Physico-Chemical Analysis of Soil from Kadegaon Tehsil (Sangli District)

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***Abstract* - Soil analysis is a valuable tool for farm as it determines the inputs required for efficient and economic production. A proper soil test will help ensure the application of enough fertilizer to meet the requirements of the crop while taking advantage of the nutrients already present in the soil. The aims of soil analysis are: To determine the level of availability of nutrients or the need for its introduction. To predict the increase in yields and profitability of fertilization (poor soils do not always provide yield increase due to fertilization because of possible limiting factors) and to save money and conserve energy by applying only the amount of fertilizer needed. In the present study it was preferred to investigate the soil samples for its physico-chemical analysis of some parameters. Nine representative samples were collected and analyzed for its pH, EC, organic carbon, phosphorous, manganese, K_2O, zinc, copper, calcium bicarbonate.**

***Index Terms* - physico-chemical, pH, EC, Organic Carbon, Nitrogen, Mn, Na, K_2O, P_2O_5, $CaCO_3$, Zn, Fe and Cu.**

1.INTRODUCTION

Soil is the thin layer of material covering the earth's surface and is formed from the weathering of rocks. It is made up mainly of mineral particles, organic materials, air, water and living organisms all of which interact slowly yet constantly. Therefore, most living things on land depend on soil for their existence. Soil analysis is a set of various chemical processes that determine the amount of available plant nutrients in the soil, but also the chemical, physical and biological soil properties important for plant nutrition, or "soil health". Chemical soil analysis determines the content of basic plant nutrients; nitrogen (N), phosphorus (P_2O_5), potassium (K_2O), pH, humus content, total $CaCO_3$, available lime, organic matter, trace elements, and other physical characteristics (capacity, permeability, density, pH - value). Soil organisms decompose fresh organic matter such as crop residues and animal manures. In the process, they help soil particles stick together into stable aggregates. They also create humus, a form of organic matter that doesn't decompose further, that helps soils hold water and nutrients, it is an ideal place for plants to grow. Soil holds the roots, and let's plants stand above the ground to collect the light they need to live. Almost as important are the fungi. There are fungi which grow into plant roots, a symbiosis known as mycorrhiza. This helps trees grow. There are many other fungi that live by breaking down dead organic material: the remains of other living things. The broken-down material is a main source of plant nutrients.

A soil test is important for several reasons: different soils have different nutrients profile; some are lacking in nutrients needed to grow certain types of plants. Some soils may be nutrients-rich in the past but the reserves have been depleted after the crops were harvested. For people who grow crops for a living, the soils nutrient profile has to be assessed prior to planting crops otherwise; all that hard work could go to waste. And other reason is to optimize crop production, to protect the environment from contamination by runoff and leaching of excess fertilizers, to aid in the diagnosis of plant culture problems, to improve the nutritional balance of the growing media and to save money and conserve energy by applying only the amount of fertilizer needed and Soil health is the continued capacity of soil to function as a vital living ecosystem that sustain plants, animals, and humans, oftentimes, the feature of a healthy soil are related to the organic matter content. Soil plays a very important role in providing food for human being as well as animal. Good soil and climate for more crop production are valuable for any nation. The increasing population, industrialization and changing lifestyle have negative effect on soil and responsible for soil pollution.

We have to study the physico-chemical parameters of soil to know its quality. Nine representative soil samples were collected from various villages of the Kadegaon Tehsil and its physico-chemical analysis has been performed to know its different parameters.

2. SAMPLE COLLECTION

The present study was carried out for three villages located in Kadegaon Tehsil. The Soil samples were collect from different farm in the clean polythene bags, from three different villages, Wangi, Kadegaon and Ambak.

3. MATERIAL AND METHODS

The soil samples were collected from three different places in the summer season. To collect soil samples in cleaned polythene bags. The collection of soil at the depth of 5 to 8 inch. Soil depth is a root space and the volume of soil from where the plants fulfill their water and nutrient demands. (The top six inches of soil has the most root activity and fertilizer application is generally restricted to this depth).

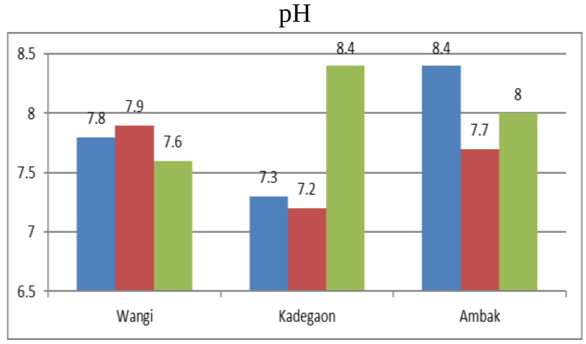
The soil samples were immediately brought into laboratory for the estimation of various physico-chemical parameters like pH was recorded by using Digital pH meter. Specific conductivities were measured by using digital conductivity meter. While other parameters such as sodium and potassium by flame Photometry. Magnesium, calcium bicarbonate, organic carbon, manganese, zinc, copper was estimated in the laboratory by using standard laboratory methods.

4. RESULT & DISCUSSION

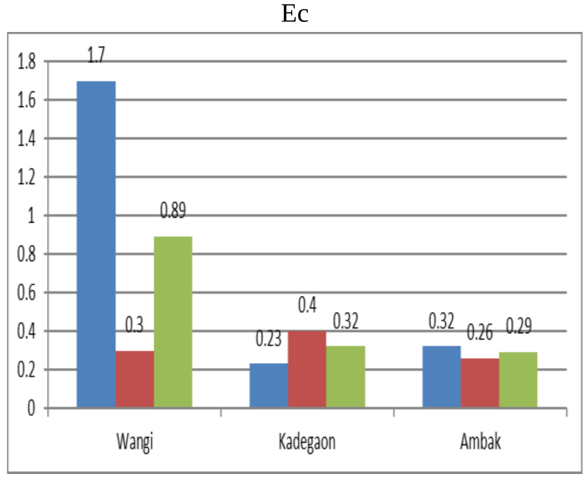
Table No. 1 Physico-chemical analysis of Soil from Collection site.

Sr. No.	Parameters	Wangi	Kadegaon	Ambak
1	pH (pH Meter)	7.8	7.9	7.6
		7.3	7.2	8.4
		8.4	7.7	8.0
2	Electrical Conductivity (EC) mmhs/ cm	1.7	0.3	0.89
		0.23	0.4	0.32
		0.32	0.26	0.29
3	Nitrogen (N) Kg/ha	376.3	112.4	106.04
		149.1	55.99	170.6
		170.6	44.71	152.4
4	Phospohrous (P_2O_5) Kg/ha	759	56	38
		48	46	69
		69	37	77
5	Potassium (K_2O) Kg/ha	646	382	204
		775	457	261
		261	662	192
6	Carbon (C)%	2.25	0.672	0.636
		0.811	0.335	1.02
		1.02	0.267	0.911
7	Calcium Bicarbonate ($CaCO_3$) %	24.5	18.38	2
		2.37	1.25	6.12
		6.12	13.88	4
8	Sodium (Na) MGM%	21.8	20.9	11.75
		20.4	27.95	23.1
		23.1	31.2	12.6
9	Iron (Fe) ppm	7.4	1.8	2.81
		1.65	4.11	3.19
		3.19	3.05	2.18
10	Manganese (Mn)ppm	2.8	1.77	1.14
		3.01	2.75	1.23
		1.23	2.6	1.98
11	Zinc (Zn) ppm	3.41	1.18	0.26
		0.41	1.44	0.21
		0.21	0.18	0.11
12	Copper (Cu) ppm	1.65	0.2	0.18
		0.65	0.26	0.17
		0.17	1.06	0.13

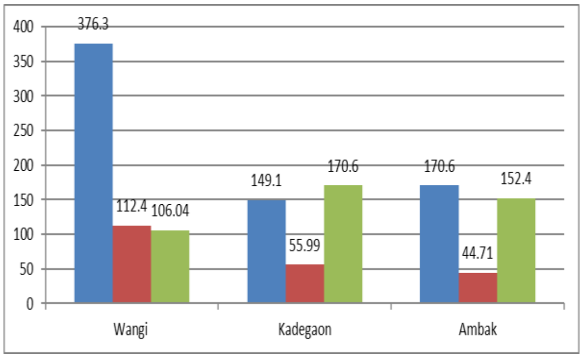
pH



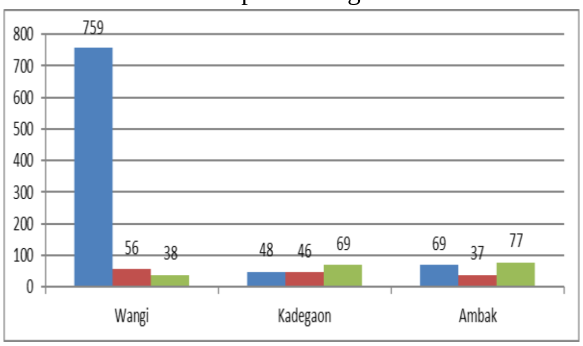
Ec



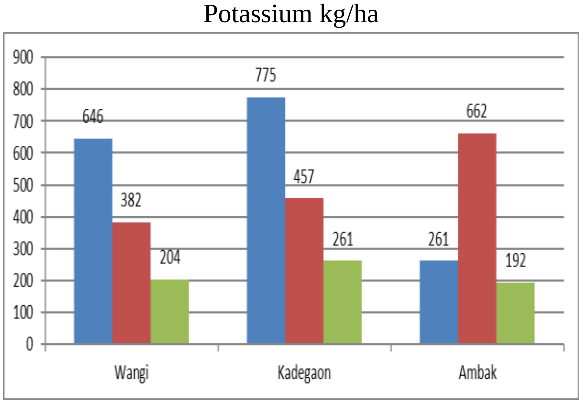
Nitrogen kg/ha



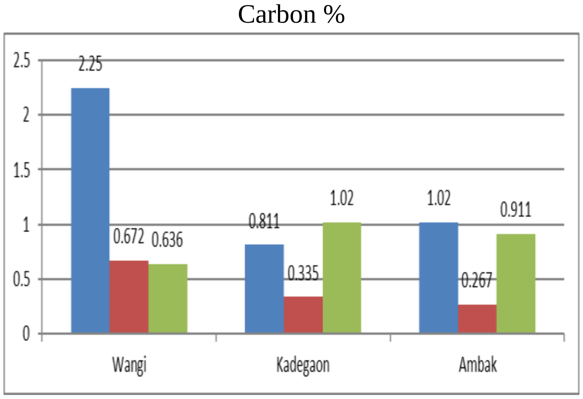
Phosphorous kg/ha



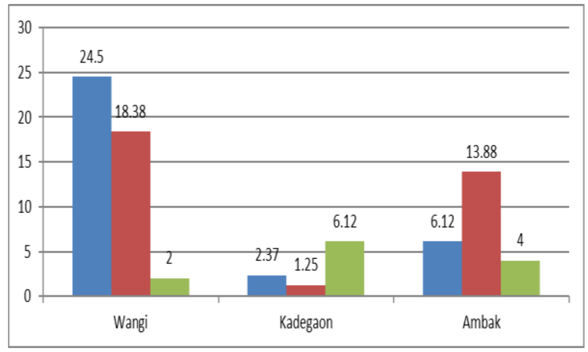
Potassium kg/ha



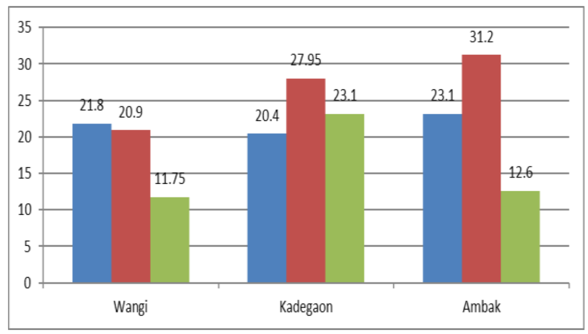
Carbon %



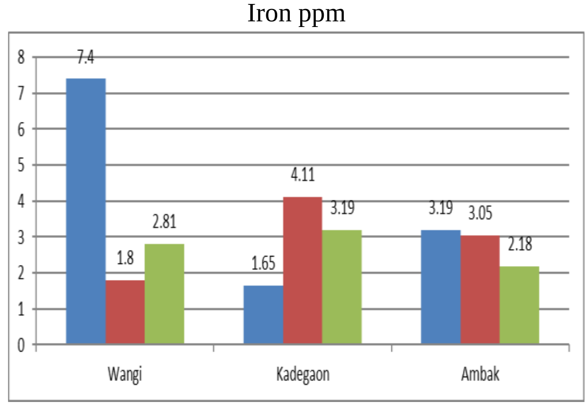
Calcium bicarbonate %



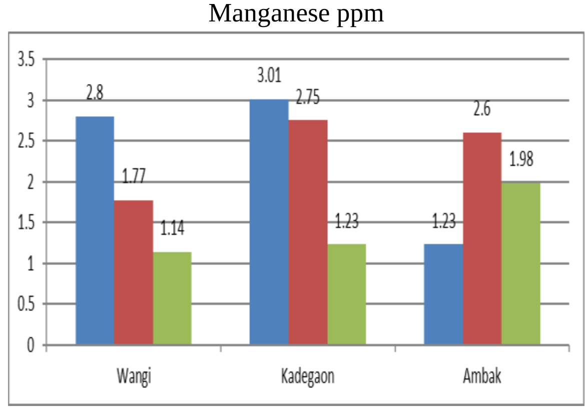
Sodium MGM %



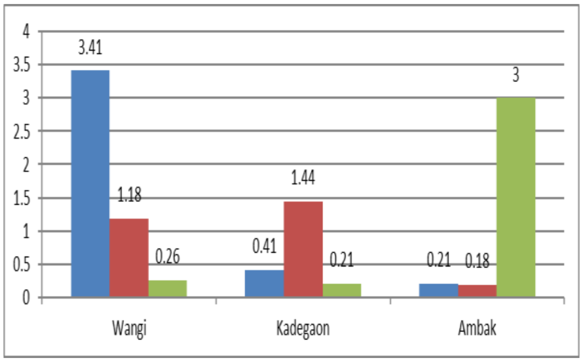
Iron ppm



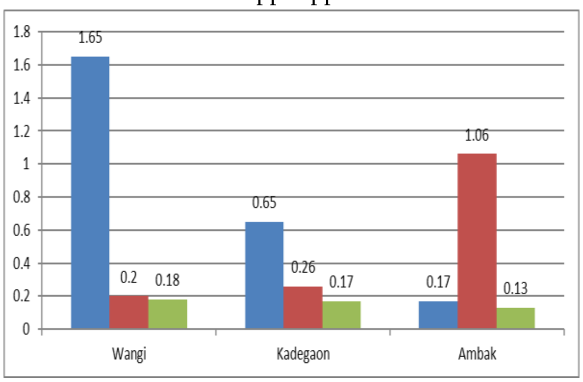
Manganese ppm



Zinc ppm



Copper ppm



4.1] pH:

Soil pH is defined as the negative logarithm of the hydrogen ion concentration. Soil pH is a measure of the acidity or alkalinity of the soil. Soils can be classified according to their pH value: 6.5 to 7.5 are neutral. Over 7.5 are alkaline. Less than 6.5 is acidic, and soils with pH less than 5.5 are considered strongly acidic. pH range found to be 7.2 to 8.4 are alkaline, Shown in (Table No.1).

4.2] Electrical conductivity (EC):

The electrical conductivity indicates the amount of soluble (salt) ions in soil. The determination of electrical conductivity (EC) is made with a conductivity cell by measuring the electrical resistance of a 1:5 soil water suspension. It is measured by taking a soil sample, making a saturated paste of soil and deionized water, extracting the water, and then measuring the EC of the extracted solution. Standard value of EC in soil Normal < 0.8 dsm-1, critical for salt sensitive crops, critical for salt tolerant crops 1.6 – 2.5 dsm-1, injurious to most crops > 2.5 dsm-1. The EC value found to be 0.2 to 1.7.

4.3] Nitrogen:

Nitrogen cycles through soil in various processes and forms. Nitrogen is added to soil naturally from N fixation by soil bacteria and legumes and through atmospheric deposition in rainfall. Additional N is typically supplied to the crop by fertilizers, manure, or other organic materials. Microorganism living in the soil requires nitrogen as an energy source. These soil microorganisms pull nitrogen from the soil when the residues of decomposing plants do not contain enough nitrogen. When microorganism take in ammonium ($NH4^+$) and nitrate ($NO3^-$), these forms of nitrogen are no longer available to the plant and may cause nitrogen deficiency, or a lack of nitrogen. The ranges found 44.71 to 376.3kg/ha.

4.4] Phosphorous (P_2O_5):

Phosphorous is found in the soil in organic compounds and in minerals. Phosphorous is an essential macro-element, required for plant nutrition. It participates in metabolic processes such as photosynthesis, energy breakdown of carbohydrates. Phosphorous is found in the soil in organic compounds and in mineral. Phosphorous is adsorbed by plants in the ionic forms $H_2PO_4^-$ and HPO_4^{--}. Phosphorous ranges found to be 37 to 759 kg/ha.

4.5] Potassium (K_2O):

Potassium is an essential plant nutrient and is required in large amounts for proper growth and reproduction of plants. Plants absorb potassium in its ionic form, K^+. The soil test for K is the best management tool for predicting the amount of potash needed in a fertilizer program. Available K in soils is estimated by measuring the total of solution K (water = soluble K) and exchangeable K. standard value of K_2O in soil low < 140 kg/ha, medium 140-280 kg/ha and high values < 280 kg/ha. Potassium ranges found to be 192 to 775 kg/ha. Different values are obtained.

4.6] Organic Carbon (OC):

Organic carbon is the main component of soil organic matter and helps give soil its water-retention capacity, its structure, and soil fertility. It release nutrient for plant growth, promotes the structure, biological and physical health of soil, and is buffer against harmful substances. Benefits of organic carbon matter is a key component of soil that affects its physical, chemical, and biological properties, contributing greatly to its proper functioning on which human societies depends. Benefits of soil organic carbon include improvement of soil quality through increased retention of water and nutrients, resulting in greater productivity of plants in natural environments and agricultural setting. The ranges of carbon in nine different samples are 0.267 to 2.25%. Different results are obtained standard value of OC are low, less than 0.50, medium 0.50 – 0.75 and high greater than 0.75.

4.7] Calcium carbonate ($CaCO_3$):
The calcium is used by the plant in developing the plant cell walls and membranes. Furthermore, it is a non-leaching mineral (it will stay in the soil) and will improve water penetrability and reduce soil salinity. It is thus helpful to determine the amount of calcium contained in soil. Usually soils with a higher pH level contain more available calcium. Soil carbonates are typically measured by dissolving carbonates in acid solution, and the reaction is -

$CaCO_3 + 2H^+ \rightarrow Ca_2^+ + CO_2 + H_2O$,

$CaMg(CO_3)_2 + 4H^+ \rightarrow Ca_2^+ + Mg_2^{++} + 2CO_2 + 2H_2O$

And then determining either H^+ consumption, Ca and Mg production, or CO_2 production. This method estimates the amount of soil carbonate by digestion with excess acid. The ranges found to be 2 to 24.5 %. Values are medium and high formed by analysis of soil.

4.8] Sodium:
While salinity can improve soil structure, it can also negatively affect plant growth and crop yields. Sodicity refers specifically to the amount of sodium present in irrigation water. Irrigating with water that has excess amounts of sodium can adversely impact soil structure, making plant growth difficult. The ranges of sodium found to be 12.6 to 27.95 MGM%.

4.9] Iron (Fe):
The solubility of iron in soils is controlled by $Fe(OH)_3$ solution in well- oxidized soils, by $Fe_3(OH)_S$ (Ferrosic hydroxide) in moderately oxidized soils, and by $FeCO_3$ (siderite) in highly reduced soils. The Fe(III) hydrolysis species $Fe(OH)_2^+$, and Fe(OH)3 are the major solution species of inorganic Fe, but they are maintained too low to supply available iron to plants. Iron is absorbed by plants as Fe_2^+. The ranges of iron is 1.65 to 7.4ppm formed, are very high and very low proportion formed in different soil samples.

4.10] Manganese (Mn):
The Earth's crust about 0.11% Mn. Total Mn in soils generally ranges from about 20 to 300 ppm (0.002 to 0.30 %), but only a fraction of this total is plant available. The most common form of Mn in soil solution is Mn_2^+, which is often complexed by organic compounds. Soil manganese exists in three oxidation states: Mn_2^+, Mn_3^+ and Mn_4^+. Manganese absorbed by plant roots is primarily Mn_2+ because it is much more soluble. The ranges of Manganese are obtained 1.23 to 3.01 ppm are very low values formed.

4.11] Zinc (Zn):
The amount of zinc present in the soil depends on the parent materials of that soil. Sandy and highly leached acid soils generally have low plant available zinc. Mineral soils with low soil organic matter also exhibits zinc deficiency. In contrast, soils originating from igneous rocks are higher in zinc. Plants take up zinc as the divalent ionic form (Zn_2^+) and chelated-zinc. The main causes of Zn deficiency in crops are mainly soil-related: low Zn availability (High pH, calcareous and sodic soils), low total soil Zn content (especially in sandy, sodic, and calcareous soils), and loss of organic matter, presence of nitrogen, sodium, calcium, magnesium and phosphates. Zinc values are low and medium ranges found to be 0.11 to 1.65 ppm.

4.12] Copper (Cu):
Soils naturally contain copper in some forms or other, ranging anywhere from 2 to 100 ppm and averaging at about 30 ppm. Most plant contains about 8 to 20 ppm. Copper is often found near mines, smelters, industrial settings, landfills, and waste disposal sites. When copper is released into soil, it can become strongly attached to the organic material and other component like clay, sand etc. in the top layers of soil and may not move very far when it is released. Copper ranges found to be 0.13 to 1.65 ppm.

5. CONCLUSION

It was observed that different areas of soil had influences on the physico-chemical characteristics of the soil. Organic matter maintenance is an important factor in controlling fertilizers availability. Management factors, such as N source, Mn, Fe, Zn, Cu placement method, timing of application, irrigation management, residue management, crop type, etc.

however, application of more labile organic inputs, liming materials and suitable inorganic fertilizers (N-P-K) would be effective for sustainable management and improving fertility status of the soils. Use of artificial fertilizers and unscientific irrigation methods, biofertilisers should be applied in field for achieving sustainable agriculture development. Application of these materials will not be harmful to soil but it helps in improving the soil fertility. Need to more organic fertilizers added to the soil for better yield and improvement of soil health.

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