



Research Article

Pollen Grains Morphology of Angiosperms

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Article Information

Received: 05 May 2020

Revised version received: 12 June 2020

Accepted: 15 June 2020

Published: 25 June 2020

Cite this article as:

P.K. Mallick (2020) *Int. J. Appl. Sci. Biotechnol.* Vol 8(2): 205-210. DOI: [10.3126/ijasbt.v8i2.28520](https://doi.org/10.3126/ijasbt.v8i2.28520)

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Peer reviewed under authority of IJASBT

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Keywords: Pollen grain; aceto-carminic; angiosperms; morphology; exine-ornamentation

Abstract

Pollen morphology of fourteen species of angiosperms from Kathmandu valley was investigated using aceto-carminic and palynological characters such as pollen size, shape, aperture numbers and exine sculpture were evaluated. The results indicate that various types of pollen grains are in angiosperms. In this investigation Pollen grains of *Linum usitatissimum* L. from the family Linaceae, *Lathyrus odoratus* L. from Fabaceae, *Magnolia grandiflora* L. from Magnoliaceae, *Malva alcea* L. and *Malva sida* L. from Malvaceae, *Murraya koenigii* Spreng from Rutaceae, *Nerium oleander* L. from Apocynaceae studied. Likewise, *Ocimum tenuiflorum* L., *Salvia coccinea* Buchz ex Etl. *Salvia splendens* Sellow ex J.A. Schultes from Lamiaceae, *Oenothera rosea* L. from Onagraceae, *Prunus persica* (L.) Batsch. from Rosaceae, *Solanum nigrum* L. from Solanaceae and *Zinnia elegans* L. from Asteraceae were studied in this investigation. Shape of the pollen grains found to be spheroidal, sub-spheroidal, elongate, oval, circular, ellipsoidal and triangular type. Ornamentation of exine wall found to be echinate, smooth, coarse, wrinkle and tected type. Aperture of the pollen grains found to be triporate to periporate. Sizes of the pollen grains encountered in this study were large, medium and small. The high diversity of exine ornamentation type in pollen grains of angiosperms has been associated to diversity in pollination systems. Echinate pollen grains train the bees to restrict to nectar collection and help the flowers to save more pollen grains for pollination. Smooth walled pollen grains are linked with wind or water pollination.

Introduction

A pollen grain is a male reproductive cell of a plant. It is very essential in the fertilization process of the plant. Pollen grains represent the male portion of the reproductive process in plants and trees. Pollen grains are microscopic structures that vary in size and shape. It is an extremely durable body. It has a tough outer coating. This hardy coat protects from the outdoor environment. The pollen grains are generally made up of three parts. The inner side of the grain is made up of cytoplasm. The outer shell is made up of two layers. The inner layer is known as intine. It is composed partly of cellulose which is a common component in the cell walls of plant cells. The tough outer layer is known as the exine. This highly complex outer layer

is rich in a compound known as sporopollenin. It is waterproof, resistant to deterioration and is a basically one of nature's polymers. Plant pollen is one of the most common causes of seasonal allergic disease worldwide Bhattacharya *et al.* (2013). The main objectives of this study are to determine shape, size, aperture numbers and exine ornamentation of pollen grains of different species of angiosperms. Pollen morphology is of great importance in relation to plant taxonomy as it reflects the phylogeny of plant kingdom. Ragho (2020) studied pollen grains of 42 species of angiosperms and found morphological characteristics of pollen grains such as shape, color, exine ornamentations, and type of apertures are very important in

plant identifications in field. According to him surface features of pollen grains plays a significant role in taxonomy and detection of crud drugs.

Materials and Method

Flowers of the plants collected from different localities of Kathmandu valley from their natural habitats. The anthers were collected in Petri-dishes. The pollen grains from mature anthers was transferred into a clean glass slide and added one percent aceto-carmin 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 methodology follows in this study as given by Mallick (2019).

Results and Discussion

Linum usitatissimum L.

The taxa *Linum usitatissimum* is commonly known as flax or linseed. It is a member of the genus *Linum* in the family Linaceae. It is a food and fiber crop cultivated in many countries of the world. The clothes made from flax are known as linen. It's also produces oil which is known as linseed oil. The plant species *Linum usitatissimum* is cultivated plant. *Linum usitatissimum* is an annual plant growing to 0.7 m. This plant flower from June to July and the seeds ripen from August to September. Spheroidal, periporate, coarse exine walled pollen grains were observed in these taxa (Figs 1. a-b).

Lathyrus odoratus L.

Lathyrus odoratus is a flowering plant commonly known as sweet pea of the family Fabaceae (legumes). *Lathyrus odoratus* is an annual climbing plant and growing to a height of about 1 to 2 meters where suitable support is available. Pollen grains of this plant are small, oval with smooth walled exine (Figs.1. c-d).

Magnolia grandiflora L.

The Taxa *Magnolia grandiflora* is commonly known as the southern magnolia is a large tree of the family Magnoliaceae, reaching 27 meters in height and is a large striking evergreen tree with large dark green leaves up to 20cm long and 12cm wide with large white fragrant flowers. The timber obtained from this plant is hard and heavy. The timber of it has been used commercially to make furniture, pallets, and veneer. Pollen grains of these taxa are large, ellipsoidal, pentaporate, with baculate exine sculpture (Figs.1.e-f).

Malva alcea L.

Malva alcea is an herbaceous perennial plant with erect stems that can grow 30 to 130 centimeters tall. The plant is harvested from the wild for local use as a food and a medicine. Mainly it is grown as an ornamental plant in

garden. Pollen grains of these taxa were periporate, circular with echinate exine ornamentation (Figs.1.g-h).

Malva sida L.

The taxa *Malva sida* is the flowering plant of family Malvaceae. They are distributed in tropical and subtropical regions worldwide. Plants of the genus commonly known as fanpetals. The plants are perennial shrubs growing up to 2 meters tall. The leaves of these plants are unlobed with serrated edges. Flowers are solitary. Circular, large, polyporate, echinate pollen grains were observed in this plant (Figs.1.i-j).

Murraya koenigii Spreng

The plant *Murraya koenigii* commonly known as curry leaves. It belongs to the family Rutaceae. The plant is usually found in tropical and subtropical regions. The height of the plant ranges from 4 to 6 meters. The useful parts of this taxa are its leaves, roots and bark. The leaves have always been sought after for their unique flavor and usefulness in cooking, but there are also a number of health benefits. Curry leaves resemble 'neem' plant. Small, spheroidal, periporate with wrinkled surfaced exine ornamentation pollen grains were observed in this plant (Figs.1.k-l).

Nerium oleander L.

The taxa *Nerium oleander* belongs to the family Apocynaceae. It is a shrub or small tree. It is commonly known as *Nerium* from its superficial resemblance to the unrelated olive olea. The height of plant ranges from 4 to 8 meters. It is often cultivated as an ornamental plant in the garden. Circular, medium sized, tri-porate with smooth walled exine sculpture were observed in this taxa (Figs.2.a-b).

Ocimum tenuiflorum L.

The taxa *Ocimum tenuiflorum* is commonly known as tulasi. It is an aromatic perennial plant of the family Lamiaceae. The plant is native to the India and widespread as a cultivated plant throughout the Southeast Asian tropics. It is cultivated for religious and traditional medicinal purposes and for its essential oil. It is mostly used as a herbal tea. It is very frequently used in ayurveda. Elongated, large sized with tected exine surface were observed in this taxon (Figs.2.c-d).

Oenothera rosea L.

The plant *Oenothera rosea* is known as rosy evening-primrose or rose evening primrose and pink evening primrose. This is a plant belonging to the genus *Oenothera* and of the family Onagraceae. The plant *Oenothera rosea* has flowers with less than 2.5 cm diameter. The pollen grains of these taxa are tricolpate, concave, triangular shaped, medium sized with spiniferous exine ornamentation were observed in present investigation (Figs.2.e-f).

***Prunus persica* (L.) Batsch**

The plant *Prunus persica* is a deciduous tree. This plant was first domesticated and cultivated in China. The fruits of this plant are edible and juicy which is called a peach. This taxon belongs to the family Rosaceae. The taxa *Prunus persica* grows up to 7m tall. The leaves are lanceolate, broad, pinnately veined. The leaves of this plant produced after the flowers. The flowers of these plants are solitary with five petals. The fruit has yellow or whitish flesh with aroma and a skin that is either velvety or smooth. Large, roughly spheroidal, periporate with smooth walled exine were revealed in these taxa (Figs. 2.g-h).

***Salvia coccinea* Buchz ex Etl.**

Salvia coccinea, commonly called as, the blood sage or tropical sage, is a herbaceous perennial plant in the family Lamiaceae. It is widespread throughout the South Eastern United States, Mexico. *Salvia coccinea* is an annual species. It is cultivated in urban green areas as well as in private gardens around the world. It has a long flowering period, from the start of summer to the end of autumn. The plant reaches 2 to 4 ft in height, with many branches. The pollen grains are oval, large sized, periporate, convex with faveolate walled exine (Figs.2.i-j).

***Salvia splendens* Sellow ex J.A.Schultes**

Salvia splendens, the scarlet sage or tropical sage, is a tender herbaceous perennial plant of the family Lamiaceae, native to Brazil. Its leaves are in even, elliptical arrangements, with tooth like margin and they have long petioles. Flowers

in erect spikes that sprout from the centre of the plant. The flowering period of this plant is summer to autumn and color of it is bright red. The plant grown as an ornamental plant in the garden. The pollen grains are oval, medium sized, polyporate with semitected exine wall found in this taxon (Figs.2.k-l).

***Solanum nigrum* L.**

The plant *Solanum nigrum* is a flowering plant of family Solanaceae. It is also commonly known as black nightshade. Black nightshade is a common annual herb found in many wooded areas as well as disturbed habitats. It reaches a height of 30 to 120 cm. Pollen grains of these taxa found to be round, small sized and triporate aperture with smooth walled exine wall in present study (Figs.2.m-n).

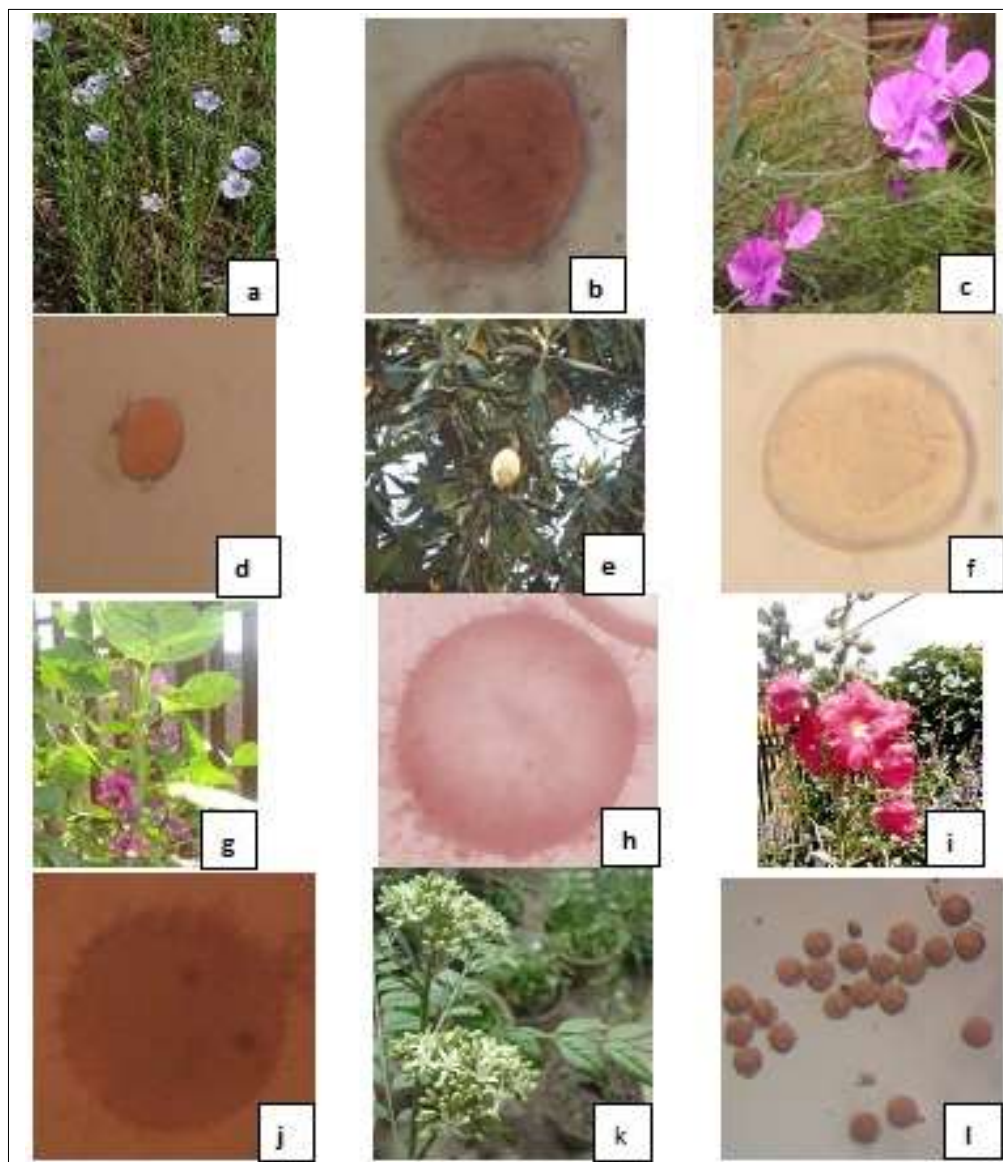
***Zinnia elegans* L**

The plants *Zinnia elegans* is a flowering plant belongs to the family Asteraceae. It is commonly known as Zinnia. It is annual plant grown as an ornamental plant in many places. It is native to Mexico. It has hairy stems and oval lance shaped leaves oppositely arranged. The solitary flower heads are borne at the ends of branches. Medium sized, spheroidal, triporate with echinate walled exine were observed in this taxon presently (Figs. 2.o-p).

Morphological characters of Pollen grains are tabulated below in a Table 1.

Table 1: Pollen grains characters of present study

S.N.	Name of plants	Family Name	Shape of Pollen grains	Size of Pollen grains	Number of Aperture	Exine ornamentation
1	<i>Linum usitatissimum</i> L.	Linaceae	Spheroidal	Large	Periporate	Coarse
2	<i>Lathyrus odoratus</i> L	Leguminosae	oval	Small	Multiporate	smooth
3	<i>Magnolia grandiflora</i> L.	Magnoliaceae	Ellipsoidal	Large	Polyporate	Smooth
4	<i>Malva alcea</i> L.	Malvaceae	Circular	Large	Polyporate	Echinate
5	<i>Malva sida</i> L.	Malvaceae	Circular	Large		Echinate
6	<i>Murraya koenigii</i> spreng	Rutaceae	Spheroidal	Small	Periporate	Wrinkle
7	<i>Nerium oleander</i> L.	Apocynaceae	Circular	Medium	Triporate	Smooth
8	<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Elongate	Large	Periporate	Tected
9	<i>Oenothera rosea</i> L	Onagraceae	Triangular	Medium	Triporate	Spiniferous
10	<i>Prunus persica</i> (L.) Batsch	Rosaceae	Sub-spheroidal	Large	periporate	Smooth
11	<i>Salvia coccinea</i> Buchz ex Etl.	Lamiaceae	Oval	Large	periporate	Faveolate
12	<i>Salvia splendens</i> Sellow ex J.A. Schultes	Lamiaceae	Oval	Medium	Multiporate	Faveolate
13	<i>Solanum nigrum</i> L.	Solanaceae	Circular	Small	Triporate	Smooth
14	<i>Zinnia elegans</i> L	Asteraceae	Spheroidal	Medium	Triporate	Echinate

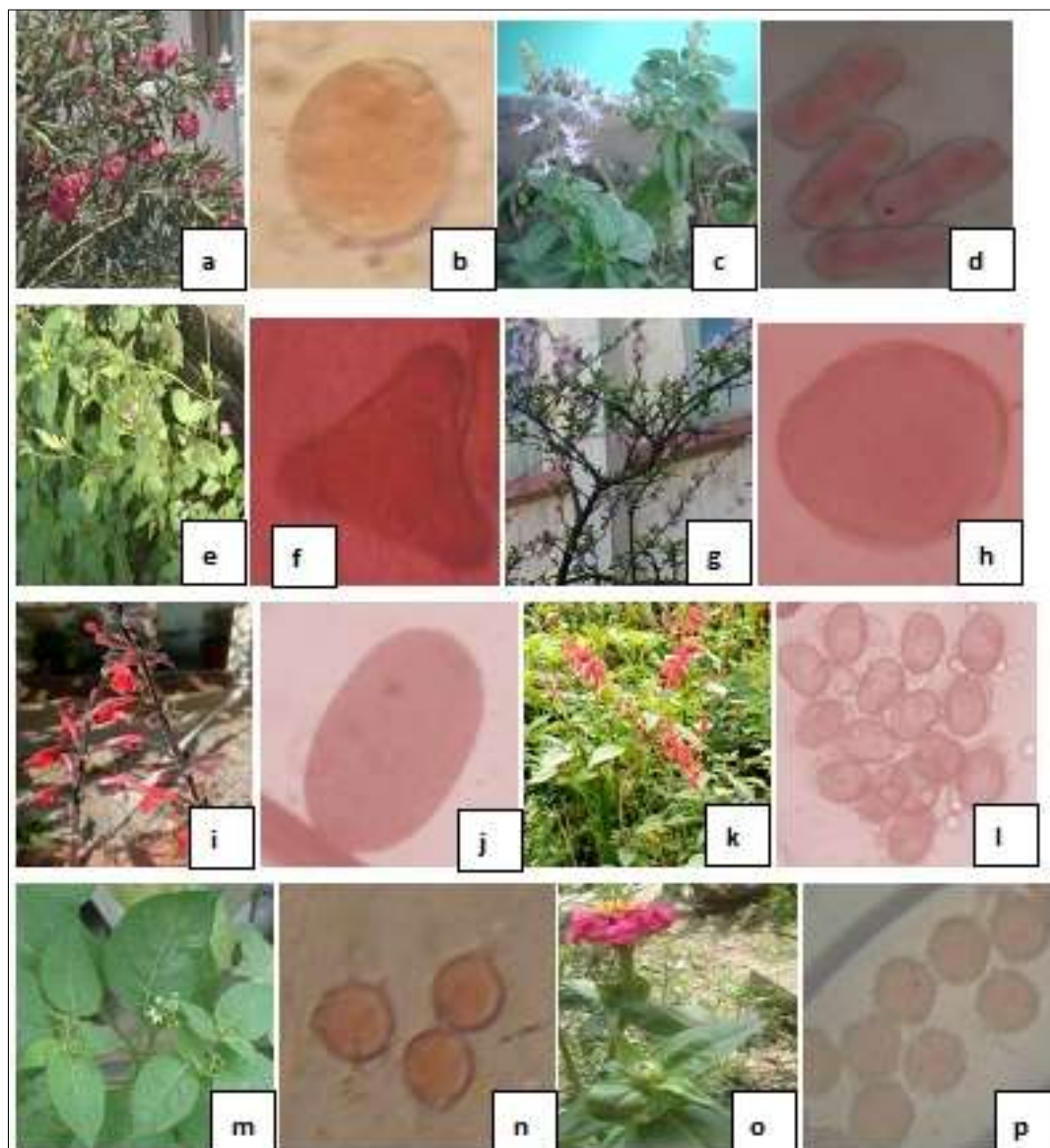


Figs. 1: a. Photograph of living plant of *Linum usitatissimum*
 c. Photograph of living plant of *Lathyrus odoratus*
 e. Photograph of living plant of *Magnolia grandiflora*
 g. Photograph of living plant of *Malva sida*
 i. Photograph of living plant of *Malva alcea*
 k. Photograph of living plant of *Murraya koenigii*
 b. pollen grain of *Linum usitatissimum*
 d. Pollen grain of *Lathyrus odoratus*
 f. Pollen grain of *Magnolia grandiflora*
 h. Pollen grain of *Malva sida*
 j. Pollen grain of *Malva alcea*
 l. Pollen grains of *Murraya koenigii*

Hinderson *et al.* (1968) studied pollen morphology of seven species of *Salvia* and Spheroidal or prolate, 6-colpate with reticulate exine walled pollen grain was observed. Edmonds (1984) studied pollen morphology of *Solanum nigrum* and found spheroidal to sub-prolate shaped, tricolporate nature and granular surface sculpturing in this taxon. The pollen grains are profound importance in classification and taxonomy of angiosperms according to Ducker and Knox (1985). Radice *et al.* (2003) studied pollen morphology of *Prunus persica* and tricolporate with striated exine ornamentation pollen grains were observed. Xu and Kirchofe (2008) studied pollen morphology of 20 species of *Magnolia* and found that pollen grains are boat shaped with a single elongate aperture on the distal face. Bhattacharya *et al.* (2013) observed five porate type pollen grain of *Nerium odoratum*.

Maciejewska-Rutkowska & Wusakowska (2018) studied pollen morphology of 11 Cultivars of *Linum usitatissimum* and found that pollen grains are prolate spheroidal tricolpate and of large sized and all grains were semitectate with discontinuous tectum. Doaigey *et al.* (2018) studied three species of acetolysed *Ocimum* and found all species are acolpate and hexacolpate. Spiny pollen grains restrict the bees to nectar collection and help the flowers to save more pollen grains for pollination. Smooth walled pollen grains are linked with wind or water pollination.

Variability in exine ornamentation particularly useful in characterization of taxa. From the present investigation it is concluded that the morphology of pollen grains such as shape size, aperture and exine ornamentation played a great role in classification, taxonomy and pollination systems of angiosperms.



Figs. 2. a. Photograph of living plant of *Nerium oleander*
 b. Pollen grain of *Nerium oleander*
 c. Photograph of living plant of *Ocimum tenuiflorum*
 d. pollen grains of *Ocimum tenuiflorum*
 e. Photograph of living plant of *Oenothera rosea*
 f. Pollen grain of *Oenothera rosea*
 g. Photograph of living plant of *Prunus persica*
 h. Pollen grain of *Prunus persica*
 i. Photograph of living plant of *Salvia coccinea*
 j. Pollen grain of *Salvia coccinea*
 k. Photograph of living plant of *Salvia splendens*
 l. Pollen grains of *Salvia splendens*
 m. Photograph of living plant of *Solanum nigrum*
 n. Pollen grains of *Solanum nigrum*
 o. Photograph of living plant of *Zinnia elegans*
 p. Pollen grains of *Zinnia elegans*

Conflict of Interest

The author declares that there is no conflict of interest with present publication

Acknowledgement

I am grateful to Associate Professor Mrs. Durga Shakya, the Department Head of Botany, Tri-Chandra Multiple Campus, Tribhuvan University, Kathmandu, Nepal for Providing Lab facilities to perform this experiment.

References

Abdullah R, Doaigey and Mohamed El-Zaidy and Ahmad H Alfarhan and Abd El-Salam Milagey and Thomas Jacob

(2018) Pollen morphology of certain species of the family Lamiaceae in Saudi Arabia. *Saudi Journal of Biological Sciences* **25**: 354-360. DOI: [10.1016/j.sjbs.2017.03.001](https://doi.org/10.1016/j.sjbs.2017.03.001)

Bhattacharya SP, Pal JK, Biswas P and Pal PK (2013) Pollen morphological study of some plant taxa from Arambagh region of Hooghly District, West Bengal, India, *Int J Curr Sci* **7**: E 97-103.

Ducker S and Knox R (1985) Pollen and Pollination: A Historical Review. *Taxon* **34**(3): 401-419. DOI: [10.2307/1221207](https://doi.org/10.2307/1221207)

- Edmonds JM. (1984) Pollen morphology of *Solanum* L. section *Solanum*, *Botanical Journal of the Linnean Society* 88(3): 237–251. DOI: [10.1111/j.1095-8339.1984.tb01573.x](https://doi.org/10.1111/j.1095-8339.1984.tb01573.x)
- Henderson DM, Prentice H and Hedge IC (1968) Pollen Morphology of *Salvia* and Some Related Genera. *Grana* 8(1): 70-85. DOI: [10.1080/00173136809427461](https://doi.org/10.1080/00173136809427461)
- Magdalena Kluza-Wieloch, Irmina Maciejewska-Rutkowska and Ilona Wusakowska (2018) Comparitive Research of Pollen Morphology of Common Flax Cultivars (*Linum usitatissimum* L., Linaceae). *Journal of Natural Fibers* 15(6): 830-842. DOI: [10.1080/15440478.2017.1369209](https://doi.org/10.1080/15440478.2017.1369209)
- Mallick PK (2019) Pollen Morphology of Angiosperms of Central Nepal. *Int J Appl Sci Biotechnology* Vol 7(1): 102-107. DOI: [10.3126/ijasbt.v7i1.23317](https://doi.org/10.3126/ijasbt.v7i1.23317)
- Radice S M, Ontivero , Giordani, Edgardo and E Bellini (2003) Morphology and physiology of pollen grains of Italian *Prunus persica* (L). Batsch. cultivars grown in Argentina. *Advances in Horticultural Science* 17: 93-96.
- Ragho KS (2020) Role of pollen morphology in taxonomy and detection of adulterations in crud drugs. *J Plant Sci Phytopathol* 4: 024-027. DOI: [10.29328/journal.jpssp.1001046](https://doi.org/10.29328/journal.jpssp.1001046)
- Xu FX and Kirchoff BK (2008) Pollen morphology and ultrastructure of selected species of Magnoliaceae. *Review of Palaeobotany and Palynology* 150(1-4): 140-153. DOI: [10.1016/j.revpalbo.2008.01.007](https://doi.org/10.1016/j.revpalbo.2008.01.007)