

## PHYSICO-CHEMICAL CHANGES IN SOIL AS INFLUENCED BY NATURAL TREE AND GRASS COVERS IN ARID RANGELAND

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### ABSTRACT

Studies were undertaken to ascertain changes as influenced by vegetation cover i.e. trees and grass over bare dune soil. Marked changes were observed in soil chemical pattern under vegetation cover in comparison to adjacent bare dune as organic carbon increased from 0.03% in bare dune soil to 0.4% under tree cover and 0.15% under grass cover, total N increased from 0.007% on bare soil to 0.04% under tree and 0.01% under grass, available P increased from 7.5 kg ha<sup>-1</sup> on bare dune soil to 17.0 kg ha<sup>-1</sup> under tree and 9.0 kg ha<sup>-1</sup> under grass cover and available K revealed similar pattern. Nutrient level under tree cover decreased with increase in soil depth while under grass cover nutrient decreased marginally upto 30 cm depth without further change with depth. Physical characteristics also improved marginally under tree and grass cover.

### INTRODUCTION

Soil under the plant cover is nutritionally improved than the adjacent bare soil. Grass by nature have major roots in depth just below the soil surface so the changes in the fertility are prominent in upper layer of the soil whereas, in the trees, bulk root biomass penetrates to the deeper layer of the soil, therefore, the changes in soil properties take place in deeper horizons.

Some studies have been conducted in the past separately either for grass (Dhir and Gajbhiye, 1970) and for trees (Aggarwal et al. 1976; Aggarwal and Lahiri, 1977) but no comparative study has been undertaken which could highlight the relative changes in physico-chemical properties of the soil.

### MATERIAL AND METHODS

The soil samples were collected from an area of western Rajasthan between 27° 28' to 29° 36' N latitude and 73° 32' to 75° 06' E longitude with predominantly *Ziziphus nummularia*, *Prosopis cineraria* and *Balanites aegyptica* tree covers and *Lasiurus indicus*, *Cenchrus ciliaris*, and *Cymbopogon jwarancusa* grass cover lands. The soil texture was sandy having more than 90% sand. Five spots were selected randomly at seven sites and plants of *Z. nummularia*, *P. cineraria* and *B. aegyptica* were used as

reference points while in grasslands five well dominated patches of grasses under reference were selected. In case of tree cover the soil samples were collected within 1 metre radial distance from the stem. Soil samples from bare dunes were also collected for comparing the fertility changes as affected by tree and grass cover.

Soils were sampled at three depth viz. 0-15, 15-30 and 30-60 cm. Soil analysis was carried out following standard procedures. The data of respective depths and sample sites were pooled and their mean values were used for interpreting the results.

## RESULTS AND DISCUSSION

**Effect of tree cover :** Soil pH was neutral to slightly alkaline under *Z. nummularia*, *P. cineraria* and *B. aegyptica* and in bare dune soil. Organic matter was highest under *B. aegyptica* followed by *P. cineraria* and *Z. nummularia*. Total N increased upto 0.05, 0.04 and 0.03% under *Z. nummularia*, *P. cineraria* and *B. aegyptica*, respectively, compared to bare dune soil.

Available N was highest under *Z. nummularia* followed by *P. cineraria*, *B. aegyptica*. Available P was same under all trees. Available K changed to higher side in comparison to bare dune soil. Exchangeable  $\text{Ca}^{2+} + \text{Mg}^{2+}$  constituted about 80% of base exchange capacity which was highest under *B. aegyptica*, followed by *P. cineraria* and *Z. nummularia* and least in bare dunes. In sub soil the organic carbon, total N and available nutrients decreased (Table 1).

**Effect of grass cover :** Organic matter increased under pasture land and was highest under *C. ciliaris*, followed by *C. jwarancusa* and *L. indicus*. Total N was highest under *C. jwarancusa* followed by *L. indicus* and *C. ciliaris* grass lands and quite low in bare dunes. Available N was highest under *L. indicus*, followed by *C. jwarancusa* and *C. ciliaris*. The variation in soil chemical properties under different covers at subsurface layers (15-30 and 30-60 cm depth) was narrower in comparison to surface soil. Nutrient content at sub layers was also low as compared to surface soil.

**Effect of tree and grass covers on physical properties of the soil :** The soil texture under trees and grass covers did not change over the time eventhough percentage of fine particles increased (Table 2) under tree and grass cover. Water holding capacity of soils under trees and grasses was more than barren dune soil. Infiltration rate decreased under tree and grass land in comparison to barren dune soil. The field capacity of soil under tree and grass covers was also more in comparison to bare dune soil.

Table 1. Soil chemical properties under trees, grasses and bare dunes

Soil properties	Depth (cm)	Trees cover			Grass cover			Bare dunes
		<i>Zizyphus nummularia</i>	<i>Prosopis cineraria</i>	<i>Balanitis aegyptica</i>	<i>Lasurus sindicus</i>	<i>Cenchrus ciliars</i>	<i>Cymbopogon jwarancusa</i>	
pH	0-15	7.8	8.3	8.2	8.3	7.6	8.0	8.2
	15-30	8.0	8.5	8.2	8.0	7.6	8.0	8.2
	30-60	8.2	8.7	8.4	8.0	8.1	8.0	8.2
O.C. (%)	0-15	0.25	0.47	0.48	0.13	0.16	0.15	0.03
	15-30	0.18	0.38	0.35	0.07	0.10	0.15	0.03
	30-60	0.13	0.20	0.30	0.07	0.08	0.15	0.03
EC (dSm <sup>-1</sup> )	0-15	0.34	0.44	0.44	0.31	0.32	0.40	0.30
	15-30	0.34	0.36	0.39	0.32	0.31	0.41	0.30
	30-60	0.35	0.36	0.36	0.32	0.32	0.32	0.29
Total N (%)	0-15	0.05	0.04	0.03	0.01	0.01	0.02	0.01
	15-30	0.03	0.04	0.03	0.01	0.01	0.02	0.01
	30-60	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Available N (kg ha <sup>-1</sup> )	0-15	230	227	195	160	120	130	87.5
	15-30	160	200	179	130	100	110	82.0
	30-60	160	120	120	130	100	110	89.0
Available P (kg ha <sup>-1</sup> )	0-15	17.0	18.0	16.0	9.0	10.0	8.0	7.5
	15-30	15.0	15.0	15.0	11.0	8.0	7.0	7.3
	30-60	11.0	11.4	11.9	6.0	8.5	7.5	7.5
Available K c mol (p <sup>+</sup> ) kg <sup>-1</sup>	0-15	0.78	0.75	0.65	0.55	0.49	0.46	0.40
	15-30	0.70	0.68	0.50	0.45	0.50	0.36	0.39
	30-60	0.67	0.69	0.56	0.39	0.39	0.35	0.39
Exch. Ca + Mg c mol (p <sup>+</sup> ) kg <sup>-1</sup>	0-15	4.1	4.4	4.8	3.8	3.5	3.0	1.90
	15-30	4.1	4.5	4.0	3.2	3.6	2.6	1.75
	30-60	4.3	5.1	4.9	3.5	3.0	2.9	1.82

Table 2. Effect of tree and grass cover on soil physical properties

Soil properties	Bare dune soil	Tree cover	Grass cover
Sand (%)	95.6	92.8	93.6
Silt (%)	2.1	3.0	3.1
Clay (%)	2.3	4.2	3.3
WHC (%)	20.6	26.6	24.8
Field Capacity (%)	5.4	8.0	7.5
I.R. (cm hr <sup>-1</sup> )	8.5	6.3	6.5

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