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Assessment of the nutritional status of pigeon pea growing soils of Latur and its adjacent tahsil by soil and plant analysis.

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Abstract
The present study entitled "Assessment of the nutritional status of pigeon pea growing soils of Latur and its adjacent tahsil by soil and plant analysis," was undertaken to evaluate the impact of soil and leaf nutrient levels on the yield and quality of pigeon pea during the 2024–2025 growing season. Soil and leaf samples were collected and analyzed using standard procedures. A total of 20 villages across four tahsils in the Latur district were selected for the study.
Physico-chemical properties like pH of Ausa tahsil soil ranged from 7.0-8.1, with average value 7.57. EC of soil was ranged from 0.4-2.7 with an average value 1.21. Organic Carbon of Ausa tahsil soil ranged from 0.21-0.91 per cent with average values 0.56 per cent. Calcium Carbonate of Ausa tahsil soil ranged from 2.1-8.4 per cent with average value 4.88 per cent.
Available Nitrogen of Ausa tahsil soil was ranged from 146-348 kg ha^{-1} with an average value 261.4 kg ha^{-1}. Available Phosphorus ranged from 2.38-19.72 kg ha^{-1} with an average value 13.36 kg ha^{-1}. Available Potassium ranged from 44-936.8 kg ha^{-1} with an average value 688.28 kg ha^{-1}. Available Sulphur ranged from 6.25-38.24 kg ha^{-1} with an average value 20.48 kg ha^{-1}. Exchangeable Ca Ausa tahsil soil ranged from 11.54-54 (cmol (p^+) kg^{-1}) with an average values 33.07 (cmol (p^+) kg^{-1}). Exchangeable Mg Ausa tahsil soil ranged from 9.7-38 (cmol (p^+) kg^{-1}) with an average value 17.67 (cmol (p^+) kg^{-1}).
DTPA micronutrients (Zn, Fe, Cu and Mn) of Ausa tahsil soil ranged from 0.12-0.99, 1.5-9.2, 5.3-32.5 and 1.2-8.9 Mg kg^{-1} with an average values 0.49, 4.93, 17.22 and 4.64 Mg kg^{-1}.
Total nutrients in Ausa tahsil (N, P, K, S) ranged from 1.21-3.33, 0.13-0.21, 0.12-0.54 and 0.05-0.9 per cent with an average values 2.04, 0.16, 0.26, and 0.27 per cent and (Fe and Zn) ranged from 142-273, 6.2-54 ppm with an average values 213.92 and 29.56 ppm.
With respect to nutrient index value Ausa tahsil was categorized low in nutrient index values Nitrogen (1.26), Mangenese (1.24) and Zinc (1.84) content. Medium in Phosphorus (1.96), Zinc (1.84) and Iron (1.96) content. High in Potassium (2.84), Sulphur (2.48), Calcium (2.9), Magnesium (3) and Copper (3) content.

Keywords: Pigeon pea, soil fertility, nutrient status, soil analysis

1. Introduction
Soil is a dynamic natural entity found in the upper layers of the Earth's surface, functioning as a crucial interface among the atmosphere, biosphere, hydrosphere, and geosphere. It serves as the foundation for most terrestrial life and is characterized by remarkable complexity. Soil quality encompasses a range of interrelated attributes, including physico-chemical properties such as pH, electrical conductivity, organic carbon, and calcium carbonate, all of which significantly influence the availability of vital nutrients for crop growth. By effectively managing these physico-chemical properties, the availability of essential nutrients in the soil can be enhanced. The presence of macro and micronutrients is critical for soil fertility and directly impacts crop yields. In any given area, crop health depends largely on the availability of soil nutrients and their profiles. These factors underscore the importance of thoroughly examining the physico-chemical composition of agricultural soils. Assessing soil fertility involves measuring the accessible essential nutrients for plants and evaluating the soil's ability to provide a continuous supply of these nutrients to crops.

Tissue tests offer an accurate representation of the nutritional status of plants, as leaf analysis indicates whether the soil can adequately meet the crop's nutrient demands. These tests should be conducted every two to five years, typically after nutrient levels in the leaves have stabilized. It's important to minimize interactions between crop levels in the plant and mineral contamination from sprays. When foliar fertilizers are applied, leaves from "control" plants that have not been treated should be thoroughly cleaned to eliminate any residue. Various factors affect the nutritional makeup of leaves, including soil moisture, texture, fertility, and fertilization techniques, which directly influence nutrient uptake. Additionally, leaf nutritional content can vary based on crop load, plant variety, rootstock, the presence of diseases and pests, weather conditions, and cultural practices such as weed control and pruning. These factors should be considered when analyzing leaf data. Leaf analysis aims to maintain nutrient levels within ideal ranges for optimal quality and yield, and appropriate corrective actions should be taken if any nutrient levels fall outside these ranges.

2. Material and Methods

Ausa taluka is one of the ten talukas (subdivisions) of Latur district in Maharashtra, India. It is located in the Marathwada region of the state. The taluka has 130 villages. Ausa taluka is situated at an average elevation of 634 meters (2,080 ft) above sea level. Latur district, including Ausa, lies on the Balaghat Plateau, with elevations ranging from 540 to 638 meters. To evaluate the soil fertility of Ausa tahsil surface soil samples (0-30 cm) were collected. The latitude and longitude of location were recorded at the time of soil sample collection, All the collected soil samples will be brought to the laboratory and dried under shade by spreading on white glazed sheets and covered with white coloured paper to avoid contamination with the extraneous material. After drying, a part of each sample meant for analysis were ground with wooden mortar and pestle, passed through a 0.5 mm sieve and preserved in paper bags with proper labeling for further estimation of primary nutrients. All necessary precautions were taken as outlined by Jackson (1973) [8] was carefully followed to avoid contamination. The tissue samples were collected at flowering stage of pigeon pea during August-September 2024. The collected leaf samples were brought to the laboratory. The samples were air dried on perfectly clean surface at room temperature for 2-3 days in dust free atmosphere free from any kind of contaminants. Samples were placed in oven at 60°C for 48 hrs. and grinded in an electric stainless steel mill using 0.5 mm sieve. Then the samples were placed in oven to dry for few hours more till constant weight and stored in well stopper plastic jars for analysis. pH, EC and OC were determined by standard procedure (Jackson, 1973) [8]. The Nutrient Index was calculated as per the formula suggested by Ramamurthy and Bajaj, (1969) [20]. The nutrient status of the study area was estimated, delineated and categorized on the basis of the NIV. The secondary and micronutrient status of pigeon pea growing area of Latur and its adjacent tahsil depicted on a thematic map. A soil fertility map was prepared by using Ramamurthy and Bajaj, (1969) [20] soil nutrient index.

3. Results and Discussion

3.1. Physico-chemical properties of soils of pigeon pea growing area of Ausa tahsil

The tables 1 and 2 indicates data of the physico-chemical properties and **c**ategorization of soil samples collected from Ausa tahsil. The pH content in soil samples ranged from 7.0 to 8.1 with a mean value of 7.57. The soil samples AM-5, AK-1 and AK-5 collected from Motola, Killari villages respectively showed the lowest pH (7.0). The highest value (8.1) was recorded in soil samples AM-2, AB-4, Abo-3 and AT-3 collected from Matola, Belkund, Borfal and Talani villages respectively. Out of 25 soil samples, 12 samples (48%) were neutral and 13 samples (52%) were alkaline in reaction.

The EC content in soil samples ranged between 0.4 to 2.7 dSm^{-1} with a mean value of 1.21 dSm^{-1}. The soil samples ABo-3 and AT-4 collected from Borfal and Talani villages showed the lowest EC (0.4 dSm^{-1}). The highest value (2.7 dSm^{-1}) was recorded in soil sample AM-5 which collected from Motola villages. Out of 25 soil samples 12 samples (48%) were shows non deleterious effect on crops, 7 samples (28%) critical for germination and 6 samples (24%) found critical for salt sensitive crops.

The organic carbon content in soil samples ranged from 0.21 to 0.91% with a mean value of 0.56%. The soil sample Abo-4 collected from Borfal village showed the lowest organic carbon content (0.21%). The highest value (0.9%) where recorded in soil sample AM-4 from Motola village. Out of 25 soil samples 9 samples (36%) were low, 10 samples (40%) were medium and 6 samples (24%) were high in organic carbon content.

The calcium carbonate content in soil samples ranged from 2.1 to 8.4% with a mean value of 4.88%. The lowest calcium carbonate content (2.1%) was recorded in soil sample AK-4 collected from Killari village. The highest calcium carbonate content (8.4%) was recorded in soil sample AM-3 collected from Motola village. Out of 25 soil samples, 2 samples (8%) were non calcareous and 20 samples (80%) were calcareous and 3 samples (12%) were highly calcareous.

Table 1: Physico-chemical properties of soils of pigeon pea growing area of Ausa tahsil

Ausa					
Sr. No.	**Sample No.**	**pH**	**EC (dSm^{-1})**	**OC (%)**	**$CaCO_3$ (%)**
1.	AM 1	7.5	2.5	0.76	4.6
2.	AM 2	8.1	0.9	0.44	3.5
3.	AM 3	7.9	0.8	0.54	8.4
4.	AM 4	7.8	0.7	0.91	3.4
5.	AM 5	**7**	**2.7**	0.76	7.5
6.	AB 1	7.3	0.5	0.41	4.5
7.	AB 2	7.5	1.2	0.46	3.4
8.	AB 3	7.8	0.9	0.64	6.3
9.	AB 4	8.1	1.6	0.66	4.5
10.	AB 5	7.2	1.4	0.22	3.2
11.	ABo 1	7.6	0.9	0.78	4.8
12.	ABo 2	7.8	0.8	0.41	4.2
13.	ABo 3	8.1	2.6	0.33	4.9
14.	ABo 4	7.5	0.4	0.21	4.8
15.	ABo 5	7.3	0.9	0.81	4.2
16.	AK 1	**7**	0.9	0.66	7.8
17.	AK 2	7.8	0.5	0.76	6.5
18.	AK 3	7.6	1.5	0.23	6.1
19.	AK 4	7.2	1.2	0.63	2.1
20.	AK 5	**7**	1.3	0.54	3.8
21.	AT 1	7.3	1.9	0.84	8.3
22.	AT 2	7.5	1.6	0.47	3.6
23.	AT 3	8.1	1.4	0.67	3.2
24.	AT 4	7.8	0.4	0.57	3.8
25.	AT 5	7.6	0.9	0.42	4.6
Range		7.0-8.1	0.4-2.7	0.21-0.91	2.1-8.4
Mean		7.75	1.21	0.56	4.88
S.E.±		0.07	0.13	0.04	0.34
C.V. (%)		4.65	53.75	36.61	35.15

Table 2: Categorization of soil samples for physico-chemical properties in Ausa tahsil.

pH	**Category**	**Acidic**	**Neutral**	**Alkaline**	
	No. of samples	00	12	13	
	%	00	48	52	
EC	**Category**	**No deleterious effect on crops**	**Critical for germination**	**Critical for salt sensitive crops**	**Injurious to most crops**
	No. of samples	12	07	04	00
	%	48	28	16	00
Organic carbon	**Category**	**Low**	**Medium**	**High**	
	No. of samples	09	10	06	
	%	36	40	24	
$CaCO_3$	**Category**	**Non Calcarious**	**Calcarious**	**High Calcarious**	
	No. of samples	02	20	03	
	%	8	80	12	

With respect to soils of Ausa tahsil, soil were shows pH range neutral to alkaline in reaction. The alkaline reaction is probably due to the presence of sufficient free lime content (Kaushal *et al*, 1986) [11] and basalt alluvial parent material rich in alluminosilcate alkaline earth from which these soils are derived. (Challa *et al*, 1998) [3] similar type of finding were reported by Waghmare *et al.* (2008) [27] recorded that the soils of Ausa tahsil ranged from 7.05 to 8.9 with an average value of 8.07.

The values of EC obtained in analysis were found in desirable range as proposed by Richard and Cambell (1948) [22], when EC exceed 4 dSm^{-1}, the salt present become harmful to the crop growth. Ajgaonkar and Patil (2017) [1] reported that the EC were ranged from 0.20 to 1.70 dSm^{-1} from the soils of Aurangabad district. These values of EC are safe for crop growth. Ushashri *et al*. (2019) [25] found that the EC ranged from 0.02 to 1.48 dSm^{-1} in soil samples collected from Bhudargad tahsil of Kolhapur district.

The data further revealed that overall soil samples were low to medium in organic carbon content. Reason behind the existence of variation in organic carbon content as Lower to medium range might be due to high temperature of Latur District (up to 41.5) and good aeration in the soil increased the rate of oxidation of organic matter resulting reduction of organic carbon content. Inadequate supply of organic manures and use of imbalanced chemical fertilizers along with poor agricultural management practices like soil tillage, mono or diversified cropping pattern, burning of trashes after harvesting etc. Kashiwar *et al*. (2019) [10] noticed that the organic carbon content ranged from 2.7 to 8.6 g kg^{-1} from the soils of Sakoli tahsil of Bhandara district.

According to categorization, it was observed that soils of Pigeon pea growing area of selected villages were calcareous to highly calcareous in nature. It might be due to relatively more accumulation of $CaCO_3$ in soils and associated black soil may be partly associated with their recent origin with rich in alkali earth and partly due to calcification process prevalent in this region (Joshi, 2000) [9]. Similar finding of calcium carbonate (13.0 to 156.0 g kg^{-1}) was recorded in swell shrink soils of Vidharbha region (Padole and Mahajan, 2003) [15].

3.2. Status of primary nutrients in soils of Ausa Tahsil.

The tables 3 and 4 indicates data of the primary nutrients and categorization of soil samples collected from Ausa tahsil. The available nitrogen content in soil samples ranged from 146 to 348 kg ha^{-1} with a mean value of 261.4 kg ha^{-1}. The minimum available nitrogen content (146 kg ha^{-1}) was observed in soil samples AK-3, AT-3 collected from Killari, Talani villages. The maximum available nitrogen content (348 kg ha^{-1}) was recorded in soil sample ABo-3 collected from Borfal village. Out of 25 soil samples, 18 samples (72%) were found low while 7 samples (28%) medium in available nitrogen content.

The available phosphorus content of soil samples ranged from 2.38 to 19.72 kg ha^{-1} with a mean value of 10.24 kg ha^{-1}. The lowest available phosphorus content (2.38 kg ha^{-1}) was recorded in soil sample ABo-1 collected from Borfal village. The highest available phosphorus content (19.72 kg ha^{-1}) was recorded in soil AK-2 collected from Killari village. Out of 25 soil samples, 4 samples (16%) were found low, 18 samples (72%) were found medium and 3 samples (12%) were high in available phosphorus content.

The available potassium content in soil samples ranged from 440 to 936.8 kg ha^{-1} with a mean value of 688.28 kg ha^{-1}. The lowest available potassium content (440 kg ha^{-1}) was noted in soil sample AT-3 collected from Talani village. The highest available potassium content (936.8 kg ha^{-1}) was recorded in soil sample AB-5 collected from Belkund village. Out of 25 soil samples, 4 samples (12%) were Medium and 21 samples (84%) were high in available potassium content.

Table 3: Status of primary nutrients in soils of Ausa tahsil.

Ausa				
Sr. No.	**Sample No.**	**N (kg ha^{-1})**	**P (kg ha^{-1})**	**K (kg ha^{-1})**
1	AM 1	276	19.42	895.2
2	AM 2	258	12.38	482
3	AM 3	290	7.79	451.2
4	AM 4	291	8.8	689.6
5	AM 5	287	13.42	682.8
6	AB 1	330	7.68	606.4
7	AB 2	287	5.35	490
8	AB 3	260	14.72	814.4
9	AB 4	232	8.7	692.8
10	AB 5	209	19.42	936.8
11	ABo 1	212	2.38	590
12	ABo 2	292	9.79	773
13	ABo 3	348	4.8	694
14	ABo 4	320	3.42	495
15	ABo 5	329	5.68	484
16	AK 1	244	9.35	684
17	AK 2	223	19.72	827.6
18	AK 3	146	17.7	714
19	AK 4	176	9.42	913.2
20	AK 5	246	18.38	926
21	AT 1	321	7.73	658.8
22	AT 2	244	9.8	882.4
23	AT 3	146	7.42	440
24	AT 4	321	6.6	893.2
25	AT 5	247	6.3	490.8
Range		146-348	2.38-19.72	440-936.8
Mean		261.4	10.24	688.28
S.E.±		11.10	1.04	33.40
C.V. (%)		21.24	51.16	24.26

Table 4: Categorization of soil for primary nutriets in Ausa tahsil.

Available N	**Category**	**Low**	**Medium**	**High**
	No. of samples	18	07	00
	%	72	28	00
Available P	**Category**	**Low**	**Medium**	**High**
	No. of samples	04	18	03
	%	16	72	12
Available K	**Category**	**Low**	**Medium**	**High**
	No. of samples	00	04	21
	%	00	16	84

Thus based on Soils of Ausa Tahsil. Nitrogen shows Low to high in range. The lower content of available nitrogen in these soils are associated with, Low content of organic matter and low total nitrogen reserve and in term C:N ratio of immobilized form of nitrogen (Malewar, 1995) [12]. These results are in confirmatory with results reported by Waghmare and Takhankar (2007) [26] in soils of Ausa and Ausa tahsil of Latur district where N content ranged from 102.22 to 385.72 kg ha^{-1} and 100.3 to 366.91 kg ha^{-1}, respectively.

It was infered from the value that all soil samples were low to medium in available phosphorus. The low available phosphorus might be due to the higher phosphorus fixing capacity of black cotton soils of Latur district that prevent the soil phosphorus to come in soil solution. The swell - shrink soils of Maharashtra were very low to high in available phosphorus content as reported by Patil and Sonar (1994) [17]. Similarly, available P ranged from 10.0 to 19.1 kg ha^{-1} in soils of Marathwada region (Waikar *et. al*. 2004) [28].

Further data revealed that the potassium content in soils of Pigeon pea growing area categorized as Medium to high. The high content of K is due to presence of potassium rich mineral in soil and associated black soils (Gajbe *et al*. 1976) [5]. Chaudhari and Kadu (2007) [4] reported that the available K of soil with an average value of 428.2 kg ha^{-1} was recorded in soils of Dhule tahsil of Dhule district.

3.3. Status of secondary nutrients in soils of Ausa tahsil.

The tables 5 and 6 indicates data of the secondary nutrients and its categorization of soil samples collected from Ausa tahsil. The available Sulphur content of soils ranged from 6.25 to 38.24 kg ha^{-1} with a mean value of 20.48 kg ha^{-1}. The lowest available Sulphur content (6.25 kg ha^{-1}) was recorded in soil sample AM-1 collected from Matola village. The highest available Sulphur content (38.24 kg ha^{-1}) was recorded in soil sample ABo-1 collected from Boarfal village. Out of 25 soil samples, 4 samples (1%) were found low, 5 samples (20%) were found medium and 16 samples (64%) were high in available Sulphur content.

The exchangeable calcium content in soil samples ranged from 11.5 to 54 cmol (p$^+$) kg^{-1} with a mean value of 33.07 cmol (P$^+$) kg^{-1}. The lowest exchangeable Ca content (11.5 cmol (P$^+$) kg^{-1}) was found in the village of Borfal soil sample Abo-5. The highest exchangeable Ca content (54 cmol (P$^+$) kg^{-1}) was found in the village of Belkund soil sample AB-5. Out of 25 soil samples, 2 samples (8%) were medium and 23 samples (92%) were high in exchangeable Ca content.

The exchangeable magnesium content in soil samples ranged from 9.7-28.6 cmol (P$^+$) kg^{-1} with a mean value of 17.67 cmol (P$^+$) kg^{-1}. The minimum exchangeable Mg (9.7 cmol (P$^+$) kg^{-1}) was observed in the villages of Borfal, Killari soil samples ABo-4, AK-4. The maximum exchangeable Mg (28.6 cmol (P$^+$) kg^{-1}) was observed in Matola village soil samples AM-5. Out of the 25 soil samples, all 25 samples (100%) were high in exchangeable Mg content.

Table 5: Status of secondary nutrients in soils of Ausa Tahsil.

Sr. No.	Sample No.	S (kgha^{-1})	Exch.Ca^{++}(cmol (p$^+$)kg^{-1})	Exch.Mg^{++}(cmol (p$^+$)kg^{-1})
1	AM 1	6.25	42	17.8
2	AM 2	23.62	18.6	13.6
3	AM 3	9.15	31.6	20.8
4	AM 4	14.26	18.4	22.7
5	AM 5	7.85	42	28.6
6	AB 1	18.26	41.5	15.9
7	AB 2	8.17	21	16.6
8	AB 3	17.36	51.5	17.8
9	AB 4	20.86	22.7	19.7
10	AB 5	33.15	54	17.6
11	ABo 1	38.24	28.7	27.8
12	ABo 2	8.07	46.5	11
13	ABo 3	15.68	34.6	16.7
14	ABo 4	31.58	14.2	9.7
15	ABo 5	22.4	11.5	19.6
16	AK 1	8.65	30.5	14.8
17	AK 2	27.3	42	18.5
18	AK 3	29.4	52.5	13.8
19	AK 4	31.65	39	9.7
20	AK 5	16.03	44.6	20.8
21	AT 1	8.7	31.6	23.6
22	AT 2	26.3	24.5	17.6
23	AT 3	28.2	29.6	14.8
24	AT 4	31.4	35.2	18.5
25	AT 5	29.5	18.5	13.8
Range		6.25-38.24	11.5-54	9.7-28.6
Mean		20.48	33.07	17.67
S.E.±		1.97	2.46	0.95
CV(%)		48.09	37.27	27.11

Table 6: Categorization of soils for secondary nutrients in Ausa Tahsil.

Available S	**Category**	**Low**	**Medium**	**High**
	No. of samples	04	05	16
	%	16	20	64
Exchangeable Ca^{++}	**Category**	**Low**	**Medium**	**High**
	No. of samples	00	02	23
	%	00	8	92
Exchangeable Mg^{++}	**Category**	**Low**	**Medium**	**High**
	No. of samples	00	00	25
	%	00	00	100

Based on Ausa data, The available sulphur shows low to high in range. This might be expected due to the presence of Fe and Al oxides in surface soils. Similar results were also reported by Medhe *et al.* (2012) [13] and Kashiwar *et al*. (2019) [10].

The high status of exchangeable calcium and Magnesium in these soils may be a result of the dry and semidry environments causing an accumulation of metallic cations in calcareous soil. Calcium is the main cation on the soil exchange complex and in the soil solution because limestone, calcite is the parent material. Ravte (2008) [21] reported that the exchangeable calcium and magnesium content from Ausa tahsil of Latur district were ranged from 11.05 to 50.7 and 2.6 to 28.9 cmol (P+) kg^{-1}, with a mean value of 31.67 and 18.2 cmol (P+) kg^{-1}. Similar findings were also reported by Bacchewar and Gajbhiye (2011) [2].

3.4. DTPA- Micronutrient status in soils of Ausa tahsil.

The tables 7 and 8 indicates data of the DTPA-extractable micronutrients and its categorization of soil samples collected from Ausa tahsil. The DTPA-Zn content in soil samples ranged from 0.12 to 0.99 mg kg^{-1} with a mean value 0.49 mg kg^{-1}. The

minimum available Zn content (0.12 mg kg^{-1}) was recorded in soil samples AT-2 and AT-5 collected from and Talani villages. The maximum available Zn content (0.99 mg kg^{-1}) was recorded in soil sample Abo-3 collected from Borfal village. Out of 25 soil samples, 4 samples (16%) were low, 21 samples (84%) were medium in available Zn content.

The DTPA-Fe content in soil samples ranged from 1.5 to 9.2 mg kg^{-1} with a mean value of 4.93 mg kg^{-1}. The lowest available Fe content (1.5 mg kg^{-1}) was observed in soil sample AB-5 collected from Belkund village. The highest available Fe content (9.2 mg kg^{-1}) was recorded in soil sample ABo-5 collected from Borfal village. Out of 25 soil samples, 5 samples (20%) were low, 16 samples (64%) were medium and 4 samples (16%) were high in available Fe content.

The DTPA-Cu content in soil samples ranged from 5.3 to 33.5 mg kg^{-1} with a mean value 17.22 mg kg^{-1}. The lowest available Cu content (5.3 mg kg^{-1}) was noted in soil sample AT-3 collected from Talani village. The highest available Cu content (33.5 mg kg^{-1}) was noted in soil sample AK-2 collected from Killari village. All 25 soil samples (100%) were high in available Cu content.

The data on DTPA-Mn content in soil samples ranged from 1.2 to 8.9 mg kg^{-1} with a mean value 4.64 mg kg^{-1}. The lowest available Mn content (1.2 mg kg^{-1}) was observed in soil sample ABo-2 collected from Borfal village. The highest available Mn content (8.9 mg kg^{-1}) was recorded in soil samples AM-5 and AB-2 collected from Matola and Belkund villages. Out of 25 samples, 12 samples (48%) Low, 5 samples (20%) were medium content and 3 samples (12%) were high in available Mn content.

Table 7: DTPA- Micronutrient status in soils of Ausa tahsil.

Ausa					
Sr. No.	**Sample No.**	**DTPA- Zn (Mg kg^{-1})**	**DTPA- Fe (Mg kg^{-1})**	**DTPA- Cu (Mg kg^{-1})**	**DTPA- Mn (Mg kg^{-1})**
1.	NH 1	AM 1	0.56	4.2	15.2
2.	NH 2	AM 2	0.51	3.6	16.3
3.	NH 3	AM 3	0.43	4.3	18.2
4.	NH 4	AM 4	0.96	3.2	15.4
5.	NH 5	AM 5	0.54	6.5	16.2
6.	NU 1	AB 1	0.81	7.3	20.3
7.	NU 2	AB 2	0.61	4.2	21.3
8.	NU 3	AB 3	0.33	6.2	17.2
9.	NU 4	AB 4	0.46	4.2	14.3
10.	NU 5	AB 5	0.94	1.5	13.2
11.	NA 1	ABo 1	0.62	2.9	12.9
12.	NA 2	ABo 2	0.82	2.5	18.3
13.	NA 3	ABo 3	0.99	2.2	15.2
14.	NA 4	ABo 4	0.43	7.2	16.3
15.	NA 5	ABo 5	0.86	9.2	15.9
16.	NP 1	AK 1	0.32	6.2	21.2
17.	NP 2	AK 2	0.64	7.5	32.5
18.	NP 3	AK 3	0.23	6.3	19.6
19.	NP 4	AK 4	0.45	1.9	16.2
20.	NP 5	AK 5	0.17	6.4	12.3
21.	NY 1	AT 1	0.15	6.5	22.4
22.	NY 2	AT 2	0.12	7.2	19.5
23.	NY 3	AT 3	0.16	8.2	5.3
24.	NY 4	AT 4	0.24	1.8	13.9
25.	NY 5	AT 5	0.12	2.2	21.5
Range		0.12-0.99	1.5-9.2	5.3-32.5	1.2-8.9
Mean		0.49	4.93	17.22	4.64
S.E.±		0.05	0.45	0.97	0.57
CV(%)		56.05	46.43	28.32	61.40

Table 8: Categorization of soil for DTPA-Micronutrients in Ausa tahsil.

DTPA- Zn (Mg kg^{-1})	**Category**	**Low**	**Medium**	**High**
	No. of samples	04	21	00
	%	16	84	00
DTPA- Fe (Mg kg^{-1})	**Category**	**Low**	**Medium**	**High**
	No. of samples	05	16	04
	%	20	64	16
DTPA- Cu (Mg kg^{-1})	**Category**	**Low**	**Medium**	**High**
	No. of samples	00	00	25
	%	00	00	100
DTPA- Mn (Mg kg^{-1})	**Category**	**Low**	**Medium**	**High**
	No. of samples	12	05	03
	%	48	20	12

Zinc shows low to Medium range in soils of Ausa tahsil. Low content of zinc, might be because the zinc cations are heavily charged to their oxides or hydroxides in an alkaline environment, which reduces the zinc's availability. Similar findings were also found to be confirmatory with Meena *et al*. (2006) [14], Gosavi and Chaudhari (2016) [7].

It is seen from the result that soil samples were low to high in Fe content. High content of Fe due to the presence of Fe in the octahedral layer of silicate clays, especially those with clay minerals with a 2:1 composition (Smectite). Fertilizer applications with Fe content cause the release of Fe from the clay under specific soil conditions, increasing the concentration of Fe in the soil solution. Similar results were reported by Kashiwar *et al*. (2019) [10].

DTPA Copper shows high in soils. High copper concentrations may result from the presence of chalcocite and cuprite minerals in soils and basaltic parent materials. Shinde (2007) [23] reported that the DTPA-extractable copper content was ranged from 0.32 to 17.5 mg kg-1 and 0.74 to 9.42 mg kg-1 from Udgir and Deoni tahsils in Latur district. Similar findings were also reported by Meena *et al*. (2006) [14].

Mostly Mn shows medium to high in range. The high Mn status in these soils might be due to the, these soils have higher ferromagnesium mineral concentrations than soils derived from basaltic parent minerals, or it might be because these soils have more magnetic mineral pressure. Waghmare and Takankhar (2007) [26] found that the DTPA extractable manganese content ranged from 1.23 to 13.57 mg kg-1 with an average value of 7.57 mg kg-1 from soils in Ausa tahsil of Latur district. Similar results were also reported by Pradeep *et al*. (2006) [18].

3.5. Total nutrient content in pigeon pea plant of Ausa tahsil. (N, P, K, S, Fe and Zn).

The tables 9 and 10 indicates data of total nutrient content and its categorization of collected plant samples from Ausa tahsil. Total nitrogen content in plant samples ranged from 1.21 to 3.33% with a mean of 2.04%. The lowest amount of total nitrogen content (1.21%) was recorded in plant sample AM-1 collected from Matola village. The highest amount of total nitrogen content (3.33%) was recorded in plant sample AT-3 collected from Talani village. Out of 25 plant samples, 19 samples (76%) were Low and 6 samples (24%) were medium in total nitrogen content.

Total phosphorus content in plant samples ranged from 0.13 to 0.21% with a mean of 0.16%. The less amount of total phosphorus content (0.13%) was noted in plant samples AM-5 and AT-3 collected from Matola and Talani villages. The high

amount of total phosphorus content (0.21%) was recorded in plant sample ABo-3 collected from Borfal village. Out of 25 plant samples, 21 samples (84%) were low and 4 samples (16%) were medium in total phosphorus content.

Total potassium content in plant samples ranged from 0.12 to 0.54% with a mean value 0.26%. The minimum content of total phosphorus content (0.12%) was recorded in plant samples AM-3, Abo-4 collected from Matola and Borfal villages. The maximum total phosphorus content (0.54%) was recorded in plant sample AB-2 collected from Belkund village. Out of 25 plant samples, 19 samples (76%) were medium and 6 samples (24%) were high in total phosphorus content.

Total sulphur content in plant samples ranged from 0.05 to 0.9% with a mean value of 0.27%. The less amount of total sulphur content (0.05%) was noted in plant sample AT-5 collected from Talani village. The high amount of total sulphur content (0.9%) was noted in plant sample (ABo-1) collected from Borfal village. Out of 25 plant samples, 19 samples (76%) were low, 2 samples (8%) were medium and 4 samples (16%) were high in total sulphur content.

Total iron content in plant samples ranged from 142 to 273 ppm with a mean value of 213.92 ppm. The less amount of total iron content (142 ppm) was noted in plant sample AT-1 collected from Talni. The high amount of total iron content (273 ppm) was noted in plant sample ABo-1 collected from Borfal village. Out of 25 plant samples, 14 samples (56%) were low, 6 samples (24%) were medium and 5 samples (20%) were high in total iron content.

Total zinc content in plant samples ranged from 6.2 to 54 ppm with a mean value of 29.56 ppm. The less amount of total zinc content (6.2 ppm) was noted in plant sample ABo-1 collected from Borfal village. The high amount of total zinc content (54 ppm) was noted in plant sample AB-4 collected from Belkund village. Out of 25 plant samples, 18 samples (62%) were low and 6 samples (24%) were medium in total zinc content

Table 9: Total nutrient content in Pigeon pea plant of Ausa Tahsil. (N, P, K, S, Fe and Zn).

Ausa							
Sr. No.	**Sample No.**	**Total N (%)**	**Total P (%)**	**Total K (%)**	**Total S (%)**	**Total Fe (ppm)**	**Total Zn (ppm)**
	AM 1	1.21	0.19	0.35	0.14	192	18.6
	AM 2	2.12	0.18	0.52	0.13	272	31.6
	AM 3	1.32	0.14	0.12	0.14	264	18.4
	AM 4	1.54	0.14	0.41	0.21	172	42
	AM 5	2.62	0.13	0.32	0.31	170	41.5
	AB 1	2.32	0.19	0.45	0.25	254	21
	AB 2	1.36	0.19	0.54	0.26	148	51.5
	AB 3	1.24	0.18	0.23	0.22	148	22.7
	AB 4	1.54	0.19	0.35	0.12	189	54
	AB 5	1.62	0.14	0.14	0.16	191	28.7
	ABo 1	1.25	0.16	0.24	0.9	273	6.2
	ABo 2	3.21	0.19	0.41	0.1	265	34.6
	ABo 3	3.12	0.21	0.25	0.8	152	14.2
	ABo 4	2.35	0.14	0.12	0.12	181	11.5
	ABo 5	2.74	0.16	0.13	0.12	268	30.5
	AK 1	2.65	0.14	0.35	0.16	259	42
	AK 2	2.42	0.19	0.24	0.13	161	52.5
	AK 3	1.52	0.19	0.42	0.14	273	39
	AK 4	1.25	0.14	0.13	0.17	265	44.6
	AK 5	1.34	0.16	0.21	0.15	150	31.6
	AT 1	1.64	0.14	0.15	0.5	142	24.5
	AT 2	1.44	0.17	0.14	0.6	268	9.6
	AT 3	3.33	0.13	0.13	0.8	259	35.2
	AT 4	3.25	0.18	0.24	0.12	161	18.5
	AT 5	2.66	0.19	0.14	0.05	271	14.5
Range		1.21-3.3	0.13-0.21	0.12-0.54	0.05-0.9	142-273	6.2-54
Mean		2.04	0.16	0.26	0.27	213.92	29.56
S.E.±		0.14	0.004	0.02	0.04	10.53	2.79
CV(%)		36.15	14.81	49.62	89.87	24.63	47.26

Table 10: Categorization of samples based on nutrient content in pigeon pea plants of Ausa tahsil.

Total N	**Category**	**Low**	**Medium**	**High**
	No. of samples	19	06	00
	%	76	24	00
Total P	**Category**	**Low**	**Medium**	**High**
	No. of samples	21	04	00
	%	84	16	00
Total K	**Category**	**Low**	**Medium**	**High**
	No. of samples	00	19	06
	%	00	76	24
Total S	**Category**	**Low**	**Medium**	**High**
	No. of samples	19	02	04
	%	76	08	16
Total Fe	**Category**	**Low**	**Medium**	**High**
	No. of samples	14	06	05
	%	56	24	20
Total Zn	**Category**	**Low**	**Medium**	**High**
	No. of samples	19	06	00
	%	76	24	00

Thus, based on overall data of study area. It indicating that majority of pigeon pea plant samples showed low to medium in Nitrogen, Phosphorus and Zinc content. These results confirm the findings reported by Ghatala *et al* (2004) [6] studied the nutrient concentration in pomegranate Plant of Jaipur district, Rajasthan and reported that nitrogen concentration in leaves ranged from 0.65 2.35 per cent. Singh and Kumar (2012) [24] found that P contents ranged from 0.184 to 0.276 per cent in Pomegranate leaves. Parwe (2013) [16] who found that Zn in plant was 50.0 to 90.2 mg kg^{-1} in pomegranate orchards of Beed district.

Total Potassium content of Pigeon pea leaves mostly categorized medium to high in range. These results are in resemblance with the findings of Raghupati and Bhargava (1998) [19]. Parwe (2013) [16] found that K contents ranged from 1.02 to 9.71per cent.

The total Sulphur content in Pigeon pea leaves showed low to high in range. These results are in resemblance with the findings of Raghupati and Bhargava (1998) [19]. Total Iron content of Pigeon pea leaves mostly categorized low to high in range.

Parwe (2013) [16] observed the range of iron in leaves was 124.0 to 3.10.0 mg kg^{-1} in pomegranate plant leaves of Beed district.

4. Soil nutrient index in soils of Ausa tahsil.

On the basis (Table 11) of resulted nutrient index value, soils from Ausa tahsil was categorized low in Nitrogen (1.26) and Manganese (1.24), content. Medium in Phosphorus (1.96), Zinc (1.84) and Iron (1.96). While High in Potassium (2.84), Sulphur (2.48), Calcium (2.9), Magnesium (3) and Copper (3). These nutrient index values were calculated as per the formula given by Ramamoorthy and Bajaj (1969).

Table 11: Nutrient index values of soils of Aua tahsil of Latur district.

Sr. No.	Soil Nutrients	Ausa	
		NIV	Category
1	Nitrogen	1.26	Low
2	Phosphorus	1.96	Medium
3	Potassium	2.84	High
4	Sulphur	2.48	High
5	Calcium	2.9	High
6	Magnesium	3	High
7	Zinc	1.84	Medium
8	Iron	1.96	Medium
9	Copper	3	High
10	Manganese	1.24	Low

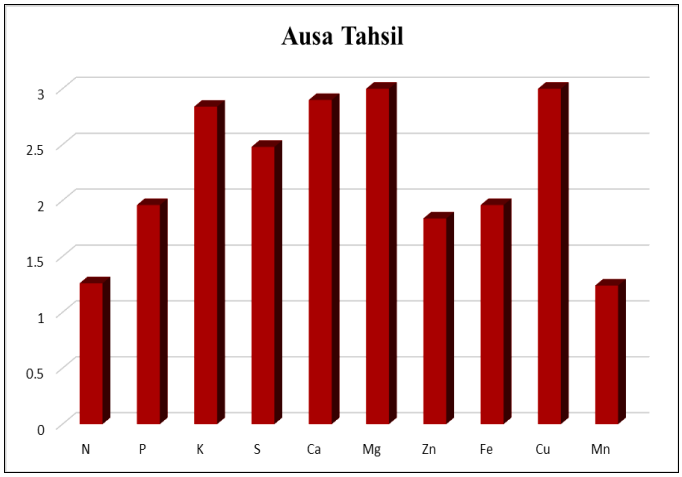

Fig 1: Nutrient index values of soils of Ausa tahsil of Latur district

5. Fertility map

The nutrient status of the study area was estimated, delineated and categorized on the basis of the NIV. Village wise Primary, secondary and micronutrient status of pigeon pea growing area of Latur and its adjacent tahsil depicted on a thematic map. (Table 12 and Fig 2).

Table 12: Village wise soil fertility status of Ausa tahsil.

No	Villeges	N	P	K	S	Ca	Mg	Zn	Fe	Cu	Mn
1	Matola	Low	Low	High	High	High	High	Medium	High	Medium	Medium
2	Belkund	Medium	Low	Medium	High	High	Medium	Medium	High	High	Low
3	Borfal	Low	Low	High	Medium	Medium	High	Medium	Medium	High	Medium
4	Killari	Low	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium
5	Talani	Medium	Medium	High	Medium	High	High	Low	High	High	Medium

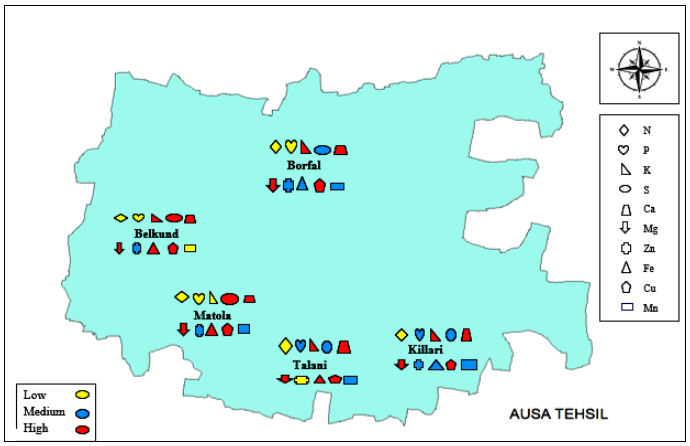

Plate 1: Fertility status of pigeon pea growing area of Ausa tahsil

References

1. Ajgaonkar SS, Patil SS. Soil health of soils in Aurangabad district (Maharashtra), India. An Asian Journal of Soil Science. 2017;12(1):121-127.
2. Bacchewar GK, Gajbhiye BR. Correlation studies on secondary nutrients and soil properties in soils of Latur district of Maharashtra. Research Journal of Agricultural Science. 2011;2(1):91-94.
3. Challa O, Vadivelu S, Sehgal JL. Soils of Maharashtra for optimizing land use. NBSS Pub: 54 (soils of India series). NBSS and Land Use Planing Nagpur, India; 1998. p. 112.
4. Chaudhari RD, Kadu PP. Assessment of fertility status of the soils of Dhule tehsil of Dhule district. Paper presented at: state level seminar on soil health enhancement for food and environmental security; October 12-13, 2007; Marathwada Agril. Univ. Parbhani.
5. Gajbe MV, Londe MG, Varade SB. Soils of Marathwada. Journal of Maharashtra Agricultural University. 1976;(2-6):55-59.
6. Gathala MK, Yadav BV, Singh SD. Mineral nutrient status of pomegranate orchards in Jaipur district of Rajasthan. J. Indian Soc. Soil. Set. 2004;52(2):206-208.
7. Gosavi NI, Chaudhari RD. Micronutrient status in soils of Shirpur Tahsil of Dhule district (M. S.), India. An Asian Journal of Soil Science. 2016;11(2):353-357.
8. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd; 1973. p. 498.
9. Joshi SV. Morphology, Genesis and Classification of Black Soil. Series A, seminars No 42. 2000;179-185.
10. Kashiwar SR, Kundu MC, Dongarwar UR. Assessment and mapping of soil nutrient status of Sakoli tahsil of Bhandara district of Maharashtra using GIS techniques. Journal of Pharmacognosy and Phytochemistry. 2019;8(5):1900-1905.
11. Kaushal GS, Tembare BR, Sinha SB. Morphology and taxonomy of black soil under bargi irrigation project in Madhya Pradesh. J. Indian Soc. Soil Sci. 1986;34(2):329-333.
12. Malewar GU. Micronutrient availability as influenced by cropping pattern in Marathwada region of Maharashtra. J. Maharashtra Agric. Univ. 1995;20(2):330-333.
13. Medhe SR, Takankhar VG, Salve AN. Correlation of chemical properties, secondary nutrient and micronutrient anion from the soils of Chakur tahsil of Latur district,

Maharashtra. An International Peer-Reviewed Journal. 2012;1(2):2318-5037.
14. Meena HB, Sharma RP, Rawat US. Status of Macro- and Micronutrients in Some Soils of Tonk District of Rajasthan. Journal of the Indian Society of Soil Science. 2006;54(4):508-512.
15. Padole VR, Mahajan SB. Status and release behavior of potassium in swell-shrink soils of Vidharbha region of Maharashtra. J. Maharashtra Agric. Univ. 2003;28(1):3-7.
16. Parwe SK. Nutritional evaluation of pomegranate orchards of south east region Beed district by soil and leaf analysis. VNMKV; 2013.
17. Patil YM, Sonar KR. Status of major and micronutrient of swell-shrink soils of Maharashtra. J. Maharashtra Agric.Univ. 1994;19(2):169-172.
18. Pradeep RG, Dasog S, Kuligod VS. Nutrient status of some groundnut growing soils of upper Krishna command area, Karnataka. Karnataka Journal of Agricultural Science. 2006;19(1):131-133.
19. Raghupathi HB, Bhargava BS. Leaf and soil nutrient diagnostic norms for pomegranate. J. Indian Soc. Soil Sci. 1998;46(3):412-416.
20. Ramamoorthy B, Bajaj JC. Available N, P and K status of the Indian soils. Fertilizer News. 1969;14(8):24-26.
21. Ravte SS. Studies on status of available secondary nutrient and micronutrient anions in Ausa and Ausa tahsils of Latur district. Vasantrao Naik Marathwada Krishi Vidyapeeth; 2008.
22. Richard H, Cambell P. In diagnosis and improvement of saline and alkali soils. Hand book, US. Dept. Agri; 1948. p. 60.
23. Shinde YR. Physio-chemical properties and nutrient availability of soils of Udgir and Deoni tahsils of Latur district. Vasantrao Naik Marathwada Krishi Vidyapeeth; 2007.
24. Singh J, Kumar R. Influence of soil nutrient status on yield and qualitative attributes of pomegranate (*Punica granatum* L.) and ber (*Zizyphus mauritiana* L.). Hort. Flora Res Spectrum. 2012;1(1):5-12.
25. Ushasri B, Kumar CM, Patil DS, Pawar RB. GPS and GIS based soil fertility maps of micronutrient status of Bhudargad tahsil of Kolhapur district (M.S.). International journal of Chemical Studies. 2019;7(6):6-10.
26. Waghmare MS, Takankhar VG. Status of available nutrients in soils of Ausa tahsil of Latur district. Paper presented at: state level seminar on soil health enhancement for food and environmental security; October 12-13, 2007; Vasantrao Naik Marathwada Agricultural University Parbhani.
27. Waghmare MS, Indulkar BS, Bavalgave VG, Mali CV, Takankhar VG. Chemical properties and micronutrient status of some soils of Ausa tahsil of Latur, Maharashtra. An Asian Journal of Soil Science. 2008;3(2):236-241.
28. Waikar SL, Malewar GU, More SD. Elemental composition of humic acid fulvic acid in soils of Marathwada region of Maharashtra. J. Maharashtra Agric. Univ. 2004;29(2):127-129.