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Studies on size, sterility and germination of pollen grains of certain members of the family Malvaceae

¹Geetha Lakshmi K., ²P.M. Mathew, ³Rogimon P. Thomas and ⁴Chandralekha C.T.

¹Department of Botany, Baselius College, Kottayam, Kerala, India

²Department of Botany, University of Kerala, India

³Department of Botany, CMS College Kottayam (Autonomous), Kerala, India

⁴PG Department of Botany, Devamatha College, Kuravilangad, Kottayam, Kerala, India

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ABSTRACT

The present study attempted to evaluate the pollen size, percentage of sterility using acetocarmine, percentage of germination in sucrose medium among the members of the family Malvaceae like *Malva viscosa* Cav., *Sida rhombifolia* L., *Urena lobata* L. *Hibiscus furcatus* Roxb. *Hibiscus rosa-sinensis* L. and *Gossypium arboreum* L. Regarding the size pollen grains of *Hibiscus rosa-sinensis* showed largest pollen. The smallest pollen grains belong to *Urena lobata*, L. The pollen sterility using acetocarmine indicated that the pollens of *Hibiscus furcatus* were completely fertile, while *Sida rhombifolia* showed highest amount of sterility. The germination of pollen grain in sucrose medium indicated that the pollen grain of all the members studied showed poor germination.

Key words : Pollen, Sterility, Germination, Malvaceae

Introduction

Pollen grains are structures that house the male gametophyte generation of angiosperms and gymnosperms. They are also the vehicles in which the male gamete genetic code is carried to the female gamete. Pollen grains develop in the anther in angiosperms. It travels and is deposited on the stigma of a receptive flower. In gymnosperms, pollen develops in the male cone, travels, and fertilizes the ovules in the female cones to produce seeds. Each pollen grain consists of the two celled male haploid plant enclosed in a thickened wall. The casing that houses the male gametophyte has a very complex structure that is reflective of that specific species' functional adaptations. The *exine* is the outer layer of a living pollen grain. It is composed of *sporopollenin*, with small quantities of polysaccharides. Sporopollenin

is very chemically stable (Briggs *et al.*, 2000) and it is resistant to almost all kinds of environmental damage. It is equipped with apertures. It is divided into two sub layers: the outermost sexine and the unsculptured underlying nexine. The sexine has surfaces that are sculptured in elaborate ways, with reticulately arranged perforations. These give the exine an amorphous or granular appearance. The inner layer of a living pollen grain is called the intine. It is composed of cellulose and is very similar in construction to ordinary plant cell walls. A layer called the endexine separates the sexine and intine. The endexine has a laminated appearance.

The Malvaceae is a cosmopolitan plant family of about 244 genera and nearly 4225 species of herbs, shrubs and trees. The bisexual flowers have 5 petals, an ovary with two carpels and many stamens. Fruits may be berries, samaras, schizocarps, or capsules.

²Head (Rtd.)

The leaves are characterized by stellate hair (Nair, 1962). The shape of a pollen grain refers to the shape of their outline in polar and equatorial views. The shape of a grain can sometimes be useful in identifying of pollen species. This study is an attempt to relate the morphological as well as germination variability of pollen grains among certain members of the family Malvaceae.

Materials and Methods

In the present study pollen characteristics of the following members of Malvaceae are compared.

Malva viscus arboreus Cav.: The flowers which look like unopened, spreading shrub to 2-3 m high. Stems densely clothed in stellate hairs. Leaves are densely clothed in velvety to tough hairs shallowly 3-lobed. Leaf margin is crenate-serrate. Leaves are 5-15 cm long with stalks 2-12 cm long. Flowers are borne solitary or few in fascicles, in leaf axils. Flowers are red and pendulous, 2-3 inches long.

Sida rhombifolia, Linn.: A weed on waste places, herb, pubescent with simple and stellate hairs. Leaves toothed, flowers axillary, corolla small yellow. Fruit globose.

Urena lobata, Linn.: Herbaceous perennial. Leaves lobed with a gland at the base of mid rib. Flowers sessile, petals pink, 5, united below. Ripe carpels covered with glochidiate spines.

Hibiscus furcatus, Roxb.: A prickly trailing under shrub, calyx persistent in flower, stem with thorns, stipules 0. Yellow flowers with maroon at the inner base of the petals..

Hibiscus rosa-sinensis L.: The leaves are alternate, simple, ovate to lanceolate, often with a toothed or lobed margin. The flowers are large, conspicuous, trumpet-shaped, with five or more petals, ranging from white to pink, red, orange, purple or yellow, and from 4-18 cm.

Gossypium arboreum L.: Tree with moderate size,

bracteoles large and cordate, persistent, foliaceous. Flowers yellow.

Methodology

Pollen size: Pollen size was measured using micrometer. 20 pollen size were measured and calculated the mean and standard deviation

Acetocarmine staining: Pollen micro preparations were stained with 2% acetocarmine and observed under light microscope. Stained full pollens were counted as fertile and shrunken unstained pollens are counted as sterile.

Percentage of sterility was calculated by the following formula

Percentage of sterility = (Number of sterile pollen/ Total number of pollen) X 100.

Pollen germination: Pollen micro preparations were made in deferent concentrations of sucrose. The concentrations of sucrose selected were 5, 10 and 20%. Observations were taken at 30 minutes interval.

Percentage of germination was calculated by the following formula

Percentage of germination = (Number of germinated pollen/ Total number of pollen) X 100.

Results

Pollen size: The pollen size of the members of the family Malvaceae is presented in Table 1. It is ob-

Table 2. Pollen sterility among the members of Malvaceae

Name of the plant	Percentage pollen sterility	
	Range	Mean
<i>Malva viscus arboreus</i> Cav.	18.2 – 85	47.96
<i>Sida rhombifolia</i> , L.	33.3 – 66.6	61.416
<i>Urena lobata</i> , L	16.6 -75	40.72
<i>Hibiscus furcatus</i> , Roxb.	0	0
<i>Hibiscus rosa-sinensis</i> L	33.33 -50	38.53
<i>Gossypium arboreum</i> L.	16.6 - 100	61.42

Table 1. Pollen size variation among the members of Malvaceae

Name of the plant	Pollen size (µm)	
	Range	Medium ± sd
<i>Malva viscus arboreus</i> Cav.	75x75 -135x135	88.5 x 88.5 ± 3.84
<i>Sida rhombifolia</i> , L.	75x75-90x90	82.5 x 82.5 ± 7.5
<i>Urena lobata</i> , L	80x80-120x120	77.25 x 77.25 ± 8.61
<i>Hibiscus furcatus</i> , Roxb.	90x90-120x120	112.5 x 112.5 ± 11.122
<i>Hibiscus rosa-sinensis</i> L	90x90-135x135	114 x 114 ± 16.015
<i>Gossypium arboreum</i> L.	90x90 – 135x135	112.5 x 112.5 ± 18.950

served that pollen from *Hibiscus rosa-sinensis* showed largest size (114µm). The smallest sized pollen grain observed in the case of *Urena lobata* (77.25 µm). The standard deviation of size indicated that *Malva viscosa* showed an almost uniform pollen size with lesser variation.

Pollen sterility: Percentage pollen sterility using acetocarmine stainability is presented in Table 2. Percentage of sterility is found to be high in *Sida rhombifolia* and *Gossypium arboreum* (61%). In the case of *Hibiscus furcatus*, all the pollen grains are fertile.

Pollen germination: Pollen germination is estimated using different concentration of sucrose with respect to time. Sucrose solution is prepared to get 5,10 and 20% concentration. Pollen grains are al-

lowed to germinate in this medium. It is observed from Table 3 that pollen grains of *Malva viscosa* possess 16% germination only even after 120 minutes. The concentration of sucrose is not influencing the percentage of germination. It is observed from Table 4 that pollen grains of *Sida rhombifolia* possess 17% germination after 120 minutes. Low sucrose concentration (15%) is sufficient to attain this 17 % germination. It is observed from Table 5 that pollen grain of *Urena lobata* showed 15 % germination in higher concentration of sucrose (20%). Thus it is evidenced that the pollen requires a higher level of sucrose for germination.

It is observed from Table 6 that pollen grains of *Hibiscus furcatus* showed only 13% germination, even after 120 minutes with 20% sucrose. It is ob-

Table 3. Pollen germination among the members of Malvaceae-

Percentage of sucrose	<i>Malva viscosa</i> Pollen germination %			
	After 30 minutes	After 60 minutes	After 90 minutes	After 120 minutes
5	8	13	14	16
10	10	14	15	16
20	9	11	13	15

Table 4. Pollen germination among the members of Malvaceae –
Sida rhombifolia

Percentage of sucrose	Pollen germination %			
	After 30 minutes	After 60 minutes	After 90 minutes	After 120 minutes
5	10	12	14	17
10	8	12	13	15
20	10	13	14	16

Table 5. Pollen germination among the members of Malvaceae - *Urena lobata*

Percentage of sucrose	Pollen germination %			
	After 30 minutes	After 60 minutes	After 90 minutes	After 120 minutes
5	6	7	10	11
10	4	4	5	6
20	10	12	13	15

Table 6. Pollen germination among the members of Malvaceae – *Hibiscus furcatus*

Percentage of sucrose	Pollen germination %			
	After 30 minutes	After 60 minutes	After 90 minutes	After 120 minutes
5	4	5	7	8
10	6	7	9	11
20	8	8	10	13

Table 7. Pollen germination among the members of Malvaceae – *Hibiscus rosa-sinensis*

Percentage of sucrose	Pollen germination %			
	After 30 minutes	After 60 minutes	After 90 minutes	After 120 minutes
5	5	7	10	12
10	7	9	10	11
20	6	8	9	10

Table 8. Pollen germination among the members of Malvaceae – *Gossypium arboreum*

Percentage of sucrose	Pollen germination %			
	After 30 minutes	After 60 minutes	After 90 minutes	After 120 minutes
5	4	5	5	6
10	3	5	6	10
20	3	4	9	11

served from Table 7 that the pollen grains of *Hibiscus rosa-sinensis* showed 12% germination and pollen require only low concentration of sucrose (5%). It is observed from Table 8 that pollen grains of *Gossypium arboreum* showed 11 percent germination in 20% sucrose. It also indicated that 10% germination is achieved from 10% sucrose. Thus higher concentration of sucrose is not induced any improvement in germination. It is observed from the above study that pollen stainability is not indicating the ability of pollen with respect to germination.

Summary and Conclusion

The present study attempted to evaluate the pollen size, percentage of sterility using acetocarmine, percentage of germination in sucrose medium among the members of the family Malvaceae. The members

studied are *Malva viscosa* Cav., *Sida rhombifolia*, L, *Urena lobata* L. *Hibiscus furcatus*, Roxb. *Hibiscus rosa-sinensis* L. and *Gossypium arboreum* L. Regarding the size pollen grains of *Hibiscus rosa-sinensis* showed largest pollen. The smallest pollen grains belong to *Urena lobata*, L. The pollen sterility using acetocarmine indicated that the pollens of *Hibiscus furcatus* Roxb. were completely fertile, while *Sida rhombifolia* L and *Gossypium arboreum* showed highest amount of sterility. The germination of pollen grain in sucrose medium indicated that the pollen grain of all the members studied showed poor germination (up to 17% only). The concentration of sucrose did not show much effect on germination. It is also indicated that the stainability showed no indication on germination response in sucrose medium.

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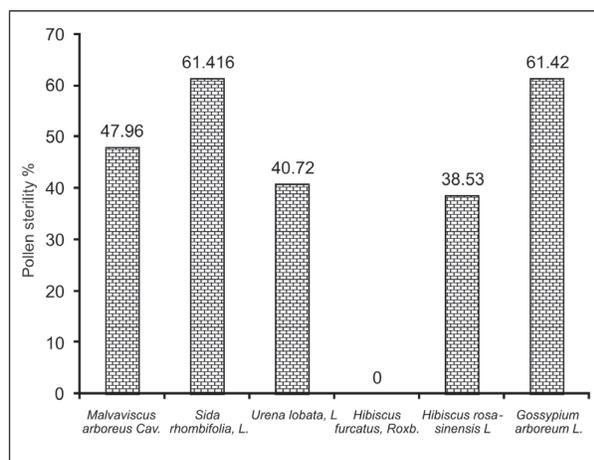


Fig.1. Pollen sterility among the members of Malvaceae

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