**Proceedings of the Iowa Academy of Science**

Volume 71 | Annual Issue Article 8

1965

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# Floral Vasculature as a Potential Taxonomic Character in *Dalea* (Leguminosae)[1]

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*Abstract.* Flowers from 15 species of the genus *Dalea* (Leguminosae) were cleared and stained. Complete isolation of the xylem of the gynoecium, androecium and corolla from the pedicel xylem was found except in two species. The most obvious feature was the "discontinuity plate" formed by the merger of the xylem of the gynoecial traces in a characteristic mass of tracheoidal cells near the base of the flower. Variation in the floral vascular pattern appears to have taxonomic implications.

The tribe Psoraleae of the Leguminosae has received a lucid circumscription by Isely (1). He recognized six North American genera: *Psoralea* (over 100 spp.), *Amorpha* (perhaps 20 spp.), *Parryella* (2 spp.), *Eysenhardtia* (10 spp.), *Dalea* (about 150 spp.) and *Petalostemon* (35 spp.). Barneby (2) has since delimited another genus, *Errazurizia* (4 spp.). The most definive characters of the tribe are the conspicuous glandular-dotted foliage, and the 1-seeded indehiscent pods.

Except for some species of *Psoralea,* the tribe is confined to North and South America, with its center of distribution presumably in the southwestern United States and northern Mexico. A limited number of chromosome counts have been made in four of the genera: in *Dalea* and *Petalostemon* x = 7, in *Amorpha* x = 10, in *Psoralea* x = 10 or 11. Counts made since Isely's synopsis are in agreement with the previous findings. Polyploidy has been found only in *Amorpha.*

Isely (1) postulated three distinct lines in the Psoraleae based on corolla differences and supported by chromosome numbers. Of the seven genera only *Psoralea* possesses, as a constant character, a papilionoid corolla with petals inserted below the stamens in a single whorl. *Psoralea,* by itself, constitutes one distinct line. *Eysenhardtia* has five petals that are attached basally, but they are all similar in appearance and scarcely papilionoid. *Amorpha* possesses only a standard, and *Parryella* is devoid of a corolla. *Errazurizia,* which seems allied to the three preceding genera, lacks constancy in petal number. One species possesses

[1] Journal Paper No. J-4869 of the Iowa Agricultural and Home Economics Experiment Station, Ames. Project No. 1073. The facilities of the Iowa State Herbarium, supported by the Industrial Science Research Institute, were used.

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five petals, while another has only one. In the latter species some flowers lack a corolla (2).

A third line is composed of *Dalea* and *Petalostemon*. Flowers of *Dalea* have a standard, wings, and keel. The standard invariably is inserted on the hypanthium, but the insertion of wings and keel varies among species. In some species all petals are inserted on the hypanthium. In other species the wings and keel are inserted laterally on the androecial tube; in these the insertion is at some intermediate point between the base and the apex of the tube. When the insertion is close to the apex, the number of stamens is sometimes reduced from the normal ten to eight or even to six in some individuals. *Petalostemon* differs from *Dalea* in having only five stamens and in the fact that the petals other than the standard are inserted at the apex of the androecial tube alternating with the stamen filaments.

Within the Papilionoideae there is probably no other tribe that exhibits as much variation in the corolla as does the Psoraleae. A comparative survey of certain aspects of floral morphology in the entire tribe has been initiated. This report is concerned with a preliminary survey of selected species of *Dalea*.

## Materials and Methods

Flowers of 15 species of *Dalea* were examined. Material was taken from herbarium specimens. In addition, fresh flowers in all stages of development were collected from living plants of three species. The species studied were not chosen at random but were selected to sample postulated subgeneric groups, e.g. Rydberg's (3) segregate genera: *Psorodendron*, *Psorothamnus*, *Parosela* and *Thornbera*. The specimens, all from ISC, are as follows:

*Dalea albiflora* Gray: Arizona, Chiricahua Mountains, M. P. Somes 1476.

*D. enneandra Nutt.*: Iowa, Plymouth County, R. F. Thorne 14675.

*D. filiformis* Gray: Arizona, Rincon Mountains, J. C. Blumer 3343.

*D. formosa* Torr.: New Mexico, Bernalillo County, A. L. Kammerer 17.

*D. fremontii* Torr.: (mature fruit) Calif., Inyo County, Alexander and Kellogg 5305.

: Calif., San Bernardino County, M. Beal 234.

*D. leporina* (Ait.) Kearney & Peebles: Minnesota, Yellow Medicine County, L. H. Pammel.

: Guatemala, Lake Retana, Goodman & Melhus 3703.

*D. mollis* Benth.: Calif., San Bernardino County, Isely & Bragonier 7244.

*D. nana* Torr.: Texas, Jones County, N. C. Henderson 62-869.

*D. polyadenia* Torr. ex Wats.: Calif., San Bernardino County, M. Beal 597.
*D. polygonoides* Gray: Arizona, Rincon Mountains, J. C. Blumer 3584.
*D. schottii* Torr.: Calif., Riverside County, Y. W. Winbald.
*D. scoparia* Gray: New Mexico, Valencia County, Hitchcock & Stanford 6765.

The most accurate and rapid way to follow the vascular bundles of a flower is by clearing and preferentially staining its vascular system. Best results were obtained by the following method (4).

Place dried flowers in 5% aqueous sodium hydroxide for several days or until colorless. Fresh flowers must first be killed in 95% alcohol or formalin-acetic acid-alcohol (FAA) and subsequently rinsed in distilled water before the sodium hydroxide treatment. The time in sodium hydroxide can be shortened by placing the specimens in a 37°C. oven in stacked Syracuse watch glasses, thus minimizing evaporation.

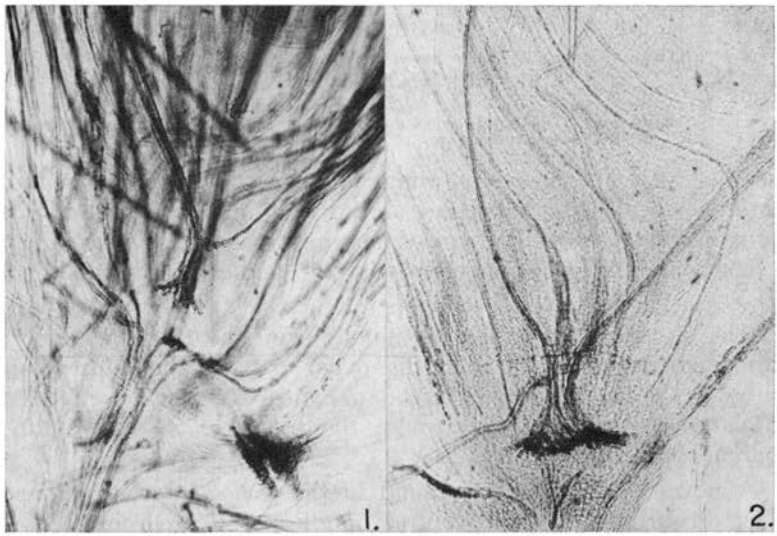
Remove the sodium hydroxide with three changes of distilled water and transfer to a chloral hydrate solution (250 mg./100 ml. water). Visual inspection will determine when the clearing action is completed. A few days are usually sufficient.

Remove all traces of chloral hydrate with three changes of distilled water. With fragile material it is advisable to first go through two or three progressively more dilute solutions of chloral hydrate. Dehydrate in steps of 10, 25, 50, 75, 95%, and two changes of absolute alcohol. Transfer to equal parts absolute alcohol : xylene. Fifteen minutes should be allowed for each step with more time allowed for thick specimens. Stain in 1% safranin in equal parts absolute alcohol : xylene. A staining duration of from five to 15 minutes is usually adequate. Destain to the desired intensity in absolute alcohol : xylene. Finally, transfer to xylene. Change twice to remove bits of precipitated safranin. If the color seems too intense, the specimen can be returned to the alcohol : xylene for further destaining. The mounting medium is Piccolyte. The cover glass should not be pressed down or weighted, because this may destroy the vascular continuity of the now brittle specimen. As the Piccolyte solvent evaporates, more Piccolyte can be added at the side of the cover glass and capillary action will fill the mounting area with the resin.

Whole mount clearings were supplemented by serial sections of flowers cut at 10 microns. Craf III was the preferred fixative and a standard safranin-fast green schedule was used (5).

## Observations

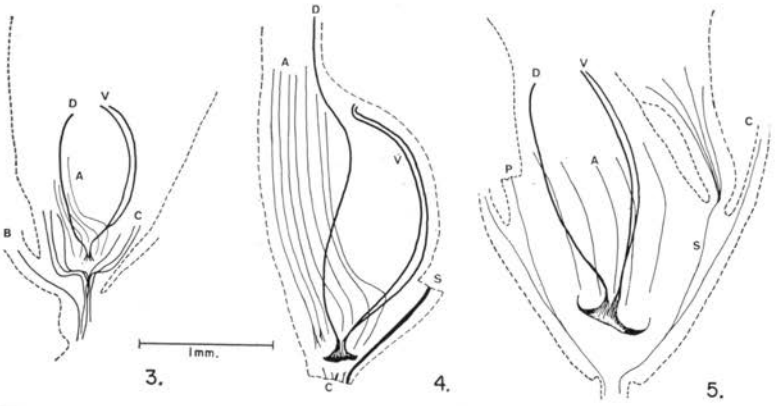
The survey of *Dalea* revealed that the xylem of the vascular bundles of the androecial tube and the gynoecium is not connected. A xylem discontinuity also exists between the androecial tube, the gynoecium and the pedicel. There is, however, continuity of phloem across the gaps. The most obvious feature is the "discontinuity plate" formed by the merger of the xylem of the gynoecial traces in a characteristic mass of tracheoidal cells. Figures 1 and 2 show these vascular peculiarities. These discontinuities are not artifacts. We have verified them in microtome sections, and they can be seen quite easily with a hand lens in fresh flowers cut in median longitudinal section with a razor blade.




Figures 1, 2. Enlargements of the pedicel and basal portion of cleared flowers.
Figure 1. *Dalea leporina*
Figure 2. *Dalea aurea*

Specific differences in floral morphology and vasculature are as follows. In *Dalea fremontii* the petals are inserted on the hypanthium free from the androecial tube (Fig. 5). The single trace of each petal is connected to the trace of the adjacent calyx lobe; therefore, the corolla vasculature is continuous into the pedicel. The same arrangement occurs in *D. schottii*, which also has the petals inserted on the hypanthium. Of the dozen flowers of these two species examined, in only one flower (*D. schottii*) was a stamen bundle found that had xylem that was continuous with the pedicel xylem, and this connection was a tenuous one.

In the rest of the species examined, representatives of the




Figures 3-5. Camera lucida drawings of the basal portions of flowers of species of *Dalea*.
Figure 3. *Dalea leporina*. The same flower as Figure 1.
Figure 4. *Dalea aurea*. The same flower as Figure 2.
Figure 5. *Dalea fremontii*
A, petal and stamen traces of the androecial tube; B, bract trace; C, calyx trace; D, dorsal carpel bundle; P, petal trace; S, standard trace; V, ventral carpel bundles.

sections of *Dalea* in which wings and keel are inserted on the androecial tube, the petal traces are discontinuous. The standard remains attached to the hypanthium and in some species retains a continuous xylem connection with the pedicel bundles (Figs. 4, 5).

The staminal traces are continuous from the free portion of the filaments down through the major part of the androecial tube. In the lowermost part of the tube, near the periphery of the discontinuity plate, the xylem of the traces ends abruptly in parenchyma tissue (Figs. 2-6).

A novel discontinuity is found in the gynoecial vasculature. The dorsal and the two ventral bundles of the carpel merge just below the base of the carpel and the xylem terminates as a discontinuity plate. Although varying in size among species, a recognizable plate was found in all species examined. Figures 3-5 show some of the kinds of discontinuity plates observed. In *Dalea fremontii* (Fig. 5) and *D. schottii*, a related species, this structure is relatively massive. *Dalea leporina*, on the other hand, has a relatively small, weakly developed plate (Figs. 1, 3). *Dalea aurea* possesses a plate of intermediate size. This latter type was most frequently observed among the species studied.

Evidence suggests that the discontinuity plate is constant within a species. For example, entire inflorescences consisting of many flowers were cleared, and no variation was found in the plate among the individual flowers. In *Dalea leporina*, flowers from a specimen collected in Minnesota and from a specimen collected in Guatemala, were cleared and compared. The weak

discontinuity plate characteristic of this species (Figs. 1, 3) was identical in flowers from these widely separated areas.

## Conclusions

The xylem discontinuities in the vasculature of the flowers described are clearly regular, recurrent features. A survey of the literature on floral vasculature is underway to determine if similar phenomena have been reported in other groups. The only previous reports we have seen relate to flowers of the Polygonaceae (6, 7). In this family floral vascular discontinuity seems to be the rule.

If such discontinuities are of rare occurrence among Angiosperms, their presence in a certain genus or tribe could be of considerable taxonomic value. Our studies are being extended to other genera of the Psoraleae.

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# Notes on Iowa Diatoms. VI. Frustular Aberrations in *Surirella Ovalis*[1]

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*Abstract.* Two types of frustular aberrations in cultures of *Surirella ovalis* Breb. have been observed. The first is a "notch deformity" occurring in approximately 0.1% of the population. It is produced by mechanical distortion where the cells are crowded. This deformity is passed to daughter cells in each successive vegetative division. The second type is characterized by the presence of one or more aberrant raphe canals crossing the valve face in various directions. It occurred only in cultures exposed to continuous light for two weeks. Little or no cell division occurred during this period. The raphe canal aberrations, which occurred in about 0.01% of the exposed population, may have resulted from abortive cell divisions. They were not observed to continue in later transfers of the exposed populations to normal growth conditions.

[1] This work was supported by Grant number WP-0221-03, from the Division of Water Supply and Pollution Control, Public Health Service

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