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Macronutrients status of red soils from Hasegaonwadi of Latur district

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Abstract
The present investigation entitled "Characterization and classification of red soils for land use planning from Hasegaonwadi of Latur district". The study area is located in Hasegaonwadi village in Ausa tahsil, Latur district situated at 18^0 16' 51" N latitude and 76^0 37' 31" E longitudes. It is twenty five km away from Latur city on the way of Budhode-Lodga road. Total geographical area of Hasegaonwadi village is 1016 ha. The study area were surveyed and finalized the site of four soil profiles and forty surface soil samples (0-30cm). Horizon wise profile and surface soil samples were collected for laboratory analysis. Soil fertility status of soils of Hasegaonwadi were found to be low to high. The available nitrogen and sulphur in these soils were low, while available phosphorus was medium to high and potassium was low to medium.

Keywords: Available macronutrients status, fertility status, red soils

Introduction
The study area Hasegaonwadi village of Ausa tahsil located at 18^0 16' 51" N latitude and 76^0 37' 31" E longitudes. Geographical area of Hasegaonwadi is 1016 ha. The climate of the study area was hot, dry and arid. The soil are formed from weathered basalt. The soil was red in colour. During the preliminary survey of area, it was observed that most of the trees grown on these soils were well developed, green foliated and bears good quality and quantity of fruits. Latur district is located on the map to the South-East of Maharashtra on the border of Maharashtra and Karnataka. Latur district is well known for growing oil seed crops (Soybean, Sunflower and Groundnut) pulses (Pigeon pea, Urd bean, Mung bean and Gram), cereals (Jowar) cash crops (Sugarcane) and fruit crops (Mango, Grapes and Pomegranate).
Soil fertility refers to the inherent capacity of the soil to supply nutrients in adequate amounts and in suitable proportions for crop growth and yield. The trend in increasing the yield by adopting high yielding varieties has resulted in deficiency of nutrients in soils and has reflected as deficiency symptoms in plants. Nitrogen, phosphorus, potassium and sulphur are important soil elements that control its fertility and yields of the crops. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response efficiency of chemical fertilizers nutrients has declined tremendously under intensive agriculture in recent years. Variations in nutrient supply is natural phenomenon and some of them may be sufficient where are deficient. Therefore, the present study was undertaken to know the macronutrient status of red soils of Hasegaonwadi of Latur district.

Material and methods
Study Area
The study area of Hasegaonwadi is situated at 18^0 16' 51" N latitude and 76^0 37' 31" E longitudes. It is 25 km away from the Latur city and 18 km away from Ausa which is tahsil of Hasegaonwadi. Total Geographical area of Hasegaonwadi is 1016 ha. The area include red soil hill and its adjoining area having also red colour soils.

Soil Characteristics
The area is covered by the basaltic lava-flows. Same layer of the lava-flow are hard and compact while other are soft. These basalt flows are the result of intense volcanic activity during Cretaceous Eocene period (almost seventy million year ago). When the lava flows were ejected through long narrow fissures on the earth surface. This area has shallow cover of gravelly sediments over a hard basaltic contact within 50 cm of the surface.

Climate
The study area is characterized by hot, dry and arid climate. It has uneven distribution of rains during the monsoon season. The annual rainfall of 794 mm at which nearly 85 per cent is received during June to September. The mean maximum and minimum temperature are 32.12 ^{0}C and 19.69 ^{0}C respectively. April and May have high temperature (37.80 ^{0}C and 39.82 ^{0}C mean temperature), December and January coolest month (12.06 ^{0}C and 13.54 ^{0}C mean temperature). The length of growing period 149 days and humid period were 104 days. The soils has Ustic moisture regime and Hyperthermic temperature regime.

Land use and natural vegetation
The study area is under natural tress viz. Babul, Pimpal and Fruit tress viz. Tamarind (*Tamarindus indica*), Ber (*Zizyphus jujube*), Mango (*Mangifera indica*), Custard apple (*Annona reticulate*). Field bunds and banks of nalas are covered under dry deciduous plant species and grasses. Other commonly occurring crops are Pigeon pea (*Cajanus cajan*), Gram (*Cicer ariantinum*), Sorghum (*Sorghum bicolar*), Soybean (*Glycine max),* Congress Grass (*Parthenium hysterophorus*), Kans (*Succharum spontaneum*).

Analysis of samples
The soil samples were collected during summer, air dried in laboratory at room temperature, grinded using wooden mortar and pestle and sieved through 2 mm sieve, properly labeled and stored in polythene bags for the determination of soil reaction, organic matter, macronutrients and micronutrients content by adopting standard laboratory methods.
Available nitrogen was estimated by alkaline permanganate method by using Automatic Kel-plus distillation unit (Subbiah and Asija, 1956) [5], Available phosphorus was extracted by Olsen's method, reading was recorded using spectrophotometer (Jackson, 1979), Available potassium was determined by flame photometer using 1N Neutral ammonium acetate (pH 7.0) solution as an extractant as described by (Jackson, 1979) and Available sulphur was determined by using spectrophotometer outlined by William and Steinberg (1969) [8]

Results and Discussion
The data in respect of soil fertility macronutrients status of selected pedons of Hasegaonwadi of Latur District are presented in Table 1.

Available Nitrogen
The data presented in Table 1 indicated that the available nitrogen content in soils of Hasegaonwadi of Latur District varied from 128.21 to 183.40 kg ha^{-1} indicating that these soils having very low to low in available nitrogen content. In general, the available nitrogen content of these soils were decreased with increase in depth. The high amount of nitrogen content (mean-162.38 kg ha^{-1}) was found in Typic Haplustepts and low amount in Typic Ustorthents. The surface soils were rich in nitrogen than sub-surface soils. This may due to the application of nitrogenous fertilizer during cultivation of crops (Subramaniam & Kumarswami, 1989) [6] and addition of more organic matter. The presence of nitrogen in murrum layers of all soil profiles may be attributed to leaching of top soil nitrogen to the sub-surface.

Available Phosphorus
The data in Table 1 indicated that the available phosphorus in soils of Hasegaonwadi of Latur District were low to moderate and varied from 21.30 to 32.46 kg ha^{-1} and it was decreased with depth. The data further indicated that the high amount of available phosphorus (mean-30.18 kg ha^{-1}) was found in Typic Haplustepts and low in Typic Ustorthents. Surface layer samples were found to be rich in phosphorus than sub-surface layer, possibly due to fertilization. Vaidya *et al.* (2014) [7] also reported similar trends.

Available Potassium
The data presented in Table 1 indicated that the available potassium in soils of Hasegaonwadi of Latur District ranged from 146.60 to 230.0 kg ha^{-1} (mean-187.74 kg ha^{-1}) indicating that these soils were low to medium in available potassium and it was decreased with depth. The maximum amount of available potassium content (230.0 kg ha^{-1}) was recorded in (P1) Typic Ustorthents, followed by P2 (225.62 kg ha^{-1}).

Available Sulphur
The data presented in table 1 indicated that the available sulphur content in soils of Hasegaonwadi of Latur District ranged from 3.12 to 5.36 mg kg^{-1}(Average 4.55 mg kg^{-1}). The available sulphur in soils were low to medium but in majority soil sample it was low. The maximum amount of available sulphur content (mean-5.36 mg kg^{-1}) was recorded in (P3) Typic Haplustepts. The low amount of available sulphur at surface soil samples were mainly because of the uptake by the crops, low EC and OC values. Mohan *et al.* (2008) [3] and Krishna *et al.* (2017) [2] also reported similar trends. As depth of the soils increses the sulphur contain in the soil was increases due to leaching of Sulphate from upper layer to lower layer.

Table 1: Available Macronutrients in Hasegaonwadi of Latur District

Horizon	Depth (cm)	N (kg ha $^{-1}$)	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	S (mg kg^{-1})
Pedon 1 Hasegaonwadi of Latur District (Typic Ustorthents)					
Ap	0-11	155.44	29.56	230.0	3.65
Ac	11-22	152.20	27.77	166.28	3.30
Cr	22-65	138.70	26.88	154.76	5.10
Pedon 2 Hasegaonwadi of Latur District (Typic Ustorthents)					
Ap	0-10	170.50	32.46	225.62	3.12
Ac	10-16	168.12	30.56	181.53	3.82
Cr	16-53	152.32	28.77	164.28	4.65
Pedon 3 Hasegaonwadi of Latur District (Typic Haplustepts)					
Ap	0-18	183.40	31.67	215.25	3.36
Ac	18-40	168.23	29.77	192.79	4.52
Bw1	40-70	154.13	30.98	180.72	4.76

Cr	70-85	145.10	27.40	161.38	5.36
Pedon 4 Hasegaonwadi of Latur District (Typic Ustorthents)					
Ap	0-18	148.30	28.08	197.81	3.15
Ac	18-40	136.25	25.29	158.38	3.85
Cr	40-70	128.21	21.30	146.60	4.28

Status of Available Macronutrients in surface soil samples (0-30 cm)

Deficiency of Nitrogen was almost universal in Indian soil. The plants absorb nitrogen either as ammonium or as nitrate ion. The transformation of the nitrogen compound in the soils involves different processes and conversion of nitrogen containing compounds into humic acid, ammonification, nitrification, denitrification, and then leaching loss of nitrogen compound by intra-soil and surface flow.

The data on status of available N, P and K (Table 2) revealed that the available N content of these soils ranged from 108.26 to 194.87 kg ha^{-1} with a mean value of 147.27 Kg ha^{-1}. The lowest N content (108.26 kg ha^{-1}) was recorded in plot no. H14 whereas the highest N content (194.87 kg ha^{-1}) was recorded in plot no. H4. All the samples were categorized in low N content category of macronutrient status. The available nitrogen is an important factor to increase the soil fertility. Low nitrogen status in the soils could be due to low amount of organic carbon in the soils. Similar results were observed to Singh *et al.* (2015) [4].

The available phosphorus content in these soils ranged from 20.24 to 34.70 kg ha^{-1} with a mean value 27.27 kg ha^{-1}. The highest (34.70 kg ha^{-1}) available phosphorus content was recorded in plot no.H11, while lowest (20.24 kg ha^{-1}) available phosphorus content was recorded in plot no. H40. The comparative study indicated that (Table 2) the phosphorus content was decreased with time. The red soils show low values of available phosphorus, which may be due to low CEC, clay content and acidic soil. Krishna *et al.* (2017) [2].

The available potassium content in soils varied from 125.31 to 277.76 kg ha^{-1} with an average value of 173.22 kg ha^{-1}. The highest available potassium (277.76 kg ha^{-1}) was reported in plot no. H5 and the lowest available potassium (125.31 kg ha^{-1}) was recorded in plot no. H12. The comparative study indicated that (Table 2) the available potassium content was decreased with time. This may be due to continuous cropping which causes continuous removal of potassium through crop harvest and removal of crop residue inferring that experimental soil had inherent high level of K but must be noted that potassium bearing mineral do not provide an inexhaustible K source, and with time, the rate of release of reserve source may decline.

The available sulphur content in soils varied from 2.82 to 4.05 mg kg^{-1} with an average value of 3.37 mg kg^{-1}. The highest available sulphur (4.05 mg kg^{-1}) was reported in plot no. H5 and the lowest available potassium (2.82 mg kg^{-1}) was recorded in plot no. H24. The low amount of available sulphur at surface soil samples were mainly because of the acidic reaction, low EC and OC values. The similar result reported by Mohan *et al.* (2008) [3] and Krishna *et al.* (2017) [2].

Table 2: Available macronutrient of surface soil sample of Hasegaonwadi of Latur district

Sr. No.	Plot No.	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Available S (mg kg^{-1})
1	H1	125.26	27.24	219.52	3.27
2	H2	120.72	25.56	160.27	3.25
3	H3	144.62	28.57	263.87	3.09
4	H4	194.87	24.74	131.82	3.98
5	H5	125.35	30.33	277.76	4.05
6	H6	187.72	24.31	195.87	3.20
7	H7	132.89	22.40	180.41	3.70
8	H8	140.35	31.38	169.66	3.55
9	H9	122.98	28.73	158.46	3.76
10	H10	152.80	29.42	258.38	3.65
11	H11	156.26	34.70	219.96	3.54
12	H12	183.62	25.60	125.31	3.56
13	H13	161.35	21.50	165.18	3.46
14	H14	108.26	20.93	179.20	3.65
15	H15	191.62	25.80	136.19	3.07
16	H16	137.35	26.45	191.39	3.05
17	H17	132.62	30.46	147.26	3.55
18	H18	142.50	25.92	180.08	3.0
19	H19	115.87	24.80	172.46	3.82
20	H20	118.75	27.90	164.84	2.98
21	H21	134.35	23.92	133.16	3.67
22	H22	129.62	26.52	180.65	3.65
23	H23	175.75	26.70	194.19	3.53
24	H24	174.87	32.59	128.96	2.82
25	H25	169.75	33.61	178.28	2.90
26	H26	134.50	28.58	144.35	3.70
27	H27	128.62	25.72	155.68	3.07
28	H28	152.62	23.70	179.07	3.09
29	H29	187.37	24.23	142.78	3.62
30	H30	146.50	27.18	161.15	3.07
31	H31	145.62	33.71	175.93	2.82
32	H32	138.75	31.80	186.46	3.69

33	H33	129.75	28.58	182.09	3.56
34	H34	133.62	31.50	190.04	3.28
35	H35	151.75	30.60	127.12	3.08
36	H36	167.50	29.44	160.14	2.98
37	H37	162.62	23.84	134.60	3.23
38	H38	157.50	22.63	150.40	3.28
39	H39	130.62	29.04	164.62	3.23
40	H40	143.72	20.24	161.58	3.35
	Range	108.26-194.87	20.24-34.70	125.31-277.76	2.82-4.05
	Mean	147.27	27.27	173.22	3.37

Table 3: Categorization of available macro nutrients of Hasegaonwadi of Latur district

Sr. No.	Nutrient	Range	Rating	No. of Samples	General %
1	Av. Nitrogen (kg ha^{-1})	108.26-194.87	Low (<250)	40	100
			Medium (250-500)	0	0
			High (>500)	0	0
2	Av. Phosphorus (kg ha^{-1})	20.24-34.70	Low (<10)	0	0
			Medium (10-25)	12	30
			High (>25)	28	70
3	Av. Potassium (kg ha^{-1})	125.31-277.76	Low (<150)	10	25
			Medium (150-300)	30	75
			High(>300)	0	0
4.	Av. Sulphur (mg kg^{-1})	2.82-4.05	Low (<5)	40	100
			Medium (5-10)	0	0
			High (>10)	0	0

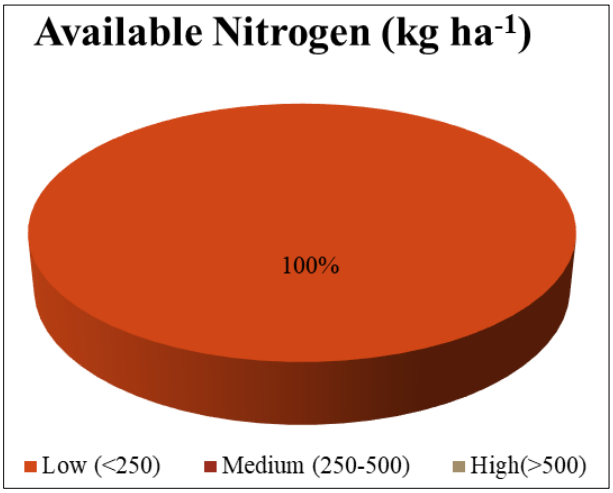

Fig 1: Status of available nitrogen in soils of Hasegaonwadi of Latur district

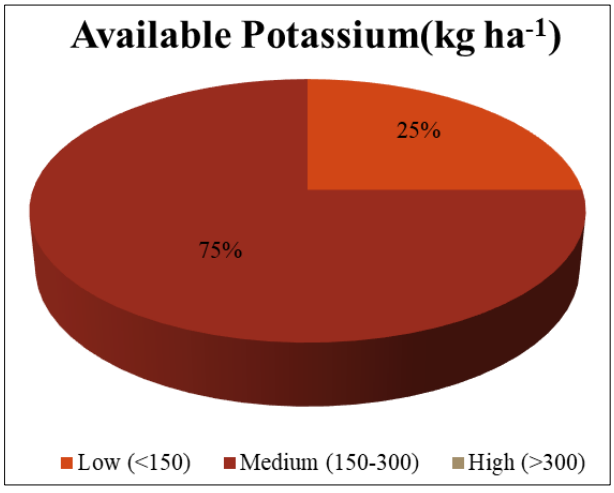

Fig 3: Status of available potassium in soils of Hasegaonwadi of Latur district

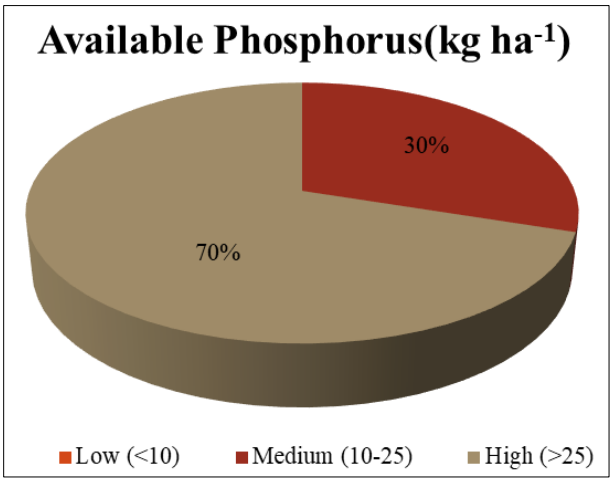

Fig 2: Status of available phosphorus in soils of Hasegaonwadi of Latur district

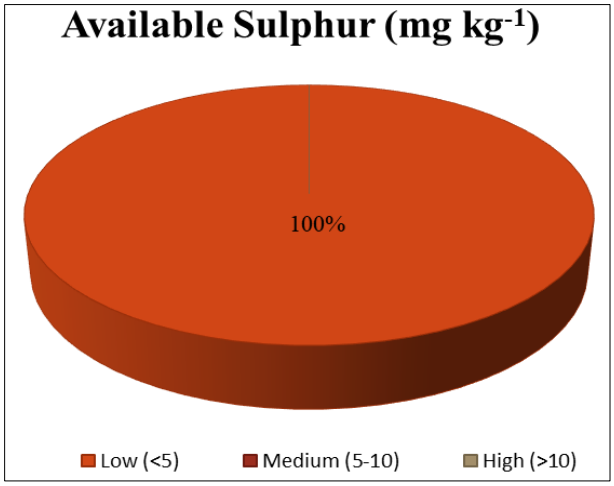

Fig 4: Status of available sulphur in soils of Hasegaonwadi of Latur district

Conclusion

It can be concluded from the results under study that the soil fertility status of surface soil samples varied from low to high. In profile sample, nitrogen, phosphorus, potassium and sulphur was ranged from 128.21 to 183.40, 21.30 to 32.46, 146.60 to 230.0 kg ha^{-1} and 3.12 to 5.36 mg kg^{-1}.

In surface soil samples, the nitrogen, phosphorus, potassium and sulphur ranged from 108.26 to 194.87, 20.24 to 34.70, 125.31 to 277.76 kg ha^{-1} and 2.82 to 4.05 mg kg^{-1}, with a mean value of 147.27, 27.27, 173.22 kg ha^{-1} and 3.37 mg kg-1. The available nitrogen and sulphur in soils were low while, available phosphorus was medium to high and potassium was low to medium.

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