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Assessment of fertility status of Shivani block of the central research station Dr. PDKV Akola

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Abstract
Soil of Shivani block of Central research station Dr. PDKV Akola was investigated for the chemical properties and Macronutrient or micronutrient status of surface soils. The exact position of soils sampling site was determined with the help GPS.

All the soils under study was slightly alkaline to moderately alkaline in reaction, EC value for these soils within safe limit. The organic carbon content in these soils is low to medium and soil of farms is moderately calcareous to calcareous due to presence of $CaCO_3$.

The soils of Shivani block contain 137.98 to 200.70 kg ha^{-1} available nitrogen, 14.78 to 19.35 kg ha^{-1} available Phosphorous and 276 to 337 kg ha^{-1} available potassium. The soils of Shivani block contain available micronutrients i.e. Zn, Cu, Fe, Mn in the range of contains 0.44 to 0.98 mg kg^{-1} 0.44 to 3.20 mg kg^{-1} 3.2 to 8.2 mg kg^{-1} 2.0 to 6.4 mg $kg^{-1.}$ Zn, Cu, Fe, Mn respectively.

The nutrient index value calculated for soils of Shivani block shows that this soil has moderate NIV for organic carbon, low NIV for available nitrogen and Shivani block whereas phosphorous show moderate NIV for Shivani block, high NIV for available potassium. The micronutrients status show high NIV for iron, copper and manganese, The Shivani block shows moderate to moderately high NIV for zinc

It is revealed that in the soils of Shivani block, the availability of nitrogen, iron, zinc decreases with increase in $CaCO_3$ content. Available copper also decreases with increase in soil pH. The availability of zinc decrease due to increase in EC. The availability of manganese, copper, increase with increase in organic carbon status in course of investigation.

Keywords: Shivani, fertility

1. Introduction
The area of soil science research which is most directly related to agricultural productivity, soil fertility and fertilizer use research and this is also an area where the expectations are high. All researches in soil fertility have one common goal that is to assess nutrient supplying capacity of the soil, deficiencies of nutrient if any and to supply nutrient based on crop needs. Thus, in the game of crop production, there are three dependent and yet interdependent players the soil, the plant and fertilizers, each one of them key players (Goswami, 1999) [1]. India's population is variously projected at 1330 million to 1620 million by 2020 (16-17 million population added each year) and food grain demand by 2020 is estimated at 260-300 million tons (117 million tons of rice, 93 million tons of wheat, 28 million tones of course grain and 24 million tones of pulses). The challenge during the next millennium is to achieve and sustain growth rates high enough to feed the swelling population without degrading the environment (NAAS, 1997).

Indian soils have been developed under different climatic conditions such as semiarid, tropical and sub-tropical and thus vastly differ in their properties. Research work done so far is still inadequate to decide their fertility status. In India, the black soils are termed as black cotton soils. These soils are characterized by dark greyish brown to very dark color, high montmorillonitic clay content, high coefficient of expansion and shrinkage and show deep cracking during dry seasons. They have varying depth ranging from shallow to very deep. They cover extensive areas in the Deccan plateau as well as Central India. Black and associated soils are developed from Deccan trap and early Pleistocene alluvial deposits (Flood plain) under tropical mansoonic environment occur extensively in Vidarbha region of Maharashtra.

Swell-shrink soil series of Maharashtra state were studied during the year 1991-1992 with respect to their available major and micronutrient status.

The result shows that these soils were low in available Nitrogen, very low to moderate in Phosphorus and moderate to very high in Potassium contents. The DTPA extractable Fe, Mn, Zn and Cu were in the range of 6.1 to 26, 14.6 to 63.0, 0.58 to 1.70 and 1.7 to 6.1 PPM, respectively. Considering the critical limits of these micronutrients except zinc, all other micronutrients were well supplied. The DTPA Fe was negatively correlated with pH, organic carbon, clay, CEC and $CaCO_3$. The available Mn was negatively but significantly correlated with pH and $CaCO_3$, while Zn showed positive relationships with organic carbon and clay content of the soil (Patil and Sonar., 1994) [2]. Available boron ranged between 0.04 to 0.85 PPM. Available boron shows positive and significant correlation with clay, silt, pH, EC, organic carbon and available N and K where as negative correlation with available P and sand content of soil (Deshmukh *et al*., 2007) [3].

Regarding the nutrient status, all soils were low in organic carbon and available nitrogen, however, medium in available phosphorous and high to very high in available potassium. The micronutrient delineation of these soils were marginal, adequate, high and low to marginal in Fe, Mn, Cu and Zn respectively. The availability of micronutrient in Fe and available Cu were significantly and positively correlated among themselves. Available Mn and other micronutrient did not show any significant relationship between themselves. (Jibhkate *et. al*., 2009) [4-5].

2. Material and Methods

The experiment was laid out at Shivani block of the central research station Dr. PDKV, Akola in the year 2015-2016 with an objective to assess the fertility status and to develop the fertility index of soils of the farms and prepare soil fertility map".

Climate, geology, vegetation, topography and time are five factor's which influence the formation of soils. The geology of the district is transitional with dominance of Deccan basalts in Western portion, sand stones and shales in Eastern portion. Different geological formations met in the vicinity of eastern part of the central research station. Effect of climate has been modified by relief rendering different soil climate and subsequent local arid and humid conditions. Due to undulating topography, soil erosion has also played on down a slope.

Most of the area under cultivation comprises of black soils. Katepurna is the main river flowing through the district.

Two type of soils have been observed in the district namely medium black soil occurring in plain central part of trap origin and deep black soil occurring in valley in northern part, predominantly laying on pediment alluvial plains and flood plains to transitional slopes. Being moderately deep and clayey of montmorillonitic mineralogy they are more water retentive.

The climate of the region is arid monsoon type and characterized by the three distinct season *viz*. with hot and dry weather from March to May, monsoon warm and rainy from June to October and winter dry mid cold from November to February.

The central research station is situated about 2 km east of Akola town. It is located at longitude 77°02'44" to 77°04', 59"E, latitude 20°42'15" to 20°43'18"N.

Average rainfall is about 1192.5mm. distribute in 48 rainy days (30 years recorded) in the year. About 77.7 percent of the mean total rainfall is received during the monsoon period in 40 rainy days (June-September) about 3 percent during the post monsoonic period.

The mean annual maximum and minimum temperature are 30 degree celcius and 24.4 degree celcius respectively. Summer month are fairly hot with maximum air temperature ranging from 37 to 44 degree celcius with relative humidity ranging from 26 to 29 percent. April and May are the hottest months of the year (40.5 to 46.4 degree celcius) with lowest relative humidity in April. The winter months experience mild cold with average temperatures ranging from 21 to 24 degree celcius.

2.1 Soil nutrient index and preparation of thematic maps

Soil nutrient index was calculated as per six tier system as follows (Ramamurthy and Bajaj, 1969) [6].

$$\text{Nutrient Index Value} = \frac{\begin{array}{c}(\text{No. of samples in very low}\times 0.5) + (\text{No. samples in low}\times 1.0) + \\ (\text{No. samples in medium}\times 1.5) + (\text{No. of samples in moderately high}\times 2) + \\ (\text{No. of samples in high}\times 2.5) + (\text{No. samples in Very high}\times 3)\end{array}}{\text{No. of Samples taken}}$$

Table 1: Ratings of Nutrient index value for major nutrients

Sr. No	Category	Value
1	Very low	0.5 to 0.75
2	Low	0.76 to 1.25
3	Moderate	1.26 to 1.75
4	Moderately high	1.76 to 2.25
5	High	2.26 to 2.75
6	Very high	2.76 to 3.00

Table 2: Ratings for major nutrients

Sr. No	Nutrient element	Category					
		Very low	Low	Medium	Moderately high	High	Very high
1	Organic Carbon (%)	<0.20	0.21-0.40	0.41-0.60	0.61-0.80	0.81 -1.0	>1.0
2	Available N (kg ha^{-1})	<140	141-280	281-420	421-560	561-700	>700
3	Available P (kg ha^{-1})	<7.0	7.1-14.0	14.1-21.0	21.1-28.0	28.1-35.0	>35
4	Available K (kg ha^{-1})	<100	101-150	151-200	201-250	251-300	>300

$$\text{Nutrient Index Value} = \frac{\begin{array}{c}\text{(No. of samples in very low}\times 0.5) + \text{(No. samples in low}\times 1.0) + \\ \text{(No. samples in medium}\times 1.5) + \text{(No. of samples in moderately high}\times 2) + \\ \text{(No. of samples in high}\times 2.5) + \text{(No. samples in Very high}\times 3)\end{array}}{\text{No. of Samples taken}}$$

Table 3: Ratings of Nutrient index value for micronutrients

Sr. No	Category	Value
1	Low	<1.67
2	Medium	1.67-2.33
3	High	>2.33

Table 4: Ratings for available micronutrient

Sr. No	Category		
	Low	Medium	High
DTPA-Fe (mg kg^{-1})	<2.5	2.5-4.5	>4.5
DTPA-Mn (mg kg^{-1})	<1.0	1.0-2.0	>2.0
DTPA-Zn (mg kg^{-1})	<0.6	0.6-1.2	>1.2
DTPA-Cu (mg kg^{-1})	<0.2	0.2	>0.2

Table 5: Chemical properties of the soils of Shivani block

Grid. No	pH (1:2.5)	EC (dSm^{-1})	Oc (g kg-1)	Ca Co3 (%)	CEC
1	7.7	0.21	3.6	5.38	42
2	7.9	0.19	3.6	5.44	38
3	8.0	0.23	3.3	5.88	46
4	8.2	0.25	3	5.63	50
5	7.9	0.21	3.3	5.06	42
6	7.7	0.17	4.5	5.56	34
7	8.1	0.23	3.6	6.00	46
8	7.8	0.22	4.5	6.16	44
9	7.9	0.20	3.3	5.95	40
10	8.0	0.27	3.9	5.63	54
11	8.1	0.22	3.9	5.39	44
12	7.9	0.18	3.3	5.56	36
13	7.8	0.27	4.5	6.38	54
14	7.9	0.22	3.9	5.36	44
15	7.8	0.24	3.3	5.19	48
16	8.0	0.18	4.5	5.24	36
17	8.2	0.26	3	5.31	52
18	7.9	0.27	3.6	5.41	54
19	7.6	0.26	3	5.33	52
20	8.0	0.24	4.8	5.78	48
Mean	7.9	0.24	3.615	5.58	45.2
Range	7.6-8.2	0.17-0.27	3-4.8	5.06-6.38	34-54

(For available Fe, Mn, Zn, Cu the critical limits are taken as per given by Katyal and Rattan 2003) [8]. Thematic map of nutrient status of soils of blocks were prepared by using ratings for different nutrients.

2.2 Place/time/duration of research work

The experiment on Shivani block of central research station Dr. PDKV, Akola soils initiated during 2015-2016 at central research station Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The present investigations have carried out during 2015-2016.

3. Result and Discussion

3.1 Soil nutrient index of available macronutrient for soils of Shivani block.

Table 6: Category wise classification of soil of blocks for available macronutrient of Shivani block soils

Grid no	AV.N	Category	AV.P	Category	AV.K	Category	Oc (g kg-1)	Ratings
1	163.07	low	15.1	medium	313.6	very high	3.6	low
2	150.53	low	15.7	medium	305.76	very high	3.6	low
3	150.53	low	14.8	medium	336	very high	3.3	low
4	137.98	low	15.9	medium	324.8	very high	3	low
5	150.53	low	16.3	medium	295.68	high	3.3	low
6	200.70	low	15.2	medium	313.6	very high	4.5	medium
7	163.07	low	19.0	medium	299.04	high	3.6	low
8	150.53	Low	15.4	medium	329.28	very high	4.5	medium
9	200.10	Low	16.0	medium	324.8	very high	3.3	low
10	163.07	Low	17.7	medium	288.96	high	3.9	low
11	137.98	Low	16.7	medium	336	very high	3.9	low

12	150.53	Low	15.0	medium	313.6	very high	3.3	low
13	200.70	Low	16.0	medium	286.72	high	4.5	medium
14	175.62	Low	16.3	medium	336	very high	3.9	low
15	150.53	Low	15.6	medium	341.6	very high	3.3	low
16	200.70	Low	16.1	medium	309.12	very high	4.5	medium
17	150.53	Low	19.4	medium	335.216	very high	3	low
18	175.62	Low	16.8	medium	335.664	very high	3.6	low
19	150.53	Low	15.9	medium	315.84	very high	3	low
20	200.70	Low	16.8	medium	338.24	very high	4.8	medium
NIV	1	Low	1.50	Moderate	2.85	high	1.25	moderate

Soils of Shivani block categorized as low to medium for organic carbon content as per six tier system. The soil nutrient index value of Shivani block calculated for organic carbon content on soils is 1.25 g kg^{-1}, Shivani blocks shows the moderate nutrient index for organic carbon content. The nitrogen, phosphorus and potassium are the major essential nutrients and its availability plays very vital role in plant growth and its productivity. The availability of N, P and K govern the fertility status of the soil. The soils of Shivani block contain 137.98 to 200.70 kg ha^{-1} available nitrogen, 14.98 to 19.35 kg ha^{-1} available phosphorous and 276 to 337 kg ha^{-1} available potassium as per the six tier classification system of soils for its nutrient content, the soils of Shivani block classified as low for available nitrogen, available phosphorus are classified as medium and high to very high for available potassium. The nutrient index calculated for Shivani block for Available Nitrogen, available phosphorus and available potassium and organic carbon is 1, 1.50, 2.85 and 1.25 respectively. Shivani block the low nutrient index for available nitrogen and medium available phosphorous and high for available potassium. The soil nutrient index for the soils of Shivani block was in category of low fertility status for available nitrogen and medium for available phosphorus and high with respect to available potassium.

3.2 Soil nutrient index of available micronutrient for soils of Shivani block

Table 7: Category wise classification of soil of blocks for available micronutrients of Shivani block

Grid No.	Zn (gm kg-1)	Ratings	Cu (gm kg-1)	Ratings	Fe (gm kg-1)	Ratings	Mn (gm kg-1)	Ratings
1	0.60	Medium	2.54	High	7.50	High	5.00	High
2	0.64	Medium	1.90	High	6.80	High	4.20	High
3	0.59	Low	1.04	High	4.28	Medium	4.00	High
4	0.65	Medium	0.44	High	6.20	Medium	3.80	High
5	0.78	Medium	2.20	High	5.80	Medium	2.00	Medium
6	0.79	Medium	1.40	High	6.40	High	5.80	High
7	0.64	Medium	2.63	High	4.80	High	3.60	High
8	0.70	Medium	3.20	High	7.60	High	3.80	High
9	0.86	Medium	2.14	High	5.00	High	4.59	High
10	0.65	Medium	1.88	High	7.82	High	5.74	High
11	0.98	Medium	3.10	High	5.09	High	4.34	High
12	0.64	Medium	2.60	High	7.50	High	6.30	High
13	0.59	Low	1.40	High	8.23	High	2.60	High
14	0.56	Low	2.60	High	6.29	High	5.20	High
15	0.65	Medium	2.80	High	3.50	Medium	6.41	High
16	0.48	Low	2.40	High	7.82	High	6.40	High
17	0.76	Medium	2.69	High	7.40	High	3.80	High
18	0.57	Low	1.40	High	8.24	High	5.60	High
19	0.79	Medium	2.80	High	4.50	Medium	6.20	High
20	0.44	Low	1.20	High	6.20	High	5.00	High
NIV	1.7	Moderate	3	High	2.75	High	2.95	High

The soils of Shivani block contain available micronutrients i.e. Zn, Cu, Fe, Mn the range of Shivani block soils contains 0.44 to 0.98 mg kg^{-1}, 0.44 to 3.20 mg kg^{-1}, 3.5 to 8.2 mg kg^{-1}, 2.0 to 6.4 mg kg^{-1} Fe, Mn, Zn and Cu respectively. As per critical limits for available micronutrient given by Katyal J.C. and R.K. Rattan (2003) [8] the soils are classified for its micronutrient content, the soils of Babhulgao block classified as low to medium for Zinc, medium to high for Iron and high for manganese and high for available copper. Nutrient index calculated for micronutrients shows the values Shivani block nutrient index values shows 1.70 for Zinc, 2.75 for Iron and 3 for Copper and 2.95 for Manganese the soils of Shivani block the medium nutrient index for available Zinc and high nutrient index for Iron, Manganese and Copper.

Table 8: Relationship between soil chemical properties with available macro and micronutrient for Shivani block

	pH	EC	OC	$CaCo_3$	N	P	K	Zn	Cu	Fe	Mn	S
pH	1	-	-	-	-	-	-	-	-	-	-	-
EC	-	1	-	-	-	-	-	-	-	-	-	-
OC	-	-	1	-	-	-	-	-	-	-	-	-
$CaCo_3$	-	-	-	1	-	-	-	-	-	-	-	-
N	-	-	0.644**	-	1	-	-	-	-	-	-	-
P	0.598**	-	-	-	-	1	-	-	-	-	-	-
K	-	-	-	-	-	-	1	-	-	-	-	-
Zn	-	-	-	-	-	-	-	1	-	-	-	-
Cu	-	-	-	-	-	-	-	-	1	-	-	-
Fe	-	-	-	-	-	-	-	-	-	1	-	-
Mn	-	-	-	-	-	-	-	-	-	-	1	-
S	-	-	-	-	-	-	-	-	-	-	-	1

*Significant at 5% level of significance

**Significant at 1% levels of significance

The significant positive correlation was observed between pH and available N (r=0.598*) and significant positive correlation OC with available N (r= 0.644**)

4. Conclusion

1. Soils of Shivani block slightly to moderately alkaline in reaction, having EC within the safe limit for crop cultivation. The organic carbon content in these soils is low to medium and $CaCO_3$ are moderately calcareous to calcareous in nature.
2. The soils of Shivani block low in available nitrogen and medium for available phosphorous and High to Very high in available potassium status.
3. The soils of Shivani block medium to high in available Fe, low to medium in available Zn and high in Cu and Mn status.
4. In the soils of Shivani block, the availability nitrogen, iron, zinc decreases with increase in $CaCO_3$ content. Available copper also decreases with increase in soil pH. The availability of zinc decrease due to increase in EC.
5. The availability of manganese, copper, increase with increase in organic carbon status.
6. Nutrient index value derived for soils of Shivani block shows that this soil has moderate NIV for organic carbon, low NIV for available nitrogen and medium for phosphorus high for available potassium. Shivani block showed low NIV for zinc, and high for iron, manganese and copper.

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