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PALYNOLOGICAL AND TAXONOMIC STUDIES OF SOME WEEDS FROM FLORA OF RAWALPINDI

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In the present study an account was made to pollen morphology as an aid in taxonomic description of eight weeds i.e. Allium jacquemontii Regel ex Kunth, Ageratum conyzoides L., Parthenium hysterophorus L., Saussuria heteromala (D.Don) Hand.-Mazz., Sisymbrium irio L., Convolvulus arvensis L., Boerhaavia procumbens Banks in Roxb. and Tribulus terrestris L. from flora of Rawalpindi. Keeping in view the importance and application of pollen study in taxonomy, a total of 8 species belonging to 8 genera of 6 angiosperm families were investigated for detailed pollen morphology, taxonomic description and Phytogeography. Polleniferous material and complete plant specimens were properly collected, identified and utilized for studies. Pollen morphology varies among these weedy species very considerably. It was found that pollen characters i.e. shape, P/E ratio, surface of exine and morphology was considered to be important characters used as an aid in taxonomy of these weeds. It was concluded from this research that palynological data is very important not only for taxonomists but also for related disciplines of pure and applied sciences because this study provided some new dimensions towards further research in the disciplines of palynology.

ABSTRACT

Key words: Palynology, taxonomy, weeds, Rawalpindi, Pakistan.

NTRODUCTION

Rawalpindi is situated in north west corner of Punjab. It lies between 33^{O} and 34^{O} north latitude and 72^{O} and 74^{O} east longitude. Rawalpindi shares boundaries with Hazara division in north, with Poonch in east, with Jhelum district in south and with Attock district in west. Its total area is 2051 sq. miles and only 936 sq. miles are cultivated. The elevation rising from 1,500 ft. at Gujar Khan and 1750 ft. at Rawalpindi to 7,500 ft. at the hill station of Murree. The district

comprises six tehsils namely Rawalpindi, Murree, Kotli Sattian, Kahuta, Gujar Khan and Taxila (Anon., 1998).

The flora of Rawalpindi is Mediterranean type of flora. Because of long dry seasons the flora of the plains is distinctly arid. Grasses are also very numerous, no less than 185 are collected (Stewart, 1957). In the plains, ferns, mosses, lichens and liverworts are not common because of the long dry seasons but these groups are better represented in the hills as the rainfall increases. Occasional reserves or graveyards in the plains give some idea of what the plant cover of the district would be like if it were given a fair chance.

Palynology is the science devoted to the study of pollen, spores and other microfossils of similar size and composition. Hyde and William (1945) used the term “palynology” for the first time for pollen analysis. Pollen grains are an outrageous invention of the seed plants, which first appeared over 300 million years ago. Pollen is produced by the seed plants, which include the gymnosperms (conifers and related groups) and the angiosperms (flowering plants).

Rawalpindi district is rich in the variety of its flora due to its varied Geo-climatic feature. The flora differing at different elevations. There are many closely related disciplines which have specific application such as in identification, differentiation of Taxa in systematic and taxonomic decision. Among these discipline palynology is one of the most important and applicable tool in taxonomic studies of flora of particular geography. Pollen morphology and fertility is closely related to its function because many of the features present in pollen grains have helped the species of plants to which it belongs to adapt to life on particular geography, be able to disperse its pollen and fertilize the female eggs to produce new seeds that would give rise to new plants. In light of this research application on pollen morphology and taxonomic description of some important weeds from flora of Rawalpindi was investigated to highlight the diagnostic pollen characters of flora used in taxonomic decision and also provide pollen inventory for future research in related disciplines.

MATERIALS AND METHODS

The research work was conducted during 2005-06 in the Plant Anatomy & Palynology Laboratory and Herbarium of Quaid-i-Azam University, Islamabad. The study was confined to pollen with taxonomic description of the weeds of Rawalpindi. Field trips were arranged to collect plant specimens and pollen material for detailed studies. For pollen morphology, pollens were separated from anthers. Pollens were stained by using glycerin jelly. Fresh polleniferous material was used according to a special techniques known as Wodehouse technique (Ronald, 2000). Slides prepared according to this standard method are known as reference slide. Common adhesive that transparent finger nail polish was used to sealed off the edges of reference slides. Different parameters were studied under light microscope for pollen morphology

(a) Qualitative Characters

Type, Shape in polar view, Shape in equatorial view, Presence of colpi & spines, Shape of pore (ora) and Sculpturing.

(b) Quantitative Characters

Polar diameter, Equatorial diameter, P/E ratio, No. of spines / pollen, No. of spines b/e colpi, No. of colpi, Length / width of colpi, No. of pores, Spine length, No. of spine and Exine thickness.

Microphotography was carried out in Electron Microscope (EM) Laboratory of Quaid-i-Azam University with the help of Camera fitted Nikon Microscope (LM). All photographs were taken on different object lens by using oil emulsion. The prepared slides were observed at low magnification. Morphological description was carried by dissecting long arm light microscope.

Morphological data confined to both quantitative and qualitative characteristics of root, stem, leaf, inflorescence, flowers and seeds. These characters were reconfirmed by comparison with flora of Pakistan (Nasir & Ali, 1995). Inventory for morphology and palynology was presented which consists of botanical name, local name, English name, Morphology, phytogeography, flower color & season and Palynomorph description.

RESULTS AND DISCUSSION

Detailed taxonomic and pollen studies of flora of Rawalpindi was carried out. In total of 8 species belonging to 8 genera of 6 families were investigated for Taxonomic description and Palynomorph features. Palynomorph inventory represents the finding in alphabetic order of botanical name followed by local name, English name, Morphology, Phytogeography, flower color & season and Palynomorph features.

1. Allium jacquemontii Regel ex Kunth (Alliaceae)

Syn: *A. przewalskianum* Regel, Allior. Monogr.

Local Name :		Jangli Thoom
English Name :		Wild garlic
Morphology	:	or sub-globose, pedicels shorter or longer than the lilac campanulate flowers, sepals oblong-lanceolate obtuse or subacute, filaments exserted subulate inner with a dilated 2-toothed base. Bulbs tufted, cylindric, elongae; fibrous coats very finely reticulate, rusty brown. The sepals, shortly exserted, inner obscurely toothed at the base. Capsule globosely ovoid, style very long. Filaments inserted much above the bases of the sepals, shortly exserted, inner obscurely toothed at the base. Capsule globosely ovoid. The inflorescence is umbel.
Phytogeography :		Central Asia, Afghanistan, India and Western Tibet. In Pakistan; Ziarat, Shokor Shal, Ladakh, Shushal, Rupshu, Da-Hanle, Shyok and Rawalpindi. Flower Color & Season Pale & March-April
Palynomorph :		exoporate. Shape in polar view is perprolate to prolate and in equatorial view it is rectangular. Polar diameter is 14.6 µm (11-15 µm) and equatorial is 20.05 µm 20-20.5 µm). P/E ratio is 0.728 µm. Exine thickness is 0.5 µm.

2. *Ageratum conyzoides* L. (Asteraceae)

***A. houstonianum* Mill. Gard.**

Local Name :		Neeli Booti
English Name :		Goat weed

Morphology :		Erect herb; young stems pubescent; leaves ovate or rhombic- ovate, acute at apex, acute to obtuse or subcordately rounded at base, pubescent on both surfaces, glandular dorsally, 2-10 cm long, 1-56 cm wide, on petiole 1-5 cm long; heads corymbose 4-6mm long; involucre subglabrous, bracts acute- acuminate, 3 mm long; florets about 75 per head; corolla about 1 mm long, white or blue-purplish, included in the involucre; style-branches exserted, achenes 1.5-2 mm long, nearly glabrous
Phytogeography :		Pantropical, Central and South America. Widespread weed. In Pakistan; Islamabad and Rawalpindi.
Flower Color & Season :		Pruplish pink & February-April.
Palynomorph	:	Pollen is monad, tricolporate. Shape of pollen in polar and equatorial view is circular. Polar diameter s 19.7 µm (15-20.5 µm). Equatorial diameter is 19 µm (16.5-20 µm). P/E ratio is 1.03 µm. The length f spine is 2.3 um (2-2.5 µm). Exine thickness is 1.2 µm (1-1.5 µm).

3. *Parthenium hysterophorus* L. (Asteraceae)

Syn: *Parthenium lobatum* Buckl.

Local Name :		Gandi Booti
English Name :		Congress weed
Morphology		An erect ephemeral herb known for its vigorous growth. It is light green with branching stems, finely lobed leaves and grows up to 1.5 meters, occasionally reaching 2 m in deep rich soils. Young plants form a basal rosette of strongly dissected leaves that are up to 30 cm in length. Once stem elongation is initiated, smaller leaves are produced and the plant becomes much-branched in its extremities.
Phytogeography :		Native to Mexico, Central and South America, introduced into several countries including Australia, India, Taiwan and Ethiopia. In Pakistan; Islamabad, Chakwal, Talagang and Rawalpindi.
Flower Color & Season :		Ceramic white & through out the year.
Palynomorph :		Pollen is monad, tricolporate and echinate. Shape of pollen in polar and equatorial view is circular to semi-angular. Polar diameter is 15.58 µm (14-17.5 µm) and equatorial diameter is 16.37 µm (14-17.5 µm). P/E ratio is 0.95 µm. Number of spines between colpi are 6-7. Exine thickness is

1.75 µm (0.75-1 µm).

4. *Saussuria heteromala* (D.Don) Hand.-Mazz. (Asteraceae)

Syn: *S. candicans* (DC.) Sch.-Bip.

Local Name :		Kali Ziri
English Name :		Costus
Morphology	:	Erect herb up to 120 cm tall; stem branched above. Basal leaves lyrately lobed. Upper ones smaller, toothed. Flower heads pale purplish, many, 20-30 mm broad. Involucral bracts lanceolate. Pappus hairs white. The inflorescence is capitulum.
Phytogeography :		Afghanistan and Kashmir to Bhutan. In Pakistan; Kurram, Chitral, Gilgit, Swat, Hazara, Salt range, Lahore, Murree, Kashmir, Jummu, Islamabad and Rawalpindi.
Flower Color & Season :		Light purple & March-September
Palynomorph :		The pollen is monad and dicolporate. The shape of pollen in polar view in both polar and equatorial view are prolate. The polar diameter is 36.66 µm (35-39 µm) and equatorial diameter is 37 µm (35.5- 39 µm). P/E ratio is 0.98 µm. Exine thickness is 5.16 µm (5-5.5 µm).

5. *Sisymbrium irio* L. (Brassicaceae)

Local Name	:	Khoob Kalan / Khakshi
English Name	:	London rocket
Morphology	:	Annual or biennial, tall, glabrous, leaves runcinate - pinnatifid, segments not auricled, flowers minute, pedicels slender, young pods overtopping the raceme, old 3-nerved, stigma sessile. Stem 1-3 ft., tall, quite glabrous, or slightly pubescent near the base. Leaves petioled, pinnatifid or pinnatipartite; segments remoste, spreading, toothed; terminal large, sometimes hastate. Pods slender, erect, glabrous, sub-torulose; valves 3-nerved; pedicels ascending, curved. The inflorescence is corymbose.
Phytogeography	:	India, Afghanishtan, Canary Islands. In Pakistan; Waziristan, Chitral, Swat, Hazara, Gilgit, Poonch, Kashmir and Rawalpindi.
Flower Color & Season	:	Yellow & January-April
Palynomorph	:	The pollen is monad and tricolporate. The shape of

pollen in polar view is circular and in equatorial view is prolate. The polar diameter is 21.25 µm (20-24 µm) and equatorial diameter is 20 µm. P/E ratio is 0.96 µm. Exine thickness is 1 µm.

6. *Convolvulus arvensis* L. (Convolvulaceae)

Local Name	:	Lali Poli
English Name	:	Field Bindweed
Morphology	:	Glabrous or pubescent perennial; stem up triangular or ovate-oblong to linear, hastate to sagittate, more or less entire. Very variable in pubescence and leaf-shape. Plants with linear to oblong-lanceolate leaves. Peduncles axillary, often about as long as bracts, 1- to 2(3) flowered. Sepals obtuse to emarginated, and often apiculate. Corolla 10-25 mm, white to pink. Ovary glabrous. The inflorescence is solitary axillary.
Phytogeography	:	Temperate and Tropical regions of the world, South Europe. In Pakistan; Sind, Ladkh, Baltistan, Attock, Mianwali, Jhang, Talagang, Chakwal and Rawalpindi.
Flower Color & Season	:	Pale pink to pink or white & mostly throughout the year.
Palynomorph	:	Pollen is monad and tricolporate. The shape of pollen in polar view is circular to semi-circular and in equatorial view is prolate. The polar diameter is 62.25 µm (56-70 µm) and equatorial diameter is61.75 µm (57.5-66 µm). P/E ratio is 01 µm. The length of colpi is 14.25 µm (11-16 µm) the width of colpi is 15.25 µm (15-16 µm). Exine thickness is 6.25 µm (5-9 µm).

7. *Boerhaavia procumbens* Banks ex Roxb. (Nyctaginaceae)

Syn: *B. cocinea* mill. Gard.

: *B. diffusa* auct. Plur

Local Name	:	Biskhapra / Jangli Itsit
English Name	:	Spreading hogweed
Morphology		Branches 2-3 ft., usually slender glabrous, leaves larger broader often rounded white beneath, more robust, branches long stout glabrous pubescent or viscous, leaves 1-2 in., ovate obtuse or acute usually cordate green beneath. Inflorescence panicled.
Phytogeography	:	India, Africa, and USA. In Pakistan; Sind, Baluchistan, NWFP, Thal to Kurram, Peshawar,

		Multan, Attock, Hazara and Rawalpindi.
Flower Color & Season	:	Purplish red & January-August
Palynomorph	:	The pollen is monad, periporate and echinate. The shape of pollen in polar and equatorial view is circular. The polar diameter with spine is 75.75 µm (72.5-79 µm). The length of spine is 3 µm (2.5-3.5 µm) and the size of pore is 6 µm (4.5-10 µm). Exine and entine are prominent but exine is broader than entine. Exine thickness is 4.8 µm (4.5-5 µm).

8 . *Tribulus terrestris* L. (Zygophyllaceae)

Local Name	:	Bakhra
English Name	:	Puncture vine
Morphology	:	Annual or biennial, peduncle shorter than the leaves, cocci with 2 long and 2 short spines. Prostrate, hirsute or silky hairy, petals often not exceeding than the calyx. Cocci very variable, glabrous or hairy and mucronate. Stigmatic lobes longer than the diameter of the style. Fruit 5-angled or tuberculate in cocci. Seeds obliquely pendulous, testa membranous, embryo without albumen, cotyledons ovate, radicle short.
Phytogeography		India, Western Tibet. In Pakistan; Gilgit, Astor, Baltistan, Salt Range, Attock, Jhelum, Kohat, Ladakh, Kahmir, Mianwali, Attock and Rawalpindi.
Flower Color & Season	:	Yellow & mostly throughout the year.
Palynomorph	:	The pollen is monad, periporate and echiate. The shape of pollen in polar view is circular. The polar diameter is 45.62 µm (45-46.5 µm). Exine thickness is 2.83 µm (2.5-3 µm).

Keeping in view, the importance and scope of application of palynology in taxonomy, in a total of 8 species belonging to 8 genera of 6 Angiosperm families were investigated for their general morphology and detailed pollen morphological characters. Out of these 6 families, one is monocot i.e. Alliaceae and 5 others are dicot families. On the basis of life form it was investigated that all species were herbs. Great diversity in taxonomic description and pollen morphology was found among the representative species of these families.

Out of these 8 species of present study, there were 3 species belonging to family Asteraceae. It is a eurypalynous family (Erdtman, 1952) and most of its genera possess zonocolporate pollen (Sachdeva and Malik, 1986). The present study showed that there is a great diversity in pollen morphology of Asteraceae, variation mostly found in size, shape, spine length, number and colpi morphology.

In *S. heteromala* the shapes of pollen were prolate whereas in rest of species of Asteraceae the shape almost circular to semi-angular. The character of pollen spine is

significance in evolution and at specific and generic level in classification of this family. Spineless pollens were observed in *S. heteromala* where as rest of the species have spines in their pollen. These findings are in agreement with of Keeley and Jones (1977) who reports pinnate and spineless pollen in some *Veronica* species and observed that both pollen and vegetative character indicate a divergence due to independent line of evolution of spine isolation. Wodehouse (1935) outlined the principles of morphological evolution of spine form in Compositae and suggested the reduction series from long to minute spines. The spinate pollen character is considered as a primitive feature as compared to spineless pollen.

One of the interesting variation found in pollen of *A. jacquemontii,* in which the pollen were found to be tricolporate. This character is varied from the rest of the monocot and considered to be of evolutionary significance in primitive and advanced monocot families.

In case of Convolvulaceae, in *C. arvensis* pollen are found to be tricolporate and smooth. It indicates a great variation in pollen morphology which would be helpful to improve the classification of Convolvulaceae.

Zygophyllaceae is also one of the established and well represented family in flora of Rawalpindi and this group is easily differentiated taxonomically from rest of the other Angiospermic families. Further investigation is required to explore the pollen diversity in this greatly significant family. In *S. irio* (Brassicaceae) pollens are tricolporate and circular to prolate in polar and equatorial view respectively. In case of *B. procumbens* (Nyctaginaceae) pollen are periporate, echinate and circular both in polar and equatorial view. Perveen and Qaiser (2001) have also reported uniform and mostly spheroidal pentporate pollens in Nyctaginaceae.

It is concluded from this research that palynological data is very important not only for taxonomists but also for related disciplines of pure and applied sciences because this study provided some new dimensions towards further research in the disciplines of palynology.

A- *Ageratum conyzoides* (Polar view -1000x), B- *Convolvulus arvensis* (Polar view - 400x), C-*Parthenium hysterophorus* (Polar view – 1000x), D- *Saussuria heteromala* (Equatorial view – 400x), E- *Boerhaavia procumbens* (Polar view – 400x), F- *Tribulus terrestris* (Polar view – 400x)

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