J. Phytol. Res. **23**(1) : 57-60, 2010

PALYNOLOGICAL STUDIES IN SOME MEMBERS OF FABACEAE

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The present work includes the study of pollen productivity, pollen viability, pollen to ovule ratio and pollen size of twenty three species of the family Fabaceae which are commonly occurring in Pondicherry region, an enclave of Pondicherry Union Territory. Pollen production per flower was maximum in *Crotalaria retusa* (1083295) and minimum in *Eleiotis monophylla* (11600). Pollen viability was maximum in *Crotalaria willdenowiana* and *Canavalia virosa* (96 percent) and minimum in *Desmodium triflorum* (81 percent). Pollen per ovule was more in *Rhyncosia capitata* (125400) and less in *Indigofera colutea* (1505). Largest pollen was encountered in *Alysicarpus rugosus* (85.248 µm) and smallest in *Zornia gibbosa* (25.923 µm). The study reveals that the parameters are useful in the identification of plant species and in the study of the richness of the population.

Keywords : Asteraceae; Palynological studies.

Inyroduction

Pondicherry is a Union Territory of India bounded by the Bay of Bengal on the east and by the South Arcot district of Tamilnadu on all other sides. It is at the north between 11°46' and 12°3' latitudes and 79°36' and 79°53' of eastern longitude. The area of Pondicherry is 290 square kilometers of which 25,832-hectare land is under cultivation. The climate is dry except during the Northeast monsoon. The average annual rainfall was 170 mm for the year 2006-07. The temperature in winter ranged from 20-30°C and in summer from 30-33°C for the same period. The relative humidity of the atmosphere ranged from 75-90 percent.

The study of pollen morphology, productivity, viability and pollen ovule ratio is significant because it is useful in the studies of Taxonomy, Environmental biology and Plant breeding. Pollen profile of a particular area reflects pattern of vegetation of that area. The plants produce a large number of pollen grains most of which are not involved in fertilization but may float in air, function as bio-pollutant and cause allergic diseases [1,2]. Pollen productivity is supposed to increase due to global warming and cause problem in human health and economy[3]. The productivity also has several potential implications. It could enhance the production of viable seeds by increasing the percentage of fertilized ovules [4,5]. Although the pollen productivity of a plant is influenced by various factors[6] and also varies periodically[7], it is important for commercially valuable plants to have an estimate of the total production of pollen per plant, as the productions of seeds usually depends on the production of pollen[8] . The decrease in the concentration of air borne pollen decreases the efficiency of wind pollination[9]. This may be due to large distance between the conspecifics, low pollen productivity and poor pollen dispersal. These conditions are assumed to affect both ovule fertilization and seed production negatively[5]. More pollen disseminated from multiple sources may also increase the rate of gene flow and could further reduce the rate of self pollination and enhance the production of viable seeds. As a result the number of pollen produced per flower and pollen viability may reflect the size of the population. The pollen to ovule ratio is another important factor which determines the density of population. The stigma usually attracts far more pollen than are needed to fertilize all ovules, leading to intra specific competition among plants to pollinate their neighbours. It may be considered as a better indicator of the plant breeding system.

The quality and quantity of pollen produced by an individual plant is influenced by various factors, which may vary from year to year. Human interference, encroachment and environmental changes pose threat to the richness of biodiversity. So it is inevitable to make a record of the vegetation of a particular area and create a gene bank. Fabaceae is the largest family among polypetalae and economically very important. So the present work has been taken up to study the pollen productivity, pollen viability, pollen to ovule ratio and pollen size of 23 herbaceous species of Fabaceae available in Pondicherry region.

Table 1. Pollen productivity in some members of Fabaceae.

Sl. No.	Name of species	Pollen / Anther	Anthers/ flower	Pollen / flowers	Flowers / inflorescence	Pollen / inflorescence
1.	*Abrus precatorius* L.	8718	9(9+0)	78462	22.732±4.320	1783598
2.	*Aeschynome indica* L.	6272	10(5+5)	62720	6.432±2.614	403415
3.	*Alysicarpus regosus* (Willd) DC.	1613	10(9+1)	16130	10.654±3.211	171849
4.	*Canavalia virosa* (Roxb) & Arn.	76932	10(10+0)	769320	18.619±4.396	14323969
5.	*Crotalaria pallida* Aiton.	135430* 18562#	10(10+0)	769960	50.260±7.375	38698189
6.	*Crotalaria retusa* L.	194375* 22284#	10(10+0)	1083295	20.800±3.914	22532536
7.	*Crotalaria verrucosa* L.	145832* 17057#	10(10+0)	814445	15.760±4.742	12835653
8.	*Crotalaria willdenowiana* DC.	52500* 9750#	10(10+0)	311250	6.910±2.738	2150737
9.	*Desmodium loxiflorum* DC.	2354	10(9+1)	23540	15.654±3.692	368495
10.	*Desmodium triflorum* (L) DC.	1916	10(9+1)	19160	3.000±0.000	57480
11.	*Eleiotis monophylla* (Burm.f.)DC.	1160	10(9+1)	11600	7.371±2.183	85492
12.	*Heylandia latibrosa* DC.	6400* 1350#	10(9+1)	38750	1.000±0.000	38750
13.	*Indigofera caerulea* Roxb.	1479	10(9+1)	14790	18.325±4.364	271026
14.	*Indigofera linnaei* Ali.	2681	10(9+1)	26810	9.247±2.831	247912
15.	*Indigofera cotulea*(Burm.f) Merr.	2108	10(9+1)	21080	10.781±2.219	227263
16.	*Pseudarthria v iscida*(L) Weight &Arn.	2638	10(9+1)	26380	23.178±5.263	611435
17.	*Rhynchosia capitata* (Roth) DC.	25080	10(9+1)	250800	3.000±0.000	752400
18.	*Rothia indica* (L) Druce.	2391	10(10+0)	23910	2.000±0.000	47820
19.	*Tephrosea purpurea* (L) Pers.	2421	10(9+1)	24210	11.752±2.452	284515
20.	*Tephrosea villosa* (L) Pers.	2683	10(9+1)	26830	7.425±1.951	199212
21.	*Vigna pilosa* Bak.	19140	10(9+1)	191400	17.663±3.793	3380698
22.	*Vigna trilobata* (L) Verdc.	3402	10(9+1)	34020	5.603±2.723	190614
23.	*Zornia gibbosa* Spanoghe.	1897	10(10+0)	18970	10.736±3.642	203661

Note: Mean ± Standard Deviation; * Long anther; # Short anther; Union of stamens in Parenthesis

Material and Methods

Twenty three herbaceous species of the family Fabaceae which occur commonly in the Pondicherry region are chosen for the present study (*Abrus precatorius* L., *Aeschynomene indica* L., *Alysicarpus rugosus* (Willd) DC., *Canavalia virosa* (Roxb) Arn., *Crotalaria pallida* Aiton.., *C. retusa* L., *C. verrucosa* L., *C. willdenowiana* DC., *Desmodium laxiflorum* DC., *D. triflorum* (L)DC., *Eleiotis monophylla* (Burm.f.)DC., *Heylandia latibrosa* DC., *Indigofera caerulea* Roxb., *I. linnaei* Ali, *I .colutea* Roxb., *Pseudorthria viscida* (L)Wtight & Arn., *Rhynchosia capitata* (Roth)DC., *Rothia indica* (L)Druce.,

Table 2. Pollen ovule ratio, viability and pollen size of some members of Fabaceae.

Sl. No.	Name of species	Number of ovules / flowers	Pollen/ Ovule	Pollen Viability %	Pollen size (µm)
1.	*Abrus precatorius*. L.	6.579 ± 1.436	11926.128	90	47.081 ± 4.532
2.	*Aeschynome indica* L.	22.454 ± 4.643	2793.266	94	26.748 ± 2.482
3.	*Alysicarpus regosus* (Willd)DC.	4.600 ± 0.813	3506.521	88	85.248 ± 6.253
4.	*Canavalia virosa* (Roxb) & Arn.	7.546 ± 1.419	101950.702	96	55.106 ± 4.937
5.	*Crotalaria pallida* Aiton.	54.750 ± 8.007	14063.196	91	28.687 ± 2.739
6.	*Crotalaria retusa* L.	20.363 ±3.733	53186.184	94	27.450 ± 2.518
7.	*Crotalaria verrucosa* L.	14.321 ±2.678	56870. 764	92	27.705 ± 3.012
8.	*Crotalaria willdenowiana* DC.	1.564 ± 0.406	1564.679	96	26.752 ± 2.310
9.	*Desmodium loxiflorum* DC.	6.000 ± 1.000	3923.000	92	34.166 ± 3.710
10.	*Desmodium triflorum* (L) DC.	5.230 ±1.892	3663.470	81	36.953 ± 3.012
11.	*Eleiotis monophylla* (Burm.f.)DC.	1.500 ±0.500	7733.000	95	37.717 ± 2.729
12.	*Heylandia latibrosa* DC.	2.000 ± 0.000	19375.500	94	25.998 ± 2.481
13.	*Indigofera caerulea* Roxb.	4.536 ±1.424	3697.550	89	40.053 ± 3.720
14.	*Indigofera linnaei* Ali.	2.000 ± 0.000	13405.500	88	40.650 ± 4.014
15.	*Indigofera colutea*(Burm.f) Merr.	13.645 ±1.978	1505.770	86	31.151 ± 3.141
16.	*Pseudarthria viscida*(L) Weight &Arn.	4.000 ± 0.000	6595.500	93	29.441 ± 2.010
17.	*Rhynchosia capitata* (Roth) DC.	2.000 ±0.000	125400.000	83	33.375 ± 2.502
18.	*Rothia indica* (L) Druce.	25.833 ±3.711	1615.370	88	26.092 ± 2.104
19.	*Tephrosea purpurea* (L) Pers.	6.276 ± 0.732	3857.550	87	30.888 ± 2.205
20.	*Tephrosea villosa* (L) Pers.	6.920 ± 0.662	3877.160	86	32.606 ± 2.132
21.	*Vigna pilosa* Bak.	18.295 ± 3.210	14517.620	97	37.800 ± 3.457
22.	*Vigna trilobata* (L) Verdc.	6.916 ± 2.021	4919.020	86	37.087 ± 2.293
23.	*Zornia gibbosa* Spanoghe.	4.080 ± 1.253	6493.872	85	25.923 ± 2.936

Note: Mean ± Standard Deviation

Tephrosia purpurea (L)Pers., *T. villosa* (L)Pers., *Vigna pilosa* Bak., *V. trilobata* (L)Verdc. and *Zornia gibbosa* Spanoghe). It includes the estimation of the number of pollen grains produced per anther, per flower, per inflorescence [10] pollen to ovule ratio; pollen viability [11] and pollen size. Pollen ovule ratio was calculated by dividing the mean number of pollen grains by the mean number of ovules of a flower. The size of a pollen grain was studied with the help of an ocular micrometer.

Results and Discussion

Pollen production, viability, pollen ovule ratio and pollen size of 23 species of Fabaceae are given in Tables1 and 2. Maximum number of pollen per flower was recorded in *Crotalaria retusa* (1083295) and minimum in *Eleiotis monophylla* (11600). Pollen viability was maximum in *Crotalaria willdenowiana* and *Canavalia virosa* (96 percent) and minimum in *Desmodium triflorum* (81 percent). Pollen to ovule ratio was more in *Rhyncosia capitata* (1:125400), *Canavalia virosa* (1:101950) and less in *Indigofera colutea* (1:1505), *Crotalaria willdenowiana* (1:1564). Largest pollen was encountered in *Alysicarpus rugosus* (85.24mm) and smallest in *Zornia gibbosa* (25.923 mm).

The pollen production and dispersal have both biological and genetic implications for the quality and genetic value of the seeds produced. The pollen production of a taxon is not only dependent on size of the anther or pollen, but is also controlled by other factors like

periodicity, response to light and availability of nutrition[12] altitudinal variation[13], heat stress[14], CO_2 concentration[3] and also controlled genetically[15] . Pollen production of 54 terrestrial angiosperms was estimated by Mondal and Mandal[1]. They have stated that the pollen production varies from genus to genus and from species to species within the same genus of a family. They have also revealed that there is an increase in pollen production from the herbs to shrubs and from shrubs to trees. It is presumed that high pollen producers are cross-pollinated, whereas low-pollen producers are either self pollinated or apomictic.

The population of a particular species may be controlled by its pollen productivity. Pollen productivity and viability are directly related with the number of seeds produced which determine the richness of the population. The successful survival of *Crotalaria* species in masses may be attributed to its high pollen production and viability. Low fruit set in ground nut was reported due to low pollen productivity and viability[13] .The number of pollen grains produced per ovule in a flower is always more in all the species studied. It is in conformity with the earlier findings[8, 16, 17]. The pollen morphology may be specific to a given family, genus or even to a species. The size of pollen grains in the species studied ranged from 25.998 µm (*Zornia gibbosa*) to 85.248 µm (*Alysicarpus rugosus*). The present study reveals that the quantification of pollen production, pollen viability, pollen ovule ratio and pollen morphology are useful in the identification of plant species, interpretation of data on the pollen content of the atmosphere and in the study of the richness of the population.

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