Palynomorphology of Some Species of Indigofera L.

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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. stemphylla, I. tinctoria and I. senegalensis, elliptic in I. hirsuta and oval in I. terminalis I. pulchra and I. prieureana 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 Galegeae 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. prieureana Guille., et Perr., I. senegalensis Lam., I. stemphylla Guille. 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 trifoliolate. 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 Erdman (1960, 1963) and good examples of the use of pollen in systematic studies are given by Cereau-Larivial (1971) on Umbelliferae and Skvarla and Turner (1966) on Compositae. Agwu and Osibe (1992). Agwu and Beug (1982) and Cowan (1969) in

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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 acetylated following the method of Erdtman (1960) with slight modification. Unstained, acetylated 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 tricollate 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 tricollate. 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. hirsuta* 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. 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: Polynomorphological features of the eight *Indigofera* species studied

<table>
<thead>
<tr>
<th>Attributes</th>
<th><em>I. hirsuta</em></th>
<th><em>I. paniculata</em></th>
<th><em>I. prieureana</em></th>
<th><em>I. pulchra</em></th>
<th><em>I. senegelensis</em></th>
<th><em>I. senepentina</em></th>
<th><em>I. terminalis</em></th>
<th><em>I. tinctoria</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall sculpture</td>
<td>Psilate</td>
<td>Faveolate</td>
<td>Psilate</td>
<td>Psilate</td>
<td>Psilate</td>
<td>Psilate</td>
<td>Psilate</td>
<td>Psilate</td>
</tr>
<tr>
<td>Number of</td>
<td>Tricolporate</td>
<td>Polyporate porus</td>
<td>Monoporate porus</td>
<td>Monoporate porus</td>
<td>Imperturate</td>
<td>Polyporate porus</td>
<td>Imperturate</td>
<td>Imperturate</td>
</tr>
<tr>
<td>Aperture</td>
<td>colpi</td>
<td></td>
<td></td>
<td></td>
<td>(No conspicuous)</td>
<td>porus</td>
<td>porus</td>
<td>porus</td>
</tr>
<tr>
<td>General appearance</td>
<td>Slightly</td>
<td>Circular</td>
<td>Almost circular</td>
<td>Almost circular</td>
<td>Circular</td>
<td>Circular</td>
<td>Circular almost</td>
<td>Circular</td>
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<tr>
<td>of pollen grain</td>
<td>longer than wide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

The reported occurrence of monoporate, tricolpate, imperturate 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-Papilionoidae. 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. prieureana* 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 suprising since previous workers have made similar observation in other groups of angiosperm. (Okoli and Mgbegbu, 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. senegelensis*,

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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