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DEVELOPMENT OF GYNOECIUM IN *TRIGLOCHIN* IN THREE DIMENSIONS[1,2]

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ABSTRACT

The gynoecium consists of three to eight pistils which appear to be inserted at about the same level. The pistil primordia, however, arise successively in a spiral fashion. The gynoecium of *Triglochin* provides an example of both increase and reduction in the number of floral parts. The species of *Triglochin* with three pistils seems to have been derived from *T. maritima* L. by reduction in number of pistils. The solitary ovule is initiated from the adaxial portion of the pistil primordium. The apparently basal position of the ovule, thus, is a derived one.

INTRODUCTION

WHEN development of floral bud is studied by traditional serial sectioning method, reconstruction of three-dimensional picture involves some element of speculation. The development of gynoecium of *Triglochin maritima* L. (Juncaginaceae) is studied here by observing directly three-dimensional development stages in order to find out the developmental sequence and positional relationship of the pistil primordia.

MATERIAL AND METHODS

Inflorescences of *Triglochin maritima* L. in various stages of development were collected from natural populations growing in brackish water near Chip Lake, Alberta, Canada, by the author in June 1971. They were fixed and preserved in formalin-acetic acid-alcohol. To obtain pictures of three-dimensional developmental stages, immature inflorescences were stained in 1% solution of acid fuchsin in 95% ethyl alcohol. They were differentiated in 70% to 95% ethyl alcohol and then dissected and photographed completely immersed in 100% ethyl alcohol. The photographs were taken on a Leitz Stereoscopic Binocular with epicondenser and dipping cones (Sattler, 1967).

OBSERVATIONS

The flowers are small, greenish and perfect, and crowded in spiciform racemes. The perianth is of six segments in two whorls, the members of the inner whorl are inserted distinctly above the outer. The stamens are attached at the base of the perianth segments. The anthers are broad, 2-celled and almost sessile. Though in the published literature the number of pistils in this species is reported as usually six (Muenscher, 1944; Jepson, 1951; Gleason, 1952; Rydberg, 1969), in the present material the number varies from three to eight. The floral buds in the lower part of the inflorescence have eight pistils and the number gradually decreases upwards so that the uppermost floral bunds have only three pistils. The pistils are closely approximate to each other and also attached along their inner margin to an erect elongate axis. The ovary of each pistil is unilocular with a solitary, erect, anatropous ovule. The stigma is sessile and plumose. The follicles are one seeded, eventually separating from each other and the axis.

After the initiation of tepal and stamen primordia the floral apex somewhat flattens. The pistil primordia arise successively on this flattening floral apex in a spiral fashion (Fig. 1). The plastochron between the initiation of two pistil primordia is short. The direction of sequence of primordia is always clockwise. After the formation of last pistil primordium a small residual floral apex is left in the centre. At first each pistil primordium is a hump of meristematic cells. Then, an area in its centre gradually stops growing (Fig. 1, primordium 1) whereas the rim continues to grow. Thus, a cup-like structure is produced. At a slightly later stage, a cross-zone is formed on the adaxial side of the rim. The solitary ovule initiates from the adaxial portion of the pistil primordium (cross-zone) (Fig. 2, cf. *Alisma*, Singh and Sattler, 1972). The rim of the cup grows upward, thus, surrounding the ovule (Figs. 3–5). The abaxial (dorsal) portion of the cup grows more quickly than the adaxial (ventral) portion. This results in a pitcher-shaped structure still open at the top. These openings come to lie nearer the centre of the flower due to rapid elongation of abaxial portion of the pistil wall (Fig. 6). The pistil becomes narrower apically and in the later stages of deve-

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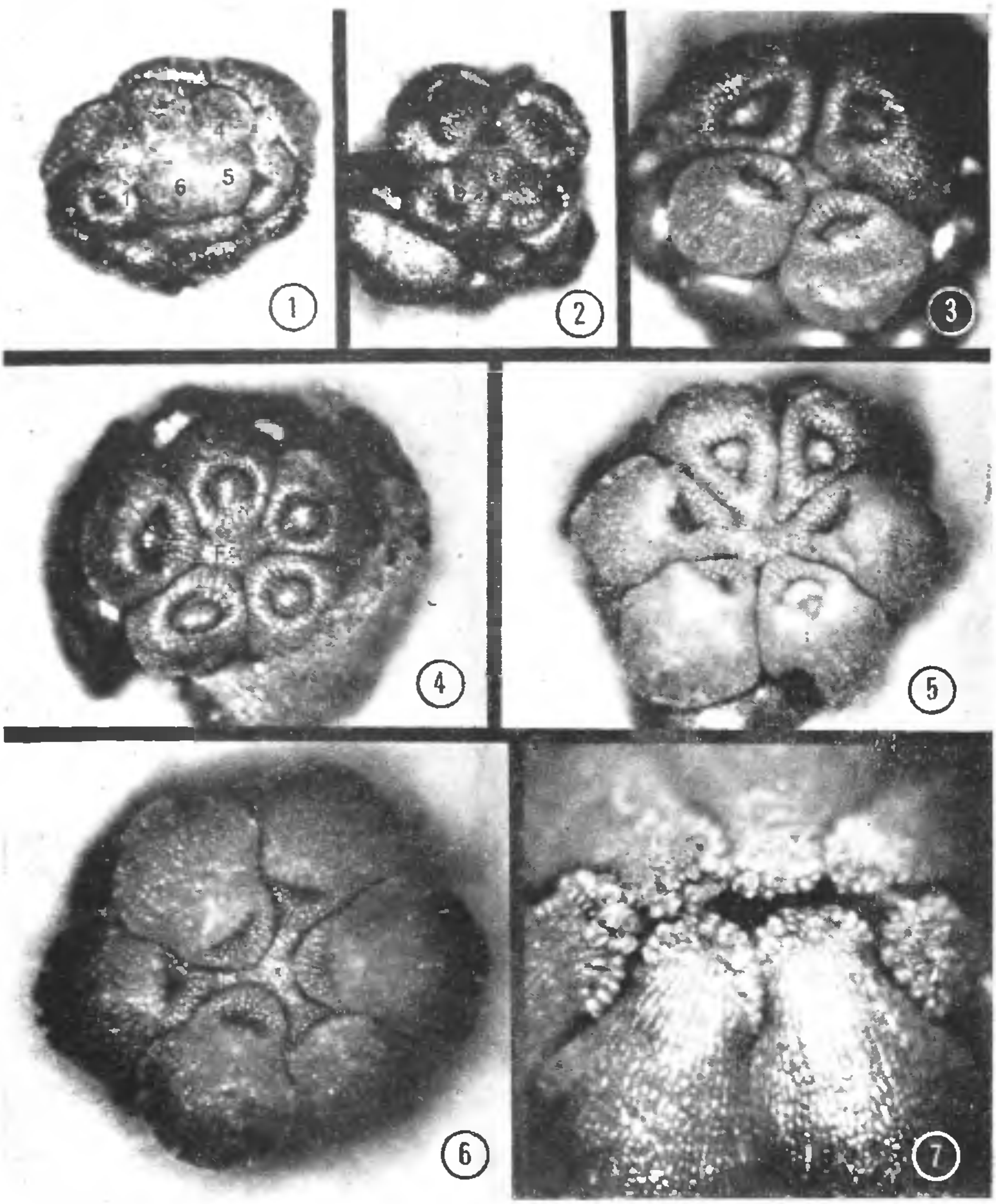
lopment a papillate stigmatic surface is differentiated which results in the closing of the mouth of the pistil (Fig. 7).

The inner integument of the ovule arises first and forms the micropyle. As the integuments develop, the body of the ovule becomes completely



FIGS. 1–7. *Triglochin maritima*, × 146. Fig. 1. Top view of a floral bud (some outer appendages removed) showing six pistil primordia. Nos. 1–6 indicate sequence of initiation of pistil primordia. Fig. 2. Gynoecium of a floral bud with four pistils after the inception of ovules (O). Figs. 3–5. Gynoecia with four, five and six pistils respectively at later stages of development. Fig. 6. Gynoecium with six pistils. Note that apertures at the top of pistils are placed nearer the centre of the flower due to rapid elongation of abaxial portion of pistil wall. Fig. 7. Gynoecium with seven pistils after differentiation of papillate stigmatic surface.

F = residual floral apex.

inverted so that micropyle and hilum come to lie close to each other.

Floral buds with three, four, five, six, seven and eight pistils were equally common in our material. In slightly later stages of development, in all these cases, the pistil primordia appear to be inserted at about the same level with equal spacing between them (Figs. 2–5). During anthesis, due to some upgrowth in a ring zone below pistils and elongation of residual floral apex, the pistils connate with each other and along their inner margin to erect elongate axis.

Discussion

Several earlier workers consider that the pistils in *Triglochin* are arranged in two whorls (Cordemoy, 1862; Hill, 1900). However, very early stages of pistil development are decisive and clearly show that the primordia of pistils arise successively in a spiral fashion, though the plastochron between the two primordia is short.

The basic pistil number for *T. maritima* is six, however, in the present material the number varies from three to eight. Thus, there is both an increase and reduction in the number of pistils. Recently several examples of a probable increase in number of floral parts have been discussed (*see* Stebbins, 1967; Carlquist, 1969; Singh and Sattler, 1972). Another example, with respect to an increase in number of pistils, is provided by the gynoecium of *Triglochin maritima.* On the other hand, reduction has also played a part in the evolution of flower in *Triglochin.* The species of *Triglochin* with three pistils seems to have been derived from *T. maritima* by reduction in the number of pistils.

The solitary ovule in *Triglochin* has been described as basal (Hill, 1900; Gleason, 1952; etc.). The present developmental studies show that the ovule initiates from the adaxial portion of the pistil primordium. Thus, the apparently basal position of the ovule has been brought about by shifting of it into the base from lateral position during later stages of development. Eames and McDaniels (1947) and Eames (1961), on the basis of anatomical evidences, have also concluded that no angiosperm ovule is cauline and the apparently basal position is always a derived one. Eber (1934) also reached to a similar conclusion on the basis of her detailed study of the *placentation* in some Helobiae.

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