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Palynological Studies of Cultivated Plant Species at University of Arid Agriculture, Rawalpindi, Pakistan

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Abstract: The present study is confined to the palynological studies (pollen morphology and pollen fertility) estimation of some cultivated plant species of University of Arid Agriculture Rawalpindi campus. Pollen morphology of the selected species indicate that the pollen of these species varies in shape i.e, spherical, elliptical and oblong. The pollen fertility ranged from 60-100% among these species. In *Bougainvellia glabra, Brassica campestris, Consolida ambigua, Tecoma stans, Crysanthemum indicum, Tagetis patela, Tradescantia indica, Hibiscus rosa-sinensis* the range of pollen fertility is 98-100% whereas *Catharanthus roseus, Canna indica, Calendula officinalis, Hibiscus circus, Jatropha integrrima, Jasminum grandiflora*, *Rosa indica* and *Rosa alba* the range of fertility is below 98%. Pollen fertility studies have been modified helpful for the recognition of wide range of variation existing within plant species and differentiating plant species with genera.

Key words: Palynology, cultivated plants, fertility, morphology

INTRODUCTION

Palynology is the study of pollen grains produced by seed plants (angiosperms and gymnosperms) and spores produced by pteridophytes, bryophytes, algae and fungi[1].

Palynology serve as a tool for reconstruction of past vegetation and environment. It can also be applied to taxonomy, genetics, evolutionary studies, honey studies, forensic sciences, allergy studies, tracing vegetation history in (a) individual species (b) communities correlation deposits and assigning tentative dates, climate change studies and study of past human impact on vegetation.

Pollen biology has direct relevance in agriculture, horticulture, forestry, plant breeding and biotechnology. Pollen grain have potential use in gene transfer, monitoring cytotoxic effect of bioactive chemical such as herbicides, pesticides and pollutants understanding the organization and function cytoskeleton and association proteins, studies on expression and cloning of gene and researches on intracellular differentiation and polarity. The list of potential uses of pollen is steadily growing.

According to Ali[2], in most of the plant groups in angiosperms, at maturity, all the pollen grains are free from each other. As the primary function of the pollen grains is to provide the male gamete to the female counterpart, in order to facilitate fertilization and ultimately the formation of the seed, such a category seems logical. However, it is also well known that in some plant groups, the pollen grains do not separate at maturity and remain associated together. The term pollen aggregate is used for all types of compound pollen grains and for various types of situations where pollen grains are dispersed in groups. Char *et al.*[3] reviewed the evolutionary trends in pollen organization and discussed their adaptive significance. In the present investigation, the pollen morphology of selected cultivated plants of UAAR and their %age of viability have been studied systematically.

Perveen[4] conducted the palynological and taxonomic studies of family Euphorbiaceae. Pollens of family Euphorbiaceae were found to be circular in polar view and elliptic to acinate in equitorial view. According to Bibi[5] the pollens of family Malvaceae are large, circular and spiny.

An interest in pollen morphology has increased as its full application in systematics, paleoecology, paleobotany and inhalant allergy has been increasingly recognized. Pollen morphologist have responded to the need, created by widespread application for more critical comparative analysis of pollen wall structure and for systematically and phyllogenetically significant wall characteristics.

In this response, successful use has been made of phase and ultra violet microscopy. Kral[6] has made palynological investigation of forest trees in relation to forest history and natural mixture of tree species on the basis of there pollen profile. It was seen that staining methods tended to over-estimate %age of viable pollen

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and their results. Only *in vitro* germination was significantly correlated with seed number or fruit number and fruit numbers, giving an accurate estimate of male fertility[7].

Most of the taxonomist identify the plant species on the basis of phenotypic character of plant like root stem and leaf structure. But now the scientist believe that the palynological studies can provide more accurate basis for the identification of a plant species[8].

Taking into account the applied form of palynology it was found desirable to carry out palynological work dealing with the fundamental palynology of the plant, cultivated in the University of Arid Agriculture, Rawalpindi. In the present investigation the pollen morphology and pollen fertility studies of the 15 cultivated ornamental plant species have been studied systematically. The selected species are *Baugainvellia glabra, Brassica campestris, Callendula officinalis, Canna indica, Chrysanthemum indicum, Catharanthus roseus, Consolida ambigua, Hibiscus ciricus, Hibiscus rosa-sinensis, Jasminum grandiflora, Jatropha integrrima, Rosa indica, Rosa alba, Tagetis petala, Tecoma stans and Tradescantia indica.* The pollen morphology is useful to identify various species and taxa in their respective families. It is used to identify hybrid plants and to solve the taxonomic problems of medicinal and other economically important plants. Palynology has been very helpful in indication of probable lines of evolutionary trends. Keeping in view the importance of pollen studies, the present study was conducted to identify plants on the basis of pollen morphology and to evaluate the morphological difference in the pollen grains of selected species. Pollen fertility studies aim to investigate plant communities to reveal their genetic variation and the indication of hybridization between different species and the pollen morphology in relation to identification of selected species within their respective genera and families. The present study will also open new avenues for application of air borne pollens to determine climatic changes, provide useful incentives in bee keeping industries and tracing vegetation history to improve the conservation status of economically important plants.

MATERIALS AND METHODS

The methodology comprises two phases, Pollen morphology and Pollen fertility investigation;

Pollen morphology: Pollen morphology of 12 cultivated plant species of university campus were studied. The florets from mature flowers were collected from fresh plants cultivated in the university campus.

Method of pollen grain study by light microscopy: Florets were taken from fresh plant for microscopic study. The florets were separated from flowers and were placed in few drops of acetic acid on a clean glass slide. With the help of dissected needles, the florets were opened, the extra material was removed by camel brush and anthers were crushed to released pollen grains on slide. Anther wall material was discarded, while excess of material was removed with filter paper.

Pollens were stained with 1% safranine mixed in glycerine jelly. Any bubble formed was clearly removed. Cover slip was placed on the prepared pollen glycerine jelly like mixture. Glass slide were labeled and the cover slip edges were sealed with white transparent nail varnish. The prepared slides were studied under the light microscope.

Pollen fertility investigation: Inflorescence from plants were fixed when they were fully emerged. Precise time for collection of pollens was vital. This was found to be an early flowering stage before seed production.

For fertility test, inflorescence were collected before anther dehiscence, placed in 70% alcohol and stored at 4C until required. Anthers were dissected in a drop of muntz's acetocarmine.

Method of pollen fertility investigation: The pollen fertility estimation was carried out by employing the technique used by Khan and Stace[9].

A mature undehiscened anther was squashed in a drop of acetocarmine. Debris was removed gently and a cover slip was placed over the stain. The slides were observed at low magnification. The number of stained and unstained pollen grains were tabulated. Fully stained pollens were considered fertile while the lightly stained pollen or unstained pollens were considered sterile.

RESULTS AND DISCUSSION

Morphological study of pollen: Pollen morphology of these species varies among different plants species (Table 1). In *Hibiscus rosa-sinesis, Hibiscus cericus,* the pollens are spherical and echinulate while *in Jasminum mesnyi* pollens are round in shape. Pollens of *Jatropha integrrima, Tecoma stans, BouganvEllia glabra, Tradescantia indica, Rosa alba* are oblong where as in *Brassica campestris* the pollens are elliptical in shape.

Pollen morphology has its application in systematic paleoecology, paleobotany and inhalt allergy which has increasingly recognized[10]. Pollen morphologists have responded to need, created by this wide spread

Table 1: Pollen morphological data of cultivated plant species of UAAR

Species name	Length of pollen (µ)	Breath of pollen (µ)	Size of pollen (µ)	Shape of pollen
Bougainvellia glabra	20	20	20x20	Spherical
Brassica campestris	15	10	15x10	Elliptical
Canna indica	15	15	15x15	Spherical
Callendula officinalis	15	15	15x15	Spherical
Hibiscus rosa-sinensis	35	35	35x35	Spherical
Hibiscus circus	45	45	45x45	Spherical
Jatropha integrrima	20	15	20x15	Oblong
Jasminum mesnyi	25	25	25x25	Spherical
Rosa alba	20	10	20x10	Elliptical
Rosa indica	20	12	20x112	Elliptical
Tradescantia indica	20	15	20x15	Oblong
Tecoma stans	20	10	20x10	Oblong

Table 2: Percentage of pollen fertility of cultivated plant species of UAAR campus

Species name	Family	Common name	No. of pollens	No. of fertile pollens	No. of sterile pollens	%age of pollen fertility
Bougainvellia glabra	Nyctaginaceae	Bougaivillia	17	17	0	100%
Brassica campestris	Brassicaceae	Sarson/mastard	74	74	0	100%
Callendula officinalis	Asteraceae	Gul-a-ashrafee	117	11	16	95%
Chrysanthemum indicum	Asteraceae	Gul-e-daudi	196	194	2	99%
Consolida ambigua	Ranunculaceae	Larkspur	322	322	0	100%
Catharanthus roseus	Apocynaceae	Sada bahar	13	10	3	77%
Canna indica	Cannaceae	Kaili	88	60	28	68%
Hibiscus rosa-sinensis	Malvaceae	Gulhar/shoe flower	59	58	1	95%
Hibiscus cericus	Malvaceae	China rose	123	83	40	60%
Jatropha integrrima	Euphorbeaceae	Sufaid arind	101	70	31	70%
Jasminum mesnyi	Oleaceae	Peeli Chambali	99	60	39	77%
Rosa alba	Rosaceae	Sufaid gulab/white rose	367	345	22	95%
Rosa indica	Rosaceae	Gulab/red rose	400	368	32	92%
Tagetes patela	Asteraceae	Gainda/ sadbarga	15	15	0	100%
Tradescantia indica	Campanulacaea	Tradescantia/Spiderwort	98	97	1	98%
Tecoma stans	Bignoneaceae	Yellow bells	47	47	0	100%

application, for a more critical comparative analysis of pollen wall structure, for an expansion in the number of recognized systematically and phyllogenetically significant wall characteristics. In this response successful use has been made of phase and ultraviolet microscopy in addition to more sophisticated light microscopy. While working on the comparative pollen morphology of *Sonchus,* Boulus[11] found that these genus were closely related. Tomb *et al.*[12] studied the pollen morphology of stephano-marriinae and showed that pollen grains of the tribe were echinolophate or tricolprote with same or almost the same, number or shape of lucanea and demonstrated strikingly different exine stratification in several genera. Fever[13] examined the pollen grains of Microseridinae, which in contrast with the Stephanomerinnae, were predominantly echinoplophate.

Keeping in view the importance of pollen morphology, differentiating studies on various aspects of pollen has been undertaken.

Pollen fertility investigation: Results of pollen fertility of 16 cultivated plant specimen from University campus are presented in Table 2.

Pollen fertility of the cultivated plant species of University campus varies among plant species. In *Tecoma stans, Bougainvellia glabra, Tagetes petala, Brassica campestris* and *Consollida ambigua* the pollen fertility is 100%. In *Chrysanthemum indicum* the pollen fertility is 99%. Whereas in *Hibiscus rosa-sinensis, Tradescantia indica*, the pollen is 98%. In *rosa alba* and *Callendula officinalis* the pollen fertility is 95% while in *Hibiscus cericus, Jatropha integrrima, Catharanthus roseus, Canna indica, Rosa indica* and *Jasminum mesnyi* the percentage of pollen fertility was 60, 70, 77, 68, 92 and 77%, respectively.

Pollen fertility studies have been modified helpful for the recognized wide range of variation existing with in plant species and differentiating plant species with genera. Many workers tried to correlate *in vitro* pollen fertility with the survival of a plant under its natural habitat.

Keeping in view the importance of pollen in a plant life, Differentiating studies on various aspects of the pollen have been conducted. For example Diaz and Lifente[8] have carried out detailed work to differentiating *Asphoidelus fistalous* and *Asphodelus cerirae* from one

another. Gonzales *et al.*[7] studied the pollen fertility estimation of 35 species of genus *Solenum* which was 68-99%.

For further confirmation of variations, detailed morphological, genetical and karyological aspects of these species will be important. These studies will be very helpful for compiling such work and identifying the flora according to their pollen fertility, economic importance and ornamental importance for wider circulation.

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