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Research Article

Vasculature pattern of the petals of the species *Kallstroemia pubescens*, which indicates the evolutionary status of this taxa

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Abstract

This paper deals with the details variation of petal venation in *Kallstroemia pubescens* of the family Zygophyllaceae. In the present study, from a pool of 100 petals, 40 petals were selected randomly to observe the variation of venation patterns of petals in different flowers of same species collected from different population of the same ecological area. All the 40 petals examined, as per Foster's classification, shows various type of anastomoses. Detailed study reveals that after the entry of a single vain in a petal, it divided into two costals and one median. Actually anastomosis takes place between the sister's branches of the costal or between a branch of the costal and a branch of the medion. Present observation on the anastomosis of the petal venation of the *K. pubescens* is clearly fits with the study of Foster (1968). At the basal region of petal, Type-I(35.2%) and Type-II(35.2%) are more prevalent, than Type-III (5.8%), Type-VI (5.8%) and Type-V (17.5%).At the middle region of petal, Type-II (47.56%) is more prevalent than Type-I (17.07%), Type-V (13.41%), Type-III (13.41%), Type-IV (4.8%) and Type-VI (3.65%). At the distal region, Type-II (44.7%) is more prevalent than Type-III (33.33%), Type-I (10.41%), Type-V (8.33 %), Type-VI (2.08 %) and Type-IV (1.04 %).

Keywords
Petal venation; *Kallstroemia pubescens*; Zygophyllaceae

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Introduction

The vasculature pattern of petal is commonly known as petal venation. The study of petal venation received the attention of many workers in different times in tracing phylogeny after the remark that petal venation shows diversity (Melville, 1969; Banerjie, 1976; Arnott and Tucker, 1963).Petal venation of irregular flower has been carried many workers (Datta and Saha, 1968; Subramanyam and Nair, 1973; Gupta, 1982), whereas petal venation of regular corolla has been documented by many other workers (Arnott& Tucker, 1963; Banerji and Mukherjee,1970; Banerji 1972, 1976 etc.). Regarding the venation pattern of petal, Foster (1966), put forward the ideas of petal architecture, which is usually with open dichotomous or weakly reticulate vasculature that may provide some information to the evolutionary development of venation pattern in the Angiosperm. Melville (1969), Foster (1971), Banerjie (1976), Jana and Mukherjee (2013) and Jana, Saha and Mukherjee (2013), have done some contribution regarding the petal venation in different taxa of Angiosperms. Literature about the study of petal venation is remarkably meager. Some of the workers have studied the petal venation of some taxa (Chetek, 1962, 1963; Arnott and Tucker, 1963; Datta and Saha, 1968; Banerji and

Table 1. Showing the number of dichotomies and anastomoses in studied petals of *Kallstroemia pubescens*

Figure No.	Number of Dichotomies at basal region	Number of Dichotomies at central region	Number of Dichotomies at Distal region	Total number of dichotomies in in each petal	Number of anastomosis in basal region	Number of anastomosis in central region	Number of anastomosis in distal region	Total number of anastomosis in in each petal
1	13	12	20	45	2	3	6	11
2	9	11	8	28	2	3	10	15
3	5	8	16	29	1	3	6	
4	7	11	28	46	2	5	12	19
5	13	16	13	42	0	13	8	21
6	14	15	14	43	2	7	9	18
7	21	18	28	67	5	3	19	27
8	3	11	16	31	0	0	10	10
9	8	15	14	37	0	5	8	13
10	9	6	16	31	2	1	5	8
11	9	10	13	32	0	2	7	9
12	10	11	16	38	1	2	12	15
13	9	18	25	52	1	3	9	13
14	17	20	17	54	1	3	11	15
15	16	23	20	59	1	12	13	26
16	5	18	19	42	0	6	13	19
17	8	15	20	43	0	4	13	17
18	13	13	17	43	1	10	14	25
19	7	12	16	35	0	2	12	14
20	9	12	12	33	0	4	7	11
21	3	11	20	34	1	2	13	16
22	7	12	16	37	0	2	14	16
23	9	15	20	44	1	6	16	23
24	11	15	13	39	2	4	15	21
25	9	12	15	36	1	9	13	23
26	11	13	15	39	5	1	13	19
27	13	9	21	43	2	9	12	23
28	10	13	16	39	0	5	15	20
29	11	8	15	34	0	2	7	9
30	9	15	20	44	1	5	10	16
31	9	15	16	40	0	3	9	12
32	8	7	11	26	0	3	12	15
33	10	8	10	28	1	5	6	12
34	6	14	11	31	0	5	7	12
35	6	17	21	44	0	7	12	19
36	6	7	16	29	0	3	10	13
37	6	8	13	27	0	1	9	10
38	3	10	7	20	0	3	9	12
39	6	8	13	27	0	7	14	21
40	5	11	13	29	0	4	9	13

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Table 2. Showing the types of anastomosis in studied petals of *Kallstroemia pubescens*

Figure	Types of anastomosis at basal region	Total	Types of anastomosis at central region	Total	Types of anastomosis at upper region	Total
1	0		Type.II-1, Type.III-1	2	Type.III-1	1
2	Type.III-1	1	Type.I-2	2	Type.III-2	2
3	Type.II-1	1	Type.II-1, Type.V-1	2	Type.III-1	1
4	0		Type.III-1, Type.V-1	2	Type.III-2, Type.II-3, Type.I-1.	6
5	0		Type.III-2, Type.II-1, Type.V-1	4	0	
6	Type.II-2, Type.I-1	3	Type.II-2	2	Type.II-2	2
7	Type.II-3, Type.I-1	4	Type.I-1, Type.II-1, Type.III-1	3	Type.III-2, Type.I-1, Type.II-1	4
8	0		0		Type.III-1	1
9	0		Type.I-2, Type. V-1	3	0	
10	0		Type.I-1, Type.II-1	2	Type.III-1	1
11	Type.V-1	1	Type.II-1	1	Type.II-3	3
12	0		Type.V-1	1	Type.II-3, Type.III-2	5
13	Type.I-1	1	Type.I-1, Type.II-1	2	Type.V-1, Type.VI-1	2
14	Type.I-1	1	Type.II-1	1	0	
15	Type.I-1, Type.V-1, Type.VI-1	3	Type.II-3, Type.III-1,Type.IV-1, Type.I-1	6	Type.II-1, Type.VI-1, Type.V-1	3
16	0		Type.I-1, Type.III-1, Type.VI-1	3	Type.II-1, Type.I-2	3
17	0		Type.II-1	1	Type.II-2, Type.III-1, Type.I-1, Type.V-1	5
18	Type.V-1	1	Type.II-2, Type.III-1, Type.I-1, Type.V-1	5	Type.III-1	1
19	0		0		Type.II-3, Type.III-1	4
20	0		Type.I-2, Type.II-2	4	Type.III-2	2
21	0		0		Type.II-1, Type. V-1	2
22	0		Type.II-1	1	Type.II-1, Type.III-1	2
23	0		Type.II-2, Type.III-3	5	Type.I-1, Type.II-2, Type.III-3	6
24	0		Type.II-1, Type.V-1	2	Type.II-2, Type.III-1	3
25	0		Type.II-2, Type.V-1	3	Type.III-1, Type.II-1	2
26	0		Type.I-1	1	Type.II-4	4
27	Type.I-1	1	0		Type.II-1, Type.V-1	2
28	0		Type.II-2	2	Type.II-1	1
29	0		Type.II-1	1	Type.III-2, Type.I-1	3
30	0		Type.II-2	2	Type.III-2	2
31	0		Type.II-1, Type.IV-2	3	Type.III-2, Type.I-1	3
32	0		Type.II-1	1	Type.I-1, Type.II-1, Type.III-1	3
33	0		Type.II-1, Type.V-1, Type.VI-1.	3	0	
34	0		Type.V-2, Type.II-1	3	Type.II-1, Type.V-1	2
35	0		Type.I-1, Type.II-1, Type.IV-1, Type.VI-1.	4	Type.II-2	2
36	0		Type.II-1	1	Type.II-3	3
37	0		0		Type.II-2, Type.IV-1, Type.V-1	4
38	0		Type.II-1	1	Type.II-1	1
39	0		Type.II-1	1	Type.I-1,	1
40	0		Type.II-2	2	Type.III-2, Type.II-1, Type.V-1	4
Total Anastomoses in basal region		17	Total Anastomoses in central region	82	Total Anastomoses in distal region	96

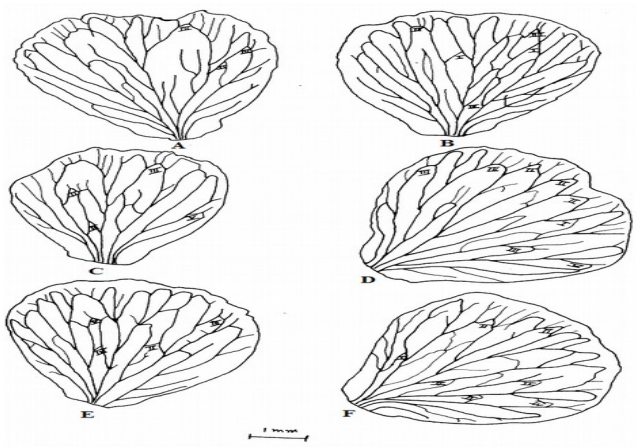

Fig. 1: (A-F). Petal venation of *Kallstroemia pubescens*

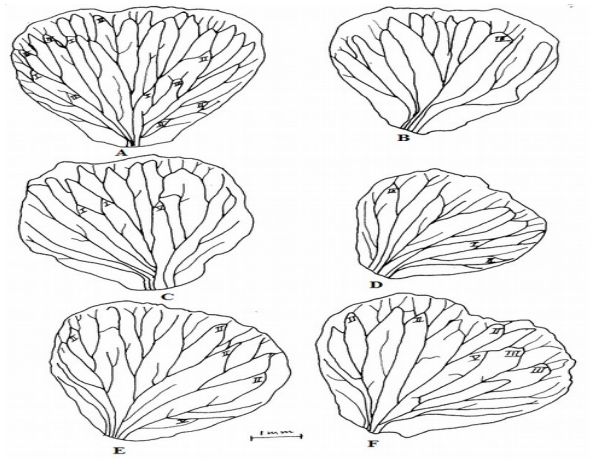

Fig. 2: (A-F). Petal venation of *Kallstroemia pubescens*

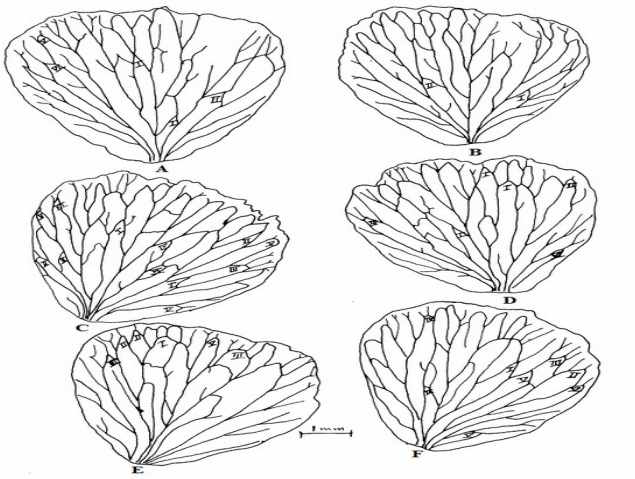

Fig. 3: (A-F). Petal venation of *Kallstroemia pubescens*

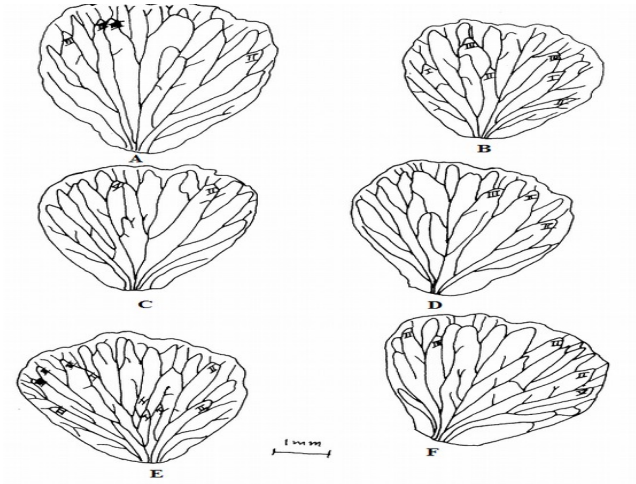

Fig. 4: (A-F). Petal venation of *Kallstroemia pubescens*

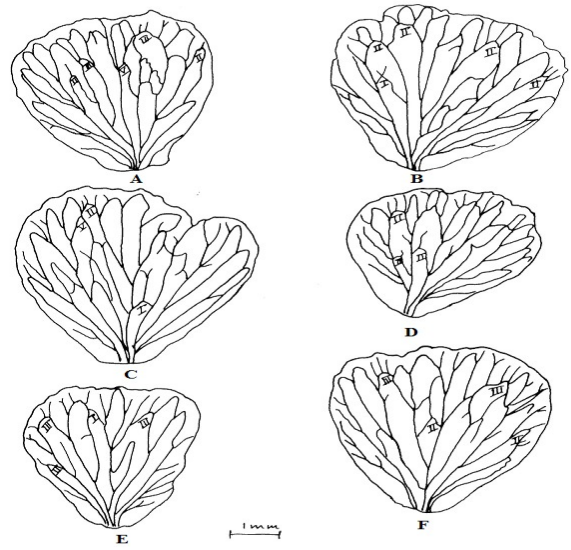

Fig. 5: (A-F). Petal venation of *Kallstroemia pubescens*

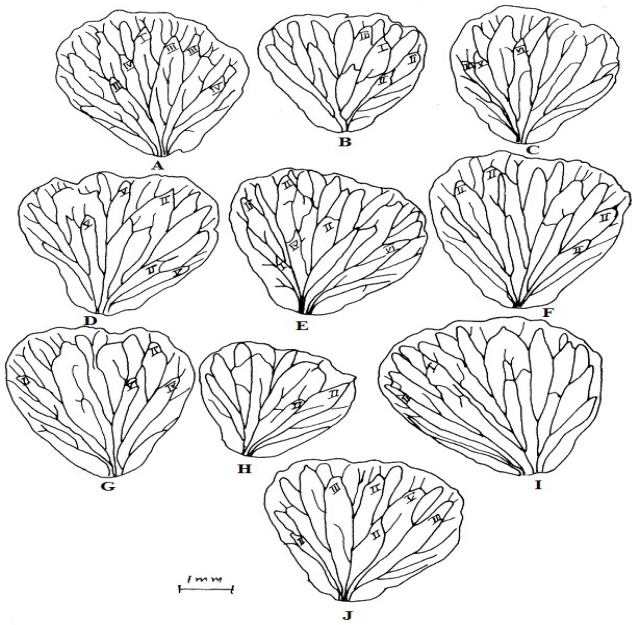

Fig. 6: (A-J). Petal venation of *Kallstroemia pubescens*

Mukherjee, 1970). But there are few works on the study of petal venation, therefore; the study of petal venation of *K. pubescens* (G. Don) Dandy, has been under taken. The randomly selected forty petals out of 100 petals from different plants of the same species of *K. pubescens*, have been taken for this study. The perusal of available literature revealed that venation of petals is especially significant at the species level. The genus has 17 species throughout the world and is usually present in Tropical and Worm America (Mabberley, 2008) and also in USA, Costa Rica, Jamaica, Peru, Colombia, Venezuela, India etc. This taxa has not been included in the "*Flora of British India*", by Hooker, (1875-1897) as well as in "*Bengal Plants*" (Prain, 1903), but has been included in some district floras of West Bengal (Bennet, 1979), Guha Bakshi (1984), Sanyal (1994), Mitra and Mukherjee (2013). The aims of this study is to show the vasculature pattern of the petals of the species *K. pubescens*, which indicates the evolutionary status of this taxa.

Materials and Methods

The plant specimens (Fresh petals of *K. pubescens*) were collected from naturalized populations of Nadia district particularly from Kalyani University campus. Flowers were studied under simple dissecting microscope. Details of the description of each petal has been taken; figures were drawn with the help of prism type of Camera Lucida.

Discussion and Conclusion

The detailed information regarding the venation pattern of each petal (Fig. 1-6), is given in the table-1 and II. The following observations were based on the study of forty petals.

All petals are usually shortly clawed, having many traces, usually obovate in shape with retuse apex. For the study of number of dichotomies and number of anastomoses and type of anastomoses, the petal area has been divided into three sectors, such as basal, middle and upper sector. This division is helpful for the classification of the veins of petals. On the basis of types of anastomoses by Foster (1966-1968), the present studied petals have been classified in to I to VI types. At the basal region of petal, Type-IV type of anastomoses is absent, whereas in middle and distal region of petals, all the VI type of anastomoses are present. It is also evident from the present study that out of VI type of anastomoses of petal veins by Foster (1966, 1968), at the basal region of petal, Type-I(35.2%) and Type-II (35.2%) are more prevalent, than Type-III(5.8%), Type-VI (5.8%) and Type-V (17.5%).At the middle region of petal, Type-II (47.56%) is more prevalent than Type-I (17.07%), Type-V (13.41%), Type-III (13.41%), Type-IV (4.8%) and Type-VI (3.65%). At the distal region, Type-II (44.7%) is more prevalent than Type-III (33.33%), Type-I(10.41%), Type-V (8.33 %), Type-VI (2.08 %) and Type-IV (1.04 %).

Therefore, maximum percentage of anastomoses has been documented in upper and middle sector of petals, rather than the lower sector of petals. It is evident that 100% anastomoses of the vein is concentrated in central and peripheral sectors.

Regarding the study of petal venation, low percentage of anastomoses has also been reported by Banerjee and Mukherjee (1970)from the species of *Ranunculus scleratus* L.

Regarding the petal venation, Chrtek (1962, 1963) had given the opinion that anastomosed venation is primitive, while Foster and Arnott (1960), Banerji (1976), Banerji and Mukherjee (1970), Subramanyam and Nair (1973) had expressed their opinion that open dichotomous vein is primitive. On the basis of these two opinion, the petal venation of *K. pubescens,* it is evident that it has an intermediate type of petal venation having both open dichotomous type as well as anastomosed type. Therefore, considering the petal venation the family Zygophyllaceae is moderately evolved family according to modern system of plant classification.

Percentage of anastomoses in basal region

Type.I= 6/17x 100% =35.2%
Type.V= 3/17x100%=17.6%
Type.VI=1/17x100%=5.8%
Type.II=6/17x100%=35.2%
Type.III=1/17x100%=5.8%

Percentage of anastomoses in central region

Type.II=39/82X100%=47.56%
Type.VI=3/82X100%=3.65%
Type.IV= 4/82x100%=4.8%
Type.I= 14/82X100%=17.07%
Type.V=11/82x100%=13.41%
Type.III=11/82x100%=13.41%

Percentage of anastomoses in distal region

Type.V=8/96x100%=8.33%
Type.II=43/96x100%=44.7%
Type.III=32/96x100%=33.33%
Type.I=10/96x100%=10.41%
Type.IV=1/96x100%=1.04%
Type.VI=2/96x100%=2.08%

Competing Interests:

The authors do not have any competing interests.

Author's contribution:

This work has been totally contributed by both the authors.

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References

Arnott, H. J. and S. C. Tucker. 1963. Analysis of petal venation in *Ranunculus* I. Anastomoses in *R. repensvpleniflorus*. *Amer. J. Bot*. 50: 821-830. http://dx.doi.org/10.2307/2440201

Banerjee, M. L. 1972. Morphological studies on petal venation of *Ranunculus diffusus* DC. And its affinities with fossil materials. *Biology of Land Plants*, pp. 1-8, SaritaPrakashan, Meerut.

Banerjee, M. L. 1976. Petal venation of *Ranunculus diffusus* DC. I. *Bull. Bot. Soc. Bengal*. 30: 37-41.

Banerjee, M. L. and M. Mukherjee. 1970. Petal venation in *Ranunculus scleratus* L. *Castanea.* 35: 157-161.

Bennet, S. S. R. 1979. Flora of Howrah District (West Bengal). International Book Distributors, Dehra Dun.

Chartek, J. 1963. Die Nervatur der Kronblatterbei den Vertretern der Ordnung Rosales s.l. *Acta. Horti. Bot. Pragensis.* Pp. 12-29.

Chrtek, J. 1962. Der Verlauf der Nervatur in den Kronblatternbzw. Kronen der Dicotyledon. *Novitates Bot. Horti. Bot. Univ. Carolineaea Pragensis*. Pp-3-10.

Datta, P. C. and N. Saha. 1968. Specificity of distribution of venation anastomosis patterns in petals of Phaseoleae (Leguminosae). *Ann. Bot*. 22: 791-861.

Foster, A. S. 1966. Morphology of anastomosis in the dichotomous venation of *Circaeaster*. *Amer. J. Bot*. 53: 588-599. http://dx.doi.org/10.2307/2440009

Foster, A. S. 1968. Further morphological studies on anastomosis in the dichotomous venation of *Circaeaster*. *J. Arnold Arb*. 49: 52-57.

Foster, A. S. 1971. Additional studies on the morphology of blind vein-endings in the leaf of *Circaeaster agrestis*. *Amer J. Bot*. 58: 263-272. http://dx.doi.org/10.2307/2441163

Foster, A. S. and H. J. Arnott. 1960. Morphology and dichotomous vasculature of the leaf of *Kingdoniauniflora*. *Amer. J. Bot*. 75: 684-698. http://dx.doi.org/10.2307/2439520

GuhaBakshi, D. J. N. 1984. *Flora of Murshidabad District, West Bengal, India*. Scientific Publishers.

Gupta, M. 1982. Petal venetion in *Trigonella* (Papilionaceae). *Proc. Indian Acad.Sci.* (Plant Sci.) 91 (5): 379-388.

Hooker, J. D. (1875-1897). *Flora of British India.* (Volume-1-7). L. Reeve & Co. Ltd. London. Reprinted, Botanical Survey of India, Calcutta, 1961.

Jana, B. K., Saha, S. and S. K. Mukherjee. 2013. A comparative study of petal venation between *Brassicanigra*and *Brassicacamprestris*. *Advance Research in Pharmacuticals and Biologicals.* 3(2): 1-5.

Jana, B. K. and S. K. Mukherjee. 2013. Study of petal venation in *Ranunculus laetus* of the family Ranunculaceae. *International Journal of Chemical and Pharmaceutical Research.* 2(10): 316-320.

Mabberley, D. J. 2008. *Mabberley's Plant Book*. Third Edition. Cambridge University Press, UK.

Melvillee, R. 1969. Leaf venation pattern and origin of the Angiosperms. *Nature, Land*. 224: 121-125.

I. Mitra, S. and S. K. Mukherjee. 2013. *Flora and Ethnobotany of West Dinajpur District, West Bengal*. Bishen Singh & Mahendra Pal Singh, Dehra Dun, India.

Prain, D. 1903. *Bengal Plants*. Volume I & II (Rep. Ed., 1963), B. S. I., Calcutta.

Saynal, M. N. 1994. *Flora of Bankura District*. Bishen Singh &Mahendra Pal Singh, Dehra Dun, India.

Subramanyam, K. and N.C. Nair. 1973. Dichotomous venation and anastomosis in corolla of an Orchid. Proc. *Indian Acad. Sci. (Plant Sci.).*78: 195-202.