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TOTAL NITROGEN CONCENTRATION IN NODULATED AND NON NODULATED TREE LEGUMES GROWING IN SINDH

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ABSTRACT

A survey of nodulation was made among 28 species of tree legumes comprising 9, members of Caesalpinaceae, 12 of Mimosaceae and 7 of Papilionaceae. The percentage of nodulation found in Caesalpinaceae, Mimosaceae and Papilionaceae were 11.1 %, 100 % and 100 %respectively. Caesalpinoid genera viz, *Bauhinia, , Delonix , Parkinsonia and Tamarindus* were found non-nodulating . All the twenty eight species including eight non-nodulated and twenty nodulated were analysed for their nitrogen contents. The role of nodulated and non nodulated trees in improving soil fertility of derelict and denuded lands of Sindh has been discussed.

Key-words: Nitrogen concentration, nodulated and non-nodulated trees, Sindh

INTRODUCTION

Nitrogen is essential for plant growth as it is a constituent of all proteins and hence of all protoplasm. It is generally taken up by plants either as ammonium or nitrate ion but the absorbed nitrate is rapidly reduced probably to ammonium, through a molybdenum containing enzyme (Tisdale and Nelson, 1974). In addition majority of leguminous plants establish symbiotic relationship with root nodule bacteria (rhizobia), a process in which elemental dinitrogen is combined with one or more chemical elements producing useful organic nitrogenous compounds (Dixon and Wheeler, 1986). Nodulated legumes have an edge over non nodulated ones, since they can acquire nitrogen from the soil as well as through BNF (biological nitrogen fixation). Although the role of nodulated legume trees in improving and maintaining soil fertility is well documented (Subramanium and Babu, 1994; Thomas, 1995; Mahmood, 1999) yet the role of non nodulated legume trees can not be underestimated. Both nodulated and non nodulated trees contribute directly to the welfare of mankind by providing products such as firewood, pulp, timber, forage and shelter for cattle, fruit and gum and indirectly by improving soil fertility, protecting the soil from erosion and transfer of nutrients from deep layers to the soil surface (Anon., 1979, 1984).

It is interesting to note that most of the non nodulated trees are members of the family Caesalpinaceae, whereas majority of nodulated trees belong to the family Mimosaceae and some to the Papilionaceae (Table 1). In the present paper total nitrogen concentration of nodulated and non nodulated legume trees is presented and role of legume trees in improving soil fertility in the arid lands of Sindh is discussed.

MATERIALS AND METHODS

Periodic field trips were made to various parts of Sindh over a period of three years (1994 - 1997) and leguminous trees were examined for nodulation in natural ecosystem. Altogether 28 species, 9 belonging to Caesalpinaceae, 12 belonging to Mimosaceae and 7 belonging to Papilionaceae were examined. The methods used in collection and preservation of nodules have been described earlier (Mahmood and Iqbal, 1994). Special care was taken to distinguish root nodules from root malformations such are those caused by nematodes , insects and other root inhabiting pathogenic microorganisms. During the nodulation survey of plants a portion of shoot was also collected from each tree. The shoot was pressed in a plant press and brought to the laboratory. The shoots were oven dried at 80 °C for 48 h and milled in an electric grinder. Hundred milligrams of the ground matter was used for the estimation of total nitrogen carried out with Microkjeldahl apparatus following Bergersen (1980).

RESULTS AND DISCUSSION

At the generic level tree legumes form about 16% of the total legume flora of Pakistan. Genera such as *Bauhinia, Cassia, Delonix, Parkinsonia, Peltophorum* and *Tamarindus* (Caesalpinaceae); *Acacia, Albizia, Adenanthera, Leucaena*; *Pithecellobium, Prosopis* and *Samania* (Mimosaceae) and *Dalbergia, Sesbania* (Papilionaceae) grow naturally in Pakistani soils (Ali, 1973 a, b ; 1977).

Table 1. Estimation of nitrogen concentration in nodulated and non-nodulated tree legumes of Sindh.

S.No.	Species	Nodulation Status Status	Nitrogen concentration % (mg)
	CAESALPINACEAE		
1	*Bauhinia purpurea* L.	-	2.0
2	*B. variegata* L.	-	1.1
3	*Cassia fistula L.*	+	1.6
4	*C. roxberghii* DC.	-	2.1
5	*C. siamea* Lamk.	-	1.2
6	*Delonix regia* (Bojer) Rafin.	-	2.2
7	*Parkinsonia aculeata* L.	-	1.9
8	*Peltophorum pterocarpum* (Dc.)Backer ex.K.Heyne	-	2.2
9	*Tamarindus indica* L.	-	3.1
	MIMOSACEAE		
10	*Acacia farnesiana* L. Willd.	+	3.5
11	*A. nilotica* L.(Delile).	+	1.7
12	*A. nilotica* ssp. *hemispherica* Ali&Faruqi.	+	1.7
13	*A. nilotica* ssp. *Indica* (Benth.)	+	1.9
14	*A. nilotica* ssp. *Subalata*(Vatke).Brenan.	+	1.8
15	*A. Senegal* (L.)Willd.	+	2.0
16	*Adenanthera pavonina* L.	+	1.9
17	*Albizia lebbeck* (L) Benth.	+	1.7
18	*Leucaena leucocephala*(Lam.)de wit.	+	2.1
19	*Pithecellobium dulce*(Roxb.)Benth.	+	2.1
20	*Prosopis cineraria* (L)Druce	+	1.9
21	*Samania saman* (Jacq.) Merr.	+	2.0
	PAPILIONOACEAE		
22	*Dalbergia latifolia*. Roxb.	+	2.5
23	*Dalbergia sissoo* Roxb.	+	2.2
24	*Sesbania bispinosa (Jacq.)W.F.Wight.*	+	2.6
25	*S.concolar* Gillett.	+	2.3
26	*S. sesban* (L.)Merrill	+	2.2
27	*S. sesban* (L.)Merrill var.*muricata* Baquar	+	2.2
28	*S. sesban* (L.)Merrill var. *sesban*	+	2.5

\+ indicates nodulated and - indicates non nodulated .

Observations on nodulation survey are presented in (Table 1). The nomenclature and classification follow those of adopted by Ali (1973 a, b; 1977). Among 28 tree legumes examined 9 belong to Caesalpinaceae, 12 to Mimosaceae and 7 to Papilionaceae. All the species of Mimosaceae and Papilionaceae were found nodulated whereas eight out of nine of Caesalpinaceae, were found non nodulated (Table 1). The percentage of nodulation found in the members of Mimosaceae and Papilionaceae were100 % and in Caesalpinaceae it was 11.1 %. The results were compared with the existing data summarized by Allen and Allen, (1981), Haliday and Nakao (1982) and Faria *et al.* (1989) and it was confirmed that nodule formation is more commonly present than absent in Mimosaceae and Papilionaceae , the reverse is true in Caesalpinaceae. Factors contributing to non nodulating behavior of Caesalpinoid legumes have been reviewed by Allen and Allen (1976).These include uncommon, sparse and thick walled root hairs, roots dark brown or black and wiry, occurrence of phenolic compounds, tannins,

quinones and their derivatives in layers of cortical cells of the roots which presumably from a physio-chemical behavior to infection by rhizobia.

A total of 28 species 9 belonging to Caesalpinaceae, 12 to Mimosaceae and 7 to Papilionaceae were analysed for their total nitrogen contents (Table 1). The values for total nitrogen contents varied between 1.2 - 3.5 %. The maximum nitrogen contents were found in *A. fornesiana* (3.5%), followed by *S. bispinosa* (2.6%) and *D. latifolia* (2.5 %) among the nodulated trees while highest nitrogen contents in non- nodulated trees were estimated in *T. indica* (3.1%) followed by *C. auriculatata* (2.6%), *P. pterocarpum* (2.3 %).

Table-2. Comparison between average nitrogen concentration of nodulated and non-nodulated trees.

	Family	Average Nitrogen concentration % (mg)
Nodulated	**Mimosaceae + Papilionaceae + *Cassia fistula* (Caesalpinaceae)**	2.14
Non-odulated	**Caesalpinaceae**	1.98

The average nitrogen contents of 8 non- nodulated trees and 20 species of nodulated trees were estimated as 1.98 % and 2.14 % respectively. These values were put to T-test (Zar, 1995) (t = 0.70). It is concluded that there is no significant difference between the nitrogen contents of nodulated and non- nodulated trees. The role of nodulated legumes in the improvement of productivity in marginal lands and providing vegetable cover in denuded and derelict lands has been discussed by Subramaniam and Babu (1994) and Thomas (1995). In the presence of non significant difference in nitrogen concentration between nodulated and non- nodulated trees a similar role of non-nodulated trees in the improvement of denuded and derelict lands cannot be under estimated. It is therefore recommended that nodulated trees showing higher nitrogen concentration such as *A. fornesiana*, *S. bispinosa* and *D. latifolia* and non- nodulated trees such as *T. indica*, *C. auriculatata* and *P. pterocarpum* (Table 1) may be included in the future afforestation schemes in Sindh in order to improve soil fertility.

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