

ARGEMONE MEXICANA LINN.

II. Morphological and Structural Studies in Some Floral Abnormalities

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INTRODUCTION

CONTROVERSIAL value of evidence offered by plant abnormalities has been the source of intense discussion among morphologists from the time of Linnaeus onwards. Bose¹ has effectively reviewed pertinent literature attaching positive importance to the value of these manifestations in the solution of problems of morphological interest. Joshi^{3,4} reported some remarkable abnormalities in *Argemone mexicana* and discussed their possible cause and phylogenetic significance. But his conclusions are neither supported by anatomical studies nor by morphological illustrations of abnormal stamens during his latter report.

During the course of an earlier investigation the authors⁵ conducted an extensive survey of wide population of *A. mexicana* growing in this region. In addition to abnormalities listed by Joshi (*loc. cit.*), it has been possible to supplement his investigations with a few more interesting observations. The latter have necessitated the submission of the following brief account.

MATERIAL AND METHODS

Material for the present study was collected from close vicinity of Regional Research Laboratory, Jammu, and fixed and preserved in formalin-aceto-alcohol. Dehydration and paraffin embedding were carried on in the customary way. Parowax blocks were sectioned at 10-12 μ thickness and the sections were stained with safranin-fast green combination. Abnormal and normal petals and stamens were cleared in chloral hydrate-glycerine mixture (5:2) kept warm at 70° C. and stained with safranin to bring out their vasculature pattern. For epidermal studies temporary mounts of peals in 10 per cent. glycerine were examined.

OBSERVATIONS

A comprehensive description of normal flowers has been furnished by Joshi.³ Flowers shown in Plate IV exhibit various abnormalities which are discussed below.

Sepals.—Abnormal sepals observed do not deviate much from the normal structures except for their extraordinarily large size which is nearly twice that of their normal counterparts (Plate IV). The prickles are sparse and the vascular strands much strongly developed. All the sepals may be sometime, though rarely, united at the base into a circular collar-like disc.

Petals.—Transparencies of one normal and three abnormal petals are photographed in Plate V. Normal petals are yellow-coloured, thin and membranous with a slightly thickened base. Vascular strands diverge apart from each other immediately after their entry into the petal base. Their further ramifications and anastomoses, resulting into typical vascular network of normal petal, take place in the way exhibited by Plate V, Fig. 1.

A transection of normal petal is figured in Text-Fig. 1 (A). Detailed structure of the areas delimited by the large and small rectangle in Fig. A is shown in Figs. G and M respectively. Rounded, oval or irregular parenchymatous mesophyll cells with large air-spaces are bounded by upper and lower epidermal layers of the wing [Text-Fig. 1 (A)]. Normal epidermal cells are narrow, \pm rectangular, with sinuous walls and a few stomata [Text-Fig. 2 (a, a')].

Morphology and anatomy of the abnormal petals is described as under. The first abnormal stage (Plate II, Fig. 2) is characterized by the following morphological features:—

(i) Pale green or green colour, (ii) spatulate outline, (iii) relative increase in thickness, (iv) a lateral coming together of chief vascular strands after their entry into the petal base and finally (v) elaboration of the vascular frame into an atypical network which tends to approach more towards that of the leaf than of petal. A transection of the aberrancy under reference is shown in Text-Fig. 1 (B). Histological structure of midrib and wing, marked by straight lines in Text-Fig. 1 (B), is shown in detail in Text-Fig. 1 (H and N) respectively. Salient anatomical features of this stage are: (i) wider and better developed xylem vessels, (ii) feebly differentiated phloem fibres, (iii) appearance of loose chlorenchyma with inter-cellular spaces and (iv) the larger size of parenchymatous cells. In the wing the mesophyll gets differentiated into a few layers thick palisade tissue and several cells thick spongy parenchyma, the latter being composed of rounded or oval thin-walled cells with large air-spaces [Text-Fig. 1 (N)]. The palisade consists of slightly elongate chlorenchymatous cells with numerous interstices. Epidermal cells of this stage are characterized by an increase in the number of stomata and a straight straightening of cell-walls, accompanied by the loss of their sinuous nature [Text-Fig. 2 (b, b')].

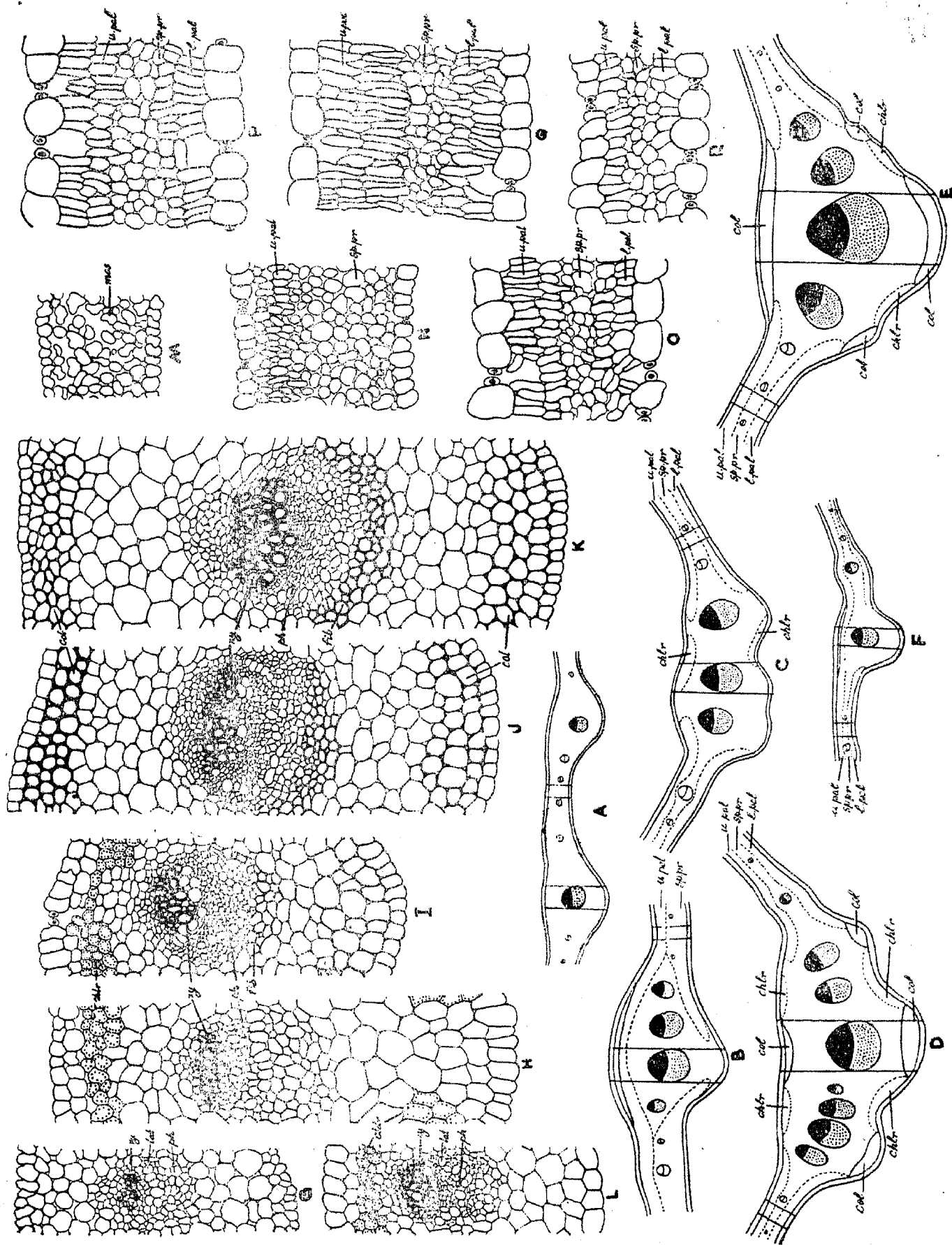
The next abnormal stage of petal is interesting inasmuch as it combines the following distinctive features: (i) development of a distinct midrib-like region, (ii) parallel course of chief vascular supplies up to the middle of petal, (iii) a still further elaboration of vasculature, and (iv) appearance of lateral, dorsal and ventral prickles (Plate V, Fig. B).

A transection of abnormal petal at this stage is delineated in Text-Fig. 1 (C). Histological details of midrib and wing are illustrated with Text-Fig. 1 (I and O) respectively. Chief anatomical interest at this stage lies in: (i) slightly thickened phloem fibres, (ii) 2–8 layers of thickened parenchyma immediately beneath the lower epidermis and (iii) appearance of chlorenchymatous bands [Text-Fig. 1 (C)], in the parenchymatous region immediately below the upper and lower epidermis. Spongy parenchyma in the wing is bounded by the upper and lower palisade layers. Laterally apposed columnar cells of upper palisade more or less closely approach those of the leaf, whereas cells of lower palisade are only slightly modified chlorenchymatous cells [Text-Fig. 1 (O)]. Epidermal peels of this petal are characterized by abundance of stomata and shorter and more or less polygonal cells [Text-Fig. 2 (c, c')].

Highest degree of abnormality is attained at the third stage, shown in Plate V (Fig. 4), where the general appearance and shape gets completely altered. Were it not for its topographical situation, this stage could easily have been overlooked for ordinary foliage. The petal margin becomes wavy, lacerated and prickly and approaches closely, though not entirely, to that of the leaf. Vascular frame also approximates closely to that of the leaf.

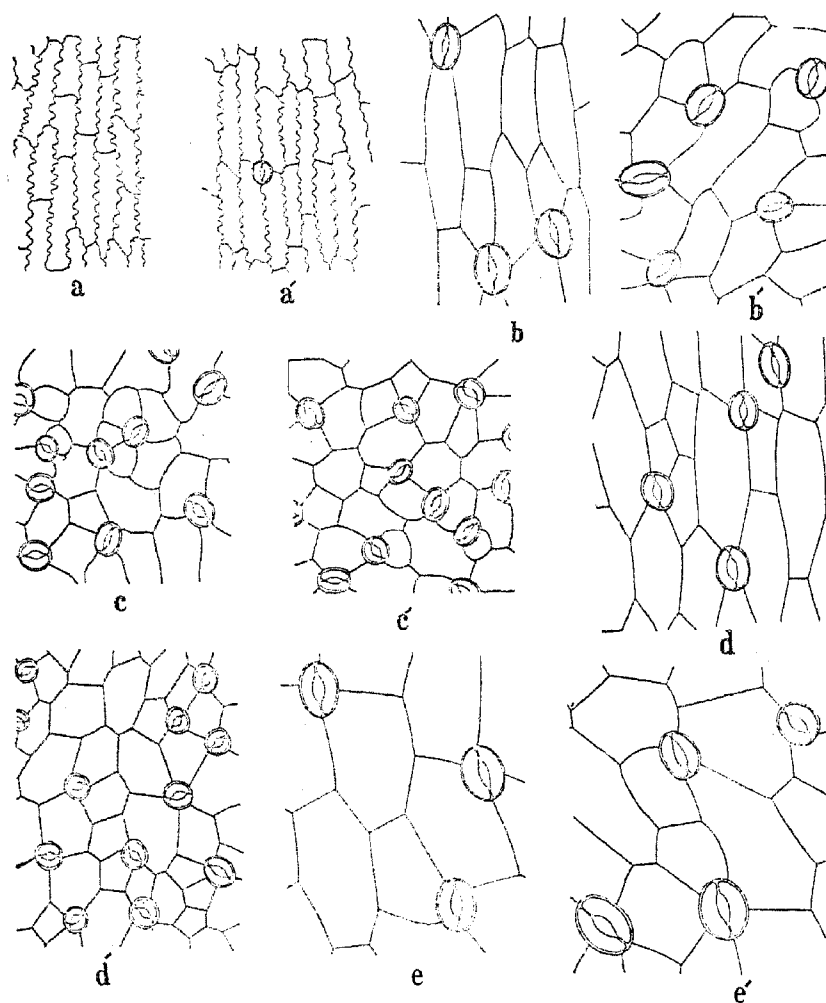
A transection of the aberrancy at this stage is figured in Text-Fig. 1 (D). General plan of the tissue distribution seems to be in agreement with that of the leaf [Text-Fig. 1 (E)]. Midrib regions demarcated by straight lines in Text-Fig. 1 (D and E) are detailed in Text-Fig. 1 (J and K) respectively. Chief anatomical details of this stage, in common with the histology of normal leaf, are: (i) general outline of transection, (ii) comparatively stronger and thicker vascular bundles, (iii) presence of a strong cap of phloem fibres, and (iv) 2–3 layers of collenchymatous cells beneath the upper and lower epidermis each. The collenchyma alternates with bands of chlorenchyma beneath the lower epidermis [Text-Fig. 1 (D and E)]. Transections of wing marked in Figs. 1 (D and E) by smaller rectangles are shown in detail in Figs. 1 (P and Q) respectively. Epidermal peels of the petal under reference are shown in Text-Fig. 2 (d, d') while those of a normal leaf are illustrated in Text-Fig. 2 (e, e').

Stamens.—Stamens of the normal flowers possess slender filaments with a weak staminal strand. The anthers are tetralocular and longitudinally



TEXT-FIG. 1

dehiscing [Text-Fig. 3 (a)]. Abnormal stamens arranged in order of increasing degree of deviation from normal stamen are also sketched in Text-Fig. 3 (b-g). The stamen shown in Text-Fig. 3 (g), though completely leaf-like, does not approach *A. mexicana* leaf specifically. Unlike the leaf, it receives a single staminal strand at its base which, as a result of its further branching and finer ramifications of subsequent branchlets, accounts for the vasculature of stamen. A transection of this stamen is shown in Text-Fig. 1 (F). Text-Fig. 1 (L) illustrates histological details of the region passing through midrib.



TEXT-FIG. 2

Fairbairn and Kapoor,² and subsequently Kapoor and Sharma (*loc. cit.*) reported total absence of laticiferous tubes in stamens. Strikingly enough the vascular supply of abnormal stamen at this stage has been observed to be accompanied by laticifers. Detailed structure of the wing in transection, corresponding to the portion demarcated by straight lines in Text-Fig. 1

(F), is shown in Text-Fig. 1 (R). Anatomical structure of stamens *e* and *f* (Text-Fig. 3) is similar to that of *g*, while the structure of stamens *b*, *c* and *d* is precisely similar to that of the stages described by Joshi in his earlier communication.



TEXT-FIG. 3

DISCUSSION AND CONCLUSIONS

Large and showy yellow-coloured flowers of *A. mexicana* constitute the chief allure for a casual observer, with the result that frequently occurring green aberrant forms may generally remain unnoticed in green foliage. Both the normal as well as abnormal flowers are met with on the same plant. Initiation of the abnormal flowers takes place late in the season. The authors have been able to discover several (nineteen) plants bearing abnormal flowers from three distantly situated localities in Jammu.

Whatever the cause or phylogenetic significance of these deviations, they are interesting inasmuch as they suggest extreme degrees of phyllody. All gradations of abnormality for a particular floral whorl (gynoecium excepted) may be met with in the same flower or distributed in different flowers of the

same individual or different individuals. Were these aberrancies of a particular organ arranged in ascending sequence in accordance with increasing extent of deviation from the normal, a series could easily be constructed (Plate V and Text-Fig. 3). The series, read in the reverse direction, would tentatively explain the origin of each of such organs from a foliar ancestor, lending support to the hypothesis of 'flower as a condensed vegetative shoot'.

Histological structure of these forms (Text-Figs. 1-2) may bear a further testimony to their external manifestations. Irrespective of any other importance, they may be regarded significant so far as they provide with a working plan for the derivation of the presently discussed organs from the ordinary foliage leaf.

SUMMARY

Some floral abnormalities, for *Argemone mexicana* have been studied morphologically and anatomically. Aberrations have been regarded important in deriving the foliar origin of the organs discussed in the present report. Vascular supply of extremely abnormal stamens has been found to be accompanied by laticifers.

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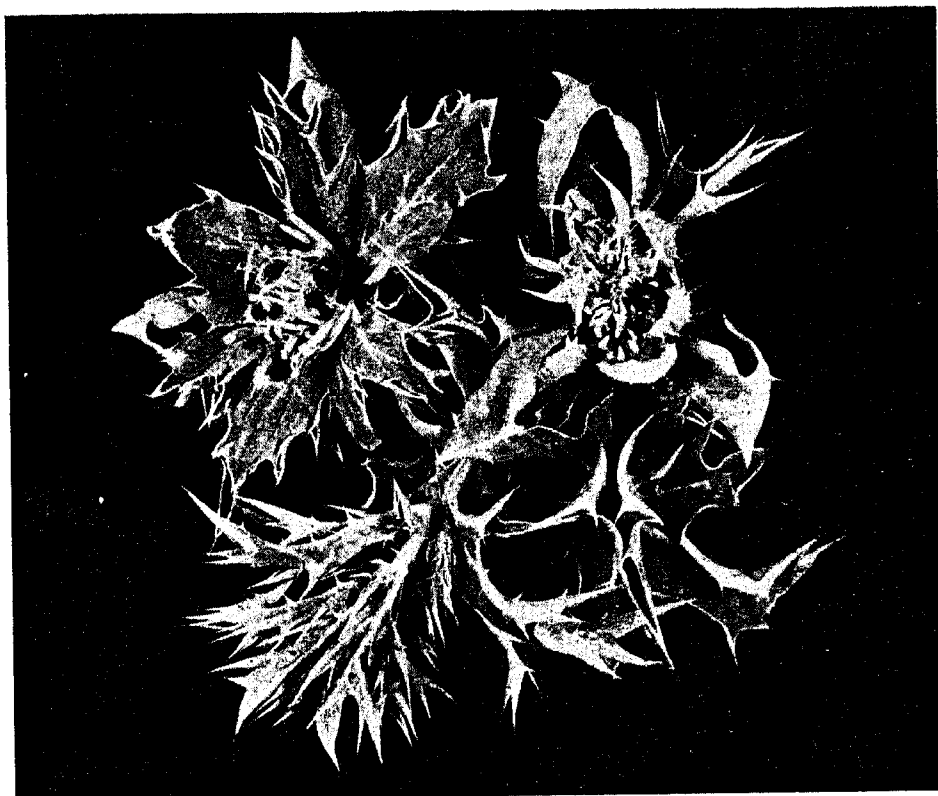
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Showing two abnormal flowers.