

**A DEVIATING FEMALE FLOWER OF *CERCIDIPHYLLUM JAPONICUM*  
(*CERCIDIPHYLLACEAE*)**

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**SUMMARY**

In one 'flower' a growing point occurred between a bract and its seemingly inverted carpel.

This investigation was carried out in order to make sure whether or not the peculiar position of the carpels could be due to turning during development. Buds were collected from a large female tree in the Botanic Garden 'de Dreyen' at Wageningen June 1984. Thirty-five buds containing primordial reproductive structures were investigated with the scanning electron microscope (see figs. 1–4).

When mature the 'flowers' seem to consist of 2–6 slender carpels arranged in a whorl on top of a short shoot. Some ephemeral bracts can be detected at the base of the young carpel whorl. Curiously enough the carpels have their sutures facing away from the axis of the short shoot, and the follicles dehisce correspondingly to the outside.

In the past these carpel assemblages have been alternatively described as flowers or as inflorescences. Hutchinson (1964, 1973) for instance described the female flowers as having four reduced sepals—the bracts—and no petals. He added that the ventral sutures of the carpels by twisting become external. The inflorescence-view was expressed by Solereder (1899), on the basis of the fact that the carpels have their sutures to the outside, also in young stages. However, the decisive argument for the inflorescence-view was presented by Harms (1916) when he discovered that in the case six carpels are present, they are arranged in decussate pairs one above the other, each carpel in the axil of a bract. The bracts of the upper pair are inserted on a level above the lower carpels. A diagram given by Swamy and Bailey (1949) shows this as well. This arrangement is confirmed by the ontogeny (see fig. 3).

The decussate arrangement may be slightly irregular, presumably because the symmetry of the apex is not isobilateral. Also it seems that there is a tendency toward trimery in the case of three or six carpels. The same occurs m.m. on the vegetative apex.

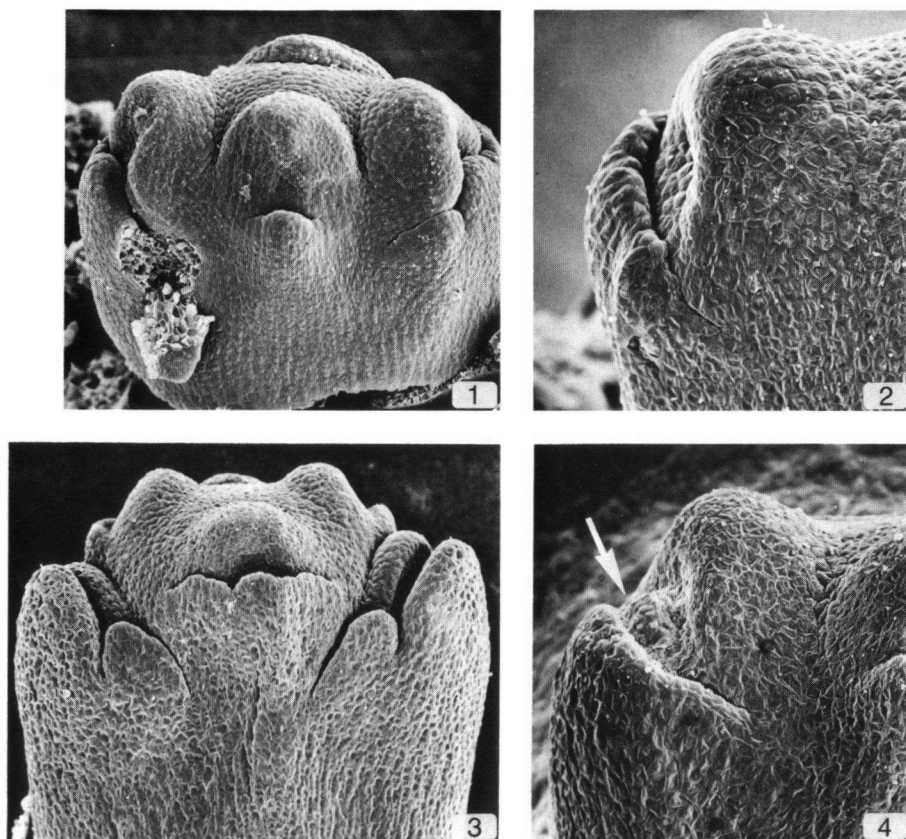


Fig. 1–4. *Cercidiphyllum japonicum*. Bars represent 0.1 mm. – 1. Two pairs of primordial carpels in the axil of bracts, the lateral bracts with stipules (one severed). 2. One primordial carpel in the axil of bract. 3. 'Inflorescence' having three pairs of carpels in the axil of bracts (the tip of the posterior carpel of the second pair shows in the background). 4. A growing point between bracts and carpel (arrow).

My photographs show clearly that the carpels develop with their sutures facing away from the axis right from the beginning. They do not develop with their sutures first facing the main axis as would be expected and then later turn or twist.

Solereder remarked that the solitary position of each carpel could be explained by the non-development of additional carpels. There is however no sign of this during ontogeny. Harms put forward the possibility of the loss of a median, second, carpel in front of the existing one during evolution, but he added that he could not find indications for that. Swamy & Bailey tried to draw arguments for the loss of a second carpel from the fossils described in *Cercidiphyllum* by R.W. Brown (1939, 1962). The results of Brown were questioned by Chandler (1961). However, Crane

(1979, 1984) investigating new material concluded that these fossils (*Nyssidium*) were more similar to *Cercidiphyllum* than to any other extant genus. They may represent a more primitive 'sister group'. The infructescences consist of branched racemes bearing fruits *singly or in pairs*. The dehiscence is by a single suture along the full length of the locule, but it is not clearly shown whether it is adaxial or abaxial.

On balance, no clear indication for a reduction of lateral groups of carpels has been found hitherto in the field of morphology, and the support from paleobotany is weak. In this respect my figure 4 may be of interest. It shows a case in which there is a growing point between a bract and a carpel. The suture of the carpel faces away from the axis as usual, but here at the same time it faces normally towards the lateral growing point. Of course one cannot guess what this growing point would have given rise to.

The systematic position of the genus is of interest here. It has been amply discussed by Endress (1969), in connection with that of *Euptelea*. Both genera form separate families that have many connections with Magnoliales families. They may be Magnoliales without perianth. According to Endress it cannot be proved that the absence of a perianth is secondary. One can only surmise this by analogy with the Hamamelidaceae, where species with reduced perianth do occur.

Stebbins (1974) suggested that the loss of perianth may in both cases be due to a shift from insect to wind pollination. The main argument to insert the families Cercidiphyllaceae and Eupteleaceae in the Magnoliales is given by the structure of the carpels (Hamamelidaceae have two partly fused carpels which are somewhat sunken in the receptacle).

It is interesting to compare the carpel position of *Cercidiphyllum* with that of *Drimys lanceolata*. As described by Tucker & Gifford (1966) the solitary carpels in the lateral female flowers of that species are oriented with their cleft facing away from the main axis. Vink (1970) added that if a second carpel is present, this is opposite to and abaxial from the first carpel. When compared with *Cercidiphyllum* this is exactly the place of the anomalous growing point shown in figure 4. Probably *Drimys lanceolata* is reduced as compared with the other species of its section which often possess several carpels per flower. In *Drimys piperita* flowers with one carpel occur especially in forms that grow at high altitudes. However, here the one remaining carpel may be oriented variously (Vink, 1970). A similar reverse orientation of the single carpel occurs in Lauraceae; whether this can be attributed to a reduction of trimery is under dispute.

The anomalous occurrence of a lateral growing point is an argument in favour of the view that the female structure of *Cercidiphyllum* is a reduced structure. The carpel faces normally toward this growing point with its ventral suture.

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