

<http://www.pjbs.org>

PJBS

ISSN 1028-8880

**Pakistan
Journal of Biological Sciences**

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Palynomorphology of Some Species of *Indigofera* L.

¹C.U. Nwachukwu and ²H.O. Edeoga

¹Department of Biology, Alvan Ikoku College of Education, P.M.B. 1033 Owerri, Imo State, Nigeria

²Department of Biological Science, Federal University of Agriculture, Umudike, P.M.B. 7267
Umuahia, Abia State, Nigeria

Abstract: Palynomorphology of eight species of *Indigofera* of the tribe Galegeae from Nigeria was investigated with the aid of light microscope. Results from this investigation revealed that these plants were characterised by different pollen grains whose structure differ markedly. The variations in the grains were so obvious that they could be added to other taxonomic information and used in an attempt to determine the relevance of palynomorphology in resolving the confusion in the nomenclature of these taxa. The monoporate, tricolpate and polyporate pollen grain aperture of the eight species of *Indigofera* are being documented for the first time in these taxa. Similarly the pollen grain shape: circular (round) in *I. paniculata*, *I. stenophylla*, *I. tinctoria* and *I. senegalensis*, elliptic in *I. hirsuta* and oval in *I. terminalis*, *I. pulchra* and *I. priureana* are equally distinct and significant in the characterization of these taxa.

Key words: *Indigofera*, pollen, Leguminosae-Papilionoideae, morphology, systematics

INTRODUCTION

The genus *Indigofera* L. is a member of the family Leguminosae-Papilionoideae and tribe Galageae that has nine genera including *Indigofera* (Burkill, 1995). The genus *Indigofera* is represented by about 700 species which are found in the warm tropical and sub tropical regions of the world (Willis, 1985). Different number of *Indigofera* species have been reported by different authors in West Africa. Burkill (1995) reported 60 species while Hutchinson and Dalziel (1958) reported 78 species. In Nigeria Burkill, (1995) reported 45 species while Hutchinson and Dalziel (1958) recorded 55 species. The reason for this confusion and discrepancies in estimation of the number of taxa in this group of plants could be due to the perceived similarities in structural and reproductive biology of these legumes. The authors in the course of their research discovered that emphasis was laid concentrated in other areas of taxonomic evidence (e.g., Anatomy, morphology, distribution etc.) probably due to lack of specific information on pollen morphology of the genus *Indigofera* despite the fact that various contribution of pollen morphology might be very helpful in proper understanding and delimitation of these taxa. Hence the necessity for this study. This assertion is supported by the works of Okwulehie and Okoli (1999) in the family Tiliaceae and Skvarla and Turner (1966) in the family compositae.

The application of pollen morphology (palynomorphology) to this study will enhance the proper understanding of the genus *Indigofera*. Hence the objective of this investigation is to contribute to the palynological data of the genus *Indigofera* and to use the diversity in these data for taxonomic delimitation. In Eastern Nigeria eight commonly occurring species of *Indigofera* were identified. These are *I. hirsuta* L., *I. paniculata* Pers., *I. pulchra* Vahl, *I. priureana* Guill., et Perr., *I. senegalensis* Lam, *I. stenophylla* Guill. and Perr., *I. terminalis* and *I. tinctoria* L.

The *Indigofera* species are creeping, prostrate or erect annual, biennial or perennial herb or semi woody under shrub and trees (Dallwitz, 1980). Stem may be slender, erect and conspicuously branched with bright green or tinged with red colour. The leaves are alternate openly spaced on the stems around 10 cm long and may be rough and velvety smooth to the touch. The leaves are also simple and prematurely trifoliate. The fruit is a pod usually smooth, reddish, brown and cylindrical with 2-15 seeds in most species. Palynological attributes of plants have attracted the attention of many researchers in recent time.

An excellent review of the systematic application of palynology is given by Erdtman (1960, 1963) and good examples of the use of pollen in systematic studies are given by Cerceau-Larrival (1971) on Umbelliferae and Skvarla and Turner (1966) on Compositae. Agwu and Osibe (1992). Agwu and Beug(1982) and Cowan (1969) in

the genus *Swartzia*. Furthermore, Edeoga *et al.* (1996) utilized Pollen attributes to establish probable evidence of relationships among certain groups of flowering plants in Nigeria.

The main characters of taxonomic value in pollen grains are the number and position of furrows, pollen wall morphology, symmetry and shape and sizes of pollen. The palynomorphology of the *Indigofera* species has not been comprehensively investigated before now to the authors knowledge though various authors have described the different applications of pollen in other families as part of wider surveys on pollen floras of particular geographical areas (Ferguson, 1981; Ferguson and Skvarla, 1988). This report thus serves as the first in literature. The probable lack of enough literature on the palynological features of the *Indigofera* species do not imply irrelevance rather proper investigation of the species of *Indigofera* needs to be carried out in order to clarify the taxonomic uncertainty and to determine the nature, relationship (intra or inter) and systematic value of palynological features of the *Indigofera* species. The pollen morphology of the *Indigofera* species has proved to be very interesting in its features and this has made this study more necessary. Emphasis is on the palynomorphology of the *Indigofera* species in view of the economic and agronomic importance especially as medicinal plants, fodder and as sources of soil nitrogen and foreign exchange earner. The data on this species of *Indigofera* investigated are presented with a view to providing basic taxonomic information on which further pure and applied research could be based.

MATERIALS AND METHODS

Eight species of *Indigofera* (*I. hirsuta*, *I. paniculata*, *I. pulchra*, *I. priureana*, *I. senegalensis*, *I. stenophylla*, *I. terminalis* and *I. tinctoria*) were studied. Pollen grains from each plant were collected by teasing out from fresh and mature flowers of these plants on a slide growing in the wild from different parts of Nigeria. Samples were made on fresh flowers from plants in their natural conditions as these do not undergo any form of deterioration (Edeoga *et al.*, 1996) in October between 2003-2004 at the science laboratory of Michael Okpara university of Agriculture Umudike Umuahia Abia State. Samples for the light microscope were acetolyzed following the method of Erdtman (1960) with slight modification. Unstained, acetolyzed pollen grains were embedded in glycerine Jelly and sealed with wax after covering with a zero size (thickness) cover slips. The slides were used for light microscope studies and photomicrograph of pollen grain were taken from the slides using a Leitz Wetzlar Ortholux microscope fitted with a vivitar-v-335 camera .

RESULTS

The important characters of the pollen grains of the eight species of *Indigofera* studied are summarised in Table 1 and illustrated in (Fig. 1 and 2). The palynomorphological characters show that some features are common with some species while others differ interspecifically. The pollen grains of the eight *Indigofera* species studied showed different shapes ranging from circular or round, to oval shaped and elliptic shaped. The pollen grains of *I. hirsuta* (Fig. 1a) are elliptic in shape with smooth wall sculpture and tricolpate in nature. Those of *I. paniculata* (Fig. 1b), *I. senegalensis* (Fig. 2a), *I. stenophylla* (Fig. 2b) and *I. tinctoria* (Fig. 2d) were circular in shape with variation in wall sculpture while *I. priureana* (Fig. 1c), *I. pulchra* (Fig. 1d) and *I. terminalis* (Fig. 2c) are oval shaped with psilate (smooth) wall sculpture. The pollen grain aperture of *I. hirsuta* has three meridionally placed furrows (Colpus and porus) and therefore tricolpate. Those of *I. paniculata* and *I. stenophylla* are polyporate while *I. priureana*, *I. pulchra* and *I. terminalis* are monoporate and are almost circular in general appearance. *I. senegalensis* and *I. tinctoria* are inaperturate (they do not possess any conspicuous colpus or porus) and are circular in their general appearance.

DISCUSSION

The palynomorphological studies of the eight species of the genus *Indigofera* reported here is distinct and remarkable and could be used for taxonomic purposes. The elliptic shaped pollen grain of *I. hirsute* separate this taxon from other taxa. *I. paniculata* (Fig. 1b) and *I. stenophylla* (Fig. 2c) equally exhibited close affinity by virtue of possessing some common morphological features (Table 1). Similarly, *I. senegalensis* and *I. tinctoria* showed similar morphological characters (Fig. 2a and d). Furthermore the highest level of intraspecific relationship in palynomorphology among the species studied that could be used for taxonomic purposes was shown by *I. priureana*, *I. pulchra* and *I. terminalis* (Fig. 1c, d and 2c). The differences in pollen morphology among the taxa are significant. This is important because the application of pollen morphological diversity will enhance the proper understanding of the genus *Indigofera* similar different authors had made suggestions in different taxa (Edeoga and Ikem, 2001; Ferguson and Skvarla, 1988; Edeoga *et al.*, 1996). This is reflected in their possession of oval shaped pollen, smooth pollen wall and monoporate pollen aperture (Table 1).

Table 1: Palynomorphological features of the eight *Indigofera* species studied

Attributes	<i>I. hirsuta</i>	<i>I. paniculata</i>	<i>I. prioureana</i>	<i>I. pulchra</i>	<i>I. senegalensis</i>	<i>I. stenophylla</i>	<i>I. terminalis</i>	<i>I. tinctoria</i>
Wall sculpture	Psilate	Faveolate	Psilate	Psilate	Psilate	Echinate	Psilate	Psilate
Number of Aperture	Tricolpate colpi	Polyporate porus	Monoporate porus	Monoporate porus	Inaperturate (No conspicuous porus or copus)	Polyporate poru	Monoporate porus	Inaperturate (No conspicuous porus or copus)
General appearance of pollen grain	Slightly longer than wide	Circular	Almost circular	Almost circular	Circular	Circular	Circular almost	Circular

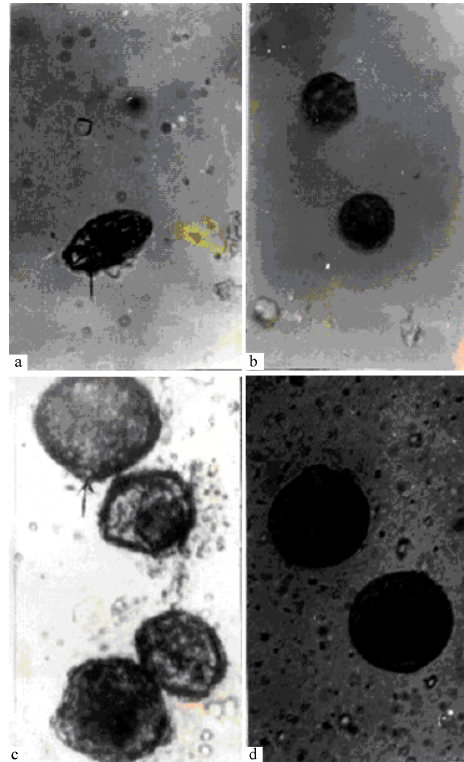


Fig. 1: (a-d) Pollen grains of *I. hirsuta*, *I. paniculata*, *I. prioureana* and *I. pulchra*. a. *I. hirsuta*. Note the elliptic shape of the pollen rain $\times 100$. b. *I. paniculata* showing foveolate pollen wall $\times 100$. c. *I. prioureana*. The pollen aperture is monoporate $\times 100$. d. *I. pulchra* circular in shape and monoporate aperture $\times 100$

The reported occurrence of monoporate, tricolpate, inaperturate and polyporate pollen grains in these eight taxa had been reported in both diverse and related groups of plants but not in the genus

Indigofera (Erdtman, 1960; Moore, 1977; Graham and Bakker, 1981). The difference in aperture character, pollen shape, wall sculpture of the pollen grains was significant in all the taxa studied since these taxa were from one genus *Indigofera* and one family Leguminosae-Papilionoideae. Conversely, this difference elucidates further research. Some evolutionary interpretations come to focus from the nature of pollen grains among these *Indigofera* species. The purposes to show that application of palynological data has proven to be of valuable assistance in interpreting problems related to

plant classification. The tricolpate pollen grains of *I. hirsuta* shows that this taxon is more advanced than the monoporate and polyporate pollen grains of the other species studied. Furthermore the different pollen sizes present in *I. prioureana* and *I. terminalis* could be an indication that hybridization may be operating in the complex.

This is because this variation in size may be due to indiscriminate mating leading to hybridisation. This is not surprising since previous workers have made similar observation in other groups of angiosperm. (Okoli and Mgbeogu, 1983; Edeoga and Okoli 1996; Agwu and Beug, 1982; Agwu and Osibe, 1992; Anozie, 1985; Okwulehie and Okoli, 1999). Conversely the general circular nature of *I. paniculata*, *I. senegalensis*,

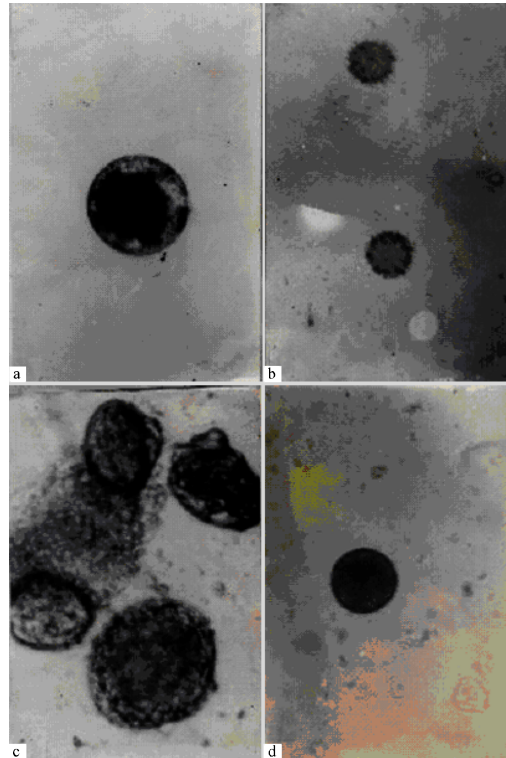


Fig. 2: (a-d)Pollen grains of *I. senegalensis*, *I. stenophylla*, *I. terminalis* and *I. tinctoria*. a. *I. senegalensis*. The pollen wall is psilate (smooth) $\times 100$. b. *I. stenophylla*. Showing echinate pollen wall $\times 100$. c. *I. terminalis*. The pollen grains are oval in shape $\times 100$. d. *I. tinctoria*. Round shape and smooth pollen wall $\times 100$

I. stenophylla and *I. tinctoria* could be related to structural adaptation for effective pollination by insects as was reported by different worker (Gimenes, 1991; Edeoga *et al.*, 1996). It is likely therefore that the nature of pollen grains could be an evolution and modification often inherited to determine the mode of pollination and thereby perpetuates a particular group of plants in a given environment. This is an interesting area that could be exploited in subsequent research.

So far the results on pollen morphology of these groups of plants investigated are of interest such that they could be utilised along with other information in clarifying taxonomic relationships of these taxa with other genera, species or sub species.

REFERENCES

- Agwu, C.O.C. and H.J. Beug, 1982. Palynological studies of marine sediment of the West African coast. *Palaeocol. Africa.*, 16: 37-39.
- Agwu, C.O.C. and E.E. Osibe, 1992. Airborne palynomorphs of Nsukka during the months of February-April 1990. *Nig. J. Bot.*, 5: 177-185.
- Anozie, G.A., 1985. Pollen analysis of water and sediments from lake Nguru, Nsukka. B.Sc Thesis, Univ. Nigeria, Nsukka, pp: 29.
- Burkill, H.M., 1995. *The Useful Plants of West Tropical Africa. Vol. 2 (2nd Edn.)*. Royal Botanic Gardens, Kew, pp: 654-670.
- Cerceau-Larrival, M. Th., 1971. Plantule of obelleferes *Mem. Mus. Nat. His. Nat Ser Brit.*, 14: 10-20.
- Cowan, R.S., 1969. *Harleyodendron*, a new genus of Leguminosae (Swartzieae). *Brittonia*, 31: 72-78.
- Dallwitz, M.J., 1980. A general system for coding taxonomic descriptions. *Taxon*, 29: 41-46.
- Edeoga, H.O., N.O. Ogbemor and A.O. Amayo, 1996. Pollen morphology of some Nigerian species of *Aneilema* R. Br. and *Ludwigia* L. *New Bot.*, 23: 223-231.
- Edeoga, H.O. and C.I. Ikem, 2001. Comparative morphology of leaf epidermis in three species of *Boerhevia* L. *J. Econ. Tax. Bot.*, 19: 197-205.
- Edeoga, H.O. and B.E. Okoli, 1996. Apomictic behaviour in *Costus afar-C. lucanusianus* (Costaceae) complex in Nigeria. *Feddes Repert*, 107: 75-82.
- Erdtman, G., 1960. The acetolysis method. *Seven. Bot. Tidskr.*, 54: 561-564.

- Erdtman, G., 1963. Palynology in Advance in Botanical Res. Preston, R.D. (Ed.), 2: 149-208.
- Ferguson, I.K., 1981. The pollen morphology of *Macrobyloma* (Leguminosae-Papilionoideae: Phaseoleae). Kew Bull., 36: 433-461.
- Ferguson, I.K. and J.J. Skvarla, 1988. Pollen Morphology of the tribe *Swartzieae* (Subfamily Papilionoideae: Leguminosae). Introduction and all genera excluding *Aldina* and *Swartzia*. Am. J. Bot., 75: 1884-1897.
- Gimenes, M., 1991. Some morphological adaptations in bees (Hymenoptera, Apoidea) for collecting pollen from *Ludwigia elegans* (Onagraceae). Rev. Brasil. Entomol., 35: 413-422.
- Graham, A. and G. Bakker., 1981. Palynology and tribal classification in the Caesalpinoideae. In Pochill, R. and P.H. Raven (Eds.) Advances in legume systematics 108-834. Royal Botanic Gardens, Kew.
- Hutchinson, J. and M.J. Dalziel, 1958. Flora of West Tropical Africa. Crown Agent for Oversea Government and Administration. Vol. 1 Part 22nd Edn. Mill Bank, London, pp: 533-543.
- Moore, P.D., 1977. Stratigraphy and pollen analysis of Moss North West Scotland. Ecology, 65: 375-397.
- Okoli, B.E. and C.M. Mgbeogu, 1983. Fluted pumpkin *Telfaria occidentalis*, West Africa vegetable crop. Econ. Bot., 37: 145-149.
- Okwulehie, I.C. and B.E. Okoli, 1999. Morphological and palynological studies in some Nigerian species of *Corchorus* L. (Tiliaceae). New Botanist, 25: 87-101.
- Skvarla, J. and B.L. Turner, 1966. Systematic Implication from electron microscopic studies of Compositae pollen: A review. Ann missour. Bot Gard, 53: 220-256.
- Willis, J.C. 1985. A Dictionary of the Flowering Plants and ferns. Cambridge Univ. Press, pp: 1245.