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NUTRITIONAL PROFILE OF SOILS AND THEIR IMPROVEMENT THROUGH INTEGRATED FERTILIZER APPLICATIONS

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ABSTRACT For the healthy growth and optimum yields of crops, organic and inorganic nutritional contents of soils are important factors. Region-wise surveys of soils for their mineral contents need to be conducted for suggesting the suitable types of crops to the farmers. It is also needed to suggest the farmers about the precautions to be taken for maintaining and improving the soil health of their lands. In this case study, 30 soil samples were selected from a village, Viramgaon, Tq. Khultabad, Dist. Aurangabad. These were critically evaluated for their nutritional contents. Based upon the analysis of the results, farmers of the region were given suggestion regarding quantities of inorganic and organic fertilizers, to be applied at appropriate times. Fertilizer applications of either organic or inorganic type, alone, hasn't been found to be sufficient. Hence, as an integrated approach for nutritional conservation of soils, this piece of study suggests combination of applications of both these types of fertilizers through a well scheduled plan.

KEYWORDS : Fertility level, Integrated approach, Soil damage, Soil health

INTRODUCTION:

Marathwada region has been traditionally prone to droughts. Almost every twenty years, a big drought has hit the region, while smaller droughts keep occurring. Eighty-seven per cent of Marathwada depends on rains for agriculture. Under these circumstances, to obtaining optimum yields of crops is a challenge faced by local farmers. The evaluation of soil health status of Aurangabad district has been carried out with 240 surface soil samples from 12 villages of 3 blocks by Ajgaonkar and Patil. The soil was analysed for various soil fertility parameters such as pH, EC, organic matter and availability of NPK. The soils of Aurangabad district are reported by them to be moderately alkaline, within acceptable range of EC, having lower organic carbon content and nitrogen content. 52.08 per cent part of Aurangabad was reported to be very low in available phosphorus content, whereas 38.75 per cent soils have low available phosphorus content. They report all the soils in their study area to be very rich in potassium. To raise the organic carbon content, they suggest the use of organic manures including intercropping, mixed cropping and adopting integrated nutrient management programme.

The excessive usage of chemical fertilizers have led the soils to get damaged. However, chemical fertilizers cannot be totally substituted. The replenishment of soil nutrients thorough the application of biofertilizers is no doubt, an excellent way of correcting the soil damage, but the dosages and schedules of application of both these types of fertilizers need to be considered critically. It is very important, therefore, that farmers receive appropriate advise to plan their crops and related cultivation practices. This is so, because both these types of fertilizers applied alone, cannot assure optimum crop yields in stipulated time.

The continuous droughts have affected the productivity of the soil (Srivastava,2015). Salt accumulation is increasing and soil reclamation is not taking place. Thus, the average rainfall of 500 to 800 mm does not sustain a healthy crop anymore. The constant drought combined with the excessive use of chemical fertilisers have brought down the carbon content of the soil from 1 per cent to 0.3 per cent. Review of literature reveals that NPK fertilizer above or below the optimum level adversely affects the growth and yield. Therefore, judicious applications of fertilizer are essential for high crop yield.

This piece of study dealt with the physico-chemical analysis of 30 soil samples of agricultural lands from the village Viramgaon, Tq. Khultabad, Dist. Aurangabad. An attempt has been made to prepare the schedule of application times and dosage of inorganic and organic fertilizers, for the soils of study area, depending upon the results of their physico-chemical analysis and conventionally grown crops on these soils.

MATERIALS AND METHODS:

Soil samples were collected from 30 different locations from the Viramgaon Village. The physico-chemical analysis of the same were carried out at MIT-CARS (CSIR certified) laboratory, Aurangabad. The methods used for analysis were the standard APHA protocols for routine soil analysis[2]. Results obtained were tested statically.

RESULTS AND DISCUSSION:

pH: Out of 30 samples analysed, sample numbers 3, 24 and 27 fall in normal range, whereas rest of the samples are slightly alkaline.

Salinity: All samples are within the permissible range of salinity.

Organic carbon: All samples reveal a very negligible deviation from standard acceptable range of organic carbon content to affect their fertility status.

Sulphates: Sample numbers 1, 22 and 26 showed adequate amounts of sulphates and rest of the samples showed a range from slightly to significantly less amounts of it.

Phosphates: Sample numbers 2 and 22, showed phosphates in normal required range. Sample numbers 1 and 28 revealed presence of extremely high amounts of it whereas samples 3-7, 9, 12-21, 23-27, 29 and 30 showed significantly high amounts of phosphates. Rest of the samples exhibited marginally higher amounts of phosphates above the standard range of values.

Nitrogen: All samples showed the values for Nitrogen in the acceptable range of standards.

Statistical Analysis of variance (ANOVA) showed that p-value is greater than 0.05 in case of physical parameters like pH & salinity as well as in case of chemical parameters like organic carbon, sulphates and phosphates. And therefore these are not statistically significant. In case of single chemical

parameter-soil nitrogen, p-value is less than 0.05 hence it is statistically significant.

The overall result obtained during present study indicated that on an average the soil samples were with pH (8.1±0.4428), salinity (0.2947±0.1573 ms/m), organic carbon (0.2947±0.1573%), sulphate (7.2197±4.8533 kg/h), Phosphate (427.86±286.17 kg/h), and Nitrogen (389.86 ±59.093). The variation in the value of pH was minimum (C.V.=0.0547%), while maximum variation (C.V.=124.28%) was experienced with Organic Carbon.

Table-1: Physico-chemical analysis and crop suitability for soil samples.

Sample No.	pH	Salinity	Organic	Sulphate	Phosphate	Nitrogen	Remark
		mS/m	carbon (%)	kg/h	kg/h	kg/h	
1	8.11	0.85	0.72	15.07	1148.05	391.37	Suitable for Cotton & Maize
2	7.36	0.33	0.78	7.87	183.77	371.3	Suitable for Cotton & Maize
3	6.82	0.28	0.28	9.74	258.76	341.19	Suitable for Cotton & Maize
4	8.39	0.31	0.56	11.21	359.09	381.33	Suitable for Cotton & Maize
5	8.3	0.36	0.16	12.43	346.42	346.21	Suitable for cotton & wheat
6	8.39	0.31	0.56	11.21	359.09	376.32	Suitable for Cotton & Maize
7	8.42	0.18	0.36	0.86	346.42	471.65	Suitable for Sugarcane & pigeon pea
8	8.35	0.16	0.2	3.97	118.29	361.26	Suitable for Cotton & Maize
9	8.27	0.19	0.21	11.23	254.53	416.46	Suitable for Cotton & Maize
10	8.47	0.17	0.43	9.43	127.8	341.19	Suitable for Cotton & Maize
11	8.18	0.24	0.39	1.58	521.74	265.93	Suitable for Cotton & Maize
12	8.53	0.21	0.16	9.21	273.55	301.05	Suitable for Cotton & Maize
13	8.51	0.17	0.33	2.61	411.9	311.09	Suitable for Cotton
14	8.94	0.22	0.32	3.84	219.68	341.19	Suitable for Cotton & Maize
15	8.49	0.19	0.28	2.08	613.63	366.28	Suitable for Cotton & Maize
16	7.87	0.36	0.09	6.16	267.21	406.42	Suitable for Cotton & sugarcane
17	8.17	0.25	0.49	4.98	288.32	366.28	Suitable for green gram & pigeon pea
18	7.83	0.19	0.67	0.99	285.48	331.16	Suitable for Gram & pigeon pea
19	8.39	0.26	0.06	1.97	243.02	416.46	Suitable for cotton & wheat
20	8.48	0.35	0.06	9.08	222.64	386.35	Suitable for Cotton
21	8.12	0.29	0.31	4.71	391.84	421.47	Suitable for Cotton and cabbage
22	7.61	0.57	0.79	15.9	148.92	426.49	Suitable for Cotton & Maize
23	7.63	0.25	0.35	2.98	434.08	336.17	Suitable for Cotton & Maize
24	7.36	0.33	0.78	7.87	838.59	386.35	Suitable for ginger and sugarcane
25	8.15	0.25	0.16	3.97	657.99	436.56	Suitable for Cotton & sugarcane
26	8.18	0.23	0.29	18.2	721.36	491.72	Suitable for Cotton & Maize
27	7.51	0.18	3.5	11.14	536.53	461.61	Suitable for Cotton & Ginger
28	8.01	0.71	0.62	11.34	1323.37	471.65	Suitable for Cotton & Ginger
29	8.15	0.25	0.16	3.97	657.99	481.68	Suitable for Cotton & Ginger
30	8.01	0.2	0.71	0.99	275.66	491.72	Suitable for Cotton & Ginger
mean	8.1	0.294666667	0.492666667	7.219666667	427.8573333	389.8636667	
S.D.	0.442797	0.157343	0.612276326	4.853294994	286.1675294	59.09322935	
C.V.	0.054666	53.39688	124.2772	67.22325	66.88386	15.157407	

Fertility levels of different soil samples were estimated (Table-2), depending upon the values of physical and chemical parameters studied, based on the guidelines given in the Agri-directory of Government of Maharashtra. This helped us in deciding the fertiliser types, their doses and times of application, to be suggested (Table-3) to the farmers.

Use of gypsum powder was suggested to the farmers if the soil sample from their farm was found to be having pH above the acceptable range.

Table: 2:,Recommendation of dosage of Chemical and organic fertilizers based on fertility level (Taken from Vikaspedia Portal: an undertaking of Central Government, Govt. of Maharashtra Agri directory, Oct.2020)

Sr.no.	Organic carbon %	Nitrogen Kh/ha	Phosphorus Kg/ha	Potassium Kg/ha	fertility level of soil	Recommended fertiliser dose
1	Less than 0.20	Less than 140	Less than 7	Less than 100	Extremely Low	**50 % more than recommended**
2	0.21-0.40	141-280	8-14	101-150	Low	**25% more than recommended**
3	0.41-0.60	281-420	15-21	151-250	Medium	**As recommended**
4	0.61-0.80	421-560	21-28	251-300	Fairly high	**10 % less than recommended**
5	0.81-1.0	561-700	29-35	301-360	High	**25% less than recommended**
6	More than 1.0	More than 700	More than 35	More than 360	Very high	**50 % less than recommended**

Different pieces of research work done in various commercially important cereal, pulse, oil seed crops and some vegetable crops were reviewed by us, as follows. These helped us to chalk out the integrated fertilizer application plan for the farmers in our study area.

S. Velumurugan et al carried out study to assess the effects of different manures on physico-chemical parameters of the soils of Sunflower fields. They reported that organic manure treatments produced an effect of presence of highest available Phosphorous, Potassium and Organic Carbon in the soils, as compared to treatments with chemical fertilizers.

It is well established that organic or chemical fertilisers alone can not be effective to improve the soil nutritional qualities and enhancing crop growth. The organic fertilisers usually

show less concentrations of plant nutrients and these too are not immediately available to be used up by plants. But organic fertilisers are reportedly very useful in adding to the useful microbial diversity of the soils, These organic manures also end up in decreasing the quantities of chemical fertilisers needed, subsequently reducing the risk of soil deterioration due to excessive use of chemical fertilisers.

Studies on impact of Organic composts like bagasse ash, cow dung, FYM, Vermicompost and poultry manure were conducted on productivity of pigeon pea and jowar crops, by Birajdar et al. They found that applications of organic manures helped in reducing soil density, improving soil porosity, its moisture retention, and also the conservation of organic carbon. According to this team, physical properties of soil improved greatly upon repeated application of composts.

Similar effects of organic manure treatments, coupled with NPK fertilisers, on the improvement of physical properties of soil were reported in one study from China, carried out by Yu Zheng et al. This team used the combinations of organic (Rice straw and biochar) and NPK fertilizers to study their effects on the biological and physico-chemical properties of paddy soils. They reported that over a period of 5 years, the combined fertiliser treatments (as mentioned above) helped in reduction of bulk density and hardness of soil, and also increase the air permeability of soils. The team also concluded that combined applications of organic and inorganic fertilisers can prevent the soil degradation caused by the later.

Vermicompost was found to be working as growth promoter, when applied as a part of integrated fertiliser treatment plan , in the experiments conducted on chilly plants by Narkhede et al. Dr. Ajay Nair of Iowa State University proposes that soil fertility and nutrient management is one of the important factors that have a direct impact on crop yield and quality. Managing optimum soil nutrient levels is the key to plan a fertilizer application program. It is also important to know the cropping and soil fertilization history of the field. Maintaining a soil pH between 6.0 and 7.0 is recommended for most crops including vegetable crops.

Among nutrients, the amounts of nitrogen, sulphur and potassium, their application timings, application methods, and sources are equally important. Nitrogen is readily leached, can volatilize if not quickly incorporated, and can be immobilized by soil microorganisms. To minimize nitrogen loss and increase fertilizer use efficiency it is recommended to split nitrogen fertilizer application in to two or three applications As far as phosphorus requirements are concerned, it is required in lower amounts than other major nutrients, but is crucial in the early developmental stages of growth, and in energy transfer within the plant throughout the growing season.

Table-3: Fertilizer dosage recommendations for crops.

Sr. No.	Suggested Crop combinations	Suggested doses of fertilizers and Time of application			Special Recommendation
		Urea (Kg/h)	Super Phosphate (Kg/h)	Murate of Potash (Kg/h)	
1	Cotton	117.39 (sowing and after 45 days)	375.00 (Sowing)	50.00 (Sowing)	Apply Green manure and Cow dung manure (10 ton/h)
	Maize	146.74 (Sowing and after 30 days)	468.75 (Sowing)	62.50 (Sowing)	
2	Cotton	58.70 (Sowing) 117.39 (after 30 and 60 days)	585.94 (Sowing)	125.00(Sowing)	Apply Green manure and Cow dung manure (10 Ton/h)
	Ginger	78.26 (after 45, 75 & 105 days)	585.94 (Sowing)	125.00 (Sowing)	Apply Green manure and Cow dung manure (25 ton/h)
3	Cotton	163.04 (sowing and after 45 days)	468.75 (Sowing)	75.00 (Sowing)	Apply Green manure and Cow dung manure (10.00 ton/h)
	Sugarcane	67.93 (Sowing) 271.74 (after 45 and 85 days)	449.22(Sowing)	71.88 (Sowing)	Apply Green manure and Cow dung manure (25ton/h)
4	Pigeon pea	67.93 (Sowing)	468.75 (Sowing)	20.83 (Sowing)	Green yard manure, Organic compost (7.5-12.5 metric ton/h), Gypsum powder 5-10 ton /h, Pressmud 12-15 ton/h

CONCLUSIONS

From the statistical analysis done on the values obtained for different physico-chemical parameters of 30 soil samples, it can be concluded that, they are having pH , salinity (physical parameters) and Organic carbon, sulphates and Nitrogen (chemical parameters) well within the permissible range, except for Phosphates, in case of few of the soil samples which were quite higher than the accepted standard values. For the 30 soil samples of the study area, suitability of the different crops to be grown was suggested. The farmers are advised the simultaneous use of different doses of NPK and organic fertilizers like press mud, FYM, and Cow dung. Appropriate times of their application are also suggested. (Table:1 and 3). Additionally farmers are also advised to use green manures like , Sun hemp, *Gliricidia*, and legumes like *Sesbania* and green gram.

That these studies can be concluded for assessment of the effects of combined action of both organic and inorganic fertilizers on the quality of soils, only after sustained applications of the same, for at least 5 years, is acutely felt.

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