Palyno-taxonomic study of some plant taxa of Fabaceae from Arambagh region of Hooghly district, West Bengal, eastern India

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ABSTRACT
The aim of the present investigation is to study different pollen parameters such as shape, size, colpa and exine ornamentation for the taxonomic assessment of the groups of plants. The pollen morphology of some plant taxa of the family Fabaceae growing in the area of Arambagh of Hooghly district, West Bengal, India were studied using light microscopy (LM) and scanning electron microscopy (SEM) during the period of September 2012 to July 2013. The pollen grains of Cassia sophera, Cassia alata, Cassia occidentalis, Cassia fistula, Cassia tora, Cassia siamea, Butea monosperma, Bauhinia purpurea, Crataalaria retusa, Delonix regia, Peltophorum pterocarpum, Sesbania grandiflora and Tamarindus indica are 3-colporate type. The polyad types of pollen grains consisting of 12 cells were observed in Acacia auriculiformis and Acacia arabica. The polyad type of pollen grain consisting of 16 cells is observed in Albizia lebbek. The flowering period of the investigated taxa are recorded.

Key Words: Pollen, Taxonomic assessment, 3-colporate, Eurypalynous

INTRODUCTION
The family Fabaceae (Leguminosae) is the third largest family of the flowering plants (Mabberley, 1997), being the sources of gums, dyes, oils, insecticides, fibre, fuel, timber, medicinals and pulses (Wojciechowski, 2003). Nearly all species of the family exhibit the formation of root-nodulation with symbiotic bacteria to fix atmospheric nitrogen and thereby improving the soil fertility (Sprent and McKey, 1994; Sprent,2001). Apart from economic importance, ecologically the family is also important as the plant species of this family grow on earth from tropical rain forests to deserts and alpine tundra. Most of the species of the family grow in wild in Arambagh region of Hooghly district, West Bengal from Eastern India. Many investigators studied different plant taxa of this broad group to find out the phylogenetic relationships of the family Fabaceae on the basis of morphological, anatomical, cytological, biochemical and molecular gene sequencing data (Kass and Wink, 1996; Doyle et al., 1997, 2000; Kajita et al., 2001; Wojciechowsk, 2003). Still now the family Fabaceae is continuing to attract the attention of scientists from diverse disciplines of plant sciences. 

Now a day’s study of pollen is an important area of research. Various pollen morphological features such as symmetry, shape, apertural pattern and exine configuration are very conservative features for the taxonomic assessment of the plants (Perveen, 2006; Bera et al., 2007; Keshavarzi et al., 2012). Moreover, some plants growing in the surroundings causes respiratory troubles or allergy in human beings (Singh and Kumar, 2004; Chauhan and Goyal, 2006). It has been reported that there are many plants growing in the surroundings such as rice, mustard, coconut, grasses etc., the pollen grains of which are responsible for allergy (Singh, 2012).
These plants also grow in Arambagh region of Hooghly district, West Bengal. It is supposed that similar allergenic activity will be observed from the plants of this region.

Some plant taxa e.g. Cassia tora, Cassia fistula, Cassia occidentalis, Delonix regia and Peltophorum pterocarpum of this family are important allergenically (Mandal et al., 2009; Hussian, 2012). In fact, during teaching and research experiences, it has been found that a large number of patients of different parts of Hooghly district, West Bengal are suffering from bronchial asthma and other respiratory troubles. There may be several causes such as pollutants, dusts, industrial dusts, fungal spores, pollen grains etc. for bronchial asthma and related respiratory troubles. One of the most important reasons of these diseases is pollen allergy.

Keeping in view the sufferings of the people due to allergic disorders in this district, primarily detailed pollen morphological study of some plants growing in Arambagh region of Hooghly district, India during the period of September 2012 to July 2013 was undertaken. Pollen morphological study is related with pollen viability tests. A comparative pollen viability study of two species of Jatropha was made by Gam, 2014.

MATERIALS AND METHODS

In the present investigation 10 genera including 16 plant species of the family Fabaceae were investigated. Out of 16 taxa investigated, the genus Cassia comprises six species namely Cassia sophera, Cassia alata, Cassia occidentalis, Cassia fistula, Cassia tora and Cassia siamea. The genus Acacia comprises two species namely Acacia auriculiformis and Acacia arabica. The remaining eight investigated genera were Butea monosperma, Bauhinia purpurea, Crotalaria retusa, Delonix regia, Peltophorum pterocarpum, Sesbania grandiflora, Albizia lebbeck and Tamarindus indica. The mature flowers of the above plant taxa were collected and pollen morpho types studied by Acetylsis method (Erdtman, 1952). The microphotographs of the pollen grains were taken in a microscope (Make- Olympus & Model- CX21i and number 12M268). The measurement of the pollen grains were taken with the help of an Ocular Stage Division (Erma) and the measuring unit converted into µm(milimicron). The terminology of pollen is in accordance with Bhattacharya et al., 2009; Erdtman, 1952; Faegri and Iversen, 1964; Kremp, 1965 and Moore and Webb (1978).

Scanning Electron Microscopic (SEM) study was carried out for the observation of pollen grains in detail. For this purpose fresh pollineferous material (non-treated pollen grains) was taken for microphotographs. The fresh pollen material was placed on stub and gold coating was made by IB₂ ion coater before taking microphotographs.

RESULTS AND DISCUSSION

The flowering period of the investigated taxa was recorded (Table 1). The pollen morphology of the investigated taxa was studied critically. Out of 16 plant species studied, tri-colporate (3-colporate) type of pollen grains were observed in 13 species namely Cassia sophera, Cassia alata, Cassia occidentalis, Cassia fistula, Cassia tora, Cassia siamea, Butea monosperma, Bauhinia purpurea, Crotalaria retusa, Delonix regia, Peltophorum pterocarpum, Sesbania grandiflora and Tamarindus indica (Figure 1 & Figure 2). The polyad types of pollen grains were found in Acacia auriculiformis, Acacia arabica and Albizia lebbeck. The polyad of Acacia auriculiformis and Acacia arabica showed 12 celled configurations, whereas it was 16 celled structures in Albizia lebbeck. Each cell of the polyad is sub-globose in periphery and square in centre in A. auriculiformis and A. Arabica. All 16 cells of polyad are rectangular in shape in Albizia lebbeck (Figure 2). The shape of the 3-colporate pollen grains varied from Oblate-spheroidal to Prolate on the basis of value of P/EX100. The shape of the grains, exine ornamentation, length of colpa, diameter of pore, exine thickness and the value (P/EX100) for determining the shape of the grains are given below (Table 2).

The pollen sample i.e. anthers of collected flowers was acetyled for clear observations of exine layers. Different parameters of the pollen grains like colpa, exine ornamentation etc. was determined from acetyled grains. Microphotographs of the acetyled grains were taken by Light Microscopy (LM). The SEM microphotographs were taken from fresh pollen grains (Figure 3 and 4). Some roundish structures called gemma were found on exine layer in Bauhinia purpurea. In Peltophorum pterocarpum some honey-comb like hexagonal meshes with muri and lumen were found on the surface of exine (Figure 4). The honey-comb like meshes was also observed in Delonix regia.
Table 1: Investigated plant taxa with their common names, respective families and flowering period

<table>
<thead>
<tr>
<th>Name of the plants</th>
<th>Common name</th>
<th>Family</th>
<th>Flowering period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassia sophera</td>
<td>Kalkashunda</td>
<td>Caesalpinaceae</td>
<td>Throughout the year</td>
</tr>
<tr>
<td>Cassia alata</td>
<td>Dadmurdan</td>
<td>Caesalpinaceae</td>
<td>June-September</td>
</tr>
<tr>
<td>Cassia occidentalis</td>
<td>Kalkashunda</td>
<td>Caesalpinaceae</td>
<td>June-September</td>
</tr>
<tr>
<td>Cassia fistula</td>
<td>Bandar lati / Shondal</td>
<td>Caesalpinaceae</td>
<td>June-September</td>
</tr>
<tr>
<td>Cassia tora</td>
<td>Chakunda</td>
<td>Caesalpinaceae</td>
<td>June-August</td>
</tr>
<tr>
<td>Cassia siamea</td>
<td>Siamese senna (Siamese cassia)</td>
<td>Caesalpinaceae</td>
<td>June-August</td>
</tr>
<tr>
<td>Bauhinia purpurea</td>
<td>Kanchan</td>
<td>Caesalpinaceae</td>
<td>Throughout the year</td>
</tr>
<tr>
<td>Delonix regia</td>
<td>Gulmohor</td>
<td>Caesalpinaceae</td>
<td>March-May</td>
</tr>
<tr>
<td>Peltophorum pterocarpum</td>
<td>Radhachura</td>
<td>Caesalpinaceae</td>
<td>March-May</td>
</tr>
<tr>
<td>Tamarindus indica</td>
<td>Tentul</td>
<td>Caesalpinaceae</td>
<td>June-August</td>
</tr>
<tr>
<td>Acacia auriculiformis</td>
<td>Sonajhuri</td>
<td>Mimosaceae</td>
<td>July-November</td>
</tr>
<tr>
<td>Acacia arabica</td>
<td>Babla</td>
<td>Mimosaceae</td>
<td>Throughout the year</td>
</tr>
<tr>
<td>Albizia lebbek</td>
<td>Sirish</td>
<td>Mimosaceae</td>
<td>April-May</td>
</tr>
<tr>
<td>Crotalaria retusa</td>
<td>Atashi</td>
<td>Papilionaceae</td>
<td>July- September</td>
</tr>
<tr>
<td>Butea monosperma</td>
<td>Palash</td>
<td>Papilionaceae</td>
<td>February- March</td>
</tr>
<tr>
<td>Sesbania grandiflora</td>
<td>Bakphul</td>
<td>Papilionaceae</td>
<td>July-August</td>
</tr>
</tbody>
</table>

The family Fabaceae (Leguminosae) is the third largest family of the flowering plants (Mabberley, 1997), below the rank of Orchidaceae and Asteraceae (Ghosh and Keshri, 2007). Fabaceae (Leguminosae) – bean or pea family (after faba, Latin name for broad bean) consists of 720-730 genera and 19,500 species (Michael, 2010). The Fabaceae are traditionally classified into three subfamilies: Caesalpinioideae, Mimosoideae and Papilionoideae (Faboideae). These are, however often treated as three separate families known as Papilionaceae/Fabaceae (Article 18.5 of the code, final sentence), Mimosaceae and Caesalpinaceae (Mc Neil and Brummitt, 2003). The sub-families Mimosoideae and Papilionoideae have both been resolved as monophyletic, nested within a paraphyletic Caesalpinioideae, in all recent molecular studies (Kass and Wink, 1996; Doyle et al., 1997, 2000; Kajita et al., 2001; Wojciechowski et al., 2004). The two sub-families Mimosoideae and Papilionoideae are derived from the third subfamily Caesalpinioideae, which is basal and paraphyletic (Doyle, 1975). Many workers carried out research for determining phylogenetic relationships among different groups of the family Fabaceae. In the present study, an attempt was made for the taxonomic assessment of the investigated taxa from the point of view of pollen morphological data.

A botanical survey of flowering plants growing in the area of Arambagh, West Bengal (India) during the period of September 2012 to July 2013 was made for the purpose of collection of the pollen materials from plants growing in the field and to study different pollen parameters such as shape, size, and colpa and exine ornamentation. The present study is useful in the preparation of a complete pollen calendar in different seasons of the area under investigation. A pollen calendar is useful for allergy clinics (Tilak, 2012). Pollen calendar is compiled based on data and knowledge obtained from field botanical survey of the area under investigation combined with data from aeropalynological survey (Agashe, 2012; Bhattacharya-Sasmal and Pal, 2013).
A considerable variation in pollen morphology was observed among the investigated taxa of the family Fabaceae, particularly exine ornamentation and apertural pattern. This observation supports the eurypalynous characteristics of the family Fabaceae. In the present study 10 genera including 16 species were studied.
Fig. 1: Acetolysed pollen grains. (X 400)
A: Cassia sophera, B & B¹: Cassia alata,
C: Cassia tora, D: Cassia fistula,
E: Cassia tora, F: Cassia siamea,
G: Bauhinia purpurea
I: Peltophorum pterocarpum
J: Tamarindus indica

Fig. 2: Acetolysed pollen grains. (X 400)
K: Acacia auriculiformis, L: Acacia arabica, M: Albizzia lebbek, N: Crotalaria retusa (Equitorial view),
N¹: Crotalaria retusa (Polar view), O: Butea monosperma, P: Sesbania grandiflora
Most of the genera such as Cassia sophera, Cassia alata, Cassia occidentalis, Cassia fistula, Cassia tora, Cassia siamea, Butea monosperma, Bauhinia purpurea, Crotalaria retusa, Delonix regia, Peltophorum pterocarpum, Sesbania grandiflora and Tamarindus indica shows 3-colporate type of pollen grains. The polyad type of pollen grains is found in Acacia auriculiformis, Acacia Arabica and Albizia lebbeck. In the previous study (Pal 1992, Pal et al., 1993a; 1993b) it has been found that the taxa having tricolporate pollen grains reveals their advanced status whereas taxa with polyad or colpate type of pollen grains shows its primitive status in the evolutionary scale. Tricolpate pollen is the main and basic type found in most eudicots while other aperture types such as 5-colpate, 6-colpate, porate, colporate and pororate are regarded as derived among eudicots (Walker and Doyle, 1975).
Thus the taxonomic assessment of the species investigated is possible considering the pollen parameters. However, the data from other field of study like cytological, serological, biochemical and immunological might strengthen this taxonomic assessment of the species. On the basis of pollen parameters, the present investigated taxa like Cassia sophera, Cassia alata, Cassia occidentalis, Cassia fistula, Cassia tora, Cassia siamea, Butea monosperma, Bauhinia purpurea, Crotalaria retusa, Delonix regia, Peltophorum pterocarpum, Sesbania grandiflora and Tamarindus indica having tricolporate pollen grains may be considered as in advanced status whereas Acacia auriculiformis, Acacia Arabica and Albizia lebbek has primitive status in scale of evolution. This observation is also supported from pollen morphological study of some plant taxa of Hooghly district, India (Bhattacharya-Sasmal et al., 2013). The prepared pollen slides of the taxa investigated may be used as reference slides for identifying the pollen grains captured from air.

**CONCLUSION**

A taxonomic assessment of some plant taxa of the family Fabaceae growing in wild condition of the Arambagh region, India was made on the basis of different parameters of pollen grains. The plant taxa having tricolporate (3-colporate) pollen grains like Cassia sophera, Cassia alata, Cassia occidentalis, Cassia fistula, Cassia tora, Cassia siamea, Butea monosperma, Bauhinia purpurea, Crotalaria retusa, Delonix regia, Peltophorum pterocarpum, Sesbania grandiflora and Tamarindus indica may be considered as in advanced status whereas Acacia auriculiformis, Acacia arabica and Albizia lebbek has primitive status in the scale of evolution. This study will be helpful in the preparation of a complete pollen calendar of a particular geographical area. A complete pollen calendar of different seasons throughout the year and the concentration of respective pollen grains in air may help for proper diagnosis and treatment of allergic patients.

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