International Journal of Academic Research and Development
ISSN: 2455-4197
Impact Factor: RJIF 5.22
www.academicsjournal.com
Volume 3; Issue 2; March 2018; Page No. 819-821

Pollen biology and morphology of *Ziziphus jujuba* Mill. (Rhamnaceae)

Byraiah Dinesh
Department of Sericulture/Life Science, Bangalore University, Bangaluru, Karnataka, India

Abstract
Ziziphus jujuba is a medium sized tree of common occurrence and distributed in deciduous and scrubby forest and play an important role in agroforestry and also a secondary food plant of tropical tasar silk worm. The pollen viability, germination and morphology were studied using light and scanning electron microscopy. The pollen viability was found to be 83±2.55 % and maximum germination was 79±2.13 % and pollen tube length of 48.35µm. Pollen grains were yellow, manods, spheroidal-prolate, isopolar, tricolporate and exine surface regulate.

Keywords: *Ziziphus jujuba*, viability, germination, morphology, SEM

1. Introduction
The genus *Ziziphus* comprises about 170 species native to the tropics and subtropics forest of the world [1]. The species are known to be distributed throughout deciduous and scrubby forest and naturalized throughout the greater part of India from low lands to Himalayas. It is associated with dry areas where tree types can be found or bushy types in grass land [2]. The two major domesticated jujubes are *Z. jujuba* and *Z. mauritiana* which are included in the national programme for underutilized crops by International Centre for underutilized crops (ICUC), Government of India [3, 11].
The *Z. jujuba* is a medium sized tree of very common occurrence, reaching a height of 10 m, semi-erect or spreading habit, adapted to hot tropical climates with low to relatively high rainfall with poor soil nutrients. This species is of multipurpose value, including cultivating for fruits which are consumed either fresh or processed in to beverage, honey production, timber, horticultural importance and environmental protection [12-14].
The *Antheraea mylitta* Drury (Lepidopeta) is a polyphagous tropical tasar silkworm and feeds on primary food plants *Terminelia arjuna, T. tomentosa* and *Shorea robusta* besides, as many as two dozens of secondary and tertiary food plants based on their feeding choice [9]. *A. mylitta* is highly adapted to different environments and 44 ecoraces have been recognized in tropical India with significant phenotypic and behavioral variations [18]. *Z. jujuba* is considered as one of secondary food plants of *A. mylitta* [16]. The role of Indian tasar in agro forestry and overall development of tribal folk is noteworthy in contributing to the production of main raw material for India's chief cottage industry. The export of tasar silk goods has brought considerable amounts of foreign exchange, hence it is often called "golden fiber" [10].
The earliest pollen studies of *Ziziphus* were made by Wodehouse [19] followed by Erdtman [4] in Rhamnaceae. Later pollen morphological studies were reported by, Hulwale, *et al*., [8], Goupta, *et al.,* [6], Perveen and Qaiser, [13], Rouhakhsh *et al*., [14] for different species and cultivars of *Ziziphus*.
In the present investigation, phenology, pollen viability, germination and pollen morphology is studied in wild *Z. jujuba* using Light and Scanning electron microscope.

2. Materials and Methods
Field studies were undertaken in different localities of Karnataka to collect Phenological data of the taxa were recorded in their natural habitats representing dry deciduous to warm temperature forests including, Devarayana durga, Banneraghata, BR hills. The specimens were collected and were authentically identified [15]. For Pollen viability, germination and morphology, fresh material was collected from the germplasm maintained at Jnana Bharathi campus, Bangalore University, Bangalore.

2.1 Pollen viability and germination
Flowering twigs were collected from healthy plants during cool hours of the day between 7-8 Am. Fresh pollen was used for germination and viability studies.
The pollen viability was tested by staining with 1% *2, 3, 5*-Triphenyltetrazolium chloride (TTC) and the percentage of viable pollen were recorded after two hours Shivanna and Rangaswamy [17]. The percentage of viable pollen grains was recorded from 5 replications and calculated by the following formula.

$$\% \text{ Pollen Viability } = \frac{\text{No. of stained pollen}}{\text{Total No. of pollen}} \times 100$$

Pollen germination was conducted in different concentration of sucrose ranging from 5, 10, 15 and 20% in Brewbekar and Kawck medium by Hanging drop method (Shivanna and Rangaswamy) [17]. Pollen tube initiation and growth was monitor from 0 hours to 6 hours. The percentage of germination was recorded from 5 replications and estimated by using the formula

$$\% \text{ Pollen germination } = \frac{\text{No. of germinated pollen}}{\text{Total No. of pollen}} \times 100$$

2.2 Pollen morphology (LM and SEM)

Anthers were collected and fixed in 70 % ethyl alcohol and acetolysis was carried out following the method of Erdtman, [5]. Pollen grains were mounted on a clean microscopic slide using glycerin jelly as mounting medium. Measurements of polar and equatorial diameters and the structural features of the exine were made with a light microscope.

The acetolysed pollen grains were dehydrated with ethyl alcohol were dusted on the surface of double stick tape pasted on to the stub and coated with gold in a spotter coater. The stub were placed in a vacuum evaporator and observed in the Scanning Electron Microscope (JEOL-JSM840A). The aperture types and surface details were observed.

The pollen general terminology and morphology concepts follow those of Erdtman [4], Hesse *et al*., [7].

3. Results and Discussion

3.1 Phenology

The tree sheds leaves during summer from March to April and bloom from June to October in umbellate cymes. Flowers are actinomorphic, bisexual and hypogenous. Fruiting from November December, fruit is a drupe with solitary stony seed.

3.2 Pollen viability and germination

Pollens were collected at the time of anthesis and viability was found to be 93±2.93 % at anthesis. The pollen germination with various concentrations was observed in the increasing order as that of concentration of sucrose. The minimum pollen germination of 35±1.61 % was observed in 5% sucrose and maximum of 91±2.65% in 20% sucrose. The maximum germinated pollen tube length of 48.35±1.75 µm (table-1).

Table 1: Pollen germination, pollen tube length and viability in *Z. jujuba*

Sucrose with BKM (%)	Germination (%)	Pollen tube length (µm)	Viability (%)
5	35±1.61	48.35±1.75	83±2.55
10	51±1.95		
15	73±2.08		
20	79±2.13		

3.3 Pollen morphology

The pollen grains were monads, small in size with polar axis 22.65 µm and equatorial diameter 21.15 µm, P/E ratio 1.08, spheroidal-prolate in shape, tricolporate, isopolar, triangular in polar view (Fig. 1. A and D), interapertural area sunken, operculum irregular (Fig. 1. B and C), exine surface rugulate in the middle and smooth towards the colpi (Fig. 1. D), (table-2).

Table 2: Pollen morphology of *Z. jujuba.*

Species	Polar axis Mean & SD (µm)	Equatorial diameter Mean & SD (µm)	P /E	Shape	Size class	Colpus type	Colpus length (µm)	Exine Sculpturing
Z. jujuba	22.85±0.42	21.15±.06	1.08	Spheroidal – prolate	Small	Tricolporate	18±45	Rugulate

The pollen biology of *Z. jujuba* with respect to fertility and germination reports was very limited. In the present studies a relatively high viability of 83% and germination of 79 % was observed (Table-1) than previously reported by Hulwale *et al*., [8].

The pollen morphology of *Z. jujuba* is in general similar to pollen found in the family *Rhamnaceae* in having tricolporate condition. Perveen and Qaiser [13], reported pollen morphology of 11 species of 5 genera of *Rhamnaceae* from Pakistan by both light and Scanning electron microscope studies and described the diversity in shape and size from oblate-spheriodal and sub prolate-prolate, tricolporate, exine surface sexine thicker than nexine, striate-rugulate and rarely reticulate-rugulate, often psilate in all the species.

Rouhakhsh *et al*., [14] have reported pollen morphology of Iranian jujube of Rhamnaceae including *Z. jujuba* with reference to taxonomic significance with two distinct groups with oblate-spheroidal and subprolate, striate with irregular pattern exine. However, the present study indicate that the pollen morphology of *Z. jujuba* is identical with respect to shape, slightly variation in shape and aperture type but slightly differ in exine sculpturing in having rugulate condition. This morphological difference may be due to geographical variations in distribution of this wild taxon representing south India.

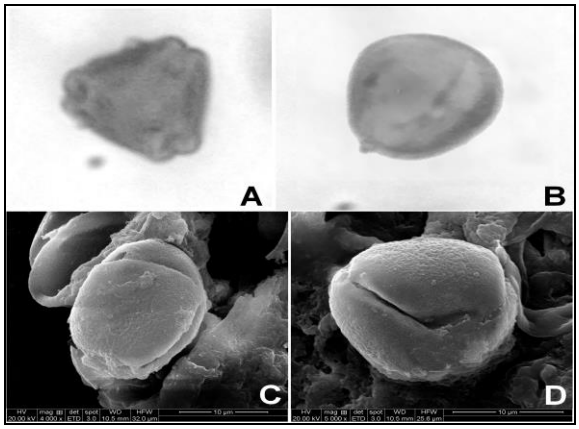

Fig 1: LM; A- Polar view, B- Equatorial view, SEM; C-Equatorial view with exine surface, D- Polar view.

4. Acknowledgements

I thank Dr. Munirajappa, Department of Sericulture / Life Science and R. Nijagunaiah, Department of Botany,

Bangalore University, Bangaluru-560056, for guidance and help.

5. References

1. Brandis D. Indian trees. A Constable & Co, London, 1906.
2. Atluri JB, Ramadevi K, SubbaReddi C. Pollen flow in *Zizyphus oenoplia* Mill (*Rhamnaceae*). Journal of Palynology. 1995; 31:260-273.
3. Azam Ali S, Bonkoungou E, Bowe C, Dekock C, Godara A, Williams JT. Ber and others jujubes. International center for underutilized crops, University of Southampton, Southampton, UK, 2001.
4. Erdtman G. Pollen morphology and plant taxonomy-Angiosperms. Stockholm: Almquist and Wiksell, 1952.
5. Erdtman G. The acetolysis method, a revised description. *Svensk. Botany. Tidskr*. 1960; 54:561-564.
6. Gupta RB, Suneel Sharma, Goyal SC. Study of pollen morphology of genus *Ziziphus*. Journal of Phytology Research. 2002; 15(2):217-220.
7. Hesse M, Halbritter H, Zetter R, Weber M, Buchner R, Frosch-Radivo A, *et al*. Pollen Terminology. An illustrated handbook. Springer Wien. New York, 2009.
8. Hulwale TD, Karale AR, Desai UT, Kaulgud SN, Keskar BG. Pollen studies of Ber (*Ziziphus mauritiana* Lamk) Cultivars. Annals of Arid Zone. 1995; 34(1):47-50.
9. Jolly MS, Sen SK, Ahsen MM. Tasar culture: Ambica publishers, Bombay, India, 1974.
10. Jolly MS, Sen SK, Sonwalker TN, Prasad GK. Non-mulberry silks. Food and Agriculture Organization of the United Nations. Rome, 1979.
11. Pareek S, Mukherjee S, Paliwal R. Floral biology of ber - a review Indian Academic Science. (Plant Science. 2007; 99:223-239.
12. Parmar C, Kaushal MK. *Zizyphus jujuba* wild fruits. Kalyani Publishers, New Delhi, India, 1982, 98-100.
13. Perveen A, Qaiser M. Pollen flora of Pakistan-XLIV. Rhamnaceae. Pakistan Journal of Botany. 2005; 37(2):195-2002.
14. Rouhakhsh H, Devaryejad G, Bahram Abedi, Majid Rahemi. Pollen grain morphological characteristics of ten Iranian Jujube *(Ziziphus jujuba*) cultivars by using Scanning Electron Microscopy. Advances in Environmental Biology. 2014; 8(5):1333-1338.
15. Saldanha JC. Flora of Karnataka, Oxford and IBH Pub. Co. Ltd. New Delhi, 1996, 2.
16. Sharma SK, Rai MM. Biodiversity and conservation of tasar ecoraces. International Journal of Research in Bioscience, Agriculture and Technology. 2015; 2(7):313-316.
17. Shivanna KR, Rangaswamy NS. Pollen biology: A laboratory manual, Narosa publishing House, New Delhi, 1992.
18. Suryanarayana N, Srivastava AK. Monograph on Indian tasar silkworm, Central tasar research and training institute, Ranchi, India, 2005.
19. Wodehouse RP. (Reprint in 1960) Pollen Grains. Their structure, identification and signification in Science and Medicine, McGraw-Hill Company, New York, London, 1935.