

## A QUALITATIVE STUDY OF THE NODULATING ABILITY OF LEGUMES OF PAKISTAN-LIST 6

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### Abstract

Nodulation was studied in 31 species belonging to 24 genera distributed in 18 tribes of subfamilies Caesalpinioideae, Mimosoideae and Papilionoideae from Balochistan. Of these *Caesalpinia gilliesii* (Hook) Dietr., *Delonix regia* (Bojer) Rafin., *Cercis siliquastrum* Linn., and *Ebenus stellata* Boiss., were found as non-nodulators whereas *Senna holosericea* of Caesalpinioideae, *Caragana ambigua* and *Onobrychis dealbata* of Papilionoideae have been reported as nodulators for the first time. The nodulation status of *Ebenus stellata* as non-nodulator is also being reported for the first time. Nodule colour, shape and frequency of the nodulated species is described.

### Introduction

The legumes form one of the largest flowering plant groups with 750 genera and 2000 species distributed world wide (Dixon & Wheeler, 1986). Many of the legume species form nodules and fix atmospheric nitrogen symbiotically as a response to infection by *Rhizobium* (Allen & Allen, 1981). The role of nodulated legumes in improving and maintaining soil fertility is well documented (Subramaneum & Babu, 1994; Thomas, 1995; Mahmood, 1999). The global records show that at species level only 20% of legume species have been examined for nodulation (Faria *et al.*, 1989).

Legumes are widely distributed in Pakistani soils and Leguminosae ranks as the third largest family in Pakistan in the order of abundance (Ali & Qaiser, 1986). Data compiled on nodulating ability of Pakistani legumes by Athar & Mahmood (1978, 1980, 1985, 1990), Mahmood & Athar (1985), Mahmood & Iqbal (1994), Athar (1996, 1997) and Mahmood (1999) indicate that majority of them were nodulated in their natural ecosystems. The present study reports the nodulation status and nodule morphology of 31 legume species of Balochistan.

### Materials and Methods

Legumes were surveyed for the presence of nodules from various parts of Balochistan. Both wild and cultivated legumes were examined in their natural habitats. Legumes examined included weeds, herbs, shrubs and climbers. Nodules were distinguished from other kinds of pathogenic root malformations and stubby outgrowths (Truchet *et al.*, 1989). In some cases, nodule smears and nodule slices were prepared and examined under the microscope. Non-nodulated species were grown from seeds in pots. The seeds were inoculated with a suspension containing a mixture of *Rhizobium trifolii*, *R. meliloti*, *R. leguminosarum*, *R. phaseoli* and *R. japonicum* using the method of Grobbelaar *et al.*, (1967). Nodulation data were recorded and herbarium specimens were prepared for the identification of legume species.

Table 1. Nodulation status and nodulation characteristics of some legume species from Balochistan, Pakistan.

Species <sup>*1</sup>	Plant		Previous		Nodules	
	Habit	Nature	Report <sup>2</sup>	Frequency <sup>3</sup>	Colour	Shape
<b>CAESALPINIOIDEAE</b>						
<b>Caesalpinieae</b>						
<i>Caesalpinia gilliesii</i> (Hook) Dietr.	S	C	A	-		
<i>Delonix regia</i> (Bojer) Rafin.	T	W	A	-		
<b>Cassieae</b>						
<i>Senna holosericea</i> (Fresen) Greuter.	S	W	D	+	White	Elongated
<b>Cercideae</b>						
<i>Cercis siliquastrum</i> Linn.	S	W	A	-		
<b>MIMOSOIDEAE</b>						
<b>Mimoseae</b>						
<i>Leucaena leucocephala</i> (Lam.) de Wit.	T	C	A	+++	Pink	Elongated
<i>Prosopis cineraria</i> (L.) Druce	S	W	A	+	Brown	Elongated
<i>P. glandulosa</i> Torr.	S	W	A	+++	Pink	Globose
<i>P. juliflora</i> (Swartz.) DC.	T	W	A	++	Pink	Globose
<b>Acacieae</b>						
<i>Acacia nilotica</i> (L.) Delile	T	W	A	+++	Brown	Elongated
<i>Albizia labbeck</i> (L.) Benth.	T	C	A	+	Pink	Globose
<i>Pithecellobium dulce</i> (Roxb.) Benth.	T	C	A	+++	Pink	Elongated
<b>PAPILIONOIDEAE</b>						
<b>Sophoreae</b>						
<i>Sophora mollis</i> (Roxl.) Baker. sub.sp. griffithii (Stocks) Ali	H	W	A	+++	Pink	Elongated
<b>Dalbergieae</b>						
<i>Dalbergia lanceolaria</i> Linn.	T	C	A	++	Pink	Elongated
<i>Dalbergia sissoo</i> Roxb.	T	C	A	+++	Pink	Globose
<b>Robinieae</b>						
<i>Robinia pseudo-acacia</i> Linn.	T	C	A	++	Pink	Elongated
<b>Indigoferaeae</b>						
<i>Indigofera cordifolia</i> Heyne ex Roth.	H	W	A	+	White	Elongated

Table 1 (Cont'd)

Species <sup>1</sup>	Plant		Previous		Nodules	
	Habit	Nature	Report <sup>2</sup>	Frequency <sup>3</sup>	Colour	Shape
<b>Phaseolineae</b>						
<i>Vigna mungo</i> (L.) Hepper	H	C	A	+++	White	Globose
<i>V. radiata</i> (L.) Wilezek	H	C	A	+++	White	Globose
<i>V. unguiculata</i> sub. sp. unguiculata (L.) Walp	H	C	A	+++	Brown	Globose
<b>Aeschynomeneae</b>						
<i>Arachis hypogaea</i> Linn.	H	C	A	+++	Pink	Globose
<b>Galegeae</b>						
<i>Alhaji maurorum</i> Madic.	S	W	A	++	White	Globose
<i>Caragana ambigua</i> Stocks.	S	W	B	++	Brown	Elongated
<b>Hedysareae</b>						
<i>Ebenus stellata</i> Boiss.	S	C	A	-	-	-
<i>Onobrychis dealbata</i> Stocks	H	W	B	+	Brown	Elongated
<b>Vicieae</b>						
<i>Vicia monantha</i> Retz. ssp. <i>monantha</i>	H	W	A	+++	Brown	Semi-globose
<b>Cicereae</b>						
<i>Cicer arietinum</i> Linn.	H	C	A	+++	Pink	Elongated
<b>Trifolieae</b>						
<i>Medicago lupulina</i> Linn.	H	W	A	+	Brown	Elongated
<i>M. sativa</i> Linn.	H	C	A	++	Pink	Elongated
<i>Melilotus indica</i> (L.) Ali	H	W	A	+++	Brown	Elongated
<i>Trifolium repens</i> Linn.	H	C	A	+++	Brown	Elongated
<b>Gemisteae</b>						
<i>Spartium junceum</i> Linn.	S	C	A	+++	White	Elongated

<sup>1</sup>Species are arranged alphabetically within genera. The nomenclature and tribal classification are as described by Polhill & Raven (1981). Author citation are quoted following instruction of Nasir & Ali (1973a, b; 1977).

<sup>2</sup>Nodulation status

A= Nodulation previously observed, B= Nodulation reported for the first time, C= Species investigated previously but nodulation never observed.

D= Plants inoculated and nodulation induced.

<sup>3</sup> Nodulation status (Frequency).

+ = Sparse nodulation (1-5 nodules per plant), ++ = Moderate nodulation (6-10 nodules per plant), +++ = Abundant nodulation (more than 10 nodules per plant), - = Nodulation not observed.

### Results and Discussion

The nodulation status of 31 species belonging to 24 genera distributed in 18 tribes of sub-families Caesalpinioideae, Mimosoideae and Papilionoideae of Balochistan were examined (Table 1). The species reported here represent less than one fourth of the legume species occurring in Balochistan (Nasir & Ali, 1973a, b; 1977). All the species examined except 5 were nodulated to various extent. *Senna holosericea* of Caesalpinioideae and *Caragana ambigua* and *Onobrychis dealbata* of Papilionoideae have been reported as nodulators for the first time. *Senna holosericea* plants were raised from seeds and inoculated with a rhizobial suspension following Grobbelaar *et al.*, (1967). The nodulation status of *Ebnus stellata* as non- nodulator is also being reported for the first time as checked against the published reports on nodulation (Allen & Allen, 1981; Athar 1997; Faria *et al.*, 1994; Athar & Harding, 2000). The nodules observed in other species is in conformity to earlier reports (Allen & Allen, 1981; Mahmood & Iqbal, 1994; Athar & Harding, 2000). The frequency of nodulation in families Caesalpinioideae, Mimosoideae and Papilionoideae was 25, 100 and 90%, respectively. The shape of the nodules was mainly globose or elongated. The colour of the nodules varied from white, brown to pink. These results conform to earlier studies that nodulation is more common in Mimosoideae and Papilionoideae than Caesalpinioideae (Allen & Allen, 1981; Mahmood & Iqbal, 1994).

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