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Petal venation in vascular plants-A review

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Abstract

The vasculature pattern of petal is known as petal venation. In comparison with leaf venation, petal venation shows greater simplicity and diversity. Present paper deals with the detailed survey of petal venation in vascular plants.

Many taxonomists[1,2,8,10,11] have studied the venation pattern of petals in vascular plants to solve a number of taxonomic and phylogenetic problems. Petal venation is especially significant at the species and also in generic level too. Petal venation may provide number of important clues for evolutionary development. The study of petal venation received the attention of different workers in different times for tracing phylogeny. Petal venation of irregular flower has been carried by many workers[8], whereas petal venation of regular flower has been documented by many other workers[1,3,4,5]. Regarding the venation pattern of petal, Foster[11], 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 Angiosperms. Foster[11] in his study has presented six different types of anastomoses for the study of petal venation.

Nature of petal venation in vascular plants:

Many workers[1,5-8] have contributed regarding the venation pattern of petals from time to time. Melville[23], Foster[12], Banerjee[4], Jana and Mukherjee[17] have done some contribution regarding the petal venation in different taxa of vascular plants.

Regarding the petal venation, Chrtek[6,7], had given the opinion that anastomosed venation is primitive, while Foster and Arnott[1], Banerji[4] had expressed their opinion that open dichotomous vein is primitive type.

According to the observation of Lesquereux[22] and Kerner[21], the study of venation is very important for the solution of a number of taxonomic and phylogenetic problems.

Datta and Chowdhury[9], have studied the venation pattern of petals of a few species

of Malvaceae and its possible utility in tracing relationships. After this study, they have mentioned nine anastomoses types. Within the studied species, they have indicated the radiate and dictyodromous category of venation. In the family Malvaceae.

Heel[15] have indicated the fasciculate nature of vascular trace in petals, stamens and sepals.Venation pattern is not only observed in petals, but it also provide a great taxonomic parameter in sepals.

Hamed and Mourad[14], have published a paper on the basis of the venation pattern of sepals in certain species of Solanaceae and have provided a contribution regarding this family. During this study, they have selected 20 species and 1 variety for investigation of venation pattern of sepals on the basis of morphological study. In this study, they have presented two principal types of venation, such as parallelodromous and pinnate type.

Jesudass *et al*.,[19] have reported same objectives to investigate the venation pattern in 16 fern species of the genus *Pteris*, which is very helpful in delimiting distantly related taxa.

Nancy and Huerta[24], have contributed regarding the venation pattern development in wild type and a homeotic sepaloid petal mutant of *Clarkia tembloriensis* of the family Onagraceae. In this work, they compared the development pattern of vascular system in sepals, petals and sepaloid petals. From their study, they have concluded that mature sepals containing three primary veins with numerous secondary veins, where as in mature petals had one primary vein with numerous secondary veins. Sepaloid petals containing the combining characters of both wild type sepals and wild type petals.

Saha and Mukherjee (2012) studied in details the patal venation of *Oxalis corniculata* L. of the family Oxalidaceae and The venation of petals in *Oxalis* is essentially open and dichotomous type, as has been noted in leaves of *Circaeaster agrestis* by Foster[12] and petals from different taxa by Arnott & Tucker[1,2], Banerjee & Mukherjee[5] and Banerjee[3,4]. Foster's[12] classification of anastomoses of vein on the study of leaves of *Circaester* fits well with the present observation. Their studies indicate that open dichotomous venation is primitive,since some of the petals have no anastomosis,while some other petals having differentpoints of fusions or anastomoses in veins. Among thedifferent types of anastomoses, type II is most frequently and type III is less in amount, and otherintermediate types are type IV, type I and type V in accordance with percentage anastomoses.Total numbers of dichotomies in each petal varies from 13 to 30. Very rare case, type "A" (afterArnott, 1959) and blind vein ending within an areole have been noted from this taxon.

Sadhukhan and Mukherjee[28], have studied the petal venation of *Galphimia gracilis* of the family Malphigiaceae. This plant exhibits predominant free dichotomous type of venation, which is usually seen in some primitive dicots as well as in ferns. At the same time, percentage of different categories of anastomoses are extremely low. Therefore, this taxon can be regarded as one of the primitive taxon on the basis of petal venation. In this study, they have

mentioned that type-I anastomoses is most frequent and type-II and type III anastomoses are less in amount and other intermediate types are type IV and type VI in accordance with percentage of anastomoses. In their study the number of anastomoses per petal varies from 15-25.

Jana *et.al.*,[18], have contributed regarding the petal venation in between *Brassica nigra* and *B. camprestris*of the family Brassicaceae. The basic pattern of petal venation consist of a single vascular trace at the base. After a short distance it divides and redivides and produce one (1) medial vein and three to five (3-5) costal veins in each side of medial vein of both species. The medial vein is divided in upper portion in both species. According to their study, the total dichotomis in each petal of *Brassica campestris* varies from 12-20 and each petal of *B. nigra* varies from 15-33. The most interesting features of two species are as follows : 1. Veins do not reach the margin of petals in *B. nigra*, 2. Veins diverge towords the apex in both species, 3. Anastomoses are prevalent towords the peripheral region of petals of both species. In their study, they have also indicated that petal venation of both the species are essentially open and dichotomous type.

Roddy *et al.*,[25], have studied regarding the uncorrelated evolution of leaf and petal venation patterns across the angiosperm phylogeny. In this work they measured the leaf and flower vain length area for a phylogenetically diverse sample of 132 species from 52 angiospermic family.

Jana and Mukherjee[20] have studied regarding the petal venation of *Ranunculus luetus* of the family Ranunculaceae. In this study, they have examined 75 petals, out of which 35 showed anastomosis according to Foster's classification. From their study, they have concluded that some petals have the appearance of a weakly reticulate organ in having large areoles, formed by the anastomosis of vain branches.

Shaikh and Mukherjee[27], have contributed a critical study regarding the petal venation in the species *Ranunculus diffusus* of the family Ranunculaceae. In this work, only 4 petals (Out of 40 petals) shows various type of anastomoses according to Foster's classification. In their study, the majority types of anastomoses of veins are recognized by Foster[10,11] are seen. From their study, they concluded that total number of dichotomis in each petal varies from 2-11. Average percentage of dichotomis is high in basal region (58.22 %), which is minimum in distal region (7.11 %). Central region of petal has about 34.66 % dichotomies. The interesting feature of petal venation of *Ranunculus diffusus* is that veins do not reach the margin of the petals. The number of anastomoses in each petal varies from 1-2 only and even no anastomosis has been observed in some petals (36 petals, out of 40 petals). Their study is closely identical with the study of Foster[10,11]. In this work, the percentage of anastomosis is very low and such type of low percentage of anastomosis has also been reported previously by Banerjee and Mukherjee[5], from another species of *Ranunculus i.e. Ranunculus scleratus*. Petal venation of *R.diffusus* indicates that it has predominant free dichotomous types of venation, which is usually seen in some primitive dicot as well as

ferns.

Hossain and Mukherjee[16] have studied seven species of *Cassia*, with special reference to the morphology of posterior petal. Characteristic features of posteriorpetal are greatly variable among the studied species of *Cassia*. Posteriorpetal is always innermost in all 7 species of *Cassia* and it is usually largestin size except in *C. siamea*, where it is smallest and in *C. laevigata*it ismore or less equal in size with other petals. Shape of posterior petal issignificantly variable in different members of *Cassia*. Smallestposterior petal has been noted in *C. tora*, whereas largest form of petal hasbeen observed in *C. laevigata*. Configuration of apical and basal part ofpetal is very valuable character for isolation of taxa. Number oflongitudinal veins varies from 1 (*C. siamea)* to 7 as in *C. sophera*. Colour of petal is basically yellow but itsvariations have been documented in different species. Length breadth ratioof petal is minimum (1.1) in *C. sophera* var. *purpurea*, which is maximum(1.76) in C. *laevigata*.Variations of the venationpattern of posterior petals in different species as well as in differentindividuals of the same species have also been noted. Shapes, sizes,colours, length-breadth ratio, apex and bases characters of posterior petal ofdifferent species are greatly variable. Morphological studies of differen-tspecies also indicate that many distinguishable characters exist among thespecies of *Cassia*. They have concluded that morphological study of theposterior petals in different species of *Cassia* are very essential and helpfulfor their characterization and identification of taxon. They have not indicated the detail venation pattern of these species.

Jana and Mukherjee[20], have studied the vasculature pattern of the petals of the species *Kallstroemia pubescens* and have enable to indicate the evolutionary status of this taxa. They have taken 40 petals for this study. On the basis of the types of anastomoses by Foster[10,11], they have classified the studied petals in to I to VI types. At the basal region of petal, Type-IV of anastomoses is absent, whereas in middle and distal region of petals, all the VI type of anastomoses are present. After this study, they have mentioned the percentage of anastomoses in basal region, central region and distal region of petals.

Though at present majority of angios-perm taxonomists are not interested about petal venation, but it has significant value to understand the phylogenetic relationship of taxa.

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