STUDIES IN FLORAL ANATOMY OF THE LYTHRACEAE I. PLACENTAL VASCULARISATION IN PEPLIS L.

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1. INTRODUCTION

Differences in the vascular skeleton of the flower within a genus have been described more than once. The known examples show as a rule a variety of degree in reduction or fusion of vascular traces (EAMES 1931). Sometimes floral anatomy can help to distinguish the species in a genus, as in *Boerhavia*, where the absence of a bundle in the perianth segments in one of the two common species is specific (PURI 1952).

When studying the development of the ovaria in some *Lythraceae* I came across the apparently fundamental difference in placental vascularisation described here.

2. TAXONOMY

In the title of this short article the conventional genus name *Peplis* L. is used, to make clear which small group of *Lythraceae* is being discussed. It may be, however, that we cannot consider the name *Peplis* as a good genus name any longer. Since the delimitation between *Peplis* and *Lythrum* is at least very vague, if it exists at all, it is perhaps better to adopt the taxonomical suggestions of WEBB (1967), who merged almost the whole genus *Peplis* L. with *Lythrum* L.

Thus *Peplis portula* L. becomes *Lythrum portula* (L.) D.A. WEBB and *Peplis nummulariifolia* Jordan (syn. *Lythrum nummulariifolium* Loisel., non Persoon) becomes *Lythrum borysthenicum* (Schrank) Litw.. Only the species *Peplis diandra* DC. should be treated separately as forming the monotypic genus *Didiplis* Raf.. Having now sufficiently circumscribed this small group of the genus *Lythrum*, from now on I will use Webb's suggestion.

3. MATERIAL

The inflorescences of *Didiplis diandra* were collected from submerged plants grown from cuttings acquired from the tropical aquarium plant trade.

Inflorescences of *Lythrum portula* and *Lythrum borysthenicum* were obtained from Hortus "De Wolf", Haren, Holland.

4. METHODS

The material was fixed in F.P.A. (Formalin-propionic acid-alcohol), dehydrated in tertiary butyl alcohol, and embedded in paraplast. Serial longitudinal and transverse sections were stained with safranine, auramine and astra blue, after MAÁCZ & VÁGÁS (1963).

Flowers and fruits were bleached in successively 10% sodium hydroxide (1 day) and sodium chlorite (3 days).

The bleached organs were stained with basic fuchsin after DEBENHAM (1939).

5. STRUCTURE OF THE FLOWER

The flower has a cup-like calyx tube with 4 (*Didiplis*) or 6 (*Lythrum*) sepals. Petals, if present, are inserted on the margin of the calyx tube alternating with the sepals.

The number of stamens is 2–6. The two-celled ovary has so-called axile placentation. The ovules are inserted on a fleshy trunk, which I will call the column.

The septa between the cells in these species mostly reach the top of the ovary; this is not always the case in the *Lythraceae*. The number of ovules is here quite specific.

The features of the examined species are:

Didiplis diandra:	cleistogamous flowers (aqueous form) with 4 sepals, no petals, 2–3 stamens and 2 carpels.
Lythrum portula:	flowers with 6 sepals, no petals, 6 stamens, and 2 carpels.
Lythrum borysthenicum:	flowers with 6 sepals, 6 petals, 6 stamens, and 2 carpels.

6. DEVELOPMENT OF THE FLOWER

The development of the ovary in particular is discussed in detail in a paper which is now in the press. Here only the main features will be mentioned.

The sepals, the stamens, and the ovary develop successively. The sepals grow out to form a calyx tube. The ovary wall primordium is ring-shaped. Separate initiation of the two carpel primordia cannot be seen.

After the initiation of the ovary wall the apex grows on to form the column which bears the ovule primordia.

The corpus and tunica layers of the apex show their usual alterations. This concurs with the observations of, among others, TEPFER (1953) in *Aquilegia* and *Ranunculus* and TUCKER (1958) in *Drimys*.

Meanwhile the ovary wall is growing upward by the activity of a ring-shaped meristem. This growth keeps pace with that of the apical meristem, which differentiates into the column. The septal primordia arise on the inner side of the ovary wall by subdermal cell divisions. At this time the space between ovary wall and column is still very narrow.

The dermal septal cells are soon pressed against the column. On top of the column they curve over a little.

In all probability a postgenital connection arises between septal margin and column.

The ovule primordia arise basipetally by cell divisions in the subepidermal layers of the column.

The vascular supply of the ovules occurs exclusively in the column. No bundles traverse the septa. In the three species examined a central bundle, coming from the receptacle, splits up into two. The two branches will be called placental strands; each supplies the ovules of one placenta with ovular traces, or, in other words, the ovules in one cell. The further ramification of these two placental strands shows specific differences.

6.1. Lythrum portula

The column is quite protracted. In each loculus 8–13 ovules are inserted on it. The ovules are inserted in three rows, the ovules of the middle row alternating with the others.

Each placental strand remains distinct throughout the column (*fig. 1*). The strand is nowhere compound. Its structure is amphicribal. The ovular supplies are represented by units of three ovular traces. Two of these traces are connected with ovules of the outer rows inserted at the same level. The third trace is connected with an ovule of the middle row, which is inserted more basally than the two fellow ovules.

The three lowermost ovular traces are most noticeably joined at their bases.

The most apical ovule of each placenta is supplied by an ovular trace in the extension of the main placental strand.

The units of three form the characteristic pattern, with variations occurring at the apical end of the column where a few traces arise in pairs or singly.

6.2. Didiplis diandra

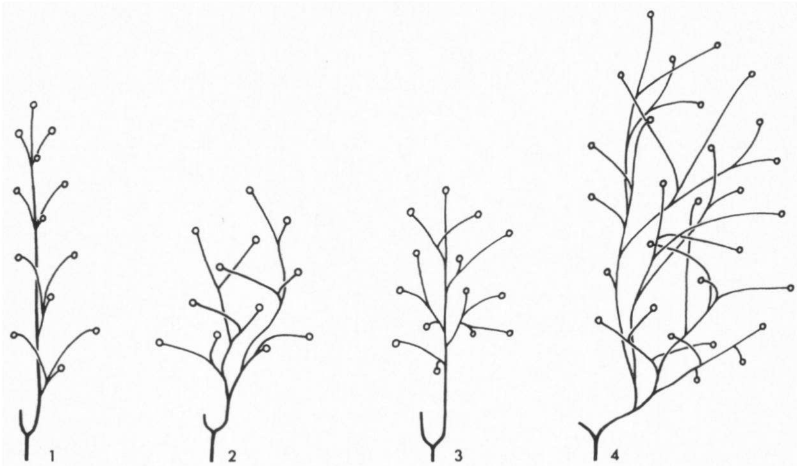
The column is much shorter than in *L. portula*, sometimes almost spherical.

Each loculus contains 9–15 ovules often inserted in two or more apparently zigzag rows interlocking with each other.

Each placental strand is already forked in the base of the column (*figs. 2* and *3*). Ovular traces unite in pairs. The united trace joins another united trace and so on. There are also a few single ovular traces which unite directly with a thicker bundle without first joining another ovular trace. This condition rarely occurs more than once or twice in any one placental vascularisation.

In a few cases it appears that the most basal forking of the placental strand results in a longitudinal division of the entire placenta into two groups of ovules (*fig. 2*). This has led to the suggestion that the placentation was originally in two rows of ovules. In other cases, however, this apparent regularity is out of the question.

Though sometimes the ovules are apparently inserted in two rows, intact ovular traces of one basal branch supply ovules of both rows. Sometimes one



Figs. 1–4 Schematic drawings of the placental vascularisation in three species. One of the two placentae of each ovule has been omitted.
1. *Lythrum portula*
2. *Didiplis diandra*
3. *Didiplis diandra*
4. *Lythrum borysthenicum.*

pair of ovules inserted at the same level is supplied by one of two basal branches, while the pair below is supplied by the other.

Occasionally trilocular ovaries occur. In these the central bundle splits into three placental strands. This indicates a correlation between the number of placental strands and the number of carpels.

6.3. Lythrum borysthenicum

The column resembles that of *Lythrum portula*, but it is much larger. Most loculi contain 27–30 ovules. The ovules cover up to five rows in the middle of the column. Here the main pattern of vascularisation can be considered the same as in *Didiplis diandra.* The placental strand has already split in the base of the column into two or more branches. However, the great number of ovules implies a very intricate branching system. The fusion of pairs of ovular traces is not so prominent as in *Didiplis diandra* (*fig. 4*).

Sometimes the placenta appears to be longitudinally divided into two halves, but this division may often be into two very unequal parts.

7. DISCUSSION

On the basis of the differences in placental vascularisation in the three species examined, especially in the branching of the placental strand, a distinction can be made between *Lythrum portula* on one side and *Lythrum borysthenicum* and

Didiplis diandra on the other. This distinction on the basis of vascularisation of the placenta is not, however, in accordance with the taxonomical divisions made by KOEHNE and others. Neither the old delineation between *Lythrum* and *Peplis* (KOEHNE 1903) nor the new delineation between *Lythrum* and *Didiplis* (WEBB, op. cit.) is confirmed by this new evidence.

The bifurcation-type of ramification of the placental vascularisation such as occurring in *Lythrum borysthenicum* and *Didiplis diandra* seems to be quite common in the *Lythraceae. Lythrum salicaria* L. and many species of *Ammannia* L. and *Cuphea* Adans. apparently possess similarly very intricate systems. When considering the placental vascularisation of the three species there is, first of all, most obviously a correspondence between *Didiplis* and *L. borysthenicum.* The placentation of *Didiplis* could typologically be considered to be derived from that of *L. borysthenicum* by reduction. But the placental vascularisation of *L. portula* also shows, less conspicuously, some correspondence to that of *L. borysthenicum.* Branching into three ovular traces, characteristic of the placenta of *L. portula,* is seen quite often in *L. borysthenicum.* So the placenta of *L. portula* can also typologically be considered as a reduced type of that of *L. borysthenicum.*

Comparing the number of flower-organs in the three species, we can conclude that in this respect *L. borysthenicum* is the least and *Didiplis diandra* is by far the most reduced of the three. As regards the placental vascularisation, however, *Lythrum portula* is certainly as reduced as *Didiplis,* perhaps even more so, for only one main strand is present, and the units of three ovules can be interpreted as being composed of a pair of ovules plus an ovule shifted to the base of the bifurcation formed by two ovular traces.

The column of *L. portula* is narrower than that of both of the others. The diameter of that of *Didiplis* is on the average a little more than 0.6 mm. The diameter of that of *Lythrum portula* is mostly only 0.2 mm.

A correlation can be suggested between the width of the column which is about the same as the width of the placenta, the number of rows of ovules, and the number of main branches of the vascularisation.

It seems better, for the time being, to leave the question as to what are the factors determining the initiation and course of placental vascularisation, although it could be suggested that the pathway of the ovular traces and higher units are influenced chiefly by environmental factors. After the ovule primordium is initiated, an ovular trace could arise in a direction from the ovule primordium toward:

1. The inner part of the column or, more precisely, away from the periphery.
2. The base of the column.
3. Other ovular traces or bundles, which are running in the direct neighbourhood and with which fusion takes place.

Although many features of the placental vascularisation can be interpreted on the basis of this scheme, it is too simple to explain all the variations. In some cases, for example, the ovular traces in even one single placenta diverge in different directions from the ovule to the base of the column. Clearly one must consider the genetic constitution of the plant as well as the response to external factors as determining the specific features of the placental vascularisation.

I am, however, of the opinion that this study confirms the value of placental vascularisation as an aid in distinguishing the species in this group of plants. The number of species examined, however, is still too small for drawing further conclusions.

Placental vascularisation in other species of *Lythrum* and in *Ammannia* is being investigated.

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