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Status of available major nutrients in soils of Aravalli district of Gujarat

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Abstract
A study was undertaken to assess the status of available major nutrients in soils of Aravalli district of Gujarat. Total 240 surface (0-15 cm) soil samples were collected from cultivated farmer's fields of 6 talukas of Aravalli district during 2016. The soil samples were analyzed for available N, P_2O_5, K_2O and S. The available N, P_2O_5, K_2O and S content in these soils ranged from 109.76 to 344.76, 18.75 to 100.40, 120.96 to 967.68 kg/ha and 5.11 to 23.87 mg/kg with a mean value of 230.30, 51.44, 345.24 kg/ha and 14.89 mg/kg, respectively. Out of 240 soil samples, 61.3 per cent were found to be low in available nitrogen status, 46.7 per cent were found to be medium in available phosphorus status, 56.7 per cent were found to be high in available potassium status and 65.4 per cent were found to be medium in available sulphur status. Overall, soils of Aravalli district had nutrient index values of 1.39, 2.22, 2.55 and 1.99 for available N, P_2O_5, K_2O and S which indicates low, adequate, high and marginal fertility status, respectively.

Keywords: Available N, P_2O_5, K_2O, S, Nutrient index

Introduction
Soil testing is the key to fertility management while reclamation and rehabilitation of degraded lands is strategic to maintain over all soil health. The basic objective of the soil-testing programme is to give farmers a service leading to better and more economic use of fertilizers and better soil management practices for increasing agricultural production. Soil major nutrients are essential to plants growth; maintain ecosystems and high crop yields. However, imbalance fertilization, deteriorate the precious soil environment particularly N and P can be potentially hazardous to water resources when their available components in soils are excessive, because available macronutrients can be transported off site in runoff due to rain or irrigation (Phupaibul *et al*., 2004 and Ju *et al*., 2007) [8, 3] and subsequently degrades the soil and reduced the productivity.

Nitrogen is one of the most important major nutrient as well as expensive input in agricultural production, which is closely associated with growth and development of plants. It plays an important role in plant metabolism by virtue of being an essential constituent of structural component of the cell and many metabolically active compounds. Phosphorus is facilitating plant nutrient as it is involved in a wide range of plant processes, from permitting division to development of a good root system ensuring timely and uniform ripening of crop. Potassium is well known for its ability to improve crop quality and its role in combating a variety of climatic and biological stress. Potassium has been, thus rightly called by many other names such as a root booster, stalk strengthener, food former, an enzyme activator, a breathing regulator, water stretcher, sugar and starch transporter, protein builder, wilt reducer and disease retardant. Sulphur recognized as fourth important plant nutrient after N, P and K and is gaining considerable importance in quality crop production in context of Indian agriculture, particularly when there is more and more use of non-S containing fertilizers as well as less use of organic manures.

Material and Methods
To assess the available nitrogen, phosphorus, potassium and sulphur content in soils of Aravalli district, total 240 representative surface soil samples were collected from farmer's fields. One representative surface soil sample was collected from field upto a depth of 0 to 15 cm by zig-zag method. Forty soil samples were collected from each 6 talukas of Aravalli district during April-2016. The soil samples were air dried in shade. The soil samples, after air

drying were ground with wooden mortar and pestle and passed through 2.0 mm sieve. The prepared soil samples were stored in polyethylene lined cloth bags with proper labels. The soil samples were brought to laboratory for further analysis. The standard analytical methods followed for estimating available nitrogen, phosphorus, potassium and sulphur content in soil are given in Table 1.

Table 1: Standard analytical methods for estimating available major nutrients

Sr. No.	Parameter	Method	Reference
1	Available N	Alkaline potassium permanganate method	Subbiah and Asija (1956) [13]
2	Available P_2O_5	Extraction : 0.5 M $NaHCO_3$ (pH 8.5) Colorimetric method	Olsen *et al.* (1954) [4]
3	Available K_2O	Extraction : 1 N NH_4OAc (pH 7.0) Flame photometric method	Jackson (1973) [2]
4	Available Sulphur	Extraction : 0.15% $CaCl_2$	Williams and Steinbergs (1959) [14]

Nutrient index was calculated utilizing the following formula suggested by Parker *et al.* (1951) [5]:

$$\text{Nutrient Index} = \frac{(N_l \times 1) + (N_m \times 2) + (N_h \times 3)}{N_t}$$

Where, N_l, N_m and N_h are the number of samples falling in low, medium and high categories for nutrient status and are given weightage of 1, 2 and 3, respectively. N_t is the total no. of sample. The nutrient index values are rated into various categories *viz.*, very low, low, marginal, adequate, high, and very high as rating given by Stalin *et al.* (2010) [12].

Results and Discussion

Available nitrogen

Overall, available nitrogen status of soils for the Aravalli district was low and it ranged from 109.76 to 344.96 kg/ha with a mean value of 230.30 kg/ha (Table 2). Such lower values for available N might be due to lower content of organic carbon and little addition of organic matter as well as less use of organic manures in the arid tract. Similar results were also reported for soils of Gir Somnath district (Polara and Chauhan, 2015) [9].

Available phosphorus

The available P_2O_5 status was medium in soils of most of talukas. The available P_2O_5 status of soils varied from 18.75 to 100.40 kg/ha with a mean value of 51.44 kg/ha, which was in medium categories (Table 2). The medium content of available phosphorus in these soils might be due to regular application of phosphatic fertilizers to realise higher yields of oil seeds, which are the principal crops of the area. Patel *et al.*, (2017) [6] observed similar results for soils of Gandhinagar district of Gujarat.

Available potassium

Overall, available potassium status of soils for the Aravalli district was high and varied from 120.96 to 967.68 K_2O kg/ha with an average of 345.24 kg/ha (Table 2). The high available potassium content in these soils might be attributed to the prevalence of potassium rich minerals like illite, feldspar, muscovite and high potassic fertilizers use. Similar results were also obtained for soils of Gandhinagar district of Gujarat (Patel *et al.*, 2017) [6].

Available sulphur

Overall, available sulphur status of soils for the Aravalli district was medium and varied from 5.11 to 23.87 mg/kg with a mean value of 14.89 mg/kg (Table 2). The medium status of sulphur in soils of Aravalli district might be due to use of S-bearing fertilizers such as ammonium sulphate and magnesium sulphate by the cultivators and cultivation of S loving oil seed crop. Such medium status of available sulphur in soils of Banaskantha district was also recorded by Patel *et al*. (2012) [7].

Table 2: Talukawise range and mean values for available N, P_2O_5, K_2O and S in soils of Aravalli district

Name of Taluka	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)	Available S (mg/kg)
Modasa	125.44-297.92 (209.72)	18.75-97.26 (49.68)	134.40-551.04 (295.34)	9.81-23.73 (17.58)
Dhansura	141.12-329.28 (232.46)	19.15-100.40 (47.26)	215.04-940.80 (463.34)	7.83-23.87 (15.69)
Bayad	109.76-313.60 (221.87)	19.82-94.71 (53.95)	147.84-967.68 (366.58)	6.46-23.63 (14.93)
Meghraj	172.48-329.28 (241.08)	23.63-99.22 (57.76)	120.96-564.48 (280.90)	5.71-19.44 (13.45)
Malpur	156.80-344.96 (240.30)	26.72-94.98 (52.96)	147.84-577.92 (281.23)	5.11-22.17 (13.97)
Bhiloda	141.12-329.28 (236.38)	19.22-88.53 (47.06)	188.16-779.52 (384.05)	5.35-21.79 (13.75)
District	109.76-344.96 (230.30)	18.75-100.40 (51.44)	120.96-967.68 (345.24)	5.11-23.87 (14.89)

Note: Value in parenthesis indicates mean values

Nutrient index values of available major nutrients

The nutrient index values for available major nutrients content in soils are presented in Table 3. Overall, soils of Aravalli district had nutrient index values of 1.39, 2.22, 2.55 and 1.99 for available N, P_2O_5, K_2O and S, respectively. Based on overall nutrient index values of soils in Aravalli district and the criteria suggested by Stalin *et al.* (2010) [12], soils of Aravalli district have low fertility class for available N, adequate fertility class for available P_2O_5, high fertility class in respect of available K_2O and marginal fertility class in respect of available S status. Similar results were reported for available nitrogen in soils of Amreli district of Gujarat (Polara and Kabaria, 2006) [10], for available phosphorus in soils of Patan district of Gujarat (Anonymous, 2013) [1], for available potassium in soils of Bhavnagar district of Gujarat (Rajput and Polara, 2012) [11] and for available sulphur in soils of Gandhinagar district of Gujarat (Patel *et al.*, 2017) [6].

Table 3: Talukawise nutrient index values and fertility status of available major nutrients in soils of Aravalli district

Name of Taluka	Nutrient index values				Fertility status			
	N	P_2O_5	K_2O	S	N	P_2O_5	K_2O	S
Modasa	1.18	2.15	2.40	2.33	Very low	Adequate	High	High
Dhansura	1.40	1.98	2.80	2.03	Low	Marginal	Very high	Adequate
Bayad	1.33	2.28	2.60	2.03	Low	Adequate	High	Adequate
Meghraj	1.43	2.48	2.28	1.78	Low	High	Adequate	Marginal
Malpur	1.50	2.30	2.43	1.93	Low	Adequate	High	Marginal
Bhiloda	1.50	2.13	2.83	1.85	Low	Adequate	Very high	Marginal
District	1.39	2.22	2.55	1.99	Low	Adequate	High	Marginal

Conclusion

In soils of Aravalli district of Gujarat, the content available nitrogen was classified in low category. Status of available phosphorus and sulphur, was medium while status of available potassium was high. Based on overall nutrient index value in soils of Aravalli district, available N, P_2O_5, K_2O and S were classified in low, adequate, high and marginal fertility status, respectively.

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