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LEAF ANATOMICAL STUDIES IN POPULATIONS OF *URGINEA INDICA* KUNTH (LILIACEAE)

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ABSTRACT

Sixteen populations of *Urginea indica* Kunth. Liliaceae were examined to provide the first detailed description of leaf anatomy following the methods employed by Johansen. The populations are distinguished into 2 types based on the fleshy and watery leaves. Populations vary in the following features. The presence of thick cuticle, larger and smaller areoles, the presence and absence of clear vascular bundles. Parenchyma cells with intercellular spaces filled with heavy and moderate wax deposition. Larger and smaller epidermal cells, palisade like tissue these characters along with other parameters plays an important role in delimiting the populations. Raphide and Calcium oxalatic crystals present in leaves. These variations between populations are of taxonomic significance.

Key Words: Anatomy, Areoles, Liliaceae, Raphides, Scilleae, *Urginea Indica*

INTRODUCTION

The genus *Urginea* Steinhilb comprises about 100 species (Willis, 1973). *Urginea indica* Kunth. an endemic species is found growing in sandy belts of South India. Populations of *U. indica* can be clearly recognized

exomorphologically as distinct populations. Anatomical studies on leaves of sixteen populations provide a reliable additional evidence for the taxonomic delimitation. As stated by Metcalfe and Chalk (1968) anatomical studies of vegetative organs of flowering plants can be taxonomically useful in identification of fragmentary material, preliminary identification of herbarium specimens and establishing interrelationships of taxa at and above the species level. Anatomical information is taxonomically useful without having obvious evolutionary or phylogenetic interpretations. Anatomical characters have been employed for systematic studies well over 100 years. However, Metcalfe and Chalk (1954) opined that the application of anatomical data for taxonomic studies has been in use in the recent years more data have been accumulated. In Monocots, systematic studies of leaf anatomy have received considerable attention. The work of Muller (1909) and Wanderlich (1950) on *Agave* and the study of Fahn (1954) on *Xanthorrhoeaceae* are notable. Tomlinson (1956) and (1959) include many subtle anatomical features like leaf, stem, root has been used in classification of *Musaceae* and *Zingiberaceae*. It is found to play an increasingly important role in the formulation of natural or phenetic group. Leaf is one of the most important vegetative organs its anatomy can be successfully exploited for systematic purpose (Carlquist, 1961). The importance of epidermal characters for making useful taxonomic deductions is exemplified by the work of Cothem (1970); Dickson (1973); Davis and Heywood (1973); Ogundipe and Olatunji (1991a & b) and Ogundipe (1996). Comparative leaf anatomical studies of five medicinal species have been made by Neerakkal *et al.*, (2001); Rathna Kumari *et al.*, (2002) have delimited. Three varieties of *Morinda Pubescens* on anatomical basis Ogundipe (2002) has made delimitation of *Zanthoxylum* species occurring in West Africa based on anatomical characteristics. Anatomical properties of endemic *Lillium ledebourii* were discussed by Kaviani *et al.*, (2008). Anna H.lynch (2006) has done biosystematic studies of *Hyacinthaceae*. However, no work has been done on *Urginea* genus of *liliaceae*, particularly

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epidermal micromorphology for taxonomic considerations. Anatomical studies were made for the first time.

Therefore, the present investigation has been undertaken to study the anatomical features of foliar epidermis of sixteen populations of *U. indica*.

MATERIALS AND METHODS

Anatomical investigations were carried out in the year 2009 to evaluate the frequency of variations in populations of *Urginea indica*. Leaves of sixteen different populations were collected from various localities in south India and were grown in Botany department garden under uniform environmental conditions.

Fresh leaves were collected from the potted plants, small bits of leaf materials were fixed in FAA to enable rapid penetration. The leaf materials were fixed for about 24 to 72 hours then stored in 70% alcohol. The usual method of dehydration and infiltration were followed using ethanol-xylene series. Leaf bits were dehydrated in alcohol series, cleared in alcohol-xylene mixtures as outlined by Johansen (1940) and embedded in paraffin. The serial sections of 10- 13 μ m thickness were cut using Jung rotary microtome sections were stained with safranin and counter stained fast green. Photomicrographs were taken on Leitz microscope.

RESULTS AND DISCUSSION

Isobilateral leaves characterize monocotyledonous plants. These leaves are positioned in such a way that equal amount of light is received on both the surface.

Anatomical features of the leaves of sixteen populations of *Urginea indica* Kunth were made and illustrated in figures 1, 2, 3 and 4. Figure 1 shows (1 to 4) populations, Figure 2 shows (5 to 8) Populations, Figures 3 & 4 shows (9 to 16) Populations respectively.

Transfer section of leaf show the following anatomical features, epidermis is covered over by a thick cuticle. Outer tangential walls of the epidermal cells are often thicker than the anticlinal inner walls. Stomata occur on both the epidermal layers. The ground tissue is not differentiated into Palisade and spongy parenchyma. However, the cells below the upper epidermis are longer and thick walled and are compactly arranged with chloroplasts forming a palisade like layer, so also, just above the lower epidermal 2 to 3 layers of such thick walled Palisade like cells containing chloroplast are seen. However, these cells are shorter and smaller in size. The ground tissue is characterized by fairly thick walled cells which were round in shape and is traversed by a number of vascular bundles.

In figure 1, the variations between populations 1, 2, 3 & 4 (a, b, c & d) is clearly evident in the depositions on the epidermal layer in Figure (d) which is not evident in (a, b, c). Presence of large areoles is seen in (a) and its absence in the other three populations, clearly found vascular bundles are seen in (a & d) but not in (b & c). The intercellular spaces between the parenchyma is filled with wax more heavily in (c) moderate in (a & b) not seen in (d) the epidermal cells are larger in (c) smaller in (d) and medium in (a & b). The parenchyma cells are thicker in (b) with starch grains. While thin parenchyma cells noticed in the other three without starch grains. Palisade like tissue is noticed only in (c) but not seen in (a, b & d). Lower epidermis is not clear in (c) but it as clear (b & d).

In Figure 2, the variations between populations (5, 6, 7 & 8) (a, b, c & d) the heavy deposition is seen in on the epidermal layer in Figure (d) moderate in (a & b) and irregular in (c) presence of areoles is characteristic in (c & d) while it is absent in (a) small in (b). Vascular bundles are clearly seen in (a) slightly visible in (b & c) and not clear in (d). Lower epidermis is not clear in (a, c & d) while clear lower epidermis noticed in (b).

In Figure 3, the populations (9, 10, 11 & 12) (a, b, c & d) vary in the presence of areoles, it is present in Figure (b) and absent in the other three. The variations are clearly evident in the thickness of cuticle. In Figure (c) epidermal cells are larger and (b) shows smaller cells with thick cuticle. In (d) cells are smaller with thin cuticle. The shape of parenchyma cells in the ground tissue is similar in (a, b & d) showing

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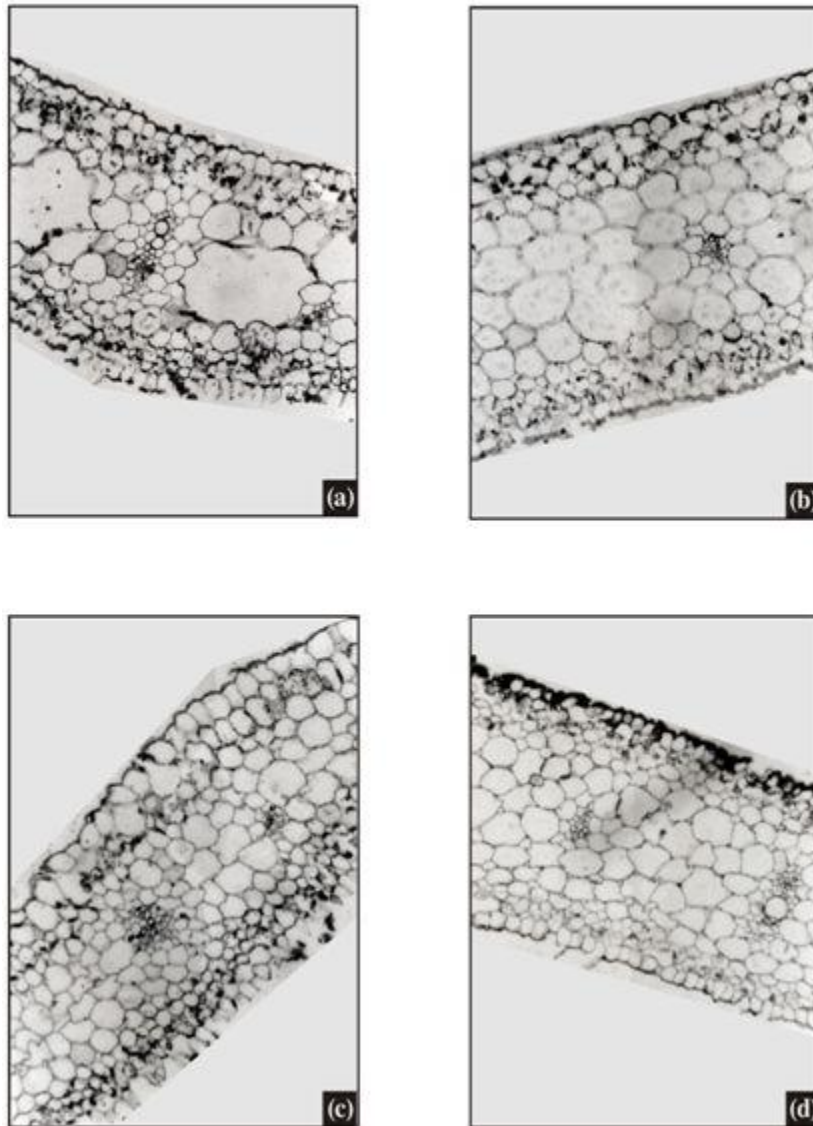


Figure 1 (a-d): Leaf anatomical studies in population of *Urginea indica* Kunth. Liliaceae population (1, 2, 3 & 4)

sinuous walls while not so in (c). Parenchyma cells are loosely arranged in (a, b & d) and it is compactly arranged in (c). Epidermal layer in Figure (b) is highly cutinized giving the appearance of sclerenchymatous layer. Which is not so evident in the (a, c & d). In the anatomical details show that the leaves are fleshy and gummy in (a & c) the lower epidermis is not clearly demarked. Semi fleshy in (d). The cells of the ground tissue show warty walls in Figure (d) and it is absent in the other 3.

In figure 4, the variations between populations (13, 14, 15, & 16) (a, b, c & d) is noticed by the presence of large areoles in (d) and its absence in the other three. The deposition on the epidermal layer is thicker and irregular in Figure (a & c) thinner in (d) and almost in traces in (b). The vascular bundles are clearly seen in (a & b) but not so clear in (c & d). Figure (b & c) shows fibre bundles and its absence in the other two. Anatomy clearly indicates gummy leaves in (b & c). Without marked lower epidermis, characteristic feature is the cells of ground tissue with warty walls.

Anatomical variations in *Urginea indica* of tribe scilleae of liliaceae are presented for the first time such variations in the leaf anatomy of other Liliaceae members are reported by Brittan (1960) in *Thysanotus*,

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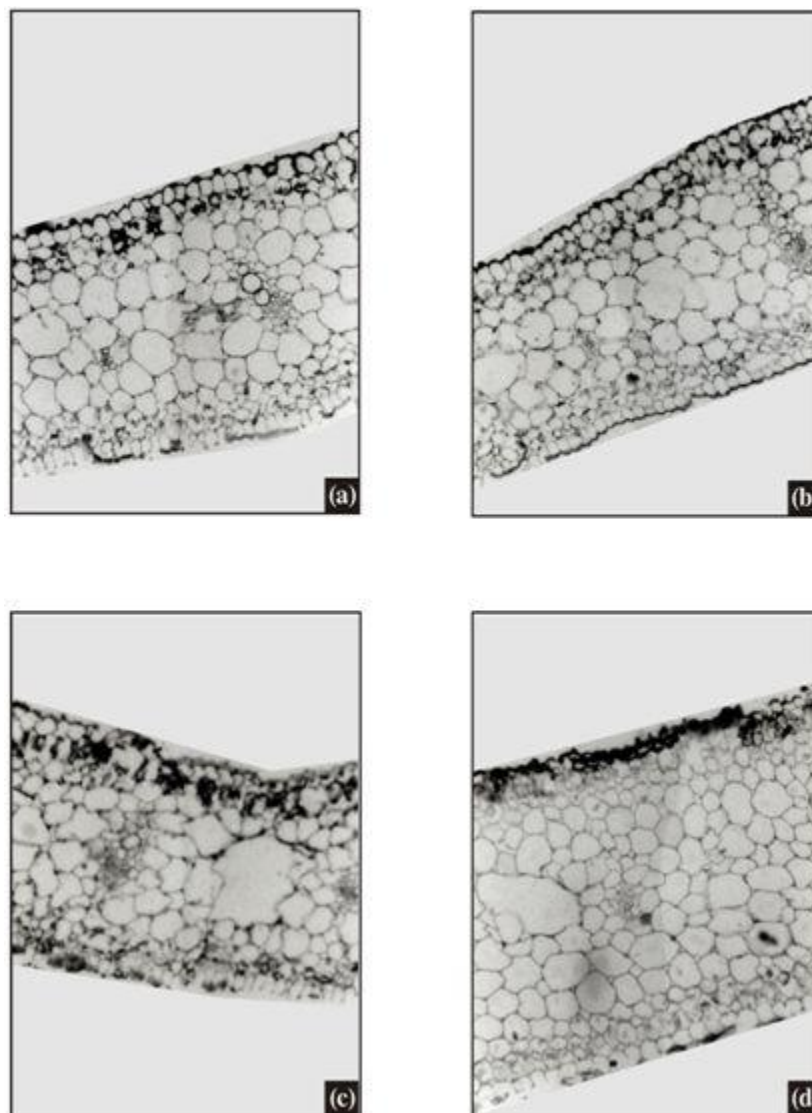


Figure 2 (a-d): Leaf anatomical studies in population of *Urginea indica* Kunth. Liliaceae population (5, 6, 7 & 8)

Naik and Nirgude (1981) in *Chlorophytum*. Biosystematic investigation on *Muscari* species were made by Jafari *et al.*, (2008) is notable. The systematic importance of anatomical data reported by Mehdi *et al.*, (2010) in *Gagea*. The study of Fahn (1954) on Xanthorrhoeaceae are notable. Tomlinsons (1956 &1959) on Zingiberaceae and Musaceae include many subtle anatomical features. Hence, this parameter is of considerable significance in the systematic evaluation of taxa.

Studies of the comparative anatomy of sixteen populations of *Urginea indica* collected from various localities of Karnataka revealed several interesting features of taxonomic significance. This study provides the first comprehensive, anatomical description of *Urginea indica* leaves on a broad comparative basis

The sixteen populations illustrated in Figure 1, 2, 3 & 4. Figure 1 comprises (1 to 4) populations, Figure 2 shows (5 to 8) populations, Figure 3 shows (9 to 12) and Figure 4 (13 to 16) populations. The populations are categorized into 2 types, populations 4, 8, 9, 11, 12 & 14 shows fleshy and gummy leaves while the remaining populations shows leaves which are watery. The populations with gummy leaves

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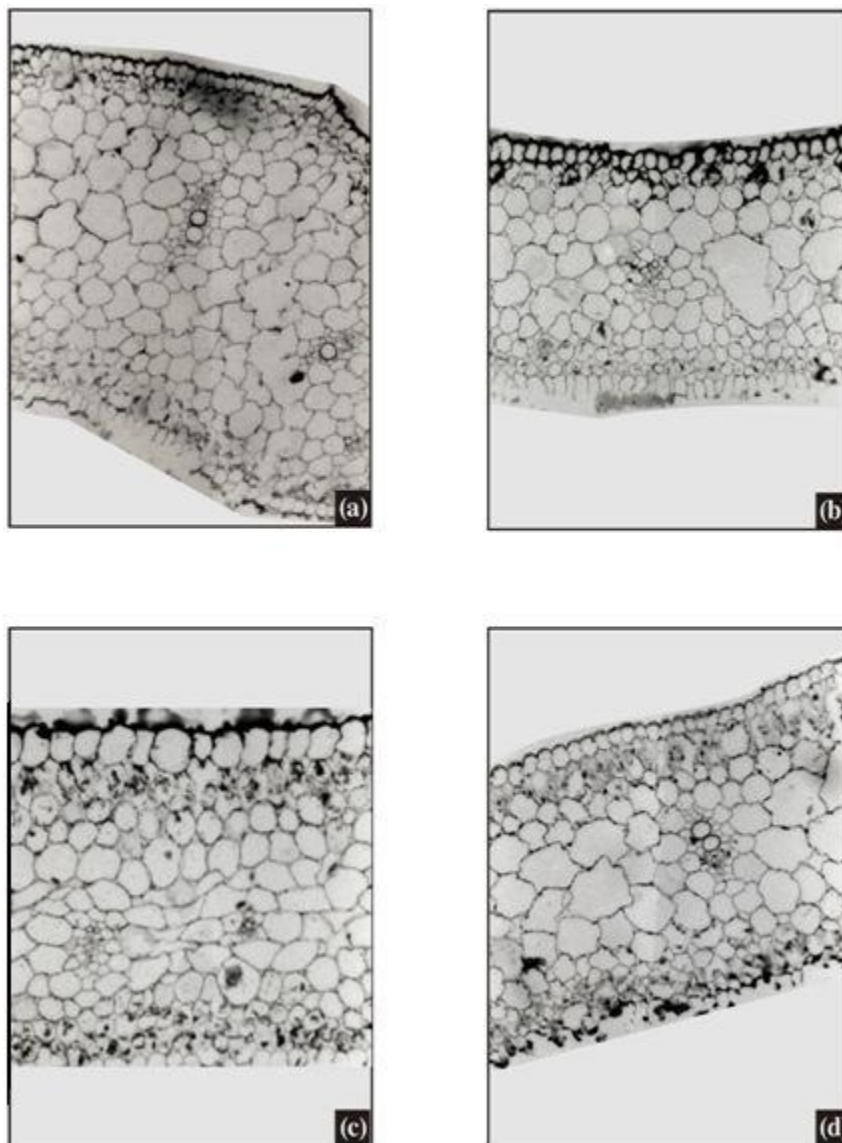


Figure 3 (a-d): Leaf anatomical studies in population of *Urginea indica* Kunth. Liliaceae population (9, 10, 11 & 12)

shows epidermis with thick deposition 4, 8, 9, 11 and 14 while the remaining populations shows thin deposition. The presence of large areoles is characteristic in population 1, 7, 8, 10, 16 and its absence in other populations or small areoles are present. Clearly seen vascular bundles is found in population 1, 4, 5, 7, 9, 12, 13 & 14 absent in other populations.

Intercellular spaces filled with wax in population 3. Moderate wax in 1 and 2 populations and wax not seen in population 4. Epidermal cells are larger in population 3 and 11. Parenchyma cells with starch grains is seen in population 2 and it is absent in other populations. Palisade like tissue seen in population 1, 2, 3, 5, 6, 8, 10, 13 & 14 and absent in other population of *Urginea indica*. The comparative studies of the anatomy of mature leave appear to have some diagnostic value.

Morpho-anatomical studies on *Bellevalia puradoxa* have been made by Kahraman *et al.*, (2010). Kaviani (2008) performed anatomical investigation in *Lillium ledebourii* by comparing the species with the flora

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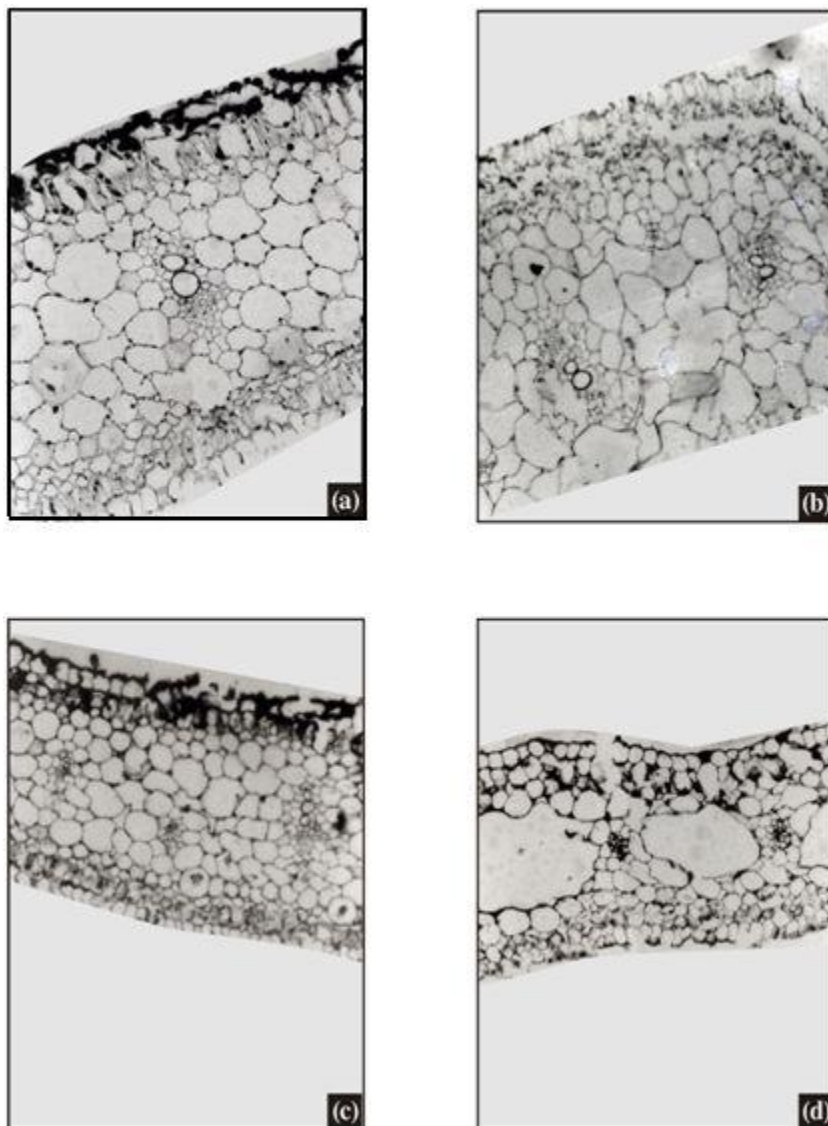


Figure 4 (a-d): Leaf anatomical studies in population of *Urginea indica* Kunth. Liliaceae population (13, 14, 15 & 16)

of Iran. Similar studies have been made by Akan and Satil, (2005) & Dhyani *et al.*, (2009) on *Lillium polyphyllum*.

Needle like calcium oxalate crystals, raphides, occur in spongy parenchyma cells in only the leaves of *U.indica* stomata are present on upper and lower surfaces of *U.indica* but they are more abundant on the lower surface. Zarin Kumar (2006) has observed that the stomata, were present on both surfaces of all the species examined in the liliaceae but stomatal frequencies on the upper surface are greater than those of the lower surface. In contrary in our studies stomatal frequency is more on the lower surface.

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