

**A QUALITATIVE STUDY OF THE NODULATING ABILITY OF LEGUMES
OF PAKISTAN: LIST I.**

M. ATHAR AND A. MAHMOOD

Department of Botany University of Karachi, Karachi-32, Pakistan.

Abstract

A survey of nodulation in leguminous plants of Pakistan has been initiated. A total of 52 species of Papilionaceae are being reported as nodule bearing, of which 5 species are new records.

Introduction

The pioneer work in this field is that of Wilson (1939) from Cornell and Allen & Allen (1947) from Wisconsin, U.S.A. Since then various workers have made similar studies from different parts of the world. Banados & Fernandez (1954) reported nodulation among some members of Leguminosae from Phillipines. There are several accounts of nodulation from Africa. Mostert (1955) made observations on nodulated legume species of South Africa. Bonnier (1957) from Zaire and Bumpus (1957) from Kenya published reports dealing specifically with legume nodulation. Grobbelaar and his associates (1964, 1967, 1972, 1974 and 1975) from Pretoria made extensive survey and compiled comprehensive lists of nodulating legume species indigenous to South Africa. Bowen (1956) examined 101 genera of legumes in Australia of which 40 were without nodules. De'Souza (1966) carried out a survey of tropical legumes in Trinidad and concluded that 64 out of 79 legume species were nodulated. Corby (1971) examined the shapes of nodules of more than 400 species of wild legumes indigenous to Rhodesia and made it a criterion for the tribal classification of the host. In another survey Corby (1974) reported nodules in 539 legume species of Rhodesia. Dubey et al (1972) recorded nodulation in 13 previously unreported legume species of Puerto Rico. Allen & Allen (1976) have reported nodulation in 44 out of 99 species of *Cassia* examined from various countries of the world. Lim & Ng (1977) reported nodulation in 35 legume species from Singapore.

The flora of Pakistan is rich in Leguminales. According to Ali (1973), 11 genera and 49 species of Mimosaceae and 15 genera and 52 species of Caesalpiniaceae occur in Pakistan. Ali (1977) has reported 81 genera and 429 species of Papilionaceae from Pakistan. No work has been done so far in this country on the nodulating ability of legume species. In the present investigation the nodulating ability of legume species was examined in which 52 species belonging to Papilionaceae are listed.

Material and Methods

Periodic field trips were made to various parts of Pakistan and plants were examined in the field growing under natural conditions. Nodulated plants were collected and herbarium specimens were prepared as mentioned by Corby (1970).

Only positive results of nodulation were recorded. Plants found without nodules were grown from seeds in pots or beds containing soils from natural habitat. The seeds were inoculated with *Rhizobium* suspension containing a mixture of *Rhizobium trifolii*, *R. meliloti*, *R. leguminosarum*, *R. phaseoli* and *R. japonicum*, (soy bean cowpea and strain specific) using the method of Grobbelaar et al (1967). In the case of legumes of agricultural importance the plants were either collected from the cultivated fields or grown in the pots from locally purchased seeds. Special care was taken to discriminate root nodules from other kinds of root malformations such as caused by nematodes, insects or different parasitic micro-organisms. Smears were prepared to examine the bacteroids. In some cases nodular isolates were also examined.

Results and Discussion

The species found to be nodulated are listed in Table 1. The tribal classification followed here is the same as adopted by Ali (1977). Professor and Mrs. Allen formerly of the University of Wisconsin, U.S.A have been compiling a card index of all the available data regarding the nodulation of legumes for many years. The results of the present investigation (Table 1) were transmitted to them. Mrs. Allen has informed us that the following five species are new records.

Crotalaria burhia Buch.-Ham. ex Benth.

C. medicaginea Lamk.

Tephrosia subtriflora Baker

Trigonella monantha C.A. Meyer subsp. *incisa* (Benth.) Ali

Sesbania sesban (Linn.) Merrill var. *muricata* Baquar.

TABLE 1. List of Legume species examined for nodulation.

Plant species(1)	Herbarium specimen number (2)	Date of collection	Legume status(3)	Nodulation Record of Allen & Allen(4)
Crotalariaeae				
<i>Crotalaria burhia</i> Buch.-Ham. ex. Benth.	70	13-2-77	w	B
<i>C. juncea</i> Linn.	146	11-9-77	c	A
<i>C. medicaginea</i> Lamk.	143	4-9-77	w	B
Tephrosieae				
<i>Tephrosia subtriflora</i> Baker	144	6-9-77	w	B
<i>T. uniflora</i> Pers.	145	9-9-77	w	A

Indigofereae

<i>Indigofera argentea</i> Burm. f.	9	31-1-76	w	A
<i>I. cordifolia</i> Heyne ex Roth.	37	14-7-76	w	A
<i>I. hochstetteri</i> Baker	40	28-7-76	w	A
<i>I. linifolia</i> (Linn.f.) Retz	51	16-11-76	w	A
<i>I. oblongifolia</i> Forsk.	134	14-6-77	w	A
<i>I. sessiliflora</i> D. C.	30	19-4-76	w	A
<i>Cyamopsis tetragonoloba</i> (Linn.) Taubert	141	7-7-77	c	A

Sesbanieae

<i>Sesbania bispinosa</i> (Jacq.) W.F. Wight.	46	20-8-76	c	A
<i>S. sesban</i> (Linn.) Merrill var. <i>muricata</i> Baquar.	140	5-7-77	c	B
<i>S. sesban</i> (Linn.) Merrill var. <i>sesban</i>	47	20-8-76	c	A

Cajaneae

<i>Cajanus cajan</i> (Linn.) Millsp.	132	6-6-77	c	A
* <i>Rhynchosia minima</i> (Linn.) DC.	10	2-2-76	w	A

Physeoleae

<i>Phaseolus lunatus</i> Linn.	43	4-8-76	c	A
<i>P. vulgaris</i> Linn.	44	4-8-76	c	A
<i>Vigna aconitifolia</i> (Jacq.) Marechal	38	19-7-76	c	A
<i>V. mungo</i> (Linn) Hepper.	34	24-5-76	c	A
<i>V. radiata</i> (L.) Wilczek	36	24-5-76	c	A
<i>V. trilobata</i> (L.) Verdc.	147	19-9-77	w	A
* <i>V. unguiculata</i> (Linn.) Walp. subsp. <i>cylindrica</i> (Linn.) van Eseltine	142	6-9-77	c	A
<i>V. unguiculata</i> (Linn.) Walp. subsp. <i>unguiculata</i>	45	4-8-76	c	A
<i>V. b. purpureus</i> (L.) Sweet	42	31-7-76	c	A

Glycineae

<i>Clioria turnatea</i> Linn.	48	31-7-76	c	A
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Vicieae

<i>Cicer arietinum</i> Linn.	23	3-3-76	c	A
* <i>Lens culinaris</i> Medic.	66	4-2-77	c	A
<i>Pisum sativum</i> Linn.	100	12-3-77	c	A
<i>Vicia faba</i> Linn.	52	24-11-76	c	A
<i>V. monantha</i> Retz.	82	22-2-77	w	A
<i>V. peregrina</i> Linn.	91	10-3-77	w	A
<i>V. sativa</i> Linn.	75	19-2-77	c	A
<i>V. villosa</i> Roth	63	23-1-77	c	A
<i>Lathyrus aphaca</i> Linn.	57	26-11-76	c	A

* <i>L. odoratus</i> Linn.	88	28-2-77	c	A
* <i>L. sativus</i> Linn.	89	28-2-77	c	A
Trifolieae				
<i>Trifolium alexandrianum</i> Linn.	3	23-12-75	c	A
<i>T. pratense</i> Linn.	2	23-12-75	c	A
<i>T. repens</i> Linn.	26	10-4-76	c	A
<i>Trigonella corniculata</i> (Linn.) Linn.	22	24-2-76	w	A
<i>T. foenum-graecum</i> Linn.	114	6-3-77	c	A
<i>T. monantha</i> C.A. Meyer subsp. <i>incisa</i> (Benth.) Ali.	115	6-4-77	w	B
<i>Medicago laciniata</i> (Linn.) Mill.	101	23-3-77	w	A
<i>M. lupulina</i> Linn.	60	19-1-77	w	A
<i>M. polymorpha</i> Linn.	21	20-2-76	w	A
<i>M. sativa</i> Linn.	15	16-2-76	c	A
<i>Melilotus alba</i> Desr.	5	15-1-76	w	A
<i>M. indica</i> (Linn.) All.	16	16-2-76	w	A
Desmodieae				
* <i>Alysicarpus monilifer</i> (Linn.) DC.	39	28-7-76	w	A
Stylosantheae				
<i>Arachis hypogaea</i> Linn.	24	7-4-76	c	A

- (1) Species are arranged alphabetically within genera. Tribal classification is the same as adopted by Ali (1977).
- (2) Herbarium sheets are kept in the author's laboratory.
- (3) Cultivated plants are indicated by a "c" and wild by a "w". By 'wild' is meant either a legume of no agricultural significance or one which, though used in agriculture is growing in a natural community (MacConnell & Bond, 1957).
- (4) The letters A and B refer to information obtained by personal communication from Mrs. Ethel K. Allen formerly of Department of Bacteriology, University of Wisconsin, U.S.A.

A. Nodulation previously observed.

B. Species reported as nodule bearing for the first time.

*Plants inoculated and nodulation induced.

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References

- Ali, S.I. 1973. Mimosaceae. Flora of West Pakistan, **36**: 1-41.
- Ali, S.I. 1973. Caesalpiniaceae. Flora of West Pakistan, **45**: 1-47.
- Ali, S.I. 1977. Papilionaceae. Flora of West Pakistan, **100**: 1-389.
- Allen, O.N. and E.K. Allen. 1947. A survey of nodulation among leguminous plants. Proc. Soil Sci. Amer. **12**: 203-208.
- Allen, O.N. and E.K. Allen. 1976. The nodulation profile of the genus *Cassia*. In "Symbiotic nitrogen fixation", (ed. P.S. Nutman) Cambridge University Press, London pp. 113-122.
- Banados, L.L. and W.L. Fernandez 1954. Nodulation among the Leguminosae Phillip. Agric. **37**: 529-533.
- Bonnier, C. 1957. Symbiose *Rhizobium*-legumineuses en region equatoriale. Publications De L. Inst. National Pour L' Etude Agron. Du Congo Belge, Serie Scient. **72**: 67 pp. Gembloux.
- Bowen, G.D. 1956. Nodulation of legumes indigenous to Queensland. Queensland J. Agr. Sci. **13**: 47-60.
- Bumpus, E.D. 1957. Legume nodulation in Kenya. I. Exploratory field experiments. E. Afr. Agric. J. **23**: 91-99.
- Corby, H.D.L. 1970. A reference-collection of legumes. In "A manual for the practical study of the root nodule bacteria" I.B.P. Handbook No 15, (ed. J.M. Vincent) Blackwell Scientific Publications, Oxford pp. 150-152.
- Corby, H.D.L. 1971. The shape of leguminous nodules and the colour of leguminous roots. Plant and Soil, Special Volume: 305-314.
- Corby, H.D.L. 1974. Systematic implications of nodulation among Rhodesian legumes. Kirkia. **9**: 301-329.
- De'Souza, D.I.A. 1966. Nodulation of indigenous Trinidad legumes. Trop. Agric. Trin. **43**: 265-267.
- Dubey, H.D., R. Woodbury and R.I. Rodriguez, 1972. New records of tropical legume nodulation. Bot. Gaz. **133**: 35-38.
- Grobbelaar, N., M.C. Van Beijma and S. Saubert. 1964. Additions to the list of nodule-bearing legume species. S. Afr. J. Agric. Sci. **7**: 265-269.
- Grobbelaar, N., M.C. Van Beijma and C.M. Todd. 1967. A qualitative study of the nodulating ability of legume species: List 1. Pubs. Univ. Pretoria, New Series **38**: 1-9.
- Grobbelaar, N. and B. Clarke. 1972. A qualitative study of the nodulating ability of legume species: List 2. Jour. S. Afr. Bot. **38**: 241-247.
- Grobbelaar, N. and B. Clarke. 1974. A qualitative study of the nodulating ability of legume species. List 4. Agroplantae **6**: 59-64.
- Grobbelaar, N. and B. Clarke. 1975. A qualitative study of the nodulating ability of legume species: List 3, Jour. S. Afr. Bot. **41**: 29-36.
- Lim, G. and H.L. Ng. 1977. Root nodules of some tropical legumes in Singapore. Plant and Soil **46**: 317-327.
- MacConnell, J.T. and G. Bond 1957. Nitrogen fixation in wild legumes. Ann. Botany, N.S. **21**: 185-192.
- Mostert, J.W.C. 1955. Observations on the nodulation of some leguminous species. Fmg. in S. Afr. **20**: 338-340.
- Wilson, J.K. 1939. Leguminous plants and their associated organisms. Memoir, Cornell Univ. Agric. Exp. Sta. No. 221.