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# Evaluation of Macro and Micro Nutrients Status in Selected Villages of Raver Tahsil, Jalgaon District, Maharashtra, India

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**A B S T R A C T**

This study on soil fertility status and to assess the nutrient indices of associated soils of selected villages in the Jalgaon district of Maharashtra was conducted during 2018-19. The villages under study were, Savda, Nimbol and Vitve, Raver tahsil, Jalgaon district, Maharashtra. A total of 150 surface soil samples (0-20 cm) were collected, which includes 50 samples from each village. The soils were neutral to slightly alkaline in reaction with no salinity hazards. Low to High in organic carbon (0.15 to 0.93 %), very low in available nitrogen (37.63-263.4 kg $ha^{-1}$), medium to high in phosphorus (16.0 to 35.8 kg $ha^{-1}$), medium to high in potassium (201.0 to 392.0 kg $ha^{-1}$) and low to medium in sulphur (3.19. to 12.0 mg $kg^{-1}$). The soils is low in DTPA-extractable iron (0.17 to 0.99 mg $kg^{-1)}$, low to high in copper (0.10 to 2.95 mg $kg^{-1}$), low to medium manganese (1.03 to 4.51 mg $kg^{-1}$), low to high in zinc (0.1 to 0.92 mg $kg^{-1}$), low in boron (0.11 to 1.22 mg $kg^{-1}$) as per three-tier system of nutrient index given by Ramamoorthy and Bajaj (1969).

## Introduction

Soil fertility is a function of several factors such as socio-economic, ecological and in some instances, parent material, natural inputs, outputs and management practices. A report by Anonymous (2000) stated that about 20 per cent of the total cultivable land in the world is declining in soil fertility and impacting about a quarter of the world's population. Soil fertility has direct relation with crop yields, provided other factors are at optimum level. Soil fertility must be periodically estimated as there is the continuous removal of macro and micronutrients by crops intensively grown in every crop season. The existence of nutrients in soils and their balance determine the growth of plants. The fertility of soils is determined by various macro and micronutrients available in the soil. Application of fertilizers by the farmers in fields without prior knowledge of soil fertility status might result in adverse effects on soils as well as crops both in terms of micronutrient deficiency and toxicity either by inadequate or overuse of fertilizers. It is anticipated that with higher yields and more intensive agriculture the secondary and micronutrient deficiency will increase both in amount and extent (NAAS, 2018). Imbalanced and inadequate use of fertilizers coupled with low use efficiency of other inputs led to decline in the response efficiency of chemical fertilizer nutrients under intensive agriculture in recent years. Micronutrients are important for maintaining soil health and increasing use efficiency of major nutrients and ultimately the crop productivity. The deficiency of micronutrients has become major constraint in sustainable crop productivity of soils and hence there is need to know the status of nutrients of the soil (Katkar *et al.,* 2018). Keeping this in view, the present study aims to analyze the fertility level of the soil with the help of N. P. and K. and micronutrient to recommend essential nutrients wherever necessary in the Jalgaon district. A soil fertility status of a particular area can prove highly beneficial in guiding the farmers. Specific fertilizers and the addition of organic matters are recommended for nutrients deficient areas which will help to keep the balance of nutrients and to restore the fertility of soils.

## Materials and Methods

### Soil sampling and analysis

One hundred and fifty surface geo-referenced soil samples (0-20 cm) were collected in Savda, Nimbol and Vitve Village Raver tahsil, Jalgaon district Maharashtra which includes 50 surface soil samples from each village after harvest of crops, which are selected through the "Soil Health Card Scheme" under the Department of Soil Science & Agricultural Chemistry, Dr Ulhas Patil College of Agriculture, Jalgaon, Maharashtra to assess the macro and micronutrients status of soils in the year 2018-19. Physico-chemical parameters like pH and EC in soil: water suspensions (1:2.5 w/v) as described by Jackson (1973). Organic carbon was determined by the Wet oxidation method described by Walkley and Black (Nelson and Sommers, 1982) available nitrogen (Subbiah and Asija, 1956), phosphorus (Olsen *et al.,* 1954), potassium (Jackson, 1973), sulphur (Chesin and Yein, 1951) and micronutrients like Fe, Cu, Mn and Zn (Lindsay and Norvell, 1978). Available boron was determined by 0.01 M $CaCl_2$ to extract with the Azo-methine method (Berger and Troug, 1939). The soil nutrient index was assessed by using the three-tier systems of Ramamoorthy and Bajaj (1969). The soil nutrient index was assessed by using the following formula,

$$NI = [NL \times 1 + NM \times 2 + NH \times 3] \div \text{Total number of samples}$$

Where, NL, NM and NH are the numbers of samples in the low, medium and high categories of the nutrient index by the three-tier system.

## Results and Discussion

### Soil reaction (pH) and electrical conductivity

Soil properties data regarding chemical properties of soils in the study area is depicted in Table 2 and 3. Investigated soils are neutral to slightly alkaline in reaction with pH varied from 7.1 – 8.3 across the district. Neutral to slightly alkaline pH may be attributed to the reaction of applied fertilizer material with soil colloids, which resulted in the retention of basic cations on the exchangeable complex of the soil. The pH value of Savda, Nimbol and Vitve ranged from 7.1-8.3, 7.4-8.2 and 7.5-8.3 respectively (Table 4). The electrical conductivity (EC) is the measure of the soluble salts present in the soil and is affected by cropping sequence, irrigation, land use and application of fertilizers, manures and compost (Singh *et al.,* 2016) and it varied from 0.31 to 0.70 dS $m^{-1}$. All the soils were non-saline and suitable for healthy plant growth. The high value of electrical conductivity represents a higher degree of salinity. The electrical conductivity of Savda, Nimbol and Vitve ranged from 0.31-0.67, 0.17-0.89 and 0.17-0.70 dS $m^{-1}$ respectively (Table 4).

### Organic carbon

The organic carbon content of Savda, Nimbol and Vitve ranged from 0.15-0.87, 0.19-0.85 and 0.31-0.93 per cent respectively. The organic carbon content of selected villages varied from low to High in category (Table 3 and 4). A similar result was found by Chalwade *et al.*, 2006

### Available macronutrients

### Nitrogen

The available nitrogen was low in the major portion having the range of 37.63-263.4 kg $ha^{-1}$ as per the three-tier system of a nutrient index. The nitrogen content in Savda, Nimbol and Vitve was categorized from 75.2-263.4 kg $ha^{-1}$, 50.1-263.4 kg $ha^{-1}$ and 37.63-188.16 kg $ha^{-1}$ respectively. According to Amara *et al.*, (2017), variation in nitrogen content may relate to soil management, application of FYM and fertilizers to crops. The nitrogen content in soils is dependent on temperature, rainfall and altitude.

### Phosphorus

Phosphorus is the second most important macronutrient in crop production is phosphorus. Phosphorus acts as an energy transformer through ADP and ATP. It is essential for growth, cell division, root growth, fruit development and early maturity of the crops. It is also required for energy storage and transfer being a constituent of several organic compounds including oils and amino acids. The level of phosphorus in the study area was medium to high in category (16.0 to 35.8 kg $ha^{-1}$) i.e. in Savda it was 17-34 kg $ha^{-1}$, for Nimbol 18.9-35.8 kg $ha^{-1}$ and for Vitve it was 16.0-35.0 kg $ha^{-1.}$

### Potassium

Shukla (2011) found that the available potassium content is generally medium to high in range. The selected villages fall under medium to high in potassium content i.e. in Savda (201.0-392.0 kg $ha^{-1}$), Nimbol (201 -392 kg $ha^{-1}$) and Vitve (179.2-392kg $ha^{-1}$).

### Sulphur

The available sulphur was low to medium as per the three-tier system. The sulphur content of Savda, Nimbol and Vitve ranged from 3.19-10.5, 04-12 and 4.12-11.09 mg $kg^{-1}$ respectively (Table 5 and 6).

The low and medium levels of available sulphur in soils of the study area might be due to lack of sulphur addition and continuous removal of sulphur by crops (Balanagoudar, 1989)

### Micronutrients status

The DTPA-extractable zinc content was in low to medium (0.1-0.92 mg $kg^{-1}$). Increased removal of micronutrients as a consequence of the adoption of high yielding varieties and intensive cropping together with a shift towards the use of high analysis NPK fertilizers which might have caused a decline in the level of micronutrients in the soil below the critical level which is required for normal productivity of crops (Zende, 1987) iron of selected villages Savda, Nimbol and Vitve was categorized under low in range (0.17-0.99mg $kg^{-1}$).

The copper content was low to high as (0.10-2.92mg $kg^{-1}$) and the manganese content was low to medium (1.03-4.51mg $kg^{-1}$).

Whereas, boron content was low to high (0.11-1.12mg $kg^{-1}$) as per the three-tier system of the nutrient index (Table 7 and 8). The range of available boron in soils of different states of India varied from traces to 12.2 mg $kg^{-1}$(Das, 2007).

### Soil fertility index and soil fertility class

The nutrient indices of soils were worked out and a three-tier system of soil nutrient index was assessed by using the scale of Ramamoorthy and Bajaj (1969).

## Soil nutrient index ratings

Considering the nutrient index values three-tier system of soil organic carbon of Ramamoorthy and Bajaj (1969) all the selected villages i.e. Savda, Nimbol and Vitve are medium in category i.e., 1.84, 1.88 and 2.02 respectively. The nutrient index values of the three-tier system of nitrogen for all the selected villages were low in category (i.e. Savda, Nimbol and Vitve are 1.00, 1.00 and 1.00 respectively). The nutrient index values of available phosphorus were high for all the villages (2.7, 2.78and 2.62 respectively).

**Table.1** Rating of nutrient index value (Three tier system)

| | | |
|---|---|---|
| **1** | **Low** | **<1.67** |
| **2** | Medium | 1.67-2.33 |
| **3** | High | >2.33 |

**Table.2** Critical levels of Macro and Micronutrients for grouping of soils (Three-tier system)

| **Classification for pH values** | | | |
|---|---|---|---|
| Strongly acid | Slightly acid | Neutral | Alkaline |
| <5.5 | <6.5 | 6.5-7.5 | >7.5 |
| **Classification for total soluble salt content (EC as dS $m^{-1}$)** | | | |
| No deleterious effect on crop | Critical for germination | Critical for salt-sensitive crop | Injurious to most crops |
| <1.0 | 1.0-2.0 | 2.0-3.0 | >3.0 |
| **Parameters** | **Low** | **Medium** | **High** |
| O.C. (%) | < 0.50 % | 0.50 – 0.75% | > 0.75% |
| N (kg $ha^{-1}$) | < 280 | 280-450 | > 450 |
| P (kg $ha^{-1}$) | < 11.0 (kg $ha^{-1}$) | 11 – 22 (kg $ha^{-1}$) | > 22 (kg $ha^{-1}$) |
| K (kg $ha^{-1}$) | < 110 (kg $ha^{-1}$) | 110-280 (kg $ha^{-1}$) | > 280 (kg $ha^{-1}$) |
| S (mg $kg^{-1}$) | < 10.0 | 10-20 | > 20.0 |
| Zn (mg $kg^{-1}$) | < 0.60 | 0.6-1.80 | > 1.80 |
| Fe (mg $kg^{-1}$) | < 4.50 | 4.50-18.0 | > 18.0 |
| Cu (mg $kg^{-1}$) | < 0.20 | 0.20-0.80 | > 0.80 |
| Mn (mg $kg^{-1}$) | < 2.0 | 2.0-8.0 | > 8.0 |
| B (mg $kg^{-1}$) | < 0.50 | 0.50-1.0 | > 1.0 |

**Table.3** Classes of soil organic carbon in the soil of selected villages of Raver tahsil, Jalgaon district

| **Organic carbon class** | **Organic carbon (%)** | **No. of samples** | | |
|---|---|---|---|---|
| | | Savda | Nimbol | Vitve |
| Low | < 0.50 % | 17 | 14 | 08 |
| Medium | 0.50– 0.75% | 24 | 28 | 33 |
| High | > 0.75% | 09 | 08 | 09 |

**Table.4** Statistical data of physicochemical properties of selected villages of Raver tahsil Jalgaon district

| Properties | | pH | | EC dS $m^{-1}$ | | OC (%) | |
|---|---|---|---|---|---|---|---|
| **Village** | **No. of farmers** | **Range** | **Mean** | **Range** | **Mean** | **Range** | **Mean** |
| Savda | 50 | 7.1-8.3 | 7.78 | 0.31-0.67 | 0.51 | 0.15-0.87 | 0.53 |
| Nimbol | 50 | 7.4-8.2 | 7.83 | 0.17-0.89 | 0.48 | 0.19-0.85 | 0.58 |
| Vitve | 50 | 7.5-8.3 | 7.81 | 0.17-0.70 | 0.43 | 0.31-0.93 | 0.62 |

**Table.5** Classification of soils of selected villages of Raver tahsil, Jalgaon district for available N, P, K and S

| Available N class | Available N (kg $ha^{-1}$) | No. of samples | | |
|---|---|---|---|---|
| | | Savda | Nimbol | Vitve |
| Low | <280 | 50 | 50 | 50 |
| Medium | 280-450 | 00 | 00 | 00 |
| High | > 450 | 00 | 00 | 00 |
| **Available P class** | **Available P (kg $ha^{-1}$)** | **No. of samples** | | |
| | | Savda | Nimbol | Vitve |
| Low | < 11.0 | 00 | 00 | 00 |
| Medium | 11 – 22 | 15 | 11 | 19 |
| High | > 22 | 35 | 39 | 31 |
| **Available K class** | **Available K (kg $ha^{-1}$)** | **No. of samples** | | |
| | | Savda | Nimbol | Vitve |
| Low | < 110 | 00 | 00 | 00 |
| Medium | 110-280 | 21 | 30 | 28 |
| High | > 280 | 29 | 20 | 22 |
| **Available S class** | **Available S (kg $ha^{-1}$)** | **No. of samples** | | |
| | | Savda | Nimbol | Vitve |
| Low | < 10.0 | 49 | 37 | 48 |
| Medium | 10 – 20 | 01 | 13 | 02 |
| High | > 20 | 00 | 00 | 00 |

**Table.6** Statistical data of available macronutrients of the selected villages Raver tahsil Jalgaon district

| | | Macronutrients (kg $ha^{-1}$) | | | | | | (mg $kg^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|
| **Properties** | **No. of farmers** | **Nitrogen** | | **Phosphorous** | | **Potassium** | | **Sulphur** | |
| **Village** | | **Range** | **Mean** | **Range** | **Mean** | **Range** | **Mean** | **Range** | **Mean** |
| Savda | 50 | 75.2-263.4 | 176.07 | 17-34 | 26.94 | 201.0-392.0 | 293.78 | 3.19-10.5 | 6.742 |
| Nimbol | 50 | 50.1-263.4 | 159.76 | 18.9-35.8 | 25.79 | 201-392 | 285.34 | 04-12 | 08.00 |
| Vitve | 50 | 37.63-188.16 | 89.310 | 16.0-35.0 | 25.12 | 179.2-392 | 277.52 | 4.12-11.09 | 7.395 |

**Table.7** Classification of soils of selected villages of Raver tahsil Jalgaon district for DTPA- extractable micronutrients

| Available- Zn class | Available Zn (mg $kg^{-1}$) | No. of samples | | |
|---|---|---|---|---|
| | | Savda | Nimbol | Vitve |
| Low | <0.60 | 27 | 50 | 43 |
| Medium | 0.6-1.80 | 23 | 00 | 07 |
| High | >1.80 | 00 | 00 | 00 |
| **Available- Fe class** | **Available Fe (mg $kg^{-1}$)** | **No. of samples** | | |
| | | Savda | Nimbol | Vitve |
| Low | <4.50 | 50 | 50 | 50 |
| Medium | 4.50-18.0 | 00 | 00 | 00 |
| High | >18.0 | 00 | 00 | 00 |
| **Available- Cu class** | **Available Cu (mg $kg^{-1}$)** | **No. of samples** | | |
| | | Savda | Nimbol | Vitve |
| Low | <0.20 | 00 | 00 | 01 |
| Medium | 0.20-0.80 | 22 | 37 | 26 |
| High | >0.80 | 28 | 13 | 23 |
| **Available- Mn class** | **Available Mn (mg $kg^{-1}$)** | **No. of samples** | | |
| | | Savda | Nimbol | Vitve |
| Low | <2.0 | 15 | 16 | 39 |
| Medium | 2.0-8.0 | 35 | 34 | 11 |
| High | >8.0 | 00 | 00 | 00 |
| **Available- Bo class** | **Available Bo (mg $kg^{-1}$)** | **No. of samples** | | |
| | | Savda | Nimbol | Vitve |
| Low | <0.50 | 25 | 32 | 23 |
| Medium | 0.50-1.0 | 21 | 14 | 25 |
| High | >1.0 | 04 | 04 | 02 |

**Table.8** Range and average of micronutrients of selected villages of Raver tahsil Jalgaon district

| Properties | No. of farmers | Micronutrients (mg $kg^{-1}$) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Zn | | Cu | | Mn | | Fe | | Bo | |
| Village | | Range | Mean | Range | Mean | Range | Mean | Range | Mean | Range | Mean |
| Savda | 50 | 0.11-0.92 | 0.51 | 0.61-2.95 | 1.16 | 1.03-3.67 | 2.29 | 0.28-0.81 | 0.52 | 0.12-1.22 | 0.55 |
| Nimbol | 50 | 0.1-0.36 | 0.23 | 0.53-0.97 | 0.72 | 1.1-4.51 | 2.39 | 0.21-0.99 | 0.71 | 0.11-1.22 | 0.50 |
| Vitve | 50 | 0.24-0.81 | 0.47 | 0.10-0.98 | 0.76 | 1.29-2.35 | 1.74 | 0.17-0.81 | 0.41 | 0.11-1.12 | 0.55 |

**Table.9** Soil fertility index and fertility class of selected villages of Raver tahsil Jalgaon district (three-tier system)

| Soil nutrient index of Savda | | |
|---|---|---|
| **Nutrient** | **Fertility index** | **Category** |
| Organic carbon | 1.84 | Medium |
| Avail. N | 1.00 | Low |
| Avail. P | 2.7 | High |
| Avail. K | 2.54 | High |
| Avail. S | 1.02 | Low |
| DTPA Zn | 1.06 | Low |
| DTPA Cu | 2.56 | High |
| DTPA Mn | 1.7 | Medium |
| DTPA Fe | 1.00 | Low |
| Bo | 1.58 | Low |
| **Soil nutrient index of Nimbol** | | |
| **Nutrient** | **Fertility index** | **Category** |
| Organic carbon | 1.88 | Medium |
| Avail. N | 1.00 | Low |
| Avail P | 2.78 | High |
| Avail. K | 2.4 | High |
| Avail. S | 1.26 | Low |
| DTPA Zn | 1.00 | Low |
| DTPA Cu | 2.26 | High |
| DTPA Mn | 1.68 | Medium |
| DTPA Fe | 1.00 | Low |
| Bo | 1.44 | Low |
| **Soil nutrient index of Vitve** | | |
| **Nutrient** | **Fertility index** | **Category** |
| Organic carbon | 2.02 | Medium |
| Avail. N | 1.00 | Low |
| Avail. P | 2.62 | High |
| Avail. K | 2.44 | High |
| Avail. S | 1.04 | Low |
| DTPA Zn | 1.14 | Low |
| DTPA Cu | 2.44 | High |
| DTPA Mn | 1.22 | Low |
| DTPA Fe | 1.00 | Low |
| Bo | 1.58 | Low |

The nutrient index values of available potassium were 2.54, 2.4 and 2.44 for Savda, Nimbol and Vitve respectively which falls under the high category. The nutrient index ratings for sulphur content were categorized under the low category i.e., 1.02, 1.26 and 1.04 of Savda, Nimbol and Vitve respectively. The DTPA-extractable zinc was low in Savda, Nimbol and Vitve i.e., 1.06, 1.00and 1.14 respectively. The soil of Savda, Nimbol and Vitve village for DTPA-extractable copper were categorized high in the category of Savda, Nimbol and Vitve i.e.2.56, 2.26 and 2.44 respectively. DTPA-extractable manganese for Savda, Nimbol were medium 1.7, 1.68 and Vitve was low i.e., 1.22. DTPA-extractable iron (Ramamoorthy and Bajaj, 1969) of Savda, Nimbol and Vitve was low in category i.e., 1.00, 1.00 and 1.00.The nutrient index values of a three-tier system of boron for all the selected villages were low in category (i.e. Savda, Nimbol and Vitve are 1.58, 1.44and 1.58 respectively). The areas where the status of nutrients are high may show a deficiency soon if the due care will not be taken for the addition of organic manures and inorganic micronutrient fertilizers based on soil testing by the cultivators in the districts for intensive cultivation of different crops (Malewar, 2005).

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