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# APPRAISAL OF SOIL FERTILITY STATUS OF SOMTHANA DAM AREA OF BADNAPUR

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## ABSTRACT

**Assessment of fertility status and ground water quality of Somthana dam area of Badnapur was carried out during the year 2020-2021. 100 soil samples were drawn from four survey to study the properties and nutrient status. The results emerged out from the present investigation revealed that soils of Somthana dam area were neutral to moderately alkaline in nature, safe in total soluble salt concentration, rarely to moderately calcareous and low to high in organic carbon content. In all 83 per cent soil samples were low and 17 per cent were placed as very low in available N content. Available phosphorus content was low in 95 per cent soil samples, 2 per cent soil samples were low to very low, while 3 per cent soil samples were medium in category. The availability of potassium found to be moderate to very high in Somthana soils. 45 per cent soil samples were deficient in the availability of iron and 61 per cent soil samples were deficient in Zinc. The soils of Somthana dam area of Badnapur were found sufficient in DTPA Cu and DTPA Mn content. The pH of the soil was positively correlated with available N and Cu and significantly negative correlation was noticed with P and Fe. Organic carbon had positive association with all nutrients. $CaCO_3$ had shown negative and significant correlation with N and K and positive correlation with Fe. The effect of bulk density and porosity did not reached to the level of significance with available nutrient contain in soil. Data on various nutrient content indicated that there is urgent need to address the management of Nitrogen, Phosphorous, Zinc and Ferrous in command area of Somthana dam.**

**(Key words: Physico-chemicals properties, major nutrients, micronutrients, correlations)**

## INTRODUCTION

Nutrients are critical for preserving soil health and increasing crop productivity. Nutrient deficiency is estimated to affect over 815 million households . Physicochemical properties of soil are important in determining nutrient retention and availability. The level of organic matter, the degree of microbial activity, pH changes, the types and amount of clay and the status of soil moisture influences nutrient retention and supply in soils. Soil physicochemical properties such as pH, calcium carbonate ($CaCO_3$) and organic carbon are important because they influences nutrient availability in soil and thus affects crop growth and production. About 20% of the total cultivable land in world is reported with low soil fertility levels and this is major concern of one fourth population of the world to meet livelihood needs from these eroding soils (Thombe *et al.,* 2020). There is an emerging widespread deficiency of macronutrients, particularly nitrogen, phosphorus and micronutrients. Similarly micronutrient deficiency has increased in magnitude and extent over the last three decades as a result of increased use of high analysis fertilizer , use of high yielding crop varieties and increase in cropping intensity, resulting in a decline in crop productivity and sustainability (Yadav and Meena, 2009). As a result, there is an urgent need to address individual nutrient deficiency and prevent it from worsening. Soil productivity is determined by both its physical properties and its nutrient status. (Jibhakate *et al.,* 2009).

## MATERIALS AND METHODS

Somthana is located in the Godavari drainage basin in central India, at a height of about 522 meters above mean sea level, between 47.53 East longitude and 19.59 North altitude. The climate of the region is classified as semi-arid tropics. The average annual precipitation is 560.6 mm, with the majority falling between June and December, during the monsoon season. The daily mean maximum temperature ranged from 28.50 to 20.70 degrees Celsius in June and December, while the daily mean minimum temperature ranged from 20.70 to 20.50 degrees Celsius. The mean minimum and maximum relative humidity were 71.8 and 57.23 per cent, respectively. Somthana is classified as a rain-guaranteed zone.

### Soil sampling and analysis

100 soil samples were collected from the Somthana dam area of Badnapur. 25 soil samples were collected from four different survey numbers i.e. 354, 356, 358 and 360, with 25 samples collected from each. The experimental farm

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of Somthana Dam area of Badnapur had covered 51 ha area. Composite soil samples were collected at random from 0-15 cm depth from each survey number were dried, pounded in a wooden mortar and passed through a 2 mm sieve. Each sample was thoroughly mixed to ensure homogeneity before being stored in properly labeled polythene bags for laboratory analysis (for determination of bulk density and free $CaCO_3$, Soil samples were retained before pounding the soil). Processed soil samples were analysed for organic carbon, pH (1:1.25 soil water ratio ), electrical conductivity as per methods described by Jackson (1973) .The free calcium carbonate content was determined by rapid titration method as outlined by Piper (1966).The bulk density was determined by following procedure as suggested by Black (1965) using formula i.e. B.D. 9($mg/m^3$) = Wt. of oven dry sample / volume of core. While, porosity was calculated by using relationship between particle density (PD) and bulk density (BD) of soil . Porosity = (1-PD/BD) x 100. Available nitrogen content in soil was determined by alkaline potassium permanganate distillation method as described by Subbiah and Asija (1956) .The available phosphorus content was determined by using 0.5 M sodium bicarbonate as an extractant as outlined by Olsen *et al*. (1954) . While, available potassium was estimated by neutral normal ammonium acetate using flame photometer at 1: 5 soil to extractant ratio as described by Jackson (1973) . DTPA extractable zinc, iron ,copper and manganese were estimated as per procedure described by Lindsey and Norwell (1978) using 0.005 M DTPA solution (Diethylene triamine penta Acetic Acid containing 0.1 M triethanol amine and 0.01 M calcium chloride, adjusted to pH 7.3 with HC1) . Soil Nutrient index was calculated as per the formula suggested by Ramamoorthy and Bajaj (1969) i.e. NIV = No. of samples Low x 1 + No. of samples Medium x 2 + No. of samples High x 3 / Total number of samples .

# RESULTS AND DISCUSSION

**Range and average values of N, P, K with Fe, Zn, Cu and Mn nutrients**

The data on ranges and mean values of major and minor nutrients of soil of Somthana dam area of Badnapur are presented in Table 1 shows that the available nitrogen of soils was ranged from 110.21to 196.80 kg $ha^{-1}$,130.61 to 225.65, 154.67 to 255.65 and 128.57 to 204.20 kg $ha^{-1}$, with an average of 153.50, 178.13, 205.16 and 166.38 kg $ha^{-1}$, respectively in block A, B, C and D. The available phosphorus content of soil was ranged from 17.93 to 31.60, 17.23 to 30.72, 15.41 to 26.71 and 11.38 to 25.80 kg $ha^{-1}$ with an average of 24.76, 23.97, 21.06 and 18.59 kg $ha^{-1}$ in block A, B, C and D respectively. While, the available potassium content of soil varied between 182.42 to 361.81, 234.60 to 598, 440.96 to 756.48 and 276.39 to 664.43 kg $ha^{-1}$ with an average of 272.11, 416.30, 598.72 and 470.41 kg $ha^{-1}$ respectively in block A, B, C and D.

**Table 1. Range and average values of nutrient status of soils Somthana dam area of Badnapur**

| Sr. No | Survey No (block) | Total samples | Available N (kg $ha^{-1}$) | Available $P_2O_5$ (kg $ha^{-1}$) | Available $K_2O$ (kg $ha^{-1}$) | Available Fe (mg $kg^{-1}$) | Available Zn (mg $kg^{-1}$) | Available Cu (mg $kg^{-1}$) | Available Mn (mg $kg^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 354 (A) | 25 | (110.21-196.80) ( 153.50) | (17.93-31.60) (24.76) | (182.42-361.81) (272.11) | (7.44-10.51) (8.97) | (0.21-2.65) (1.43) | (0.76-1.03) (0.89) | (7.23-15.81 (11.52) |
| 2 | 356 (B) | 25 | (130.61-225.65) (178.13) | (17.23-30.72) (23.97) | (234.60-598) (416.30) | (2.48-10.05) (6.26) | (0.42-2.41) (1.41) | (0.73-3.82) (2.27) | (3.45-14.94) (9.19) |
| 3 | 358 (C) | 25 | 154.67-255.65 (205.16) | ( 15.41-26.71) (21.06) | 440.96-756.48 (598.72) | (2.65-6.23) (4.44) | (0.40-3.60) (2.0) | (1.42-3.82) (2.62) | (3.45-14.94) ( 9.19) |
| 4 | 360 (D) | 25 | 128.57-204.20 (166.38) | (11.38-25.80) (18.59) | 276.39-664.43 (470.41) | (1.68-9.31) (5.49) | (0.39-3.88) (2.13) | 0.77-6.32 (3.54) | (3.45-18.20) (10.82) |

**Table 2 . Categorization of soils on the basis of ratings of nutrients**

| Soil property | Survey number 354 | 356 | 358 | 360 | Total |
|---|---|---|---|---|---|
| | | | **Available N (kg $ha^{-1}$)** | | |
| Very low | 11 | 06 | Nil | Nil | 17 |
| Low | 14 | 19 | 25 | 25 | 83 |
| **Available $P_2O_5$ (kg $ha^{-1}$)-** | | | | | |
| Very low | Nil | Nil | Nil | 2 | 2 |
| Low | 23 | 24 | 25 | 23 | 95 |
| Medium | 2 | 01 | Nil | Nil | 3 |

| | | | | | |
|---|---|---|---|---|---|
| **Available K (kg ha$^{-1}$)** | | | | | |
| Moderate | 5 | 2 | Nil | Nil | 7 |
| Moderately high | 16 | 12 | Nil | Nil | 28 |
| High | 2 | 2 | Nil | 4 | 8 |
| Very high | 2 | 9 | 25 | 21 | 57 |
| **Available Fe (mg kg$^{-1}$)** | | | | | |
| Deficient | Nil | 6 | 19 | 20 | 45 |
| Sufficient | 25 | 19 | 6 | 5 | 55 |
| **Available Zn (mg kg$^{-1}$)** | | | | | |
| Deficient | 11 | 20 | 13 | 17 | 61 |
| Sufficient | 14 | 5 | 12 | 8 | 39 |
| **Available Cu (mg kg$^{-1}$)** | | | | | |
| Deficient | Nil | Nil | Nil | Nil | Nil |
| Sufficient | 25 | 25 | 25 | 25 | 100 |
| **Available Mn (mg kg$^{-1}$)** | | | | | |
| Deficient | Nil | Nil | Nil | Nil | Nil |
| Sufficient | 25 | 25 | 25 | 25 | 100 |

The available Fe content of soil varied between 7.44 to 10.51, 2.48 to 10.05, 2.65 to 6.23 and 1.68 to 9.31 mg kg $^{-1}$ with an average of 8.97, 6.26, 4.44 and 5.49 mg kg$^{-1}$, respectively in the block A, B, C and D , while the available Zn content of soil was ranged from 0.21 to 2.65, 0.42 to 2.41, 0.40 to 3.6 and 0.39 to 3.88 with an average of 1.43, 1.41, 2.0 and 2.13 mg kg$^{-1}$, respectively in the block A, B, C and D . The available Cu content of soil varied between 0.76 to 1.03, 0.73 to 3.82, 1.42 to 3.82 and 0.77 to 5.42 mg kg $^{-1}$ with an average of 0.89, 2.27, 2.62 and 3.54 mg kg$^{-1}$, respectively in the block A, B, C and D and the available Mn content of soil are depicted in Table 1 varied between 7.23 to 15.81, 3.45 to 14.94, 3.45 to 14.94 and 3.45- 18.20 mg kg$^{-1}$ with an average of 11.52, 9.19, 9.19 and 10.82 mg kg$^{-1}$, respectively.

**Categorization of soils on the basis of ratings of nutrients**

Soils of Somthana dam area of Badnapur are categorized in various categories and the related data are presented in Table 2.The critical appraisal showed that among 100 samples, only 17.00 per cent were categorized very low in available N content and 83 samples (83.00 per cent) were found low in available N content. 14,19, 25 and 25 soil samples were categorized as low in survey number 354, 356, 358 and 360, respectively. The variation in available N content in soil could be attributed not only to the differences in their physiography, differential cultivation and management practices of these soils but also removal of N by the crop, losses through leaching, denitrification and volatization . Some nitrogen is immobilized by soil microbes. These results are in confirmatory with the results reported by Dhanve *et al.* (2018). They found available nitrogen in the range of 137.9 to 269.6, 149.2 to 236.6, 153.6 to 235.6, 150.5 to 268.9 and 137.9 to 269.6 kg ha$^{-1}$ respectively in block B, C, D, E and F with an average of 203.83, 192.9, 194.6, 209.7 and 203.75 kg ha$^{-1}$ respectively in block B, C, D, E and F in Agricultural Research Station, Badnapur.

As regard to available phosphorus content 95 per cent soil samples categorized as low and 2 per cent very low and 3 per cent medium. 23, 24, 25, 23 soil samples in survey number 354, 356, 358 and 360 were low. The low amount of available P might be due to application of lower doses of P fertilizer, fixation of P on clay minerals or $CaCO_3$ surfaces with the time elapsed between fertilizer application and crop uptake. The similar results were also reported by Dhamak *et al.* (2014). They reported that the available P in Vertisols, Inceptisols and Entisols ranged from 1.14 to 21.62, 1.03 to 21.47 and 1.65 to 26.08 kg ha$^{-1}$ with a mean value of 7.44, 7.06, 6.86 kg ha$^{-1}$ respectively in Ambajogai Tahsil of Beed District.

In available potassium 7 per cent survey soils were moderate, 28 per cent moderately high, 8 per cent high and 57 per cent very high. These soils were rated as moderate to very high in potassium. This could be attributed due to the presence of potassium bearing mineral like, Feldspar and mica in the parent material. These results are in confirmatory with the results of Dhanve *et al.* (2017). They reported that the available potassium content in soils of Maharashtra was varied from 450.24 to 769.4 kg ha$^{-1}$.

The soils of various survey number were analyzed for Fe content. 55 per cent soils were found sufficient in Fe content and only 45 per cent were found deficient. 6, 19 and 20 soil samples in survey number 356, 358, 360 were deficient respectively and 25, 19, 6 and 5 soil samples in survey number 354, 356, 358, 360 were sufficient respectively. 55 per cent soil sample contain sufficient iron due to the presence of minerals like Feldspar, Magnetite, Hematite and Limonite which together constitute bulk of trap rock in these soils. Similar results were reported by Mandavgade *et al.* (2015) . They found Fe in the range of 2.32 to 12.97 with an average value of 7.38 mg kg$^{-1}$ in Jintur, Selu and Pathri of Parbhani district.

The soils of survey number (354, 356, 358 and 360) were analyzed for Zn content. 39 per cent soils were found sufficient in Zn content and 61 per cent were found deficient. 11, 20, 13 and 17 soil samples in survey number 354, 356, 358, 360, respectively were deficient. Low DTPA extractable zinc might be due to low organic matter content in soil which acts as natural chelating agent. Similar results were found by Surabhi *et al.* (2017). They reported very low to medium DTPA extractable Zn which ranged from 0.21-4.35 mg kg$^{-1}$ and 2.20- 9.05 mg kg$^{-1}$ respectively in Shirol Tehsil of Kolhapur District.

100 per cent soils of this area were found sufficient in Cu content this might be due to presence of Cu minerals like Cuprite and chalcocite, etc. in the parent material. The similar results were reported by Adat *et al* .(2017). They found available DTPA-Cu contents of Hingoli soils in the range of 0.27 to 5.50 mg $kg^{-1}$ with an average value of 1.73 mg $kg^{-1}$. Similarly 100 per cent soils of this area were found sufficient in Mn content . This is attributed to higher manganese content in soils originated from granite genesis parent material with semi-arid climate. These results are in conformity with the results recorded by Mokale *et al*. (2016). They reported that the available DTPA Mn content of soils of Badnapur Agriculture College was ranged from 2.97 to 15.02 mg $kg^{-1}$ with a mean value of 8.90 mg $kg^{-1}$ soil.

**Table 3. Correlation between the physico-chemical properties and available nutrient in soils of Somthana dam area of Badnapur**

| Soil Properties | Available N | Available P | Available K | Available Fe | Available Zn | Available Cu | Available Mn |
|---|---|---|---|---|---|---|---|
| $P^H$ | 0.221* | -0.251* | 0.307 | -0.360** | 0.108 | 0.261** | -0.191 |
| EC | 0.131 | -0.336** | 0.231 | -0.440** | -0.001 | 0.245* | -0.104 |
| Organic carbon | 0.072 | 0.040 | 0.114 | -0.082 | -0.092 | 0.027 | -0.092 |
| $CaCO_3$ | -0.392** | 0.129 | -0.384** | 0.391** | 0.036 | -0.316 | 0.079 |
| Bulk density | 0.073 | 0.090 | 0.120 | -0.106 | -0.027 | -0.007 | -0.181 |
| Porosity | -0.081 | -0.077 | 0.120 | -0.106 | -0.027 | -0.007 | 0.181 |

*Significant at 5% level (value =0.195) **Significant at 1% level (value=0.254)

The data on correlation coefficient between physio -chemical properties and available nutrient in soil are presented in Table 3 shows that the pH of soil was negative and significantly correlated with available phosphorus and iron content which is evident from 'r' value of -251*, -0.360**. However , pH of soil did not established any significant relationship with potassium , zinc and copper content .The EC of soil showed negative and significant correlation with available iron and phosphorus content which evident from 'r' values of - 0.440*,* -0336** , while it was not reached to the level of significance in rest of available nutrients. However , the organic carbon in soil was positively associated with all nutrients. The $CaCO_3$ had shown negative and significant correlation with available nitrogen and potassium ('r values -392**, and -384**).While it did not show any significant correlation with available phosphorus, zinc and manganese. The effect of bulk density and porosity did not reach to the level of significance with available nutrient content in soil. It was depicted from the Table 3 that increased the availability of nutrients indicated by 'r' values know to promote the availability of nutrients.

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