



Research Article

Morphological Study of Pollen Grains of Angiosperms

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Abstract

Pollen morphology of twelve species of angiosperms from Central Nepal was cytologically carried out in present investigation. In this investigation pollen morphology of *Bignonia venusta* Ker Gawl. and *Jacranda mimisifolia* D. Don from the family Bignoniaceae; *Brassica campestris* L. from Brassicaceae; *Cuphea hyssopifolia* Kunth. from Lythraceae; *Coriandrum sativum* L. from Apiaceae; *Crepis japonica* L. and *Dichrocephala integrifolia* (L. f.) Kunze. from Asteraceae; *Delphinium ajacis* L. from Ranunculaceae; *Dianthus barbatus* L. from Caryophyllaceae; *Euphorbia Mili* Des Moul. and *Euphorbia pulcherima* L. from Euphorbiaceae and *Magnolia fuscata* from Magnoliaceae were studied. Shape of the pollen grains found to be mostly spheroidal, few circular, one elliptical, one triangular and one elongated in this study. Sculpture of exine wall found to be smooth, echidnae, tectate, reticulated and perforated type. Aperture of the pollen grains found to be triporate to pentaporate. The large, medium and small sized pollen grains were observed in present research. The high diversity of sculpture type in pollen grains of angiosperms has been associated to diversity in pollination systems. Smooth pollen grains are linked with wind or water pollination while sculptured pollen grains associated with biotic pollination. The morphology of pollen grain is one of the significant tools in solving some taxonomic problems such as identification, tracing phylogenetic relationship on the family, generic or specific level and in plant systematic and evolution.

Introduction

Pollen grains are the male sex cells and are various shaped and sized of a flowering plant. It is a microscopic body that contains the male reproductive cell of a plant. It is essential in a plant's fertilization process. Generally, the pollen grains consist of two layers, outer exine and inner intine. The intine is a uniform thin layer made up of pectolase which is destroyed by acetolization. The exine layer is resistant to physical, biological and acetolysis. Because of this property pollen grains can be preserved for long periods of time. Morphological characters of the pollen grains are important

in understanding the functional aspects of pollen such as pollination biology.

The pollen apertures provide the main routes for exchange with the environment and serves as exit point for the pollen tube. Palynological studies on ten species of angiosperms from Nepal have been reported by Karna-Mallick (2017). In another study, Karna-Mallick (2019) studied pollen morphology of 15 species of angiosperms and found that most of the pollen grains are spheroidal and apertures of the pollens are triporate to polyporate. Bove (1993) studied

pollen morphology of 33 species of the family Bignoniaceae and found that pollens are monads, medium to large sized, spheroidal, sub-spheroidal, prolate and multiporate apertured pollens.

Pollen characters are greatly used in taxonomy of angiosperms and they are used in establishing phylogenetic relationships in the family. Pollen grains of fossil and living plants provides information on the floristic and climatic characters of geological formation (Mobel *et al.*, 2014). The main aims of present studies are to determine pollens shape, size, apertures and exine sculpture of different species of angiosperms.

Materials and Methods

Flowers of the plants collected from different localities of central Nepal from their natural habitats. The anthers were collected in petridishes. The pollen grains from mature anthers was transferred into a clean glass slide and added one percent aceto-carmine dropwise covered with cover slip and observed under compound microscope using 10x eyepiece and 40x objective magnification. Photomicrographs were taken with help of digital camera of 12.1 megapixels. Later on the photographs were enlarged to suitable sizes. The terminology follows in this study as given by Weber and Ghobary (1985).

Results and Discussion

Morphological study of pollen grains of the flowering plants such as pollen shape, pollen size, pollen aperture and pollen sculpture characters are very much important in plant taxonomy. Characters of Pollen grains are tabulated in Table 1. The morphological observations of presently studied taxa are given below.

Bignonia venusta Ker Gawl.

Bignonia venusta commonly known as orange trumpet vine or flame vine is a plant species of the family Bignoniaceae. It is a well-known garden species Flaming trumpet is a vigorous, fast-growing, evergreen woody vine that blooms in winter and spring with spectacular reddish-orange flowers. Pollen grains of *Bignonia venusta* are round multiporate, psilate with smooth walled surface and tected exine structure (Fig.1.a-b).

Brassica campestris L.

Brassica campestris L. is a genus of plants in the mustard family Cruciferae. The genus of the Brassica is known as cruciferous vegetables, cabbages, or mustard plants. The leaf of plant is eaten in many countries. Seed oil of mustard is used as cooking oil. Species of *Crepis* are used as food plants by the larvae of some Lepidoptera species. The seeds of *Crepis* species are an important food source for some bird species. Prolate, tricolpate, pentaporate with coarse exine ornamentation and large sized pollen grains were observed in this taxa (Fig.1.c-d).

Cuphea hyssopifolia Kunth.

Cuphea hyssopifolia is a small evergreen shrub of the family Lythraceae. Pollen grains of *Cuphea hyssopifolia* are triangular, small with rough exine wall (Fig.1.e-f).

Coriandrum sativum L.

It is an annual herb with pinnately divided leaves and compound umbels of white purplish flowers of the family Apiaceae. Commonly it is also called Chinese parsley; all parts of the plants are edible. The aromatic dried seeds are used in cooking. Pollen grains of this plant are small. Rod shaped, elongated, micro-reticulate, tected and semitected exine ornamentation (Fig.1.g-h).

Crepis japonica L.

It is commonly known in some parts of the world as hawksbeard is a genus of annual and perennial flowering plants of the family Asteraceae. Pollen grains of *Crepis* plant is triporate, spheroidal, echinate exine wall coarsed (Fig.1.i-j).

Delphinium ajacis L.

It is commonly known as rocket larkspur is an annual flowering plant of the family Ranunculaceae native to Eurasia. The plants frequently grown in gardens as an ornamental for its spikes of blue, pink or white flowers. It often branches freely at the base and forms new roots at the leaf nodes. Circular, irregular, triporate pollen grains with tected exine wall observed in this taxa (Fig.1.k-l).

Dianthus barbatus L.

Dianthus barbatus, commonly called sweet William and features small flowers held in dense, flat-topped terminal clusters of the family Caryophyllaceae. Many cultivars are available in market, including double-flowered forms as well as some dwarf plants. Flowers are various coloured such as red, pink, white and bicolor, sometimes with a contrasting eye. The blooming periods of flowers from late spring to early summer. Large, round, multiporate with smooth walled exine pollen grains were observed in this taxa (Fig.2. a-b).

Dichrocephala integrifolia (L f.) Kunz

It is a genus of flowering plants in the family Asteraceae or sunflower family. *Dichrocephala integrifolia* is an erect or spreading, aromatic annual plant growing 20 - 60cm tall, occasionally to 100cm. The plant is harvested from the wild for local use as a medicine. Triporate, echinate, spheroidal, medium sized pollen grains were observed in this taxa (Fig.2.c-d).

Euphorbia pulcherrima L.

Euphorbia pulcherrima also known as Christmas Flower is a commercially important plant species of family Euphorbiaceae. It is particularly well known for its red and green foliage and is widely used in Christmas floral displays. *Euphorbia pulcherrima* is a shrub or small tree, reaching a height about 0.6–4 metres. *Euphorbia* plants may be

annuals, perennials, shrubs or succulents, with milky sap and small flowers held within cupped, often colourful bracts. The medium sized, spheroidal, circular, prolate, sunken with reticulate, collumellate exine walled pollen grains were observed in this taxa (Fig.2.e-f).

***Euphorbia Milii* Des Moul.**

Euphorbia milii, commonly called crown of thorns, is a woody, succulent shrub that features fleshy, bright green leaves, inconspicuous flowers in clusters subtended by very showy petal-like red or yellow bracts and thick sharp black thorns which cover its water-storing branches and stems. In

this taxa tricolporate, prolate, spheroidal, large sized with thick tectate exine walled pollen grains were observed (Fig 2.g-h).

***Jacaranda mimisifolia* D.Don**

It is a sub-tropical tree native to south-central America that has been widely planted elsewhere because of its attractive and long-lasting pale indigo flowers of the family Bignoniaceae. It is also known as jacaranda, blue jacaranda or as the fern tree. Pollen grains of this taxa are irregular, oval or slightly triangular-elliptical, tricolporate, medium sized with smooth walled exine (Fig.2.i-j).

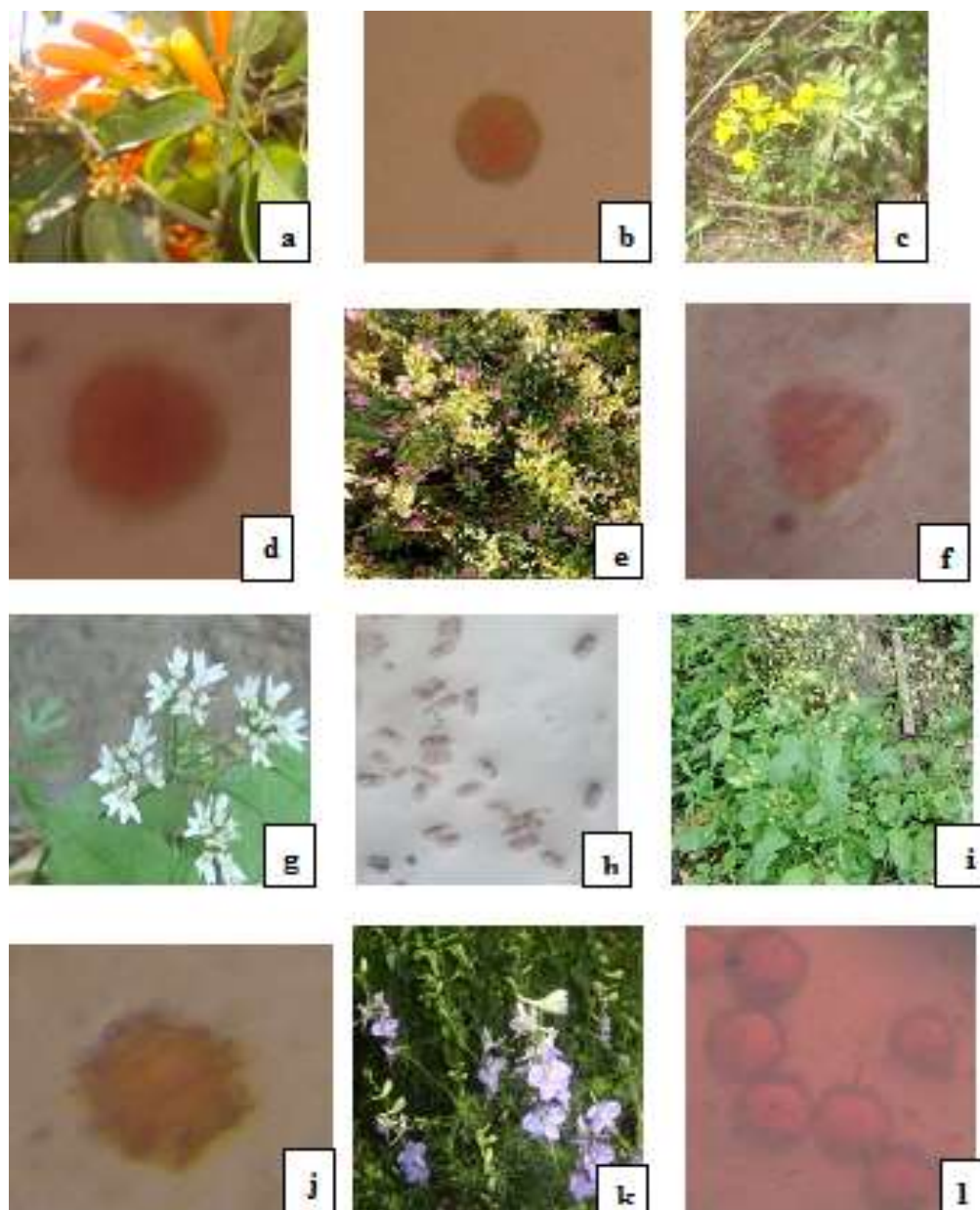


Fig.1. a. Photograph of living plant of *Bignonia venusta*; b. pollen grains of *Bignonia venusta*;
 c. Photograph of living plant of *Brassica campestris*; d. pollen grains of *Brassica campestris*;
 e. Photograph of living plant of *Cuphea hyssopifolia*; f. pollen grain of *Cuphea hyssopifolia*
 g. Photograph of living plant of *Coriandrum sativum*; h. pollen grain of *Coriandrum sativum*;
 i. Photograph of living plant of *Crepis japonica*; j. pollen grain of *Crepis japonica*
 k. Photograph of living plant of *Delphinium ajacis*; l. pollen grain of *Delphinium ajacis*

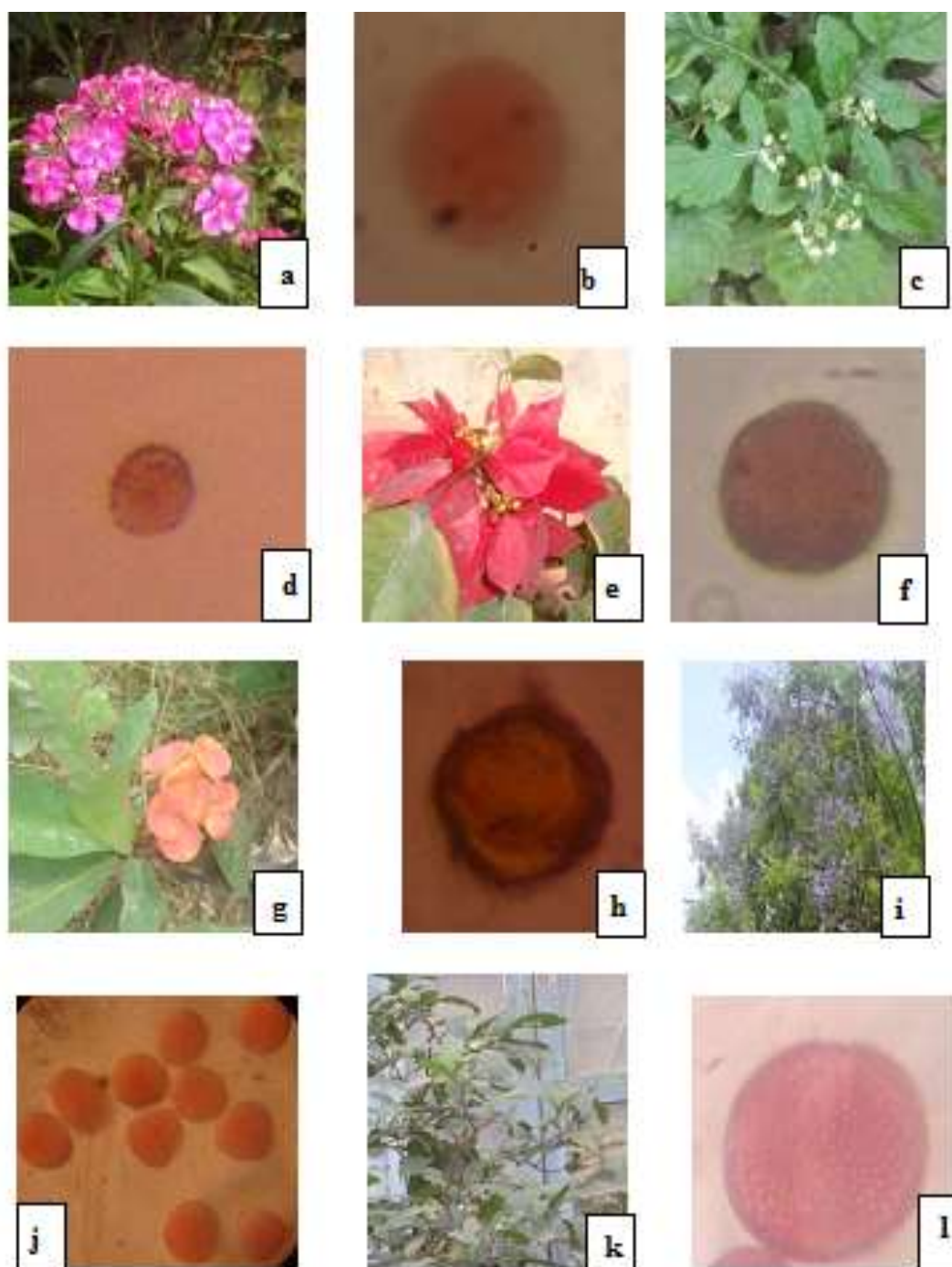


Fig.2 a. Photograph of living plant of *Dianthus barbatus*; b. pollen grain of *Dianthus barbatus*;
 c. Photograph of living plant of *Dichrocephala integrifolia*; d. pollen grain of *Dichrocephala integrifolia*;
 e. Photograph of living plant of *Euphorbia pulcherrima*; f. pollen grain of *Euphorbia pulcherrima*;
 g. Photograph of living plant of *Euphorbia Mili*; h. pollen grain of *Euphorbia Euphorbia Mili*;
 i. Photograph of living plant of *Jacaranda mimosifolia*; j. pollen grains of *Jacaranda mimosifolia*;
 k. Photograph of living plant of *Magnolia fuscata*; l. pollen grain of *Magnolia fuscata*.

Magnolia fuscata L.

It is a historical genus of flowering plants belonging to the family Magnoliaceae. It is cultivated as an ornamental plant for its fragrant flowers. The leaves of the plants are

leathery, dark glossy-green, up to 10 cm long. This plant is used in China as a tall evergreen hedge. Perforated, reticulated, tected, multiporate, prolate, spheroidal and large sized pollen grains were observed in this plant (Fig. 2. k-l).

Table 1: Characters of Pollen grains of presently studied Taxa

Name of Taxa	Family	Pollen shape	Pollen size	Aperture pattern	Exine Sculpture
<i>Bignonia venusta</i> Ker Gawl.	Bignoniaceae	Round	Medium	Multiporate	Smooth
<i>Brassica compestris</i> L.	Brassicaceae	Spheroidal	Large	Pentaporate	Coarse
<i>Cuphea hyssopifolia</i> Kunth.	Lythraceae	Triangular	Small	Triporate	Rough
<i>Coriandrum sativum</i> L.	Fabaceae	Elongated-rod shaped	Small	Multiporate	Intected
<i>Crepis japonica</i> L.	Asteraceae	Spheroidal	Small	Triporate	Echinate
<i>Delphinium ajacis</i> L.	Ranunculaceae	Round	Medium	Multiporate	Smooth
<i>Dianthus barbatus</i> L.	Caryophyllaceae	Round	Large	Triporate	Intected
<i>Dichrocephala integrifolia</i> (L. f.) kunzte.	Asteraceae	Spheroidal	Small	Triporate	Echinate
<i>Euphorbia pulcherrima</i> L.	Euphorbiaceae	Spheroidal	Large	Multiporate	Spinules-tected
<i>Euphorbia Mili</i> Des Moul.	Euphorbiaceae	Prolate-spheroidal	Large	Pentaporate	Thick-tected
<i>Jacranda mimisifolia</i> D.Don	Bignoniaceae	Slightly triangular-elliptical	Medium	Triporate	Smooth
<i>Magnolia fuscata</i> L.	Magnoliaceae	Spheroidal	Large	Multiporate	Perforated

Dalia (2018) studied pollen morphology of 10 species of Brassicaceae from eastern region of Saudi Arabia and found morphology of pollen grains can be useful for to differentiate between species belong to the same genera. The morphology of pollen grain is one of the important tools in solving some taxonomic problems such as identification tracing phylogenetic relationship on the family, generic or specific level and has become part of the multidisciplinary and collaborative approach in plant systematic and evolution (Dalia, 2018). The present study shows partial agreement with the previous report by Graham and Graham (1967) reported for 125 species of *Cuphea* pollens and found nine species have diporate. This study Pollen grains of *Crepis* plant is triporate, spheroidal, echinate exine wall coarsed that shows agreement with the report of Mabel *et al.* (2014).

From the morphological study of pollen grains it is concluded that high diversity of sculpture type in pollen grains of angiosperms has been associated to diversity in pollination systems. Smooth pollen grains are linked with wind or water pollination while sculptured pollen grains associated with biotic pollination. The morphology of pollen grain is one of the important tools in solving some taxonomic problems such as identification tracing phylogenetic relationship on the family, generic or specific level and in plant systematic and evolution.

Conflict of Interest

The authors declare that there is no conflict of interest with present publication.

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