

Research Article

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Soil fertility status and nutrient recommendations based on soil analysis of Jaisalmer district of western Rajasthan

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Summary

The present investigation was carried out for assessment of soil fertility status of Jaisalmer district of western Rajasthan. For this purpose 125 representative soil samples were collected from two Panchayat Samiti *i.e.* Sankda village Ujala and Jaisalmer village Basanpeer and Amersagar of Jaisalmer district. These soil samples were analyzed for soil properties, macro and micronutrient fertility status. The soils were moderately alkaline to very strongly alkaline in reaction with an average pH of 9.75. The EC value varied from 0.05 to 0.71 dS/m with average value of EC is 0.25 dS/m. The organic carbon content ranged from 0.01 to 0.70 per cent with an average value of 0.09 per cent. Available nitrogen, phosphorus (P_2O_5), potassium (K_2O) and sulphur (ppm) content of the soils ranged from 13.53 to 230.07, 5.43 to 56.72, 170.13 to 379.95 kg ha⁻¹ and 0.88 to 21.76 ppm with an average value of 131.95, 25.96, 258.13 kg ha⁻¹ and 11.34 ppm, respectively. However, available micronutrient DTPA Zn, Fe, Cu and Mn ranges varied from 0.04 – 1.63, 1.05- 3.94, 0.01-0.21 and 0.14-2.88 ppm with an average value of 0.51, 0.21, 0.09 and 1.55 ppm per hectare, respectively. Among major nutrients, about 100 per cent of the soil samples were low in available nitrogen, 57.60, 36.00 and 6.40 per cent soil samples were observed to be low, medium and high in available P_2O_5 , 87.20 and 12.80 per cent samples were in medium and high in available K. whereas, 44.80, 54.40 and 0.80 per cent soil samples were observed to be low, medium and high in available sulphur. Nutrient indexing of the areas was low for N (1.00), Cu (1.016) and Mn (1.112), whereas, it was medium in case of phosphorus, potassium, sulphur, DTPA-Zn and Fe. With respect to micro-nutrients 66.40, 46.40, 99.2, 94.40 per cent samples were found to be deficient in DTPA-Zn, Fe, Cu and Mn, respectively. The correlation studies among the chemical characteristics showed that organic carbon contributed most towards nutrient availability and found to be positively correlated with all parameters except pH and Zn.

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It was now obvious that the increased use of

fertilizers would benefit not only the farmers, but also the entire nation. The more immediate problem was to

determine the right rates of application for the various crops in each region. A country wide survey of responses to fertilizers had become essential. Soil fertility fluctuates throughout the growing season each year due to alteration in the quantity and availability of mineral nutrients by the addition of fertilizers, manure, compost, mulch and lime or sulfur, in addition to leaching. Hence, soil testing will determine the current fertility status and provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields and further to maintain the optimum fertility in soil year after year.

Resource and Research Methods

The study area district Jaisalmer is located within a rectangle lying between 26° 4' –28° 23' North parallel and 69° 20'–72° 42' east meridians. It is the largest district of Rajasthan and one of the largest in the country. The breadth (East-West) of the district is 270 kms and the length (North-South) is 186 kms. On the present map, district Jaisalmer is bounded on the north by Bikaner, on the west and south-west by Indian boarder, on the south by Barmer and Jodhpur, and on the east by Jodhpur and Bikaner districts. The length of international boarder attached to district Jaisalmer is 471 kms. Geographically this district is spread over in 38,401 sq. kms. The climate is extremely hot during summer with maximum temperature reaching upto 49.2°C and extremely cold during winter with minimum temp. in the range of 1°C. The variation in temperature from morning to noon and the late midnight is a sudden phenomenon. The average rainfall is only 16.4 cms as against the state average of 57.51 cms. The district comes under the Agro Climatic Regions IC-Hyper Arid Partial Irrigated Zone with annual

rainfall 100-350 mm. Desert soils and sand dunes aeolian soil loamy coarse in texture and calcareous soils are found in this region. In order to study on assessment of soil fertility status of jaisalmer district 125 surface soil samples with the depth of 0-15 cm were collected from two Panchayat Samiti namely Sankda village Ujala and Jaisalmer village Basanpeer and Amersagar. The composite surface soil samples (0-15 cm) were air dried and sieved through 2 mm sieve to remove stones and organic residues by following standard procedure. The processed samples were analyzed for their chemical properties employing conventional methods. The soil pH, EC and organic carbon were estimated by the standard procedures as described by Jackson (1973). Available nitrogen was determined following the method of Subbiah and Asija (1956). Available phosphorus and potassium were determined by Bray and neutral ammonium acetate methods, respectively (Jackson, 1971). Available sulphur was determined by the procedure described by Chesnin and Yien (1951). DTPA extractable zinc, iron, manganese and copper contents in the soils were determined by atomic absorption spectrophotometer (Lindsay and Norwell, 1978). The soil nutrient index was calculated according to the procedure given by Parker (1951).

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Chemical properties :

The pH value of the Jaisalmer district is highly alkaline. The pH ranges between 8.01 and 10.63 (Table 1) and the average value of pH is 9.75. The pH of 100

	Minimum	Maximum	Range	Mean	Standard deviation
pH	8.01	10.63	2.62	9.75	0.52
EC (dS/m)	0.05	0.71	0.66	0.25	0.19
OC (%)	0.01	0.7	0.69	0.09	0.08
N (kg ha ⁻¹)	13.53	230.07	216.54	131.95	46.16
P ₂ O ₅ (kg ha ⁻¹)	5.43	56.72	51.29	25.96	11.84
K ₂ O (kg ha ⁻¹)	170.13	379.95	209.82	258.13	49.26
S (ppm)	0.88	21.76	20.88	11.34	5.4
Zn (mg kg ⁻¹)	0.04	1.63	1.59	0.51	0.28
Fe (mg kg ⁻¹)	1.05	3.94	2.89	0.21	2.88
Cu (mg kg ⁻¹)	0.01	0.21	0.2	0.09	0.05
Mn (mg kg ⁻¹)	0.14	2.88	2.74	1.55	0.4

% (Table 2) soil samples found more than 8.5 pH. The high degree of sodium saturation which on hydrolysis gives OH⁻ ion and high carbonate and bicarbonate. Similar results were also reported by Singh *et al.* (2010). Whereas the EC value of the soils was in neutral range *i.e.* 0.05 to 0.71 dS/m (Table 1) and the average value of EC was 0.25dS/m. The EC of 100 per cent (Table 2) soil sample under 1 dS/m. These values are fairly comparable to the result reported by Singh *et al.* (2010). The organic carbon content of the soils was very low due to hot arid climate. It ranged between 0.01 and 0.71 per cent (Table 1). The average value of OC was 0.25 per cent. The OC of 100 per cent (Table 2) sample were found lower than 0.50 per cent of OC. The low OC content of these soils may be attributed to occasional addition of organic materials, lack of natural vegetation, poor decomposition due to low rainfall, oxidation due to high summer temperature and wind erosion. The similar result were also reported by Prasad (2010). The nitrogen content of soil varied between 13.53 and 230.07 kg/ha (Table 1) with an average of 131.95 kg/ha. The available N of 100 per cent (Table 2) samples were found lower than 280 kg/ha N. The reasons for low available N in soils of area under study might be due to low organic

matter content, low precipitation and prevailing high temperature which aggravates the problem of organic matter oxidation. The results of present study are in conformity of those reported by Dhale and Prasad (2009). The phosphorus nutrient was found medium in the soils with the variation of 5.43 to 56.72 kg/ha and an average was recorded 25.96 kg/ha (Table 1). The available P in study area was found to be in the order of high, medium and low in 6.4, 36.0 and 57.6 per cent (Table 2) samples, respectively. The available P was found medium to low due to low mobility of phosphorus similarly result was also found by Singh (2009). The potassium content was found medium and varied in the soils between 170.13 and 379.95 kg/ha with an average value of 258.13 kg/ha (Table 1). The available K was found 12.8 and 87.2 per cent (Table 2) high and medium. The available K high to Medium was found due to presence of potash bearing minerals (Muscovites, biotits and feldspar) which on weathering slowly release potash. The results of present study are in accordance with those reported by Marathe and Bharambe (2007). As a secondary nutrient, sulphur was estimated low and varied from 0.88 ppm to 21.76 ppm with an average of 11.34 ppm (Table 1). The available S of in study area was found to be in the order

Table 2 : Soil samples (%) falling in different ranges of pH, EC, OC and available N, P, K and S			
Parameter	Value	Rating	Sample %
ph (1:2)	less than 6.5	Acidic	0
	6.5 to 8.5	Normal	0
	Greater than 8.5	Alkaline	100
EC (1:2) (dS/m)	Less than or equal to 1.0	Normal	100
	Greater than 1.0	Saline	0
Organic carbon (%)	less than 0.50	Low	100
	0.50 to 0.75	Medium	0
	Greater than 0.75	High	0
Available N (kg/ha)	less than 280	Low	100
	280 to 560	Medium	0
	Greater than 560	High	0
Available P ₂ O ₅ (kg/ha)	less than 25	Low	57.6
	25 to 50	Medium	36
	Greater than 50	High	6.4
Available K ₂ O (kg/ha)	less than 130	Low	0
	130 to 330	Medium	87.2
	Greater than 330	High	12.8
Available sulphur (ppm)	less than 10	Low	44.8
	10 to 20	Medium	54.4
	Greater than 20	High	0.8

of high, medium and low in 0.8, 54.4 and 44.8 per cent (Table 2) samples, respectively. The DTPA Zn, Fe, Cu and Mn were found deficient with 66.4, 46.4, 99.2 and 94.4 per cent (Table 3) and rest of soil samples were found sufficient, respectively.

Nutrient index values :

Nutrient indexing approach (Ramamoorthy and Bajaj, 1969) was followed to evaluate the nutrient status of Jaisalmer area as in this strategy the variation in individual field was not taken into consideration but the

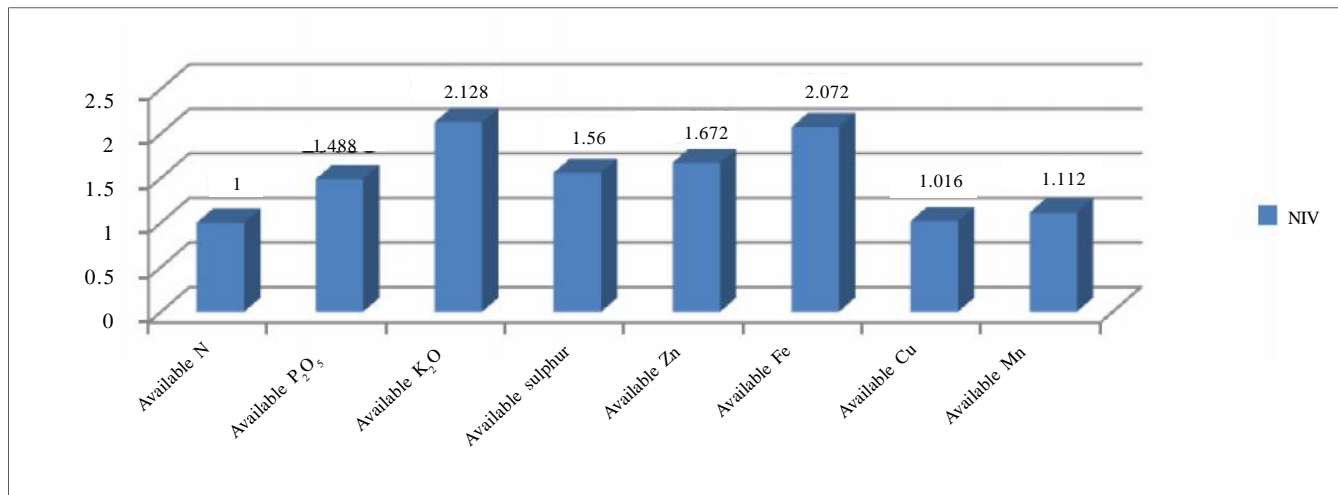


Fig. 1 : Nutrient index value of Jaisalmer district of Rajasthan

Table 3 : Micronutrient status (mg kg⁻¹) of soils in Jaisalmer district of Rajasthan

Available micronutrients	Rating	Sample %
Zinc (Zn) ppm	Deficient <0.60 ppm	66.4
	Sufficient > 0.60 ppm	33.6
Iron (Fe) ppm	Deficient <2.50 ppm	46.4
	Sufficient > 2.50ppm	53.6
Copper (Cu) ppm	Deficient <0.20 ppm	99.2
	Sufficient > 0.20ppm	0.8
Manganese (Mn) ppm	Deficient <2.0 ppm	94.4
	Sufficient > 2.0ppm	5.6

Table 4 : Correlation co-efficients among important nutritional parameters of the soil of Jaisalmer district of Rajasthan

Parameter	pH	EC	OC	N	P	K	S	Zn	Fe	Cu	Mn
pH	1	.640**	-.006	.381**	-.275**	.583**	.465**	-.069	.253**	.344**	-.072
EC		1	.232**	.527**	-.014	.576**	.660**	-.141	.267**	.354**	-.152
OC			1	.557**	.262**	.274**	.259**	-.098	.195*	.333**	.063
N				1	.090	.521**	.281**	-.005	.481**	.609**	.061
P					1	-.050	-.080	.072	-.022	.023	-.040
K						1	.342**	-.082	.148	.273**	-.127
S							1	-.118	.160	.184*	-.101
Zn								1	-.070	.148	.067
Fe									1	.683**	.064
Cu										1	.151
Mn											1

* and ** indicate significance of values at P=0.05 and 0.01 level (2-tailed), respectively

fertilizer recommendations were made on the basis of overall nutritional status of the study area. As per nutrient index (Fig. 1) study of the Jaisalmer areas of Rajasthan, soils were deficient in available nitrogen (1.0), copper (1.016) and manganese (1.112), whereas in case of phosphorus, potassium, sulphur, zinc and iron it was medium (1.48, 2.128, 1.56, 1.672 and 2.072, respectively). It shows that soil has great demand for nitrogen, copper and manganese followed by potassium, phosphorus, sulphur, zinc and iron was in adequate amount in most of the soils, against the fertility index values < 1.67 for low, 1.67 to 2.33 for medium and > 2.33 for high fertility status of soils of Jaisalmer district. Hence, fertilizers recommendation should be applied on the basis of soil test.

Correlation study :

The result reflected in Table 4 *i.e.* the soil pH was positively correlated to EC, available N, K, S, Fe and Cu and negatively correlated with OC, P and micronutrients (Table 4). Whereas, EC was positively correlated with soil OC, available N, K, S, Fe and Cu but negatively correlated with P, Zn and Mn. OC was significantly correlated with all the nutrients except with pH and Zn. N was positively correlated to all macro and micronutrients except Zn. Available P was positively correlated to OC, N, Zn and Cu and negatively correlated to EC, pH, K, Fe and Mn. Available K was negatively correlated to P, Zn and Mn except K which was positively correlated to rest all nutrient. The available S was positively correlated with each other except P, Zn and Mn. The available Zn was negatively correlated to all nutrient except available P, Cu and Mn. Available Fe was positively correlated to all the nutrients except available P and Zn. Available Cu was positively correlated with all the available nutrients. The available Mn was positively correlated to OC, N, Zn, Fe and Mn but negatively correlated with pH, EC, available P, K and S.

Conclusion :

Based on the criteria for calculating nutrient index, the soils of Jaisalmer district were characterized as low medium- low (LML) category. Majority of the soil samples were having low to medium per cent organic carbon and available nitrogen and it is useful to apply organic wastes as an important source of nutrient to the agricultural fields. Soils from agricultural fields with low

to medium phosphorus content could be supplemented by applying phosphorus rich fertilizers as required by a specific crop. Soil samples with deficient and doubtful supply of potassium can be enriched with garden compost that contains 0.48 per cent K_2O or vermicompost containing around 0.7 per cent K_2O . Further micronutrient Fe and Zn were found low and Cu and Mn medium. So required micronutrient fertilizers application should be according nutrient index values.

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