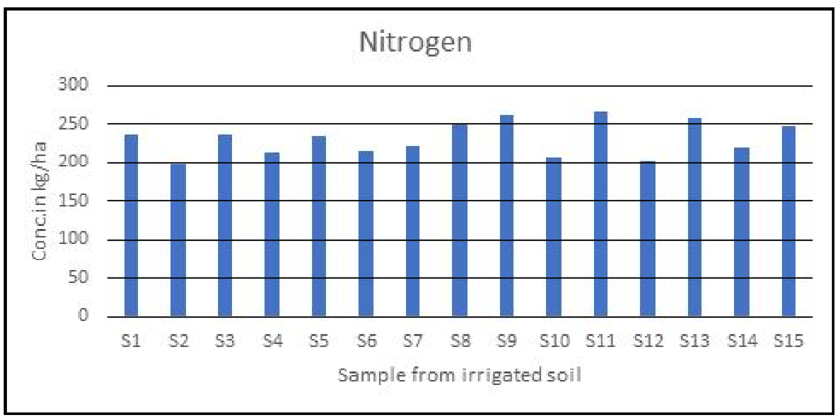

Fig. 4. Show the Average Nitrogen values in selected soil samples

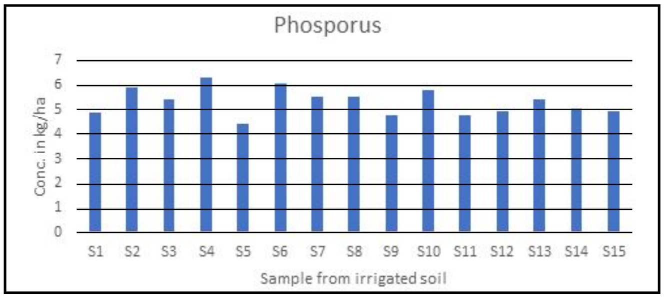

Fig. 5. Showing the Average Phosphorus values in the selected study area

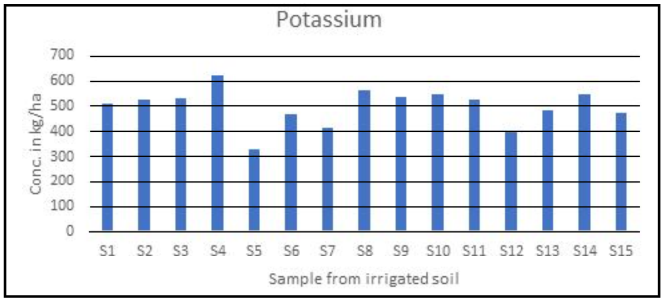

Fig. 6. Display the Pottasium (K) values in the irrigated soil samples in study area

Table-2. Obtained result of 15 sampling sites from non-irrigated area soil sample

Sample No.	pH	EC	Nitrogen	Phosphorus	Potassium
S16	7.52	735	267.75	5.83	748.69
S17	7.46	953	253.75	6.27	584.95
S18	7.5	855.75	283.5	5.48	560.95
S19	7.56	737.25	301	5.77	606.34
S20	7.59	841.75	306.25	5.39	590.32
S21	7.41	845.25	291	5.9	569.9
S22	7.44	883.75	304.5	5.9	567.64
S23	7.63	913.5	318.5	5.57	593.81
S24	7.6	786.5	311.5	5.74	528.06
S25	7.74	865.75	288.75	6.18	580.41
S26	7.73	758.25	288.75	5.71	572.74
S27	7.62	887.25	283.5	5.9	566.66
S28	7.55	706.75	348.25	6.24	512.52
S29	7.66	906.75	299.25	5.64	594.9
S30	7.6	927.25	334.25	6.15	634.67
Minimum	7.41	706.75	253.75	5.39	512.52
Maximum	7.74	953	348.25	6.27	748.69
Average	7.57	840.25	298.70	5.84	587.50

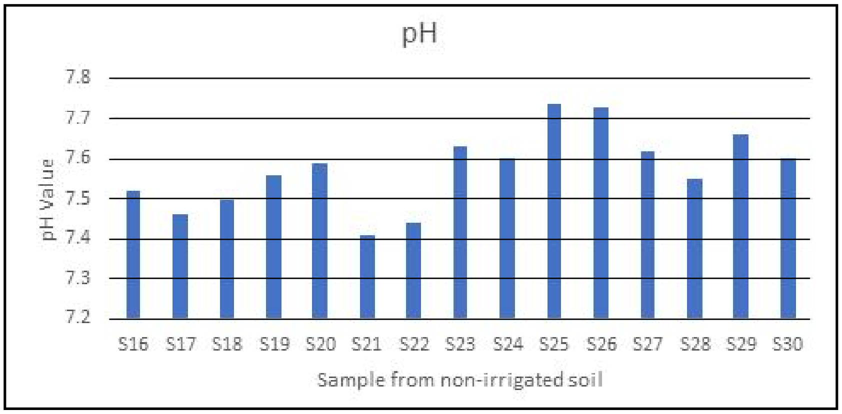

Fig. 7. Showing the Average pH values of non-irrigated soil samples

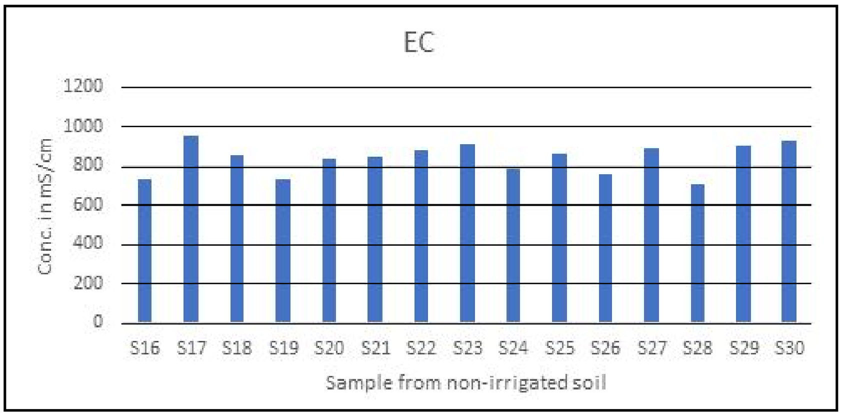

Fig. 8. Proving the Average EC values in the non-irrigated soil samples

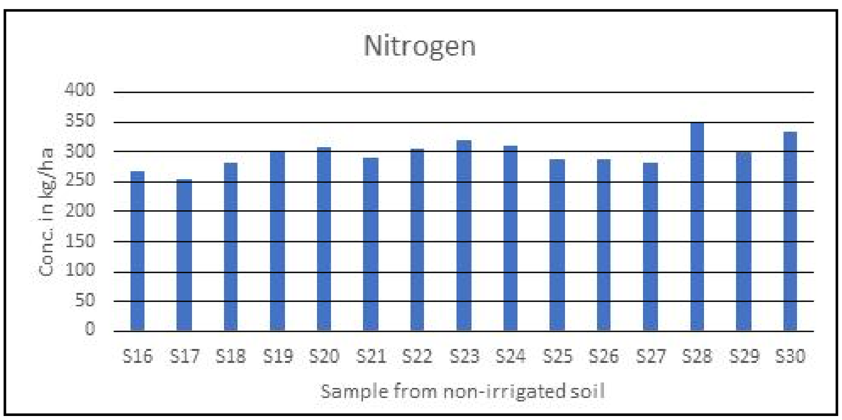

Fig. 9. Exhibiting the values of Nitrogen (N) in the non-irrigated soil samples

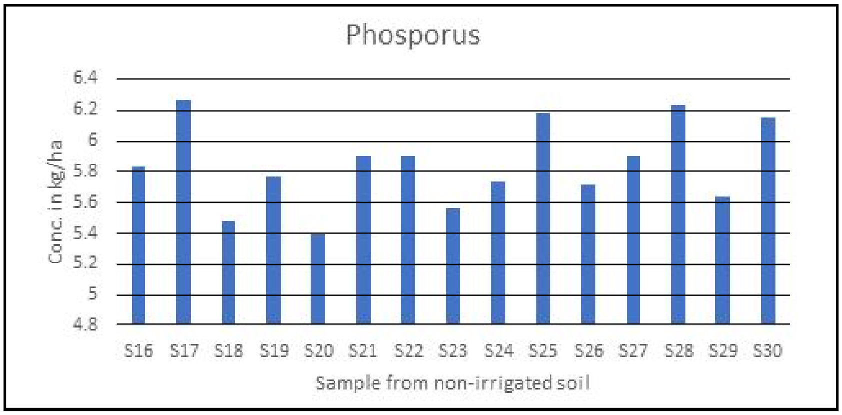

Fig. 10. Explaining the Phosphorus values in the non-irrigated soil samples

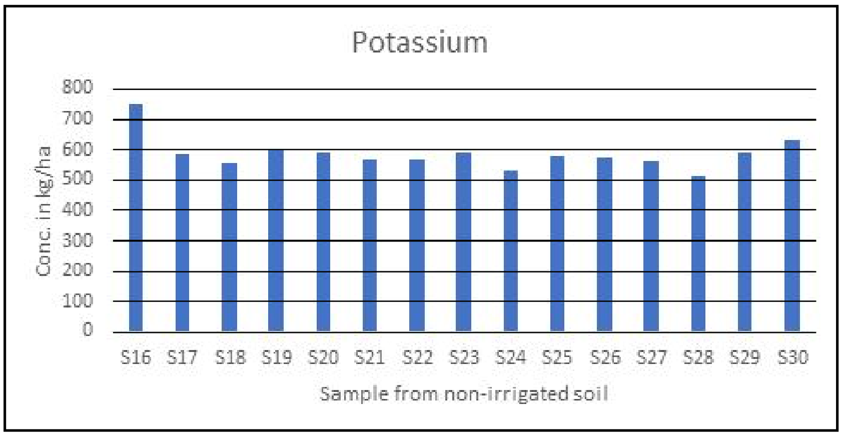

Fig. 11. Indicating the Potassium values in the non-irrigated soil samples

pH :

The pH and EC are important soil parameters to estimate its quality. The range of soil pH is found generally in the range of 0-5 (acidic) in nature it causes nutrient deficiencies and toxicities, the range 6-8 is an ideal for plant growth, and the range 8-9 is alkaline in nature and the range 9-14 is highly alkaline in nature it also cause nutrient deficiencies and toxicity. All the obtaining result of pH from first 15 soil samples of selected sampling site that is non-irrigated area showed in Fig. 7 and for irrigated area in table Fig. 2. The minimum range of pH is 7.41 and the maximum is 7.74 in non-irrigated area and 6.57 to 6.88 in irrigated areas. The obtained values of pH are ideal for plant growth and determines good soil quality. Srinivasan *et al.*,[26] studied macronutrients and micronutrients relation to soil characteristic of wellington reservoir Tamil Nadu, India. This study revealed the pH values of the soil samples are in between range of 6.9 -8.3 with an average 7.57 these values of pH is basic to moderately alkaline in nature.

Electric conductivity :

Soil EC is measured of the amount of salt in soil. It is excellent indicator of nutrient availability and loss and shows soil texture and available water capacity. The range between 110-570 is ideal for plant growth, the value of EC below the ideal range is indicate low availability of nutrients and the values above the range is denoted the excess of nutrients. The obtained range of EC from first 15 soil sample of selected sampling site that is non-irrigated area showed in table Fig. 8 and for irrigated area in Fig. 3 the minimum range of EC is 706.75 and the maximum range is 953 in soils from non-irrigated and 645.5 and 932.5 in irrigated soils. The obtained results of EC are showing variation and is above the ideal range. Clay has high conductivity and most of the soil sample has clay soil indicating excess nutrients. Srinivasa *et al.*,[26] studied macronutrients and micronutrients relation to soil characteristic of wellington reservoir Tamil Nadu, India and observed values of EC in the of 0.12-2.3 with mean value 1.21 μS/cm. All values were normal in range. Robert *et al.*,[21] studied precision farming tool for soil conductivity in the field of Virginia. They compare soil survey with EC map of two different field, in this observation the value of EC is different but along the field boundaries the values are slightly similar.

Nitrogen :

Soil nitrogen is beneficial for plant growth and yield capacity of soil and its health. It helps to make to DNA synthesis, proteins and chlorophyll level of nitrogen in soil 75-125 kg/ha which is adequate for quantitative production. The obtained result of Nitrogen from first 15 soil samples from non- irrigated area showed minimum range of Nitrogen is 253.75 kg/ha and maximum range is 348.25 kg/ha fig. 9 and for irrigated soils minimum range is 199.5 kg/ha and the maximum range is 266 kg /ha (fig. 4). Most of the soil samples has very high Nitrogen level those obtained values of N is leading to eutrophication of soil. It reduces their fruit production and delaying fruit maturity. Deshmukh[7] worked on nutrient analysis of soil from Nanded district, Maharashtra. This study shows the percentage of available nitrogen range in between 88.4-154.4 kg/ha this range in between low to medium in range. It causes deficiency of nitrogen in plant and it effect on productivity. The availability of nitrogen depends on the varying degree of soil microbial decomposition. Dhavne *et al.*,[8] worked on Assessment of soil fertility of agricultural research station Badnapur, India his study revels the level of available nitrogen range is 137.9-269.6 kg/ha its medium to moderate it effects on activity of microbes and growth.

Phosphorus :

Phosphorus has a role to store and transfer energy, the energy produced by photosynthesis processes to promote plant growth and reproduction in plant. Generally, phosphorus level in soil is 10-25 kg/ha. The obtained result of Phosphorus from first 15 soil sample from non-irrigated area showed minimum value of 5.39 and maximum 6.27 Kg/ha (fig. 10) and maximum of 6.33Kg/ha for irrigated soil samples fig. 5. All the soil samples have low level of phosphorus. The anthropogenic activities such as continuous use of chemical fertilizer which is accountable for soil condition. It also affects plants aerobiotic vegetative growth and crop yield. Deshmukh[7] worked on for the nutrient analysis of soil from Nanded, Maharashtra. During his work, he found that the availability of phosphorus was in the level of 4.10 – 15.20 kg/ha low to medium in range. The obtained results were good for plant growth but if it further reduces it may affect soil quality as well as crop yield. Ghode *et al*.,[12] studied distribution of available macro and micronutrients in cotton growing soils of Nanded district, Maharashtra, India. This work showed the level of phosphorus which is present low to medium in range that is 3.5 – 17.92 kg/ha due to anthropogenic activities as well as natural.

Potassium :

Potassium is the important to crop it help to provide dissolve minerals and water from soil by root. Normal range of potassium in soil is 145-337 kg/ha. All the obtained result of potassium from soil samples selected from non-irrigated area (fig. 11) showed minimum value 512.52 and the maximum level is 748.69Kg/ha. and minimum of 328.27 and maximum 625 Kg/ha. for irrigated soils (fig. 6). The content of available potassium in all the soil samples were medium to very high level due to excess uses of chemical fertilizers, too much potassium is affecting the way soil absorbs other excess amount of unwanted nutrients and it is unhealthy for plant growth. Deshmukh[7] worked on Nutrient analysis of soil from Nanded District, Maharashtra. This study observed the content of available potassium is in range of medium to high varied from 183.10 – 488.30 kg/ha. High level of potassium caused soil pollution and directly effect on crop production. Ghode *et al*.,[12] studied vertical distribution of available macro and micronutrients in cotton growing soils of Nanded district in Maharashtra, India and observed soil potassium in medium range, it varied from 197.6 – 535.3 kg/ha.

Study has been carried out by using different soil samples from area of Ardhapur tehsil region. The obtained result of soil analysis shows variations in irrigated soil samples and non-irrigated soil samples. The soil parameters *i.e*., pH, EC, N, K are all above the BIS standards except phosphorus. It may because of excess uses of chemical fertilizer and evenly it decreases soil quality. Most of the samples has high nitrogen and very potassium level in irrigated soil samples as comparatively non-irrigated soil samples. All the soil samples of irrigated and nonirrigated soil has low level of phosphorus it effects on plants aerobiotic vegetation growth and crop production.

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