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# Assessment of major and micronutrients in Panzara command area of Dhule district

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**Abstract**
The investigation was carried out on 'Assessment of major and micronutrients in Panzara command area of Dhule district' during the year 2024-25 with the objectives to characterize the soils in the Panzara command area for major and micronutrients content and to categorize the soils in Panzara command area based on major and micronutrients content. A systematic survey was carried out and surface (0-22.5 cm depth) soil samples were collected from 100 different sites of 20 villages from Panzara command area i.e. Dhule and Sakri tehsil of Dhule district. The exact sample location was recorded using a GPS. Samples were analysed for soil chemical properties using standard procedures. The data thus obtained was interpreted with their relative properties and categorized as per ratings of soils. In Panzara command area, regarding soil available N, 8% samples were very low and 82% samples were under low category. About 32% samples were low in soil available P. Regarding soil available K, samples were under the category of moderately high to very high. About 55%, 12%, 85% and 16% samples were deficient in DTPA-Fe, DTPA-Mn, DTPA-Zn and DTPA-Cu content, respectively.

**Keywords:** Panzara command, major nutrients, micronutrients

## Introduction
Soil is crucial component that defines the life layer of plants as it is a medium of unconsolidated nutrients and minerals. It is one among the biospheres fundamental life sustaining elements (Kumar *et al.*, 2013) [16]. The ability of the soil to provide nutrients has a direct impact on the growth, development, metabolism, production and quality of plants (Alwitwat, 2022) [1]. Concentration of these nutrients gives the land degradation evaluation. The primary nutrients have an effect on micronutrient uptake either negatively or positively. Nutrient interaction in soil can significantly affect plant growth and yield. Understanding these interactions is crucial for effective nutrient management in agriculture (Bhuvaneswari *et al.*, 2019) [9].

Consistent soil nutrient monitoring is essential for not only to maximize crop production but to identify plant nutrient deficiencies and to reduce runoff contamination from excess fertilizer applications. Farms release large amounts of agrochemicals, organic matter, sediments and saline drainage into water bodies (Motley, 2020) [19]. An estimate of the quantity of fertilizer nutrients required to supplement the soil is given to the agricultural producer by soil analysis. When fertilizer is applied according to soil analysis the overall amount of nutrients applied to a particular region and crop is decreased. Applying the right kind and quantity of fertilizer will increase the likelihood that farmers will produce the target crop yield with the least amount of soil contamination (Meshram and Singare, 2020) [18]. The concentration of dissolved components is steadily rising as a result of excessive groundwater extraction. Agrochemical and industrial pollution of surface and groundwater presents a serious risk to public health and could have a substantial financial impact on the nation (Anonymous, 2022) [4].

In Dhule district about 70% of the population is engaged in farming with the marginal farmers. The district has a geographical area of 7195 $km^2$. Out of which 2089 $km^2$ is covered by forest, whereas cultivable area is 4752 $km^2$ and net sown area is 4966 $km^2$. Agriculture is the main occupation of the people of Dhule district. About 5.5 Lakh ha of the total area is cultivable land. About 70% of the total land holders are small and marginal farmers.

The soil of the district is broadly classified into three zones: deep black, medium black and light black. This district is situated at the foot of the Satpuda hills. The mountain range of Sahyadri has reached the western side of this district. Tapi, Panzara, Kan, Arunavati, Amravati, Aner, Evil and Sandy rivers flow through the districts. Panzara river is vital source of irrigation in Dhule district (Anonymous, 2021) [4]. The present investigation was further planned in order to develop the database on soil quality degradation particularly major and micronutrients in area to diversify the cropping pattern and analysis will be further used to maintain the soil health.

## Materials and Methods

A systematic survey was carried out and surface (0-22.5 cm depth) soil samples were collected from 100 different sites of 20 villages of Dhule and Sakri tehsil of Dhule district and samples locations are showed in Fig. 1. Details regarding the site of sampling were noted as under: name of farmers, name of village, GPS location, latitude, longitude and vegetation. The soil samples from each village were collected from field using hand auger. The exact sample location was recorded using a GPS. After sampling, samples were air dried, ground and sieved through 2 mm sieve to obtain 500 gram size of each sample. Soil samples were analysed for available nitrogen by the alkaline permanganate method (Subbiah and Asija, 1956) [25], available phosphorus (Olsen-P) by 0.5 M $NaHCO_3$ extraction (Olsen *et al.* 1954) [20] and available potassium ($NH_4OAc$ K) by 1*N* neutral $NH_4OAc$ extraction on flamephotometer (Knudsen *et al.*, 1982). DTPA extractable micronutreints (Mn, Fe, Cu, Zn) by DTPA exctractant on Atomic absorption spectrophotometer (Lindsay and Norvell, 1978) [17].

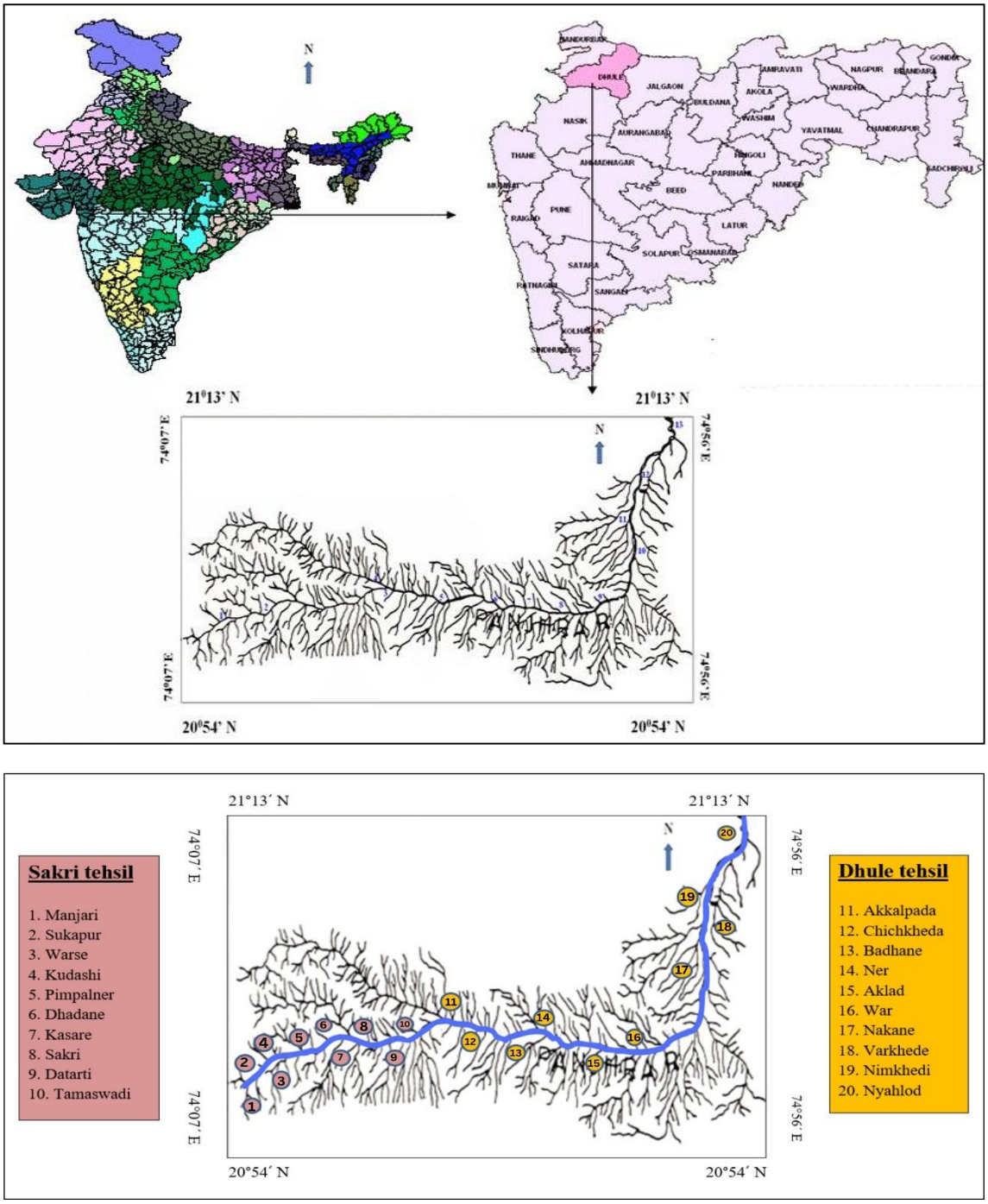


**Fig 1:** Location of Panzara command area of Dhule district

## Results and Discussion

### Major nutrients

#### Soil available N

The available nitrogen content in soil samples from Panzara command area ranged from 117 to 287 kg $ha^{-1}$ with an average of 195 kg $ha^{-1}$. Among the 100 soil samples tested, as per the six tier system given by Bangar and Zende (1978) [8], 8% samples were very low, 82% samples were low and 10% samples were under moderate category. In Sakri tehsils soil available nitrogen content ranged from 127 to 287 kg $ha^{-1}$ with mean 209 kg $ha^{-1}$ and in Dhule tehsils soil available nitrogen content ranged in between 117 to 241 kg $ha^{-1}$ with mean 182 kg $ha^{-1}$. The low available nitrogen in most of the soils might be due to the higher temperature in semi-arid climate of Dhule tehsil, which might have decline the organic matter status by faster degradation resulted in low status of available nitrogen. Sakri tehsil has numerically higher organic carbon providing high nitrogen content in the area. De Datta and Buresh (1989) [12] also reported that, one likely reason for the low nitrogen availability in the semi-arid climate where high temperatures can accelerate nitrogen loss through processes such as volatilization, nitrification, denitrification, microbial fixation, leaching and runoff which collectively reduces the amount of nitrogen available to plants. Differences in nitrogen content across the area may be influenced by soil management practices and the extent to which organic manures and fertilizers were applied to previous crops. Similar observations have been documented by Patil *et al.* (2019) [21] and Chaubey (2020) [10].

#### Soil available P

The available phosphorus content in soil samples from Panzara command area of Dhule district ranged from 10.24 to 26.03 kg $ha^{-1}$ with an average of 16.79 kg $ha^{-1}$. As per the six tier system given by Bangar and Zende (1978) [8], among the 100 soil samples tested, 32% samples were low, followed by 53% samples were moderate and 15% were in moderately high category in the command area. The available phosphorus content in soil samples from Sakri tehsil ranged from 10.24 to 26.03 kg $ha^{-1}$ with mean 17.49 kg $ha^{-1}$ and in Dhule tehsil the available phosphorus content of soil samples ranged from 10.87 to 24.33 kg $ha^{-1}$ with mean 16.08 kg $ha^{-1}$. The most of the samples were low to moderate in available phosphorus content in soils of studied area might be due to alkaline soil reaction and high content of $CaCO_3$ in the soil. Sakri tehsil has moderate phosphorus availability which might be due to slightly alkaline pH compared to more alkaline soils and higher organic carbon which forms organic phosphorus complex availability increase. Similar result regarding available phosphorus were also reported by Amara *et al.* (2015) [2] and Singh *et al.* (2022) [24].

#### Soil available K

The available potassium content of Panzara command area ranged from 208 to 683 kg $ha^{-1}$ with an average of 348 kg $ha^{-1}$. As per the six tier system given by Bangar and Zende (1978) [8], among the 100 soil samples tested, 11% samples were moderately high, 37% samples were high and 52% samples were in high category. In the Sakri tehsil region, available potassium content of soil samples was ranged from 224 to 683 kg $ha^{-1}$ with mean 385 kg $ha^{-1}$ and in Dhule tehsil the available potassium content of soil samples was ranged from 208 to 584 kg $ha^{-1}$ with mean of 311 kg $ha^{-1}$. The high content of available K in the soil may be attributed due to the dissolution and diffusion of K from internal crystal lattice of silicate clay minerals. The available potassium content in major portion of the study area in both the tehsils Sakri and Dhule was in high category. Comparable findings were made with respect to potassium content by Arulkumar *et al.*, (2022) [6] and Prasad *et al.*, (2023) [22].

### Micronutrients

#### DTPA-Fe

The DTPA-Fe content in the soil samples from Panzara command area ranged from 2.16 to 9.63 mg $kg^{-1}$ with an average of 4.74 mg $kg^{-1}$. As per the six tier system given by Katkar and Patil (2010) [13], among the 100 soil samples tested, 4% samples were very low, 51% samples were low, 44% samples were moderate, 1% sample were moderately high. As per the critical limit of 4.5 mg $kg^{-1}$, 45% samples were sufficient and 55% samples were deficient in DTPA-Fe content. The DTPA-Fe content in soil samples from Sakri tehsil ranged from 2.63 to 9.63 mg $kg^{-1}$ with mean 5.18 mg $kg^{-1}$ and in Dhule tehsil the DTPA-Fe content in soil samples ranged from 2.16 to 7.27 mg $kg^{-1}$ with mean 4.30 mg $kg^{-1}$. The available iron content in the surface soil samples ranged from very low to moderate. This variation may be partly due to differences in organic carbon levels across the command area, as soils with higher organic matter tend to retain more iron. Practices like excessive liming or irrigation with alkaline water can reduce iron availability. Conversely, applying iron-containing fertilizers can increase it especially in areas with known deficiencies. These observations corroborated with the findings by Seth *et al.* (2017) [23] and Damor *et al.*, (2023) [11].

#### DTPA Mn

As per the six tier system given by Katkar and Patil (2010) [13], among the 100 soil samples tested, 12% samples were low, 53% samples were moderate, 33% samples were moderately high and 2% samples were in high category for DTPA-Mn content. As per the critical limit of 2.0 mg $kg^{-1}$, 88% samples were sufficient and 12% samples were deficient in DTPA-Mn content. In Sakri tehsil the DTPA-Mn content in soil samples ranged from 1.78 to 9.20 mg $kg^{-1}$ with mean 4.06 mg $kg^{-1}$ and in Dhule tehsil the DTPA-Mn content of soil samples ranged from 1.77 to 5.84 mg $kg^{-1}$ with mean 3.36 mg $kg^{-1}$. The results are in conformity with the results reported by Kumar (2019) [15].

#### DTPA Zn

The DTPA-Zn content in the soil samples from Panzara command area ranged from 0.17 to 0.88 mg $kg^{-1}$ with an average of 0.43 mg $kg^{-1}$. As per the six tier system given by Katkar and Patil (2010) [13], among the 100 soil samples tested, 21% samples were very low, 64% samples were low and 15% samples were moderate. As per the critical limit of 0.6 mg $kg^{-1}$, 15% samples were sufficient and 85% samples were deficient in DTPA-Zn content. Low zinc levels were associated with alkaline soil conditions where zinc becomes less soluble and thus less available to plants. Additionally, high calcium carbonate content and excessive phosphorus fertilization can further reduce zinc availability due to nutrient interactions and fixation. The DTPA-Zn content in soil samples from Sakri tehsil ranged from 0.22 to 0.88 mg $kg^{-1}$ with mean 0.46 mg $kg^{-1}$ and in Dhule tehsil the DTPA-

Zn content in soil samples ranged from 0.17 to 0.82 mg $kg^{-1}$ with mean 0.39 mg $kg^{-1}$. Similar results regarding DTPA-Zn content were reported by Balaji *et al.* (2021) [7] and Anand *et al.* (2024) [3].

**DTPA Cu**

The DTPA-Cu content in soil samples from Panzara command area in Dhule district ranged from 0.11 to 0.98 mg $kg^{-1}$ with an average of 0.40 mg $kg^{-1}$. As per the six tier system given by Katkar and Patil (2010) [13], among the 100 soil samples tested, 16% samples were low, 41% samples were moderate, 35% samples were moderately high and 8% samples were under high category. As per the critical limit of 0.2 mg $kg^{-1}$, 84 samples were sufficient and only 16 samples were deficient in DTPA-Cu content. The DTPA-Cu content in soil samples from Sakri tehsil ranged from 0.14 to 0.98 mg $kg^{-1}$ with the mean of 0.46 mg $kg^{-1}$ and in Dhule tehsil the DTPA-Cu content of soil samples of command area was ranged from 0.11 to 0.86 mg $kg^{-1}$ with the mean of 0.34 mg $kg^{-1}$. These observations corroborated with the findings of Amara *et al.* (2015) [2] and Kumar (2019) [15].

**Table 1:** Categorization of soil available N (kg $ha^{-1}$) in Panzara command area

| Category Sample no. | Sakri tehsil | Dhule tehsil | Panzara command area |
|---|---|---|---|
| | 1-50 | 51-100 | (% samples) |
| Very low (< 140) | 6 | 2 | 8 |
| Low (141-280) | 34 | 48 | 82 |
| Moderate (281-420) | 10 | 0 | 10 |
| Moderately high (421-560) | 0 | 0 | 0 |
| High (561-700) | 0 | 0 | 0 |
| Very high (> 700) | 0 | 0 | 0 |

**Table 2:** Soil available N (kg $ha^{-1}$) in Panzara command area

| Particulars Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area 1-100 |
|---|---|---|---|
| Minimum | 127 | 117 | 117 |
| Maximum | 287 | 241 | 287 |
| Mean | 209 | 182 | 195 |
| SD | 45.51 | 29.49 | 42.82 |
| CV (%) | 23.63 | 16.20 | 21.86 |

**Table 3:** Categorization of soil available P (kg $ha^{-1}$) in Panzara command area

| Category Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area (% samples) |
|---|---|---|---|
| Very low (< 7) | 0 | 0 | 0 |
| Low (7.1-14) | 12 | 20 | 32 |
| Moderate (14.1-21) | 28 | 25 | 53 |
| Moderately high (21.1-28) | 10 | 5 | 15 |
| High (28.1-35) | 0 | 0 | 0 |
| Very high (> 35) | 0 | 0 | 0 |

**Table 4:** Soil available P (kg $ha^{-1}$) in Panzara command area

| Particulars Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area 1-100 |
|---|---|---|---|
| Minimum | 10.24 | 10.87 | 10.24 |
| Maximum | 26.03 | 24.33 | 26.03 |
| Mean | 17.49 | 16.08 | 16.79 |
| SD | 3.97 | 3.85 | 3.95 |
| CV (%) | 22.69 | 23.93 | 23.55 |

**Table 5:** Categorization of soil available K (kg $ha^{-1}$) in Panzara command area

| Category Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area (% samples) |
|---|---|---|---|
| Very low (<100) | 0 | 0 | 0 |
| Low (101-150) | 0 | 0 | 0 |
| Moderate (151-200) | 0 | 0 | 0 |
| Moderately high (201-250) | 3 | 8 | 11 |
| High (251-300) | 15 | 22 | 37 |
| Very high (>300) | 32 | 20 | 52 |

**Table 6:** Soil available K (kg $ha^{-1}$) in Panzara command area

| Particulars Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area 1-100 |
|---|---|---|---|
| Minimum | 224 | 208 | 208 |
| Maximum | 683 | 584 | 683 |
| Mean | 385 | 311 | 348 |
| SD | 116.7 | 79.0 | 105.9 |
| CV (%) | 30.32 | 25.41 | 30.44 |

**Table 7:** Categorization of DTPA-Fe (mg $kg^{-1}$) in Panzara command area

| Category Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area (% samples) |
|---|---|---|---|
| Very low (<2.5) | 0 | 4 | 4 |
| Low (2.5-4.5) | 25 | 26 | 51 |
| Moderate (4.5-9) | 24 | 20 | 44 |
| Moderately high (9-18) | 1 | 0 | 1 |
| High (18-27) | 0 | 0 | 0 |
| Very high (>27) | 0 | 0 | 0 |
| Sufficient (>4.5) | 25 | 20 | 45 |
| Deficient (<4.5) | 25 | 30 | 55 |

**Table 8:** DTPA Fe (mg $kg^{-1}$) in Panzara command area

| Particulars Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area 1-100 |
|---|---|---|---|
| Minimum | 2.63 | 2.16 | 2.16 |
| Maximum | 9.63 | 7.27 | 9.63 |
| Mean | 5.18 | 4.30 | 4.74 |
| SD | 1.81 | 1.30 | 1.63 |
| CV (%) | 35.49 | 30.26 | 34.50 |

**Table 9:** Categorization of DTPA-Mn (mg $kg^{-1}$) in Panzara command area

| Category Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area (% samples) |
|---|---|---|---|
| Very low (<1) | 0 | 0 | 0 |
| Low (1-2) | 4 | 8 | 12 |
| Moderate (2-4) | 24 | 29 | 53 |
| Moderately high (4-8) | 20 | 13 | 33 |
| High (8-16) | 2 | 0 | 2 |
| Very high (>16) | 0 | 0 | 0 |
| Sufficient (>2) | 46 | 42 | 88 |
| Deficient (<2) | 4 | 8 | 12 |

**Table 10:** DTPA Mn (mg $kg^{-1}$) in Panzara command area

| Particulars Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area 1-100 |
|---|---|---|---|
| Minimum | 1.78 | 1.77 | 1.77 |
| Maximum | 9.20 | 5.84 | 9.20 |
| Mean | 4.06 | 3.36 | 3.71 |
| SD | 1.74 | 1.08 | 1.48 |
| CV (%) | 43.50 | 32.35 | 40.01 |

**Table 11:** Categorization of DTPA-Zn (mg $kg^{-1}$) in Panzara command area

| Category Sample no. | Sakri tehsil | Dhule tehsil | Panzara command area |
|---|---|---|---|
| | 1-50 | 51-100 | (% samples) |
| Very low (< 0.3) | 2 | 19 | 21 |
| Low (0.3-0.6) | 41 | 23 | 64 |
| Moderate (0.6-1.2) | 7 | 8 | 15 |
| Moderately high (1.2-1.8) | 0 | 0 | 0 |
| High (1.8-2.4) | 0 | 0 | 0 |
| Very high (>2.4) | 0 | 0 | 0 |
| Sufficient (>0.6) | 7 | 8 | 15 |
| Deficient (<0.6) | 43 | 42 | 85 |

**Table 12:** DTPA Zn (mg $kg^{-1}$) in Panzara command area

| Particulars Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area 1-100 |
|---|---|---|---|
| Minimum | 0.22 | 0.17 | 0.17 |
| Maximum | 0.88 | 0.82 | 0.88 |
| Mean | 0.46 | 0.39 | 0.43 |
| SD | 0.13 | 0.17 | 0.15 |
| CV (%) | 28.47 | 43.58 | 36.65 |

**Table 13:** Categorization of DTPA-Cu (mg $kg^{-1}$) in Panzara command area

| Category Sample no. | Sakri tehsil | Dhule tehsil | Panzara command area |
|---|---|---|---|
| | 1-50 | 51-100 | (% samples) |
| Very low (< 0.1) | 0 | 0 | 0 |
| Low (0.1-0.2) | 5 | 11 | 16 |
| Moderate (0.2-0.4) | 19 | 22 | 41 |
| Moderately high (0.4-0.8) | 20 | 15 | 35 |
| High (0.8-1.2) | 6 | 2 | 8 |
| Very high (> 1.2) | 0 | 0 | 0 |
| Sufficient (> 0.2) | 45 | 39 | 84 |
| Deficient (< 0.2) | 5 | 11 | 16 |

**Table 14:** DTPA Cu (mg $kg^{-1}$) in Panzara command area

| Particulars Sample no. | Sakri tehsil 1-50 | Dhule tehsil 51-100 | Panzara command area 1-100 |
|---|---|---|---|
| Minimum | 0.14 | 0.11 | 0.11 |
| Maximum | 0.98 | 0.86 | 0.98 |
| Mean | 0.46 | 0.34 | 0.40 |
| SD | 0.22 | 0.17 | 0.21 |
| CV (%) | 47.82 | 52.64 | 52.50 |

## Conclusion

In Panzara command area, regarding soil available N, 8% samples were very low and 82% samples were under low category. About 32% samples were low in soil available P. Regarding soil available K, samples were under the category of moderately high to very high. About 55%, 12%, 85% and 16% samples were deficient in DTPA-Fe, DTPA-Mn, DTPA-Zn and DTPA-Cu content, respectively. Soils from Sakri tehsil were slightly healthier with higher nutrient availability as compared to Dhule tehsil in Panzara command area. From the experimental results it is concluded that, the soils from Panzara command area possess strong potential for sustainable agriculture, provided implementation of targeted soil fertility interventions including use of nitrogenous fertilizers, use of acid forming fertilizers, micronutrient supplementation particularly zinc and iron containing micronutrient fertilizers.

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