



**ROOT ANATOMICAL STUDIES IN *URGINEA INDICA*. KUNTH,
HYACINTHACEAE**

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Article Received on 16/01/2015

Article Revised on 06/02/2015

Article Accepted on 27/02/2015

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ABSTRACT

The root anatomical features of *Urginea indica* (Hyacinthaceae) in different accessions of Kashmir, Ranganathittu, Yarkad, Seethampundi and Kerala were investigated. These specimens were collected during April may 2013 & 2014. For anatomical investigation, sections of the roots were cut manually with a razor blade. The root anatomy of the species display the common properties of monocotyledons. Variations

have been noticed in by the development of good number of vascular arrangements in vascular bundles, pith size, cortical layers and epidermal thickenings. These features are of evolutionary significance. Among the five populations selected Seethampundi showed high evolution in vascular tissue and shows large pith. Population from Kashmir showed primitiveness in having small stele with less developed Xylem. In this work we are trying to correlate the vascular development as well as rhizodermal development in roots based on their geographical location.

KEYWORDS: Anatomy, Hyacinthaceae, Morphology, *Urginea Indica*.

INTRODUCTION

Urginea indica is a small perennial bulbiferous herb grows upto 75 cm in height. The aerial part, it perishes every year, with persisting bulb. Leaves simple, long, acute and pubescent. Flower stalk vertical, long with drooping ends. Flowers brownish white and small, fruits oval, contain 3 seeds. Plant pacifies vitiated vata, kapha, cough, asthma, bronchitis, cardio myopathy, urinary retention, urinary calculi, worm infestation, skin disease, arthritis, and traumatic edema. Bulbs contain cardiac glycosides, scillarens A and B. Bulb, leaves and root contain stigmasterol, sitosterol 2004; Satıl & Akan 2006; Coşkunçelebi et. al. 2008). In the

present study there is an effort to compare and find out the similarities in root anatomy which was as observed by Kauff *et.al.*(2000). *Urginea indica* possess multilayered exodermis, sclerenchyma in cortex, periderm below endodermis and cell endodermal thickenings. In root vascular bundles whether metaxylem is thin or thick with lateral wall thickenings. Presence or absence of perforation plates in vessels and presence of vascular bundles in central pith. In monocotyledons systematic studies of root anatomy has been made by Soboik and Speta (1997) in Hyacinthaceae. Other investigators include those of Olivier (1988) . Anatomical study of Hyacinthaceae *glabrescens* has been made by Kadriye Yestisen (2012).

MATERIALS AND METHODS

Plants of *Urginea indica* were collected from different locations namely, Kashmir, Ranganathittu, Yarkadu, Seethampundi and Kerala and were grown in *Urginea* germplasm, Bangalore University, Botany department. Roots were cut from fresh bulbs and free hand cross sections were made. Sections were stained with safranin/fast green and viewed with white light (Seago and Marsh, 1989) Observed under low and high power lense.

Observations: Following observations were made in roots of five accessions of *U.indica* collected from various localities (Table – 1).

Urginea indica can extend up to 50cms . The roots are creamish white and branched, fibrous root system. The table explains about the number of layers in epidermis, exodermis, cortex, endodermis, pericycle and size of stele.

Kashmir – 1: Transverse section of the root appears as complete circle Fig. (1- a,b & c) Epidermal cells appear slightly angular. Suberized cells are found outside epidermis forming the bark. Next to it there are two to three layer of hypodermis or exodermis. Inner to this around 8 rows of large circular parenchyma cells of the cortex.

The endodermis is a single layer with very thin-walled cells with casperian thickenings. The pericycle is two layered. Stele in comparison to others is smaller. Vascular bundles: (Table – 2). Stele is primitive with protostele characters. Stele is around 22% compaired with other parts in the section. Xylem is pentarch and radial. It has 5 metaxylem and protoxylems are not seen. Pith is almost absent. (Fig: 1 – c).

Ranganathittu – 2: Epidermis or rhizodermis is single layered with angular cells. Exodermis is also single layered with polygonal cells. Cortex is multilayered and heterogenous. Outer cortex is around 10 layered with circular cells. Inner cortex is small with hardly 3 layers with

compactly arranged parenchyma. Endodermis and pericycle are single layered. Endodermis shows the presence of "U" shaped casperian thickenings. Vascular bundles (Table – 2). Stele is advanced and is siphonostele with pith occupying the center around 42% of the total root. Vascular bundles are radial and hexarch. Around 6 metaxylem units are found with 21 radiating arms of protoxylem with radiating nature fig 2-c). Pith is small with only around 15 cells. So pith occupies around 20% of stele.

Yarkadu – 3: Epidermis is single layered with oval shaped cells. Epidermis is with wavy outline. Exodermis is around 3-4 layered. Outer cortex is around 8 layered with circular cells. Inner cortex is around 10 layered with small globose cells that are compactly arranged. Endodermis is single layered with distinct casperian thickenings. Pericycle is like endodermis with barrel shaped cells. Pith is too large with around 200 cells and show mixture of both large and smaller circular cells. Vascular bundles (Table – 2). Advanced siphonostele with larger pith. It occupies around 40% of the root. Vascular bundles are radial and polyarch. Around 9 metaxylem are found with radiating arms of protoxylem. (Fig 3-c). Pith is large with around 75 cells containing circular parenchyma cells. Size of pith compared to stele is 80%

Seethampundi – 4: It shows multilayered exodermis, sclerenchyma in inner cortex , periderm below endodermis. Metaxylem is thin, thickenings on laterall walls of vessel are reticular and scalariform. Perforation plates of vessels are scalariform. Central pith is parenchymatous, no vascular bundles exist in central pith. Vascular bundles: (Table – 2) It shows an advanced Siphonostele with a huge pith and it occupies around 60% of the root. Vascular bundles are polyarch with around 11 radiating arms of xylem and phloem. Around 11 metaxylem units with around 2 protoxylem are found. Pith is made up of around 120 cells and it occupies around 90 % of the stele.

Kerala – 5: Epidermis is single layered with thick covering. Hypodermis is 3 layered. Outer Cortex is around 5 layered with elongated cells and inner cortex around 4 layers with compact circular cells. Endodermis with single layer and a layer of pericycle. Pith has small circular with around 22 cells. Vascular bundles : (Table – 2) Stele is of mixed type. It lack proper pith as vascular tissues are found at the center of stele. Stele occupies around 33% in root. Its vascular bundles are radial and polyarch with around 8 strips of xylem and phloem. Protoxylem are around 32 in number. Pith is of 22 parenchyma cells. It occupies around 14% of the stele.

Table – 1 Root anatomical features in cortical region *Urginea indica*, accessions

Accessions	Habitat	Epi dermal cells	Exo-dermis	Cortex		Endodermis	Pericycle	Stele
				Outer layer	Inner layer			
Kashmir	High altitude	Angular	2-3 layered	8	20	single	2 layered	small
Ranganathittu	Sandy soil	Angular	1 layered	10	3	Single with casperian thickenings	1 layered	Medium size with 12 cells
Yarkadu	Rocky hills	Oval	3-4 layered	8	10	Single with tangential wall thickenings	1 layered	Large with around 100 cells
Seethampundi	Plantinum (Hard soil)	Oval	2 layered	10	7	single	3 layered	Large, with around 200 cells
Kerala	Wet land	Oval	3 layered	5	4	single	1 layered	Very small with around 22 cells

Table – 2 Comparative account of variations in vascular bundles and type of stele

Accessions	Stele type	Stele size compaired to total root In cms	Type of vascular bundle	Metaxylem number	Protoxylem number	Number of cells in pith	Size of pith comared to stele area
Kashmir	Protostele	2/9 = 22%	Radial pentarch	5	Absent	Absent	0.00%
Ranganathittu	Siphonostele	3/7 = 42%	Radial hexarch	6	21 radiate from metaxylem	Around 15	20.00%
Yarkadu	Siphonostele	4/10 = 40%	Radial polyarch with 9 strips of xylem and phloem	9	2 protoxylem with each metaxylem =18	Around 75 cells	80.00%
Seethampundi	Siphonostele	6/10 = 60%	Polyarch with 11 xylem & phloem strips	11	2 protoxylem with each metaxylem =22	Around 120 cells	90.00%
Kerala	Mixed stele	2/6 = 33%	Radial with 8 xylem and phloem strips	8	4- protoxylem with each metaxylem =32	Around 22 cells	14.00%

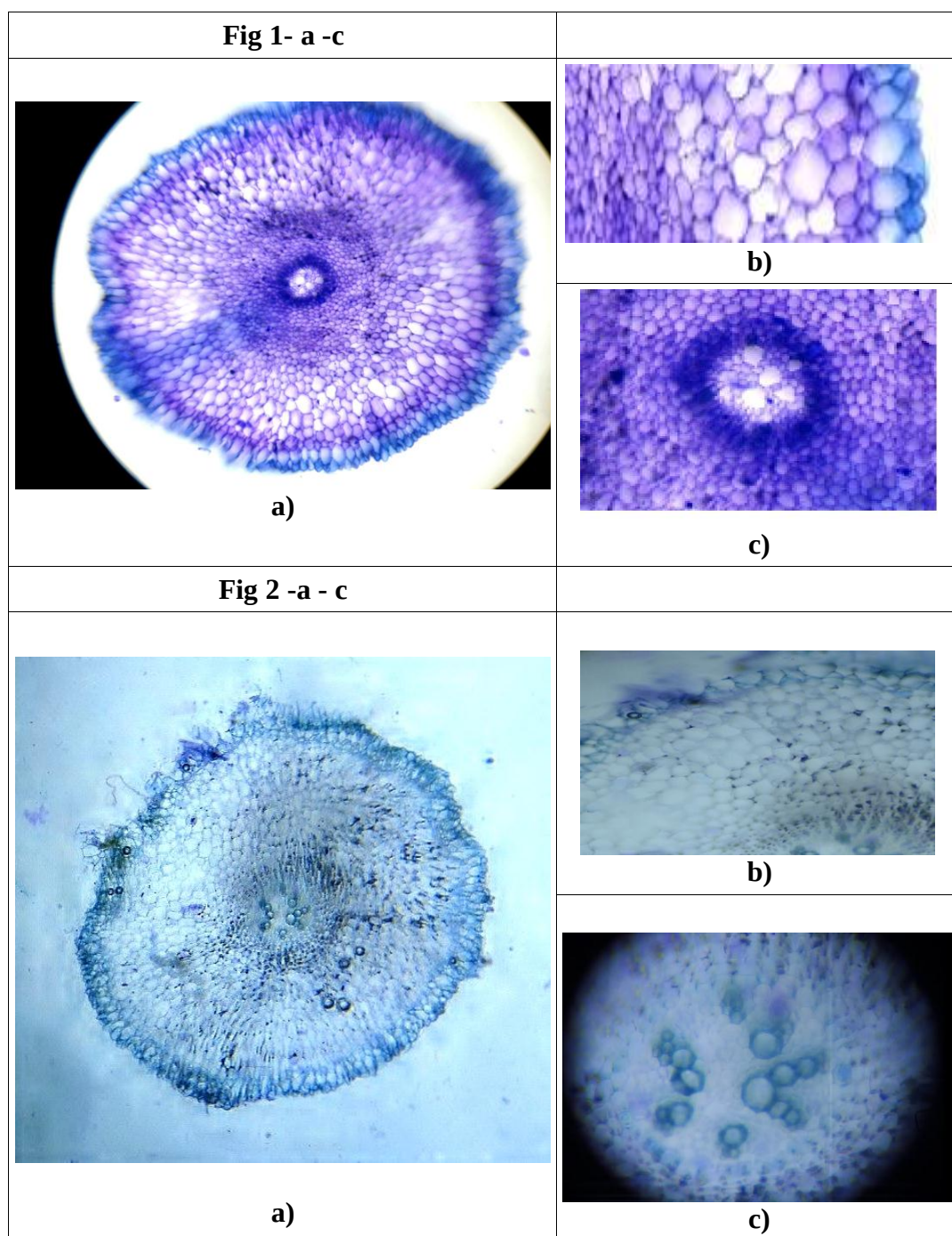


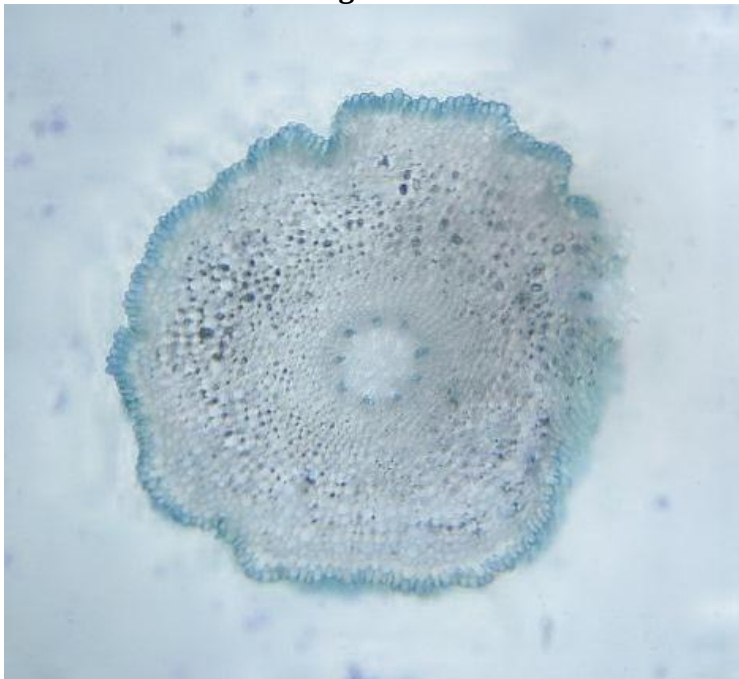
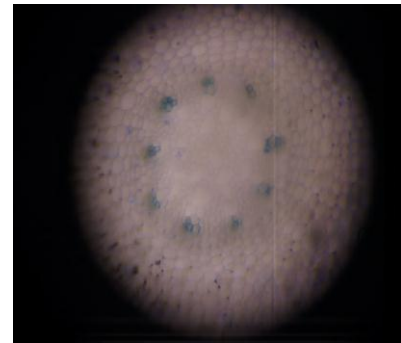
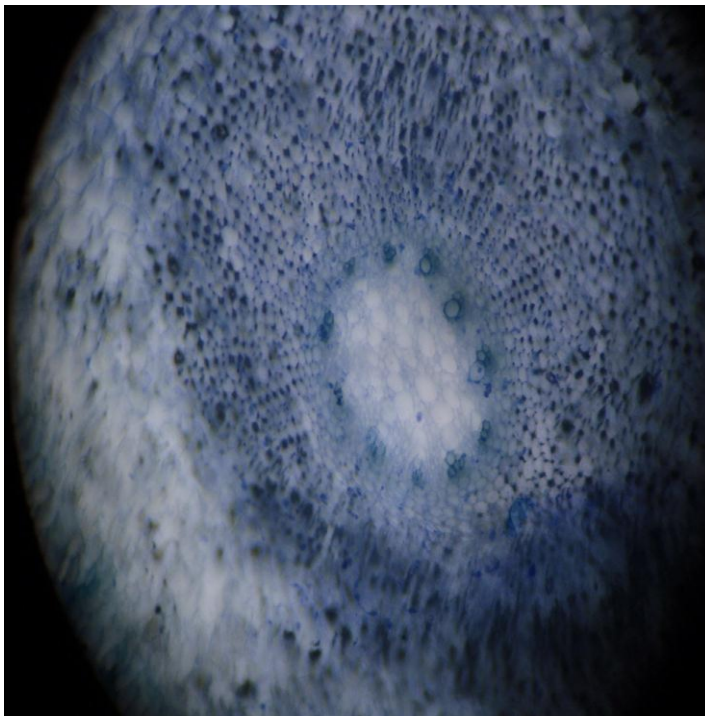
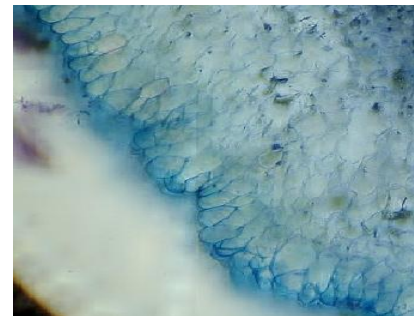
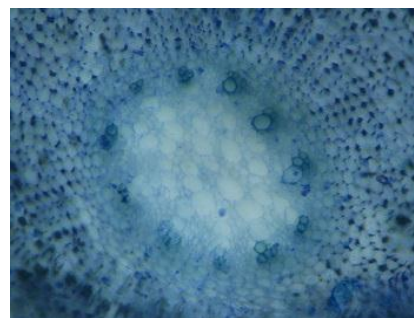
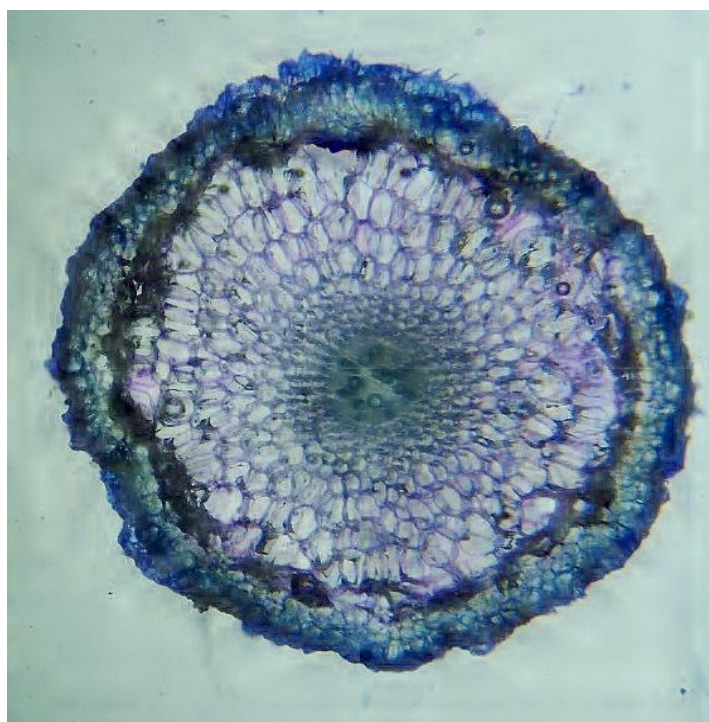
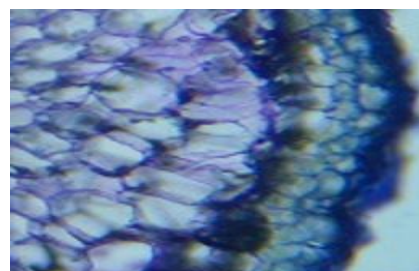
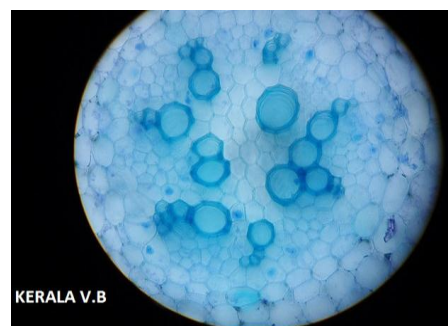
Fig 3-a -c**a)****b)****c)****Fig 4 a-c****a)****b)****c)**

Fig 5 a-c

a)



b)



c)

Figures 1 a- 5 C Photos showing anatomy of roots of *Urginea indica*

Fig 1-a- Root anatomy of Kashmir population, 1- b – enlarged cortex, 1-c- vascular bundle

Fig 2 -a- Root anatomy of Ranganathittu population: 2-b- Vascular bundle, 2-c enlarged cortex

Fig 3-a- Root anatomy of Yarkad population, 3-b- vascular bundle,, 3-c- enlarged cortex

Fig 4-a- Root anatomy of Seethampundi population, 4-b- enlarged cortex, 4-c- vascular bundle

Fig 5-a- Root anatomy of Kerala population, 5-b- enlarged cortex, 5-c- vascular bundle

DISCUSSION

In all five accessions of *Urginea indica* there are following findings were observed. Epidermis: It is an outer layer with thickenings that resembles bark. There is hypodermis of varying size with circular or elongated cells.

Exodermis

Seethampundi shows large exodermis with thickenings at corners Ranganathittu has single layered exodermis It is obvious that Ranganathittu has roots that are soft and with less mechanical support.

Cortex

This layer consists of different dimensions and shapes of parenchymatic cells were placed under the epidermis. After the cortex endodermis lies which is single layered with casparian strips.

Ranganathittu grows in sandy soil . So its xylem is less developed . Endodermis is followed by sclerenchymatous pericycle. Central vascular bundles consists of metaxylem elements radially arranged. In spite of growing the populations in uniform environmental conditions it is showing variations in root anatomy.

The above findings were similar to that of Yentur (1995) Vardar (1982) and Fazil Ozen *et al* (2012)

In all accessions cortex is two types with outer large and inner small cells. Large parenchymatous cortex in Kashmir with circular cells while smaller one in Kerala and cells are elongated in it showing radial conduction.

Stele

Largest stele with around 200 cells of parenchyma in Seethampundi, and almost absent in Kashmir accession.

Primitive and protosteles found in Kashmir , all other accessions showed advanced siphonosteles and Kerala showed mixed steles. Stele occupies largest area in roots of Seethampundi (60%) where as it occupies smallest area in Kashmir population (22%) Number of Metaxylem units are maximum in Seethampundi (Around 11) and least number in Kashmir accession. Protoxylem number is also highest in Seethampundi (120 cells), very few in Ranganathittu, and absent in Kashmir population.

Largest pith that occupies around 80% of the stele is seen in Seethampundi population, and second largest stele in Yarkadu and totally absent in Kashmir accession.

The roots of Kerala accession examined here shows more layers of Rhizodermis as the outermost tissue. The dimorphic rhizodermis is normally persistent and remains as the boundary tissue (outermost layer) of the root. Rhizodermal cells are circular with outer radial walls thickened . Some older roots show lignified thickenings. A persistent dimorphic rhizodermis consists of living cells Kauff *et.al* (2000) In Yarkad accession and Seethampundi

the cortical parenchyma can be subdivided into two or three clearly distinct concentric regions distinguished by cell size. Jerastedt (1984) has also reported these observations in *Hyacinthus orientalis*. Calcium oxalate crystals in the form of Raphides are present in the root cortex. Presence of raphides in accessions Kerala and Seethampundi and absent in Kashmir and Yarkad.

CONCLUSIONS

Root anatomy of 5 accessions indicate that they prefer moist sandy area but few even grow in rocky places and slopes. Their cortex cells show elongation indicating radial circulation. Thickenings on epidermis shows protection against soil hardness. It explains its geographical area as among all accession Ranganathittu grows in watery or aquatic habitat thus it has least mechanical tissues. Seethampundi shows highly advanced vascular bundles due to its large number of Metaxylem, protoxylem and clear radiating arms of xylem.

Even the pith is well developed compared to other accessions in Seethampundi Kashmir population shows least development of Stele and vascular tissue indicating the geographical location that needs less mechanical tissues. Rhizodermis is absent altogether.

Multilayered exodermis is found in all populations. It is more prominent in Kerala accession. There is a periderm below endodermis in all accessions of *Urginea indica*. The layers are thick and many layered in Kashmir and Kerala accessions.

Metaxylem is thinner in Kashmir population, in contrast it is thick in Ranganathittu accession.

Pith is large and parenchymatous in Yarkad and Seethampundi accessions. In Kashmir, Ranganathittu and Kerala accessions vascular bundles i.e xylem and phloem appear mixed with the pith area (as observed by Kauff) The presence of dimorphic rhizodermis in Kerala populations and its absence in other populations is of systematic significance. Root anatomical characters of *U. indica* probably indicate xerophytic. (Vascular bundles in centre of the pith) occurs spasmodically in all the 5 populations observed. Similar studies of xeric habitats have been observed in Agavaceae by Kauff *et al.* 2002.

ACKNOWLEDGEMENT

The 2nd author is grateful to UGC for financial assistance and to the department of Botany Banagalore University, Banagalore for providing facilities.

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