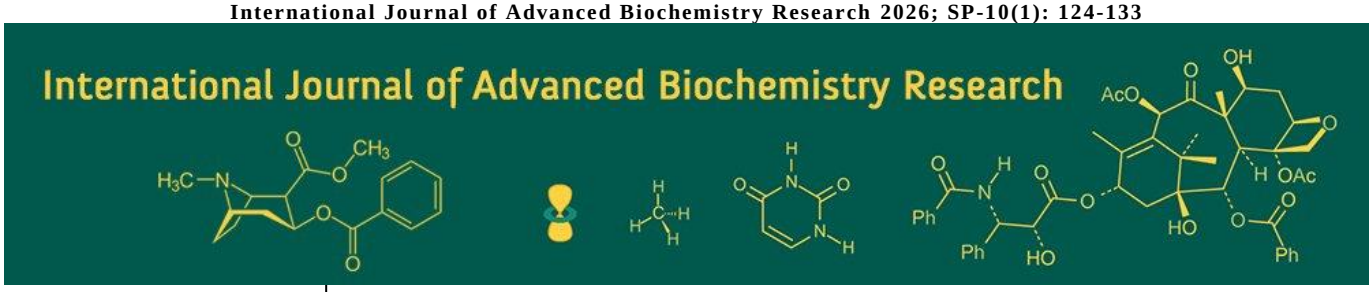

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Studies on evaluation of fertility status of soybean growing area of Latur and its adjacent Tahsil

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Abstract
The present investigation entitled "Studies on Evaluation of Fertility Status of Soybean Growing Area of Latur and its Adjacent Tahsil" was carried out with object to know the influence of soil and leaf nutrient status on yield and quality of Soybean during 2024-2025. The collected soil and leaf samples were analyzed for different parameters using standard procedure. 20 villages were selected from four tahsils of latur district. The results obtained are summarized below.
Physico-chemical properties like pH of Latur tahsil soil ranged from 7.1-8.4, with average value 7.6. EC of soil was ranged from 0.4-2.7 with average value 1.2. Organic Carbon of Latur tahsil soil ranged from 0.27-0.81 per cent with average values 0.54 per cent. Calcium Carbonate of Latur tahsil soil ranged from 2.1-8.1 per cent with average values 4.6 per cent.
Available Nitrogen of Latur tahsil soil was ranged from 156-424 kg ha^{-1} with average value 252.96 kg ha^{-1}. Available Phosphorus ranged from 1.11-23.32 kg ha^{-1} with average value 13.3 kg ha^{-1}. Available Potassium ranged from 199-992 kg ha^{-1} with average value 654.05 kg ha^{-1}. Available Sulphur ranged from 9.12-31.8 kg ha^{-1} with average value 18.69 kg ha^{-1}. Ex-Ca Latur tahsil soil ranged from 18.6-52.2 (cmol(p^+) kg^{-1}) with average values 41.71 (cmol (p^+) kg^{-1}). Ex-Mg Latur tahsil soil ranged from 9.3-23.4 (cmol(p^+)kg^{-1}) with average value 15.09 (cmol (p^+)kg^{-1}).
DTPA micronutrients (Zn, Fe, Cu and Mn) of. Latur tahsil soil ranged from 0.12-0.98, 1.7-9.1, 6.48-36.32 and 1.1-9.8 Mg kg^{-1} with average values 0.61, 4.7, 18.04 and 4.01 Mg kg^{-1}.
Total nutrients in Latur tahsil (N, P, K, S) ranged from 2.23-4.91, 0.11-0.65, 2.1-6.5 and 0.24-4.2 per cent with average values 2.82, 0.22, 5.19, and 2.71 per cent and (Fe and Zn) ranged from 88-509, 18.6-78.7 ppm with average values 339.16 and 43.51 ppm.
With respect to nutrient index value Latur tahsil was categorized low in Nitrogen (1.44), Phosphorus (1.44) and Zinc (1.64) content. Medium in Manganese (2), Iron (2.12), Sulphur (2.2) While High in Potassium (2.88), Calcium (3), Magnesium (3) and Copper (3).

Keywords: Soil fertility evaluation, Soybean, Latur district, Physico-chemical properties, Macro-nutrients, Micro-nutrients, Nutrient index

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

The soils in the Latur taluka are primarily black and clayey, ranging from shallow to very deep and varying in color from black to yellowish-brown. They are often moderately alkaline, with a pH between 7.25 and 8.53, and are low to moderate in organic carbon. These soils are suitable for crops like sugarcane and soybean, though they may have low to medium phosphorus and zinc content. To evaluate the soil fertility of Latur 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 soybean 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 soybean 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 Soybean growing area of Latur Tahsil.

The data (Table 1) indicated that, pH of soils of Soybean growing area of Latur Tahsil ranged from 7.1 to 8.4 with mean value of 7.6, SE value 0.07 and CV value 4.73%. The soil sample LS-4 collected from Sakhra village showed the lowest pH (7.1) while, the highest value (8.4) was recorded in soil samples LW-4 and LW-5 collected from Wanjarkheda village, respectively. On the basis of categorization of soil samples, out of 25 samples, 9 were neutral (36%) and 16 samples were alkaline (64%) in reaction (Table 2).

The data (Table 1) revealed that the EC of soils of Soybean growing area varied between 0.4 to 2.7 dSm^{-1} with mean value of 1.2 dSm^{-1}, SE value 0.14 and CV value 60.55%. The soil sample LS-4, LSar-1, LW-3 and LK-5 collected from Sakhra, Sarsa, Wanjarkheda and Karkatta villages showed the lowest EC (0.4 dSm^{-1}) however, the highest value (2.7 dSm^{-1}) was recorded in soil samples LH-5 and LW-1which collected from Harangul and Wanjarkheda villages, respectively. As per categorization of soils of Soybean growing areas, out of 25 samples 13 (52%) were shows No deleterious effect on crops, 9 (36%) samples shows Critical for germination and 3 (12%) samples were found Critical for salt sensitive crops (Table 2).

The organic carbon content in soils ranged from 0.27 to 0.81 per cent an average value of 0.54 per cent, SE value 0.03 and CV value 30.77%. The soil samples LH-2 collected from Harangul village, respectively showed the lowest organic carbon content (0.27%). While, the highest value (0.81%) was recorded in soil sample LK-4 from Karkatta village (Table 1). On the basis of categorization of organic carbon content of soils of Soybean growing area, out of 25 samples, 6 (24%) soil samples were categorized as low in organic carbon content, 18 (72%) were medium and 1 (4%) high with respect to organic carbon content. (Table-2).

The calcium carbonate content in soils ranged from 2.1 to 8.1 per cent with mean value of 4.6 per cent, SE value 0.41 and CV 44.89%. The lowest calcium carbonate content (2.1%) was recorded in soil sample LH-1 collected from Harangul village whereas, the highest calcium carbonate content (8.1%) was recorded in the sample no LSar-5 collected from Sarsa village (Table 1). Out of 25 soil samples, 3 (12%) soil samples were Non calcareous, 14 (56%) Calcarious and 8 (32%) soil samples were rated as highly calcareous (Table 2).

Table 1: Physico-chemical properties of soils of Soybean growing area of Latur Tahsil.

Latur					
Sr. No.	**Sample No.**	**pH**	**EC (dSm^1)**	**OC (%)**	**$CaCO_3$ (%)**
1.	LS 1	8.1	0.6	0.41	3.2
2.	LS 2	7.9	1.6	0.28	3.3
3.	LS 3	7.8	0.9	0.47	4.2
4.	LS 4	7.1	0.4	0.77	3.8
5.	LS 5	7.3	1.6	0.68	3.1
6.	LH 1	7.5	0.9	0.51	2.7
7.	LH 2	8.1	0.6	0.27	2.1
8.	LH 3	7.8	1.4	0.51	2.4

9.	LH 4	7.6	0.6	0.37	2.2
10.	LH 5	7.2	2.7	0.73	3.6
11.	LSar 1	7.2	0.4	0.77	3.4
12.	LSar 2	7.7	2.6	0.45	3.5
13.	LSar 3	7.6	1.3	0.47	3.9
14.	LSar 4	7.8	1.6	0.56	4.2
15.	LSar 5	7.6	0.6	0.57	8.1
16.	LW 1	7.5	2.7	0.36	7.5
17.	LW 2	7.6	1.9	0.74	7.9
18.	LW 3	7.9	0.4	0.67	2.8
19.	LW 4	8.4	0.8	0.58	6.6
20.	LW 5	8.4	1.7	0.56	4.1
21.	LK 1	8.2	1.6	0.36	6.7
22.	LK 2	7.7	0.8	0.32	7.5
23.	LK 3	7.4	1.8	0.52	7.9
24.	LK 4	7.2	0.6	0.81	4.2
25.	LK 5	7.5	0.4	0.76	8.0
Range		7.1-8.4	0.4-2.7	0.27-0.81	2.1-8.1
Mean		7.6	1.2	0.54	4.6
S.E.		0.07	0.14	0.03	0.41
C.V. (%)		4.73	60.55	30.77	44.89

Table 2: Categorization of soil samples for physico-chemical properties in Latur Tahsil.

pH	**Category**	**Acidic**	**Neutral**	**Alkaline**	
	No. of samples	00	09	16	
	%	00	36	64	
EC	Category	No deleterious effect on crops	Critical for germination	Critical for salt sensitive crops	Injurious to most crops
	No. of samples	13	09	03	00
	%	52	36	12	00
Organic Carbon	Category	Low	Medium	High	
	No. of samples	06	18	01	
	%	24	72	4	
$CaCO_3$	Category	No Calcarious	Calcarious	High Calca.	
	No. of samples	03	14	08	
	%	12	56	32	

With respect to soils of Latur tehsil, 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 Soybean 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 Latur Tahsil.

The data (Table 3) revealed that there was wide range of variation in the available nitrogen in these soils. It ranged from 156 to 424 kg ha^{-1} with mean value of 252.96 kg ha^{-1}, SE 16.35 and CV 32.32%. The minimum available nitrogen content (156 kg ha^{-1}) was observed in soil sample LS-4 collected from Sakhra village whereas, the maximum content (424 kg ha^{-1}) was recorded in soil sample LW-4 collected from Wanjarkheda village. The data (table 4.10 fig 6) further showed that 16 (64%) soil samples were found low, 7 (28%) medium while 2 (4%) were high in available nitrogen. (table 4)

The available phosphorus content of soil samples ranged from 1.11 to 23.32 kg ha^{-1} with an average value of 13.3 kg ha^{-1}, SE 1.11 and CV 41.57%. The lowest content (1.11 kg ha^{-1}) of available P was recorded in soil sample LK-2 collected from Karkatta village whereas, the highest content

(23.32 kg ha^{-1}) was recorded in soil sample LW-1 collected from Wanjarkheda village (Table 3). Out of 25 samples, 14 (56%) soil samples were found low while, 11 (44%) samples were found medium in available phosphorus content (table 4)

The data (Table 3) indicated that available K content in soils Soybean growing area of Latur Tahsil varied from 199 to 992 kg ha^{-1} with a mean value of 654.05 kg ha^{-1}, SE 45.31 and CV 34.64%. The lowest available potassium (199 kg ha^{-1}) was noted in soil sample LK-3 collected from Karkatta village whereas, the highest available potassium (992 kg ha^{-1}) was recorded in soil sample LW-2 collected from Wanjarkheda village. Out of 25 soil samples, 3 (12%) samples were Medium and 22 (88%) samples were high in potassium content (Table 4)

Table 3: Status of primary nutrients in soils of Latur Tahsil.

Latur				
Sr. No.	**Sample No.**	**N (kg ha^{-1})**	**P (kg ha^{-1})**	**K (kg ha^{-1})**
1.	LS 1	194	11.38	496
2.	LS 2	348	5.57	649.6
3.	LS 3	340	7.34	406.4
4.	LS 4	156	19.36	650.4
5.	LS 5	261	12.36	669.2
6.	LH 1	163	16.76	658.4
7.	LH 2	261	17.52	435
8.	LH 3	263	6.34	892
9.	LH 4	165	19.36	860.8
10.	LH 5	164	11.44	849.6
11.	LSar 1	282	12.84	661.6
12.	LSar 2	312	11.04	984
13.	LSar 3	163	17.34	694.4
14.	LSar 4	267	8.76	482.4
15.	LSar 5	265	14.38	690
16.	LW 1	284	23.32	881.6
17.	LW 2	168	19.48	992
18.	LW 3	169	18.52	890
19.	LW 4	424	12.52	648
20.	LW 5	312	4.57	696
21.	LK 1	273	17.37	231
22.	LK 2	422	1.11	244
23.	LK 3	321	13.32	199
24.	LK 4	173	19.1	856
25.	LK 5	174	12.8	634
Range		156-424	1.11-23.32	199-992
Mean		252.96	13.3	654.05
S.E.		16.35	1.11	45.31
C.V. (%)		32.32	41.57	34.64

Table 4: Categorization of soil for primary nutriets in Latur Tahsil.

Available N	**Category**	**Low**	**Medium**	**High**
	No. of samples	16	07	02
	%	64	28	8
Available P	Category	Low	Medium	High
	No. of samples	14	11	00
	%	56	44	00
Available K	Category	Low	Medium	High
	No. of samples	00	03	22
	%	00	12	88

Thus based on Soils of Latur 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 confarmatory with results reported by Waghmare and Takhankar (2007) [26] in soils of Ausa and Nilanga 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 Soybean growing area categorized as Medium to high. The high content of K is due do 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 Latur Tahsil.

The available Sulphur content of soils ranged from 9.12 to 31.8 kg ha^{-1} with an average value of 18.69 kg ha^{-1}, SE 1.03 and CV 27.80%. The lowest content (9.12 kg ha^{-1}) of available Sulphur was recorded in sample LW-3 collected from Wanjarkheda village whereas, the highest content (31.8 kg ha^{-1}) was recorded in soil sample LK-5 collected from Karkatta village (Table 5). Out of 25 soil samples, 2 (8%) samples were found low while, 16 (64%) samples were found medium and 7 (28%) high in available Sulphur content (Table 6).

The exchangeable calcium varied from 18.6-52.2 cmol (p^+) kg^{-1} with a mean value of 41.71 cmol (p^+) kg^{-1}, SE 1.91 and CV 22.95%. The lowest exchangeable calcium (18.6 cmol kg^{-1}) was found in the village of Harangul (sample no. LH-2), while the highest exchangeable calcium (52.2 cmol (p^+) kg^{-1}) was found in the village of Harangul (sample no.LH-3) (Table 5). Out of 25 soil samples from, all 25 samples (100%) had a high exchangeable calcium content (Table 6).

The status of exchangeable magnesium in the soils of studied area was ranged from 9.2-23.4 cmol (p^+) kg^{-1} with the mean value of 15.09 cmol kg^{-1}, SE 0.83 and CV 27.50%. The minimum exchangeable magnesium (9.2 cmol (p^+) kg^{-1}) was observed in the village of Sakhra (sample no LS-1) whereas maximum exchangeable magnesium (23.4 cmol kg^{-1}) was observed in Sakhra village (sample no LS-2) (Table 5). Among the 25 soil samples, all 25 samples (100 percent) were in the high category. (Table 6).

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

Latur				
Sr. No.	**Sample No.**	**S (kgha^{-1})**	**Exch Ca^{++} (cmol (p^+)kg^{-1})**	**Exch Mg^{++} (cmol (p^+)kg^{-1})**
1.	LS 1	22.16	46.8	9.3
2.	LS 2	18.2	34.3	23.4
3.	LS 3	17.2	19.2	21.2
4.	LS 4	18.4	39.5	13.5
5.	LS 5	22.2	44.7	14.4
6.	LH 1	16.1	30.8	15.25
7.	LH 2	25.3	18.6	16.42
8.	LH 3	27.33	52.2	12.45
9.	LH 4	19.55	51.2	13.5
10.	LH 5	23.65	47.6	14.2
11.	LSar 1	22.4	51.4	11.22
12.	LSar 2	17.8	42	9.4
13.	LSar 3	19.8	38.6	15.6
14.	LSar 4	18.44	39.2	9.4
15.	LSar 5	17.6	48.7	17.5
16.	LW 1	18.2	35.7	9.4
17.	LW 2	19.45	42.1	14.6
18.	LW 3	9.12	48.5	9.38
19.	LW 4	9.44	41.7	13.35
20.	LW 5	13.35	51.4	16.4
21.	LK 1	12.4	52	18.2
22.	LK 2	13.67	30.8	20.1
23.	LK 3	18.42	37	19.38
24.	LK 4	15.38	51.7	21.2
25.	LK 5	31.8	47.1	18.6
Range		9.12-31.8	18.6-52.2	9.3-23.4
Mean		18.69	41.71	15.09
SE		1.03	1.91	0.83
CV		27.80	22.95	27.50

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

	Category	**Low**	**Medium**	**High**
Available S	No. of samples	02	16	07
	%	8	64	28
Exchangeable Ca^{++}	Category	Low	Medium	High
	No. of samples	00	00	25
	%	00	00	100
Exchangeable Mg^{++}	Category	Low	Medium	High
	No. of samples	00	00	25
	%	00	00	100

Based on Latur 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 Latur Tahsil.

The DTPA-Zn content in soils was varied from 0.12 to 0.98 mg kg^{-1} with an average value 0.61 mg kg^{-1}, SE 0.06 and CV 51.64%. The minimum Zn content (0.12 mg kg^{-1}) was recorded in soil samples LW-4, LK-1 and LH-2 collected from Wanjarkheda, Karkatta and Harangul villages, respectively whereas, the maximum content (0.98 mg kg^{-1}) was recorded in samples LK-3 collected from Karkatta village (Table 7). The data (Table 8) further revealed that among 25 samples, 9 (36%) samples were low and 16 samples (64%) were medium in zinc content.

The data pertaining to Fe varied from 1.7 to 9.1 mg kg^{-1} with an average tahsil value of 4.7 mg kg^{-1}, SE 0.51 and CV 53.94% in soils of selected villages of Latur district. The lowest value (1.7 mg kg^{-1}) was observed in soil sample LH-5 collected from Harangul village whereas, the highest value (9.1 mg kg^{-1}) was recorded in soil sample LSar-5 collected from Sarsa village (Table 7). As per the categorization of soil samples, Out of 25 samples, 9 (36%) were low, 4 (16%) were medium and 12 (48%) were high in available Fe content (Table 8).

Available Cu varied from 6.48 to 36.32 mg kg^{-1} with an average value 18.06 mg kg^{-1}. The lowest available Cu content (6.48 mg kg^{-1}) was noted in soil sample LH-2 collected from Harangul village whereas, the highest available Cu content (36.32 mg kg^{-1}) was noted in soil sample LSar-2 collected from Sarsa village (Table 7), respectively. All 25 (100%) soil samples were high in copper content (Table 8).

The data on DTPA-Mn showed that it was varied from 1.1 to 9.8 mg kg^{-1} with an average value 4.01 mg kg^{-1} in soils of Soybean growing of Latur tahsil. The lowest content (1.1 mg kg^{-1}) of Mn was observed in soil sample LSar-2 collected from Sarsa village while, the highest value (9.8 mg kg^{-1}) was recorded in soil sample LS-5 collected from Sakhra village (Table 7). According to categorization of soil samples, out of 25 samples, 9 (36%) Low, 7 (28%) soil samples were medium in manganese content and 9 (36%) were found to be high with respect to manganese content. (Table 8).

Table 7: DTPA- Micronutrient status in soils of Latur Tahsil.

Latur					
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.	LS 1	0.33	4.2	14.2	2.5
2.	LS 2	0.52	4.2	22.45	1.2
3.	LS 3	0.41	4.1	21.9	5.6
4.	LS 4	0.97	2.3	9.81	1.3
5.	LS 5	0.59	7.1	24.01	9.8
6.	LH 1	0.82	7.1	21.8	7.5
7.	LH 2	0.12	7.1	6.48	5.1
8.	LH 3	0.23	6.1	7.43	2.3
9.	LH 4	0.56	2.2	14.79	2.4
10.	LH 5	0.92	1.7	10.71	3.9
11.	LSar 1	0.64	2.5	21.81	1.4
12.	LSar 2	0.81	1.8	36.32	1.1
13.	LSar 3	0.97	1.8	20.1	1.5
14.	LSar 4	0.44	7.2	18.22	9.3
15.	LSar 5	0.98	9.1	15.9	3.4
16.	LW 1	0.88	6.1	21.22	1.3
17.	LW 2	0.91	7.1	19.16	8.9
18.	LW 3	0.23	6.1	19.12	2.7
19.	LW 4	0.12	1.8	16.46	1.2
20.	LW 5	0.19	8.1	11.22	8.6
21.	LK 1	0.12	1.9	22.4	6.6
22.	LK 2	0.88	7.1	18.44	2.5
23.	LK 3	0.98	8.1	17.22	7.8
24.	LK 4	0.85	1.9	17.19	1.2
25.	LK 5	0.81	2.1	22.79	1.2
Range		0.12-0.98	1.7-9.1	6.48-36.32	1.1-9.8
Mean		0.61	4.7	18.04	4.01
SE		0.06	0.51	1.25	0.61
CV		51.64	53.94	34.66	76.06

Table 8: Categorization of soil for DTPA-Micronutrients in Latur Tahsil.

DTPA- Zn (Mg kg^{-1})	**Category**	**Low**	**Medium**	**High**
	No. of samples	09	16	00
	%	36	64	00
DTPA- Fe (Mg kg^{-1})	Category	Low	Medium	High
	No. of samples	09	04	12
	%	36	16	48
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	09	07	09
	%	36	28	36

Zinc shows low to Medium range in soils of Latur 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 Soybean plant of Latur Tahsil. (N, P, K, S, Fe and Zn).

Total nitrogen content of Soybean leaves varied from 2.23 to 4.91 per cent with an average of 2.82 per cent, SE 0.15 and CV 27.43%. The lowest amount of total nitrogen (2.23%) was recorded in leaves samples LS-4 collected from Sakhra village whereas, the highest amount (4.91%) was recorded in leaves sample LW-4 collected from Wanjarkheda village (Table 9). On the basis of categorization (Table 10), among 25 samples, 17 (68 per cent) leaves samples was Low in total N content and 8 (32%) medium.

Total phosphorus content of Soybean leaves ranged from 0.11 to 0.65 per cent with an average of 0.22 per cent, SE 0.02 and CV 54.45%. The less amount of total P (0.11 per cent) was noted in leaves sample LK-2 collected from Karkatta village, respectively. However, the high amount of total P (0.65 per cent) was recorded in leaves LW-1 collected from Wanjarkheda village (Table 9). The data further revealed that Out of 25 leaves samples (Table 10), 15 (60%) samples were categorized as low and 10 (40%) samples medium in total phosphorus content.

Total potassium content of Soybean leaves varied from 2.1 to 6.5 per cent with a mean value 5.19 per cent, SE 0.31 and CV 30.35%. The minimum content of total K (2.1%) was recorded in leaves samples LK-3 collected from Karkatta village. Whereas, maximum content (6.5%) was recorded in leaves samples LSar-3, LW-2 and LW-5 collected from Sarsa and Wanjarkheda villages (Table 9). Out of 25 leaves samples 12 (48%) leaves samples were low and 13 (52%) Medium in total potassium content (Table 10).

Total Sulphur content in leaves ranged from 0.24 to 4.2% with a mean value of 2.71%, SE 0.24 and CV 45.49%. The less amount of total S (0.24%) was noted in leaves sample Lw-3 collected from Wanjarkheda village. However, the high amount of total S (4.2%) was noted in leaves sample (LK-5) collected from Karkatta village (Table 9). Out of 25 soybean leaves samples, 1 (4%) samples low, 3 (12%) leaves samples were medium, while 21 (84%) leaves samples high in Sulphur content (Table 10).

Total Iron content in leaves sample ranged from 88 to 509 ppm with a mean value of 339.16 ppm, SE 35.62 and CV 52.51%. The less amount of total Fe (88 ppm) was noted in leaves sample LW-4 collected from Wanjarkheda village. However, the high amount of total Fe (509 ppm) was noted in leaves sample LK-3 collected from Karkatta village (Table 9). Out of, 25 soybean leaves samples, 2 (4%) samples low, 10 (40%) leaves samples were medium, while 13 (52%) leaves samples high in Iron content (Table 10).

Total zinc content in leaves sample ranged from 18.6 to 78.7 ppm with a mean value of 43.51, SE 2.76 and CV 31.79%. The less amount of total Zn (18.6 ppm) was noted in leaves sample LH-5 collected from Harangul village. However, the high amount of total Zn (78.7 ppm) was noted in leaves sample LSar-5 collected from Sarsa village (Table 9). Out of, 25 soybean leaves samples, 2 (8%) samples low and 23 (92%) leaves samples were medium in zinc content (Table 10).

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

Latur							
Sr. No.	**Sample No.**	**Total N (%)**	**Total P (%)**	**Total K (%)**	**Total S (%)**	**Total Fe (ppm)**	**Total Zn (ppm)**
1	LS 1	2.36	0.12	2.95	2.1	507	31.74
2	LS 2	3.52	0.19	6.2	0.26	506	34.3
3	LS 3	2.47	0.18	5.2	3.4	152	19.2
4	LS 4	2.23	0.32	6.2	3.2	181	39.5
5	LS 5	2.48	0.14	6.4	3.5	506	74.7
6	LH 1	2.36	0.35	5.6	3.6	504	30.8
7	LH 2	2.41	0.26	6.5	2.2	161	47.6
8	LH 3	2.43	0.17	2.2	3.4	506	52.2
9	LH 4	2.26	0.43	4.2	3.2	180	51.2
10	LH 5	2.27	0.15	6.2	0.25	175	18.6
11	LSar 1	2.24	0.16	6.4	3.6	504	51.4
12	LSar 2	3.23	0.12	5.4	3.2	507	42
13	LSar 3	3.42	0.22	6.5	2.2	185	38.6
14	LSar 4	4.27	0.16	2.3	3.8	503	39.2
15	LSar 5	4.47	0.23	5.4	3.4	167	78.7
16	LW 1	2.28	0.65	4.4	3.7	159	35.7
17	LW 2	3.42	0.17	6.5	0.29	507	42.1
18	LW 3	3.21	0.24	6.4	0.24	185	48.5
19	LW 4	4.91	0.18	6.2	2.1	88	41.7
20	LW 5	2.46	0.13	6.5	3.6	502	51.4
21	LK 1	2.46	0.26	2.3	3.4	176	52
22	LK 2	2.44	0.11	6.1	3.3	507	30.8
23	LK 3	2.37	0.13	2.1	2.2	509	37
24	LK 4	2.28	0.34	6.4	3.6	98	51.7
25	LK 5	2.36	0.16	5.4	4.2	504	47.1
Range		2.23-4.91	0.11-0.65	2.1-6.5	0.24-4.2	88-509	18.6-78.7
Mean		2.82	0.22	5.19	2.71	339.16	43.51
SE		0.15	0.02	0.31	0.24	35.62	2.76
CV		27.43	54.45	30.35	45.49	52.51	31.79

Table 10: Categorization of samples based on nutrient content in soybean plants of Latur Tahsil.

	Category	**Low**	**Medium**	**High**
Total N	No. of samples	17	08	00
	%	68	32	00
Total P	Category	Low	Medium	High
	No. of samples	15	10	00
	%	60	40	00
Total K	Category	Low	Medium	High
	No. of samples	00	12	13
	%	00	48	52
Total S	Category	Low	Medium	High
	No. of samples	01	03	21
	%	4	12	84
Total Fe	Category	Low	Medium	High
	No. of samples	02	10	13
	%	8	40	52
Total Zn	Category	Low	Medium	High
	No. of samples	02	23	00
	%	8	92	00

Thus, based on overall data of study area. It indicating that majority of Soybean 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 Soybean 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 Soybean 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 Soybean 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 Latur tahsil.

On the basis (Table 11, Fig 1) of resulted nutrient index value, soils from Latur tahsil was categorized low in Nitrogen (1.44), Phosphorus (1.44) and Zinc (1.64) content. Medium in Sulpur (2.2), Manganese (2) and Iron (2.12), While High in Potassium (2.88), Calcium (3), Magnesium (3) and Copper (3). These nutrient index values were calculated as per the formula given by Ramamoorthy and Bajaj (1969) [20].

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

Sr. No.	Soil Nutrients	Latur	
		NIV	Category
1	Nitrogen	1.44	Low
2	Phosphorus	1.44	Low
3	Potassium	2.88	High
4	Sulphur	2.2	Medium
5	Calcium	3	High
6	Magnesium	3	High
7	Zinc	1.64	Low
8	Iron	2.12	Medium
9	Copper	3	High
10	Manganese	2	Medium

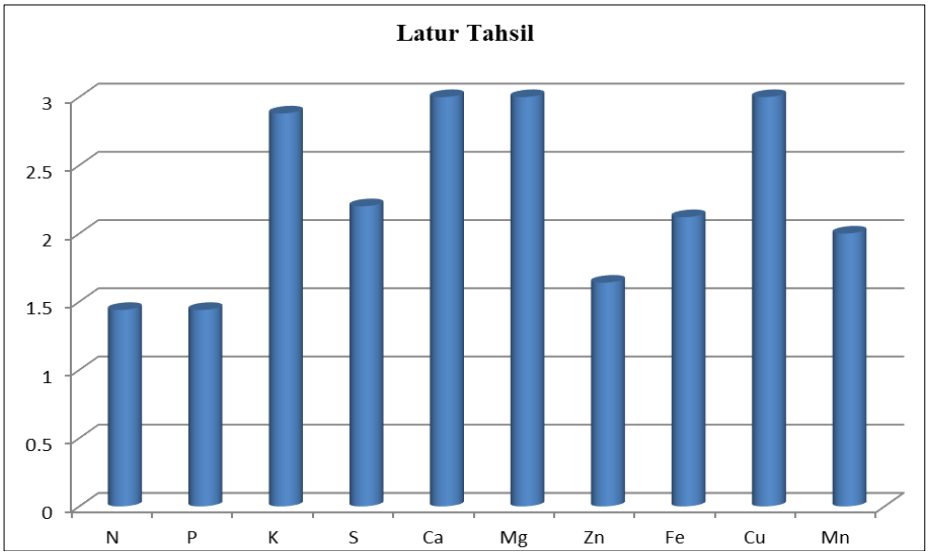

Fig 1: Nutrient index values of soils of Latur tahsil of Latur district

5. Fertility map

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

Table 12: Villegewise soil fertility status of Latur tahsil.

Sr. No.	Villeges	N	P	K	S	Ca	Mg	Zn	Fe	Cu	Mn
1	Sakhra	Low	Low	High	High	High	High	Low	Medium	High	Medium
2	Harangul	Low	Low	High	High	High	High	Low	Medium	High	High
3	Sarsa	Low	Low	High	Medium	High	High	Medium	High	High	Medium
4	Wanjarkheda	Low	High	High	Low	High	High	Low	High	High	Medium
5	Karkatta	Low	Low	High	Medium	High	High	Medium	High	High	Medium

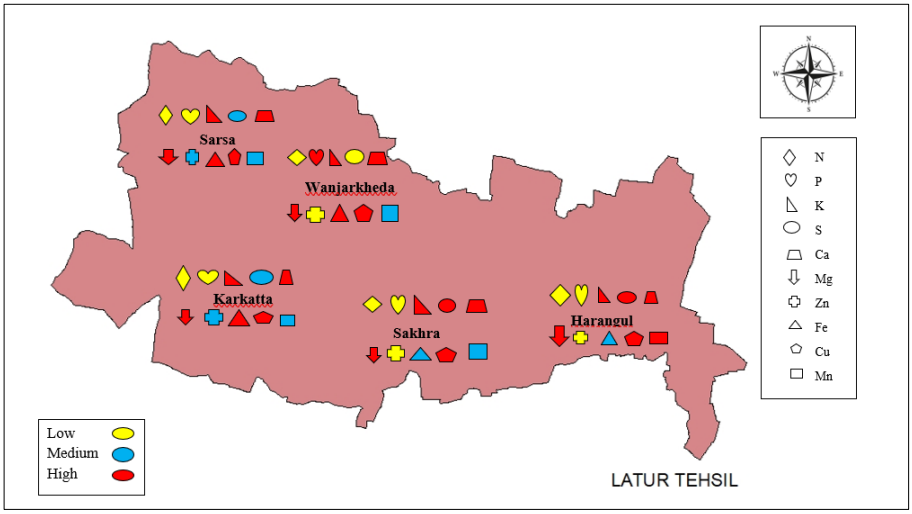

Fig 1: Fertility status of Soybean growing area of Latur tahsil.

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