ANALYSIS AND ASSESSMENT OF SOIL SAMPLE FOR THEIR PHYSICO-CHEMICAL PROPERTIES FROM PALUS TEHSIL (SANGLI DISTRICT)

A. L. More [1*], J. C. Thorat[2] and D. C Kore[3]

[1]Department of Chemistry,

[*]Bharati Vidyapeeth's Matoshri Bayabai Shripatrao Kadam Kanya Mahavidyalaya, Kadegaon, Dist - Sangli

[2]Bharati Vidyapeeth's College of Engineering, Kolhapur, Maharashtra

[3] C. B. Khedgi's College Akkalkot, Dist - Solapur

Abstract:

The quality & health of soils not only determine agricultural sustainability but also environmental quality & the plant, animal & human health. Thus the land care & soil quality management assume great significance for ensuring agricultural sustainability which is inevitable to feed the burgeoning population The quality & health of soils not only determine agricultural sustainability but also environmental quality & the plant, animal & human health. Thus the land care & soil quality management assume great significance for ensuring agricultural sustainability which is inevitable to feed the burgeoning population The quality & health of soils not only determine agricultural sustainability but also environmental quality & the plant, animal & human health. Thus the land care & soil quality management assume great significance for ensuring agricultural sustainability which is inevitable to feed the burgeoning population A study was conducted on the analysis and assessment of soil for its Physicochemical properties in different agricultural areas from Palus Tehsil Dist.- Sangli (M.S.) India. The natural soil is clean, but due to the multifarious activities of humans, it gets polluted resulting in what is called soil pollution. Fifteen representative samples were obtained and analyzed for their pH, Electrical Conductivity, Sulphur, Phosphorus, Nitrogen, Potassium, Organic Carbon, Free Lime, Iron, Sodium, Copper, Zinc, etc. A soil analysis is used to determine the level of nutrients found in a soil sample. As such, it can only be as accurate as the sample taken in a particular field. The results of a soil analysis give information about the agricultural producer with an estimate of the amount of fertilizer nutrients needed to supplement those in the soil. Applying the appropriate type of needed fertilizer will give the agricultural a more reasonable chance to obtain the desired crop yield. Ensure the application of enough fertilizer to meet the requirements of the crop, a proper soil test will help while taking advantage of the nutrients already present in the soil. The aims of soil analysis are: 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, to determine the level of availability of nutrients or the need for its introduction.

Key Words: Physico-chemical, nutrients, fertilizer, pH, Electrical Conductivity, Nitrogen, Phosphorus, Potassium, Sulfur, Organic Carbon, Free Lime, Sodium, Iron, Manganese, Zinc, Copper

Introduction:

Crops require an abundant supply of the 16 essential nutrient elements to high yields of top quality. In addition to providing a place for crops to grow, the soil is the source of most of the essential nutrients required by the crops. Yields will decrease accordingly if nutrients are removed by one crop and not replaced for subsequent crop production. Soil is a product of several factors: the soil's parent materials (original minerals) interact over time,[1] the influence of climate, organisms, and relief. By way of numerous physical, chemical, and biological processes, undergoes continual soil development. Given its complexity and strong internal connectedness, soil ecologists regard soil as an ecosystem.[2] However, as demonstrated

by aquaponics, aeroponics, and hydroponics, soil material is not an absolute essential for agriculture, and soilless cropping systems have been claimed as the future of agriculture for the endless growing mankind.[3] Agricultural soil scientists study ways to make soils more productive. They classify soils and test them to determine whether they contain nutrients vital to plant growth. Such nutritional substances include compounds of nitrogen, phosphorus, and potassium.

The movement of nutrients through the soil and the amount of nutrients absorbed by a plant's roots are investigated by Agricultural soil scientists. Agricultural soil scientists also examine the relation of roots to the soil and the development of roots. The structure and function of soils in relation to soil fertility are tried to understand by Some agricultural soil scientists. Agricultural soil science studies the chemical, biological, physical, and mineralogical composition of soils as they relate to agriculture. Agricultural soil scientists develop methods that will improve the use of soil and increase the production of food and fiber crops. Emphasis continues to grow on the importance of soil sustainability. Soil degradation such as lowered fertility, erosion, compaction, and contamination continues to be a serious concern.[4] Nitrogen (N), potassium (K), and Phosphorus (P) are very essential for plant growth and also for the strengthening of reproductive parts, activation of enzymes, and carbohydrate metabolism1. Potassium (K) is present in elemental form, exchangeable form, or as a part of mineral lattices. Calcium (Ca) and Magnesium (Mg) interfere in soil activity as well as activate a number of plant enzyme systems. Nitrogen and Phosphorous are not available to the plants directly. They are incorporated into the organic material. The deficiency of any of these elements has retarding effect on the growth of the plant. [5,6]

Nutrient	Symbol	Form available	Category
Nitrogen	N	NO_3, NH_4^+	macronutrients required by plants in large amounts
Phosphorus	P	PO_4^{-3}	
Potassium	K	K^+	
Calcium	Ca	Ca^{++}	secondary nutrients required by plants in moderate amounts
Magnesium	Mg	Mg^{++}	
Sulfur	S	SO_4^{--}	
Boron	B	HBO_4^-	micronutrients required by plants in small amounts
Chlorine	Cl	Cl^-	
Copper	Cu	Cu^{++}	
Iron	Fe	Fe^{2+}, Fe^{3+}	
Manganese	Mn	Mn^{2+}	
Molybdenum	Mo	MoO_4^-	
Zinc	Zn	Zn^{2+}	
Carbon	C	CO_2	Non-Fertilizer elements supplied through air, water, and soil nutrients
Hydrogen	H	H_2O	
Oxygen	O	O_2	

Objectives of soil analysis:

The basic objective of the soil-testing programme is to give farmers a service leading to better and more economic use of fertilizers and better soil management practices for increasing agricultural production. To provide an index of nutrient availability or supply in a given soil. The soil extract is designed to evaluate a portion of the nutrients from the same “pool” used by the plant. To determine the probability of obtaining a profitable response to fertilizer application.

To provide a basis for fertilizer recommendations for a given crop. To evaluate the fertility status of the soil and plan a nutrient management program [7].

Importance of Soil Analysis:

To optimize crop production. To protect the environment from contamination by runoff and leaching of excess fertilizers. To aid within the identification of plant culture issues. To improve the nutritional balance of the growing media and to save lots of cash and conserve energy by applying solely the quantity of fertilizer Pre- plant media analyses provide an indication of potential nutrient deficiencies, pH imbalance or excess soluble salts.

Sample Collection:

Sampling for soil fertility is usually confined to the plough layer (0-15 cm). which is enriched in humus and serves as the main storehouse of plant nutrients. Actually 1-10 g of soil used for each chemical analysis should represent the entire surface layer (0-15 cm) of soil.[23] The present study was carried out for Seventeen villages located in Palus Tehsil. The Soil samples were collected from different farm in the clean polythene bags, from seventeen different villages that are Kundal, Andhali, Dudhondi, Tupari, Ghogaon, Palus, Aamanapur, Yelavi, Ankalkhop, Burli, Balwadi, Morale, Dhangaon, Dahyari, Nagaon, Nagrale, and Bambwade.

Material and Methods:

Sample	Parameters	Methods
Soil sample collected from different farm from different villeges	pH	pH metric method
	Electrical Conductivity	potentiometric method
	available nitrogen	Alkaline permanganate method
	available phosphorus	Bray's method
	available potassium	Flame photometric method
	soil Organic Carbon	walkley and Black Method
	available micronutrients (Zn, Cu, Fe, Mn, Na)	DTPA extract method
	available Salt and free lime	Standard laboratory method

1. pH:

pH level is the most significant property of soil, its effects on all other parameters of soil. Therefore, while analysing any kind of soil pH is considered [9]. If the pH is greater than 8.5 then it is said to be alkaline soil [9][10], less than 6 then it is said to be an acidic soil and the pH ranges from 6-8.5 it's a normal soil and. Where the soil pH is between 5.5 and 7.5. is the correct balance. The acidity or basicity (alkalinity) of a soil is measured by pH. The pH of Soil is a key characteristic that can be used to make informative analysis both qualitative and quantitatively regarding soil characteristics.[8]

2. Electrical conductivity:

Electrical conductivity is used to check the quality of the soil. Electrical conductivity is also a very important property of the soil. It is a measure of ions present in solution. [11] With the increase in concentration of ions in soil, the electrical conductivity of a soil solution increases. To check health of soils, Electrical conductivity is a very quick, simple and inexpensive method. It is a measure of ions present in solution [12]. With the increase in concentration of ions in soil, the electrical conductivity of a soil solution also increases. The Electrical Conductivity (EC) of a normal soil should be less than 4mS/cm (<4mS/cm), [13] According to Abegunrin et. al (2013). Observed values are less than 4.0 mmho/cm.

3. Phosphorus:

Phosphorus is an important element present in every living cell. It is one of the most important micronutrients essential for plant growth. Phosphorus most often limits nutrients remains present in plant nuclei and act as an energy storage [14].

4. Potassium:

Potassium plays an important role in different physiological processes of plants; it is the important elements for the development of the plant. It is involved in many plant metabolism reactions, ranging from lignin and cellulose used for the formation of cellular structural components, for regulation of photosynthesis and production of plant sugars that are used for various plant metabolic needs.

5. Sulphur:

Sulphur is as necessary as phosphorus and is considered an essential mineral [15]. Sulphur in plants helps form important enzymes and assists in the formation of plant proteins. It is needed in very low amount, but deficiency can cause serious plant health problems and loss of vitality. Historically and in literature sulphur is also called brimstone [16].

6. Organic Carbon (OC):

The Basis of soil fertility is soil organic carbon. Soil organic carbon releases nutrient for plant growth, promotes the structure, biological and physical health of soil, and is buffer against harmful substances. Increasing soil organic carbon has two benefits- as well as helping to mitigate climate change, it improves fertility and soil health. Many management practices that increase soil organic carbon also improve crop and pasture yields [17]. Soils containing greater than 12–18% organic carbon are generally classified as organic soils [18].

7. Calcium:

It is present in the soil either as soluble Ca^{2+} on the base complex or as free Calcium carbonate ($CaCO_3$). It has a double role in the fertility of soil. It acts as plant nutrient at the same level as N, P and Mg as well as a pH regulator.[19]

8. Magnesium:

It is the constituent of chlorophyll molecule, related to the metabolism of Phosphorus. It also activates number of plant enzymes. It is absorbed by the plant roots as Mg^{++} ion. [20,21] If the soil has deficiency of Mg, then the plant grown in such soil will become pale yellow and then turns brown and necrotic.[22]

Result and Discussion:

Village	pH	EC mmho/cm	(N) Kg/ha	(P) Kg/ha	(K) Kg/ha	OC %
Kundal	7.92	0.178	100	8	202	0.11
Andhali	7.82	0.234	188	62	524	3.43
Dudhondi	7.52	0.512	163	15	618	1.01
Tupari	7.66	0.326	90	5	108	0.04
Ghogaon	7.75	0.469	90	25	538	0.38
Palus	7.60	0.560	112	52	470	0.50
Aamanapur	7.80	0.550	125	9	511	0.65
Yelavi	8.15	1.000	112	22	363	0.59
Ankalkhop	7.82	0.240	137	62	363	0.54
Burli	7.60	2.400	165	62	1532	1.06
Balwadi	7.96	0.327	138	11	255	0.78
Morale	8.20	0.225	112	12	161	0.53
Dhangaon	8.33	0.182	75	23	376	0.12
Dahyari	8.13	0.195	138	65	914	0.74
Nagaon	8.14	0.093	100	24	444	0.49
Nagrale	7.20	0.093	188	65	538	1.51
Bambwade	7.45	0.063	163	60	67	1.05

Village	Free Lime %	Na %	Fe ppm	Mn ppm	Zn ppm	Cu ppm
A	2.06	10	3.80	6.75	2.40	7.95
B	9.3	19	4.30	8.05	2.35	5.00
C	1.3	23	5.05	14.58	7.00	16.35
D	2.1	16	7.05	9.46	0.95	6.15
E	1.6	23	6.25	9.48	3.95	16.65
F	3.6	30	9.35	7.56	4.22	21.20
G	3.3	42	8.65	10.52	3.95	10.95
H	12.5	51	0.25	2.80	1.80	5.20
I	2.5	19	5.90	1.55	0.65	5.95
J	7.9	63	19.65	22.41	7.40	8.90
K	1.0	21	4.90	9.00	1.90	12.40
L	6.3	12	8.60	11.55	2.30	6.05
M	6.0	24	3.20	4.55	2.35	6.10
N	4.6	25	2.10	2.20	2.80	4.00
O	11.4	22	2.40	4.80	1.75	5.05
P	10.1	21	8.10	6.58	6.60	13.75
Q	10.1	6	6.00	5.38	0.90	5.70

Conclusion:

Physico-chemical analysis is the measurement of nutrients present in the soil and quality of soil. The Physico-chemical analysis of soil will provide the necessary information to set the target of nutrient application. It is then used to set up the target of nutrient application which is then used to calculate the rate of manure and fertilizer application to reduce cost. The results of tests from regular field sampling will allow the detection and monitoring of the changes in soil parameters [22] (pH, nutrients, salinity) with the time. It is must for the soil analysis results to be interpreted within the context of the expected yield response for the crop which is to be grown under the specific management and environmental conditions. The results depend on the quality of soil samples collected and also the strategy of sampling that is used.[22] If the samples are poor it will lead to inaccurate nutrient recommendations. Soil testing is an inexpensive practice to learn about the ability of soils to support crop growth. With knowledge of what each soil test value means, growers can make more informed crop input decisions to minimize risk and maximize profitability.

References:

1. Gilluly, James; Waters, Aaron Clement; Woodford, Alfred Oswald (1975). Principles of geology (4th ed.). San Francisco, California: W.H. Freeman. ISBN 978-0-7167-0269-6.
2. Ponge, Jean-François (2015). "The soil as an ecosystem". Biology and Fertility of Soils. 51 (6): 645–648. doi:10.1007/s00374-015-1016-1. S2CID 18251180. Retrieved 3 April 2022.
3. AlShrouf, Ali (2017). "Hydroponics, aeroponic and aquaponic as compared with conventional farming". American Scientific Research Journal for Engineering, Technology, and Sciences. 27 (1): 247–255. Retrieved 15 August 2021.
4. I'm An Agronomist! Archived October 1, 2016, at the Wayback Machine
5. Kerkhoff AJ, Fagan WF, Elser JJ, Enquist BJ (2006) American Naturalist 168: E103–E122.
6. Soil testing manual by department of agriculture and cooperation, India
7. R.D. Baker, Extension agronomist Shane T. Ball, Extension agronomy specialist Robert Flynn, assistant professor.

8. Thomas, G. W. (2018). "Soil pH and Soil Acidity". Methods of Soil Analysis. SSSA Book Series.pp. 475–490. doi:10.2136/sssabookser5.3.c16. ISBN 978-0-89118-866 7. S2CID 93493509.
9. Slessarev, E. W.; Lin, Y.; Bingham, N. L.; Johnson, J. E.; Dai, Y.; Schimel, J. P.; Chadwick, O. A. (21 November 2016). "Water balance creates a threshold in soil pH at the global scale" (PDF). Nature. 540 (7634): 567–569. Bibcode:2016Natur. 540..567S. doi:10.1038/nature20139. PMID 27871089. S2CID 4466063.
10. Queensland Department of Environment and Heritage Protection. *"Soil pH"*. www.qld.gov.au. *Retrieved 15 May 2017*.
11. Patriquin, D.E.; H. Blaikie; M.J. Patriquin; and C. Yang. 1993. On-farm measurements of pH, electrical conductivity, and nitrate in soil extracts for monitoring coupling and decoupling of nutrient cycles. Biological Agriculture and Horticulture. Volume 9, pages 231-272.
12. Thorat J. C. https://ijirt.org/master/publishedpaper/IJIRT153400_PAPER.pdf
13. https://in.search.yahoo.com/search?fr=mcafee&type=E211IN826G0&p=mmho%2Fcm&guccounter=1
14. Lide, D. R., ed. (2005). "Magnetic susceptibility of the elements and inorganic compounds". CRC Handbook of Chemistry and Physics (PDF) (86th ed.). Boca Raton (FL): CRC Press. ISBN 0-8493-0486-5.
15. Greenwood, N. N.; & Earnshaw, A. (1997). Chemistry of the Elements (2nd ed.), Oxford: Butterworth-Heinemann. ISBN 0-7506-3365-4.
16. Griffin, E, Hoyle, FC & Murphy, DV 2013, 'Soil organic carbon', in *Report card on sustainable natural resource use in Agriculture*, Department of Agriculture and Food, Western Australia,viewed16November016, https://www.agric.wa.gov.au/sites/gateway/files/2.4%20Soil%20organic%20carbon.pdf
17. Sandaa RA, Torsvik V, Enger O: Influence of long-term heavy-metal contamination on microbial communities in soil. SoilBiolBiochem 2001
18. Jobbágy, E.G; Jackson, R.B. (2000). "The vertical distribution of soil organic C and its relation to climate and vegetation" (PDF). Ecological Applications. 10 (2): 423–436. doi:10.1890/1051-0761(2000)010[0423:tvdoso]2.0.co;2
19. Soil Nutrient Testing: How to Get Meaningful Results Dr Donald S. Loch Formerly Department of Primary Industries and Fisheries, Redlands Research Station, Cleveland
20. Dairy Manure Nutrient Content and Forms. Manure Technical Guide Series University of California Cooperative Extension
21. Chandak Nisha, Malti Barnali, analysis of soil samples for its Physico-chemical Parameters from Kadi City ISSN:2349-3372
22. Wan J.H.C., Wong M.H. (2004): Effects of earthworm activity and P-solubilising bacteria on P availability in soil. J. Plant Nutr. Soil Sci
23. https://www.researchgate.net/publication/334465162_Book_Soil_Analysis#fullTextFileContent