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FLORAL VASCULATURE AND MORPHOLOGY OF *OCHNA SERRULATA*(Hochst.) Walp.

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Vascular supply of flower of *Ochna serrulata* shows that 9-10 vascular bundles in the pedicel supply three traces to each sepal, a median and two laterals, (sepal marginals), petal and staminal traces are conjoint. Five free petals receive a trace each which is composite having 3-5 bundles. Numerous free stamens borne on anthophores are arranged in three whorls and each stamen gets 3-5 bundles from the conjoint bundles. Carpels are 6-10, fused at the base but free upward. The carpels are spherical and their fused style is gynobasic. The capillary bundles are, one dorsal bundle, many lateral bundles and an ovular bundle. The ovular bundle directly enter into the stalk of the ovule. The dorsal bundle and marginal bundles traverse through out the wall of the carpels, ascend and then take downward turn before entering the deeply based style. The carpellary bundles in the style run up to stigmatic base. In the basal region the dorsal surface of adjacent carpels are fused and the ventral surface is free, a little higher up the dorsal surfaces are free, but the ventral surfaces are fused before extending to the style. Thus at the base the ovary is unilocular but later it becomes multilocular. Single ovule in each locule receives a vascular supply arising directly from the carpellary supply. The placentation here is described as basal.

Key words: Flower vasculature morphology, *Ochna serrulata*.

Ochna serrulata of Ochanaceae is placed under Parietals (Lawrence 1951), Ochnales (Hutchison 1923) and Theales (Bessey 1915 and Cronquist 1988). The family has received little attention and only the horticultural importance is given of its taxa in literature. However, the present studies were under taken while studying the biology of reproduction of *Ochna serrulata* whose flowers are with beautiful bright yellow petals, and sepals becoming brick red in colour at maturity surrounding the dark black shining fruits. The fruits (1-10) in mature condition are attached on a receptacular torus are drupe and studded individually on torus (Fig. 1. A-C). The present paper refers to the floral vascular supply and based on this interpretation of placentation and carpel morphology is discussed.

Gross morphology of flower

The flowers of *Ochna serrulata* (syn. *Ochna multiflora*) are bright yellow in colour, solitary, axillary or penicled cyme growing in bunches. The flowers measure about 20-25 mm in diameter when in bloom during spring in the months April May and mature in the month of June. The petals drop early but the sepals which change their colour from green to scarlet red and later brown remain persistent for long along with the fruits which are drupes. Both sepals and petals are 5-6 in numbers, free and spirocyclic, the sepals are imbricate while petals are valvate. Indefinite stamens are arranged in 2-3 whorls and anthers of each ring alternate with those of other rings. Stamens are free with short, flat filaments attached on an anthophore and anthers are basifixed. At the junction of filament and anther of a stamen there is a notch which is the place of disjunction or separation of anther lobes after pollination. The anthophore parts remain attached with the receptacle after anthers are dropped. The anthers are large 2-3 mm. in length, finger like with a well developed connective and black in colour (Fig.3A).

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Figures 1, A-C. A- a tree in flowering, B- flower of *Ochna serrulata*, C- flower after fertilization showing coloured sepals and nutlets.

Vasculature of flower

The vascular supply of flower is studied in serial transverse sections and median longitudinal sections. In transverse section pedicel show 9-10 conjoint, collateral vascular bundles which are large and arranged in a ring (Fig.2A). At the base of the receptacle these bundles first divide and give off five median traces which enter into the five sepals. The median traces branch before entering the organ (Fig.2A, B and 3A). Then the remaining vasculature gives off marginal traces to the adjacent sepals which branch with in the sepals (Fig.2B, C). Simultaneously, along with marginal traces, traces for petals also arise from the main vasculature. The vasculature of petals in fact organize into a row or a ring of 3-5 small bundles (Fig.2D, E). The remaining vasculature reorganizes into 7-9 rings of bundles (Fig.2D, E). Each ring of bundles supply to the stamens on outer side and carpels on the inner side (Fig.2D, E). The receptacular region at this stage show two rings of vasculature, the outer ring is for the supply of stamens which are arranged in three concentric rings. Vascular rings for stamens supply 3-5 branches of vasculature to each stamen (Fig.2F, G, H). Each filament of stamen receives 3-5 small bundles which are arranged in a row or in circular group. These bundles transverse up to the base of anther (Fig.2I, J and 3A).

The carpellary bundles destine to supply the ovary are numerous, and group into 7-10 groups of bundles. The number of vascular bundle groups corresponds to the number of carpels (Fig.2F, G, H). While reorganizing in groups, corresponding to the number of carpels, ovular traces arise and enter into the ovule (Fig.2F, G). The remaining bundles which are supplying the ovary wall of each carpel are arranged radially into 7-9 groups (Fig.2F, G, H), and the area of carpels is also marked in the receptacle. Each group of carpel vasculature can be distinguished into a prominent dorsaly placed dorsal bundle of carpel and many small bundles laterally placed are the marginal bundles (Fig.2H and 3D, E).So far carpellary locules are not distinct (Fig.2H). A little higher up 7 to 9 carpels each with a locule having single ovule appears (Fig. 2I and 3C, D). At this level the 9 carpels are deeply lobed and are fused by their dorsal surfaces along the margins of adjacent carpels, and ventral margins are free and extended towards the center (Fig.2I and 3D, E).At a little higher level the dorsal bundles and the lateral bundles extend towards the fused margins of same carpel which extend towards center forming style and supply up to the base of stigmatic lobes. The style is hollow, and stigma lobes are free.

After the extension of margins of carpels, the carpels separate from each other and become spherical. Due to this the dorsal bundles and lateral bundles traverse along the wall of carpel upward and then descent downward before they enter into the style at the base. Hence in transverse sections the dorsal bundles and lateral bundles are cut transversely at two places. The prominent dorsal bundle is cut both at the distal site and proximal site of the ovary. The one cut on the proximal side is inverted and gives the impression of fused ventrals of the same carpel. In a mature flower the receptacular parts grow fast and each carpel of ovary appears to be studed on it, surrounding the single style on the torus. Anthers dehise by apical pores. It was observed that outer ring of stamens contain 21-24 stamens, middle 15-18 and inner ring 12-15 stamens. Gynoceium consists of 6-10 carpels which are fused at the base but free in the upper region giving an impression of apocarpus condition, but the common fused style is gynobasic which is deeply situated. Style terminates into stigma lobes which correspond to the number of carpels. The ovary is spherical and each carpel bears a single ovule which is anatropous, attached at the base. At maturity after fertilization, each ovary separate out and out of 6-10 carpels 1-7, rarely 9 form the fruits, while rest abort. The separation of carpels is due to the growth of receptacular region which forms a dome shaped torus, separating each ovary. However, the fused stigma of the ovary remains attached at the centre of the torus. The fruits developed into dark, shiny drupe. There is a nectariferous tissue between the stamens and the carpels.

DISCUSSION

Vascular supply to the flower of *Ochna serrulata* shows a high degree of fusion of vascular traces of different organs inspite of the facts that organs are free. Usually cohesion of bundles is seen more in flowers in which organs are fused or in inferior ovaries (Govil 1994). Puri (1951) considered that the vasculature of the flower, number of traces, and arrangement and disposition of vascular bundles in different flower parts is fairly constant and has both phylogenetic and taxonomic significance. In *Ochna serrulata* sepals receive median trace independently while sepal laterals, petal traces, staminal traces and carpellary traces are conjoint. These traces branch within the receptacle and organize into groups of bundles before entering into their respective organs. Such course of vascular supply has been reported in several taxa of Saxifragaceae (Saxena 1976). Usually traces from the axial vasculature directly enter the organ with or without branching, but do not reorganize in groups (Puri 1951, Govil 1994). Conjoint sepal marginals, petal, stamen and carpellary traces become distinct in the receptacle itself. The staminal traces, after the supply to petals separate out successively for the stamens of three whorls and enter the anthophore which are free and terminate at the base of short filament. Thus stamens and their stalks are free. The carpellary bundles are arranged radially and the median dorsal trace is distinct and the rest bundles are lateral. At this point ventral which may be fused marginals and form the ovular bundles. This disposition of carpellary bundles indicates the carpel vascular supply is unique and not described earlier in any other taxa (see Govil 1994).

Multicarpellary ovary shows that the dorsal surface of the adjacent margins are fused and the ventral surface is free, which means that syncarpous ovary forms a unicellular condition and the placentation therefore should have been parietal, but at this point, the ovules have been supplied earlier by the bundles directaly derived from the main stele and each carpel has single ovule at the base. But at a little higher up, the ventral margins of same carpel are fused and the dorsal surface becomes free, simulating the axile placentation condition. Since the carpels are free in this region it could be marginal placentation condition too. This makes the situation of placentation in *Ochna serrulata* more complicated, i.e. basal due to the position of

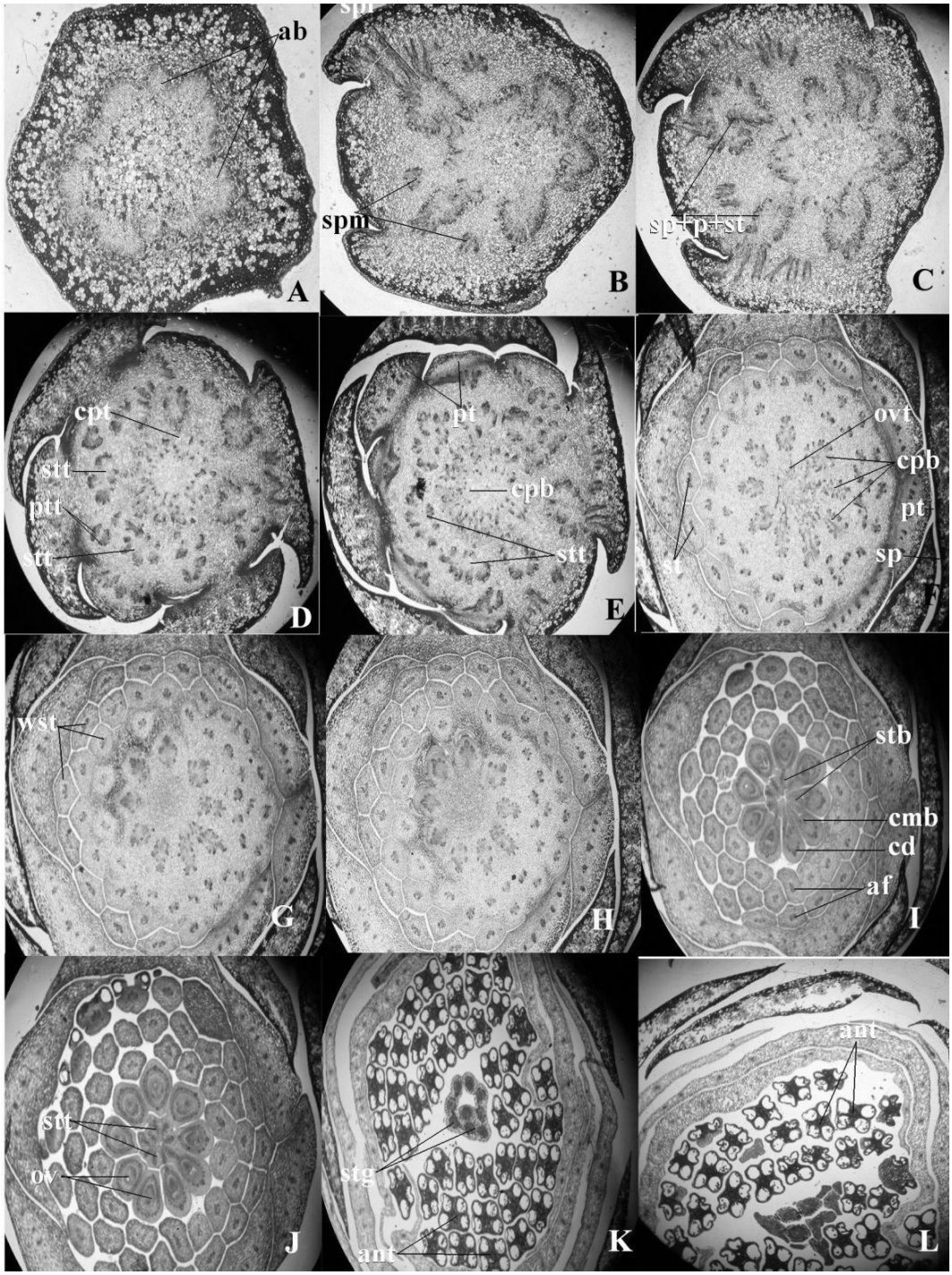

Figure 2A-l. Serial transverse sections of a flower showing vascular supply to different organs (see text for details) (af-anthophore, ant-anther, ab-axial bundle, cd-carpeliary dorsal, cpb-carpeliary bundles, cpt-carpeliary traces,n-nectariferous tissue, ov-ovule, ovt- ovular trace, pt-petals, ptt- petals traces, spm-sepal median, spl-sepal lateral trace, sp+p+st-fused sepal, petal staminal traces, st- staminal trace, stb- stylar bundles, stg-stigma bundles, stt-stylar bundles, wst-whorl of stamens)

ovular supply and of ovule, but unilocular condition makes it parietal and later the multilocular condition makes it axile. Puri (1952) describes three basic placental types, viz. marginal, axile and parietal on the basis of locule, position of placenta and the vascular supply to the carpel and ovules. While focusing on the evolutionary tendencies he considered the

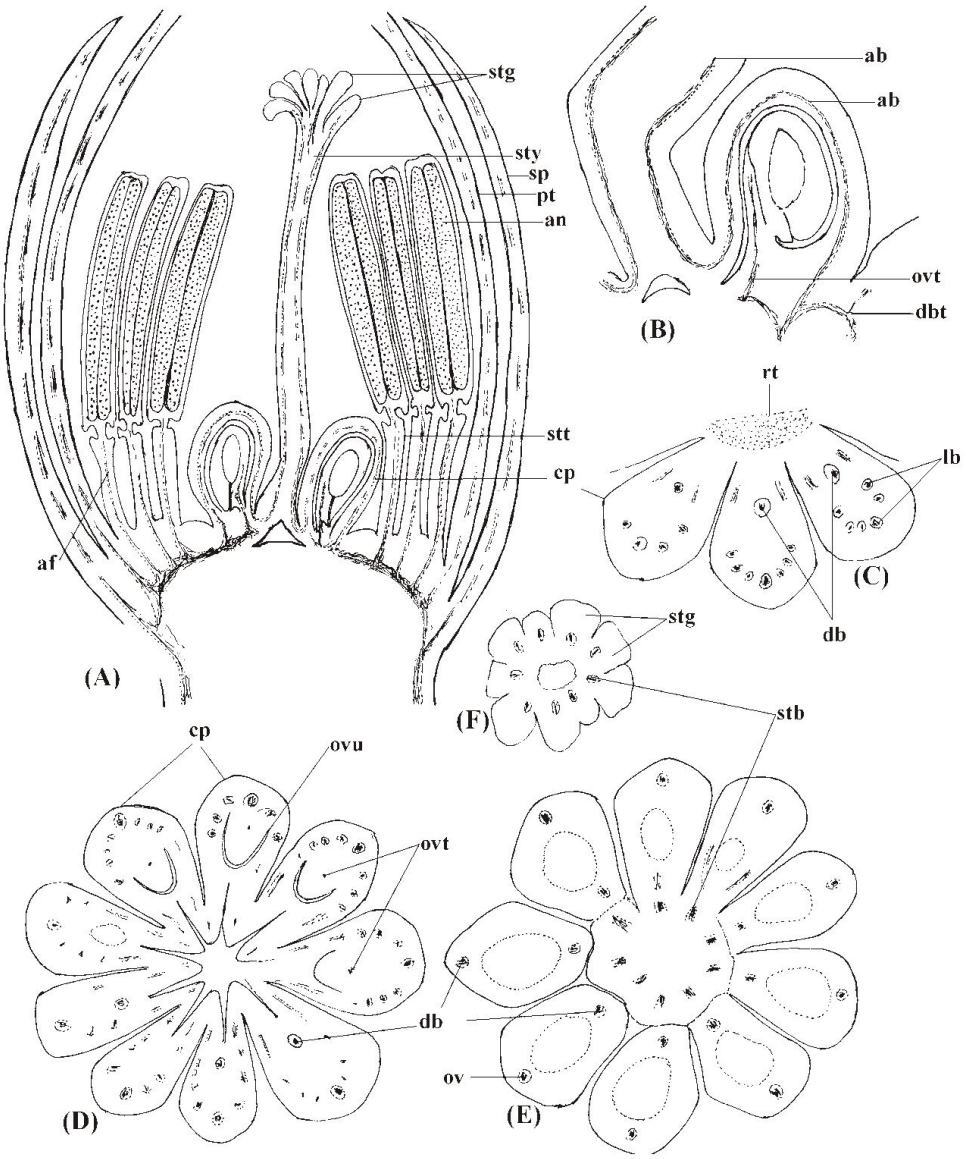

Figure 3. A-F. **A-** reconstruction of median longitudinal section of flower, **B-** a portion of ovary region enlarged, **C-** a portion in TS basal region of ovary, **D**- TS of ovary in the basal region showing fusion of carpels, **E-** TS of flower showing separation of ovaries and supply to style, **F-** TS of style with central cavity and stigma lobes.
(af-anthophore, an-anther, cp-carpel, db-dorsal bundle, dbt-dorsal trace, lb-lateral bundles of carpel, ovu-ovule, ovt-ovular trace, pt-petal, rt-receptacle tissue, sp-sepals, stb-stylar bundles, stg-stigma, stt- staminal trace sty-style)

marginal placentation as the basic type, from this he derived the parietal type through axile placentation. However, there are some authors who believed that the parietal placentation is more primitive (Gauthier 1950). According to the taxonomic literature of flowering plants more than 56% families have axile placentation (Saxena and Govil 1995). Some families show more than one type of placentation and in some cases flower at the base of ovary show axile placentation and in the upper region parietal placentation or vice-versa (Lawrence 1951). In case of *Ochna serrulata* on the basis of anatomy of gynoecium, the initial stage of placentation is parietal because the ovary is unilocular, since the margins of adjacent carpels are fused along their dorsal surface. This situation must have arisen from multicarpellary apocarpous condition due to crowding of carpels, each carpel with one basal ovule as in Rannunculales, and fusion of ventral surface of margins is a later development. Further, the carpellary margins do

not appear to involutely folded, rather they show conduplicate folding, as the margins are vascularized by lateral vascular bundles (Bailey and Swami 1951), and their ventral surfaces are face to face. In multicarpellary syncarpous ovary this is not reported earlier. This warrants further investigation in floral ontogeny of Ochnaceae. Regarding the nature of gynobasic style, this condition has arised due to growth and lobing of the gynoecium into nut lets in an early stages of development. The vascular supply and cause of vascular bundles shows clearly that in their nature they are similar to the vascular supply in normal styles. This type of vascular supply was earlier reported in members of family Boraginaceae (Lawrence 1937) and *Mertensia* (Moore 1941)..

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