

## Storage of Nutrients In Different Components of Selected Tree Species, Shrubs and Herb Layer Under the Tree Species



### Science

**KEYWORDS :** Nutrient concentration, tree components, shrubs, herb layer, sand dunes

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### ABSTRACT

*In the present study accumulation of nutrients (N, P, Ca, Mg, and K) in various plant parts of three different dominant trees i.e. Acacia senegal (As), Acacia tortilis (At) and Eucalyptus camaldulensis (Ec), shrubs and herb layer present under their canopy was determined. Concentration of nutrients was determined for bole, first order branch, other branch, foliage, seeds, stump root, lateral root and fine roots while for the dominant shrubs nutrient concentration was determined in stem, foliage and roots. In case of herbaceous ground vegetation, nutrient concentration was estimated for above ground and below ground parts. The study was carried out in the sand dunes of Western foot hill gaps of Central Aravalli located at a distance of 10 Km N-W to Ajmer, a centrally situated city of Rajasthan. The concentration of nutrients was found to be maximum in foliage except for nitrogen which was estimated higher in seeds of A. senegal and A. tortilis. A different pattern was recorded for E. camaldulensis where N, Ca, and Mg were recorded maximum in other branch, while P and K in foliage parts. The pattern of nutrient concentration in different life forms was observed in the order: Trees > Shrubs > Herbs. Result shows the concentration of nutrients in different tree components in the order: foliage > seeds > other branch > first order branch > bole, and in root components: fine root > lateral root > stump root. Total nutrient concentration was found to be maximum in As followed by At and Ec. It is concluded that the foliage and above ground component of various trees, shrubs and herb layer has maximum nutrient concentrations. There are marked variations in the concentration of different nutrients in each component.*

### Introduction

Nutrient elements play an important role in physiological activities of plants. The primary production of forest ecosystem is influenced by the availability of nutrients (Sharma, 1993). The functioning of most forest ecosystems is generally influenced by the availability of nutrients, which in turn depends on the pattern and rate of their cycling particularly with regard to primary production (Adhikari et al. 1995).

Stabilization of sand dunes is initiated along with enrichment of nutrients and their cycling. The distribution of nutrients in various plant parts and also in different life forms of the vegetation depends upon the functional balance within the system. Reports on nutrient accumulation are available mainly of forest ecosystem (Switzer et al., 1960; Foster and Morrison, 1976; Turner and Singer 1976; Cole and Rapp, 1980) including the tropical forest of India (Singh and Misra, 1978; Singh and Singh, 1986; Kumar et al 2009; Rai B. and Malik B. 2013). In sand dune habitat nutrient storage particularly in the root system is important because they are required for roots or root systems as a whole that enhances the sand binding capacity. Nutrient concentration in plants controls the biochemical as well as biogeochemical cycles (Jha, 2000). The accumulation and the pattern of distribution in different components of plants are affected by climate (Bezilevich and Rodin 1966) and by the type and age of the species (Ovington, 1968).

### Site of study

The area of the study is located at a distance of 10 km N-W to Ajmer, a centrally situated city of Rajasthan lies between 26°25' and 26°29' N latitude and 74°37' and 74°42' E longitude. The area is represented by Aravalli hillocks, sand dunes, sandy plains agricultural fields and fresh water bodies. The region may be regarded as 'ecotone' between NW drier and SE humid climate. The sand dunes selected for present investigation i.e. Pushkar valley Base (dominated by A.tortilis), Leela sewri (dominated by A.sengal) and Pachkund (dominated by E. camaldulensis) are situated in 48 sq.km area in the north-west foot hills of Nagpahar, a prominent mountain belt of central Aravallis. A major part of these sand dunes and sandy plains is stabilized (under the sand dune stabilization programmes by the Forest Department).

### Methods of Study

Freshly fallen plant components of the selected tree species (i.e. As, At and Ec), in about 10x10 m area were collected from the sites of study from 10-20 trees of all available girth classes separately and brought to the laboratory. Samples were weighed and equal portions of samples of different sites and of same species were pooled together.

To study nutrient concentration of organic material, the plant components were air dried in shade for about one month and a known quantity (4gm) of dried and ground plant parts (freshly fallen) of each selected tree species, under storey shrubs and herbs were taken in 3 replicates and chemical analysis was done. Nitrogen (N) was estimated using micro-kjeldahl distillation unit. A 250 gm of plant material was taken and procedure as described by Misra (1968) was followed. Ash content was determined by the method described by Peach and Tracy, 1956. The ash was dissolved in 10 ml of Hcl and heated on water bath for 15 min. Then it was filtered in a flask through Whatman (no. 42) filter paper. The filter paper was again washed with dilute Hcl and water and volume of the filtrate was made up to 250 ml. A 50 ml aliquot was taken from the ash solution and from this aliquot Ca and K contents were estimated according to the method described in Misra (1968). Filtrate from Calcium determination was used for estimation of Mg and further preceded according to the method described by Misra (1968). A 5gm plant material was washed in presence of magnesium nitrate to prevent the loss of the P in ash solution. Percentage of transmission was read at 660 nm on systronic spectrophotometer Model 106. Phosphorus concentration was estimated with the help of standard curve.

### Result and Discussion

The pattern of nutrient concentration in different life forms was in the order: Trees > Shrubs > Herbs (for As- 114.397%> 30.095%> 12.747%, for At- 81.483%> 35.806%> 13.550% and for Ec- 68.215%> 27.960%> 14.474%) table-1. Since the leaf component of the plant is metabolically more active, it accumulates maximum amount of nutrients and the proportional contribution of leaves decreases from herbs to trees, the overall nutrient concentration also decreases (Golley et al., 1975).

**Table: 1.The pattern of nutrient concentration in different life forms of Acacia senegal, Acacia tortilis and Eucalyptus camaldulensis.**

Name of trees/ Life forms	Acacia Senegal	Acacia tortilis	Eucalyptus camaldulensis
Trees	114.397%	81.483%	68.215%
Under storey Shrubs	30.095%	35.806%	27.960%
Under storey Herbs	12.747%	13.550%	14.474%

In the present study concentration of nutrients in different above ground tree component was observed in the order: foliage > seeds > other branch > first order branch > bole (in As 26.65%> 18.107%> 13.84%> 12.137%> 10.11%, in At 17.44%>

16.61%> 13.93%> 11.05%> 6.15% and in Ec 13.37%> 12.53%> 11.93%> 09.06%> 05.93%) and in root components: fine roots > lateral roots > stump root (for As 15.82%> 9.67%> 8.03%, for At 7.26%> 6.62%> 2.41% and for Ec 06.91%> 05.26%> 03.22%) table-2, 3 and 4. This pattern confirms with the earlier reports of Rodin and Bazilevich (1967).

An analysis of different nutrients (N, P, Ca, Mg, and K) in As tree components showed that the foliage had the higher percentage of nutrients (Ash- 15.7%, N- 6.2%, P- 0.32%, Ca- 0.68%, Mg- 0.35%, K- 3.40% and Total- 26.65%) as compared to other components (table -1) except N which was maximum in

seeds (10.2%). The order of nutrient concentration in different components of As was found as follows: Ash (55.17%)> N (46.60%)> K (06.41%) > Ca (03.64%)> Mg (01.70%)> P (00.87%). In shrub component under As foliage had maximum amount of nutrients (13.65%) followed by stem (09.14%) and roots (07.30%). In herb layer under As above ground components had higher amount of nutrients (8.15%) than below ground component (04.59%). N in both aboveground and belowground components of herb layer (3.40% and 1.40% respectively), was maximum, while P concentration was lowest in both above and below ground components (0.302% and 0.075%) table-2.

**Table: 2 Concentration of nutrients (% + 1 s.e.) in different components of tree Acacia senegal (As)**

Components	Ash	N	P	Ca	Mg	K	Total
Tree							
Bole	05.12±0.701	04.2±0.984	0.070±0.005	0.47±0.086	0.10±0.038	0.15±0.017	10.11
First order branch	06.20±1.000	04.7±0.735	0.090±0.006	0.58±0.600	0.19±0.035	0.37±0.029	12.13
Other branch	07.05±1.110	04.9±0.401	0.100±0.009	1.00±0.132	0.30±0.042	0.49±0.018	13.84
Foliage	15.70±1.570	06.2±1.990	0.320±0.105	0.68±0.069	0.35±0.027	3.40±1.000	26.65
Seeds	05.70±0.927	10.2±3.003	0.200±0.013	0.30±0.025	0.20±0.030	1.50±0.024	18.10
Stump root	04.40±0.502	03.3±0.582	0.003±0.001	0.18±0.006	0.09±0.007	0.10±0.006	08.07
Lateral root	05.20±0.931	03.9±0.501	0.034±0.005	0.20±0.046	0.17±0.035	0.17±0.019	09.67
Fine root	05.80±1.200	09.2±1.000	0.060±0.007	0.23±0.048	0.30±0.025	0.23±0.056	15.82
Total	55.17	46.6	0.877	3.64	1.70	6.41	114.397
Shrub							
Stem	4.03±0.680	4.32±0.890	0.060±0.005	0.37±0.058	0.23±0.23	0.13±0.010	09.140
Foliage	6.00±0.821	5.80±1.005	0.230±0.011	0.48±0.053	0.39±0.015	0.75±0.068	13.650
Root	3.39±0.503	3.14±0.257	0.045±0.006	0.29±0.012	0.20±0.021	0.24±0.019	07.305
Total	13.42	13.26	0.335	1.14	0.82	1.12	30.095
Herb							
Above ground	2.35±0.124	3.40±0.500	0.302±0.034	0.40±0.053	0.60±0.042	0.11±0.075	8.152
Below ground	1.35±0.038	1.40±0.043	0.075±0.006	0.20±0.025	0.57±0.058	0.10±0.056	4.595
Total	3.70	4.80	0.377	0.60	1.17	2.10	12.747
Grand Total							155.404

Tree components of At contained higher values of ash content as compared to other nutrients. The nutrient concentration in different components of At tree was in the order: Ash (47.1%)> N (16.29%)> K(9.65%)> Ca(4.51%)> Mg(2.22%)> P(0.713%).

The foliage of At contained higher amount of total nutrients (17.44%) as compared to other tree components (table-2). A similar pattern as As was also observed for shrub and herb layer under At, table-3.

**Table: 3 Concentration of nutrients (% + 1 s.e.) in different components of tree Acacia tortilis (At)**

Components	Ash	N	P	Ca	Mg	K	Total
Tree							
Bole	4.10±0.802	1.00±0.032	0.030±0.006	0.13±0.008	0.16±0.032	0.73±0.071	06.150
First order branch	7.32±1.010	2.00±0.120	0.071±0.008	0.30±0.105	0.32±0.045	1.04±0.032	11.051
Other branch	8.50±1.200	2.30±0.382	0.073±0.005	0.90±0.100	0.34±0.041	1.82±0.042	13.933
Foliage	9.56±1.950	2.40±0.470	0.240±0.015	1.20±0.052	0.33±0.050	3.71±0.720	17.440
Seeds	8.40±0.785	5.10±1.200	0.191±0.013	0.50±0.065	0.37±0.062	2.05±0.252	16.611
Stump root	1.12±0.082	0.84±0.085	0.023±0.005	0.28±0.035	0.11±0.030	0.04±0.012	02.413
Lateral root	3.90±0.750	1.30±0.042	0.031±0.008	1.00±0.132	0.29±0.025	0.10±0.012	06.621
Fine root	4.20±0.834	1.35±0.051	0.054±0.007	1.20±0.130	0.30±0.028	0.16±0.013	07.264
Total	47.100	16.290	00.713	04.510	02.220	09.650	81.483
Shrub							
Stem	4.00 ±0.491	2.72±0.210	0.060±0.007	1.10±0.120	0.27±0.013	1.94±0.104	10.090
Foliage	8.65±0.920	4.35±0.980	0.136±0.050	1.35±0.045	0.43±0.032	2.40±0.120	17.316
Root	3.73±0.722	2.10±0.732	0.030±0.003	0.98±0.068	0.25±0.012	1.31±0.100	08.400
Total	16.38	09.17	00.226	03.43	00.95	05.56	35.806
Herb							
Above ground	2.90±0.250	4.00±0.970	0.260±0.008	0.300±0.012	0.60±0.054	1.02±0.074	09.08
Below ground	1.14±0.028	1.70±0.712	0.100±0.005	0.100±0.007	0.56±0.042	0.87±0.019	04.47
Total	04.04	05.70	00.36	00.40	01.16	01.89	13.55
Grand Total							130.839

In the tree components of Ec, nutrient concentration was observed to be lower as compared to the other trees (As- 114.397> At- 81.483> Ec- 68.215) table-1. The trend was found bit different for Ec, only in some of the elements. It seems that young

branches/ shoots of trees are metabolically more active than older plant parts, where other branch contains higher nutrients (N- 2.60%, Ca-0.80%, Mg- 0.36%) except P (0.17%) and K (1.80%) which was more in foliage component (table-4).

**Table: 4 Concentration of nutrients (% + 1 s.e.) in different components of tree Eucalyptus camaldulensis (Ec)**

Components	Ash	N	P	Ca	Mg	K	Total
Tree							
Bole	4.00±0.871	0.98±0.030	0.007±0.001	0.10±0.005	0.07±0.005	0.78±0.060	05.93
First order branch	5.80±0.825	1.70±0.150	0.030±0.005	0.32±0.024	0.18±0.035	1.03±0.031	09.06
Other branch	6.20±0.710	2.60±0.204	0.174±0.013	0.80±0.120	0.36±0.042	1.80±0.027	11.93
Foliage	6.96±1.000	1.50±0.120	0.330±0.100	0.50±0.035	0.28±0.061	3.80±0.100	13.37
Seeds	7.60±1.100	1.21±0.245	0.201±0.012	0.40±0.074	0.31±0.025	2.81±0.270	12.53
Stump root	1.78±0.120	0.02±0.007	0.010±0.002	0.08±0.002	0.03±0.007	1.30±0.012	03.32
Lateral root	3.00±0.950	0.80±0.052	0.022±0.003	0.30±0.071	0.10±0.020	1.04±0.075	05.24
Fine root	3.99±0.250	1.50±0.015	0.021±0.005	0.39±0.035	0.21±0.022	0.80±0.024	06.91
Total	39.33	10.31	0.795	2.89	1.53	13.36	68.292
Shrub							
Stem	4.20±0.720	0.95±0.120	0.127±0.032	0.27±0.051	0.21±0.054	2.97±0.875	08.727
Foliage	6.66±0.517	1.62±0.352	0.363±0.027	0.53±0.042	0.35±0.016	4.01±1.112	13.533
Root	3.01±0.489	0.52±0.042	0.200±0.010	0.19±0.005	0.14±0.009	1.64±0.250	05.70
Total	13.87	3.09	0.69	0.99	0.70	8.62	27.96
Herb							
Above ground	2.22±0.120	5.20±0.720	0.364±0.025	0.30±0.022	0.63±0.065	0.80±0.071	9.514
Below ground	1.28±0.155	2.00±0.514	0.070±0.004	0.20±0.012	0.61±0.062	0.80±0.084	4.96
Total	3.50	7.20	0.434	0.50	1.24	1.60	14.474
Grand Total							110.726

Tsutsmi (1971) observed that the nutrient concentration of bole and branch varies widely among individual stands even within the same species. Similar observations have been reported for different species of Eucalyptus studied elsewhere (Attiwill, 1979, 1980, Hingston et al 1980, Turner and Lambert, 1983). In general, the major nutrient was N, however in Ec, K (13.36%) was found to be main nutrient. A similar trend was observed in shrubs (08.62%), while in herb layer under Ec contain higher amount of N (07.20%) than K (01.60%). The total nutrient concentration in different components of Ec was in the order K> N> Ca> Mg> P.

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