Proc. Indian natn. Sci. Acad. B 45 No. 4 pp 518-523 (1980)

Floral Organogenesis of *Martynia diandra* (Martyniaceae)

D K JAIN[1], P C PANDE[1] and V SINGH[2]
[1]*School of Plant Morphology, Meerut College, Meerut 250 001*
[2]*Department of Botany, Meerut University, Meerut 250 001*

(Received 30 January 1980)

The flower reflects some zygomorphy in its development as the formation of sepal, petal and stamen primordia proceeds from anterior to posterior side. Although the petal primordia arise as discrete units, soon a corolla tube is initiated by extension of growth between them. Further upgrowth takes place by intercalary growth in the common bases of petal and stamen primordia. The reduction in androecium has progressed from posterior to anterior side. The gynoecium is initiated in the form of a somewhat tetragonal rim. Two placental ridges arise from the lateral wall of the ovary, they grow inward and become closely appressed giving a bilocular appearance to the ovary.

Key Words: ***Martynia diandra*, Floral organogenesis, Intercalary growth**

Introduction

The genus *Martynia* has been included in the family Pedaliaceae along with *Sesamum* and *Pedalium* by Bentham and Hooker (1862–1883). Engler and Prantl (1895), however, retained only latter two genera in the Pedaliaceae and removed *Martynia* to a family of its own, the Martyniaceae. This treatment is followed by most of the recent taxonomists including Takhtajan (1969). However, Cronquist (1968) retains *Martynia* in Pedaliaceae. Since no information is available on the development of flower in *Martynia*, the present study was initiated to fill up this gap.

Materials and Methods

The inflorescences of *Martynia diandra* Glox (*M. annua* L.) in various stages of development were collected from natural populations growing in Meerut in September 1978. They were fixed in FAA and later preserved in 70% alcohol. Immature inflorescences were stained in 1% solution of acid fuchsin in 95% alcohol, differentiated in 70% to 95% alcohol and then dissected and photographed completely immersed in absolute alcohol, following the technique of Sattler (1968).

Observations

Organography: The rose-coloured, zygomorphic, pentamerous and hypogynous flowers are borne in terminal racemes. The calyx is of five distinct sepals. The corolla is gamopetalous, ventricose, oblique, somewhat bilabiate and five-lobed. There are two fertile stamens (anterio-lateral pair) and two staminodes (posterio-lateral pair). Sometimes a third staminode in the posterior position is also present. The anthers are dithecous, divergent and dehiscing by longitudinal slits. The gynoecium is bicarpellary and syncarpous with a superior and unilocular ovary showing parietal placentation. The two placentae cohere to form a false septum. There are two rows of anatropous ovules on each placenta. The style is slender and the stigma has two flat sensitive lobes.

Organogenesis: The first primordia which are formed on the dome-shaped floral apex are those of the sepals. They have a sequential inception. First, the primordia of anterio-lateral pair of sepals are initiated at the same time. They are followed by the posterior sepal primordium and finally two posterio-lateral sepal primordia appear simultaneously (figure 1). The sepal primordia grows fast and enclose the floral bud even before the inception of gynoecial primordia.

Soon after sepal inception, the five petal primordia are initiated in a rapid succession in alternation and inner to the sepal primordia (figure 2). The anterior petal primordium is first to arise, followed by two posterio-lateral primordia, and finally two anterio-lateral primordia are formed. The stamen primordia are formed immediately after the petal primordia (figures 2, 3). The formation of stamen primordia also proceeds from anterior to posterior side of the floral apex. The anterio-lateral pair of stamen primordia is closely followed by the posterio-lateral pair. The posterior stamen primordium is formed slightly later or it does not form at all in some floral buds. A difference in the size of the stamen primordia becomes evident in the early stages of stamen development (figures 4–6). The two anterio-lateral primordia which are the largest, develop into fertile stamen with dithecous anthers (figures 9–11, 14). The posterio-lateral pair of primordia which are smaller, develop into staminodes with rudimentary anthers. The fifth posterior primordium, when present, is smallest and it gives rise to a filamentous staminode (figures 9,10).

Shortly after the formation of the stamen primordia, extension of growth between the discrete petal primordia interconnects them in the form of a ridge which encircles the stamen primordia (figures 5, 6). The corolla tube thus initiated grows further by intercalary growth in the common bases of the petal and stamen primordia (figure 7). The developing stamens are also carried up along with the corolla tube and thus the stamens become epipetalous. The free lobes of corolla continue to grow, become conspicuous and subequal, and assume an imbricate aestivation (figure 8).

The gynoecium is initiated in the form of a somewhat tetragonal rim. The four corners of this rim alternate with the four stamen primordia (anterio-lateral and posterio-lateral pairs of stamen primordia). The adaxial corner of the rim which is opposite to the posterior stamen primordium is more prominent (figure 5). The adaxial and abaxial portions of the gynoecial rim grow more rapidly and as a consequence of this the gynoecial rim becomes two-lobed (figures 6,7). Further upgrowth of the lower cylindrical portion of the gynoecial rim produces the ovary whereas the two lobes form the stigma (figures 9–11,13,14). Two placentae develop from the lateral side of the ovary wall at right angle to the gynoecial lobes. The placentae grow inward and meet in the centre (figure 12). Consequently, the ovary becomes bilocular. Two series of ovule primordia are initiated on each placenta in acropetal succession. Each ovule primordium forms a single integument.

Discussion

The primordia of the floral appendages are initiated in acropetal order. The formation of sepal, petal and stamen primordia proceeds from anterior to posterior side. Thus the flower shows some zygomorphy even in its development. Although the petal primordia arise as discrete units, soon a corolla tube is initiated which becomes very prominent in the mature flower. Studies on the development of corolla tubes have shown various modes of their formation in different plants. In *Vinca* the upper portion of the corolla tube is formed by ontogenetic fusion of the petal primordia and its lower part by the zonal growth (Boke 1948). In *Downingia* active zonal growth under the junction of the petal primordia results in the formation of the corolla tube (Kaplan 1968). The upper portion of the corolla tube (above the level of insertion of stamens) in *Justicia* is formed by ontogenetic union and the lower portion (below the level of stamen insertion) by intercalary growth in the common bases of petal and stamen primordia (Singh & Jain 1975).

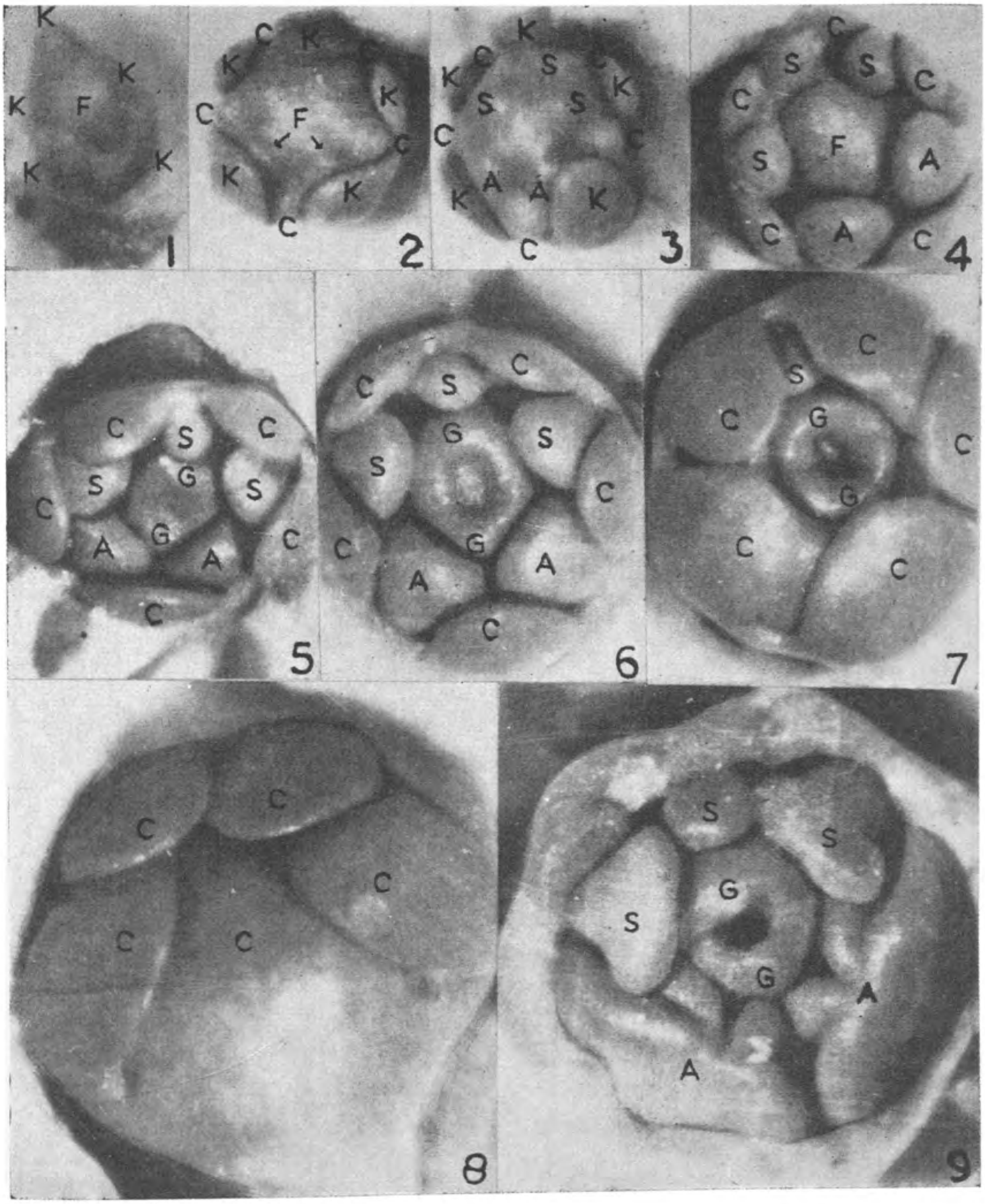
The corolla tube in *Pharbitis* develops by co-operation of interprimordial growth and marginal growth of primordia (Nishino 1976). More recently, Nishino (1978) reported on the corolla tube formation in four species of Solanaceae. According to him the bases of the petal primordia extend and connect with each other as a result of meristematic activity, and the short tube thus formed develops into the lower portion of the corolla tube which carries up with it the developing stamen primordia. The bases of the petal primordia extend further and they connect with each other at the back of the stamen primordia. The upward growth at the connected regions results in the formation of the upper portion of the corolla tube. The corolla tube in *Solanum dulcamara* is initiated by the extension and fusion of marginal meristems of adjacent separate petal primordia (Sattler 1977; Daniel & Sattler 1978).

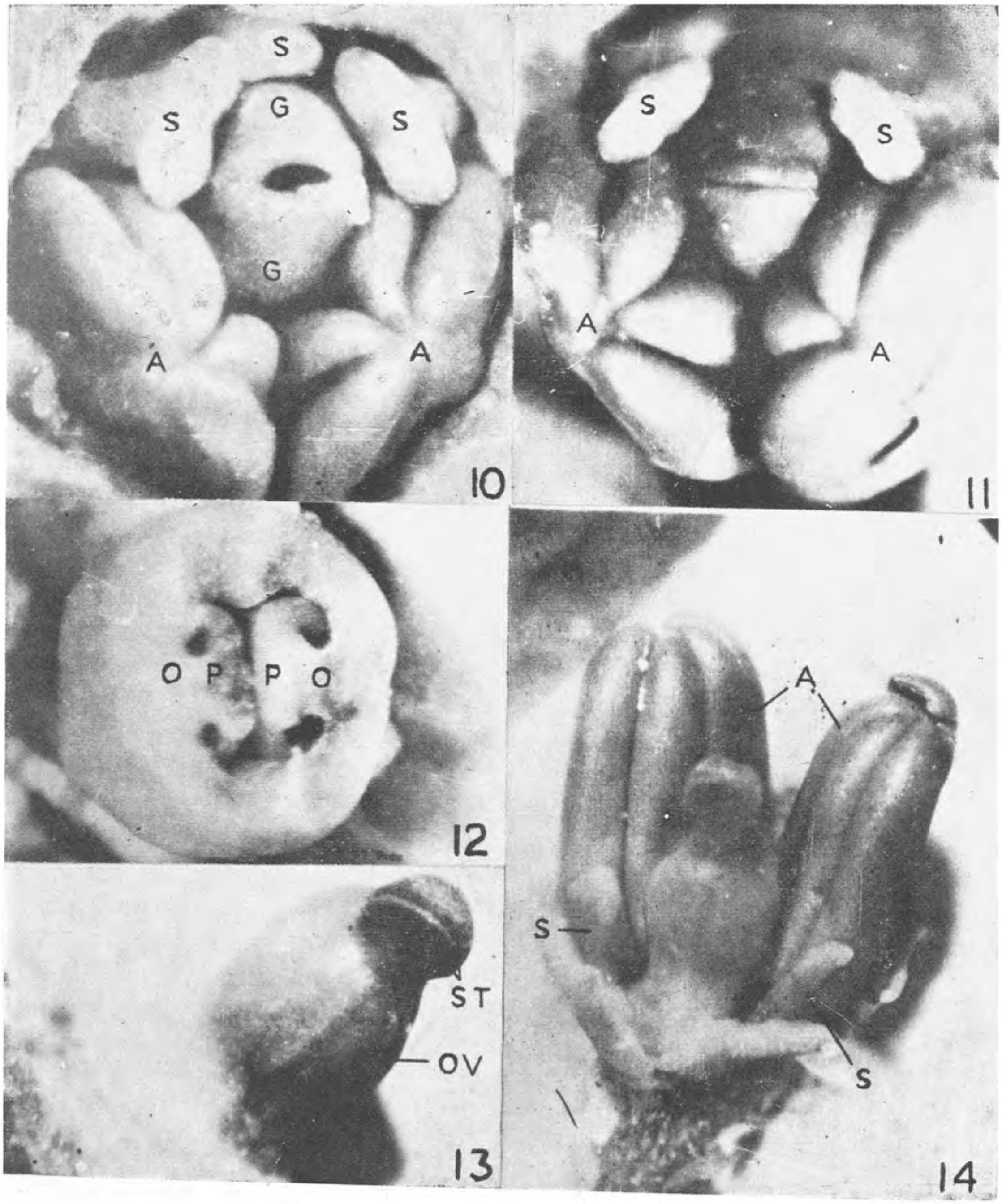
Our observations on the organogenesis of flower of *Martynia* show that here the corolla tube is initiated by extension of growth between separate petal primordia. Further upward growth takes place by intercalary growth in the common bases of petal and stamen primordia.

The androecium of *Martynia* seems to have arisen from a typical five-staminate form. The reduction has, however, progressed from the posterior side. The posterior stamen is either altogether absent even in rudimentary form or when it is initiated, the growth of the primordium is checked in an early stage of development. The anterio-lateral pair of stamen primordia develops into staminodes which may form rudimentary anthers. The posterio-lateral pair of the primordia alone develops into fertile stamens.

In *Martynia* the placental ridges arise from the lateral wall of the ovary, grow inward and eventually become closely appressed. This gives rise to a bilocular appearance to the ovary. However, the

Figures 1–9 *Martynia diandra. 1,* Top view of a floral bud at the time of the inception of sepal primordia, *2,* Top view of a floral bud showing inception of petal primordia. The site of initiation of some stamen primordia is indicated by arrows. *3,* Top view of a floral bud during the inception of stamen primordia; *4,* Top view of a floral bud before gynoecium inception where sepal primordia were removed to exhibit petal and stamen primordia; *5,* Top view of a floral bud during the gynoecium inception. The sepal primordia were removed; *6–7,* Top views of floral buds showing stages of the gynoecium development and the formation of the corolla tube. Sepal primordia were removed; *8,* Side view of a floral bud where sepal primordia were removed to show a later stage of corolla tube formation; *9,* Top view of a floral bud showing a later stage of androecium and gynoecium development. The sepal and petal primordia were removed (× 100).


1
2
3
4
5
6
7
8
9


S
S
G
S
G
A
A
10
S
S
A
A
11
O P P O
12
ST
OV
13
A
S
S
14

development of the gynoecium is as one with typical parietal placentation (c.f. Singh & Jain 1975). The ovules are initiated in an acropetal course which is correlated to the ovaries with parietal placentation (Payer 1857; *see* also Kaplan 1968).

References

Bentham G and Hooker J D 1862–1883 *Genera Plantarum* Vol. II. (London: L. Reeve & Co.)

Boke N H 1948 Development of perianth in *Vinca rosea* L.; *Am. J. Bot.* **35** 413–423

Cronquist A 1968 *The Evolution and Classification of Flowering Plants* (London: Thomas Nelson and Sons Ltd.)

Daniel E and Sattler R 1978 Development of perianth tubes of *Solanum dulcamara:* Implications for comparative morphology; *Phytomorphology* **28** 151–171

Engler A and Prantl K 1895 *Die naturiichen Pflanzenfamilien;* IV (3b): 265–269 (Leipzig: W. Engelmann)

Kaplan D R 1968 Structure and development of perianth in *Downingia bacigalpii; Am. J. Bot.* **55** 406–420

Nishino E 1976 Developmental anatomy of foliage leaves, bracts, calyx and corolla in *Pharbitis nil. Bot. Mag. Tokyo* **89** 191–209

—— 1978 Corolla tube formation in four species of Solanaceae; *Bot. Mag. Tokyo* **91** 263–277

Payer J B 1857 *Traité d' organogénie comparée de la fleur.* (Paris: Librairie de Victor Masson.)

Sattler R 1968 A technique for the study of floral development; *Can. J. Bot.* **46** 720–722

—— 1977 Kronrohrenentstehung bei *Solanum dulcamara* L. und "kongenitale Verwachsung"; *Ber. Deutsch. Bot. Ges.* **90** 29–38

Singh V and Jain D K 1975 Floral development of *Justicia gendarussa* (Acanthaceae); *Bot. J. Linn. Soc.* **70** 243–253

Takhtajan A 1969 *Flowering plants: origin and dispersal* (Edinburgh: Oliver & Boyd Ltd.)

Figures 10–14 *Martynia diandra. 10–11,* Top views of floral buds showing stages of androecium and gynoecium development (sepals and petals were removed). The posterior staminode is missing in figure 11; *12,* An ovary cut transversely to show placentae and ovule primordia; *13,* Gynoecium of a floral bud in side view; *14,* A floral bud in side view showing gynoecium, stamens and staminodes figures 10–13 (× 100) figure 14 (× 62)

A, stamen primordium; **C,** petal primordium; **F,** floral apex; **G,** gynoecial primordium; **K,** sepal primordium; **O,** ovule primordium; **OV,** ovary; **P,** placenta; **S,** staminodial primordium; **ST,** stigma.