STUDIES IN THE FLORAL MORPHOLOGY OF THE MARANTACEAE


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ABSTRACT

The floral anatomy of two species of the genus *Phrynium* belonging to the tribe Phrynieae is described in detail. Varying degrees of reduction of the gynoecium leading to the functionally unilocular condition of the ovary are witnessed in *Ph. parviflorum*, a condition characteristic of species of the tribe Maranteae. The placentation is basal. The present study brings forth further evidence in regard to the nature of the labellum and the condition of the functional stamen.

INTRODUCTION

In the previous paper in this series (Tilak and Pai, 1966), the vascular anatomy of the flower of *Schumannianthus virgatus* Rolfe was described. The present paper presents the details of the floral anatomy of two species of the genus *Phrynium*.

MATERIAL AND METHODS

The fixed flowering material was kindly supplied by Professor Kai Larsen, Denmark. The usual paraffin method was followed. Serial trans-sections of the paraffin infiltrated material (10–14 μ in thickness) and longi-sections were stained in crystal violet using erythrosin as counter stain.

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OBSERVATIONS

*Phrynium capitatum* Willd.—Within the short aerenchymatous floral axis are present two rings of vascular bundles, an outer with six and an inner with three strands (Fig. 1). Upwards, the bundles of the inner ring extend laterally to develop a siphonostelic structure. From this are successively derived the principal strands of the different floral whorls. In each of the postero-lateral and the anterior positions, the MS and the DOS traces are derived, the latter lodged radially within the former (Figs. 2–3). In the alternating posterior and antero-lateral positions, the PIS traces emerge out (Fig. 3). The remaining vascular tissue of this ring gets organized into six carpellary ventrals and three ovular traces (Fig. 3). A postero-lateral ovular trace is the most prominent while the other two are comparatively smaller. The bundles of the outer ring shift outwards and then extend upwards into the ovary wall exhibiting a few divisions in their upward course (Figs. 2–3). These are referred to here as the laterals. The MS and the DOS traces extend opposite the loculi while the PIS traces, opposite the septa of the ovary (Fig. 4).

At the level where the carpellary ventrals are organized, the septal nectaries appear and these are flanked by the ventrals (Fig. 3). The ovarian loculi appear a little above this level. The ovary is trilocular, with each loculus unio luate. The ovules are on a basal placenta. The ovular traces extend into the ovules. It is interesting to note that in some flowers sectioned, of the three loculi, the anterior one is distinctly smaller (Fig. 5). So is the ovule. The carpellary ventrals end towards the tip of the ovary. The ovarian loculi are continued upwards in the form of three small cavities (Fig. 6) that merge above the level of the plexus into a single stylar canal (Fig. 7).

Towards the tip of the ovary, some of the bundles of the ovary wall either exhibit fusions amongst themselves or end to reduce the number to 15 bundles—three MS, three DOS, three PIS and six lateral strands. Excepting the MS traces, the other bundles develop lateral extensions, the adjacent ones of which merge to form a vascular plexus for a short length (Fig. 6). At this level, the carpellary dorsals separate out (Fig. 6). These shift inwards and flank the stylar canal (Fig. 7). The lateral bundles of the ovary wall bear outer branches that extend into the sepals as their marginal traces (Fig. 6).

The three sepals are detached immediately above the level of the plexus. Each of them receives a median and two lateral traces, the latter exhibiting
a division into two (Fig. 7). Thus each sepal contains five bundles. The floral tube now contains the three PIS, the three OS, and a few other traces that are the upward continuations of the lateral strands of the ovary wall above the plexus level. These are roughly arranged in a ring surrounding the three stylar strands (Fig. 7). The number of bundles within the floral...
tube increases on account of division of some of these strands (Figs. 8–9). The PIS traces split into the outer median bundles of the petals and the inner, inner staminal strands (Fig. 9). In some flowers, the postero-lateral OS traces may exhibit sporadic divisions for a short length to effect a merger again. In some other flowers, the division is not marked. A few traces in the floral tube along with the median bundles of the petals shift to an outer position. These extend upwards into the petals. The petals are detached at a comparatively higher level. Each of the petals receives five to seven traces.

The floral tube now represents only the androecial members to which the style is laterally adnate (Fig. 10). The postero-lateral staminodes are the first to be detached. Each of them receives the solitary OS trace which exhibits a division into three to four strands at the level of their insertion. Within them, these divide further to increase the number to six to nine strands (Fig. 11). The anterior OS trace is steadily attenuated in its upward course (Figs. 9–10) and ends at about the level of insertion of the members of the inner staminal whorl with or without a division. The three members of the inner androecial whorl and the style separate out together.

Within the filament are present two traces—the prominent IS1 trace in its thick margin and a tiny bundle in its narrow flat petaloid part. The anther is marginally attached to the filament. This flat narrow part extends almost to the tip of the anther (Fig. 13). The bundle within it ends a little beneath its tip. The IS1 trace extends right up to the tip of the anther. The anther is one-celled.

The cucullatum receives the median IS2 trace and 9–10 other strands. It has a thick base with a prominent median pubescent ridge (Fig. 11, pubescence not shown) which narrows steadily upwards. The bundles within it extend right up to its tip with minor sporadic divisions and fusions.

Within the labellum are present a smaller median and two prominent laterals (Fig. 11). The median is lodged slightly on one side of the labellum and not exactly in its middle (Fig. 11). One of the laterals extends obliquely along the margin of the labellum and then ends in the upper attenuated part while the second along with the median extends upwards with a few divisions. The attenuated part also separates out in the form of a lobe (Fig. 14).

The style contains the three carpellary dorsals flanking the stylar canal (Figs. 7–11). One of the postero-lateral stylar traces is the most prominent. The style is bent at its tip and the stigma is laterally cleft. The two smaller traces end first in the cleft base of the stigma (Fig. 12). The prominent strand
then branches out in the stigmatic base (Fig. 12) and ends. The stylar canal freely opens to the outside.

Figs. 15-18. *Ph. parviflorum*, transections through pedicel and ovary.
Phrynium parviflorum Roxb.—In this species, the flowers of a pair are fused for some length, at least up to the base of the carpels (Fig. 15). The gynoecium shows varying degrees of reduction. According to taxonomic descriptions, the ovary is expected to be trilocular in this species. But, in none of the twenty-six flowers sectioned was this condition witnessed. In some flowers, a bilocular condition of the ovary with the anterior loculus aborted is observed (Fig. 18). Such flowers develop three ovular traces of which the anterior one ends at the base of the ovary (Fig. 17). In some others, a bilocular condition with an abortive ovule is witnessed (Fig. 20). These flowers develop either three (Fig. 19) or two ovular traces. In the former case, the anterior trace ends at the base of the loculi while the trace to the abortive ovule ends within it (Fig. 20). In most others, only a unilocular condition with only one postero-lateral loculus is observed (Figs. 16, 22). These flowers develop two (Fig. 21) or one postero-lateral ovular traces of which one ends at the base of the ovary. The three ovular traces also show a difference in size. The placentation is basal (Fig. 29).

There is the usual development of the plexus above the ovary (Fig. 23). Each of the sepals initially receives three traces (Fig. 24) of which the laterals divide into two to increase the number to five. Each of the petals receives 5–7 traces (Fig. 25). The vascular supply to the androecium and the style (Figs. 25–26) shows little variation from that of the previous species. The anther is one-celled (Fig. 27). The flat petaloid filament extends beyond the tip of the anther as a short crest (Fig. 28).

**DISCUSSION**

The plan of vascular supply to the flower in the present two species of the genus Phrynium is very much similar to that observed in Schumannianthus virgatus (Tilak and Pai, *op. cit.*). From the inner ring of bundles of the pedicel are derived the median traces of the sepals, the petals and the members of the androecium and the carpels. The bundles of the outer ring extend into the sepals and the petals and further upwards into the members of the inner androecial whorl. Although two of the three carpels are aborted in Ph. parviflorum, still the carpellary dorsal and the ventral bundles are developed. Only the ovular traces are reduced in varying degrees. The carpellary dorsals invariably extend into the style.

The carpellary dorsals and the outer staminal strands are fused right up to the top of the ovary. The median bundles of the petals and the inner staminal strands are united up to about the middle of the length of the floral
Figs. 19-23. *Ph. parviflorum*, transections through ovary.
Figs. 24–29. Figs. 24–28. Ph. parviflorum, transections of the flower above the ovary. Fig. 29. L.s. of the ovary of Ph. parviflorum showing basal placentation.
tube. Only the median bundles of the sepals are not involved in fusion. These may be attributed to the varying degrees of adnation of the floral whorls.

The Marantaceae are taxonomically further delimited on the basis of the number of loculi into the following two tribes: Tribe Phrynieae—Ovary trilocular with a single ovule per loculus. Tribe Maranteae—Ovary functionally unilocular with a single ovule.

The present genus belongs to the tribe Phrynieae. All the same, trends in reduction of two of the three carpels are witnessed in this tribe itself. The anterior and a postero-lateral stylar traces are distinctly attenuated and end first at the base of the stigma. The second postero-lateral one is the most prominent and ends later. Furthermore, the carpel with the prominent stylar trace also develops the larger ovular trace. The other two ovular traces are comparatively smaller. It is interesting to note that the prominent stylar and ovular traces of the carpel in species of the tribe Phrynieae belong to the carpel which in position is comparable to the functional carpel in the studied species of the tribe Maranteae (Tilak and Pai, unpublished data). This may be taken to indicate the trends in reduction of two of the three carpels of the marantaceous flower.

The observations on the present specimens of *Ph. parviflorum* bear out this contention. None of the twenty-six flowers sectioned showed the normal trilocular, triovulate condition. The anterior loculus is always aborted. A series of progressive stages in reduction to the functionally unilocular condition with the development of a solitary ovular trace may be observed. Evidently, this is the highest stage in reduction of the gynoecium in the Scitamineae. ‘Phylogenists agree that the Marantaceae are the most highly evolved alliance of the order’ (Lawrence, 1951).

In *Schumannianthus* (Tilak and Pai, 1966), the ovule, although very near to the base of the loculus, is thought to be on an axile placenta. In the present species, it is clearly basal (Fig. 29). In members of the tribe Maranteae (Thompson, 1933; Tilak and Pai, unpublished data), it is clearly basal. In certain of the tribe Phrynieae (Tilak and Pai, unpublished data) it is clearly axile. The basal type of placentation in this family appears to be derived from the axile type.

*Androecium.*—In both the present species, five members of the androecium are represented in the flower. Of these, two are the postero-lateral staminodes of the outer whorl and a functional stamen, the labellum and
the cucullatum belonging to the inner whorl. The functional stamen in both the species contains the median marginally located IS 1 trace and a tiny bundle in its flat petaloid part. In *Schumannianthus* (Tilak and Pai, op. cit.), the stamen contains four bundles in the flat petaloid part in addition to the IS 1 trace. The flat petaloid part separates from the anther and ends at about the middle of its length. The four traces within it end much earlier. In the present plants, however, the flat petaloid part does not detach and it may extend above the tip of the anther as a short crest. The solitary trace within it, however, ends earlier, while the IS 1 trace extends into the crest. These observations may be taken to indicate varying degrees of development and reduction in vascular supply of the functional stamen.

The labellum receives a median and two laterals one of which extends obliquely into its narrow margin and ends. Even this narrow margin may separate out in the form of a small lobe. Also, the median bundle may not be median in position. As observed in *Schumannianthus*, it seems very likely that the labellum is the second member of the androecium, and incidentally belonging to the inner androecial whorl, to suffer reduction in part.

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**REFERENCES**


**ABBREVIATIONS USED**

D, carpellary dorsal; DOS, carpellary dorsal-cum-outer staminal strand; IS, inner staminal strand; L, labellum; MS, median bundle of a sepal; N, nectary; OS, outer staminal strand; OT, ovular trace; P, median bundle of a petal; PIS, median bundle of a petal-cum-inner staminal strand; STD, staminode; STY, style; V, carpellary ventral.