TAXONOMIC AND PALYNOLOGICAL DIVERSITY OF THE FAMILY PAPILIONACEAE IN THE FLORA OF SHISHI KOH VALLEY, CHITRAL, PAKISTAN

S. Wali, Siraj-ud-Din and N. Akhtar*

Department of Botany, University of Peshawar
*Department of Botany, Islamia College Peshawar
Corresponding Author's email: sherwali_icup@yahoo.com

ABSTRACT: The research project was conducted to study the diversity of family Papilionaceae in the flora of Shishi Koh Valley, Chitral. Plants were described on the basis of taxonomy and playnology. Family Papilionaceae was represented by thirty eight plants including thirty one species, three subspecies and four varieties. These plants belonged to ten tribes and fifteen genera. Among them *Trifolieae* was the dominant tribe with four genera i.e. *Medicago*, *Trifolium*, *Melilotus* and *Trigonella*. The dominant genus *Medicago* contributed five species and three varieties. *Trifolium*, *Trigonella* and *Melilotus* were represented by six, four and three species respectively. The next dominant tribes were *Vicieae* and *Phaseoleae* with seven and three species respectively. The remaining tribes were each represented by a single genus and species. Each tribe's contribution in the form of genera, species and infra-specific categories has been assessed. Palynological study of ten species with wide distribution showed a considerable degree of pollen variation. Monad pollen mostly of ellipsoid and oblong shapes were the characteristics of all the specimens discussed so for. Pollen apertures were mostly zono and colpate. Common size class was mediae, exine sculpture was reticulate and symmetry was bilateral.

Key Words: Papilionaceae, Vicieae, Phaseoleae, Palynology, Shishi Koh, Chitral.

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INTRODUCTION

The research area lies in district Chitral part of the eastern Irano-Thuraian phytogeographic subregion; present at 1493.52 m altitude. Total area of the district is 14,850 Km^2 located at 71° 46' 55" E and 35° 50' 32"N (IUCN, 1998). According to 2008 census report of the district total population is 318689.District Chitral is bounded by Badakhshan, Asmar, Nooristan, and Wakhan areas of Afghanistan in west and south-west. On the southern boundary is district Dir Upper while on the eastern boundary is Swat Kohistan (Ali *et al*., 2012). Drosh has the rank of Tehsil in district Chitral, forming a gateway to the district on its southern side. Total population of Drosh is 71276 with male and female ratio 36854 and 34422 respectively. Shishi Koh Valley lies in Tehsil Drosh. Administratively this valley is ranked as a union council, which is divided in to 23 small and large villages (Anonymous, 1998).

Plants of the family Papilionaceae Giseke show great diversity with respect to distribution, habit and habitat in the study area. On the basis of habit plants are divided into climbers, herbs, shrubs and trees. Fruit is legume, may be indehiscent and if dehiscent release seeds via one or two sutures. Seeds may be albuminous or exalbuminous. Chaudhary and Srivastava (2006) revise the nomenclature, distribution and descriptions of 25 species of *Astragalus* L. Conservation status, cibachrome photographs and relationships of some species are also included. Perveen (2007) describe that Pollen of *Pisium sativum* stored at low temperature shows better germination percentage compared to pollen stored at +4°C and fresh. Leht (2009) describes the phylogenetic relationships in 67 *Vicia* species in comparison with *Trifolium montanum* based on 91 morphological characters. Zaidi *et al*. (2013) study that electromagnetic fields on some species of different families including Papilionaceae caused abnormal meiotic products and significant number of sterile pollen grains. Javaid *et al*. (2014) perform the ISSR analysis of genetic diversity in *Dalbergia sissoo*. Memon *et al*. (2014) reports 5 species of the family Papilionaceae present as weeds from the cotton crops in Sindh. Ali *et al*. (2016) reports 25 species of the family Papilinaceae from Chail Valley, Swat.

The current research work is designed to find the taxonomic diversity and the use of palynological data for the characterization of the papilionaceous flora of Shishi Koh Valley Chitral.

MATERIALS AND METHODS

Taxonomic Study: The research area was explored through several field trips for the collection of plants in different seasons during 2014-15. Plants of the family Papilionaceae grew throughout the year but most of the plants were in good vegetative growth and were in full

bloom in spring and early summer. Therefore most of the plants were collected from March through the end of August. The plants in Madak Lasht were collected in the late summer as it was the last boundary of the research area and weather here remains extremely cold during spring and start of summer. This village has the highest 2700m altitude in the valley. General information regarding the research area was collected before starting the field work.

Plants specimens were dried and pressed following the method of Bridson and Forman (1989). After the plants were sufficiently dried and pressed naphthalene powder was applied for protecting specimens from insects, pests, and fungi. The dried, pressed and preserved plants were mounted on herbarium sheets taken from the Department of Botany, University of Peshawar. The plants were identified through morphological characters with reference to floras like flora of Pakistan and other floras available online. Each identified plant species was given a voucher number.

Pollen Analysis: The pollen material was obtained from the flowers of the dried plants. The pollen specimens were treated with 9% acetic anhydride and 1% concentrated sulphuric acid (H_2SO_4) to remove any foreign contaminant or plant debris following the method of Erdtman (1952). The pollen specimens were then gold coated by SPI Sputter Module Coater USA. A number of pollen grains of each specimen were examined in both polar and equatorial views with the help of scanning electron microscope. Scanning electron micrographs were taken for each specimen.

RESULTS AND DISCUSSION

The research area was highly rich in terms of floristic composition and Papilionaceae was one of the dominant families of this area. Plants collected from the research area were classified taxonomically. Thirty eight (38) plants belonging to fifteen (15) genera were collected from the research area. These genera represented ten (10) tribes. *Trifolieae* is dominant tribe in all with four (4) genera. Genus *Medicago* with five (5) species and three (3) varieties were dominant with respect to other three genera in this tribe. *Trifolium* with six (6) species was next dominant. *Trigonella* contributed two (2) species and two (2) subspecies while *Melilotus* had three (3) species. *Vicieae* tribe comprising three (3) genera was second dominant. Type genus *Vicia* with four (4) species was dominant in this tribe; the other genera in this tribe i.e. *Pisum* was represented by a single and *Lathyrus* by two (2) species. Three species represented the single type genus *Phaseolus* in the tribe *Phaseoleae*. *Lespedezeae* was represented by a single variety while *Sophoreae* contributed a single subspecies. The remaining tribes *Astragaleae*, *Lespedezeae*, *Indigofereae*, *Sophoreae*, *Psoralieae*, *Robinieae* and *Mellettieae* were represented by a single type genus with a single type species each.

Family Papilionaceae had a good representation and has a dominant position in plant families of the area. In the order Fabales the other two families i.e. Mimosaceae and Ceasalpinaceae were not so prominent as family Papilionaceae. Plants collected from the research area were classified taxonomically and divided into different categories according to the dominance, nature, habit, and habitat as shown in Table 1. The plants were also classified into different groups according to their habit, actual and percentage numbers as shown in figure 1. Herbs were with the highest representation. Plants were also classified into species, subspecies and varieties on the basis of the taxonomic rank in taxonomic hierarchy as is shown in figure 1. In all the 38 plants species, subspecies and varieties had 81.58%, 7.89% and 10.53% representation respectively. Among the ten tribes *Medicago* contributed the highest percentage of genera 4 (26.7%) as is shown in figure 2. Contribution of each genus in the form of species, subspecies, varieties and as a whole is shown in figure 3. Genus *Trifolium* had the highest percentage of species and varieties contributing 75% followed by *Medicago* 25% while the highest percentage (66.67%) of subspecies was contributed by the genus *Trigonella* followed by *Sophora* contributing 33.33%. *Medicago* showed the highest (21.1%) overall percentage.

The archaic tribes of the family Papilionaceae exhibited the basic chromosome numbers whereas the advanced tribes had lower basic numbers (Khatoon and Ali, 2006). Evaluation of plant resource indicated that out of 111 species of 46 families, Papilionaceae was represented by 10 species in Mastuj Valley (Hussain *et al*., 2007). Pollen of *Glycine max* stored at low temperature showed better germination while the highest germination percentage was shown by freeze dried pollen (Perveen and Khan, 2009). Baskauf and Burke (2009) reported *Astragalus bibullatus* to be an endangered plant species endemic to limestone cedar glades in Tennessee. Kirkbride (2010) described and illustrated *Lotus alianus*. Jalilian *et al.* (2010) gave a description of *Vicia kurdica* from Iran. They also presented the line drawing of the species. Ranjbar (2011) illustrated and described a new record: *Astragalus baftensis* from Iran. Meng *et al.* (2012) studied the taxonomic history of *Glycyrrhiza inflata* and its medicinal uses. Moura *et al.* (2012) made description and illustration of a new species *Mucuna monticola* in the genus *Mucuna*. Papilionaceae contributed significant number of 7 species in the medicinal flora of Hingol National Park, Balochistan (Qureshi, 2012). Hussain *et al*. (2015) reported 38 plants belonging to the family Papilionaceae from Mastuj valley. Family Papilionaceae has also been reported as

the second dominant family after Rosaceae by Hussain and Perveen (2015).

Ten (10) plant species were selected for palynological study**.** The pollen analysis revealed the differences among different species which were useful in plant classification (Bhattacharya *et al*., 2011). All the species had monad pollen. The most common pollen shapes were ellipsoid (Plates 7,8,11 and 12) and oblong (Plates 3,4,19 and 20). Diameter of the pollen ranged from the smallest 15µm in *Melilotus alba* to largest50µm in *Sophora mollis* (Table-2). Width of the pollen ranged from the smallest 12µm in *Melilotus alba* to largest50µm in *Medicago sativa* (Table-2). Radial symmetry was found in pollen of 30% plants, bilateral in 60% plants and 10% were Asymmetrical, non-fixiform. In regard to polarity, 80% pollen were Isolpoar, 10% Apolar and 10% Heteropolar (Table 2). Aperture characters showed that pollen of 60% plants was Trizonocolporate, 20% Trizonoporate, 10% Trizonocolpate and 10% Irregular. Exine sculptures of 80% plant pollen were Reticulate while 20% had psilate pollens (Figure 4). These pollen characters were helpful in the differentiation and characterization of different plant species as described by Elkiran *et al*. (2017).

It was concluded that family Papilionaceae had great taxonomic diversity in the research area and members of the family showed considerable degree of pollen variation which was useful for identification of genera and species.

Table 1: List of plants based on dominancy at tribe, generic and specific levels with habit, nature and locality.

S. No.	Tribes	Genera		Species and infra specific categories	Habit	Nature	Locality
1	Trifolieae	a. *Medicago*	i.	*Medicago falcata* L.	Herb	Wild	Madak Lasht
			ii.	*Medicago lupulina* L.	Herb	Wild	Kalas
			iii.	*Medicago laciniata* var. *brachycantha* Boiss.	Herb	Wild	Gorain
			iv.	*Medicago laciniata* var. *laciniata*	Herb	Wild	Tingal
			v.	*Medicago minima* (L.) Grufb in L.	Herb	Wild	Pursad
			vi.	*Medicago polymorpha* L.	Herb	Wild	Birga Nisar
			vii.	*Medicago sativa* L.	Herb	Wild	Muzdeh
			viii.	*Medicago* x *varia* Martyn	Herb	Wild	Madak Lasht
		b. *Trifolium*	i.	*Trifolium alexandrianum* L.	Herb	Cultivated	Patigar
			ii.	*Trifolium carmeli* Boiss, Diagn.	Herb	Wild	Ustrom
			iii.	*Trifolium fragiferum* L.	Herb	Wild	Ziarat
			iv.	*Trifolium pratense* L.	Herb	Wild	Matai
			v.	*Trifolium repens* L.	Herb	Wild	Tar
			vi.	*Trifolium resupinatum* L.	Herb	Cultivated	Birga Nisar
		c. *Trigonella*	i.	*Trigonella monantha* ssp. *incisa*	Herb	Wild	Huzarbakandeh
			ii.	*Trigonella monantha* ssp. *monantha*	Herb	Wild	Huzarbakandeh
			iii.	*Trigonella monspelica* L.	Herb	Wild	Madak Lasht
			iv.	*Trigonella pubescens* Edgew. ex Baker in Hook. f.	Herb	Wild	Birga
		d. *Melilotus*	i.	*Melilotus alba* Desr. in Lam.	Herb	Wild	Kalas
			ii.	*Melilotus indica* (L.) All.	Herb	Wild	Madak Lasht
			iii.	*Melilotus officinalis* (L.) Pall.	Herb	Wild	Birga Nisar
2	Vicieae	a. *Vicia*	i.	*Vicia faba* L.	Herb	Cultivated	Madak Lasht
			ii.	*Vicia monantha* Retz.	Herb	Wild	Tar
			iii.	*Vicia sativa* L.	Herb	Wild	Birga Nisar
			iv.	*Vicia tenuifolia* Roth.	Herb	Wild	Shahi Darbar
		b. *Lathyrus*	i.	*Lathyrus aphaca* L.	Herb	Wild	Shahi Darbar
			ii.	*Lathyrus pratensis* L.	Herb	Wild	Sherati
		c. *Pisum*	i.	*Pisum sativum* L.	Herb	Cultivated	Patigar
3	Phaseoleae	a. *Phaseolus*	i.	*Phaseolus coccineus* L.	Shrub	Cultivated	Gorain
			ii.	*Phaseolus lunatus* L.	Herb	Cultivated	Barpanch
			iii.	*Phaseolus vulgaris* L.	Herb	Cultivated	Kashingarh
4	Astragaleae	a. *Astragalus*	i.	*Astragalus grahamianus* Royle ex Benth.	Herb	Wild	Huzarbakandeh
5	Lespedezeae	a. *Lespedeza*	i.	*Lespedeza juncea* var. *variegata* (Camb.) Ali	Herb	Wild	Birga
6	Indigofereae	a. *Indigofera*	i.	*Indigofera argentea* Burm. f.	Herb	Wild	Huzarbakandeh
7	Psoralieae	a. *Psoralea*	i.	*Psoralea drupacea* Bunge.	Herb	Wild	Tingal
8	Mellettieae	a. *Wisteria*	i.	*Wisteria sinensis* (Sims) DC.	Shrub	Cultivated	Kalas
9	Robinieae	a. *Robinia*	i.	*Robinia pseudo-acacia* L.	Tree	Wild	Pursad
10	Sophoreae	a. *Sophora*	i.	*Sophora mollis* subsp. *griffithii*	Shrub	Wild	Huzarbakandeh

Table 2: Characteristics of the pollen grains from selected species of the family Papilionaceae.

S. No.	Specimen	Pollen Units	Shape	Diameter	Width	Symmetry	Polarity	Aperture Character	Exine sculpture
1	*Psoralea drupacea*	Monads	Triangular	26-34µm	22-30µm	Radial	Apolar	Trizonoporate	Reticulate
2	*Sophora mollis*	Monads	Oblong	43-50µm	13-19µm	Bilateral	Isopolar	Trizonocolpate	Reticulate
3	*Medicago sativa*	Monads	Spherical oblong	26-34µm	26-34µm	Radial	Isopolar	Trizonocolporate	Psilate
4	*Pisum sativum*	Monads	Ellipsoid	34-40µm	17-26µm	Bilateral	Isopolar	Trizonocolporate	Reticulate
5	*Vicia sativa*	Monads	Spherical	26-35µm	18-27µm	Bilateral	Isopolar	Trizonocolporate	Reticulate
6	*Vicia faba*	Monads	Ellipsoid	37-43µm	22-30µm	Bilateral	Isopolar	Trizonocolporate	Regulate
7	*Robinia pseudo-acacia*	Monads	Irregular	23-31µm	23-31µm	Asymmet-rical non-fixiform	Heteropolar	Irregular	Psilate
8	*Melilotus alba*	Monads	Spherical oblong	15-27µm	12-19µm	Radial	Isopolar	Trizonoporate	Reticulate
9	*Melilotus officinalis*	Monads	Ellipsoid, oblong	26-34µm	17-26µm	Bilateral	Isopolar	Trizonocolporate	Reticulate
10	*Melilotus indica*	Monads	Oblong	28-37µm	14-22µm	Bilateral	Isopolar	Trizonocolporate	Reticulate

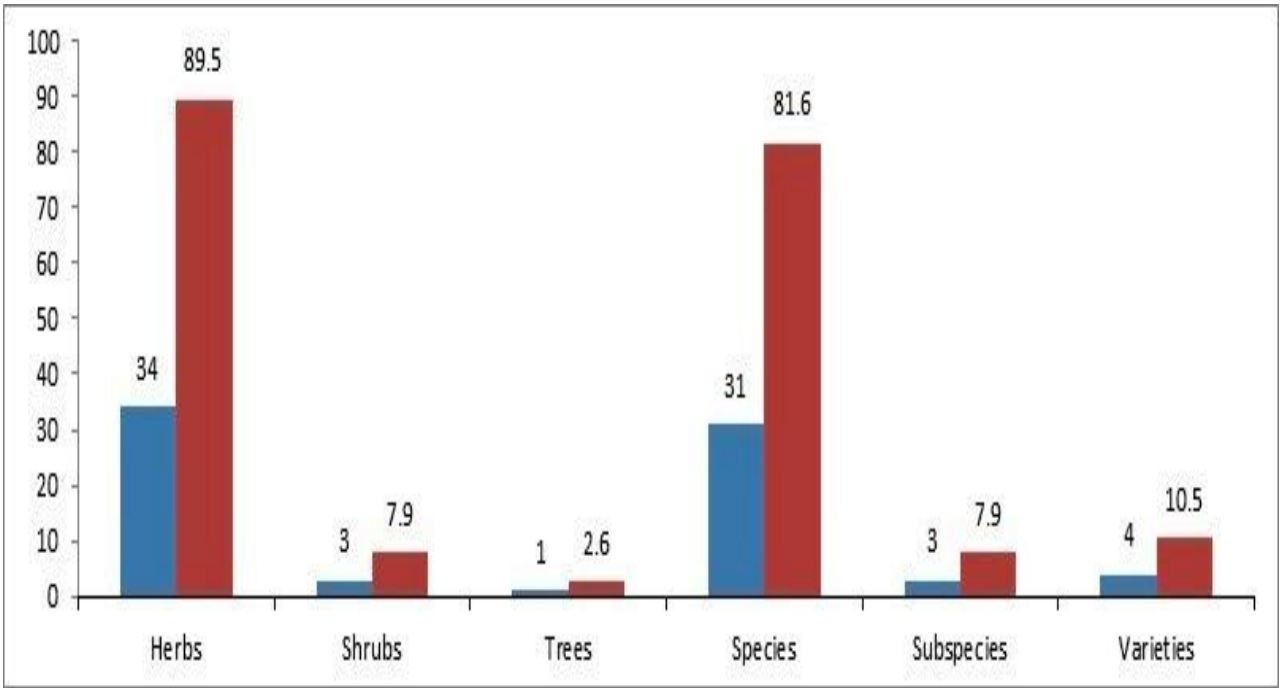

Figure 1: Actual and percentage numbers of Herbs, Shrubs, Trees, Species, Subspecies and Varieties in the research area

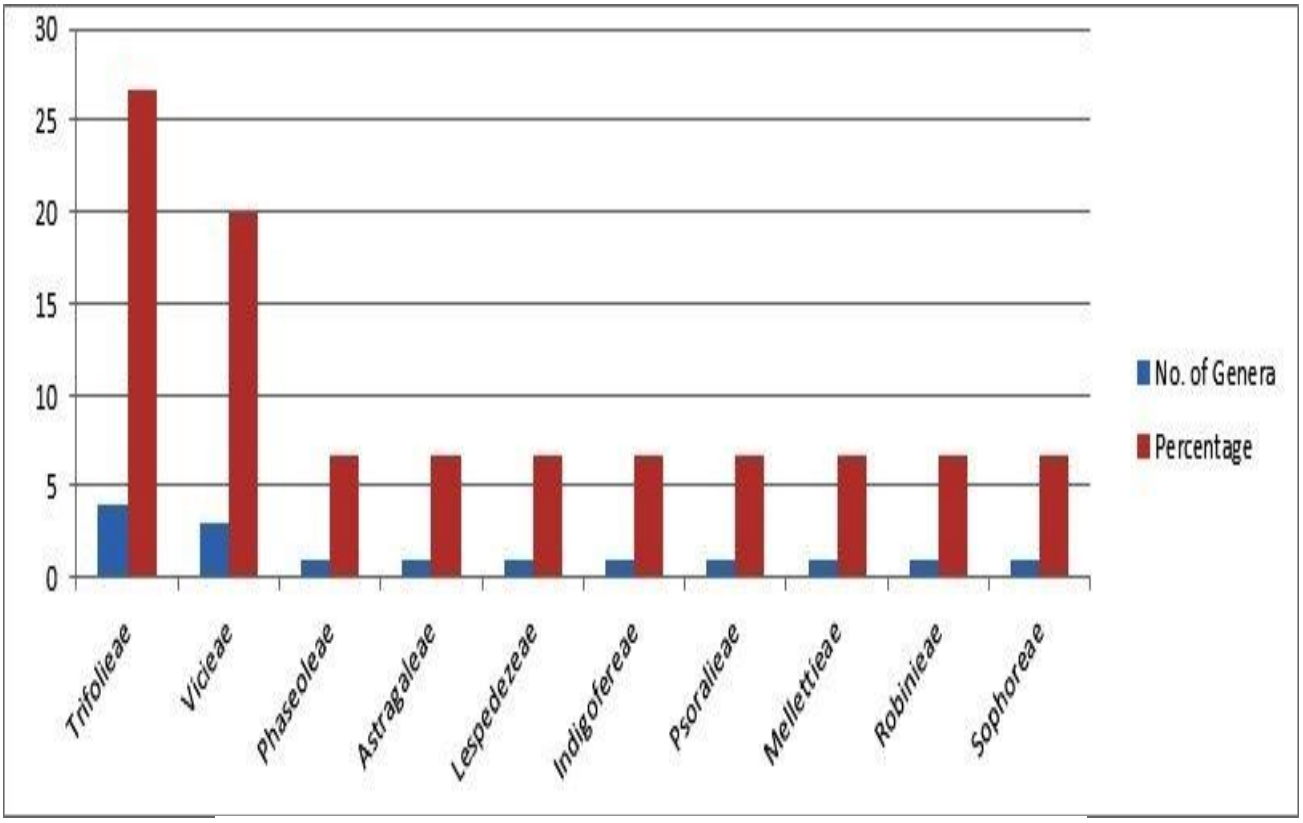

Figure 2: Number of genera in each Tribe number with percent contribution

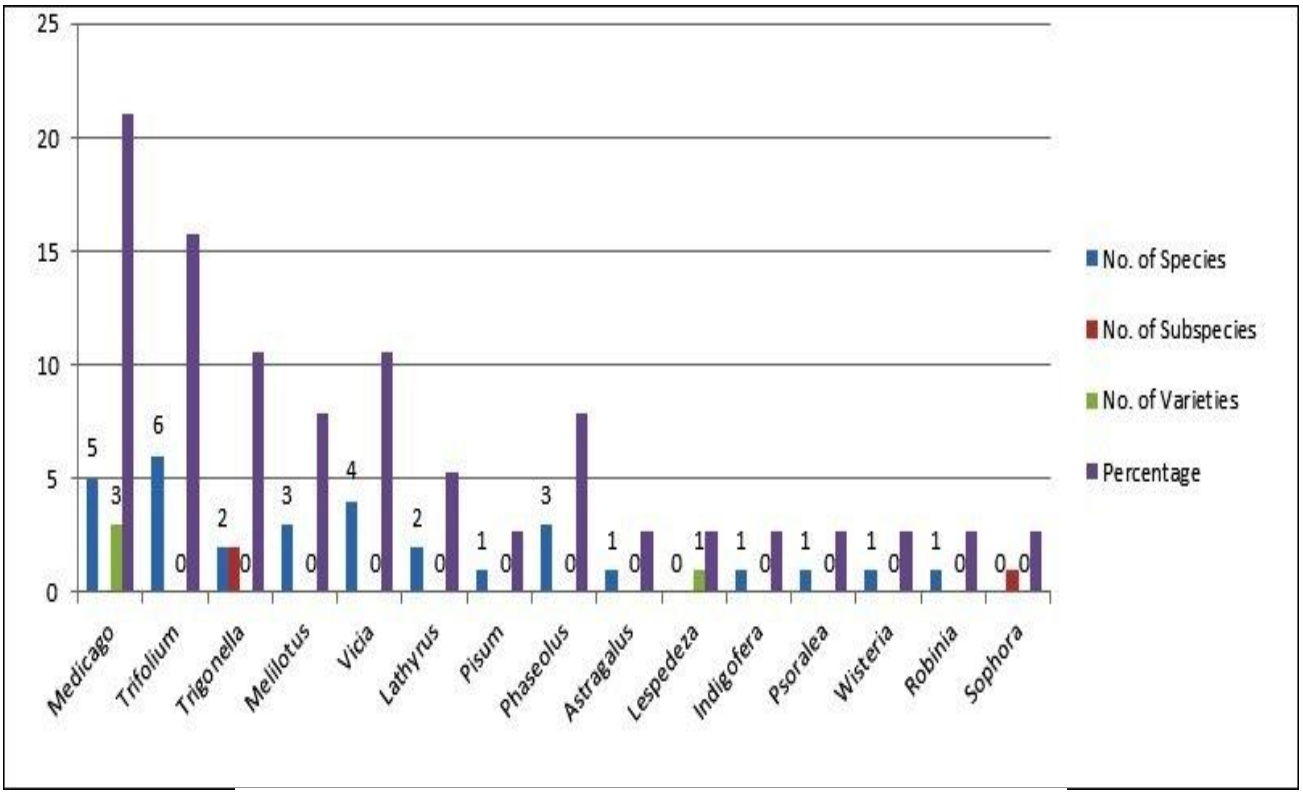

Figure 3: Contribution of species, subspecies and varieties by each genus.

Figure 4: POLLEN PLATES

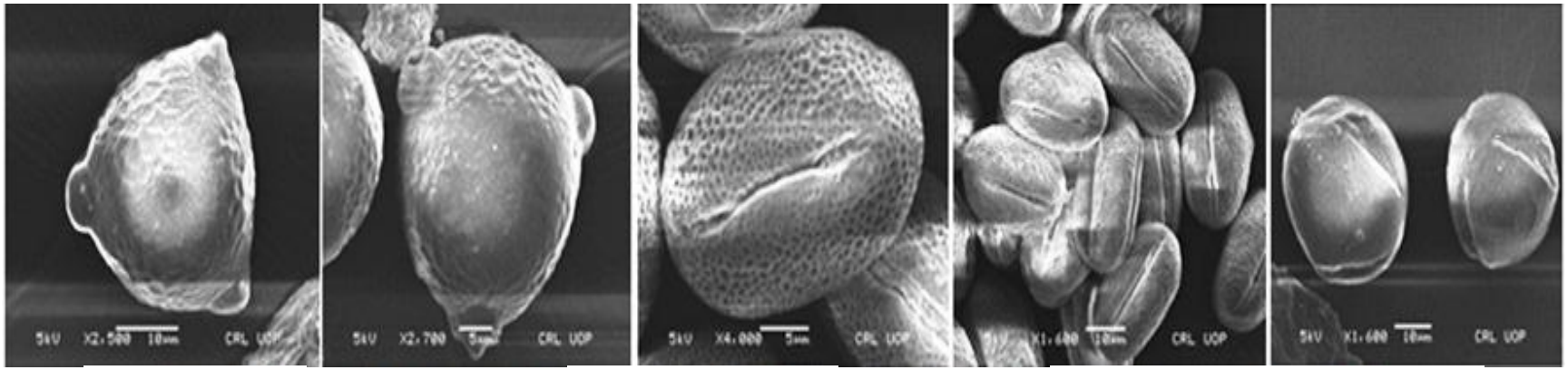

Plate No. 1&2 (*Psoralea drupacea*) Plate No. 3& 4 (*Sophora mollis*) Plate No. 5 (*Medicago sativa*)

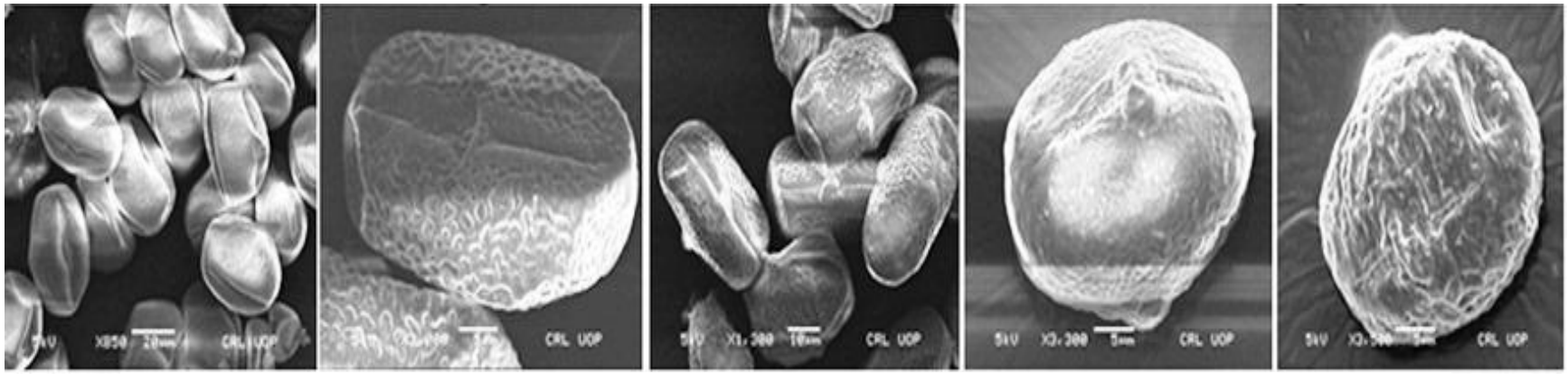

Plate No. 6 (*Medicago sativa*) Plate No. 7& 8 (*Pisum sativum*) Plate No. 9 & 10 (*Vicia sativa*)

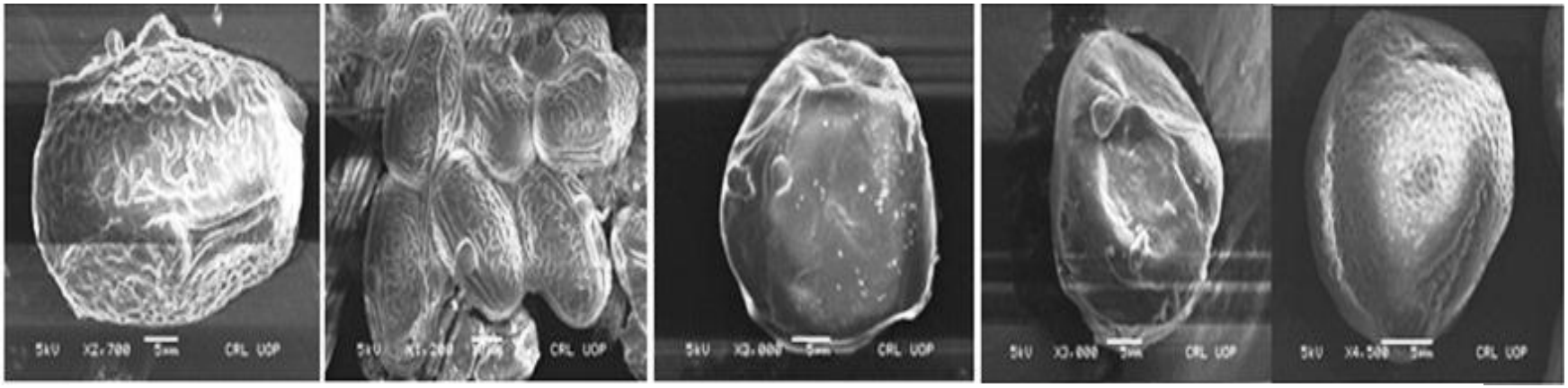

Plate No. 11&12 (*Vicia faba*) Plate No. 13&14 (*Robinia pseudo-acacia*) Plate No. 15(*Melilotus alba*)

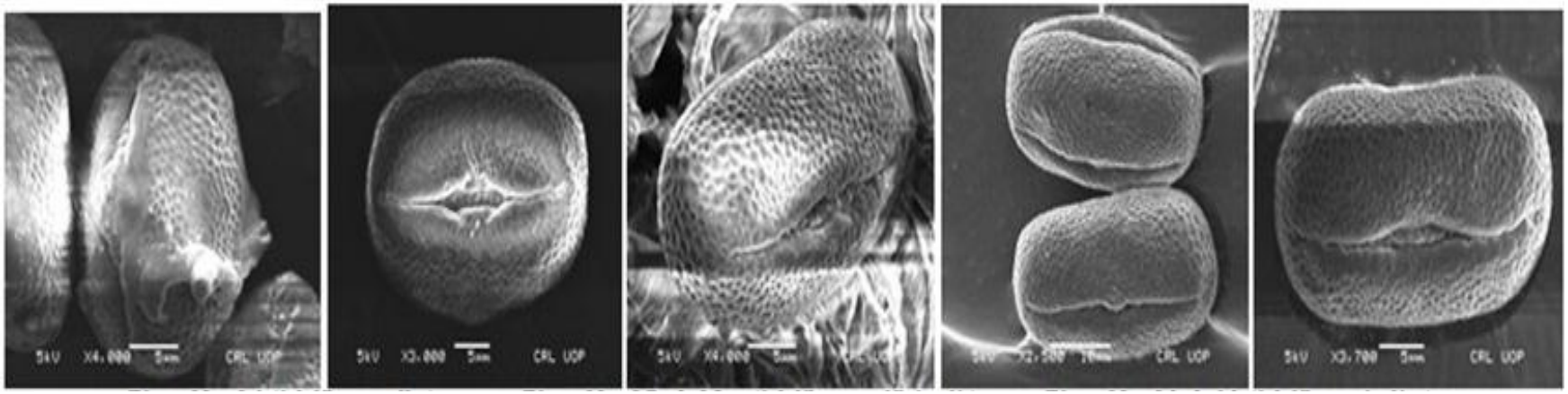

Plate No. 16 (*Melilotus alba*) Plate No. 17& 18 (*Melilotus officinalis*) Plate No. 19& 20 (*Melilotus indica*)

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